HIPULSE U UPS Single Module And “1+N” (Expandable)

160/200/300/400kVA

User Manual

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This manual contains information concerning the installation and operation of the HIPULSE U single module (expandable) UPS of Emerson Network Power Co., Ltd. (Emerson for short).

All relevant parts of the manual should be read prior to commencing installation.

The UPS must be commissioned by an engineer approved by the manufacturer (or its agent) before being put into service. Failure to observe this condition will invalidate any implied warranty.

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

The Manual Describes The Following Equipment:

Equipment	Model
160kVA UPS (6-pulse)	HIPULSE U/160/S/6P
160kVA UPS (12-pulse)	HIPULSE U/160/S/12P
200kVA UPS (6-pulse)	HIPULSE U/200/S/6P
200kVA UPS (12-pulse)	HIPULSE U/200/S/12P
300kVA UPS (6-pulse)	HIPULSE U/300/S/6P
300kVA UPS (12-pulse)	HIPULSE U/300/S/12P
400kVA UPS (6-pulse)	HIPULSE U /400/S/6P
400kVA UPS (12-pulse)	HIPULSE U /400/S/12P
Option	Model
160kVA 11th harmonic filter (50/60Hz)	-
160kVA 5th harmonic filter (50/60Hz)	-
200kVA 11th harmonic filter (50/60Hz)	-
200kVA 5th harmonic filter (50/60Hz)	-
300kVA 11th harmonic filter (50/60Hz)	-
300kVA 5th harmonic filter (50/60Hz)	-
400kVA 11th harmonic filter (50/60Hz)	-
400kVA 5th harmonic filter (50/60Hz)	-
Bypass load sharing inductor	-
Battery circuit breaker (BCB) box	UF-BCB500/0500-03 UF-BCB300/0500-03
Battery temperature sensor	TMP12Z
SNMP card	UF-SNMP114
UPS JBUS/MODBUS adapter	UF-MODBUS110
Low voltage dry contact card	UF-DRY210
Universal dry contact card	-
UPS Ambient Signal Adapter	UF-DRY110
Class C surge protection device (SPD)	SPD24Z-SPD-24
Top cabling option	-
SiteMonitor UPS monitoring software	-
Load bus synchronization (LBS) cable (10m/15m/20m)	-
Parallel cable (10m/15m/20m)	-

Safety Precautions

 Conformity and standards

This equipment complies with the following requirements:
Normative references: Uninterruptible Power System (UPS).

- IEC60950-1, IEC62040-1-1 — General and safety requirements for use in operator access area
- IEC/EN62040-2 — EMC requirements
- 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

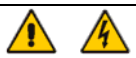
HIGH EARTH LEAKAGE CURRENT: EARTH CONNECTION IS ESSENTIAL BEFORE CONNECTING THE INPUT SUPPLY.
This equipment must be earthed in accordance with local electrical codes.

 Warning

Upstream power distribution protection device of the UPS must be selected according to local electrical codes.

 Warning

If any internal fuse of the UPS is damaged, it must be replaced by professionals with a new one of the same specifications.

 Caution

This equipment is fitted with radio frequency interference (RFI) suppression filters.
Earth leakage current exceeds 3.5mA and is less than 1000mA.
Transient and steady-state earth leakage currents, which may occur when starting the equipment, 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

This system has a signal available for use with an automatic device, externally located, to protect against backfeeding voltage through the mains Static Bypass circuit. If this protection is not used with the switchgear that is used to isolate the bypass circuit, a label must be added at the switchgear to advise service personnel that the circuit is connected to a UPS system.
The text is the following or equivalent:

ISOLATE THE UNINTERRUPTIBLE POWER SYSTEM BEFORE WORKING ON THIS CIRCUIT.

 General

As with other types of high power equipment, dangerous voltages are present within the UPS and battery enclosure. The risk of contact with these voltages is minimized as the live component parts are housed behind a hinged, lockable door.
Further internal safety screens make the equipment protected to IP20 standards.
No risk exists to any personnel when operating the equipment in the normal manner, following the recommended operating procedures.
All equipment maintenance and servicing procedures involve internal access and should be carried out only by trained personnel.

Batteries
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. Particular attention should be paid to the recommendations concerning local environmental conditions and the provision of protective clothing, first aid and fire-fighting facilities.

The warning triangle indicates all the personal safety instructions.

Contents

Chapter 1 General Description

This chapter briefly introduces the features, design concept and operation mode of the HIPULSE U UPS.

1.1 Features

The HIPULSE U UPS is connected between a critical load, such as a computer, and its 3-phase mains power supply. Being designed to furnish a well regulated 3-phase output power supply under all rated load and input supply conditions, the system offers the user the following advantages:

- increased power quality

  The UPS has its own internal voltage and frequency regulators which ensure that its output is maintained within close tolerances independent of voltage and frequency variations on the mains power lines.

- increased noise rejection

  By rectifying the input AC power to DC power, and then converting it back to AC power, any electrical noise present on the input mains supply line is effectively isolated from the UPS output, therefore the critical load sees only clean power.

- power blackout protection

  If the mains power fails, the UPS continues to power the critical load from its battery source, leaving the load immune from power disturbances.

1.2 Design Concept

1.2.1 HIPULSE U Module Design

This section describes the operating principle of an individual module. The UPS basically operates as an AC-DC-AC converter (see Figure 1-1). The first conversion stage (from AC to DC) uses a 3-phase, fully controlled silicon-controlled resistor (SCR) bridge rectifier to convert the incoming mains supply into a regulated DC busbar.

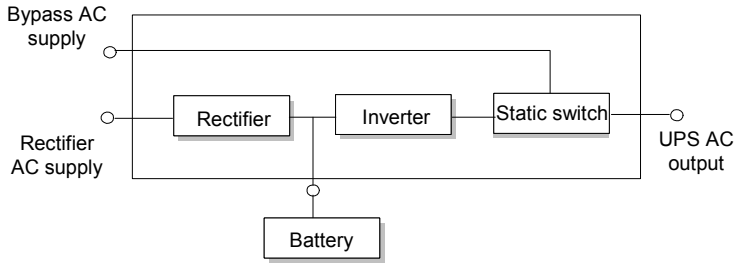


Figure 1-1 Single module block diagram

The DC busbar produced by the rectifier provides both battery charging power – being equipped with a temperature compensated battery charging system, to prolong battery life – and power to the inverter section – which utilizes the latest integrated gate bipolar transistor (IGBT) switching space vector pulse width modulation (SVPWM) design – and provides the second conversion phase, that is, reconverting 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 (that is, 330Vdc for a 400Vac system).

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 Supplies

The circuit block annotated “Static switch” in Figure 1-2 contains an electronically controlled switching circuit, which enables the critical load to be connected either to the inverter output or to a bypass power source through the static bypass line. During normal system operation, the load is connected to the inverter, and the inverter-side of the static switch is closed. But in the event of a UPS overload or inverter failure, it is automatically transferred to the static bypass line.

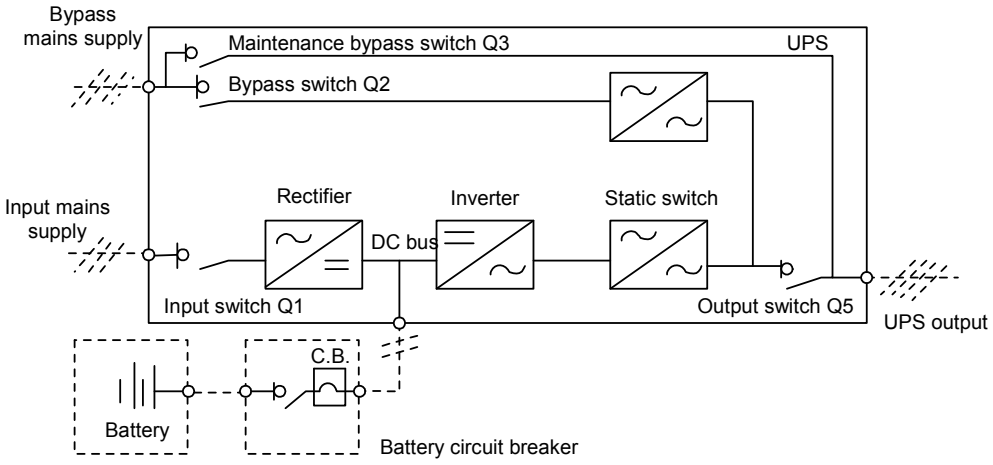


Figure 1-2 UPS power switches configuration

To provide a clean (no-break) load transfer between the inverter output and static bypass line, the static switch activates connecting the load to the bypass supplies. To achieve this, the inverter output and bypass supply must be fully synchronized during normal operating conditions. This 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 also incorporated into the UPS design. Its purpose is to enable the critical load to be powered from the mains (bypass) supply while the UPS is shut down for routine maintenance.

Note: The load equipment is not protected from normal supply aberrations when operating on bypass side or in the maintenance bypass mode.

1.2.3 System Control Philosophy

Normal operation

During normal operation, that is, when the UPS input supply is present and within specification, both the rectifier and inverter sections are active and the static switch is turned on to connect the inverter output to the critical load busbars. The battery circuit breaker (BCB) is also closed and the battery is therefore permanently float charged at the DC busbar voltage level.

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

A module's static switch cannot close until these conditions are satisfied.

Mains failure

If the power mains has a failure or is out of tolerance the rectifier will go off automatically, while the inverter will continue to operate on power from the battery for a period of time which depends on the load and the capacity of the battery. If the mains supply has not returned within this time, the inverter will go off automatically and an alarm message will appear on the operator control and display panel of the UPS.

Critical load will not be interrupted in the event of a drop or return of the AC power mains.

Return of power mains

When the mains returns within the required tolerance, the rectifier will start up again automatically and gradually (power walk-in), supplying power to the inverter and recharging the battery at the same time. There will be no interruption of the critical load.

Off-battery

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

UPS module fault

In the event of an inverter fault, the static transfer switch will automatically transfer the load onto the bypass mains with no interruption. In such an event, seek technical assistance from Emerson local customer service center.

("1+N" parallel UPS system) In the event of a fault in a unit, the unit's static transfer switch will automatically exclude the unit from the system. If the system is still capable of providing the required load, the remaining units will continue to supply the load with no interruption. When the units still present in the system are no longer capable of fulfilling power requirements, the load will automatically be transferred onto the bypass mains.

Overload

In the event of an overload at the inverter output which lasts longer than the typical time/current (refer to table 8-6), the inverter will shut down and the static transfer switch will automatically transfer the load onto the bypass mains with no interruption. If the overload falls within the typical time/current that has been specified, the load will be returned to the inverters when the power drops to a level which can be supported by the number of active units in the system (parallel "1+N").

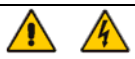
In the event of a short circuit in the output, the load will normally be transferred onto the bypass mains, which will cause the inverter to shut down. This switch is determined above all by the features of the protective devices in use in the system.

In either case, an alarm message will appear on the operator control and display panel of the UPS.

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

Maintenance bypass

A second bypass circuit contained in the UPS cabinet, identified as the maintenance bypass line, is included to enable a raw mains supply to be made available to the load while facilitating a safe working environment for carrying out scheduled UPS system maintenance or trouble shooting. The circuit is manually selected by the maintenance bypass switch in the OFF position.

 Warning
The internal maintenance bypass must not be used when the UPS system is comprised of more than two UPS modules in parallel. CAUTION: If an automatic circuit breaking device is not present in the input distribution panel, there remains a dangerously high voltage at the output busbars and also on the input busbars of the UPS module that is switched off.

1.2.4 ECO Mode (For Single UPS Only)

In ECO mode, the system prefers to put the load on the bypass mains, with the inverter on stand-by. The load is switched over to the inverter when the mains goes outside of standard frequency and voltage values (settable).

The ECO mode configuration requires a different setup in the default menu configuration.

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.

1.2.5 UPS Power Switch Configuration

Figure 1-2 illustrates the HIPULSE U UPS module in what is known as the split bypass configuration. In the split bypass configuration, the static bypass line is connected by a separate power switch to a dedicated bypass power source which also feeds the maintenance bypass line. Where a separate power source is not available the bypass (Q2) and rectifier (Q1) input supply connections would be linked together.

With the exception of the maintenance bypass switch, all the switches shown must be closed during normal UPS operation.

1.2.6 Battery Circuit Breaker

The battery should be connected to the DC busbar through a circuit breaker fitted inside the battery cabinet — or located adjacent to the batteries where a battery cabinet is not used. This circuit breaker is closed manually, but it contains an undervoltage release coil which enables it to be tripped from the UPS control electronics following certain detected faults. It also has a magnetic trip facility for overload protection.

1.2.7 Battery Temperature Compensation

HIPULSE U UPS system offers a battery temperature compensation circuit. As the temperature inside the battery cabinet/area rises, the DC busbar voltage reduces in order to sustain the battery at its optimum charge voltage. This must be used in conjunction with the battery temperature sensing device.

1.2.8 System Expansion

If necessary, a single module system can be expanded to cater for an increased load requirement by adding additional modules — up to a maximum of six UPS modules can be connected in parallel.

System expansion requires a change in the SETUP of the operator control and display panel of each UPS module.

Note:

1. System expansion should be carried out only by trained service personal.
2. The individual modules connected to the system must be of the same power rating.

1.3 Operation Mode

The UPS permits operation in the following alternative modes:

Normal mode

The UPS inverter continuously supplies the critical AC load. The rectifier/charger derives power from the AC mains input source and supplies DC power to the inverter while simultaneously float or boost charging its associated backup battery.

Battery mode

Upon failure of the AC mains input power, the critical AC load is supplied by the inverter, which obtains power from the battery. There is no interruption in power to the critical load upon failure or restoration of the AC mains input power after which the Normal mode operation will continue without the necessity of user intervention.

Note: Battery start device (optional) is available for switching the UPS on into Battery (charged) mode directly during mains failure.

Auto-restart mode

The battery becomes exhausted following an extended AC mains failure. The inverter shuts down when the battery reaches the end-of-discharge voltage (EOD). The UPS can be programmed to Auto Recovery after EOD after a set variable delay time. This mode and any delay time are programmed by the commissioning engineer.

Bypass mode

The load power is supplied though the mains static bypass line. This may be considered as an intermediate operating condition being utilized for the purpose of load transfers between inverter and maintenance bypass or supply under abnormal operating conditions.

Maintenance mode

The UPS is shut down but the load is connected to the unprotected mains through the maintenance bypass supply line.

Source Share mode

The UPS has the capability of fully supporting their critical load while limiting the amount of power taken from the incoming AC mains supply. Any balance of power required is supplied by the UPS battery. This feature is useful, for example, in applications where peak-hour tariffs apply or where a generator smaller than needed feeds the UPS during mains outages. The Source Share mode is user-activated and the ratio of the mains AC input power is programmable from 20% to 100% of the rated UPS power.

ECO mode (for single UPS only)

All power switches and the BCB are closed, the system prefers to put the load on the bypass mains, with the inverter on stand-by; only when the voltage and/or frequency of the bypass supply are beyond pre-defined and adjustable limits is the critical AC load transferred to the inverter.

Parallel redundancy mode (system expansion)

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

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 45Hz to 65Hz. In this mode, it is required to open the bypass switch to disable the static bypass operation, and the battery becomes optional depending on any requirement to operate in Battery mode.

Chapter 2 Mechanical Installation

This chapter briefly introduces the mechanical installation of the HIPULSE U UPS, including the notes, environmental considerations, mechanical considerations, preliminary checks and installation drawings.

2.1 Notes

Warning
Do not apply electrical power to the UPS equipment before the arrival of the commissioning engineer.

Warning
The UPS equipment should be installed by a qualified engineer in accordance with the information contained in this chapter and all equipment not referred to this manual is shipped with details of its own mechanical and electrical installation.

Warning: battery hazards
Special care should be taken when working with the batteries associated with this equipment. When connected together, the battery terminal voltage will exceed 400Vdc and is potentially lethal. 1. Eye protection should be worn to prevent injury from accidental electrical arcs. 2. Remove rings , watches and all metal objects. 3. Only use tools with insulated handles. 4. Wear rubber gloves. 5. 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. 6. If electrolyte comes into contact with the skin the affected area should be washed immediately with water.

Warning
The UPS system can be connected to an isolated neutral (IT) power system.

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

Because every site has its peculiarities, it is not the aim of this chapter to provide step-by-step installation instructions, but to act as a guide as to the general procedures and practices that should be observed by the installing engineer.

2.2 Environmental Considerations

2.2.1 UPS Location

The UPS module should be located in a cool, dry, clean-air environment with adequate ventilation to keep the ambient temperature within the specified operating range (see Table 8-2).

All models in the HIPULSE U UPS range are cooled with the aid of internal fans. Cooling air enters the module through ventilation grills located at various parts of the cabinet and exhausted through grills located in the cabinet roof. When the cabinet is located on a raised floor, and bottom cable entry is used, additional cooling air also enters the UPS through the floor void. If necessary, a system of extractor fans should be installed to aid cooling-air flow, and a suitable air filtration system used where the UPS is to operate in a dirty environment.

Note:

1. When batteries are cabinet-mounted adjacent to the UPS module, it is the battery which dictates the designed maximum ambient temperature, not the UPS.

2. Power losses from the system which may be used in an air conditioning system are intended for operation using the inverter, as in the ECO mode configuration they would be undersized.

2.2.2 Battery Location

Temperature is a major factor in determining the battery life and capacity. Battery manufacturers quote figures for an operating temperature of 20°C. Operating above this temperature will reduce the battery life, and operation below this temperature will reduce the battery capacity. On a normal installation the battery temperature is maintained between 15°C and 25°C. Batteries should be mounted in an environment where the temperature is consistent and even over the whole battery. Keep batteries away from main heat sources or main air inlets, and so on.

The batteries can be mounted in a purpose-built battery cabinet, which is positioned adjacent to the UPS module. Pedestals are required for the battery cabinets when they are located on raised floors, in the same way as for the UPS cabinets If the batteries are rack-mounted, or otherwise located remote to the main UPS cabinet, a BCB must be mounted as close as possible to the batteries themselves, and connected using the most direct route possible.

2.3 Mechanical Considerations

2.3.1 System Composition

A UPS system can comprise a number of equipment cabinets, depending on the individual system design requirements, for example, UPS cabinet, battery cabinet. The 300kVA UPS (12-pulse rectifier) and 400kVA UPS comprise a main cabinet and a side cabinet. In general, all the cabinets used in a particular installation are of the same height and designed to be positioned side-by-side to form an aesthetically appealing equipment suit.

2.3.2 Moving The Cabinets

Warning
Ensure that any lifting equipment that used in moving the UPS cabinet has sufficient lifting capacity.

Ensure that the UPS weight is within the designated surface weight loading of any handling equipment. See Table 8-3 for UPS weight details.

The UPS cabinet can be moved by fork lift. Before moving the UPS cabinet, it is necessary to remove both the front, rear (or side) grille panels located at the base of the cabinet.

In the eventuality that the equipment cannot be moved by fork lift, then rollers should be used.

2.3.3 Clearances

As HIPULSE U UPS has no ventilation grills at either the sides or the rear, no clearances are required. However, where space permits, a clearance of approximately 600mm at the back will ease access to magnetic component parts. Clearance around the front of the equipment should be sufficient to enable free passage of personnel with the doors fully opened.

2.3.4 Fixing Of The Magnetic Components

Before the equipment is in place, remove the transportation restraints that hold the output transformer in place. For procedures, refer to *Appendix 1 Transportation Restraints Removing Procedures.*

2.3.5 Cable Entry

Cables can enter for HIPULSE U UPS and battery cabinet either from below or through either side.

Side entry is made possible by removing blanking pieces fitted in the side panel to reveal the cable entry holes.

This cable entry method allows the equipment to be positioned on a solid floor without the need for cable trenching and allows cables to pass from one module to the other when positioned side-by-side.

Optionally a top cable entry extension may be used.

Note: When selecting the power cables for side entry to a module located on a solid floor, consideration must be given to the minimum permissible radius of the proposed cables to ensure that they can be fashioned to reach the UPS connection busbars.

2.4 Preliminary Checks

Before you install the UPS hardware you should carry out the following preliminary checks:

1. Verify that the UPS room satisfies the environmental conditions stipulated in the equipment specification, paying particular attention to the ambient temperature, air exchange system, and dust density.

2. Remove any packaging debris, visually examine the UPS and battery equipment for transit damage, both internally and externally. Report any such damage to the shipper immediately.

2.5 Installation Drawings

The following drawings illustrate the key mechanical characteristics of the various UPS system cabinets.

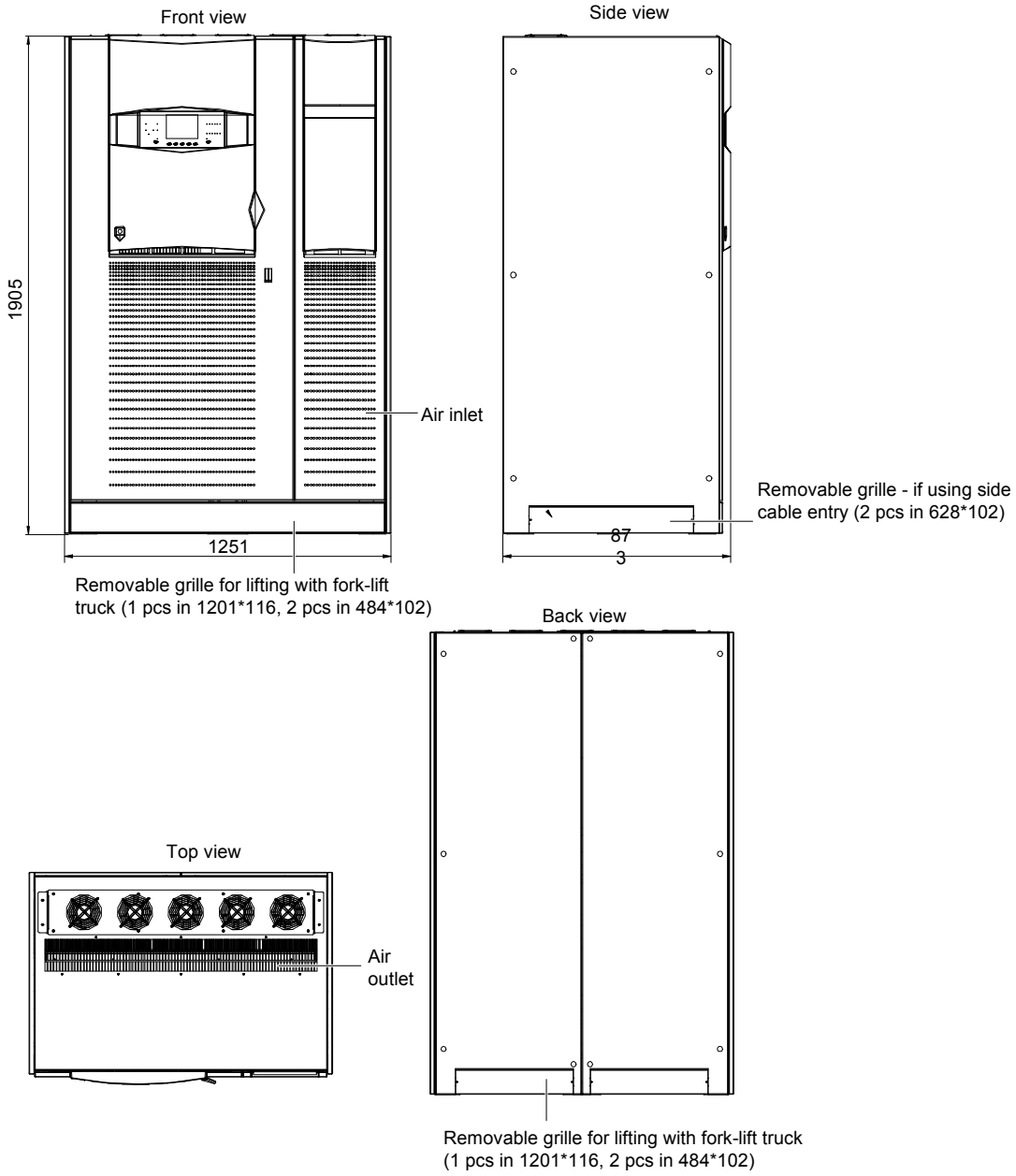


Figure 2-1 Front, side, top, back views of 160kVA/200kVA UPS (6-pulse rectifier) (unit in mm)

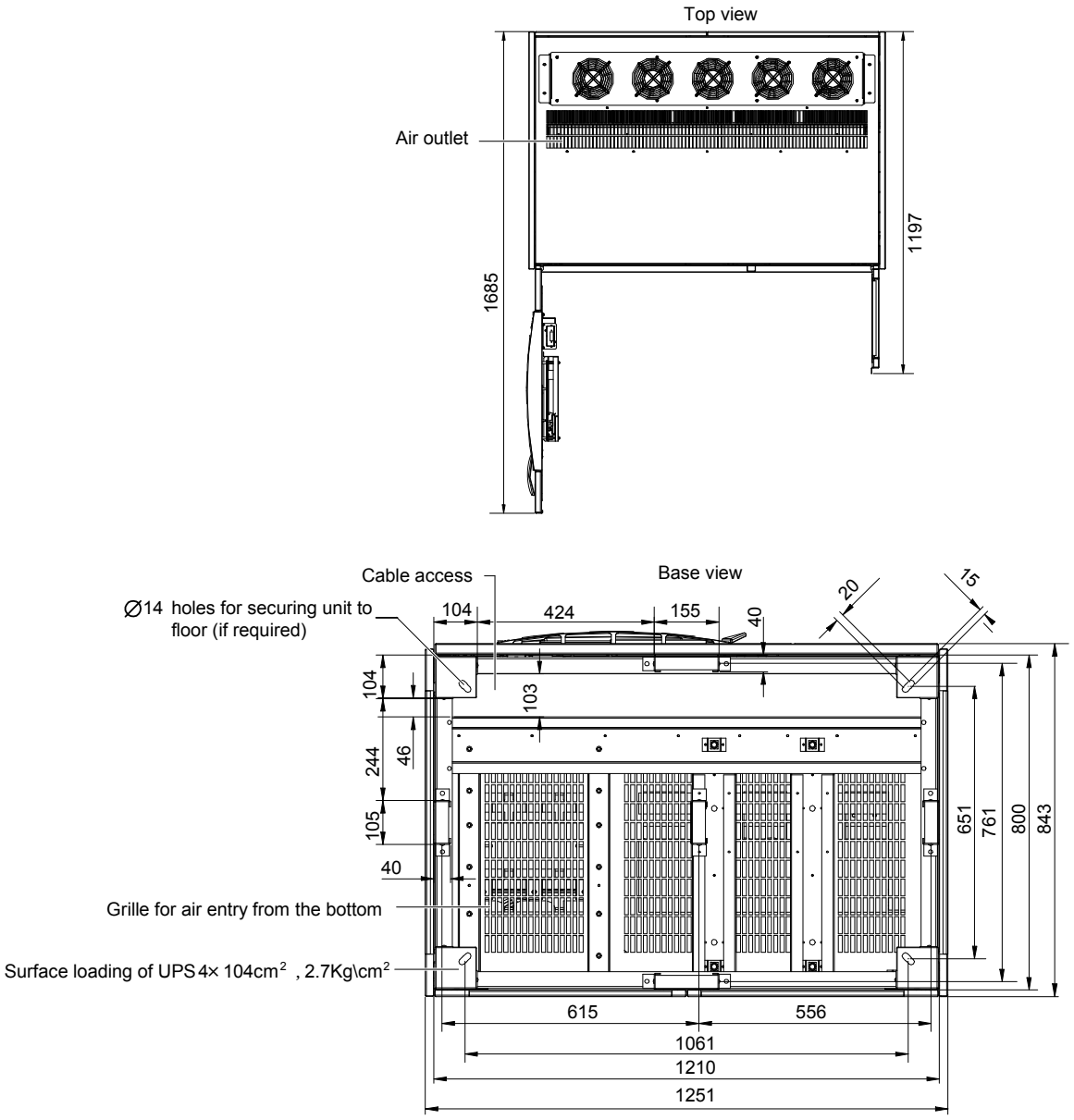


Figure 2-2 Top, base views of 160 kVA/200kVA UPS (6-pulse rectifier) (unit in mm)

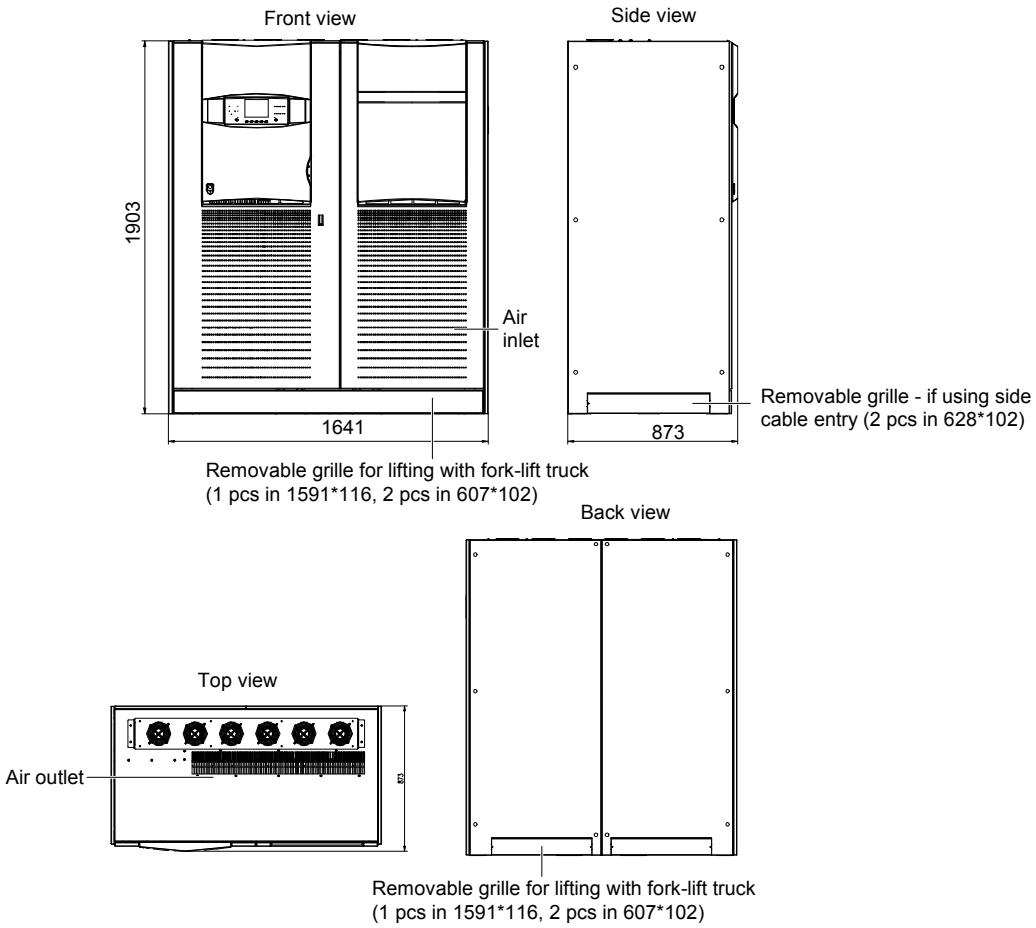


Figure 2-3 Front, side, top, back views of 160 kVA/200kVA UPS (12-pulse rectifier) (unit in mm)

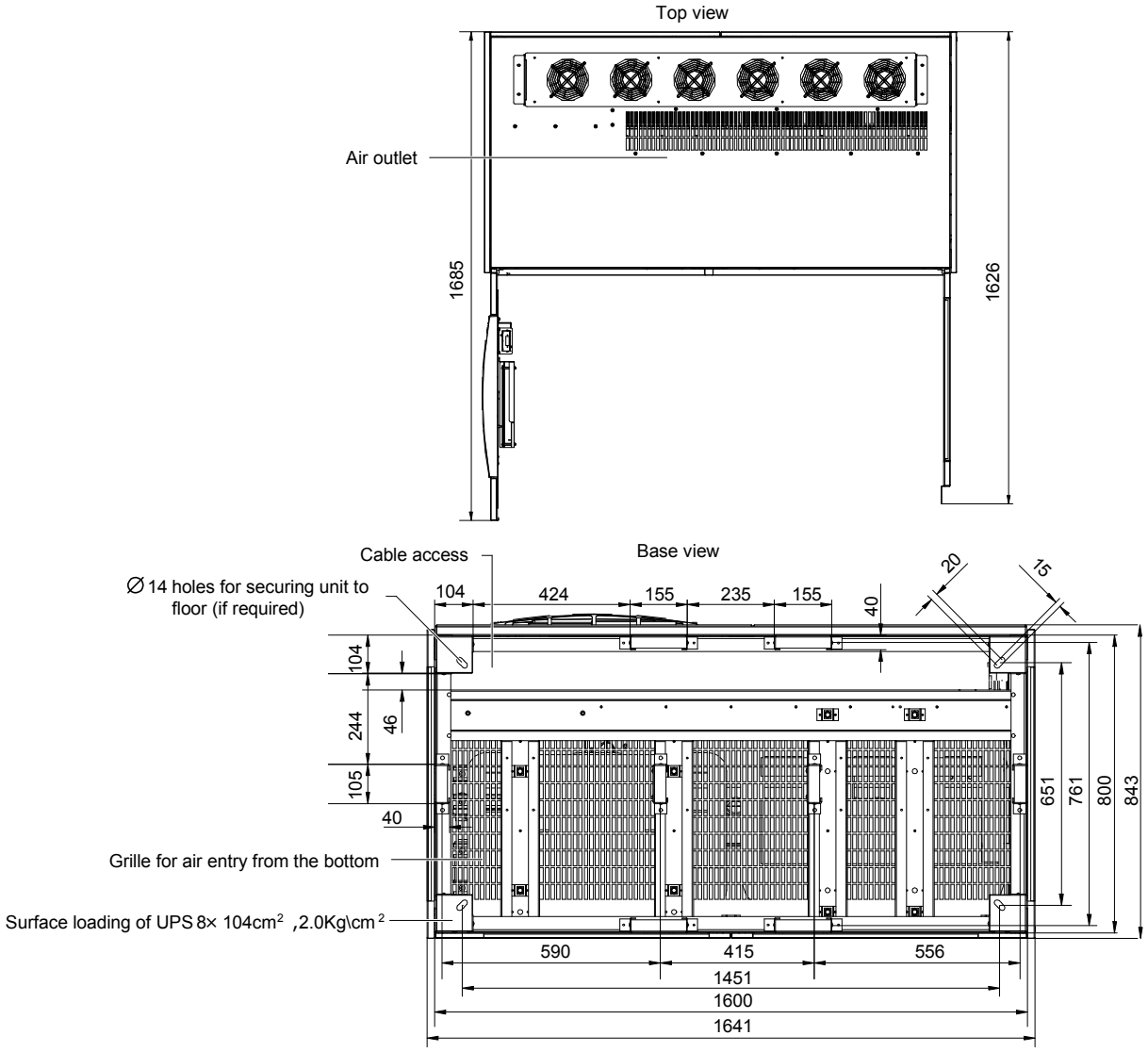


Figure 2-4 Top, base views of 160 kVA/200kVA UPS (12-pulse rectifier) (unit in mm)

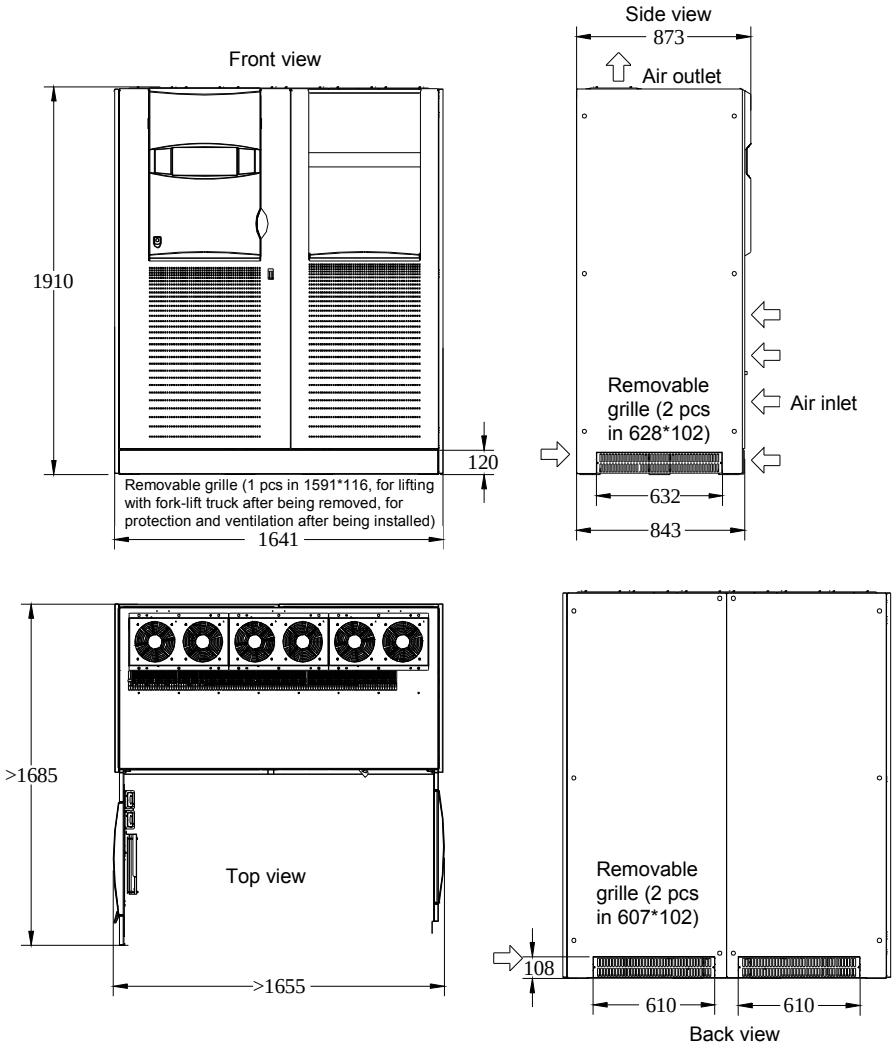


Figure 2-5 Front, side, top, back views of 300kVA UPS (6-pulse rectifier) (unit in mm)

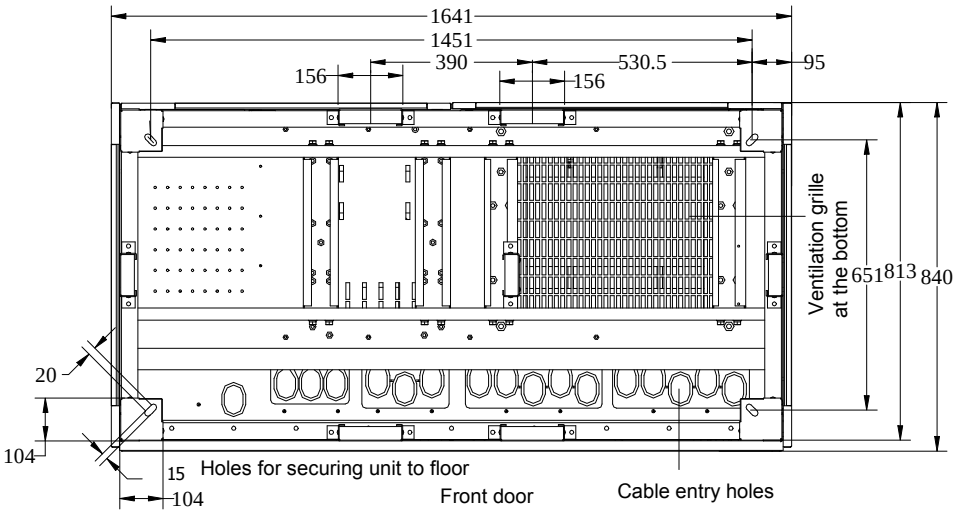


Figure 2-6 Base view of 300kVA UPS (6-pulse rectifier) (unit in mm)

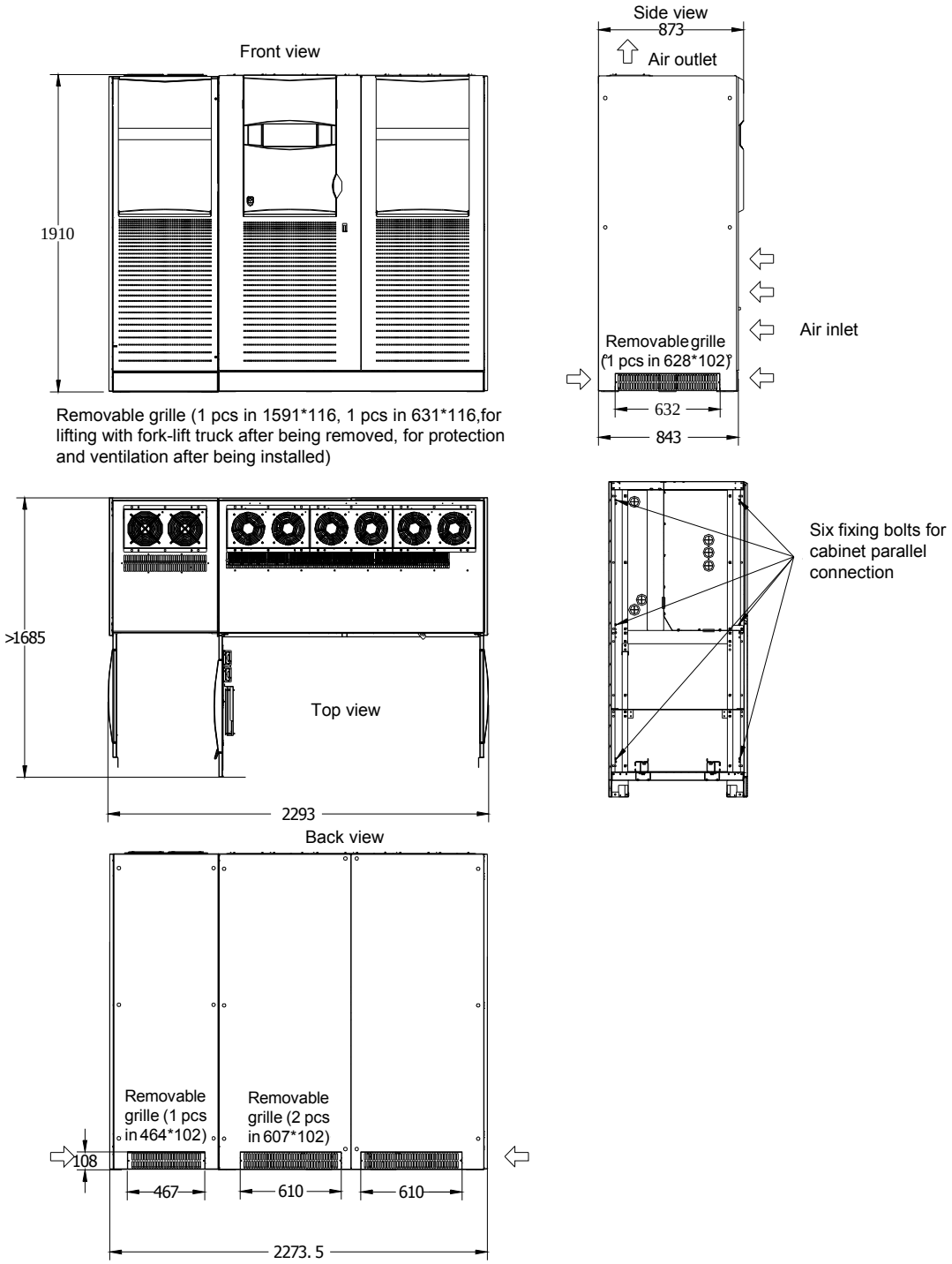


Figure 2-7 Front, side, top, back views of 300kVA UPS (12-pulse rectifier) and 400kVA UPS (6/12-pulse rectifier) (unit in mm)

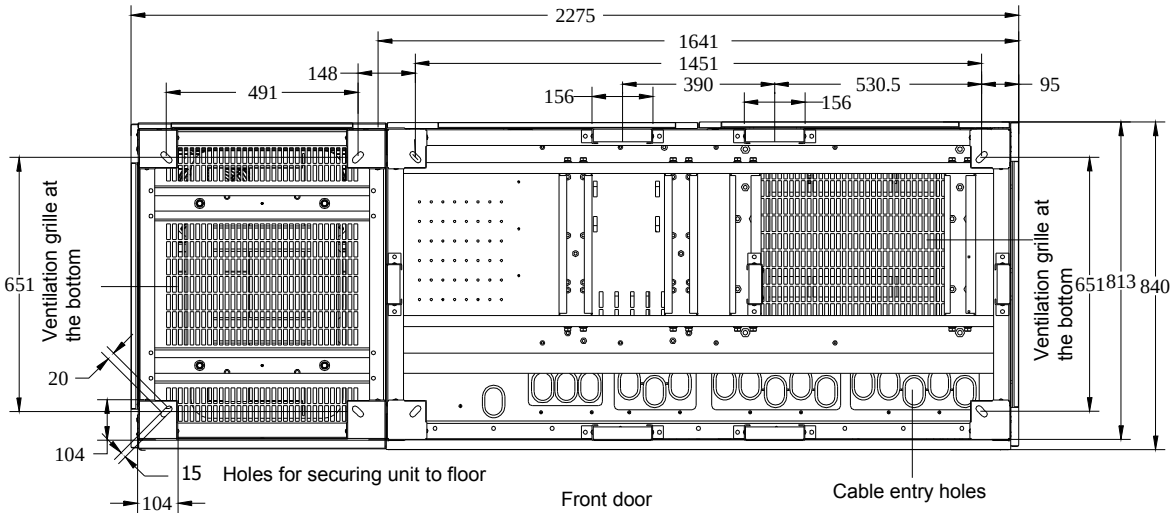


Figure 2-8 Base view of 300kVA UPS (12-pulse rectifier) and 400kVA UPS (6/12-pulse rectifier) (unit in mm)

Chapter 3 Electrical Installation

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

The UPS requires both power cabling and control cabling once it has been mechanically installed. All control cables, whether screened or not, should be run separate from the power cables in metal conduits or metal ducts which are electrically bonded to the metalwork of the cabinets to which they are connected.

3.1 Power Cabling

Warning
BEFORE CABLING UP THE UPS, ENSURE THAT YOU ARE AWARE OF THE LOCATION AND OPERATION OF THE EXTERNAL ISOLATORS THAT CONNECT THE UPS INPUT/BYPASS SUPPLY TO THE MAINS DISTRIBUTION PANEL. CHECK THAT THESE SUPPLIES ARE ELECTRICALLY ISOLATED, AND POST ANY NECESSARY Warning SIGNS TO PREVENT THEIR INADVERTENT OPERATION.

For cable entry, refer to *2.3.5 Cable Entry*.

3.1.1 System Configuration

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

Module input cables

The input cables must be sized for the maximum input current, including the maximum battery recharge current, given in the Table 3-1, with respect to the module rating and the input AC voltage.

Module bypass and output cables

The bypass and output cables must be sized for the nominal output current, given in the Table 3-1, with respect to the module rating and the output AC voltage.

Battery cables

Each UPS module has its own battery which is connected using two cables, one positive and one negative. The battery cables must be sized for the battery discharge current at the end-of-discharge voltage, as given in Table 3-1 with respect to the module rating.

3.1.2 Cable Rating

The power cables can be sized to suit the UPS module rating according to Table 3-1.

Table 3-1 UPS module power cable rating

UPS rating (kVA)	Nominal current: Amps							Busbar stud size			
	Input mains with full battery recharge (subtract 5% for 12-pulse)			Bypass/output at full load			Battery at minimum battery voltage (400Vac)*	Input/output cables		Battery cables	Torque (Nm)
	380V	400V	415V	380V	400V	415V		Bolt	Ø		
160	341	324	312	243	231	222	464	M10	11	M10 bolt	26
200	426	405	390	304	289	278	580	M10	11	M10 bolt	26
300	634	602	572	456	434	413	870	M12	13	M12 bolt	50
400	848	803	772	607	578	556	1160	M12	13	M12 bolt	50
Note*: Maximum battery discharge current at 380Vac supply increases by 3%, and for a 415Vac supply decreases by 3%											

3.1.3 General Notes

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

1. The neutral conductor should be sized for 1.5 times the output/bypass phase current.

2. The earth conductor should be sized at 2 times the output/bypass conductor (this is dependent on the fault rating, cable lengths, type of protection etc.).

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 3Vdc is permissible at the current ratings given in Table 3-1.

5. In most installations, especially those concerning parallel multi-module systems, the load equipment is connected to a distribution network of individually protected busbars fed by the UPS output rather than being connected directly to the UPS itself. Where this is the case the UPS output cables can be rated to suit the individual distribution network demands rather than being fully load-rated.

3.1.4 Cable Connections

The rectifier input, bypass, output and battery power cables (all require lug type terminations) are connected to busbars situated below the power isolator switches, as shown in Figure 3-2 and Figure 3-3.

A terminal block X3 is used for connecting the control cables to the battery circuit breaker (BCB). These are female spade type connections (fast-on 6.3*0.8) and are described later in *3.3.2 Battery Control*.

3.1.5 Safety Earth

The safety earth busbar is located near the input and output power supply connections as shown in Figure 3-2 and Figure 3-3. The safety earth cable must be connected to the earth busbar and bonded to each cabinet in the system.

All cabinets and cable trunking should be earthed in accordance with local regulations. The earth cable should be bound with binding strips onto the metallic column for cabling so as to prevent the fixing screw of the earth cable from loosening in the case the earth cable is pulled.

Warning
FAILURE TO FOLLOW ADEQUATE EARTHING PROCEDURES CAN RESULT IN ELECTRIC SHOCK HAZARD TO PERSONNEL, OR THE RISK OF FIRE, SHOULD AN EARTH FAULT OCCUR.

3.1.6 Protective Devices

For safety reasons, it is necessary to install, external to the UPS system, circuit breaking protective devices in the input AC supply and towards the battery. Given that every installation has its own characteristics, this chapter provides general useful information for qualified installation engineers, with knowledge of operating practices, of regulatory standards, and of the equipment to be installed.

Rectifier and bypass input supply of the UPS

1. Protection against excessive overcurrents and short circuits in the mains supply input

These inputs must be protected, installing suitable protective devices at the distribution panel of the incoming mains supply, considering that the protection should discriminate with overload capacity of the system (see Table 8-6 and Table 8-7).

2. Split bypass

In the case of a split bypass being used, separate protective devices should be installed in the incoming mains distribution panel. The protective devices must be selected for the nominal input current, with respect to the UPS rating and the input AC supply voltage as given in Table 3-1.

3. Protection against earth faults

In the event of a residual current detector (RCD) device being installed upstream of the input supply, one must take into account the transient and steady state earth leakage currents that are produced during start-up of the UPS.

The presence of a radio frequency interference (RFI) suppression filter inside the UPS determines a residual earth current greater than 3.5mA and less than 1000mA.

Residual current circuit breakers (RCCBs) must be sensitive to DC unidirectional pulse (Class A) in the network and insensitive to transient current pulses. They are identified by the symbols respectively:

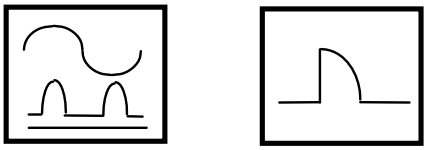


Figure 3-1 Symbols of residual current circuit breaker (RCCB)

These isolators must have an average sensitivity, possible adjustable between 0.3A and 1A.

It is recommended that the selectivity with every RCD be verified both upstream of the input distribution board and downstream (towards the load).

UPS battery

The UPS Battery is protected by means of a control circuit that operates the tripping mechanism of an automatic circuit breaking device (having a variable trip setting). The tripping mechanism using an undervoltage release coil that operates on a present minimum voltage level.

The circuit breaker is essential for maintenance of the battery and is normally located near to the battery installation.

Output of the system

In the eventuality that an external distribution panel is used for load distribution, the selection of protective device must provide discrimination with those that are use at the input to the UPS module.

3.1.7 Cabling Procedure

Once the equipment has been finally positioned and secured, refer to Figure 3-2 and Figure 3-3 to connect the power cables as described in the following procedures:

1. Verify that the UPS equipment is totally 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 UPS door and remove the lower protective cover to gain access to the connections bars.

3. Connect the safety earth and any necessary bonding earth cables to the copper earth busbar located on the floor of the equipment below the power connections.

Note: The earthing and neutral bonding arrangement must be in accordance with local and national codes practice.

Common Input Connections

4. For common bypass and rectifier inputs, connect the AC input supply cables between the mains distribution panel and the UPS input supply busbars (U1-V1-W1-N1 terminals) and tighten the connections to 13 Nm (M8 bolt), and to 26 Nm (M10 bolts). **ENSURE CORRECT PHASE ROTATION.**

Split Bypass Connections

5. If a split bypass configuration is used, connect the AC input supply cables to the input busbars (U1-V1-W1 terminals) and the bypass AC supply cables to the bypass busbars (U2-V2-W2-N2 terminals) and tighten the connections to 13 Nm (M8 bolt), to 26 Nm (M10 bolt), and to 50 Nm (M12 bolt). **ENSURE CORRECT PHASE ROTATION.**

Warning

Ensure that any links (⋆) fitted between rectifier input and bypass busbars are removed. But do not remove those between the neutral terminals. See Figure 3-2 and Figure 3-3.

Output System Connections

6. Connect the system output cables between the output busbars (N3-U3-V3-W3 terminals) and the critical load and tighten the connections to 13 Nm (M8 bolt), to 26 Nm (M10 bolt), and to 50 Nm (M12 bolt). **ENSURE CORRECT PHASE ROTATION**.

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

UPS Battery Connections

7. Connect the battery cables between the UPS terminals (+/-) and its associated BCB. Connect screened auxiliary cables from each BCB control board to the auxiliary terminal block (X3). **OBSERVE THE BATTERY CABLE POLARITY**.

Warning
Do not close the BCB before the equipment has been commissioned.

8. Refit the lower protective cover.

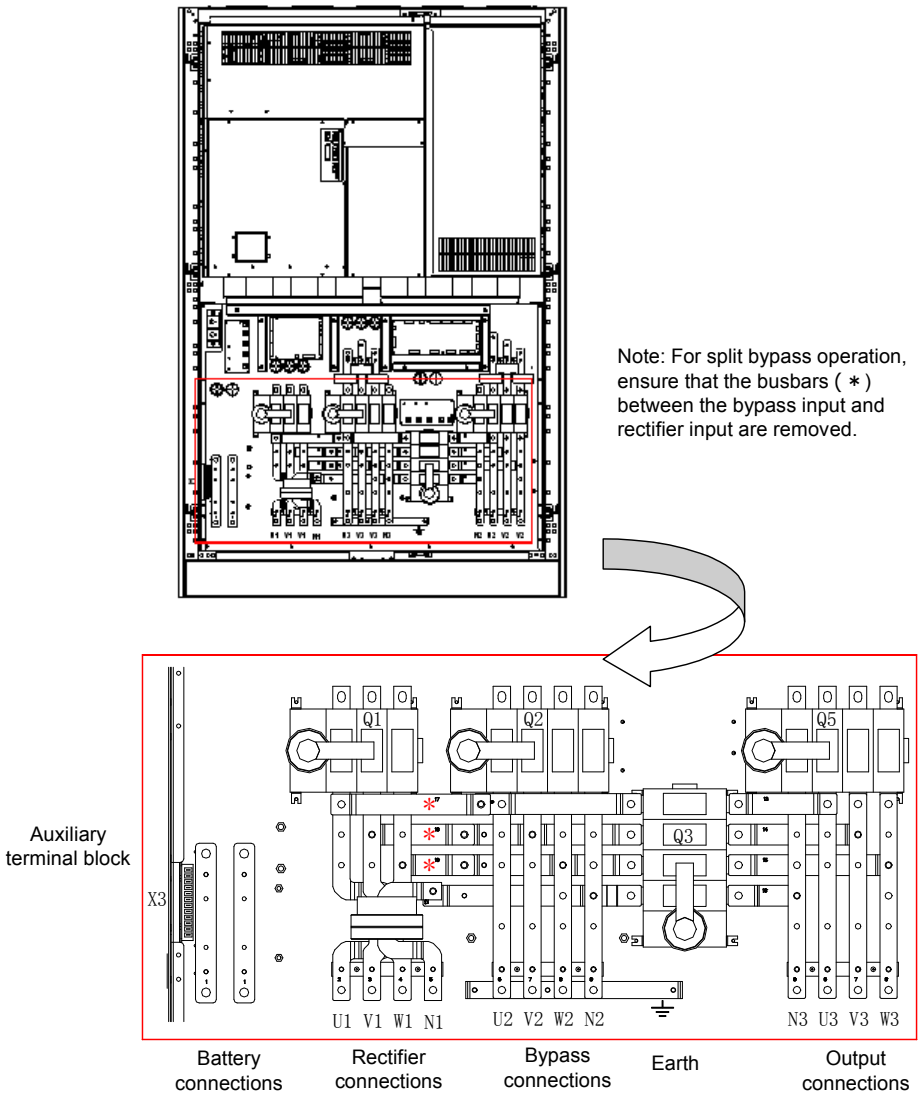


Figure 3-2 Power cable connections for 160/200kVA UPS

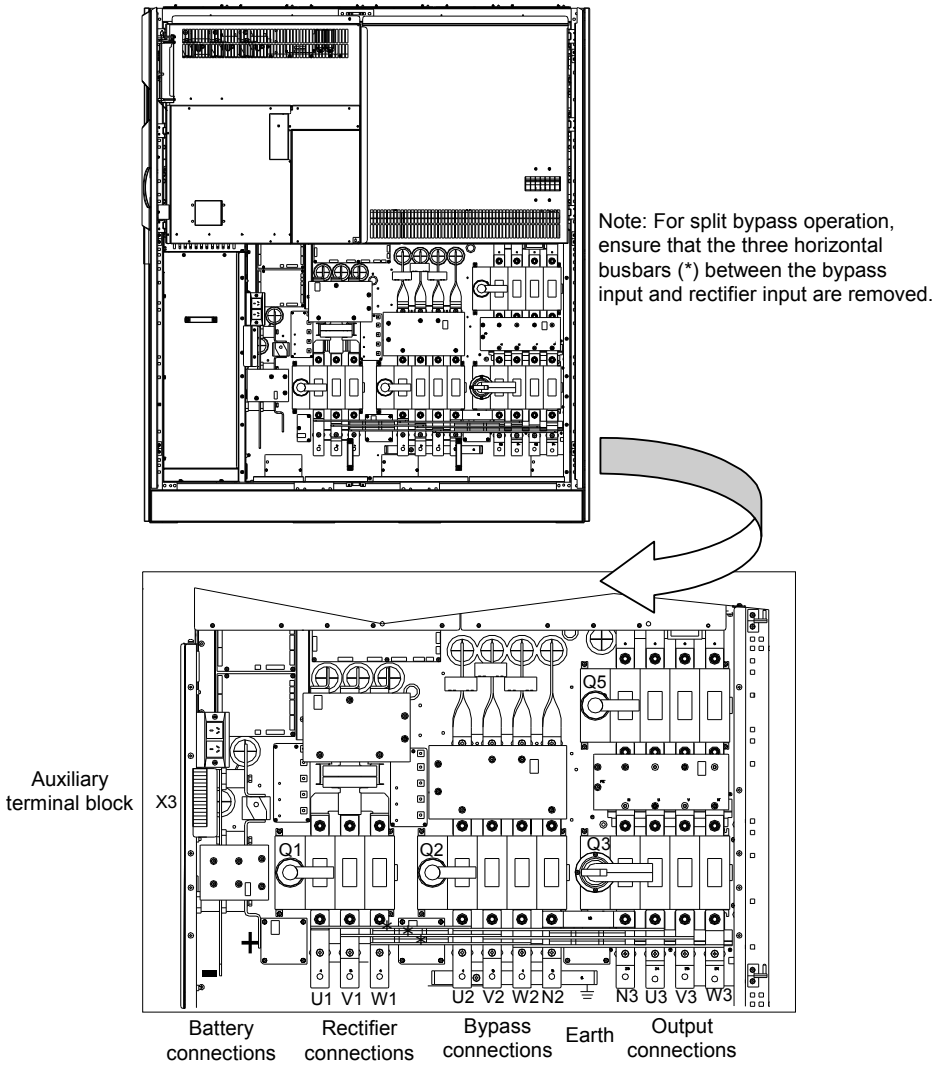


Figure 3-3 Power cable connections for 300/400kVA UPS

3.2 Distance From Floor To Connection Point

The distances from floor to connection points are provided in Table 3-2.

Table 3-2 Distance from floor to connection point

UPS	Minimum distance (mm)		
	160/200kVA	300kVA	400KVA
Rectifier AC input supply	247.5	273	273
Bypass AC input supply	247.5	273	273
UPS AC output	247.5	267.5	273
Battery power	244	300	305
Battery control and temperature compensation	325	350	350
Ground	247.5	270	274

3.3 Control Cabling

3.3.1 Monitoring Board Ports

Based on your site's specific needs, the UPS may require auxiliary connections to manage the battery system, communicate with a personal computer or provide alarm signaling to external devices or for remote Emergency Power Off (EPO). The monitor board, arranged for this purpose, is located on the rear of the operator access door. As shown in Figure 3-4, it provides the following ports:

- dry contact input ports (X3)
- dry contact output ports (X1)
- emergency Power Off (EPO) input port (X2)
- auxiliary DC power output port (X5)
- communication ports: serial ports RS232-1 and RS232-2, Intellislot ports

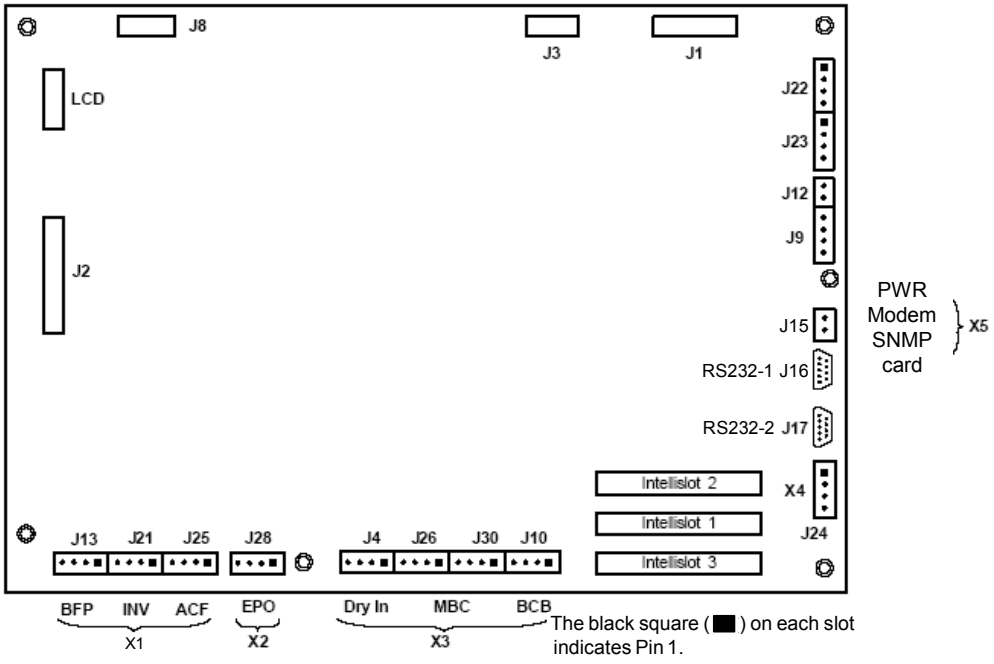


Figure 3-4 Ports of the monitoring board

Dry contact input ports (X3)

The dry contact input ports (X3) include a battery environment, battery ground fault and generator supply detection port (J4) and a maintenance bypass cabinet port (J26, J30), as shown in Figure 3-5.

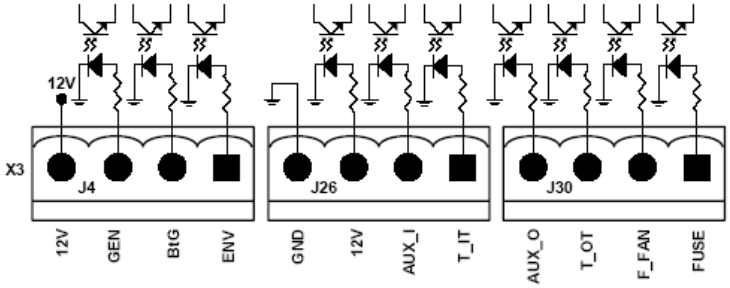


Figure 3-5 Dry contact input port

1. Battery environment, battery ground fault and generator supply detection port (J4)

The battery environment, battery ground fault and generator supply detection port is described in Table 3-3.

Table 3-3 Description of battery environment, battery ground fault and generator supply detection port

Position	Name	Description
J4.1	ENV[3]	Battery environment detection (NC)
J4.2	BtG	Battery ground fault detection (NC)
J4.3	GEN[1, 2]	On generator (NO)
J4.4	＋12V	+12V power
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 will limit the battery charging		

The UPS accepts external signaling from voltage-free (dry) contacts connected to finger-proof, push-in terminal J4. Subject to prior software programming, the signaling is accepted by the UPS when connection between the relevant terminal and the +12V terminal of J4 is altered. Cables connected to J4 must be segregated from power circuits (for screening purposes), double insulated and of a typical 0.5 to 1mm^2 cross-section area for maximum runs between 25 and 50 meters, respectively.

2. Maintenance bypass cabinet port (J26, J30)

J26 and J30 are the maintenance bypass cabinet (MCB) port. The ports are described in Table 3-4.

Table 3-4 Description of maintenance bypass cabinet port

Position	Name	Description
J26.1	T_IT*	Input transformer overtemperature (NC)
J26.2	AUX_I	(Reserved)
J26.3	＋12V	+12V power
J26.4	GND	Power ground
J30.1	FUSE	(Reserved)
J30.2	F_FAN	Fan fail alarm (NC)
J30.3	T_OT*	Output transformer overtemperature (NC)
J30.4	AUX_O	(Reserved)
Note*: Must be configured by software before becoming active		

Note
All auxiliary cables must be double insulated. Wire should be 0.5~1.5mm^2 stranded.

Dry contact output port (X1)

There are three output dry contact relays at the X1 slot, see Figure 3-6 and Table 3-5.

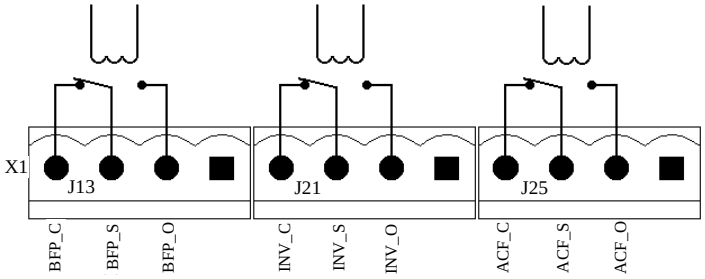


Figure 3-6 Dry contact output port

Table 3-5 Description of dry contact output port

Position	Name	Description
J13.2	BFP_O	Bypass feedback protection relay (NO)
J13.3	BFP_S	Bypass feedback protection relay center
J13.4	BFP_C	Bypass feedback protection relay (NC)
J21.2	INV_O	On inverter dry contact relay (NO)
J21.3	INV_S	On inverter dry contact relay center
J21.4	INV_C	On inverter dry contact relay (NC)
J25.2	ACF_O	Main input voltage or frequency fault relay (NO)
J25.3	ACF_S	Main input voltage or frequency fault relay center
J25.4	ACF_C	Main input voltage or frequency fault relay (NC)

Note

All auxiliary cables must be double insulated. Wire should be 0.5~1.5mm^2 stranded.

EPO input port (X2)

The UPS has an Emergency Power Off (EPO) function that operates by a button on the UPS door or by a remote contact provided by the user.

The X2 slot, shown in Figure 3-7, is the remote EPO input port, which is described in Table 3-6.

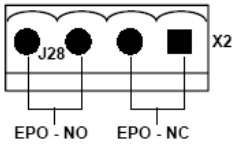


Figure 3-7 EPO input port

Table 3-6 Description of EPO input port

Position	Name	Description
J28.1	EPO_NC	EPO activated when opened to J28.2
J28.2	EPO_NC	EPO activated when opened to J28.1
J28.3	EPO_NO	EPO activated when shorted to J28.4
J28.4	EPO_NO	EPO activated when shorted to J28.3

The remote EPO facility is connected to the normally open or normally closed remote stop switch between these two terminals using shielded cable. If this function is not used, terminals J28: 3&4 must be opened and J28: 1&2 must be closed.

Note

The emergency stop action within the UPS shuts down the rectifier, inverter and static bypass. It does not internally disconnect the input power supply. To disconnect ALL power to the UPS, open the upstream feeder breaker(s) when the remote EPO is activated.
Normally closed EPO–J28: 1, 2, these terminals are supplied factory-linked on the monitor board.

Auxiliary DC power output port (X5)

The auxiliary DC power output port X5 provides auxiliary DC power for optional SNMP card. The voltage is between 9V to 12V. The maximum current is 500mA.

Communication ports

The communication ports include the serial ports RS232-1 and RS232-2, Intellislot intelligent communication ports.

1. Serial ports RS232-1 and RS232-2

RS232-1 provides serial data and is intended for direct use with Emerson UPSitePlus^{TM} UPS monitoring software.

RS232-2 provides serial data and is intended for use by authorized commissioning and service personnel.

2. Intellislot intelligent communication ports

There are three intelligent communication ports (Intellislot 1, Intellislot 2, and Intellislot 3) available for installing optional SNMP card, UPS JBUS/MODBUS adapter, and relay card.

The serial ports RS232-1, RS232-2, and the Intellislot intelligent communication ports share the same communication resources, as described in Table 3-7.

Table 3-7 Communication port resource deployment table

Port	On the UPS LCD screen, under Settings, controlled by:	Monitoring devices supported	Baud rate	Comments
Intellislot 2	Comm 1	SNMP card	9600	Not simultaneous with RS232-2
		JBUS/MODBUS adapter	Any	
		Relay card	Any	
Intellislot 1	Comm 2	SNMP card	9600	Not simultaneous with RS232-2
		JBUS/MODBUS adapter	Any	
		Relay card	Any	
Intellislot 3	Comm 3	SNMP card	9600	Not simultaneous with RS232-2
		JBUS/MODBUS adapter	Any	
		Relay card	Any	
RS232-1	Comm 1	UPSitePlusTM UPS monitoring software	9600	-
RS232-2	Comm 2	Commissioning and service software (only for use by authorized commissioning and service personnel)	9600	Not simultaneous with the three Intellislot ports

3.3.2 Battery Control

The BCB is controlled by the BCB control board. Both are located within the BCB box. This board controls the circuit breaker's undervolts release coil and also provides a path for the circuit breaker auxiliary contacts to signal the circuit breaker status back to the UPS control logic.

All connections between the BCB control board and the UPS module are made through the auxiliary terminal block X3 located on the base of the UPS Cabinet. X3 is shown in Figure 3-8 and described in Table 3-8.

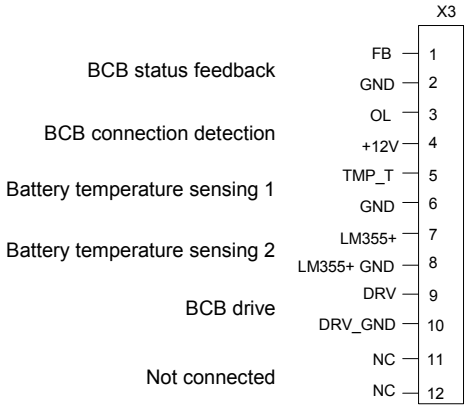


Figure 3-8 Auxiliary terminal block X3

Table 3-8 Description of auxiliary terminal block X3

X3 terminal reference	Reference label	Description
1	FB	BCB normally open auxiliary contact
2	GND	Signal ground
3	OL	Cable detection
4	+12V	Power positive
5	TMP_T	Temperature sensing terminal
6	GND	Temperature sensing signal ground
7	LM355+	LM335 detection positive
8	LM355+GND	LM335 signal ground
9	DRV	BCB drive
10	DRV_GND	Drive ground

Note:
1. The auxiliary cables of the battery must be screened and double insulated.
2. The screen is connected to the earth of the battery cabinet or supporting rack.
3. Use multiple-core shielded cables with a section of 0.5 to 1 mm^2.
4. Connect the cables with the fast-on 6.3*0.8 mm terminals (female)

Connect the BCB control and temperature compensation cables between the UPS auxiliary terminal block X3 and BCB control board. For details, refer to Figure 6-5. These cable must be shielded, shield should be connected at protective earth of battery cabinet or battery breaker, not of UPS.

Note

If battery temperature compensation is needed, this function must be activated by the commissioning engineer.

3.4 Connecting Main Cabinet And Side Cabinet

The 300kVA UPS (12-pulse rectifier) and 400kVA UPS comprise a main cabinet and a side cabinet.. In installation, you need to make electrical connection between the main cabinet and side cabinet.

3.4.1 Connecting Power Cables

The power cable connections between the main cabinet and side cabinet of the 300kVA UPS (12-pulse rectifier) and 400kVA UPS are shown in Figure 3-9 to Figure 3-11. The installation engineer should make cable connection in strict accordance with these figures.

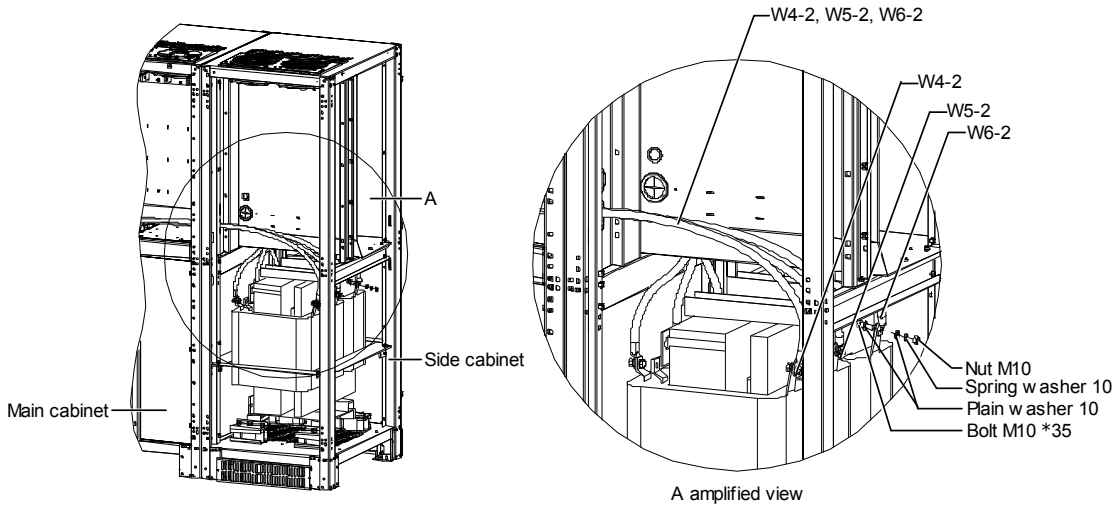


Figure 3-9 Power cable connection between main cabinet and side cabinet of 300kVA UPS (12-pulse rectifier)

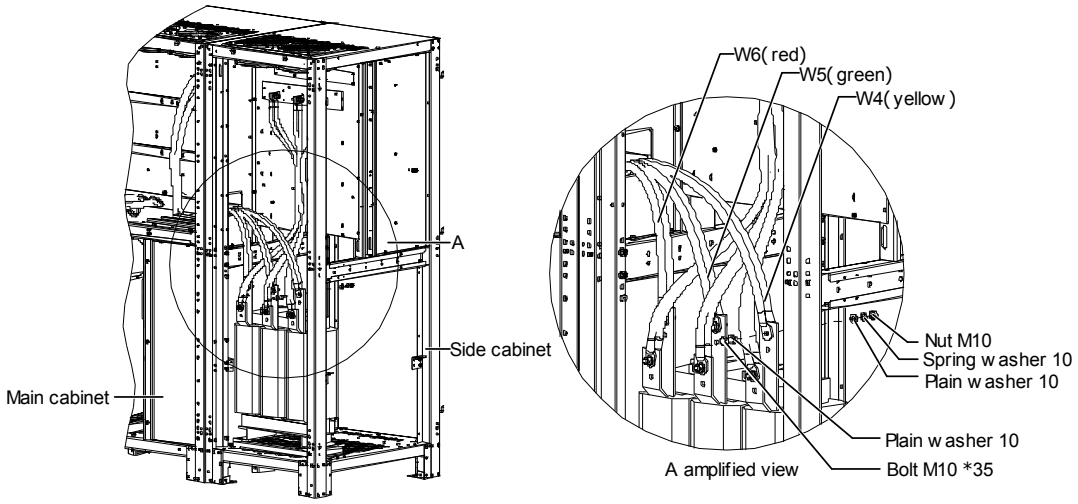


Figure 3-10 Power cable connection between main cabinet and side cabinet of 400kVA UPS (6-pulse rectifier)

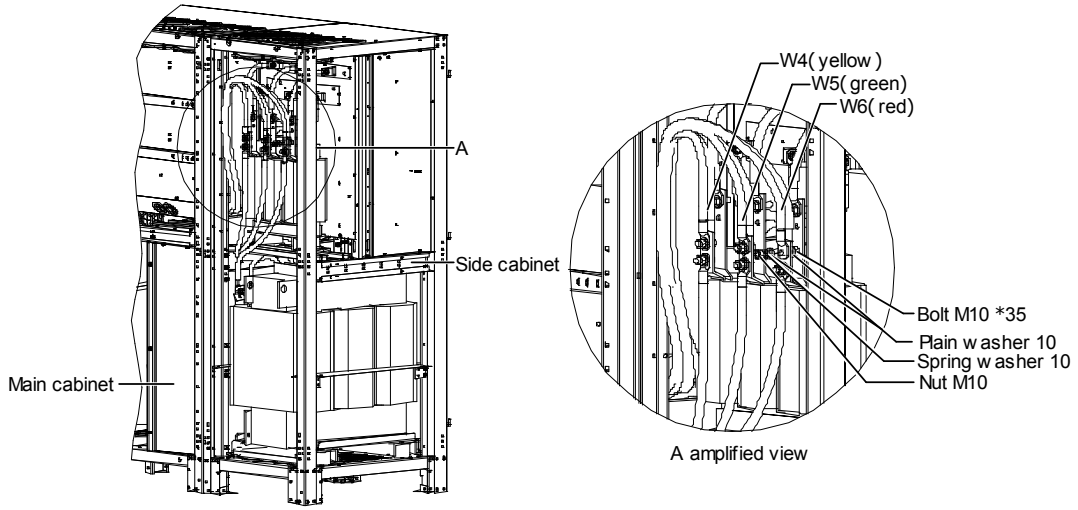


Figure 3-11 Power cable connection between main cabinet and side cabinet of 400kVA UPS (12-pulse rectifier)

3.4.2 Connecting Signal Cables

You need not connect signal cables between the main cabinet and side cabinet of the 300kVA UPS (12-pulse rectifier).

When you connect signal cables between the main cabinet and side cabinet of the 400kVA UPS, you should connect the signal cables from the main cabinet to the corresponding ports on the ULW366SA8 board of the side cabinet. The connection relationship is shown in Table 3-9, you just need to connect the J2, J4, J6, J7 and J10 ports. The positions of the ports on the ULW366SA8 board are shown in Figure 3-12.

Table 3-9 Signal cable connection between main cabinet and side cabinet of 400kVA UPS

Port (side cabinet)	Cable No. (main cabinet)	Meaning
J2	W98-12	Fan power
J4	W98-13	Fan power
J6	W45	Rectifier current detection
J7	W41-5	Fuse fault detection
J10	W58	Rectifier drive

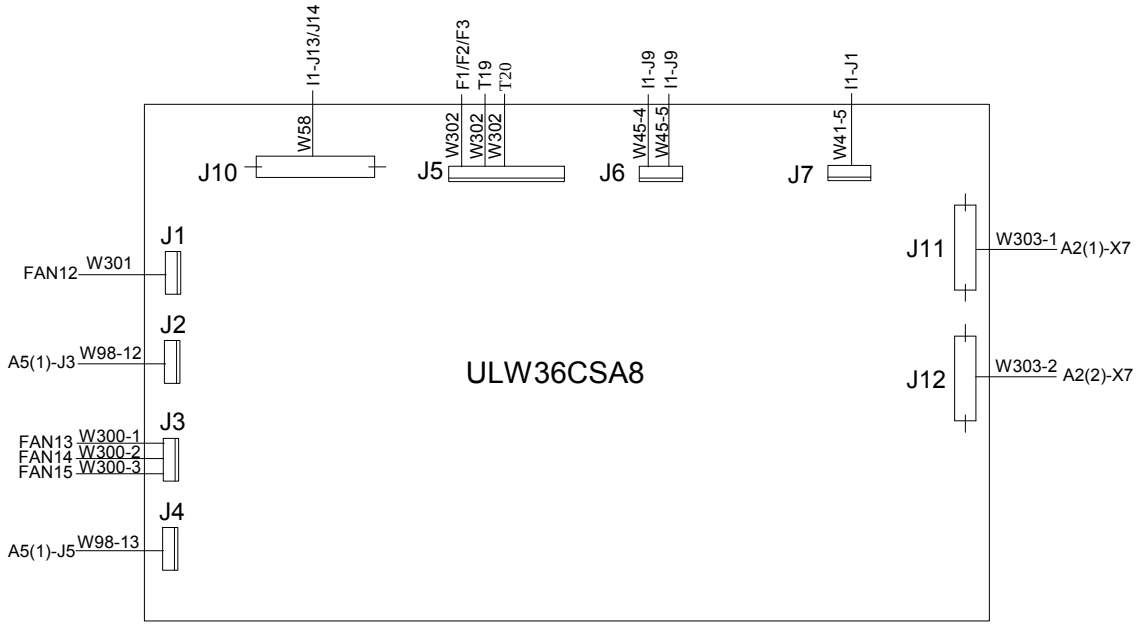


Figure 3-12 Signal cable connection between main cabinet and side cabinet of 400kVA UPS

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 HIPULSE U UPS, and provides LCD display information, including the LCD screen types, detailed menu messages, prompt windows and UPS alarm message list

4.1 Introduction

The operator control and display panel is located on the front door of the UPS. The panel is the access point for operator control and monitoring of all measured parameters, UPS and battery status and of event and alarm logs.

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

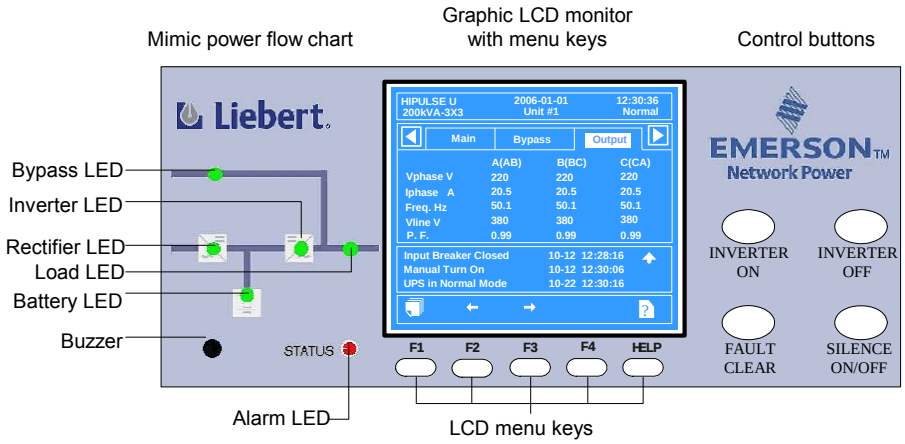


Figure 4-1 Operator control and display panel

4.1.1 LED Indicators

The six LEDs mounted on the mimic flow chart represent the various power paths of the UPS, and indicate the current UPS operational status and alarm status by color (red, green, yellow) and state (ON, OFF, flashing), as described in Table 4-1.

Table 4-1 Description of LED indicators

LED	State	Description
Rectifier LED	Steady green	Rectifier in normal operation
	Flashing green	Input AC normal, but rectifier not operating
	Steady red	Rectifier f failed
	OFF	Rectifier not operating, input ac not available or out of normal range
Bypass LED	Steady green	Load on bypass power
	Steady red	Bypass not available, out of normal range or static bypass switch fault
	OFF	Bypass normal, load not on bypass power
Battery LED	Steady green	Battery normal, but discharging and powering the load
	Flashing green	Battery end-of-discharge pre-warning
	Steady red	Battery abnormal (failed, absent or polarity reversed) or battery circuit breaker abnormal
	OFF	Battery and battery circuit breaker normal, battery charging
Inverter LED	Steady green	Inverter normal and powering the load
	Flashing green	Inverter ON, starting up, synchronizing, or standing by (ECO mode)
	Steady red	Inverter failed
	OFF	Inverter not operating

LED	State	Description
Load LED	Steady green	UPS output ON and normal
	Steady red	UPS output ON and overloaded
	OFF	UPS output OFF
Alarm LED (STATUS)	Steady green	Normal operation
	Steady yellow	UPS warning (for example, AC input failure)
	Steady red	UPS fault (for example, fuse or hardware failure)

4.1.2 Buzzer

The operator control and display panel provides a buzzer. UPS activity is accompanied by the following sounds.

Table 4-2 Audible alarm description

Single beep	Direct access key acknowledgement
One beep per second	UPS warning. For example, AC input failure
Continuous beep	Fault. For example, fuse or hardware failure

4.1.3 Control Buttons

The operator control and display panel provides four control buttons, as described in Table 4-3.

Table 4-3 Description of control buttons

Control button	Description
INVERTER ON	Pushing this button turns on the inverter. Note: If the inverter is not ready, pushing this button cannot turn on the UPS
INVERTER OFF	During UPS operation, pushing this button turns off the inverter and transfers the load to the bypass
FAULT CLEAR	In case the UPS shuts down due to fault, after eliminating the alarm conditions, pushing this button clears the fault
SILENCE ON/OFF	When an alarm is active, pushing this button silences the audible alarm. When a new alarm occurs afterwards, the buzzer will give audible alarm again. When there is no audible alarm, pushing this button initiates the audible alrm test

Note

To activate the above control buttons, you are required to press and hold the buttons for approximately 2 seconds until a beeping sound is heard.

4.1.4 LCD And Menu Keys

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

Table 4-4 Menu key icons and their meaning

Key	F1	F2	F3	F4	HELP
Function 1	Shift	Left	Right	Enter	Help
Function 2	ESC Escape	Up	Down		

The user-friendly and menu-driven LCD allows you to easily browse through the input, output, load and battery parameters, 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.

As shown in Figure 4-2, the LCD primary screen is divided into five windows: system information window, menu window, UPS data window, and current record window. Pressing the F1 key scrolls through the user-operable windows.

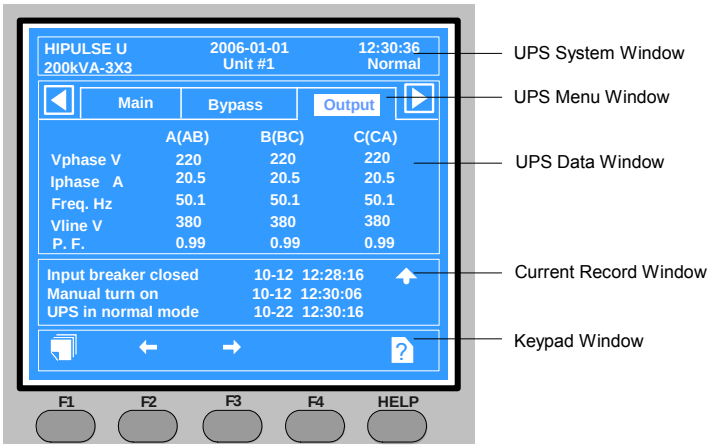


Figure 4-2 LCD primary screen

4.1.5 Detailed Description Of Menu Items

The description that follows refers to the LCD primary screen shown on Figure 4-2.

System information window

The system information window displays current time and date and identifies the UPS, its configuration and its status. For details, see Table 4-5.

Table 4-5 System information window

No.	Item	Explanation
1	HIPULSE U	UPS family name
2	2006-01-01	Current date
3	12:30:36	Current time
4	200kVA-3x3	200kVA: UPS rated output 3 x 3: 3-phase input and output
5	(Configuration) Single, ECO, or Unit # 1	Single: single unit ECO: single unit operating in ECO mode Unit # 1: of max 6 units in a parallel system
6	(Status) Normal, Warning, or Fault	Normal: UPS in normal operation, load on inverter, no alarm Warning: system attention required Fault: serious UPS fault existing

Menu window and UPS data window

The menu window provides the menus of the STS data window. The UPS 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 UPS data window. Details are provided in Table 4-6.

Table 4-6 Menu window and UPS data window

No.	Menu	Item	Explanation
1	Mains	L-L voltage (V)	Line voltage
		Frequency (Hz)	Input frequency
2	Bypass	L-N voltage (V)	Phase voltage
		Frequency (Hz)	Bypass frequency
		L-L voltage (V)	Line voltage
3	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

No.	Menu	Item	Explanation
4	Load	Sout (kVA)	Apparent power
		Pout (kW)	Active power
		Qout (kVAR)	Reactive power
		Loadlevel (%)	The percentage of the UPS rating load
		Crest factor	Output current crest factor
5	System	Sout (kVA)	Apparent power
		Pout (kW)	Active power
		Qout (kVAR)	Reactive power
		Single system, no parallel data	When configured as a single unit, UPS has only native load, no system load
6	Battery	Battery voltage (V)	Battery bus voltage
		Battery current (A)	Battery bus current
		Battery temperature (°C)	Internal battery temperature °C
		Battery remain time (Min.)	Battery run time remaining
		Battery boost charging	Battery is boost charging
		Battery float charging	Battery is float charging
		Battery is not connected	Battery is not connected
7	Records	…… Inverter output abnormal 20-01-2006 11:30:02 22-01-2006 13:38:06 Battery maintained 22-01-2006 13:38:02 22-01-2006 13:38:36 ……	Displays up to 512-event history log indicating system status with start/stop date and time stamp for each event. You may scroll through the history log. Refer to Table 4-8 for a complete list of UPS alarm messages
8	Language	中文/English	Selects display in Chinese or English. Use F1, up and down arrow keys (F2, F3) to select this menu item, and press the Enter key (F4). Use left and right arrow keys (F2, F3) to reach desired language and press the Enter key (F4)
9	Settings	Display contrast	Adjusts the graphic LCD monitor contrast for best viewing. Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt this setting. Press the Enter key (F4). Select setting with left and right arrows (F2, F3) and press the Enter key (F4)
		Date format set	YYYY MM DD, DD MM YYYY and MM DD YYYY formats can be selected. Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt this setting. Press the Enter key (F4). Select setting with left and right arrows (F2, F3) and press the Enter key (F4)
		Date & time	Adjusts time (in 24-hr format) and Date format (in user defined format previously set). Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt this setting. Press the Enter key (F4). Enter each date or time digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered
		Comm1 baud rate (Monitoring board RS232-1, Intellislot 2) Comm2 baud rate (Monitoring board RS232-2, Intellislot 1) Comm3 baud rate (Monitoring board Intellislot 3)	Adjusts the transmission speed of any of the 3 UPS communication ports available. Available settings are - 9600bps (default setting, SNMP card supports this baud rate only) - 4800bps - 2400bps Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt the desired port and baud rate. Press the Enter key (F4)

No.	Menu	Item	Explanation
9	Settings	Communication address	This setting applies to RS485 communication and the "one-to-multiple points" communication mode of parallel system. It is required to set the parameter Host communication mode of COM1 in parallel system to Multipoint to point using background software before setting the communication address of each UPS module
		Communication mode	Reserved modem function. No need to change the default setting "RS232"
		Callback times	(reserved)
		Phone No.1	(reserved)
		Phone No.2	(reserved)
		Phone No.3	(reserved)
		Command password	Modifies password for the Command menu. Use the Shift key (F1) to highligt Command Password, press the Enter key (F4). Enter each old password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered. Follow prompts and repeat the process for new password
10	Command*	Battery maintenance test	Manually initiates battery maintenance test, which will lead to the battery being partly discharged, for rough assessment of the battery capacity. The Load must exceed 20% and be less than 80% of rated UPS capacity, and the battery must have been float charging for 5 hours or more. Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt the desired test. Press the Enter key (F4). Enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered
		Battery capacity test	Manually initiates battery capacity test, which will lead to the battery being completely discharged, for accurate assessment of the battery capacity. The Load must exceed 20% and be less than 80% of rated UPS capacity, and the battery must have been float charging for 5 hours or more. Use the Shift key (F1) and up and down arrow keys (F2, F3) to highligt the desired test. Press the Enter key (F4). Enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered
		System test	Manually initiates the system test. The user actives this function, after 5 seconds, a pop window will appear to show the result of this diagnosis: Rectifier, Inverter, Monitor OK or Fault
		Stop testing	Manually stop the test, including maintenance test, capacity test and system test
		Freshening charge	Manually initiates freshening charge, when the battery is not in boost charge state. Use the Shift key (F1) and up and down arrow keys (F2, F3) to highlight this item. Press the Enter key (F4). Enter each password digit with up arrow (F2) and use right arrow (F3) to access next field. Press the Enter key (F4) when all digits have been entered
		Stop freshening charge	Manually stop the freshening charge
11	Version	Monitor Version：Vxxx Rectifier Version：Vxxx Inverter Version：Vxxx	Displays UPS firmware versions, including inverter, rectifier, monitoring board firmware versions
		UPS model	Displays UPS model information; for example, 380V-50Hz
Note*: password controlled. The default passward is "12345", please enter Settings=>Command password to change the password. In case the password is lost, please contact the local customer service center of Emerson			

Current record window

Keeps a log of current alarms, ignores transient conditions that have been resolved. Use F1, F2 and F3 to read the alarm messages.

For a complete history log, refer to the **Records** menu in Table 4-6.

Refer to Table 4-8 for a complete list of UPS alarm messages.

Keypad window

The function of menu keys F1 to F4 and HELP is shown by a self-explanatory icon as appropriate for the particular window.

4.1.6 EPO Button

As shown in Figure 4-3, the UPS door provides an emergency power off (EPO) button. It is housed beneath a safety cover to prevent inadvertent operation. After the EPO button has been pressed and hold for 2 seconds, it disables the static switch block entirely (so removing load power). It also disables the rectifier and inverter, and trips the battery circuit breaker. Under normal circumstances it does not remove UPS input power since this is applied through a manually controlled external isolator; however, if the UPS input supply is connected through circuit breaker having an electrical trip facility, the EPO switch can be used to drive the external circuit breaker's trip circuit so as to remove the UPS input power.

Figure 4-3 Emergency power off button

4.2 LCD Screen Types

4.2.1 Start Screen

Upon UPS start, the UPS executes system test, and the start screen will appear and remains approximately 15 seconds, as shown in Figure 4-4.

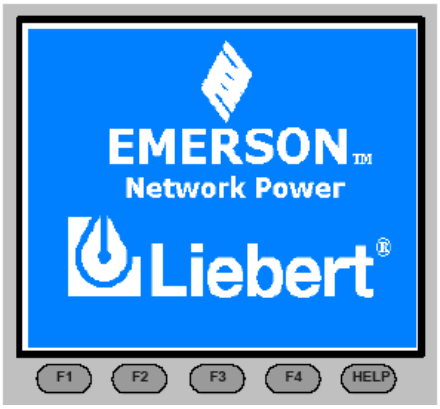


Figure 4-4 Start screen

4.2.2 Primary Screen

After the UPS starts and finishes system test, the primary screen will appear, as shown in Figure 4-5. For details about the primary screen, refer to *4.1.5 Detailed Description Of Menu Items*.

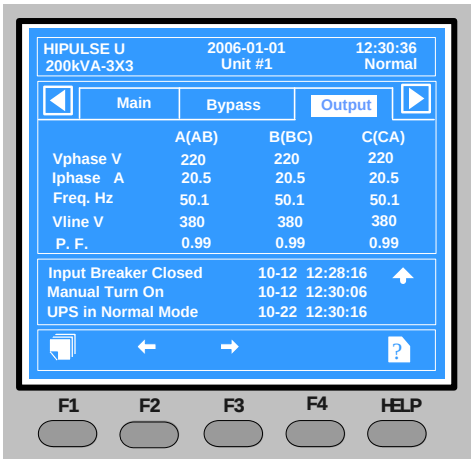


Figure 4-5 Primary screen

4.2.3 Default Screen

During UPS operation, if there is neither an alarm nor a keypad operation within two minutes, the default screen will appear, as shown in Figure 4-6. Two minutes later, the LCD backlight will turn off. When an alarm occurs or a key is pressed, the primary screen will return, and the LCD backlight will turn on.

The LCD will also return to the primary screen when pressing any menu key at the default screen.

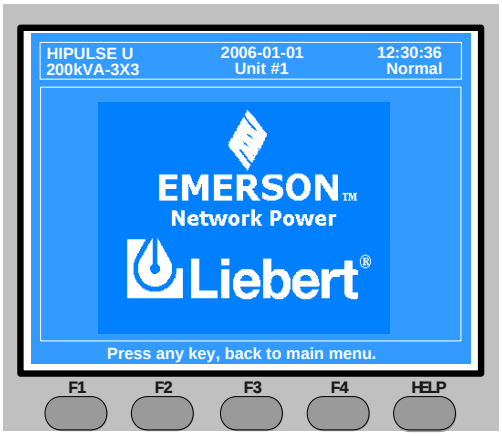


Figure 4-6 Default screen

4.2.4 Help Screen

At the primary screen, use the HELP key to display the help screen, as shown in Figure 4-7. This screen describes current meanings of the menu keys to help you with the menu operation. Pressing the HELP key exits the help screen and returns to the primary screen.

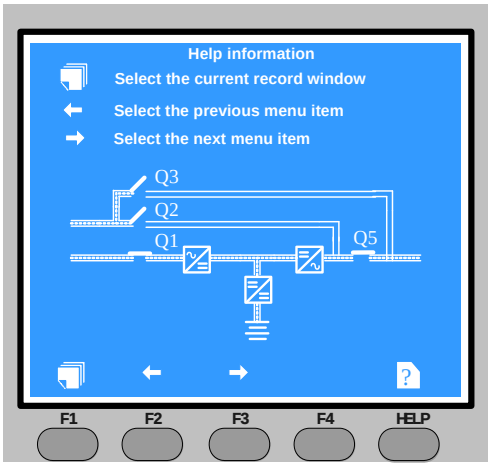


Figure 4-7 Help screen

Operation of the HELP key:

1. Only at the primary screen can you use the HELP key to display the help screen.

2. The HELP key is invalid at the start screen.

3. At the default screen, help screen, or when the LCD backlight is off, the primary screen will return if you press the HELP key.

4.3 Prompt Window

A prompt window is displayed during the operation of the system to alert you to certain conditions and/or to require your confirmation of a command. The prompts are provided in Table 4-7.

Table 4-7 Prompts and meanings

No.	Prompt	Meaning
1	Transfer with interrupt, confirm or cancel	Inverter and Bypass supplies are not synchronized and any load transfer between the supplies will cause a brief load interruption
2	The load is too high to be transferred with interrupt	The total load must be less than the capacity of one unit to allow a parallel system to perform an interrupted transfer from bypass to inverter
3	This operation leads to output shutdown, confirm or cancel	No alternative supply is available and any Inverter Off operation will cause the load to be de-energised
4	This operation leads to inverter overload, confirm or cancel	Turning off this inverter will lead to the overload of remaining inverter(s) in a parallel system
5	Turn on more UPS to carry current load	The number of paralleled inverters already turned on is insufficient to carry the existing load
6	Battery will be depleted, confirm or cancel	Battery capacity test discharges the battery 100%. This prompt apears to require your confirmation. Cancelling the test will ends the test and transfers the UPS to Normal mode
7	System selftest finished, everything is ok	No action required
8	System selftest finished, please check the current warnings	Check the current record window
9	Enter control password	Required for battery or UPS test (default: 12345)
10	Battery selftest condition is low, please check battery state and loadlevel	Battery test condition is not met. Please check whether the battery is in boost charge state and the load level meet the battery test conditions. To initiate the battery test, the load must range between 20% and 80%
11	Freshening charge condition is low, please check battery settings and state	This prompt appears when you select the freshening charge command while the freshening charge condition is not met (such as no battery, charger failure)

4.4 UPS Alarm Message List

Table 4-8 provides the complete list of UPS alarm messages supported for display either on the Records menu (historical data) or in the current record window (prevailing data) as described in *4.1.5 Detailed Description Of Menu Items*.

Table 4-8 UPS alarm message list

Alarm message	Description
Rectifier comm. fail	Internal RS485 communication failure between monitor and rectifier
Mains volt. abnormal	Mains Voltage exceeds the upper or lower limit and results in rectifier shutdown. Check the input line-to-neutral voltage amplitude of rectifier
Mains undervoltage	Mains voltage is undervoltage. Check the input line voltage
Mains freq. abnormal	Mains frequency is out of limit range and results in rectifier shutdown. Check the input voltage and frequency
Battery fuse fail	Battery fuse flowout led to BCB tripping
Rectifier block	Rectifier detected faulty. Rectifier shuts down. Battery discharges
Rectifier overtemp.	The temperature of heat sink is too high to keep the rectifier running. The UPS can recover automatically. Check the environment and ventilation
Input fuse fail	Input fuse blowout led to rectifier turning off
Control power 1 fail	UPS operates but Control Power is not available
Control power 2 fail	UPS operates but Redundant Control Power is not available
Mains phase reversed	Rectifier AC input phase sequence is reversed
Rectifier current limit	Rectifier overcurrent led to power limiting operating
Soft start fail	Rectifier could not start due to low DC bus voltage
Input filter fault	Filter inductor overtemperature led to filter contactor tripping
Filter contactor fault	Filter contactor operation abnormal
Filter overcurrent	Mains power outside the normal voltage or frequency range of the input passive filter results in filter overcurrent. Please find out the reason for the mains power abnormality
REC drive cirtuit fault	Rectifier being off due to improper connection of rectifier drive cable or rectifier type setting error
REC input Ph. missing	Rectifier input phase missing. Check the input power connection or if the mains power is abnormal
DC bus over voltage	Rectifier and inverter were shut down because DC bus voltage is too high. Check whether there is a fault in rectifier side
Bus capacitor overvolt	Bus capacitor voltage exceeds 350V, rectifier is off. Check the voltages of the two groups of bus capacitors
EPO	Emergency Power Off direct access key pressed or external command received
Input disconnect open	Rectifier input switch open
Input disconnect closed	Rectifier input switch closed
Normal mode	Load supplied from inverter output through double conversion of the AC mains input supply
Source share mode	Load supplied from inverter output through shared double conversion of the AC mains input supply and of the Battery supply
PPF online	Reactive input filter connected
PPF disconnecting	Reactive input filter disconnected
Battery mode	Load supplied from inverter output through battery
No battery	Check the battery and the battery wiring; check whether the BCB is closed and the BCB dry contact is connected
Auto start	After UPS was shutdown at EOD, inverter auto starts when utility restore
Generator connected	The generator has been connected to the UPS
BCB open	Battery Circuit Breaker status (open)
BCB closed	Battery Circuit Breaker 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	Automatic periodic battery maintenance discharge test (20% capacity discharge)
Batt. capacity testing	User initiated battery capacity discharge test (100% capacity discharge)
Batt. maint. testing	User initiated maintenance discharge test (20% capacity discharge)
UPS system testing	User initiated system test
Inverter in setting	Inverter starting up and synchronizing
Rectifier in setting	Rectifier starting up and synchronizing
Battery Room Alarm	Environment in Battery Room Needs Attention

Alarm message	Description
REC FLASH UPDATE	Ongoing update of rectifier firmware
INV FLASH UPDATE	Ongoing update of inverter firmware
MONITOR FLASH UPDATE	Ongoing update of monitor firmware
Unit off confirm	Prompt to press the Enter key (F4) to acknowledge that the UPS will be disconnected from other paralleled UPS modules
System off confirm	Prompt to press the Enter key (F4) to acknowledge that the all paralleled UPS will be disconnected from the load
Fault reset	FAULT CLEAR direct access key pressed
Alarm silence	SILENCE ON/OFF direct access key pressed
Turn on fail	Inverter failed to turn on when INVERTER ON direct access key was pressed. This may be as a result of Invalid Operation (Maintenance bypass on) or DC bus or rectifier not ready
Alarm reset	FAULT CLEAR or SILENCE ON/OFF direct access key pressed
Transfer confirm	Prompt to press the Enter key (F4) to acknowledge that an interrupted load transfer to bypass will happen
Transfer cancel	Prompt to press the ESC key (F4) to avoid that an interrupted load transfer to bypass will happen
Manual turn on	Manual Turn On through operator control and display panel
Manual turn off	Manual Turn Off through operator control and display panel
Battery ground fault	Battery leakage to ground detected (option)
Protocol version clash	Firmware incompatibility between Monitor Board and Digital Signal Processor Board
Setting save error	History records not saved. (Reserved)
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 UPS room
Battery fault	Battery detected faulty (Reserved)
Battery maintained	Battery test failed, Battery should be replaced
Battery low pre-warning	Before the end of discharge, battery undervoltage pre-warning should occur. After this pre-warning, battery should have the capacity for 3 minutes discharging with full load. The time is user-configured from 3 to 60 minutes. Shut down the load in time
Battery end of discharge	Inverter turned off due to low battery voltage. Check the utility failure and try to recover it
Inverter comm. fail	Internal RS485 communication failure between monitor and inverter
Parallel comm. fail	The CAN communication between different UPSs within a parallel system fails. 1.Check if there are some UPSs not powered on in the parallel system. If so, power on these UPSs and check if the alarm disappears. 2. Press the FAULT CLEAR push button
Bypass unable to trace	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage is beyond the normal range. The amplitude threshold is fixed for positive and negative 10% rating. This alarm automatically resets once the bypass voltage goes normal. 1. First verify that the bypass voltage and frequency displayed on the operator control and display panel is within the selected range. Note here the rated voltage and frequency are specified by the system 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 to be faulty
Bypass abnormal	This alarm is triggered by an inverter software routine when the amplitude or frequency of bypass voltage exceeds the limit. This alarm automatically resets once the bypass voltage goes normal. First check if there are some relevant alarms such as Bypass disconnect open, Bypass phase reverse. If they appear, solve them first. 1. Then verify that the bypass voltage and frequency displayed on the operator control and display panel is within the bypass limit. Note here the rated voltage and frequency are specified by the system 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 bypass supply if it is found to be faulty. If the utility is likely to trigger this alarm frequently, the bypass limit can be changed a little larger through the configuration software according to the customer's agreement
Inverter asynchronous	This alarm is triggered by an inverter software routine when the inverter and bypass waveforms are misaligned by more than 6 degrees in phase. 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 output abnormal	Inverter output voltage beyond limits. Load transfers to bypass

Alarm message	Description
Inverter overtemp.	The temperature of the inverter heat sink is too high to keep inverter running. This alarm is triggered by the signal from a temperature monitoring thermostat on the inverter bridge heat sink. The UPS will recover automatically after a 5 minute delay from the disappearance of the overtemperature signal. If the overtemperature condition is true, then check for and verify: 1. high ambient air temperature. 2. blocked cooling airway. 3. any fan failure. 4. prolonged inverter overload
Fan fault	At least one of the cooling fans has failed
Inverter STS fail	At least one of the static switches of inverter side is open or short circuit. This fault is locked until power off
Bypass STS fail	At least one of the static switches of bypass side is open or short circuit. This fault is locked until power off
Operation invalid	This record is registered following an incorrect operation
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 being overloaded. 2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm
System over load	The UPS parallel system is confirmed to overload when the total load arises above 105% nominal rating for the set basic number of UPSs. The alarm automatically resets once the overload condition is removed. 1. Confirm that the alarm is true by checking the system load percent indicated on the LCD to determine which phase is being overloaded. 2. If the alarm is true, measure the actual output current to verify that the indications are valid. Disconnect unnecessary load and ensure the safety. In a parallel system, a severe load sharing error can also leads to the alarm
Unit over load timeout	The UPS is confirmed to overload and the overload times out. Note 1: the highest loaded phase will indicate overload timing-out first. Note 2: When the timer is active then alarm “unit overload” should also be active as the load is above nominal. Note 3: When the timer has expired, the inverter Static Switch is opened and the load transferred to bypass. The inverter shutdown and will restart after 10 seconds. Note 4: If the load decreases lower than 95% after 5 minutes, the system will transfer back to inverter mode. Confirm that the alarm is genuine by checking the load percent indicated on the LCD. If an overload is indicated then check the load, and investigate any additional load connected prior to the alarm (if applicable)
Byp. abnormal shutdown	Both bypass and inverter voltages unavailable. Load interruption
Inverter over current	Inverter pulse width modulation module overloaded
Bypass phase reverse	The phase sequence direction of bypass voltage is reversed. Normally, the phase of phase B lags 120 degrees behind phase A, and the phase of phase C lags 120 degrees behind phase B. Verify that the phase rotation of the bypass supply presented to the UPS 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 inverter
Transfer time-out	The load is 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
Load sharing fault	UPS modules within a parallel system are not sharing the load current equally
DC bus abnormal	DC input voltage to inverter beyond limits. Inverter shuts down. Load transfers to bypass
System transfer	The whole paralleled UPS system transferred to bypass at the same time. This message will appear on the UPS which passive transfer to bypass
Parallel board fault	Malfunction of the paralleling control circuits of this UPS module. Can cause system transfer to bypass
Parallel connect fault	The parallel cables are not connected correctly in a parallel system. Reset the fault by pressing the FAULT CLEAR button, then restart the inverter by pressing the INVERTER ON button
Bypass over current	Bypass current is over limit above 135% rating. The UPS just alarms and does nothing
LBS Active	Load Bus Synchronization is active. The UPS is acting as an LBS master or slave in a dual bus configuration
LBS abnormal	UPS set to LBS mode (master or slave), but no LBS signal on LBS bus. Check the LBS bus connection
Byp. induct overtemp.	Bypass load sharing inductor overtemperature. Check the environment and ventilation
Static Sw. overtemp.	Overtemperature of static switch on bypass or inverter side. Check the environment and ventilation

Alarm message	Description
Byp. feedback fault	UPS feeds output voltage back to the mains grill through bypass due to shortcircuit of static switch on bypass side during mains failure. In this case, lack of protective bypass switch or improper connection of switch auxiliary contact will endanger the user safety. Special attention should be paid to this
INV drive circuit fault	Improper connection of inverter drive cable, or equipment type setting error
Bypass disconnect closed	Bypass switch closed
Bypass disconnect open	Bypass switch open
Maint. disconnect closed	Maintenance bypass switch closed
Maint. disconnect open	Maintenance bypass switch open
Output disconnect closed	Output switch closed
Output disconnect open	Output switch open
Check UPS output	The UPS is off and has no output
Output disabled	If the UPS auto-recovery after EOD function is disabled, after UPS shutdown due to battery discharge to EOD (end-of-discharge) voltage, when the mains power is restored, the UPS will not restart automatically, and the LCD will display this alarm message
Normal mode	The UPS is in Normal mode
Battery mode	The UPS is in Battery mode
Source share mode	The UPS is in Source Share mode
Bypass mode	The UPS is in Bypass mode

Chapter 5 Operating Instructions

This chapter provides detailed operating notes and instructions of the HIPULSE U UPS.

5.1 Introduction

5.1.1 Notes

Important
Only after an authorized engineer has conducted the initial power-on and finished the UPS configuration is the user allowed to operate the UPS. No user accessable parts are located behind covers that require a tool for their removal. Only qualified service personnel are authorised to remove such covers. Hazardous voltages are always present at the UPS input and output terminals. If the UPS is fitted with an internal Class A filter, the filter carries hazardous voltages too.

1. All the user controls and indicators (LED) mentioned in these procedures are identified in *Chapter 4 Operator Control And Display Panel*.

2. The audible alarm may annunciate at various points in these procedures. It can be canceled at any time by pressing the SILENCE ON/OFF button.

3. The HIPULSE U UPS system incorporates an optional automatic boost charge facility, which can be used in systems containing conventional flooded lead-acid batteries. If this type of battery is used in your installation you may notice that the battery charger voltage may be greater than its nominal (432Vdc for 380Vac, 446Vdc for 400Vac and 459Vdc for a 415Vac system) when the mains supply returns from a prolonged outage. This is the normal response of the boost charge facility: the charger voltage should return to normal after a few hours.

5.1.2 Power Switches

The UPS can be separated by means of power switches, mounted inside the cabinet and accessible after opening the front door, which has a key. The location of the UPS power switches is shown in Figure 5-1 and Figure 5-2.

The UPS module power switches are:

Q1 — input switch: Connects the UPS with the mains supply.

Q2 — bypass switch: Connects the UPS with the bypass supply.

Q3 — maintenance bypass switch (padlocked): Permits supply of the load directly by the bypass line for maintenance of the UPS module.

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

Q5 — output switch: Connects the output of the UPS to the load.

Note: The battery circuit breaker (BCB) is not expected inside of the UPS and should be installed in the proximity of the respective battery.

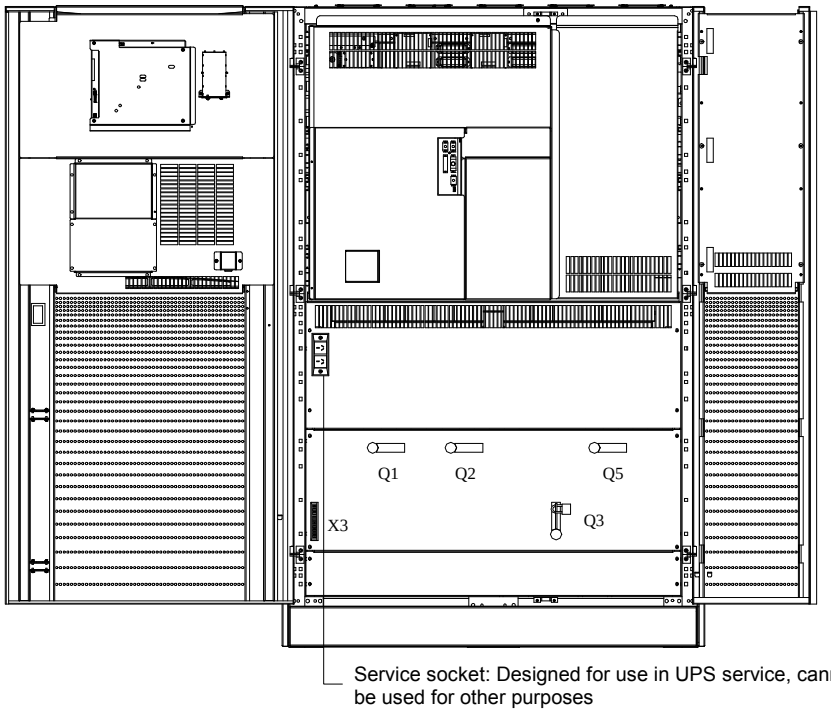


Figure 5-1 Power switch location of 160/200kVA UPS

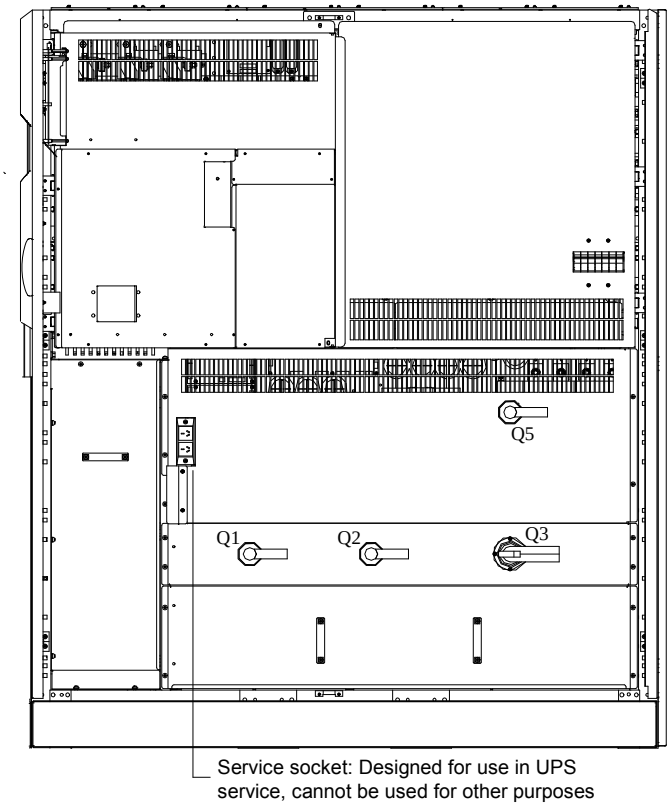


Figure 5-2 Power switch location of 300/400kVA UPS

5.2 Start-Up Procedure (Into Normal Mode)

This procedure must be followed when turning on the UPS from a fully powered down condition, that is, where the load is not being initially supplied at all or where supplied by the maintenance bypass switch. It is assumed that the installation is complete, the system has been commissioned by authorized personnel and the external power isolators are closed.

 Warning – Mains voltage will be applied to UPS output terminals
This procedure results in mains voltage being applied to the UPS output terminals. Isolate and attach warning labels to any downstream load connections, as applicable.

1. Open the UPS door to gain access to the power switches.
2. Close the bypass switch Q2 and output switch Q5. Close also any external output isolation switches, where used.

The LCD display becomes active and after initialization, the UPS output is powered from the bypass. At this point, the status of the LEDs is as described in Table 5-1.

Table 5-1 LED status

LED	Status
Bypass LED	Steady green
Load LED	Steady green
Battery LED	Steady red
Alarm LED	Steady yellow

3. Close the input switch Q1.

The rectifier LED flashes during the startup of rectifier and becomes steady green once the rectifier reaches normal operation state after about 15s.

4. Verify the bus voltage and the battery polarities, and close the BCB, which is located in the BCB box.
5. Following battery availability being detected by the UPS, the red battery LED extinguishes.
6. Open (or confirm open) the internal maintenance bypass switch Q3.
7. Press and hold the INVERTER ON button for two seconds.

The inverter will start up and the inverter LED flashes while it synchronizes to the bypass voltage frequency.

After the inverter is ready, the UPS transfers from bypass to inverter, the bypass LED turns off, and the inverter LED becomes steady green.

8. Check that no “Warning” message is displayed in the top right corner of the LCD screen and the status of the LEDs is as described in Table 5-2.

Table 5-2 LED status

LED	Status
Rectifier LED	Steady green
Bypass LED	Off
Battery LED	Off
Inverter LED	Steady green
Load LED	Steady green
Alarm LED	Off

The UPS is now operating in Normal mode

5.3 Start-Up Procedure (Into ECO Mode)

Apply only to a single module UPS and when programmed by the commissioning engineer to perform ECO mode control of the power delivered to the load.

Follow previous *5.2 Start-UP Procedure (Into Normal Mode)* and observe at the end of the procedure that bypass LED on the operator control and display panel remains green (indicating that the load is supplied by the bypass mains).

The UPS is now operating in ECO mode

5.4 Battery Test Mode Procedures

The Battery test mode procedures transfer the UPS into shared source mode wherein approximately 15% of the load power is supplied by the battery and the balance by the AC input mains.

Battery test type and preconditions

1. There are two battery tests to select from:
   - Battery maintenance test: verifies the battery integrity and leads to the battery being partly discharged (20%).
   - Battery capacity test: verifies precisely the battery capacity and leads to the battery being fully discharged (until Battery low prewarning alarm)

2. The tests can be carried out from the operator control and display panel of the UPS by the operator when the following conditions are satisfied:
   - The load must be between 20% and 80% of rated UPS capacity.
   - The battery must have been float charging for 5 hours or more.

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

Test procedure

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

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

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

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

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

3. Wait until the test completes.

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

4. Stop the test.

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

5.5 System Test Procedure

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

Test procedure:

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

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

2. Select the System test option.

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

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

3. Wait until the test completes.

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

4. Stop the test.

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

5.6 Maintenance Bypass Procedure (And UPS Shut Down)

The following procedure transfers the load supply from being protected by the UPS into being connected directly to the AC input bypass supply though a maintenance bypass switch.

Caution – risk of load interruption
Except in emergency situations, so as not to risk a short interruption in powering the load, before initiating this bypass procedure, confirm that no warning status is displayed in the top right corner of the LCD screen. If a warning status is displayed, the operator will be prompted to confirm or cancel any action that can lead to load interruption.

1. Press the INVERTER OFF button on the operator control and display panel.

The UPS inverter will shut down and the load is supplied through the static bypass supply. At this point, the inverter LED extinguishes, and the alarm LED turns on.

2. Close the maintenance bypass switch Q3.

The maintenance bypass supply is now in parallel with the UPS static switch supply, and the LCD shows messages reflecting the actions taken (that is, maintenance bypass closed, etc.).

3. Open the output switch Q5.

This ends the bypass procedure. The load is now powered directly from the maintenance bypass supply.

Note
The load equipment is not protected from AC supply aberration.

Proceed with following steps if rectifier and battery shutdown is also required.

4. Press and hold the emergency power off (EPO) button on the UPS door for two seconds.

This will disable further rectifier, inverter, static switch and battery operation, but will not affect the maintenance bypass switch.

Note
Before carrying out this step, verify that the EPO contact is not connected to any external switch or device.

5. Open the input switch Q1 and the bypass switch Q2.

6. Open the BCB, which is located in the BCB box.

All LED indications and messages on the operator control and display panel will extinguish as the mains driven internal power supplies decay.

The load is now powered from the maintenance bypass supply and the UPS is completely shut down.

5.7 Shutdown Procedure (Complete UPS And Load Shutdown)

This procedure must be followed to completely power down the UPS and load. All power switches, isolators and circuit breakers will be opened and power will be removed from the load.

Caution
The following procedure will switch off all power to the load equipment.

1. Press the EPO button on the UPS door. This will disable rectifier, inverter, static switch and battery operation. The Load will be de-energised.
Note: Except in an emergency situation, do not press any remote EPO button.

2. Open the UPS door to gain access to the power switches.

3. Open the input switch Q1.

4. Open the BCB, which is located in the BCB box.

5. Open the output switch Q5.

6. Open the bypass switch Q2.

7. Ensure that the maintenance bypass switch Q3 is open.

All LED indications and messages on the operator control and display panel will extinguish as the mains driven internal power supplies decay.

8. To completely isolate the UPS from the AC supplies, the main external power input switches (both switches, where split supplies are provided for rectifier and bypass) and external output switch must be opened and tagged with warning labels accordingly.

5.8 EPO Procedure

The UPS provides an EPO button on the UPS door. The EPO button is designed to switch off the UPS in emergency conditions (that is, fire, flood, etc.). To achieve this, just press and hold the EPO button for two seconds, and the system will turn off the rectifier, inverter and stop powering the load immediately (including the inverter and bypass), and the battery stops charging or discharging.

If the input utility is present, the UPS control circuit will remain active; however, the output will be turned off. To remove all power from the UPS, the external feeder breaker should be opened.

5.9 UPS Reset Procedure

Once all appropriate measures have been taken to correct the problem indicated by the alarm message appearing on the LCD, carry out this procedure to restore the UPS to regular operation following an EPO action or for the following reasons: inverter overtemperature, cut-off overload, battery overvoltage, excessive switching, etc.

After confirming that the fault is cleared and there is no EPO signal:

1. Press the FAULT CLEAR button to clear all alarms.

Note
The rectifier restarts, and the bypass supplies power to the load. When the rectifier starts, the rectifier LED flashes. When the rectifier is in normal operation (about 15s later), the rectifier LED turns steady green.

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

Note
Five minutes after the overtemperature signal disappears, that is, when the overgemperature fault is eliminated, the rectifier will automatically start.

After the EPO button is pressed, if the input utility is removed, the UPS will shut down completely. When input utility is returned, if the bypass switch Q2 and output switch Q5 are closed, the UPS will start up on Bypass. There will be power at the output terminals of the UPS.

Warning
If the maintenance bypass switch Q3 is closed and the mains input is available, the UPS has output.

5.10 Auto Restart

When the mains power fails, the UPS draws power from the battery system to supply the load until the batteries are depleted. When the UPS reaches its end of discharge (EOD) threshold, it will shut down.

The UPS will automatically restart and enable output power:

- After the mains power is restored.
- If the Auto Recovery after EOD Enabling feature is enabled.
- After the Auto Recovery after EOD Delay Time expires (the default delay is 10 minutes) During the auto recovery delay, the UPS will be charging 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 system manually by pressing the FAULT CLEAR button.

5.11 Language Selection

The LCD menus and data display are available in two languages: Chinese, English.

To select a different language than the one being displayed:

1. From the main menu, press the F1 (Shift) key to move the cursor to the menu at the top of the screen.
2. Press the F2 and F3 (left and right arrows) keys as needed to select the Language menu.
3. Press the F1 (Shift) key to move the cursor to the UPS Data Window of the LCD.
4. Use the F2 and F3 (up and down arrows) keys to select the required language.
5. Press the F4 (Enter) key to accept the language selection.
6. Return to the main menu by repeatedly pressing the F1 (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:

1. From the main menu, press the F1 (Shift) key to move the cursor to the menu at the top of the screen.
2. Press the F2 and F3 (left and right arrows) keys as needed to select the Settings menu.
3. Press the F1 (Shift) key to move the cursor to the UPS Data Window of the LCD.
4. Use the F2 and F3 (up and down arrows) keys to select the Date & time option, then press the F4 (Enter) key.
5. Position the cursor on the row in which the date and time are displayed, then press the F4 (Enter) key.
6. Using the F2 and F3 (up and down arrows) keys, enter the current time and date information.
7. Press the F4 (Enter) key to save the settings, and then press the F1 (ESC) key to return to the main menu.

Chapter 6 Battery

This chapter introduces the battery, including the battery safety points, installation, maintenance, and the battery protection function, as well as the connections of the optional battery circuit breaker (BCB) box and battery temperature sensor.

6.1 Introduction

The UPS battery consists of battery blocks connected in series to provide a nominal DC input voltage for the UPS inverter. The required autonomy time (the time that the battery can maintain supply to the load in the event of a mains failure) is limited by the ampere-hour size of the individual battery blocks and in some cases this could mean several strings are connected in parallel.

It must be possible to disconnect the battery from the UPS module when undertaking maintenance or service procedures. This is facilitated by means of a suitably rated circuit breaker which must be located as close as possible to the battery terminals, and the power and control cables connected to the UPS using the most direct route possible.

If multiple sets of batteries connected in parallel are used to increase battery autonomy, the extension must be fitted with a sectioning device to permit work to be performed on one set of batteries while the others remain in service.

For external battery assembly, Emerson offers an optional battery circuit breaker (BCB) box, the features of which depend on the size of the UPS. Normally, you must select a corresponding BCB box for each UPS, in order to disconnect the battery from the UPS when the UPS requires maintenance or repair. The BCB box includes a BCB control board. This box is designed to be either wall-mounted or assembled on a frame, and is connected between the UPS and the battery. Refer to *6.9 BCB Box (Optional)* for more information.

6.2 Safety

Special care should be taken when working with the batteries associated with the HIPULSE U UPS. When all the cells are connected together, the battery terminal voltage will exceed 400V and is potentially lethal. A primary safety consideration is to physically isolate the battery installation from all but appropriately qualified maintenance personnel; which is best achieved by locating the cells in a key-lockable cabinet or a purpose-designed, dedicated battery room.

 Warning
The following general battery safety precautions and warnings should be observed at all times: 1. A battery can present risk of electric shock or burn from high short circuit currents. 2. When connected in a string the voltage could be 460Vdc, this voltage is potentially lethal always observe high voltage precautions. 3. Only qualified personnel should install or service batteries. 4. Eye protection should be work to prevent injury from accidental electrical arcs. 5. Remove rings, watches, necklaces, bracelets and all metal objects. 6. Only use tools with insulated handles. 7. Wear rubbers gloves and a rubber apron when handling batteries. 8. If a 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. 9. If electrolyte comes into contact with the skin the affected area should be washed with plenty of clean water immediately. 10. Batteries must always be disposed of according to local environmental laws.

6.3 UPS Batteries

It is common practice in UPS installations to use valve-regulated cells. The term '*valve regulated*' is used currently in place of either '*sealed*' or '*maintenance free*' both of which have been used in the past.

Valve-regulated cells are not 'sealed,' and will vent, particularly on overcharge. The amount of gas given off is less than for a flooded cell but when considering the design of the battery installation allowances must be made for

adequate ventilation and heating of the cells. Boost charging must not be applied to valve regulated cells as this will cause them to overcharge and subsequently vent.

Similarly, valve-regulated cells cannot be regarded as maintenance-free as they must be kept clean and their connections checked periodically for tightness and lack of corrosion. Specific inspection instrument can also be used to check each battery cell periodically to learn about the variation in capacity.

Batteries are fully charged before delivery; however, storage and transportation times mean that, inevitably, some charge is lost by the time the battery is commissioned. All the cells forming the battery should be brought to the same state of charge and be recharged within 6 months of the factory charge.

It is especially important that the battery is fully charged before attempting a witness test of the autonomy time. This may require several days to complete; therefore any witness test concerning the batteries should take place only after the battery has been on uninterrupted float charge for at least one week.

Cell performance typically improves after a few weeks in service or after two or three discharge and recharge cycles.

6.4 Installation Design Considerations

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 which must be taken into account during the installation design process and might affect the design outcome depending on localized conditions.

6.5 Battery Installation And Maintenance

6.5.1 Temperature Considerations

Battery performance depends on the ambient battery temperature. Capacity and autonomy times are quoted for a new battery operating at 20°C. Battery capacity is increased by 1% for every 1°C increase in temperature up to 25°C. If a battery is used at temperatures above 25°C, its life is reduced; consequently its capacity and UPS autonomy time will reduce more rapidly over a period of time. Operating below 20°C will reduce the battery capacity by approximately 1% to 1.5% per 1°C. For example, if a battery discharge test is attempted during the middle of winter when the ambient temperature is 5°C the battery capacity will be only 77.5% of its design value and will not satisfy its specified autonomy time.

Ambient temperature, ventilation, spacing, float voltage and ripple current all affect the battery temperature. Uneven temperature distribution through the battery string will cause the voltage distribution to be uneven which can also lead to problems — it is therefore important to maintain an even temperature across the whole battery chain.

Valve-regulated cells are very sensitive to temperature and should be operated at a temperature between 15°C and 25°C. To help sustain this operating temperature range the battery is normally float charged at 2.25V/cell.

When batteries are cabinet-mounted adjacent to the UPS module, it is the battery which dictates the designed maximum ambient temperature, not the UPS. That is, in the case of valve-regulated cells, the ambient room temperature should be kept between 15°C and 25°C, and not between 0°C and 40°C (which is the specified main equipment operating temperature range). Temperature excursions are permissible for short periods of time provided the average temperature does not exceed 25°C.

6.5.2 Battery Population

The nominal DC bus voltage, and therefore battery float voltage, is set according the module's rated input and output voltages, and usually set to 432Vdc (380Vac), 446Vdc (400Vac) or 459V (415Vac). Given that the desired cell float voltage is 2.25V, this means that a different number of cells are required in each case (see Table 6-1).

Table 6-1 Battery population

Parameter	380V	400V	415V
Number of cells used (standard)	192 pcs	198 pcs	204 pcs
End-of-discharge voltage	320V	330V	340V
Float voltage	432V	446V	459V

6.6 Battery Protection

The battery is connected to the UPS through a BCB which is manually closed and electronically tripped through the UPS control circuitry. If the cells are rack-mounted (or located remote from the main UPS cabinet), the BCB must be mounted as near as possible to the batteries themselves, and the power and control cables connected to the UPS using the most direct route possible.

Features of the BCB include:

- Isolation from battery to achieve safety and reliability
- Shortcircuit protection
- Automatic opening in the event of inverter lockup due to battery undervoltage to prevent battery damage caused by overdischarge
- Tripping by remote emergency power off (EPO) button if installed
- Operation error protection

To achieve the required autonomy time, it may be necessary to parallel battery strings. In which case, the battery circuit breaker should be placed downstream of all parallel battery strings.

Note: All equipment servicing procedures should be carried out only by trained personnel.

6.7 Battery Connection

6.7.1 Fitting The Batteries

1. In general a minimum space of 10 mm must be left on all vertical sides of the battery block to permit free air movement around the cells.

2. A clearance of 150 mm should be allowed between the top of the cells and the underside of the shelf above (this is necessary for monitoring and servicing the cells).

3. When installing the batteries always work from the bottom shelf upwards to prevent raising the center of gravity.

6.7.2 Connecting The Battery

1. All cabinets (or racks) must be earthed.

2. In general it is recommended that the inter-connecting cables be fitted to the batteries within their particular level before fitting the inter-level connecting cables, followed finally by the cables to the circuit breaker.

3. An insulating shroud should be fitted to each terminal after its connection has been made.

4. When connecting the cables between the battery extremities to the circuit breaker always connect the circuit breaker end of the cable first.

6.8 Battery Installation

Whatever the type of mounting system selected, the following conditions should be noted (see Figure 6-1):

❶ Layout of cells:

Whatever battery mounting system is used, the batteries should be laid out in such a manner as to make simultaneous contact with two exposed live parts having a potential greater than 150V impossible. Where this is not possible, insulated terminal shields must be installed and insulated cables must be used for connections.

❷ Service platform:

The service platform (or duckboard) must be slip-proof, insulated from the floor and be at least one meter wide.

❸ Connections:

All connections must be as short as possible.

❹ BCB:

A BCB is generally installed in an enclosure on the wall close to the battery installation. The connection of BCB box available for the HIPULSE U UPS is described in the following section.

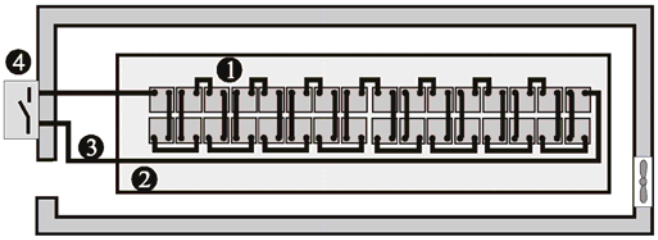


Figure 6-1 Battery room design

6.9 BCB Box (Optional)

The battery circuit breaker (BCB) box of 160/200kVA UPS adopts wall mounting, while that of the 300/400kVA UPS can adopt both wall mounting and floor mounting. The installation hole dimensions are shown in Figures 6-2 to 6-4.

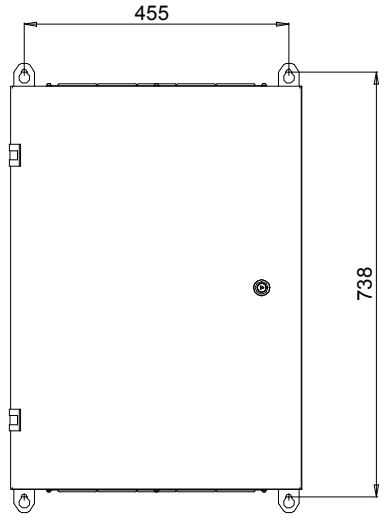


Figure 6-2 Installation hole dimensions for wall mounting of BCB box of 160/200kVA UPS (unit: mm)

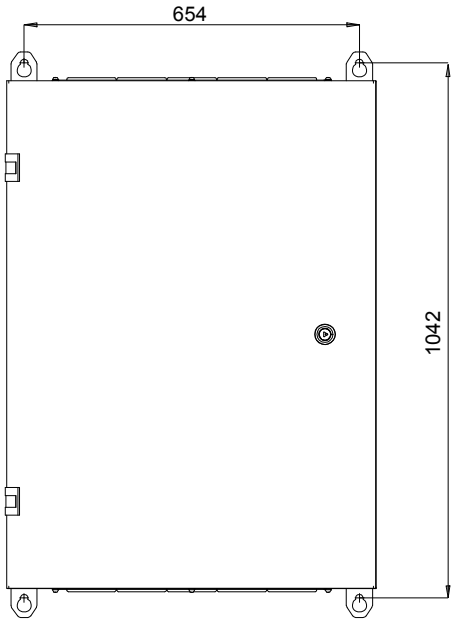


Figure 6-3 Installation hole dimensions for wall mounting of BCB box of 300/400kVA UPS (unit: mm)

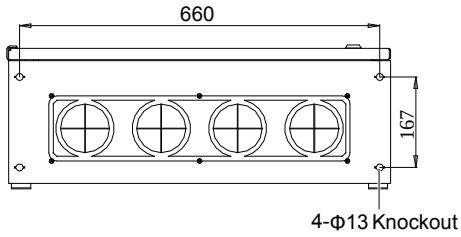


Figure 6-4 Installation hole dimensions for floor mounting of BCB box of 300/400kVA UPS (unit: mm)

The battery circuit breaker (BCB) box contains a BCB and a BCB control board (ULK366SC1).

The BCB box is fitted as close as possible to the battery and connected to the UPS, as illustrated in Figure 6-5.

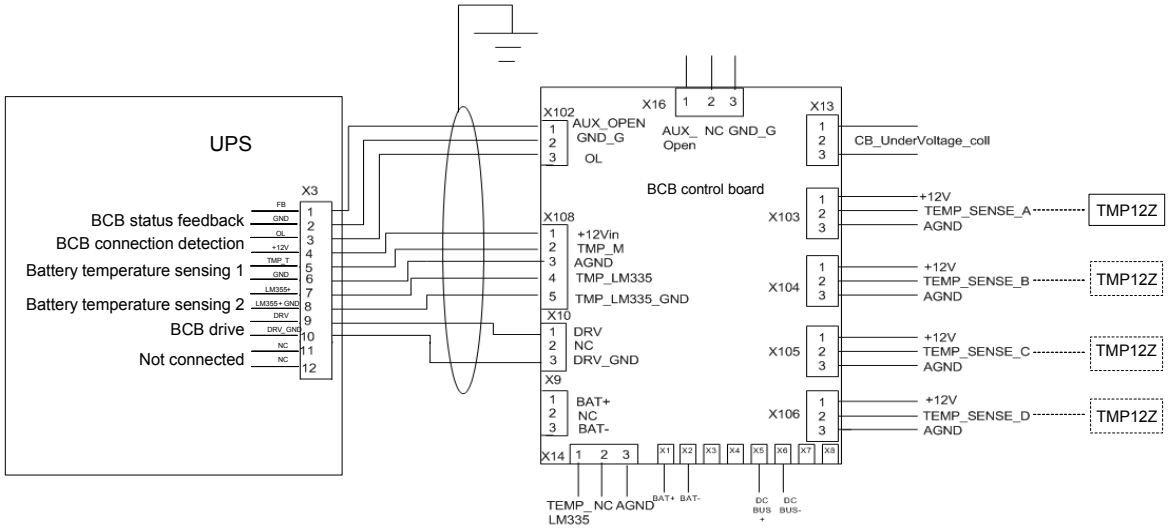


Figure 6-5 BCB box connection

Note: The control cables from the UPS to the BCB control board must be made using the accessory cable of the BCB, which is a shielded cable located in a separate conduit to that containing the battery power cables. The cable shield must be earthed to prevent induced noise affecting the control operation, and a separate safety earth must be connected between the UPS and BCB box.

6.10 Battery Temperature Sensor (Optional)

A battery temperature sensor (model: TMP12Z) supplied separately from the BCB is connected with the UPS logic through the BCB control board. For the connection, see Figure 6-5.

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

Chapter 7 “1+N” System

This chapter introduces the installation procedures, operating instructions of the “1+N” system, and the installation of the dual bus system, of the HIPULSE U UPS.

7.1 General

The system can comprise of up to 6 UPS modules of the same power rating and connected in parallel without the need for a centralized mains static bypass. Instead the bypass static switches of each UPS share the load when the system transfers to the mains bypass supply.

From a ‘power’ viewpoint, each module is internally identical to the ‘single module’ configuration. A “1+N” system requires inter-module control signals to manage the load sharing, synchronizing and bypass switching. The control signals are connected through the parallel cables, which are multi-way ribbon cables connected between the units of the system to form a ring.

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

7.2 “1+N” System Installation Procedures

The basic installation procedure of a parallel system comprising two or more UPS modules is the same as that of single module system. This section only introduces the installation procedures specific to the parallel system. The installation of a parallel UPS must follow the installation procedure for a single UPS module with the additional requirements detailed in this section.

7.2.1 Preliminary Checks

Be sure that a parallel kit is present and fitted in each of the modules, 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 Emerson service & support trained personnel.

7.2.2 Cabinet Installation

Place the UPS modules side by side and interconnect as shown in Figure 7-1.

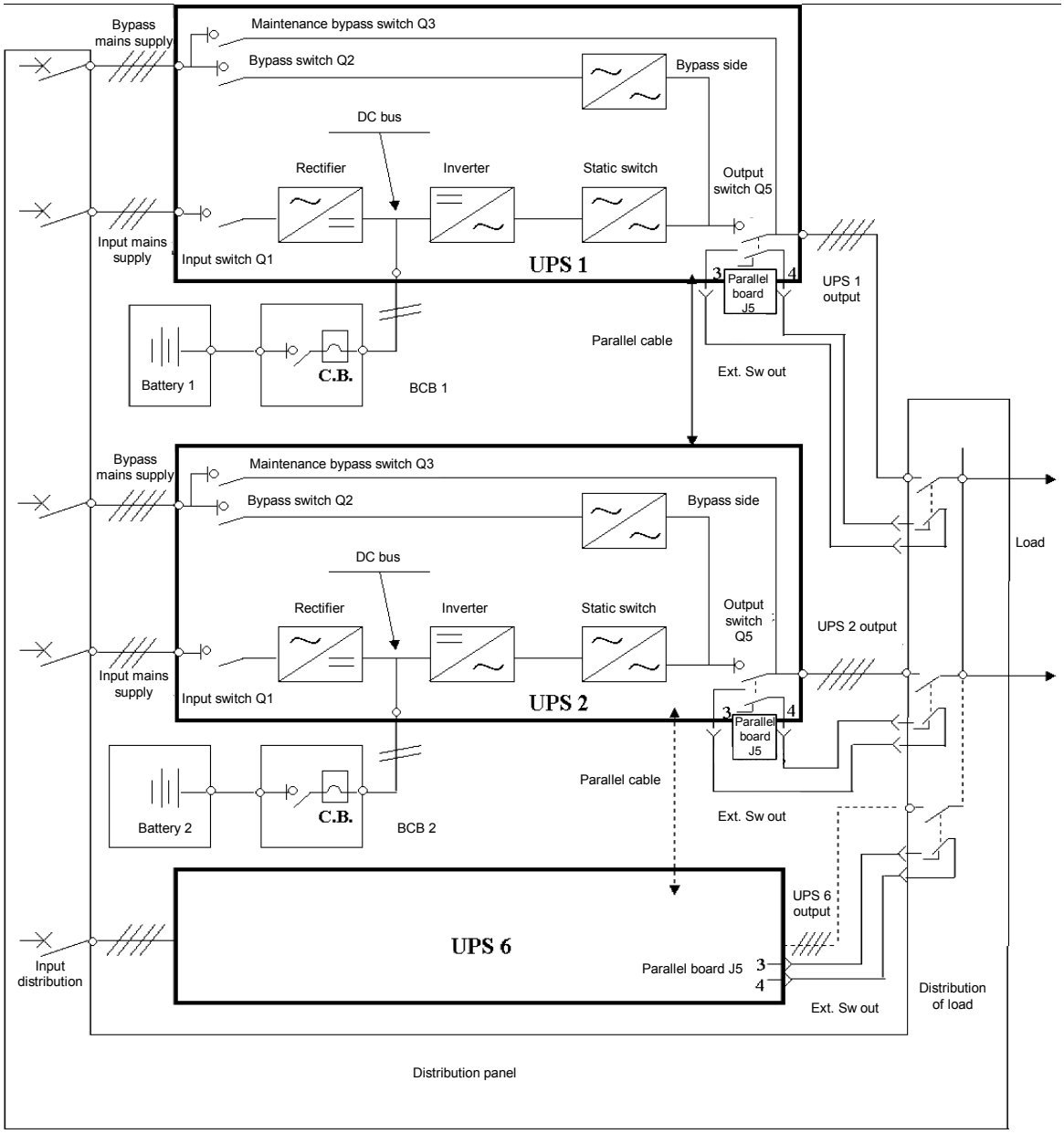


Figure 7-1 “1+N” system block diagram

7.2.3 Protective Devices

Refer to the instructions supplied in *3.1.6 Protective Devices*.

Note: Use of residual current detectors (RCDs) on UPS unit inputs requires installation of a common device only on the system bypass mains.

7.2.4 Power Cables

Refer to the instructions supplied in *3.1 Power Cabling*.

Note: The length and specification of power cables including the bypass input cables and UPS output cables should be the same. This facilitates load sharing when operating in bypass mode.

7.2.5 Control Cables

Parallel Cable

Shielded and double insulated control cables available in length up to 20 meters must be must be interconnected in a ring configuration between UPS modules as shown in Figure 7-2. Specifically, connect the two parallel cables from X1-1 and X2-2 on the parallel board of the first module respectively to X1-2 and X2-1 on the parallel board of the second module, and so on.

The parallel board is mounted on the inner door of each UPS module. The ring configuration ensures high reliability of the control.

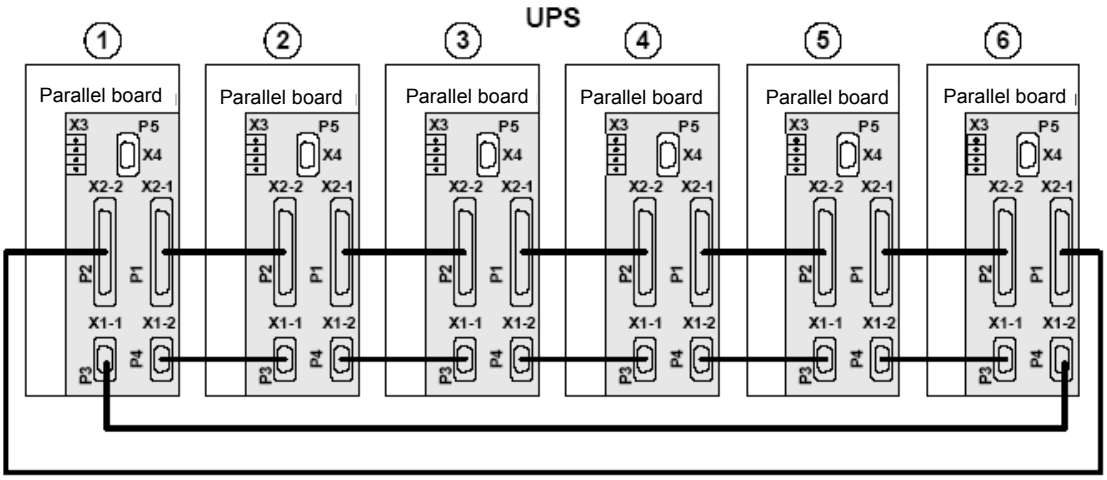


Figure 7-2 Connection of “1+N” system parallel cables

Emergency power off (EPO)

Refer to the *EPO input port (X2)* part in *3.3.1 Monitoring Board Ports*.

Battery control

Refer to *3.3.2 Battery Control*.

External bypass and output interlock

EXT-Maint (X3-1&2) on UPS parallel board M3 (leave open if no external bypass switch is used) provides external maintenance bypass interlock protection for the UPS. Short circuit means external bypass closed.

EXT-Out (X3-3&4) on UPS parallel board M3 (leave shorted if no external output switch is used) provides external output interlock protection for paralleled UPS modules. Short circuit means external output switch closed.

Note
UPS parallel board M3 is located behind protective covers accessible aftr opening the UPS front door — removal of this barrier requires the use of a tool and is restricted to service personnel. Jumper JP1 (located next to X3) needs to be removed for X3: 3&4 to work properly.

7.3 “1+N” System Operating Instructions

Warning
If residual current detectors (RCDs) are used on UPS unit inputs, use a common device only on the system’s bypass mains. At the instant of electrical connection, the current may not be split instantaneously and this may cause the residual current circuit breakers (RCCBs) to trip separately.

These operations must be performed one at a time, progressing to the next step only after having completed the previous step on both UPS modules.

7.3.1 Start-Up Procedure (Into Normal Mode)

This procedure must be followed when turning on the UPS from a fully powered down condition, that is, where the load is not being initially supplied at all or where supplied by the maintenance bypass switch. It is assumed that the installation is complete, the system has been commissioned by authorized personnel and the external power isolators are closed.

Refer to *5.2 Start-Up Procedure (Into Normal Mode)*.

7.3.2 Maintenance Bypass Procedure (And UPS Shut Down)

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

Refer to *5.6 Maintenance Bypass Procedure (And UPS Shut Down)*.

7.3.3 Switching OFF And Isolating One UPS While The Other Remains In Service

1. In sequence, open the UPS output switch Q5, input switch Q1, and bypass switch Q2.

2. Open the BCB inside the battery cabinet.

To completely isolate the UPS, open the AC power supply circuit breaker (both circuit breakers if separate supplies are provided for the rectifier and the bypass supply) and the output circuit breaker on the power distribution switchboard.

If individual UPS output isolation circuit breaker (and its auxiliary contacts) are not installed on the power distribution switchboard, remember that voltage supplied by the others UPS which remains in service will still be present on the output terminals of the shutdown UPS.

Warning
If individual UPS output isolation circuit breaker are not installed on the power distribution switchboard, remember that voltage supplied by the others UPS which remains in service will still be present on the output terminals of the shutdown UPS. **Warning: Wait five minutes for the internal d.c bus bar capacitors to discharge.**

7.3.4 Insertion Procedure (Of One Module In A Parallel System)

This procedure is indicated to re-integrate a UPS module that has been previously isolated from other modules of a group of paralleled UPS modules. It is assumed that the installation is complete, the system has been commissioned by authorized personnel and the external power isolators are closed.

1. Open the UPS door to gain access to the power switches.

2. Open (or confirm disabled) maintenance bypass switch Q3.

3. Close the bypass switch Q2, output switch Q5, and any external output isolation switches (where used). The LCD display becomes active.

4. Close the input switch Q1.
The rectifier LED flashes on the operator control and display panel during the startup of rectifier and becomes steady green once the rectifier reaches normal operation state after about 15 seconds.

5. Close the external BCB. This breaker is located inside the battery cabinet (if used) or is otherwise adjacent to the battery racks.

6. Following battery availability being detected by the UPS, the red battery LED extinguishes moments after when the battery charger starts operation.

7. Press and hold the INVERTER ON button for two seconds.
The inverter will start up and the inverter LED flashes while it synchronizes to the load voltage frequency. After the inverter is ready, the UPS connects to the load, the inverter LED becomes steady green and the load LED turns green.

8. Check that no warning message is displayed in the top right corner of the LCD screen and the status of the LEDs as follows:

Table 7-1 LED status

LED	Status
Rectifier LED	Steady green
Bypass LED	Off
Battery LED	Off
Inverter LED	Steady green
Load LED	Steady green
Alarm LED	Off

7.3.5 Shutdown Procedure (Complete UPS And Load Shutdown)

Refer to *5.7 Shutdown Procedure (Complete UPS And Load Shutdown)*.

7.4 Dual Bus System Installation Procedures

7.4.1 Cabinet Installation

As shown in Figure 7-3, the dual bus system consists of two independent UPS configurations each consisting of one or more UPS modules. Dual bus systems are high availability configurations suitable for loads with multiple input terminals. For single input loads an optional static transfer switch (STS) may be added.

The objective of the dual bus system is to keep the output of two independent UPS systems (or parallel systems) in synchronization using optional load bus synchronization (LBS) cable. One system is designated as the master; the other is designated as the slave. The operating modes covered comprise master and or slave operating inverter or bypass mode.

In installation, place the UPS modules side by side and interconnect as described in the following sections.

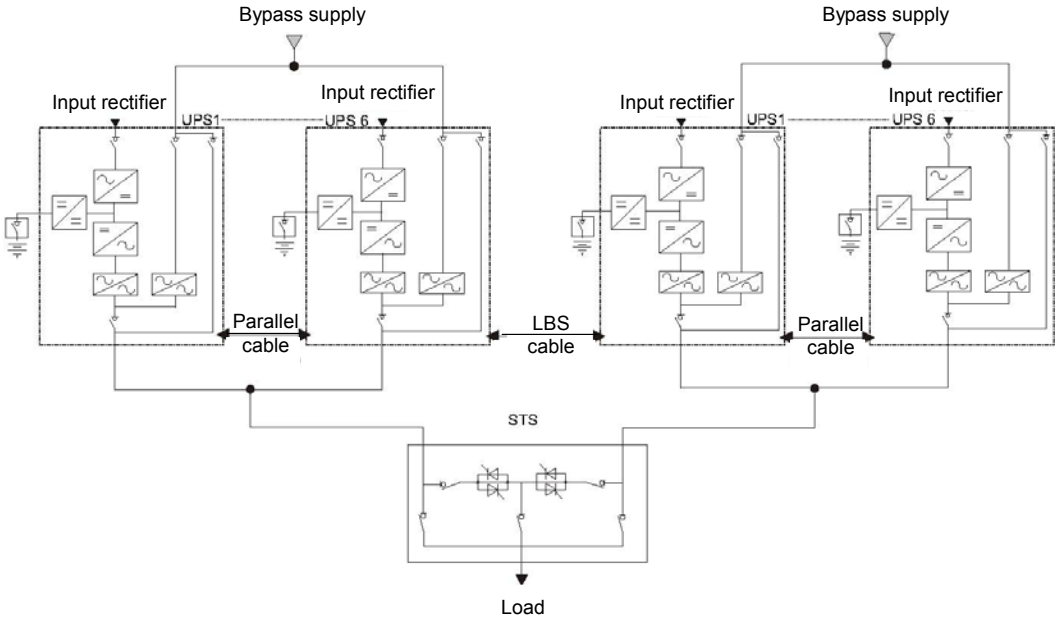


Figure 7-3 Typical dual bus system (using STS and LBS cable)

7.4.2 Protective Devices

Refer to *3.1.6 Protective Devices*.

7.4.3 Power Cables

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

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

7.4.4 Control Cables

Control cable connection of dual bus system consisting of two single units

If the dual bus system consists of two single units, use the optional 9-core LBS cable to connect between the LBS interfaces (X4 socket on parallel board) of the two single units, and use another optional LBS cable to connect between any two 25-core interfaces (X2-1 or X2-2) of the two single units, as shown in Figure 7-4.

Warning
Although the dedicated 25-core LBS cable looks like the parallel cable, it is absolutely not the parallel cable, and cannot be replaced by it. Otherwise, UPS system chaos may occur.

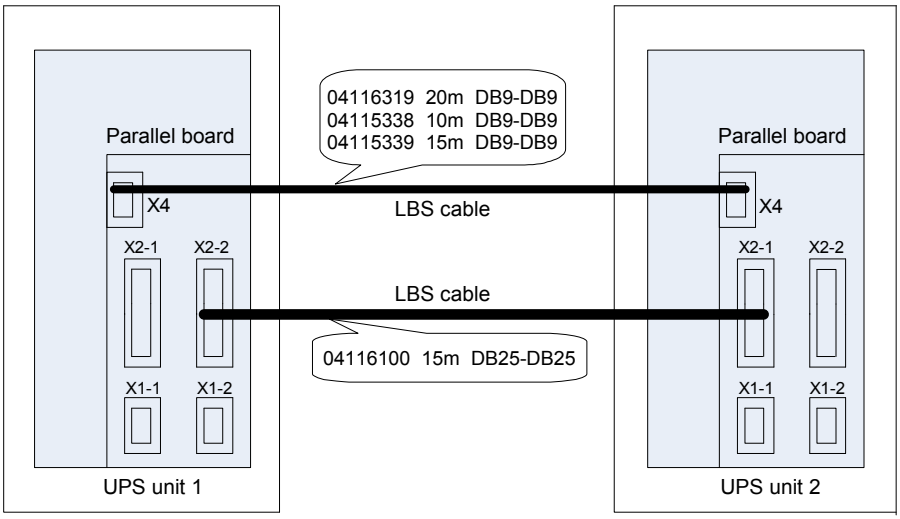


Figure 7-4 Control cable connection of dual bus system consisting of two single units

Control cable connection of dual bus system consisting of a single unit and a parallel system

Figure 7-5 shows the control cable connection of the dual bus system consisting of a single unit and a parallel system composed of two or more single units. Use the optional 9-core LBS cable to connect from the LBS interface (X4 socket on parallel board) of the single unit to the LBS interface of any single unit in the parallel system; and use another optional LBS cable to connect from any 25-core interface (X2-1 or X2-2) of the single unit to the LBS interface of any single unit except for the aforesaid one in the parallel system, note that this LBS cable has a 9-core end and a 25-core end, respectively connecting the X4 interface of the parallel system and the 25-core interface of the single unit.

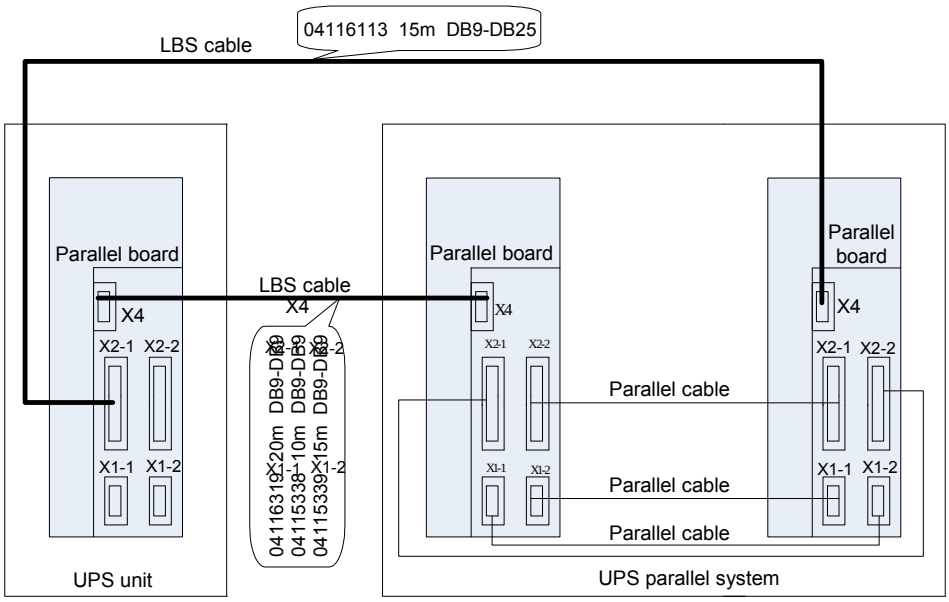


Figure 7-5 Control cable connection of dual bus system consisting of a single unit and a parallel system

Control cable connection of dual bus system consisting of two parallel systems

For the dual bus system consisting of two parallel systems respectively composed of two or more single units, you must form a ring connection between the two parallel systems with the optional 9-core LBS cables. The connection interfaces are the X4 sockets on the parallel boards, as shown in Figure 7-6.

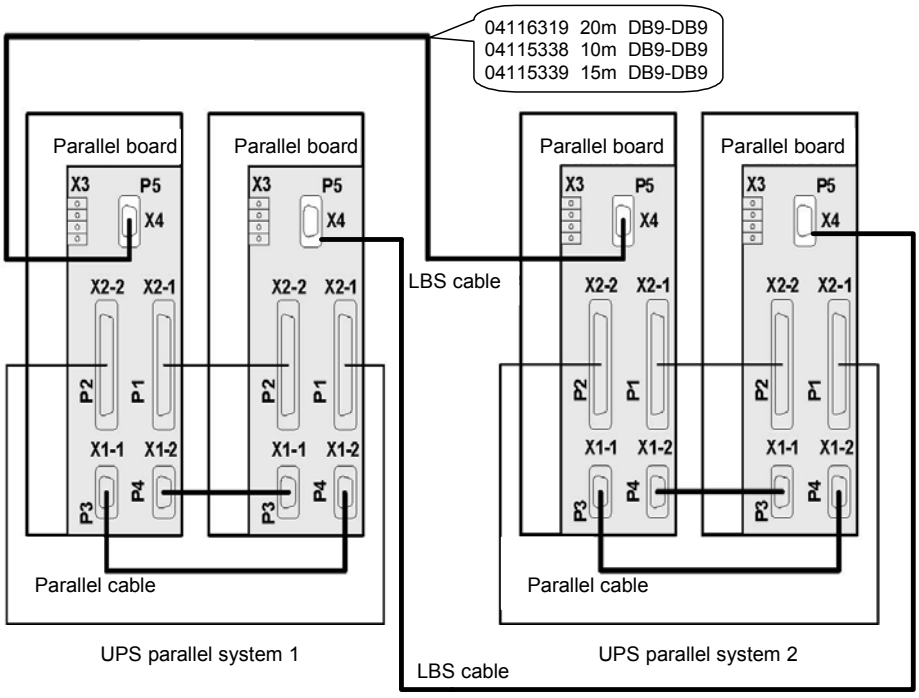


Figure 7-6 Control cable connection of dual bus system consisting of two parallel systems

Chapter 8 Specifications

This chapter provides the specifications of the HIPULSE U UPS.

8.1 Conformity And Standard

Table 8-1 Conformity and standard

Description	Year	Normative references
Safety requirements	1999	IEC60950-1, IEC62040-1-1, UL1778
EMC	2005	IEC/EN62040-2
Design and test methods	1999	IEC62040-3

8.2 Environmental Requirements

Table 8-2 Environmental requirements

Item	Unit	Power rating (kVA)			
		160	200	300	400
Operating Temperature	°C	0~40			
Maximal temperature for 8hr day	°C	40°C (derate power by 1.5% per °C between 40°C and 50°C			
Mean Temperature for 24hr	°C	Maximally 35			
Relative humidity	-	≤95% at 20°C			
Altitude of operation	m	≤1000m asl (derate power by 1% per 100m between 1000m and 2000m)			
Storage temperature and transport temperature	°C	-25 to 70			

8.3 Mechanical Characteristics

Table 8-3 Mechanical characteristics

Item	Unit	Power rating (kVA)							
		160 (6-pulse)	160 (12-pulse)	200 (6-pulse)	200 (12-pulse)	300 (6-pulse)	300 (12-pulse)	400 (6-pulse)	400 (12-pulse)
Height	mm	1900							
Width	mm	1250	1640	1250	1640	1640	2280	2280	2280
Depth	mm	875							
Weight	kg	1200	1725	1350	2000	1600	2200	2100	2750
Ventilation	-	By internal intake fans							
Airflow	m^3/h	2590	2750	2750	2910	5350	5350	6150	6150
Cable entry	-	Bottom or either side (top optional)							

8.4 Electrical Characteristics (Input Rectifier)

Table 8-4 Electrical characteristics (input rectifier)

Item	Unit	Power rating (kVA)							
		160 (6-pulse)	160 (12-pulse)	200 (6-pulse)	200 (12-pulse)	300 (6-pulse)	300 (12-pulse)	400 (6-pulse)	400 (12-pulse)
Rated mains voltage	Vac	**380**, 400, or 415							
Supply	-	Three phase without neutral							
Input voltage tolerance [1]	%	±15, (maxmally, from 290Vac to 498Vac)							
Frequency	Hz	**50** or 60							
Input frequency tolerance	Hz	45~65							

Item	Unit	Power rating (kVA)							
		160 (6-pulse)	160 (12-pulse)	200 (6-pulse)	200 (12-pulse)	300 (6-pulse)	300 (12-pulse)	400 (6-pulse)	400 (12-pulse)
Rated input power[2]	kVA	197	191	245	236	365	354	488	469
Rated input current[2]	A	298	289	371	358	551	535	739	708
Maximal input Power[3]	kVA	246	239	306	295	420	407	609	584
Maximal input current[3]	A	373	362	464	447	634	616	931	885
Duration of progressive power walk-in[4]	s	5~300							

Note:
1. With mains at -15% and suggested battery elements the UPS maintains the output rated voltage at rated load but cannot guarantee float charge to battery; the battery does not discharge.
2. IEC62040-3 (5.2.2): UPS, rated load, input rated voltage 380V, no current to battery.
3. IEC62040-3 (5.2.2): UPS, rated load or overload, input rated voltage 380V, battery on boost charge with maximal allowed current.
4. Set by dedicated background software

8.5 Electrical Characteristics (DC Intermediate Circuit)

Table 8-5 Electrical characteristics (DC intermediate circuit)

Item	Unit	Power rating (kVA)			
		160	200	300	400
Voltage range for inverter operation	Vdc	320~490			
Recommended number of lead-acid cells[1, 2]	pcs	**192 (380Vac)** 198 (400Vac) 204 (415Vac)			
Recommended float charge voltage 2.25V/el.[1]	Vdc	**432 (380Vac)** 446 (400Vac) 459 (415Vac)			
Recommended boost charge voltage 2.35V/el.[1]	Vdc	**451 (380Vac)** 465 (400Vac) 479 (415Vac)			
Maximum voltage on manual charge 2.40 V/el.[1]	Vdc	**461 (380Vac)** 475 (400Vac) 490 (415Vac)			
End-of-discharge voltage 2.45V/el.[1]	Vdc	**471 (380Vac)** 485 (400Vac) 500 (415Vac)			
Max boost charge duration[3]	min	480~1800			
Freshening charge duration[3]	h	1~36			
Boost-float threshold current[3]	A	0.001C~0.025C			
Ripple voltage superimposed[4]	%	≤1			

Note:
1. (According to rated voltage).
2. Factory set for rated 380V, different cells number and voltage per cell may be set by configuration software.
3. Set by software.
4. Battery disconnected, RMS percentage value referred to DC voltage

8.6 Electrical Characteristics (Inverter Output)

Table 8-6 Electrical characteristics (inverter output)

Item	Unit	Power rating (kVA)			
		160	200	300	400
Rated mains voltage[1]	Vac	**380**, 400, or 415			
Supply	-	Three phase with neutral			
Frequency[2]	Hz	**50** or 60			
Rated Power at cos = 0.9	kVA	160	200	300	400
Rated Power at cos = 1	kW	144	180	270	360
Three-phase transient overload[3]	Min, I/In	60, 1.10 10, 1.25 1, 1.5			
Maximal non linear load allowed[4]	-	100%Pn			
Voltage stability, steady State test[3]	%	±1			
Voltage stability, transient test[5]	%	±5			
Maximum rate of charge of frequency[6]	Hz/s	0.1			

Note:
1. Factory set 380V, 400 or 415 voltages with software setting.
2. Factory set at 50Hz 60 Hz with software setting.
3. IEC62040-3 (5.3.2).
4. IEC62040-3 (ANNEX E).
5. IEC62040-3 (5.3.1), also for 0~100~0%, load transient, restore time 20 ms to 1%.
6. Factory set at 0.1Hz/s; up to 1Hz/s with software setting

8.7 Electrical Characteristics (Bypass Input Mains)

Table 8-7 Electrical characteristics (bypass input mains)

Item	Unit	Power rating (kVA)								
		160	200	300	400					
Rated mains voltage[1]	Vac	**380**, 400, or 415								
Supply	-	Three phase with neutral								
Rated current	A									
380Vac		243	304	456	607					
400Vac		231	289	433	577					
415Vac		222	278	416	554					
Bypass voltage tolerance[2]	%	Default upper limit: 15%; default lower limit: -20%								
Delay time to recognise bypass voltage returned to window	s	2								
Inverter output voltage window	%	±5								
Frequency[3]	Hz	**50** or 60								
Input frequency tolerance[4]	%	±5								
Maximum frequency slew rate	Hz/s	1								
Current rating of neutral cable	-	1.3In								
Protection, bypass line	-	The bypass line should be protected using an external device in the input distribution system. This device should be sized to discriminate with the load protection								
Transient overload	ms	10	20	50	100	200	500	1000	2000	5000
	I/In	14.3	12.6	11.0	10.0	9.0	8.0	7.1	6.6	5.7

Note:
1. Factory set 380V. 400 or 415 voltages with software setting.
2. Other values in -20%~15% with software setting.
3. Factory set at 50Hz 60 Hz with software setting.
4. Other values -5%~5%with software setting

8.8 Electrical Characteristics (System Performance)

Table 8-8 Electrical characteristics (system performance)

Item	Unit	Power rating (kVA)							
		160 (6-pulse)	160 (12-pulse)	200 (6-pulse)	200 (12-pulse)	300 (6-pulse)	300 (12-pulse)	400 (6-pulse)	400 (12-pulse)
No load losses	kW	2.75	3.30	3.50	4.15	3.90	4.65	4.70	6.51
Full load losses (100%)	kW	9.63	11.89	11.12	13.91	19.33	21.8	28.2	31.6

8.9 Electrical Characteristics (ECO Mode)

Table 8-9 Electrical characteristics (ECO mode)

Item	Unit	Power rating (kVA)							
		160 (6-pulse)	160 (12-pulse)	200 (6-pulse)	200 (12-pulse)	300 (6-pulse)	300 (12-pulse)	400 (6-pulse)	400 (12-pulse)
Full load losses (100%)	kW	2.97	3.52	3.55	4.20	5.23	5.91	7.10	8.96

Chapter 9 Service & Maintenance

Regular service and maintenance are required during the long term operation of the UPS system (including the associated battery). The battery maintenance is expounded in chapter 6. This chapter deals with the life characteristics of the key components of the UPS, and provides recommendation for the regular check and service of the key components. Proper service and maintenance of the UPS system can extend the UPS life and reduce the risk of system malfunction.

9.1 Safety

Warning

The daily patrol check of the UPS system can be conducted by trained personnel, while the check and replacement of the UPS components should be done by authorized professionals.

9.2 UPS Key Components And Their Lives

During the UPS operation, some UPS components' lives are shorter than the UPS life due to wear and tear in working. To ensure the safe power supply of the UPS system, regular check and replacement of these components are required. This section introduces the key components of the HIPULSE U series UPS and their reference working lives. For systems working in different conditions (environment, load, and so on), you may ask professionals to assess the components and provide advices whether to replace the components by referring to the information provided in this section.

9.2.1 Magnetic Components: Transformer, Inductor

The design life of the magnetic components is 20 years. The key factors affecting the life of the magnetic components are the interwinding isolation system and the temperature increase in operation. The HIPULSE U series UPS adopts H-level isolation system and can withstand up to 220°C working temperature. Normally, the UPS works in forced air cooling condition.

9.2.2 Power Semiconductor Devices

The power semiconductor devices include SCR (silicon-controlled rectifier) and IGBT (insulated gate bipolar transistor). In normal UPS working condition, there is no rated life of the power semiconductor devices. The SCR and IGBT failures are always caused by other problems, as they do not have the problem of life expiration. However, in system service and maintenance, you should check on an annual basis the appearances of the power semiconductor devices for erosion and damage. If you spot any risk of failure , replace the device.

9.2.3 Electrolytic Capacitors

The life of the electrolytic capacitors depend on the DC bus voltage and ambient temperature of the UPS.

To ensure safe and stable UPS operation, it is recommended to check the operation status of the electrolytic capacitors on an annual basis. The electrolytic capacitors must be replaced before their life expires, advisably, within 5 to 6 years of operation.

9.2.4 AC Capacitors

It is recommended to replace the AC capacitors within 5 to 6 years of continuous operation, and to check the AC capacitors on a half year basis. Replace the AC capacitor if spotting any deformation.

9.2.5 Lives And Recommended Replacement Time Of Key Components

The key components listed in Table 9-1 are used in the UPS. To prevent system malfunction caused by failure of key components due to wear and tear during working, you are recommended to check them regularly, and replace them within their life expectancy.

Table 9-1 Lifves and recommended replacement time of key components

Key components	Life expectancy	Recommended replacement time	Recommended check period
AC capacitor	≥7 years (~62,000hr)	5~6 years	6 months
Electrolytic capacitor	≥7 years (~62,000hr)	5~6 years	1 year
Fan	≥7 years (~62,000hr)	5~6 years	1 year
Air filter	1~3 years	1~2 years	3 months
Valve-regulated lead-acid battery (5 years of life)	5 years	3~4 years	6 months
Valve-regulated lead-acid battery (10 years of life)	10 years	6~8 years	6 months

9.2.6 Replacing Fuses

When replacing the fuse on the high-voltage interface board or the fuse in the fuse box, use a fuse of the same model, avoid being misled by the parameter screenprint on the fuse box.

380V systems can use both 380V/4A fuse and 500V/4A fuse, while 400V/415V systems can use 500V/4A fuse only.

Appendix 1 Transportation Restraints Removing Procedures

1. 160kVA&200kVA UPS Transportation Restraints Removing Procedures

Transformer transportation restraints removing procedures for UPS with 6-pulse rectifier

1. Open the front door of the cabinet, remove the lower switch baffle plate and the installation hole cover, as shown in Figure 1. Retain the screws.

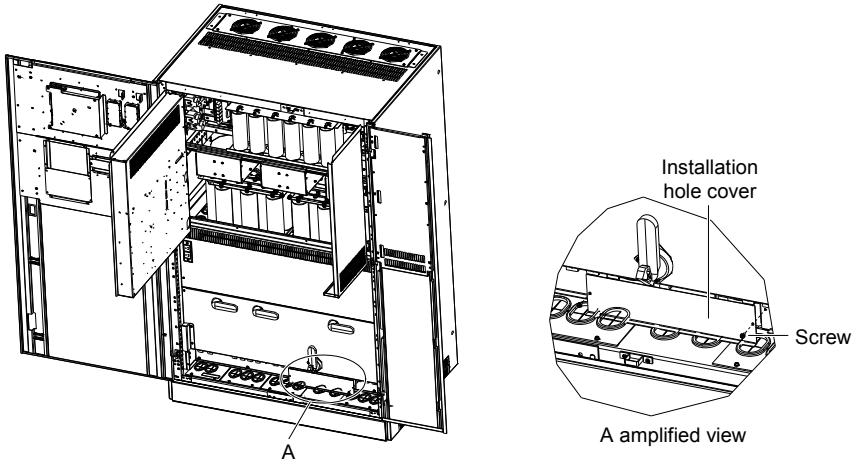


Figure 1 Removing the installation hole cover

2. Remove the back panel of the cabinet to reveal the output transformer, as shown in Figure 2. Retain the screws.

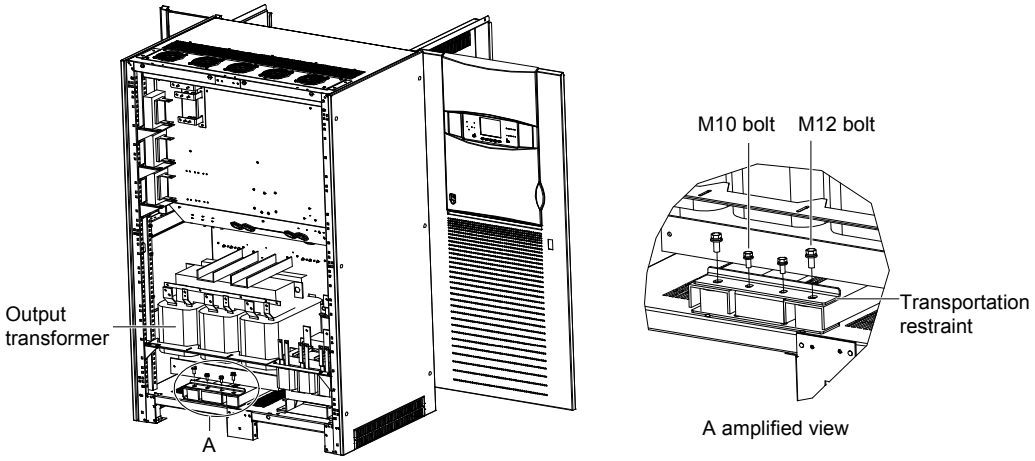


Figure 2 Removing the output transformer transportation restraints

3. There is a transportation restraint respectively in the front and at the back at the bottom of the output transformer. The one at the back is shown in Figure 2. Remove the fixing bolts of the one at the back, including two M10 bolts in the middle and two M12 bolts at sides; then, remove the fixing bolts, including two M10 bolts in the middle and two M12 bolts at sides, of the transportation restraint in the front through the installation hole revealed in step 1.

4. Remove the two transportation restraints, and install the four M12 bots removed in step 3 in their original positions.

5. Reinstall the installation hole cover and the lower switch baffle plate with the screws removed in step 1. You might as well install the lower switch baffle plate after UPS commissioning.

6. Reinstall the back panel of the cabinet with the screws removed in step 2. You can also carry out this step after UPS commissioning.

Transformer transportation restraints removing procedures for UPS with 12-pulse rectifier

1. Repeat the preceding steps 1 through 4 to remove the transportation restraints of the output transformer (see Figure 3).

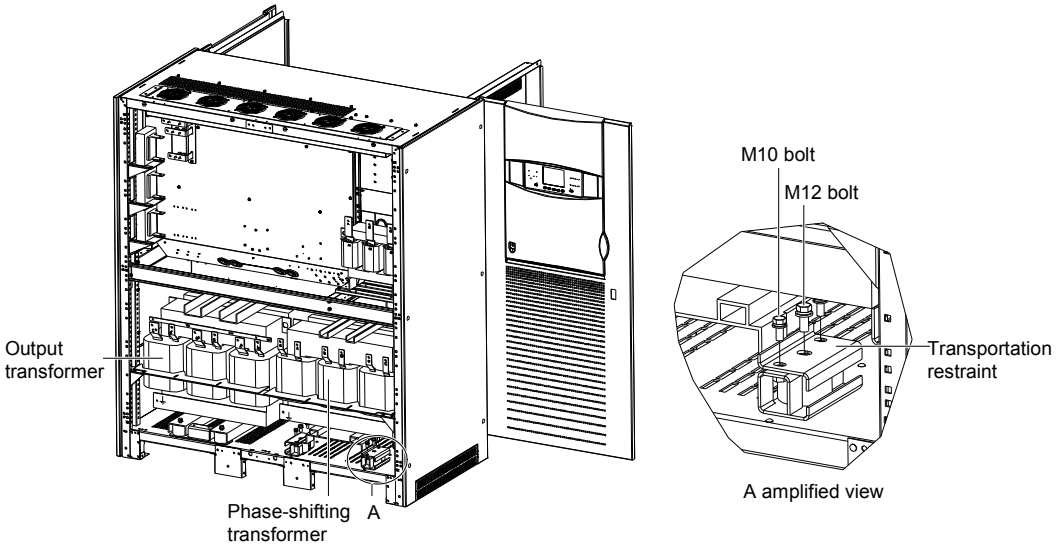


Figure 3 Removing the transformer transportation restraints

2. Remove the transportation restraints of the phase-shifting transformer.

There are two transportation restraints respectively in the front and at the back, totally four, at the bottom of the phase-shifting transformer. Remove the two M10 bots at both sides and one M12 bolt in the middle of each transportation restraint, as shown in Figure 3. Remove the four transportation restraints, and then reinstall the four M12 bolts in their original positions.

3. Repeat the preceding steps 5 and 6.

2. 300kVA UPS Transportation Restraints Removing Procedures

Transformer transportation restraints removing procedures for UPS with 6-pulse rectifier

1. Remove the back panel of the cabinet to reveal the output transformer, as shown in Figure 4. Retain the screws.

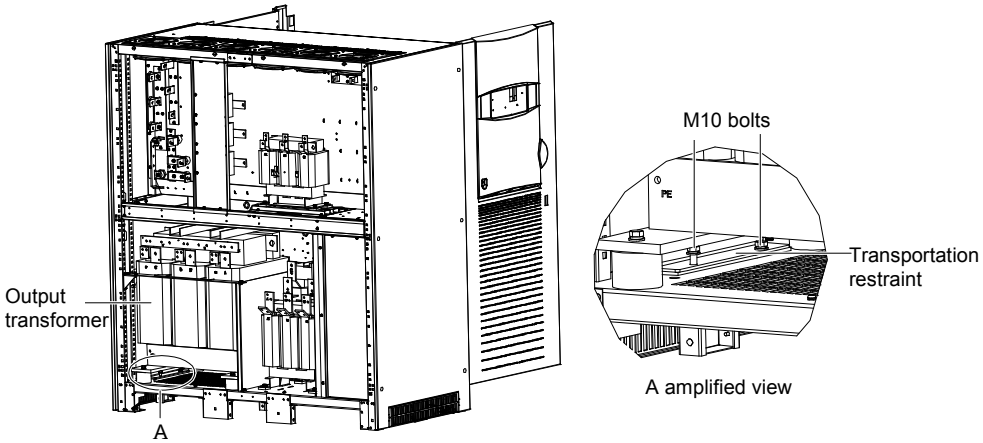


Figure 4 Removing the output transformer transportation restraints

2. There is a transportation restraint respectively on the right side and left side at the bottom of the output transformer. Remove the two M10 bolts of each transportation restraint, as shown in Figure 4.

3. Reinstall the back panel of the cabinet with the screws removed in step 1. This step can also be done after UPS commissioning.

Transformer transportation restraints removing procedures for UPS with 12-pulse rectifier

The removing procedures of the output transformer transportation restraints of 300kVA UPS with 12-pulse rectifier are the same as those of 300kVA UPS with 6-pulse rectifier. The removing procedures of the transportation restraints of the phase-shifting transformer are as follows:

1. Open the front door and remove the back panel of the side cabinet to reveal the phase-shifting transformer, as shown in Figure 5. Retain the screws.

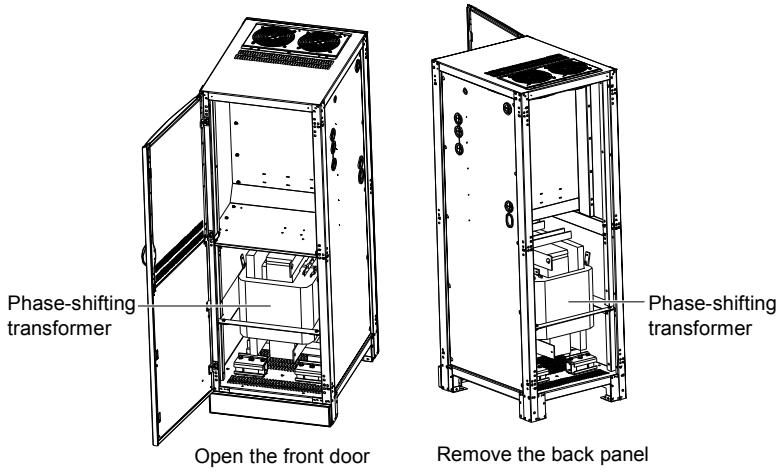


Figure 5 Opening the front door and removing the back panel

2. There are two transportation restraints respectively in the front and at the back, totally four, at the bottom of the phase-shifting transformer. Remove the two M10 bots at both sides and one M12 bolt in the middle of each transportation restraint, as shown in Figure 6. Remove the four transportation restraints, and then reinstall the four M12 bolts in their original positions.

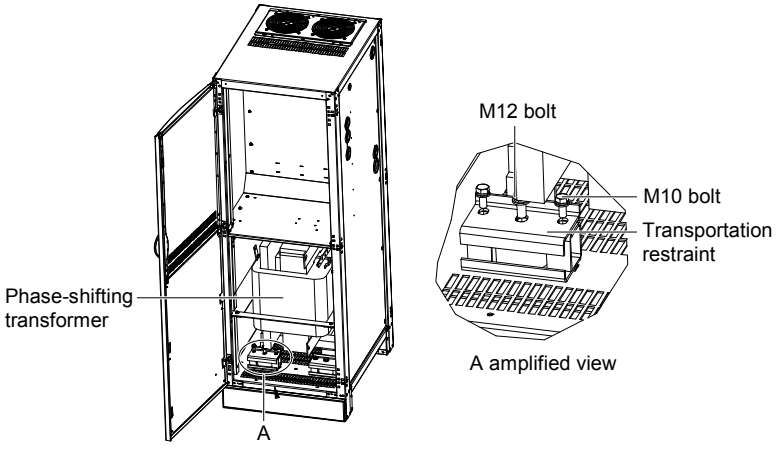


Figure 6 Removing the phase-shifting transformer transportation restraints

3. Reinstall the front and back doors of the side cabinet with the screws removed in step 1. This step can also be done after UPS commissioning.

3. 400kVA UPS Transportation Restraints Removing Procedures

Transformer transportation restraints removing procedures for UPS with 6-pulse rectifier

1. Open the front door of the main cabinet, remove the lower switch baffle plate and the installation hole covers, as shown in Figure 7. Retain the screws.

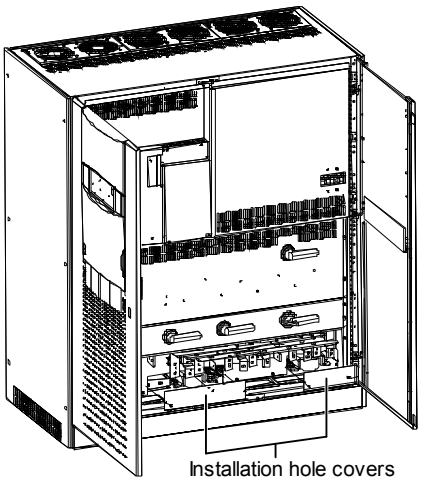


Figure 7 Removing the installation hole covers

2. Remove the back panel of the main cabinet to reveal the output transformer, then remove the two transportation restrains at the back of the output transformer, as shown in Figure 8.

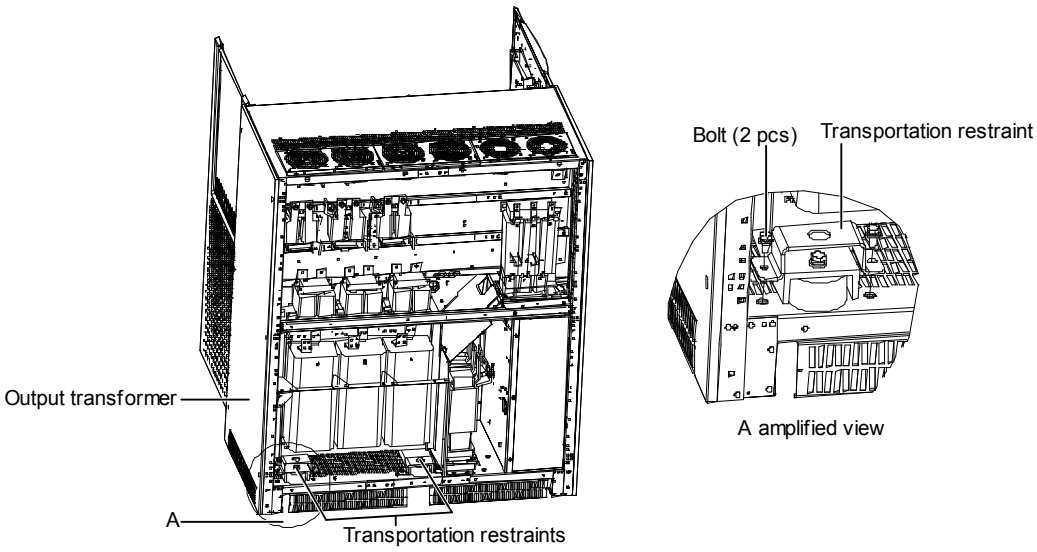


Figure 8 Removing the two transportation restraints at the back

3. Remove the two transportation restrains in the front of the output transformer, as shown in Figure 9.

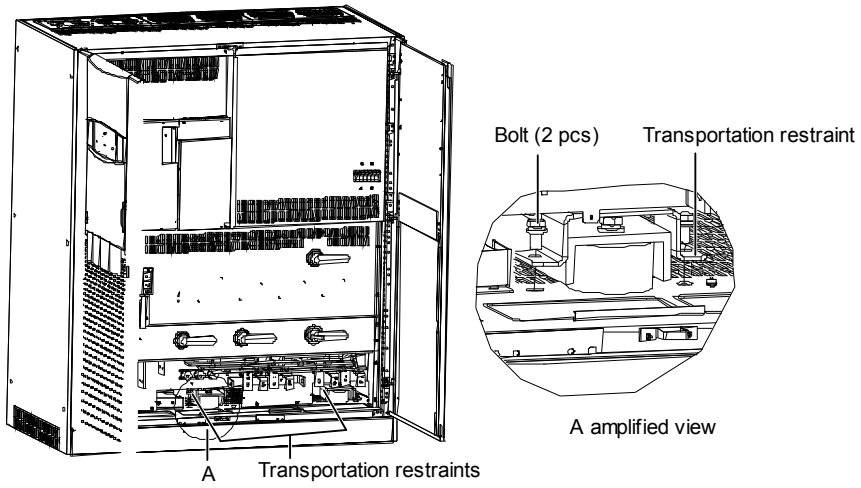


Figure 9 Removing the two transportation restraints in the front

4. Reinstall the installation hole covers and the lower switch baffle plate with the screws removed in step 1. You might as well install the lower switch baffle plate after UPS commissioning.

5. Reinstall the back panel of the main cabinet with the screws removed in step 2. You can also carry out this step after UPS commissioning.

Transformer transportation restraints removing procedures for UPS with 12-pulse rectifier

The removing procedures of the output transformer transportation restraints of 400kVA UPS with 12-pulse rectifier are the same as those of 400kVA UPS with 6-pulse rectifier. The removing procedures of the transportation restraints of the phase-shifting transformer are as follows:

1. Open the front door and remove the back panel of the side cabinet to reveal the phase-shifting transformer, as shown in Figure 10. Retain the screws.

2. Remove the two transportation restraints in the front of the phase-shifting transformer, as shown in Figure 10.

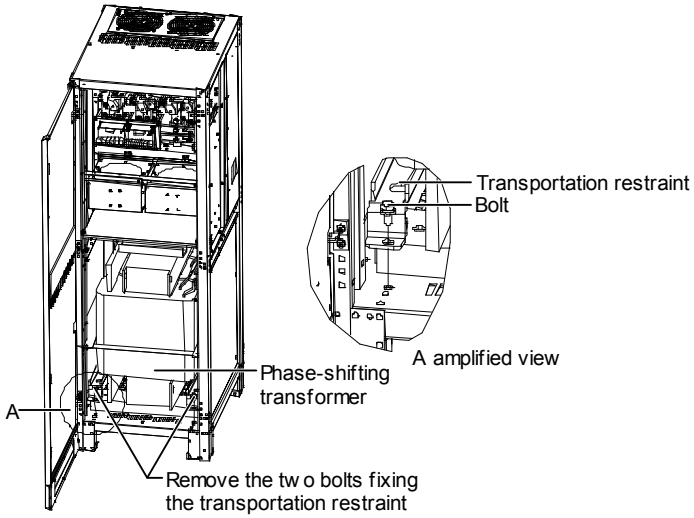


Figure 10 Removing the two transportation restraints in the front

3. Remove the two transportation restraints at the back of the phase-shifting transformer, as shown in Figure 11.

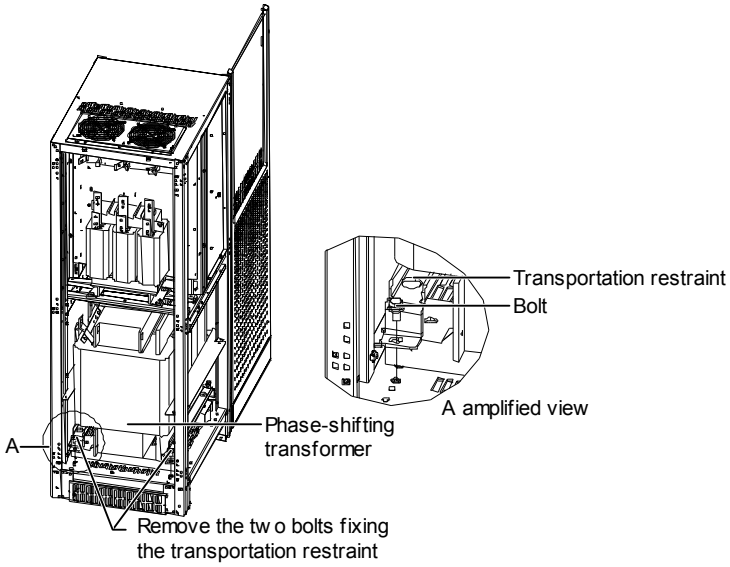


Figure 11 Removing the two transportation restraints at the back

4. Reinstall the back panel of the side cabinet with the screws removed in step 1. You can also carry out this step after UPS commissioning.