KOHLER
UNINTERRUPTIBLE
POWER

KOHLER *PW* 8000DPA (ST)

Modular three-phase uninterruptible power supply

(10-200 kVA/kW)
Parallelable up to 400 kVA/kW

User Manual

Document Control

ISSUE	DATE	REVISION SUMMARY
TS_841_01	29/11/2023	Rebranding to KUP International Version
TS_841_02	02/04/2024	Corrections to battery data and efficiency
TS_841_03	22/07/2024	Addition of Warranty wording

Useful Contacts

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All product, product specifications and data are subject to change without notice to improve reliability, function, design or otherwise. Kohler Uninterruptible Power has taken every precaution to produce an accurate, complete and easy to understand specification document and will assume no responsibility nor liability for direct, indirect or accidental personal or material damage due to any misinterpretation of, or accidental errors, in this manual.

1 Safety

1.1 Description of symbols used in this manual

WARNING: The warning symbol is used where there is danger of an electrical shock, equipment damage or personal-injury.

CAUTION: *The caution symbol is used to highlight important information to avoid possible equipment malfunction or damage.*

1.2 User precautions

WARNING: Keep this manual with the UPS for future reference.

WARNING: The UPS and peripheral equipment must be installed by suitably qualified and trained personnel who are aware of the potential shock hazards.

WARNING: Do not attempt to install this UPS system until you have read and understood ALL the safety instructions and hazard warnings contained in this manual.

WARNING: High leakage current!
Ensure that the UPS has been correctly earthed before you connect the mains power supply

WARNING: Do not apply electrical power (AC or DC) to the UPS before it has been commissioned by a fully trained engineer authorised by Kohler Uninterruptible Power.

WARNING: All servicing must be performed by a Kohler Uninterruptible Power approved engineer.

WARNING: Do not attempt to service the UPS yourself. You run risk of exposure to dangerous voltages if you open or remove the UPS covers!

WARNING: Kohler Uninterruptible Power will assume no responsibility or liability for accidents or injuries due to incorrect operation or manipulation of the UPS or peripheral equipment.

CAUTION: *The PW 8000DPA ST is a Class A UPS product (according to EN 62040-3). In a domestic environment the UPS may cause radio interference. In such an environment the user may be required to undertake additional measures.*

1.3 Declaration of Safety conformity and CE marking

The PW 8000DPA ST UPS system is designed and manufactured in accordance with Quality Management Systems standard EN ISO 9001. The CE marking indicates conformity to the EEC Directive by the application of the following standards in accordance with the specifications of the harmonized standards:

- 2006/95/EC Low voltage directive
- 2004/108/EC Electromagnetic Compatibility directive (EMC)

Standards as reference:

- EN-IEC 62040-1
  Uninterruptible power supply (UPS). Part 1-1: General and safety requirements for UPS's used in accessible areas by end users.
- EN-IEC 62040-2
  Uninterruptible power supply (UPS). Part 2: EMC requirements
- EN-IEC 62040-3
  Uninterruptible power systems (UPS). Part 3: Performance and test requirements
- 2011/65/EU
  Restriction of the use of certain hazardous substances (RoHS) DIRECTIVE

The supplier's responsibility is excluded if the customer modifies, or intervenes with, this product in any way.

	Product Standards	Standards
Safety	EC/EN 62040-1	EC/EN 60950-1
Electromagnetic Compatibility (EMC)	IEC/EN 62040-2 (C1) Emission cat. C3 Immunity cat. C3	IEC/EN 61000-4-2 IEC/EN 61000-4-3 IEC/EN 61000-4-4 IEC/EN 61000-4-5 IEC/EN 61000-4-6 IEC/EN 61000-4-8 IEC/EN 61000-2-2
Performance	EN-IEC 62040-3 2011/65/EU	VFI-SS-111
RoHS	EN50581:2012	EN50581:2012

2 General Introduction

2.1 General introduction

Congratulations on your purchase of the Kohler PW 8000DPA ST Uninterruptible Power Supply system.

2.1.1 Reliability and quality standards

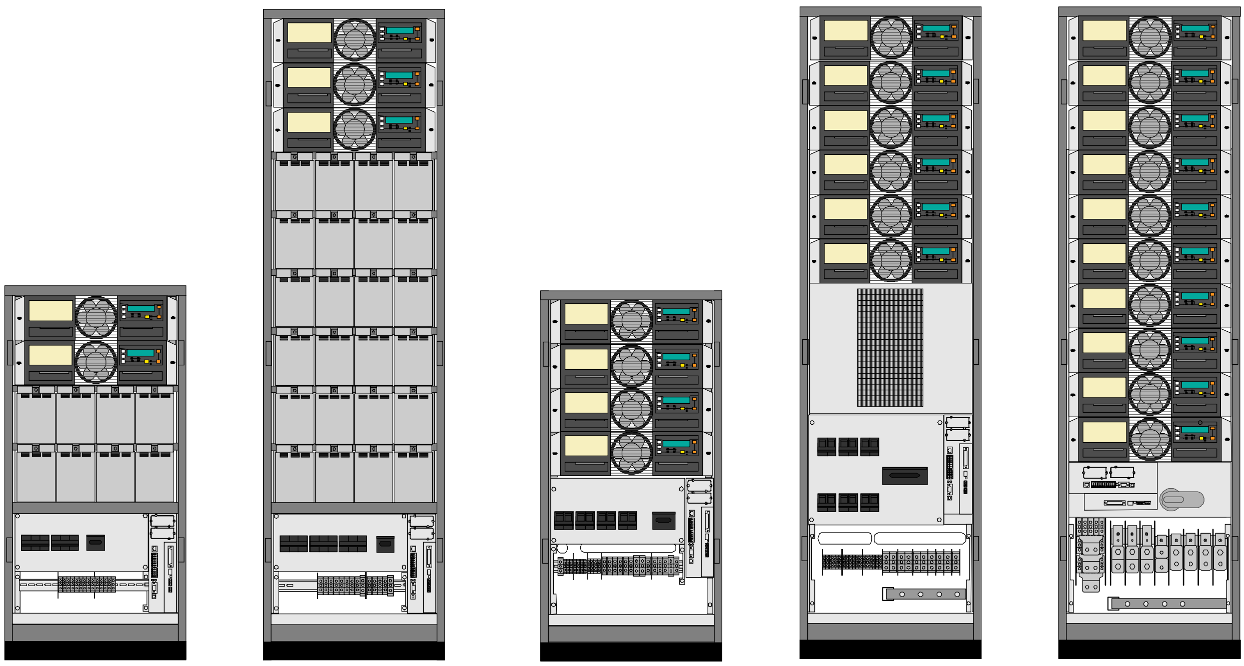
Using a unique modular construction, the Kohler PW 8000DPA ST represents a completely new generation of medium power, 3 phase UPS-Systems, incorporating the latest technological developments in power engineering. High reliability, upgrade ability, low operating costs and excellent electrical performance are only some of the highlights of this innovative UPS solution.

Kohler Uninterruptible Power specialises in the design, building, installation and maintenance of Uninterruptible Power Systems. This compact and powerful UPS is just one example of our wide range of state-of-the-art power protection devices and will provide your critical equipment with a steady and reliable power supply for many years.

The criteria and methods we use in the design, manufacture, and maintenance of Uninterruptible Power Supply systems are certified to International Standard ISO 9001/EN 29001 and ISO 14001. A full UPS Specification is provided in Chapter 9 of this manual.

2.2 Kohler PW 8000DPA ST system

2.2.1 UPS cabinet model range



ST-40 Cabinet	ST-60 Cabinet	ST-80 Cabinet	ST-120 Cabinet	ST-200 Cabinet
2x modules 80 Batteries	3x modules 240 Batteries	4x modules No Batteries	6xmodules No Batteries	10x modules No Batteries

Figure 2.1 Kohler PW 8000DPA ST module configuration

The PW8000DPA ST is a truly flexible, modular UPS system designed around 10 kW or 20 kW UPS power modules. Up to ten UPS modules can be installed in a range of purpose-designed, free-standing cabinets, as shown in Figure 2.1. The UPS cabinet is rated according to the maximum number of 20kW modules that it can house – i.e. 40 kW, 60 kW, 80 kW, 120 kW and 200 kW. The 40 kW and 60 kW cabinets contain the UPS batteries but the 80kW, 120 kW and 200 kW models require external batteries which are usually contained in a purpose-designed battery cabinet that is installed as close as possible to the UPS cabinet. A range of matching battery cabinets is available.

Key Point: All the modules fitted within a UPS cabinet must be of the same rating.

2.2.2 Advanced design features

Decentralized Parallel Architecture (DPA)

The PW8000DPA ST system features Decentralized Parallel Architecture (DPA) paralleling technology that provides N+x redundancy without introducing a single-point-of-failure. Each power module is a fully functional, self-contained UPS that includes an individual battery charger, power inverter, bypass, CPU, control panel and separate battery configuration; making it a completely autonomous operating unit.

The outputs from all the modules fitted in a UPS cabinet are connected in parallel at the cabinet's output terminals, and the electronics built into each module's control system ensures that:

- The UPS modules equally share the load current.
- The inverter/bypass load transfer operation is synchronised such that, for example, if the operator selects 'bypass' mode the static switch in ALL the modules change over in unison.
- The UPS modules are always frequency-synchronised to each other – and to the bypass supply (when present).

Note: The parallel control mechanism is applied on a 'master'/ 'slave' basis in which one module (usually module 1) is set as the 'master' module and the remaining modules as 'slaves.' If the 'master' module shuts down, the next module in the chain will take over the 'master' role automatically.

Hot swappable modules

Although the illustrations in Figure 2.1 show fully populated UPS cabinets, thanks to the UPS module's advanced Distributed Parallel Architecture (DPA) design it is possible to operate the PW8000DPA ST system with just a single module fitted – additional module(s) can then be installed to expand the system capacity as needed, without needing to shut down the system or transfer the load to the bypass supply.

This 'hot-swappable' design similarly allows a UPS module to be exchanged during UPS operation without disrupting the load supply – but of course this depends on the system redundancy and the load demand at the time the exchange takes place.

Input booster technology

The PW8000DPA ST UPS module's advanced booster technology results in an input power factor of 0.99 with a harmonic content of <4.5% THD (10KW module) and <3% THD (20KW module). This enhances the system reliability and minimises the winding losses of any generator or transformer connected to the UPS input, which in turn reduces the generator/ transformer costs. It also overcomes the need for an input harmonic filter, resulting in further savings.

Cabling and fusing costs are also reduced as a result of the high input power factor due to the low reactive power consumption.

In summary, the benefits of the UPS module's high input power factor are:

- reduced cable losses
- no over-sizing of generators required
- no erratic operation of sensitive connected loads
- low input harmonic currents
- reduced heating of transformers and generators
- no false circuit breaker tripping and malfunction
- no resonance with power factor correction capacitors

Flexible battery management

This equipment employs flexible battery charging management which avoids premature deterioration of battery life and provides preventive failure diagnostics.

The major benefits are:

- AC-ripple free battery charging due to a dc-dc charger separated from the rectifier and inverter.
- Wide range of number of battery blocks (30-50 blocks of 12V; depending autonomy times).
- Wide UPS input voltage operating window extends the battery life due to fewer discharge cycles.
- Battery discharge protection caused by load jumps.
- Proactive battery protection from false manipulations and inadequate charging voltages.
- Proactive battery failure detection thanks to Advanced Battery Diagnosis (ABD) algorithm.
- User selectable battery tests.
- Optional temperature compensated charging to enhance battery life.

2.2.3 System expansion using parallel cabinets

Some UPS applications present a low initial power requirement which increases over time as the application grows; and it is therefore essential that the installed UPS system can be expanded to meet the growing demand without compromising the existing load. This requirement is well met with the 'hot swappable' nature of the Kohler PW 8000DPA ST UPS power modules just described, which allows additional module(s) to be inserted into a vacant slot in an existing cabinet when needed; however, it is also possible to further increase the UPS system capacity by connecting the outputs of several UPS cabinets in parallel.

When two or more UPS cabinets are connected together all the UPS modules within the cabinets are effectively paralleled – for example a UPS system comprising three fully populated ST-120 cabinets will contain 18 fully paralleled UPS modules offering a system capacity of 360 kW.

Note: If a system expansion requires an additional cabinet to be installed, the system will have to be shut down while the cabinet is being electrically connected.

Key Point: When planning a multi-cabinet system, it is not necessary to fully populate one cabinet with UPS modules before installing the next cabinet. For example, if it is known at the outset that the eventual load is likely to reach 300 KW it makes good design sense to install and cable-up four ST-80 cabinets and equally distribute the number of initially required modules between them.

The maximum number of PW8000DPA ST cabinets that can be paralleled is shown in the table below.

	ST-40	ST-60	ST-80	ST-120	ST-200
Number of UPS power modules per cabinet	2	3	4	6	10
Parallel cabinets per system	4	4	4	3	2
Max number of UPS power modules per system	8	12	16	18	20
Max system capacity (without redundancy)	160	240	320	360	400

Parallel control in a multi-cabinet UPS system

A parallel cabinet system requires the same degree of inter-module control concerning synchronisation, load sharing, bypass switching etc. as described for the modules operating in an individual cabinet. In order to achieve this a parallel communication bus, carrying all the necessary parallel control signals, is connected between the cabinets as shown in Figure 2.7. The parallel control mechanism still relies on a 'master'/ 'slave' relationship between the modules fitted in the various cabinets and it is usual for UPS module 1, fitted in cabinet 1, to be set as the 'master' module.

Note: For reasons described later, the cabinet containing UPS module 1 is designated as being the 'master cabinet'

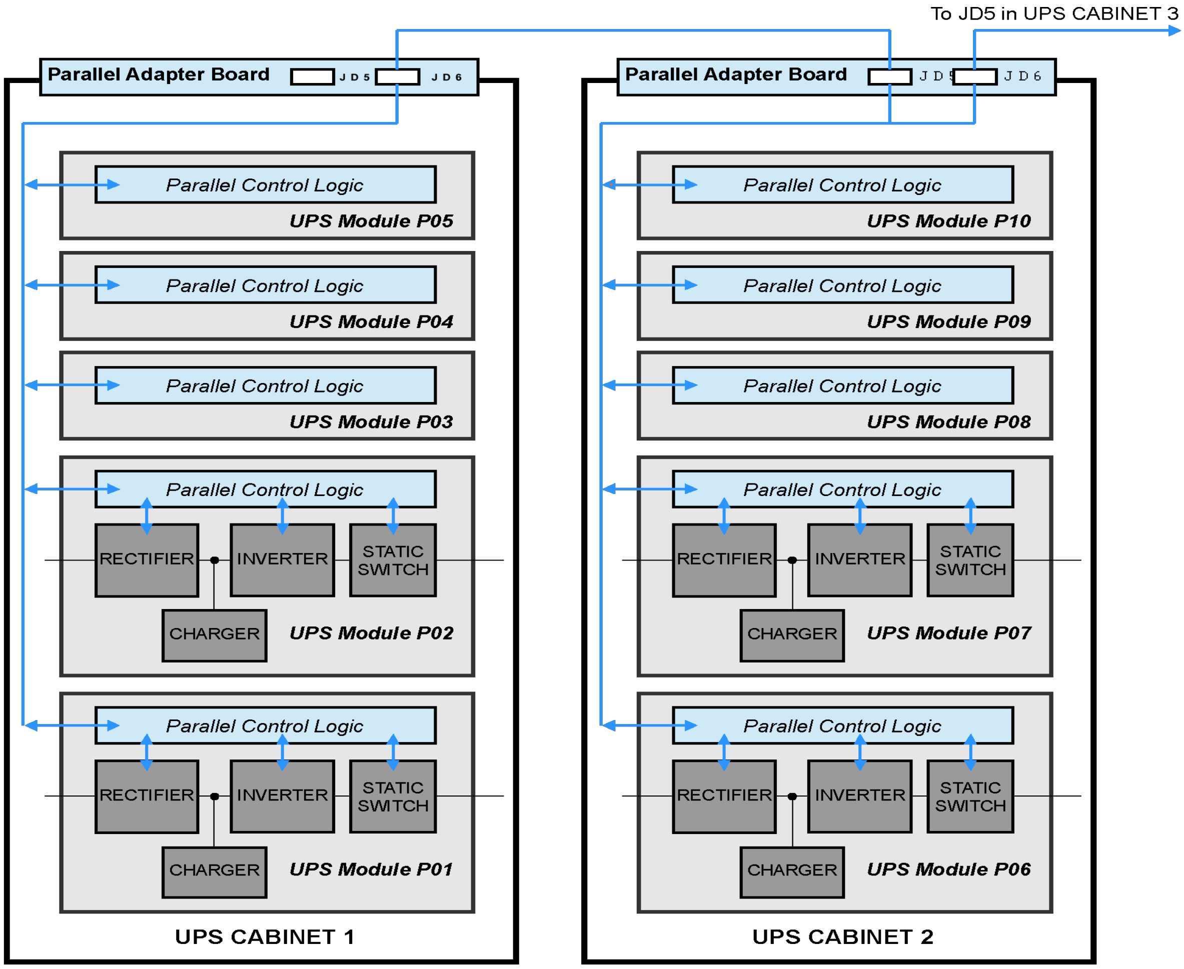


Figure 2.2 Parallel system control

'Capacity' parallel system

When a system is described as being a 'capacity system' it implies that the potential full load requires ALL the paralleled UPS modules to be operational – i.e. if one module trips off line due to a fault, the remaining modules will be unable to supply the load demand and will automatically transfer the load to the bypass supply, where it will no longer be protected against supply aberrations.

'Redundant' parallel system

If a system is designed with module redundancy it must contain at least one UPS module over and above that necessary to power the applied load.

Using the example given above, four fully populated ST-80 cabinets (16 modules = 320 kW) would present one redundant module for a 300 kW load. Under normal circumstances with all 16 power modules on-inverter they would each provide 18.75kW when full load is applied, but if one module fails or is taken off-line, the remaining 15 modules can sustain the load by each providing their rated 20 kW output.

Clearly, the ability to lose one UPS module yet still supply the rated load with processed, backed-up power significantly increases the overall system reliability.

Note: A parallel system operating with one redundant module is known as an 'N+1' system.

2.3 Functional description of operation

This section describes:

- A block-diagram level explanation of the UPS module internal operation *(see paragraph 2.3.1)*.
- The various operational states of the UPS module *(see paragraph 2.3.2)*.
- UPS system-level operation – 'ON-LINE' versus 'OFF-LINE' UPS system operation *(see paragraph 2.3.3)*.

2.3.1 UPS Power module internal operation

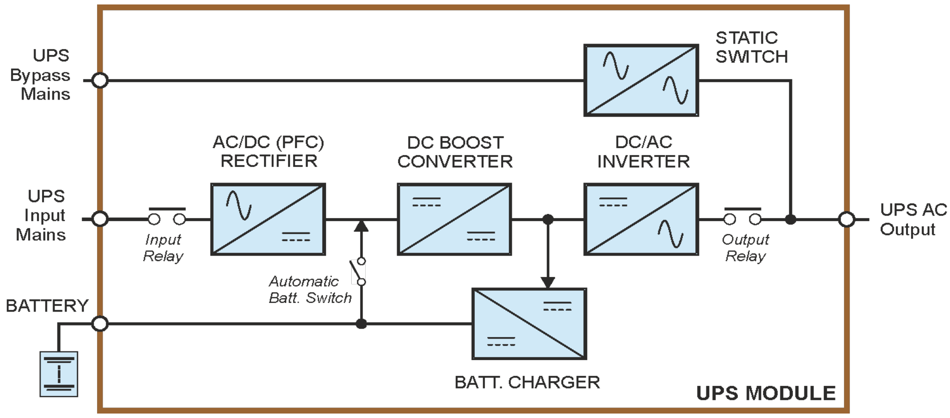


Figure 2.3 UPS module functional block diagram

UPS input/bypass mains supplies

Figure 2.3 illustrates separate UPS module input mains and bypass mains supplies. These two inputs can be connected to separate mains power sources or linked together at the UPS input power terminal blocks and fed with a single mains supply source. Where the UPS is cabled for separate mains inputs it is described as having a 'split-bypass' input; conversely, when the two mains inputs are linked together it is described as a 'common-bypass' input.

Rectifier (PFC controlled converter)

The rectifier converts the UPS input mains to a DC power source that can satisfy the inverter power demands at 100% load. This is possible with a UPS input mains voltage range of -20% to +15%. This wide input voltage operating range means that the battery is not called upon during substantial power dips (brown outs), which in turn maximises the UPS battery life and availability. The rectifier uses leading-edge switched-mode techniques that result in a module input power factor of almost unity over its complete operating range (0.99 at full rated linear load).

DC Boost converter

The DC boost converter converts the DC voltage connected to its input, from either the rectifier or battery, to a regulated DC voltage that is required by the inverter to operate efficiently.

Battery charger

A multi-stage battery charger, powered from the DC boost converter regulated output, charges the battery whenever the UPS input mains supply is available and the rectifier/boost converter is turned on. The charger uses an intelligent charging profile to obtain the best battery charge/discharge performance to optimise the battery life.

Inverter

The inverter converts the regulated DC voltage applied to its input into a sinusoidal AC output that is suitable for connecting to the load equipment. In addition to providing output voltage regulation, the inverter control logic also provides various levels of overload protection, frequency regulation and synchronisation, and output voltage error detection.

In a parallel-module installation (i.e. where two or more UPS modules fitted to the frame) the inverter control logic also ensures balanced load sharing between the on-line modules together with inter-module frequency synchronisation.

Static switch

The static switch provides a means of connecting the UPS AC output directly to the unregulated bypass mains supply.

Working in conjunction with the inverter and output relay, the static switch control logic is able to transfer the UPS AC output (load) between the inverter and bypass supply without a break in the load supply. Load transfer between the inverter and bypass can be selected manually from the operator control panel and takes place automatically following a UPS fault that prevents the inverter from providing its correct output (including temporary overload situations).

Note: A brief load break will occur when transferring from bypass to inverter following a bypass supply failure, or if the bypass/inverter are not synchronised when a transfer is demanded. (See 'Off Line Mode' in section 2.3.3).

Automatic battery changeover switch

If the UPS mains input supply fails, or undergoes a sustained dip (brownout), the automatic battery switch will close to connect the battery to the DC boost converter input. This enables the inverter to continue its normal operation and maintain the UPS output load supply from battery power.

2.3.2 UPS module operational states

Under normal circumstances the UPS module will operate in one of three states: On Inverter, On Battery or ON Bypass – these are described below.

UPS ON-INVERTER mode

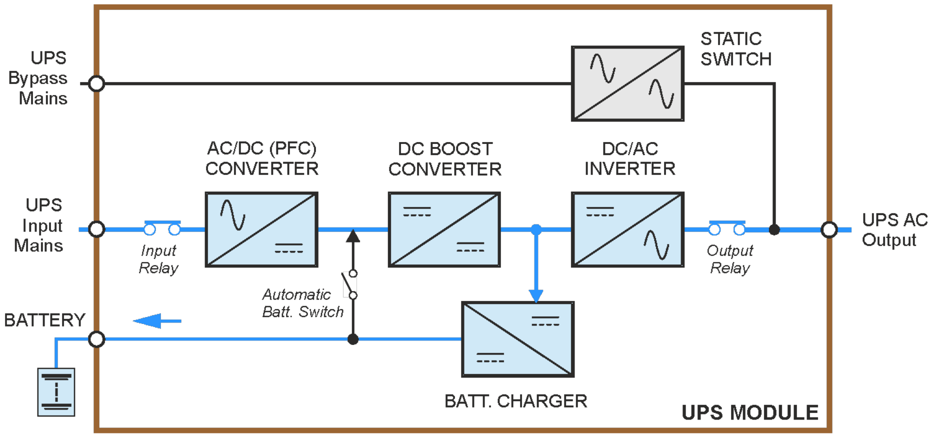


Figure 2.4 UPS ON-INVERTER

Figure 2.4 illustrates the UPS `ON-INVERTER` mode, which is usually considered the 'normal' mode of operation:

- The input relay is closed.
- The rectifier and DC boost converter are turned on to supply controlled DC power to the inverter input.
- The battery charger is operational and provides controlled battery charging.
- The inverter is operational and provides an AC output.
- The output relay is closed to connect the inverter output to the UPS AC output terminals to provide the load with processed power.
- The static switch is off.

UPS ON-BATTERY mode

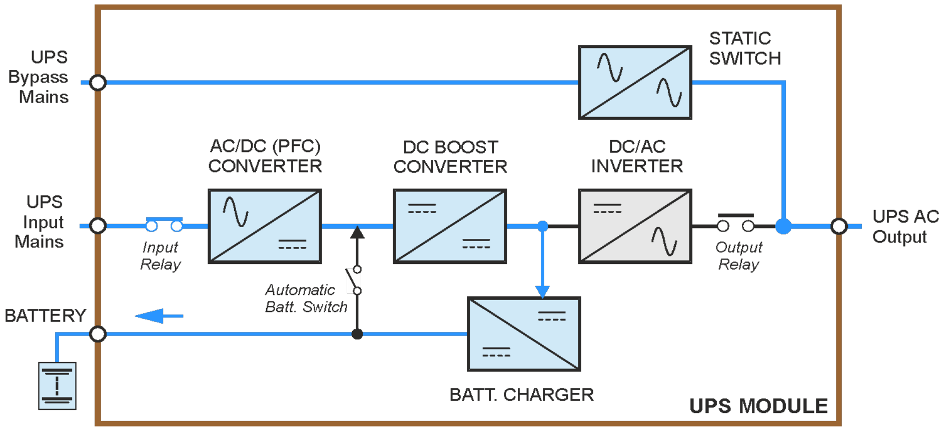


Figure 2.5 UPS ON-BATTERY

The UPS automatically changes to the `ON-BATTERY` mode if the mains input supply fails during normal operation:

- The rectifier is turned off.
- The automatic battery switch is closed.
- The battery discharges through the DC boost converter which remains fully operational and continues to provide the inverter with its regulated DC input.
- The inverter continues its normal operation (the changeover to battery power is transparent to the inverter).
- The output relay remains closed.
- The battery charger is turned off.
- The static switch is off.

UPS ON-BYPASS mode

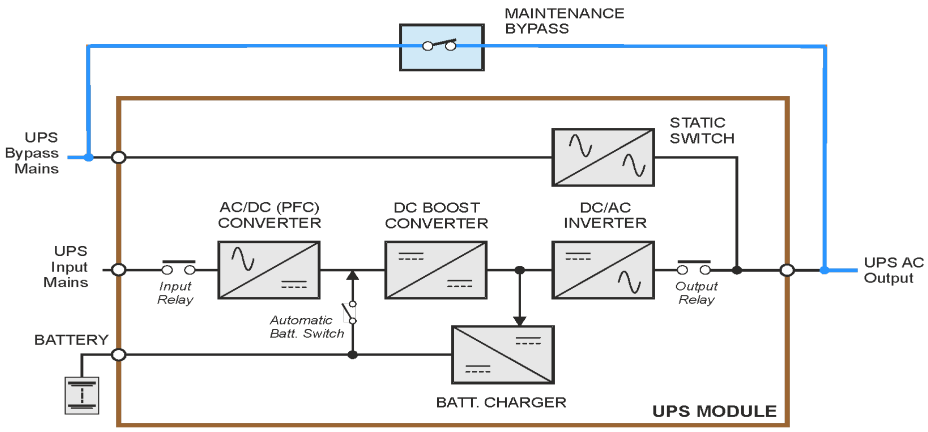


Figure 2.6 UPS ON-BYPASS

This mode can be selected by the operator as part of the system operating procedure. It is also entered following certain fault occurrences such as a UPS output overload:

- The static switch is turned on to connect the load to the unregulated UPS bypass mains input.

Depending on whether or not the transfer to bypass was 'selected' or following a 'fault':

- The rectifier, boost converter and battery charger will remain active to maintain battery charging.
- The inverter may/may-not remain powered up and in operational readiness to be brought into use.

Note: When operating in this mode the load is not protected against any mains input supply disturbances or loss.

UPS ON MAINTENANCE BYPASS

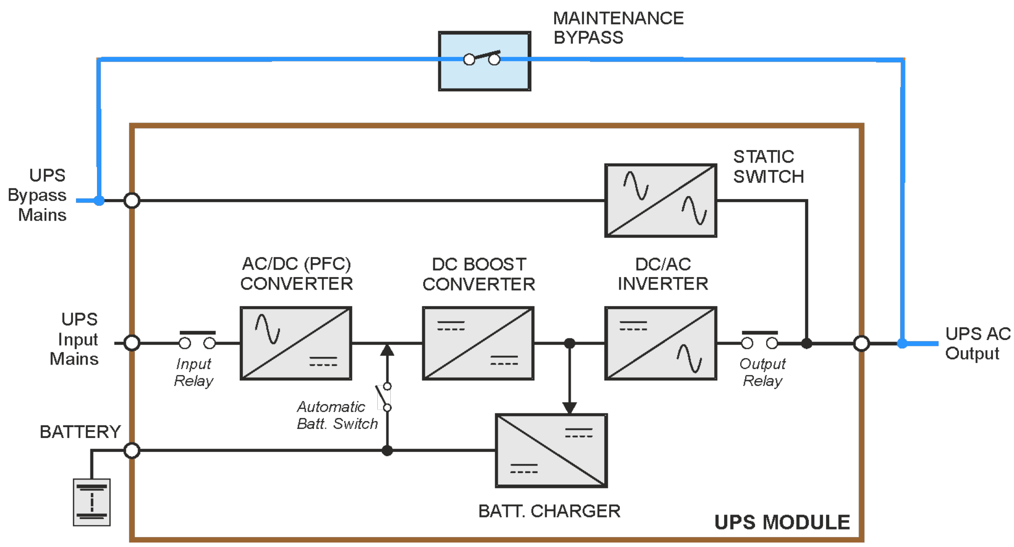


Figure 2.7 UPS ON MAINTENANCE BYPASS

Although the maintenance bypass switch is not fitted within the UPS module, the maintenance bypass mode of operation is shown here for completeness. A maintenance bypass switch (IA1) is fitted to the UPS cabinet switch panel and, when closed, it provides an alternative power path for the load which completely bypass the UPS module(s). This mode is primarily used to maintain the load supply when it is necessary to completely shutdown the UPS cabinet for repair. The maintenance bypass line is connected to the same unprotected supply source as that used by the static switch so for reasons of load security the UPS should only be operated in this mode when absolutely necessary.

2.3.3 UPS system operation

Summary of UPS module operating modes

UPS installations are generally categorised as being either ‘ON-LINE’ or ‘OFF-LINE’ systems; and the PW8000DPA ST can be configured to operate in either mode. The two systems are described below.

ON-LINE UPS system

An ‘ON-LINE’ system provides the highest degree of load protection, especially in the event of a mains supply disturbance or complete failure, and we always recommended its use if the critical load (e.g. computer system) will not tolerate even a very brief supply interruption.

When the PW8000DPA ST is used as an ‘ON-LINE’ UPS it is configured to normally operate in the ON-INVERTER mode, as shown in Figure 2.4. In the event of a UPS input mains supply failure, the UPS changes to its ON-BATTERY mode (Figure 2.5) without affecting its output supply – i.e the UPS will continue to provide its rated output running from battery power and the changeover to battery operation is totally transparent at the UPS output.

If the UPS input mains supply returns when the module is operating on battery power the module will automatically revert to normal ‘ON-LINE’ operation once the returning input mains supply is validated.

If the UPS input mains supply does not return when the module is operating on battery power, it will continue to provide its rated output until the battery discharges to a low cut-off point, at which time the UPS will attempt to switch to its ‘on bypass’ mode; however, if the bypass input supply is unavailable the module will shut down in a controlled manner. An audible and visual alarm will warn the operator that the battery is discharging to enable any necessary intervention actions to be carried out to safeguard the load integrity (e.g. initiate a data backup).

It is usual, especially in larger installations, to provide the UPS with an alternative input supply from a standby generator which starts automatically following a mains supply failure. If such a standby UPS input power source is made available it means that the batteries discharge only until the generator comes on-line. This not only avoids the UPS from eventually shutting down due to discharged batteries but the short battery discharge period also increases the battery life cycle.

Bypass supply and fault handling

If the UPS experiences an internal fault during ON-LINE operation, the inverter is turned off and the static switch transfers the load to the bypass supply automatically and without interruption provided the inverter and bypass supplies are synchronised (Figure 2.6). In the event of an output overload the inverter is designed to supply the load for a limited time, depending on the overload severity, and if the permitted time is exceeded the load is transferred to the static bypass. The additional power available from the bypass supply will attempt to clear the overload but if it persists it will ultimately rupture the bypass supply fuses. If the overload condition clears while operating on bypass the load will be transferred back to the inverter and the UPS will return to its normal ON-LINE mode of operation.

OFF-LINE (On stand-by) UPS system operation

When the PW8000DPA ST is used as an 'OFF-LINE' UPS system it is normally operated in its ON BYPASS mode (Figure 2.6) with the load supplied via the bypass line. However, the rectifier, DC boost converter and battery charger are all operational to maintain battery charging, and the inverter section is turned on but operating on standby.

In the event of a bypass supply failure, the inverter is immediately brought on line and the load is transferred from the bypass line to the inverter by the static switch within 3 to 5 milliseconds. If the UPS bypass and mains inputs are connected to separate sources and the mains supply is still live when the transfer takes place then the UPS will operate in its ON-LINE mode. However, if these supplies are connected to a common source the UPS will immediately revert to its ON-BATTERY mode (Figure 2.5).

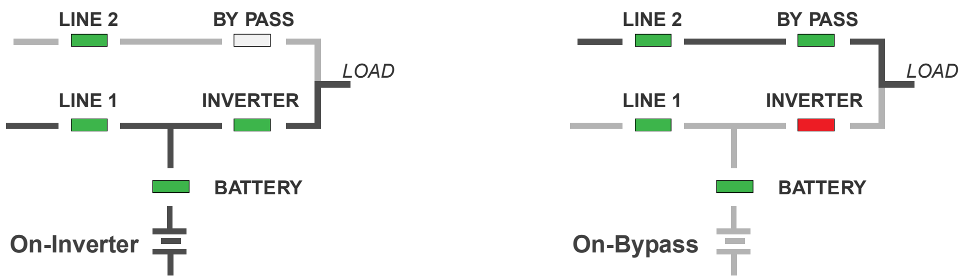
When the bypass supply returns to normal, the load is re transferred back to the bypass line and the inverter returns to its standby operation.

Operating in this mode is slightly more energy efficient than operating in the ON-LINE mode due to the reduced rectifier and inverter losses during normal system operation; and it is sometimes referred to as the 'ECO' (economy) mode. However, this mode is recommended only if the connected load equipment can tolerate power interruptions of up to 3~5 ms during the transfer period

WARNING: The ON-LINE mode should always be used for critical load protection.

Control panel mimic indications

The module control panel mimic led indications for the ON-INVERTER and ON-BATTERY mode are shown below:



2.4 Module component identification

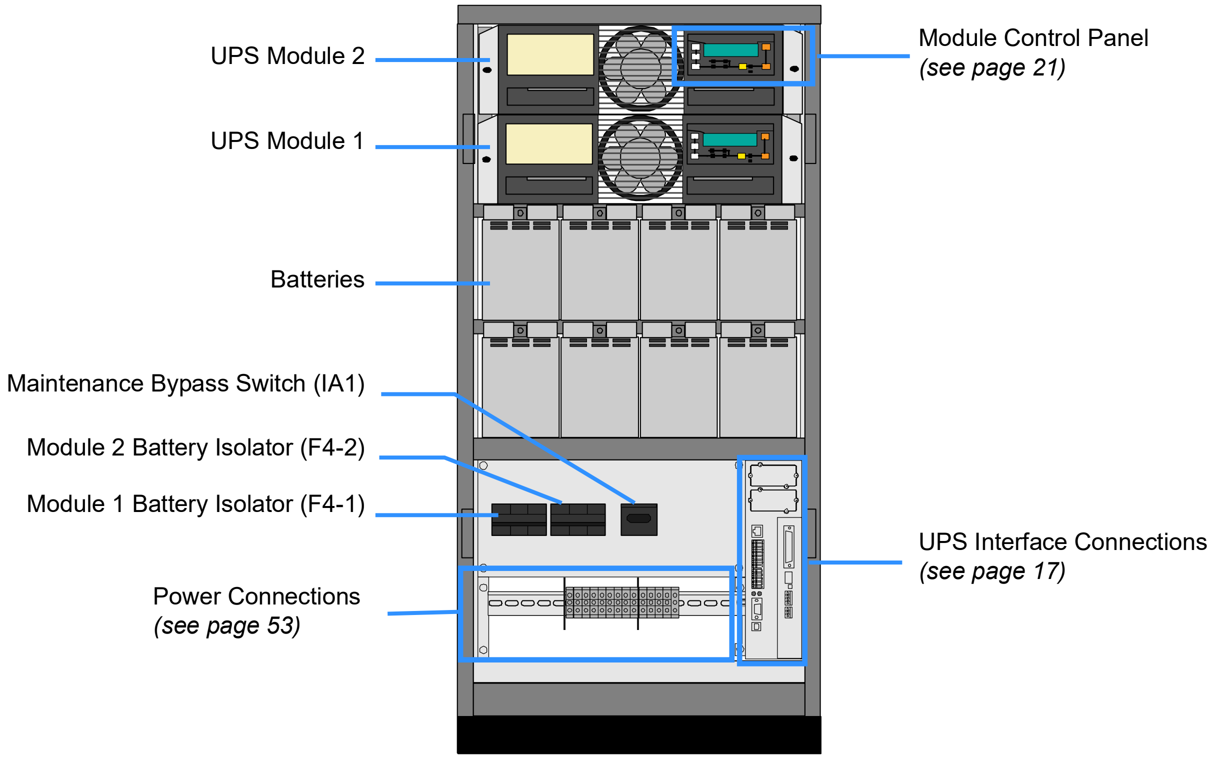


Figure 2.8 ST-40 Cabinet front view

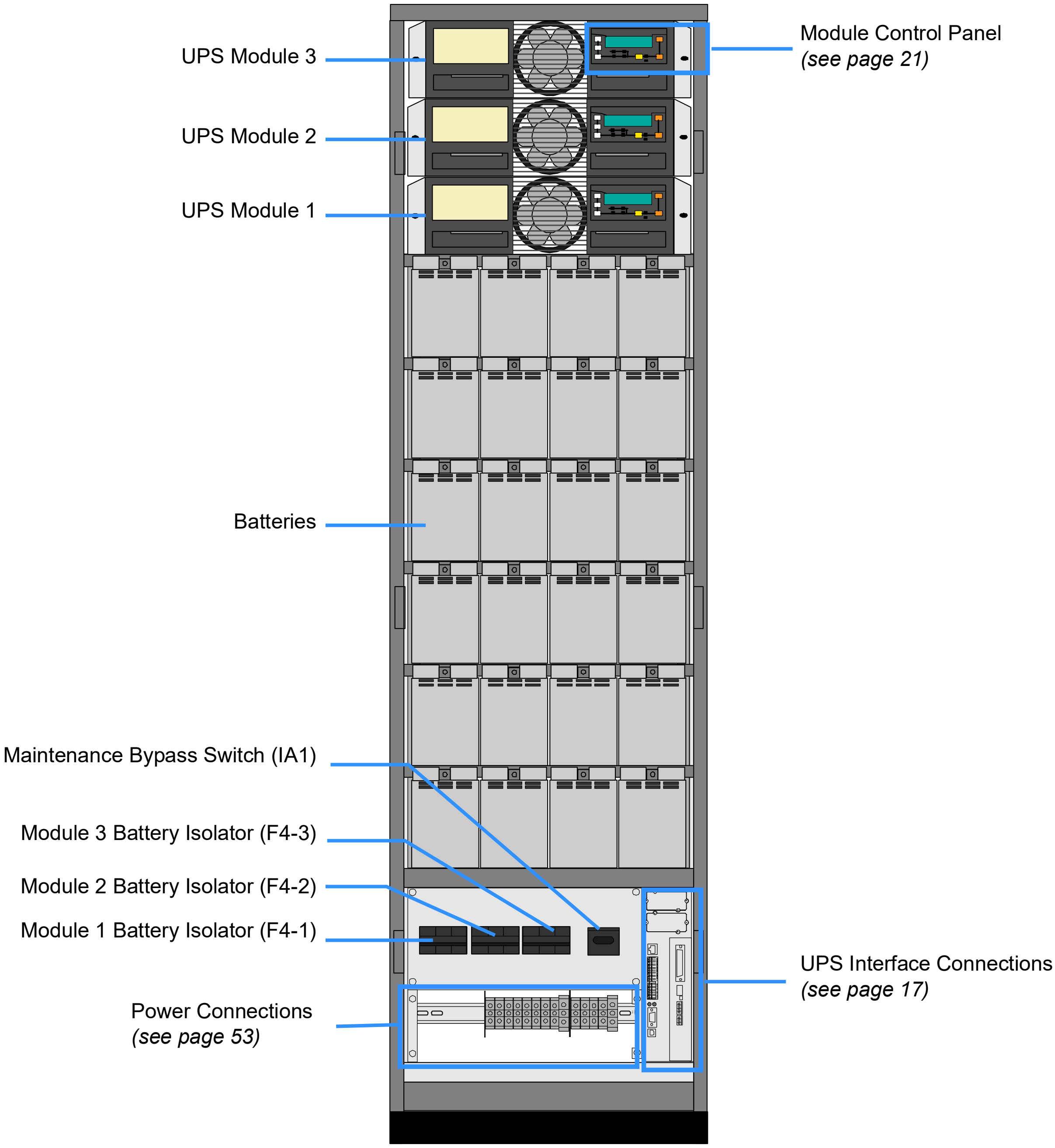


Figure 2.9 ST-60 Cabinet front view

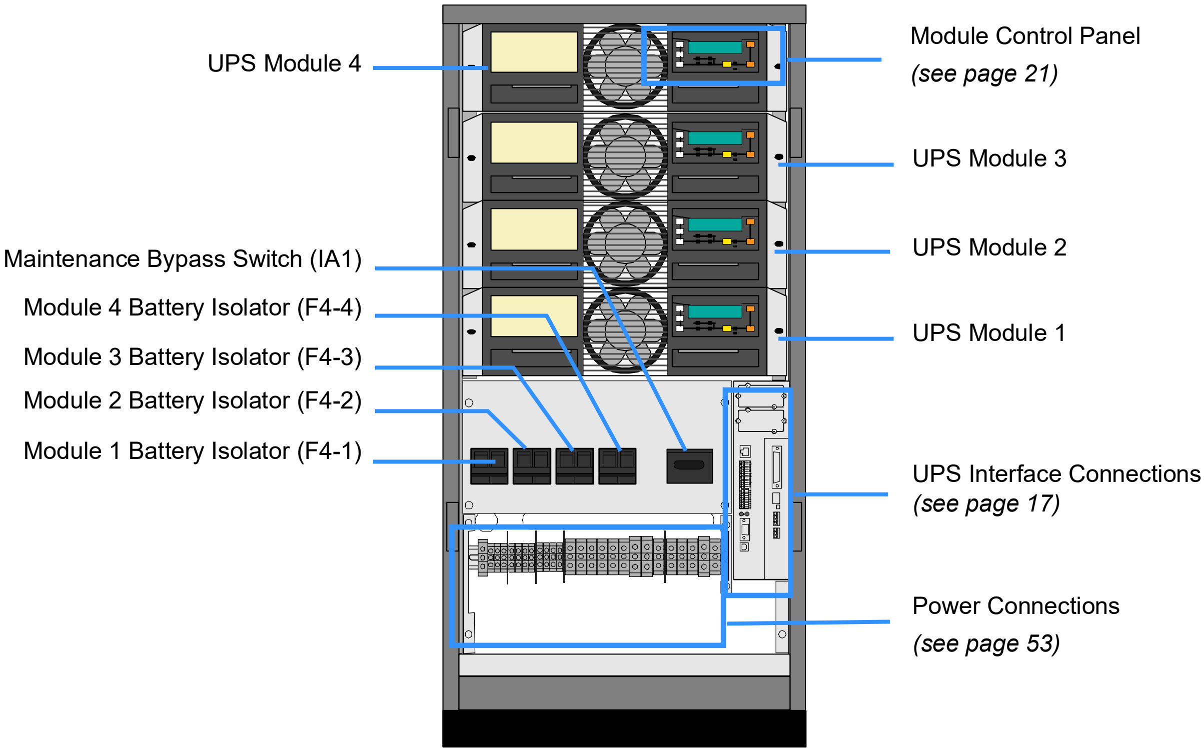


Figure 2.10 ST-80 Cabinet front view

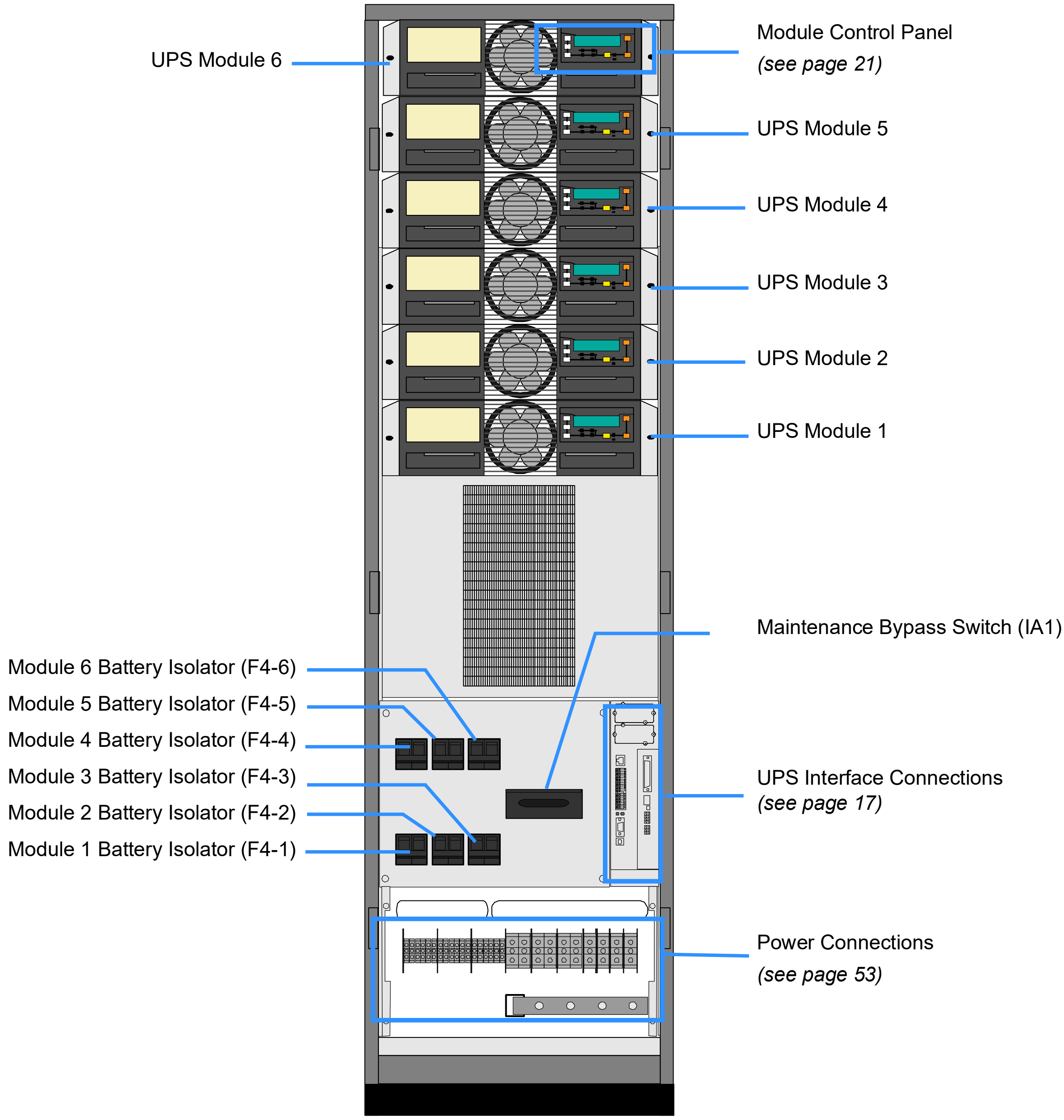


Figure 2.11 ST-120 Cabinet front view

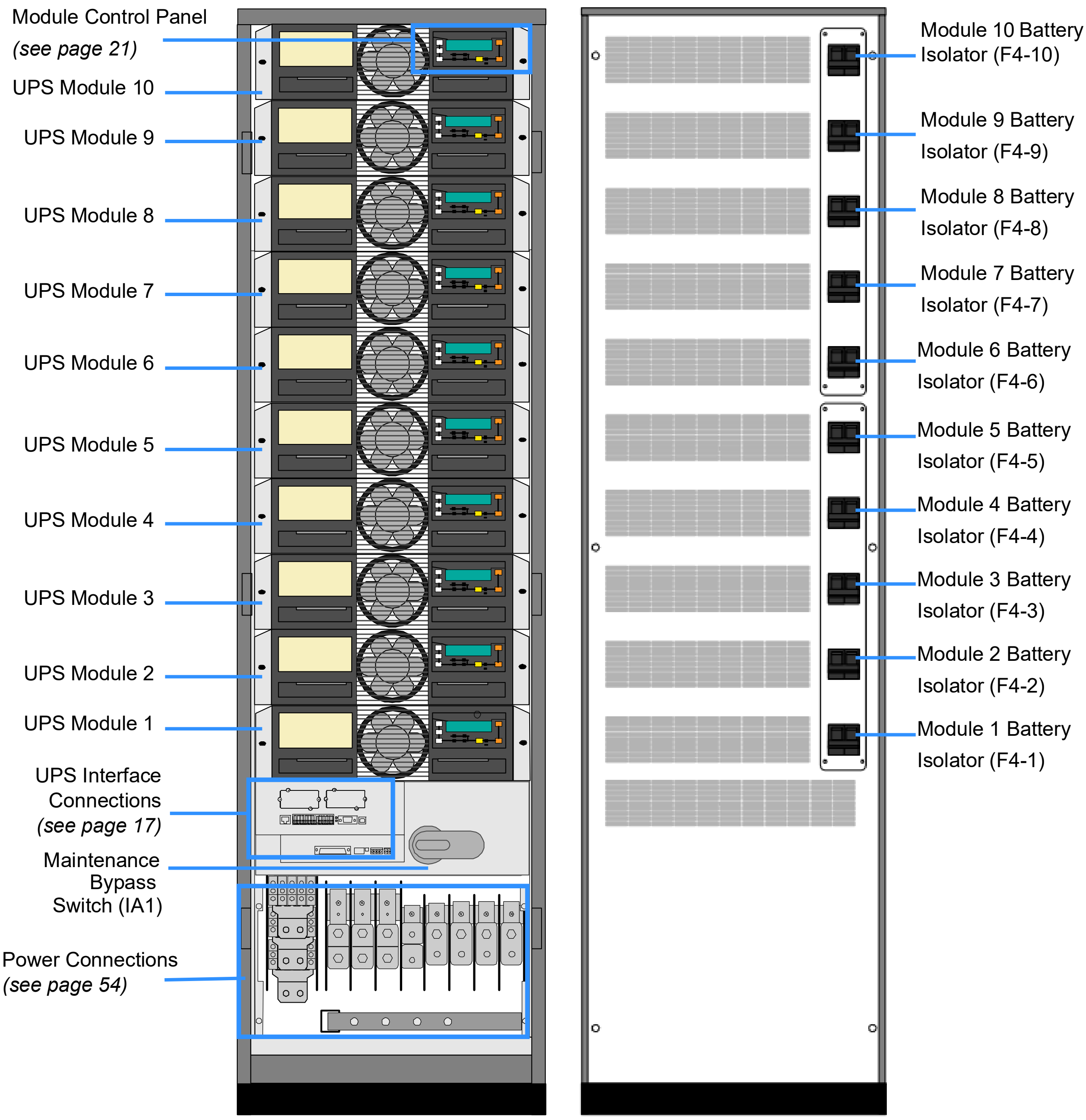


Figure 2.12 ST-200 Cabinet front and back view

2.5 Kohler PW 8000DPA ST Communications

2.5.1 Standalone cabinet communication

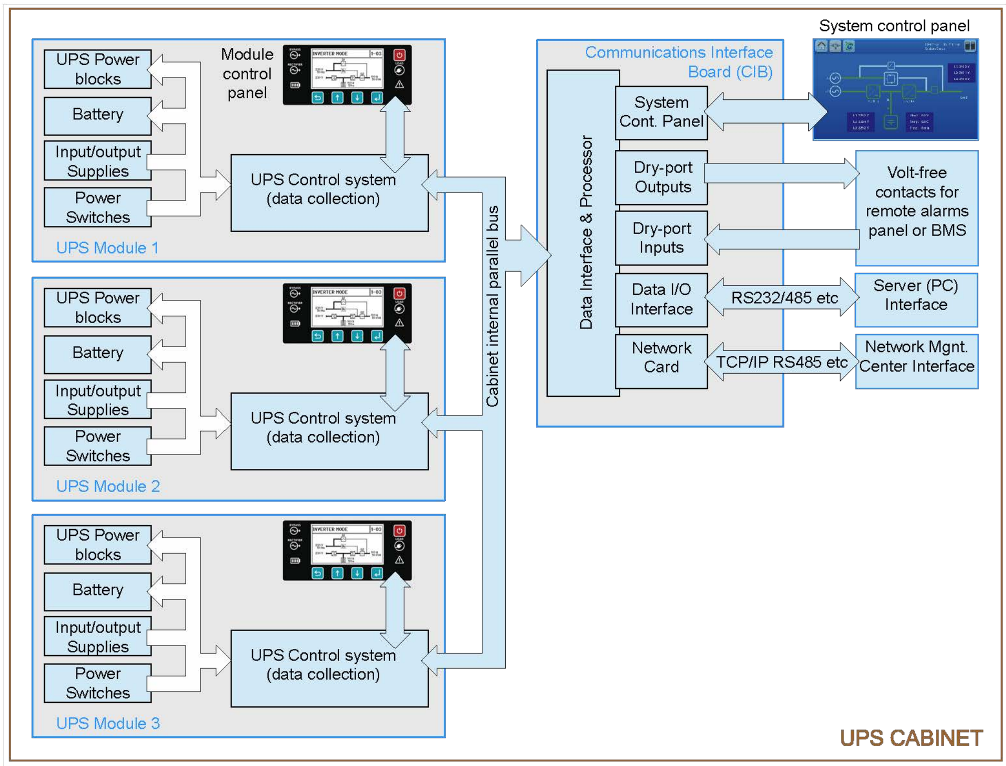


Figure 2.13 Standalone cabinet UPS module communications

Figure 2.13 illustrates the communication facilities within a standalone UPS cabinet. The diagram shows three fitted UPS modules but of course this could be as many as 10 modules in the ST-200 model.

Module parallel control

Each UPS module contains a dedicated control system which responds to data generated by numerous control and monitoring functions within the module itself together with data generated by the other UPS modules and transmitted along the cabinet's internal parallel bus. The inter-module signals carried along the internal parallel bus allows each module to function as part of a parallel UPS system in terms of load sharing, synchronisation etc as previously described.

The internal parallel bus is implemented by a multi-way connector fitted to the backplane of the UPS module mounting slots, so the module is automatically connected to the bus when it is inserted.

A module control panel, fitted to each UPS module, provides the means to monitor and control each module individually and also transmit 'system-wide' command signals, such as load transfer requests, to all the modules in the system.

Customer interface facilities

As shown, the internal parallel bus is also connected to a communications interface board (CIB). This board provides a summary data collection and processing point for the entire UPS system and offers a range of input/output communications facilities that can be interfaced with an external remote alarm panel, BMS or IT management network.

The system control panel, shown connected to the customer interface board, is an optional control panel with a graphical user interface that can be fitted to the UPS cabinet door. When used, the system control panel can monitor and control the entire UPS system or each individual UPS module.

2.5.2 Parallel cabinet communication

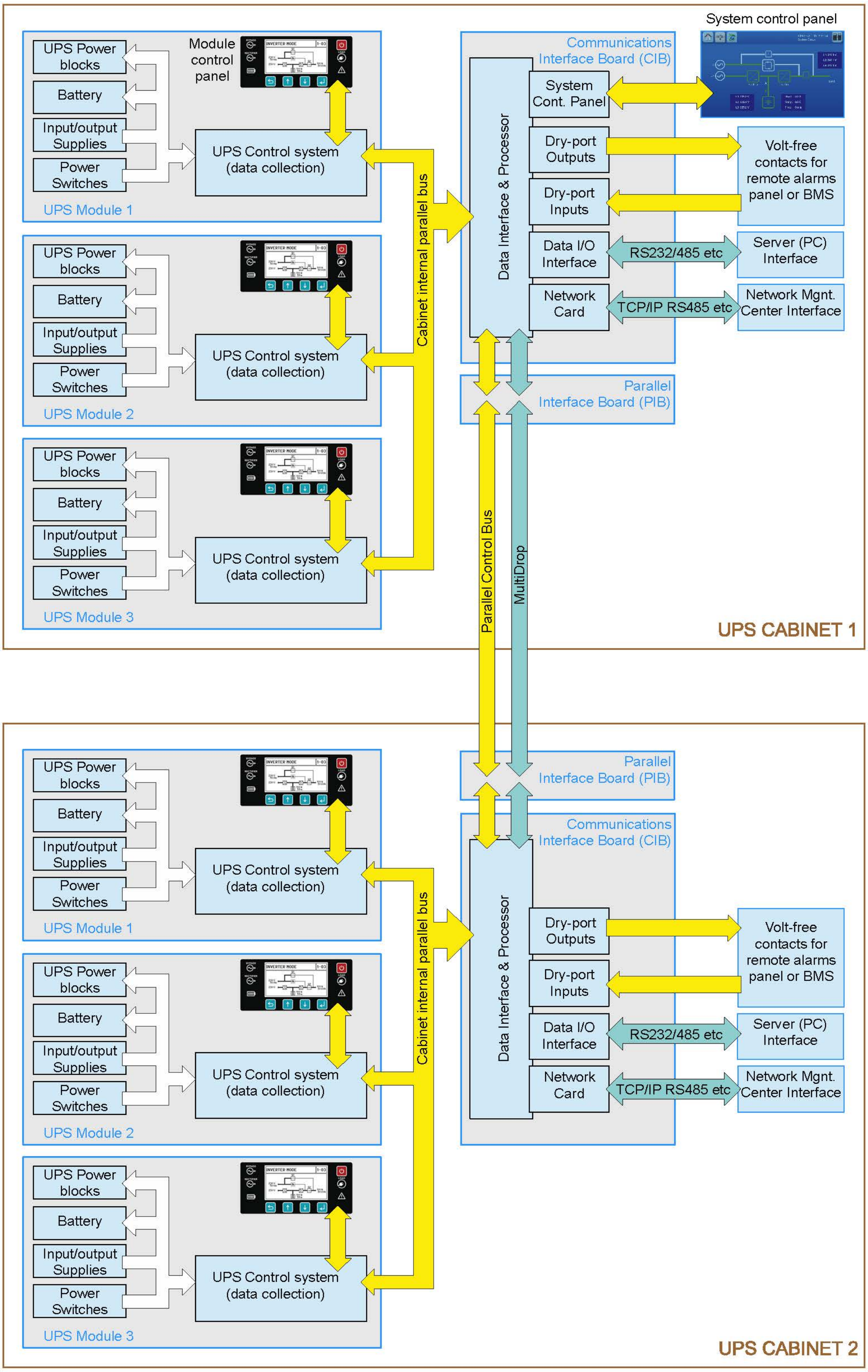


Figure 2.14 Parallel cabinet UPS module communications

Figure 2.14 illustrates the UPS module communication facilities for a parallel cabinet Kohler PW 8000DPA ST installation (two cabinets are shown).

Module parallel control

This diagram shows that in a parallel cabinet system the UPS modules within each cabinet communicate with each other via the cabinet's internal parallel bus in exactly the same manner as described for a standalone cabinet system. However, in this instance an external parallel control bus is connected between the cabinets which effectively links the internal parallel buses to form a single, common parallel control system.

For control purposes, the cabinet that contains the master UPS module is configured as being the 'master' cabinet, and as module 1 is normally set to be the master module, the master cabinet is usually cabinet 1. Note that the master module/ cabinet configuration is set by the commissioning engineer.

A system control panel is fitted to the door of the master cabinet which, as in the standalone cabinet installation, can monitor and control each module (in any cabinet) individually or operate at a system-wide level.

Customer interface facilities

The communications interface board (CIB) fitted to each cabinet offers the same external interface facilities as those described for the standalone cabinet installation. However, this can be modified by the 'multidrop' feature, which is shown as a separate parallel connection between the cabinets in Figure 2.14.

Multidrop is an optional feature that enables the customer interface board fitted in the master cabinet to collect data from ALL the slave cabinets. It then generates a single data-stream combining the data from every cabinet, and makes it available at the RS232, RS485 and NIC interface ports in the master cabinet. With multidrop installed, the interface between the entire UPS system and a network management system can therefore be implemented using a single cable rather than requiring an individual cable for each UPS cabinet.

Key Point: When the multidrop feature is used, the I/O facilities of communication interface board in the 'slave' cabinet(s) are all disabled, but the customer interface board fitted to the 'master' cabinet remains fully functional.

Note: Although the multidrop option is shown as being connected using a separate cable in Figure 2.14, in the PW8000DPA ST series UPS the multidrop data is transmitted via the parallel control bus cable and is operationally configured during the system commissioning.

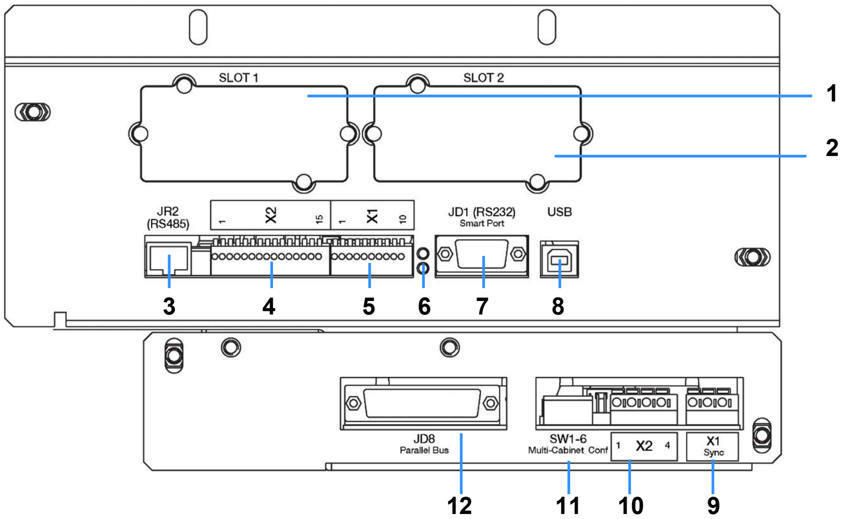
2.5.3 UPS Interface boards

Two interface boards are fitted in the lower part of the UPS cabinet, adjacent to the maintenance bypass switch. One is the customer interface board, which provides a means of connecting the UPS cabinet to a range of external monitoring and control facilities. The other is the parallel interface board which contains the connections used to control and monitor the cabinets when connected as part of a parallel cabinet system.

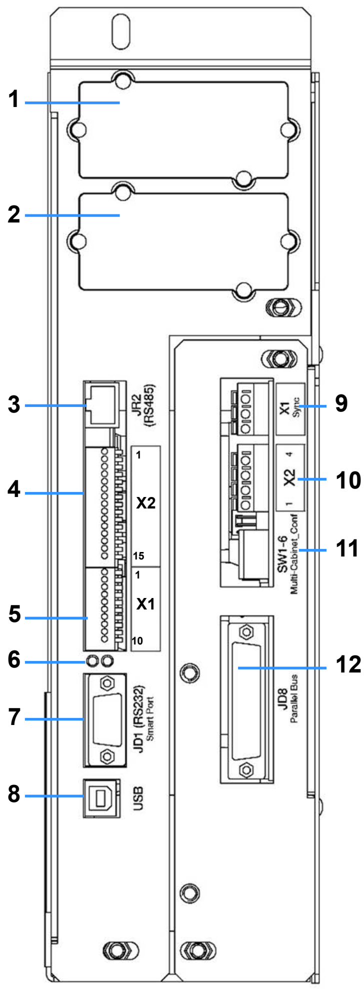
Key Point: The parallel interface board is part of the factory-fitted 'paralleling kit' and is installed only in UPS cabinets that are used in a parallel system.

These boards are illustrated in Figure 2.15, with detailed application and connection details provided in the Options chapter of this manual.

ST200 Cabinet



ST40-120 Cabinet



Customer Interface Board		
1	SLOT 1	Slot for optional Modem/Ethernet card ONLY
2	SLOT 2	Slot for optional SNMP card ONLY.
3	JR2	RJ45 Port: (Not used)
4	X2	Customer output dry ports (Phoenix terminal block): Up to 5 output dry contacts used for signalling of the status of the UPS system (e.g. mains failure, load on inverter, battery low, common alarm).
5	X1	Customer input dry ports (Phoenix terminal block): Up to 5 input dry contacts used for remote shut down and generator operation facilities, battery temp sensor or bespoke customer function.
6	LEDs	Status LEDs (red/green): 2 LEDs that indicate the customer interface board operational status. The red led indicates a circuit board fault that most likely requires a board replacement. The flashing rate of the green led indicates the board’s status and normally flashes twice/second when the board is healthy
7	JD1	RS232 Smart port computer interface: A Sub D-9 female connector that provides an RS232 interface for remote systems monitoring using a computer application, such as WAVEMON. This allows the computer terminal to continuously monitor the mains voltage and computer operating status, and process any alarm messages.
8	USB	Standard USB interface: Provides a USB user interface for remote systems monitoring, as above
Parallel Interface Board (fitted in a parallel UPS cabinet only)		
9	X1	Sync Input: Allows an external synchronisation control source to be connected.
10	X2	External manual bypass: Auxiliary signals from external manual bypass switch and (optional) external output breaker providing open/close status information for parallel system configuration
11	S1-6	Configuration DIP switch: Used to configure the cabinet position in a parallel system.
12	JD8	Parallel bus: The parallel adapter board, plugs into JD8. The adapter board contains the parallel control bus cable connectors

Figure 2.15 UPS Interface Boards

2.6 Module control panel

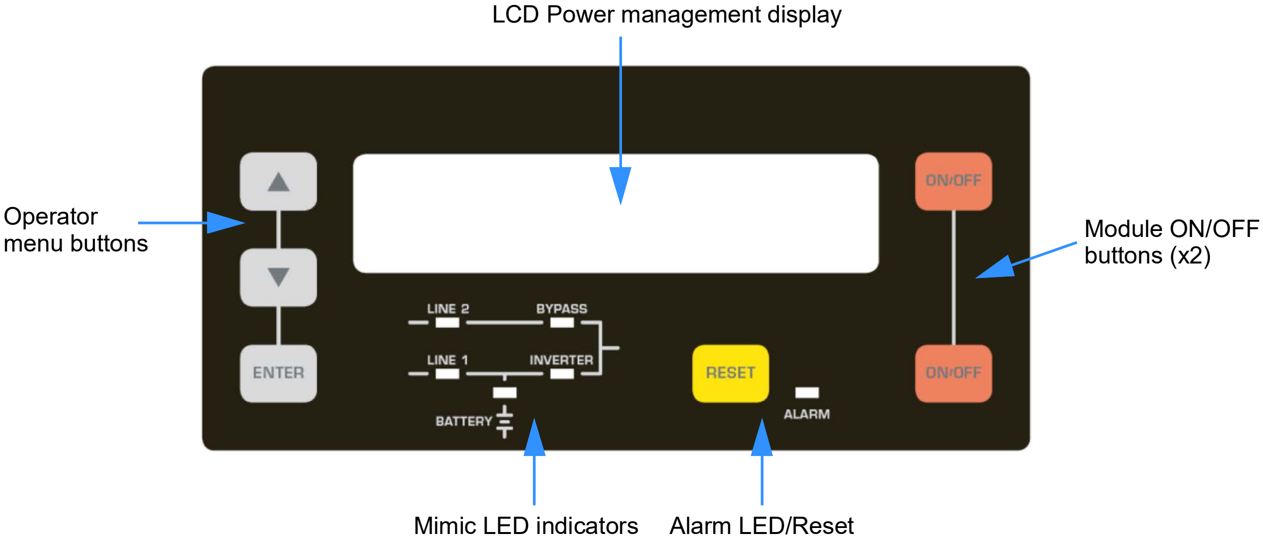


Figure 2.16 LCD Control panel

2.6.1 Module mimic LED indicators

The module mimic LED colours change between `GREEN`, `RED` and `OFF` to indicate the operational status of key UPS stages, and thereby serve to show the active power path through the UPS.

- `LINE 1` (rectifier) and `LINE 2` (bypass) LEDs indicate the availability of the input mains and bypass mains supplies respectively.
- `INVERTER` and `BYPASS` LEDs illuminate green to indicate which of the two sources is providing the UPS output supply.
- `BATTERY` illuminates green when the battery is being charged and flashes when the battery is discharging – e.g. when the inverter is operating from battery power. The indication change to red if the battery is faulty or fully discharged.
- Although it is not part of the module mimic, the `ALARM` LED, located towards the lower-right of the control panel, provides a visual indication that an alarm condition has been detected. When an alarm condition is present the LED is accompanied by an audible alarm.

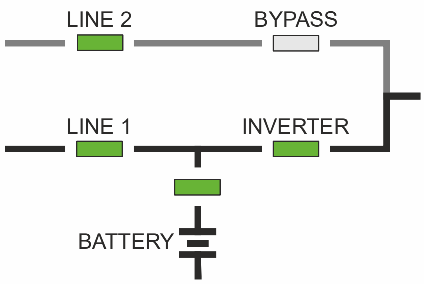


Figure 2.17 Module mimic diagram

LED Indication summary

INDICATOR	STATUS	INTERPRETATION
LINE 1	GREEN RED	Input mains supply is available and within acceptable parameters Input mains supply is unavailable or not within acceptable parameters – this is the normal display during an input mains power failure
LINE 2	GREEN RED	Bypass mains supply is available and within acceptable parameters Bypass mains supply is unavailable or not within acceptable parameters
ALARM	OFF Flashing RED + buzzer RED	No alarm condition Alarm condition is currently active Alarm condition is present but the audible warning has been reset
INVERTER	OFF GREEN RED	Inverter turned OFF or the load is connected to the bypass Load on inverter Inverter is unavailable, or locked out
BYPASS	OFF GREEN RED	Bypass not operating (the module is turned OFF or the load is connected to the inverter Load on bypass Static bypass is unavailable, or locked out
BATTERY	GREEN Flashing GREEN RED Flashing RED	Battery charger is ON and the battery is OK Load on battery and battery is discharging – normal display during input mains failure Battery faulty or discharged (e.g. high voltage, high temperature, failed battery test) Battery not detected. Battery is disconnected or battery fuse open, low battery voltage, (Note this is the default status before turning on the module)

2.6.2 Operator buttons

The operator buttons allow the user to:

- Set operating parameters and make adjustments via the menu-driven LCD display.
- Start and stop the UPS, and transfer the load between inverter and bypass.
- Monitor the UPS input/output voltage, current, frequency and other parameters – shown on the LCD display.

Button function summary

BUTTON	FUNCTION
ON/OFF	Used to switch-on or switch-off the UPS
UP (▲)	Scroll upwards through a displayed menu
DOWN (▼)	Scroll downwards through a displayed menu
RESET	Cancels the audible alarm. If the alarm condition was transient the ALARM LED will also extinguish, otherwise the LED will remain ON (red)
ENTER	Confirms (selects) a chosen menu item

The UPS can be switched `ON` or `OFF` by simultaneously pressing both `ON/OFF` buttons. The requirement to press both buttons is to help avoid accidental operation.

During normal operation, simultaneously pressing the two `ON/OFF` buttons will shut down the UPS module.

- In a single UPS module installation this will disconnect the UPS output unless the load is first transferred to the maintenance bypass – see the operating instructions.
- In a parallel module system the UPS module will shut down and its output will be disconnected from the parallel load bus. However, the load may or may-not transfer to bypass depending on the number of remaining live modules – i.e. if the number of remaining modules is sufficient to support the connect load then the load will not be transferred.

To shut down all the modules in a parallel system you must press both `ON/OFF` buttons on every module.

2.6.3 LCD Power management display

Working in conjunction with the UP, DOWN and ENTER buttons, the LCD screen presents a range of selectable menus which allows the user to operate the UPS and monitor its performance – the menu tree is shown in Figure 2.18.

Status screens

During normal operation the LCD displays a UPS status screen similar to those shown below. From the status screen the user can access the 'top level' menu by pressing either the UP or DOWN button; and then further navigate through the nested sub-menus using the UP / DOWN buttons to scroll, and the ENTER button to make a selection.

This status screen indicates that the UPS is operating 'on inverter' and providing protected power to the load.	LOAD P01 PROTECTED
This status screen indicates that the UPS is operating 'on bypass' and the load is therefore not protected.	LOAD P01 NOT PROTECTED
This status screen indicates that the load is not being powered from the UPS, usually because the UPS has been switched off by the ON/OFF buttons.	LOAD OFF P01 SUPPLY FAILURE
This status screen indicates that the UPS parallel switch (IA2) is open and the UPS module is disconnected from the parallel system. Although in a redundant parallel system the load might still be receiving protected power from the remaining on-line modules.	LOAD DISCONNECTED P02 PARALLEL SWITCH OPEN

On the right hand side of the LCD status screen display is a three digit module ID indicator which shows a module's position in a multi-module system.

S	Stands for **S**ingle module. The UPS frame only contains one UPS module
P01	Stands for **P**arallel system and 01 identifies the module as being the 1st module (MASTER) in the system
P02	Stands for **P**arallel system and 02 identifies the module as being the 2nd module (SLAVE) in the system. This number can range from 02 to 04 in a fully populated RI-40 UPS system.

Top level menu

The following sub-menus can be accessed from the top level menu:

EVENT LOG – The event log stores the last 64 UPS events in date/time stamp order. These include both 'fault' events, such as [OVERLOAD], and 'operational' events such as [LOAD TO BYP.].

MEASUREMENTS – This sub menu provides access to a range of input, output and battery monitoring.

COMMANDS – This sub menu provides access to a range of commands that might be used during day-to-day UPS operation. Those most commonly accessed are the [LOAD TO INVERTER] and [LOAD TO BYPASS] command which are used to transfer the load between inverter and bypass during the UPS start-up and shut down procedures.
– [PERFORM BATT. TEST] Stops the charger and monitors the off-load battery voltage for 1 min. then transfers the load to battery for a further 1 min.
– [PERFORM DEEP BATT. TEST] Performs as above, but runs with battery on load until the low voltage alarm activates.

UPS DATA – This is a read-only menu and shows the UPS details input by the manufacturer/commissioning engineer.

SET-UP USER – This sub menu allows the user to select the LCD display language, set the local date/time which is used to stamp the Event Log, set up the automatic battery test operation and configure the UPS options when running on standby generator.

SET-UP SERVICE – This menu is used by the commissioning engineer and is password-protected to restrict access.

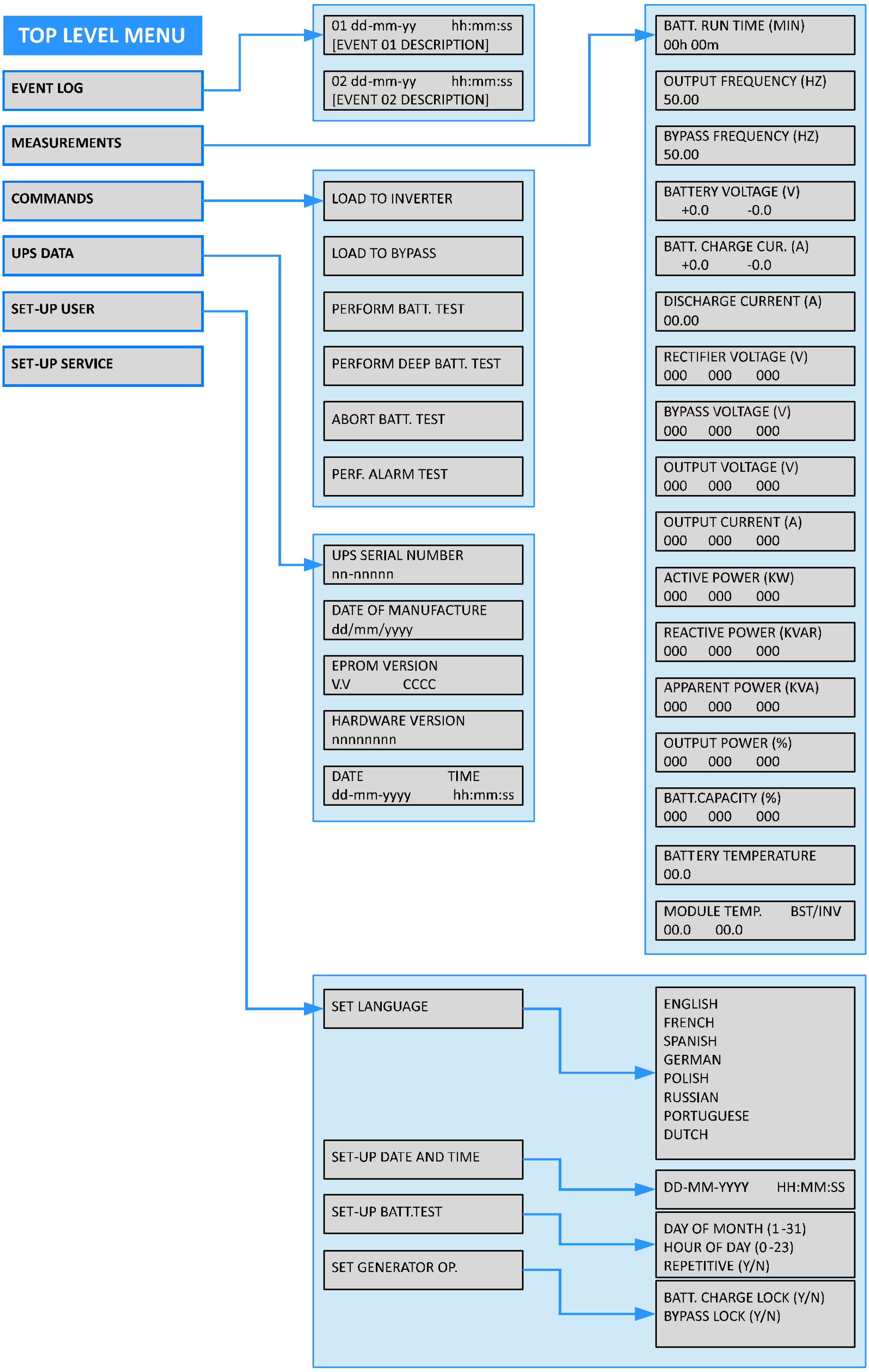


Figure 2.18 Module control panel menu

2.7 Optional system control panel

The system control panel is an optional component which is fitted to one UPS cabinet, usually the ‘master’ UPS, in a parallel cabinet system.

It contains a microprocessor-based TFT touch-screen display which enables the operator to monitor the status of the overall UPS system as well as each individual UPS module. It also allows the operator to transfer the load between the inverter and bypass. All other UPS module-level commands must be performed from an individual module’s control panel. By having both control panels in place, working at ‘module’ and ‘system’ level, the UPS offers enhanced user friendliness without compromising on robustness.

Using the touch-screen, the operator can:

- check system’s operational status and measurements
- execute system-level commands
- monitor the power flow through the UPS system
- check alarm and events history
- silence alarms
- adjust programmable parameters
- view the battery status

Figure 2.19 System control panel

The display turns on automatically when the first UPS power module is energised; and after a few seconds of initialisation it displays the default module mimic screen shown in Figure 2.20.

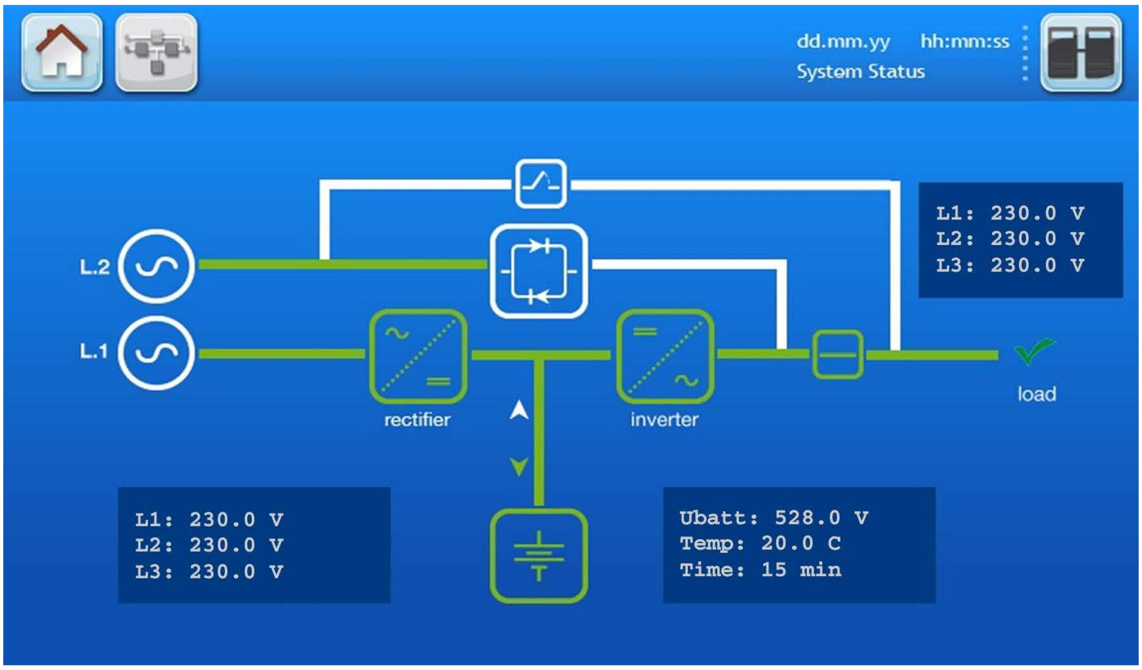


Figure 2.20 System control panel – default display

2.7.1 Display header bar

A navigation and status bar is displayed in the header area of every screen.

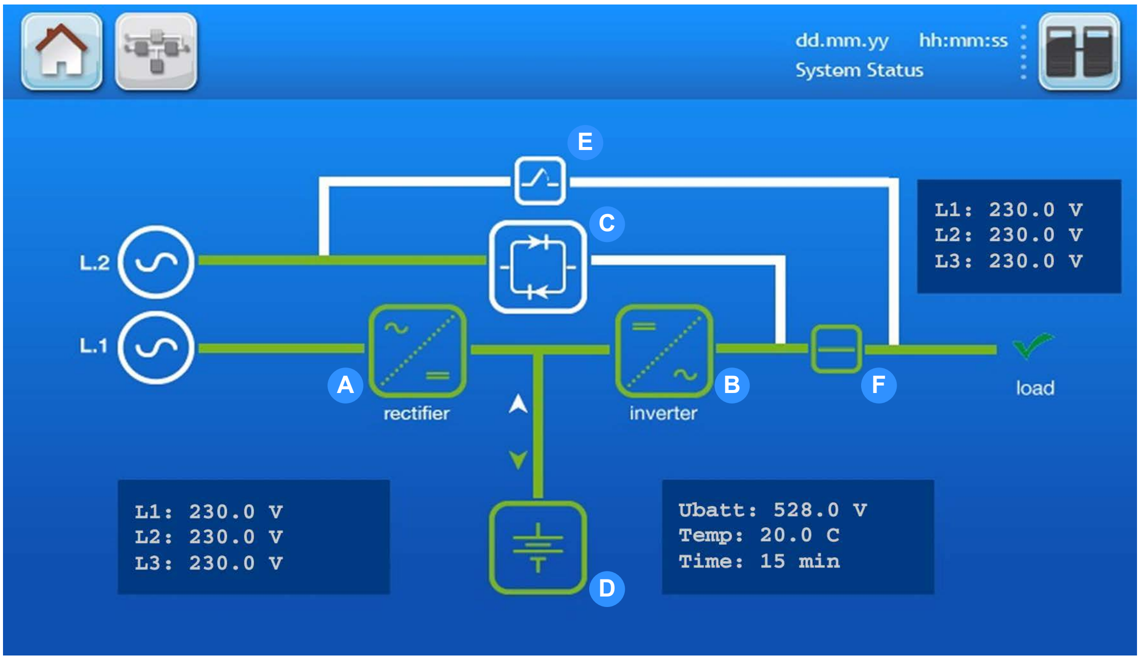
A	Home	Accesses the HOME screen.
B	Mimic diagram	Accesses the `MIMIC` diagram screen.
C	Warning	The warning symbol is only visible in the presence of a monitored alarm or fault event. Touching this icon will silence the audible alarm and open the `EVENTS` screen.
D	Date	Current date indication. Set in the user menu and used to date-stamp the alarms/events log.
E	Time	Current time indication. Set in the user menu and used to time-stamp the alarms/events log.
F	Module selection	Accesses `MODULE SELECTION` screen from where it is possible to select a particular module and exercise the navigation (status and measurements) at module level.
G	UPS number	Each UPS module is given a sequential number in a parallel system. The number shown here is used to identify a particular module –e g. `P01` indicates the UPS number `01`. This can be used to identify the module associated with the conditions displayed on the screen (e.g. identify a faulty module).
H	System status OR Load Status	`System status`: indicates that the user is in the system level navigation. Load status: displays whether or not the load is protected, when the user is in the module navigation level.

Figure 2.21 Navigation and status header bar

2.7.2 Mimic diagram – system level

The system level mimic diagram is the default screen. It shows the power flow through the UPS system and indicates its operational status – in either a single cabinet or multi-cabinet configuration.

The operational status of each block is identified by its line colour, as shown below in Figure 2.22, with the green connecting lines indicating the power flow in the system.



A	Rectifier	Green: Red:	Rectifier is on. Rectifier is switched off.
B	Inverter	Green: Red:	Load is on inverter. Inverter is switched off.
C	Bypass	Green: Red:	Load is on bypass (or the system is operating in eco-mode). Bypass is switched off.
D	Battery	Green: Yellow: Red:	Battery is charging or discharging (the direction of flow is indicated by the adjacent green arrowheads.) Battery is not charging nor discharging. Battery is in fault condition or is discharged.
E	Maintenance Bypass Isolator IA1	Yellow: White:	Load is on maintenance bypass Maintenance bypass opened
F	Output Switch	Green: White:	Output Switch is closed (Position ON) Output Switch is opened (Position OFF)

Figure 2.22 System level mimic display screen

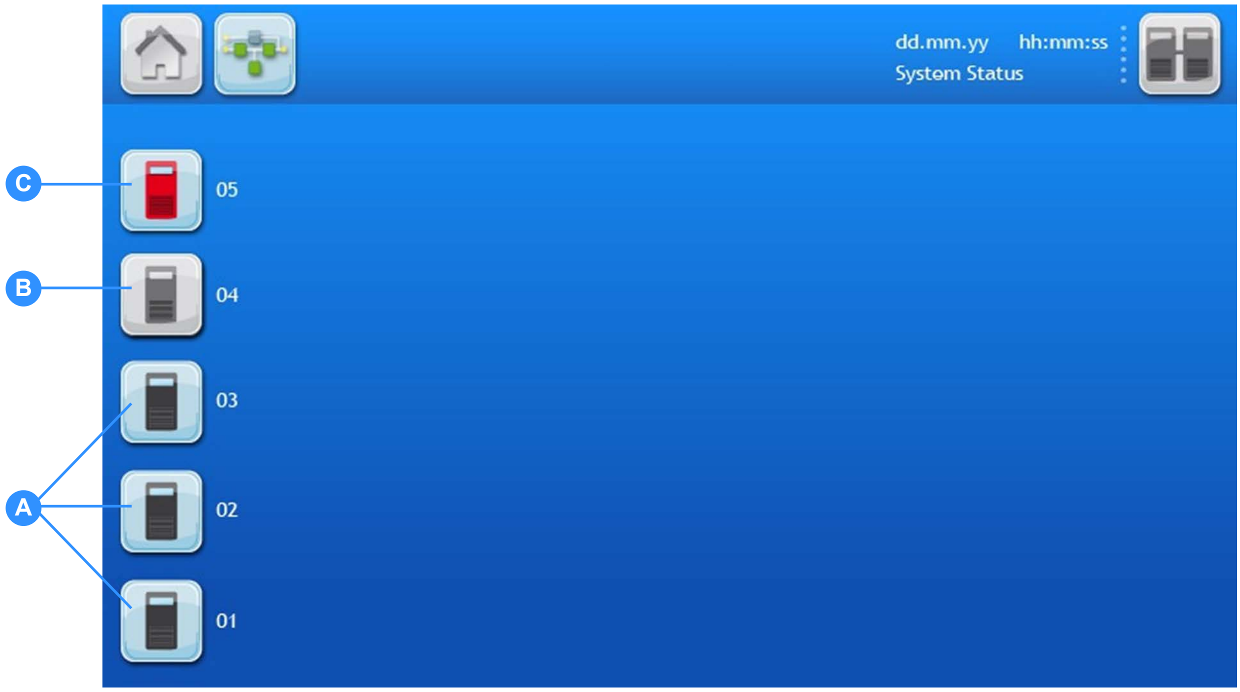
Three meters are included on the mimic display screen to indicate the rectifier, inverter, bypass and load voltage, frequency and current. The displayed battery parameters include the battery temperature and remaining autonomy time. The meter display sources are selected by pressing lightly on the touch-sensitive area on the mimic display.

2.7.3 Module selection screen

The module selection screen is accessed by pressing the `MODULE SELECTION` icon on the display header bar (item F in Figure 2.21). On opening, the screen displays an icon for every UPS module connected to the system (in all cabinets) and indicates their operating status through the colour-coding shown in Figure 2.23.

The UPS modules, which are identified numerically by the ID number entered into the module's configuration set-up during commissioning, are shown in vertical columns representing each UPS cabinet.

Touching a module icon provides access the status and measurements navigation screen for the selected module.



A	Black	Module in normal operation
B	White	Module inactive – switched OFF
C	Red	Module has a general alarm

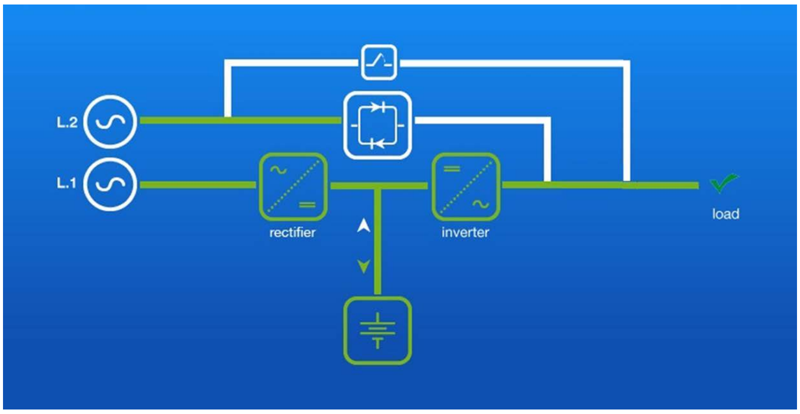
Figure 2.23 Module selection display screen

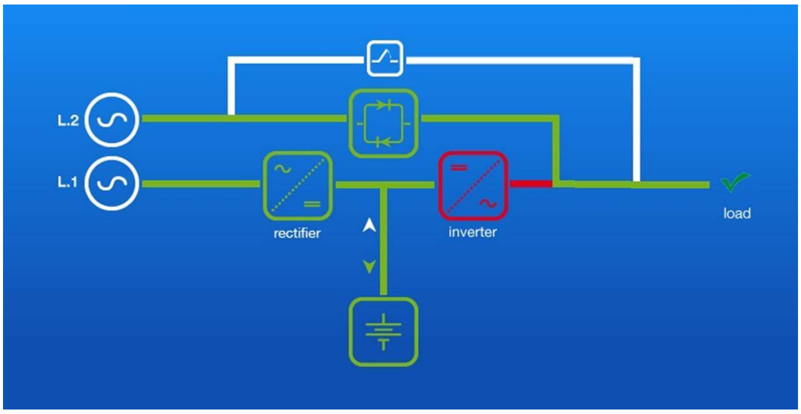
Module / System operational status mimic

When a UPS 'module level' screen is accessed it's display is similar to the default 'system-level' screen, except that the mimic display and metering refers specifically to the selected UPS module.

Module / System ON-LINE
This is the normal mimic indications for a (standard) `ON-LINE` UPS.

1. The rectifier and inverter are working normally.
2. The battery is charging.
3. The bypass line is live and available.





Module / System ON-BYPASS
This is the normal mimic indications if the UPS is operating in ECO mode. In the case of a standard ON-LINE UPS it indicates that either the UPS has a fault/overload which has transferred its output to the bypass, or the number of off-line modules has exceeded the system redundancy.

1. The rectifier is working normally.
2. The battery is charging.
3. The inverter is turned OFF.

Module / System
ON MAINTENANCE BYPASS
This mimic indicates that the maintenance bypass isolator is closed and the UPS output is connected to the bypass supply through both the 'maintenance' and 'static' bypass lines in parallel.

1. The rectifier is working normally.
2. The battery is charging.
3. The Inverter is turned OFF.

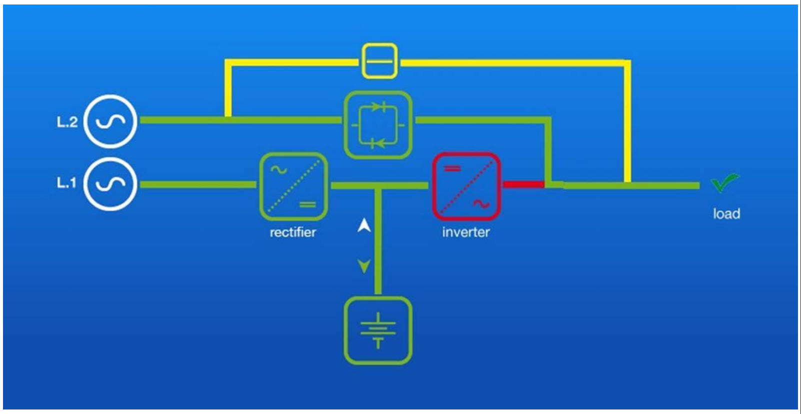
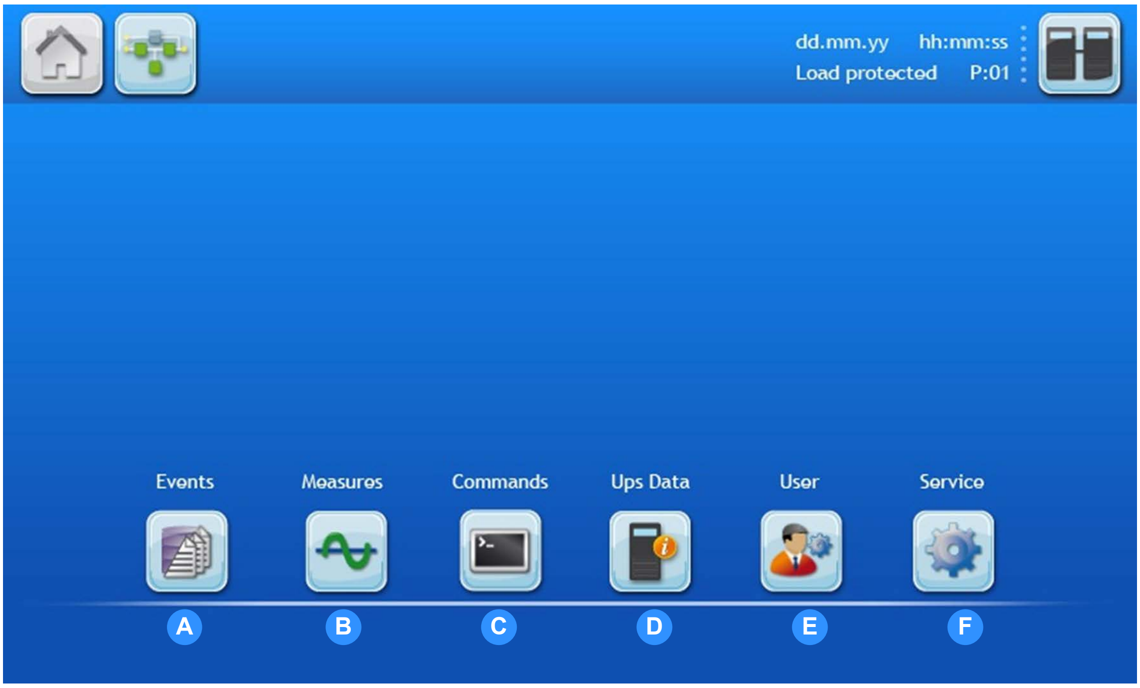


Figure 2.24 Operational status mimic display

2.7.4 Home screen

The home screen, which is accessed by pressing the HOME icon on the display header bar on any screen (item A in Figure 2.21), contains six icons that provide access to various control and set-up function screen.



A	Events	Displays a list of recently occurred events with date, time, event name, description and sequential ID number. It is possible to order the events and as default the most recent appears on top
B	Measures	This item displays the full set of measurements for each functional block of the UPS (detailed below).
C	Command	In this menu, the user can change the operating mode of the UPS. Once the command is executed, the user is immediately directed to the mimic diagram where the new status of the UPS is indicated (detailed below).
D	Ups Data	Gives information regarding the identity of the UPS module (detailed below).
E	User	Enables the adjustment of data such as date and time, automatic battery test, etc (detailed below).
F	Service	This password protect facility enables the service technician to adjust several UPS parameters (detailed below).

Figure 2.25 Home display screen

Measures

UPS Measurements	Output Voltage (V)	Output Current (A)	Output Frequency (Hz)
	Output Power (%)	Active Power (kW)	Reactive Power (kVAr)
	Apparent Power (kVA)	Inverter Voltage (V)	Bypass Voltage (V)
	Bypass Frequency (Hz)	Rectifier Voltage (V)	Booster Temperature (°C)
	Inverter Temperature (°C)	Udc Gain +	Udc Gain -
Battery Measurements	Temperature (°C)	Discharge Current (A)	Charge Current (A)
	Voltage (V)	Run Time	Capacity(%)

Commands

Available commands	*Load to inverter	*Load to bypass	
**User password protected*			

UPS Data

UPS Data	Serial Number	Manufacturing	Firmware Version
	Hardware Version	Display Version	

User

UPS Settings	Language	Date	Time
	Battery Test	Repeat Test	Generator Operation

Service

For the use of trained maintenance personnel only.

2.8 Warranty

The PW8000DPA ST UPS is supplied with a limited warranty that the UPS and its component parts are free from defects in materials and workmanship for a period of one year from the date of original commissioning or fifteen months from the date of original delivery, whichever is the sooner. This warranty is the only warranty given and no other warranty, express

This warranty is invalidated if the UPS is put into use without having first been commissioned by a fully trained and authorised engineer. This warranty does not apply to any losses or damages caused by misuse, abuse, negligence, neglect, unauthorised repair or modification, incorrect installation, inappropriate environment, accident, act of God or inappropriate application.

If the UPS fails to conform to the above within the warranty period then Kohler Uninterruptible Power will, at its sole option, repair or replace the UPS. All repaired or replaced parts will remain the property of Kohler Uninterruptible Power

As a general policy, Kohler Uninterruptible Power does not recommend the use of any of its products in life support applications where failure or malfunction of the product can be reasonably expected to cause failure of the life support device or to significantly affect it's safety or effectiveness. Kohler Uninterruptible Power does not recommend the use of any of its products in direct patient care. Kohler Uninterruptible Power will not knowingly sell its products for use in such applications unless it receives in writing assurances satisfactory to Kohler Uninterruptible Power that the risks of injury or damage have been minimized, the customer assumes all such risks and the liability of Kohler Uninterruptible Power is adequately protected under the circumstances

CAUTION: *The UPS system may contain batteries which must be re-charged for a minimum of 24 hours every six months to prevent deep-discharging. Batteries that have been, for whatever reason, deeply-discharged are not covered by the warranty.*

2.8.1 Extended Warranty

The Standard Warranty may be enhanced by protecting the UPS with an Extended Warranty Agreement (maintenance contract). An Extended Warranty Agreement enhances the standard warranty by providing:

- Regular preventative maintenance inspections
- Guaranteed speed of response to operational problems
- 24 hour telephone support
- Fully comprehensive (excluding batteries) cover

2.9 Contacting service

Kohler Uninterruptible Power has a service department dedicated to providing routine maintenance and emergency service cover for your UPS. If you have any queries regarding your UPS please contact us.

UK

www.kohler-ups.co.uk	Kohler Uninterruptible Power web site
ukservice.ups@kohler.com	Service department – booking service, fault reporting etc.
ukservicesales.ups@kohler.com	Extended warranty agreements etc

IRELAND

www.kohler-ups.ie	Kohler Uninterruptible Power web site
ieinfo.ups@kohler.com	Service department, technical queries, hardware sales and extended warranty agreements

SINGAPORE

www.kohler-ups.sg	Kohler Uninterruptible Power web site
serviceups.sg@kohler.com	Contract customer support, maintenance contracts renewals

3 Installation Planning

3.1 Introduction

A certain amount of pre-planning will help ensure a smooth and trouble-free UPS installation process.This chapter contains essential information concerning the environmental, mechanical and electrical requirements that should be considered when planning the installation of the Kohler PW 8000DPA ST UPS system.

Key Point: If you are installing an external battery cabinet supplied by Kohler Uninterruptible Power you should refer to the manual that is provided with the cabinet for installation requirements.

3.2 Environmental and mechanical planning

3.2.1 Environmental considerations

It is essential that the following environmental guidelines are observed when planning a suitable UPS location and operating environment.

1. The route between the equipment off-loading point and the installation location must allow the equipment to be transported in an upright position.
2. The floor at the proposed installation site and en-route from the off-loading point must be able to safely take the weight of the UPS and battery equipment plus any transport aids used during transit.
3. Locations with high ambient temperature, moisture or humidity must be avoided.
    a) The installation site humidity should be <95% non-condensing.
    b) The specified equipment ambient temperature is 0°C to +40°C but ideally this should be around 20°C to 25°C.
    c) A battery temperature of 20°C to 25°C is recommended to achieve a long battery life.
    d) The air conditioning system must be able to provide a sufficient amount of cooling air to keep the room within the prescribed temperature range.
    e) The air entering the UPS must not exceed +40°C.
4. To obtain the best system performance the following environmental conditions should also be considered:
    a) Fire protection standards must be respected.
    b) The location must be free of dust and corrosive, or explosive, gases.
    c) The location must be vibration free.
    d) If the UPS is located in bayed enclosures, partition walls must be installed.
    e) The minimum cabinet clearances described below must be provided.

3.2.2 Installation

The PW 8000DPA ST is designed as a modular system contained in a range of UPS cabinets as illustrated in the table below.

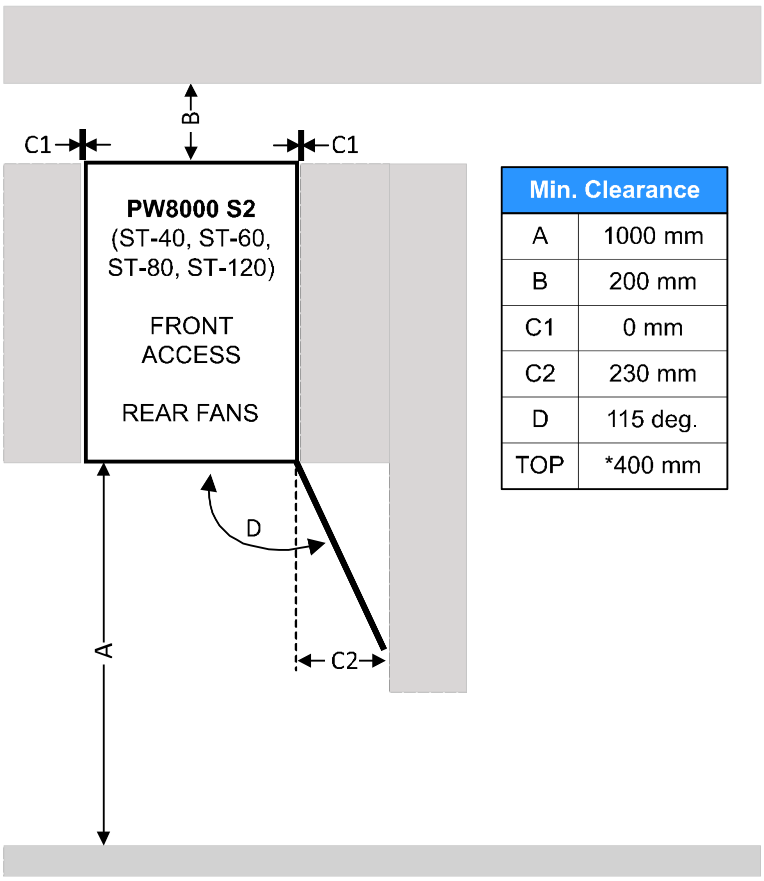
	ST-40	ST-60	ST-80	ST-120	ST-200
Dimensions (WxHxD) mm	550 x 1135 x 775	550 x 1975 x 775	550 x 1135 x 775	550 x 1975 x 775	550 x 1975 x 775
Maintenance Accessibility	*Totally front accessibility for service and maintenance				
Input/Output Power Cabling	From the bottom front				
Note: The battery fuses are located on the back of the ST-200 cabinet and rear access is required to operate the equipment. See Figure 3.2 for optional installation positioning of the ST200 cabinet.					

When several cabinets are connected together to form a parallel-cabinet UPS system they should be positioned as close together as possible – ideally standing immediately adjacent to each other to form a cabinet suite. The ST-40 and ST-60 cabinets contain internal batteries but the other models require external batteries contained in a purpose designed enclosure, or rack mounted. Kohler Uninterruptible Power can provide a range of suitable battery cabinets if required

An external battery enclosure should be located as close as possible to the UPS cabinet(s) to reduce the volts drop on the DC cables when the batteries are in use – again, in an ideal installation the battery enclosure should be installed adjacent to the UPS cabinet(s) if possible.

3.2.3 Clearances

Figures 3.1 and 3.2 illustrates the required clearances that must be provided around the UPS cabinet.

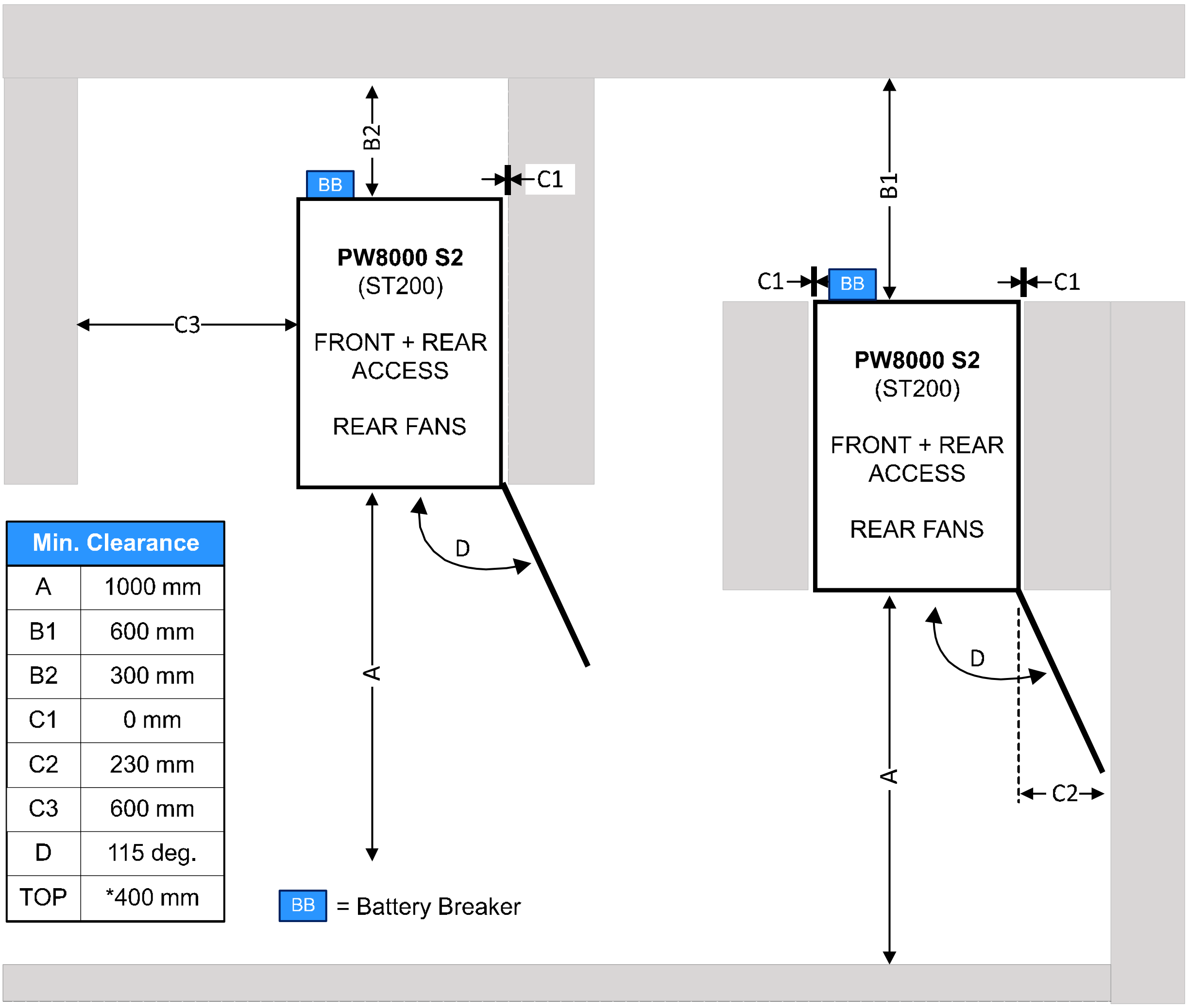


Min. Clearance	
A	1000 mm
B	200 mm
C1	0 mm
C2	230 mm
D	115 deg.
TOP	*400 mm

Figure 3.1 ST40 - ST120 Clearance recommendations

ST40 - ST120 clearances notes

1. No rear or side access is required for maintenance, servicing or user operation.
2. A clearance of 1000mm is required at the front of the UPS cabinet to allow the UPS modules to be withdrawn (A).
3. A clearance of 200mm must be provided at the back of the cabinet to provide adequate ventilation airflow (B).
4. No side clearance is necessary (C1).
5. The cabinet right-hand door must be opened by 115° in order to remove/fit the UPS power modules so the right-hand side of the cabinet cannot be positioned directly against a projecting wall – in this case an additional side clearance must be provided immediately in front of the cabinet right side (C2).
6. A clearance of 400mm should be provided at the top of the cabinet to assist ventilation if the route at the back of the cabinet is insufficient to dissipate the cooling airflow.



Min. Clearance	
A	1000 mm
B1	600 mm
B2	300 mm
C1	0 mm
C2	230 mm
C3	600 mm
D	115 deg.
TOP	*400 mm

Figure 3.2 ST200 Clearance recommendations

ST-200 clearances notes

1. A clearance of 1000mm is required at the front of the UPS cabinet to allow the UPS modules to be withdrawn (A).
2. The ST200 battery circuit breaker [BB] is located on the back of the cabinet and suitable access must be provided to operate the breaker. Two alternative installation layouts are shown in Figure 3.2.
   a) In the left hand diagram there is no through passageway behind the cabinet so a rear clearance of 300 mm (B2) and left side clearance of 600 mm (C3) is provided to enable battery breaker access.
   b) In the right hand diagram there is a passageway behind the cabinet and a passage width of 600 mm (B1) should be adequate to enable battery breaker access. In this situation there is no need to allow any clearance on the left side of the cabinet (C1)
3. No right side clearance is necessary (C1).
4. The cabinet right-hand door must be opened by 115° in order to remove/fit the UPS power modules so the right-hand side of the cabinet cannot be positioned directly against a projecting wall – in this case an additional side clearance must be provided immediately in front of the cabinet right side (C2).
5. A clearance of 400mm should be provided at the top of the cabinet to assist ventilation if the route at the back of the cabinet is insufficient to dissipate the cooling airflow.

Key Point: When planning a UPS installation that incorporates external batteries it is important that the battery enclosure installation requirements (access clearance, ventilation requirements, weight etc.) are accounted for in the planning process – if a non-Kohler Uninterruptible Power battery cabinet is to be used, these details must be obtained from the battery cabinet supplier.

3.3 Electrical and cabling planning

3.3.1 General requirements

It is the customer's responsibility to design the UPS input and load distribution circuits, and provide all the external fuses, isolators and cables that are required to connect the UPS input and output power supplies. The information in this section should help with the preparation and planning of the UPS power cabling.

IMPORTANT NOTE: The UPS does not contain internal fuse protection for the bypass mains or input mains supplies. It is the customer's responsibility to ensure that external supply fuses (or other protective devices) are fitted and correctly sized to provide the recommended level of UPS protection. We also recommend that a spare set of fuses are held locally to ensure they are readily available if required.

The UPS bypass mains and input mains terminals should be connected to the utility mains supply through a LV mains switchboard that contains suitable circuit breakers or fused isolators. These are necessary to provide a means of isolating the UPS from the mains supplies when required and also provide suitable overload protection. Similarly, the UPS output supply terminals should be connected to the load equipment via a fused output distribution panel.

Input neutral grounding

A permanently connected input neutral is required to enable the rectifier to operate correctly and allow the UPS to function properly. The input neutral must also be grounded to ensure correct operation when the UPS is running on battery.

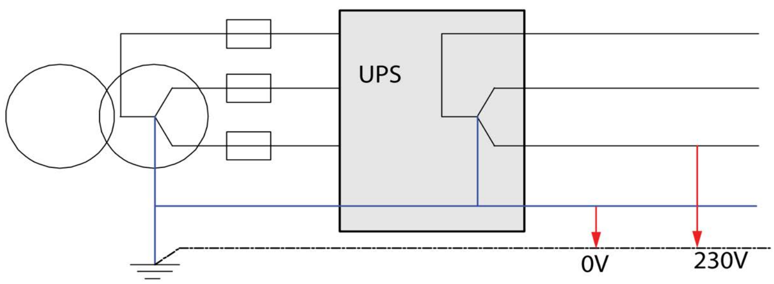


Figure 3.3 Input neutral grounding

Key Point: As the input neutral must be unswitched and connected to the UPS at all times, a 4-pole input switch or isolator must not be used at the LV mains switchboard on a TN-S system.

External Backfeed protection

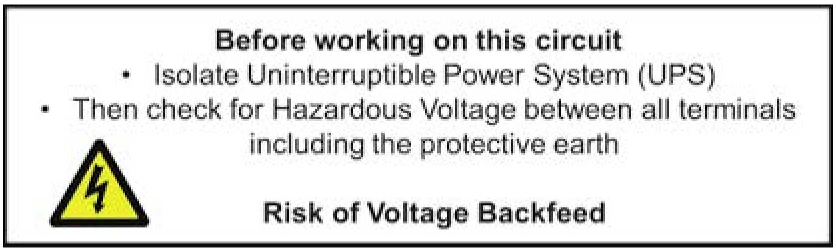
A UPS shall prevent hazardous voltage or hazardous energy from being present on the UPS input AC distribution after interruption of the input AC power. This is achieved by mandatory backfeed protection. Unless optional internal protection is included in UPS frame, such protection shall be provided by others and be installed as part of building installation. The backfeed protection shall be implemented in the form of an air gap, separating the upstream circuit from UPS when AC input fails. This is typically achieved through a contactor installed over the common AC input line or over each separate AC input line. Preferred location is just after the overcurrent protective devices serving each UPS input line. Such contactors shall have the coil supplied by the AC upstream circuit, to be engaged when AC upstream voltage is ON or dis-engaged when AC upstream voltage is OFF.

Specifications:

The device shall be three-poles, creating an air gap of at least 3 mm.

The thermal current shall meet the external overcurrent protection’s rating described in the coming sections.

Electrical contractor is required to attach following “Voltage backfeed warning label” as close as possible to the external isolator:



3.3.2 Cable and fuse sizing

Key Point: All external fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulation – e.g. BS7671.

Input/bypass mains supply cables

The UPS cabinet can be wired for a 'single feed' or 'dual feed' (split bypass) mains supply.

In a 'single feed' system (standard) the UPS input mains and bypass mains terminals are linked within the UPS cabinet, but in a 'dual feed' system the links are removed and the bypass mains terminals are connected to a dedicated bypass mains supply. The two configurations are shown in Figure 3.4.

The input supply and bypass supply neutrals are connected to a common neutral busbar. If the input mains and bypass mains are obtained from the same AC power source in a 'dual feed' system it is permissible to connect just one neutral cable.

All input mains and bypass mains cables should be connected through a LV mains switchboard and protected by circuit breakers or fuses to provide overload protection and a means of isolating the UPS from the mains supply when required.

Note: We recommend that the input cables are sized for the full cabinet rating even if some UPS modules are not initially installed. This will allow the system to be expanded to its full rating without having to shut it down to up-rate the input cables. For example: the cables connected to the PW 8000DPA ST-200 cabinet should be rated for the full 200 kW load even if fewer than ten UPS modules are fitted.

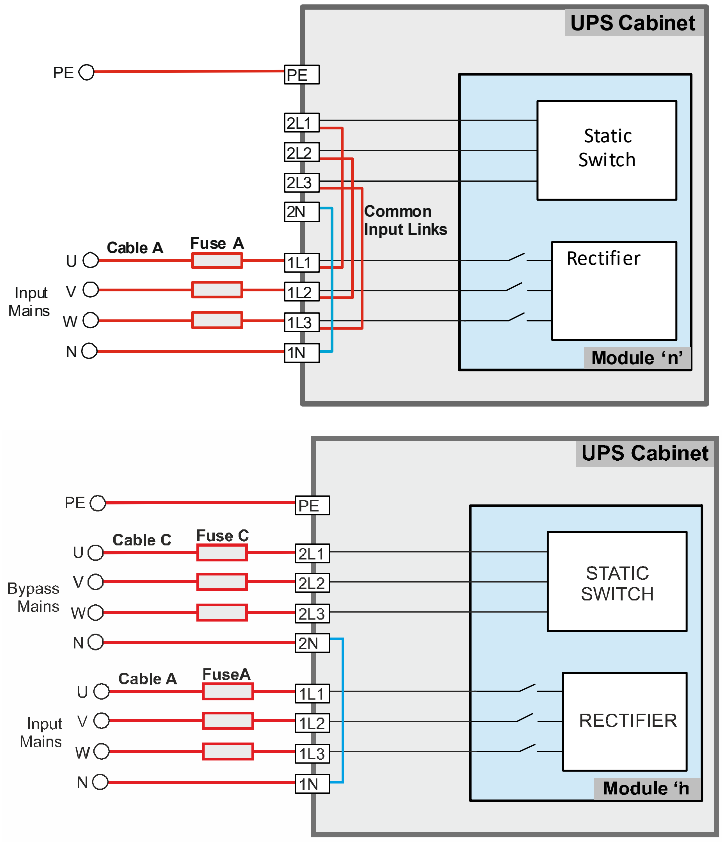


Figure 3.4 Single and dual feed input configuration

UPS Output cables

The UPS output cables should be connected to the load equipment via a suitably fused output distribution panel.

Note: We recommend that the output cables are sized for the full cabinet rating even if some UPS modules are not initially installed. This will allow the system to be expanded to its full rating without having to shut it down to up-rate the output cables. For example: the output cables connected to the PW 8000DPA ST-200 frame should be rated for the full 200 kW load even if fewer than ten UPS modules are fitted.

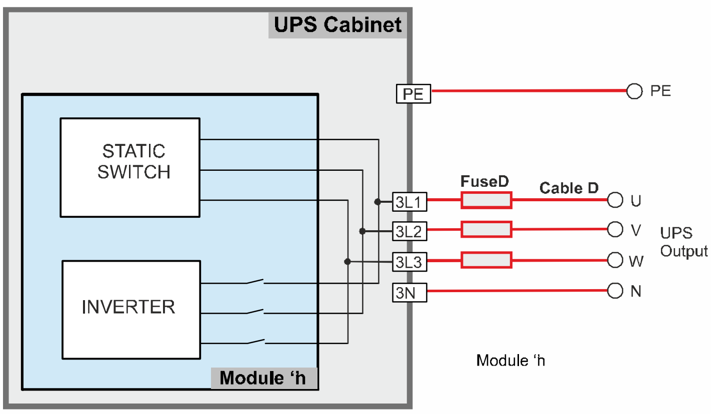


Figure 3.5 UPS Output cables

Battery cables

Internal batteries

The internal batteries in PW 8000DPA ST models ST-40 and ST-60 are installed on shelves that form part of the UPS frame. Each shelf contains a complete battery string which is connected to a UPS module via a battery breaker (F4-*x*).

Key Point: The PW8000 ST-40 and ST-60 cabinets are shipped without the batteries installed.

External batteries

PW 8000DPA ST models ST-80, ST-120 and ST-200 do not have provision for internal batteries and therefore require the batteries to be installed in an external enclosure. A range of external battery enclosures is available from Kohler Uninterruptible Power

When planning for an external battery installation please consider the following:

- The external battery must be installed as close as possible to the UPS cabinet.
- We recommend that a separate battery is provided for each UPS module. (See 'common' / 'separate' battery configuration details below.)
- If a bespoke battery installation is planned, it must include a 3-pole battery breaker (for each set of battery cables) installed as close as possible to the battery installation.
- The battery and DC cables must be connected by the commissioning engineer.
- External battery cables and fuses are bespoke to the installation and will be provided by Kohler Uninterruptible Power, but it is the customer's responsibility to design and install any cable containment where necessary. *Note that the external battery string connection requires three cables, one each connected to the battery positive (+) and negative (–) extremities and a third (N) cable that is connected to the mid-point of the battery string.*

Common battery configuration

A 'common battery' installation is shown in Figures 3.6 and 3.8.

In this configuration a single external battery, which can itself comprise several parallel battery strings, is connected to the battery terminals (+, N, –) within the UPS cabinet from where it is connected to the UPS modules via dedicated circuit breakers (F4-*x*).

Following a mains outage, if there is a total battery failure in a 'common battery' system the entire UPS is unable to operate from battery power, resulting in the loss of the critical load supply. However, the battery normally consists of several parallel battery strings, and a battery failure in one string only means that the UPS will operate on battery power as normal but with a much reduced autonomy.

Separate battery configuration

A 'separate battery' configuration enhances the overall reliability/availability of the UPS system by providing a degree of battery redundancy – i.e. following a mains outage, the total failure of a battery only affects it's associated module and the remainder of the UPS system can fully support the critical load – assuming n+1 module redundancy.

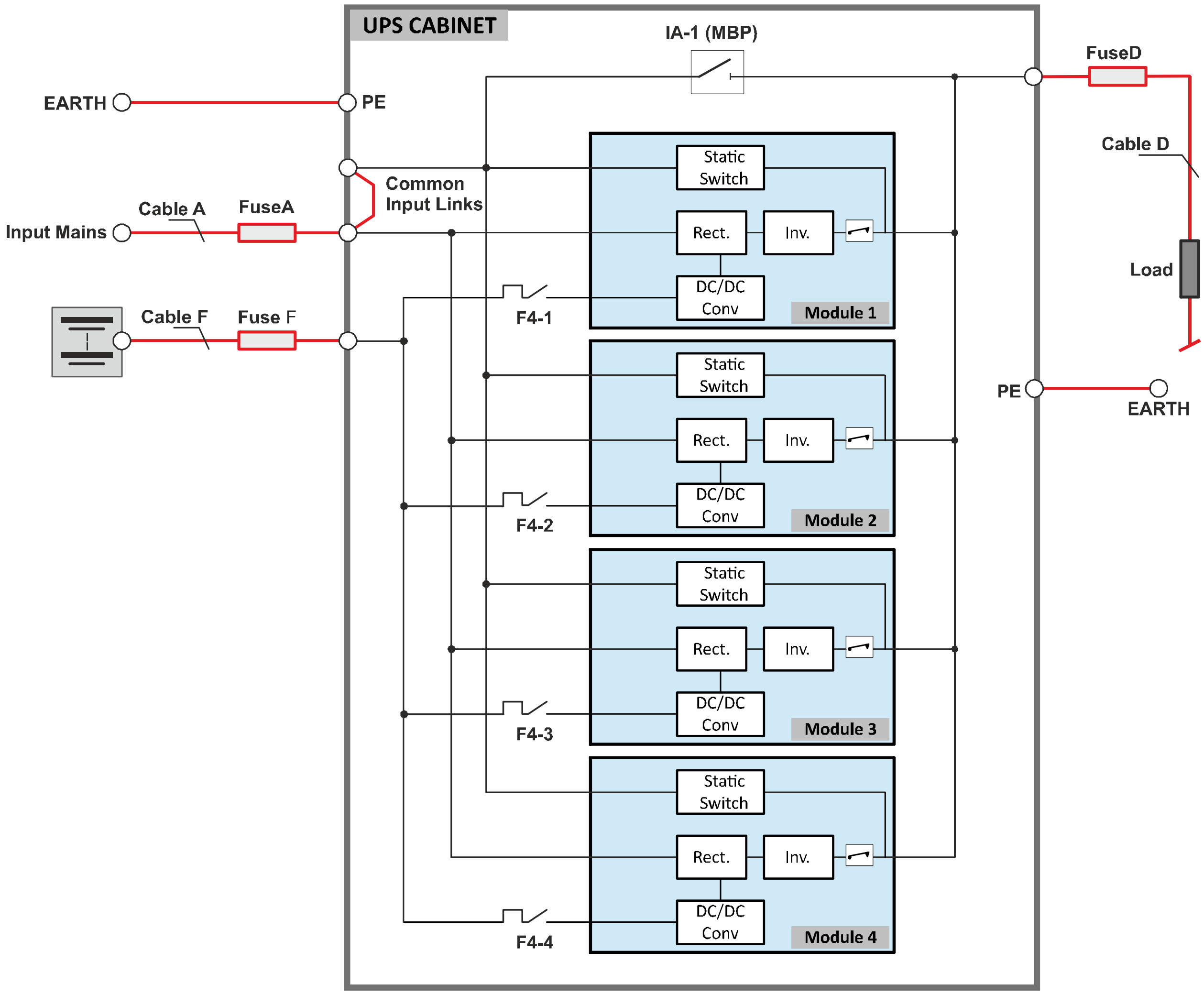
A 'separate battery' installation is shown in Figures 3.7 and 3.9 for a single-feed input and dual-feed input respectively. In these illustrations each battery is connected directly to the module circuit breakers (F4-*x*) and not to the main battery busbars (+ve & -ve).

Cabling diagrams

The following diagrams provide recommended cable and fuse rating for the entire PW 8000DPA ST range.

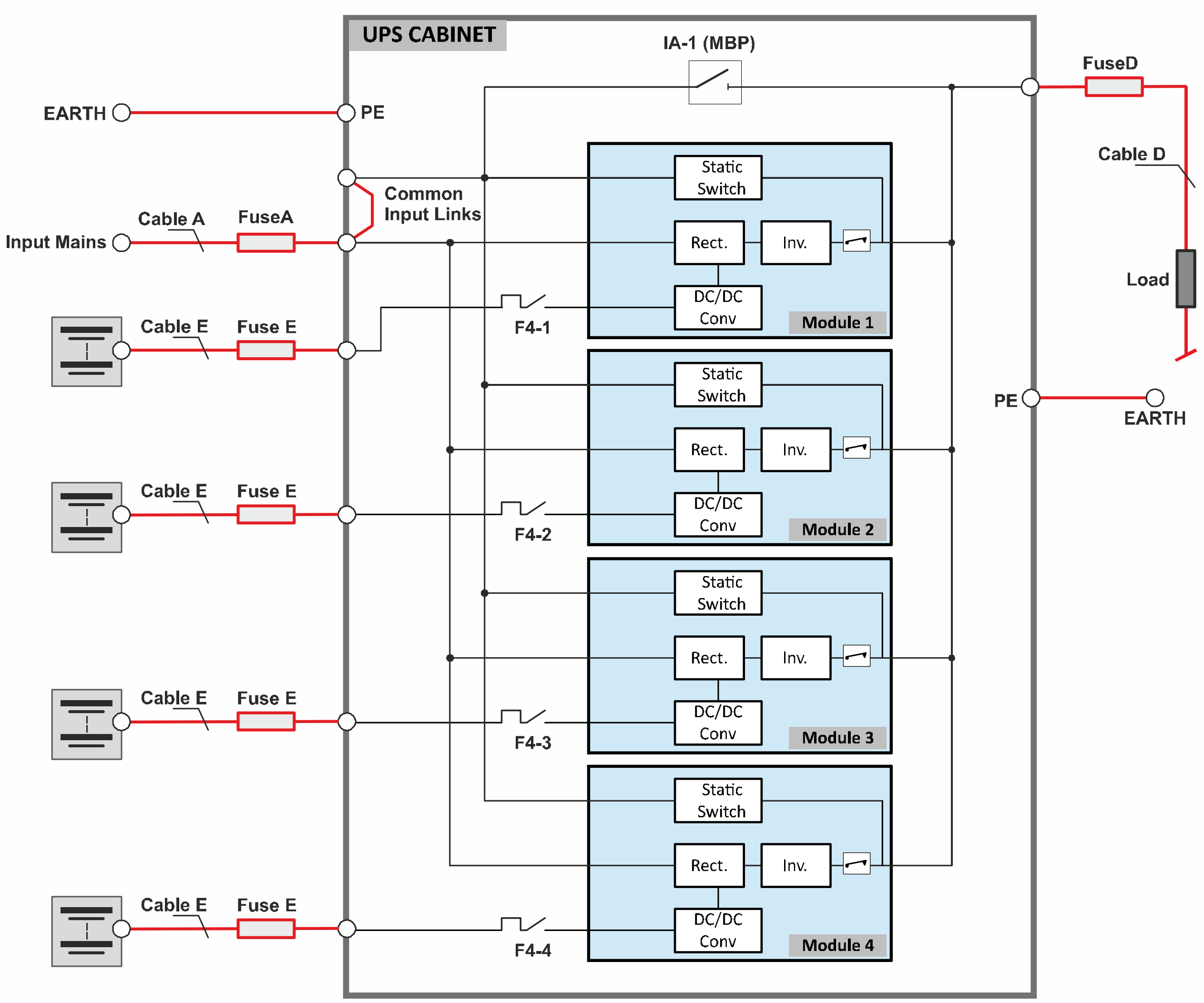
Note: The diagrams illustrate the ST-80 (4- module) cabinet, but the attached rating tables cover the complete range.

- The protective earth cable must be sized according to local and national regulations
- Rating are shown for 400V operation with unity load factor. See specification chapter for 380/415V operation.



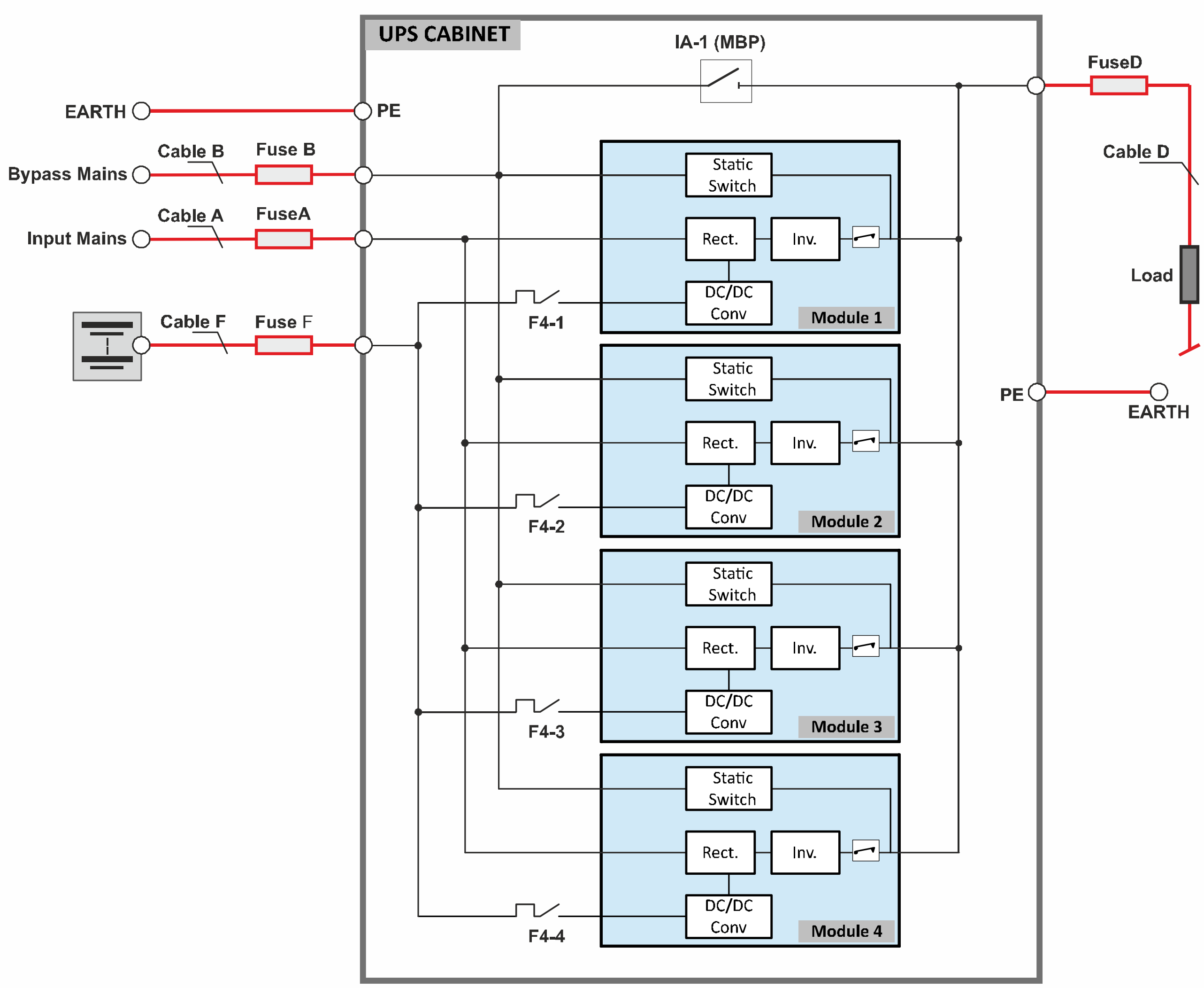
UPS CABINET CONNECTIONS					
UPS Module	**ST-40**	**ST-60**	**ST-80**	**ST-120**	**ST-200**
Load (kW)	40 kW	60 kW	80 kW	120 kW	200 kW
Input mains Fuse A (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Input mains Cable (A) Max input current, including max battery charging	68A	102A	136A	208A	333A
UPS output Cable D nominal current	58A	87A	116A	174A	290A
Battery Fuse F (AgI/CB) (with common battery only)	Bespoke to installation				

Figure 3.6 Single input cabling with common battery



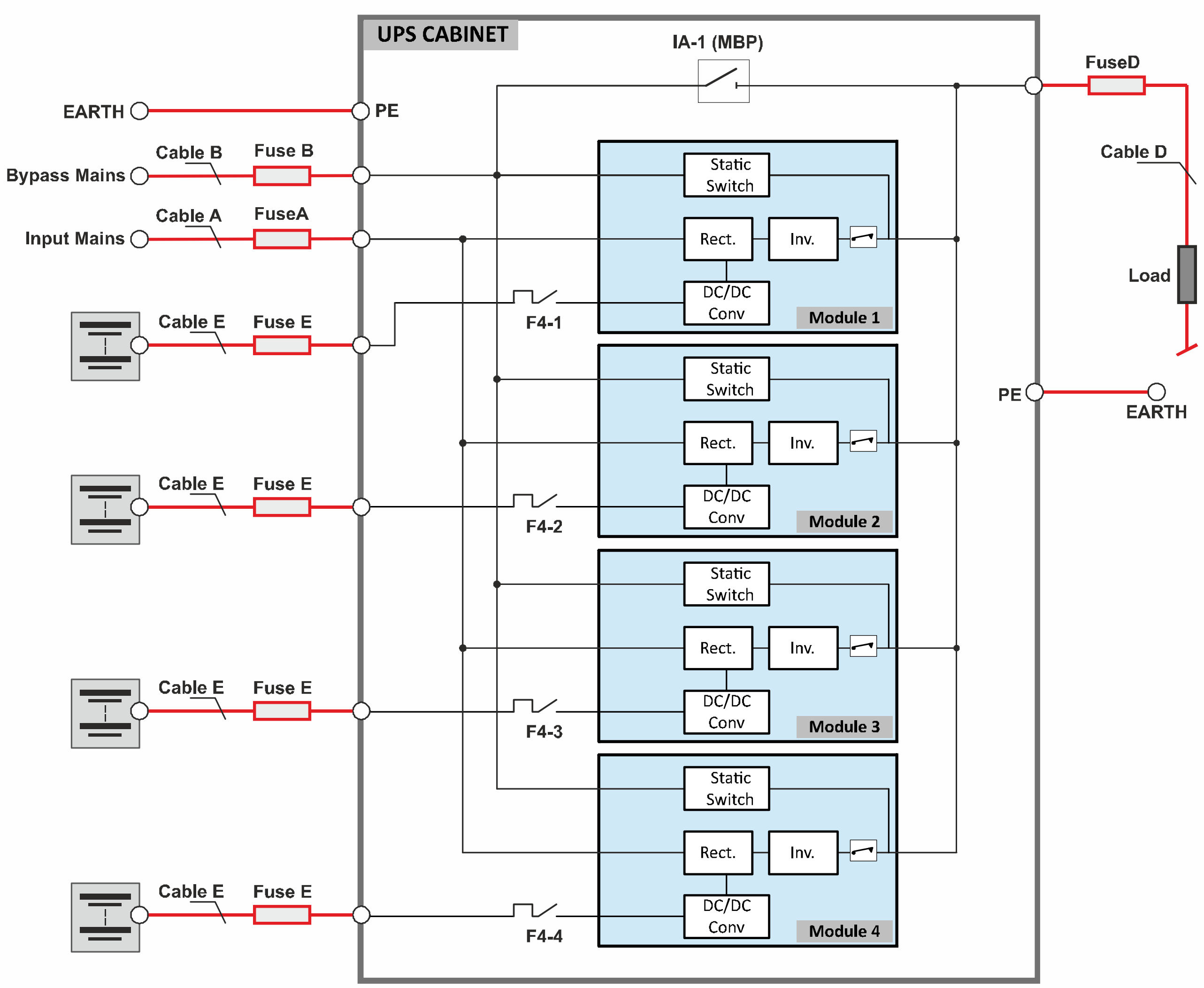
UPS CABINET CONNECTIONS					
UPS Module	**ST-40**	**ST-60**	**ST-80**	**ST-120**	**ST-200**
Load (kW)	40 kW	60 kW	80 kW	120 kW	200 kW
Input mains Fuse A (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Input mains Cable (A) Max input current, including max battery charging	68A	102A	136A	208A	333A
UPS output Cable D nominal current	58A	87A	116A	174A	290A
Battery Fuse F (AgI/CB) (with common battery only)	Bespoke to installation				

Figure 3.7 Single input cabling with separate batteries



UPS CABINET CONNECTIONS					
UPS Module	**ST-40**	**ST-60**	**ST-80**	**ST-120**	**ST-200**
Load (kW)	40 kW	60 kW	80 kW	120 kW	200 kW
Input mains Fuse A (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Input mains Cable (A) Max input current, including max battery charging	68A	102A	136A	208A	333A
Bypass mains Fuse B (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Bypass mains Cable B, max bypass current	58A	87A	116A	174A	290A
UPS output Cable D nominal current	58A	87A	116A	174A	290A
Battery Fuse F (AgI/CB) (with common battery only)	Bespoke to installation				

Figure 3.8 Dual input cabling with common battery



UPS CABINET CONNECTIONS					
UPS Module	**ST-40**	**ST-60**	**ST-80**	**ST-120**	**ST-200**
Load (kW)	40 kW	60 kW	80 kW	120 kW	200 kW
Input mains Fuse A (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Input mains Cable (A) Max input current, including max battery charging	68A	102A	136A	208A	333A
Bypass mains Fuse B (AgI/CB)	3x 80A	3x 125A	3x 160A	3x 224A	3x 350A
Bypass mains Cable B, max bypass current	58A	87A	116A	174A	290A
UPS output Cable D nominal current	58A	87A	116A	174A	290A
Battery Fuse F (AgI/CB) (with common battery only)	Bespoke to installation				

Figure 3.9 Dual input cabling with separate batteries

Key Point: All fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulations – e.g. BS7671.

The table below provides physical details of the UPS power connections.

	400V / 230V			BATTERY		
	UPS INPUT MAINS (Rectifier)	UPS BYPASS MAINS (Bypass)	UPS OUTPUT	PE	Separate	Common
	Terminal (mm²)	Terminal (mm²)	Terminal (mm²)	Terminal (mm²)	Terminal (mm²)	Terminal (mm²)
ST-40	3x 25 (T) 1x 25 (N)(T) 1x 25 (PE)(T)	3x 25 (T) 1x 25 (N)(T)	3x 25 (T) 1x 25 (N)(T) 1x 25 (PE)(T)			
ST-60	3x 35 (T) 1x 35 (N)(T) 1x 50 (PE)(T)	3x 35 (T) 1x 35 (N)(T)	3x 35 (T) 1x 35 (N)(T) 1x 50 (PE)(T)			
ST-80	3x 50 (T) 1x 50 (N)(T) 1x 50 (PE)(T)	3x 50 (T) 1x 50 (N)(T)	3x 50 (T) 1x 50 (N)(T) 1x 50 (PE)(T)	1x 50 (T)	3x (4x16) (T)	3x M6 (B)
ST-120	3x 95 (T) 1x 95 (N)(T) 1x M10 (PE)(B)	3x 95 (T) 1x 95 (N)(T)	3x 95 (T) 1x 95 (N)(T) 1x M10 (PE)(B)	1x M10 (B)	3x (6x 16) (T)	3x (2x M5) (B) or 3x M10 (B)
ST-200	3x M12 (B) 1x M12 (N)(B) 1x M12 (PE)(B)	3x M12 (B) 1x M12 (N)(B)	3x M12 (B) 1x M12 (N)(B) 1x M12 (PE)(B)	1x M10 (B)	3x (5x35) (T)*	3x (2xM10) (B)

(PE) = Protective Earth
(N) = Neutral
(B) = Busbar connections with indicated bolt size. Cable must be terminated with a suitable lug.
(T) = Screwed terminal block with indicated maximum cable c.s.a. Cables must be suitably prepared.
* In the ST-200 model with individual battery configuration, each battery feeds two UPS modules

3.3.3 Parallel cabinet cabling recommendations

In order to achieve equal load sharing between the various UPS cabinets in a multi-cabinet installation, the input cables from the mains switchboard to each UPS cabinet should be of equal length. Similarly the UPS output cables to the output (load) distribution panel should be of approximate equal length.

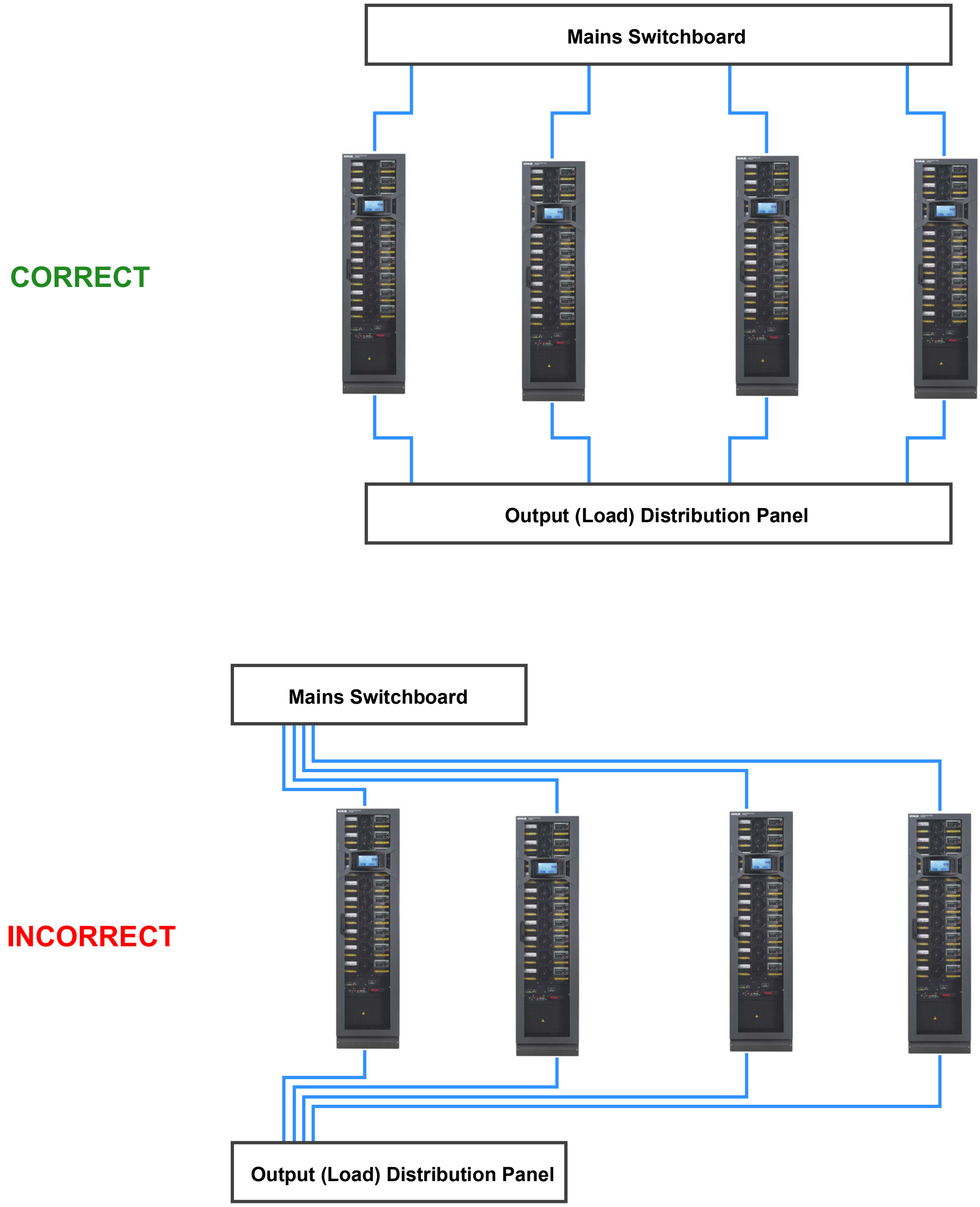


Figure 3.10 Parallel cabinet cabling considerations

3.3.4 External maintenance bypass

An external maintenance bypass is a required part of a multi-cabinet PW 8000DPA ST system but is optional in the case of a single cabinet installation.

The external bypass is bespoke to the installation but generally comprises three isolators rated to carry the full system load and connected in a similar fashion to that shown in Figure 3.11.

Depending on size and location, the isolators may be installed in a dedicated Maintenance Bypass cabinet or included in an existing (or dedicated) switch-panel.

Kohler Uninterruptible Power can provide a range of external maintenance bypass solutions to suit all of its UPS systems.

Note: When starting the UPS system we advise that the load is initially turned on while the system is operating on the maintenance bypass in order to handle any large inrush currents that might occur.

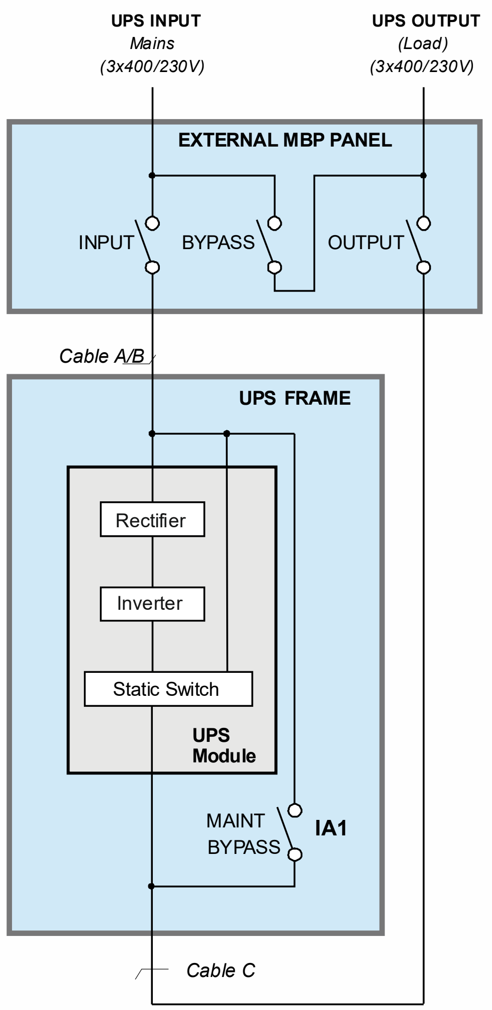


Figure 3.11 External Maintenance Bypass

Single UPS cabinet installation

An external maintenance bypass facility is not essential for a single cabinet installation as the internal maintenance bypass switch (IA1) is fully rated and can be used to connect the load directly to the raw UPS bypass mains supply.

However, when the load is powered via IA1 the UPS cabinet's bypass mains terminals must be permanently live in order to supply the load. This means that it is not possible to fully isolate the mains supplies from the UPS cabinet while the internal maintenance bypass is in use.

This situation can be overcome by the addition of the optional external maintenance bypass facility which can supply the load through an external BYPASS switch while allowing the UPS input and output supplies to be totally isolated by opening the external INPUT and OUTPUT switches.

Parallel UPS cabinet installation

If two (or more) UPS cabinets are connected as a parallel system each one still contains the internal maintenance bypass switch (IA1). However, the switch is only rated for the specified cabinet output and is not designed to switch the potential full system load.

An external maintenance bypass facility containing a 'system rated' bypass switch is therefore an essential part of a parallel cabinet system as it allows the full load to be switched between the system and maintenance bypass. It also allows the modules' mains supplies to be isolated as described above for the single UPS cabinet system.

Key Point: When operating a parallel system ALWAYS use the external maintenance bypass facility. Do not operate the internal maintenance bypass switch (IA1).

3.4 Battery configuration

IMPORTANT NOTE

High voltage battery strings can be extremely dangerous and should not be installed by the customer's installation team. The batteries must be fitted and connected to the UPS by an Kohler Uninterruptible Power service engineer.

The UPS battery comprises a number of battery blocks (typically between 40-50 VRLA 12V blocks) connected in series to form a battery 'string.' The string voltage is determined by the number of battery blocks contained in the string and the string capacity is determined by the capacity of the individual battery blocks (e.g. 7 Ahr). The string capacity can be increased by connecting two or mores strings in parallel.

The required battery string characteristics (voltage and capacity) will be calculated at the UPS system design stage, taking into account UPS load demand and required autonomy time, and once these are known the composition of the battery strings can be designed for a chosen battery type.

As stated above, the batteries will be installed and connected by a Kohler Uninterruptible Power approved commissioning engineer. However, where external batteries are required (ST80, ST-120, ST-200) the customer's should be aware of the external battery cabling requirements as it is the customer's responsibility to provide appropriate containment for the DC power cables between the UPS cabinet and battery cabinet so the customer – e.g. cable trays or trunking.

3.4.1 Common / Individual battery cabling

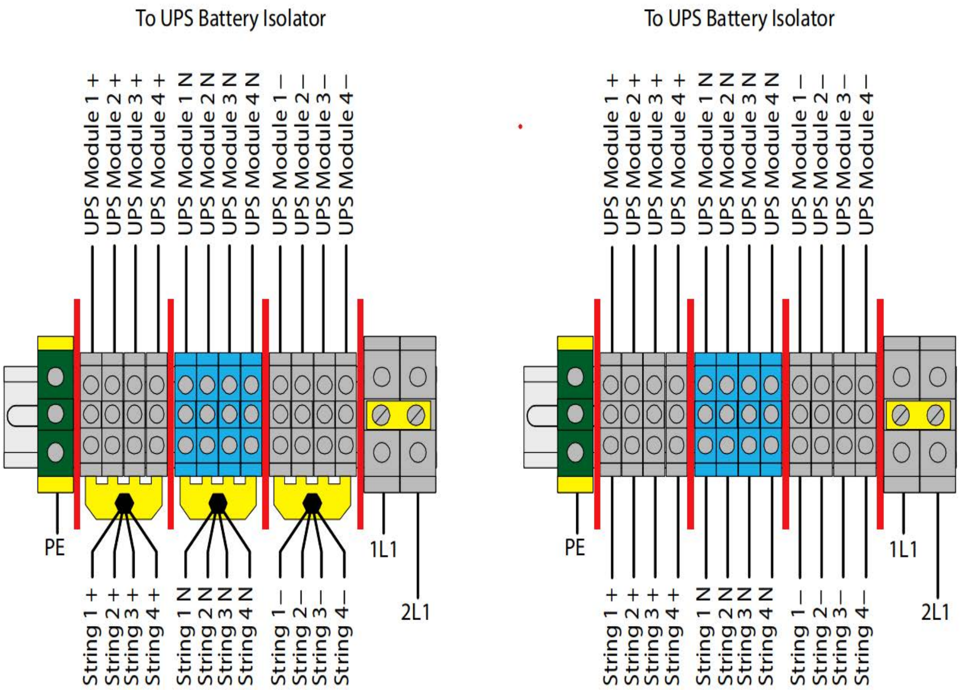


Figure 3.12 Battery connections (ST-80 cabinet shown)

4 Installation

4.1 Introduction

This chapter contains essential information concerning the unpacking, positioning, mechanical installation and cabling of the Kohler PW 8000DPA ST UPS.

WARNING: All cabling operations must be supervised by an authorised electrician or other suitably qualified person. All installation procedures must be carried out in strict accordance with the instructions contained in this manual. Kohler Uninterruptible Power will take no responsibility for any personal injury or material damage caused by the incorrect installation, cabling or operation of this product.

WARNING: Once the UPS equipment is installed it must be commissioned by an engineer approved by Kohler Uninterruptible Power before it is powered-up. Kohler Uninterruptible Power will take no responsibility for any personal injury or material damage caused by the application of electrical power to this equipment before it has been fully commissioned and handed over to the customer.

4.2 Taking receipt of the UPS

The UPS cabinet(s) and accessories are delivered on purpose designed pallets that are easy to off load and move using a forklift or suitable pallet jack.

CAUTION: *Observe the following precautions when off-loading and moving the UPS:*

- *Always keep the packages in an upright position.*
- *Do not drop the equipment.*
- *Due to the high-energy batteries involved and heavy weight, do not stack the pallets.*

Depending on the shipping method, the UPS is wrapped in film or packed in either a cardboard or wooden container designed to protect it from mechanical and environmental damage.

Before you accept the shipment you should ensure that the received package(s) correspond to the description shown in the delivery documentation. Note that some optional equipment packages might be shipped inside the UPS container.

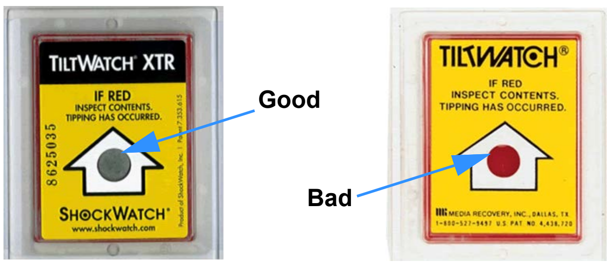


Figure 4.1 Tiltwatch indicators

Upon receiving the UPS you should carefully examine the packing container for any sign of physical damage.

External 'TiltWatch' indicators (2 off) will indicate RED if the equipment has been tilted during transportation.

WARNING: If the TiltWatch indicators indicate that the UPS has been tilted in transit DO NOT connect the UPS to the mains electricity supply.

4.2.1 Reporting transportation damage

If the 'TiltWatch' indicators are red or there are other signs of suspected transportation damage you must inform both the carrier and Kohler Uninterruptible Power immediately. Claims for shipping damage must be filed immediately when found, and the carrier must be informed of ALL claims within seven days of receipt of the equipment. If the equipment is to be stored for longer than seven days before it is installed, you should unpack it and inspect it for signs of internal damage before you put it into storage. Any optional equipment packages that are shipped inside the main UPS package should also be inspected.

If the equipment is damaged you should store the packing materials for further investigation.

4.2.2 Local transportation

The UPS is delivered on a specially designed pallet that is easy to move using a forklift or a pallet jack. Please observe the following precautions when you transport the UPS equipment after it has been off-loaded.

CAUTION: *Local transportation:*

- *When moving the UPS cabinet using a forklift or pallet jack, ensure that you fully insert the lifting equipment forks below the package .*
- *Do not at any time tilt the cabinet by more than 10° from vertical as it could cause internal damage or allow the cabinet to topple over.*

Figure 4.2 ST-40, ST-80 packaging

WARNING: Potential dangers:

- *If tilting occurs at any stage do not connect the UPS to the mains electrical supply.*
- *The cabinet weight can cause serious personal injury and/or structural damage to the surrounding area if it is dropped in transit. Always take extreme care when moving the equipment.*

4.2.3 Storage

UPS Cabinet

If you plan to store the UPS equipment prior to use it should be held it in a clean, dry environment with a temperature between -25°C to +70°C and RH <95% (non condensing). An ideal storage temperature is between +20°C to +25°C.

The UPS should be stored in its original packing and shipping carton. If the packing container is removed you must take measures to protect the UPS from the ingress of dust and moisture.

Battery

The UPS uses sealed, maintenance-free batteries that are shipped in a separate container. The storage capacity of the batteries is temperature dependant and it is important that they are not stored for longer than 6 months at 20°C, 3 months at 30°C, or 2 months at 35°C without being fully recharged.

For longer term storage the batteries should be fully recharged every 6 months @20°C.

An storage temperature between +20°C to +25°C will help achieve optimum battery life.

CAUTION: *Sealed batteries must never be stored in a fully or partially discharged state. Extreme temperature, under-charge, overcharge or over-discharge will destroy batteries!*

- *Charge the battery both before and after storing.*
- *Always store the batteries in a dry, clean, cool environment in their original packaging.*
- *If the packaging is removed, protect the batteries from dust and humidity.*

4.3 Unpacking

Key Point: Remove all packaging materials carefully, causing as little damage as possible, and temporarily store them in case the UPS has to returned to the manufacturer for any reason prior to commissioning.

4.3.1 Removing the standard UPS packaging (cardboard container)

THIS NEEDS THOUROUGH CHECKING

The outer packaging of ST-40 and ST-80 models comprises a cardboard sleeve with a folded top cover, as shown in Figure 4.2. A cardboard sleeve and separate top cover is used as the outer packing for the taller ST-60, ST-120 and ST-200 models. The top cover is held in place by two plastic straps as shown in Figure 4.3.

Perform the following steps to unpack the UPS equipment from the standard packaging:

1. Open the packaging top cover (after cutting the two plastic straps where applicable).
2. Carefully remove the accessories box that is shipped on top of the main UPS cabinet. [Confirm that this is not also wrapped in the plastic shhe, which my be removed first]

   The standard accessory box contents are: user manual, 2x painted kick-plates, screws, 4x adjustable feet and keys.
3. Remove the cardboard sleeve by pulling it towards the top of the cabinet.
4. Remove any cardboard or polystyrene fillets that are taped to the outside of the plastic wrapping.
5. Remove the plastic wrapping by pulling it upwards over the top of the cabinet.

   Note: The edges of the cabinet are not protected, so if you have to cut the wrapping take care not to scratch or damage the cabinet paintwork.
6. Remove the four screws securing the pallet to the cabinet legs, as indicated in Figure 4.4.
7. Using a forklift or pallet jack, raise the cabinet clear of the ground.
   a) Remove the pallet.
   b) Fit the four adjustable levelling feet, found in the accessories package, to the bottom of the cabinet legs.
8. Open the cabinet door, remove any further internal packaging where applicable and inspect for internal damage. Report any damage to the shipper immediately
9. If no damage is found, move the cabinet to its final location and adjust the levelling feet as necessary.
10. Fit the painted front and back kick plates, found in the accessories package, as required.

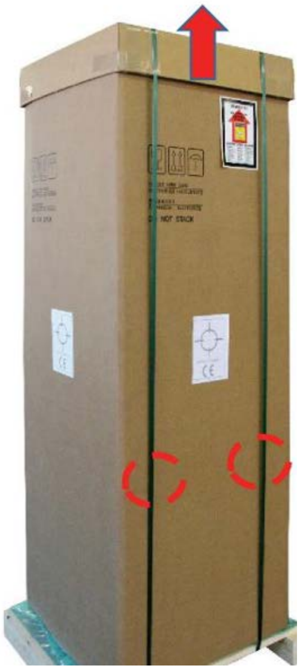


Figure 4.3 ST-60, ST-120, 200 packaging

Figure 4.4 Pallet removal

QUESTION: The illustration shows that with the pallet attached the forks are inserted under the sides of the cabinet. When the pallet is removed can the forks be inserted under the front/rear of that cabinet (I don't know how the cabinet is constructed!)

4.3.2 Removing the alternative wooden crate packaging

1. Remove the wooden crate sides and top by removing the securing screws from the bottom and sides of each panel
2. Carefully remove the accessories box that is shipped on top of the main UPS cabinet.
3. Remove any cardboard or polystyrene fillets that are taped to the outside of the plastic wrapping.
4. Remove the plastic wrapping by pulling it upwards over the top of the cabinet.

   Note: The edges of the cabinet are not protected, so if you have to cut the wrapping take care not to scratch or damage the cabinet paintwork.

5. Remove the four screws securing the pallet to the cabinet legs, as indicated in Figure 4.4.
6. Using a forklift or pallet jack, raise the cabinet clear of the ground.
   a) Remove the pallet.
   b) Fit the four adjustable levelling feet, found in the accessories package, to the bottom of the cabinet legs.
7. Open the cabinet door, remove any further internal packaging where applicable and inspect for internal damage. Report any damage to the shipper immediately
8. If no damage is found, move the cabinet to its final location and adjust the levelling feet as necessary.
9. Fit the painted front and back kick plates, found in the accessories package, as required.

Figure 4.5 Wooden crate packaging

4.3.3 Batteries

CAUTION: *The UPS batteries must ALWAYS be installed by the commissioning engineer.*

Unless they are to be stored for a long period *(see paragraph 4.2.3)*, the batteries should remain in their packaging until they are required by the Kohler Uninterruptible Power commissioning engineer.

Battery life depends very much on temperature and should ideally be stored and operated at a temperature of 20°C.

WARNING: If the UPS is delivered without batteries, Kohler Uninterruptible Power will not accept responsibility for any damage or malfunctioning caused to the UPS by the incorrect storage, installation or connection of batteries carried out by third parties.

4.4 Power cabling

It is the customer's responsibility to provide all the external fuses, isolators and cables that are used to connect the UPS input and output power supplies.

Paragraph 3.3 describes the following UPS power configurations and provides recommended fuse ratings:

- Single input cabling with common battery *(see Figure 3.6 on page 40)*
- Single input cabling with separate batteries *(see Figure 3.7 on page 41)*
- Dual input cabling with common battery *(see Figure 3.8 on page 42)*
- Dual input cabling with separate batteries *(see Figure 3.9 on page 43)*

Please study the information provided in paragraph 3.3 *(see "Electrical and cabling planning," on page 36)* before you begin cable installation.

Key Point: This information given for guidance only and all fuses, isolators and power cables must be rated and installed in accordance with the prescribed IEC standards or local regulation – e.g. BS7671:2008.

4.4.1 Safety notes

Please ensure you read and understand the following safety notes before you begin the UPS electrical installation.

1. Do not start cabling the UPS before its mechanical installation is completed.
2. The power cable installation procedure must be performed or supervised by a qualified electrician.
3. Do not connect power cables to the UPS if there is water or moisture present.
4. Before you work on the UPS power cables or power terminations, you must ensure that the UPS input/bypass mains supplies are isolated and 'locked-out' at their respective mains switchboards. Post warning notices to avoid any inadvertent operation of the UPS external supply isolators. Similarly, ensure that the UPS AC output supply is isolated and locked out at the UPS output distribution panel.
5. Before you connect the UPS power cables ensure that the fuses and cables are suitably rated in accordance with the prescribed IEC standards or local regulations – for example BS7671.
6. Once the electrical installation is completed the UPS must be commissioned by an engineer authorised by Kohler Uninterruptible Power before it is powered up and brought into use.
7. If an external maintenance bypass facility is used you should familiarise yourself with its operation and input/output power connections as these determine the source/destination of the UPS input and output power cables.

WARNING: Do not apply electrical power to the UPS before it has been commissioned.

8. When installing the UPS cables ensure that the connection procedures are performed under the following conditions:
   a) No mains voltage is present at the UPS mains/bypass switchboard terminals.
   b) All loads are shut down and isolated at the UPS output distribution panel.
   c) The UPS is fully shut down and voltage-free.
   d) The UPS maintenance bypass switch is IA1 is open (and external maintenance bypass switch, if used).

4.4.2 Power connections

Cable access

The PW 8000DPA ST power cables are connected to a terminal block which is located in the lower front of the cabinet.

ADD CABLE ENTRY/GLANDING DETAILS

Terminal block connections

The ST-40 and ST-60 models have internal batteries so no battery terminal block is provided.

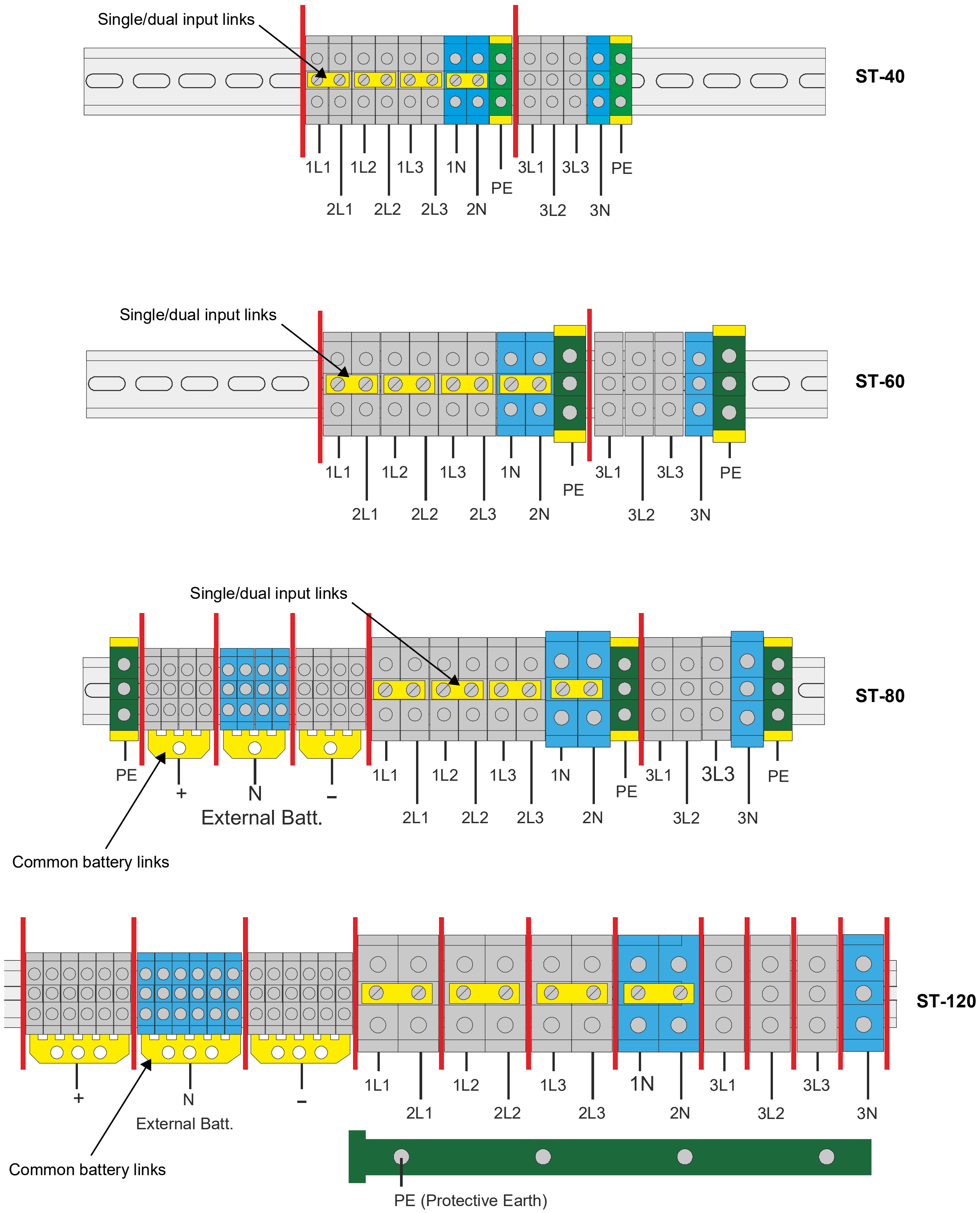
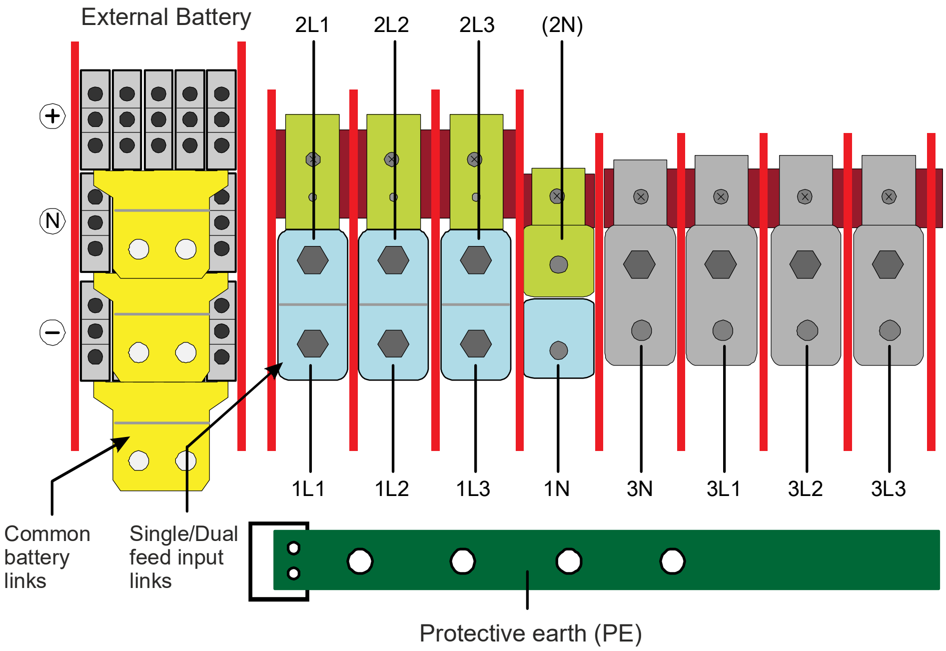


Figure 4.6 ST-40, ST-60, ST-80, ST-120 Power terminal connections



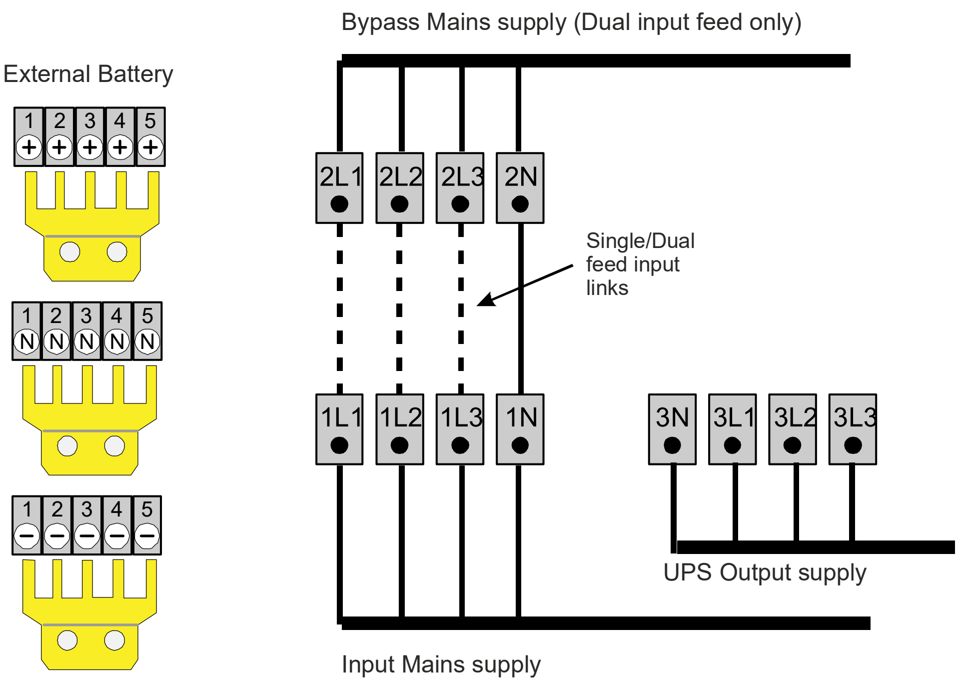


Figure 4.7 ST-200 Power terminal connections

4.4.3 Connecting the power cables (single-feed input)

1. Connect an earth cable from the input mains switchboard to the UPS protective earth terminal (PE).
2. If an external battery cabinet is used, connect an earth cable between the battery cabinet and the UPS battery earth terminal (PE).
3. Ensure the single-feed links, shown in yellow in Figures 4.6 and 4.7, between the input mains terminals and bypass mains terminals (i.e. 1-L1 to 2-L1, 1-L2 to 2-L2, 1-L3 to 2-L3, 1N to 2N) are fitted.
4. Connect the UPS input mains supply cables to terminals 1-L1, 1-L2, 1-L3. Ensure correct (clockwise) phase rotation.
5. Connect the input mains neutral to terminal 1N.

***CAUTION:** The input neutral cable must be unswitched and grounded.*

4.4.4 Connecting the power cables (dual-feed input)

1. Connect an earth cable from the input mains switchboard to the UPS protective earth terminal (PE).
2. If the bypass mains supply is obtained from a different mains switchboard to the input mains supply, connect an earth cable from the bypass mains switchboard to the protective earth terminal (PE).
3. If an external battery cabinet is used, connect an earth cable between the battery cabinet and the UPS battery earth terminal (PE).
4. Remove the single-feed links (if fitted) between 1-L1 to 2-L1, 1-L2 to 2-L2 and 1-L3 to 2-L3), shown in yellow in Figures 4.6 and 4.7. <u>Leave the neutral link connected between 1N and 2N</u>.
5. Connect the UPS input mains supply cables to terminals 1-L1, 1-L2, 1-L3. Ensure correct (clockwise) phase rotation.
6. Connect the input mains neutral to terminal 1N.
7. Connect the UPS bypass mains supply cables to terminals 2-L1, 2-L2, 2-L3. Ensure correct (clockwise) phase rotation.
8. If the bypass mains supply is obtained from a different mains switchboard to the input mains supply, connect the bypass mains neutral to terminal 2N (ensure the neutral link is connected between 1N and 2N).

   Note: If the input mains and bypass mains are connected to the same switchboard the 2N cable is not necessary.

***CAUTION:** The input neutral cable(s) must be unswitched and grounded and the neutral terminals 1N & 2N must be linke..*

Note: The UPS commissioning engineer will re-configure the UPS electronics to operate with a dual feed input at the time of commissioning.

4.4.5 Connecting the UPS output cables

We recommend that the UPS AC output is connected to a dedicated output (load) distribution panel.

1. Before you connect the UPS output cables to the output distribution panel:
   a) Verify that the projected load does not exceed the UPS output power rating (`OUTPUT POWER` on the nameplate).
   b) Ensure the load circuit breakers on the output distribution panel are correctly sized with respect to the individual load ratings and associated cabling.
   c) Ensure that the maximum total load rating, and the maximum load rating of each individual load socket, is indicated on the output distribution panel.
2. Connect the earth cable from the output distribution panel to the UPS protective earth (PE) terminal.
3. Connect the UPS AC output cables from terminals 3-L1, 3-L2, 3-L3 to the appropriate input feed connections on the output distribution panel. Ensure correct (clockwise) phase rotation.
4. Connect the UPS output neutral cable from terminal 3-N to the neutral connection on the output distribution panel

***CAUTION:** The output neutral cable must ALWAYS be connected.*

4.4.6 Connecting the battery

IMPORTANT NOTE

The batteries must be installed and connected by an approved Kohler Uninterruptible Power commissioning engineer. High voltage battery strings can be extremely dangerous and **should not** be installed by the customer's installation team.

It is the customer's responsibility to provide any external DC power cable containment facilities between the UPS cabinet and battery cabinet where necessary – e.g. cable trays or trunking. Contact Kohler Uninterruptible Power for further installation advice if required.

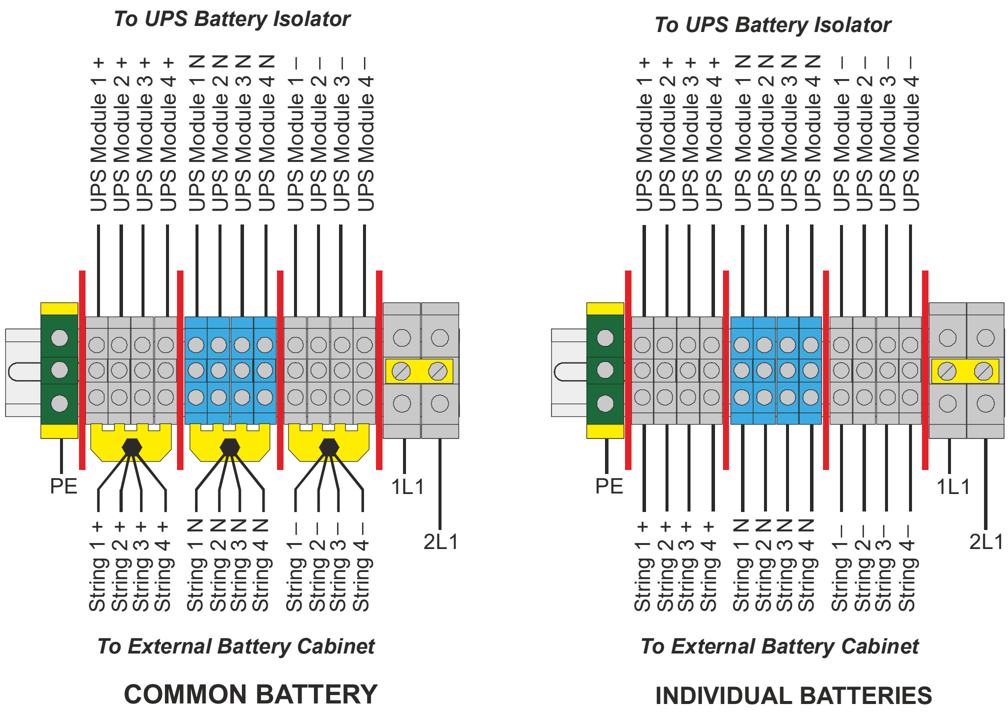


Figure 4.8 Battery connections (ST-80 cabinet shown)

In the ST-80, ST-120 and ST-200 models the external batteries are connected to terminal blocks located on the left hand side of the power terminal connection rail. The cables at the top of the terminal blocks are connected to the battery isolators associated with each UPS module and the terminals at the bottom of the terminal blocks are connected to the external battery cabinet(s).

The example in Figure 4.8 illustrates the ST-80 cabinet which has four terminal block connections, one for each UPS module. Each battery string is shown to have three connections annotated '+,' 'N' and '–'. The 'N' connection is connected to the centre of the battery string.

Note: In the case of the ST-200 each external battery is connected to two UPS power modules so only five sets of battery connections are provided to cater for the (up to) ten modules. However each UPS power module has an individual battery isolator located on the back of the UPS Cabinet.

Common battery configuration

If a 'common battery' configuration is required, all the UPS modules are fed by a common battery source – which may comprise a number of parallel battery strings. Where this type of installation is used the 'common battery' links must fitted to the battery terminal block connections as shown in the left-hand diagram of Figure 4.8. These links must be removed for 'individual battery' configuration.

4.5 Remote monitoring and control facilities

4.5.1 PW 8000DPA ST communications interface

Various optional remote monitoring and control facilities can be connected to the PW 8000DPA ST communications interface located on the front of the UPS frame. These are described on page 17 with connection details contained in Chapter 8.

Although all the connected optional features will be checked by the commissioning engineer, they can be connected by the customer installation team at this point provided no external power is applied to the circuits until they have been properly commissioned.

4.6 Installation completion

This now completes the installation process.

WARNING: Ensure that power is not applied to any part of the UPS or its connected optional facilities until the UPS has been commissioned and handed over.

5 Operation

5.1 Introduction

The Kohler PW 8000DPA ST UPS system must be commissioned by a fully trained engineer authorised by Kohler Uninterruptible Power before it is put into use.

The commissioning engineer will:

- Check the UPS electrical and mechanical installation, and operating environment.
- Install and connect the UPS batteries.
- Check and complete the UPS configuration settings.
- Check the installation and operation of any optional equipment.
- Perform a controlled UPS start-up and fully test the system for correct operation.
- Provide customer training and hand over the system in a fully working condition.

WARNING: Kohler Uninterruptible Power will not accept responsibility for the equipment or the safety of any personnel if the UPS system is operated before it has been fully commissioned.
The manufacturer's warranty will be invalidated if power is applied to any part of the UPS system before it has been fully commissioned and handed over to the customer.

5.1.1 Operating procedure summary

Under normal circumstances all the UPS modules in a multi-module system are turned on and operating in the 'on inverter' mode. If one module fails in a redundant module system the faulty module will shut down but it will not affect the remaining module(s), which will continue to operate normally. If necessary, the failed module can then be removed or tested off-line.

If a UPS module fails in a non-redundant system, the load will immediately transfer to the static bypass and the load will be powered from the unprotected bypass mains supply.

When starting and stopping, the UPS the system goes through four operational states, as shown in Figure 5.1. The procedures contained in this chapter describe transitions between these states as follows:

- *How to start the UPS system from a fully powered-down condition - see paragraph 5.2*
- *Operating in ECO (on bypass) mode - see paragraph 5.3*
- *How to transfer the load to the maintenance bypass - see paragraph 5.4*
- *How to shut down the complete UPS system - see paragraph 5.5*

5.1.2 General warnings

WARNING: These operating procedures should be performed by a trained operator.

WARNING: When the UPS system is operating on `BYPASS` or via the `MAINTENANCE BYPASS SWITCH`, the load supply is unprotected if the bypass mains supply fails. It is essential that the load user is informed of this possibility before you intentionally select either of these operating modes.

WARNING: When the UPS is shut down, power is still applied to the UPS input/bypass terminals unless the mains supplies are isolated at the incoming switchboard. It is not permissible to turn off the bypass mains supply if the load is intentionally connected via the internal maintenance bypass switch (IA1) as this will also disconnect the load power.

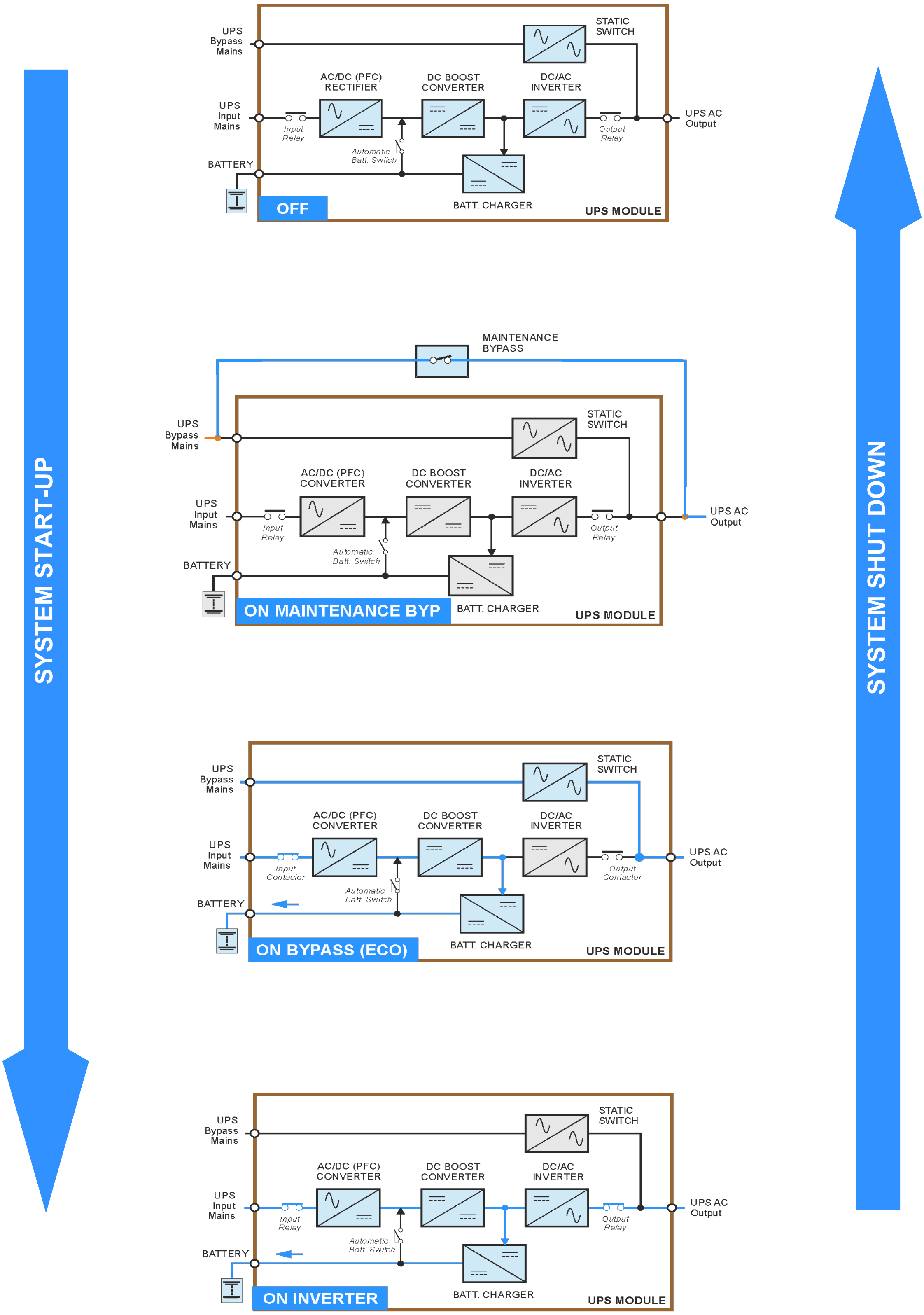


Figure 5.1 Operating procedure transitions

5.2 How to start the UPS system from a fully powered-down condition

IMPORTANT NOTE

In the following procedures, all references to the 'Maintenance Bypass Switch' apply to the internal maintenance bypass switch (IA1) unless the system is connected to an external maintenance bypass facility.

If an external maintenance bypass facility is installed all references to the 'Maintenance Bypass Switch' apply to the maintenance bypass switch in the external facility.

Key Point: To reduce the possible effects of high inrush currents that might occur when turning on large loads, we recommend that you initially power-up the load when the UPS system is operating on the maintenance bypass then transfer it to the UPS inverter(s), as described in this procedure.

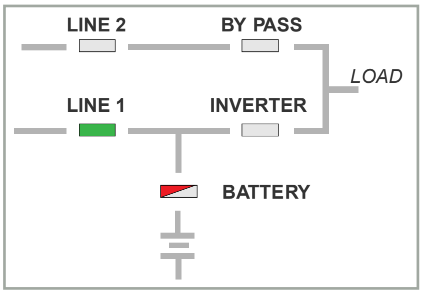
CAUTION: *You should familiarise yourself with the operation of the external maintenance bypass circuit operation before using this procedure.*

Initial conditions:

This procedure assumes the following initial conditions for each UPS cabinet:

- The UPS maintenance bypass switch is open.
- The UPS system output isolator on the external output distribution panel is open.
- The UPS input/bypass supply fuses or (breakers) are open (`OFF`) at the incoming mains switchboard(s).
- The battery fuses (F4-x) are open (`OFF`).

Power-up the load:

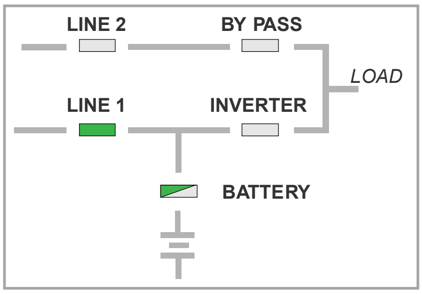


1. Turn ON the UPS system input/bypass mains supply at the incoming mains switchboard(s).
   a) Power is now applied to the UPS modules, but they are turned OFF.
2. On the module control panel (of ALL modules) verify that:
   a) The `LINE 1` LED is green.
   b) The `BATTERY` LED is flashing red.
   c) All other mimic LEDs are OFF
   d) The LCD displays `LOAD OFF, SUPPLY FAILURE`.
   If necessary press the `RESET` button to obtain this display.
3. Close the external UPS system output isolation device on the external output distribution panel.
4. Close the UPS maintenance bypass switch *(see the IMPORTANT NOTE above)*.
5. Turn on power to the load equipment by closing the individual load isolation devices at the output distribution panel.
   a) The load is now powered through the maintenance bypass.
   b) The module control panel mimic indications do not change.
   c) The LCD displays `MANUAL BYP IS CLOSED`.
6. Press the `RESET` button.
   a) The LCD displays `LOAD OFF, SUPPLY FAILURE`.

Start the UPS modules

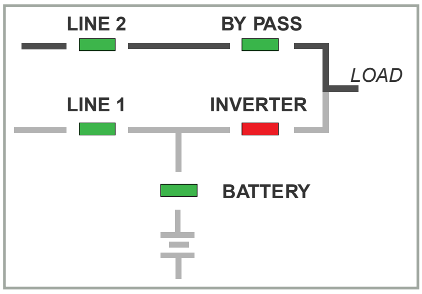
7. Carry out steps 8 to 10 below **on each UPS module.**

8. Close the fused battery isolator (F4-x) (also close the battery fuse in the external battery cabinet where used).
    a) The `LINE 1` LED is green.
    b) The `BATTERY` LED is flashing green.
    c) All other mimic LEDs are OFF
    d) The LCD displays `LOAD OFF, SUPPLY FAILURE`.
    If necessary press the `RESET` button to obtain this display.



9. On the module control panel, simultaneously press both `ON/OFF` buttons.
    a) The UPS module will begin to power up over approximately 60s.

10. On the module control panel, after 60s verify that:
    a) The `LINE 1` LED is green.
    b) The `LINE 2` LED changes to green.
    c) The `BYPASS` LED is green.
    d) The `INVERTER` LED is red.
    e) The `BATTERY` LED is green.
    f) The LCD displays `LOAD NOT PROTECTED`.



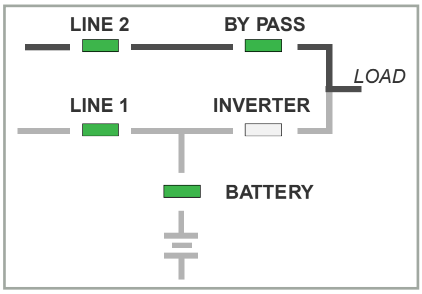
11. Before you continue, ensure that the indications on the module control panels of ALL modules in a parallel-module system are identical and as described above.

Transfer the load to static bypass:

12. Only proceed if the module control panel `BYPASS` LED is green (on ALL modules).

    Note: If the `BYPASS` LED is not green, repeat step 7 then seek trained advice if it still fails to light green.

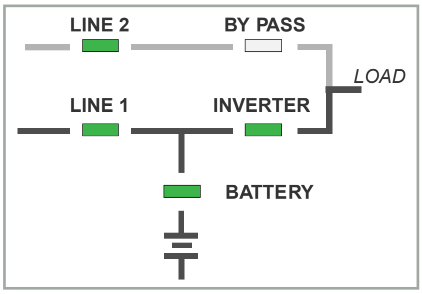
13. Open the maintenance bypass switch *(see the IMPORTANT NOTE above)*.
    a) The module control panel LCD should display `MANUAL BYPASS OPEN` followed by `LOAD NOT PROTECTED`.
    b) The `INVERTER` led will extinguish.



14. The load is now being powered through the UPS static bypass.
    a) Check the UPS input and output metered parameters to ensure that they are correct.
    b) Make a note any active alarm and take appropriate actions if an alarm cannot be reset.

Transfer the load to inverter

15. On the module control panel of any UPS module:
    a) Press the `UP` key once to access the menu system.
    b) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
    c) Use the `UP/DOWN` keys to move the cursor so that it is adjacent to `LOAD TO INVERTER` and then press the `ENTER` key.
    d) The UPS module output should transfer to inverter (on all modules in a parallel module system).



16. On the module control panel (of ALL modules) verify that:
    a) The `BYPASS` LED is extinguished.
    b) The `INVERTER` LED changes to green.

The UPS system is now operating in its ‘on inverter’ mode and providing the load with processed, protected power.

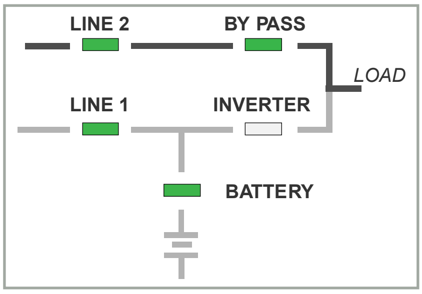
5.3 Operating in ECO (on bypass) mode

When the UPS system is operated in ECO (on bypass) mode the load is powered from the UPS bypass mains supply, via the static switch, under normal conditions and transfers to the inverter (on inverter mode) automatically if the bypass mains supply fails.

CAUTION: *There will be a very short supply break when the UPS switches to the 'on inverter' mode, so you should elect to operate the system in the ECO mode only if a load can withstand a brief power break.*

5.3.1 How to power-up the UPS system and operate in ECO (on bypass) mode

1. To power-up the UPS system from a fully shut down condition, follow the standard UPS system start-up instructions in paragraph 5.2 but do not perform the '*"Transfer the load to inverter"*' stage (step 15 onwards).
2. On the module control panel, after 60s verify that:
   a) The `LINE 1` LED is green.
   b) The `LINE 2` LED changes to green.
   c) The `BYPASS` LED is green.
   d) The `INVERTER` LED is OFF.
   e) The `BATTERY` LED is green.
   f) The LCD displays `LOAD NOT PROTECTED`.

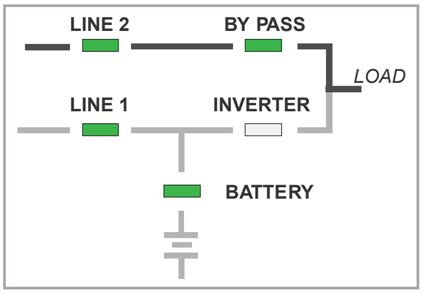


5.3.2 How to transfer to ECO (on bypass) from on-line (on inverter) mode

CAUTION: *Before you carry out this procedure, warn the critical load user that the load will not be supplied with processed, backed-up power once the transfer to maintenance bypass has been performed.*

The UPS can be manually switched to ECO (on bypass) from the on-line (on inverter) mode using the module control panel load transfer menu.

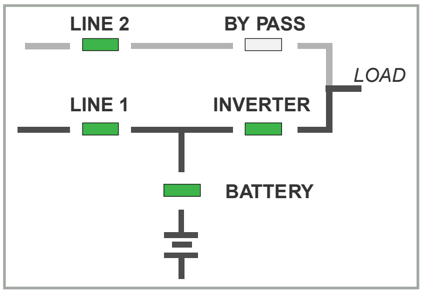
1. On the module control panel (of any UPS module) press the `ENTER` key once to access the menu system.
2. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
3. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `LOAD TO BYPASS` and then press the `ENTER` key.
   a) The UPS system will transfer the load to the static bypass (on all UPS modules).
4. On the module control panel(s), verify that:
   a) The `INVERTER` LED is extinguished.
   b) The `BYPASS` LED is green.
   c) The LCD displays `LOAD NOT PROTECTED`.



5.3.3 How to transfer to on-line (on inverter) from ECO (on bypass) mode

The UPS can be manually switched to on-line (on inverter) from the ECO (on bypass) mode using the module control panel load transfer menu.

1. On the module control panel (of any UPS module) press the `ENTER` key once to access the menu system.
2. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
3. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `LOAD TO INVERTER` and then press the `ENTER` key.
   a) The UPS system will transfer the load to the static bypass (on all UPS modules in a parallel-module system).
4. On the module control panel(s), verify that:
   a) The `INVERTER` LED is green.
   b) The `BYPASS` LED is extinguished.
   c) The LCD displays `LOAD PROTECTED`.



5.3.4 How to Turn OFF the UPS system when operating in ECO (on bypass) mode

1. Follow the standard UPS system shut down operating instructions in paragraph 5.4 beginning at step 7 – as the load is already operating on bypass.

5.4 How to transfer the load to the maintenance bypass

It may be necessary to transfer the load to the maintenance bypass supply to perform certain UPS service or maintenance operations – for example, when replacing a module in non-redundant system.

This procedure is usually carried out by a trained service engineer and is not part of the normal day-to-day management of the UPS system.

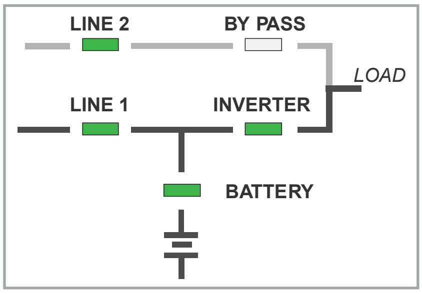
CAUTION: *Before you carry out this procedure, warn the critical load user that the load will not be supplied with processed, backed-up power once the transfer to maintenance bypass has been performed.*

Initial conditions:

This procedure assumes one of the following two initial conditions.

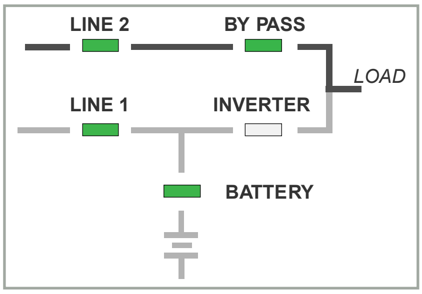
1. The UPS system is operating normally, 'on inverter'

   In which case continue at step 3 below:



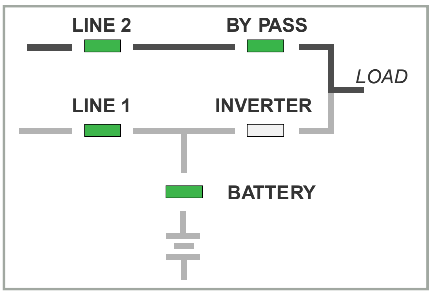
2. The UPS system is operating with the load 'on bypass' due to either
   - a system fault
   - severe overload
   - loss of redundancy
   - or operating in 'ECO' mode

   In which case continue with step 7 below:



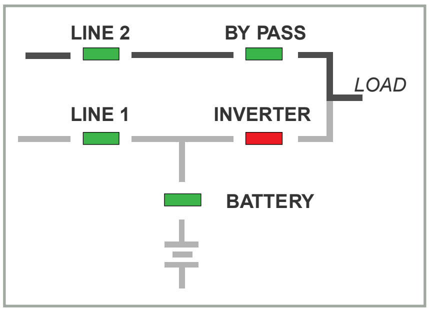
Transfer the load to the UPS static bypass:

3. On the UPS control panel (of any UPS module) press the `ENTER` key once to access the menu system.
4. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `COMMANDS` and then press the `ENTER` key.
5. Using the `UP/DOWN` keys, move the cursor so that it is adjacent to `LOAD TO BYPASS` and then press the `ENTER` key.
   a) The UPS system will transfer the load to static bypass (on all UPS modules).
6. On the module control panel(s), verify that:
   a) The `INVERTER` LED has extinguished.
   b) The `BYPASS` LED is green.
   c) The LCD displays `LOAD NOT PROTECTED`.



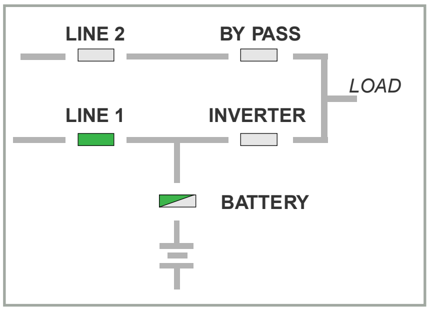
Transfer the load to maintenance bypass:

7. Close the maintenance bypass switch *(see the IMPORTANT NOTE above)*.
8. On the module control panel(s), verify that:
   a) The INVERTER LED is red.
   b) The BYPASS LED is green.
   c) The module control panel will display MANUAL BYP IS CLOSED.
9. Press the RESET button (*on all UPS modules*) to cancel the audible alarm.



Turn off the UPS module(s):

10. Carry out steps 11 to 12 on each UPS module in turn.
11. On the module control panel, simultaneously press both ON/OFF buttons and verify that:
    a) All LEDs turn OFF except for LINE 1 and BATTERY (flashing green).
12. Open the battery fuses (F4-x).
    a) The BATTERY LED will now flash red.



Key Point: The UPS system is operating on maintenance bypass and the load is unprotected.

WARNING: When using the internal maintenance bypass switch (IA1), the UPS bypass mains supply must be maintained in order to provide power at the UPS output terminals.
DO NOT OPEN THE BYPASS MAINS SUPPLY FUSES/ CIRCUIT BREAKER.

If an external maintenance bypass facility is used, the UPS modules' input/bypass supply can be turned off – see the operating instructions for the bespoke external maintenance bypass facility for details.

Key Point: It is now safe to remove/replace the UPS module(s).

5.5 How to shut down the complete UPS system

The UPS system can be completely shut down if the load does not require power for an extended period of time.

CAUTION: *Before you carry out this procedure, warn the critical load user that power is about to be removed.*

1. If the UPS system is not already operating on maintenance bypass, transfer the load to the maintenance bypass and turn OFF the UPS module(s) as described in paragraph 5.4.
2. Turn OFF power to the load equipment by opening the load isolation devices and UPS system output isolation device on the load distribution panel.
3. Open the maintenance bypass switch *(see the IMPORTANT NOTE above)*.
4. Turn OFF the UPS input mains and bypass mains supplies at the incoming mains switchboard. Where used, refer to the operating instructions for the bespoke external maintenance bypass facility for additional details of how to isolate the UPS mains supply if necessary.
5. Open any external battery fuses/isolators where fitted.
6. The UPS system cabinet(s) is now voltage free.

6 Maintenance

6.1 Introduction

WARNING: The procedures described in this chapter must be performed by an authorised electrician who has received the appropriate level of training on this UPS system.

The UPS maintenance requirements of the user are minimal as there are no user-serviceable parts contained within the UPS cabinet. However, the UPS contains life limited components that require to be replaced at regular intervals, we recommend that the UPS and batteries are inspected and checked for calibration on a 6 monthly basis as part of a preventative maintenance schedule to maximise the system's working life and reliability.

6.2 User responsibilities

The UPS equipment should be inspected daily to ensure that the environment in which it is operating is kept cool and dust free at all times, and that the operating temperature and humidity is within the limits given in the specifications chapter of this manual.The UPS equipment should also be maintained in accordance with the manufacturer's recommendation and any life limited components replaced at the required intervals and critical updates are performed. Any active alarm or status indication that suggests that the UPS is not functioning correctly should be dealt with immediately by referring to the troubleshooting chapter of this manual or contacting the manufacturer's service desk

Routine maintenance

WARNING: When working inside the UPS cabinet there is a risk of exposure to potentially lethal AC and DC voltages. All work that requires internal cabinet access must be carried out by trained personnel only.

The commissioning engineer will leave a service record book with the UPS which will be used to log the UPS service history. To ensure optimum UPS operation we recommend that the system's operating parameters are checked and logged every six months.

Preventative maintenance inspections form an integral part of all Extended Warranty Agreements (maintenance contracts) offered by Kohler Uninterruptible Power For further details on Extended Warranty Agreements see the warranty information at the front of this manual.

A preventative maintenance inspection includes the following:

• Site/environment conditions	• Integrity of electrical installation
• Cooling airflow	• Rectifier/booster operation and calibration
• Inverter operation and calibration	• Static switch operation
• Battery status and condition	• Load characteristics
• Integrity of alarm and monitoring systems	• Correct operation of all installed options
• Condition of life limited components	• Manufacturer recommended updates

6.3 Battery testing

A battery test can be initiated from the module control panel and takes approximately 3 minutes to complete. The test procedure can be carried out irrespective of the operating mode ('on inverter' or 'on bypass') and whether or not the load is connected, should be performed only if there are no existing alarm conditions and the battery is initially fully charged.

WARNING: Batteries contain dangerous substances that will harm if discarded without out due care. Please ensure that any faulty batteries are discarded in accordance with local and national codes of practice for the disposal of hazardous waste.

7 Troubleshooting

7.1 Alarms

A number of UPS operating parameters and conditions are monitored and will generate an alarm or warning event notification on the UPS control panel if an error is detected or an abnormal condition occurs.

In the event of an alarm occurrence you should:

1. Silence the audible warning.
2. Identify the cause of the alarm by noting any recent events in the UPS module control panel 'event' register.
3. Interpret the cause of the alarm (see below) and seek assistance from your nearest service centre if the cause of the alarm is beyond simple rectification.

> **IMPORTANT NOTE**
>
> Certain alarm conditions may 'latch-on' even after the cause of the alarm is no longer present. For example, if there is a brief mains failure during unattended operation the `MAINS FAIL` alarm will activate and it may still indicate a fault condition even after the mains supply has returned to normal. Similarly, a `LOAD ON BYPASS` alarm might have been caused by an inverter overload, and a brief load transfer to bypass while the fault cleared.
>
> If any alarm appears, the first action you should take is to attempt to `RESET` it.
>
> If the alarm indication resets then it was probably caused by a transient condition; the UPS has responded correctly and no further action is required. Investigative action is necessary only if it is not possible to reset the alarm or if the alarm occurrence is repetitive, in which case you should seek advice or assistance from the Kohler Uninterruptible Power Service Department.

7.2 Module control panel

The module control panel is described on page 21.

If an alarm condition occurs, the red `ALARM` led will flash accompanied by an audible warning:

1. Cancel the audible warning by pressing the `RESET` button.
   a) If the alarmed condition was transient the audible warning will stop and the red warning light will extinguish.
   b) If the red warning remains ON it indicates that the cause of the alarm is still present and must be investigated.
2. Investigate the cause of the alarm by making a note of the `EVENT LOG`, which is accessed from the `MAIN MENU` – this will present a list of time-stamped events that took place preceding the detected alarm. The module control panel menu map is shown in Figure 2.24 on page 24.
3. Access the `MEASURMENTS` screen from the `MAIN MENU` and make a note of the UPS input, output, battery parameters etc.
4. Refer to the following troubleshooting table for possible fault resolutions.

7.3 Troubleshooting table

ALARM CONDITION	MEANING	SUGGESTED SOLUTION
MAINS RECT. FAULT	Input mains power supply is outside prescribed tolerance	The UPS input mains voltage to UPS is low or missing. If site power appears to be OK, check the UPS input mains supply fuses /circuit breakers etc.
MAINS BYP. FAULT	Bypass mains power supply is outside prescribed tolerance.	The UPS bypass mains voltage to UPS is low or missing. If site power appears to be OK, check the UPS input mains supply fuses /circuit breakers etc.
OUTPUT SHORT	There is a short circuit at the output of UPS (on the load side).	Check for a short circuit on a connected load. Check all output connections and protective devices.
OVERLOAD	Load exceeds the UPS rated power	Identify which piece of equipment is causing the overload and disconnect it from the UPS
TEMPERATURE HIGH	UPS temperature has exceeded the allowed value.	Check the ambient temperature of the UPS is <40°C. If the ambient temperature is normal call the authorised service centre for assistance.
INV. PHASE FAULT	Inverter is faulty.	Call the authorised service centre for assistance.
BATTERY IN DISCHARGE	Battery is near end of autonomy.	Shutdown the load connected to UPS before the UPS switches itself off to protect its batteries
MANUAL BYP IS CLOSED	Maintenance bypass closed. Load supplied by mains	This alarm is only displayed if the UPS is on maintenance bypass. If this is not a desired state, turn on the UPS system following the correct operating procedure.

7.4 Contacting service

Kohler Uninterruptible Power has a service department dedicated to providing routine maintenance and emergency service cover for your UPS. If you have any queries regarding your UPS please contact us.

UK

www.kohler-ups.co.uk	Kohler Uninterruptible Power web site
ukservice.ups@kohler.com	Service department – booking service, fault reporting etc.
uktechnicalsupport.ups@kohler.com	Technical queries
uksales.ups@kohler.com	Hardware sales
ukservicesales.ups@kohler.com	Extended warranty agreements etc

IRELAND

www.kohler-ups.ie	Kohler Uninterruptible Power web site
ieinfo.ups@kohler.com	Service department, technical queries, hardware sales and extended warranty agreements

SINGAPORE

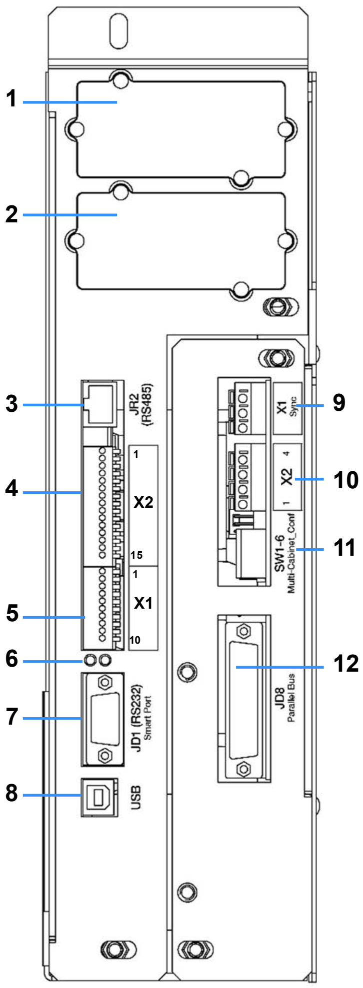
www.kohler-ups.sg	Kohler Uninterruptible Power web site
salesups.sg@kohler.com	Hardware sales
serviceups.sg@kohler.com	Contract customer support, maintenance contracts renewals

We recommend that your UPS is protected by an extended warranty agreement. These agreements assist us in caring for your UPS, ensuring that it is well maintained and attended to promptly should any problems occur.

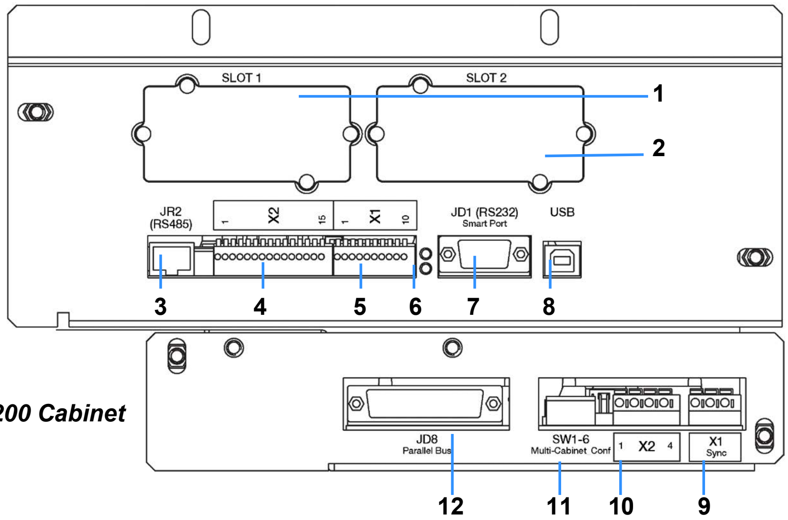
8 Options

8.1 Customer communications

ST-40, ST-60, ST-80, ST120 Cabinet



ST200 Cabinet



Customer Interface Board		
1	SLOT 1	Slot for optional Modem/Ethernet card ONLY
2	SLOT 2	Slot for optional SNMP card ONLY
3	JR2	RJ45 Port: (Not used)
4	X2	Customer output dry ports
5	X1	Customer input dry ports
6	LEDs	Status LEDs (red/green)
7	JD1	RS232 Smart port computer interface
8	USB	Standard USB interface
Parallel Interface Board (fitted in a parallel UPS cabinet only)		
9	X1	Sync Input
10	X2	External manual bypass
11	S1-6	Configuration DIP switch
12	JD8	Parallel bus

Figure 8.1 Customer communications

A communications interface board offers a range of connections that enable the user to interface the UPS with a local network, building management system or a simple remote alarms facility.

The communications interface board is located near the bottom of the UPS cabinet adjacent to the power switchgear and all the board connections are accessible from the front of the UPS cabinet – see Figures 2.8 to 2.12.

CAUTION: When the UPS cabinet is installed as part of a parallel cabinet system the communications interface board I/O is disabled in the 'slave' cabinets if the system 'Multidrop' application is enabled. Under such circumstances the required interface connections should be made to the board fitted in the 'master' module only.

8.1.1 Customer control inputs (X1)

Terminal block X1 provides a range of standard input interfaces that can be used by the customer as required. All connections are made to Phoenix spring terminals. These terminals will accept wires up to 1.5 mm² but we recommend 0.5 mm² gauge wires are used for ease of connection.

Four switched inputs are used to signal an external Remote Shut Down, On Generator and a customer-specific function (special application) operation, together with a battery temp sensor input. These are applied to the UPS internal control system via isolation relays fitted on the communications interface board that are controlled directly by the external inputs.

	Terminal	Contact	Signal	Function
X1	X1/10	Gnd	Gnd	UPS-protected+12 Vdc output supply (max 200mA).
	X1/8	In	+12 Vdc*	
	X1/8	Gnd	Gnd	REMOTE SHUTDOWN (Do not remove the factory-fitted bridge if this feature is not used)
	X1/7	In	+12 Vdc*	
	X1/6	Gnd	Gnd	BATTERY TEMPERATURE SENSING (If connected this input is battery temperature dependent)
	X1/5	In	+3.3V	
	X1/4	Gnd	Gnd	CUSTOMER SPECIFIC INPUT (Function on request to be defined)
	X1/3	In	+12 Vdc*	
	X1/2	Gnd	Gnd	GENERATOR OPERATION (NC = Generator on line)
	X1/1	In	+12 Vdc*	
	**+12 Vdc is the terminal open-circuit voltage. This are pulled down to 0V (Gnd) when the external circuit is closed.*			

Remote shutdown

The remote shutdown facility comprises a normally-closed switched connected between terminal X1/7 and X1/8.

When the remote switch is opened it shuts down the UPS and turns OFF the UPS output which removes the load supply.

When the remote shutdown option is used, we recommend that a terminal block with linking facilities is installed between the UPS shutdown port and the remote shutdown switch, as shown, in order to allow the removal, maintenance or testing of the remote circuit without affecting the UPS operation.

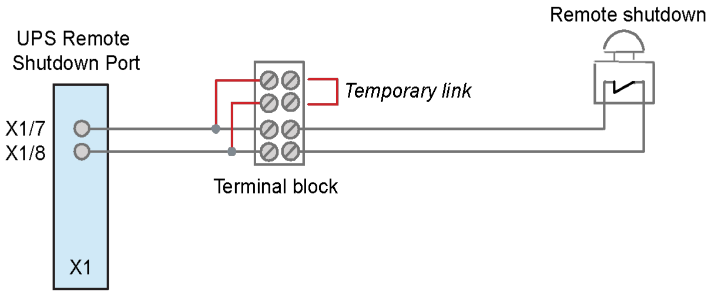


Figure 8.2 Remote shutdown connection

If the remote shutdown option is required, it must be activated by a hardware code on the `SETUP SERVICE` menu, which will be done as part of the UPS system commissioning process. If you wish to activate this feature after the system has been commissioned please contact Kohler Uninterruptible Power service department for advice.

To fit an external remote shutdown facility:

1. Use a screened cable with 1 pair (section of wires 0.5 mm^2 - 1.5 mm^2) and maximum length of 100m.

2. Connect the cable as shown in Figure 8.2.

WARNING: The remote shutdown is designed to disconnect the UPS AC output supply but does not totally shut down the UPS system. For this reason it should not be considered as an 'Emergency Stop' mechanism. A full Emergency Stop application is available as a factory-fitted option.

Generator ON facilities

The generator ON facility must use a normally-open contact which closes when the standby generator is running and providing the UPS input power source.

When this option is used, it can be configured to inhibit the operation of the battery charger and/or static bypass while the generator is on-line.

To fit an external remote Generator ON facility:

1. Use a screened cable with 1 pair (section of wires 0.5 mm^2 - 1.5 mm^2) and maximum length of 100m.
2. Connect the cable as shown in Figure 8.3.

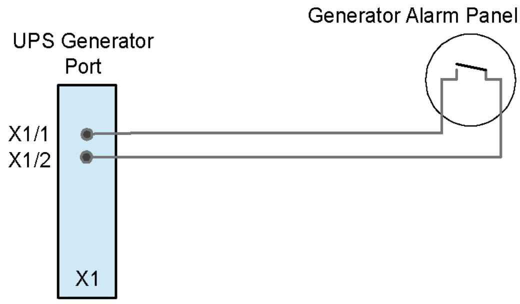


Figure 8.3 Generator ON Connection

+12V Supply source (X1 9/10)

The UPS-protected +12 Vdc power source available between X1 terminals 9 & 10 can be used as a power source for any external devices, such as relays, that are used as part of the control mechanism that govern the switched inputs.

Battery temperature sensor (X1 5/6)

Key Point: The battery temperature features will only function with the battery temperature sensor supplied by Kohler Uninterruptible Power. If you attempt to use any other type of sensor it could have a damaging effect on the UPS operation.

The optional battery temperature sensor allows the battery charger to automatically and continuously compensate the battery charging voltage according to the battery temperature

The battery sensor is supplies with a 1.8m long cable, but this can be extended up to 15m if necessary.

To fit the battery temperature option:

1. Install the temperature sensor in the hottest area of the battery installation, typically on the top of the battery cabinet. The supplied adhesive is suitable for use on aluminium, stainless steel and enamelled steel only.
2. Connect the cable to X1 terminals 5/6 as shown in Figure 8.4. These connections are not polarity sensitive.

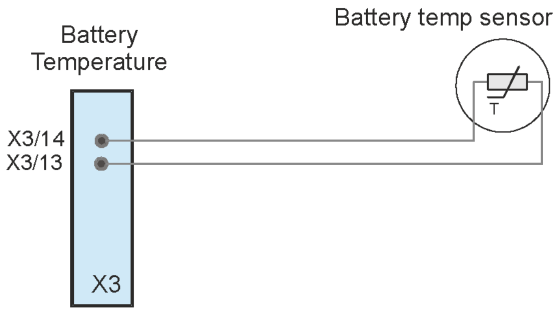
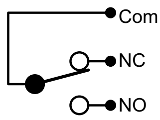


Figure 8.4 Battery temperature sensor

8.1.2 Dry port outputs (X2)

	Terminal	Contact	Signal	Display	Function	Contacts
X2	X2/15	Com	ALARM	COMMON_ALARM	Common	
	X2/14	N/C			No Alarm Condition	
	X2/13	N/O			Common Alarm (system)	
	X2/12	Com	MESSAGE	LOAD_ON_MAINS	Common	
	X2/11	N/C			Load On Inverter	
	X2/10	N/O			Load On Bypass (mains)	
	X2/9	Com	ALARM	BATTERY_LOW	Common	
	X2/8	N/C			Battery OK	
	X2/7	N/O			Battery Low	
	X2/6	Com	MESSAGE	LOAD_ON_INV	Common	
	X2/5	N/C			Load On Bypass (mains)	
	X2/4	N/O			Load On Inverter	
	X2/3	Com	ALARM	MAINS_OK	Common	
	X2/2	N/C			Mains Not Present	
	X2/1	N/O			Mains Present	

All the dry port output terminals (X2) can accept cables from 0.5 mm² to 1.5 mm².
X2 outputs are switched by volt-free contacts and are suitable for driving an external alarm panel or providing automatic and orderly shutdown of servers, AS400 or automated building systems. The contacts are rated at a maximum of 30 VAC/ 6A or 60 VDC/0.7A.

8.1.3 Serial RS232 Computer interface – USB & JD1 (Smart Port)

A serial RS 232 interface is available through a standard 9-pin D-Type female socket (JD1) or via the USB port.

The RS232/USB interface allows the UPS to be connected to a computer which, when used with appropriate power management software, allows the computer to continuously monitor the input mains voltage and UPS status, and display messages in response to any UPS system changes.

USB Port

To establish communication between the UPS and a computer, connect the USB cable that is supplied with the UPS between the UPS USB port and the USB port on the computer. The USB port is compliant with USB 1.1 protocol.

JD1 RS232 Port

J1 is a standard 9-pin D-Type female socket which provides an intelligent RS-232 serial port.

Figure 8.5 shows the connector pin-out for a 9-pin and 25-pin.

Note that the maximum length for the interconnecting RS232 cable is 15m.

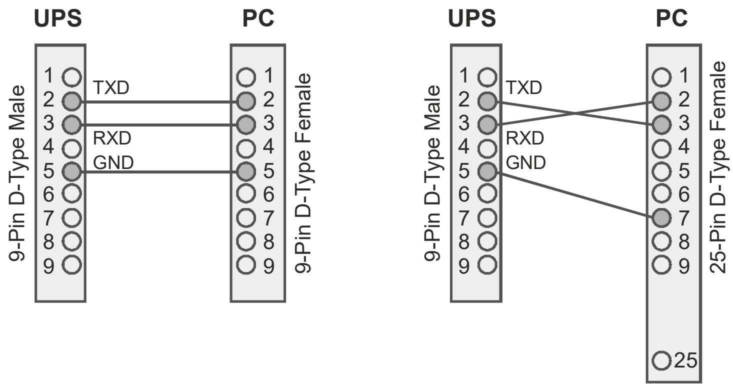


Figure 8.5 Connector Cable - PC Serial Port

8.1.4 Network interface card slots

The communications interface board contains two card slots that can be used with a range of network interface cards to interface the UPS system with a building management system or computer network. A suitable network interface card can be chosen to enable the UPS to be monitored and interrogated by one of following protocols:

- Simple Network Management Protocol (SNMP)
- MODBUS over TCP/IP
- MODBUS over RS-485

SNMP is a world-wide, standardised communication protocol and the one that is used most often to integrate the UPS with a wider building/network management system. It can be used to monitor any network-connected device via a simple control language and display the results in an application running within a standard web browser.

An SNMP/Ethernet adapter card contains an RJ-45 connector which can be connected to the network using a standard CAT-5 cable. Once connected, the UPS-Management software agent which is already installed in the SNMP adapter can monitor the UPS operation and output its data to the connected network in SNMP format. In a parallel module UPS system such as the PW 8000DPA ST the SNMP interface can communicate 'system-wide' data or data for an individual UPS module.

The SNMP adaptor card requires a PC with terminal connections and, for normal operation, at least one Ethernet connection. The SNMP card enables event/alarm email traps, server shut down (with optional licenses) and other tasks; and can also be integrated with BMS software over a local area network (LAN) for SNMP or Modbus information over IP.

Alternatively, SNMP connectivity can be implemented using an external SNMP adapter connected to the communications interface board RS232 output (JD1), as shown in Figure 8.6.

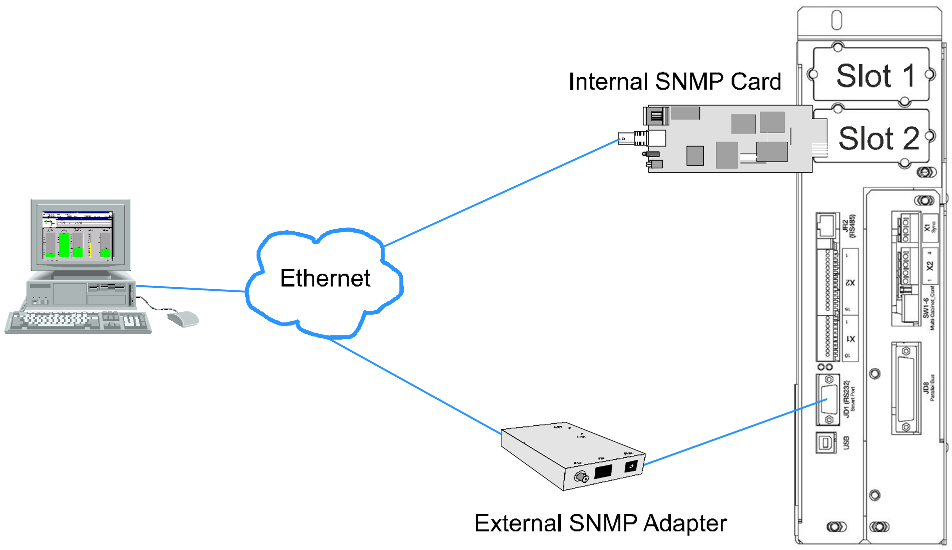
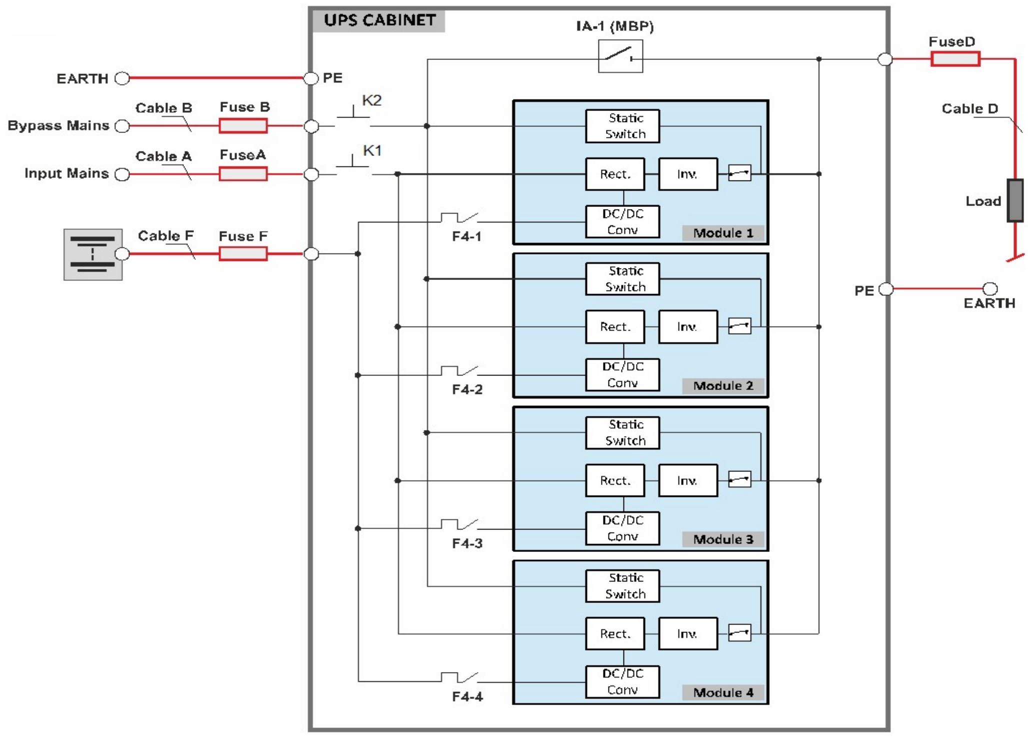


Figure 8.6 SNMP Connection

8.1.5 Internal backfeed protection

The UPS backfeed protection prevents any hazardous voltage or energy from being present on the UPS input AC terminals after interruption of the input AC power.
The backfeed protection is implemented in the DPA UPScale ST by internal backfeed protection contactors (K1 and K2) as shown in the wiring diagram below.

Figure 8.7



K1 Mains backfeed contactor (option) In the event of an AC failure, prevents the occurrence of any hazardous voltage at the rectifier mains terminal due to backfeed from the power modules sourced by the batter.y

K2 Bypass backfeed contactor (option) In the event of an AC failure, prevents the occurrence of any hazard voltage at the bypass input terminal due to backfeed from the power modules sourced by the battery

8.2 UPS Monitoring and automated control software

8.2.1 The importance of UPS management

The utility supply is inevitably unreliable every now and then; and assuring continuous power to all the facilities connected to it can be a difficult task. The situation is further complicated if worldwide systems are managed via a Local or Wide Area Network (LAN/WAN).

However, by interfacing the PW 8000DPA ST UPS system with purpose-designed network management tools, a System Administrator can take measures to back-up data and prevent system errors in the event of a long utility supply outage.

Suitable UPS management software can enable a System Administrator to monitor all attached networks from a central point and identify bottlenecks at an early stage but, in spite of extensive system monitoring, serious damage can still occur if an administrator fails to intervene in a timely manner. It is therefore important that, when appropriate, the installed UPS software can react automatically to shut down the supplied system in a safe and controlled manner.

Kohler Uninterruptible Power considers it important to have a complete solution for its UPS systems and offers its customers a number of remote control and monitoring tools to provide optimum protection.

Three (optional) monitoring systems are available for use with the PW 8000DPA ST UPS system:

- SNMP – can be used for monitoring and controlled UPS shutdown
- WAVEMON – can be used for monitoring and controlled UPS shutdown
- PowerREPORTER – can be used to automatically email details of monitored parameters and alarm events to Kohler Uninterruptible Power for appropriate service support response

8.2.2 SNMP monitoring software

The SNMP adapter described above requires a PC with terminal connections and, for normal operation, at least one Ethernet network connection. It also requires that the network operating system in use is SNMP-compatible.

8.2.3 WAVEMON UPS monitoring and control software

WAVEMON is a bespoke software package, designed to operate in conjunction with many of the systems supplied by Kohler Uninterruptible Power, which features both UPS monitoring and automatic UPS/server shutdown facilities.

The package is installed on a local PC and communicates with the UPS via USB or an RS-232 serial cable so does not require the purchase of an SNMP card or adapter.

The main features of WAVEMON are:

- on-screen autonomy time/battery time countdown
- on-screen server log-off and shutdown procedure
- time and date stamp event log
- extensive logging of all UPS activity and power quality data
- permits alarm warnings to be monitored remotely via email
- scheduled UPS service mode and other systems status
- graphical user interface for Windows-compatible platforms
- automatic unattended local shutdown
- special modules for MS-Office software to close and save open documents
- compatible with all optional modules like UPSDIALER, SNMP adaptors, temperature sensors, etc.

Functional description

WAVEMON is a client/server software application designed for networks and local workstations. In general, it consists of two parts: the server module of the UPS management software is *UPSMAN,* which communicates with the UPS via an RS232/USB interface. Running as a background application, *UPSMAN* collects and interprets the messages received from the UPS and places them at the disposal of the client module *UPSMON,* as well as any connected SNMP-based instrumentation and control system.

If *UPSMAN* detects voltage variations or a power failure, it can execute various ‘system event’ routines, by means of which, for example, the server is switched off or a warning/alarm is sent to the connected users. These ‘system event’ routines are a part of the management software and can be configured in to suit local application requirements.

The PW 8000DPA ST UPS software unit can be integrated into a network in two ways:

1. By the server which is supplied by the UPS itself and has been integrated into the network.

   In most cases this server is used as a sub-agent and you only need the WAVEMON software (without an SNMP adapter). You will also need to establish an RS232/USB connection between the UPS and computer/server.

2. By the use of an SNMP card/adapter

   An SNMP card/adapter is to be preferred in order to integrate the UPS into the network. In this case up to 50 computers can be shut down in one RCCMD environment. RCCMD (remote console command) is an additional software module that is used in order to execute a command (typically a shutdown command) in a remote system.

Licensing

A licence is issued with every software serial number for use of what is known as the 'UPS service' on a single server in connection with one UPS and an unlimited number of connected WINDOWS workstations. For operation with two or more servers, a further licence is required for each additional server. In this case it is of no importance whether the UPS service on these servers is active or whether the server was stopped by a remote UPS service. The same applies to the use of RCCMD with the 'remote send/receive' modules for 'multi-server shutdown' under NT, UNIX and other operating systems.

The service programs are generally supplied as single licences. In order to use a single CD-ROM for several 'multi-server shut-down' units you must acquire additional licence codes.

RCCMD Server shutdown

In order that remote shutdown of servers can take place, initiated by the SNMP card or WAVEMON software, further licenses must be purchased. The license is for the RCCMD client (or listening) software that resides in each target server.

8.2.4 PowerREPORTER™ management software

PowerREPORTER is a remote monitoring and management service which provides peace-of-mind protection by offering a continuous (24/7/365) watch over mission-critical facilities. Continuous monitoring is an affordable insurance policy to detect issues and provide an early warning before they develop into a crisis.

The main features and benefits offered by PowerREPORTER are:

- real time alarm or critical event email notification sent directly to Kohler Uninterruptible Power service centre
- acquisition of key performance data and productivity information to allow a better understanding of the UPS system performance and quickly troubleshoot downtime events
- improved service level. Combined with a service contract, PowerREPORTER ensures an engineer can determine if site attendance is necessary and bring relevant spare parts
- Monthly status report detailing trends and alarms

An optional battery analysis and care service; PowerNSURE - measures battery voltage, temperature, impedance and prolongs battery service life through the application of battery charge equalization.

Functional description

PowerREPORTER communicates constantly with your UPS system to automatically detect any error or alarm messages. If it encounters an incident, PowerREPORTER will automatically transmit a status message, via email, to the Kohler Uninterruptible Power service centre providing details relating to the identified fault, a snapshot of the UPS performance parameters and a device identification string.

The email automatically alerts the service centre personnel who then remotely diagnose the UPS incident and liaise with the company's field service team so that they can reach the facility with appropriate spare parts within the contracted service agreement time-frame.

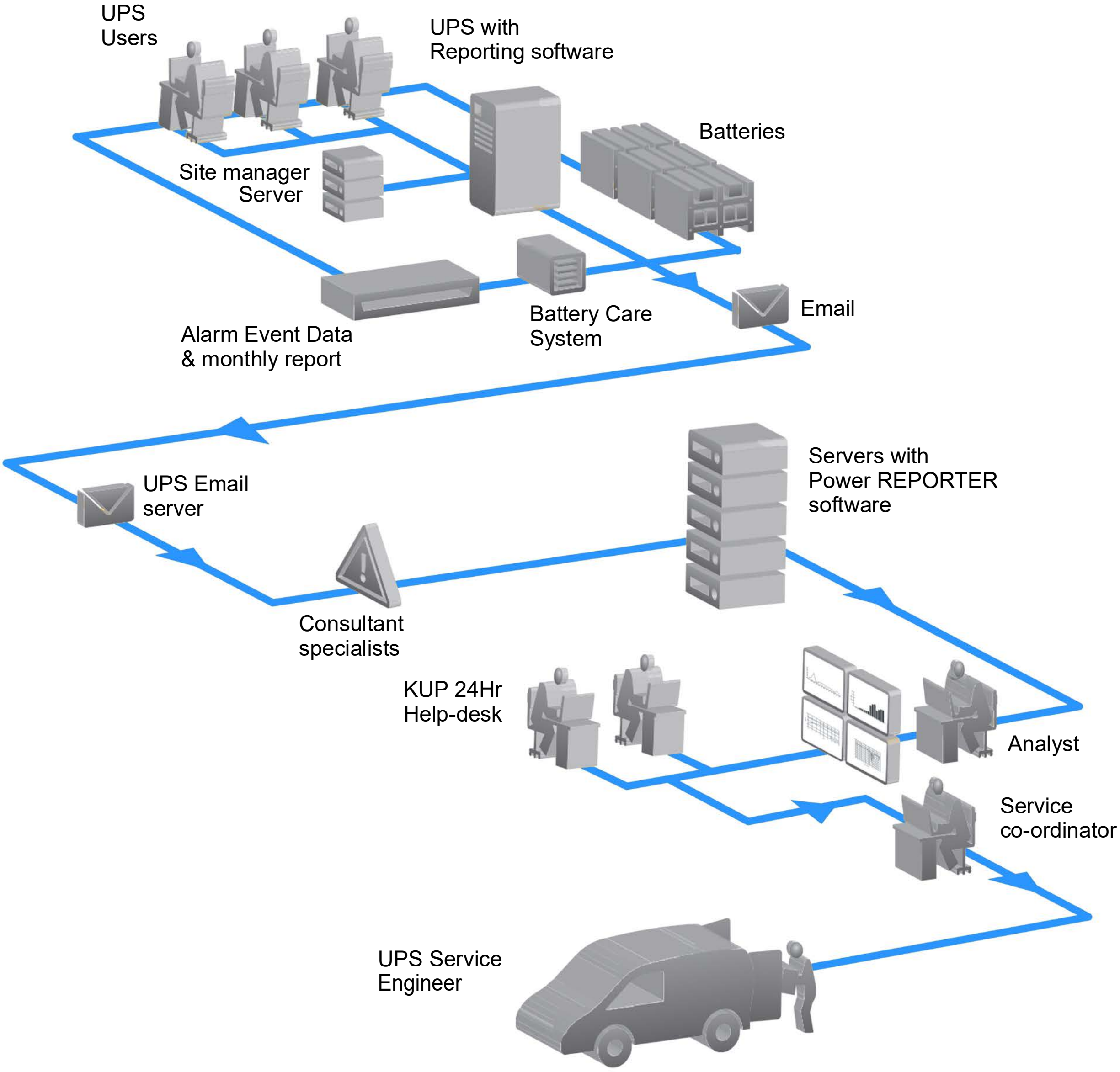
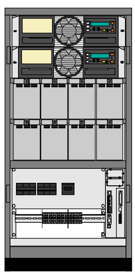
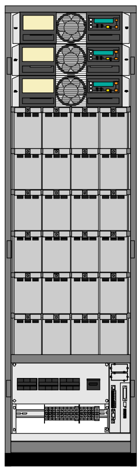
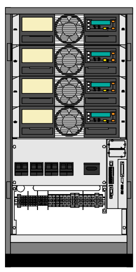
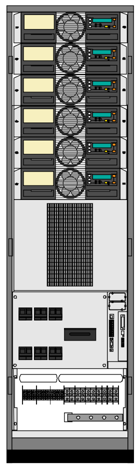
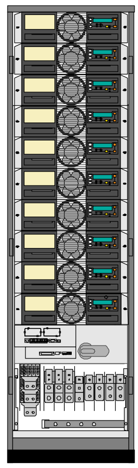


Figure 8.8 Remote monitoring communications chain

9 Specification

9.1 Mechanical characteristics – UPS Cabinet

		ST-40	ST-60	ST-80	ST-120	ST-200
						
Maximum configuration		2 module (10 or 20KW) + 80 x 7Ah batteries	3 modules (10 or 20KW) + 240 x 7Ah batteries	4 modules (10 or 20KW) NO batteries	6 modules (10 or 20KW) NO batteries	10 modules (10 or 20KW) NO batteries
Max. Power	kW	40	60	80	120	200
Dimensions (WxHxD)	mm	550x1135x775	550x1975x775	550x1135x775	550x1975x775	
Weight of empty cabinet	kg	92	173	82	133	174
Weight with modules and no batteries	kg	130 up to 136 (with 2 Modules)	229 up to 238 (with 3 Modules)	157 up to 169 (with 4 Modules)	245 up to 263 (with 6 Modules)	360 up to 389 (with 10 Modules)
Max number parallel cabinets		4	4	4	3	2
Max number of modules per system		8	12	16	18	20
Max system capacity (no redundancy)		160kW	240kW	320kW	360kW	400kW
Backfeed Protection		Optional				
Colour		Black (RAL 9005)				
Operator access		Front				
Cable entry		From the bottom				
Protection class		IP20				

9.2 UPS Module characteristics

Mechanical		10 kVA UPS module	20 kVA UPS module
Dimensions (WxHxD) (with front mounting wings)	mm	448 x 132 x 540 (3 HU) 488 x 132 x 540 (3 HU)	
Weight UPS module	kg	18.6	21.5
Colours		Front: RAL 9005	
Input characteristics			
Output rated power per module cosφ 0.8	kVA	10	20
Output rated power per module cosφ 1.0	KW	10	20
Nominal input voltage	VAC	3x380/220V+N, 3x400V/230V+N, 3x415/240V+N	
Input voltage tolerance (ref to 3x400/230V) for loads in %	VAC	(-20%/+15%) 3x320/184 V to 3x460/264 V for <100 % load (-26%/+15%) 3x296/170 V to 3x460/264 V for < 80 % load (-35%/+15%) 3x260/150 V to 3x460/264 V for < 60 % load	
Input frequency	Hz	35 – 70	
Input power factor		PF=0.99 @ 100% load	
Overvoltage Category		II (2500Vpk)	
Inrush current	A	max. In	
Input distortion THDI @ 100% load		< 4.5%	< 3.0
Max. input power with rated output power and charged battery per module (output cosφ = 1.0)	kW	10.5	21
Max. input current with rated output power and charged battery per module (output cosφ = 1.0)	A	15.2	30.4
Max. input power with rated output power and discharged battery per module (output cosφ = 1.0)	kW	11.5	23
Max. input current with rated output power and discharged battery per module (output cosφ = 1.0)	A	16.6	33.3
Output characteristics			
Output rated power per module cosφ 0.8	kVA	10	20
Output rated power per module cosφ 1.0	KW	10	20
Output current in @ cosφ 1.0 (400 V)	A	14.5	29
Output rated voltage	VAC	3x380/220V or 3x400/230V or 3x415/240V	
Output voltage stability	%	Static: < ±1% Dynamic (Step load 0%-100% or 100%-0%) < ±4%	
Output voltage distortion	%	With Linear Load< 1.5% With Non-linear Load (EN62040-3:2001)< 3%	
Output frequency	Hz	50 Hz or 60 Hz	
Output frequency tolerance	%	Synchronized with mains < ±2% (selectable for bypass operation) or < ±4% Free running+/- 0.1%	
Bypass operation		At Nominal Input voltage of 3x400 V ±15% or 196 V to 264 V ph-N	
Permissible unbalanced load	%	100% (All 3 phases regulated independently)	
Phase angle tolerance	Deg.	2.0 deg. (With 100% unbalanced load)	
Overload capability on inverter	%	125% load 10 min. 150% load 60 sec.	
Output short capability (RMS)	A	Inverter: 3.0 x In during 40 ms Bypass: 10 x In during 20 ms	Inverter: 2.25 x In during 40 ms Bypass: 10 x In during 20 ms
Crest factor		3:1	
Heat Dissipation With Non-linear Load		10 kVA UPS module	20 kVA UPS module

Mechanical		10 kVA UPS module	20 kVA UPS module
Heat dissipation with 100% non-linear load. Per module (EIN 62040-1-1:2003	W	550	1100
Heat dissipation with 100% non-linear load. Per module (EIN 62040-1-1:2003)	BTU/h	1887	3754
Airflow (25° - 30°C) with non-linear load. Per module (EIN 62040-1-1:2003)	m³/h	150	150
Dissipation at no load	W	120	150
Module efficiency			
Efficiency ac-ac up to (at Cosφ 1.0) (depending on % module power)	100% 75% 50% 25%	94.5% 95.0% 95.0% 94.0%	
Efficiency with linear load at cosφ = 0.8ind Efficiency non-linear load (EN 62040-1-1:2003)		Typically up to 1% higher of above values Typically up to 1% lower of above values	
ECO mode efficiency at 100% load	%	98%	
Environmental Characteristics			
Audible noise with 100% / 50% load	dBA	55 / 49*	57 / 49*
Operation temperature	°C	0 – 40	
Ambient temperature for batteries (recommended)	°C	20	
Storage temperature	°C	-25 - +70	
Battery storage time at ambient temperature		Max. 6 months	
Max. altitude (above sea level)	m	1000m (3300ft) without de-rating	
De-rating factor for use at altitudes above 1000m sea level according to (IEC 62040-3) (ALL MODULES) to a maximum of 3000m.		Height above sea level (m / ft) 1500 / 4850 2000 / 6600 2500 / 8250 3000 / 9900	De-Rating Factor for Power 0.95 0.91 0.86 0.82
Relative air-humidity		Max. 95% (non-condensing)	
Accessibility		Totally front accessibility for service and maintenance	
** These are approximate figures for one module only. The audible noise also depends on the characteristics of the host cabinet in which the UPS sub-rack is fitted*			

9.3 Battery Data

Battery characteristics		10 kVA UPS module	20 kVA UPS module
Battery type		Maintenance free VRLA or NiCd	
Permitted number of VRLA 12V battery blocks	No.	30-50 *	40-50 *
Permitted number of 1. NiCd cells	No.	300-500 *	400-500 *
Maximum battery charger current	A	4 A (6A on request)	
Floating voltage	VDC	VRLA: 2.26V/cell at 20C - NiCad: 1.4 V/cell	
End of Discharge Voltage	VDC	VRLA: 1.265V/cell at 20C - NiCad: 105 V/cell	
Battery charging curve		Ripple free: IU (DIN 41773)	
Temperature compensation		Standard (temp. sensor optional)	
Battery test		Automatic and periodically (adjustable)	
		** Depending of the effective load in kW used by the module*	

* Battery capacity usage	10KW UPS Module			20KW UPS Module									
Number of battery blocks	30	32	34-50	30	32	34	36	38	40	42	44	46	48-50
Max. Power in KW	8.6	9	10	12	13	14	14.8	15.6	16	17	18	19	20

9.4 Standards

Standards	
Safety	EN 62040-1-1, EN 60950-1
Electromagnetic Compatibility	EN 61000-6-4 Prod. Standard: EN 62040-2, EN 61000-6-2 Prod. Standard: EN 62040-2, EN 61000-4-2, EN 61000-4-3 – EN 61000-4-4 – EN 61000-4-5 – EN 61000-4-6
Emission class	C3
Immunity class	C3
Performance	IEC/EN62040-3
Product certification	UKCA CE
Degree of protection	IP 20

9.5 Communication Options

Communication options (All systems)	
Module control panel LCD display	1 x LCD display fitted to module control panel of each module
RJ45 Plug (Not used)	RJ45 Plug (for future options)
Customer interfaces: outputs DRY PORT X2	5 Voltage free contacts For remote signalling and automatic computer shutdown
Customer interfaces: inputs DRY PORT X1	1 x Remote Shut down [EMERGENCY OFF (Normally closed)] 2 x Programmable Customer's Inputs (1st default as GEN-ON (Normally open) (2nd free Programmable Customer's Inputs (Normally open)) 1 x Temp. Sensor for Battery Control 1 x 12 Vdc output (max. 200mA)
Serial ports RS232 on Sub-D9	1 x system frame For monitoring integration in network management and service
USB	1x For monitoring and software management
Slot for SNMP	SNMP card (optional) For monitoring and integration in network management

9.6 Multi-cabinet configuration

The PW 8000DPA ST may be paralleled to increase the power capacity up to 400kW in steps of 10 or 20kW. A maximum of 20 modules can be paralleled, into four UPS cabinets.

The following system configurations are available

PW8000DPA ST Series 2 system	ST-40	ST-60	ST-80	ST-120	ST-200
Number of modules per cabinet	2	3	4	6	10
Parallel cabinets per system	4	4	4	3	2
Maximum number of modules per system	8	12	16	18	20
Maximum total system capacity w/o redundancy	160kW	240kW	320kW	360kW	400kW