VERTIV.

Liebert APM 300

User Manual

APM 300 Integrated UPS Single Module And Parallel System

User Manual

Version V1.5
Revision date March 10, 2017
BOM 31012521

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.
Address: Block B2, Nanshan I Park, No.1001 Xueyuan Road, Nanshan District, Shenzhen, 518055, P.R.China
Homepage: www.emersonnetworkpower.com
E-mail: overseas.support@emerson.com

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 cannot be used as power supply of life support equipment.
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. It is prohibited to use this product in places:
   - 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 defection 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 important instructions that should be followed during installation and operation of this Emerson APM 300 integrated UPS system (UPS for short).

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

The UPS must be commissioned and serviced by trained engineers approved and qualified by the manufacturer or its agent. Failure to do so could result in personnel safety risk, equipment malfunction and invalidation of warranty.

The UPS has been designed for commercial and industrial use only, and is not for use in any life support application.

This is a Class C3 UPS product for commercial and industrial application in the second environment. Installation restrictions or additional measures may be needed to prevent distrubances.

The UPS complies with CE 2006/95/EC&93/68/EEC (low voltage safety) and 2004/108/EC, with Australia and New Zealand EMC Framework (C-Tick), and with the following product standards for UPS:

- IEC62040-1 general and safety requirements for UPS
- IEC62040-2 EMC, class C3
- IEC62040-3 performance requirements and test methods

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

This UPS system receives power from more than one source . Disconnection of all AC sources and the DC source is required before servicing.

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

Warning: high leakage current

Earth connection is essential before connecting the input supply (including the AC mains and battery). The UPS must be earthed in accordance with local electrical codes.
Earth leakage current exceeds 3.5mA and is less than 3000mA.
Transient and steady state earth leakage currents, which may occur when the equipment is started, should be taken into account when selecting instantaneous RCCB or RCD devices.
RCCBs must be selected insensitive to DC unidirectional pulses (Class A) and transient current pulses.
Also note that the earth leakage currents of the load will be carried by this RCCB or RCD.

Warning: backfeeding protection

This UPS is fitted with a contact closure signal for use with an external automatic disconnect device (supplied by others) to protect against backfeeding dangerous voltage into the input terminal through the bypass static switch circuit. A label must be added at the external power disconnect device to warn service personnel that the circuit is connected to the 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 parts

All equipment maintenance and servicing procedures involving internal access requires the use of a tool and should be carried out only by trained professionals. There are no user-serviceable parts behind covers requiring a tool/special key for removal.

Battery voltage exceeds 400Vdc

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

Warning

The area around the cover of the monitoring board is a static sensitive area, take anti-static measures when accessing this area.

Warning

When selecting the UPS system pre-stage distribution protection equipment, ensure that it complies with the local electric regulations.
The specified upstream breakers are required to obtain the conditional short-circuit current rating, Icc at 10kA symmetrical rms. The specified upstream breakers should comply with an IEC 60947 series standard.

The Manual Covers The Following Equipment

Product	Model
APM 300	Liebert APM 300

Revision Information

V1.0 (August 17, 2011)

Initial release.

V1.1 (April 3, 2014)

Adopt new manual format with options added; add Hazardous Substances Or Elements Announcement in Appendix 2.

V1.2 (October 10, 2014)

Change the address of Emerson Network Power Co., Ltd.; add Frequency converter mode, Dual bus (LBS) system mode, and ECO mode in Section 1.5; change Figure 6-5; change the description in Section 7.1.

V1.3 (March 26, 2015)

Modify Figure 2-3 and Figure 5-1.

V1.4 (December 8, 2015)

Add a Warning in Safety Precatuions.

V1.5 (March 10, 2017)

Update Appendix 2.

Contents

Chapter 1 Overview

This chapter briefly introduces the features, composition, design concept, parallel system, operation mode, battery management and battery protection of the Liebert APM 300 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:

- Increase power quality

The UPS protects its output against the input power change through the internal voltage and frequency controller.

- Improve noise rejection

Due to the application of AC-DC-AC conversion mode, the noise in the input power is effectively filtered, and the load gets clean power supply.

- 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.

1.2 Composition

The UPS consists of a main power cabinet and a switch cabinet. The cabinets use steel framework structure enclosed by removable panels, with the top panels and side panels fixed by screws. The UPS structure is shown in Figure 1-1. The UPS component configuration is provided in Table 1-1.

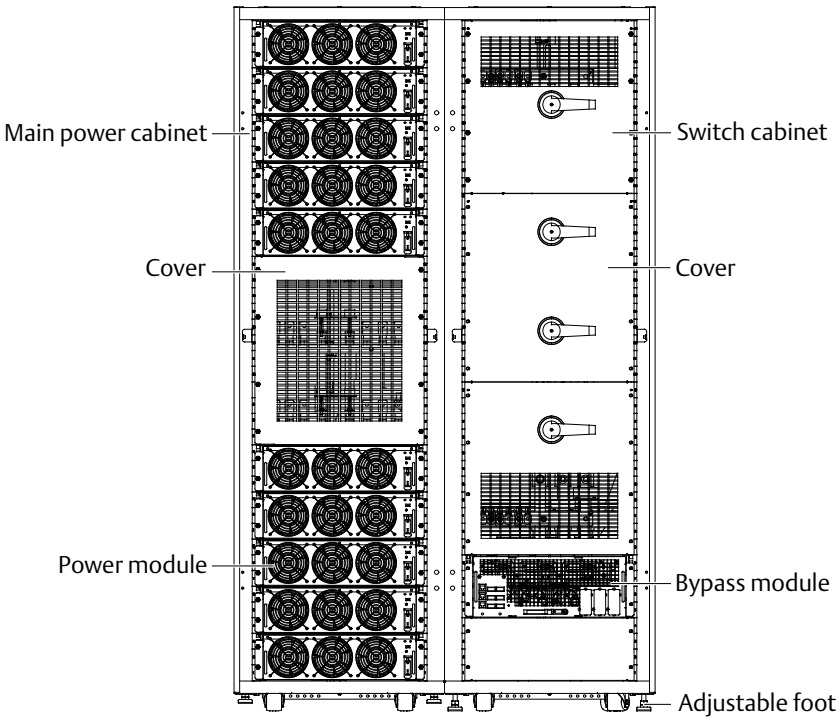


Figure 1-1 UPS structure

Table 1-1 UPS component configuration

Component	Quantity (pcs)	Remark
Main power cabinet	1	Standard component
Switch cabinet	1	Standard component
Bypass module	1	Standard component
Power module	1 ~ 10	Mandatory option. Installed at site

1.3 Design Concept

1.3.1 System Design

As shown in Figure 1-2, the AC mains source is converted by the rectifier into DC power. The inverter converts that DC power from the rectifier or the DC power from the battery into AC power, and provides the AC power for the load. The battery powers the load through the inverter in the event of a power failure. When the inverter is faulty or turned off, the mains source can also power the load through the static bypass.

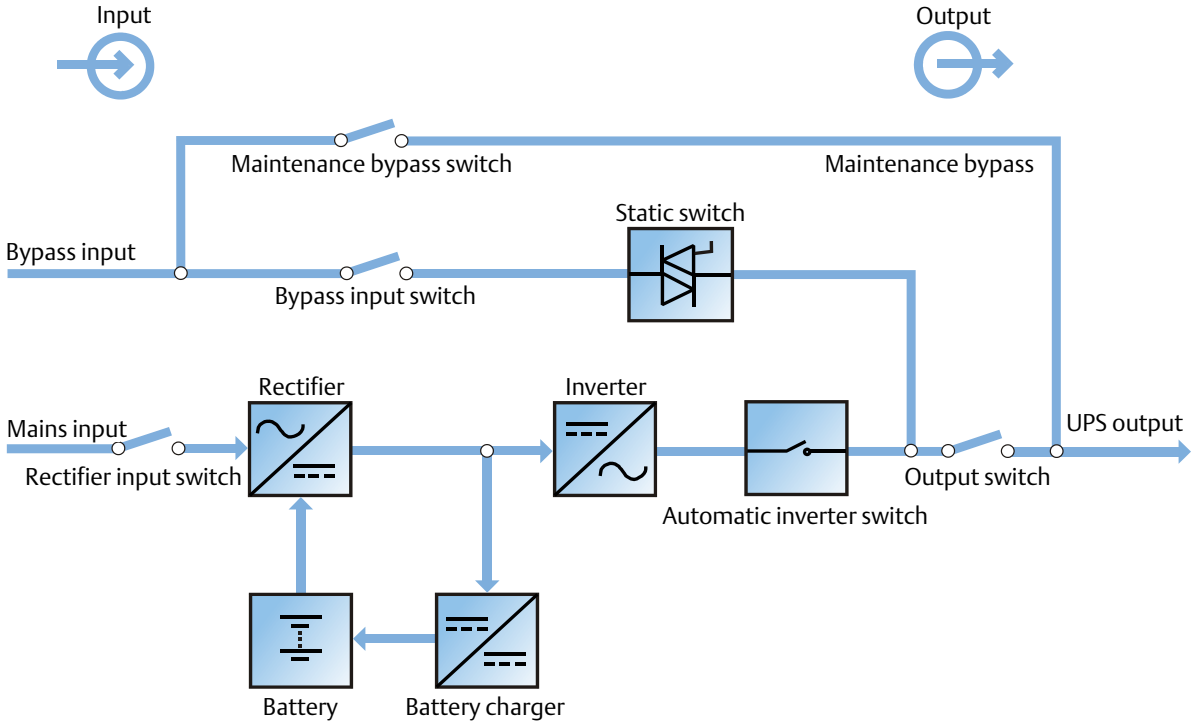


Figure 1-2 System schematic diagram

If UPS maintenance or repair is necessary, the load can be transferred to the maintenance bypass without power interruption.

1.3.2 Bypass

The circuit block labeled static switch in Figure 1-2 contains an electronically controlled switching circuit that enables the load to be connected to either the inverter output or to a bypass power source through the static bypass line. During normal system operation, the load is connected to the inverters; but in the event of a UPS overload or inverter failure, the load is automatically transferred to the static bypass line.

During normal operating conditions, the inverter output and bypass supply must be fully synchronized so as to achieve a clean (no-break) load transfer between the inverter output and static bypass line. The synchronization between the inverter output and static bypass is achieved through the inverter control electronics, which make the inverter frequency track that of the static bypass supply, provided that the bypass remains within an acceptable frequency window.

A manually controlled, maintenance bypass supply is incorporated into the UPS design. It enables the critical load to be powered from the maintenance bypass supply while the UPS is shut down for routine maintenance and repair.

Note
When the UPS is operating in bypass mode or on maintenance bypass, the connected equipment is not protected from power failures or surges and sags.

1.3.3 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, and the battery is in stable floating charge state.

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

Mains abnormal

When the mains fails or is abnormal, the rectifier will stop working automatically, and the system will transfer to battery output (through inverter). The length of the operation time in battery mode depends on the load and the battery capacity. 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.

Mains recovery

When the mains resumes normal within allowable time, the rectifier will start automatically (at this time its output power will increase gradually) and supply the load and charge the battery again. Therefore, the power supply to the load will not be interrupted.

Battery disconnection

If the battery system is taken out of service for maintenance, it is disconnected from the rectifier/charger and inverters by means of a battery switch. The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

UPS module failure

In case of inverter failure, automatic inverter switch failure, output fuse blowout and bypass STS failure, the load will automatically transfer to the bypass, and the output power supply will not be interrupted. In this situation, please contact the local customer service center of Emerson Network Power Co., Ltd for technical support.

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

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.

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

Maintenance bypass

The UPS has a second bypass circuit, 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.

Warning

The internal maintenance bypass must NOT be used when the UPS system is comprised of more than two UPS modules in parallel.

1.3.4 UPS Power Supply Switch Configuration

Figure 1-3 describes the block diagram of the UPS module. The UPS has split bypass configuration (that is, the bypass adopts independent mains input) and common source 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 (linked before 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.

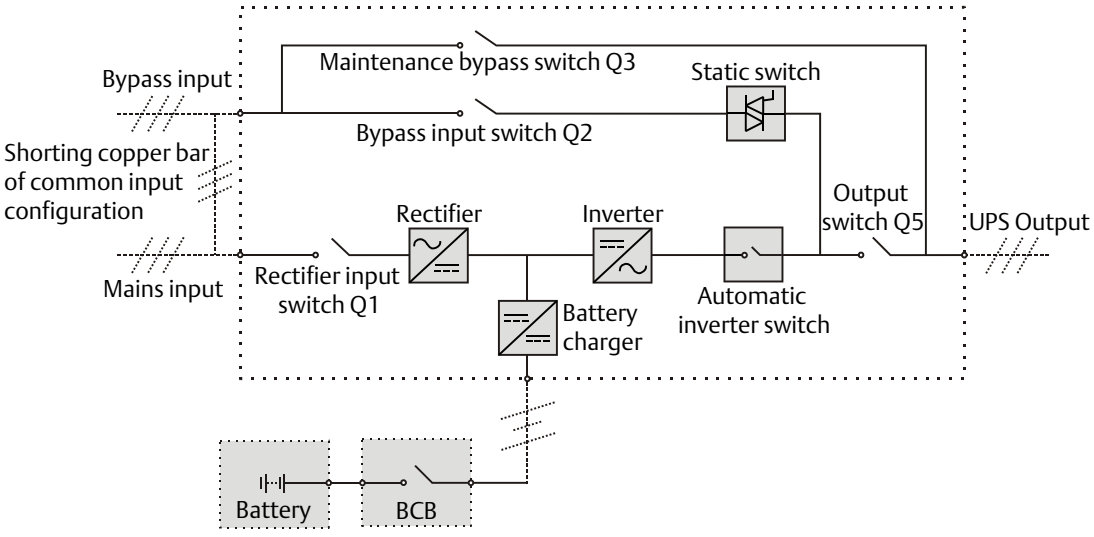


Figure 1-3 UPS power supply switch configuration

1.3.5 Battery Circuit Breaker (BCB)

The external battery shall be connected to the UPS through the BCB. The BCB box is an option, which shall be installed near the battery. The BCB is closed manually or electrically. The BCB has undervoltage tripping coil. Upon the battery undervoltage, the UPS control circuit will send a signal to the coil to trip the BCB. It also has a magnetic trip facility for overload protection.

1.4 Parallel System

As shown in Figure 1-4, two UPS modules can be parallel-connected to form a parallel system to increase the system capacity or reliability, or both. The load is equally shared between the paralleled UPSs.

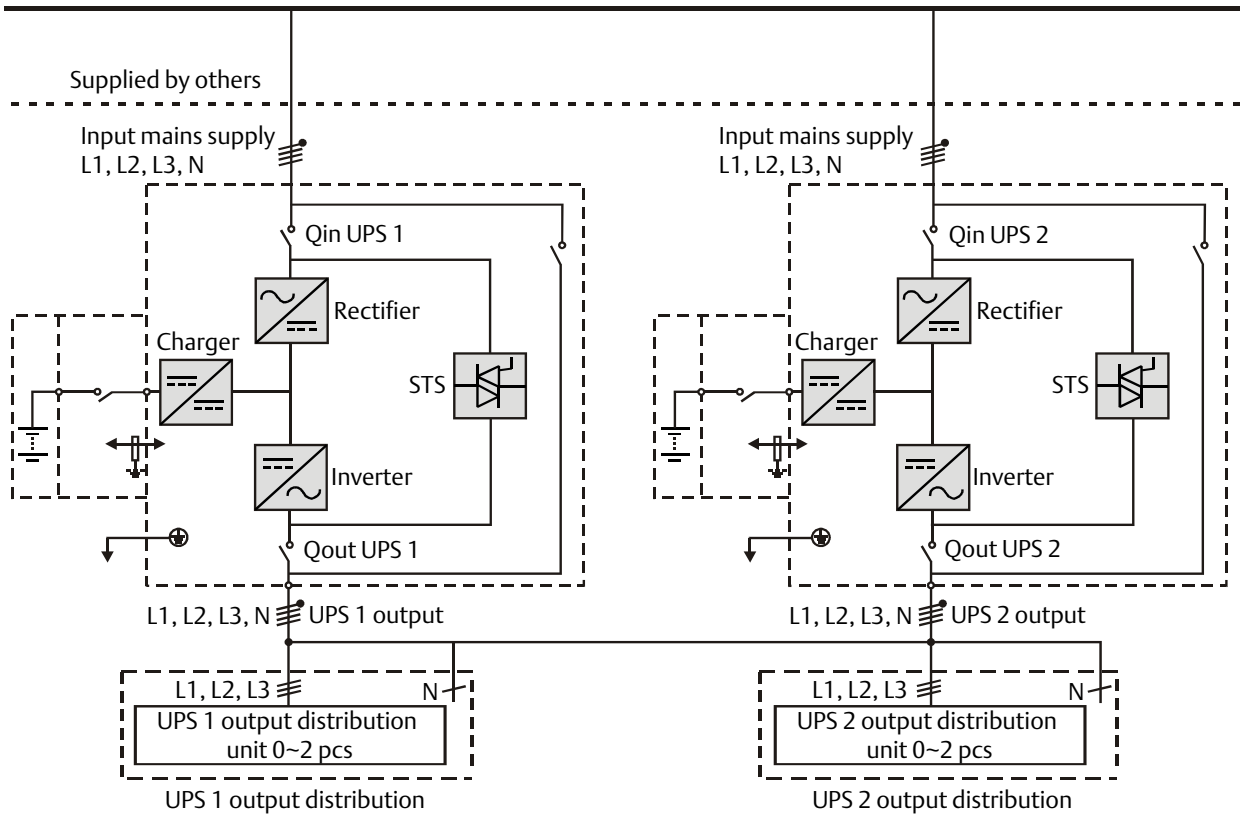


Figure 1-4 Parallel system

1.4.1 Parallel System Features

1. The hardware and software of parallel system are completely the same as those of single UPS module. The parallel configuration is achieved through settings in configuration software. The parameter settings of each UPS module in parallel system should be the same.

2. Parallel control cables are connected in a ring, providing both system reliability and redundancy. Dual bus control cables are connected between any two UPS modules of each bus. The intelligent parallel logic provides the user with maximum flexibility. For example, shutting down or starting up UPS modules in a parallel system can be done in any sequence. Transfers between normal and bypass modes of operation are synchronized and self-recoverable, for example, following overloads and their clearance.

3. The total load of the parallel system can be queried from each UPS module's LCD.

1.4.2 Parallel System Requirements

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

1. All UPS modules must be of the same rating and must be connected to the same source.
2. Any RCD, if installed, must be of an appropriate setting and located upstream of the common neutral bonding point. Alternatively, the device must monitor the protective earth current of the system. Refer to *Warning: high leakage current* before *Contents*.
3. The outputs of the two UPS modules must be connected to a common output bus.

1.5 Operation Mode

The UPS is an on-line, double-conversion, reverse-transfer UPS that permits operation in these modes:

- Normal mode
- Battery mode
- Automatic restart mode
- Bypass mode
- Maintenance mode (manual bypass)
- ECO mode
- Parallel and redundancy mode
- Dormancy mode
- Common battery mode
- Frequency converter mode
- Dual bus (LBS) system mode

Normal mode

As shown in Figure 1-5, the UPS rectifiers derive power from the AC mains input source and supply DC power to the inverters, which continuously supply the AC load. Simultaneously, the charger, which derives power from the rectifiers, float or boost charges the associated backup battery of the UPS.

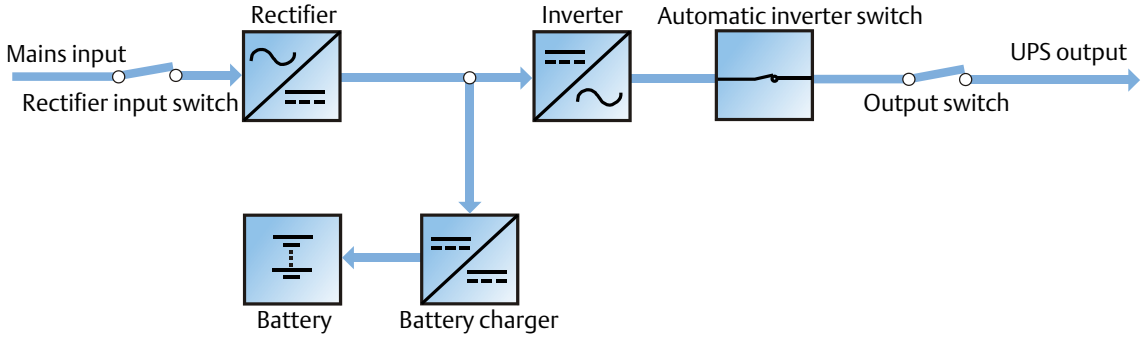


Figure 1-5 Schematic diagram of normal mode

Battery mode

As shown in Figure 1-6, the UPS is operating in battery mode when the battery is supplying backup power to the load through the inverters. Upon mains failure, the UPS automatically transfers to battery mode without power interruption to the load. Upon restoration of the AC mains, the UPS automatically transfers back to normal mode without the necessity of user intervention, without power interruption to the load.

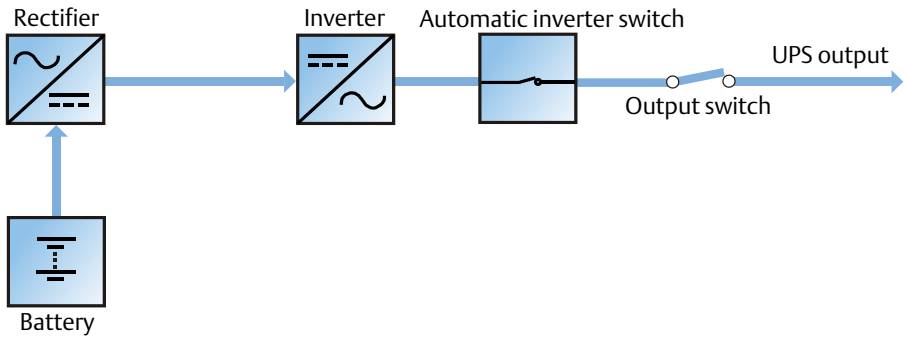


Figure 1-6 Schematic diagram of battery mode

Note: Battery start function is available for switching the UPS on into Battery (charged) mode directly during mains failure. Thus, the battery power can be used independently to increase the UPS utility.

Automatic restart mode

The battery becomes exhausted following an extended AC mains failure. The inverters shut down when the battery reaches the EOD voltage. The UPS can be programmed to automatic restart after EOD after a set variable delay time. This mode and any delay time are programmed by the commissioning engineer.

During the delay time before automatic restart, the UPS charges the battery so as to avoid power interruption to load in case of a following power failure.

In case the UPS is not programmed to automatic restart, you can use the FAULT CLEAR key to manually start the UPS.

Bypass mode

As shown in Figure 1-7, during normal mode operation, if the inverters fail, are overloaded or turned off, the static switch will perform a transfer of the load from the inverters to the bypass source, with no interruption in power to the load. Should the inverters be asynchronous with the bypass, the static switch will perform a transfer of the load from the inverters to the bypass, with interruption in power to the load. This is to avoid paralleling of unsynchronized AC sources. This interruption is programmable but typically set to be less than 3/4 of an electrical cycle, for example, less than 15ms (50Hz) or less than 12.5ms (60Hz).

Figure 1-7 Schematic diagram of bypass mode

Maintenance mode

As shown in Figure 1-8, if UPS maintenance or repaired is needed, you may use the manual maintenance bypass switch to transfer the load to the maintenance bypass, with no interruption in power to the load.

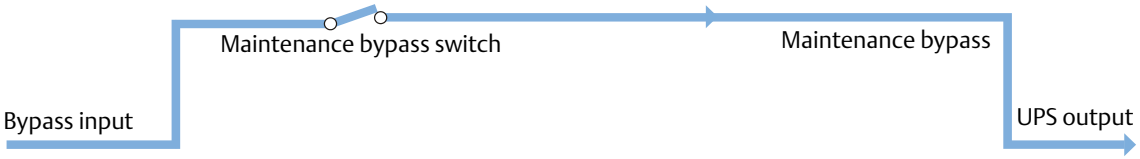


Figure 1-8 Schematic diagram of maintenance mode

Warning: risk after load transfer to maintenance bypass

After the UPS is transferred to maintenance bypass, the power modules and bypass module are inoperative and the LCD has no display, only the green indicator of the input SPD shows that the UPS has mains input, but the output terminals corresponding to closed output distribution switches and the neutral bars are energized.

ECO mode

As shown in Figure 1-9, in ECO mode, except for the maintenance bypass switch, all power switches and the BCB are closed, the system prefers to put the load on the bypass mains to save energy. When the bypass frequency and voltage are in normal range (settable), the load is supplied by the bypass, with the inverter on standby. When the bypass frequency and voltage are beyond the normal range, the system will transfer to the inverter. In ECO mode, the battery is normally charged by the charger.

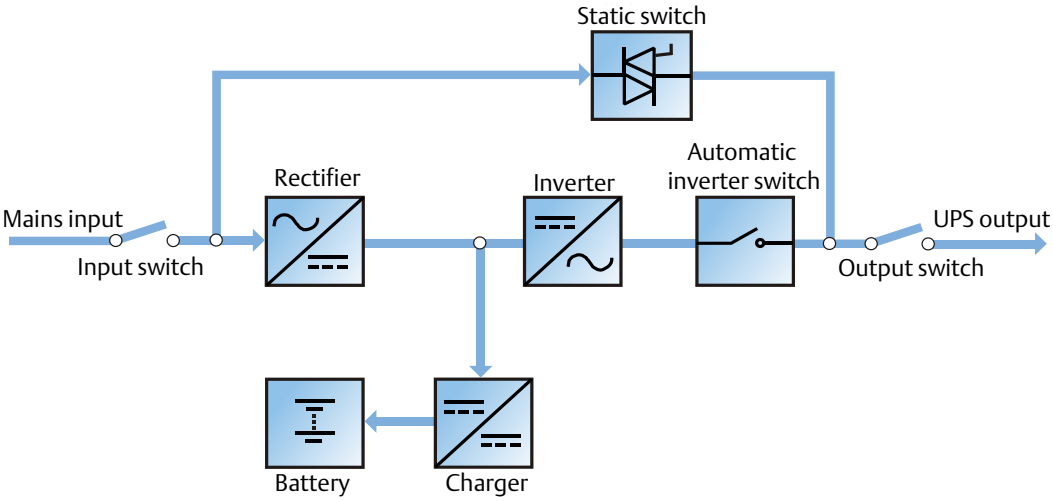


Figure 1-9 Schematic diagram of ECO mode

The ECO mode configuration requires a different setup in the default menu configuration through the operator control and display panel.

Operating procedures in ECO mode are the same as those described in *Chapter 5 Operating Instructions*, except that the load is normally on the bypass mains, the Inverter LED is normally off, and the corresponding alarm message 'Bypass mode' will appear on the LCD.

Warning

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

Parallel redundancy mode

For higher capacity or higher reliability or both, the outputs of two UPS modules can be programmed for direct paralleling while a built-in parallel controller in each UPS ensures automatic load sharing.

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 five power modules, the power module addresses should be 1, 2, 3, 4 and 5 in turn; when there are four power modules, the power module address should be 1, 2, 3 and 4 in turn; when there are three power modules, the power module addresses should be 1, 2 and 3 in turn; when there are two power modules, the power module addresses should be 1 and 2 in turn.

Note

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

Common battery mode

Common battery function means that in UPS paralleling, the UPS modules can share a battery string to save cost and space and improve efficiency.

Note
Batteries of different manufacturers, models or used time cannot be used together.

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. In 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.

Dual bus (LBS) system mode

A dual bus system consists of two independent UPS single unit systems. The dual bus system has high reliability and is suitable for load with multiple inputs. For single input load, an optional STS can be installed to power the load. For the operation principle diagram of the dual bus system mode, see Figure 7-5.

1.6 Battery Management (Set By Commissioning Engineer)

1.6.1 Normal Function

1. Constant current boost charge.

The charge current can be set.

2. Constant voltage boost charge.

The boost charge voltage can be set as required by the type of battery.

For VRLA batteries, the maximum boost charge voltage should not exceed 2.4V/cell.

3. Float charge.

The float charge voltage can be set as required by the type of battery.

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

4. Float charge temperature compensation (optional).

The temperature compensation coefficient can be set as required by the type of battery.

5. EOD protection.

When the battery voltage drops to the EOD voltage, the battery converter shuts down automatically and the battery is isolated to avoid further battery discharge. The EOD voltage is settable from 1.6V/cell to 1.75V/cell (VRLA) or 0.9V/cell to 1.1V/cell (NiCd).

6. Battery low pre-warning time.

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

1.6.2 Advanced Function

The UPS provides battery maintenance test function. Battery maintenance test is also called as battery self-test. At periodic intervals, 20% of the rated capacity of the battery will be discharged automatically, and the actual load must exceed 20% of the UPS nominal 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 self-test can be disabled.

Conditions: battery at float charge for at least 5h, load equal to 20% ~ 80% of rated UPS capacity.

Trigger: manually through the command of Battery Maintenance Test on LCD or automatically.

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

1.6.3 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).

1.7 Battery Protection (Set By Commissioning Engineer)

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. The EOD voltage is adjustable from 1.6V/cell to 1.75V/cell (VRLA) or 0.9V/cell to 1.1V/cell (NiCd).

BCB open alarm

This warning occurs when the BCB opens. The battery is connected to the UPS through the BCB, which is manually closed and electronically tripped by the UPS control circuits.

Chapter 2 Mechanical Installation

This chapter introduces the installation of the UPS, including the notes, preliminary check, environmental considerations, mechanical considerations, and installation drawings.

2.1 Notes

This chapter describes the requirements that must be taken into account when installing 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 apply electrical power to the UPS before being authorised to do so by the commissioning engineer.
2. The UPS shall be installed by a qualified engineer in accordance with the information contained in this manual.

Note: 3-phase, 5-wire input supply required

The standard UPS is suitable for connection to 3-phase, 5-wire (A, B, C, N, PE) TN and TT AC power distribution systems (IEC60364-3).

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 insulating 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 Preliminary Check

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

1. Visually examine the UPS for shipping damage, both internally and externally. Report any damage to the shipper immediately.

2. Verify that the correct UPS is being installed. The UPS has an identification tag on the back of the front door reporting the model, capacity and parameters of the UPS.

2.3 Environmental Requirements

2.3.1 UPS Location

For optimal design life, the place chosen must offer:

- Easy connection

- Enough space to easily work on the UPS
- Sufficient air exchange to dispel heat produced by UPS
- Protection against atmospheric agents
- Protection against excessive humidity and high heat sources
- Protection against dust
- Compliance with the current fire prevention requirements
- Operating environment temperature between 20°C and 25°C. The batteries are at maximum efficiency in this temperature range

The UPS is intended for indoor installation and should be located in an environment with clean air and with adequate ventilation to keep the ambient temperature within the specified operating range.

The UPS is air-cooled with the aid of internal fans. Cold air enters the UPS through the ventilation grilles in the front of the cabinet and hot air is released through the grilles on the back. Do not cover the ventilation openings.

If necessary, install a system of room extractor fans to avoid room temperature build-up. Optional air filters are available if the UPS is to operate in a dusty environment.

Note

The UPS is suitable for mounting on concrete or other non-combustible surface only.

2.3.2 Battery Location

The batteries will generate small amount of hydrogen and oxygen at the end of battery charge. Therefore, make sure that the new air ventilation amount in the battery room meets the EN50272-2001 requirement.

Batteries should be mounted in an environment where the temperature is consistent and even over the whole battery. Temperature is a major factor in determining the battery life and capacity. Typical battery manufacturer performance data are quoted for an operating temperature of 20°C. Operating above 20°C will reduce the battery life while operation below 20°C will reduce the battery capacity. Provided that the average battery operating temperature increases from 20°C to 30°C, the battery life will be reduced by 50%; provided that the average battery operating temperature is above 40°C, the battery life will be reduced by an exponential multiple. In a normal installation the battery temperature is maintained between 15°C and 25°C. Keep batteries away from main heat sources and main air inlets.

The UPS uses external batteries, a battery protection device (for example, fuses or circuit breakers) must be mounted as close as possible to the batteries themselves, and connected using the most direct route possible.

2.3.3 Storage

Should the UPS not be installed immediately, it must be stored in a room for protection against excessive humidity and heat sources. The batteries should be stored in a dry, cool environment with adequate ventilation, at temperature ranging from 20°C to 25°C at best.

Warning

During storage, periodically charge the battery according to the battery manufacturer instructions. In the charge process, temporarily connect the UPS to the mains for the time required for recharging the battery to activate the battery.

2.4 Positioning

2.4.1 Moving The Cabinet

Warning

1. Ensure that any equipment used to move the UPS has sufficient lifting capacity. For the UPS weight, refer to Table 11-3.
2. The UPS is fitted with casters. Take care to prevent the cabinet from moving when unbolting the cabinet from the shipping pallet. Ensure that adequate personnel and lifting aids are available when removing the shipping pallet.
3. The UPS casters are just strong enough for cabinet moving on flat surface. They may not function well when you move the cabinet on uneven surface.
4. The cabinet can be pushed forward or backward only. Pushing it sideward is not allowed. When pushing the cabinet, take care not to overturn it as the gravity center is high.

The UPS can be moved by a forklift or similar equipment. It can also be moved short distances by its casters.

2.4.2 Clearances

The UPS has no ventilation grilles at either side, therefore, no clearance is required at either side.

The component layout of the UPS supports front access and rear access in UPS service, diagnosis and repair. To enable routine tightening of power terminations within the UPS, in addition to meeting any local regulations, it is recommended to provide adequate clearance in the front and at the back of the cabinet for unimpeded passage of personnel with the front and back doors fully opened.

2.4.3 Cable Entry

The UPS uses top cable entry and bottom cable entry, with cable entry holes provided both at the bottom and on the top of the UPS.

2.4.4 Final Positioning And Fixing

After final positioning, fix the UPS directly on the installation surface through the anchor holes on the UPS base. Figure 2-1 shows the UPS installation dimensions.

Important

Fixing the UPS to the installation surface through the anchor holes on the UPS base is mandatory.

2.5 Mechanical Installation

2.5.1 Installation drawing

Refer to Figure 2-1 for the UPS installation dimensions.

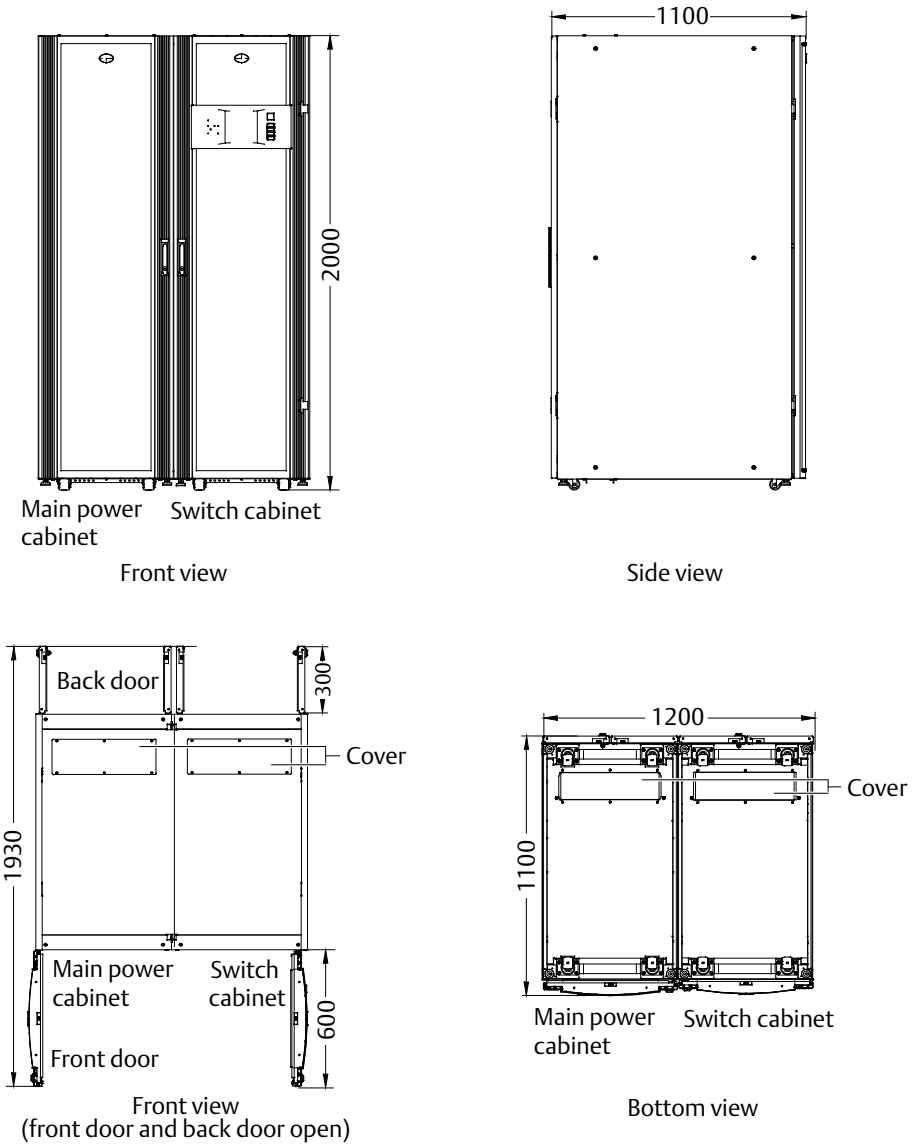


Figure 2-1 UPS installation dimensions (unit: mm)

2.5.2 Mechanical Connection Between Cabinets

The UPS consists of a main power cabinet and a switch cabinet. The two cabinets are shipped separately and should be connected mechanically at site. The connection procedures are as follows:

1. Place the main power cabinet and switch cabinet closely side by side, with the main power cabinet on the left side and the switch cabinet on the right side, as shown in Figure 2-2.

2. Adjust the two cabinets to the same height and fix them securely in the position by adjusting the adjustable feet (see Figure 1-1).

3. Open the front door of the switch cabinet and remove the cover (see Figure 2-2) at the front.

Note

Replace the cover at the front of the switch cabinet after connecting the parallel power cables. Refer to *3.1.8 Connecting Power Cables*.

4. Connect the cabinets with screws: There are two screw holes for cabinet connection (see Figure 2-2) in the same positions of each beam (totally three beams) on the right side of the main power cabinet. In the corresponding positions on the left side of the switch cabinet, there are also three beams; and in the same

positions of each beam, there are also two screw holes for cabinet connection. Use the accessory M8 × 20 screws to connect the two cabinets through these screws holes, and tighten the connections to 13N.m.

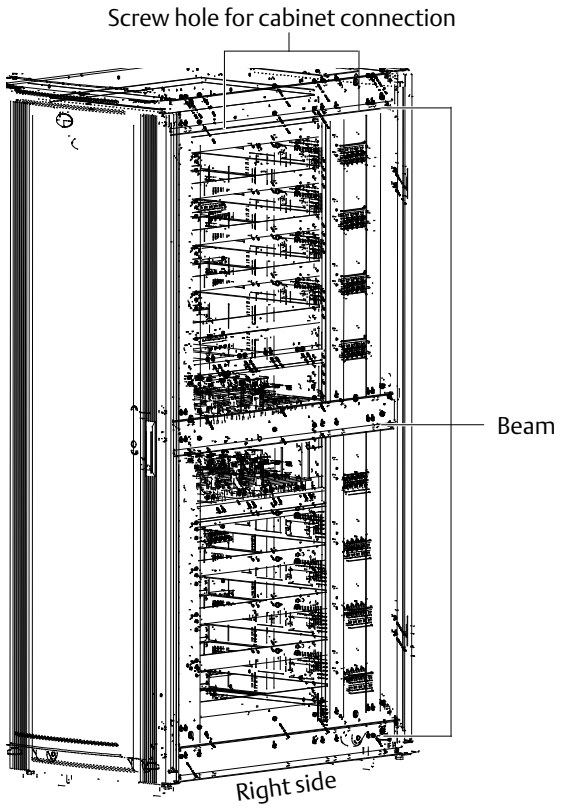


Figure 2-2 Screw holes for cabinet connection on main power cabinet

2.5.3 Installing Power Module

The installation positions of the power modules are shown in Figure 2-3. Install the power modules from bottom to top to avoid cabinet tipping due to high gravity center.

Refer to Figure 2-3, and use the following procedures to install the power module:

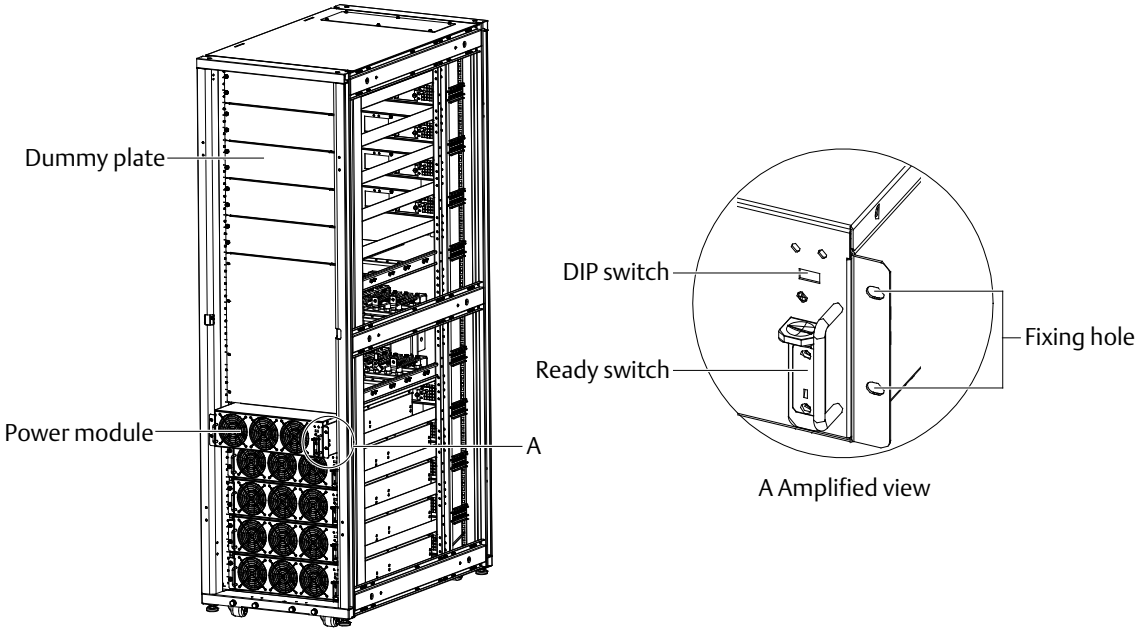
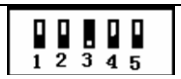


Figure 2-3 Installing power module

1. Use the DIP switch on the front panel of the module to set the module address. The setting range is from 1 to 10. The module address should be exclusive. The setting method is shown in Table 2-1.

Table 2-1 DIP switch setting method

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

2. Place the ready switch on the front panel of the module to the up position (that is, in unready state).

3. Remove the dummy plate in the installation position of the module, insert the module in the installation position, and push it into the cabinet.

4. Secure the module to the main power cabinet through the fixing holes on both sides of the front panel of the module.

5. Place the ready switch to the down position (that is, in ready state).

Chapter 3 Electrical Installation

This chapter introduces the electrical installation of the UPS, including the procedures or methods for power cabling and control cabling, the distance from floor to connection point, and the connection of cabinets.

The UPS requires both power cabling and control cabling once it has been mechanically installed. All control cables, whether shielded or not, should be run separately from the power cables.

Warning: professional installation

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

3.1 Power Cables

3.1.1 System Configuration

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

UPS input cables

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

UPS bypass and output cables

The 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 rated output or bypass current, see Table 3-1.

Battery cables

Each UPS connects to its battery through two cables connecting to the positive pole and negative pole. 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, see Table 3-1.

3.1.2 Maximum Steady State AC And DC Currents

Table 3-1 Maximum steady state AC and DC currents

UPS rated power (kVA)	Rated current (A)						
	Input mains current[1, 2] with full battery recharge			Total output current[2] at full load (36 cells)			Battery discharge current at EOD
	380V	400V	415V	380V	400V	415V	
300	560	530	510	450	430	410	1050
270	514	477	459	405	387	369	945
240	448	424	408	360	344	328	840
210	392	371	357	315	301	287	735
180	336	318	306	270	258	246	630
150	280	265	255	225	215	205	525
120	224	212	204	180	172	164	420
90	168	159	153	135	129	123	315
60	112	106	102	90	86	82	210
30	56	53	51	45	43	41	105

Note

1. Rectifier and bypass input mains current.

2. Non-linear loads (switch mode power supplies) affect the design of the output and bypass neutral cables. The current circulating in the neutral cable may exceed the nominal phase current. A typical value is 1.732 times the rated current.

3.1.3 Distance From Floor To UPS Connection Point

Table 3-2 provides the distances from the floor to the UPS connection points.

Table 3-2 Distance from floor to UPS connection point

UPS connection point	Distance (mm)
Rectifier input	1444
Bypass input	1084
AC output	804
Battery power	842

3.1.4 Notes

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

1. Earth cable: Follow the most direct route possible to connect the earth cable to the cabinet. Size the earth cable by referring to IEC60950-1 Table 3B and following the local electrical regulations, and in accordance with the AC supply fault rating, cable lengths and type of protection.

2. In battery cable selection, a maximum voltage drop of 4Vdc is permissible at the current ratings given in Table 3-1. To minimize the formation of electromagnetic interference, do not form coils.

3. The connection terminals are shown in Figure 3-1 and Figure 3-2.

Warning

Failure to follow adequate earthing procedures may result in EMI or hazards involving electric shock and fire.

3.1.5 Power Cable Connecting Terminals

The rectifier input, bypass, output and battery power cables are connected to the corresponding busbars situated of the UPS, as shown in Figure 3-1 to Figure 3-2.

3.1.6 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 follow adequate earthing procedures could result in electric shock hazard to personnel, or the risk of fire, should an earth fault occur.

3.1.7 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.

Rectifier and bypass input supply of the UPS

1. Overcurrent

Install suitable protective devices in the distribution of the incoming mains supply, considering the power cable current-carrying capacity and overload capacity of the system (see Table 11-6, Table 11-7). Generally, thermomagnetic circuit breaker with IEC60947-2 tripping curve C (normal) at 125% of the current listed in Table 3-1 is recommended.

Split bypass: In case a split bypass is used, separate protective devices should be installed for the rectifier input and bypass input in the incoming mains distribution panel.

The rated voltage of the external main/bypass overcurrent protective device should not be less than 415Vac, and its AC breaking current should be more than 6kA, and it should be a 3P device for three phases.

Note

The UPS output neutral line is from the input neutral line. If the external block device blocks input neutral line, the output neutral line will be lost, and then the system risk may be caused.

2. Earth leakage

The residual earth current introduced by the RFI suppression filter inside the UPS is greater than 3.5mA and less than 1000mA. It is recommended that the sensitivity of all differential devices be verified upstream of the input distribution panel.

3. Battery

A battery protective device (for example, a fuse or a breaker) must be fitted to provide overcurrent protection for the 4. The rated voltage of the overcurrent protective device of the external battery should be higher than 500Vdc, and its DC breaking current should be higher than 20kA.

4. UPS 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).

3.1.8 Connecting Power Cables

For cable access mode of the UPS, refer to *2.4.3 Cable Entry*.

Warning

The power cables should be routed through cable tunnel or metallic cable trough to avoid being damaged under mechanical stress and reduce EMI to the environment.

The procedures for connecting the parallel power cables are as follows:

1. Remove the cover at the front and the left side panel of the main power cabinet.

2. The parallel power cables have been connected in factory to the copper bars in the upper part and lower part of the switch cabinet, as shown in Figure 3-1. Run the parallel power cables into the main power cabinet by the cabling route shown in Figure 3-1 to the corresponding connection terminals.

3. According to the labels of the parallel power cables and those of the corresponding connection terminals of the main power cabinet, use the accessory M8 × 25 screws and M8 nuts to connect the cables to the connection terminals with the same labels correspondingly, and tighten the connections to 13N.m. Note that each connection terminal should be connected to two cables.

4. Use a multimeter to measure and confirm that the connections are correct and no inter-phase short circuit exists.

5. Bind the parallel power cables.

6. Replace the cover and left side panel of the main power cabinet removed in step 1 and the cover at the front of the switch cabinet removed in the procedures in *2.5.2 Mechanical Connection Between Cabinets*.

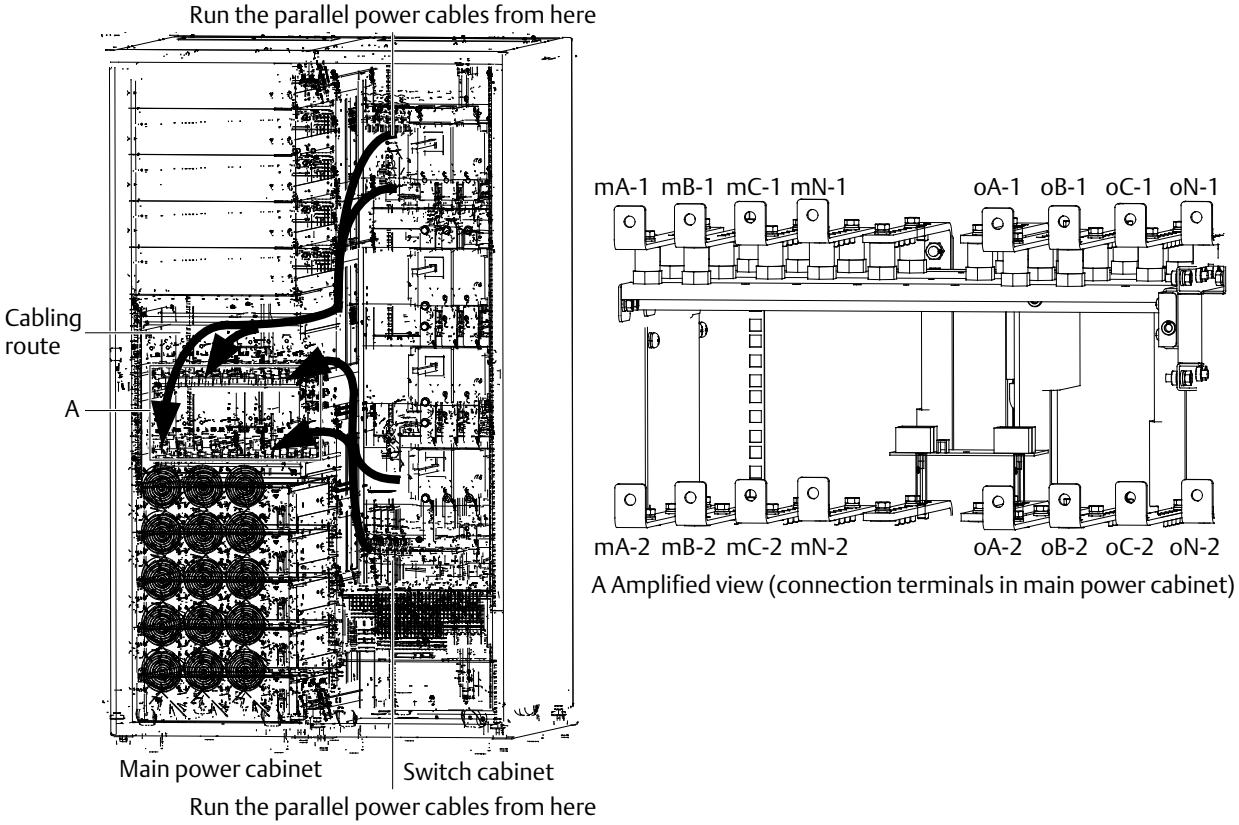


Figure 3-1 Connecting parallel power cables

3.1.9 Connecting External Power Cables

Important

The operations described in this section must be performed by authorised personnel. If you have any questions, please contact the local customer service center of Emerson immediately.

Once the UPS has been finally positioned and secured, connect the power cables as described in the following procedures.

1. Verify that the external input switch and all internal power switches of the UPS are open. Post warning signs on these switches to prevent inadvertent operation.

2. Open the back doors of the main power cabinet and switch cabinet to reveal the connection terminals of the power cables, including the rectifier input terminals, bypass input terminals, output terminals, battery input terminals and PE terminals, as shown in Figure 3-2.

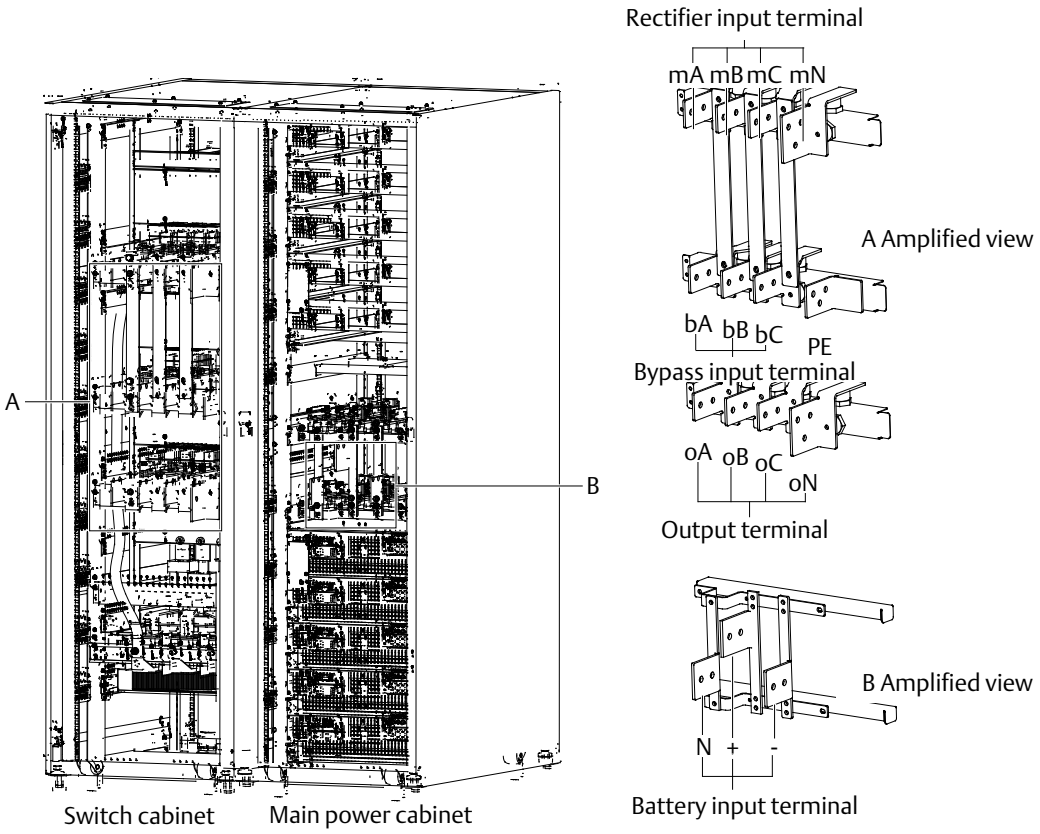


Figure 3-2 Connection terminals of power cables (back view)

3. The UPS uses top cable entry and bottom cable entry. Remove the covers on the top or bottom of the switch cabinet and main power cabinet of the UPS according to your need.

4. Connect the input earth cable to the PE terminal.

Note
The earth cable and neutral cable must be connected in accordance with local and national codes of practice.

5. Identify and make power connections for the input cables according to one of the following two procedures, depending on the type of installation.

Common input connection

a) In common bypass and rectifier input configuration, use the accessory M12 screws to connect the AC input cables to the rectifier input terminals (mA-mB-mC-mN) or bypass input terminals (bA-bB-bC-mN), and tighten the connections to 50N.m. Ensure correct phase rotation.

Split bypass connection

b) In split bypass configuration, use the accessory M12 screws to connect the rectifier input cables to the rectifier input terminals (mA-mB-mC-mN), connect the bypass input cables to the bypass input terminals (bA-bB-bC-mN), and tighten the connections to 50N.m. Ensure correct phase rotation.

Warning
In split bypass configuration, remove the linking busbars between the bypass input and rectifier input. The rectifier input and bypass input must be referenced to the same neutral point.

System output connection

6. Connect the system output cables between the UPS output terminals (oA-oB-oC-oN) and the critical load, and tighten the connections to 50N.m. Ensure correct phase rotation.

Warning

If the load is not ready to accept power on the arrival of the commissioning engineer, ensure that the system output cables are safely isolated at their ends.

Battery connection

7. For UPS not fitted with a BCB, ensure correct polarity of batter string end connections to the UPS terminals, that is, (+) to (+), (–) to (–) and (N) to (N). But do not make these connections before authorized by the commissioning engineer.

For UPS fitted with a BCB, ensure correct polarity of battery string end connections to the BCB and from the BCB to the UPS terminals, that is, (+) to (+) and (–) to (–), but disconnect one or more battery cell links in each tier. Do not reconnect these links or close the BCB before authorized by the commissioning engineer.

8. Replace the covers removed in step 3, and close the back doors of the cabinets.

Note

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

3.2 Control Cables And Communication Cables

3.2.1 Overview

As shown in Figure 3-3, the bypass module provides dry contact ports (J5 ~ J10) and communication ports (RS485 port, RS232 port and Intellislot port) on the front panel.

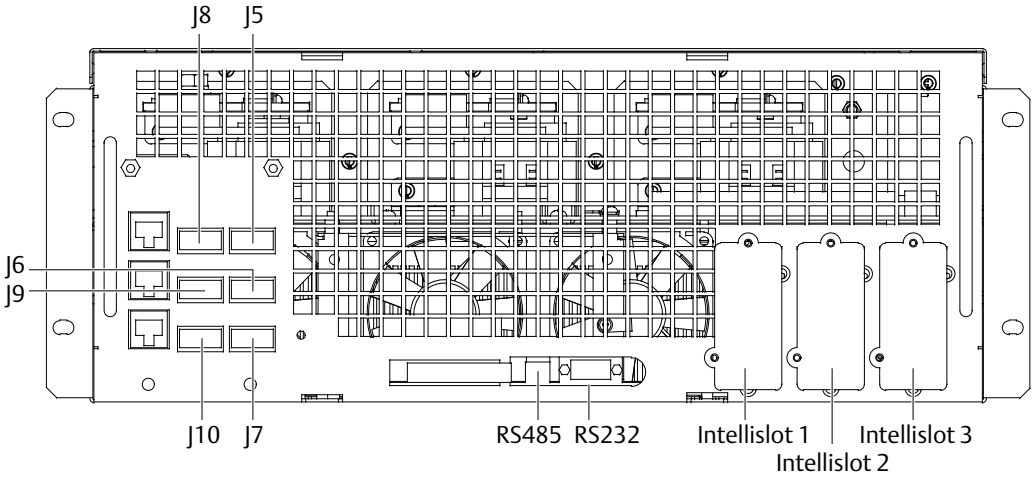


Figure 3-3 Dry contact ports and communication ports

The UPS accepts external signalling from voltage-free (dry) contacts connected to push-in input dry contact terminal. Subject to prior software programming, the signalling is accepted by the UPS when relevant terminals and the +12V terminals are shorted. All control cables must be routed separately from the power cables and parallel cables, and must be double insulated. For maximum run between 20m and 30m, the typical control cable CSA should be from 0.5mm^2 to 1.5mm^2.

3.2.2 Input Dry Contact Port

The input dry contact ports J7 and J8 provide battery room environment, battery ground fault and battery temperature signals. The ports are shown in Figure 3-4 and described in Table 3-3.

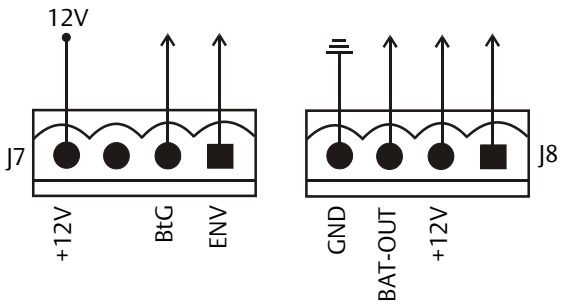


Figure 3-4 Input dry contact ports J7 and J8

Table 3-3 Description of input dry contact ports J7 and J8

Position	Name	Description
J7.1	ENV/GEN	Battery room environment detection (normally closed)/Generator connected
J7.2	BtG	Battery ground fault
J7.4	+12V	+12V power
J8.2	+12V	+12V power
J8.3	BAT_OUT	Battery temperature detection
J8.4	GND	Power ground

Note

1. The default function of J7.1 is 'battery room environment detection', then 'generator connected' must be configured by configuration software before becoming active. When the function of J7.1 becomes active, the charger current can be limited through software to a percentage of the full charger current (0 ~ 100%).
2. Activating the preceding dry contacts turns the battery charger off.

3.2.3 BCB Port

J6 is the BCB port. The port is shown in Figure 3-5 and described in Table 3-4.

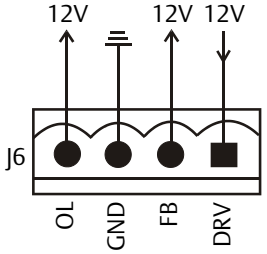


Figure 3-5 BCB port

Table 3-4 BCB port description

Position	Name	Description
J6.1	DRV	BCB driver signal (reserved)
J6.2	FB	BCB contact state (reserved)
J6.3	GND	Power ground
J6.4	OL	BCB online input (normally open). This pin will become active when the BCB port is connected

The connection between the BCB port and the BCB is shown in Figure 3-6.

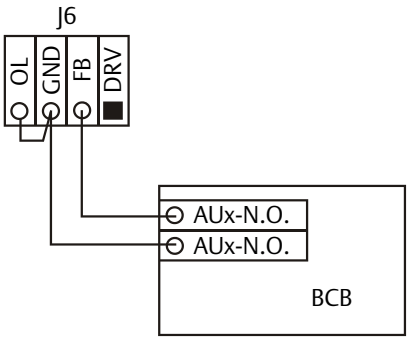


Figure 3-6 Connection between BCB port and BCB

3.2.4 Maintenance Bypass Switch And Output Switch State Port

J9 is the maintenance bypass switch and output switch state port. The port is shown in Figure 3-7 and described in Table 3-5.

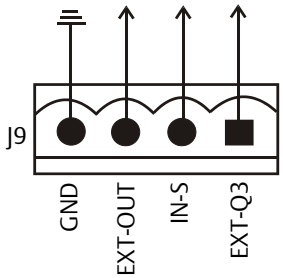


Figure 3-7 Maintenance bypass switch and output switch state port

Table 3-5 Description of maintenance bypass switch and output switch state port

Position	Name	Description
J9.1	EXT_Q3	External maintenance bypass switch state. Connect to J9.4. The auxiliary contact requirement for the external maintenance bypass switch is as follows: When the switch is open, the external bypass auxiliary contact is closed
J9.2	IN_S	Internal maintenance bypass switch state. Connect to J9.4
J9.3	EXT_OUT	Output switch state. Connect to J9.4. When the output switch is open, the auxiliary contact of the output switch is open
J9.4	GND	Power ground

3.2.5 Output Dry Contact Port

J5 is the output dry contact port, providing two relay output dry contact signals. The port is shown in Figure 3-8 and described in Table 3-6. The shunt trip coil of the external air breaker can be driven directly through this dry contact. The shunt trip coil of the external air breaker should be 250Vac/5A or 24Vdc/5A.

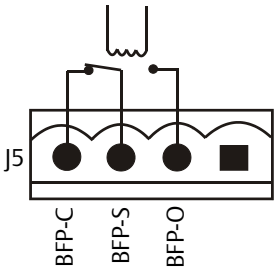


Figure 3-8 Output dry contact port

Table 3-6 Description of output dry contact port

Position	Name	Description
J5.2	BFP_O	Bypass feedback protection relay (normally open), closed when bypass SCR is shorted
J5.3	BFP_S	Bypass feedback protection relay center
J5.4	BFP_C	Bypass feedback protection relay (normally closed), open when bypass SCR is shorted

3.2.6 Remote EPO Input Port

The UPS has the EPO function that operates by a switch on the operator control and display panel of the UPS or by a remote contact provided by the user. The EPO key is under a hinged, plastic shield.

J10 is the remote EPO input port. The port is shown in Figure 3-9 and described in Table 3-7.

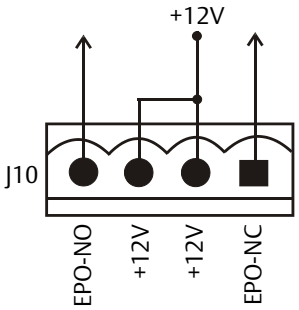


Figure 3-9 Remote EPO input port

Table 3-7 Description of remote EPO input port

Position	Name	Description
J10.1	EPO_NC	EPO activated when shorted to J10.2
J10.2	＋12V	EPO activated when shorted to J10.1
J10.3	＋12V	EPO activated when opened to J10.4
J10.4	EPO_NO	EPO activated when opened to J10.3

EPO is triggered when pins 3 and 4 of J10 are shorted or pins 2 and 1 of J10 are opened.

If an external EPO facility is required, pins 1 and 2 or 3 and 4 of J10 are reserved for this function. The external EPO facility is also connected to the normally open or normally closed remote stop switch between these two terminals using shielded cable. If this function is not used, pins 3 and 4 of J10 must be opened or pins 1 and 2 of J10 must be shorted.

Note

1. The UPS EPO action shuts down the rectifiers, inverters and static bypass. But it does not internally disconnect the input power supply. To disconnect all power to the UPS, open the upstream input switch when EPO is activated.
2. Pins 1 and 2 of J10 are supplied factory-shorted.

3.2.7 RS485 Port, RS232 Port And Intellislot Port

The RS485 and RS232 ports provide serial data and are intended for use by authorized commissioning and service personnel in UPS commissioning and service.

The three Intellislot ports are used to install optional communication cards at site, including dry contact card, Modbus card, SIC card and UF-RS485 card. For details, refer to the user manuals of these cards.

Note

Intellislot 1 port shares communication resource with the RS232 port. To avoid conflict, when the RS232 port is used for service or commissioning, it is not recommended to use Intellislot 1 port.

Chapter 4 Operator Control And Display Panel

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

4.1 Introduction

The operator control and display panel of the UPS is located on the front door of switch cabinet. It is the access point for operator control and monitoring of 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. The components of the operator control and display panel are described in Table 4-1.

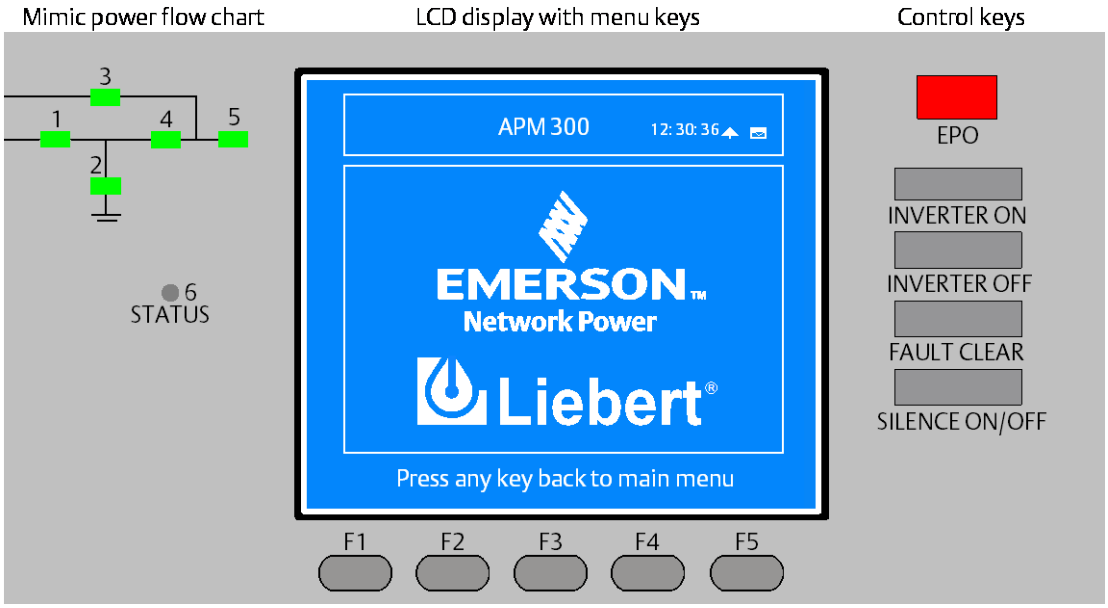


Figure 4-1 Operator control and display panel

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

Indicator No.	Function		Control key	Function
1	Rectifier indicator		EPO	EPO switch
2	Battery indicator		INVERTER ON	Inverter start switch
3	Bypass indicator		INVERTER OFF	Inverter shutdown switch
4	Inverter indicator		FAULT CLEAR	Fault reset switch
5	Load indicator		SILENCE ON/OFF	Audible alarm silencing switch
6	Status indicator		F1 ~ F5	LCD menu keys

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 Description of indicators

Indicator	State	Description
Rectifier indicator	Solid green	Rectifiers in normal operation
	Flashing green	Mains input normal, but rectifiers not operating
	Solid red	Rectifiers failed
	Off	Rectifiers 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 inverters
	Flashing green	Inverters turning on, starting up, synchronizing, or standing by (ECO mode)
	Solid red	Inverter fault
	Off	Inverters not operating
Load 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	Alarm (for example, AC input failure)
	Solid red	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	A UPS alarm (for example, AC input failure) took place
Continuous beep	A UPS fault (for example, fuse or hardware fault) took place

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	Description
EPO	Cut off the load power, shut down the rectifier, inverter, static bypass and battery
INVERTER ON	Start the inverter
INVERTER OFF	Shut down the inverter
FAULT CLEAR	Restart the UPS (subject to any fault being cleared)
SILENCE ON/OFF	When an alarm is active, pressing this key silences the audible alarm. Pressing this key again enables the buzzer again

4.1.4 LCD And Menu Keys

The operator control and display panel provides an LCD and five menu keys (F1, F2, F3, F4, and F5). The menu keys are described in Table 4-5.

Table 4-5 Description of menu keys

Key	F1	F2	F3	F4	F5
Function 1	HOME	ESC Escape	Left	Right	Enter
Function 2			UP	Down	

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, learn current UPS status and alarm information, perform functional setting and control operation. The LCD also stores up to 1024 historical records that can retrieve for reference and diagnosis.

4.2 LCD Screen Types

4.2.1 Start Screen

Upon UPS start, the UPS executes self-test, and the start screen appears and remains approximately 15 seconds, as shown in Figure 4-2.

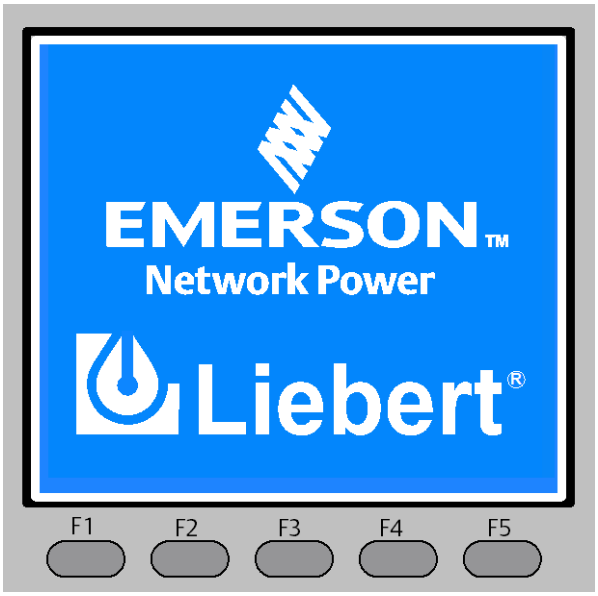


Figure 4-2 Start screen

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, menu window, data window and keypad window.

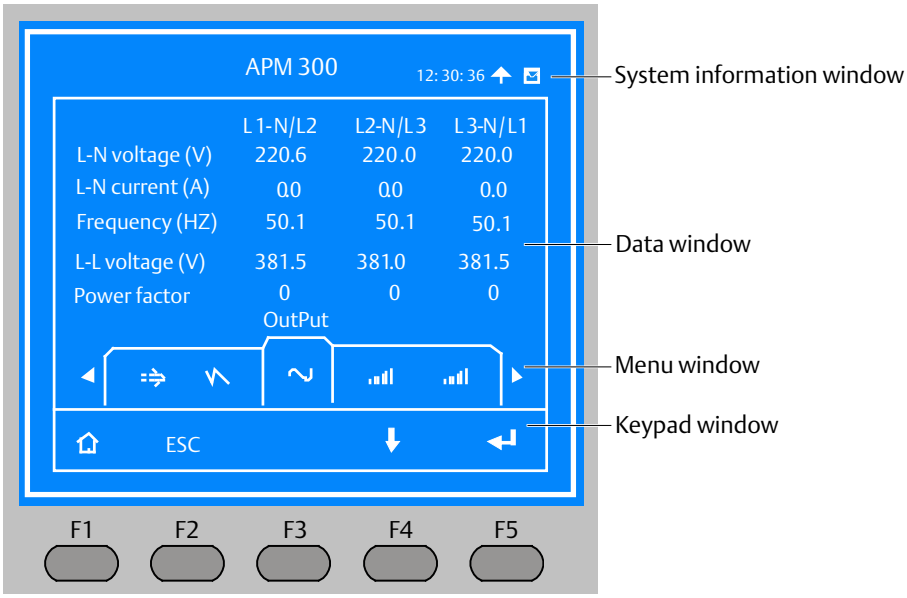


Figure 4-3 Primary screen

Functions of the menu keys F1 ~ F5 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, and pressing the F3 + F4 keys enters the screen displayed in Figure 4-4, where you can select the required power module.

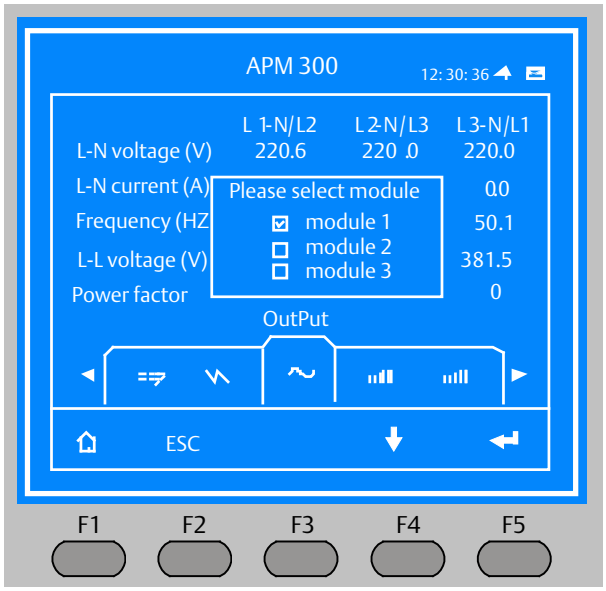


Figure 4-4 Selecting power module

4.2.3 Default Screen

During UPS operation, if there is no alarm within two minutes, the default screen will appear, as shown in Figure 4-5. After a short delay, the LCD backlight will turn off. Pressing any keys (F1 ~ F5) restores the default screen.

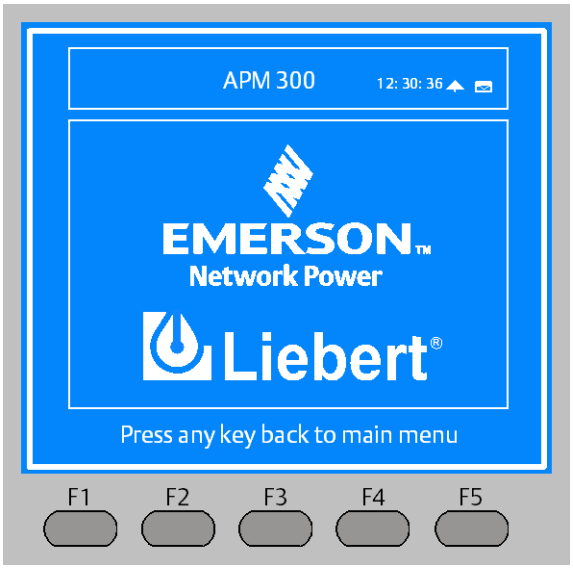


Figure 4-5 Default screen

4.3 Detailed Description Of Menu Items

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

System information window

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

Table 4-6 Item description of system information window

Item	Explanation
APM 300	UPS name
12:30:36	Current time (24hr, HH:MM:SS format)

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

Menu	Item	Explanation
Load	Sout (kVA)	Sout: apparent power
	Pout (kW)	Pout: active power
	Qout (kVAR)	Qout: reactive power
	Load level (%)	The percentage of the UPS rating load
	Crest factor	Output current crest factor
System	Sout (kVA)	Sout: apparent power
	Pout (kW)	Pout: active power
	Qout (kVAR)	Qout: reactive power
Battery	Battery voltage (V)	Battery bus voltage
	Battery current (A)	Battery bus current
	Battery temperature (°C)	Battery temperature
	Battery remain time (min)	Battery run time remaining
	Battery capacity (%)	The percentage of the capacity of the 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)	Displays the active alarms. For the list of the alarms that may be displayed on the LCD on the UPS operator control and display panel, refer to Table 4-9
Records	(alarm history)	Displays the alarm history. For the list of the alarms that may be displayed on the LCD on the UPS operator control and display panel, refer to Table 4-9
Language	(language option)	Provides 12 optional LCD languages
Settings	Display contrast	Adjusts the LCD contrast
	Date format set	Three formats selectable: MM/DD/YYYY, DD/MM/YYYY, YYYY/MM/DD
	Date & time	Sets the date and time
	Comm1 baud rate	Sets the communication baud rate of the RS232 port
	Comm2 baud rate	For internal communication. Not settable
	Comm3 baud rate	Sets the communication baud rate of the SIC card ports
	Communication address	Applicable to RS485 communication
	Communication mode	Set the communication mode
	Callback times	If the communication mode of the Intellislot 1 port is modem mode, this parameter sets the number of times of a number is redialed to send an alarm notification
	Phone No.1	If the communication mode of the Intellislot 1 port is modem mode, this is the first phone number to be dialed (to send an alarm notification)
	Phone No.2	If the communication mode of the Intellislot 1 port is modem mode, this is the second phone number to be dialed (to send an alarm notification)
	Phone No.3	If the communication mode of the Intellislot 1 port is modem mode, this is the third phone number to be dialed (to send an alarm notification)
	Command password	Sets the control password. Set by commissioning engineer
	Protocol	Sets the communication protocol: Velocity, YDN23. However, because no optional communication cards of the UPS support Velocity, users can only select YDN23

Menu	Item	Explanation
Command (initiate, stop battery, system test or freshening charge; control password required)	Battery maintenance test	This test performs a partial discharge of the battery to obtain a rough estimate of the battery capacity. Load must be between 20% and 100%
	Battery capacity test	This test performs a full discharge of the battery to obtain a precise measure of the battery capacity. Load must be between 20% and 100%
	System test	This is a self-test of the UPS. When the user activates this function, a window appears about five seconds later to show the test result
	Stop testing	Manually stops a battery maintenance test, battery capacity test or system test
	Freshening charge	Manually initiates a battery freshening charge
	Stop freshening charge	Manually stops a battery freshening charge
Version	Monitor Version	Provides the monitoring software version
	Rectifier Version	Provides the rectifier software version
	Inverter Version	Provides the inverter software version
	Bypass Version	Provides the bypass software version
	SPM Version	Provides the SPM DSP software version

Keypad window

The functions of the menu keys F1 ~ F5 for the current screen are shown by self-explanatory icons on 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 inverter and bypass supplies are not synchronized and any load transfer between the inverters and bypass will cause a brief load interruption
This operation leads to output shutdown, confirm or cancel	The bypass is abnormal, turning off the inverters will cause the load to be de-engergised
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 inverters
Battery will be depleted, confirm or cancel	If you select battery maintenance test, the battery will discharge until the UPS shuts down. This prompt appears to require your confirmation. Cancelling the test will ends the test and transfers the UPS to normal 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
Battery Self Test aborted, conditions not met	Battery selt-test condition is not met. Please check whether 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 supported for display either on the Event menu or on the Records menu as described in Table 4-7.

Table 4-9 Alarm list

Alarm	Explanation
Comm. fail	The communication of the internal monitor with the rectifier, inverter or bypass failed
Parallel Comm. Fail	The communication between the inverters of each UPS in the parallel system failed. 1. Check if any UPSs are offline. If yes, power on these UPSs and check if the alarm disappears. 2. Press the FAULT CLEAR key
Battery Overtemp.	The battery temperature is over limit. Check the battery temperature and ventilation
Ambient Overtemp.	The ambient temperature is over limit. Check the ventilation of the UPS room
Battery Replaced	Battery test failed. The battery needs replacement
Battery Low Pre-warning	Before the EOD, battery low pre-warning will occur. After this pre-warning, the battery will have the capacity for three minutes discharging with full load. The time is user-settable from 3 minutes to 60 minutes. Please shut down the load in time
Battery End of Discharge	Inverters turned off due to battery EOD. Check the mains failure and try to recover it
Mains Volt. Abnormal	The mains voltage is outside specifications and results in rectifier shutdown. Check the rectifier input phase voltage
Mains Undervoltage	Mains voltage is under limit with derated load. Check the rectifier input line voltage
Mains Freq. Abnormal	The mains frequency is outside specifications and results in rectifier shutdown. Check the rectifier input voltage and frequency
Batt. Charger Fail	The voltage of the battery charger is too high
Control Power 1 Fail	The UPS is operating but the control power is abnormal or not available
Mains Phase Reversed	The AC input phase rotation is reversed
Rectifier Fault	Internal fault of a power module is detected and results in rectifier shutdown and battery discharging
Rectifier Overtemp	The temperature of the heatsink is too high to keep the rectifier running. The UPS can recover from this fault automatically. Check the environment and ventilation
Soft Start Fail	The rectifier can not start owing to low DC bus voltage. Seek assistance from the local customer service center of Emerson
Bypass Unable to Trace	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage is outside specifications. The amplitude threshold is fixed for ±10% rating. This alarm automatically resets once the bypass voltage goes normal. 1. First verify that the bypass voltage and frequency displayed on the LCD are within the selected ranges. Note that here the rated voltage and frequency are specified by Output voltage level and Output frequency level respectively. 2. If the displayed voltage is believed to be abnormal, then verify the bypass voltage and frequency presented to the UPS. Check the external supply if it is found faulty
Bypass Abnormal	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage exceeds the limit. The amplitude threshold is fixed for ±10% rating. This alarm automatically resets once the bypass voltage returns to normal. 1. First check if there are some relevant alarms such as Bypass phase reverse and Mains neutral lost. If they appear, solve them first. 2. Then verify that the bypass voltage and frequency displayed on the LCD are within the bypass limits. Note that here the rated voltage and frequency are specified by Output voltage level and Output frequency level respectively. 3. If the displayed voltage is believed to be abnormal, then measure the bypass voltage and frequency presented to the UPS. If the bypass voltage and frequency are abnormal, check the external bypass supply. 4. If the mains is likely to trigger this alarm frequently, the bypass limits can be changed to a wider tolerance through the service configuration software

Alarm	Explanation
Inverter Asynchronous	This alarm is triggered by an inverter software routine when the inverter and bypass waveforms are misaligned by more than six degrees in phase. The amplitude threshold is fixed for ±10% rating. This alarm resets automatically once the condition is no longer true. 1. First check if the alarm Bypass unable to trace or Bypass abnormal occurs. If so, solve it first. 2. Verify the waveform of the bypass voltage
Inverter fault	Inverter output voltage outside specifications. Load transfers to bypass. The faulty power module will shut down and open output relay, and the remaining power modules will remain online
Fan fault	At least one of the cooling fans failed
Bypass STS Fail	At least one of the STSs at the bypass side is open or shorted. This fault is locked until power-off
Output Fuse Fail	At least one of the inverter output fuses is blown. The inverter shuts down, and the load transfers to bypass if the remaining power modules are insufficient to support the load
Control power 1 fail	The UPS is operating but the redundant control power is abnormal or not available
Unit Over load	This alarm appears when the load arises above 105% of the nominal rating. The alarm automatically resets once the overload condition is removed. 1. Find out if this alarm is true by checking which phase has overload through the load (%) displayed on the LCD. 2. If this alarm is true, measure the actual output current to confirm if the displayed value is correct. 3. If yes, disconnect the non-critical load. In a parallel system, this alarm will be triggered if the load is severely unbalanced
System Over load	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. 1. Find out if this alarm is true by checking which phase of which unit has overload through the load (%) displayed on the LCD. 2. If this alarm is true, measure the actual output current to confirm if the displayed value is correct. 3. If yes, disconnect the non-critical load. This alarm will be triggered if the load is severely unbalanced
Unit Over load Timeout	The UPS overload status continues and the overload times out. Note that: 1. The highest loaded phase will indicate overload time-out first. 2. When the timer is active, then the alarm Unit Over load should also be active as the load is above the nominal rating. 3. When the time has expired, the load transfers to static bypass. The inverter shuts down and will restart after 10 seconds. 4. If the load decreases to lower than 95%, after five minutes, the system will transfer back to the inverter. Check the load (%) displayed on the LCD to confirm if this alarm is true. If the LCD tells that overload happens, then check the actual load and confirm if the UPS has overload before the alarm happens
Byp. Abnormal Shutdown	Both the bypass and inverter voltages are abnormal, and the output is off
Inverter Over Current	The inverter has overcurrent fault
Bypass Phase Reversed	The phase rotation of the bypass voltage is reversed. Normally, phase B lags 120 degrees behind phase A, and phase C lags 120 degrees behind phase B. Check that the phase rotation of the UPS bypass supply is correct

Alarm	Explanation
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
Transfer Time-out	The load remains on bypass power owing to excessive number of transfers that occurred within the last hour. The UPS can recover automatically and will transfer the load back to inverter power within an hour
Load Sharing Fault	The UPSs in a parallel system are not sharing the load current correctly
DC Bus Abnormal	The DC bus voltage is abnormal and results in inverter shutdown. The load transfers to bypass
System Transfer	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
DC Bus Over Voltage	The rectifier, inverter and battery converter shut down because the DC bus voltage is too high.. Check if the rectifier has any fault. If no, check if an overload has occurred. Restart the inverter after the fault is cleared
Bypass Over Current	The bypass current is above 135% of the rated current. The UPS alarms but has no action
LBS Active	The LBS setting is active. The UPS is acting as an LBS master or slave in a dual bus configuration
Mains Neutral Lost	The neutral line of the AC input mains is not detected
Battery ground fault	The battery ground fault option has detected a battery ground fault. Contact the local customer service center of Emerson to inspect the battery installation
Manual Turn On	INVERTER ON key activated on the operator control and display panel to turn on the inverter
Manual Turn Off	INVERTER OFF key activated on the operator control and display panel to turn off the inverter
EPO	The local or remote EPO has been activated
Interrupted Transfer Confirm	A prompt for the user to decide whether to press the Enter key to acknowledge an interrupted load transfer to bypass
Transfer Cancel	A prompt for the user to decide whether to press the ESC key to avoid an interrupted load transfer to bypass
Unit Risk Off Confirm	A prompt for the user to decide whether to press the Enter key to shut down a UPS in the parallel system
Parallel System Risk Off Confirm	A prompt for the user to decide whether to press the Enter key to shut down the parallel system
Fault Reset	FAULT CLEAR key pressed
Alarm Silence	SILENCE ON/OFF key pressed
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 on) or DC bus or rectifiers not ready
Audible Alarm Reset	FAULT CLEAR or SILENCE ON/OFF key pressed
Bypass Mode	The UPS is in bypass mode
Normal Mode	The UPS is in normal mode
Battery Mode	The UPS is in battery mode
Source share mode	The inverter is supplied by the battery and rectifier at the same time
UPS Shutdown	UPS shutdown with no output power
BCB Open	BCB state (open)
BCB Close	BCB state (closed)
Batt. Float Charging	Battery state (float charge mode)
Batt. Boost Charging	Battery state (boost charge mode)
Battery Discharging	Battery state (discharge mode)
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)

Alarm	Explanation
Battery Maintenance Testing	The user initiated a maintenance test (20% capacity discharge)
Inverter in Setting	The inverter starts up and is in synchronization
Rectifier in Setting	The rectifier starts up and is in synchronization
Battery room alarm	The temperature in the battery room is high and needs to be attended
BCB open	BCB state (open)
BCB closed	BCB state (closed)
Battery Reverse	Reconnect battery and check battery wiring
Auto start	After UPS shutdown at EOD, the inverter automatically starts upon mains restoration
Rec Flash Update	Rectifier software being updated
Inv Flash Update	Inverter software being updated
Monitor Flash Update	Monitoring software being updated
Bypass Flash Update	Bypass software being updated
LBS abnormal	LBS abnormal
SPM Board Not Ready	The acquisition board is not properly connected. Seek technical assistance from the local customer service center of Emerson
SPM CRC Check Error	Data check error of acquisition arithmetic module. Seek technical assistance from the local customer service center of Emerson
SPM Branch Curr Over LL	Load too large, exceeding route current low threshold (set by commissioning engineer, 60% of rated route current by default)
SPM Branch Curr Over HL	Load too large, exceeding route current high threshold (set by commissioning engineer, 80% of rated route current by default)
SPM Branch Over Current	Load too large, exceeding route overcurrent point (set by commissioning engineer, 105% of rated route current by default)
SPM Branch 1 Inrush OC	Load too large, exceeding route impact overcurrent point (set by commissioning engineer, 130% of rated route current by default)
SPM Branch Breaker Fail	Output distribution switch open. Check whether it was caused by human intervention or fault. Check the load if was caused by fault
SPM Internal Comm Failure	Power interruption between bypass module and SPM monitoring module
SPM Maintenance Bypass Breaker Close	The maintenance bypass switch of the UPS is closed
SPM Output Breaker Open	The output switch of the UPS is open

Note

If the alarms are caused by the values set by the Emerson-authorized commissioning engineer using the configuration software, and the user needs to change the setting values, please contact the local customer service center of Emerson.

Chapter 5 Operating Instructions

This chapter provides detailed operating procedures of the UPS.

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

Warning: hazardous mains and battery voltage present behind covers

No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers.

5.1.2 Power Switches

Opening the front door of the switch cabinet reveals the power switches, including the rectifier input switch, bypass input switch, maintenance bypass switch and output switch, as shown in Figure 5-1.

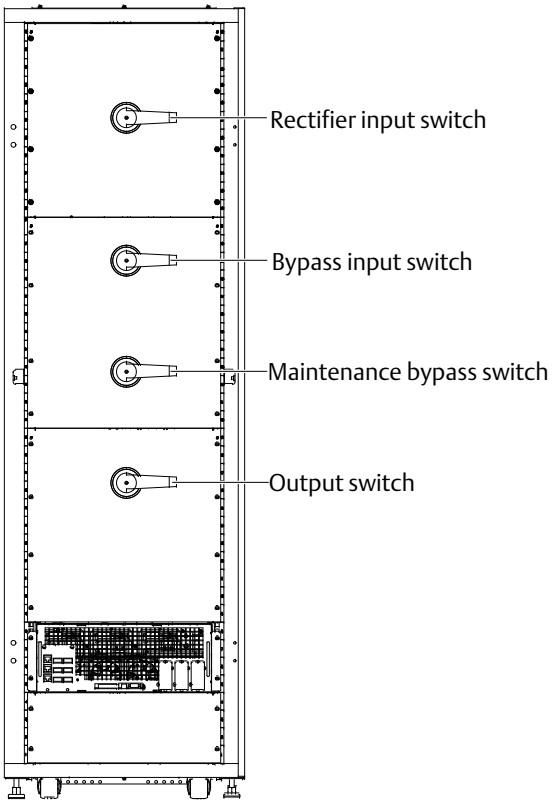


Figure 5-1 Positions of power switches

5.2 UPS Start-Up Procedures

Before startup, the UPS must be fully installed and commissioned, and the external input switch must be closed. Once those general conditions are met, the UPS may be started.

5.2.1 Start-Up Procedures

Warning

During these procedures the output terminals are live. If any load equipment is connected to the UPS output terminals, please check with the load user and ascertain whether it is safe to apply power to the load. If the load is not ready to receive power, open the corresponding output distribution switch.

The procedures for turning on the UPS from a fully powered down condition are as follows. In a parallel system, perform each step of the procedures in every UPS module before proceeding to the next step.

1. Close the output switch, bypass input switch and rectifier input switch of the UPS in turn.

At this point, the LCD displays the start screen. The rectifier indicator flashes green while the rectifiers are starting up. It stops flashing and becomes solid green about 30 seconds after the rectifiers enter normal operation. After initialization, the bypass static switch closes. The states of the indicators are shown in Table 5-1.

Table 5-1 Indicator state

Indicator	State
Rectifier indicator	Green
Battery indicator	Off
Bypass indicator	Green
Inverter indicator	Off
Load indicator	Green

Indicator	State
Status indicator	Yellow

2. Press and hold the INVERTER ON key for two seconds.

Note

You must close the UPS output switch first, then close the bypass input switch and rectifier input switch, and finally turn on the inverters. Otherwise, the inverters will not start, and the UPS will generate Bypass STS fail alarm.

At this point, the inverters start and the inverter indicator flashes green. After the inverters enter normal operation, the UPS transfers from the bypass to the inverters, the bypass indicator turns off, the inverter indicator and load indicator turn on.

The UPS begins to operate in normal mode, and the states of the indicators are as shown in Table 5-2.

Table 5-2 Indicator state

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

5.2.2 Start-Up Procedures Into Battery Mode (Battery Cold Start)

Note

Only one power module is allowed in the main power cabinet before battery cold start.

1. Verify that the battery is properly connected.
2. Press the battery start button (see Figure 5-2) on the front panel of the power module.

Note

If more power modules are required, insert each power module 20 seconds after step 2. The interval for inserting each power module should be more than 20 seconds. Ensure that the power modules are inserted into place. After inserting each power module, press the battery start button of this power module.

At this point, the LCD displays the start screen, and the battery indicator flashes green. It stops flashing and becomes solid green about 30 seconds after the rectifiers enter normal operation.

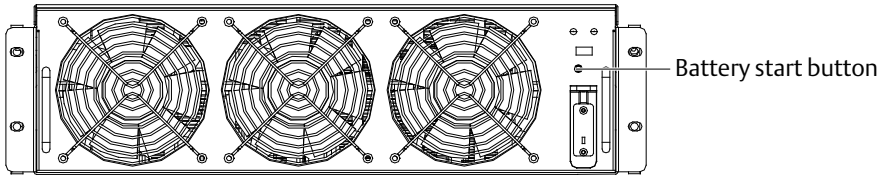


Figure 5-2 Location of battery start button

Note

After step 2, if any of the following conditions occurs, open the BCB or confirm that the BCB has tripped automatically and is open. The system can be started up one minute later.

- EPO pressed in emergency
- Fault in system commissioning

3. Press and hole the INVERTER ON key for two seconds, and the UPS operates in battery mode.

5.3 Procedures For Transfer Between Operation Modes

5.3.1 Transfer From Normal Mode To Battery Mode

Open the rectifier input switch to cut off the mains input, and the UPS enters battery mode. To return to normal mode, wait a few seconds and close the rectifier input switch to connect the mains power to the UPS. The rectifiers will restart automatically after 10 seconds and resume feeding power to the inverters.

5.3.2 Transfer From Normal Mode To Bypass Mode

Press and hold the INVERTER OFF key for two seconds to transfer the UPS to bypass mode.

Note

In bypass mode, the load is being powered by the mains input and is not receiving conditioned power through the inverters.

5.3.3 Transfer From Bypass Mode To Normal Mode

In bypass mode, press and hold the INVERTER ON key for two seconds. When the inverters are ready, the UPS transfers to normal mode.

5.3.4 Transfer From Normal Mode To Maintenance Mode

When the UPS is operating in normal mode, use the following procedures to transfer the load from the inverter output to the maintenance bypass.

Caution

Before performing this operation, read the messages on the LCD to be sure that bypass supply is normal and the inverters are synchronous with it. If these conditions are not present, there is a risk of a short interruption in powering the load.

1. Press and hold the INVERTER OFF key on the right side of the operator control and display panel for two seconds.

The inverter indicator turns off, the status indicator turns yellow and an audible alarm sounds. The load is transferred to the static bypass and the inverters turn off.

Note

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

2. Close the maintenance bypass switch. The load is now on maintenance bypass.

Warning

If you need to maintain a faulty module, wait about 10 minutes for the internal DC bus capacitors to discharge before removing the faulty module.

3. Open the rectifier input switch, bypass input switch and output switch.

Caution

1. The load is not protected from normal supply aberrations when the UPS is operating in maintenance mode.
2. After the UPS is transferred to maintenance bypass, the power modules and bypass module are inoperative and the LCD has no display, only the green indicator of the input SPD shows the UPS has mains input, but the output terminals corresponding to closed output distribution switches and the neutral bars are energized.

5.4 Battery Test Mode Procedures

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

Battery test type and preconditions

1. There are two battery tests to select from:
   - Battery maintenance test: verifies the battery integrity and leads to the battery being partly discharged (20%)
   - Battery capacity test: verifies precisely the battery capacity and leads to the battery being fully discharged (until Battery low pre-warning alarm)
2. The tests can be carried out from the operator control and display panel of the UPS by the operator when the following conditions are satisfied:
   - The load must be greater than 5% of rated UPS capacity and must be stable (for battery maintenance test)
   - The load must be between 20% and 80% of rated UPS capacity and must be stable (for battery capacity test)
   - The battery must have been float charging for 5 hours or more before battery capacity test

The battery test procedures are password controlled and menu driven. The test is immediately terminated in the event of a battery or a mains failure and the total load power is supported from the remaining source without interruptions.

Test procedure

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

Use the right or left arrow key to navigate to the Command menu.

2. Select the desired test (the Battery maintenance test or Battery capacity test option).

Use the Shift key (F1), up and down arrow keys (F2, F3) to highlight the desired test. Press the Enter key (F4).

When prompted, enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered.

3. Wait until the test completes.

This test updates the battery information, including the battery autonomy time (battery discharge duration during AC input failure) and the battery aging coefficient (battery capacity percentage when compared to a new battery).

4. Stop the test.

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

5.5 System Test Procedure

The UPS test procedure checks the control functions of the UPS, the mimic flow chart LEDs and the audible alarm. This self-test is password controlled and menu driven. It can be carried out from the operator control and display panel by the operator and takes 5 seconds.

Test procedure:

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

Use the right or left arrow key to navigate to the Command menu.

2. Select the System test option.

Use the Shift key (F1) and up and down arrow keys (F2, F3) to highlight the desired test. Press the Enter key (F4).

When prompted, enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered.

3. Wait until the test completes.

After five seconds, a pop window will appear to showing 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 testing on the Command menu.

5.6 UPS Shutdown Procedures

5.6.1 Procedures For Completely Powering Down UPS

Caution

The following procedures will switch off all power to the load.

The following procedures are used to completely power down the UPS and load. All power switches, isolators and circuit breakers will be open and the power will be removed from the load. In a parallel system, perform each step of the procedures in every UPS module before proceeding to the next step.

1. Press the EPO key on the UPS operator control and display panel. This disables the rectifier, inverter, static switch and battery operation, and the corresponding UPS is isolated from the load.

Note: Unless in an emergency situation, do not press the remote EPO key.

2. Open the rectifier input switch, bypass input switch and BCB.

In a parallel system, at this point, other UPSs report Parallel Comm. Fail, which is normal. Other UPSs continue to power the load through the inverter.

All of the indicators and the LCD on the operator control and display panel will extinguish as the mains-driven internal power supplies decay.

3. Open the output switch of the UPS.

Warning: hazardous battery voltage

After the UPS is powered down completely, the battery terminals still remain energized at hazardous voltage levels.

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

Caution

Ensure that the UPS has been installed with an external maintenance bypass cabinet before carrying out these procedures.

The following procedures are applicable for completely powering down the UPS and still keeping the power supply to the load. In a parallel system, perform each step of the procedures in every UPS module before proceeding to the next step.

1. Use the procedures in *5.3.4 Transfer From Normal Mode To Maintenance Mode* to transfer the UPS to maintenance mode.
2. Close the maintenance bypass switch of the external maintenance bypass cabinet.
3. Open the rectifier input switch and bypass input switch of the UPS.
4. Open the output switch of the UPS.

5.7 EPO Procedures

The EPO key on the UPS operator control and display panel is designed to switch off the UPS in emergency conditions, for example, fire, flood, and so on. The system will turn off the rectifiers, inverters and stop powering the load immediately (including the inverters and bypass), and the battery stops charging or discharging.

If the mains input is present, the UPS control circuit will remain active; however, the output will be turned off. To remove all power from the UPS, the rectifier input switch, bypass input switch of the UPS should be opened.

5.8 UPS Reset Procedures After EPO

After UPS shutdown due to an EPO action, inverter over-temperature or overload, battery overvoltage, excessive transfer, and so on, once all appropriate measures have been taken to correct the problem indicated by the alarm message appearing on the LCD, carry out the following reset procedures to restore the UPS to normal operation

1. Press the FAULT CLEAR key to let the system exit the emergency off state.
2. Press and hold the INVERTER ON key for two seconds.

Note

1. The rectifiers will start again, and the bypass will begin to power the load. The Rectifier indicator flashes while the rectifiers are starting up. When the rectifiers enter the normal operation state (about 30 seconds), the rectifier indicator turns solid green.
2. The rectifiers will turn on automatically when the overtemperature fault disappears five minutes after the disappearance of overtemperature signals.
3. After the EPO key is pressed, if the mains input is removed, 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.

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 end of EOD threshold, it will shut down.

The UPS will automatically restart and enable output power:

- After the mains power is restored
- If Auto Recovery after EOD Enabling is enabled
- After the Auto Recovery after EOD Delay Time expires (the default delay is 10min). During the automatic recovery delay, the UPS will charge its batteries to provide a safety margin for equipment shutdown if input power fails again

If the Auto Recovery after EOD Enabling feature is disabled, the user may restart the UPS manually by pressing the FAULT CLEAR key.

5.10 Selecting Language

The UPS provides 12 LCD languages for your selection, including Chinese, Dutch, English, French, German, Italian, Japanese, Polish, Portuguese, Russian, Spanish and Swedish.

Carry out the following procedures to select the language:

1. From the OutPut menu, press the F3 or F4 (left or right) key as needed to select the Language menu.
2. Press the F5 (enter) key to move the cursor to the data window on the screen.
3. Use the F3 or F4 (up or down) key to select the required language.
4. Press the F5 (enter) key to accept the language selection.
5. Return to the OutPut menu by repeatedly pressing the F2 (ESC) key as needed; all text on the LCD will now be displayed in the selected language.

5.11 Changing The Current Date And Time

To change the system date and time, carry out the following procedures:

1. From the OutPut menu, press the F3 or F4 (left or right) key as needed to select the Settings menu.
2. Press the F5 (enter) key to move the cursor to the data window on the screen.
3. Use the F3 or F4 (up or down) key to select the Date & time option, then press the F5 (enter) key.
4. Move the cursor to the row in which the date and time are displayed, then press the F5 (enter) key.
5. Use the F3 or F4 (up or down) key to enter the current time and date information.
6. Press the F5 (enter) key to save the settings, then press the F2 (ESC) key to return to the OutPut menu.

5.12 Command Password

Password protection is used to limit the control functions accessible to the operator. This password provides access to UPS and battery test functions.

Chapter 6 Battery

This chapter introduces the relevant information of the battery, including the introduction, safety, power cables, maintenance, recycling, reference current and connection of external BCB.

6.1 Introduction

The UPS battery string consists of batteries connected in series to provide rated DC input voltage for the UPS inverters. The battery backup time (that is, the duration for the battery to supply the load when the mains supply is interrupted) is subject to the ampere-hour capacity of the batteries. Therefore, it may be necessary to parallel-connect several battery strings. Batteries of different manufacturers, models or used time cannot be used together.

It is required to connect external batteries to the UPS. The external batteries are normally placed in a battery cabinet.

 Note
Before maintenance or service, it may be required to disconnect the battery from the UPS.

6.2 Safety

Take special care when working with the batteries associated with the UPS. When all the cells are connected together, the battery string voltage can be up to 576Vdc and is potentially lethal. Please follow the precautions for high voltage operation. Only qualified personnel are allowed to install and maintain the battery. To ensure the safety, the external batteries shall be installed inside a key-lockable cabinet or in a purpose-designed, dedicated battery room, so that they are segregated from all but qualified maintenance personnel.

During battery maintenance, pay attention to the following items:

- Isolate the battery string to be serviced completely from the UPS
- The battery cell number setting (set by commissioning engineer) in the background software must be consistent with the actual battery cell number

 Note
Full safety instructions concerning the use and maintenance of UPS batteries are provided in the appropriate battery manufacturers manuals. The battery safety information contained in this section relates to key considerations that must be taken into account during the installation design process and might affect the design outcome depending on the local conditions.

 Warning: battery hazard
1. No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers. 2. Before operating the copper bars connected with the external battery, please disenergize the copper bars. 3. Observe the following safety precautions when working with the batteries: a) The battery shall be firmly and reliably connected. After the connection is completed, all connections between the terminals and the batteries shall be calibrated. The requirements on torque specified in the instructions or user manual provided by the battery manufacturer shall be satisfied. All connections between the terminals and the batteries shall be

Warning: battery hazard

inspected and tightened at least once a year. Failure to observe this may cause fire!
b) Inspect the battery appearance before accepting and using the battery. If there exist any package damage, dirty battery terminal, terminal erosion, rust, or enclosure crack, deformation or electrolyte leakage, replace it with new product. Otherwise, battery capacity reduction, electrolyte leakage or fire may be caused.
c) The battery is very heavy. Please use proper method to move and hoist the battery to prevent to human being or the battery terminals. Severe damage to the battery may cause fire.
d) The battery terminals 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, and severe damage 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 personal may be caused.
f) The battery shall be kept away from heat sources like transformers, or fire sources. Do not burn the battery or the battery in fire, otherwise, electrolyte leakage, battery bulge, fire or explosion may be caused.
g) Do not directly connect any conductor between the positive and negative terminals of the battery. Remove finger rings, watches, necklaces, bracelets and other metal objects before operating the battery, and ensure that the tools (for example, wrench) are wrapped with insulating material. Otherwise, battery burning, explosion, human death or injury may be caused.
h) Do not disassemble, modify or damage the battery. Otherwise, battery short circuit, electrolyte leakage or even personal may be caused.
i) Clean the battery enclosure with 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 the worst case, fire may be caused.
j) The battery contains diluted sulfuric acid. In normal use, the diluted sulfuric acid is absorbed to the baffle plate and polar plate of the battery. However, if the battery is damaged, the acid may leak from the battery. Therefore, use personal protective equipment, such as, goggles, rubber gloves and apron, 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.
4. The battery terminal voltage is hazardous. The battery can present a risk of electrical shock and high short circuit current. Observe the following precautions when working on the battery.
a) Wear eye protection to prevent injury from accidental electrical arcs.
b) Remove rings, watches and all other metal objects.
c) Use tools with insulated handles.
d) Wear rubber gloves and boots.
e) Do not lay tools or metal parts on top of the battery.
f) Disconnect the charging source prior to connecting or disconnecting battery terminals.
g) Check if the battery is inadvertently grounded. If yes, remove source from ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock can be reduced if such grounds are removed during installation and maintenance.
h) If electrolyte comes into contact with skin, the affected area should be washed immediately with large amount of water.
i) The battery may have short circuit, electrolyte dry-up or positive-pole plate erosion at the end of its life. If it is still used in this state, the battery thermorunaway, bulging or electrolyte leakage may occur. Before the battery enters this state, replace it, store it in a container resistant to sulfuric acid and dispose of it in accordance with local regulations.

6.3 Power Cable

6.3.1 Overview

Please install and connect the batteries according to the following description and graphic presentation.

6.3.2 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 a clearance of 10mm between the vertical sides of the batteries for the smooth flow of the air around the batteries.
3. Certain clearance shall be maintained between the battery top and the underside of the layer above it to facilitate battery monitoring and maintenance.
4. The batteries shall be installed from the bottom layer upwards to avoid high gravity center. The battery shall be properly installed and protected from vibration and shock.
5. Measure the battery voltage, and calibrate the battery voltage after UPS startup.

6.3.3 Battery Connection

1. When the battery cabinet is installed on a raised floor, the battery power cables and optional BCB control cables can enter the UPS cabinet through the cabinet bottom. If the UPS and battery cabinet are installed side by side on a solid floor, these cables can be led into the UPS cabinet through the cable entry holes on the lower part of the battery cabinet.
2. When multiple battery strings are used, they shall be connected in series and then in parallel. Before applying load and power-up, be sure to measure the total voltage of the battery strings and make sure that it is correct. The negative and positive terminals of the battery must be connected to the corresponding negative and positive battery terminals of the UPS according to the labels on the battery and UPS. Reverse battery connection may cause explosion, fire, battery damage, UPS damage, and personal injury.
3. After connecting the battery cables, install an insulating shroud on each terminal.
4. When connecting the cables between the battery terminals and the BCB, connect from the BCB side first.
5. The bending radius of the cable shall be larger than 10D, where D is the outer diameter of the cable.
6. After cable connection, it is prohibited to pull the battery cables or the cable terminals.
7. Do not cross the battery cables during connection, and do not tie the battery cables together.
8. Refer to Figure 6-1 for the battery cable connection.

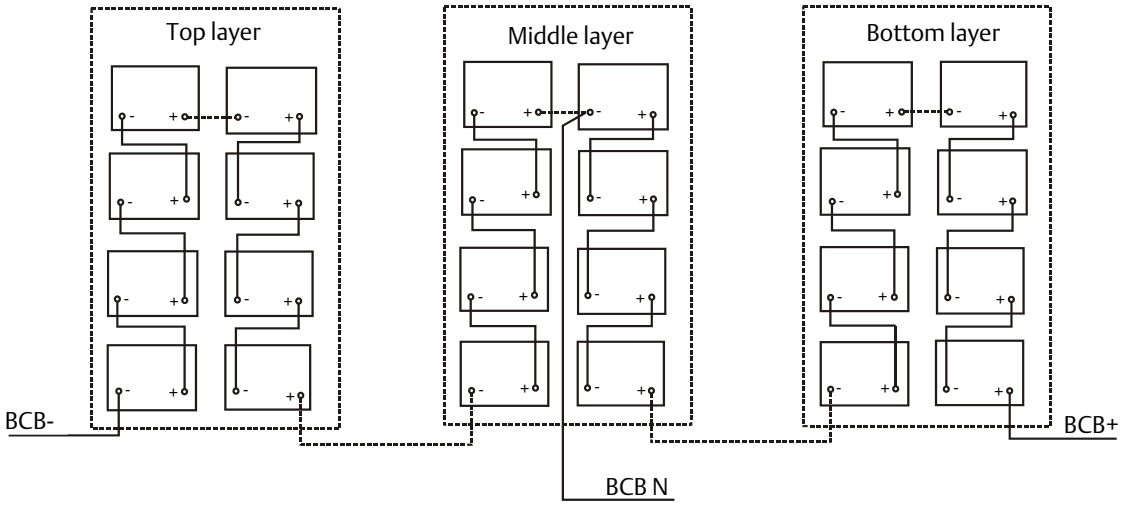


Figure 6-1 Battery cable connection

6.4 Reference Current And Connection Of External BCB

Table 6-1 provides the maximum battery discharge current at full load and the reference BCB rated current. Refer to IEC60950-1 Table 3B and follow the local electrical regulations to select the CSA.

Table 6-1 Maximum battery discharge current at full load and reference BCB rated current

Item		Unit	UPS rated power (kVA)									
			30	60	90	120	150	180	210	240	270	300
30-cell battery	Max. battery discharge current at full load	A	105	210	315	420	525	630	735	840	945	1050
	Reference rated current of BCB	A	150	250	350	450	550	650	750	850	950	1050
32-cell battery	Max. battery discharge current at full load	A	100	200	300	400	500	600	700	800	900	1000
	Reference rated current of BCB	A	150	250	350	450	550	650	750	850	950	1050
34-cell battery	Max. battery discharge current at full load	A	94	188	282	376	470	564	658	752	846	940
	Reference rated current of BCB	A	100	200	300	400	500	600	700	800	900	1000
36-cell battery	Max. battery discharge current at full load	A	88	176	264	352	440	528	616	704	792	880
	Reference rated current of BCB	A	100	200	320	400	450	550	630	750	800	1000
38-cell battery	Max. battery discharge current at full load	A	84	168	252	336	420	504	588	672	756	840
	Reference rated current of BCB	A	100	200	260	350	450	550	600	700	800	850
40-cell battery	Max. battery discharge current at full load	A	80	160	240	320	400	480	560	640	720	800
	Reference rated current of BCB	A	100	200	250	320	400	500	600	700	750	800

Note

1. If the external battery is configured to have separate wiring of positive terminal and negative terminal (that is, four wires will be led out from the battery side), for the UPS, due to the limitation of the rated current, it is recommended to use a 4P DC MCCB (DC rated voltage of the breaker meeting 1-pole 250Vdc, 2-pole 500Vdc, 3-pole 750Vdc, rated breaking capacity limit being 35kA) or two 2P DC MCCBs (DC rated voltage of single breaker meeting 1-pole 250Vdc, 2-pole 500Vdc, rated breaking capacity limit being 20kA). Connections between the battery, BCB and UPS are shown in Figure 6-2.

2. If the external battery is configured to use CT wiring (that is, three wires will be led out from the battery side), it is recommended to use a 4P DC MCCB, with DC rated voltage of the breaker meeting 1-pole 250Vdc, 2-pole 500Vdc, 3-pole 750Vdc, and rated breaking capacity limit being 35kA. If the battery cell number ranges from 30 to 34, for cost-saving purpose, refer to Figure 6-3 for the connections between the battery, BCB and UPS. If the battery cell number ranges from 36 to 40, refer to Figure 6-4 for the connections between the battery, BCB and UPS.

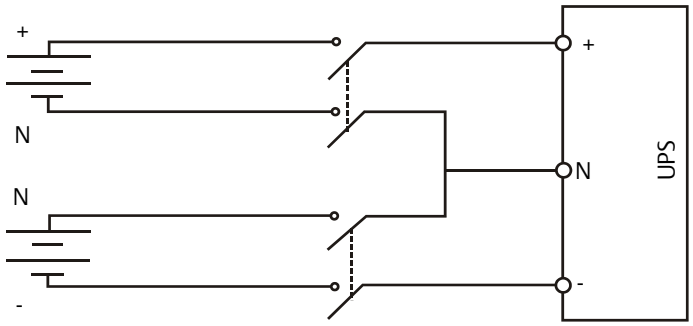


Figure 6-2 Connections between battery, BCB and UPS (4 wires at battery side)

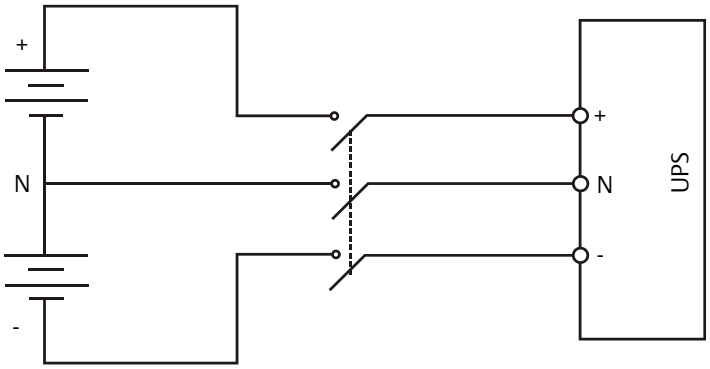


Figure 6-3 Connections between battery, BCB and UPS (3 wires at battery side, battery consisting of 30 to 34 cells)

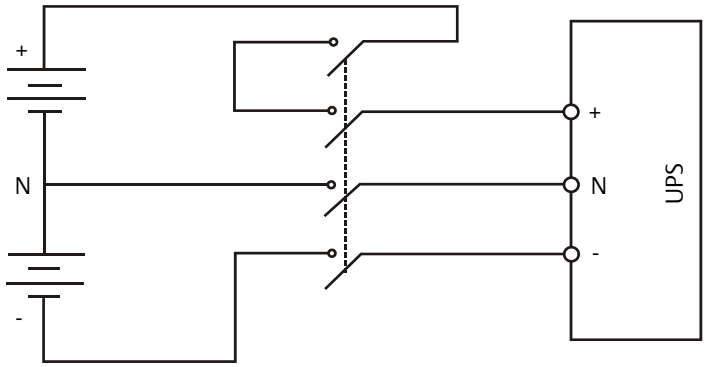


Figure 6-4 Connections between battery, BCB and UPS (3 wire at battery side, battery consisting of 36 to 40 cells)

If you select the BCB box (containing a BCB and a BCB control board) made by Emerson, you need to modify the BCB box and connect the BCB box with the battery and UPS according to Figure 6-5.

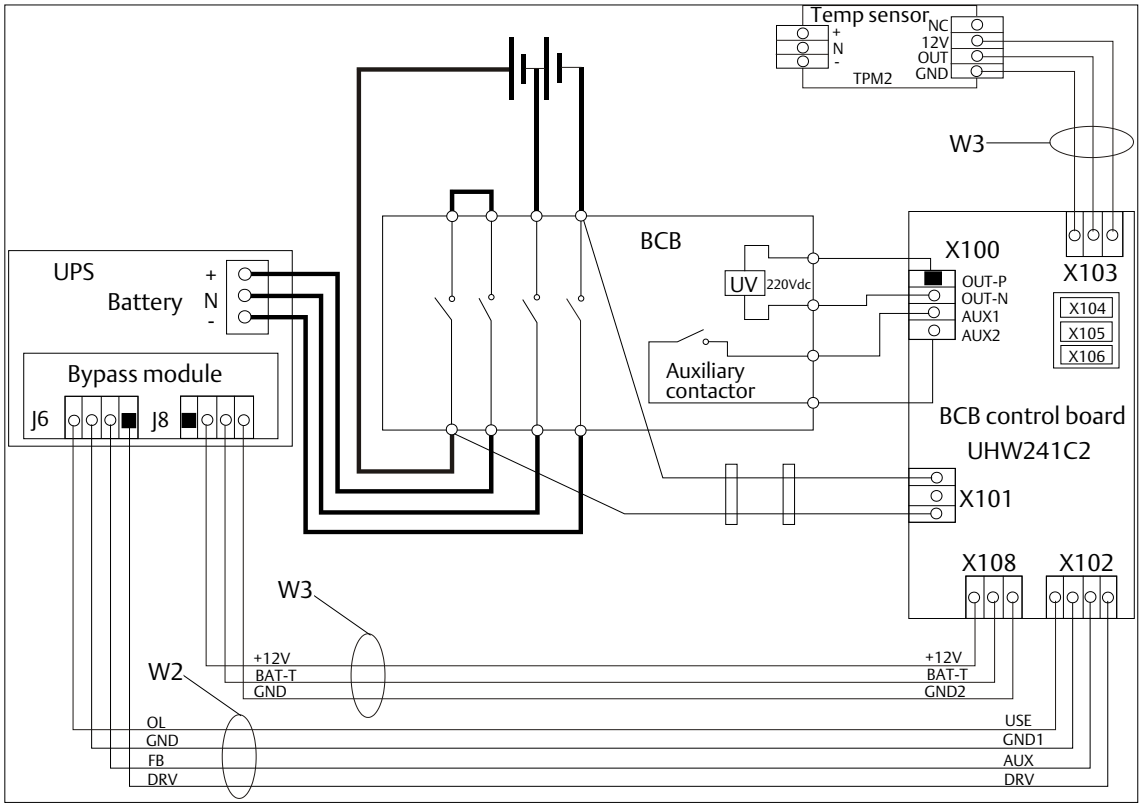


Figure 6-5 Connections between UPS, BCB and BCB control board

6.5 Battery Maintenance

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

Warning

The batteris should be of the same capacity and type. Using different types of battery may cause fire!

Note

1. Periodically check the screws of the battery terminals for loose connection. If there is any loose screw, tighten it immediately.
2. Check that all safety devices are present and that their functions are normal. Check that the battery management parameters are set correctly.
3. Measure and record the air temperature in the battery room.
4. Check the battery terminals for damage and heating. Check the battery enclosure and terminal covers for damage.

6.6 Disposal Of The Used Battery

If the battery leaks electrolyte, or is otherwise physically damaged, it should be placed in a container resistant to sulphuric acid and disposed of in accordance with local regulations.

Disused lead-acid storage battery belongs to dangerous waste, and it is a key item for disused 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 disused battery pollution prevention and other standards.

According to the relevant national regulations, the disused 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 disused 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 Dual Bus System

This chapter details the installation and wiring of the parallel system and dual bus system.

7.1 Overview

Two UPSs can be connected in parallel to form a 1 + 1 parallel system (parallel system for short).

7.2 System Installation Procedures

The basic installation procedure of a parallel system comprising two or more UPS modules 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

Position the UPS modules and make connection as shown in Figure 7-1. The output distribution mode (where Q1EXT and Q2EXT must be fitted) shown in Figure 7-1 is recommended to facilitate maintenance and system testing.

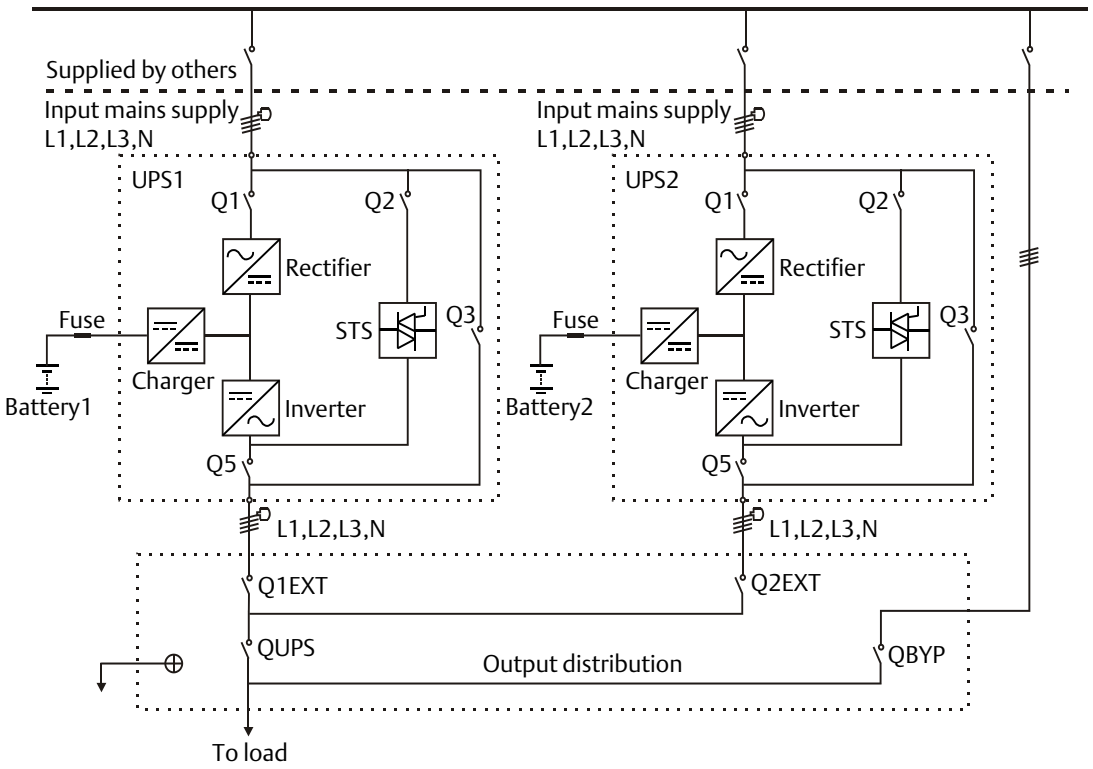


Figure 7-1 Schematic diag. of typical parallel system (with common input, separate batteries, output/bypass distribution cabinet)

7.2.3 External Protective Device

Refer to *3.1.7 External Protective Device*.

7.2.4 Power Cable

The power cable wiring is similar to that of UPS module. See *3.1 Power Cables*.

The bypass and main 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 common neutral sinking point.

Note

The lengths and specifications of the power cables of each UPS module, including the bypass input cables and UPS output cables, should be the same. This facilitates load sharing in bypass mode.

7.2.5 Parallel Control Cable

Shielded and double-insulated parallel control cables available in lengths 5m, 10m and 15m must be interconnected in a ring configuration between the two UPS modules, as shown in Figure 7-2. The parallel ports J2 and J3 are 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!

Note

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

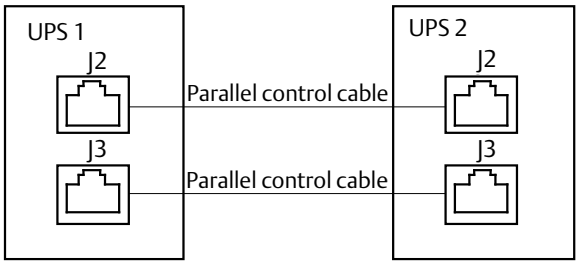


Figure 7-2 Connection of parallel control cables of parallel system

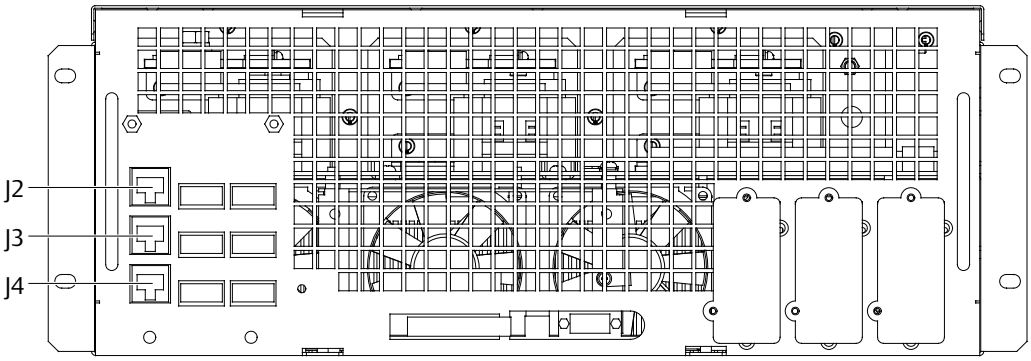


Figure 7-3 Locations of ports J2, J3 and J4 on bypass module

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 closed.
2. The open circuit voltage provided is 5Vdc, <20mA.
3. The external EPO device can be composed of another control system which can disconnect the UPS mains supply or the bypass input.
4. Pins 1 and 2 of the normally closed EPO-J10 port on the bypass module have been linked in factory.

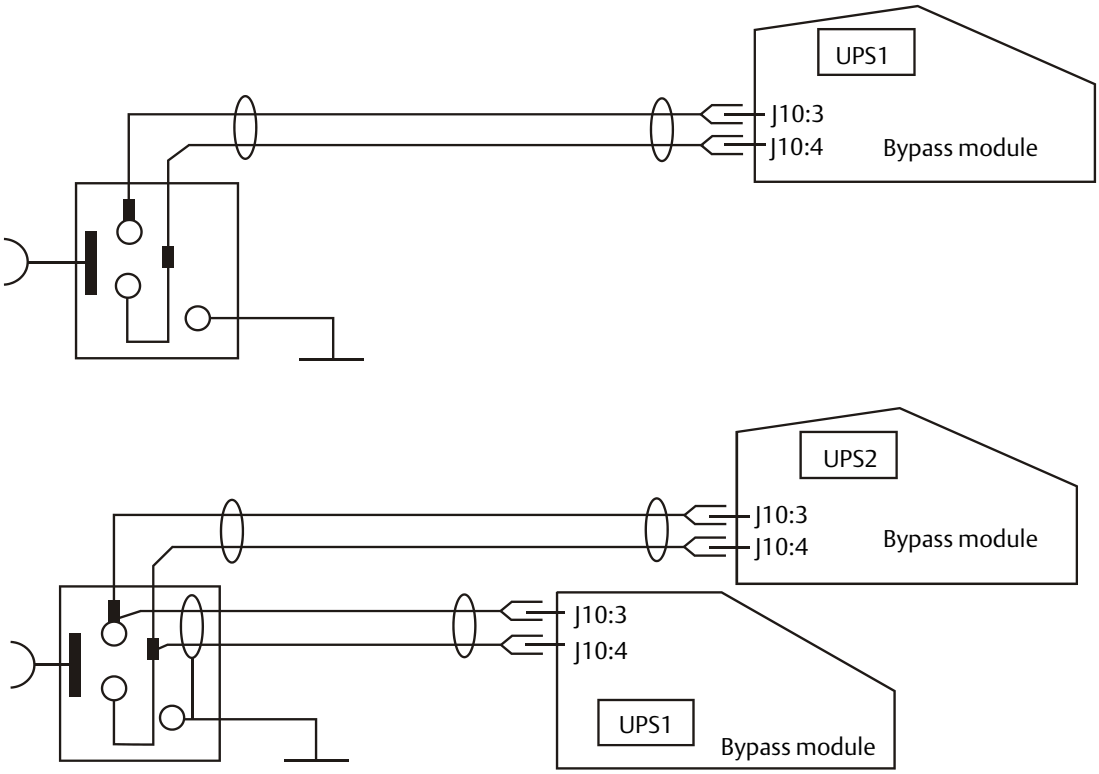


Figure 7-4 EPO circuit diagram

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.

For the detailed operation procedures, see *5.2.1 Start-Up Procedures*.

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.

For the detailed operation procedures, see *5.3.4 Transfer From Normal Mode To Maintenance Mode*.

7.3.3 Isolation Procedures (Of One UPS In A Parallel System)

Caution

The following procedures will switch off all power to the load.

The following procedures are used to isolate one UPS from a parallel system.

1. Press the EPO key of the UPS to be isolated.
2. Open the rectifier input switch, bypass input switch and BCB of the UPS.

At this point, other UPSs report 'Parallel Comm. Fail', which is normal. Other UPSs continue to power the load through the inverter.

3. Open the output switch of the UPS.
4. Wait for 10 minutes before carrying out UPS maintenance or repair.

Warning: hazardous battery voltage

The UPS battery and connecting terminals remain energized at hazardous voltage levels at all times.

7.3.4 Insertion Procedures (Of One UPS In A Parallel System)

The procedures are used to re-integrate a UPS that has been previously isolated from a parallel system. It is assumed that the installation is completed and the system has been commissioned by authorized personnel.

1. Close the output switch of the UPS to be re-integrated.
2. Close the rectifier input switch, bypass input switch and BCB of the UPS.
3. Press and hold the INVERTER ON key of the UPS for 2s.

The inverter starts up, and the inverter indicator starts flashing in green color. When the inverter is ready, the UPS transfers to parallel operation with other UPSs, and the inverter indicator goes to a continuous on state.

The UPS is in normal mode, and the UPS indicator states are as listed in Table 7-1.

Table 7-1 UPS indicator state

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

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.

Warning: hazardous battery voltage

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

For the detailed operation procedures, see *5.6.1 Procedures For Completely Powering Down The UPS*.

7.3.6 Procedures For Complete UPS Shutdown While Maintaining Power To Load

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.

Warning: hazardous battery voltage

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

For the detailed operation procedures, see *5.6.2 Procedures For Completely Powering Down UPS While Maintaining Power To Load*.

7.4 Dual Bus System

7.4.1 Cabinet Installation

As shown in Figure 7-5, a dual bus system consists of two independent UPS systems. Each UPS system may be a UPS module or a parallel system consisting of two parallel UPS modules. The dual bus system has high reliability and is suitable for load with multiple input terminals. For single-input load, an optional STS can be fitted to start the LBS supplied in standard configuration.

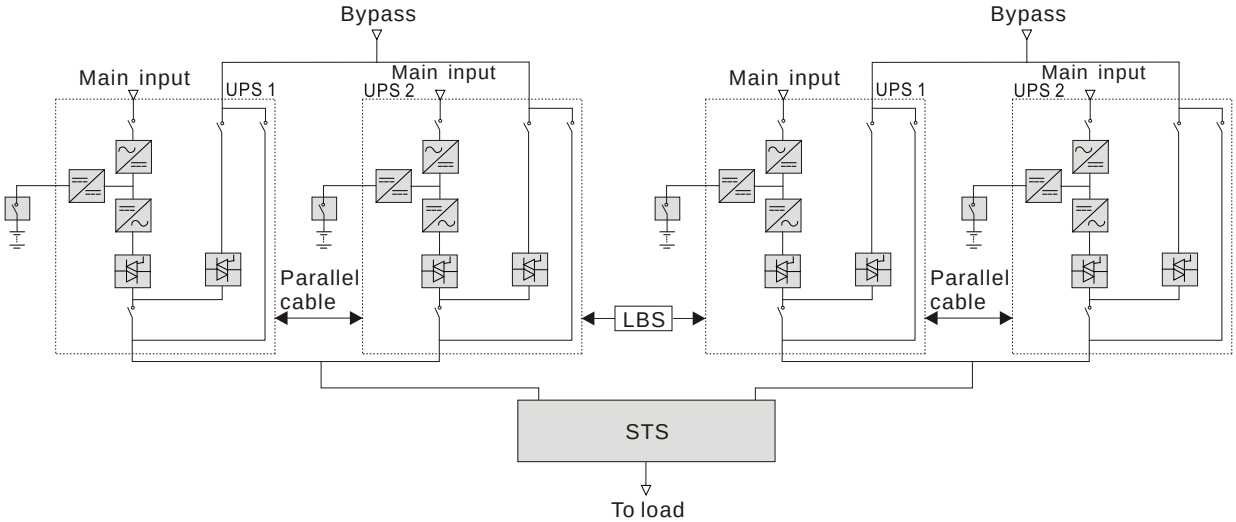


Figure 7-5 Typical dual bus system (with STS and LBS)

The dual bus system uses the LBS to keep the output of the two independent UPS systems (or parallel 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/or slave operation in normal or bypass mode.

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

7.4.2 External Protective Device

Refer to *3.1.7 External Protective Device*.

7.4.3 Power Cable

The wiring of power cables is similar to that of single module system. See *3.1 Power Cables*.

The bypass and the main input sources must be referenced to the same neutral potential, and the input earth leakage monitoring devices, if installed, must be located upstream of the common neutral sinking point.

7.4.4 Control Cable

For a dual bus system composed of two APM UPSs, connect the optional LBS cables between the two UPS systems as shown in Figure 7-6 to Figure 7-8. The J3 and J4 ports are provided on the front panel of the bypass module, as shown in Figure 7-3.

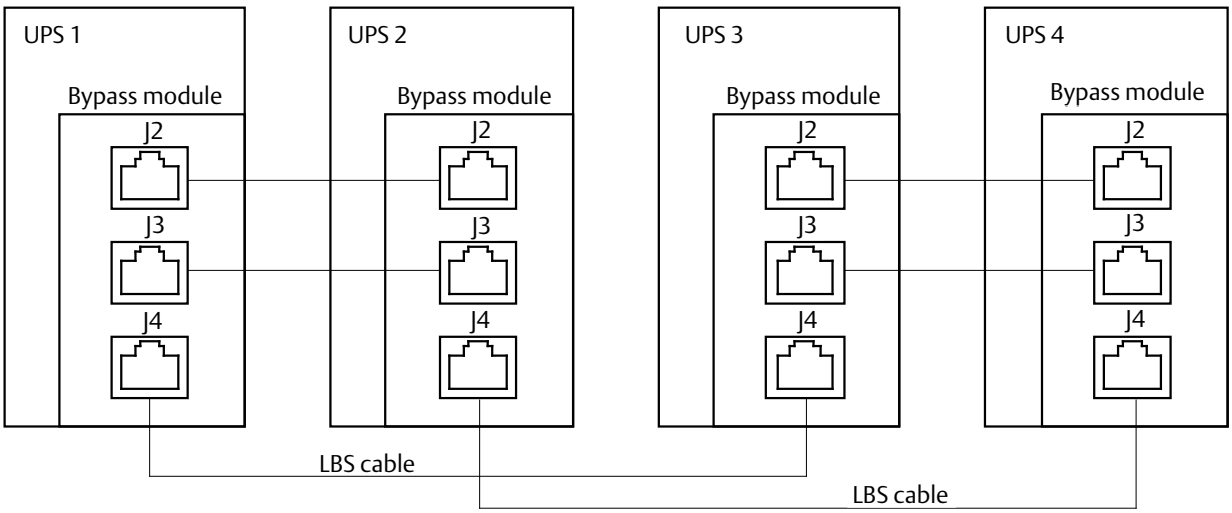


Figure 7-6 Connection of typical dual bus system of two parallel systems

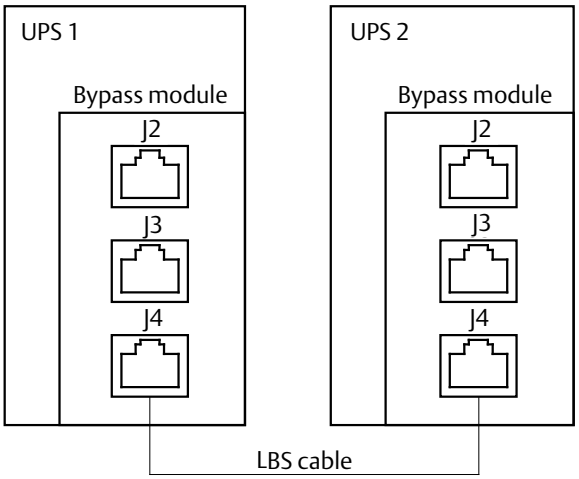


Figure 7-7 Connection of typical dual bus system of two single UPSs without redundancy LBS cable

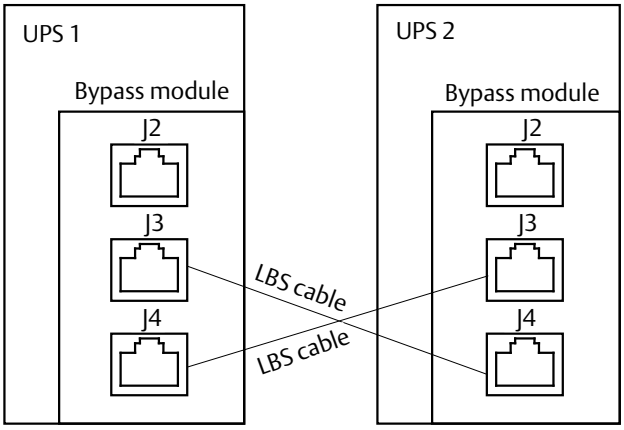


Figure 7-8 Connection of typical dual bus system of two single UPSs with redundancy LBS cable

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 lists all of the UPS options.

Table 8-1 Option list

No.	Option	Model	Part No.	Remark
1	Bypass load sharing inductor	UF-NRBYPCK	02355086	Applicable to APM 300 UPS
2	Battery temperature sensor	UF-SENSOR	02350174	
3	Air filter		21120752	3 air filters
4	Relay card	UF-DRY410	02354309	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port
5	SIC card	UF-SNMP810	02351817	Installed in Intellislot 1, 2 or 3 port, advisably in Intellislot 2 port
6	UF-RS485 card	UF-RS485	02351786	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port
7	Modbus card	UFMOD41Z1	02354066	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port
8	LBS cable (5m, 10m, 15m)		5m cable (04118683) 10m cable (04118684) 15m cable (04118685)	Two cables should be selected to achieve redundancy
9	Parallel control cable (5m, 10m, 15m)		5m cable (04118683) 10m cable (04118684) 15m cable (04118685)	Two cables should be selected to achieve redundancy

8.2 Option

8.2.1 Bypass Load Sharing Inductor

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.

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.

Preparing installation tools

Make sure that all installation tools are present, including a cross head screwdriver, a pair of diagonal cutting pliers, a sleeve spanner and an adjustable spanner.

Checking installation materials

Check that all installation materials are present and complete, including three bypass load sharing inductors LA, LB and LC; cables W63, W64, W65, W66, W67 and W68; six M10 × 30 screws; six flat washers; six spring washers; six M10 nuts; twelve M6 × 12 screws and a user manual.

Installation 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 the rectifier input, bypass input, battery input and output load of the UPS.
2. Wait five minutes for the internal DC bus capacitors of the UPS to fully discharge.
3. Open the back door and remove the right side panel of the UPS cabinet.
4. Remove the cables W60, W61 and W62 between the copper bars Q2-A, Q2-B, Q2-C and the copper bars ZA, ZB, ZC. Retain the screws and nuts. The positions of the copper bars are shown in Figure 8-1.

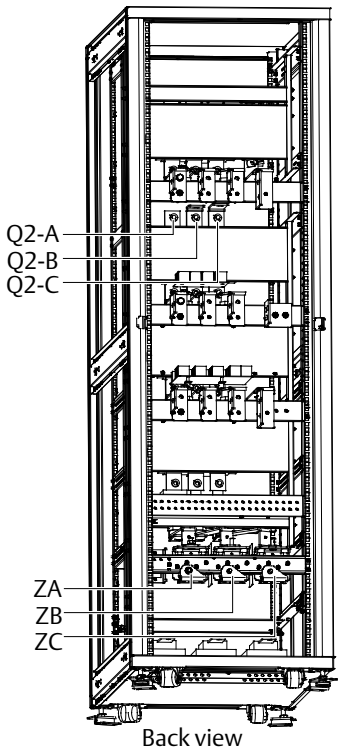


Figure 8-1 Positions of copper bars

5. Place the three inductors LA, LB and LC in the installation positions shown in Figure 8-2, and fix them on the base plate of the UPS cabinet with twelve M6 × 12 screws.

There are 12 installation holes on the base plate of the UPS cabinet for fixing the inductors, four installation holes for each inductor.

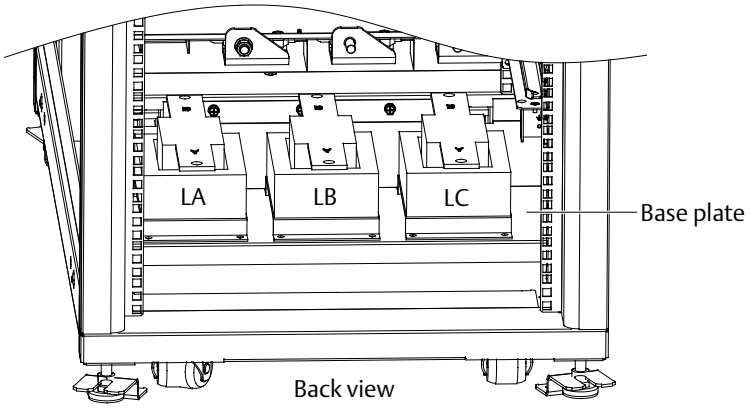


Figure 8-2 Installation positions of inductors

Connections

1. Connect the cables W63, W64 W65, W66, W67 and W68 between the copper bars Q2-A, Q2-B, Q2-C, ZA, ZB, ZC and the inductors LA, LB and LC, as shown in Figure 8-3. Use six M10 × 30 screws, six flat washers, six spring washers and six M10 nuts to connect the cables to the inductors, and use the screws and nuts removed in step 4 to connect the cables to the copper bars.

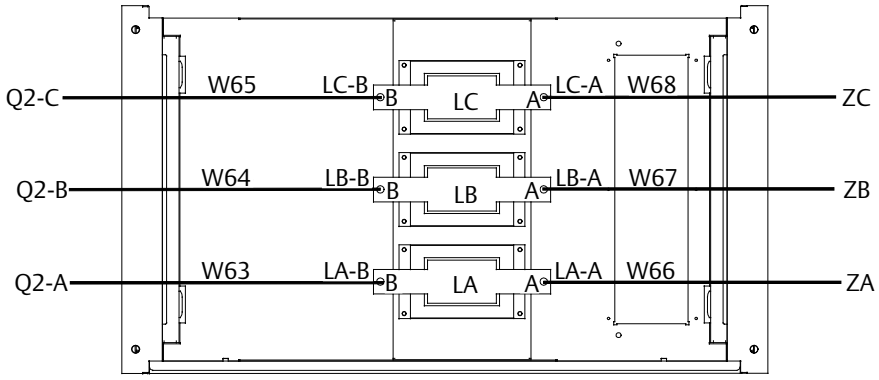


Figure 8-3 Cable connection

2. Replace the right side panel and close the back door of the UPS.
3. Connect the rectifier input, bypass input, battery input and output load of the UPS.

Maintenance

1. Keep the connections tight.

Tighten all connections in installation and at least annually thereafter.

2. Keep the inductors clean.

Maintain the inductors free of dust and moisture.

3. Keep good records.

Troubleshooting is easier if you have historical background.

8.2.2 Battery Temperature Sensor

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) Wait five minutes for the internal DC bus capacitors of the UPS complete discharging.

2. Connect one end of the specified cable to the battery temperature sensor, and the other end to the corresponding dry contact port. For details, see Figure 6-5 in Chapter 6.

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

8.2.3 Air Filter

Air filter needs regular inspection and replacement, whose time interval is related to the environmental conditions under which UPS is working. Under normal environmental conditions, the air filter should be cleaned or replaced every two months and need more frequent cleaning and replacement in dusty or other bad environment. Frequent inspection or replacement should also be made in newly-built construction.

The replacement method of the air filter is shown in *10.3 Replacement Procedures Of Air Filter*.

8.2.4 SIC Card

The SIC card is a network management card. It can make the UPS developed by Emerson Network Power Co., Ltd has 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.

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

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.

The SIC card should be installed in the Intellislot port (see Figure 3-3) in the UPS. See Table 8-1 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 8-1, and then fasten the screws.

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

8.2.5 Relay Card

The UPS provides relay card for the user to use dry contact signals to monitor the UPS. It is hot pluggable for easy installation.

The relay card can provide four channels of relay digital signal output to the remote site. They are UPS on Battery, Battery Low, UPS on Bypass or in Standby, UPS Faulty. Each dry contact signal output channel provides both normally open and normally closed ports. The relay card can also receive three channels of digital signal input, two of which control the UPS turn-on and turn-off respectively, the third is reserved.

Appearance and hardware description

The appearance of the relay card is shown in Figure 8-4.

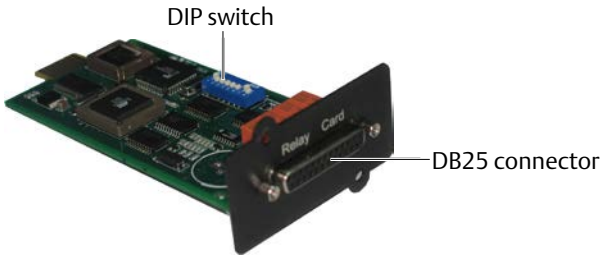


Figure 8-4 Relay card appearance

The DIP switch is used to configure the UPS turn-on and turn-off signal input function of the relay card. The DB25 connector provides dry contact signal input and output. The pins of the DB25 connector are described in Table 8-2.

Table 8-2 DB25 connector pin description

Pin No.	Pin name	Description	
Pin 1	Va, power output	9 ~ 15Vdc (reserved for factory use)	
Pin 14	K0_NO, Channel 0 dry contact normally open output contact	Closed: UPS on Battery	Electrical parameter: 30Vdc/1.8A, resistive load
Pin 2	K0_COM, Channel 0 dry contact common output contact		
Pin 15	K0_NC, Channel 0 dry contact normally closed output contact	Open: UPS on battery	
Pin 3	K1_NO, Channel 1 dry contact normally open output contact	Closed: Battery Low	
Pin 16	K1_COM, Channel 1 dry contact common output contact		
Pin 4	K1_NC, Channel 1 dry contact normally closed output contact	Open: Battery Low	
Pin 17	K2_NO, Channel 2 dry contact normally open output contact	Closed: UPS on Bypass or in Standby	
Pin 5	K2_COM, Channel 2 dry contact common output contact		
Pin 18	K2_NC, Channel 2 dry contact normally closed output contact	Open: UPS on Bypass or in Standby	
Pin 6	K3_NO, Channel 3 dry contact normally open output contact	Closed: UPS Faulty	
Pin 19	K3_COM, Channel 3 dry contact common output contact		
Pin 7	K3_NC, Channel 3 dry contact normally closed output contact	Open: UPS Faulty	
Pin 24	DRY_IN2, Channel 2 dry contact signal input	Reserved	
Pin 12	DRY_IN1, Channel 1 dry contact signal input	The UPS is turned off if this contact is closed for more than one second	
Pin 25	DRY_IN0, Channel 0 dry contact signal input	The UPS is turned on if this contact is closed for more than one second	

Pin No.	Pin name	Description
Pin 9	RXD_PC, for communication to PC, receive terminal	Reserved, for factory commissioning
Pin 21	TXD_PC, for communication to PC, send terminal	Reserved, for factory commissioning
Pin 13	GND, common GND	Power GND, dry contact signal input common GND
Others	NC	

Cable options

Emerson provides three cable options to connect the DB25 connector of the relay card, to suit the user's different requirements on the functions of the connector.

Figure 8-5 ~ Figure 8-7 show the appearance and wiring principle of each cable.

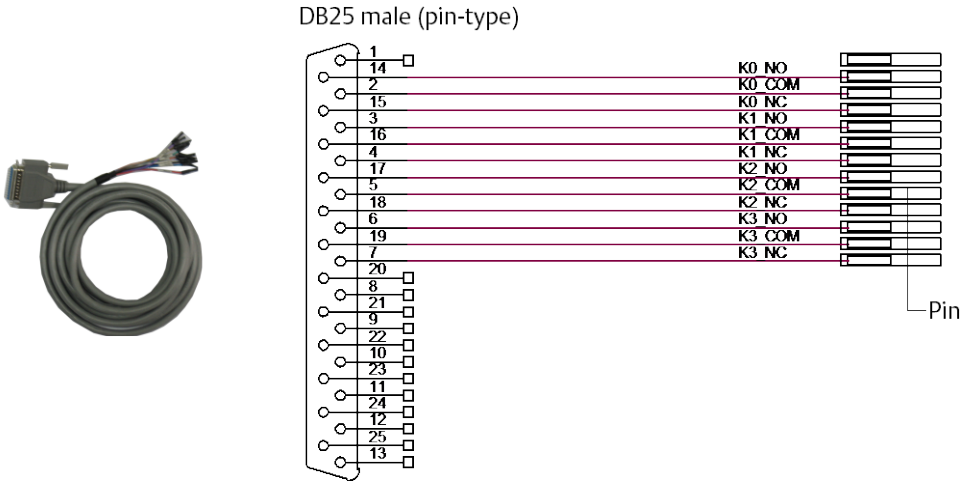


Figure 8-5 Appearance and wiring schematic of cable 1 (UFDRY21SL1)

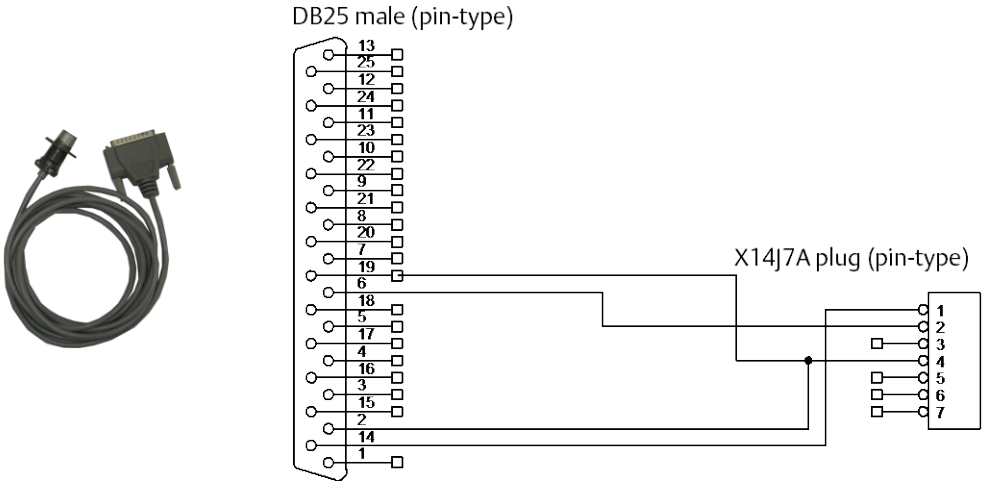


Figure 8-6 Appearance and wiring schematic of cable 2 (UFDRY21SL2)

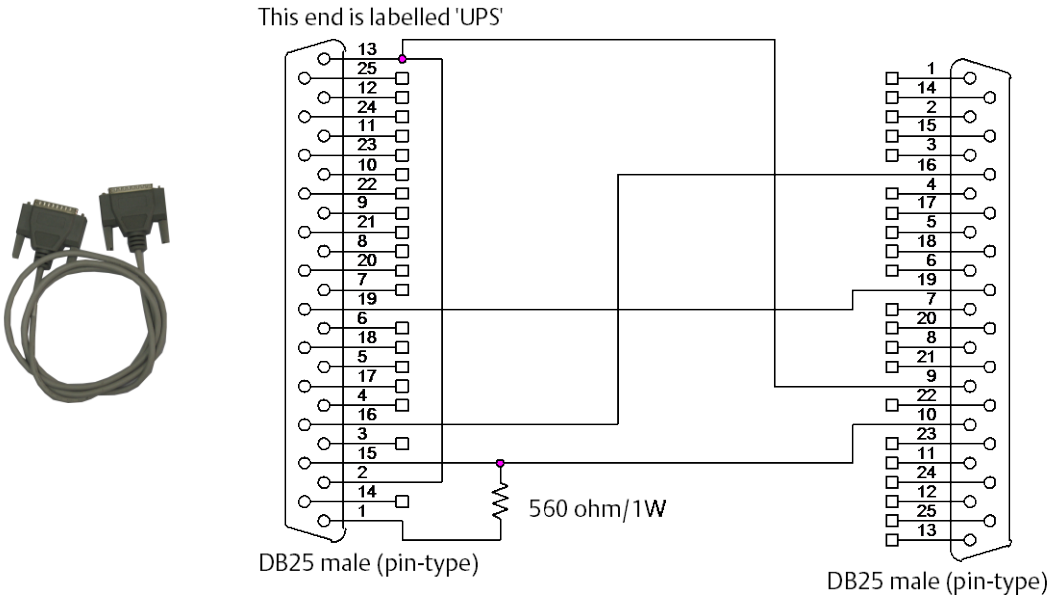


Figure 8-7 Appearance and wiring schematic of cable 3 (UFDRY21SL3)

Installation procedures

Note

Some electronic components on the relay card are sensitive to static electricity. To prevent static electricity from damaging the relay card, do not touch its electronic components or circuits, also avoid their contact with live objects. Please hold the side edges of the relay card when moving or installing it.

1. Set the DIP switch of the relay card.

Skip this step if you need not control the UPS turn-on and turn-off through the relay card.

The location of the DIP switch is shown in Figure 8-4. It is an 8-bit DIP switch. Its factory default setting is shown in Figure 8-8.

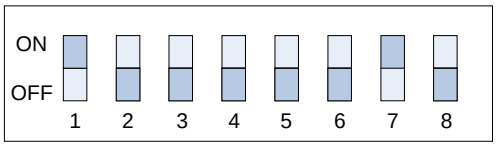


Figure 8-8 Factory default setting of the DIP switch

Bits 1 through 7 are designed for use in factory, the user is not allowed to change their default settings. Bit 8 is used to configure the UPS turn-on and turn-off signal input function of the relay card, its setting method is described in Table 8-3.

Table 8-3 Setting of UPS turn-on and turn-off signal input function

Bit 8	Function
ON	UPS turn-on and turn-off signal input function enabled
OFF	UPS turn-on and turn-off signal input function disabled

2. Insert the relay card into the UPS.

Note

1. The relay card should be installed in Intellislot 1 or 3 port (advisably in Intellislot 3 port).
2. The relay card is hot-pluggable, you can install it without shutting down the UPS.

a) Remove the Intellislot port (see Figure 3-3) cover on the bypass module, reserve the screws.

b) Align the relay card with the Intellislot port, insert the relay card into the port along the grooves on both sides of the port.

c) Fix the relay card through the fixing holes on the relay card panel with the screws obtained in step 1.

3. Connect the cable.

You can select an optional cable according to your needs, or make the cable according to Table 8-2 and Figure 8-5 ~ Figure 8-7. Connect the cable end with a DB25 male connector to the DB25 connector of the relay card, and the other end to the user equipment.

Warning

1. The DB25 connector must connect to SELV circuit. Failure to observe this could cause damage to the relay card and even lead to safety accidents.
2. The external equipment must meet the electrical parameter requirement in Table 8-2, failure to observe this could cause damage to the dry contact output terminal.

Troubleshooting

See Table 8-4 for the troubleshooting of the relay card.

Table 8-4 Troubleshooting

No.	Problems	Action to take
1	The dry contact output signal does not change with the UPS status	Verify that the relay card is properly inserted into the Intellislot port
2	The UPS does not respond to the UPS turn-on dry contact input signal	Verify that bit 8 of the DIP switch of the relay card is placed in the 'ON' position

8.2.6 UF-RS485 Card

The UF-RS485 card converts RS232 signal to RS485 signal to realize UPS networking and communication. It should be installed in an Intellislot port (see Table 8-1) of the UPS. It is hot pluggable for easy installation.

Appearance

The appearance of the UF-RS485 card is shown in Figure 8-9.

Figure 8-9 Appearance of UF-RS485 card

The gold finger is used for insertion into the Intellislot port of the UPS. It provides RS232 input signal. The RJ45 port 1 and RJ45 port 2 are in parallel connection. They provide RS485 output signal.

Installation

Note

1. The UF-RS485 card is hot-pluggable, so you can install it without shutting down the UPS.
2. Some electronic components on the UF-RS485 card are quite sensitive to static electricity. To prevent static electricity from damaging the card, do not touch its electronic components or circuits with hands or other live objects. Please hold the side edges of the UF-RS485 card when moving or installing it.

1. Insert the UF-RS485 card into the UPS.

a) Remove the Intellislot port cover on the front panel of the bypass module. Save the screws.

b) Align the UF-RS485 card with the Intellislot port, insert the card into the port along the grooves on both sides of the port.

c) Fix the UF-RS485 card through the fixing holes on the UF-RS485 card panel with the screws obtained when removing the Intellislot port cover previously.

2. Connect the cable. Users can select a standard network cable in proper length as the connecting cable according to needs.

a) Insert one end of the standard network cable into the RJ45 port 1 or RJ45 port 2 of the UF-RS485 card.

b) Insert the other end of the standard network cable to the corresponding port of the user equipment.

Warning

1. The RJ45 ports of the UF-RS485 card must connect to SELV circuit. Failure to observe this could cause damage to the card and even result in safety accidents.
2. The connecting cable of the UF-RS485 card and the external equipment must be a double-end shielded cable.

Troubleshooting

Fault: The UF-RS485 output signal does not change with the UPS status.

Action to take: Ensure that the UF-RS485 card is properly inserted into the Intellislot port and the cable is properly connected.

8.2.7 Modbus Card

The Modbus card can realize the conversion from UPS internal protocol to Modbus RTU protocol, so you can use your host monitoring software to manage your UPS through Modbus RTU protocol, to learn about the UPS operating status by acquiring the UPS electrical parameter data, operating data and alarm data, thus achieving UPS monitoring.

One UPS can be fitted with up to two Modbus cards, which allows you to monitor the UPS through multiple hosts.

For the installation and setting of the Modbus card, refer to *UPS JBUS/MODBUS Adapter User Manual* in accessory.

The installation method of the Modbus card is the same as that of the SIC card described in *8.2.4 SIC Card*.

8.2.8 LBS Cable

Shielded and double-insulated parallel control cables available in lengths 5m, 10m and 15m must be interconnected in a ring configuration between the UPS modules, as shown in Figure 7-6.

8.2.9 Parallel Cable

Shielded and double-insulated parallel control 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.

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 and dry contact communication. This chapter provides information relevant to these types of communication.

9.1 SNMP Protocol Communication

In order to monitor the UPS through web network, user needs to select the SIC card. It is a network management card which supports SNMP protocol.

It can also be connected to the IRM series sensor to provide environment monitoring function. Upon the alarm generated by intelligent equipment, the SIC card notify the user by recording the log, sending trap information, and by sending a mail.

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

- **Web browser**: User can use Web browser to monitor your intelligent equipment and equipment room environment through the Web server function provided by the SIC card
- **NMS**: To monitor your intelligent equipment and equipment room environment through the SNMP function provided by the SIC card
- **SiteMonitor**: It's a network management software to monitor your intelligent equipment and equipment room environment through the TCP/IP interface provided by the SIC card

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

9.2 Modbus Protocol Communication

The Modbus card helps to realize the conversion from UPS internal protocol to Modbus RTU protocol. Consequently, the user can use the Modbus RTU protocol to acquire the UPS switch values to achieve UPS monitoring.

For the installation and basic setting of the Modbus card, refer to the *UPS JBUS/MODBUS Adapter User Manual*.

9.3 Dry Contact Communication

The UPS provides the following two dry contact communication approaches:

- **Relay card (optional)**: The UPS provides an optional Relay card for the user to use dry contact signals to monitor the UPS. The Relay card should be installed in an Intellislot port of the communication box in the cabinet. For the installation and use of the Relay card, refer to *8.2.5 Relay Card*.
- **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

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. Daily inspection of UPS systems can be executed by people who have received relevant training, and the inspection and replacement of devices should be operated by authorized professionals.
2. The components that can only be accessed by opening the protective cover with tools cannot be operated by the user. Only qualified service personnel are authorized to remove such covers.
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 to prevent cabinet tipping 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 bypass module is hot pluggable; it can be removed/replaced without shut down the UPS/power modules.
5. The power modules and bypass module should be serviced five minutes, and installed in the cabinet again 10 minutes, after they are removed.

10.2.2 Service Procedures Of Power Module

Provided that the UPS is in normal mode, and that the bypass is normal:

1. If the UPS has redundant power modules, press and hold the INVERTER OFF key on the operator control and display panel for two seconds to manually turn off the inverters, and the UPS transfers to bypass mode; if the UPS has no redundant power module, skip this step.
2. Place the ready switch on the front panel of the power module to the up position (that is, in unready state).
3. Two minutes later, 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 is in the range 1 ~ 5. 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. Wait for two seconds, place the ready switch of the module to the down position, and the module is ready. Then the module will be added into the system automatically and begin to work.

10.2.3 Standard default procedure (when load transfer to Bypass is allowed) for service the bypass module:

Provided that the UPS is in normal mode, and that the bypass is normal:

1. Press and hold the INVERTER OFF key on the operator control and display panel for two seconds to manually turn off the inverters, and the UPS transfers to bypass mode.

2. Close the maintenance bypass, and the UPS transfers to maintenance mode.

3. Open the output switch, rectifier input switch and bypass input switch of the UPS.

4. Press the EPO key, ensure that the battery current is 2A. Open the BCB or disconnect the batteries.

5. Remove the fixing screws on both sides of the front panel of the bypass module, disconnect the cables and pull the module out of the cabinet. Wait for 10 minutes before servicing the bypass module.

6. After servicing the module, push the module into the cabinet, tighten the screws on both sides and restore the connection of the cables disconnected in step 5.

Note

It requires massive force to push the bypass module into and pull it out of the cabinet. To pull it out of the cabinet, move it left and right slightly first, and then try several times to pull it out. When pushing it into the cabinet, you are required to push it into place by one time; or else, the bypass module may not be connected properly, which may cause malfunction of the bypass module and the whole system. The bypass module is regarded to have been pushed into place if the fixing screws on both sides can be tightened and the brackets on both sides of the bypass module cling to the vertical columns of the cabinet.

7. Close the output switch, rectifier input switch and bypass input switch of the UPS in turn.

Two minutes later, the bypass indicator on the operator control and display panel turns on, indicating the UPS is operating in bypass mode.

8. Open the maintenance bypass switch, press and hold the INVERTER ON key on the operator control and display panel for two seconds to manually turn on the inverters, and the UPS transfers to normal mode.

10.2.4 Alternate Procedure (When Load transfer to Bypass is not allowed):

1. Please make sure that the running load is within the capacity of Power modules, connected On-Line

2. Please check firmware version for compatibility

3. Swap the faulty Static Bypass module following step

4. Remove the fixing screws on both sides of the front panel of the bypass module, and pull the module out of the cabinet. Wait for 10 minutes before servicing the bypass module.

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

10.3 Replacement Procedures Of Air Filter

The UPS provides four air filters on the back of the front doors of the main power cabinet and switch cabinet respectively. Each air filter is fixed by a fixing bar on either side. The replacement procedures of each air filter are the same. The following takes the switch cabinet as an example to describe the air filter (see Figure 10-1) replacement procedures.

1. Open the front door of the switch cabinet to reveal the air filters on the back of the front door.
2. Remove the fixing bar on either side of the air filter that needs replacement.
3. Remove the air filter, and insert a clean one.
4. Replace the fixing bar.

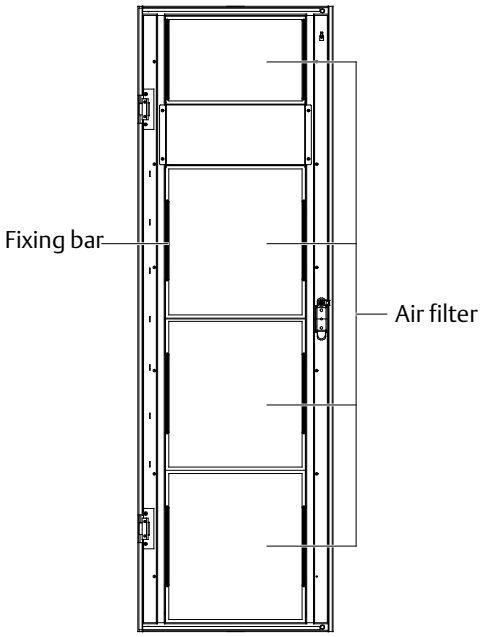


Figure 10-1 Replacing air filters (switch cabinet)

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 *6.5 Battery Maintenance*.

Chapter 11 Specifications

The chapter provides the UPS specifications.

11.1 Conformity And Standards

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

Table 11-1 European and international standards

Item	Specifications
General and safety requirements for UPS	EN62040-1/IEC62040-1/AS62040-1
EMC requirements for UPS	EN50091-2/IEC62040-2/AS 62040-2 (C3)
Method of specifying the performance and test requirements of UPS	EN50091-3/IEC62040-3/AS 62040-3 (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)				
		30	60	90, 120	150, 180, 210	240, 270, 300
Noise within 1m (in the front)	dB	56	58	60	62	65
Altitude	m	≤1000, derate power by 1% per 100m between 1000m and 2000m				
Relative humidity	%RH	20 ~ 90, non condensing				
Operating temperature	°C	0 ~ 40; battery life is halved for every 10°C increase above 20°C				
Storage and transport temperature for UPS	°C	-25 ~ +55				
Recommended battery storage temperature	°C	-20 ~ +30 (20°C for optimum battery storage)				
Over-voltage level		Over-voltage level 2				
Pollution level		Pollution level 2				

11.3 Mechanical Characteristics

Table 11-3 Mechanical characteristics

Item	Unit	Main power cabinet	Switch cabinet	Power module
Dimensions (W × D × H)	mm	600 × 1100 × 2000	600 × 1100 × 2000	440 × 598 × 173
Weight	kg	150	180	34
Color	N/A	Black ZP7021		
Protection degree, IEC (60529)	N/A	IP20 (front door open or closed, back door closed)		

11.4 Electrical Characteristics (Input Rectifier)

Table 11-4 Rectifier AC input (mains)

Item	Unit	Rated power (kVA)
		30 ~ 300
Rated AC input voltage[1]	Vac	380/400/415 (3-phase and sharing neutral with the bypass input)
Input voltage tolerance[2]	Vac	305 ~ 477; 304 ~ 228 (output derated below 80%)
Frequency[2]	Hz	50/60 (tolerance: 40Hz ~ 70Hz)
Power factor	kW/kVA, full load (half load)	0.99 (0.98)
Input power	kVA rated[3] (maximum[4])	30 ~ 300
Input current	A rated[3] (maximum[4])	60 ~ 600
Total current harmonic distortion (THDi)	%	<3
Duration of progressive power walk-in	s	10s to reach full rated current (selectable 5s through 30s in 5-second intervals)

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 previously charged battery.
3. IEC62040-3/EN50091-3: at rated load and input voltage is 400V, battery remains fully charged.
4. IEC62040-3/EN50091-3: at rated load and input voltage is 400V, battery charging at maximum rated power.

11.5 Electrical Characteristics (Intermediate DC Circuit)

Table 11-5 Battery

Item		Unit	Rated power (kVA)									
			30	60	90	120	150	180	210	240	270	300
Battery bus voltage		Vdc	Nominal: 432V (VRLA float charge is 540V), range: 300V ~ 576V									
Number of lead-acid cells	Nominal		180 = [30 × 6-cell (12V) blocks]									
	Maximum		240 = [40 × 6-cell (12V) blocks]									
	Minimum		180 = [30 × 6-cell (12V) blocks]									
Float voltage		V/cell (VRLA)	2.25V/cell (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 voltage		% V float	≤1									
Ripple current		% C_{10}	≤5									
Boost voltage		VRLA	2.35V/cell (selectable from 2.30V/cell to 2.40V/cell) Constant current and constant voltage charge mode									
Boost control			Float-boost current trigger 0.050C_{10} (selectable from 0.030 to 0.070) Boost-float current trigger 0.010C_{10} (selectable from 0.005 to 0.025) 24hr safety time timeout (selectable from 8hr to 30hr) Boost mode inhibit also selectable									
EOD voltage		V/cell (VRLA)	1.63V/cell (selectable from 1.60V/cell to 1.750V/cell) Automatic inverse EOD voltage × discharge current mode (the EOD voltage increases at low discharge currents)									

Item	Unit	Rated power (kVA)									
		30	60	90	120	150	180	210	240	270	300
Battery charge	V/cell	2.4V/cell (selectable from 2.3V/cell to 2.4V/cell) Constant current and constant voltage charge mode Programmable automatic trigger or inhibit of boost mode									
Battery charging power[1]	kW	4.5	9	13.5	18	22.5	27	31.5	36	40.5	45
maximum current (adjustable)[2]	A	11	22	33	44	55	66	77	88	99	110

Note

1. At low input voltage the UPS recharge capability increases with load decrease (up to the maximum capacity indicated).
2. Maximum currents listed are for EOD voltage of 1.67V/cell for 240 cells.

11.6 Electrical Characteristics (Inverter Output)

Table 11-6 Inverter output (to critical load)

Item	Unit	Rated power (kVA)
		30 ~ 300
Rated AC voltage[1]	Vac	380/400/415 (three-phase four-wire, with neutral reference to the bypass neutral)
Frequency[2]	Hz	50/60
Overload	%	110% for 60min 125% for 10min 150% for 1min >150% for 200ms
Fault current	%	340% current limitation for 200ms
Non-linear load capability[3]	%	100%
Neutral current capability	%	170%
Steady state voltage stability	%	±1 (balanced load), ±2 (100% unbalanced load)
Transient voltage response[4]	%	±5
Total voltage harmonic distortion	%	<1 (linear load), <4 (non-linear load[3])
Synchronisation window		Rated frequency ±2Hz (selectable from ±0.5Hz to ±3Hz)
Slew rate (max change rate of synchronisation frequency)	Hz/s	0.6
Inverter voltage tolerance	%V (ac)	±5

Note

1. Default nominal voltage set at 400V at factory but can be changed to 380V or 415V by commissioning engineer at site.
2. Default nominal frequency set at 50Hz at factory but can be selectable to 60Hz by commissioning engineer at site. Frequency converter operation also be selectable.
3. EN 50091-3 (1.4.58) crest factor 3:1.
4. IEC 62040-3/EN 50091-3 also for 0 ~ 100% ~ 0 load transient. Transient recovery time: return to within 5% of steady state output voltage within half a cycle.

11.7 Electrical Characteristics (Bypass Mains Input)

Table 11-7 Bypass mains input

Item	Unit	Rated power (kVA)
		30 ~ 300
Rated AC voltage[1]	Vac	380/400/415 (three-phase four-wire, sharing neutral with the rectifier input and providing neutral reference to the output)
Rated current	A	500
Overload	%	500A, long term >500A, alarm, no action[2]
Upstream protection, bypass line	N/A	Thermomagnetic circuit breaker, rated up to 125% of nominal output current. IEC 60947-2 curve C
Current rating of neutral cable	A	1.7 × In
Frequency[3]	Hz	50/60
Transfer time (between bypass and inverter)	ms	Synchronous transfer: ≤1ms Asynchronous transfer (default): 15ms (50Hz), 13.3ms (60Hz) Or 40ms, 60ms, 80ms, 100ms selectable
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
Synchronisation window	%Hz	10

Note

1. Default nominal voltage set at 400V at factory but can be changed to 380V or 415V by commissioning engineer at site.
2. Bypass protected by upstream air breaker only; bypass input cable CSA dependent on rating of upstream air breaker.
3. Default nominal frequency set at 50Hz at factory but can be selectable to 60Hz by commissioning engineer at site.

11.8 Efficiency, Heat Losses And Air Exchange

Table 11-8 Efficiency, heat losses and air exchange

Item	Unit	Rated power (kVA)									
		30	60	90	120	150	180	210	240	270	300
Overall efficiency											
Normal mode (double conversion)	%	96									
ECO mode	%	98									
Inverter efficiency (DC/AC) (battery at nominal voltage 432Vdc and full-rated linear load)											
Battery mode	%	96									
Heat losses and air exchange											
Normal mode	kW	1.2	2.4	3.6	4.8	6	7.2	8.4	9.6	10.8	12
ECO mode	kW	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
No load	kW	0.6	1.2	1.8	2.4	3	3.6	4.2	4.8	5.4	6
Maximum forced air cooling (front intake, back exhaust)	L/s	96	192	288	384	480	576	672	768	864	960
Note: Input and output voltage 400Vac battery charged, full rated linear load											

Note

Above condition applicable to voltage input and output range set at 400V and battery remains fully charged.

Appendix 1 Glossary

AC	Alternating current
BCB	Battery circuit breaker
CSA	Cross sectional area
CT	Center tap
DC	Direct current
DIP	Dual in-line package
DSP	Digital signal processor
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
EOD	End-of-discharge
EPO	Emergency power off
LBS	Load bus synchronizer
LCD	Liquid crystal display
MCCB	Moulded-case circuit breaker
PE	Protective earth
PWM	Pulse width modulation
RCCB	Residual current circuit breaker
RCD	Residual current detector
SCR	Silicon-controlled rectifier
STS	Static transfer switch
UPS	Uninterruptible power system
VRLA	Valve-regulated lead-acid

Appendix 2 Hazardous Substances And Content

Parts	Hazardous substances					
	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						
About battery: Generally follow the environmental protection use period of the battery, otherwise five years.						
Applicable scope: APM 300 Integrated UPS						

VertivCo.com | **Emerson Network Power Limited,** George Curl Way, Southampton, SO18 2RY, VAT Number: GB188146827