Liebert APM UPS

Modular & Scalable Digital UPS with integrated Power Distribution Unit

User & Installation 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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Safety Precautions

This manual contains information concerning the installation and operation of this Liebert APM modular UPS

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.

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

This is a Class A 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 votlage safety) and 89/336 (EMC), 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 use in operator access area
- IEC62040-2 — EMC, Class C3
- IEC62040-3 — Performance requirements and test methods

Please refer to Chapter 6 for more details

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 connecting the input supply (including the AC mains and battery). This equipment must be earthed in accordance with local electrical codes.

Earth leakage current exceeds 3.5mA and is less than 1000mA.

Transient and steady state earth leakage currents, which may occur when the equipment is started, should be taken into account when selecting instantaneous residual current circuit breaker (RCCB) or residual current detector (RCD) devices.

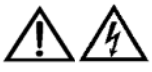
RCCBs must be selected insensitive to DC unidirectional pulses (Class A) and transient current pulses.

Note also 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 operating 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. Special care should be taken 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.

Contents

Chapter 1 Installation

This chapter introduces the installation of Liebert APM modular UPS, including preliminary checks, location, positioning, cable connection and installation drawings.

1.1 Introduction

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

This chapter is a guide to general procedures and practices that should be observed by the installing 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 equipment before being authorised to do so by the commissioning engineer.
2. The UPS shall be installed by a qualified engineer in accordance with the information contained in this manual. All the equipment not referred to in this manual is shipped with details of its own mechanical and electrical installation information.


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

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


Warning: battery hazards

Special care should be taken when working with the batteries. When connected together, the battery terminal voltage will exceed 400Vdc and is potentially lethal.

- Eye protection should be worn 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.

1.2 Preliminary Checks

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

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

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

1.3 Location

1.3.1 Power Distribution Room

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

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

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

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

1.3.2 Battery Room

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.

When using external batteries, the battery protection device (e.g., fuses or circuit breakers) must be mounted as close as possible to the batteries and connecting cables should be as short as possible.

1.3.3 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 user manuals. In charging process, temporarily connect the UPS to mains and activate it for the time required for recharging the batteries.

1.4 Positioning

Jacking feet are provided at the bottom of the UPS cabinet to prevent the UPS from moving once it has been placed to its final position. For optimal design life, the place chosen must offer:

- easy connection
- enough space to easily work on the UPS
- sufficient air exchange to dispel heat produced by UPS
- protection against atmospheric agents
- protection against excessive humidity and high heat sources
- protection against dust
- compliance with the current fire prevention requirements
- For VRLA (Valve Regulated Lead Acid) batteries the operating environment temperature is kept between 20°C and 25°C. VRLA batteries are at maximum efficiency in this temperature range (see Table 6-2)

1.4.1 UPS Composition

The UPS structure is shown in Figure 1-1. The UPS configuration is provided in Table 1-1.

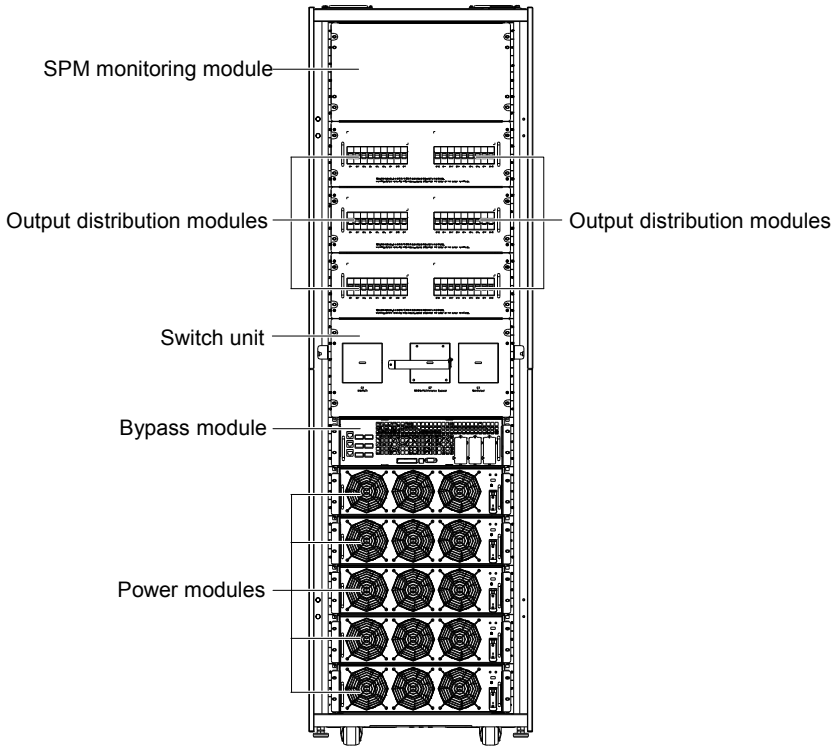


Figure 1-1 Libert APM Internal General Arrangement Drawing (Front View)

Table 1-1 UPS configuration list

Component	Quantity (pcs)	Remark
SPM Brach Circuit monitoring module	1	Optional, installed at site
Output Power distribution module	0 ~ 3	Optional, installed at site
Switch unit	1	
Static Bypass module	1	
UPS Power module	1 ~ 5	Requisite, installed at site

1.4.2 Moving The Cabinet

Warning
1. Ensure that any equipment used to move the UPS cabinet has sufficient lifting capacity. 2. The UPS is fitted with casters. Take extra caution when unbolting the UPS from its shipping pallet. Ensure that adequate personnel and lifting aids are available when removing the shipping pallet. 3. 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.

Ensure that the UPS weight is within the designated surface weight loading of any handling equipment.

The cabinet can be moved by means of a forklift or similar equipment. It can also be moved in short distances only by using its casters.

1.4.3 Clearances

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

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 doors fully opened for accessing cable termination. Refer to Figure 1-15 for the positioning of the cabinet. It is recommended to have at least 150mm of rear clearance for ventilation purposes.

1.4.4 Front Access And Rear Access

The component layout of the UPS supports front access and minimal rear access in UPS service, diagnosis and repair, thus reducing the space requirement for side access.

1.4.5 Final Positioning

Warning
Casters are strong enough for movement across even surfaces only. Caster failure could occur in movement across uneven surfaces.

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

1.4.6 Installing Power Modules And Output Distribution Modules (Optional)

The installation positions of the power modules and output distribution modules are shown in Figure 1-1. Please install the power modules and output distribution modules from bottom to top, so as to ensure cabinet's stability.

Installation procedures of power modules

Refer to Figure 1-2, and use the following procedures to install the power module:

1. Use the DIP switch on the front panel of each Power 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 1-2.

Table 1-2 DIP switch setting method

Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Module address
1	0	0	0	0	1
0	1	0	0	0	2
1	1	0	0	0	3
0	0	1	0	0	4
1	0	1	0	0	5

2. Place the ready switch on the front panel of the module to the up position (i.e., in unready state).
3. Insert the module in the installation position, and push it into the cabinet.
4. Secure the module to 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 (i.e., in ready state).

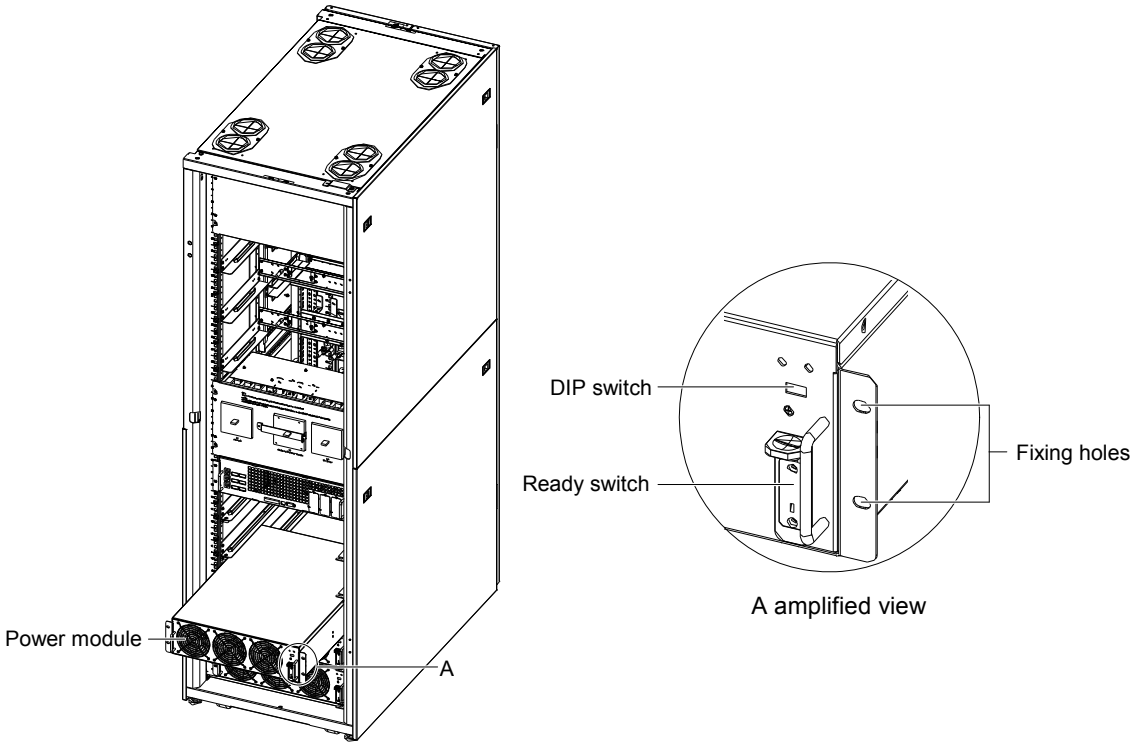


Figure 1-2 Installing power module

Installation procedures of Optional output distribution modules

Use the following procedures of install the output distribution module:

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

1.4.7 Cable Entry

The Rack cabinet uses top cable entry or bottom cable entry, with cable entry punch-holes provided both at the bottom and on the top of the cabinet..

1.5 Protective Devices

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.

1.5.1 Rectifier and Bypass Input

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

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

Earth Leakage

Any residual current detector (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 0.3 and 1A

Residual current circuit breaker (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 1-3.

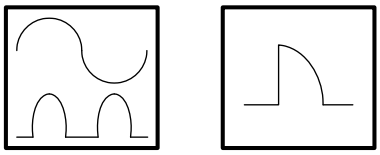


Figure 1-3 RCCB symbols

1.5.2 Battery

The battery system must be fitted with a battery circuit breaker (BCB) or Switch Fuse Unit for over-current protection and isolating battery string during battery maintenance.

1.5.3 UPS Output

Liebert APM is fitted with an output isolator for disconnecting the UPS from the load. An optional internal output distribution unit is available for load distribution. In the eventuality that an external distribution panel is used for load distribution, the selection of protective devices must provide discrimination with those that are used at the input to the UPS

1.6 Power Cables

The cable design must comply with the instructions provided in this section, follow local wiring practices, take the environmental conditions into consideration, and refer to IEC60950-1 Table 3B.

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.

1.6.1 Maximum Steady State AC And DC Currents

Table 1-3 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			Battery discharge current at end of discharge (EOD)
	380V	400V	415V	380V	400V	415V	
150	280	265	255	225	215	205	525
120	224	212	204	180	172	164	420
90	168	159	153	135	129	123	315
60	112	106	102	90	86	82	210
30	56	53	51	45	43	41	105

Note:

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

1. Protective earth cable: Follow the most direct route possible to connect the earth cable to the cabinet. The earth cable shall be sized in accordance with the AC supply fault rating, cable lengths and type of protection. Typical cross sectional area (CSA) is 80mm^2 (150kVA) according to AS / IEC60950-1.
2. When sizing battery cables, a maximum volt drop of 4Vdc is permissible at the current ratings given in Table 1-3. Do not form coils, so as to minimize the formation of electromagnetic interference.
3. For terminal location, refer to Figure 1-16 and Figure 1-17.

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

1.6.2 Distance From Floor To Connection Point On The Equipment

Table 1-4 Distance from floor to connection point on the equipmen

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

1.6.3 Cable Connection

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 equipment has been finally positioned and secured, refer to Figure 1.8 Installation Drawing, and connect the power cables as described in the following procedures.

1. Verify that the UPS equipment is isolated from its external power source and all the UPS power isolators are open. Check that these supplies are electrically isolated and post any necessary warning signs to prevent their inadvertent operation.

2. Open the rear door of the UPS cabinet and remove the protective cover to gain access to the input terminals, battery terminals and earth terminals.

3. Connect the input earth cable to the input earth terminal.

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

4. The UPS uses common bypass and rectifier input. 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 battery circuit breaker (BCB). Ensure correct battery cable polarities.

Warning–hazardous battery terminal voltage 400Vdc
Ensure correct polarity of string end connections to the BCB and from the BCB to the UPS terminals, i.e., positive to positive and negative to negative, but disconnect one or more battery cell links in each tier. Do not reconnect these links or close the BCB without permission of the commissioning engineer.

6. Connection of the load cables.

- In case output distribution modules are installed, please connect the output cables between the output terminals of the output distribution modules and the loads, and connect the output earth cables to the output earth bars

at the rear of the UPS cabinet. Tighten the output neutral bar connections to 5Nm (M6 bolt). Ensure correct phase rotation.

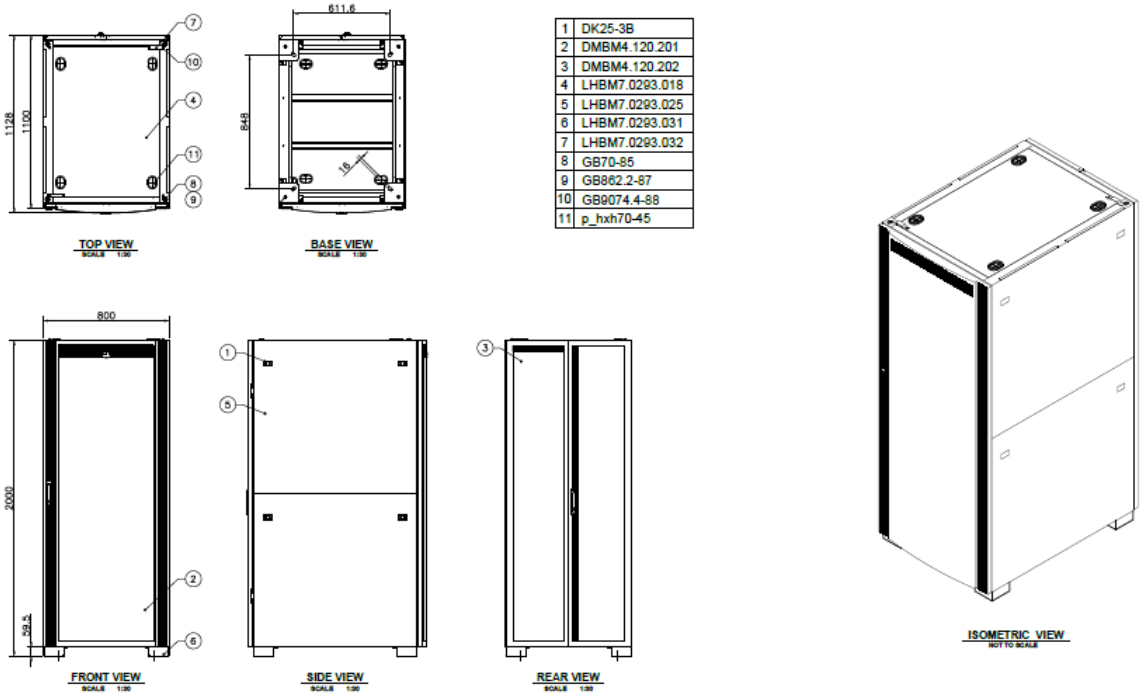
- In case output distribution modules are not installed, please connect the output cables between the output terminals in the front of the UPS cabinet and the loads, and connect the output earth cable to the output earth terminal at the rear of the UPS cabinet.

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.

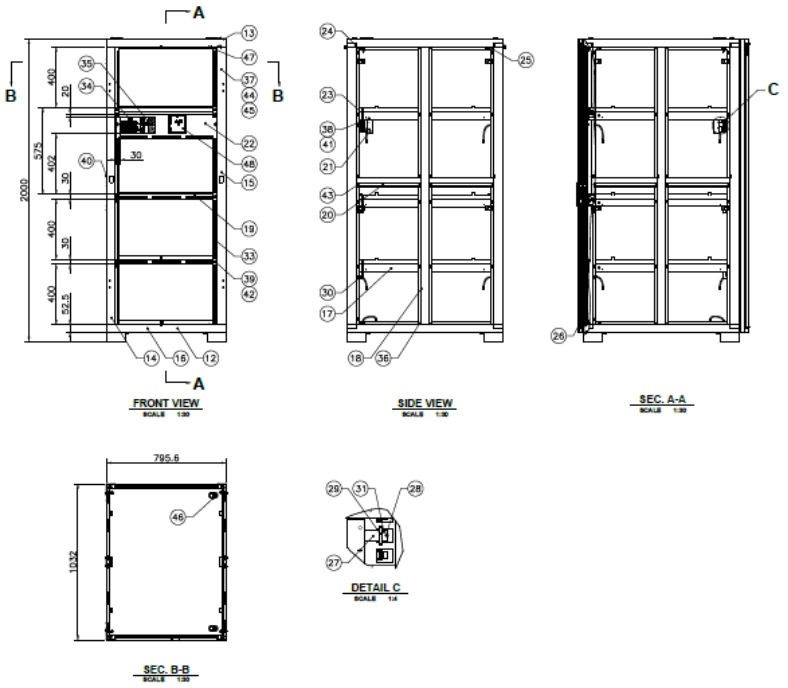
1.6.4 Optional Matching Battery Cabinet

The matching battery cabinet structure is shown below.



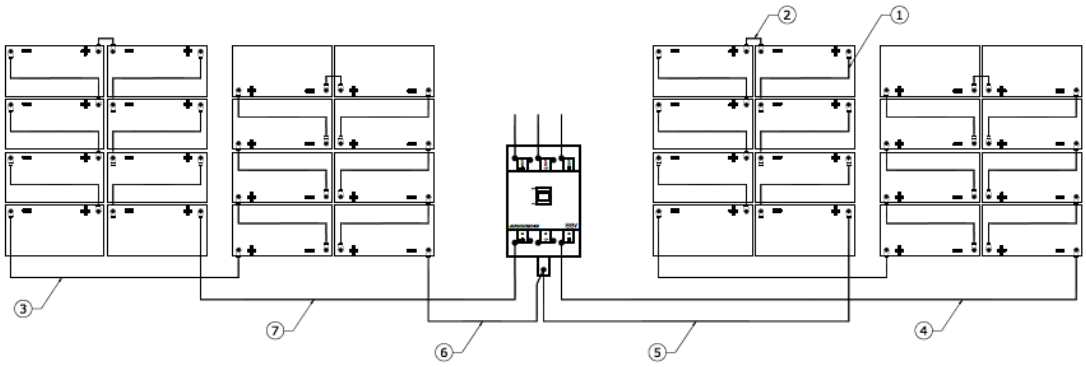
1	DK25-3B
2	DMBM4.120.201
3	DMBM4.120.202
4	LHBM7.0293.018
5	LHBM7.0293.025
6	LHBM7.0293.031
7	LHBM7.0293.032
8	GB70-85
9	GB862.2-87
10	GB9074.4-88
11	p_hxh70-45

Figure 1-4 Battery Cabinet Outline Drawing

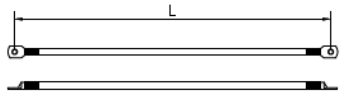


12	LHBM7.0293.001	31	GB9074_4_88
13	LHBM7.0293.005	32	DKBA0.480.0024
14	LHBM7.0293.008	33	DKBA0.480.0192
15	LHBM7.0293.012	34	DMBM8.817.523
16	LHBM7.0293.014	35	DMBM8.817.736
17	LHBM7.0293.020	36	GB12618-90
18	LHBM7.0293.021	37	GB6170
19	LHBM7.0293.022	38	GB70-85
20	LHBM7.0293.028	39	GB70-85
21	LHBM7.0293.029	40	GB845-85
22	LHBM7.0293.030	41	GB862.2-87
23	LHBM7.0293.033	42	GB862.2-87
24	LHBM7.0293.034	43	GB9074.4-88
25	LHBM7.0293.035	44	GB93
26	LHBM7.0293.036	45	GB97.1
27	LHBM7.0293.037	46	KG-010
28	LHBM7.0293.038	47	Q/DKBA8.817.1004
29	LHBM7.0293.039	48	S3N250R250/3P
30	LHBM7.0293.040		

Figure 1-5 Battery Cabinet Details



ITEM / DESC	CABLE TYPE		QTY	MATCHING CONNECTORS	
L1	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 420mm	24 PCS	OT50-Ø8	2 END
L2	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 250mm	4 PCS	OT50-Ø8	2 END
L3	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 800mm	2 PCS	OT50-Ø8	2 END
L4	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 1400mm	1 PC	OT50-Ø8	2 END
L5	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 1000mm	1 PC	OT50-Ø8	2 END
L6	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 400mm	1 PC	OT50-Ø8	2 END
L7	CABLE - 450V/750V - RV50sq mm/BLACK - ROUND	L = 800mm	1 PC	OT50-Ø8	2 END



NOTE
Battery connection is based on 6FM134-X battery for other than 6FM134-X adjust accordingly

BATTERY MODEL	MAX. NO OF BLOCKS
6FM17-X	120
6FM24-X	60
6FM33-X	72
6FM40-X/45-X	60
6FM55SG-X	48
6FM60-X/75-X	40
6FM65-X/80-X	32
6FM90T-X	40
6FM100-X	32
6FM120-X	24
6FM134-X	32
6FM150-X	20
6FM175-X	16
6FM200-X	12
6FM230-X	12

Figure 1-6 Battery Connection

1.7 Control And Communications

As shown in Figure 1-7, the bypass module provides dry contact ports (J5 ~ J10) and communication ports (RS232 port and SNMP card ports) on the front panel.

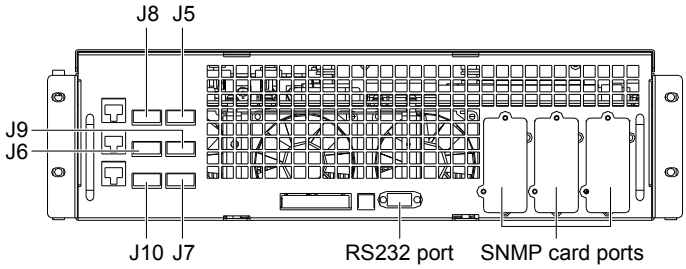


Figure 1-7 Dry contact ports and communication ports

The UPS accepts external signalling from voltage-free (dry) contacts connected to push-in input dry contact terminal. Subject to prior software programming, the signalling is accepted by the UPS when relevant terminals and the +12V terminals are shorted. All control cables must be routed separately from the power cables, and must be double insulated. A typical 0.5mm^2 to 1.5mm^2 CSA for maximum runs between 25m and 50m, respectively.

1.7.1 Input Dry Contact Port

The input dry contact ports J7 and J8 provide environmental, battery ground fault and generator contacts. The ports are shown in Figure 1-8 and described in Table 1-5.

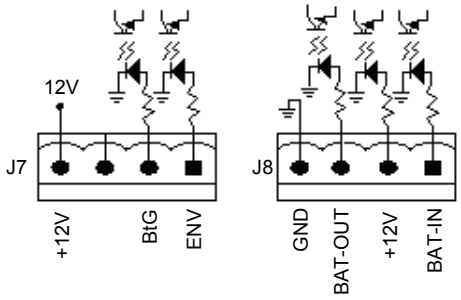


Figure 1-8 Input dry contact ports J7 and J8

Table 1-5 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]	On generater (normally open)
J7.4	+12V	+12V power
J8.2	+12V	+12V power
J8.3	BAT_OUT	Battery temperature detection
J8.4	GND	Power GND

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

1.7.2 BCB Port

J6 is the battery circuit breaker (BCB) port. The port is shown in Figure 1-6 and described in Table 1-9.

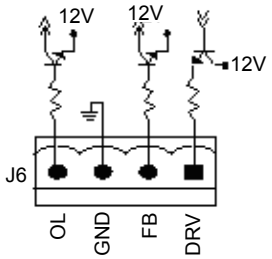


Figure 1-9 BCB port

Table 1-6 BCB port description

Position	Name	Description
J6.1	DRV	BCB driver signal – (reserved)
J6.2	FB	BCB contact state – (reserved)
J6.3	GND	Power GND
J6.4	OL	BCB on line – 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 1-10.

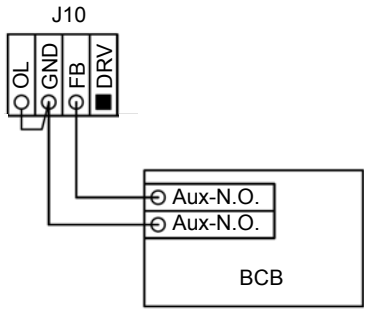


Figure 1-10 Connection between BCB port and BCB

1.7.3 Maintenance Bypass Switch And Output Switch State Port

J9 is the maintenance bypass switch and output switch state port. The port is shown in Figure 1-8 and described in Table 1-7.

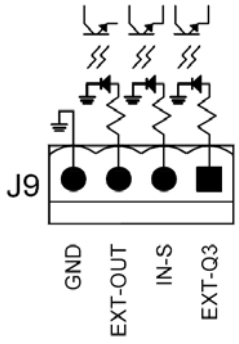


Figure 1-11 Maintenance bypass switch and output switch state port

Table 1-7 Description of maintenance bypass switch and output switch state port

Position	Name	Description
J9.2	IN_S	Maintenance bypass switch state
J9.3	EXT_OUT	Output switch state
J9.4	GND	Power GND

1.7.4 Output Dry Contact Port

J5 is the output dry contact port, providing two relay output dry contact signals. The port is shown in Figure 1-12 and described in Table 1-8.

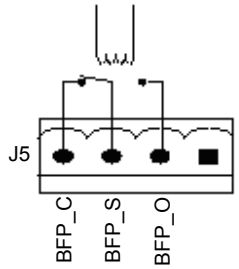


Figure 1-12 Output dry contact port

Table 1-8 Description of output dry contact port

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

1.7.5 Remote EPO Input Port

The UPS has an Emergency Power Off (EPO) function that can be operated by pressing a button 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 1-13 and described in Table 1-9.

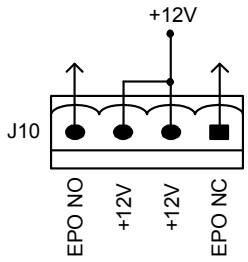


Figure 1-13 Remote EPO input port

Table 1-9 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 breaker when EPO is activated.
2. Pins 1 and 2 of J10 are shorted as default setting of UPS.

1.7.6 Other Communication Interface

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

Liebert APM UPS has facility of internally fitted SNMP and Modbus card options.

1.8 Installation Drawing

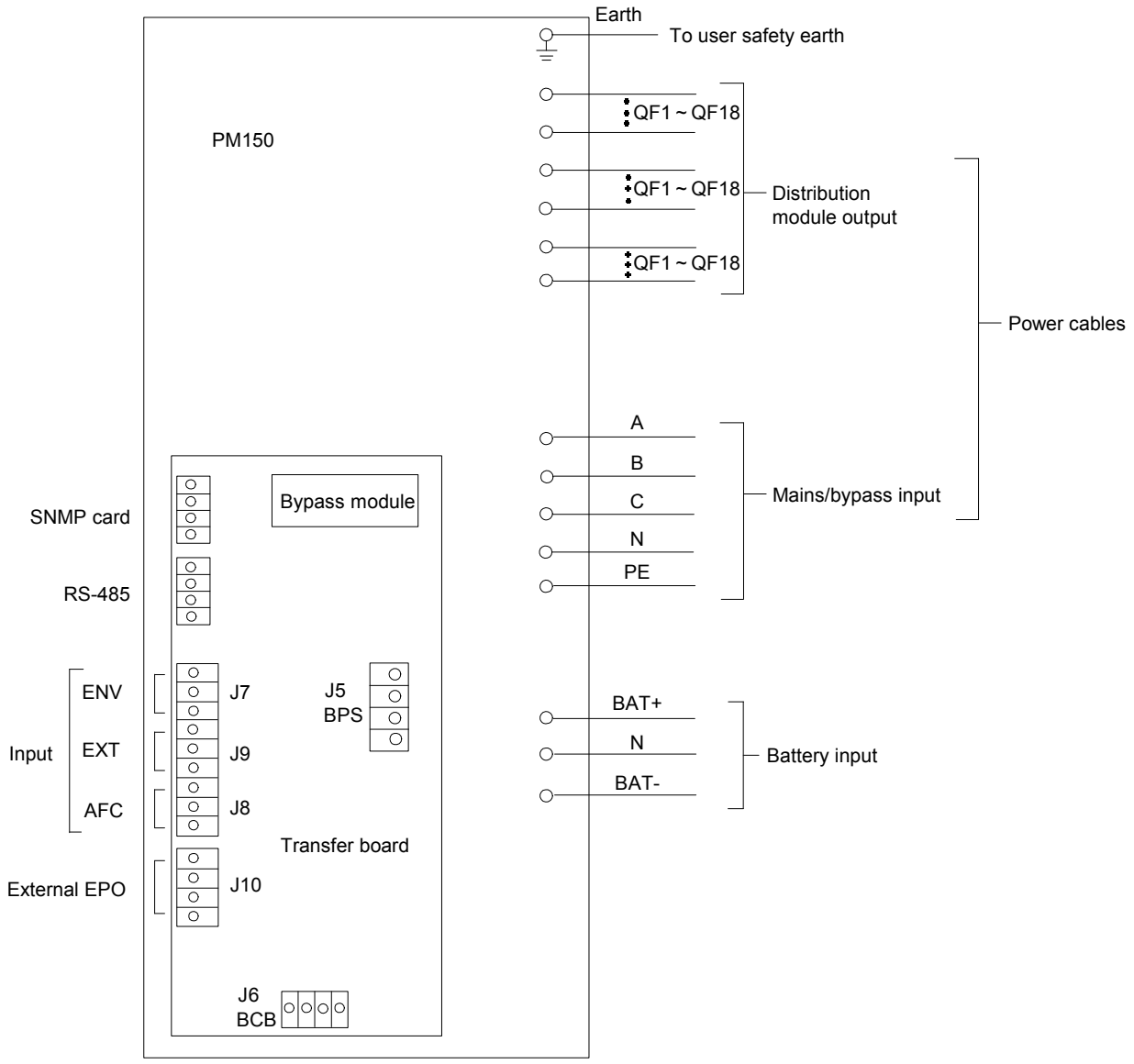


Figure 1-14 UPS electrical connection diagram

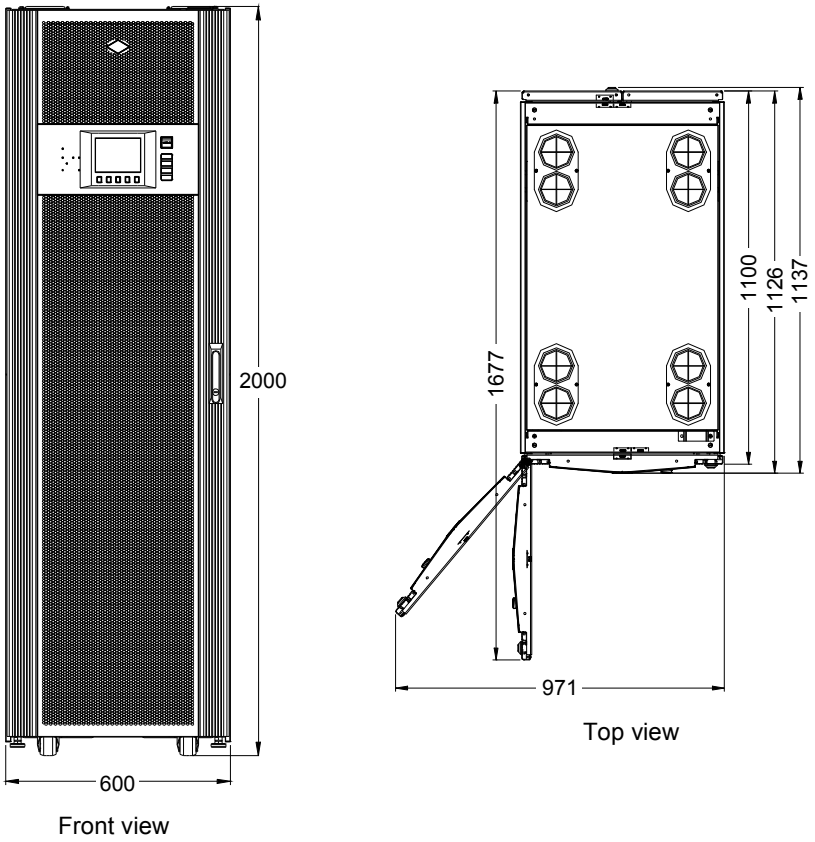


Figure 1-15 UPS installation size (unit: mm)

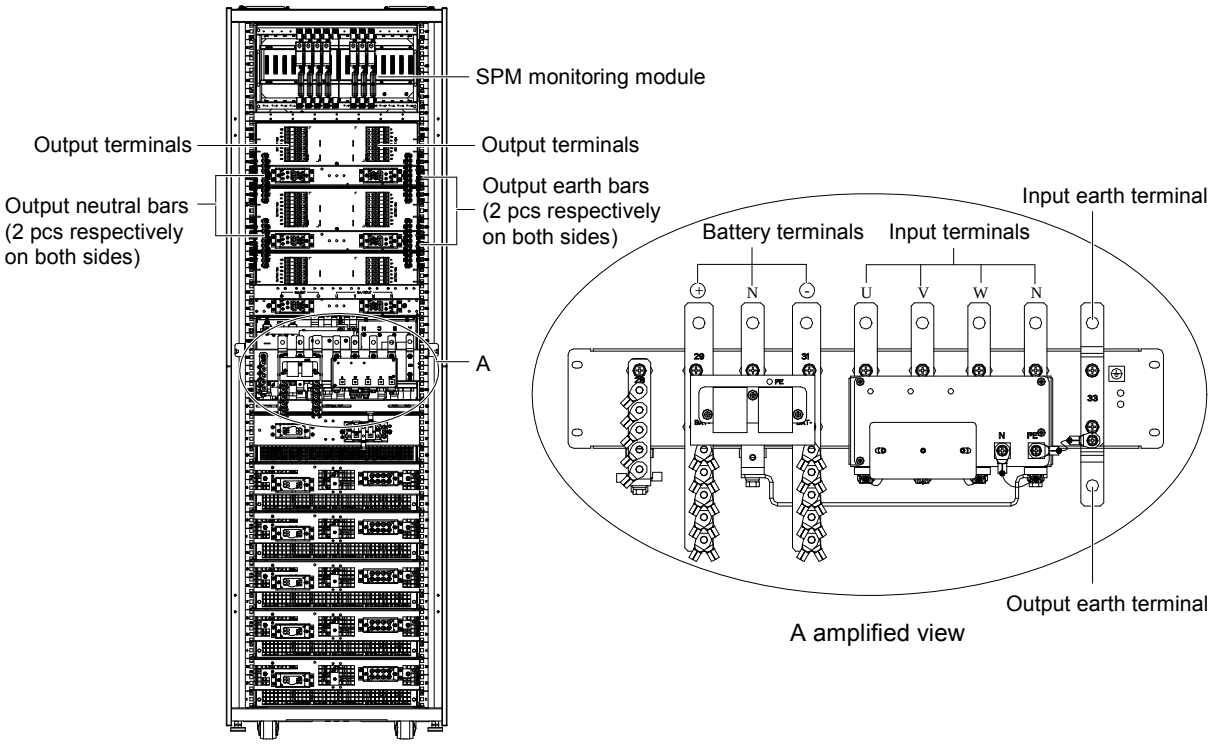


Figure 1-16 Rear view of UPS (door open) with output distribution modules

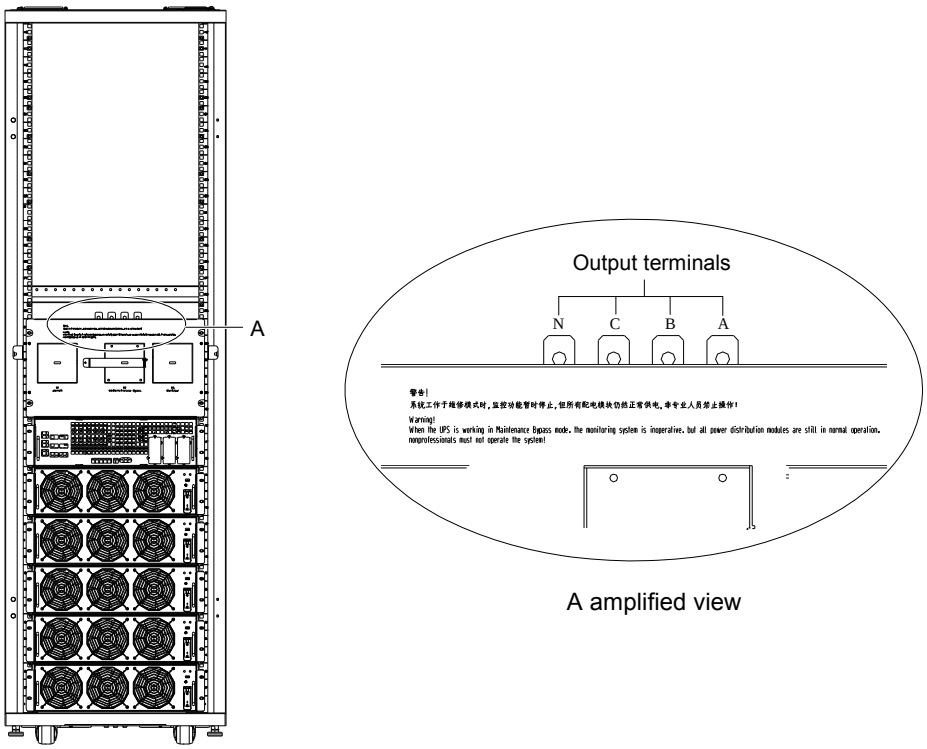


Figure 1-17 Front view of UPS (door open) without output distribution modules

Chapter 2 Operation

This chapter introduces the basic knowledge of UPS operation, including the operating theory, operation mode, battery management and battery protection of the UPS.

Warning: hazardous mains and battery voltage present behind covers
1. No user-serviceable parts are located behind covers that require a tool for their removal. 2. Only qualified service personnel are authorised to remove such covers.

2.1 Brief Introduction

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 in high frequency, double-conversion pulse width modulation (PWM) technology and fully digital control (DSP) technology to enhance its reliability and increase the ease of use.

2.1.1 Operating Theory

As shown in Figure 2-1, the AC mains source is converted by the rectifiers into DC power. The inverters convert that DC power from the rectifiers or the DC power from the batteries into AC power, and provide the AC power for the load through the output distribution modules. The batteries power the load through the inverters in the event of a power failure. When the inverters are faulty or turned off, the mains source can also power the load through the static bypass.

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

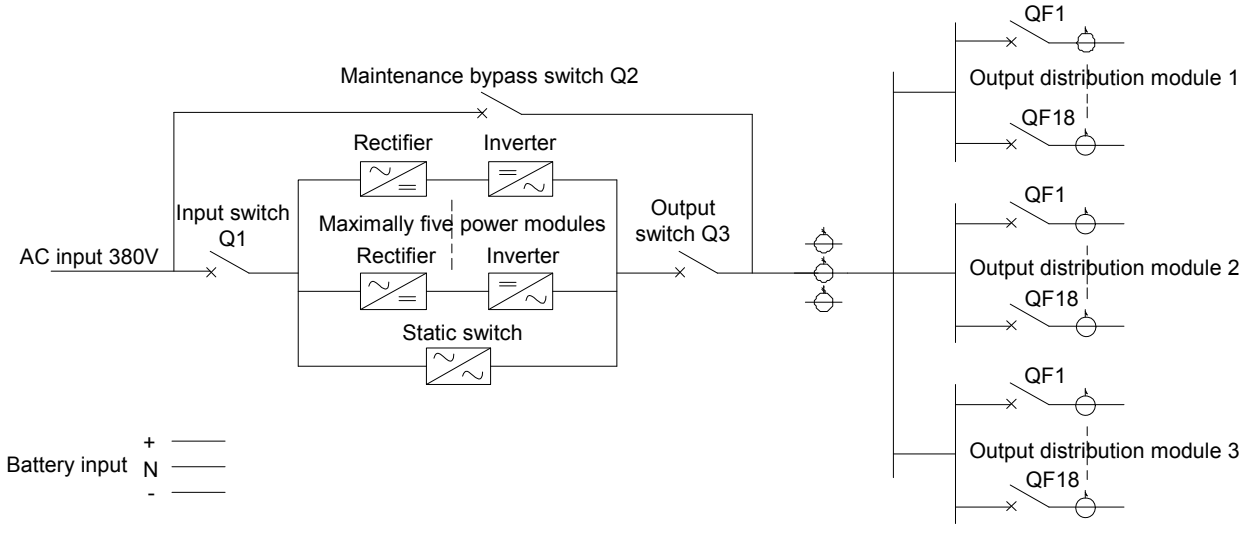


Figure 2-1 System schematic diagram

2.1.2 Static Switch

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

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

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

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

2.2 Operation Mode

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

- Normal mode
- Battery mode
- Auto-restart mode
- Bypass mode
- Maintenance bypass mode (manual bypass)
- ECO mode

2.2.1 Normal Mode

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.

2.2.2 Battery Mode

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.

2.2.3 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.

2.2.4 Bypass Mode

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).

2.2.5 Maintenance Bypass Mode

If UPS maintenance or repaired is needed, you may use the manual maintenance bypass switch to transfer to the load to the maintenance bypass, with no interruption in power to the load.

 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 surege protective device (SPD) shows the UPS has mains input, but the output terminals corresponding to closed output distribution switches and the neutral bars are energized.

2.2.6 ECO Mode

IF economical (ECO) mode is selected, the double-conversion UPS operation is inhibited at most times for the purpose of saving energy. In this mode of operation, the bypass is the preferred source, and only when the voltage and frequency of the bypass supply are outside specifications will the load be transferred to the inverters. This transfer takes place with an interruption of less than 3/4 of an electrical cycle, for example, less than 15ms (50Hz) or less than 12.5ms (60Hz).

2.3 Battery Management

2.3.1 Normal Function

The following functions are configured by the commissioning engineer through dedicated configuration software.

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 valve regulated lead acid (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 and 2.3V.

4. Float charge temperature compensation (optional)

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

5. EOD protection

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

6. Battery low warning time

The setting range is between 3 minutes and 60 minutes. The default setting is 5 minutes.

2.3.2 Advanced Function——Battery Self-Test And Self-Service

At periodic intervals 20% of the rated capacity of the battery will be discharged automatically. The minimum amount of load must exceed 20% of the nominal rating of the UPS. If the load is less than 20%, auto-discharge cannot be executed. The periodic interval can be set from 30 days to 360 days. The periodic testing can also be inhibited.

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

Trigger: Manually through the Battery maintenance test command on LCD, or automatically.

Battery self-test interval: 30 days ~ 360 days (default setting: 60 days).

2.4 Battery Protection

The following functions are configured by the commissioning engineer through dedicated configuration software.

Battery low warning

The battery low warning occurs before the EOD. After this warning, the battery should have the capacity for 3 remaining minutes discharging at full load. The time is settable from 3 minutes to 60 minutes.

Battery EOD protection

If the battery voltage is lower than the EOD voltage, the battery converter will shut down. The EOD voltage is settable from 1.6V/cell to 1.75V/cell (VRLA) or 0.9V/cell to 1.1V/cell (NiCd).

Battery circuit breaker (BCB) open warning

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 3 Operating Procedures

This chapter provides detailed operating procedures of the UPS.

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

Warning: hazardous mains and battery voltage present behind covers
1. No user-serviceable parts are located behind covers that require a tool for their removal. 2. Only qualified service personnel are authorised to remove such covers.

3.1 Power Switches

As shown in Figure 3-1, opening the UPS front door reveals the power switches, including the input switch, output switch, maintenance bypass switch (locked) and output distribution switches.

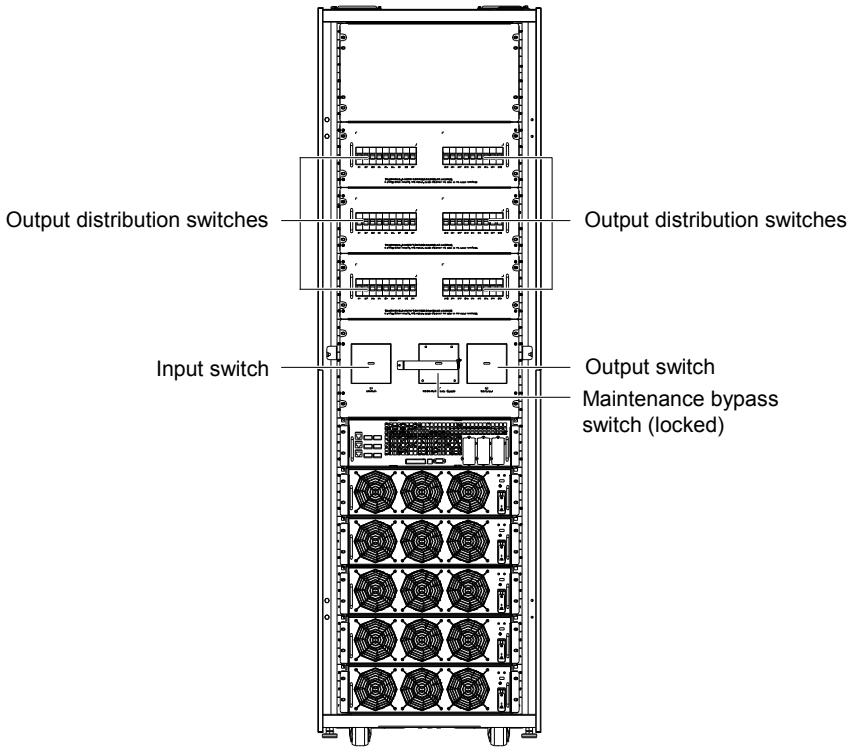


Figure 3-1 Positions of power switches

3.2 UPS Start-Up Procedures

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

3.2.1 Start-Up Procedures (Into Normal Mode)

Procedures are as follows for starting the UPS from a fully powered-down condition:

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.

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 3-1.

Table 3-1 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 inverter. Otherwise, the inverter will not start, and the UPS will generate Bypass STS fail alarm.

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

The UPS begins to operate in normal mode, and the states of the indicators are as shown in Table 3-1.

Table 3-2 Indicator state

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

3.2.2 Start-Up Procedures (Into Battery Mode)

1. Verify that the battery is properly connected.

2. Press the battery start button (see Figure 3-2) 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.

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

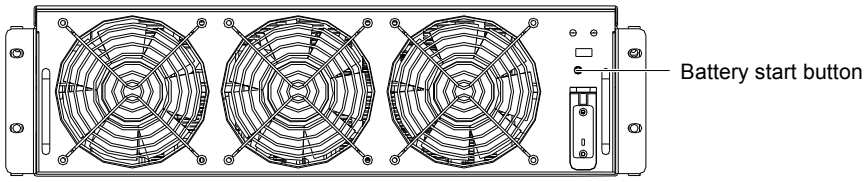


Figure 3-2 Location of battery start button

3.3 Procedures Of Transfer Between Operation Modes

3.3.1 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.

3.3.2 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.

3.3.3 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.

3.3.4 Transfer From Normal Mode To Maintenance Bypass Mode

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

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

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

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

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

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

Warning
If a module needs repair, wait about 10 minutes for the internal DC bus capacitors to discharge before removing the faulty module.

3. Open the input switch and output switch.

Caution
1. The load is not protected from normal supply aberrations when the UPS is operating in maintenance bypass 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 surege protective device (SPD) shows the UPS has mains input, but the output terminals corresponding to closed output distribution switches and the neutral bars are energized.

3.4 Powering Down The UPS

To power down the UPS completely, follow the procedures in *3.3.4 Transfer From Normal Mode To Maintenance Bypass Mode* to transfer the UPS from normal mode to maintenance bypass mode.

To completely isolate the UPS from the AC supplies, open the external power input isolator.

3.5 Emergency Shutdown Procedures

The Emergency Power Off (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.

3.6 UPS Reset Procedures

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

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

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

3.7 Selecting Display Language

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

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.

3.8 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.

3.9 Command Password

Password protection is used to limit the control functions accessible to the operator. The default password is ‘123456’. This password provides access to UPS and battery test functions.

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 UPS 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.

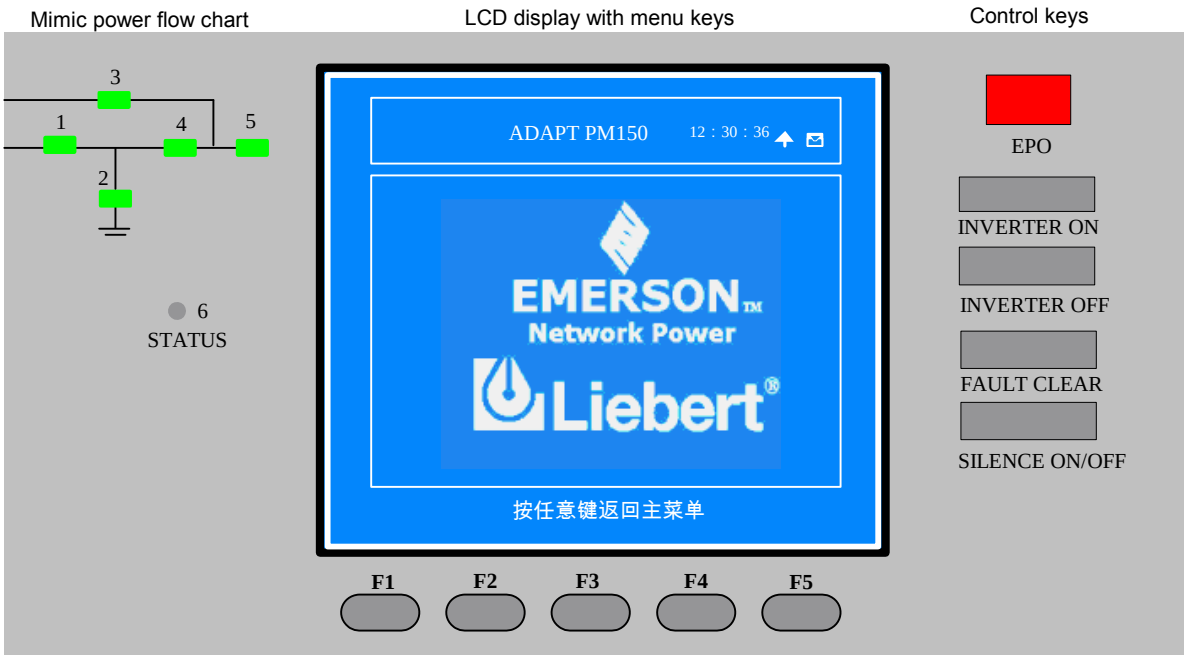


Figure 4-1 Operator control and display panel

Table 4-1 Description of operator control and display panel

Indicator No.	Function		Control key	Function
1	Rectifier indicator		EPO	Emergency power off (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 nad 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	Description
Emergency power off (EPO) switch	Disconnects power to the load, disables rectifier, inverter, static bypass and battery operation
Inverter start switch	Enables inverter operation
Inverter shutdown switch	Disables inverter operation
Fault reset switch	Restore UPS functions (subject to any fault being cleared)
Audible alarm silencing switch	When an alarm is active, pressing this key silences the audible alarm. Pressing this key again enables the buzzer again

4.1.4 LCD And Menu Keys

The operator control and display panel provides an LCD and five menu keys (F1, F2, F3, F4, 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 512 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.

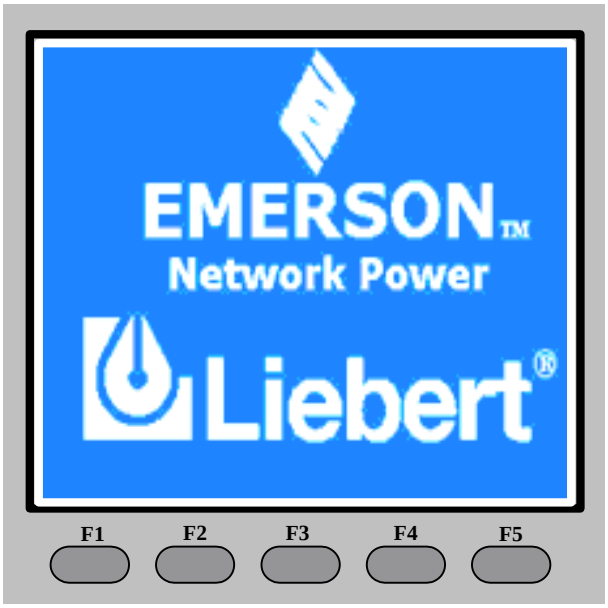


Figure 4-2 Start screen

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.

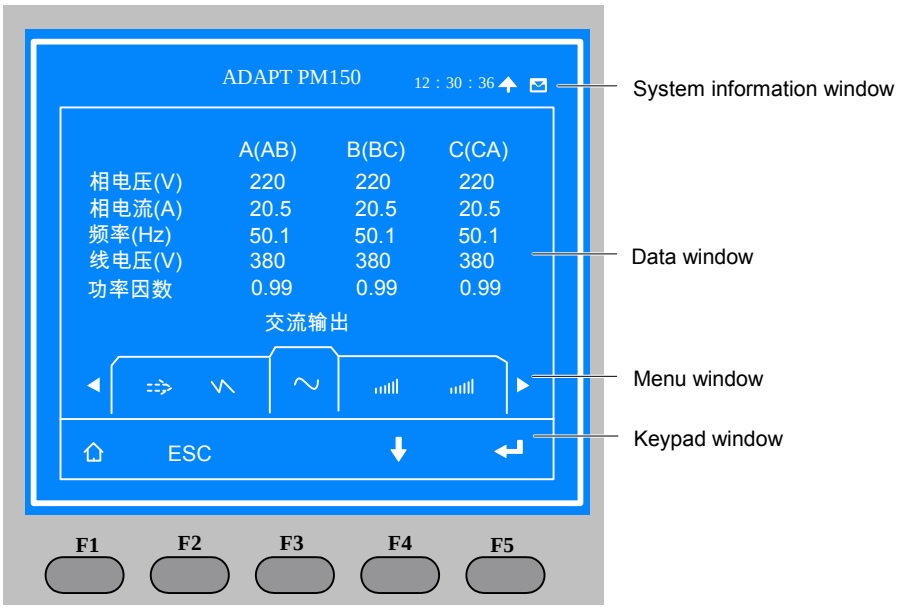


Figure 4-3 Primary screen

The function of menu keys F1 ~ F5 is shown by a self-explanatory icon as appropriate for the particular window. 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.

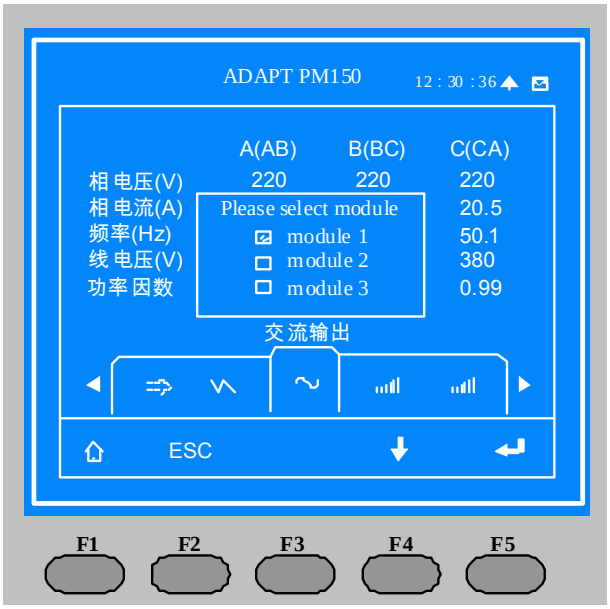


Figure 4-4 Selecting power module

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.

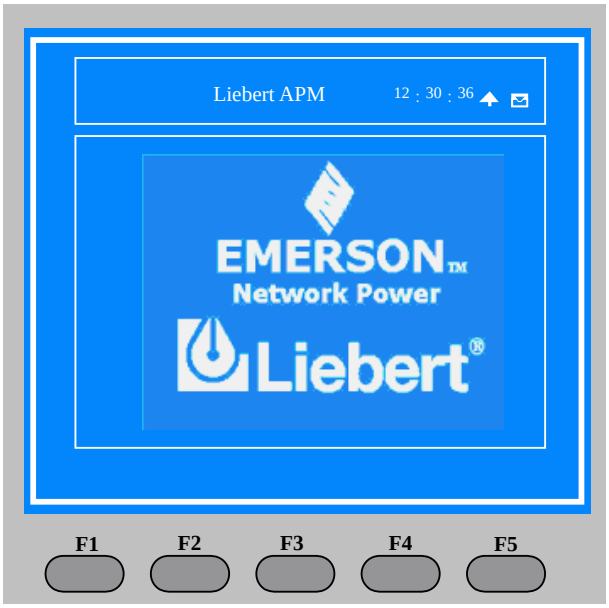


Figure 4-5 Default screen

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 discription of system information window

Item	Explanation
Liebert PM 150kVA	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 discription 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)	Pahse current
	Frequency (Hz)	Output frequency
	L-L voltage (V)	Line voltage

Menu	Item	Explanation
	Power factor	Power factor
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°C
	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
Settings	Display contrast	Adjusts the LCD contrast
	Date format set	Four 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 communicaiton. Not settable
	Comm3 baud rate	Sets the communication baud rate of the SNMP card ports
	Communication address	Applicable to RS485 communication
	Communication mode	Set the communcation mode
	Callback times	If the communcation mode of the SNMP card port is modem mode, this parameter sets the number of times of a number is redialed to send an alarm notificiaton
	Phone No.1	If the communcation mode of the SNMP card port is modem mode, this is the first phone number to be dialed (to send an alarm notification)
	Phone No.2	If the communcation mode of the SNMP card port is modem mode, this is the second phone number to be dialed (to send an alarm notification)
	Phone No.3	If the communcation mode of the SNMP card port is modem mode, this is the third phone number to be dialed (to send an alarm notification)
	Command password	The user can modify the command password

Menu	Item	Explanation
Command (initiate, stop battery, system test or freshening charge	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 function of menu keys F1 ~ F5 is shown by a self-explanatory icon as appropriate for the particular window.

4.4 Prompt Windows

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 dis-engergised
Turn on more UPS to carry current load	The number of inverters already turned on is insufficient to carry the exisitng 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 (default: 123456)
Battery Self Test aborted, conditions not met	Battery selt-test condition is not met. Please check whether the battery is in boost charge state and the load is more than 20%
Battery Refresh Charge aborted, conditions not met	This prompt appears when you select the Freshening charge command while the a battery freshening charge condition (such as no battery, charger failure) is not met

4.5 Alarm List

The following table 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 4-9.

Table 4-9 Alarm list

Alarm	Explanation
Inverter comm. fail	Internal communication failure between monitoring board and inverters
Rectifier comm. fail	Internal communication failure between monitoring board and rectifiers
Parallel comm. fail	Communication between different power modules failed. 1.Check if there are some power modules not powered. If so, power on these power modules and check if the alarm disappears. 2. Press the FAULT CLEAR key
Battery overtemp.	The battery temperature is over limit. Check the battery temperature and ventilation
Ambient overtemp.	The ambient temperature is over limit. Check the ventilation of the UPS room
Battery fault	The battery is aged (reserved)
Replace battery	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-voltage 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 frequency
Rectifier fault	Rectifiers detected faulty, rectifiers shut down, battery discharges
Rectifier overtemp.	The heatsink temperature is too high and results in rectifier stop. The UPS can recover automatically. Check the environment and ventilation
Charger fault	The voltage of the battery charger is too high
Control power 1 fail	The UPS is operating but the control power is abnormal or not available
Mains phase reversed	The AC input phase rotation is reversed
Rectifier overcurrent	The rectifiers are overloaded
Soft start fail	The rectifiers could not start due to low DC bus voltage
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 goes 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 a little larger through the configuration software according to the user's agreement

Alarm	Explanation
Inverter asynchronous	This alarm is triggered by an inverter software routine when the inverter and bypass waveforms are misaligned by more than six degrees in phase. The amplitude threshold is fixed for ±10% rating. This alarm resets automatically once the condition is no longer true. 1. First check if the alarm Bypass unable to trace or Bypass abnormal occurs. If so, solve it first. 2. Verify the waveform of the bypass voltage. If it is too distorted, ask the customer to verify and seek any possible measurements
Inverter fault	Inverter output voltage outside specifications. Load transfers to bypass
Inverter overtemp.	The temperature of the inverter heatsink is too high and reusults in inverter stop. This alarm is triggered by the signal from a temperature monitoring thermostat on the inverter bridge heatsink. The UPS will recover automatically after a five minute delay from the disappearance of the overtemperature signal. If the overtemperature condition is true, then check for: 1. high ambient temperature. 2. obstructed cooling airway. 3. any fan failure. 4. prolonged inverter overload
Fan fault	At least one of the cooling fans failed
Main STS fail	At least one of the static switches at the inverter side is open or shorted. This fault is locked until power off
Bypass STS fail	At least one of the static switches at the bypass side is open or shorted. This fault is locked until power off
Operation invalid	This record is registered following an incorrect operation
Output fuse fail	At least one of the inverter output fuses is blown. The inverters shut down, and the load transfers to bypass
Control power 2 fail	The UPS is operating but the redundant control power is abnormal or not available
Unit over load	The UPS is confirmed to be overload when the load arises above 105% nominal rating. The alarm automatically resets once the overload condition is removed. 1. Confirm that the alarm is true by checking the load percent indicated on the LCD to determine which phase is overloaded. 2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect uncessary load and ensure the safety
Byp. abnormal shutdown	Both bypass and inverter voltages are abnormal, and the load power is interrupted
Inverter over current	Overcurrent of inverter pulse width modulation module
Bypass phase reverse	The phase rotation of the bypass voltage is reverwed. 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, and rectify it if it is found to be in error
Load impact transfer	A transfer to bypass occurred due to a large step load. The UPS should recover automatically. Turn on connected equipment in sequential order to reduce the step loading of the inverters
Transfer time-out	The load remains on bypass power due to excessive number of transfers that occurred within the last hour. The UPS will recover automatically and will transfer the load back to inverter power within an hour
DC bus abnormal	The DC bus voltage is abnormal and results in inverter shutdown. The load transfers to bypass
Parallel board fault	Parallel board is faulty. This may result in UPS transfer to bypass
DC bus over voltage	Rectifiers, inverters and battery converter were shutdown because the DC bus voltage is too high. Check whether there is a fault at the rectifier side. If no, then check whether overload occurs. Restart the inverters after resetting the fault
Bypass over current	The bypass current is above 135% rating. The UPS just alarms and does nothing
Setting save error	Alarm history not saved (reserved)
Mains neutral lost	The neutral line of the AC input mains is not detected
Protocol version clash	Protocol version incompatibility between the monitoring board and DSP board
Battery ground fault	The battery ground fault dry contact alarms
Inv. turned ON manually	One used the INVERTER ON key on the operator control and display panel to turn on the inverters
Inv. turned OFF manually	One used the INVERTER OFF key on the operator control and display panel to turn off the inverters
EPO	EPO switch pressed or external EPO command received
Transfer confirm	Prompt to press the enter key to acknowledge an interrupted load transfer to bypass
Transfer cancel	Prompt to press the ESC key to avoid an interrupted load transfer to bypass
Fault reset	FAULT CLEAR key pressed

Alarm	Explanation
Alarm silence	SILENCE ON/OFF key pressed
Turn on fail	Inverters failed to turn on when the INVERTER ON key was pressed. This may be the result of an invalid operation (maintenance bypass on) or DC bus or rectifiers not ready
Alarm reset	FAULT CLEAR or SILENCE ON/OFF key pressed
Bypass mode	The UPS is in bypass mode
Normal mode	The UPS is in normal mode
Battery mode	The UPS is in battery mode
Check UPS output	UPS shutdown with no output power
Generator connected	Generated connection signal is received
BCB open	BCB status (open)
BCB closed	BCB status (closed)
Battery float charging	Battery status (float charge mode)
Battery 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)
Batt. maint. testing	The user initiated a maintenance test (20% capacity discharge)
UPS system testing	The user initiated a UPS self-test
Inverter in setting	Inverters starting up and synchronising
Rectifier in setting	Rectifiers starting up and synchronising
MBP-T cabinet Fans Fault	Maintenance bypass cabinet fan fault
Ext Input TX Overtemp	External input isolation transformer overtemperature
Ext Output TX Overtemp	External output isolation transformer overtemperature
Battery Room Alarm	Environment in battery room needs attention
Battery reverse	Connect the battery again and check the battery cable connection
No battery	Check the battery and the battery cable connection
Auto start	After the UPS shut down at EOD, the inverters automatically start upon mains restoration
REC FLASH UPDATE	Rectifier software is being updated
INV FLASH UPDATE	Inverter software is being updated
MONITOR FLASH UPDATE	Monitor software is being updated
Input contactor fault	Input contactor fault
Contactor P.S. 1 fault	Contactor power supply board 1 fault
Contactor P.S. 2 fault	Contactor power supply board 2 fault
DSP firmware error	The inverter software does not match the rectifier firmware
SPM Board Not Ready	The acquisition board is not properly connected. Seek technical assistance from the local customer service center of Emerson
SPM CRC Check Error	Data check error of acquisition arithmetic module. Seek technical assistance from the local customer service center of Emerson
SPM Branch Curr Over LL	Load too large, exceeding route current low threshold (set by commissioning engineer, 60% of rated route current by default)
SPM Branch Curr Over HL	Load too large, exceeding route current high threshold (set by commissioning engineer, 80% of rated route current by default)
SPM Branch Over Current	Load too large, exceeding route overcurrent point (set by commissioning engineer, 105% of rated route current by default)
SPM Branch 1 Inrush OC	Load too large, exceeding route impact overcurrent point (set by commissioning engineer, 130% of rated route current by default)
SPM Branch Breaker Fail	Output distribution switch open. Check whether it was caused by human intervention or fault. Check the load if was caused by fault
SPM Internal Comm Failure	Power interruption between bypass module and SPM monitoring module
SPM Maitainance Bypass Breaker Close	The maintenance bypass switch of the UPS is closed
SPM Output Breaker Open	The output switch of the UPS is open
Note: If the alarms are caused by the values set by the Emerson-authorized commissioning engineer using the configuration software, and the user need to change the setting values, please contact the local customer service center of Emerson	

Chapter 5 Service

This chapter introduces the UPS service, including the service procedures of the power module, bypass module and output distribution module, and the replacement of air filter.

5.1 Replacement Procedures Of Power Module, Bypass Module And Output Distribution Module

5.1.1 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 centre of gravity .

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 static bypass module is not hot pluggable. It should be replaced only when the UPS is in maintenance bypass mode or completely powered off.

5. The power modules and bypass module should be serviced five minutes, and installed in the cabinet again 10 minutes, after they are removed.

5.1.2 Power Module Replacement Procedures

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

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

2. Place the ready switch on the front panel of the power module to the up position (i.e., 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 at 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, confirm that the DIP switch of the module is set correctly, and 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.

5.1.3 Power Module Service Procedures

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

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

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

3. Open the UPS output switch and input switch.

4. Press the EPO switch, and open the battery circuit breaker (BCB).

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

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

5.1.4 Output Distribution Module replacement Procedures

1. Open each output distribution switch of the output distribution module.
2. Remove the cables connected to the output terminals of the 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, confirm that all output distribution switches of the module are open.
5. Push the module into the cabinet, and tighten the screws on both sides.
6. Restore the cable connection to the output terminals of the module.

5.2 Replacement Procedures Of Air Filter

As shown in Figure 5-1, 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.

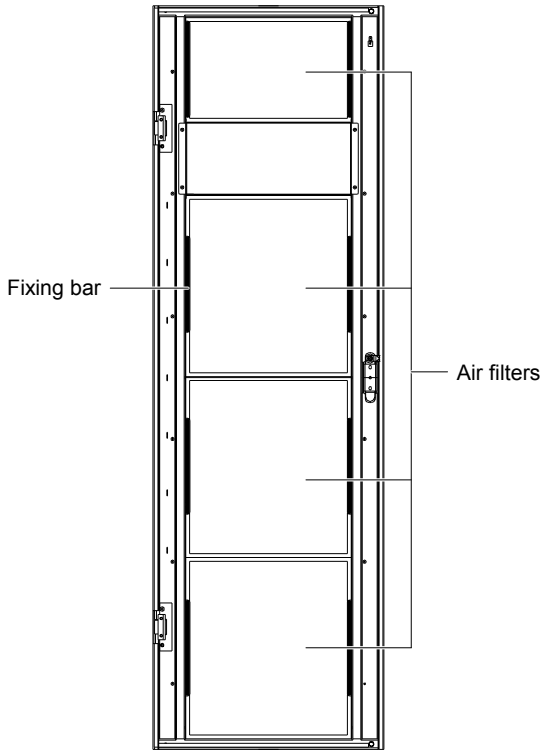


Figure 5-1 Air filters on the back of the UPS front door

Chapter 6 Specifications

The chapter provides the UPS specifications.

6.1 Conformity And Standards

The UPS has been designed to conform to the European and international standards listed in Table 6-1.

Table 6-1 European and international standards

Item	Normative reference
General and safety requirements for UPS used in operator access areas	EN50091-1-1/IEC62040-1-1/AS 62040-1-1
Electromagnetic compatibility (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 IECand ENstandards for safety (IEC/EN/AS60950), electromagnetic emission and immunity (IEC/EN/AS61000 series) and construction (IEC/EN/AS60146 series and 60529)	

6.2 Environmental Characteristics

Table 6-2 Environmental characteristics

Item	Unit	Specifications
Noise within 1m	dB	56.0
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)

6.3 Mechanical Characteristics

Table 6-3 Mechanical characteristics

Rated power (kVA)	Unit	30 ~ 150
Dimensions, W × D × H	mm	600 × 1100 × 2000
Weight	kg	300
Color	N/A	Black
Protection degree, IEC(60529)	N/A	IP20 (front door and back door open or closed)

6.4 Electrical Characteristics (Input Rectifier)

Table 6-4 Rectifier AC input (mains)

Rated power (kVA)	Unit	150
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 ~ 208 (output derated below 70%)
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 ~ 150
Input current	A rated [3] (maximum[4])	60 ~ 300
Harmonic current distortion	THDI% FL	<3
Duration of progressive power walk-in	s	10s to reach full ratd 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 charged. 4. IEC62040-3/EN50091-3: at rated load and input voltage 400V, battery charging at maximum rated power		

6.5 Electrical Characteristics (Intermediate DC Circuit)

Table 6-5 Battery

Intermediate DC circuit						
Rated power (kVA)	Unit	30	60	90	120	150
Battery bus voltage	Vdc	Nominal: 432V (VRLA float charge is 540V), range: 400V ~ 616V				
Number of lead-acid cells	Nominal	216 (6cells x 36 12V battery block)				
	Maximum	240 (6cells x 40 12V battery block)				
	Minimum	180 (6cells x 30 12V battery block)				
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/□/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 0.050C10 (selectable from 0.030 to 0.070) Boost-float current trigger 0.010C10 (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)				
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] max current (adjustable)[2]	kW	6	12	18	24	30
	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						

6.6 Electrical Characteristics (Inverter Output)

Table 6-6 Inverter output (to critical load)

Rated power (kVA)	Unit	30 ~ 150
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
Tatal harmonic voltage	%	<1 (linear load), <4 (non-linear load[3])
Synchronisation window		Rated frequency ±2Hz (selectable from ±0.5Hz to ±3Hz)
Slew rate (max change rateof synchronisation frequency)	Hz/s	1; selectable from 0.1 to 3
Inverter voltage tolerance	%V(ac)	±5

Note:
1. Factory set to 400V. 380 or 415V selectable by commissioning engineer.
2. Factory set to 50Hz. 60 Hz selectable by commissioning engineer.
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

6.7 Electrical Characteristics (Bypass Mains Input)

Table 6-7 Bypass mains input

Rated power (kVA)	Unit	30 ~ 150
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	%	135% 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
Synchronixation window	Hz	Rated frequency: ±2Hz (selectable fromm ±0.5Hz to ±3Hz)
Note: 1. Factory set to 400V. 380V or 415V selectable by commissioning engineer. 2. Factory set to 50Hz. 60Hz selectable by commissioning engineer.		

6.8 Efficiency, Heat Losses And Air Exchange

Table 6-8 Efficiency, heat losses and air exchange

Rated power (kVA)	Unit	30	60	90	120	150
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	48	96	144	192	239
Note: input and output voltage 400Vac battery charged, full rated linear load						

Appendix 1 BCB Model Selection And Connection

Table 1 Selection reference table of BCB rated current and connection cable cross CSA

Rated power (kVA)	Unit	30	60	90	120	150
Max battery discharge current at full load	A	105	210	315	420	525
Reference rated current of circuit breaker	A	150	250	350	450	550
CSA of connection cable	mm^2	35	70	105	140	175

Note :

1. In the case the battery is configured for independent wiring for positive group and negative group respectively (that is, lead four cables from battery terminals), for the UPS, due to the limitation of the rated current, it is recommended to use a 4P DC moulded-case circuit breaker (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, breaker and UPS are shown in Figure 1.
2. In the case the battery is configured for center tap wiring (that is, lead three cables from battery terminals), 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. Connections between the battery, breaker and UPS are shown in Figure 2

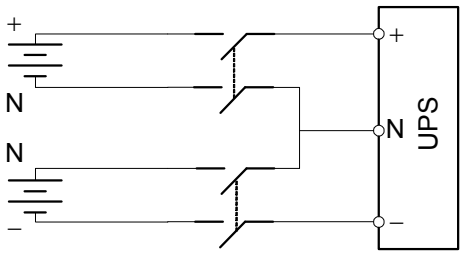


Figure 1 Connections between the battery, breaker and UPS (four cables connected to battery)

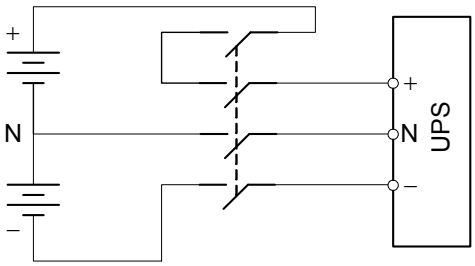


Figure 2 Connections between the battery, breaker and UPS (three cables connected to battery)