Liebert APM 150

User Manual

Liebert APM 150 Integrated UPS Single Module And Parallel System User Manual

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

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Special Declaration

Personnel Safety

1. This product must be installed and commissioned by professional engineers of the manufacturer or its authorized agent. Failure to observe this could result in product malfunction or personnel safety risk.
2. Take the time to read this product manual and the safety precaution thoroughly before installing and commissioning this product. Failure to observe this could result in product malfunction or personnel safety risk.
3. This product 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 Precautions

Always observe the following safety symbols!

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

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

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

This manual contains information concerning the installation and operation of this Emerson Liebert APM 150 Integrated UPS Single Module And Parallel System (UPS for short).

This manual must be read prior to installation.

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

This is a C3 UPS product. In a residential environment, this product may nevertheless cause radio interference, in which case, the user may be required to take additional measures.

Conformity and standards

This equipment complies with CE directives 73/23 & 93/68 (low voltage safety), 89/336 (EMC) and 2011/65/EU (RoHS), with Australia and New Zealand EMC Framework (C-Tick), and with the following product standards for UPS:

- IEC62040-1-1 General and safety requirements for UPS used in operator access areas
- 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.

Warning: high leakage current

Earth connection is essential before the input supply (including the AC mains and battery) is connected. This equipment must be earthed in accordance with local electrical codes.
Earth leakage current exceeds 3.5mA and is less than 2500mA.
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.
Note that the earth leakage currents of the load will be carried by this RCCB or RCD.

Warning: backfeed protection

This UPS is fitted with a voltage-free contact closure signal for use with an external automatic disconnect device (supplied by others) to protect against back-feeding voltage into the static bypass input. If this signal is not used by the installer, a label must be added at the external bypass input disconnect device to warn service personnel that the circuit is connected to a UPS.
The text to use is the following or equivalent: Isolate the UPS 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 personnel. There are no user-serviceable parts behind covers requiring a tool for removal.
This UPS is fully compliant with safety regulations for equipment located in an operator accessible area. Hazardous voltage is present within the UPS but out of reach of non-service personnel. Contact with hazardous voltage is minimized with live parts housed behind safety panels that require a tool for their removal. No risk exists to any personnel when you operate the equipment in the normal manner, following the recommended operating procedures.

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, please make anti-static processing when in contact with 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.

This Manual Describes The Following UPS Product

Product	Model
150kVA	Liebert APM 150

Revision Information

V1.0 (April 6, 2011)

Initial release.

V1.1 (July 29, 2011)

Adjust corresponding content in user manual.

V1.2 (January 6, 2013)

Adopt new format with Options added.

V1.3 (April 18, 2014)

Change dimensions (W × D × H) in Table 11-3; add Hazardous Substances Or Elements Announcement in Appendix 2.

V1.4 (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 1.4; change Figure 6-6.

V1.5 (December 8, 2015)

Add a Warning in Safety Precautions; update Table 11-3.

V1.6 (March 10, 2017)

Change ' UF-DRY310' to ' UF-DRY410' in Table 8-1; update Appendix 2; Change user manual name to 'Liebert APM 150 Integrated UPS Single Module And Parallel System'.

Contents

Chapter 1 Overview

This chapter introduces the features, design concept, parallel system, operation mode, battery management and battery protection of Liebert APM 150 Integrated UPS Single Module And Parallel System (UPS for short).

1.1 Features

The UPS is connected between the three-phase input power and the critical loads (e.g. computer) to provide high quality three-phase power for the loads. The UPS has the following advantages:

- Increase the power supply quality

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

- Improve noise suppression

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 Design Concept

The UPS provides continuous, high-quality AC power to your critical equipment, such as telecommunications and data processing equipment. The UPS supplies power that is free of the disturbances and variations in voltage and frequency common to mains power, which is subject to brownouts, blackouts, surges and sags.

The UPS uses the latest high frequency, double-conversion PWM technology and DSP technology to enhance its reliability and increase the ease of use.

1.2.1 System Design

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

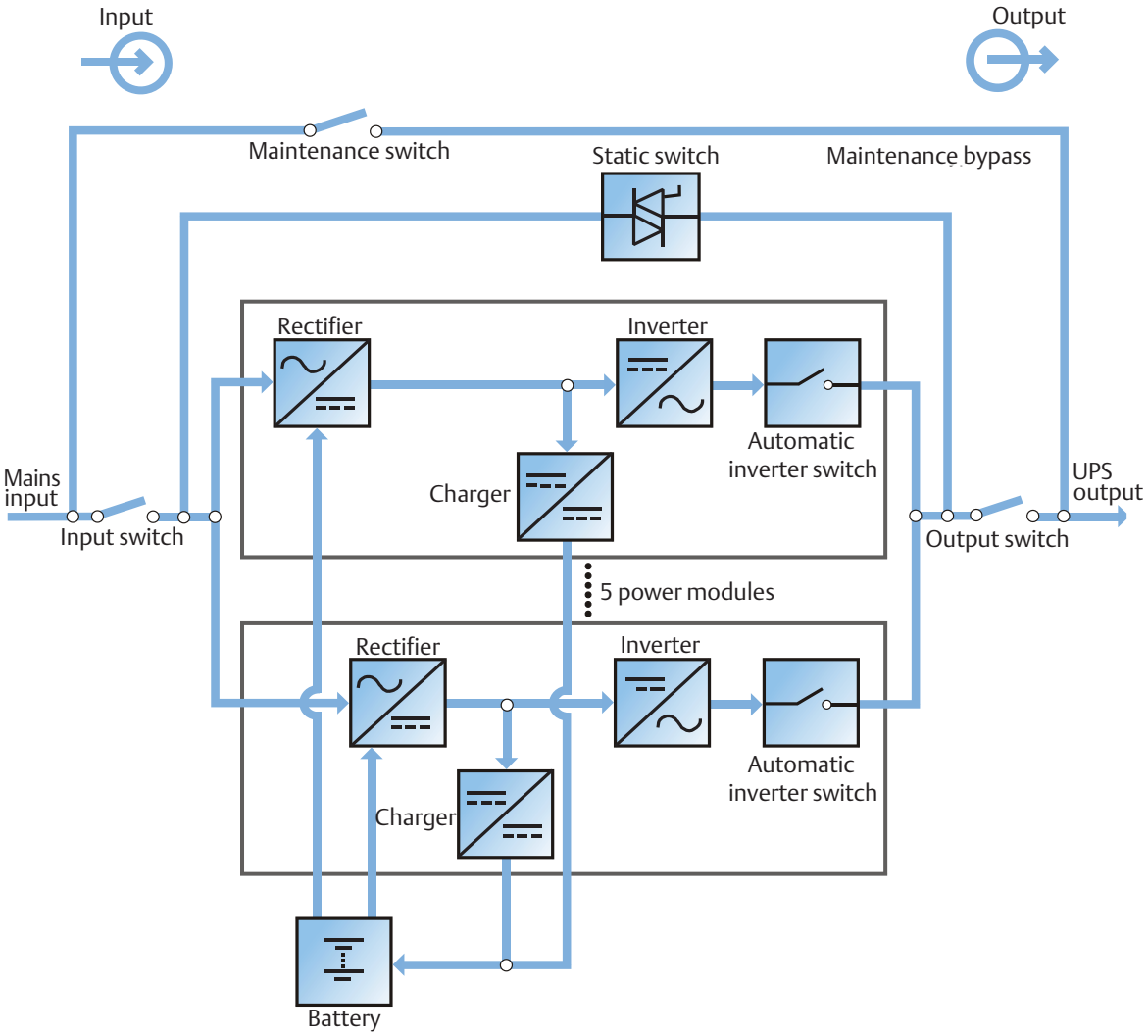


Figure 1-1 Block diagram for operating principle of single module

The UPS provides independent battery charger, and uses advanced temperature compensation technology to prolong the battery life. The inverter uses high power IGBT switching and advanced SVPWM design to reconvert the DC busbar voltage back into an AC voltage waveform.

During normal operation, both the rectifier and inverter sections are active and provide regulated load power whilst simultaneously charging the battery. In the event of a mains power failure, the rectifier becomes inoperative and the inverter is powered solely from the battery. Critical load power is maintained under these conditions until the battery is fully discharged, whereupon the UPS shuts down. The end of battery discharge is assumed when the battery voltage falls below a preset value.

The period for which the load can be maintained following a mains power failure is known as the system's autonomy time and is dependent upon both the battery A/Hr capacity and the applied percentage load.

1.2.2 Bypass

The static switch and automatic inverter switch shown in Figure 1-1 contain 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.

1.2.3 System Control Principle

Normal operation

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

Mains abnormal

When the mains fails or is abnormal, the rectifier will stop working automatically, and the system will transfer to battery output (through inverter). The length of the operation time in battery mode depends on the load and the battery capacity. During this period, if the battery voltage falls to the EOD voltage and the mains still has not been recovered, the inverter will stop working automatically, and the UPS operation control panel will display corresponding alarm message.

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

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

UPS Single Module failure

In case of an inverter failure, rectifier fault or output fuse blow-out, the load will be automatically transferred to the bypass, and the output power supply will not be interrupted. In this case, please contact the local customer service center of Emerson for technical support.

Overload

If the inverter is overloaded or the inverter current remains outside the specifications (refer to Table 9-6) longer than the specified time, the load will be automatically transferred 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 at this point the short circuit is removed, the load will be transferred back to the inverter. The transfer is determined first of all by the features of the protection device of the system.

In the above two situations, the UPS operation control panel will display alarm message.

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 switch. It can be disconnected by turning the switch to OFF.

1.2.4 UPS Power Supply Switch Configuration

As shown in Figure 1-2, the main input power and bypass input power of the UPS are fed from the common input switch Q1, and the UPS provides the maintenance switch Q2 and output switch Q3 as well.

During normal UPS operation, all power switches except for the maintenance switch Q2 should be closed.

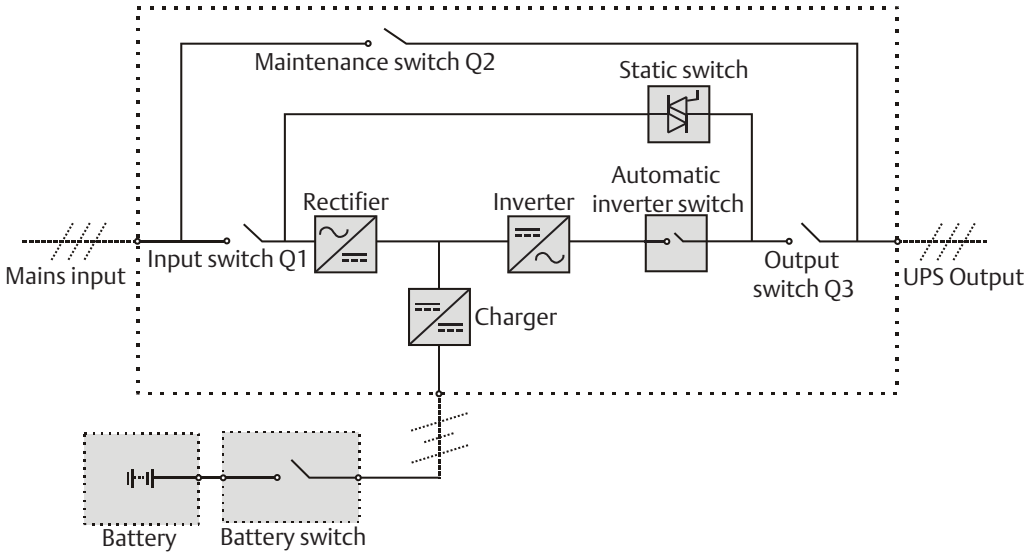


Figure 1-2 UPS power supply switch configuration

1.2.5 BCB

The external battery must be connected to the UPS through a BCB. The BCB should provide overcurrent protection, short circuit protection and automatic tripping functions. The BCB should be installed near the battery.

1.3 Parallel System

As shown in Figure 1-3, 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.

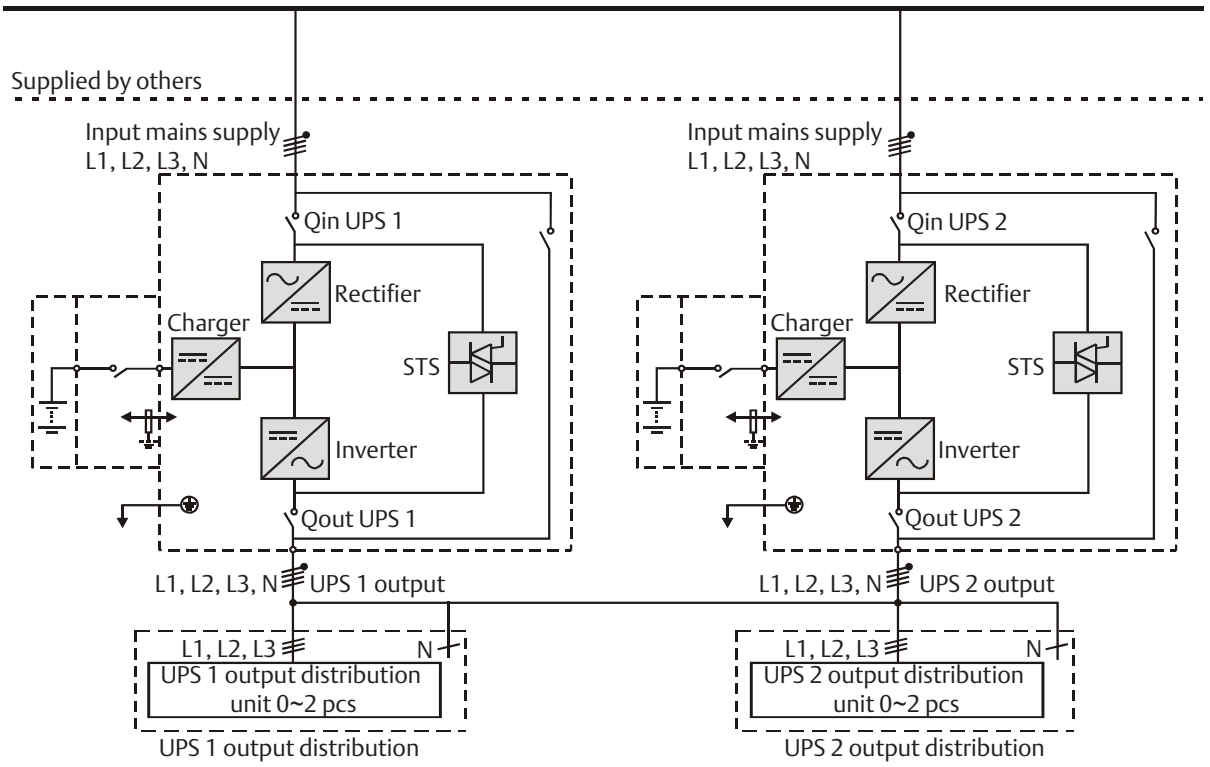


Figure 1-3 Parallel system

1.3.1 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 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.

1.3.2 Requirements For Paralleling Of UPS Modules

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.

1.4 Operation Mode

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

- Normal mode
- Battery mode

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

Normal mode

As shown in Figure 1-4, 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.

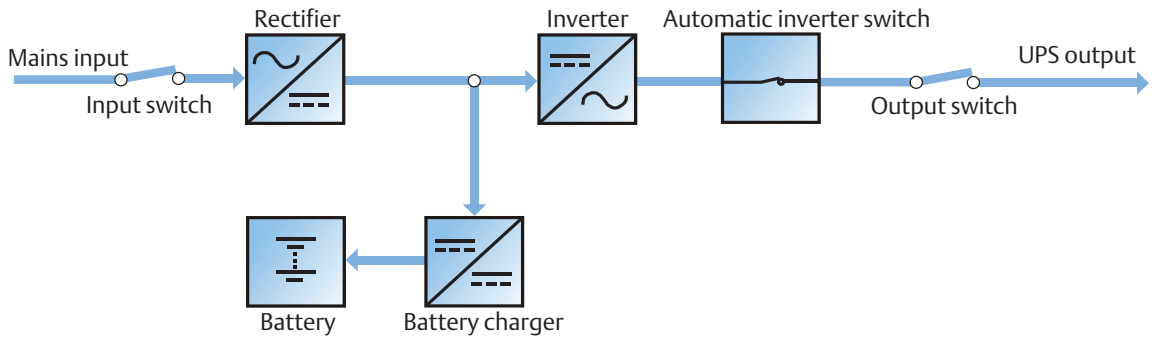


Figure 1-4 Schematic diagram of normal mode

Battery mode

As shown in Figure 1-5, 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.

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.

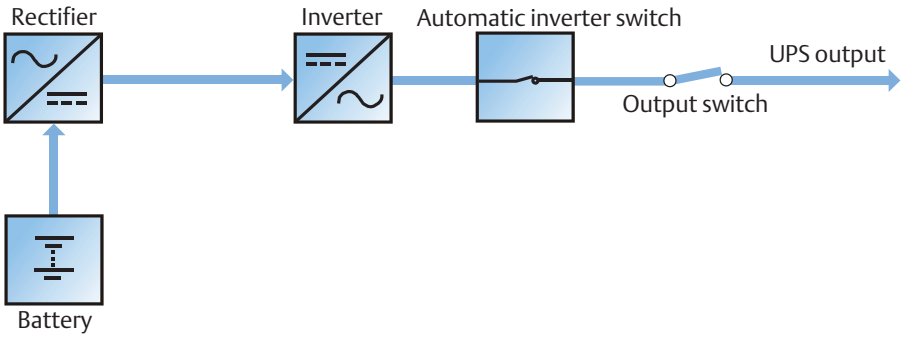


Figure 1-5 Schematic diagram of battery mode

Bypass mode

As shown in Figure 1-6, 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 1-6 Schematic diagram of bypass mode

Maintenance mode

As shown in Figure 1-7, if UPS maintenance or repaired is needed, you may use the manual maintenance switch to transfer the load to the maintenance bypass, with no interruption in power to the load.

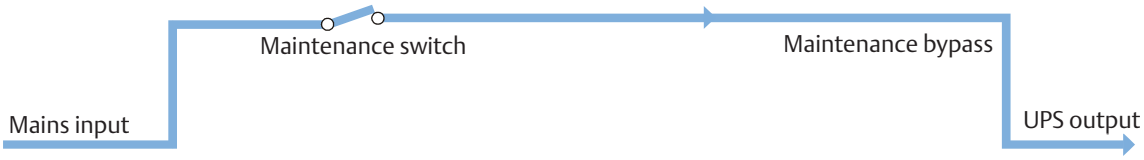


Figure 1-7 Schematic diagram of maintenance mode

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 1-8, 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.

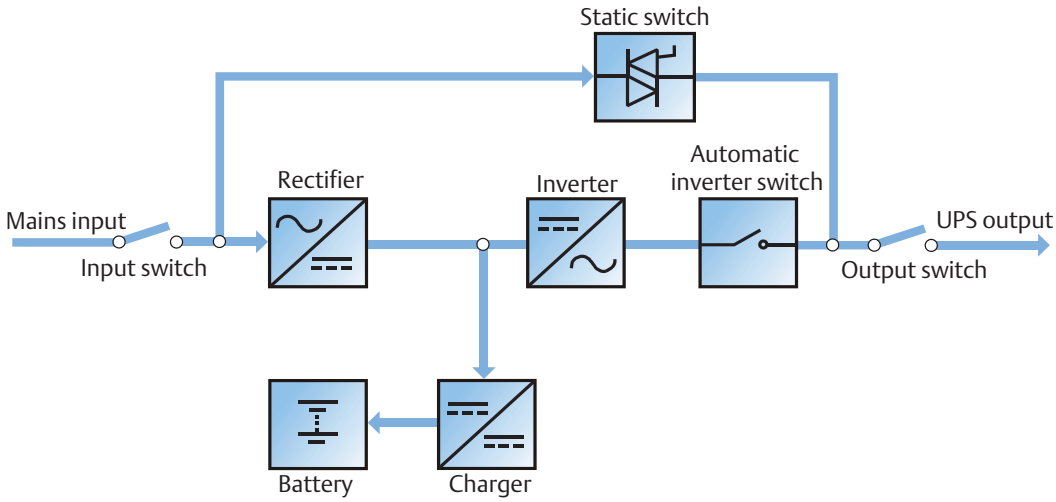


Figure 1-8 Schematic diagram of ECO mode

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.

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.

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 7-7.

1.5 Battery Management

The following battery management functions are set by the commissioning engineer through background software.

1.5.1 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).

6. Battery low pre-warning time.

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

1.5.2 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 Battery Protection

The following battery protection functions are set by the commissioning engineer through background software.

Battery low pre-warning

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

EOD protection

When the battery voltage drops to the EOD voltage, the battery converter shuts down. The EOD voltage is adjustable from 1.6V/cell to 1.75V/cell (VRLA).

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 briefly introduces the mechanical installation of the UPS, including the precautions, preliminary check, environmental requirement, mechanical requirement and installation diagram.

2.1 Precautions

This chapter describes the requirements that must be taken into account in location selection and cabling of the UPS.

This chapter is a guide as to general procedures and practices that should be observed by the installation engineer. The particular conditions of each site will determine the applicability of such procedures.

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 chapter.

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

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

Warning: battery hazards

Take special care when working with the batteries. After the battery cells are connected together, the battery terminal voltage will exceed 400Vdc and is hazardous.

- Wear eye protection to prevent injury from accidental electrical arcs.
- Remove rings, watches and all other metal objects.
- Use only tools with insulated handles.
- Wear rubber gloves.
- If a battery leaks electrolyte or is otherwise physically damaged, it must be replaced, stored in a container resistant to sulfuric acid and disposed of in accordance with local regulations.
- If electrolyte comes into contact with the skin, the affected area should be washed immediately with water.

2.2 Preliminary Check

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

1. Make sure that the environment of the UPS machine room (especially the ambient temperature, ventilation and dust) meets the environmental specifications of the UPS product.

2. Unpack the UPS, visually examine the UPS and check if there is any external or mechanical damage. If you spot any damage, seek assistance from the local customer service center of Emerson.

3. 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 Requirement

2.3.1 UPS Location Selection

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

The UPS 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.

2.3.2 Battery Location Selection

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 Mechanical Requirement

2.4.1 UPS Composition

UPS uses steel framework structure enclosed by removable panels, with the top panel and side panels fixed by screws. The UPS structure is shown in Figure 2-1. The UPS component configuration is provided in Table 2-1.

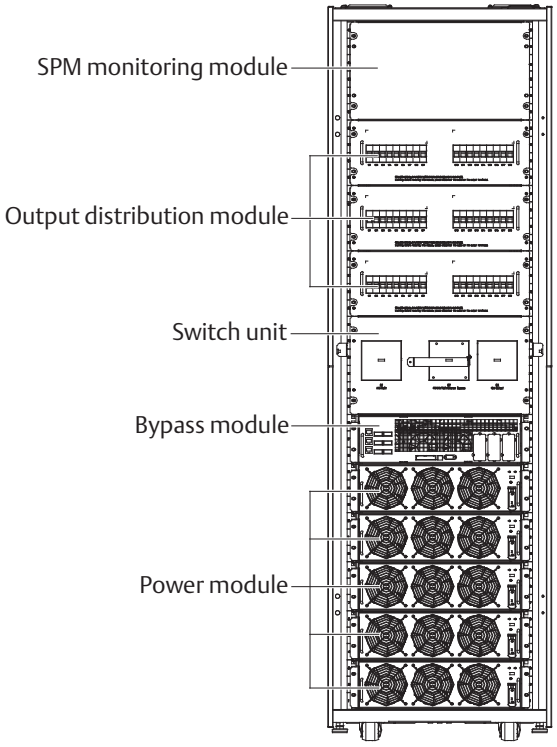


Figure 2-1 UPS structure

Table 2-1 UPS component configuration

Component	Quantity (pcs)			Remark
	APM 150	APM 150P	APM 150S	
SPM monitoring module*	0 ~ 1	0	1	Optional. Installed in factory if selected
Output distribution module*	0 ~ 4	0 ~ 4	0 ~ 3	Optional. Installed at site. Available in four types: intelligent distribution module with MCBs, intelligent distribution module with hot-pluggable MCBs, non-intelligent distribution module with MCBs and non-intelligent distribution module with hot-pluggable MCBs. Max. configuration of the former 2 types: 3 pcs; max. configuration of the latter 2 types: 4 pcs. If 4 output distribution modules are configured, then the SPM monitoring module cannot be configured. In this case, the position of the SPM monitoring module shown in Figure 1-1 is used to install an output distribution module
Switch unit	1	1	1	Standard component
Bypass module	1	1	1	Standard component
Power module	1 ~ 5	1 ~ 5	1 ~ 5	Requisite. Installed at site

Note

*: For details on the SPM monitoring module and output distribution module, refer to *8.2.10 SPM Monitoring Module* and *8.2.12 Output Distribution Module*.

2.4.2 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 means of a forklift or similar equipment. It can also be moved short distances by its casters.

2.4.3 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.

2.4.4 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.

2.4.5 Final Positioning And Fixing

When the UPS has been finally positioned, ensure that the adjustable feet are set so that the UPS will remain stationary and stable.

2.4.6 Installing Power Module And Output Distribution Module

The installation positions of the power modules and output distribution modules are shown in Figure 2-1. If four output distribution modules are configured, the position of the SPM monitoring module shown in Figure 2-1 is used to install an output distribution module.

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

Installation procedures of power module

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

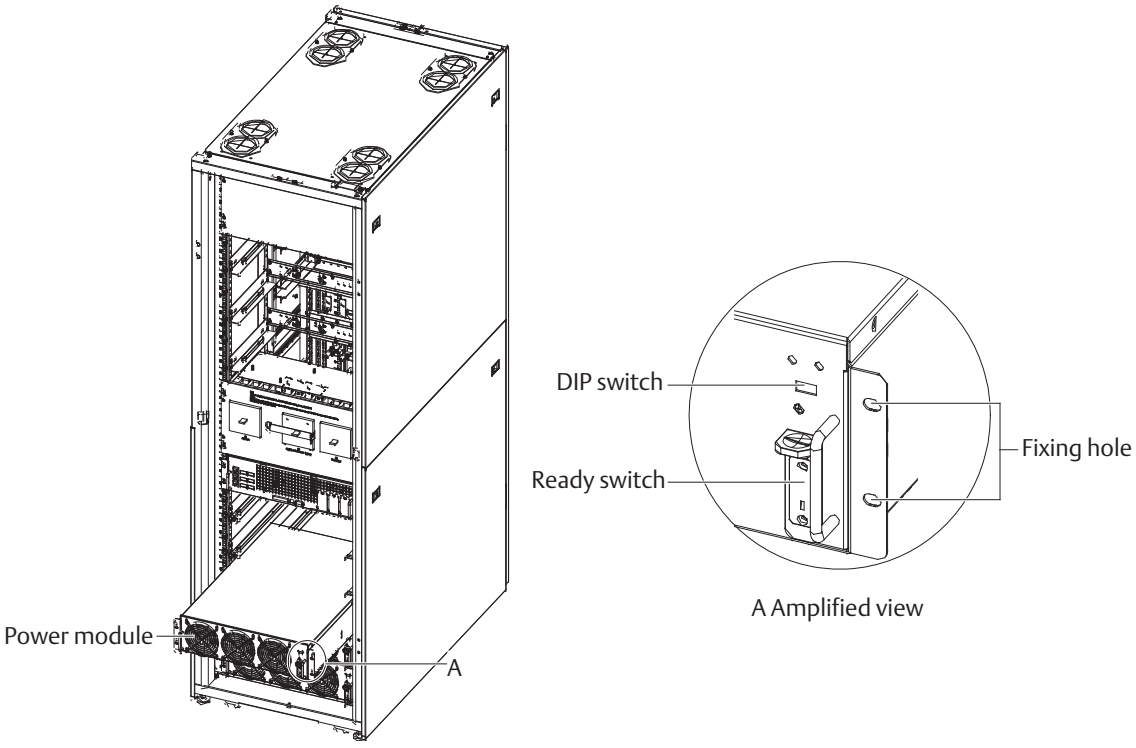
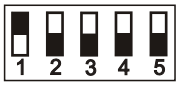
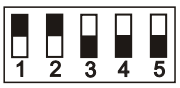
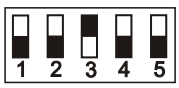
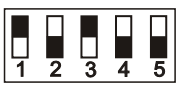


Figure 2-2 Installing power module

1. Use the DIP switch on the front panel of the module to set the module address. The setting range is from 1 to 5. The module address should be exclusive. The setting method is shown in Table 2-2.

Table 2-2 DIP switch setting method

Module address	1	2	3	4	5
DIP switch setting					

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

Installation procedures of output distribution module (optional)

The installation procedures of the four types of output distribution module are the same. Use the following procedures to install the output distribution module:

1. Dummy plates have been installed in the installation positions of output distribution module. Remove a dummy plate.

Note

Retain the removed dummy plate. If in the future the output distribution module is not needed any more and should be removed, it is required to reinstall this dummy plate.

2. Insert the output distribution module in the installation position, and push it into the cabinet.
3. Secure the module to the cabinet through the fixing holes on both sides of the front panel of the module.

2.5 Installation Diagram

Figure 2-3 describes the key mechanical characteristics of the UPS.

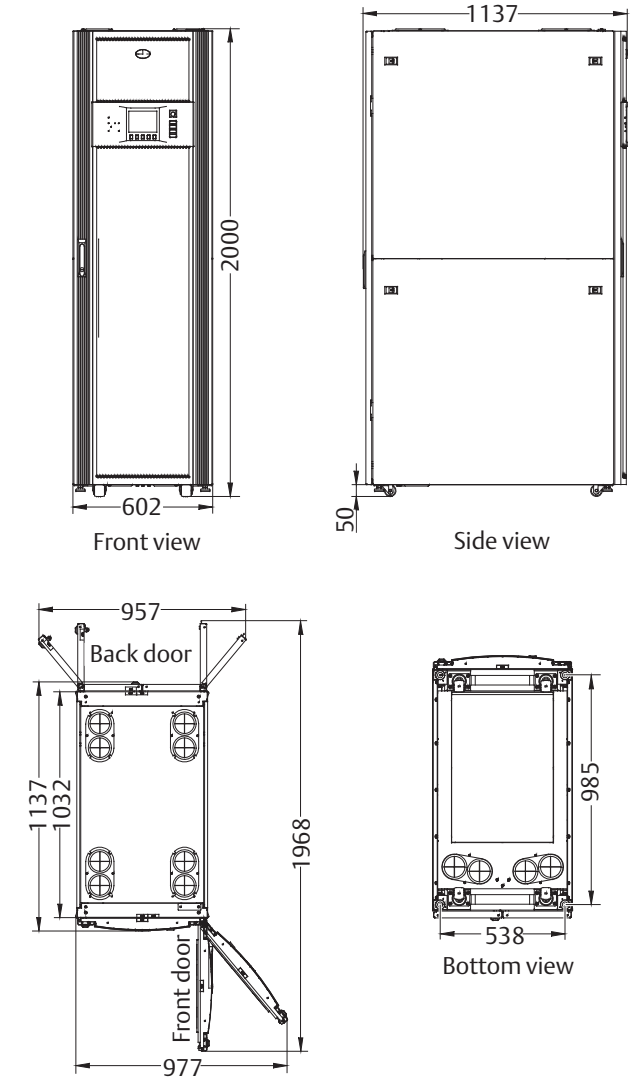


Figure 2-3 UPS installation dimensions (unit: mm)

Chapter 3 Electrical Installation

This chapter mainly introduces the electrical installation of the UPS, including the wiring of the power cables and signal cables.

After completing the mechanical installation of the UPS, it is required to connect the power cables and control cables of the UPS. All the control cables, whether shielded or not, shall be kept away from the power cables.

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 chapter.

3.1 Wiring Of Power Cable

3.1.1 System Configuration

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

UPS input cable

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

UPS bypass and output cable

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

Battery cable

Each UPS connects to its battery through the positive, negative and neutral battery cables. The cable size of the battery cable differs with the UPS power ratings, provided that it meets the battery discharge current requirement when the battery discharges to near EOD voltage, as shown in Table 3-1.

3.1.2 Maximum Steady State AC And DC Currents

The power cable must be selected according to the current and voltage values in Table 3-1, the local wiring regulations, the environmental conditions (temperature and physical media) and requirements in IEC60950-1 Table 3-B.

Table 3-1 Maximum steady state AC and DC currents

UPS rating (kVA)	Rated current (A)						
	Input mains current[1, 2] with full battery recharge			Output current[2] at full load (36 cells)			Battery discharge current at EOD
	380V	400V	415V	380V	400V	415V	
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 Minimum Distance From Floor To UPS Connection Point

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

Table 3-2 Distance from floor to UPS connection point

UPS connection point	Minimum distance (mm)
AC input	1087
AC output	1156
Battery power	1087

3.1.4 Notes

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

1. The neutral line shall be sized according to the load characteristics. It should be sized for the max. output/bypass phase current to 1.5 times the output/bypass phase current.

2. The PE cable shall be sized in accordance with the AC supply fault rating, cable length and type of protection. Typical CSA is 75mm^2 (120kVA) according to AS/IEC60950-1. Follow the most direct route possible to connect the PE cable to the cabinet.

3. Consideration should be given to the use of paralleled smaller cables for heavy currents, as this can ease installation considerably.

4. When sizing battery cables, a maximum volt drop of 4Vdc is permissible at the current ratings given in Table 3-1.

5. To minimize the formation of electromagnetic interference, do not form coils.

3.1.5 Power Cable Connecting Terminal

The input terminals, battery terminals and PE terminals are shown in Figure 3-2. The output terminals are shown in Figure 3-3 ~ Figure 3-5.

3.1.6 Protective Earth

The PE cables should be connected solidly to the PE terminals (see Figure 3-2).

The cabinet and cable troughs shall be earthed according to the local regulations. The earth cables shall be tied up reliably to prevent the loosening of the earth cable tightening screws when the earth cables are pulled.

Warning

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

3.1.7 External Protective Device

It is recommended to install circuit breakers or other protective devices in the AC supply, external to the UPS. This section provides guidelines for qualified installers, who must have knowledge of local wiring practices pertaining to the equipment to be installed.

Rectifier and bypass input

1. Overcurrent

Overcurrent protection must be installed at the distribution panel of the incoming main supply. The protection must discriminate with the power cable current capacity and with the overload capacity of the

system (see Table 11-6 and Table 11-7). As a guideline, a thermomagnetic circuit breaker, with an IEC60947-2 trip curve C (normal) for 125% of the current listed in Table 3-1 is suitable.

Note

For IT power systems, four-pole protective devices must be used upstream of the input distribution panel, external to the UPS.

2. Earth leakage

Any RCD installed upstream of the UPS input supply must:

- Be sensitive to DC unidirectional pulses (Class A) in power distribution network
- Be insensitive to transient current pulses
- Have an average sensitivity, adjustable between 0.3A and 1A

RCCB must be sensitive to DC unidirectional pulses (Class A) in power distribution network, and insensitive to transient current pulses, as respectively shown in Figure 3-1.

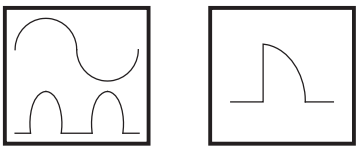


Figure 3-1 RCCB symbols

Battery

The battery must be fitted with a BCB to provide overcurrent protection for the battery.

UPS output

Each route of the UPS output is fitted with an output distribution switch.

3.1.8 Power Cable Connection Procedures

Warning

Before cable connection, ensure that you are aware of the location and state of the breaker that connect the UPS input to the mains distribution panel. Check that this breaker is off, and post any necessary warning sign to prevent inadvertent operation of the breaker.

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 door of the UPS cabinet and remove the protective cover to gain access to the input terminals, battery terminals and PE terminals, as shown in Figure 3-2.

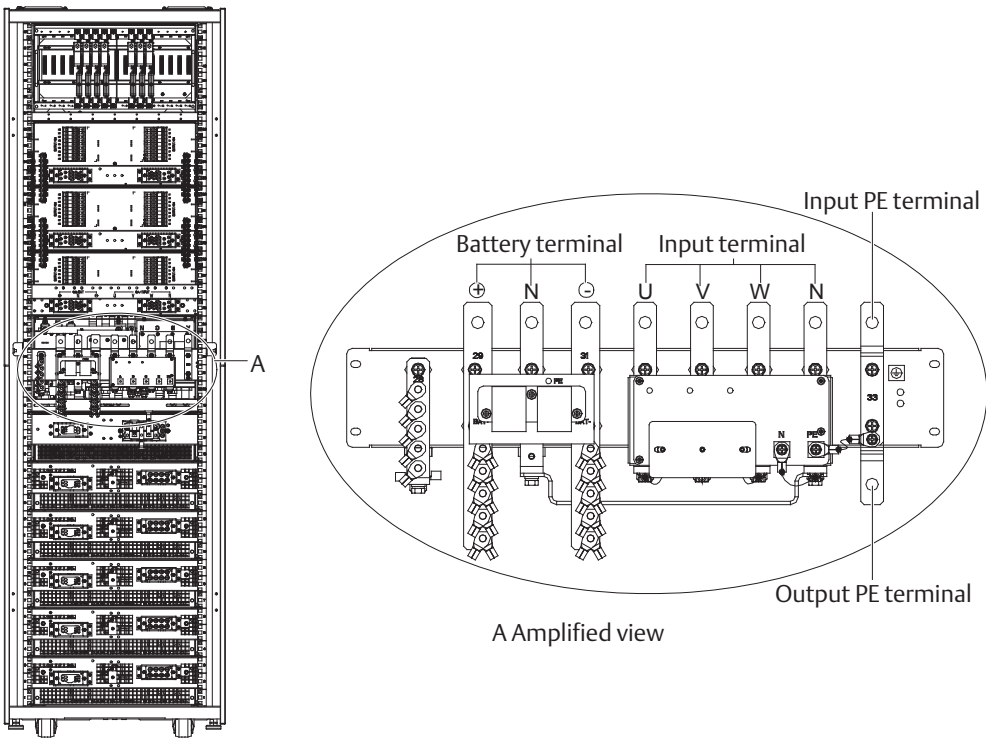


Figure 3-2 Input terminals, battery terminals and PE terminals (back view)

3. Connect the input PE cable to the input PE terminal. Note: The PE cable connection must be in accordance with local and national codes of practice.

4. Connect the AC input cables to the input terminals (U-V-W-N) of the UPS and tighten the connections to 13Nm (M8 bolt). Ensure correct phase rotation.

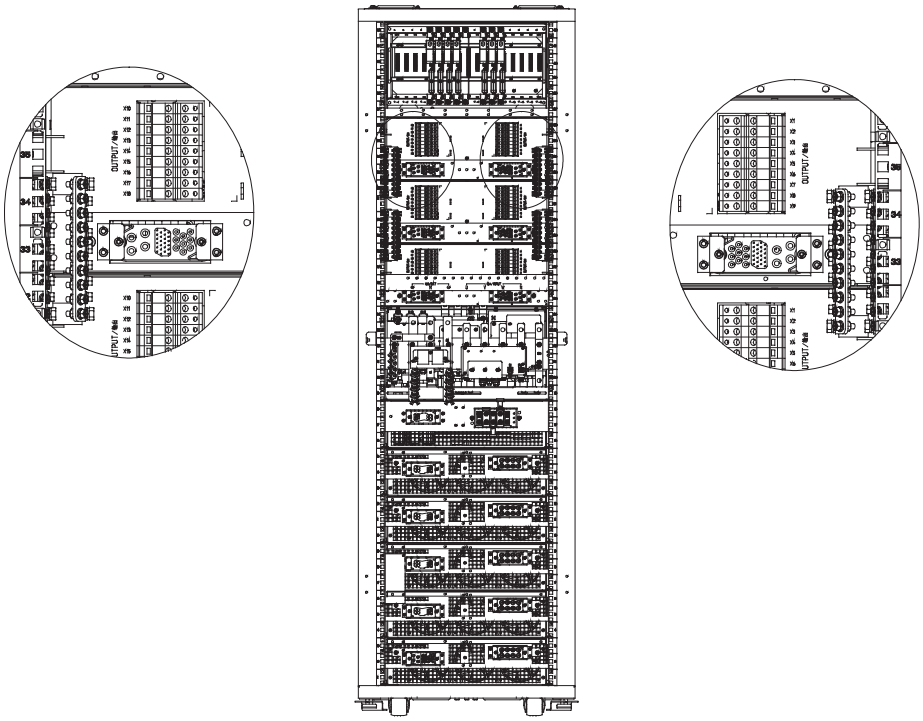
5. Connect the battery cables between the battery terminals of the UPS and the BCB. Ensure correct battery cable polarities.

Warning: hazardous battery terminal voltage 400Vdc

Ensure correct polarities of the connections from the terminals of the battery string to the BCB and from the BCB to the battery terminals of the UPS, that is, positive to positive and negative to negative. Disconnect one or more battery cell links between battery tiers. Do not reconnect these links or close the BCB without permission of the commissioning engineer.

6. Connect the output cables.

a) If output distribution modules are configured, connect the L cables, N cables and PE cables between the output terminals of the output distribution modules and the load according to Figure 3-3. Tighten the bolts (M6) to 5Nm. Ensure correct phase rotation.



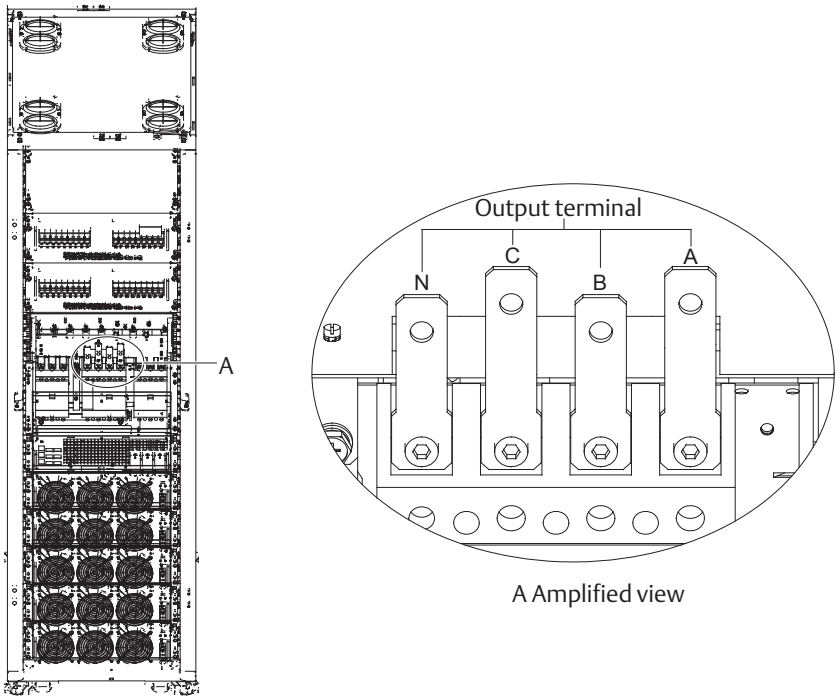


Figure 3-5 Output terminals of UPS with output distribution module (front view)

Warning

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

7. Replace the protective cover.

3.2 Wiring Of Signal Cable

3.2.1 Overview

As shown in Figure 3-6, the bypass module provides dry contact ports (J5 ~ J10) and communication ports (RS485 port, RS232 port and Intellislot port) on the front panel.

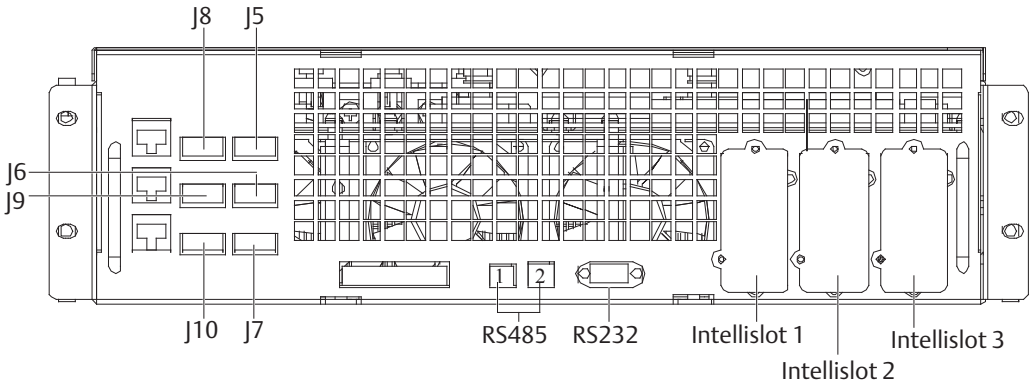


Figure 3-6 Dry contact ports and communication ports

The UPS accepts voltage-free (dry) contact signals from external input dry contact terminals through the phoenix terminals on the bypass module. Subject to prior software programming, the signals are 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 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 3-7 and described in Table 3-3.

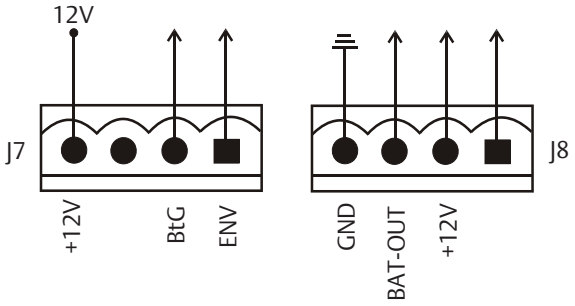


Figure 3-7 Input dry contact ports J7 and J8

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

Position	Name	Description
J7.1	ENV[3]	Battery room environment detection (normally closed)
J7.2	BtG[1, 2]	Battery ground fault
J74	+12V	+12V power
J8.2	+12V	+12V power
J8.3	BAT_OUT	Battery temperature detection
J8.4	GND	Power ground

Note

1. Must be configured by configuration software before becoming active.
2. When activated, the charger current can be limited through software to a percentage of the full charger current (0 ~ 100%).
3. Activating this feature turns the battery charger off.

3.2.3 BCB Port

J6 is the BCB port. The port is shown in Figure 3-8 and described in Table 3-4.

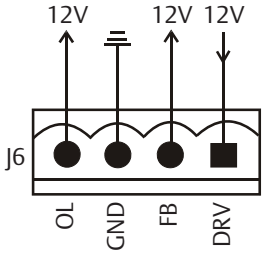


Figure 3-8 BCB port

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 3-9.

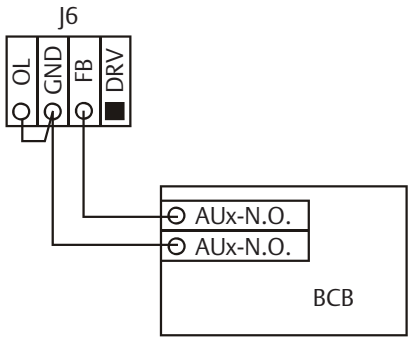


Figure 3-9 Connection between BCB port and BCB

3.2.4 Maintenance Switch And Output Switch State Port

J9 is the maintenance switch and output switch state port. The port is shown in Figure 3-10 and described in Table 3-5.

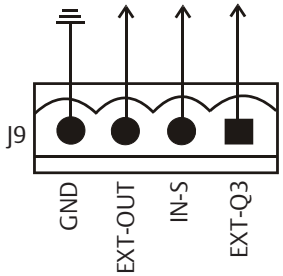


Figure 3-10 Maintenance switch and output switch state port

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

Position	Name	Description
J9.1	EXT_Q3	External maintenance switch state. Connect to J9.4. The auxiliary contact requirement for the external maintenance switch is as follows: When the switch is open, the external bypass auxiliary contact is closed
J9.2	IN_S	Internal maintenance 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 3-11 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.

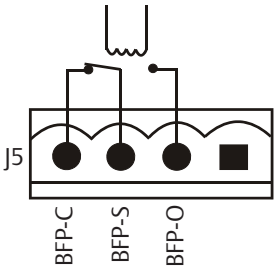


Figure 3-11 Output dry contact port

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 switch is under a hinged, plastic shield.

J10 is the remote EPO input port. The port is shown in Figure 3-12 and described in Table 3-7.

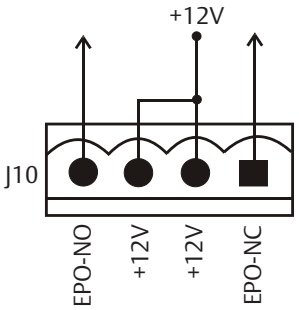


Figure 3-12 Remote EPO input port

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 relay card, Modbus card, SIC card and UF-RS485 card. For details, refer to *Chapter 8 Option*.

Note

1. 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.
2. Intellislot 2 port shares communication resource with the SPM monitoring module. If the SPM monitoring module is configured, optional communication cards cannot be installed in Intellislot 2 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 is located on the front door of the UPS. 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.

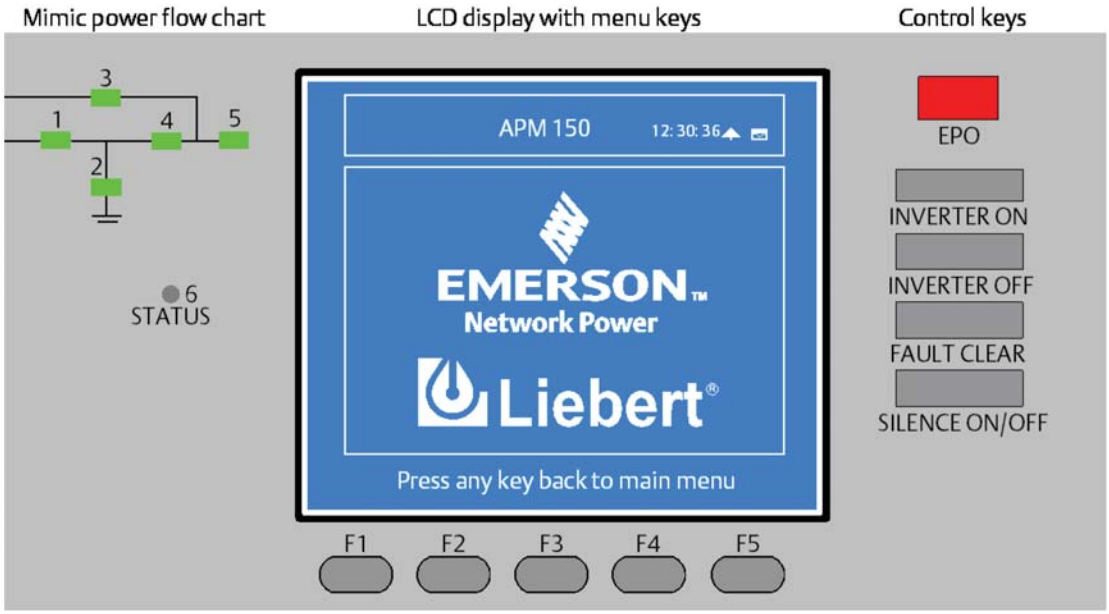


Figure 4-1 Operator control and display panel

Table 4-1 Component description of 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 Indicator description

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 Audible alarm description

Alarm sound	Meaning
Beep every other second	UPS alarm, for example, AC input failure
Continuous beep	UPS fault, for example, fuse or hardware fault

4.1.3 Control Keys

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

Table 4-4 Description of control keys

Control key	Silkscreen	Description
EPO switch	EPO	Cut off the load power, shut down the rectifier, inverter, static bypass and battery
Inverter start switch	INVERTER ON	Start the inverter
Inverter shutdown switch	INVERTER OFF	Shut down the inverter
Fault reset switch	FAULT CLEAR	Restart the UPS (subject to any fault being cleared)
Audible alarm silencing switch	SILENCE ON/OFF	When an alarm is active, pressing this button silences the audible alarm. Pressing this button 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, F5). The menu keys are described in Table 4-5.

Table 4-5 Menu key description

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.

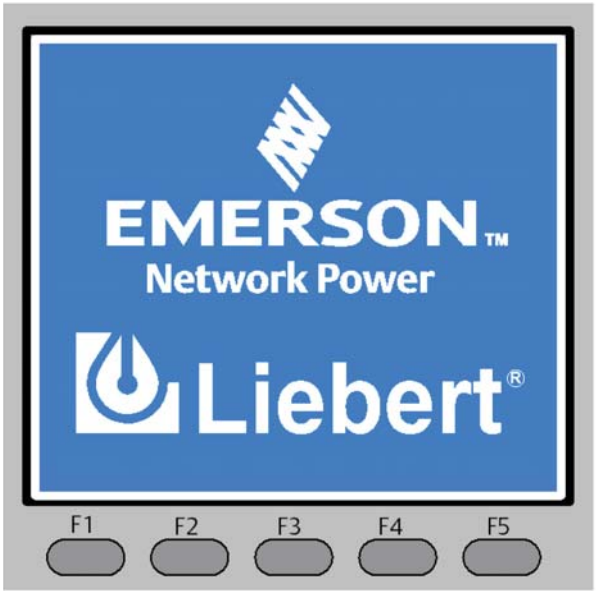


Figure 4-2 Start screen

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.

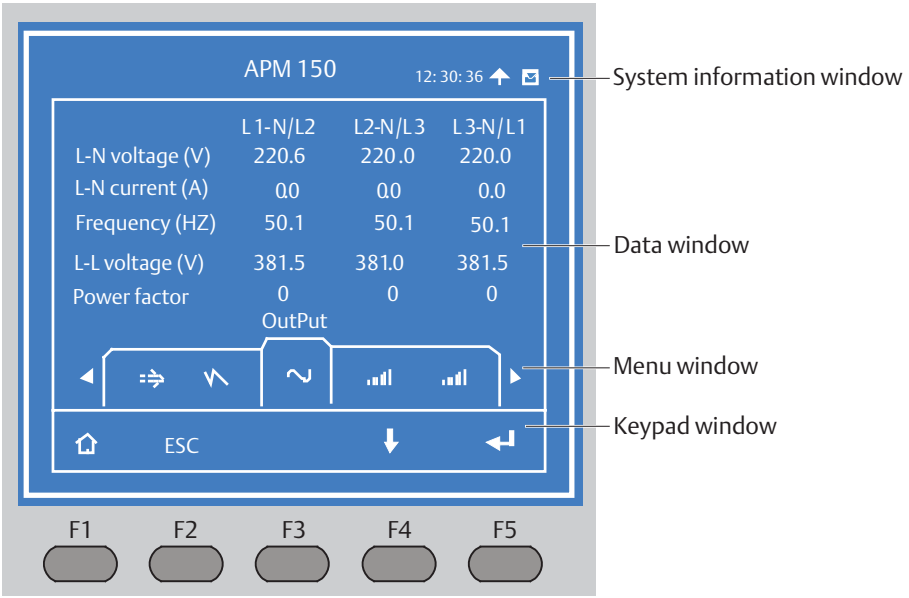


Figure 4-3 Primary screen

Some 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.

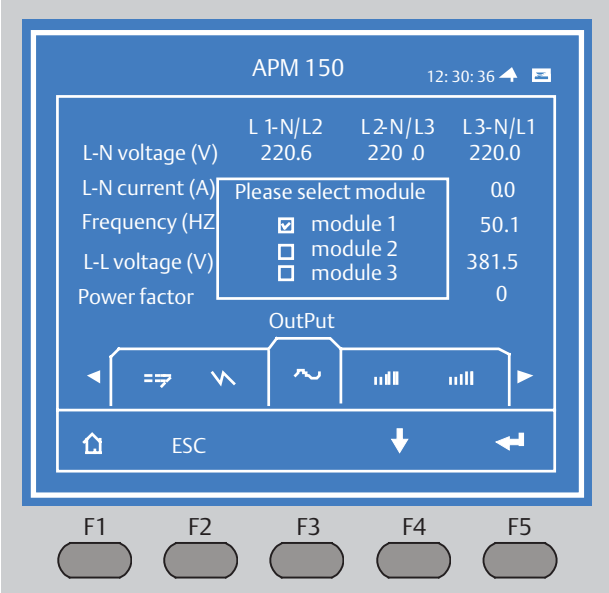


Figure 4-4 Selecting power module

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.

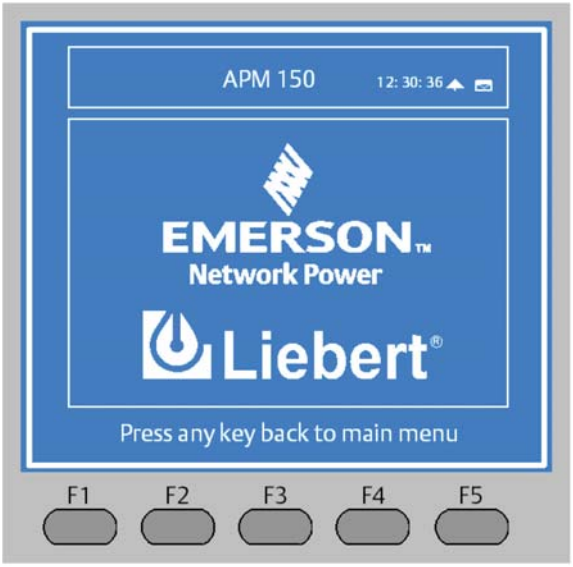


Figure 4-5 Default screen

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 150/APM 150P/APM 150S	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
SPM Branch	I (A)	Displays the current, rated current and current percentage of each SPM output route (up to 54 routes). When '-' is displayed, it means the corresponding output route is not connected or the measurement point of this output route is defined as input measurement
	In (A)	
	Load (%)	
SPM Meter	Electric energy (kwh)	Displays the current, current harmonic percentage and switch status of each SPM output route (up to 54 routes). When '-' is displayed, it means the corresponding output route is not connected or the measurement point of this output route is defined as input measurement
	State	
	Current ripple coefficient	Optional. Set by commissioning engineer
SPM Loads	Pout (kW)	Displays the active power, apparent power and power factor of each SPM output route (up to 54 routes). When '-' is displayed, it means the corresponding output route is not connected
	Sout (kVA)	
	Power factor	
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 two optional LCD languages

Menu	Item	Explanation
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
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-energised
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 self-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 button
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

Alarm	Explanation
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
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

Alarm	Explanation
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
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

Alarm	Explanation
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 button activated on the operator control and display panel to turn on the inverter
Manual Turn Off	INVERTER OFF button 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 button pressed
Alarm Silence	SILENCE ON/OFF button pressed
Turn On Fail	The inverter failed to turn on when the INVERTER ON button 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 button 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
UPS Shutdown	UPS shutdown with no output power
BCB Open	BCB status (open)
BCB Close	BCB status (closed)
Batt. Float Charging	Battery status (float charge mode)
Batt. Boost Charging	Battery status (boost charge mode)
Battery Discharging	Battery status (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)
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 status (open)
BCB closed	BCB status (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

Alarm	Explanation
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 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 need to change the setting values, please contact the local customer service center of Emerson.

Chapter 5 Operating Instructions

This chapter provides the operating precautions and 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

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

1. All control keys and LED indication mentioned in these procedures are identified in *Chapter 4 Operator Control And Display Panel*.
2. Audible alarm may sound at various points during these procedures. It can be canceled at any time by pressing the SILENCE ON/OFF key.

5.1.2 Power Switch

As shown in Figure 5-1, opening the UPS front door reveals the power switches, including the input switch, output switch, maintenance switch (locked) and output distribution switches.

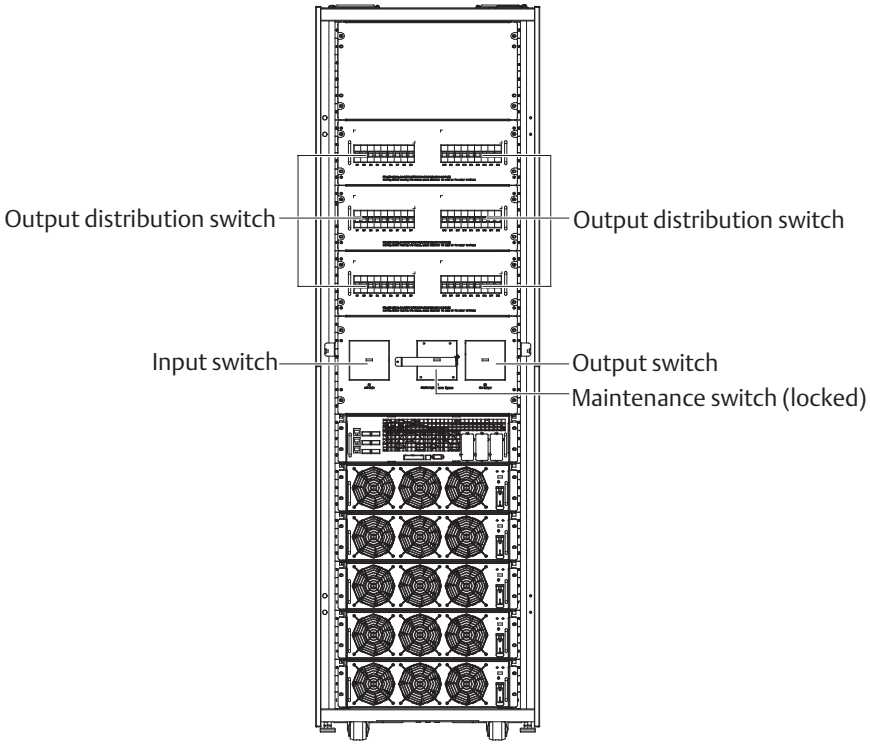


Figure 5-1 Positions of power switches

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 (Into Normal Mode)

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 UPS output switch and input switch 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
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 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)

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

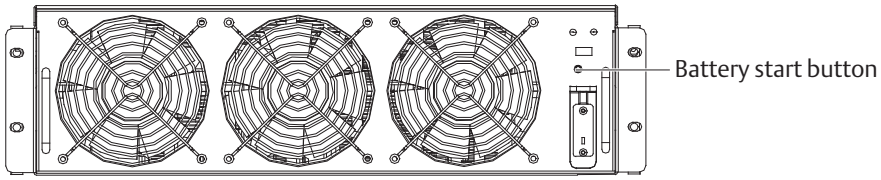


Figure 5-2 Location of battery start button

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 action
- 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 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 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 switch Q2. 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 input switch Q1 and output switch Q3.

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.

5.3.5 Transfer From Maintenance Mode To Normal Mode

The following procedures will transfer the UPS from maintenance mode to normal mode.

1. Open the front door of the cabinet and close the input switch Q1.
2. Close the output switch Q3.
3. Wait until the LCD screen starts up, switch the display to the Event men and confirm that Bypass mode is displayed.

Warning

The bypass must be started before the maintenance switch is opened. Or else, the load power will be interrupted.

4. Open the internal maintenance switch Q2.
5. Wait until the rectifier indicator begins to illuminate green constantly, press and hold the INVERTER ON key for two seconds. Then the inverter starts, and the inverter indicator begins to blink green. After the inverter enters normal operation, the UPS transfers from bypass mode to normal mode, and the inverter indicator begins to illuminate constantly.

At the moment, the load has been transferred to the inverter supply

5.4 Battery Maintenance Test Procedures

The battery maintenance test includes periodic test and manual maintenance test. The battery discharges up to 20% of the total battery capacity. The time interval of the periodic test is set through the background software. The manual maintenance test is initiated through the LCD menu on the operator control and display panel, and it requires password verification.

The procedures for the manual maintenance test are as follows:

1. At the Command menu, press the F3 (up) or F4 (down) key to select the Battery maintenance test menu. Press the F5 (enter) key to confirm.

2. Upon screen prompt, press the F3 (up) and F4 (right) keys to enter the password. Press the F5 (enter) key to confirm.

3. Wait until the battery test is finished.

When the battery maintenance test is finished, the UPS will transfer to normal mode, and the battery is charged.

4. Stop the battery test.

During battery maintenance test, you can stop it be selecting the Stop testing option on the Command menu.

5.5 Battery Capacity Test Procedures

The battery capacity test is to test the battery activity, check the battery residual capacity and calculate the battery autonomy time. In battery capacity test, the battery continuously discharges to the battery undervoltage shutdown threshold. When the capacity test is finished, the system updates the battery curve chart.

The battery capacity test is initiated through the LCD menu on the operator control and display panel, and it requires password verification. The procedures are as follows:

1. At the Command menu, press the F3 (up) or F4 (down) key to select the Battery capacity test menu. Press the F5 (enter) key to confirm.

2. Upon screen prompt, press the F3 (up) and F4 (right) keys to enter the password. Press the F5 (enter) key to confirm.

3. Wait until the battery test is finished.

When the battery capacity test is finished, the system will automatically update the battery data and actual battery capacity, which are used to calculate the battery autonomy time.

4. Stop the battery test.

During battery capacity test, you can stop it be selecting the Stop testing option on the Command menu.

5.6 System Test Procedures

The system test is to check the LED indication on the operator control and display panel. It lasts five seconds. It is initiated through the LCD menu on the operator control and display panel and requires password verification.

The procedures for the system test are as follows:

1. At the Command menu, press the F3 (up) or F4 (down) key to select the System test menu. Press the F5 (enter) key to confirm.

2. Upon screen prompt, press the F3 (up) and F4 (right) keys to enter the password. Press the F5 (enter) key to confirm.

3. Wait until the system test is finished.

Five seconds later, if all indicators illuminate green constantly, and then turns constant red, it indicates that all indicators are normal.

4. Stop the test.

During system test, you can stop it be selecting the Stop testing option on the Command menu.

5.7 UPS Shutdown Procedures

5.7.1 Completely Powering Down The 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 switch on the UPS operator control and display panel. This disables the rectifier, inverter, static transfer 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 switch.

2. Open the 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.

5.7.2 Completely Powering Down The UPS Whilst Maintaining The Power Supply To The 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.

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

5.8 EPO Procedures

The EPO switch 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 UPS input switch should be opened.

5.9 UPS Reset Procedures

After UPS shutdown due to an EPO action, inverter overtemperature 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 switch 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.

5.10 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 button.

5.11 Selecting Language

The UPS provides two LCD languages for your selection: Chinese and English.

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.

5.12 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.

5.13 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 battery safety, installation and maintenance information, battery protection function and the battery temperature sensor.

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 limited by 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: hazardous battery voltage present behind covers
1. No user-serviceable parts are located behind covers that require a tool for their removal. Only qualified service personnel are 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 on 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

Warning: hazardous battery voltage present behind covers

be 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.
k) 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. Please replace the battery before it enters this state.
l) Before connecting or disconnecting the battery connection cables, please cut off the charging power.
m) Check if the battery has been unexpectedly earthed. If yes, remove the earth power. Contact with any part of the earthed battery may cause electric shock.

6.3 UPS Battery

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

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

Besides, the valve-regulated battery is not maintenance free. The valve-regulated battery must be kept clean, and it shall be inspected regularly to check if the connection is reliable, and if it is corroded. For details, please refer to *6.11 Battery Maintenance*.

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

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

It is very important to fully charge the battery before carrying out onsite test on the battery backup time. The test may take several days. Therefore, it should be conducted after the battery has been subject to uninterrupted float charging for at least one week.

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

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

6.4 Precautions For Installation Design

Note

Precautions for installation, use and maintenance of the battery are described iin the relevant battery manual provided by the battery manufacturer. The safety precautions described in this section include the important matters that must be considered during the installation design. The design results may be changed according to the local situations.

6.5 Battery Installation Environment And Number Of Batteries

6.5.1 Installation Environment:

Fresh air volume (EN50272-2001)

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

$Q=0.05 \times n \times Igas \times Crt \times 10^{-3}[m^3/h]$

Where:

Q - The fresh air ventilation volume per hour, the unit is m^3/h

n - Number of cells

Igas - The gas evolving current density under battery float charging or equalizing charge conditions, the unit is mA/Ah

Igas=1, under the float charging condition of 2.27V/cell

Igas=8, under the equalizing charge condition of 2.35V/cell

Crt - 20hr battery rated capacity

Temperature

Table 6-1 Ambient temperature range

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

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

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

The ambient temperature, ventilation, space, float/equalizing charge voltage and ripple current will affect the battery temperature. Uneven temperature among the battery strings will cause uneven voltage distribution and thus result in problem. Therefore, it is very important to maintain balanced temperature in the battery string, and the temperature difference between batteries of different layers shall be kept within 3°C.

Valve-regulated battery is very sensitive to the temperature, therefore, valve-regulated battery shall be used in 15°C ~ 25°C. If the battery cabinet is installed near the UPS, the maximum design ambient temperature shall be determined according to the battery rather than the UPS. That is, if valve-regulated battery is used, the indoor ambient temperature shall be 15°C ~ 25°C rather than the operating temperature range of the main equipment. Under the precondition that the average temperature will not exceed 25°C, it is allowed to have short time temperature deviation.

6.5.2 Number Of Batteries

Set the DC bus voltage and battery float charging voltage, which is usually 490Vdc, according to the rated input/output voltage of the UPS, to ensure that the expected cell float charging voltage is 2.27V. The number of batteries, EOD voltage, float charging voltage under the 380V/400V/415V voltage system are consistent, as shown in Table 6-2.

Table 6-2 Number of batteries

Parameter	380V/400V/415V
Number of cells (standard)	180 ~ 240 pcs, 240 pcs is recommanded
End of discharge voltage	1.60Vdc/Cell ~ 1.88Vdc/Cell, 1.62V/cell recommended, that is the EOD voltage is 389V
Float charging voltage	2.15Vdc/Cell ~ 2.3Vdc/Cell, 2.27V/cell recommended, that is the float charging voltage is 490V

6.6 Battery Protection

The battery is connected to the UPS through the BCB. The BCB can be manually closed. If the battery adopts rack mounting or is far away from the UPS cabinet, the BCB shall be installed as close to the battery as possible, and the wiring distance of the power and signal cables connected to the UPS shall be minimized.

The BCB should provide:

- Overcurrent protection
- Short circuit protection
- Automatic tripping function

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

Note

Only properly trained personnel shall maintain or operate the BCB.

6.7 Battery Installation And Connection

6.7.1 Battery Installation

1. Before installation, check the battery appearance to ensure that there is no damage, inspect and count the accessories, and carefully read this manual and the user manual or installation instruction provided by the battery manufacturer.
2. There shall be 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.

6.7.2 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.

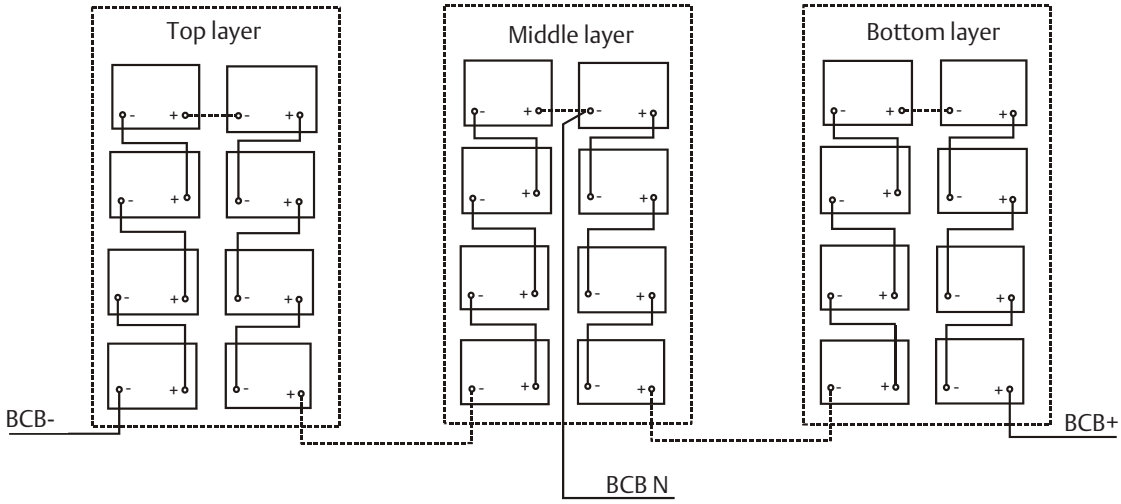


Figure 6-1 Battery cable connection

6.8 Battery Room Design

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

❶Layout of cells

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

❷Workbench

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

❸Wiring

All the wiring distances shall be minimized.

❹BCB

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

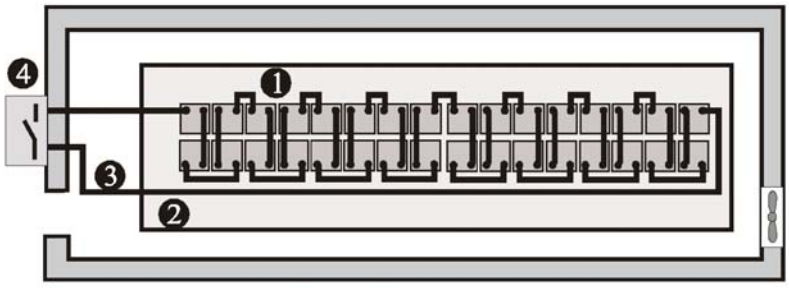


Figure 6-2 Battery room design

6.9 Battery Temperature Sensor (Option)

The battery temperature sensor is used to detect the battery temperature. It is placed near the battery where it can detect the highest battery temperature. For details, refer to the user manual of the battery temperature sensor.

With this function, we can adjust the float charging voltage of the battery to make it inversely proportional to the ambient temperature of the battery cabinet/chamber, so as to prevent the over-charge of the battery under high ambient temperature.

6.10 Reference Current And Connection Of BCB

Table 6-3 provides recommended BCB rated current and connection cable CSA.

Table 6-3 Reference table for selection of BCB rated current and connection cable CSA (recommended)

Item		Unit	UPS rating (kVA)			
			30	60	90	120
30-cell battery	Max. battery discharge current (both positive and negative))at full load	A	105	210	315	420
	Reference rated current of BCB	A	150	250	350	450
	Connection cable CSA	mm^2	35	70	120	150
32-cell battery	Max. battery discharge current (both positive and negative) at full load	A	100	200	300	400
	Reference rated current of BCB	A	150	250	350	450
	Connection cable CSA	mm^2	35	70	120	150
34-cell battery	Max. battery discharge current (both positive and negative) at full load	A	94	186	282	376
	Reference rated current of BCB	A	100	200	300	400
	Connection cable CSA	mm^2	35	70	95	120
36-cell battery	Max. battery discharge (both positive and negative) current at full load	A	88	176	264	352
	Reference rated current of BCB	A	100	200	320	400
	Connection cable CSA	mm^2	25	50	95	120
38-cell battery	Max. battery discharge (both positive and negative) current at full load	A	84	168	252	336
	Reference rated current of BCB	A	100	200	260	350
	Connection cable CSA	mm^2	25	50	95	120
40-cell battery	Max. battery discharge (both positive and negative) current at full load	A	80	160	240	320
	Reference rated current of BCB	A	100	200	250	320
	Connection cable CSA	mm^2	16	35	70	95

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 35kA). Connections between the battery, BCB and UPS are shown in Figure 6-3.

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 6-4 for the connections between the battery, BCB and UPS. If the battery cell number ranges from 36 to 40, refer to Figure 6-5 for the connections between the battery, BCB and UPS.

3. The max. battery neutral cable current can reach half of the current of the battery positive and negative cables. When sizing the neutral cable, refer to this cable, and take the neutral cable currents as half of the currents listed in the table.

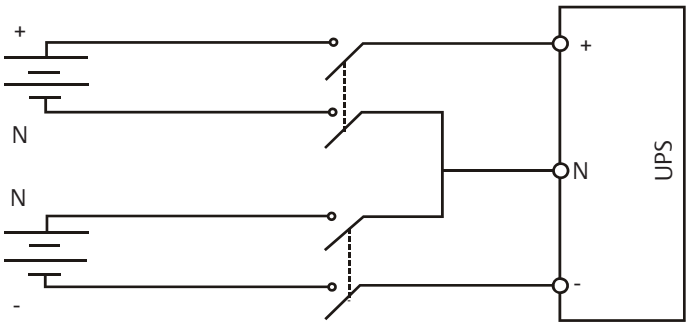


Figure 6-3 Connections between battery, BCB and UPS (4 wires at battery side)

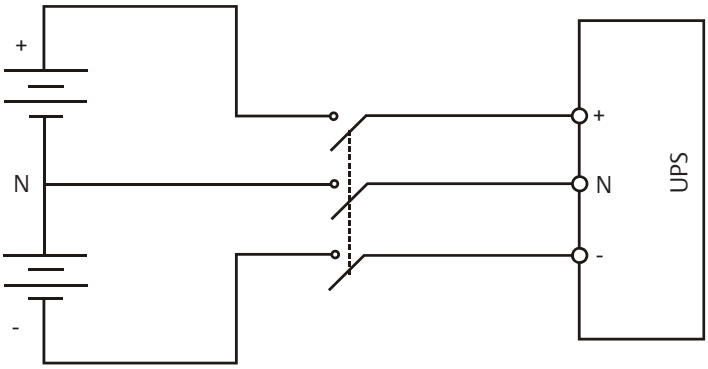


Figure 6-4 Connections between battery, BCB and UPS (3 wires at battery side, battery consisting of 30 to 34 cells)

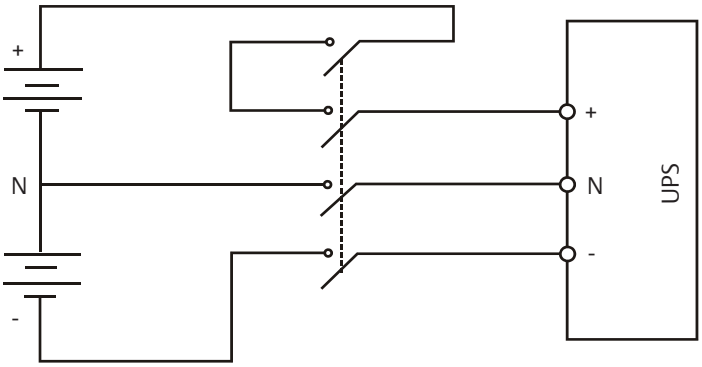


Figure 6-5 Connections between battery, BCB and UPS (3 wire at battery side, battery consisting of 36 to 40 cells)

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 6-6.

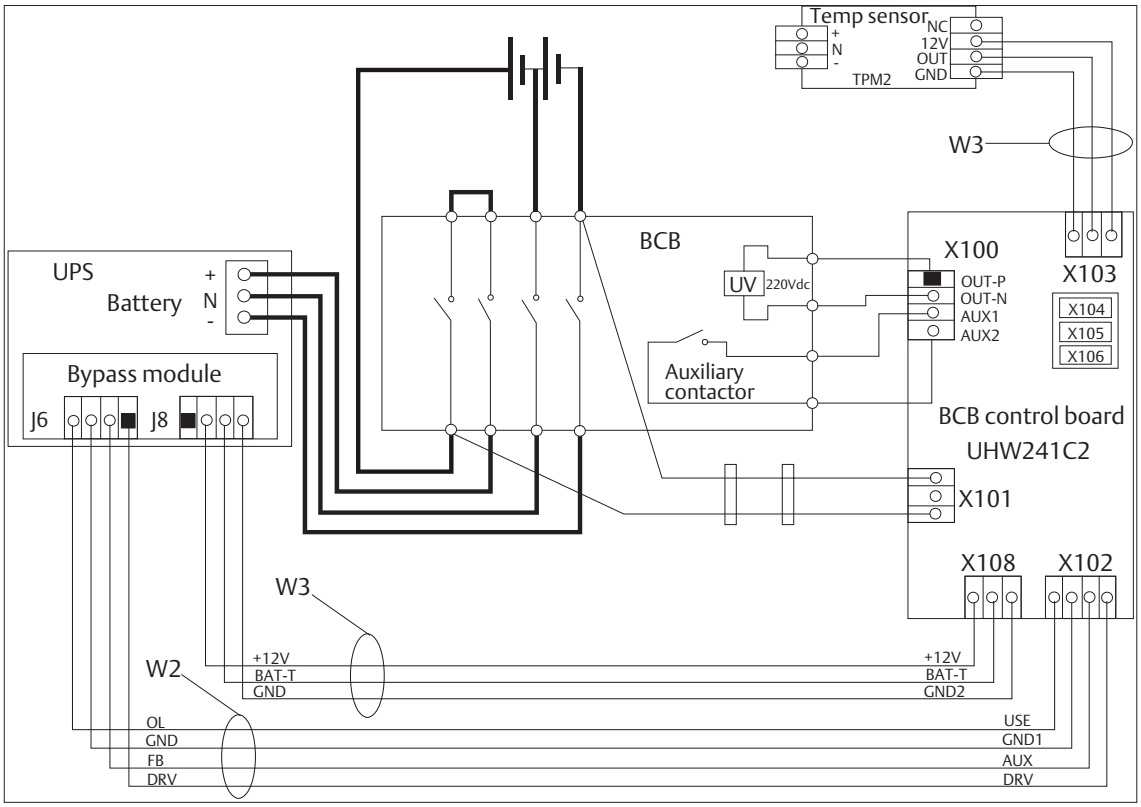


Figure 6-6 Connections between UPS, BCB and BCB control board

6.11 Battery Maintenance

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

Note

1. Periodically check the screws of the battery 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.

6.12 Waste Battery Disposal

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 & Dual Bus System

This chapter introduces the installation and operating of the parallel system and the installation of the dual bus system.

7.1 Overview

Two UPSs can be connected in parallel to form a 1 + 1 parallel system (parallel system for short). The parallel system installation shall be carried out according to the installation procedures of the UPS module and the requirements in this chapter.

From a 'power' viewpoint, each module is internally identical to the 'single module' configuration. A parallel system requires inter-module control signals to manage the load sharing, synchronizing and bypass switching. The control signals are connected through the parallel cables, which are multi-way ribbon cables connected between the units of the system to form a ring.

7.2 Installation Of Parallel System

The basic installation steps of a parallel system are the same as those of a UPS module. The following sections describe the differences between the parallel system installation and UPS module installation.

7.2.1 Preliminary Check

Be sure that the parallel cable is selected, and that the modules are of the same rating 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 background configuration software. This must be done by specialized service personnel of the manufacturer.

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.

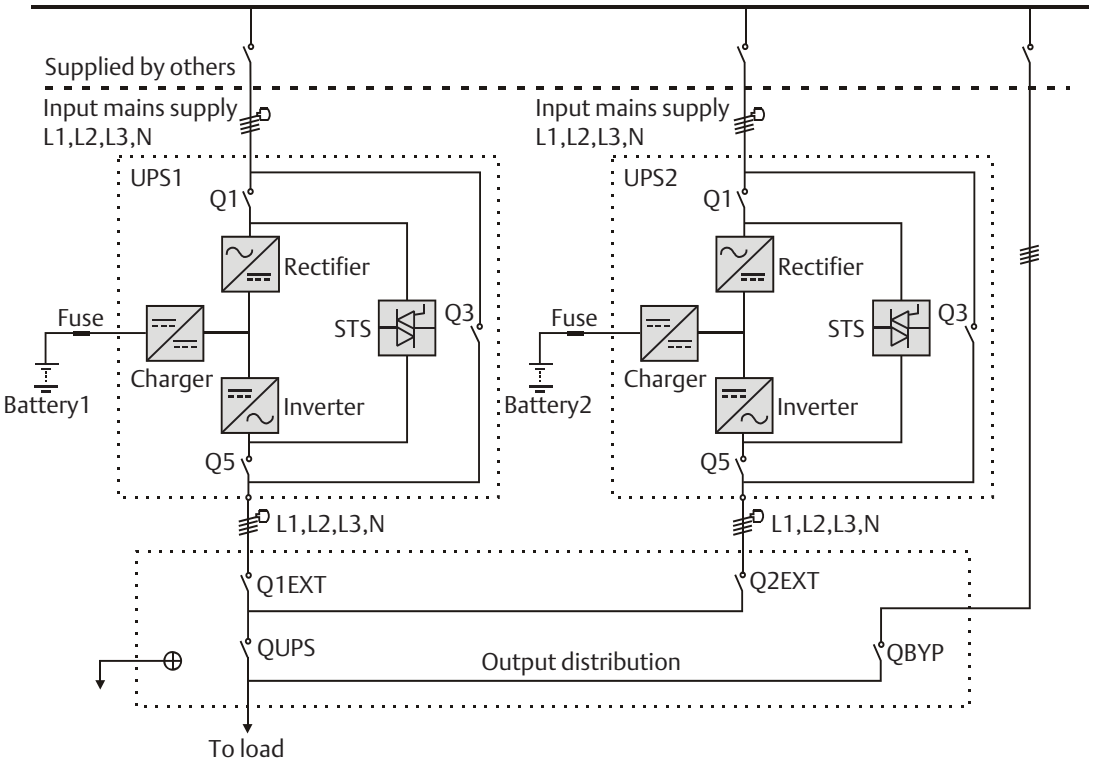


Figure 7-1 Typical parallel system (with common input, separate batteries and output/bypass distribution cabinet)

7.2.3 External Protective Device

Warning

Large ground leakage current: Before connecting the input power (including AC mains and batteries), the grounding must be reliable.
Equipment grounding must comply with local electric regulations.

Refer to *3.1.7 External Protective Device*.

7.2.4 Power Cable

The power cable wiring is similar to that of UPS module. 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.

For parallel system, you need to connect the parallel power cables. The connection procedures are as follows:

1. For UPS without output distribution module, remove the four copper bars on the bottom of the UPS cabinet, as shown in Figure 7-2; connect these four copper bars respectively to the four terminals (A, B, C, N) of the maintenance switch in the front of cabinet, which serve as output terminals, as shown in Figure 7-3.

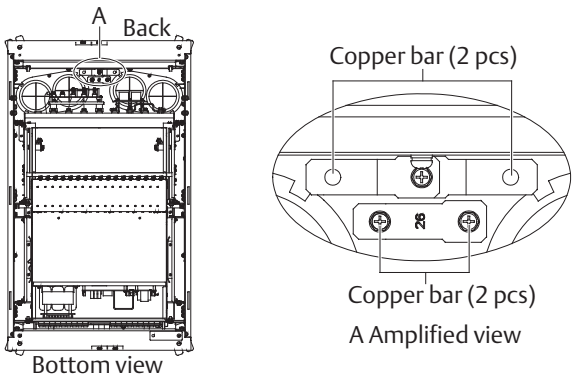


Figure 7-2 Removing copper bars (bottom view)

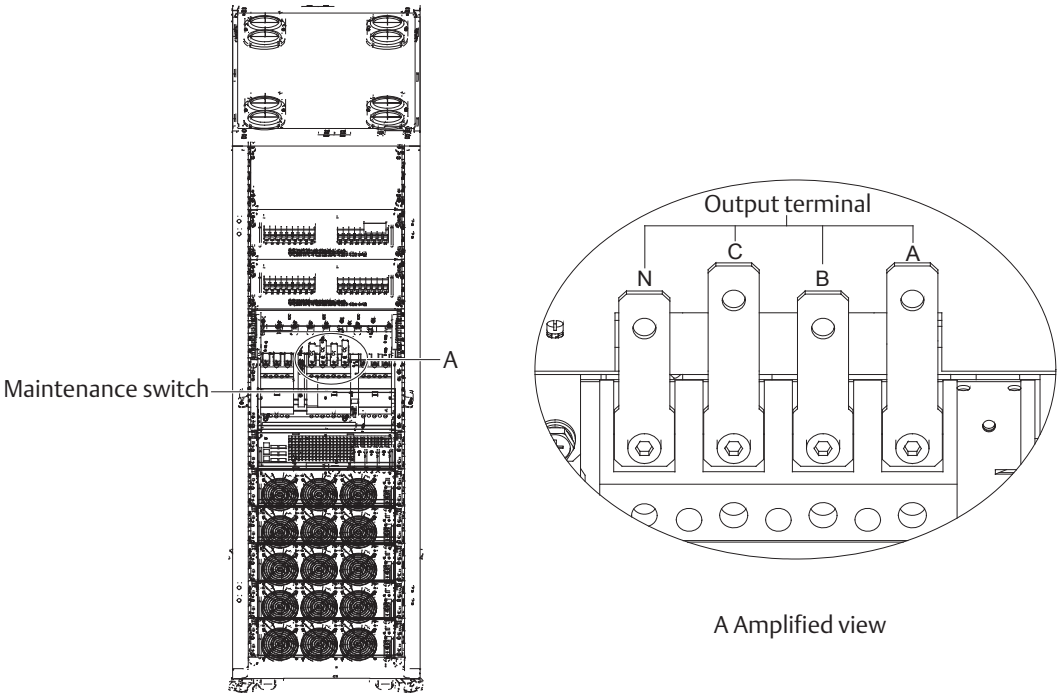


Figure 7-3 Installing copper bars

For UPS without output distribution module, the output terminals have been connected to the A, B, C, N terminals of the maintenance switch in the factory; therefore, skip this step.

2. Connect the corresponding output terminals (A, B, C, N) of the two UPSs.

7.2.5 Parallel Cable

Shielded and double-insulated parallel cables available in lengths 5m, 10m and 15m must be interconnected in a ring configuration between the two UPS modules, as shown in Figure 7-4. The parallel ports J2 and J3 are provided on the front panel of the bypass module, as shown in Figure 7-5. 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 cables to suit the application and must not coil excess. Meanwhile, separate the parallel cables from the power cables to prevent electrical interferences.

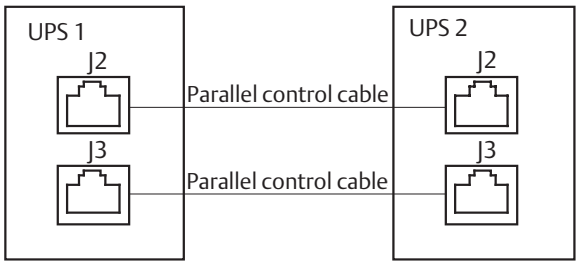


Figure 7-4 Connection of parallel cables of parallel system

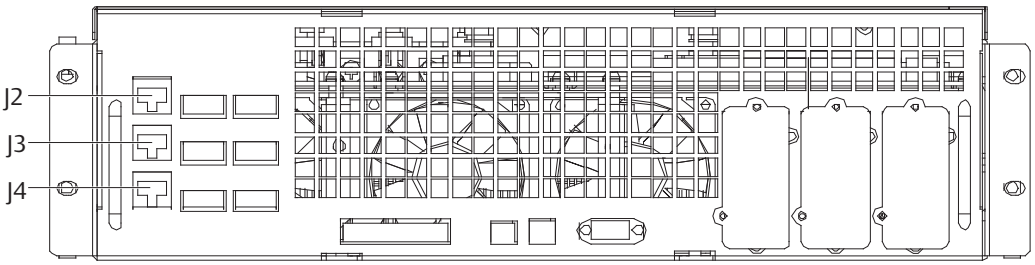


Figure 7-5 Locations of ports J2, J3 and J4 on bypass module

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 7-6.

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.

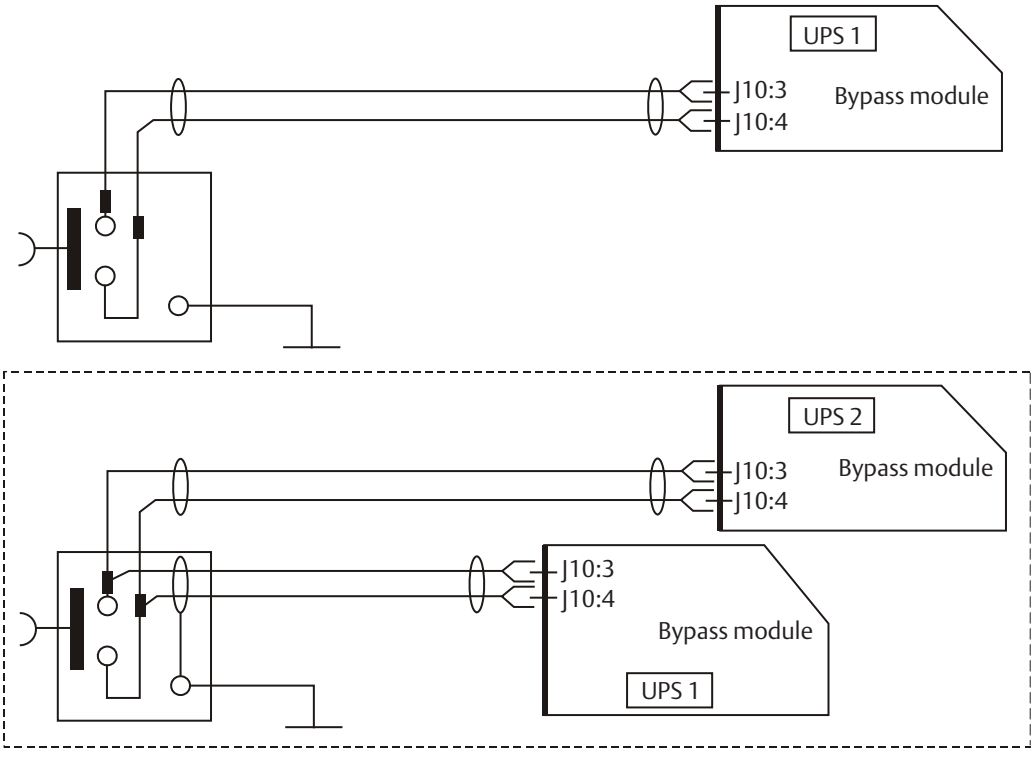


Figure 7-6 EPO circuit diagram

7.3 Operating Procedures Of Parallel System

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 Start-Up Procedures (Into Normal Mode)

These procedures are applicable to start the UPS under total power-down state, which means the UPS or the maintenance bypass 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 closed.

Warning

These procedures will make the output terminals of UPS have dangerous voltage. 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, please disconnect downstream load connection switches and attach warning label to the connection points of the load.

Refer to *5.2.1 Start-Up Procedures (Into Normal Mode)* for the operating procedures.

7.3.2 Procedures For Operating From Maintenance Bypass

The following procedures will transfer the load from the protected UPS power supply to the maintenance switch.

Refer to *5.3.4 Transfer From Normal Mode To Maintenance Mode* for the operating procedures.

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 switch of the UPS to be isolated.
2. Open the 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 input switch and BCB of the UPS.
3. Press and hold the INVERTER ON button 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 Shutdown Procedures (Completely Powering Down The UPS)

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

Refer to *5.7.1 Completely Powering Down The UPS* for the operating procedures.

Caution

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

Warning: hazardous battery voltage

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

7.3.6 Shutdown Procedures (Completely Powering Down The UPS Whilst Maintaining The Power Supply To The Load)

This procedure is applicable for completely powering down the UPS and still keeping the power supply to the load.

Refer to *5.7.2 Completely Powering Down The UPS Whilst Maintaining The Power Supply To The Load* for the operating procedures.

7.4 Installation Of Dual Bus System

7.4.1 Cabinet Installation

As shown in Figure 7-7, 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 STS can be fitted to feed power to the load.

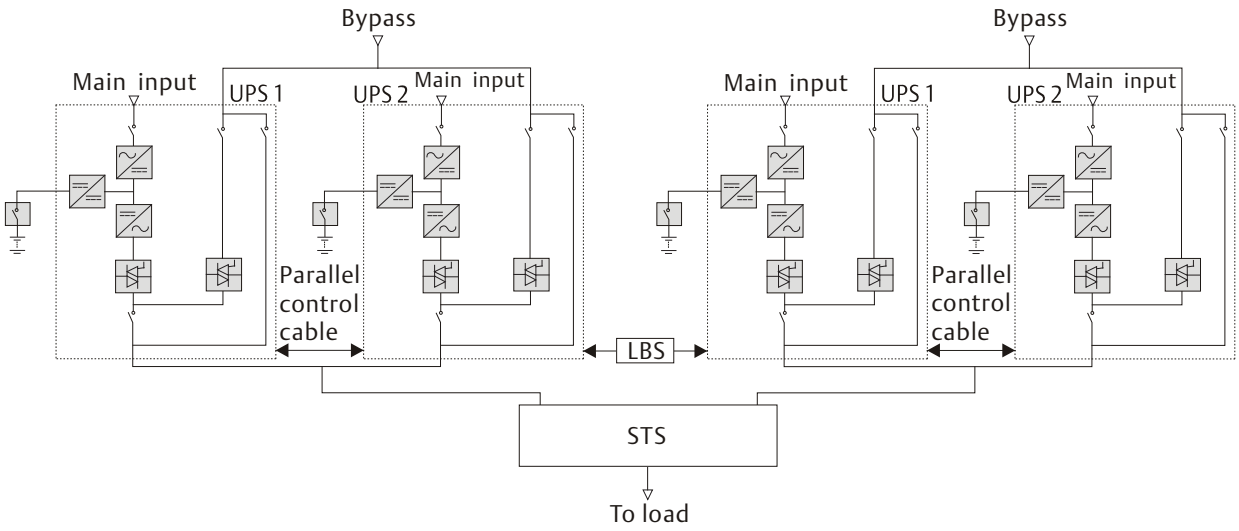


Figure 7-7 Typical dual bus system (with STS and LBS)

The dual bus system uses the LBS cable/adapter 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. 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 LBS Cable

For APM-to-APM dual bus system, connect the optional LBS cables (5m, 10m and 15m selectable) between the two UPS systems as shown in Figure 7-8 to Figure 7-10. The J3 and J4 ports are provided on the front panel of the bypass module, as shown in Figure 7-5.

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

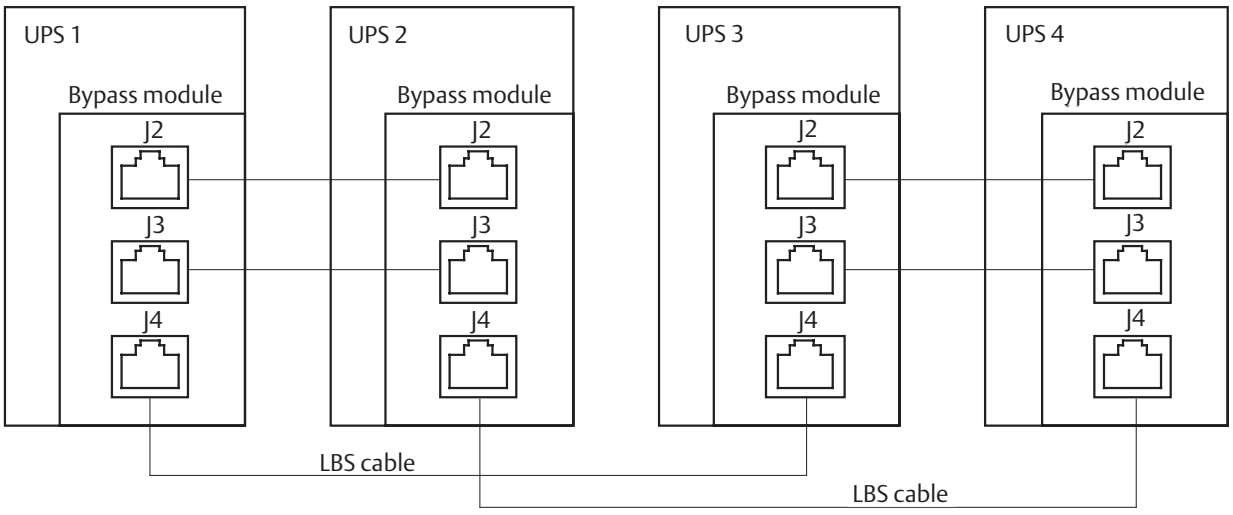


Figure 7-8 Connection of typical dual bus system of two parallel systems

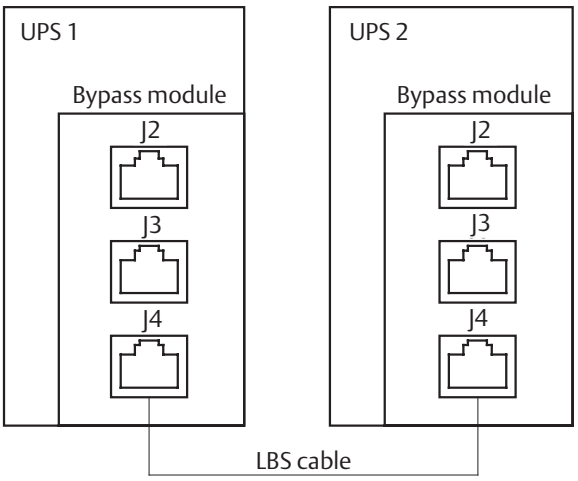


Figure 7-9 Connection of typical dual bus system of two single UPSs without redundancy LBS cable

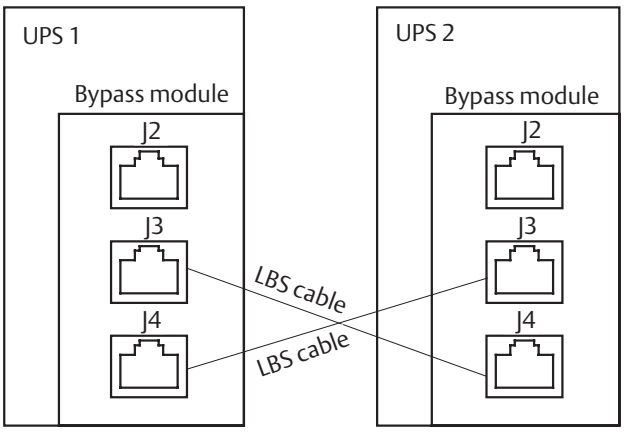


Figure 7-10 Connection of typical dual bus system of two single UPSs with redundancy LBS cable

Chapter 8 Option

This chapter provides the UPS option list and introduces the functions and installation of the options.

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	Battery temperature sensor		UF-SENSOR	02350174	
2	Parallel cable/LBS cable (5m, 10m, 15m)			04118683 (5m) 04118684 (10m) 04118685 (15m)	
3	SIC card		UF-SNMP810	02351817	Installed in Intellislot 1, 2 or 3 port*
4	Relay card		UF-DRY410	02354309	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port*
5	Modbus card		UFMOD41Z1	02354066	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port*
6	UF-RS485 card		UF-RS485	02351786	Installed in Intellislot 1 or 3 port, advisably in Intellislot 3 port*
7	LBS adapter		UF-LBS01	02350359	
8	SiteMonitor monitoring software		UPS02R100 UPS03R100 UPS03R100	05112042 05112043 05112044	
9	SPM monitoring module		UHRF3S672Z7	02352143	
10	Basic unit for common distribution		UHRF3S672Z15	02353995	
11	Output distribution module	Intelligent MCB distribution module	APM-IDM	02352141	Providing current and switch state detection function
		Intelligent hot-pluggable MCB distribution module	APM-SIDM	02352142	Providing current and switch state detection function
		Non-intelligent MCB distribution module	APM-DM	02353962	No current or switch state detection function
		Non-intelligent hot-pluggable MCB distribution module	APM-SDM	02353963	No current or switch state detection function

Note

*: 1. 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.

2. Intellislot 2 port shares communication resource with the SPM monitoring module. If the SPM monitoring module is configured, optional communication cards cannot be installed in Intellislot 2 port.

8.2 Option

8.2.1 Battery Temperature Sensor

The battery temperature sensor is used to detect the battery temperature. With this function, we can adjust the float charging voltage of the battery to make it inversely proportional to the ambient temperature of the battery, so as to prevent the over-charge of the battery at high ambient temperature.

The battery temperature sensor is placed near the battery where it can detect the highest battery temperature. The sensor is connected to the UPS internal logic circuit through the J8 port of the UPS bypass module.

The installation procedures of the battery temperature sensor are as follows:

Warning

Install the battery temperature sensor strictly in accordance with the following steps, or else, the UPS and battery may be damaged.

1. Turn off the load.
2. Power down the UPS completely. For details, refer to *5.7.1 Completely Powering Down The UPS*.

All UPS indication goes off, wait five minutes for the internal DC bus capacitors of the UPS to discharge completely.

3. Place the battery temperature sensor near the battery where it can detect the highest battery temperature.
4. Connect the cable of the battery temperature sensor to the J8 port of the UPS bypass module, as shown in Figure 8-1.

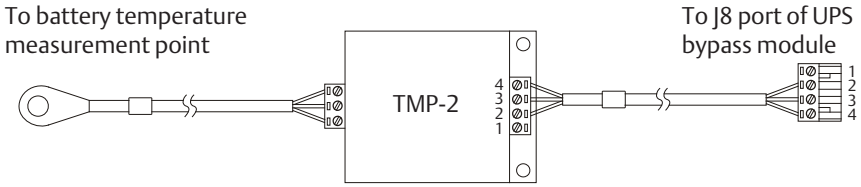


Figure 8-1 Connection between battery temperature sensor and UPS

8.2.2 Parallel Cable

The UPS provides shielded and double insulated parallel cables in length 5m, 10m, 15m. The parallel cables must be interconnected in a ring configuration between all UPS modules to manage the UPS module synchronization, load sharing and bypass transfer, thus ensuring the high reliability of the control of the parallel system.

For the connection of the parallel cables, refer to *7.2.5 Parallel Cable*.

8.2.3 LBS Cable

The UPS provides LBS cable in length 5m, 10m, 15m to keep the outputs of two independent UPSs (or parallel systems) in a dual bus system in synchronization.

For the connection of the LBS cable, refer to *7.4.4 LBS Cable*.

8.2.4 SIC Card

If you need to monitor the UPS through network, you may select the SIC card, which supports SNMP protocol. The SIC card is a network management card. It can make the UPS made by Emerson real network equipment. 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.

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

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 8-2.

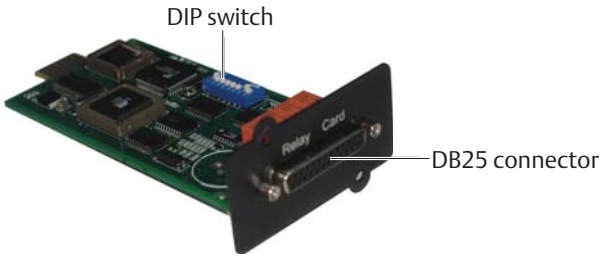


Figure 8-2 Relay card appearance

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 No.	Pin name	Description
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 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 8-3 ~ Figure 8-5 show the appearance and wiring principle of each cable.

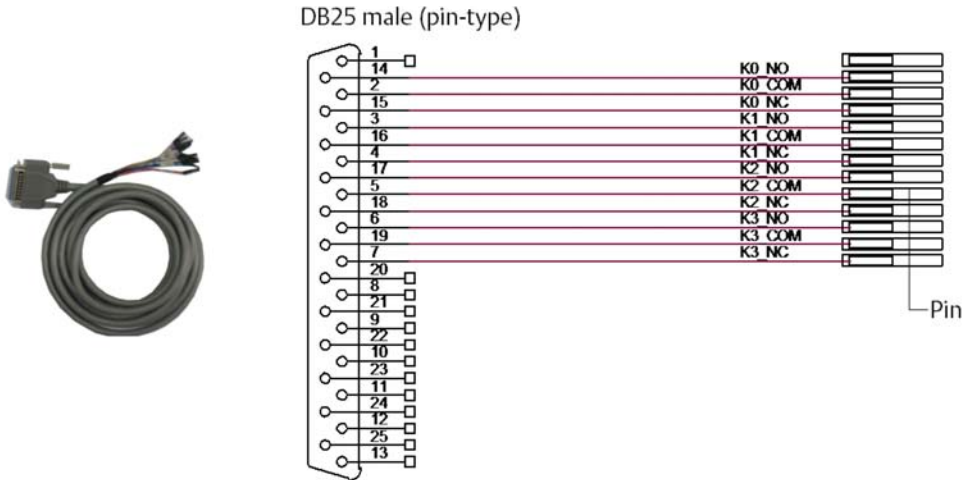


Figure 8-3 Appearance and wiring schematic of cable 1 (UFDRY21SL1)

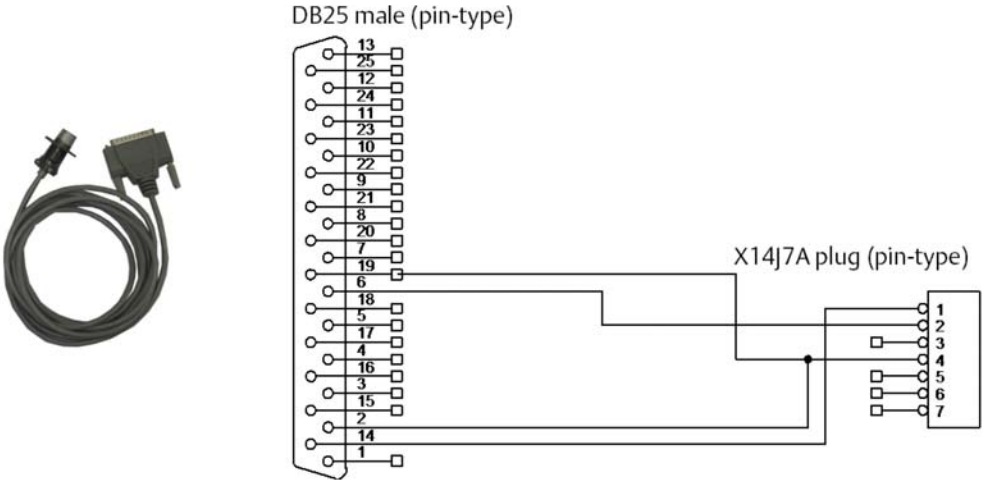


Figure 8-4 Appearance and wiring schematic of cable 2 (UFDRY21SL2)

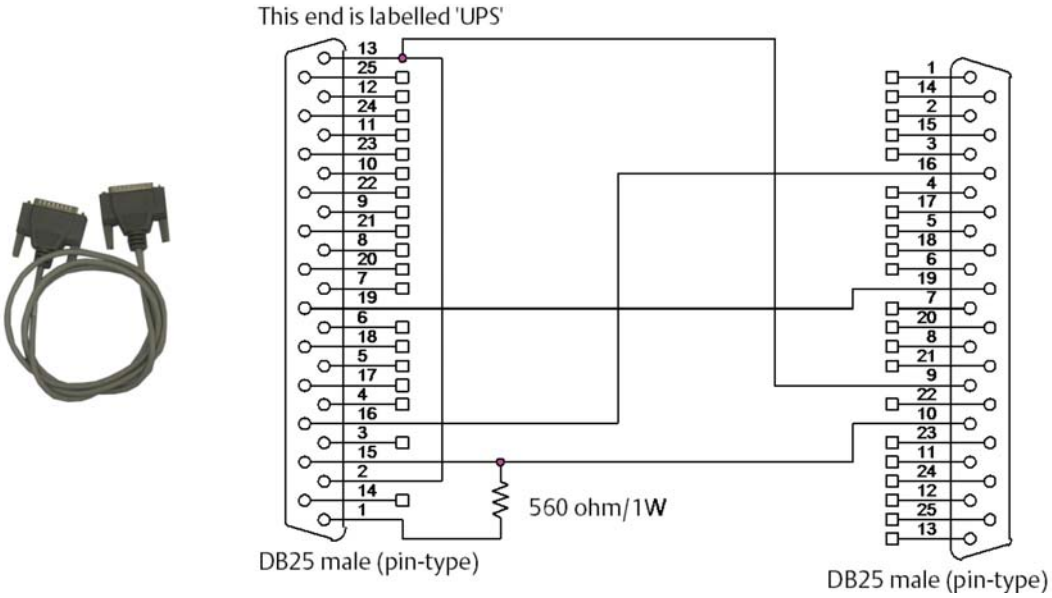


Figure 8-5 Appearance and wiring schematic of cable 3 (UFDRY21SL3)

Instllation

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 8-2. It is an 8-bit DIP switch. Its factory default setting is shown in Figure 8-6.

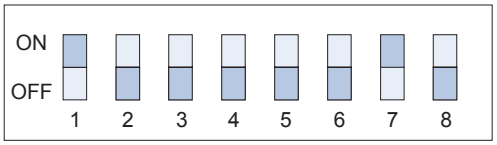


Figure 8-6 Factory default setting of the DIP switch

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

The relay card is hot-pluggable, you can install it without shutting down the UPS.

a) Remove the Intellislot port cover on the front panel of the control module on the top of the UPS bypass cabinet. Save 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 8-3 ~ Figure 8-5. 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 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.

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

8.2.7 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 of the UPS. It is hot pluggable for easy installation.

Appearance

The appearance of the UF-RS485 card is shown in Figure 8-7.

Figure 8-7 Appearance of UF-RS485 card

The goldfinger 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 control module on the top of the UPS bypass cabinet. 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.

8.2.8 LBS Adapter

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

Appearance

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

Figure 8-8 Appearance of LBS adapter

The LBS adapter provides ports, LED indicators and a switch on the front panel, which are described in Table 8-5.

Table 8-5 Description of ports, LED indicators and switch of LBS adapter

Item	Description
Power port	Connect to phase A, neutral and ground of output of UPS
LED1 (red)	Power LED. It illuminates when the power is on, turns off when the power fails
COM1	LBS signal port. Connect to APM 150 UPS
COM2	RS485 port. Connect to the other LBS adapter. Green LED. On: The communication power is OK; off: The communication power fails. Yellow LED. On: The LBS adapter is connected to a non-APM 150 UPS; off: The LBS adapter is connected to an APM 150 UPS
SWITCH	The switch should be placed to right if the LBS adapter is connected to an APM 150 UPS; it should be placed to left if the LBS adapter is connected to a non-APM 150 UPS

Electrical parameters

The electrical parameters of the LBS adapter are listed in Table 8-6.

Table 8-6 Electrical parameters of LBS adapter

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

Installation

Warning

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

1. Fix the LBS adapter.

The dimensions of the LBS adapter are shown in Figure 8-9. The LBS adapter can use horizontal installation (see Figure 8-10) or vertical installation (see Figure 8-11).

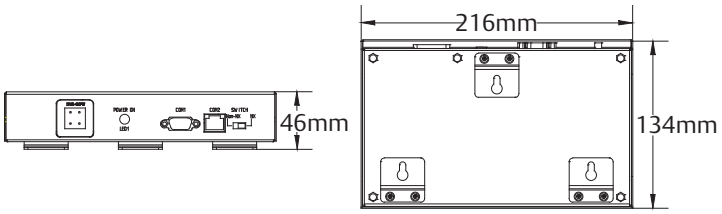


Figure 8-9 Dimensions of LBS adapter

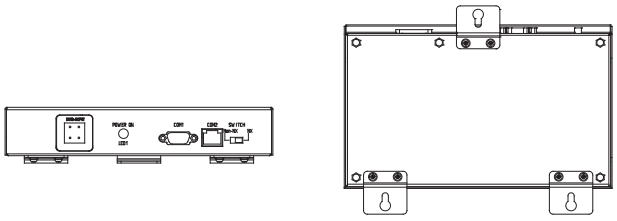


Figure 8-10 Horizontal installation

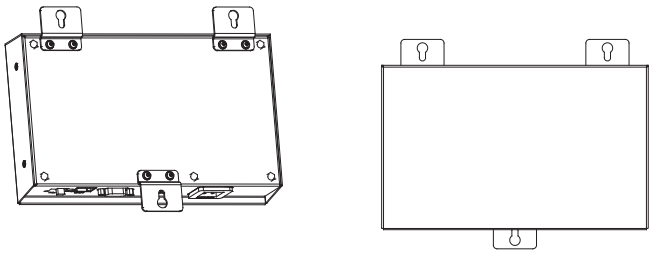


Figure 8-11 Vertical installation

2. Make cable connection.

- APM 150 UPS to APM 150 UPS

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

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

b) Connect the end of the LBS cable with a DB9 port to COM1 port of the LBS adapter, and connect the other end of the LBS cable with an RJ45 port to the J4 port of the bypass module of the UPS.

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

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

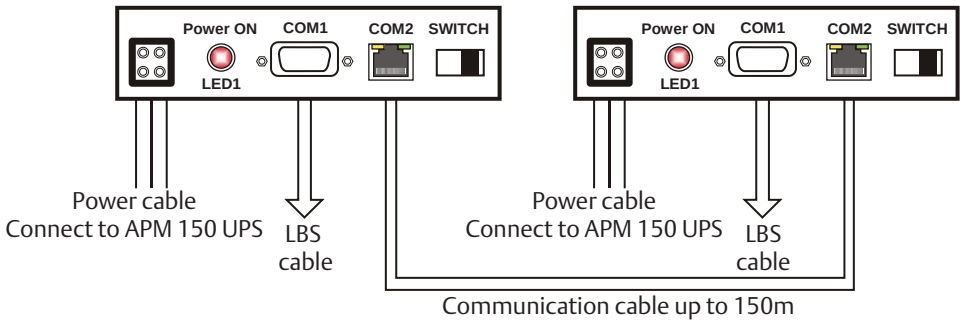


Figure 8-12 Connection between two LBS adapters (APM 150 UPS to APM 150 UPS)

- APM 150 UPS to non-APM 150 UPS

See Figure 8-13, the connection procedures are as follows:

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

2) Connect the end of the LBS cable with a DB9 port to COM1 port of the LBS adapter, and connect the other end of the LBS cable with an RJ45 port to the J4 port of the bypass module of the APM 150 UPS. Make no connection to the COM1 port of the LBS adapter connected to the non-APM 150 UPS.

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

4) Place the switch of the LBS adapter connected to the APM 150 UPS in the right position, and place the switch of the LBS adapter connected to the non-APM 150 UPS in the left position.

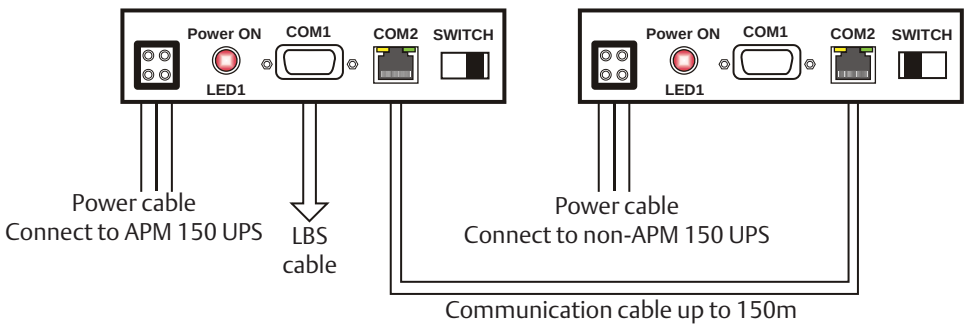


Figure 8-13 Connection between two LBS adapters (APM 150 UPS to non-APM 150 UPS)

8.2.9 SiteMonitor Monitoring Software

SiteMonitor monitoring software is designed to monitor the UPS (UH11, US11R, UH31, UL31, UL33, 2G, Nfinity, NX, Hipulse, Hipulse U), air-conditioner (CM+, DataMate3000, DME, Deluxe), and LTS series STS developed by Emerson. It can also perform centralized monitoring over various ambient signals, such as temperature, humidity, smoke and fog, water logging, infrared, through optional equipment developed by Emerson, like UPS ambient signal adapter.

SiteMonitor can run on Windows, Linux, Solaris, AIX and HP-UX operating systems. It is accessed with a Web browser. You may use any computer over the network to log in SiteMonitor to conduct equipment monitoring and maintenance management.

For the installation and operation of the SiteMonitor monitoring software, refer to *SiteMonitor UPS Monitoring Software User Manual*.

8.2.10 SPM Monitoring Module

The SPM monitoring module is an intelligent power distribution management module. It provides voltage, current, power, harmonic wave, power factor and switch state detection for each power distribution branch. It provides 2-level current pre-warning, which can be set by commissioning engineer through the background software. The SPM monitoring module is installed in factory. It is used with the intelligent MCB distribution module or the intelligent hot-pluggable MCB distribution module.

8.2.11 Basic Unit For Common Distribution

The basic unit for common distribution connects the UPS output busbar to the output distribution module to achieve common load power distribution function. It does not provide branch circuit monitoring or intelligent monitoring or management of various power data. The basic unit for common distribution is installed in factory. It is used with the non-intelligent MCB distribution module or the non-intelligent hot-pluggable MCB distribution module.

8.2.12 Output Distribution Module

The UPS provides four types of optional output distribution module for your selection: intelligent MCB distribution module, intelligent hot-pluggable MCB distribution module, non-intelligent MCB distribution module, non-intelligent hot-pluggable MCB distribution module. The electrical connection of the output distribution modules in the UPS system is shown in Figure 8-14.

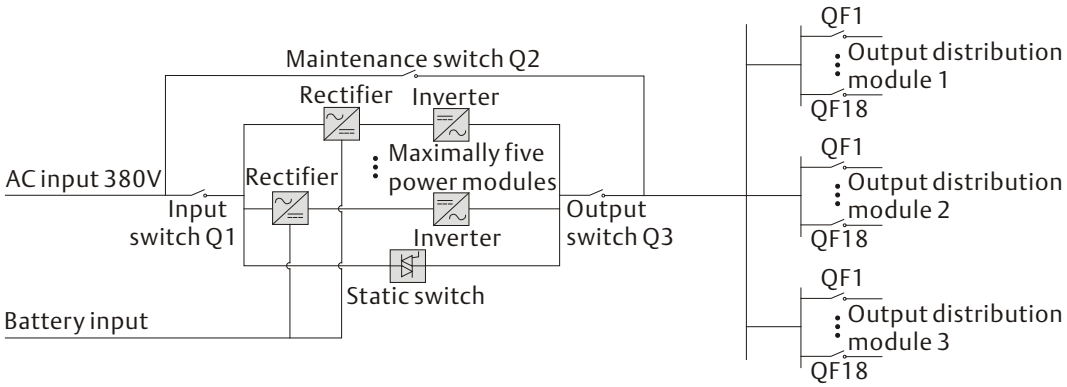


Figure 8-14 Electrical connection between output distribution module and UPS

The maximum configuration number of the former two types is three, and that of the latter two is four.

The intelligent MCB distribution module and intelligent hot-pluggable MCB distribution module are used with the SPM monitoring module to achieve intelligent power distribution and management function.

The non-intelligent MCB distribution module and non-intelligent hot-pluggable MCB distribution module are used with the basic unit for common distribution to achieve common power distribution function, with no distribution circuit monitoring or intelligent management.

The installation and service procedures of the four output distribution modules are the same. Refer to *2.4.6 Installing Power Module And Output Distribution Module* and *10.4.4 Service Procedures Of Output Distribution Module*.

Intelligent MCB distribution module

The intelligent MCB distribution module uses hot-pluggable terminals to connect the UPS output busbar to facilitate installation. The intelligent MCB distribution module in standard configuration provides eighteen 25A/1P MCBs and provides 18 branches of built-in current detection components and switch state monitoring circuit to acquire and report the current, voltage and state of each MCB.

Intelligent hot-pluggable MCB distribution module

Except that the built-in MCBs are hot-pluggable, the intelligent hot-pluggable MCB distribution module is completely the same as the intelligent MCB distribution module.

The intelligent hot-pluggable MCB distribution module uses built-in hot-pluggable MCBs. Therefore, with no need to turn off the whole distribution module, you can regulate the phases of each MCB or replace each MCB to adjust the branch capacity. Hence, load distribution can be adjusted in equipment operation.

Non-intelligent MCB distribution module

Except that the non-intelligent MCB distribution module does not provide branch monitoring function, it is completely the same as the intelligent MCB distribution module.

Non-intelligent hot-pluggable MCB distribution module

Except that the non-intelligent hot-pluggable MCB distribution module does not provide branch monitoring function, it is completely the same as the intelligent hot-pluggable MCB distribution module.

Configuration of MCBs

The preceding four types of output distribution modules all provide eighteen 25A/1P MCBs in standard configuration. In addition, the MCB configurations provided in Table 8-7 are also available for users' selection.

Table 8-7 MCB configuration (optional)

Switch capacity	Pole number of switch	Switch quantity (pcs)
10A, 16A, 25A	1P	18
32A	1P	12
32A	3P	4
63A	1P	6
63A	3P	2

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

UPS system (including battery) needs regular maintenance in the long-term operation. This chapter mainly elaborates the advice on service life, regular inspection and maintenance of UPS key components, as well as the maintenance of UPS and the optional parts .Effective maintenance of UPS systems can reduce the risk of UPS failure and enable longer use of UPS.

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 user. Only qualified service personnel are authorised to remove such covers.
3. In UPS maintenance, note that the neutral line is energized.

10.2 Key Components And Service Life Of UPS

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

10.2.1 Magnetic Components: Transformers, Inductors

The designed service life of magnetic components is 20 years. Key factors that affect their service life are insulation system to use and temperature rise at work among windings.

10.2.2 Power Semiconductor Component

Power semiconductor components include SCRs and IGBTs. In normal UPS working state, the power semiconductor components have no rated years of service life. SCR and IGBT failures are always caused by other problems. However, in system service and maintenance, it is required to check on a yearly basis for corrosion and damaged enclosure in the appearance of the power semiconductor components, and replace those in risk of failure.

10.2.3 Electrolytic Capacitor

The actual operating life of the electrolytic capacitors is mainly affected by the DC bus voltage, capacitor ripple current and ambient temperature of the system.

To ensure the safety and stability of the UPS system, the user must replace the electrolytic capacitors by the end of their service life. It is recommended to replace the electrolytic capacitors after five to six years in service.

10.2.4 AC Capacitor

It is recommended to replace the AC capacitors after five to six years of continuous work, and inspect them regularly once a half year. The abnormal ones should be replaced immediately.

10.2.5 Service Life And Recommended Replacement Time Of Key Component

The key components listed in Table 10-1 are used in the UPS system. To prevent system malfunctions caused by component failure by wear, it is recommended to regularly inspect the components and replace them by the end of their estimated life.

Table 10-1 Service life and recommended replacement time of key components

Key component	Estimated life	Recommended replacement time	Recommended inspection period
AC Capacitor	≥7 years	5 ~ 6 years	6 months
Electrolytic capacitor	≥7 years	5 ~ 6 years	1 year
Fan	≥7 years	5 ~ 6 years	1 year
Air filter	1 ~ 3 years	1 ~ 2 years	2 months
VRLA battery (5-year life)	5 years	3 ~ 4 years	6 months
VRLA battery (10-year life)	10 years	6 ~ 8 years	6 months

10.2.6 Fuse Replacement

When replacing the fuses, use fuses in the same model as the original ones. Avoid being misled by the parameter silkscreens on the fuse boxes. The AC fuses and DC fuses in the system are not interchangeable.

10.2.7 Replacement Procedures Of Air Filter

As shown in Figure 10-1, the UPS provides four air filters on the back of the front door, each fixed by a fixing bar on both sides. The air filter replacement procedures are as follows:

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

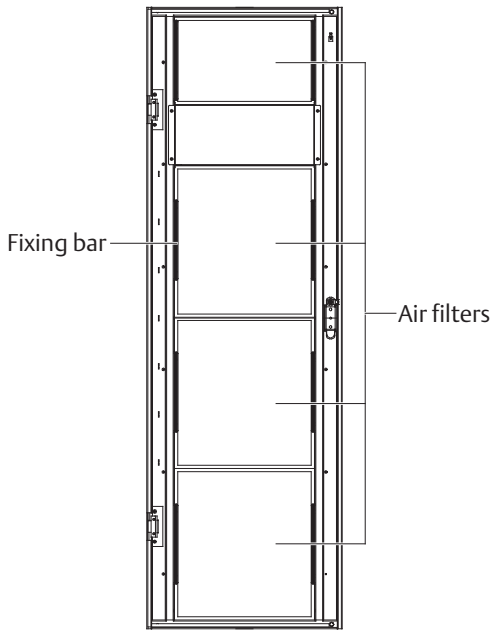


Figure 10-1 Replacing air filter

10.3 The 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 UPS Battery Maintenance, refer to *6.11 Battery Maintenance*.

10.4 Service Procedures Of Power Module, Bypass Module And Output Distribution Module

10.4.1 Notes

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

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

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

4.The bypass module is hotpluggable; it can be removed/replaced without shutdown 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.

10.4.2 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.

10.4.3 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 button 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 UPS output switch and input switch.

4. Press the EPO switch, 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, 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 (at least 10s after another) into the cabinet, and tighten the screws on both sides.

7. Close the UPS output switch and input switch 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 switch, press and hold the INVERTER ON button on the operator control and display panel for two seconds to manually turn on the inverters, and the UPS transfers to normal mode.

10.4.4 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.

10.4.5 Service Procedures Of Output Distribution Module

The service procedures of the four types of output distribution module are the same, as follows:

1. Open all output distribution switches of the output distribution module.

2. Disconnect all cables from the output terminals of this output distribution module.

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

4. After servicing the module, verify that all output distribution switches of this module are open.

5. Insert the module into the cabinet, and tighten the screws on both sides.

6. Connect the cables back to the output terminals of this module.

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 used in operator access areas	EN50091-1-1/IEC62040-1-1/AS 62040-1-1
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
Noise within 1m (in the front)	dB	56	58	60
Altitude	m	≤1000, derate power by 1% per 100m between 1000m and 2000m		
Relative humidity	%RH	0 ~ 95, 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	-20 ~ +70		
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	Rated power (kVA)				
		30	60	90	120	120 (with redundant power module)
Dimensions (W × D × H)	mm	600 ×1100×2000				
Weight (excluding battery)	kg	230	264	298	332	366
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 ~ 120
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 ~ 120
Input current	A rated[3] (maximum[4])	60 ~ 240
Total current harmonic distortion (THD)	%	≤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 400V, battery fully charged.
4. IEC62040-3/EN50091-3: at rated load and input voltage 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	120 (with redundant power module)
Battery bus voltage	Vdc	Nominal: 432V (VRLA float charge is 540V), range: 300V ~ 576V				
Number of lead-acid cells	Nominal	36 = [a cell (12V)]				
	Maximum	40 = [a cell (12V)]				
	Minimum	30 = [a cell (12V)]				
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	120 (with redundant power module)
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
max current (adjustable)[2]	A	11	22	33	44	55

Note

1. At low input voltage the UPS recharge capability increases with load decrease (up to the maximum capacity indicated).
2. Max. 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 ~ 120
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 harmonic voltage 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. Factory set to 400V. 380 or 415V can be selected by commissioning engineer through software.
2. Factory set to 50Hz. 60 Hz can be selected by commissioning engineer through software. Frequency converter operation is also 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 ~ 120
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	225, 380V 215, 400V 205, 415V
Overload	%	110% long term 170% for 10min 1000% for 100ms
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[2]	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	%	±2.5, ±5, ±10 or ±20, default: ±10
Synchronisation window	Hz	Rated frequency: ±2Hz (selectable from ±0.5Hz to ±3Hz)

Note

1. Factory set to 400V. 380V or 415V can be selected by commissioning engineer.

2. Factory set to 50Hz. 60Hz can be selected by commissioning engineer. Bypass condition ignored when UPS set as frequency converter.

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	120 (with redundant power module)
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
ECO mode	kW	0.6	1.2	1.8	2.4	3
No load	kW	0.6	1.2	1.8	2.4	3
Maximum forced air cooling (front intake, back exhaust)	L/s	96	192	288	384	480

Note

Input and output voltage 400Vac, battery fully charged, full rated linear load.

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 150, APM 150P, APM150S Integrated UPS						

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