KOHLER®

UNINTERRUPTIBLE POWER

KOHLER *PW* 9250DPA

Modular three-phase uninterruptible power supply

(50-300 kVA/kW)
Parallelable up to 1500 kVA/kW

User Manual

Document Control

ISSUE	DATE	REVISION SUMMARY
TS_850_01	05/09/2023	Rebranding to KUP International Version

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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 concerning the correct operation of the system and the avoidance of 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 a qualified engineer trained by Kohler Uninterruptible Power.

WARNING: Do not attempt to install this UPS system until you have read and understood ALL the safety instructions and hazard warnings contained in Chapter 4 "Installation Planning" and Chapter 5 "Installation Procedure" of this manual.

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

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. 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 9250DPA (50-300 kW) 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 9250DPA (50-300 kW) 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:

- 2014/35/EC Low voltage directive
- 2004/30/EC Electromagnetic Compatibility (EMC) directive

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

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

	Product Standards	Standards
Safety	IEC/EN 62040-1	EC/EN 60950-1
Electromagnetic Compatibility (EMC)	IEC/EN 62040-2 Emission cat. C3 Immunity cat. C3	IEC/EN 61000-6-2 IEC/EN 61000-6-4 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
Performance standard	IEC/EN 62040-3	
Manufacture Quality	ISO 9001/EN 29001	IEC 62040-3 VDE 0558 Part 530

2 General Description

2.1 Introduction

Congratulations on your purchase of the PW 9250DPA (50-300 kW) UPS system.

Continuous power availability is essential in today's dynamic IT and process-reliant work environments. It is equally important that any installed power protection system is sufficiently resilient and adaptable to handle any changes in power requirements brought about by the introduction of new server technologies, migration and centralization.

Such demands are well met by the PW 9250DPA (50-300 kW) UPS system, which provides the foundation for continuous power availability of network-critical infrastructures both in enterprise data centres, where business continuity has paramount importance, and in process control environments, where manufacturing continuity is essential.

2.1.1 Reliability and quality standards

The PW 9250DPA (50-300 kW) UPS is a truly modular system that incorporates the latest technological developments in power engineering. Representing a completely new generation of high power three phase UPS systems, its advanced double conversion VFI (Voltage and Frequency Independent) topology responds fully to both the highest availability and environmentally friendly requirements compliant with IEC 62040-3 (VFI-SS-111) standards.

Kohler Uninterruptible Power specialises in the installation and maintenance of uninterruptible power systems; and this powerful UPS is just one example of our wide range of state-of-the-art power protection devices that can provide your critical equipment with a steady and reliable power supply for many years.

2.1.2 Key features

High reliability, upgrade-ability, low operating costs and excellent electrical performance are just some of the highlights afforded by this innovative UPS solution. Other key features include:

- *Decentralised Parallel Architecture (DPA)* – highest availability, with near zero down time
- *Truly modular design* – the PW 9250DPA (50-300 kW) is designed around 50 kW UPS modules
- *Hot-swappable modules* – enables system expansion and module replacement in a live system
- *Compact size, small foot print* – output up to 400 kW/m² (without battery) saving on expensive floor space
- *Flexible battery management* – advanced management of battery charging and preventive-failure diagnostics
- *High ac-ac efficiency (>97%) even with partial loads* – energy and operational cost savings (TCO)
- *Full power available from 0.9 lead to 0.7 lag* – no de-rating required with leading power factor loads
- *Very low input current distortion (THDi <2% @ 100% load)* – savings in generator-set power and installation costs
- *XtraVFI mode reduces the number of modules operating under light load conditions* – reduce energy costs (TCO)

2.2 PW 9250DPA (50-300 kW) model range

2.2.1 Single cabinet system (50-300 kW)

A PW9250DPA UPS cabinet can contain up to six, 50 kW UPS modules. The modules frame-mounted, supported on shelf runners located on the cabinet side-walls and plug into heavy-duty power sockets fitted to the back of the frame, making them easy to install or remove without having to disrupt any power cables. With all six UPS modules installed, the cabinet can be used as a 300 kW capacity system or 250 kW (N+1) redundant system. This is shown in Table 2.1:

Table 2.1 Standalone cabinet capacity rating

Number of UPS Modules	1	2	3	4	5	6
Capacity system (N+0)	50 kW	100 kW	150 kW	200 kW	250 kW	300 kW
Redundant system (N+1)	–	50 kW	100 kW	150 kW	200 kW	250 kW

Note: System redundancy is entirely load-dependant.
For example, a cabinet fitted with three modules (150 kW) can operate as a 'capacity' system for loads between 100 kW and 150 kW, and as an N+1 redundant system for loads that are less than 100 kW.

All the UPS modules installed in a PW9250DPA cabinet inherently operate as a parallel UPS system as the power outputs from each module are connected in parallel at the cabinet's output power terminals.

A parallel UPS system requires that:

- the modules are always frequency-synchronised to each other – and to the bypass mains (when present)
- the modules equally share the load current
- the modules are synchronised in terms of load transfer between the inverter and bypass, such they ALL transfer their output between inverter and bypass simultaneously when commanded

The electronic control systems of every PW9250DPA module installed in the cabinet communicate with each other over a parallel control bus to ensure that these required conditions are met.

For the purposes of frequency synchronisation, current sharing, voltage equalisation (etc.), one UPS module is observed as being the 'master' and the other modules as 'slaves'. However, if the 'master' module goes faulty the next module in the parallel chain (a former 'slave') will immediately take over the role of 'master.' The 'master/slave' hierarchy is determined by both the position of the modules within the cabinet and module configuration data set during commissioning.

The UPS batteries must be installed in a separate enclosure or battery rack and is usually positioned adjacent to the PW9250DPA cabinet. A range of battery cabinets can be provided by Kohler Uninterruptible Power on request.

2.2.2 Multi-cabinet system (300-1500 kW)

Up to five of the PW 9250DPA (50-300 kW) cabinets just described can be connected in parallel if a system capacity greater than 300 kW is required. For design reasons a maximum of thirty PW9250DPA modules can be connected in a multi-cabinet system, which can be achieved using five cabinets each populated with six modules.

As shown in Table 2.2, a fully populated five cabinet installation results in a maximum 1500 kW 'capacity' system.

Table 2.2 Multi-cabinet system capacity

No Cabinets	1	2	3	4	5
1 Module	50 kW	100 kW	150 kW	200 kW	250 kW
2 Modules	100 kW	200 kW	300 kW	400 kW	500 kW
3 Modules	150 kW	300 kW	450 kW	600 kW	750 kW
4 Modules	200 kW	400 kW	600 kW	800 kW	1000 kW
5 Modules	250 kW	500 kW	750 kW	1000 kW	1250 kW
6 Modules	300 kW	600 kW	900 kW	1200 kW	1500 kW

When two or more PW9250DPA cabinets are connected together to form a multi-cabinet system the parallel control bus described above is extended between the cabinets to enable the modules fitted in ALL cabinets to communicate with each other. The inter-cabinet 'parallel control bus' is implemented by connecting a multi-way control cable between the cabinets in a ring fashion.

2.2.3 System expansion

As just described, the capacity of a PW9250DPA cabinet can range from 50 kW to 300 kW depending on the number of installed UPS modules. If a cabinet is not fully populated, the pluggable nature of the UPS modules makes it easy to install additional modules, to increase the system's capacity, without disrupting the load supply. This 'hot-swappable' design also allows a module to be exchanged while the system remains fully operational (redundancy permitting).

If an additional cabinet is required to expand the capacity of an existing PW9250DPA system, the load will have to be shut down or transferred to an external 'maintenance bypass' supply to allow the power cables to be connected to the newly added cabinet. Therefore, when planning a parallel-cabinet system we recommend that a sufficient number of cabinets are included in the initial system design to cater for any anticipated load expansion. This then allows additional UPS modules to be inserted into the free cabinet 'slots' as-and-when required without having to disrupt the load supply.

For example: consider a PW9250DPA (N+1) redundant system where the initial load is around 300 kW but likely to increase in stages to 800 kW.

Initially, the 300 kW (N+1) system will require a minimum of two PW9250DPA cabinets housing seven UPS modules and will grow to three cabinets housing 17 modules as the load approaches its predicted 800 kW.

In this case, rather than initially installing a two cabinet system and adding a third cabinet at a later stage, it is beneficial to install a three cabinet system at the outset with the UPS modules distributed between them and then add further modules incrementally to match the staged increases in load demand.

2.3 PW9250DPA Cabinet design and construction

Figure 2.1 Shows a PW9250DPA cabinet with bottom cable entry and fully populated with six 50 kVA UPS modules. The weight of each UPS module is approximately 66 kg. and a fully populated cabinet weighs approximately 667 kg.

Figure 2.1 PW9250DPA Cabinet

WARNING: ALWAYS use two people when lifting a UPS module.

The dimensions of a basic cabinet is 1978 x 795 x 943 mm (h x w x d), although the height of the unit is increased to 2148 mm if the optional 'Elevation Kit' is fitted to raise the cabinet off a solid floor to facilitate easier bottom entry cabling.

Internal access is necessary to start/shutdown the cabinet and turn the individual UPS modules OFF/ON; however, a key-lockable door is fitted to the front of the cabinet to control internal access.

WARNING: Access should be granted to trained operators only.

The door-mounted system control panel can be used for day-to-day management of the system with regards to system monitoring, load transfer between the inverter(s) and bypass supply, and alarms/events handling. Once again, for reasons of security certain system control panel operations can be password protected to provide controlled access.

Although the UPS modules cannot be turned OFF/ON without gaining access to the cabinet or the password-protected area of the system control panel, the large mesh on the cabinet door makes the individual module control panels observable, as can be seen in Figure 2.1, making it easy to identify individual module alarm events or abnormal operation.

Cooling air is drawn into the cabinet through the door mesh and extracted through the back of the unit with the aid of rear-mounted extractor fans. To ensure adequate cooling air flow the cabinet must be installed with a minimum rear clearance of 300 mm, in a location where the air entering the cabinet is clean and unlikely to be restricted.

2.3.1 Component identification

Figure 2.2 shows the location of the major components fitted to the PW9250DPA cabinet for both top and bottom cable entry models.

50 kW UPS modules

The UPS modules are rack-mounted and plug into heavy duty connectors fitted to the back of the cabinet. They are secured in place by two bolts that are fitted through mounting flanges on the left and right of the module front panel. Handles are fitted to the front of the module to assist in inserting and removing the assembly.

The modules are assigned an identification number 1 to 6, as shown.

System control panel

The system control panel displays the operational performance and status of every module connected to the system. Only one system control panel is fitted to a multi-cabinet system as it can show information for an individual module in any cabinet's, or for the system as a whole.

Maintenance bypass switch (Q1)

The maintenance bypass switch provides a means of connecting a 'wrap-around' mains supply to enable the UPS cabinet to be totally powered down if required.

Note: In a multi-cabinet installation the maintenance bypass function is implemented using an external maintenance bypass facility which contains a 'wrap-around' mains supply for the entire UPS system.

Output isolation switch (Q2)

The output isolation switch connects the cabinet output to the critical load. It is fitted to every cabinet in a multi-cabinet system.

DC (battery) breakers

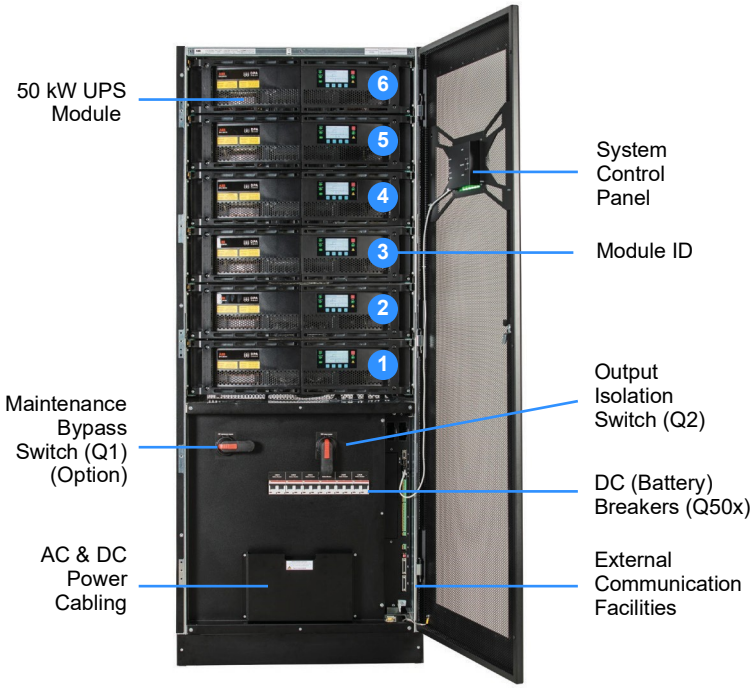
Six DC (battery) breakers are fitted, one for each UPS module. They can be wired to connect each module to an individual battery string or a common (shared) battery, depending on the system design.

External communication facilities

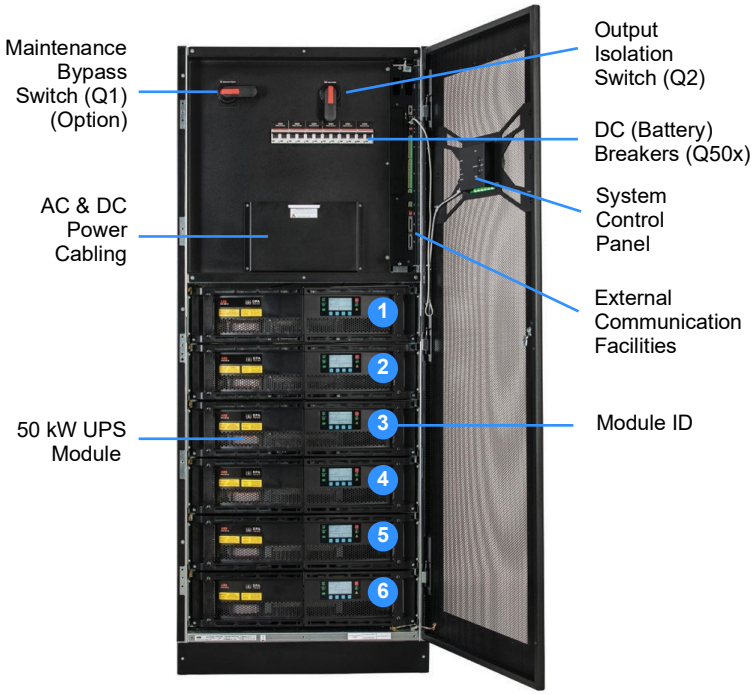
The PW9250DPA Features several communication ports, as described on page 18.

AC & DC Power cabling

All AC and DC power cables are bolted to busbars that can be accessed by removing the safety cover shown.



PW9250DPA With bottom cable entry



PW9250DPA With top cable entry

Figure 2.2 PW9250DPA Cabinet construction

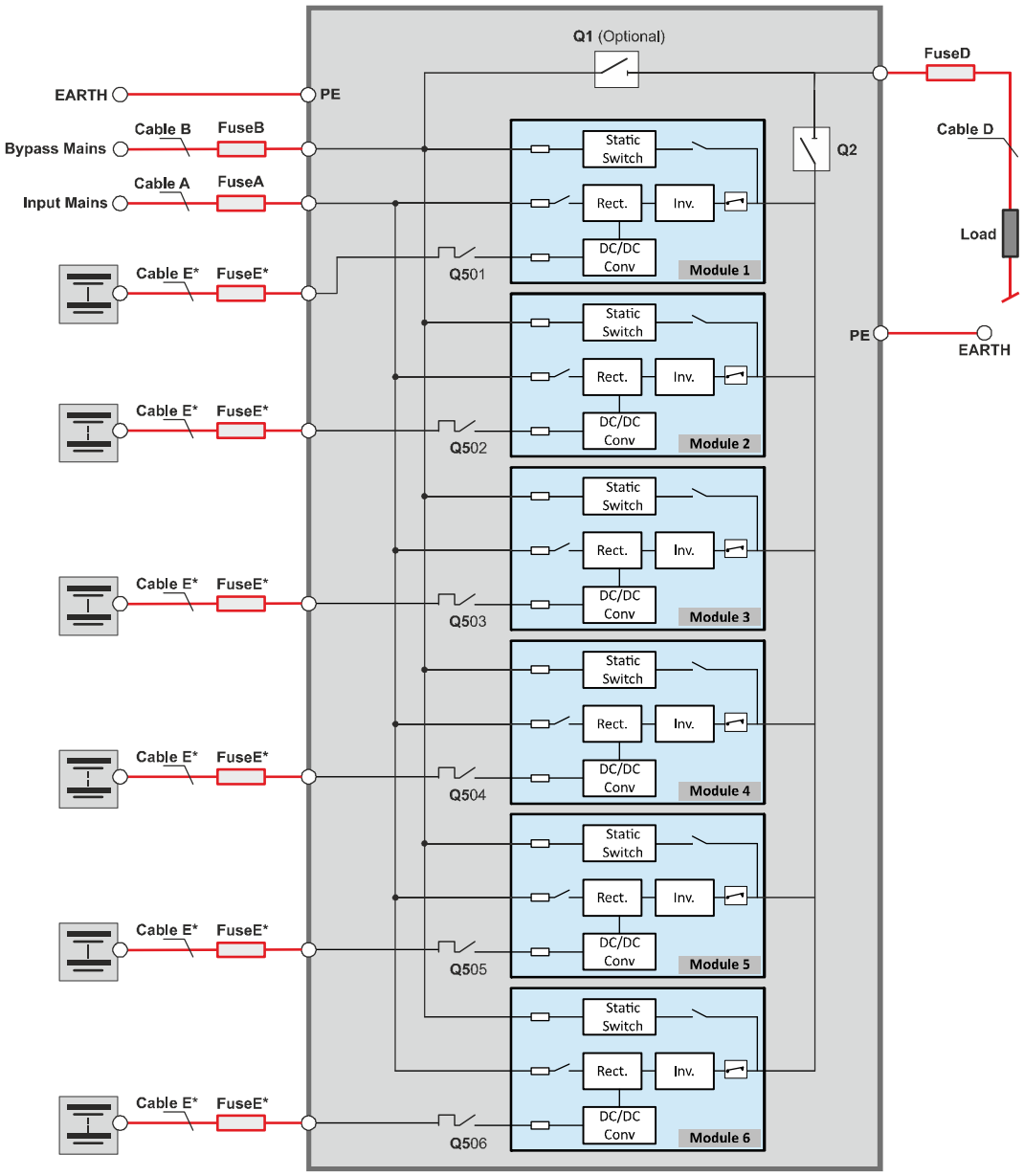


Figure 2.3 PW9250DPA Cabinet with dual-input supply and separate battery configuration

Figure 2.3 shows a fully populated PW9250DPA cabinet containing six plug-in UPS modules connected to a dual input supply – i.e. a separate three phase supply is shown connected to the cabinet's input mains and bypass mains terminals. It also shows an individual battery connected to each UPS module. This is just one of several possible input and battery configurations that can be used, see "Fuse & cable sizing," on page 41 for details.

Notice that although each UPS module contains internal fuses in its input mains and bypass mains supply lines, there are no mains supply isolation devices fitted within the cabinet. It is therefore essential that the cabinet's input mains and bypass mains supplies are connected using suitable external isolation and protective devices.

2.4 Functional description of operation

This section contains:

- a functional description of the PW9250DPA at block-diagram level *(see paragraph 2.4.1)*
- a description of the UPS module operating modes *(see paragraph 2.4.2)*
- a description of the UPS system operational modes – 'On-line' versus 'Off-line' operation *(see paragraph 2.4.3)*

2.4.1 PW 9250DPA (50-300 kW) module block diagram

Figure 2.4 illustrates an internal block diagram of a single UPS module inserted into the PW9250DPA UPS cabinet rack. As shown, the module plugs into a heavy duty connector which carries the input mains, bypass mains, battery and output supplies.

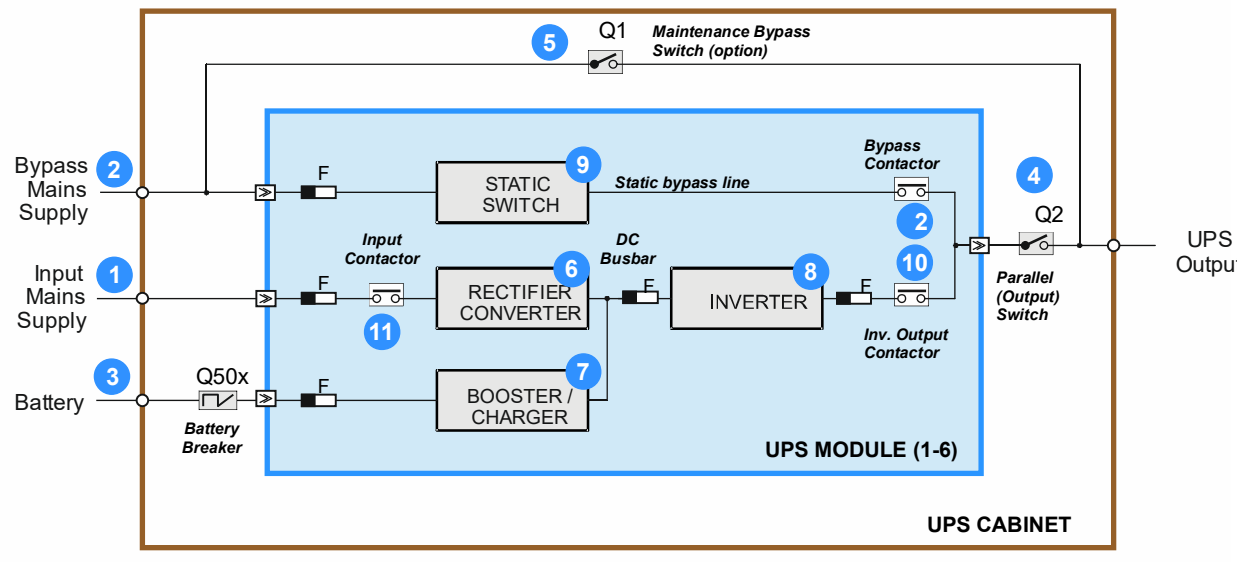


Figure 2.4 PW 9250DPA (50-300 kW) module

Input power connections (1)/(2)

The UPS input mains and bypass mains both require a 4-wire (3-phase + N) mains feed. Although the two inputs are shown connected to separate feeds in Figure 2.4, the input mains terminals (1) and bypass mains terminals (2) are usually linked at the input busbars in a standard installation so only one mains feed is required – this is generally referred to as a 'single input' mains configuration in this manual, as opposed to a 'dual input' configuration where separate feeds are used.

The mains supplies are unswitched within the UPS cabinet and are connected directly to each installed UPS module.

CAUTION: *As the mains power supplies are unswitched within the UPS cabinet, the module will be live at all times unless the input/bypass supply is isolated at the external mains switchboard.*

Within the UPS module, the bypass mains supply is connected to the static switch power block, and the input mains supply is connected to the rectifier power block via an input contactor (11).

Battery connections (3)

Each UPS module is connected to a battery via a dedicated breaker (Q50x). Two major types of battery installations are used, known as 'separate' or 'common' battery configurations. A 'separate' battery configuration provides a separate battery system for each UPS module, whereas for a 'common' battery configuration a single battery system is connected to all the modules. Note that in each type of installation the battery system will comprise several battery strings connected in parallel to provide the necessary battery capacity.

Output switch (4)

The 'parallel isolator' switch (Q2) is located on the cabinet's power panel and thereby external to the UPS module(s). It is connected between the output of the UPS module(s) and the cabinet's output terminals and can be used to disconnect the modules from the load – for example when operating on maintenance bypass.

Maintenance bypass (5)

The maintenance bypass switch (Q1) is external to the UPS module(s), located on the cabinet's power panel. This switch connects the UPS cabinet output (load) terminals directly to the bypass mains supply terminals and can be used to connect the load to the (unprotected) bypass supply if the UPS modules have to be shut down for service repair etc. If a maintenance bypass is required for a multi-cabinet UPS system an external maintenance bypass facility must be installed – see "External maintenance bypass switch," on page 39.

Rectifier Converter (6)

The rectifier converts the incoming mains supply into a regulated DC busbar which provides the operating power for the inverter and battery booster/charger. Its employs a specialised switched-mode dc booster technology which results in an input power factor of almost unity over its entire operating range (pf=0.99 at 100% linear load). The rectifier can provide 100% of the inverter power demand over an input mains voltage range of -20% to +15%. This means that battery power is not called upon even during substantial power dips (brown outs), which in turn maximises the battery life and availability.

Battery booster/charger (7)

This block has bi-directional functions. When the input mains supply is available, and the rectifier is turned on, it acts as a multi-stage battery charger which uses an intelligent charging profile to optimise the battery life and ensure the battery recharges quickly following a deep discharge cycle.

If the input mains supply fails, or the rectifier is unable to provide a sufficient output to sustain the prevailing inverter load, the battery is called upon to provide the inverter's DC operating power source, and under these circumstances the booster/charger block changes over to its 'boost' mode to maintain a regulated dc busbar at a voltage suitable for the inverter operation as the battery discharges.

Inverter (8)

The inverter converts the regulated dc busbar produced by the rectifier (or the battery via the booster/charger) into a three phase ac output voltage that is suitable to power the load. In addition to providing output voltage regulation, the inverter control system also provides various levels of overload protection, frequency regulation and synchronisation, load sharing, and output voltage error detection.

Static switch (9)

The static switch provides a means of connecting the UPS output to the bypass mains supply and is used to maintain the load supply when the inverter is unavailable, or overloaded. The electronic transfer control mechanism ensures the operation of the static switch and inverter are mutually exclusive – i.e. when transferring the load to 'bypass' the inverter is switched OFF at the same time as the static switch is turned ON, and vice-versa.

Note: A brief load break will occur if transferring from bypass to inverter following a bypass supply failure. (See 'Off Line Mode' in paragraph 2.4.3).

Inverter/bypass output contactors (10)(12)

Contactors (10)(12) isolate the inverter/static switch from the UPS module output following certain overload or fault conditions. The inverter contactor also opens when the UPS is operating on maintenance bypass to prevent back-feeding.

Input contactor (11)

Contactor (11) is driven by the UPS module's control logic and used to isolate the UPS input mains supply to the rectifier under abnormal supply conditions or in response to certain internal faults.

Internal fuses

The UPS module contains several internal fuses, as shown. These fuses are not accessible to the operator and in the event of a fuse failure the module must be removed and repaired by an authorised service agent.

2.4.2 UPS Module operating modes

Simplified block diagrams are used in this section to illustrate the various UPS module operating modes. Note that the module internal fuses and contactors have been omitted for reason of clarity.

Load on inverter

This is the only operating mode that will provide the load with continuously processed and backed-up power – and in the vast majority of installations can be considered as being the 'normal' operating mode.

In this mode, the input mains supply is converted to dc by the rectifier converter and produces a regulated dc busbar which is connected to the inverter and battery booster/charger.

The inverter converts the dc power available from the dc busbar into a three phase ac power source which is then connected to the load. The inverter frequency will be synchronised to the bypass supply provided the bypass frequency remains within preset limits, but if these limits are exceeded, or if the bypass supply fails altogether, the inverter frequency will be controlled by a free-running oscillator which produces a constant 50/60 Hz UPS output.

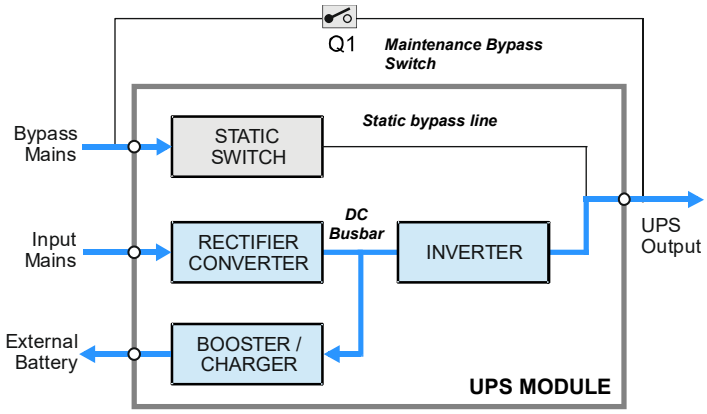


Figure 2.5 Load on inverter

The charger section of the battery booster/charger converts dc busbar voltage into a regulated voltage suitable for charging the battery.

Load on battery

If the mains supply fails, the rectifier will shut down and the battery will provide the power source for the dc busbar via the booster section of the battery booster/charger. The booster maintains a regulated voltage on the dc busbar as the battery discharges in order to provide the inverter with a stable input power source.

In the case of a dual feed input – if the bypass supply is still live when the input mains supply fails, the inverter frequency will remain synchronised to the bypass mains provided it is within its preset limits.

In the case of a single feed input – the bypass supply will fail at the same time as the input mains supply, in which case the inverter frequency control will revert to a free-running oscillator and it will provide a constant 50/60 Hz UPS output.

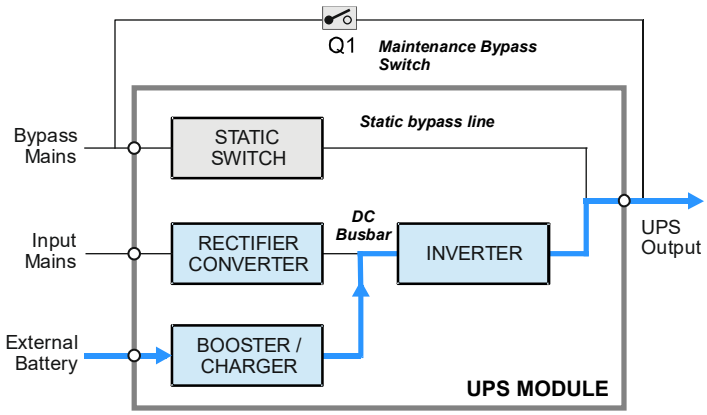


Figure 2.6 Load on battery

Battery discharge operation

When the battery is placed on load, and begins to discharge, the module control panel BATTERY LED flashes green accompanied by an audible alarm. The LED will continue flashing green until the battery discharges to a preset low voltage threshold, at which point it changes to yellow. The remaining battery charge (%) and autonomy time (m) is shown on the module control panel LCD screen to allow the operator to gauge the appropriate time to shut down the load in an orderly manner, if necessary, before the battery becomes fully discharged and the UPS drops its output supply. Various optional software-controlled shutdown applications are available to automate the load shut down process.

The initial 'battery' audible alarm can be cancelled but it will reappear when the battery voltage falls to its low battery threshold, whereupon the audible alarm will sound once again to warn the operator that the battery is nearing its end-of-discharge.

Load on bypass

In the 'load on bypass' mode the static switch will connect the load to the unprotected static bypass line.

This mode can be selected manually (see 'ECO Mode' below) or entered as the result of a UPS fault (or overload) condition that transfers the load from inverter to bypass because the inverter is unable to support it.

Depending on the reason for entering the 'load on bypass' mode, the rectifier and charger sections might turn off entirely or remain operational and continue to provide battery charging (as shown in this illustration). Similarly, the inverter may be operating on stand-by (see 'ECO Mode' below), manually turned OFF or shut down due to a fault.

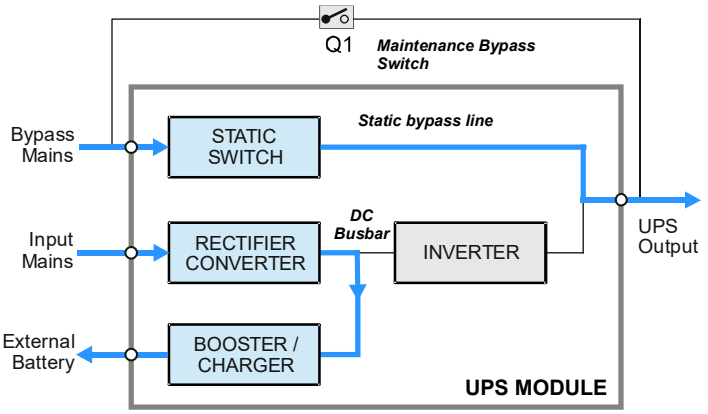


Figure 2.7 Load on bypass

Maintenance bypass (standalone cabinet)

In a standalone cabinet installation the maintenance bypass switch (Q1) can be closed to connect the cabinet output terminals directly to the bypass mains supply. This is normally used as a temporary measure to provide the load with unprotected power if it is necessary to shut down the UPS modules for repair/replacement.

When operating via the maintenance bypass the cabinet's bypass supply must be kept available so it is not possible to shut down the cabinet completely, and the cabinet will therefore still contain live terminals.

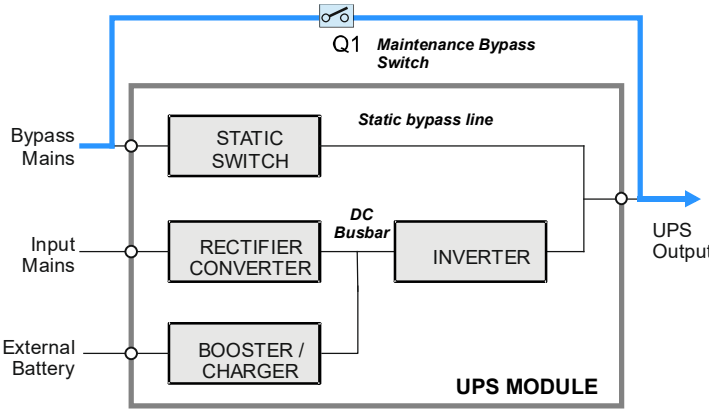


Figure 2.8 Module OFF (Load on maintenance bypass)

Maintenance bypass (multi-cabinets)

Q1 is not fitted to cabinets that form part of a multi-cabinet system. In this instance, an external maintenance bypass facility is installed that wraps-around the complete system *(see page 39)*.

2.4.3 UPS System operating modes

Section 2.4.2 described the operating modes for an individual UPS module: but UPS systems are also categorised according to the way in which they operate at a 'system' level, and are typically described as being either an 'on-line', or 'off-line' ('line interactive') system. A PW9250DPA system can be operated in either of these categories.

ON-LINE UPS system

An 'on-line' UPS system provides the highest degree of load protection and we always recommended this mode of operation if the critical load cannot tolerate even a very brief supply interruption.

When the PW9250DPA is used as an 'on-line' system, the UPS modules normally operate in the 'on inverter' mode (Figure 2.5), and will switch to the 'on battery' mode if the input mains supply fails (Figure 2.6). The changeover to battery operation is totally transparent at the UPS output and an audible/visual alarm warns the operator that the battery is discharging in order to undertake any necessary intervention to safeguard the load integrity.

The UPS system will continue to provide its rated output until the battery discharges to a low cut-off point at which time it will attempt to switch to its 'on bypass' mode (Figure 2.7), but if the bypass mains supply is unavailable the UPS will shut down in a controlled manner and turn off its output (load) supply.

Standby generator

Some UPS installations include a standby generator which starts automatically following a mains outage to provide the UPS with an alternative input power source. Where such an alternative input supply is made available the batteries will only discharge for a short period following an input mains failure before the generator comes on line. In practice, operating on generator not only avoids the UPS eventually shutting down due to a fully discharged battery but also helps maximise the battery life by reducing the battery discharge time.

Inverter fault

If a UPS module experiences an internal fault during 'on-inverter' operation, it will turn off its inverter and open its output contactor. The system response will depend on whether or not system is operating with redundancy. That is, if the number of remaining 'healthy' modules is sufficient to power the load demand then the system will continue operating in the 'on-inverter' mode, with the failed module having no affect on the UPS system output. However, if the load demand exceeds the available capacity then the system will transfer the load to the static bypass supply ('on-bypass').

Inverter overload

The inverter is designed to sustain an overload based on an inverse load/time characteristic. If the designed overload parameters are exceeded the load is transferred to the static bypass whereby the additional power available from the bypass supply will usually clear the protective device(s) in the overloaded circuit. If the overload condition clears while operating 'on bypass' the load will re-transfer back to the inverter and the UPS return to its normal 'on-inverter' operation. If the overload persists while operating 'on-bypass' it will ultimately rupture the bypass mains supply fuses.

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

When the PW9250DPA is used as an 'off-line' system, the UPS modules are normally operated in their 'on bypass' mode (Figure 2.7); however, the rectifier and battery charger are still powered up in each module to maintain battery charging, and the inverter is turned on and operating on standby.

If the bypass supply fails, the inverter is immediately brought on line and the load transferred from the static bypass to the inverter within 3 to 5 milliseconds. If the bypass mains and input mains are connected to separate power sources and the input mains supply is still live when the load is transferred, the modules will operate in their 'on inverter' mode (Figure 2.5). However, if the input/bypass mains supplies are connected to a common feed, or the input mains is unavailable in a dual feed system, the modules will immediately revert to the 'on battery' mode (Figure 2.6).

When the bypass supply returns to normal, the load will be re-transferred from the inverter to the static bypass line automatically without a load break and the inverter will return to standby.

***CAUTION:** if the bypass supply is unavailable when the system is operating 'on-inverter,' the bypass is unable to take over the load supply if the inverter fails, or assist the inverter to handle an output overload. It is therefore important that the cause of any load transfer from bypass to inverter is quickly rectified.*

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

The ‘off-line’ mode is sometimes referred to as the “ECO” (economy) operating mode as it is slightly more energy efficient than the ‘on-line’ mode due to the reduced rectifier and inverter losses during normal system operation. However, this mode is recommended only if the connected load equipment can tolerate a power interruption of up to 3~5 ms during the load transfer period.

2.4.4 Xtra VFI operation

The UPS system efficiency will deteriorate if the connected load is low compared to the system’s rated capacity. This is due mainly to an increase in relative power losses and is especially noticeable when the load falls to less than about 25%.

‘Xtra VFI’ is an innovative feature that adapts the number of active modules according to the applied percentage load and can be applied to an on-line system to improve its operating efficiency. ‘Xtra VFI’ continuously assesses the number of UPS modules required to supply the load and:

- as the load reduces, Xtra VFI places any surplus modules in a standby mode, by turning off the module(s) inverter
- as the load increases, Xtra VFI brings the required number of standby modules back on line, by turning on their inverters

Xtra VFI not only helps optimise the system efficiency, as illustrated in Figure 2.9, but also reduces wear and tear on the standby modules.

Note: The selected standby modules are rotated on a weekly basis so that all modules are aged equally.

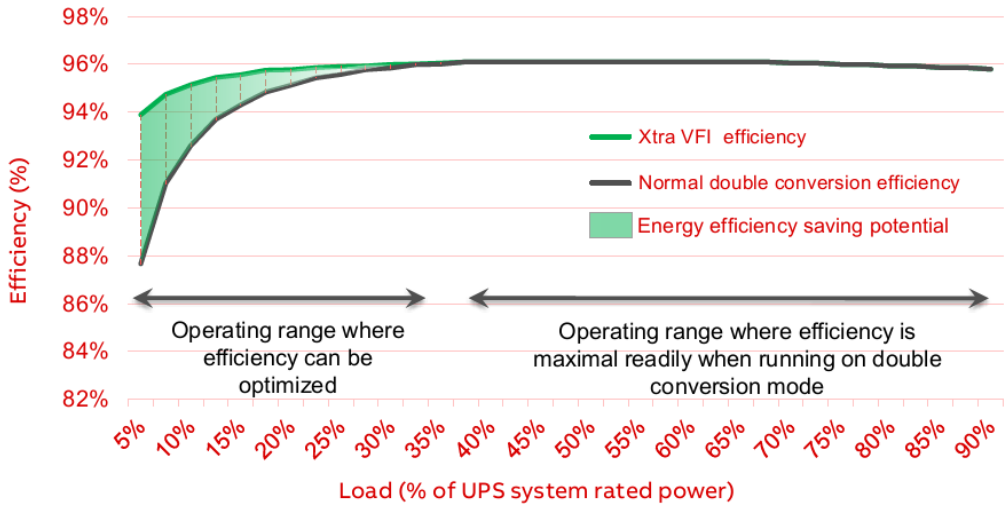


Figure 2.9 System efficiency

Implementation

The ‘Xtra VFI’ feature is built in to all PW9250DPA UPS modules but its use is optional and the Xtra VFI function can be turned OFF/ON from the system control panel as required by the operator; however, the ‘Xtra VFI’ operating parameters are configured via the system control panel ‘service set-up’ menu which is password protected and thereby only accessible to an authorised user or a Kohler Uninterruptible Power trained engineer.

If the optional Xtra VFI is required it is normally configured as part of the UPS commissioning procedure and, once set, it will not require further attention unless there is a significant change in load usage. When configuring the ‘Xtra VFI’ operation, the commissioning engineer will enter parameters concerning the system redundancy (i.e. the number of redundant modules) and the anticipated highest step load (HSL) that is likely to be encountered during normal system operation.

Using these two set parameters, ‘Xtra VFI’ can dynamically calculate the number of active modules required to power the prevailing load demand.

Key Point: The highest load step (HLS) equates to the highest load increase that can be expected to be applied to the system in less than 50 ms which the UPS is expected to handle without any compromise. When the load step is applied, 'Xtra VFI' will turn on a standby module(s) within 50 ms to increasing the number of active modules to support the additional load.

Examples

Consider a 6x 50 kW module system (300 kW capacity):

Conditions	# Active modules	Comments
Load = 100 kW Redundancy = 1 module HSL = 10 kW	3 (150 kW capacity)	3 modules can be used for 100 kW (N+1). The redundant module provides a sufficient headroom to handle the 10 kW HSL when required.
Load = 100 kW Redundancy = 1 module HSL = 60 kW	4 (200 kW capacity)	3 modules can be used for 100 kW (N+1). But in this example the redundant module does not provide a sufficient headroom to handle the 60 kW HSL, therefore two additional active modules are needed.

Note that in the event of an input mains failure or a fault on any module in the system, whether active or on standby, 'Xtra VFI' will immediately activate ALL modules until the input supply returns or the alarms on the faulty module are accepted.

An Xtra VFI status bar screen on the system control panel indicates:

- Load: the existing load demand
- Active: the free capacity immediately available from the active modules due to the programmed HLS or redundancy configuration
- Standby: the power available from those modules currently running on standby that can be called upon when needed

Figure 2.10 Xtra VFI Status bar screen

The operator can also access an Xtra VFI active module screen on the system control panel *(see Figure 2.11)*. This screen identifies the currently active modules (green) and standby modules (blue).

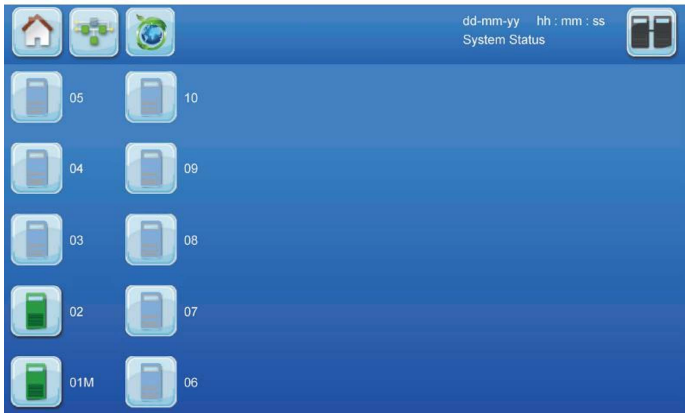


Figure 2.11 Xtra VFI Active modules screen

2.5 Module Control Panel

A module control panel is fitted to the front of each UPS module. It allows the module to be individually controlled and monitored, and comprises an ON/OFF button, LED status indicators, LCD display and control/navigation buttons.

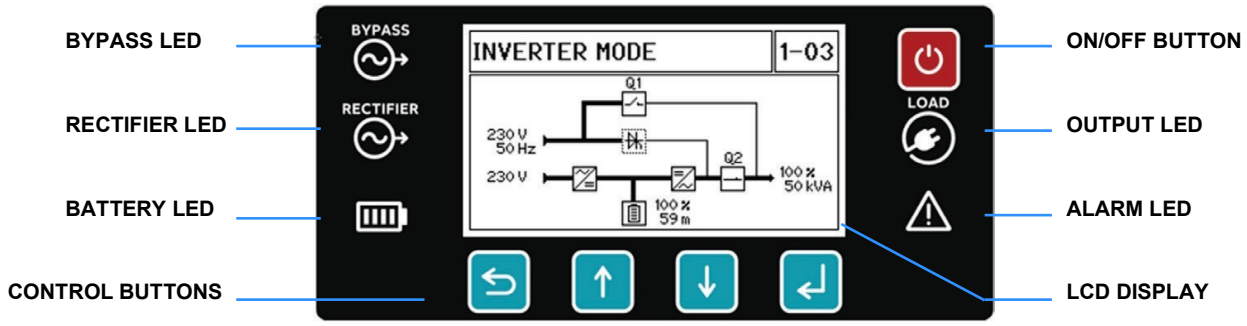


Figure 2.12 Module Control Panel

2.5.1 ON/OFF button

The UPS module can be started and stopped by pressing the ON/OFF button:

Function	Action
Start-up	Press the ON/OFF button – the UPS module will start
Shut-down	Press the ON/OFF button for 3 seconds – the UPS module will shut down after confirmation by the operator

2.5.2 LED indicators

The LEDs indicators on the left and right side of the module control panel change colour to indicate the status of key parameters. They remain active when the LCD display is in its screensaver mode:.

LED	COLOUR	INTERPRETATION
BYPASS LED	GREEN	Bypass mains is available with valid voltage/frequency
	RED	Bypass mains is unavailable or its voltage/frequency is invalid
RECTIFIER LED	GREEN	Rectifier (input) mains is available with valid voltage/frequency
	RED	Rectifier (input) mains is unavailable or its voltage/frequency is invalid
BATTERY LED	GREEN	Steady – Battery is connected and charged
		Flashing – Battery is discharging (on-battery mode, or during battery test)
	RED	Steady – Battery Failure, high voltage/temperature, failed battery test
		Flashing – battery is not detected, or disconnected
	YELLOW	Battery voltage is low, battery is discharged
OUTPUT LED	GREEN	UPS module output is being supplied by the inverter
	YELLOW	UPS module output is being supplied by the bypass
	BLUE	UPS module is in standby mode (XTRA-VFI status)
	RED	UPS module output voltage/frequency is out of tolerance
	OFF	UPS module is OFF or the output isolator Q2 is open
ALARM LED	OFF	No active event/alarms pending
	YELLOW	Events pending
	RED	Common alarm

2.5.3 LCD Display

During normal operation the module control panel LCD display appears as shown in Figure 2.13. The screen enters a screensaver mode and turns OFF after 5 minutes of control button inactivity. Screensaver mode is deactivated when any control button is pressed or an alarm is activated.

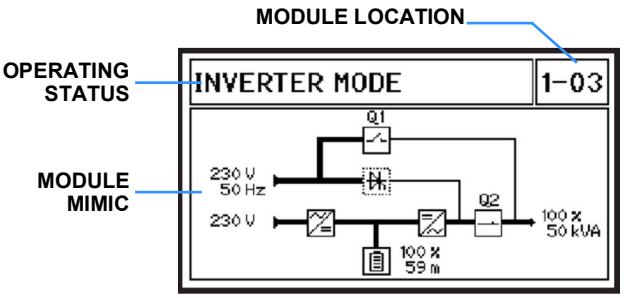


Figure 2.13 Module control panel LCD

Operating status

Indicates the UPS module current operating status:

- MODULE OFF
- INVERTER MODE
- BATTERY MODE
- MODULE DISCONNECTED
- BYPASS MODE
- STAND-BY MODE

Module location

This number indicates the position of the UPS module within the overall UPS system and is allocated by the service engineer when the UPS system is commissioned or a new UPS module is installed. The first number refers to the cabinet number (1-5) and the second number indicates the position of the module within the cabinet – e.g. the example shown in Figure 2.13 refers cabinet 1 module 3.

Note that the modules are numbered from bottom to top in a bottom cable entry cabinet and from top to bottom in a top cable entry cabinet, as shown in Figure 2.2.

All the module slots in a multi-cabinet system are incremented across the cabinets – i.e. the module slots in cabinet two are allocated 07-12, cabinet three are 13-18.... and so on, to the maximum 5-30.
The module location number is used by the fault detection and event history functions to identify a particular module.

Module mimic

The LCD module mimic shows the active power path through the UPS. It also provides:

- metering of the input and bypass mains voltage and frequency
- metering of the output load (percentage and kVA)
- an indication of % battery charge and estimated autonomy time for the applied load. Note that the number of illuminated bars in the LCD battery icon also provides a quick indication of the state of battery charge.

2.5.4 Control Buttons

The control buttons are used to access and navigate the module control and monitoring menu system shown in Figure 2.15:

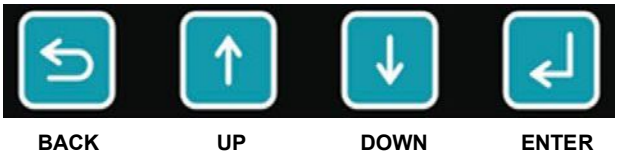


Figure 2.14 Module control panel buttons

BACK button –

- Scroll back to top-level menu
- Cancel any setting back to the previous value
- Cancel the audible alarm

UP button –

- Scroll up the sub-menu or setting/parameter
- Increment the value or setting of a parameter

DOWN button

- Scroll down the sub-menu or setting/parameter
- Decrement the value or setting of a parameter

ENTER button

- Enter a selected sub-menu
- Confirm the value of a setting or selected parameter

2.5.5 Module control panel menu configuration

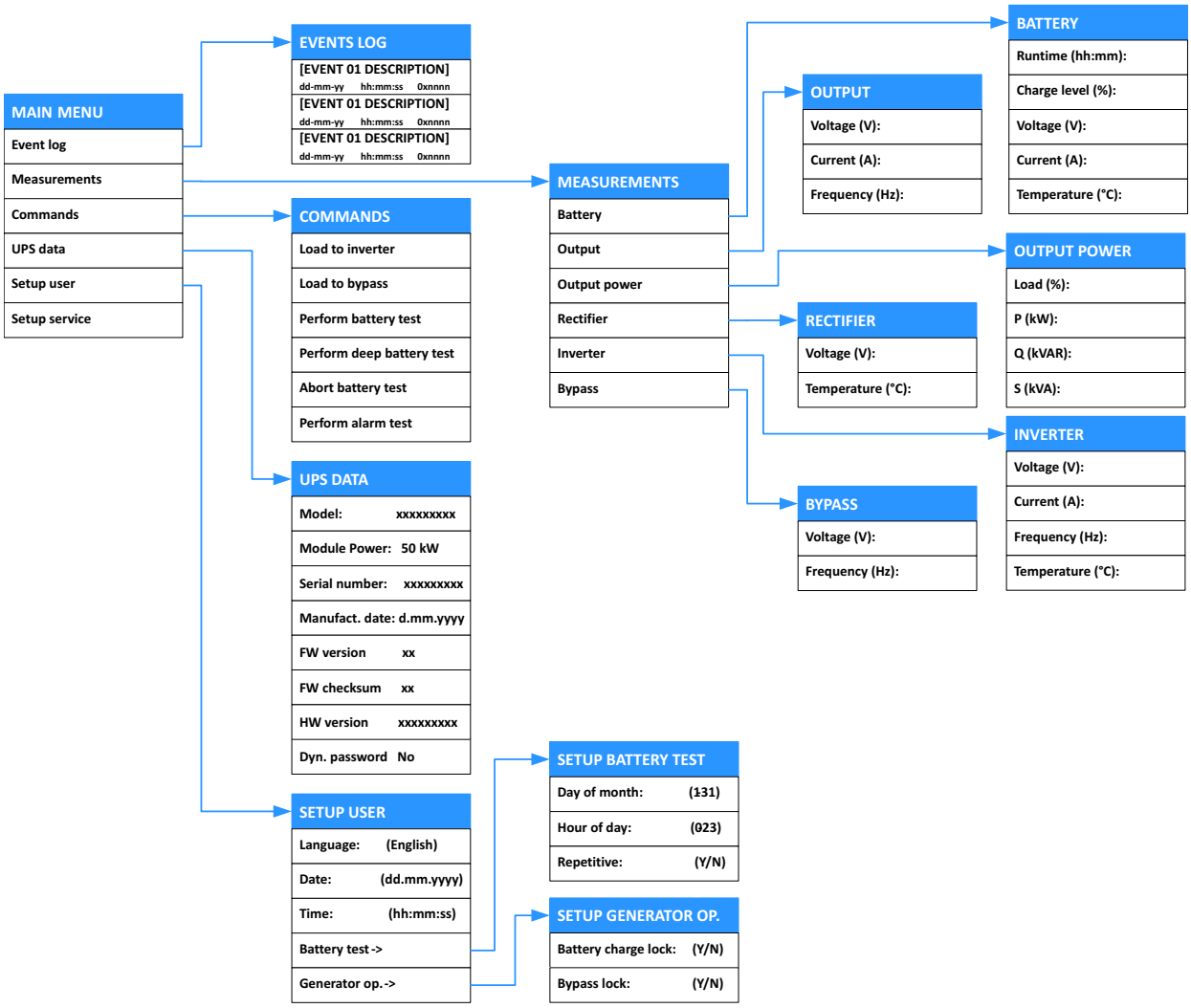


Figure 2.15 Module control panel menus

MAIN MENU

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

EVENTS LOG – The event log stores the last 99 UPS events in date/time stamp order. These include both 'fault' events, such as [Overload], and 'operational' events such as [Load to bypass].

MEASUREMENTS – This sub menu provides metering access of the monitored output, rectifier, bypass, battery and inverter parameters.

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] commands which are used to transfer the load between inverter and bypass during the UPS start-up and shut down procedures.

– [Perform battery test] stops the battery charger and monitors the off-load battery voltage for 1 minute then transfers the load to battery for a further minute.

– [Perform deep battery test] as above, but runs with the battery on load until the low battery alarm activates.

– [Abort battery test] stops the battery test in progress.

– [Perform alarm test] activates the 'common' alarm. Used mainly during commissioning to check the alarm interface with an external alarm panel or BMS system. The alarm will automatically clear after five minutes.

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

SETUP USER – This sub menu allows the LCD display language to be selected and the local date/time to be set. The date/time is used by the automated battery test feature and to stamp the Event Log entries. The SETUP USER sub menu also provides access to two further menus:

> **SETUP BATTERY TEST –** allows the operator to configure a (timed) battery test schedule. This can be for a single or repetitive battery test event.

> **SETUP GENERATOR OP. –** allows the operator to configure aspects of the UPS operation when it is being powered from a standby generator – i.e. Disable battery charging and transfer to bypass.

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

2.6 UPS Communication facilities

A customer interface board, located adjacent to the power switch panel, provides a number of external connections that enable the customer to interface the UPS with a local network, building management system or a simple remote alarms facility. It also contains several connectors that are used to provide inter-cabinet communications in a multi-cabinet system – e.g. the parallel control bus described earlier.

All the customer interface board connections are accessible from the front of the UPS cabinet.

2.6.1 Customer connections

Network interface card slots (Slots 1/2) – two network interface card slots are provided to enable the UPS to be connected to a local or wide area network (LAN/WAN) using a compatible SNMP/Ethernet interface card. This allows the UPS system to be incorporated into a network manage system for control and monitoring purposes.

RS232 and USB serial ports (J1/USB) – RS232 and USB serial ports allow the UPS to be connected to a computer for monitoring purposes. These ports process the same data stream and only one port should be used at any particular time.

Wired input connections (X3) – a number of external control inputs can be connected to terminal block X3 to implement various UPS control functions, such as remote shutdown.

Dry port output connections (X2) – various volt-free UPS alarms and status signals are made available at terminal block X2. These outputs are suitable for connecting to an external remote alarm panel or building management system.

A detailed description of these connections is contained in Chapter 9 of this manual.

2.6.2 UPS internal system communications

Graphical display connection (J3) – interfaces the UPS control system I/O with the (optional) system control panel – when used, the system control panel only fitted to the master cabinet in a multi-cabinet system.

RS485 Multidrop connector (J2) – the 'multidrop' feature is used in a multi-cabinet system only. It allows the customer interface board in the master cabinet to collect data/messages from the other system cabinets via the cables connected to J2. The received data is then processed at a centralised point on the 'master' customer interface board and the resulting 'system-wide' data stream is made accessible to the system control panel and the RS232 port (J1) or USB connection. The data can also be transmitted to the SNMP card if it is inserted in the relevant card-slot.

Parallel bus connector (JD1/JD2) – the parallel control bus is connected to two, 25 pin D-type connectors (JD1 and JD2). These connectors effectively allow the parallel control bus to be connected between all the cabinets in a 'ring' configuration.

2.6.3 Configuration DIP switches

DIP switches S1 and SW1 are used to configure the customer interface board in a parallel system. They will be set by the commissioning engineer and should not be changed thereafter.

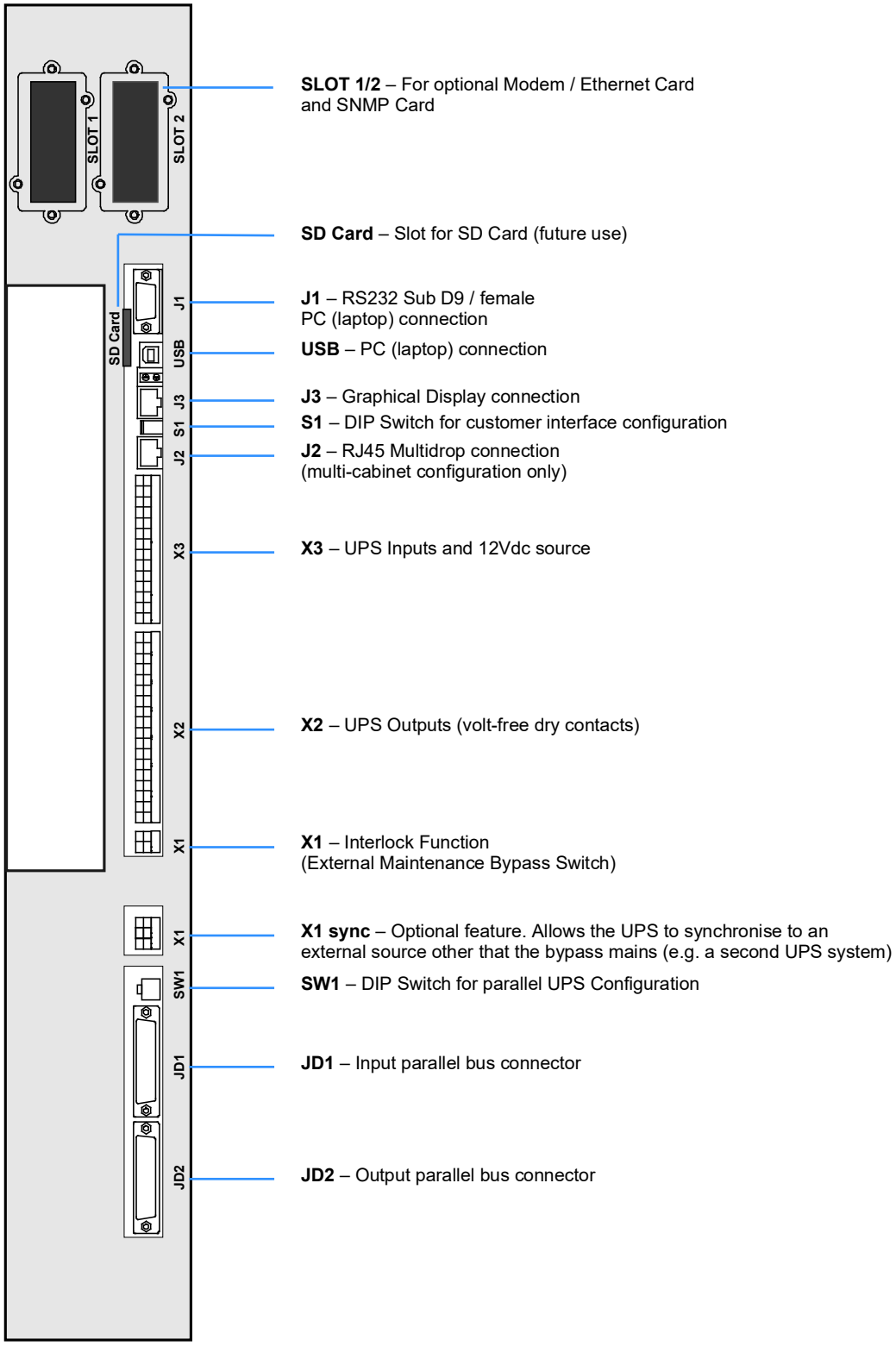


Figure 2.16 Customer interface board

3 System Control Panel

3.1 Introduction

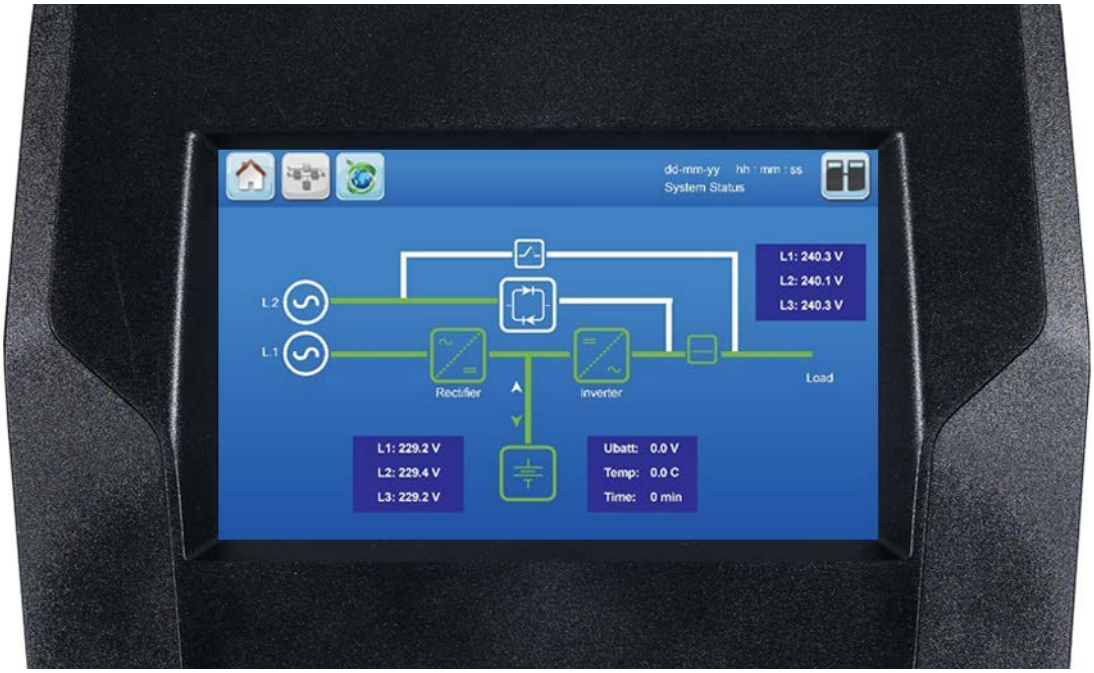


Figure 3.1 System control panel default display

The system control panel contains a microprocessor-based TFT touch-screen display which enables you to monitor and operate the UPS installation at a 'system' level. Only one system control panel is fitted to a multi-cabinet system – installed on the door of the cabinet that contains the 'master' UPS module (Module 01).

The system control panel displays the operational status of the overall UPS system as well as that of each individual UPS module. It enables you to:

- view the input/output/battery operating parameters (voltage, current etc.) for the entire system
- execute a load transfer between inverter and bypass, and vice-versa (password controlled)
- monitor the power flow through the UPS system or selected UPS module through a colour-coded mimic diagram
- check alarm and events histories
- acknowledge an event occurrence
- silence alarms
- monitor the battery state and autonomy time

3.1.1 Display Header Bar

Figure 3.2 illustrates the display header bar that is presented at the top of every screen. It contains number of touch-sensitive icon buttons and also displays some key system status information.

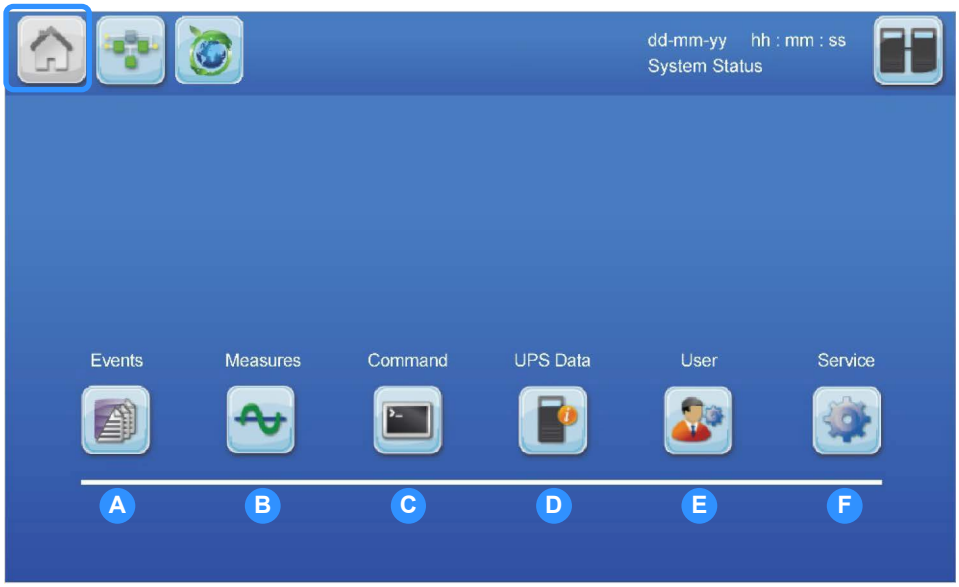
A	**Home button**	Accesses the HOME screen from any other screen *(see paragraph 3.2)*.
B	**Mimic button**	Accesses the MIMIC diagram screen which shows the shows the path of the power flowing through the UPS system and indicates its operating status *(see paragraph 3.3)*.
C	**Xtra VFI button**	This button is only visible if the Xtra VFI function has been activated. Pressing this button toggles between the `EXTRA VFI MEASURES` screen and the `EXTRA VFI STATUS BAR` screen *(see paragraph 3.4)*.
D	**Warning & Event button**	This button is only visible if an alarm or newly monitored event occurs. Pressing this button will silence the audible alarm and open the `EVENTS` screen *(see paragraph 3.2.1)*.
E	**Date**	The date is set in the `USER` screen menu and used to date-stamp the alarms/events log.
F	**Time**	The time is set in the `USER` screen menu and used to time-stamp the alarms/events log.
G	**Module selection button**	Accesses the `MODULE SELECTION` screen from where it is possible to select an individual module and observe its status and measurements data *(see paragraph 3.5)*. This icon is red if there is an active fault or event associated with a UPS module.
H	**UPS number**	When the UPS system is commissioned, each UPS module is given a sequential ID number. The number shown on the display header bar is used to identify the module associated with the data currently being displayed on the system control panel screen (e g. `P:01` = module 1 in the example shown). No number is displayed if the module control panel is displaying 'system' level parameters, such as the system mimic screen, measurements screens etc.
I	**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 viewing at the module navigation level.

Figure 3.2 Display header bar

A detailed description of each of the screens that can be accessed using the display header bar buttons is provided on the following pages.

3.2 HOME screen

The HOME screen is accessed by pressing the Home icon on the display header bar. At the bottom of this screen are six touch-sensitive buttons that provide access to various monitoring, control and set-up function screens.



A	**Events**	Displays a list of recently occurred events with date, time, event name, description and sequential ID number. The Events are described in paragraph 3.2.1.
B	**Measures**	This item displays the full set of measurements for each of the UPS functional blocks, as described in paragraph 3.2.2.
C	**Command**	This menu enables the user to change the UPS operating mode between LOAD ON INVERTER and LOAD ON BYPASS *(see paragraph 3.2.3)*.
D	**UPS Data**	Provides non-editable information regarding the UPS module identity *(see paragraph 3.2.3)*.
E	**User**	Enables setting the date and time, automatic battery test, etc, as described in paragraph 3.2.5.
F	**Service**	This area is used by a trained service engineer only and is password protected .

Figure 3.3 HOME screen

3.2.1 Events

Pressing the HOME screen Events button or display header bar Warning button (when visible) will open the EVENTS screen, shown here, which displays a list of events in chronological order.

Each event line identifies the affected UPS module (Id), together with an event status and number (Ev.) as well as a textual event description. The UP/DOWN arrows on the top right of the screen allow you to scroll through the events history.

Note that changes to the system/module operating status are registered as events and not just operating errors or faults.

Figure 3.4 EVENTS screen

3.2.2 Measures

Pressing the HOME screen Measures button will open the MEASURES screen, shown here, which displays the working values of various UPS, Battery and Xtra VFI operating parameters.

You can select the parameters to be displayed by pressing the UPS Meas, Battery and Xtra VFI buttons on the left side of the screen.

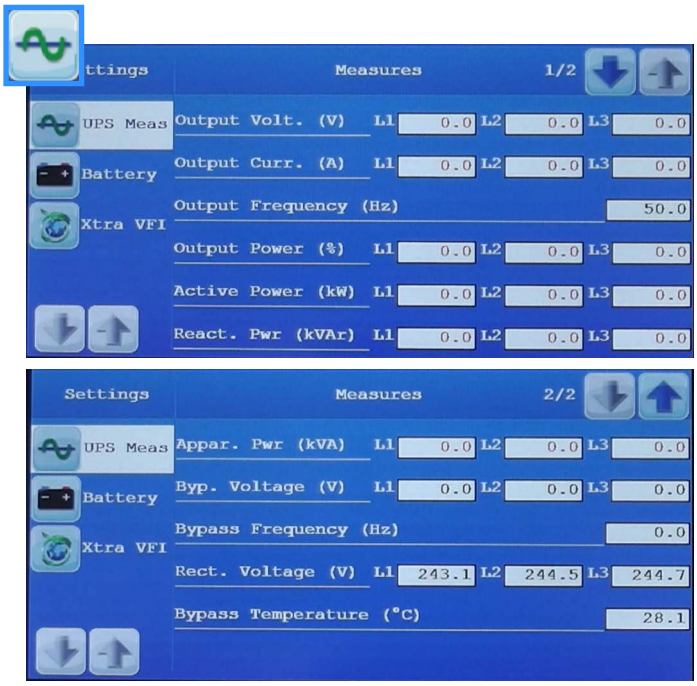


Figure 3.5 MEASURES screen (UPS)

UPS Measures (Figure 3.5)

Two screens are required to show all the UPS parameter measurements; these can be selected using the UP/DOWN arrows on the top right of the screen.

Battery Measures (Figure 3.6)

In a multi-battery installation such as a large UPS system where the UPS modules are connected to a number of separate batteries, the Battery MEASURES screen monitors every battery installation and indicates the 'worst-case' scenario.

For example, the screen will show the highest temperature, greatest discharge current and lowest capacity of any battery installation.

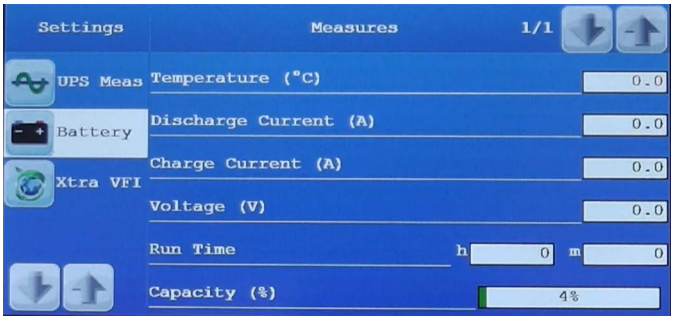


Figure 3.6 MEASURES screen (Battery)

Xtra VFI Measures (Figure 3.7)

The XTRA VFI screen show the Xtra VFI operating status and indicates the number of inverters that are operating or on 'standby'. It also indicates the energy saving attributed to the Xtra VFI operation.

The Total Saved Energy [kWh] indication is cumulative, but the Saved Energy [kWh] value can be reset by pressing the Reset button located at the lower right corner of the screen. This allows you to measure the amount of save energy over a given period, between resets.

Note that this screen can also be accessed by pressing the Xtra VFI button on the display header bar when the XTRA VFI STATUS BAR screen is displayed.

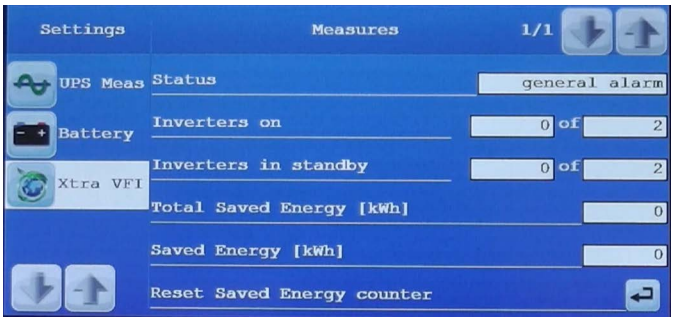


Figure 3.7 MEASURES screen (Xtra VFI)

Measures summary

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)	Bypass Temperature (°C)
Battery Measurements	Temperature (°C)	Discharge Current (A)	Charge Current (A)
	Voltage (V)	Run Time	Capacity(%)
Xtra VFI Measurements	Status	Inverters on (operating)	Inverters in standby
	Total Saved Energy (kWh)	Saved Energy (kWh)	Reset (Saved Energy Counter)

3.2.3 Commands

Pressing the HOME screen Commands button will open the COMMANDS screen shown here.

This password-protected screen allows you to manually transfer the load between inverter and bypass by pressing the appropriate button on the right side of the screen.

When the selected transfer has taken place, the screen will change to show the MIMIC screen *(see paragraph 3.3)*.

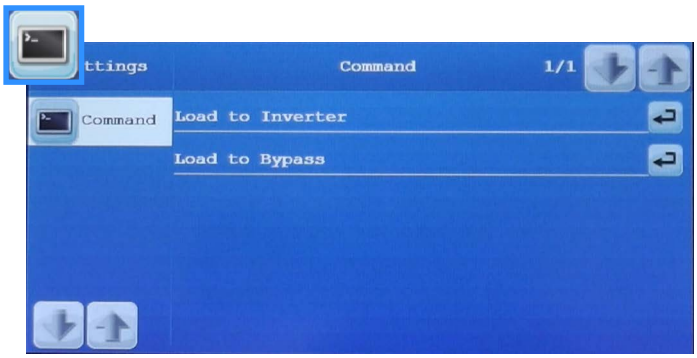


Figure 3.8 COMMANDS screen

3.2.4 UPS Data

Pressing the HOME screen UPS Data button will open the UPS DATA screen shown here. This screen displays the UPS serial number of the master module and other none-editable data that is entered by the manufacturer or commissioning engineer.

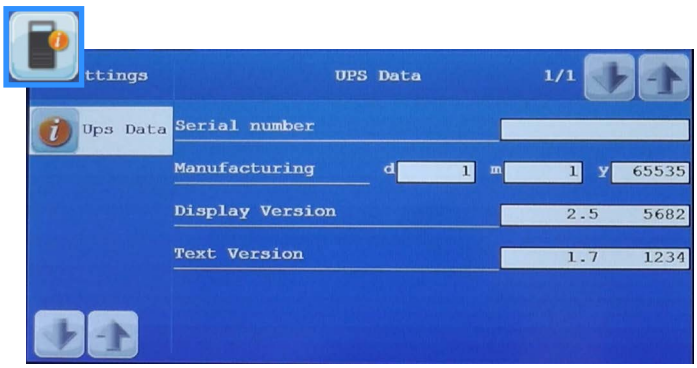


Figure 3.9 UPS DATA screen

3.2.5 User

Pressing the HOME screen User button will open the USER screen shown here. This screen allows you to select the system control panel language, set the screen contrast, and turn off/on the sound associated with operating the touch buttons.

Note: The screen will be calibrated by the commissioning engineer if necessary and we strongly recommend that you do not touch the Display Calibration button.

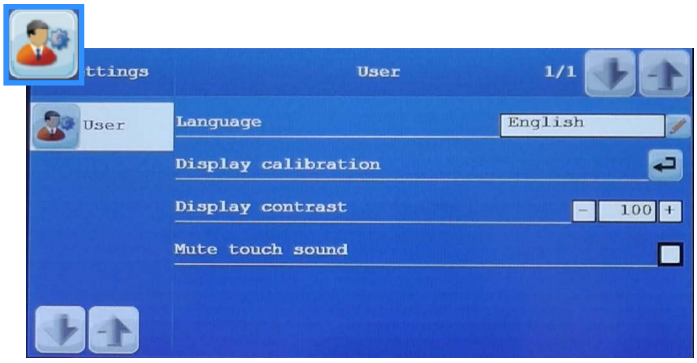


Figure 3.10 USER screen

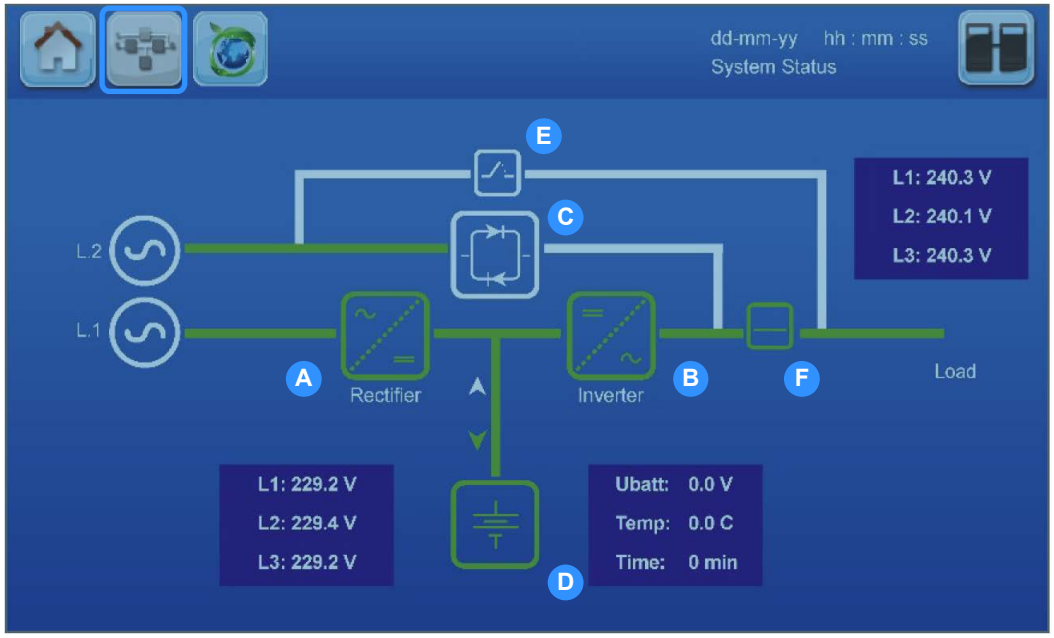
3.3 MIMIC screen

The MIMIC screen is the default screen shown on the system control panel during normal operation. It shows the path of the power flowing through the UPS system and provides basic input, battery and output metering.

This screen can also be accessed by pressing the Mimic button on the display header bar or by pressing a particular UPS Module icon button on the MODULE SELECTION screen *(see paragraph 3.5)*.

If you access the MIMIC screen from the HOME screen the mimic diagram and on-screen metering relate to the UPS 'system' as a whole; but when it is accessed from the MODULE SELECTION screen the mimic diagram relates directly to the selected module, and no on-screen metering is presented.

Note: When the screen is working at a 'module' level the module number is shown adjacent to the Module Selection button on the display header bar (e.g. P:01).



A	**Rectifier**	Green: Red:	The rectifier is turned on. The rectifier is switched off.
B	**Inverter**	Green: Red:	The inverter is turned on and supplying load power. The inverter is switched off.
C	**Static Bypass**	Green: White:	The load is connected to the bypass (or the system is operating in ECO-mode). The bypass is off.
D	**Battery**	Green: Yellow: Red:	Battery is charging or discharging – the direction of flow is indicated by the adjacent green arrowheads. Battery low. Battery is either faulty, not connected or fully discharged.
E	**Maintenance Bypass Switch Q1**	Yellow: White:	Load is on maintenance bypass Maintenance bypass switch is open
F	**Parallel switch Q2**	Green: White:	Parallel switch is closed (Position ON) Parallel switch is opened (Position OFF)

Figure 3.11 MIMIC screen (at system level includes on-screen metering)

3.3.1 MIMIC screen indications

The status of the major UPS power blocks and power paths is colour-coded as follows:

GREEN:	ACTIVE – the power block is turned on and operational / the power path is live.
WHITE:	INACTIVE – the power block is functional but not currently in use (e.g. static bypass operational but not required so it is turned OFF) / the power path is available but not currently used
YELLOW:	WARNING – the UPS is operating on maintenance bypass
RED:	FAULT – the power block is faulty or turned off / the power path has lost its power source

Three meters are included on the mimic display screen to indicate the UPS input and output voltage, frequency and current. The displayed battery parameters include the battery voltage, temperature and remaining autonomy time.

Examples of the mimic displays for the major operating modes are shown below.

ON-INVERTER

This is the normal mimic indications for an On-Line UPS system.

1. The rectifier and inverter are working normally.
2. The battery is charging.
3. The parallel switch (Q2) is closed and connecting the UPS output to the load.
4. The bypass line (L2) is live and available.

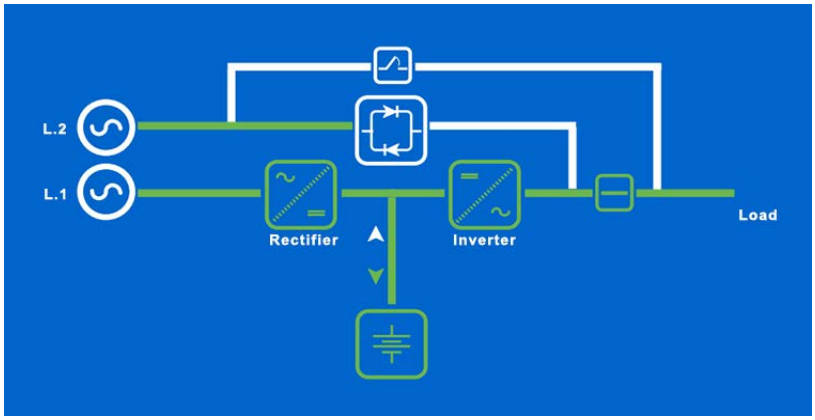


Figure 3.12 ON INVERTER mimic

ON-BATTERY

This mimic shows that the UPS is operating on battery due to the loss of mains power (L1).

1. The rectifier is turned off.
2. The battery is discharging.
3. The inverter is still operating and the providing power to the load.
4. In a split-bypass system the bypass line (L2) will be live if the bypass supply is still available, otherwise it will indicate a power loss (red) along with the rectifier mains input (L1).

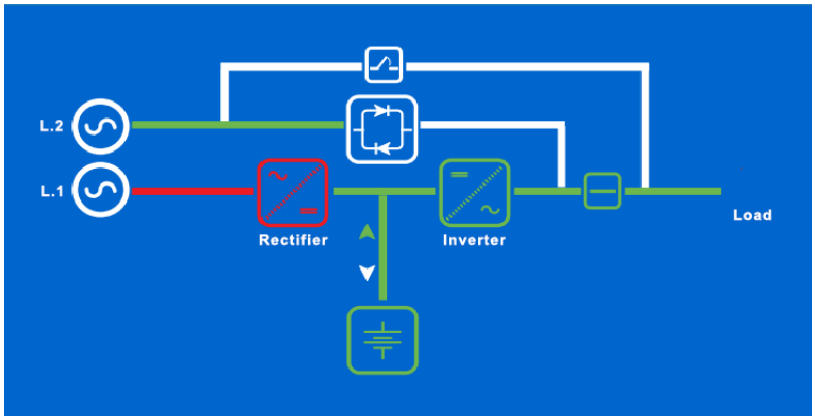


Figure 3.13 ON BATTERY mimic

ON-BYPASS

This mimic indicates that the load is being supplied via the static bypass line, and it is the normal indication if the system is operating in 'ECO' mode.

If the system is not set to operate in ECO mode, this state indicates that the load has either been:

1. Manually transferred to bypass.
2. Automatically transferred due to an output overload that has caused the inverter to shut down.
3. Transferred due the loss of module redundancy.

If the transfer to bypass is due to an inverter fault, the rectifier will continue working normally to maintain battery charging.

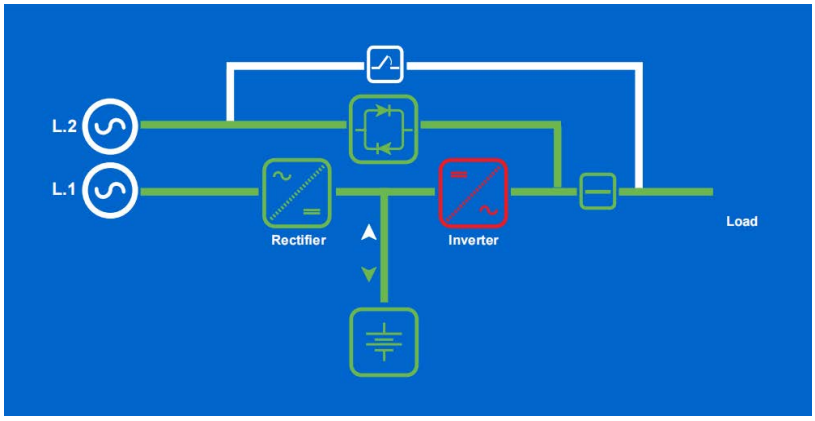


Figure 3.14 ON BYPASS mimic

ON MAINTENANCE BYPASS

This mimic indicates that the maintenance bypass switch is closed and the load is connected to the bypass supply through both the 'maintenance bypass' and 'static bypass' lines in parallel.

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

if the cabinet's parallel switch (Q2) is now opened, the UPS modules will be totally isolated from the UPS output and can be shut down, and withdrawn from the cabinet rack if required.

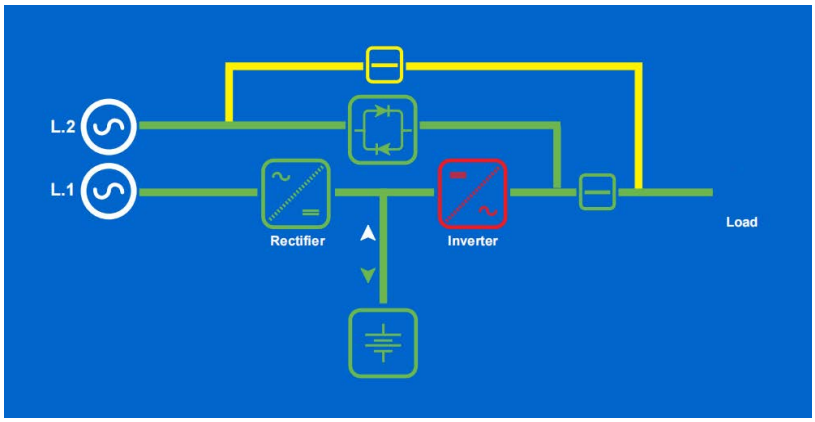


Figure 3.15 ON MAINTENANCE BYPASS mimic

3.3.2 Metering from the MIMIC screen

On the MIMIC screen, the icons representing the rectifier, inverter, static bypass and battery power blocks also act as touch-sensitive buttons which, when pressed, open a version of the MEASURES screens related to the selected power block. This is applicable when the mimic is displaying both 'system' or 'module' level data.

Note: The screens that are accessed through this path use the same data sources as the MEASURES screens described earlier, but the displayed content is organised differently.

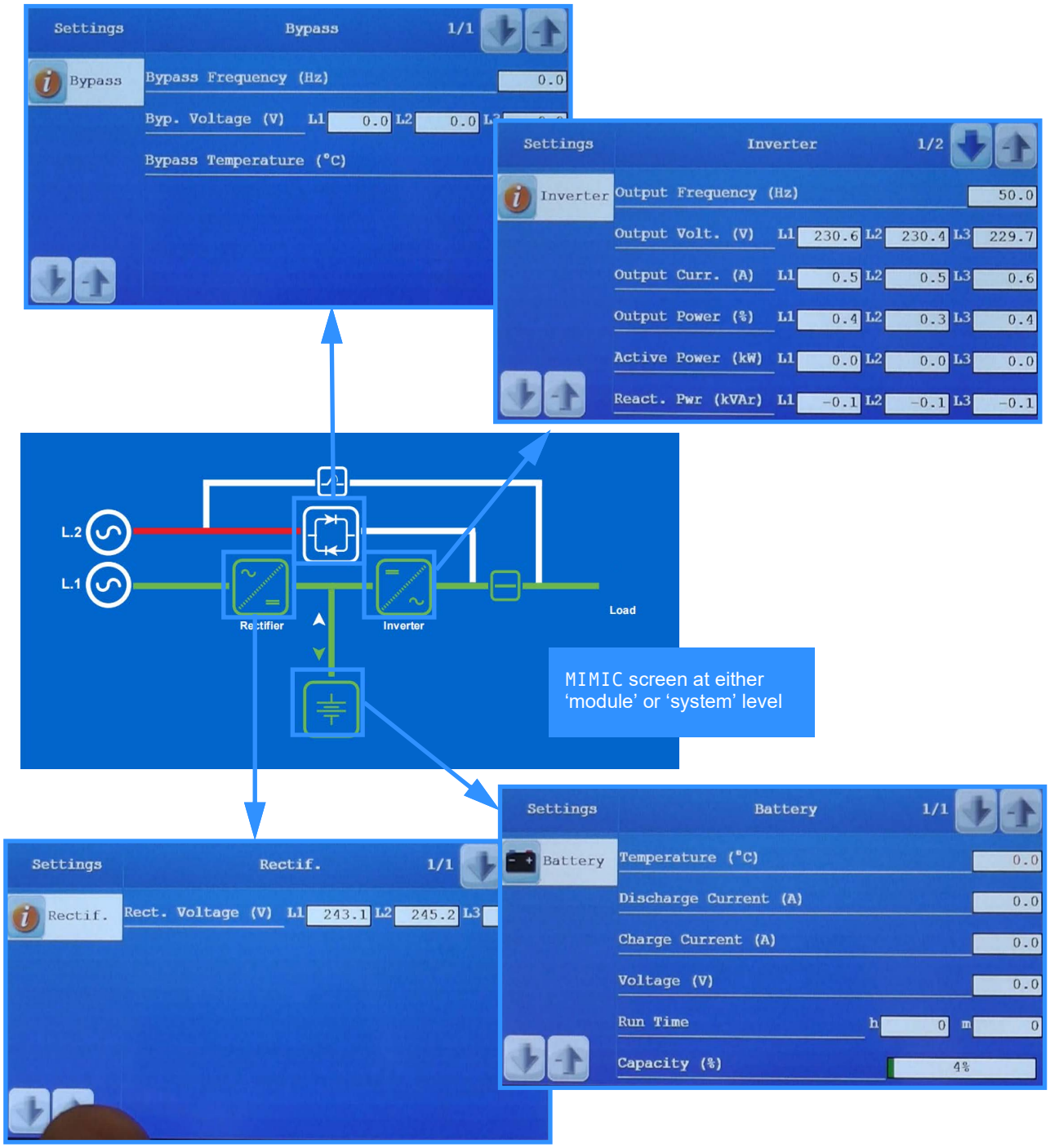


Figure 3.16 MIMIC Metering

3.4 XTRA VFI screen(s)

There are two screens directly related to the Xtra VFI function; the XTRA VFI STATUS BAR screen and the 'XTRA VFI MEASURES' screen. These can be accessed by pressing the Xtra VFI button on the display header bar, which is only visible if the Xtra VFI function is enabled.

You can toggle between these two screens by pressing the Xtra VFI button on the display header bar. To exit these screens you must press a different button on the display header bar or select another function in the MEASURES *screen.*

A	**Load**	The dark green area of the status bar indicates the applied load as a percentage of the UPS system rated capacity.
B	**Active**	The light green area of the status bar indicates the remaining capacity of the active inverters – i.e. those inverters that are turned on, and operating under the control of the Xtra VFI function.
C	**Standby**	The light blue area of the status bar indicates the capacity of the modules operating on standby that can be called upon by the Xtra VFI function if required to support any load increase.

Figure 3.17 Xtra VFI status bar screen

The XTRA VFI STATUS BAR screen, shown above, provides a bar chart representation of the Xtra VFI operation in terms of relative capacity:

- Load: the existing load demand
- Active: the free capacity immediately available from the active modules due to the programmed HLS or redundancy configuration
- Standby: the power available from those modules currently running on standby that can be called upon when needed

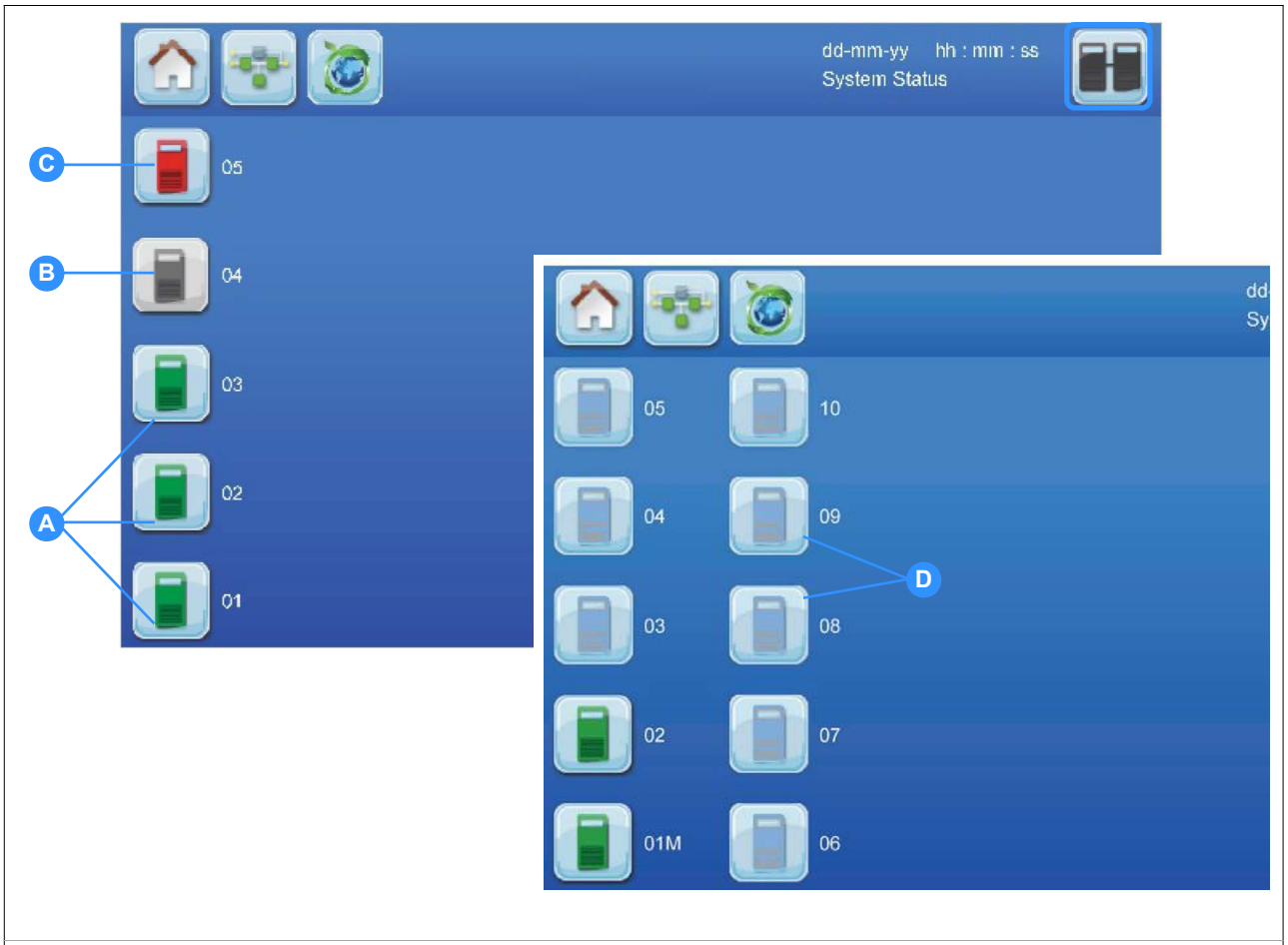
Figure 3.18 Xtra VFI measures screen

The 'XTRA VFI MEASURES' screen, which can also be access by pressing the Measures button on the HOME screen, provides numerical data concerning the Xtra VFI module status and saved energy, and is described in detail on page 23.

3.5 MODULE SELECTION screen

The module selection screen, shown below, is accessed by pressing the `Module Selection` button on the display header bar. On opening, the `MODULE SELECTION` screen displays an icon for each UPS module installed in the system and immediately indicates its operational status by means of its displayed colour.

The UPS modules are identified numerically by an ID number which is allocated during commissioning. The diagram below identifies five modules fitted to a single cabinet, with the bottom module assigned an ID of 01. A PW9250DPA system can comprise up to five modules each fitted with six UPS modules, therefore the screen shown in Figure 3.19 can display a maximum of 30 UPS modules.



A	**Green**	Module in normal operation – on line
B	**Grey**	Module inactive – turned off
C	**Red**	Module has a general alarm
D	**Light Blue**	Module operating in standby – Xtra VFI mode only

Figure 3.19 Module selection display screen

Note that in a multi-cabinet system if a UPS cabinet is not fully populated, the numbering protocol will not skip the missing module(s). For example, if both cabinets in a two cabinet system each have only five modules installed there will be no icons shown in the [06] and [12] slots, and the numbering sequence for cabinet 2 will begin with module [07].

If you press one of the touch-sensitive module icon buttons the `MIMIC` screen will open to allow you to observe the operation and metering for the selected module, as described in paragraph 3.3.

4 Installation Planning

4.1 Introduction

It is the responsibility of a customer-appointed installation team to ensure that the UPS system is located in a suitable environment and to carry out any necessary mechanical and electrical preparation prior to installing the UPS system.

A certain amount of pre-planning will help ensure a smooth and trouble-free UPS installation experience. This chapter contains essential information concerning the environmental, mechanical and electrical requirements that should be considered when planning the installation of the Kohler PW 9250DPA (50-300 kW) UPS system.

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

4.2 Environmental and mechanical planning

4.2.1 Environmental considerations

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

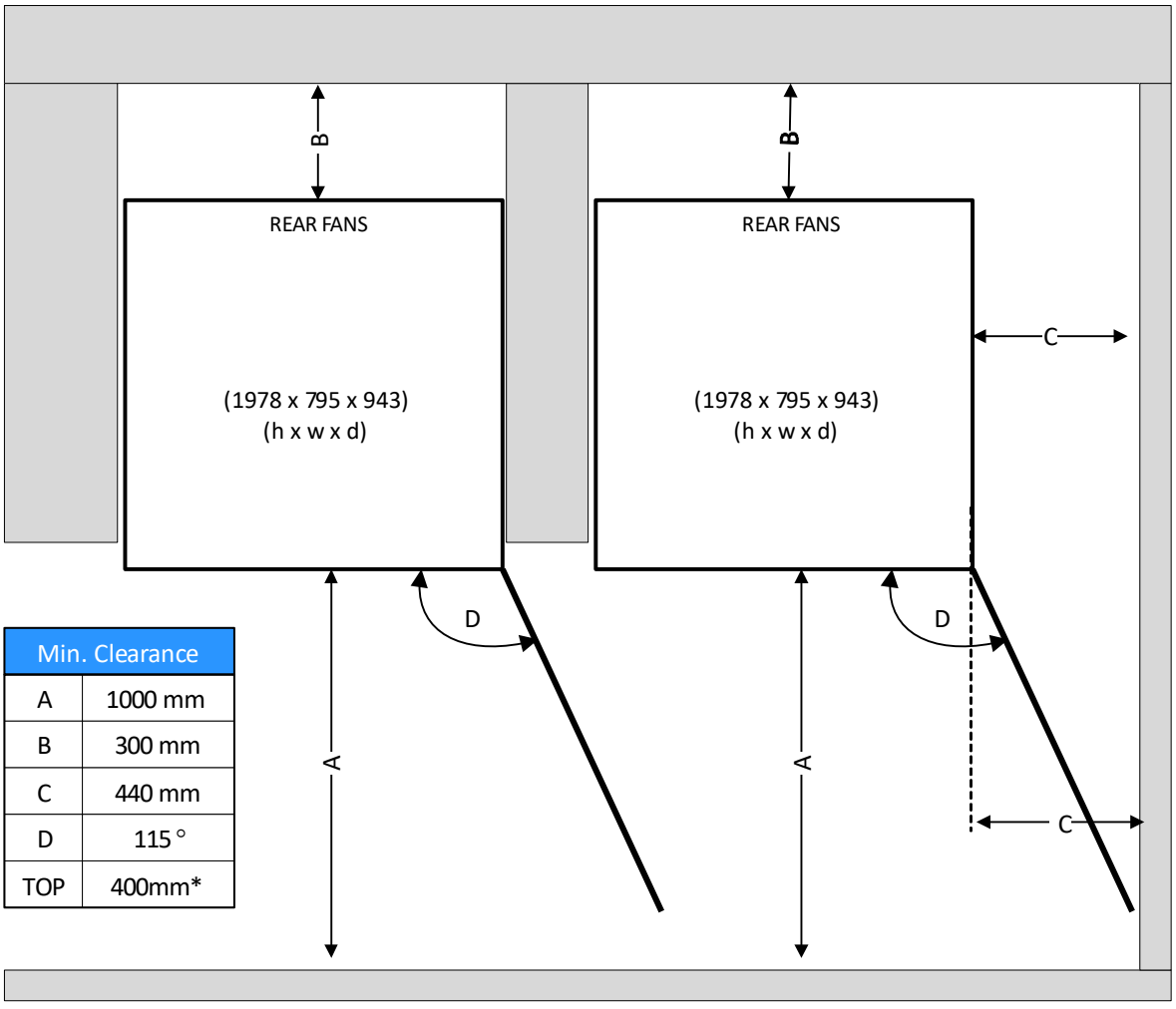
1. The route to the installation location must allow the equipment to be transported in an upright position.
2. The floor at the proposed installation site and en-route from the off-loading point must be able to safely take the weight of the UPS and battery equipment plus fork lift or moving aids during transit.
3. You must avoid a locations with a high ambient temperature, moisture or humidity:
   a) The installation site humidity should be <95% non-condensing.
   b) The prescribed equipment ambient temperature is 0°C to +40°C.
   c) A battery temperature of 20°C is recommended to achieve a long battery life.
   d) If an air conditioning system is used it 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 you should also consider the following conditions:
   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.

4.2.2 Installation clearances

Figure 4.1illustrates the clearances required when installing a standalone or multi-cabinet PW9250DPA UPS system. The CBAT 150T battery cabinet (shown) is the battery cabinet recommended by Kohler Uninterruptible Power, although other battery cabinets are available.

Key Point: The height of the cabinets indicated in Figures 4.1 and 4.2 will be increased by 170 mm if the optional elevation kit is fitted.

Kohler PW 9250DPA (50-300 kW) standalone cabinet installation



Min. Clearance	
A	1000 mm
B	300 mm
C	440 mm
D	115 °
TOP	400mm*

Figure 4.1 Clearances for a Kohler PW 9250DPA (50-300 kW) stand-alone cabinet

All the parts of the UPS that might require access for cabling, maintenance, service replacement and general operation are accessible from the front of the cabinet and therefore there is no need for any access clearance to be provided at the sides of the cabinet.

It is necessary to open the cabinet door fully in order to remove some major components, including the UPS modules. To achieve this the cabinet door must be opened to approximately 115° and where the right-hand side of the cabinet is located against a pro-protruding wall, space must be provided to enable the door to be fully opened. The clearance diagram shows the required side clearance in this case to be approximately 440 mm.

No side clearance is necessary if the right-hand side of the cabinet is not adjacent to a protruding wall (as shown in the left hand diagram in Figure 4.1).

Although the front clearance is shown as 1000 mm this should be considered as a 'minimum' and where possible it should be increased to allow free passage of personnel with the door open.

For a standalone UPS cabinet a rear clearance of 300mm is required to enable adequate cooling air flow.

*A minimum TOP clearance of 400mm is required to dissipate the cooling air if there is no side clearance.

Kohler PW 9250DPA (50-300 kW) parallel-cabinet installation

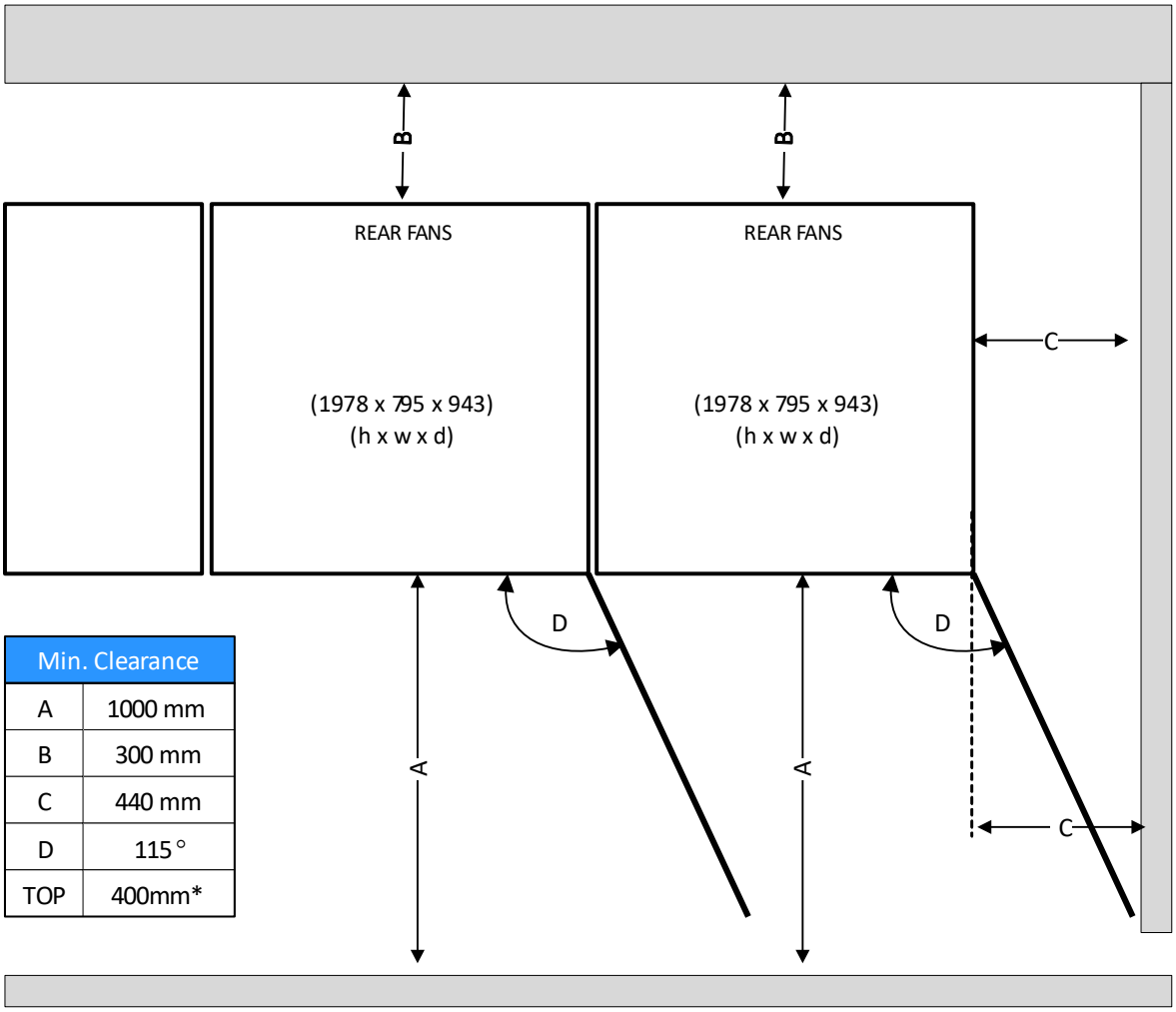


Figure 4.2 Clearances for a Kohler PW 9250DPA (50-300 kW) parallel-cabinet installation

The clearances required by a Kohler PW 9250DPA (50-300 kW) multi-cabinet installation are similar to those just described for a stand-alone cabinet.

Although Figure 4.2 shows the same clearances applied to the battery cabinet this will in fact depend upon the battery cabinet manufacture. Before planning a multi-cabinet installation you should ascertain the access clearances required to install and service the battery cabinet from the cabinet supplier.

Battery installation

The design of the battery installation is bespoke to the individual site; however, we recommend that where possible the battery is contained in a purpose-built cabinet and installed immediately adjacent to the UPS cabinet.

Key Point: Although the Kohler CBAT 150T cabinet does not require any side or rear clearance for ventilation purposes, this may differ with other battery cabinet designs.

If the battery is to be mounted in an external battery rack we recommend that the rack is installed is as close as possible to the UPS cabinets to minimise the length of the DC cable runs. The battery cables should be sized to compensate for the DC voltage drop between the battery installation and UPS. Contact Kohler Uninterruptible Power for installation advice and support if necessary.

4.3 Electrical planning

The information in this section should help with the preparation and planning of the UPS power cabling.

Key Point: To ensure that the UPS power and control cables are easily accessible once the UPS cabinet has been installed, it is important that all cable containment provisions should be completed (and cables laid if necessary) before the cabinets are placed in their final position.
This is especially relevant if the cabinets are to be installed with no rear or side access.

It is the customer's responsibility to provide all the external fuses, isolators and cables that are required to connect the UPS inputs and outputs to their respective power distribution boards. The DC cables and fuses will be provided by Kohler Uninterruptible Power.

WARNING: 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.

4.3.1 General requirements

Input protection

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

IMPORTANT NOTE: The UPS does not contain internal fuse protection for the bypass mains, input mains (rectifier), or battery cables. It is the customer's responsibility to ensure that external supply fuses (or other protective devices) are 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.

Input neutral grounding

A permanently connected input neutral is required to enable the rectifier to function correctly and provide the inverter with a neutral reference when the input mains supply is unavailable and the UPS is operating from battery power.

If a separate mains supply source is connected to the bypass mains input (dual input feed) the neutral of the bypass mains supply and input mains supply must be connected together, and earthed.

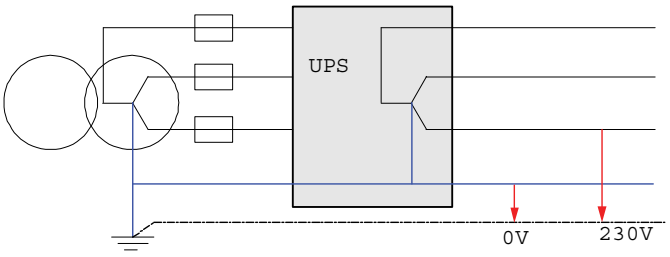


Figure 4.3 Input neutral grounding

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Key Point: As the input neutral must be permanent and unswitched, a 4-pole input switch or isolator must not be used at the LV Distribution board on a TN-S system.

4.3.2 UPS Power Cabling

Cable connections

Two versions of the Kohler PW 9250DPA (50-300 kW) cabinets are available: the main difference between them being the method of cable entry – i.e. 'top' or 'bottom.' However, the diagrams and ratings given in the remainder of this chapter are relevant to both cabinet variants.

In the following diagrams all the cables and fuses identified as 'A', 'B', 'C' and 'D' are bespoke to the installation and must be provided by the customer. The cable current capacity and termination details are shown in the ratings tables provided on pages 42 to 48.

In all cases the power cables should be fitted with 'eye' terminations and bolted to the UPS power busbars.

Input/Bypass Mains Supply Cables

The UPS cabinet can be wired for a 'single feed' or 'dual feed' input mains supply.

In a 'single feed' system (standard) the UPS input mains terminals and bypass mains busbars are linked within the UPS cabinet, but in a 'dual feed' system the links are removed and the UPS bypass mains terminals are connected to a dedicated bypass mains supply. The two configurations are shown in Figure 4.4.

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 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 distribution switchpanel 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: Although the required input cable rating depends upon the number of installed UPS modules, we recommend that the input cables are sized for the full 300 kW cabinet rating even if fewer than six UPS modules are 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.

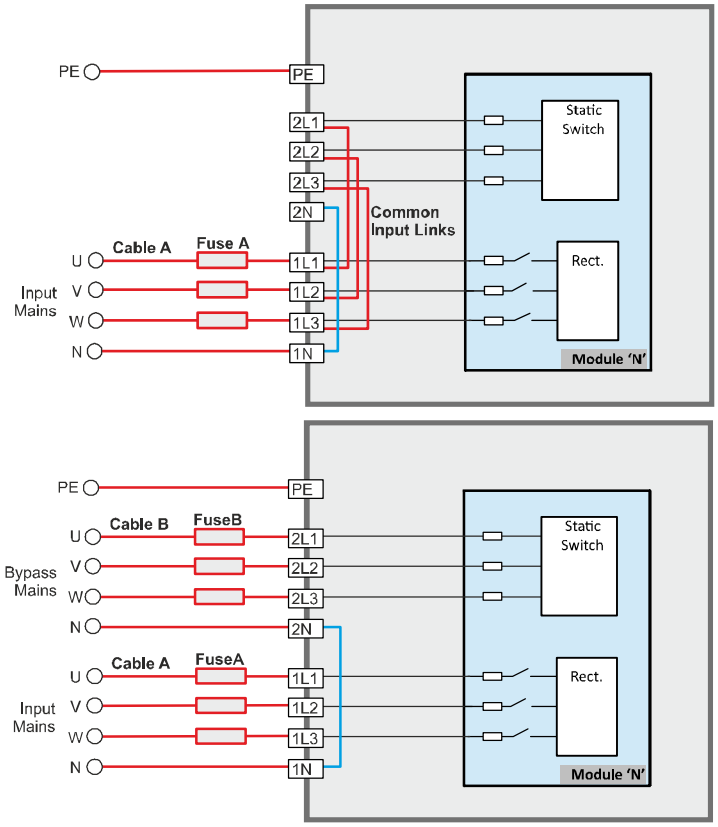


Figure 4.4 Single and dual feed input configuration

UPS Output cables

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

Note: Although the required output cable rating depends upon the number of installed UPS modules, we recommend that the output cables are sized for the full 300 kW cabinet rating even if fewer than six UPS modules are 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.

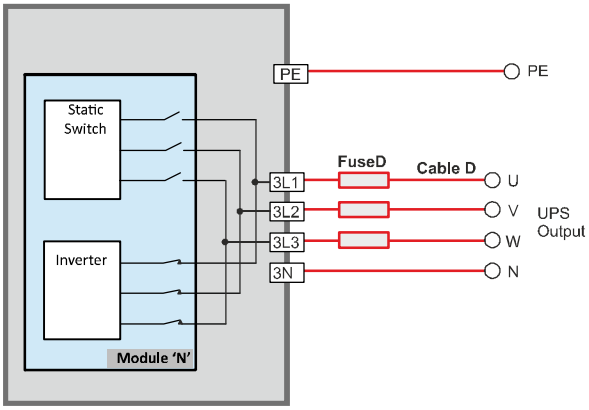


Figure 4.5 UPS Output cables

Battery cables

The batteries can be connected to the UPS in either a 'common battery' or 'separate battery' configuration. These are illustrated in figures 4.9 to 4.11.

A circuit breaker or other isolation device must be fitted as close to the battery containment as possible. For a 'separate battery' installation, where two or more sets of batteries are installed, a separate circuit breaker or isolation device must be provided for each set.

The battery and dc cables must be connected by the commissioning engineer. The battery cables (cable C) and fuses (fuse C) are bespoke to the installation and will be provided by Kohler Uninterruptible Power.

Common battery configuration

A 'common battery' installation is shown in Figures 4.9 and 4.11.

In this configuration a single battery, which can itself comprise several parallel battery strings, is connected to the battery busbars (+ve & -ve) within the UPS cabinet from where it is connected to the UPS modules via dedicated circuit breakers (Q501 – Q506). The tables that accompany Figure 4.9 and Figure 4.11 show the nominal battery discharge current that the battery cables are required to carry for this type of configuration.

Note: As with the input and output power cable recommendations we also recommend that the battery cables are sized for the full 300 kW cabinet rating even if fewer than six UPS modules are initially installed, as this will ease future expansion.

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 the battery failure is in one string only then the UPS will operate on battery power as normal but with a much reduced back-up time.

Separate battery configuration

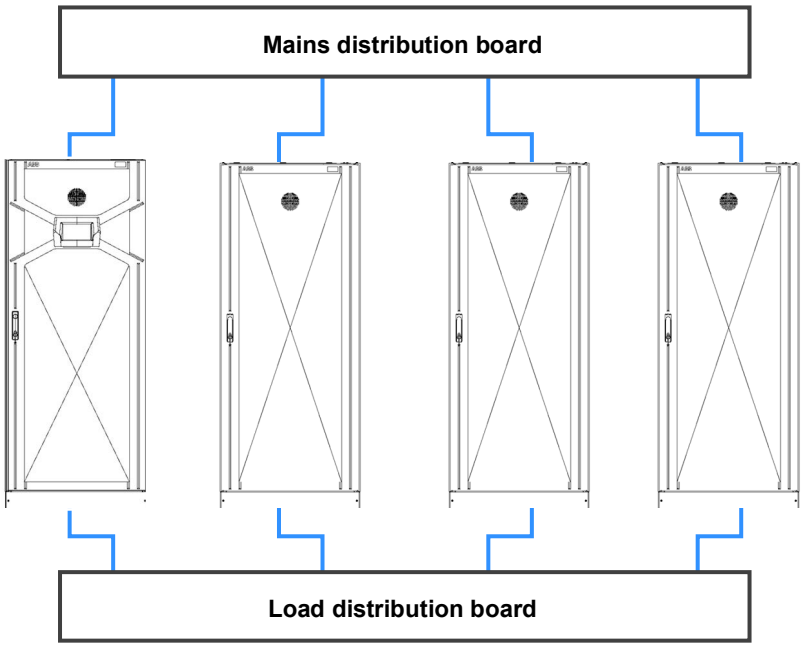
A 'separate battery' configuration enhances the overall reliability/availability of the UPS system by providing a degree of battery redundancy – i.e. following a mains outage, the total failure of a battery only affects it's associated module and the remainder of the UPS system can fully support the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

A 'separate battery' installation is shown in Figures 4.10 and 4.12 for a single-feed input and dual-feed input respectively. In these illustrations each battery is connected directly to the module circuit breakers (Q501 – Q506) and not to the main battery busbars (+ve & -ve).

Input/Output power cable lengths

To achieve equal load sharing between the UPS cabinets in a multi-cabinet installation, the input cables from the mains distribution board to each UPS cabinet should be of equal length. Similarly, the length of the UPS output cables to the load distribution board should be of equal *(see Figure 4.6)*.

CORRECT



INCORRECT

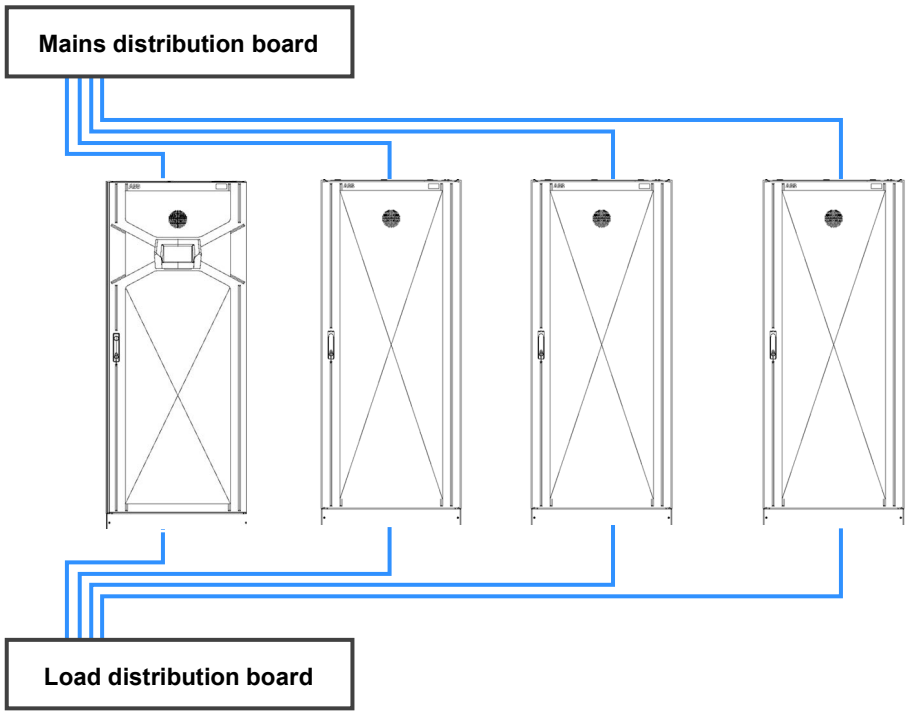


Figure 4.6 Cable lengths for multi cabinet configuration

4.3.3 External maintenance bypass switch

An external maintenance bypass facility is a required part of a multi-cabinet system but it is optional for a standalone UPS installation.

The design and implementation of the external bypass is bespoke to the site installation but generally comprises three switches rated to carry the full system load and connected in a similar fashion to that shown in Figure 4.7.

The switches may be installed in a dedicated 'External Maintenance Bypass' cabinet or included in an existing switchgear panel. Kohler Uninterruptible Power can supply a range of external maintenance bypass solutions to suit all of its UPS systems.

Note: When you initially start the UPS system, the start-up procedure recommends that if the load produces a large inrush current you should ideally turn on the load while the UPS is operating on the maintenance bypass supply before bringing the UPS inverter(s) on-line

Single UPS cabinet installation

An external maintenance bypass facility is not an essential part of a single cabinet installation as the internal maintenance bypass switch (Q1) is fully load rated for the cabinet's output.

However, in a standalone installation it is not possible to fully power-down the UPS cabinet for test or repair when the internal maintenance bypass switch (Q1) is closed, because the UPS bypass mains supply is required to power the maintenance bypass circuit.

This situation can be overcome by adding an external maintenance bypass (MBP) facility, similar to that shown in Figure 4.7, which can supply the load through the external `BYPASS` switch while allowing the UPS cabinet input and output power terminals to be totally isolated by opening the external MBP `INPUT` and `OUTPUT` switches.

Parallel system installation

When two, or more, UPS cabinets are connected as a parallel system an external maintenance bypass facility is an essential part of the UPS installation, and the individual maintenance bypass switches (Q1) are not installed in the UPS cabinets.

Note that the required cable ratings for the UPS input/ bypass/output power connections are the same as those detailed earlier for the single and dual-feed installations. However the external MBP panel switches and input/output protection devices must be rated to carry the full 'system' load. This will require additional protective devices to be connected in the feed(s) to the UPS input mains (and UPS bypass mains) – e.g. to protect 'Cable A' in the example shown.

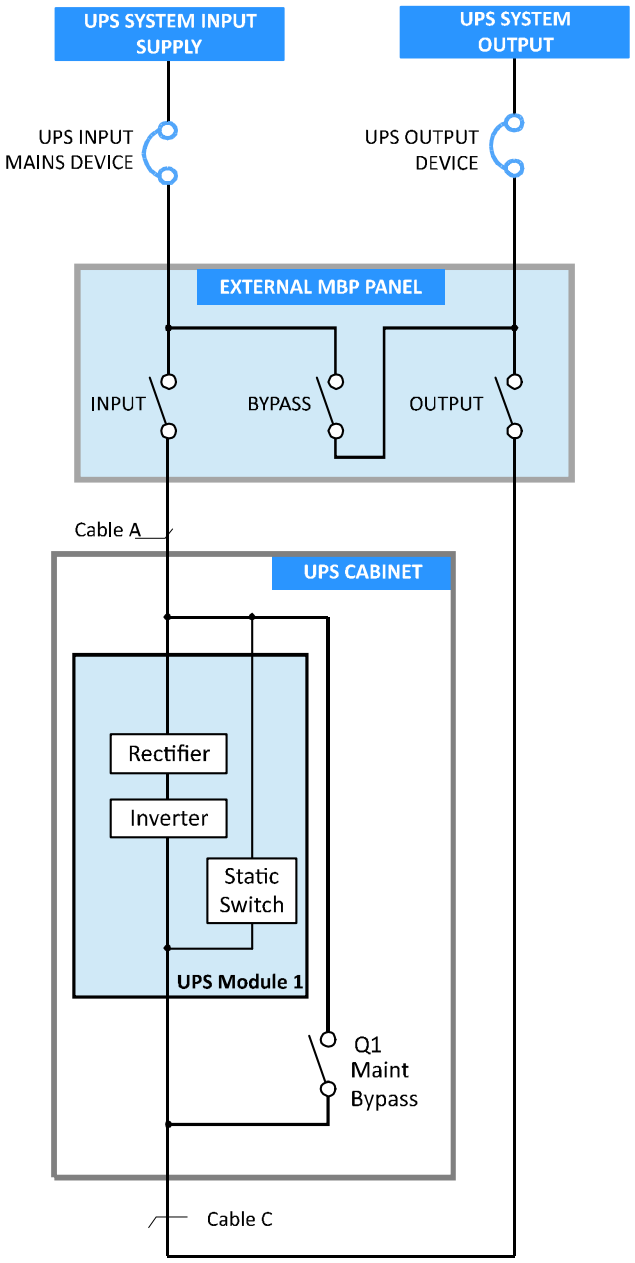


Figure 4.7 External Maintenance Bypass

4.3.4 Control cables

External interface cables

It is possible to connect a range of external interface facilities to the communications interface board which is located adjacent to the UPS power panel. The facilities offered by this board are optional but are typically used for remote monitoring and control applications either through a remote alarms panel, building management system (BMS) or integrated into a computer-controlled network management system. The available features are described on page 73.

If the available access between the UPS cabinet and remote monitoring device will make it difficult to install the interface cables once the cabinet is fixed in place we recommend that the cables are laid before the cabinet is put in position, leaving a sufficient length of free cable to allow the commissioning engineer to make the necessary connections. This, however, requires a certain amount of planning with regards to the interface facilities that will be used.

If there is no cable routing problem then the interface options can be connected at any time.

Inter-cabinet parallel control cables

In a multi-cabinet PW9250DPA system a ‘parallel control bus’ is facilitated by connecting a control cable between each cabinet in a ‘ring’ fashion as shown in Figure 4.8.

These cables are provided in the accessories pack of each UPS cabinet and connected between JD1 and JD2 on the communications interface board, as shown. As the UPS cabinets are normally positioned adjacent to each other there should be no problem in fitting these cables after the cabinets have been positioned, however if the cabinets are placed between walled partitions it might be beneficial to lay the cables prior to the cabinet installation.

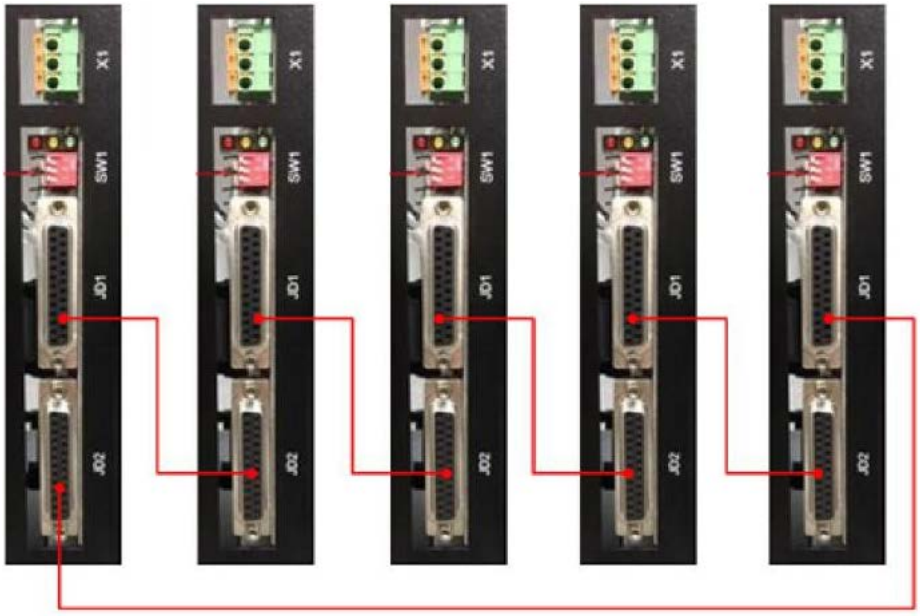


Figure 4.8 Inter-cabinet parallel control cables

4.4 Fuse & cable sizing

Input/output supply protection

The input/output AC and DC cables and protective devices are identified in Figures 4.9 to 4.12.

The fuse and cable sizing details given in the following tables are provided for guidance only:

- The UPS must be installed to prescribed IEC or local regulations (e.g. BS7671).
- The required DC cables and battery fuses are bespoke to the installation, depending on the battery type and quantity. All DC cables and fuses are provided by Kohler Uninterruptible Power, and the ratings shown on the following pages are for guide reference only.
- We recommend that ALL AC power cables are sized for the full cabinet (300 kW) rating even if fewer than six UPS modules are installed initially, as this will allow the system to be expanded to include the full six modules at a later date without having to shut down the system for re-cabling.

4.4.1 UPS cabinet cabling details for a single-feed input and common battery

Table 4.3 Refer to Figure 4.9

UPS CABINET CONNECTIONS								
UPS Module Rating (kVA)			50	100	150	200	250	300
Cable A	1L1,1L2,1L3,1N, PE[a]	Input demand[b]	78A	157A	236A	314A	393A	471A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse A	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable C	B+, B-, [c] PE[a]	Nominal discharge current	90-110A	175-220A	260-330A	350-440A	435-550A	525-660A
		Termination	4x M6					
		Tightening Torque	50 Nm					
Fuse C	Agl/CB	2x[d]	125A	250A	400A	500A	630A	700A
Cable D	3L1,3L2,3L3,3N,PE[a]	Rated output[e]	72A	144A	216A	288A	360A	433A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse D	Agl/CB	3x	80A	160A	250A	315A	400A	500A

a.Protective Earth (PE) cable must be sized in accordance with local and national regulations

b.Rating shown for nominal 400V operation and batteries charging. See specification for 380/415V current ratings.

c.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

d.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

e.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.

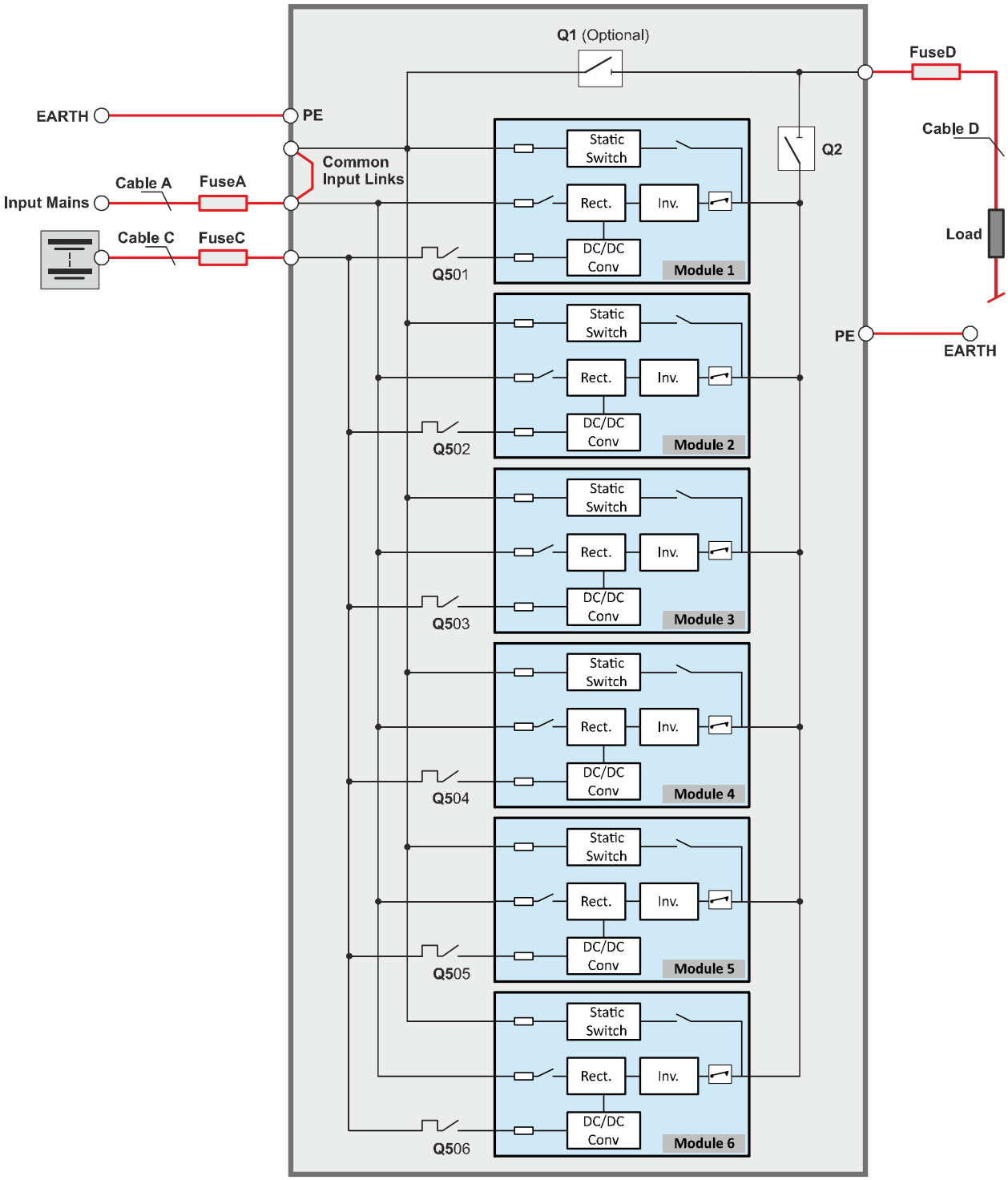


Figure 4.9 UPS cabinet cabling details for a single feed input and common battery

4.4.2 UPS cabinet cabling details for a single-feed input and separate batteries

Table 4.4 Refer to Figure 4.10

UPS CABINET CONNECTIONS								
UPS Module Rating (kVA)			**50**	**100**	**150**	**200**	**250**	**300**
Cable A	1L1,1L2,1L3,1N, PE[a]	Input demand[b]	78A	157A	236A	314A	393A	471A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse A	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable D	3L1,3L2,3L3,3N,PE[a]	Rated output[c]	72A	144A	216A	288A	360A	433A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse D	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable E[d]	Q501-Q506, PE[a]	Nominal discharge current	90-110A for each UPS module					
		Termination	Circuit breaker screwed connections					
Fuse E[e]	Agl/CB	2x	(Nominal 125A for each UPS module -- see footnote)					

a.Protective Earth (PE) cable must be sized in accordance with local and national regulations

b.Rating shown for nominal 400V operation and batteries charging. See specification for 380/415V current ratings.

c.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.

d.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

e.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

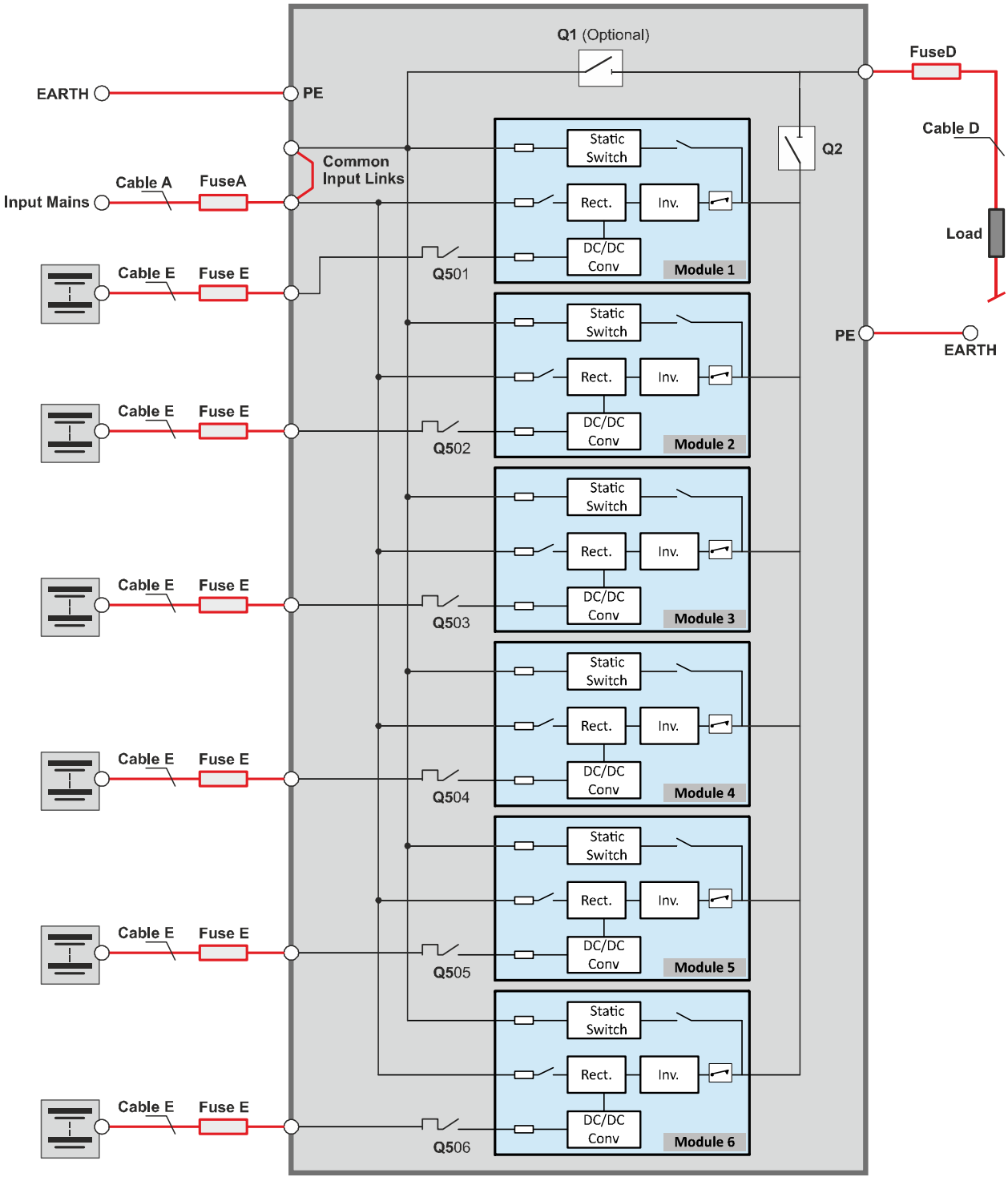


Figure 4.10 UPS cabinet cabling details for a single feed input and separate batteries

4.4.3 UPS cabinet cabling details for a dual-feed input and common battery

Table 4.5 Refer to Figure 4.11

UPS CABINET CONNECTIONS								
UPS Module Rating (kVA)			50	100	150	200	250	300
Cable A	1L1,1L2,1L3,1N, PE[a]	Input demand[b]	78A	157A	236A	314A	393A	471A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse A	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable B	1L1,1L2,1L3,1N, PE[a]	Bypass demand[c]	72A	144A	216A	288A	360A	433A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse B	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable C[d]	B+, B-, PE[a]	Nominal discharge current	90-110A	175-220A	260-330A	350-440A	435-550A	525-660A
		Termination	4x M6					
		Tightening Torque	50 Nm					
Fuse C	Agl/CB	2x[e]	125A	250A	400A	500A	630A	700A
Cable D	3L1,3L2,3L3,3N,PE[a]	Rated output[f]	72A	144A	216A	288A	360A	433A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse D	Agl/CB	3x	100A	200A	315A	400A	500A	630A

a.Protective Earth (PE) cable must be sized in accordance with local and national regulations

b.Rating shown for nominal 400V operation and batteries charging. See specification for 380/415V current ratings.

c.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.

d.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

e.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

f.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.

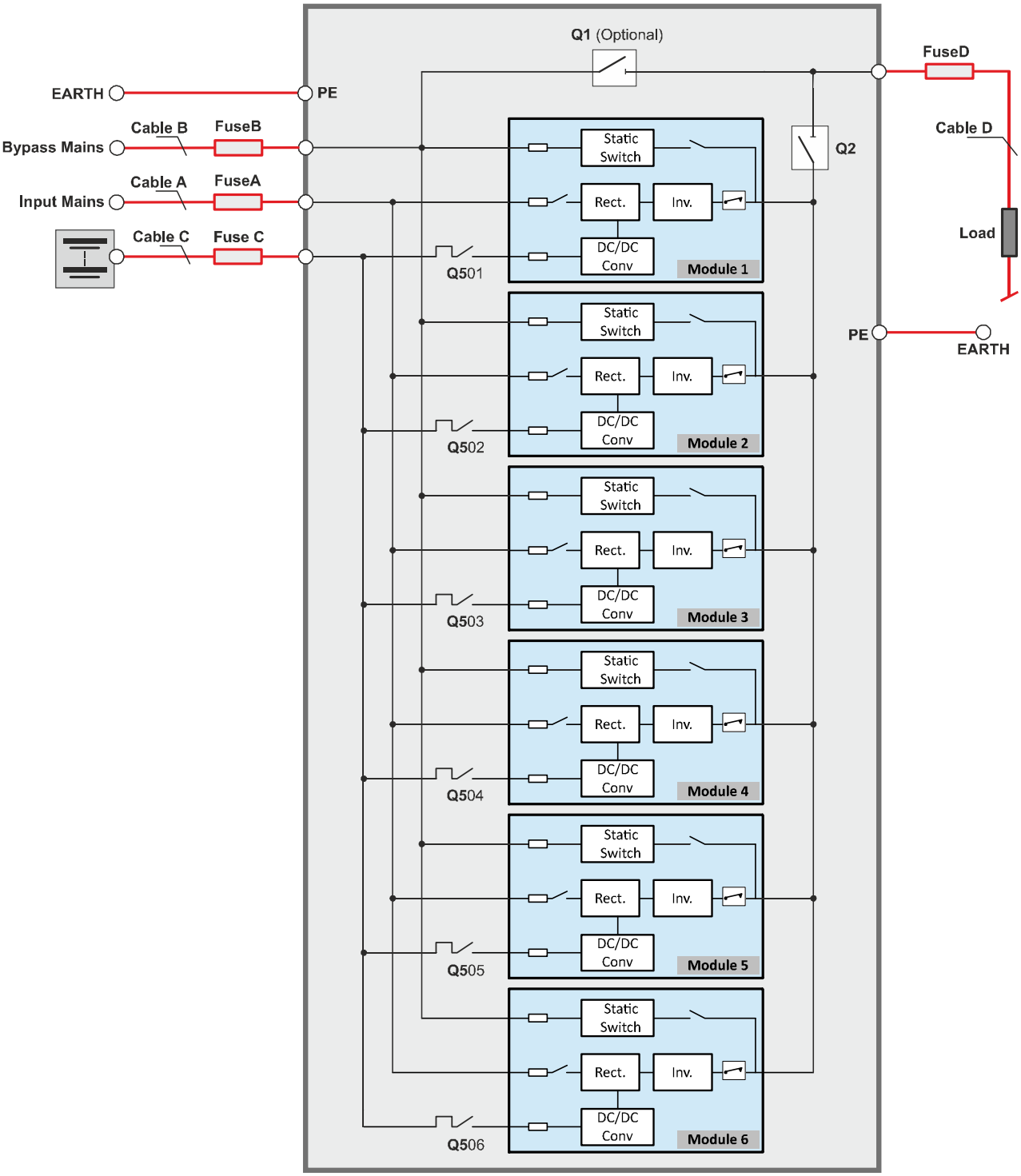


Figure 4.11 UPS cabinet cabling details for a dual-feed input and common battery

4.4.4 UPS cabinet cabling details for a dual-feed input and separate batteries

Table 4.6 Refer to Figure 4.12

UPS CABINET CONNECTIONS								
UPS Module Rating (kVA)			50	100	150	200	250	300
Cable A	1L1,1L2,1L3,1N, PE[a]	Input demand[b]	78A	157A	236A	314A	393A	471A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse A	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable B	1L1,1L2,1L3,1N, PE[a]	Bypass demand[c]	72A	144A	216A	288A	360A	433A
		Termination	5x M12					
		Tightening Torque	50-75 Nm					
Fuse B	Agl/CB	3x	80A	160A	250A	315A	400A	500A
Cable D	3L1,3L2,3L3,3N,PE[a]	Rated output[d]	72A	144A	216A	288A	360A	433A
		ermination	5x M12					
		Tightening Torque	50-75 Nm					
Cable E[e]	Q501-Q506, PE[a]	Nominal discharge current	90-110A for each UPS module					
		Termination	Circuit breaker screwed connections					
Fuse E[f]	Agl/CB	2x	(Nominal 125A for each UPS module -- see footnote)					

a.Protective Earth (PE) cable must be sized in accordance with local and national regulations
b.Rating shown for nominal 400V operation and batteries charging. See specification for 380/415V current ratings.
c.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.
d.Rating shown for nominal 400V operation at full load @ 1.0PF. See specification for 380/415V current ratings.
e.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).
f.Bespoke to site, depending on the DC installation (supplied by Kohler Uninterruptible Power).

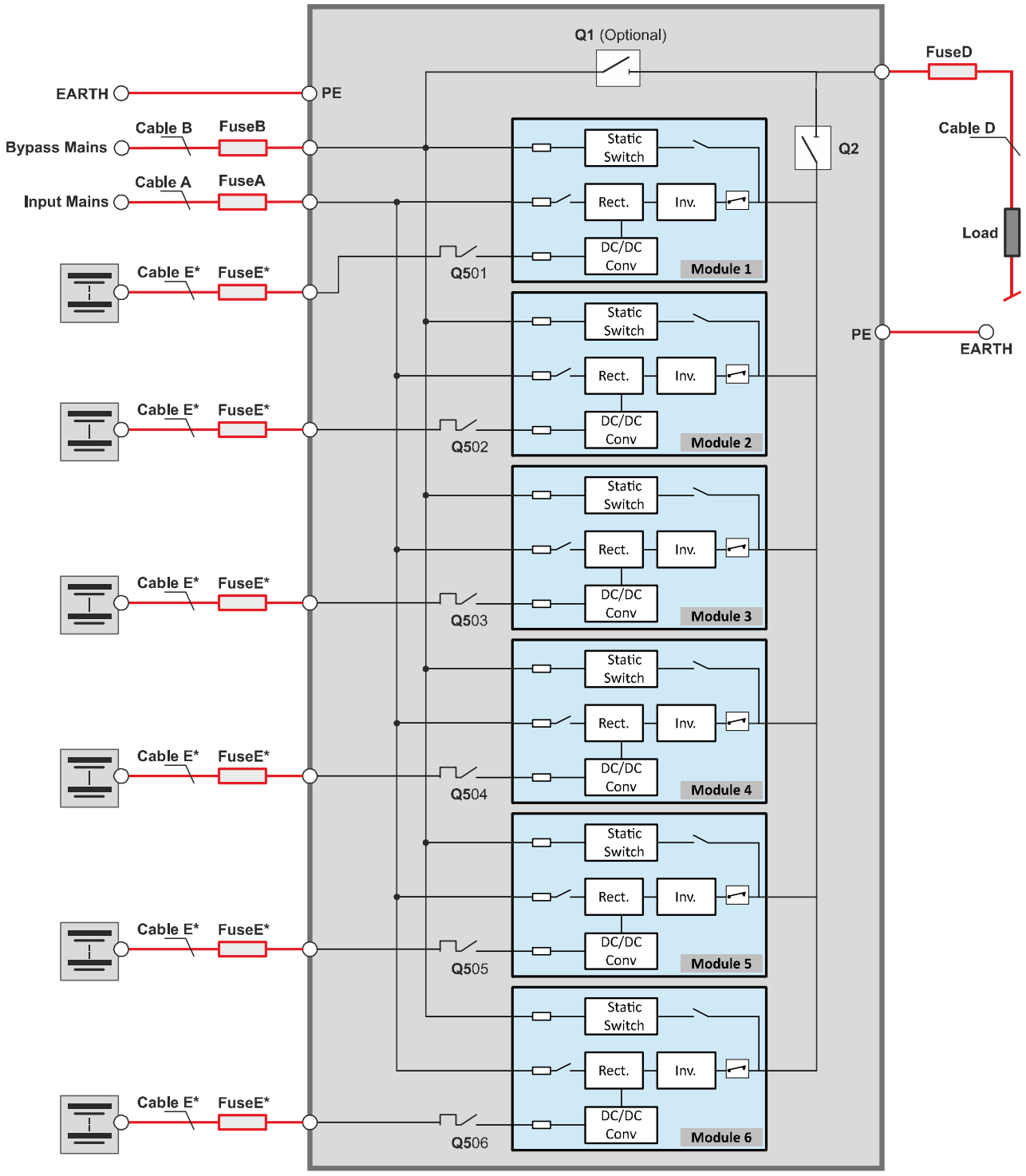


Figure 4.12 UPS cabinet cabling details for a dual-feed input and separate batteries

5 Installation Procedure

5.1 Introduction

This chapter contains essential information concerning the unpacking, positioning and cabling of the PW 9250DPA (50-300 kW) UPS system. Please read Chapter 4 before you begin this procedure as it contains key information regarding the UPS installation requirements.

Key Point: The UPS batteries are contained in an external cabinet or battery rack. This chapter does not include details for the installation of the battery containment system. Always refer to the installation manual provided by the supplier of the battery system for installation details.

WARNING: The customer installation team should not install the batteries or connect the dc cables between the UPS cabinet(s) and battery system. This MUST be carried out by the commissioning engineer.

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 any part of the UPS equipment before it has been fully commissioned and handed over to the customer.

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.

5.2 Taking receipt of the UPS

The UPS cabinet and accessories are delivered on a purpose designed pallet that is 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.*

The UPS cabinet is shipped in a cardboard or wooden container designed to protect it from mechanical and environmental damage. Further protection is provided by wrapping the equipment with a plastic sheet.

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 ordered optional equipment packages might be shipped inside the UPS cabinet.

Upon receiving the UPS you should immediately 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.

Figure 5.1 'Tiltwatch' indicators

5.2.1 Reporting transportation damage

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

If the 'TiltWatch' indicators are red, or there are other signs of suspected transportation damage, you must inform 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. Note that some optional equipment packages might be shipped inside the UPS cabinet and these too should be inspected.

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

5.2.2 Local transportation

Please observe the following precautions when you transport the UPS equipment after it has been off-loaded.

CAUTION: *Local transportation:*

- *When using a forklift or pallet jack to move the UPS cabinet on its pallet, ensure that the forks are fully inserted through the bottom of the pallet to lift the cabinet securely and prevent it from toppling over.*
- *When using a forklift or pallet jack to lift the UPS cabinet off its pallet, ensure that the forks are fully inserted squarely below the cabinet.*
- *When lifting, do not at any time tilt the cabinet by more than 10° from vertical.*

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.*

5.2.3 Storage

UPS Cabinet

If you plan to store the UPS cabinet 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 whose storage capacity depends on the ambient temperature. It is important not to store the batteries for longer than 6 months at 20°C, 3 months at 30°C, or 2 months at 35°C storage temperature without fully recharging them.

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

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!

- *Fully 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.*

5.3 Unpacking

Removing the standard UPS packaging *(see Figure 5.2)*

Store for later

1. Cut and remove the two green straps that secure the cardboard box in place.
2. Carefully remove the cardboard box by sliding it off the cabinet from bottom to top.
3. Cut the tape securing the four polystyrene fillets (A) then carefully remove the fillets without damaging them if possible.
4. Unwrap the plastic film and remove by pulling it over the top of the cabinet.
5. Remove the 4x angle brackets (B) securing the cabinet to the pallet.
6. Remove the retaining box (C) from the pallet.
7. Fit 4x adjustable feet to the inside angle of the cabinet legs and secure using 4x M8 tensilock nuts. The feet will be shipped in the accessories box or located inside the cabinet.

   Note: The adjustable feet is shipped in the cabinet's accessory box.
8. Fit the kick-plates (from the accessories package) to the lower front and back of the cabinet and secure in place using the screws provided.
9. Position the UPS in its intended final location and screw down the adjustable feet to anchor and level the cabinet.

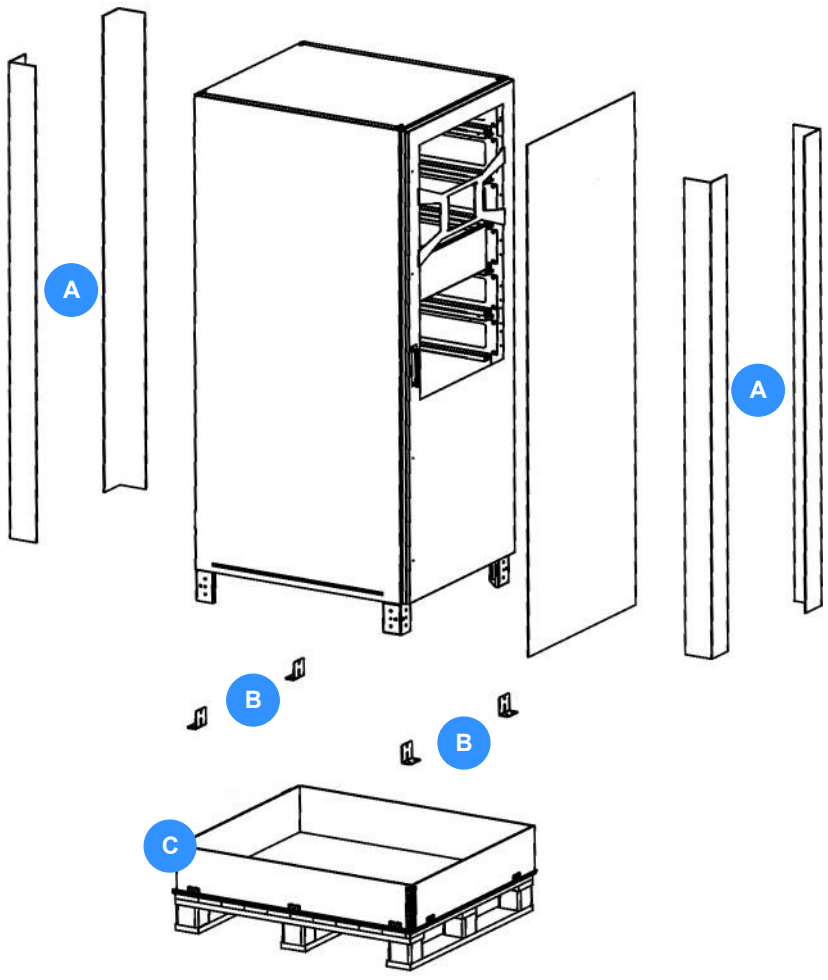


Figure 5.2 Unpacking the UPS cabinet (standard packaging)

Removing the sea freight UPS packaging

1. Use a screwdriver and a pair of pliers to carefully lift-up all the tabs around the top of the case (A).
2. Remove the lid (B).
3. Use a screwdriver and a pair of pliers to carefully lift-up the remaining tabs around the side and bottom of the case (C).
4. Remove the front panel (D) followed by the back panel (E) taking care to support the side panels to prevent them from falling.
5. Remove the side panels (F) and (G).
6. Remove the 8x polystyrene corner fillets (H) and the VCI bags.
7. Remove the accessories package – which should contain a user manual, 2 painted kick-plates (with screws), 4 feet and a set of door keys – from its shipping location beneath the cabinet.
8. Remove all the screws that secure the cabinet to the pallet angle brackets (I).
9. Lift the cabinet off the pallet and place on the floor.
10. Fit 4x adjustable feet to the inside angle of the cabinet legs and secure using 4x M8 tensilock nuts.
11. Position the UPS in its intended final location and screw down the adjustable feet to anchor and level the cabinet.

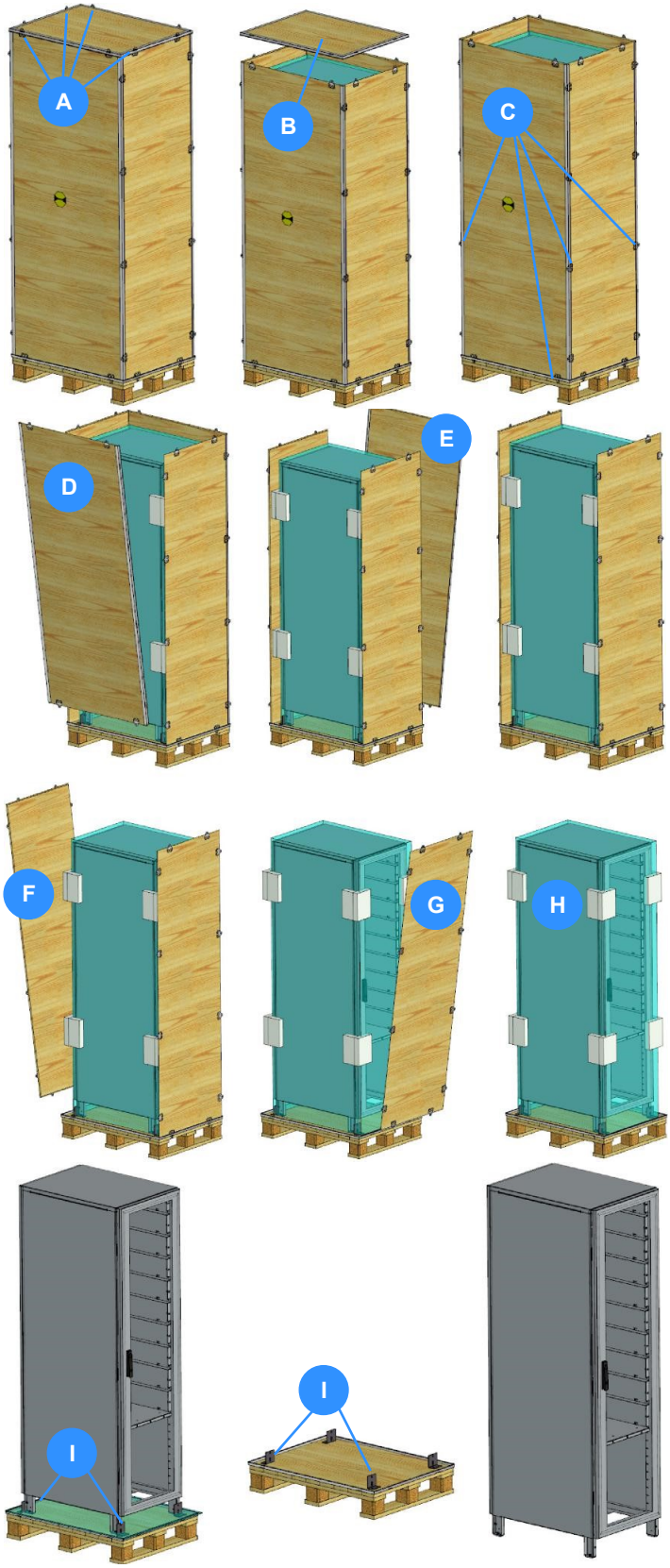


Figure 5.3 Unpacking the UPS cabinet (sea freight packaging)

5.4 UPS Cabling procedure

5.4.1 Safety notes

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

1. Do not connect the power cables before the UPS mechanical installation is completed.
2. All the cable installation procedures detailed below 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. Do not connect the battery system. This must be done by the commissioning engineer.
5. Before you work on the UPS power cables or terminals, you must familiarise yourself with the location and operation of the intended mains power sources to be connected to the UPS system and ensure that they are externally isolated and 'locked-out' at their respective distribution switchboards. Warning notices should be posted to prevent any inadvertent operation of the external supply isolators.
6. If an external maintenance bypass facility is used you should familiarise yourself with its operation and its input/output power connections as these determine the source and destination of the UPS input and output power cables. An external maintenance bypass facility is bespoke to the installation site, so no connection details are provided here.
7. Before you connect the UPS power cables, ensure that the external fuses and cables provided by the customer are suitably rated in accordance with the prescribed IEC standards or local regulations – for example BS7671.
8. 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.

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

9. 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 distribution board terminals.
   b) All loads are shut down and isolated at the UPS output load distribution board.
   c) The UPS is fully shut down and voltage-free.
   d) If fitted, the UPS Maintenance Bypass Isolator (Q1) is open (OFF).
   e) The UPS Parallel Isolator (Q2) is open (OFF).

5.4.2 Power cable connections

Two versions of the UPS cabinet are available, one uses bottom cable entry and the other uses top cable entry; however the layout of the power panel switches and busbars is identical for both models.

Figure 5.4 and Figure 5.5 show details for single feed and dual feed input connections respectively. Paragraph 4.4 onwards explains the various cabling configurations together with suitable fuse and cable ratings.

Single feed power connections *(see Figure 5.4)*

1. Gain access to the UPS power panel.
2. Ensure the dual feed links are fitted between X3 and X4.
3. Connect the input and output power cables as described below (starting with the earth cables (PE)).

INPUT MAINS		BYPASS MAINS		UPS OUTPUT		BATTERY
Cable	Busbar	Cable	Busbar	Cable	Busbar	
1L1	X3.1	–	–	3L1	X2.1	To be connected by the commissioning engineer
1L2	X3.2	–	–	3L2	X2.2	
1L3	X3.3	–	–	3L3	X2.3	
1N	X6.N	–	–	3N	X6.N	
PE	X7.PE	–	–	PE	X7.PE	

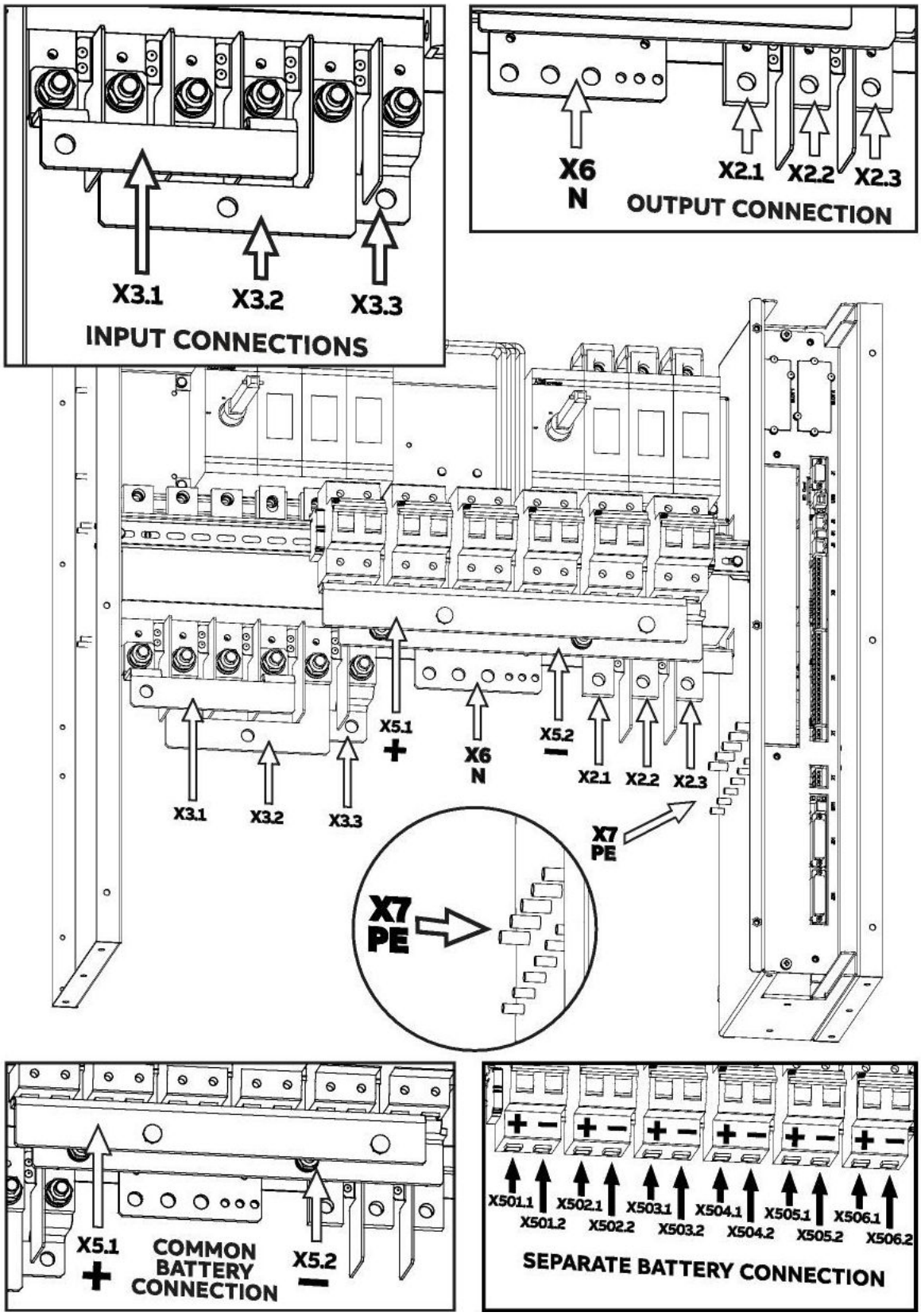


Figure 5.4 Connection details for a PW9250DPA single input feed

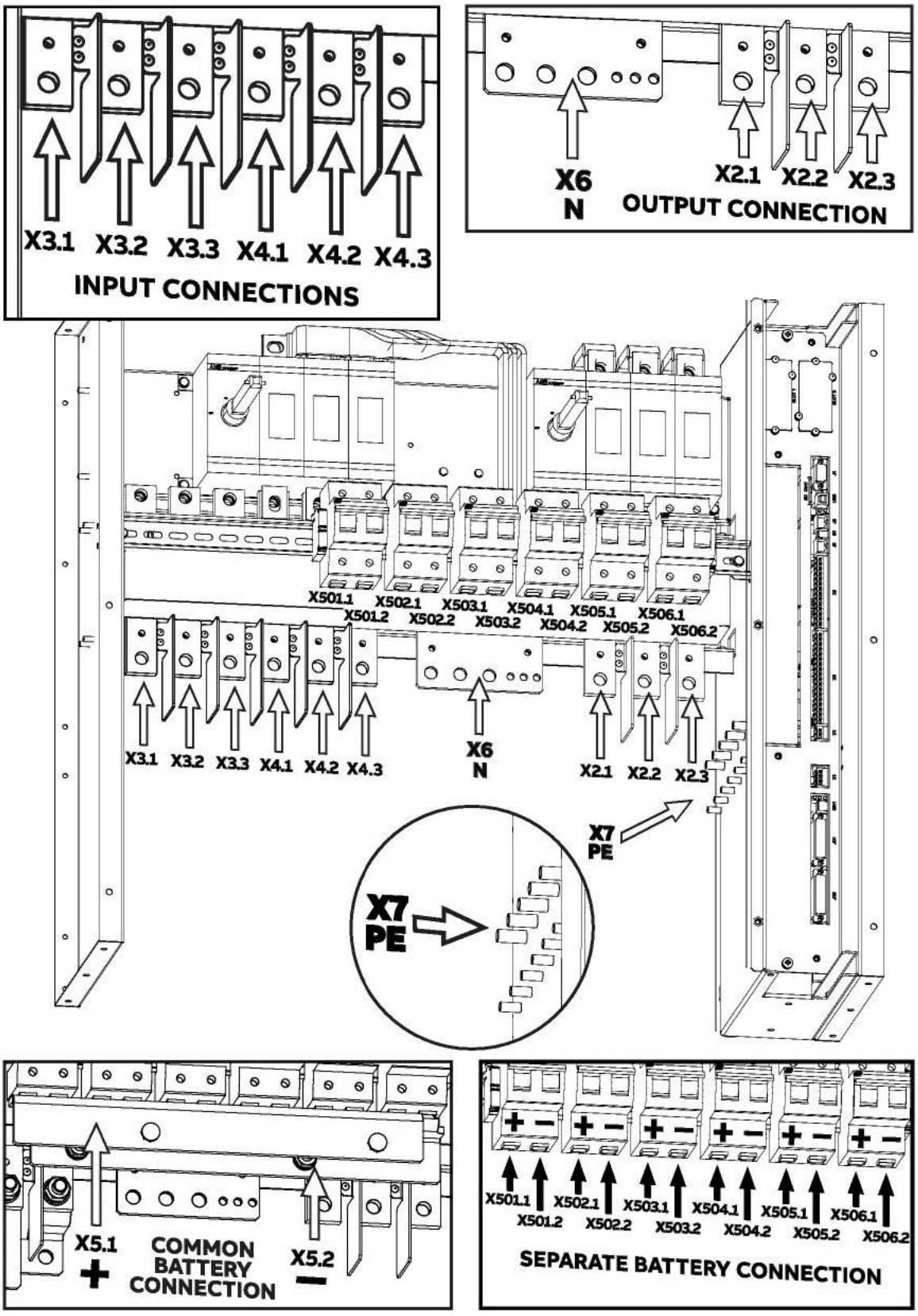


Figure 5.5 Connection details for a PW9250DPA dual input feed

Single dual power connections *(see Figure 5.4)*

1. Gain access to the UPS power panel.
2. Ensure the dual feed links are fitted between X3 and X2.
3. Connect the input and output power cables as described below (starting with the earth cables (PE)).

INPUT MAINS		BYPASS MAINS		UPS OUTPUT		BATTERY
Cable	Busbar	Cable	Busbar	Cable	Busbar	
1L1	X3.1	2L1	X4.1	3L1	X2.1	To be connected by the commissioning engineer
1L2	X3.2	2L2	X4.2	3L2	X2.2	
1L3	X3.3	2L3	X4.3	3L3	X2.3	
1N	X6.N	2N	X6.N	3N	X6.N	
PE	X7.PE	PE	X7.PE	PE	X7.PE	

Connecting the battery

IMPORTANT NOTE

The batteries must be installed and connected to the UPS by the 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 the DC power cables and install appropriate 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.

5.5 Remote monitoring and control facilities

5.5.1 Communications interface board

Various remote monitoring and control facilities can be connected to the communications interface board located adjacent to the UPS power panel. The external cables enter the cabinet through the cabinet floor or roof (depending on model) in the same manner as the power cables.

Although the connection and operation of all the optional communications features will be checked by the commissioning engineer when the UPS system is commissioned, the cables 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.

Alternatively, the cables can be laid but left for the commissioning engineer to connect.

Details of the interface facilities and other options are provided in Chapter 9.

6 Operating Instructions

6.1 Introduction

The PW 9250DPA (50-300 kW) 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
- fully test the system for correct operation
- provide operator training and hand over the system to the customer in a fully working condition – usually with all the UPS modules turned on and operating in the inverter mode (or bypass mode, if appropriate)

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.

6.1.1 Operating procedure summary

Under normal circumstances all the UPS modules are turned on and operating in the inverter mode. If a module fails, or is turned off, in a redundant module system it will not affect the remaining module(s), which will continue to operate normally and provide protected load power. The shut-down module can be replaced by a trained service engineer if necessary without affecting the operation of the remaining UPS system.

If a UPS module fails in a capacity (non-redundant) rated system the remaining modules may be overloaded, depending on the prevailing load demand. If such an overload is sustained the load will eventually transfer to the static bypass and thereby connected to the raw bypass mains power supply.

A multi-cabinet PW9250DPA installation requires an external maintenance bypass facility which wraps around the entire UPS system – this is optional for a standalone PW9250DPA cabinet. The external maintenance bypass installation is bespoke but usually contained in a separate cabinet or switchgear panel *(see page 39)*.

Important notes

- Although these procedures describe the UPS input/bypass supply fuses/breakers as being on an 'incoming mains distribution switchboard,' if the UPS system includes an external maintenance bypass facility these devices may be located within the external maintenance bypass installation.
- If an external maintenance bypass facility is installed you should familiarise yourself with its operation and use before using the UPS operating procedures in this chapter.
- All the cabinet switches and module control panel operations mentioned in this chapter are identified and described in Chapter 2. The door-mounted system control panel is described in Chapter 3.
- The actions described in these operating procedures generally refer to the module control panel fitted to the front of each UPS module but many of the operations, such as manual load transfer between inverter and bypass, alternatively can be carried out from the door-mounted system control panel *(see paragraph 3.2.3 on page 24)*.
- It is normal to receive some alarm activation at certain points in these procedures. When an alarm occurs you can accept the audible warning by pressing the `BACK (RETURN)` button on the module control panel or the triangular `WARNING` icon on the system control panel header bar. If you are unable to clear an alarm as expected then please seek technical assistance.

This chapter contains the following procedures:

6.1.2 General warnings

WARNING: The procedures given below must be performed by a trained operator.

WARNING: When the UPS system is operating on BYPASS or via the MAINTENANCE BYPASS SWITCH, the load supply will be unprotected if the bypass mains supply fails. It is essential that the load user is informed of this possibility before you intentionally select 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 switchgear panel. In a standalone cabinet installation it is not permissible to turn off the external bypass mains supply if the load is connected via the internal maintenance bypass switch (Q1) as this will also disconnect the load power.

IMPORTANT NOTE

In the following procedures, all references to the 'Maintenance Bypass Switch' apply to the internal maintenance bypass switch (Q1) a standalone UPS cabinet if it is not connected to an external maintenance bypass facility.

If an external maintenance bypass facility is installed (standard in a multi-cabinet system) all references to the 'Maintenance Bypass Switch' used in these procedures apply to the maintenance bypass switch in the external facility.

It is important that you should familiarise yourself with the operation of any external maintenance bypass circuit before using these procedures.

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

Key Point: In order to reduce the possible effects of high inrush currents that might occur when the load is initially turned on, we recommend that you initially power-up the load when the UPS system is operating on the maintenance bypass before transferring it to the UPS inverter(s), as described in this procedure.

Summary

This procedure describes the sequence of actions required to start the UPS system from a totally powered down condition. That is, where both the UPS and load are initially unpowered.

The procedure has three stages each of which must be passed successfully before progressing to the next:

- Power up the load via the UPS maintenance bypass supply.
- Start the UPS modules – in ALL cabinets in a multi-cabinet system.
- Transfer the load from the maintenance bypass to the static bypass, and then to the UPS inverters.

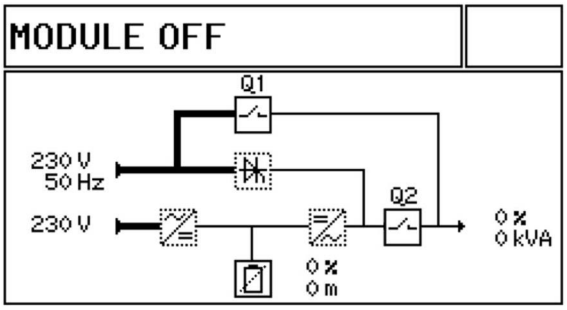
Initial conditions:

This procedure assumes the following initial conditions (for each cabinet in a multi-cabinet system):

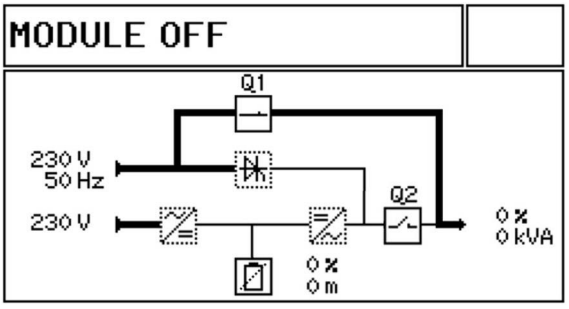
- The UPS maintenance bypass switch is open.
- The external UPS output isolator on the load distribution panel is open (OFF).
- The UPS input/bypass supply fuses/breakers are open (OFF) at the incoming mains distribution switchboard.
- The UPS cabinet(s) parallel isolator (Q2) is open (OFF).
- The UPS cabinet(s) internal battery breakers (Q501 – Q506) are open (OFF).
- The DC fuses/breakers fitted in the battery cabinets/racks are open (OFF).

Power-up the load:

1. Close the UPS input/bypass fuses/breakers at the incoming mains distribution switchboard – for ALL cabinets in a multi-cabinet system.
   a) Power is now applied to the UPS modules but the modules are turned OFF.
   b) The module control panel mimic should appear as shown here – for ALL modules.



2. On the module control panels verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is OFF.
   d) The BATTERY LED is flashing red.
3. Close the external UPS output isolator on the load distribution panel.
4. Close the UPS maintenance bypass switch *(see the IMPORTANT NOTE on page 58)*.
   a) The module control panel mimic of all modules should appear as shown here.



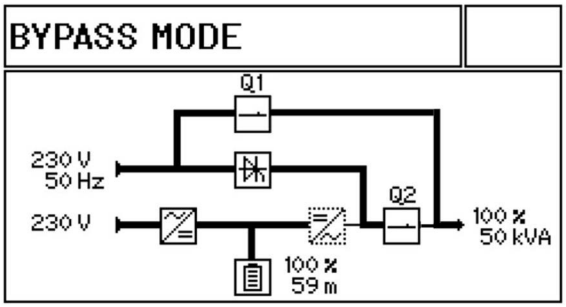
5. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED changes to yellow.
   d) The BATTERY LED is flashing red.
   e) The message MAN BYP CLOSED is registered in the module event log.
6. Turn on the load equipment.

   Note: We recommend turning on the largest loads first where possible.
   a) The load is now powered through the unprotected maintenance bypass supply.
   b) Check the output metering to ascertain that the load demand is within the UPS system rating.

Start the UPS modules:

7. Close the UPS cabinet parallel isolator (Q2) (in every cabinet in a multi-cabinet system).
8. Check that the UPS cabinet internal battery breakers (Q501 – Q506) are open (OFF).
9. Close the battery fuses/breakers fitted in the battery cabinets/racks.
10. Complete steps 11 to 13 below for each module in turn.
11. On the module control panel, press the ON/OFF button to start the module.
    a) The UPS module will power up over approximately 60 seconds and operate in its bypass mode. At this stage, the load is being supplied by the maintenance bypass in parallel with the module's static bypass.

12. Close the cabinet's internal battery breaker (Q50x) associated with the module being started.
    a) The BATTERY LED should flash green.
    b) Wait (up to 2 minutes) for the module to recognise the battery, whereupon the BATTERY LED will change to solid green and begin charging.
    c) Once the battery is recognised, the module control panel mimic should appear as shown here.



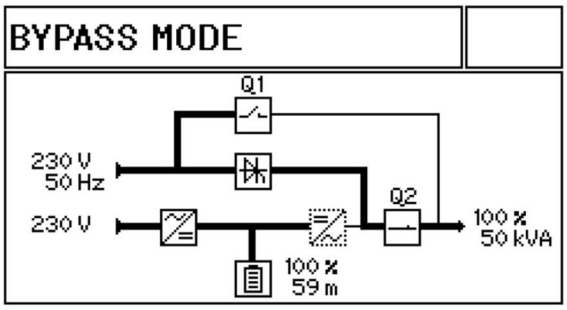
13. On the module control panel verify that:
    a) The RECTIFIER LED is green.
    b) The BYPASS LED is green.
    c) The LOAD LED is yellow.
    d) The BATTERY LED is green and charging.
14. Before you continue, ensure that the indications on the module control panels of ALL modules are identical and as shown above.

Transfer the load to inverter:

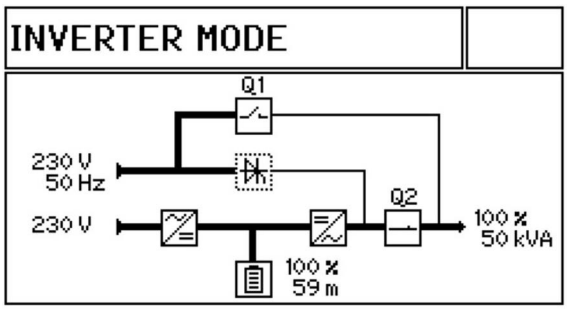
15. Only proceed if the module control panel BYPASS LED is green on ALL modules.

    Note: If the BYPASS LED is not green, repeat step 10 then seek trained advice if you still have a problem.

16. Open the maintenance bypass switch *(see the IMPORTANT NOTE on page 58)*.
17. The load is now being powered through the UPS static bypass alone, and the module control panel mimic should appear as shown here.
    a) The message MAN BYP OPENED is registered in the module event log.
    b) Check the UPS input and output metered parameters to ensure that they are correct.
    c) Note any active alarms and take appropriate actions if an alarm cannot be reset.



18. 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 then press the ENTER key.
    c) Use the UP/DOWN keys to move the cursor so that it is adjacent to LOAD TO INVERTER then press the ENTER key.
19. The UPS modules should transfer their output from bypass to inverter and the module control panel mimic of all modules should appear as shown here.
20. On the module control panel verify that:
    a) The RECTIFIER LED is green.
    b) The BYPASS LED is green.
    c) The LOAD LED is changes to green.
    d) The BATTERY LED is green and charging.
    e) The message INVERTER MODE SELECTED is registered in the module event log



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Key Point: The UPS System is now in inverter mode and providing the load with processed, protected power.

6.3 How to start the UPS system from the maintenance bypass

Summary

This procedure describes the sequence of actions required to re-start the UPS system if it had been shut down for operational reasons whilst supporting the load via the unprotected maintenance bypass supply.

This is very similar to the previous procedure, *"How to start the UPS system from a fully powered-down condition"*, except that in this case the maintenance bypass switch is already closed.

Initial conditions:

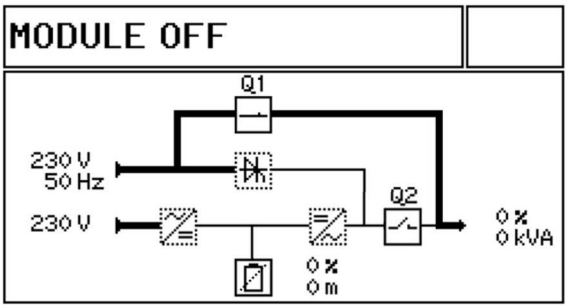
This procedure assumes the following initial conditions.

- The load equipment is turned on and receiving power through the maintenance bypass.
- For a standalone cabinet: the bypass mains supply is live. The input mains supply is live in a single input feed configuration but may not be live in a dual feed input configuration.
- In a multi-cabinet system: the UPS cabinet input/bypass mains supplied may or may not be live, depending on the state of the external maintenance bypass switchgear.
- The UPS cabinet(s) parallel isolator (Q2) is open (`OFF`).
- The UPS cabinet(s) internal battery breakers (Q501 – Q506) are open (`OFF`).
- The DC fuses/breakers fitted in the battery cabinets/racks are open (`OFF`).

Key Point: If the load is not already turned on, turn it on now, while the UPS system is operating on maintenance bypass before you begin this procedure.

Powering up the UPS cabinet:

1. Ensure that the UPS input/bypass fuses/breakers at the incoming mains distribution switchboard (or external maintenance bypass switchboard) are closed (`ON`) – for ALL cabinets in a multi-cabinet system.
2. With the input mains power now applied, the module control panel mimic of all modules should appear as shown here.
3. On the module control panel verify that:
   a) The `RECTIFIER` LED is green.
   b) The `BYPASS` LED is green.
   c) The `LOAD` LED is changes to yellow.
   d) The `BATTERY` LED is flashing red.



Start the UPS modules:

4. Start the UPS modules as described in paragraph 6.2 (*"How to start the UPS system from a fully powered-down condition"*) beginning at step 7.

Transfer the load to inverter:

5. Transfer the load to the inverters as described in paragraph 6.2 (*"How to start the UPS system from a fully powered-down condition"*) beginning at step 15.

Key Point: The UPS System is now in inverter mode and providing the load with processed, protected power.

6.4 How to transfer the load to the maintenance bypass

Summary

It may be necessary to transfer the load to the maintenance bypass supply to perform certain service or maintenance operations – for example, when replacing a UPS module in a capacity (non-redundant) rated system. This procedure is normally carried out by a trained service engineer and is not usually part of the day-to-day management of the UPS system.

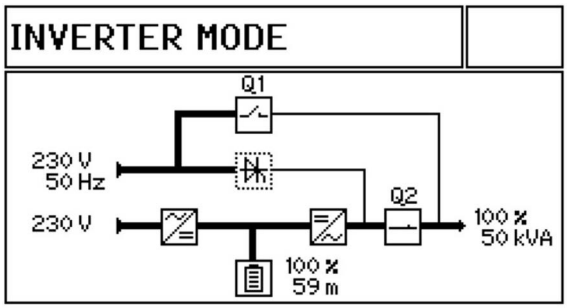
CAUTION: *Before you carry out this procedure, warn the critical load user that the load will not be supplied with processed, backed-up power once the transfer to maintenance bypass has been performed.*

Initial conditions:

This procedure assumes one of the following initial conditions.

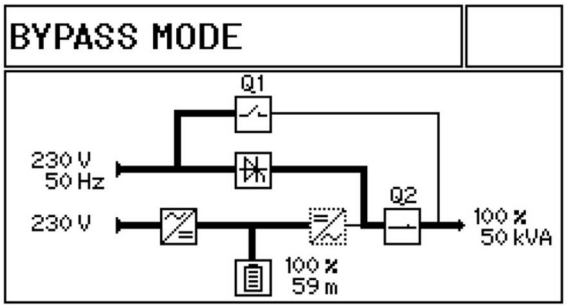
1. The UPS system is operating in inverter mode, with the load powered by the UPS inverters (shown here).

   In which case continue with step 3 below:



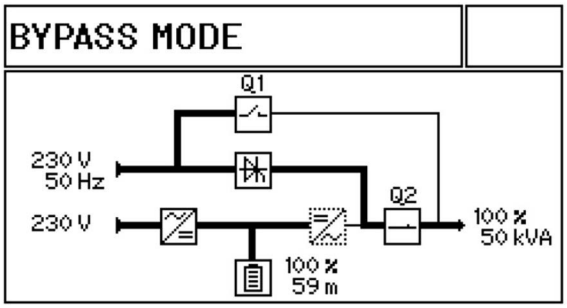
2. The UPS system is operating in bypass mode, with the load ‘powered through the static bypass due to either:
   - a system fault
   - severe overload
   - loss of redundancy
   - or operating in ‘ECO’ mode

   In which case continue with step 6 below:



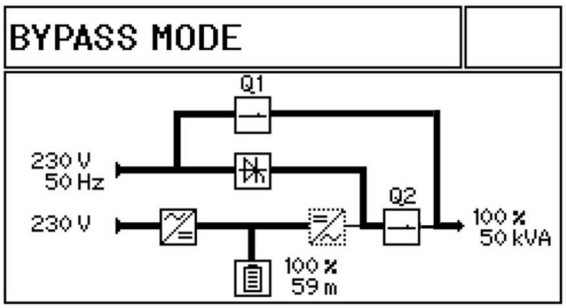
Transfer the load to the UPS static bypass:

3. 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 BYPASS` and then press the `ENTER` key.
4. The UPS will transfer the load to the static bypass, and the module control panel mimic should appear as shown here.
5. On the module control panel verify that:
   a) The `RECTIFIER` LED is green.
   b) The `BYPASS` LED is green.
   c) The `LOAD` LED is changes to yellow.
   d) The `BATTERY` LED is green and charging.



Transfer the load to maintenance bypass:

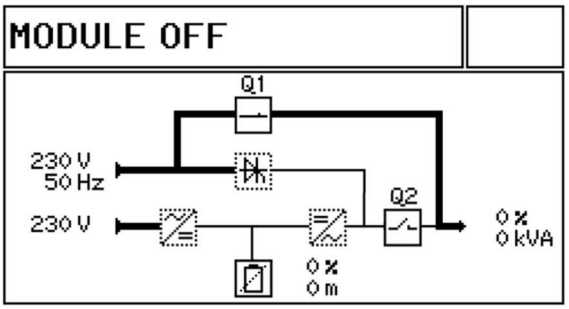
6. Close the maintenance bypass switch *(see the IMPORTANT NOTE on page 58)*.
7. The load is now being powered through maintenance bypass switch in parallel with the UPS static bypass, and the module control panel mimic should appear as shown here.



8. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is yellow.
   d) The BATTERY LED is green and charging.
   e) The message MAN BYP CLOSED is registered in the module event log.

Turn off the UPS modules:

9. Turn OFF each UPS module in turn by pressing the ON/OFF button for 3 seconds.
10. Once all modules are turned OFF, open the internal battery breakers (Q501 - Q506).
11. Open the DC fuses/breakers fitted in the battery cabinets/racks.
12. Open the UPS cabinet parallel isolator (Q2) – in every cabinet in a multi-cabinet system.
13. The UPS system is now operating on maintenance bypass with the modules turned OFF. The module control panel mimic of all modules should appear as shown here.



14. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is yellow.
   d) The BATTERY LED is flashing red.

Key Point: The load is unprotected against mains supply aberrations or outage.

WARNING: When using the internal maintenance bypass switch (Q1) a standalone cabinet installation, the UPS bypass mains supply must remain ON in order to provide power at the UPS output terminals. This means that the UPS cabinet will contain live mains voltages at all times and care should be taken when working inside the cabinet.
DO NOT OPEN THE BYPASS MAINS SUPPLY FUSES/ CIRCUIT BREAKER.

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

6.5 How to completely shut down the UPS system

Summary

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

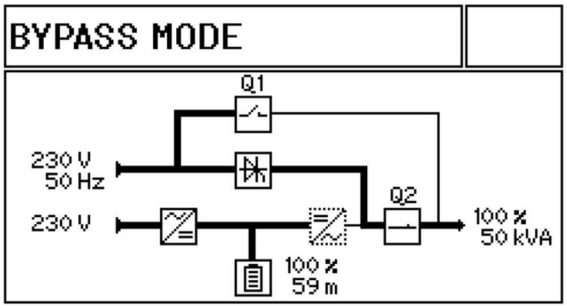
CAUTION: *Before you carry out this procedure, warn the critical load user that power is about to be disconnected.*

Isolate the load

1. Turn OFF the load equipment.
2. Open the external UPS output isolator on the load distribution panel.
3. Depending on the current operating mode:
   a) If the system is in 'inverter mode' continue with step 4.
   b) If the system is in 'bypass mode' (static bypass) continue at step 7.
   c) If the system is on maintenance bypass continue at step 12.

If the UPS is currently operating in inverter mode:

4. 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 BYPASS and then press the ENTER key.
5. The UPS will transfer the load to the static bypass, and the module control panel mimic should appear as shown here.
6. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is changes to yellow.
   d) The BATTERY LED is green and charging.



Turn off the UPS modules:

7. Turn OFF each UPS module in turn by pressing the ON/OFF button for 3 seconds.
8. Once all modules are turned OFF, open the internal battery breakers (Q501 - Q506).
9. Open the UPS cabinet parallel isolator (Q2) – in every cabinet in a multi-cabinet system.
10. Open the DC fuses/breakers fitted in the battery cabinets/racks.
11. Open The UPS input/bypass supply fuses/breakers at the incoming mains distribution switchboard.

Open the maintenance bypass switch:

12. Open the maintenance bypass switch, if closed *(see the IMPORTANT NOTE on page 58)*.

WARNING: The UPS system is now completely shut down. Wait at least 5 minutes to allow the UPS AC and DC capacitors to completely discharge before gaining internal access to the UPS cabinet power sections.

6.6 Operating in ECO mode

Summary

When operating the UPS system in ECO mode, the load is normally powered through the UPS bypass supply (in bypass mode) and automatically switches over to inverter mode if the bypass supply fails. Then, if the bypass supply returns to normal while the UPS is operating in inverter mode it will automatically transfer back to bypass mode

When operating the UPS system in ECO mode you can manually transfer the system between bypass mode and inverter mode at any time – for example, if the load required additional power security.

CAUTION: *When operating the UPS in ECO mode there will be a very short supply break when the UPS automatically switches from bypass mode to the inverter mode due to a bypass mains failure, so you should only choose to operate the system in the ECO mode if the load equipment can withstand a brief supply break.*

6.6.1 How to turn on the UPS system and operate in ECO mode

Starting from a fully powered down state:

1. If you are starting from a fully powered down state, follow the standard UPS system start-up operating instructions in paragraph 6.2 but do not perform the *"Transfer the load to inverter:"* stage (step 15 onwards).

Starting from load on maintenance bypass

1. If you are starting from the load being initially powered through the maintenance bypass, follow the standard UPS system start-up operating instructions in paragraph 6.3 beginning but do not perform the *"Transfer the load to inverter:"* stage (step 5 onwards).

6.6.2 How to shut down the UPS system when operating in bypass mode

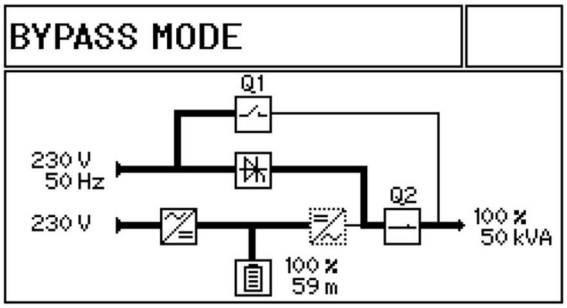
1. Follow the standard UPS system shut down operating instructions in paragraph 6.5.

6.6.3 How to manually transfer between bypass mode and inverter mode

The UPS can be manually switched between the 'bypass mode' and 'inverter mode' mode through the module control panel load transfer menu.

To transfer the UPS system from inverter mode to bypass mode:

1. 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 BYPASS` and then press the `ENTER` key.
   d) The UPS will transfer the load to the static bypass, and the module control panel mimic should appear as shown here.

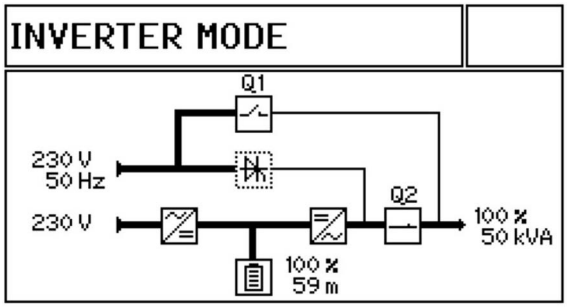


2. On the module control panel verify that:
   a) The `RECTIFIER` LED is green.
   a) The `BYPASS` LED is green.
   b) The `LOAD` LED is changes to yellow.
   c) The `BATTERY` LED is green and charging.

Key Point: The UPS System is now in bypass mode and the load power is unprocessed.

To transfer the UPS system from 'bypass mode' to 'inverter mode':

3. 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.
4. The UPS modules should transfer the load to the inverters and the module control panel mimic of all modules should appear as shown here.
5. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is changes to green.
   d) The BATTERY LED is green and charging.



Key Point: The UPS System is now on inverter and providing the load with processed, protected power.

6.7 Individual module stop/start procedure (redundant system only)

Summary

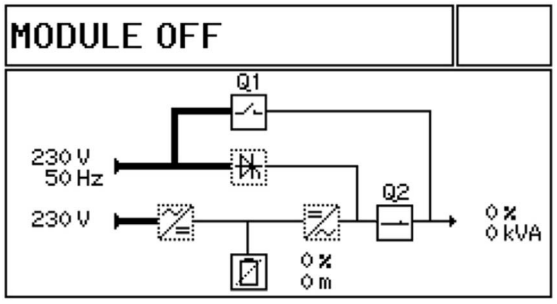
If the UPS system is operating with module redundancy it is possible to turn off one UPS module without affecting the overall system operation.

Situations where this might be put into effect are usually managed by a qualified service engineer when undertaking service checks or module replacement. However, under certain circumstances there may be a case for an individual module to be turned off by the user. For example, if a large proportion of the load is to be shut down for a significant period the number of on-line modules in the UPS system might be reduced to save on the utility power demands – although this particular scenario is better covered using the inbuilt Xtra VFI feature.

WARNING: If you turn OFF a module in a capacity (non-redundant) system the load will transfer to the unprotected bypass supply.

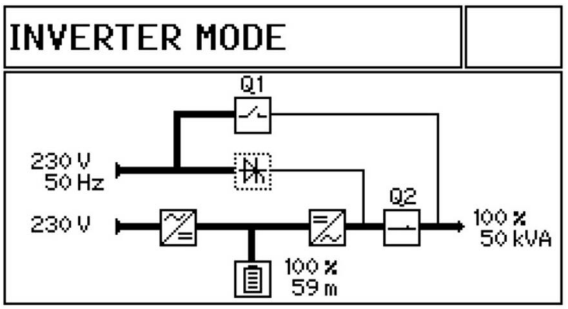
To turn off a UPS module:

1. Turn OFF the UPS module by pressing the ON/OFF button for 3 seconds.
2. Open the module's associated internal battery breaker (Q50x).
3. The UPS module is now turned OFF and its module control panel mimic should appear as shown here.
4. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is OFF.
   d) The BATTERY LED is flashing red.



To turn on a UPS module:

1. On the module control panel, press the ON/OFF button to start the module.
   a) The UPS module will run through it's start-up sequence over approximately 60 seconds and once it has passed all of its self-checks and synchronised to the on-line system it will turn on its inverter.
2. Close the internal battery breaker (Q50x) associated with the module being started.
   a) The BATTERY LED should flash green.
   b) Wait (up to 2 minutes) for the module to recognise the battery, whereupon the BATTERY LED will change to solid green and begin charging.
   c) Once the battery is recognised, the module control panel mimic should appear as shown here.
3. On the module control panel verify that:
   a) The RECTIFIER LED is green.
   b) The BYPASS LED is green.
   c) The LOAD LED is green.
   d) The BATTERY is green and charging.



6.8 Cold start

Summary

The ‘cold start’ feature allows the UPS modules to be started using battery power without the presences of the UPS input mains supply – i.e. when the UPS is turned OFF. As the battery is immediately placed on load when starting in this manner the UPS run time is limited.

This option is typically used in applications where the UPS output voltage is feeding the control switching of the input mains supply, for example a motorised contactor, in which case in a total blackout situation or during the first start-up application the battery is used to feed the inverter in order to supply the output voltage that is necessary to operate the application of the input mains supply.

To ‘cold-start ‘a module (battery switch preparation)

1. Ensure that the UPS upstream and downstream protection devices are operating correctly for the protection of the UPS and load.
2. Ensure that internal battery breakers (Q501 - Q506) are open.
3. Ensure that the DC fuses/breakers fitted in the battery cabinets/racks are closed.
4. With the battery fuses/breakers in the conditions stated above, wait for at least 60 seconds then close the internal battery breakers (Q501 - Q506).
   a) This will apply power to the UPS control board.
   b) The UPS control board will remain live (from battery power) for 10 minutes.
5. Ensure that the UPS cabinet parallel isolator (Q2) is closed – in every cabinet in a multi-cabinet system
6. Turn ON the UPS module(s) in turn by pressing the `ON/OFF` button on the module control panel(s).
   a) The message `START UP FROM BAT` is registered in the module event log.
7. Once the UPS inverters are operations, if the UPS cabinet input mains supply is not established automatically then turn ON the input mains supply from the external distribution switchboard.

7 Maintenance

7.1 Introduction

WARNING: The procedures described in this chapter must be performed by an authorised engineer/Kohler Uninterruptible Power approved engineer 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 calibrated on a 6 monthly basis as part of a preventative maintenance schedule to maximise the system's performance, working life and reliability.

7.2 User responsibilities

The UPS equipment should be inspected daily to ensure that its operating environment is kept cool and dust free, and the operating temperature and humidity is within the equipment's specified operating range. The UPS equipment should also be maintained in accordance with the manufacturer's recommendations and any life limited components replaced at the required intervals and critical updates 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.

7.3 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 inside the front of 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 – see the extended warranty information at the front of this manual.

A preventative maintenance inspection carried out as part of an Extended Warranty Agreement typically includes the following checklist:

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

7.4 Battery testing

A battery test can be initiated from the UPS control panel and takes approximately 3 minutes to complete.

The battery test procedure, which can be carried out irrespective of the UPS operating mode 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.

8 Troubleshooting

8.1 Introduction

A number of internal and external UPS parameters and conditions are monitored and any changes are recorded in the UPS module's 'event log.' These include changes in the UPS operating mode (e.g. "Manual byp is closed"), abnormal operating conditions (e.g. "Mains bypass fault") or direct UPS faults (e.g. "Inv. Phase fault"). Most abnormal and fault conditions are accompanied by an audible warning and an 'alarm' indication on the UPS module control panel and the door-mounted system control panel.

8.1.1 Alarms

Figure 8.1 illustrates the alarm leds and reset buttons on the module control panel (top) and system control panel.

The alarm icon on the system control panel header bar is displayed only when an alarm is active. This icon also acts as a touch-button which, when pressed, mutes the audible warning and opens up the `Events log` which shows the alarm details.

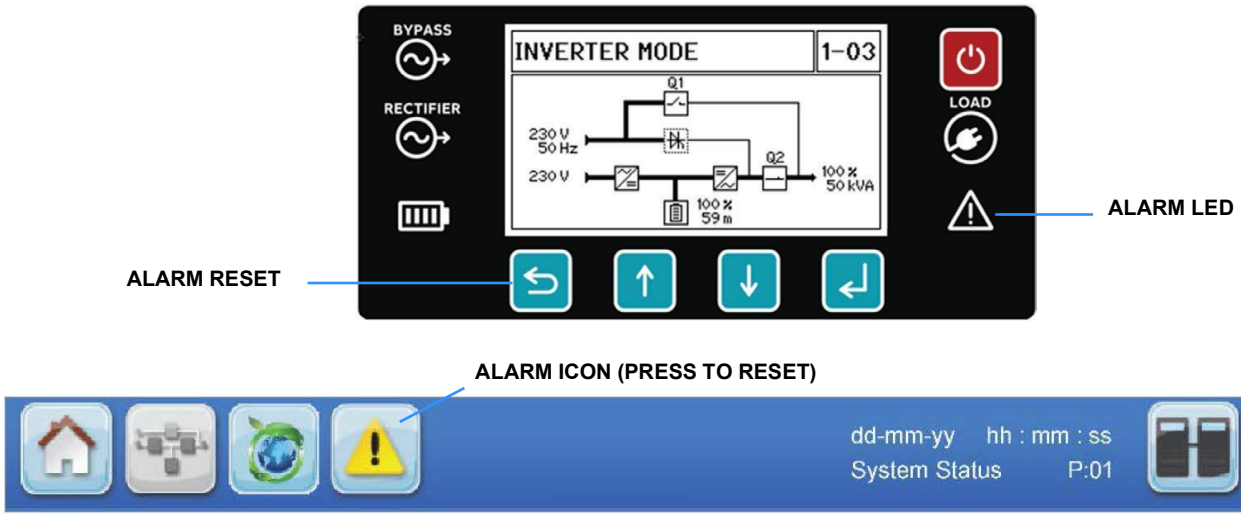


Figure 8.1 Control panel alarms

8.1.2 Events log

The event log for an individual UPS modules can be viewed on the module control panel by selecting `Event log` from the main menu then scrolling through the time-stamped event history *(see page 17)*.

A system-wide events log can be viewed by pressing the `Events` button on the door-mounted system control panel `HOME` screen. This will open an events log screen which displays a chronological list of events triggered by any UPS module in the system, with the source of each event identified by module number, as described on page 22.

8.2 Troubleshooting procedure

If an alarm occurs we recommend you take the following actions:

1. Attempt to RESET the alarm.
   a) The audible warning should mute.
   b) If the alarm condition is no longer present the alarm led/icon should extinguish.
   c) If the alarm led/icon does not extinguish it indicates that the detected alarm condition is still active

   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 RECT FAULT` alarm will activate and the alarm led/icon and audible warning may still be active even after the mains supply has returned to normal. Similarly, an `OVERLOAD` alarm might have been caused by a brief inverter overload.

   If any alarm appears, the first action to take is to always attempt to `RESET` it.

   If the alarm resets then it was probably caused by a transient condition – i.e. the UPS has responded correctly to events 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.
2. Note and record any available information that might help diagnose the problem.
   a) Access the `Event logs` and note the latest sequence of events.
   b) Note and record the condition of the status leds on the module control panel and any other indications on the module control panel and system control panel.
   c) Note and record the indicated input, output and battery supply parameters on the control panel meters.
3. Seek assistance from your nearest service centre if the cause of the alarm is beyond the simple rectification measures suggested in the troubleshooting table below.

8.3 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.
SYNCHRON. FAULT	The inverter and mains are not synchronised	The frequency of the UPS input mains supply is outside the configured UPS operating limits and the UPS static bypass has been temporarily disabled. Call the authorised service centre for assistance if this is a repetitive problem.
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.

8.4 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.
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

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.

9 Options

9.1 UPS Communication facilities

A communications interface board, located adjacent to the power switch panel, 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. All the communications interface board connections are accessible from the front of the UPS cabinet.

9.1.1 UPS internal system communications

In addition to providing connectivity with external systems and devices, the communications interface board also contains several connectors that are used for inter-cabinet communication in a multi-cabinet system. The following 'internal system' interfaces are connected and configured by the commissioning engineer and should not be disconnected or changed in any way by the user.

Graphical display connection (J3) – interfaces the UPS control system I/O with the system control panel – only used in a standalone cabinet and in the master cabinet in a multi-cabinet system.

RS485 Multidrop connector (J2) – the 'multidrop' feature is used in a multi-cabinet system only. It allows the customer interface board in the master cabinet to collect data/messages from the other system cabinets.

Parallel bus connector (JD1/JD2) – in a multi-cabinet installation cables are connected between JD1 and JD2 in each cabinet in a 'ring' configuration. These cables form a 'parallel control bus' that is accessed by every cabinet to allow functions such as load sharing and frequency synchronisation to be performed.

Configuration DIP switches

DIP switches S1 and SW1 are used to configure the communications interface board in a multi-cabinet system – e.g. to set 'master/slave' operation. They will be set by the commissioning engineer and should not be changed thereafter.

Status LEDs

Two LEDs on the communications interface board indicate the board's operating status:

- the green led indicates the UPS cabinet's master/slave status in a multi-module system
  – flashing twice/sec = interface is master (1st cabinet)
  – flashing once/sec = Interface is slave (2nd.... 5th cabinet)
- when lit, the red led signifies a communications interface board malfunction

9.1.2 Customer connections

The following connections can be used by the customer to interface the UPS system with a range of external devices and control/monitoring systems – each one is described in detail on the following pages.

Dry port output connections (X2) – various UPS alarms status signals are made available on terminal block X2. These volt-free outputs are suitable for connecting to an external alarm panel or building management system.

Wired input connections (X3) – a range of external control inputs can be connected to terminal block X3 to implement particular UPS control functions such as a remote shutdown.

RS232 and USB serial ports (J1/USB) – RS232 and USB serial ports allow the UPS to be connected to a computer for monitoring purposes. These ports process the same data stream and only one port should be used at any particular time.

Network interface card slots (Slots 1/2) – two network interface card slots are provided to enable the UPS to be connected to a local or wide area network (LAN/WAN) using a compatible SNMP/Ethernet interface card. This allows the UPS system to be incorporated into a network management system for control and monitoring purposes.

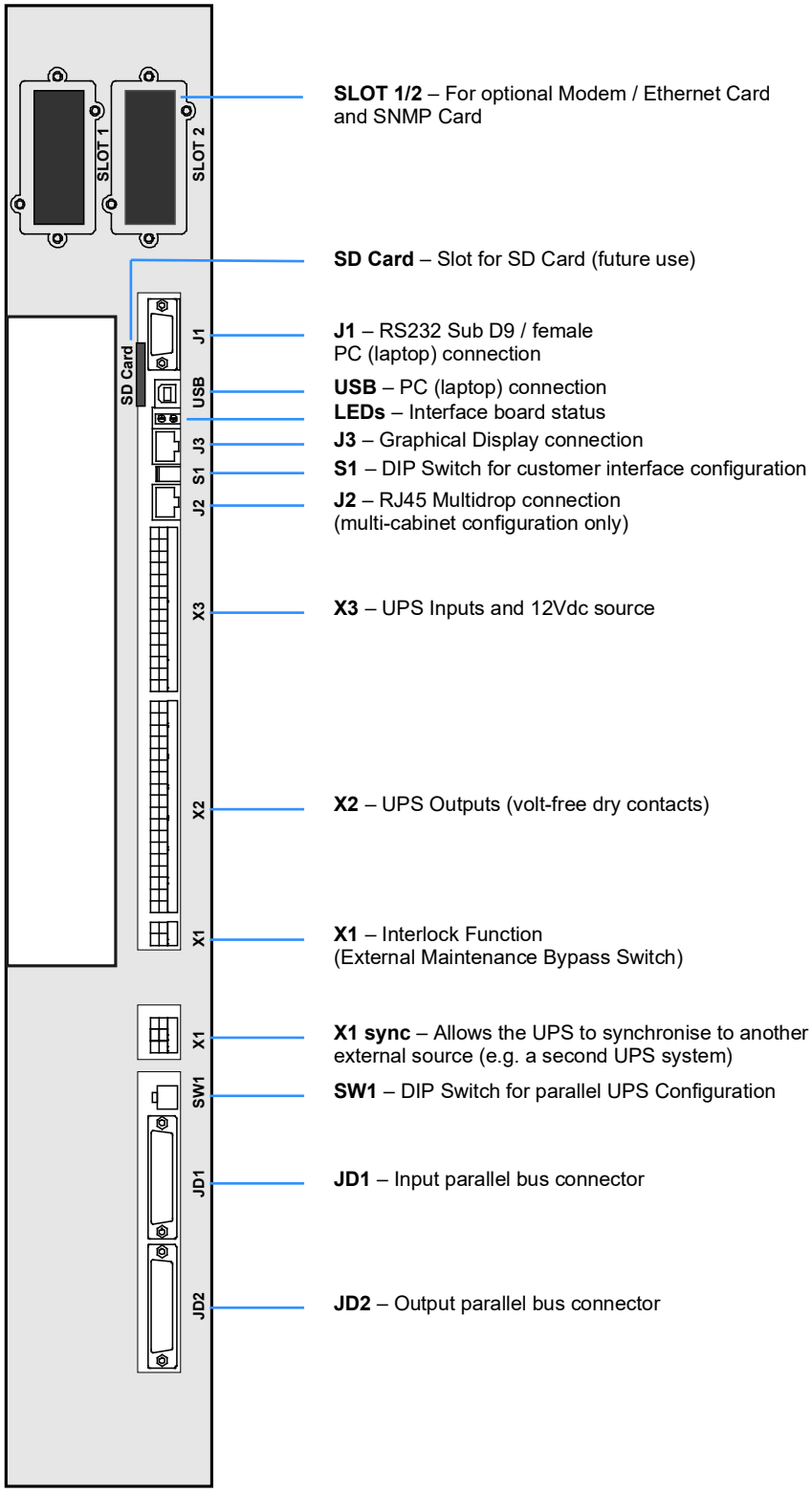


Figure 9.1 communications interface board

9.1.3 Multidrop (RS485 connector (J2)

In a multi-cabinet system ‘Multidrop’ can be used to allow the customer interface board in the master cabinet to collect data/messages from the other slave cabinets. The received data is then processed at a centralised point on the ‘master’ customer interface board and the resulting ‘system-wide’ data stream is made accessible to the RS232 port (J1), USB port and an SNMP/Ethernet card inserted in card-slot 1.

The advantage of using multidrop is that it enables the entire UPS system to be integrated into a LAN/WAN network management system using a single interface cable rather than requiring separate cables connected to the customer interface board in the individual UPS cabinets.

Multidrop is implemented by connecting cables between the customer interface board fitted in each UPS cabinet in a daisy-chain fashion. The cables are terminate with RJ45 connectors and are fitted to the customer interface board J2. Cable splitter adapters are required to make the paralleled RJ45 connections in the middle cabinets – i.e. those cabinets not located at the ends of the daisy-chain connection.

Once the inter-connecting multidrop cables are fitted, the customer interface boards must be configured for multidrop operation. This will be carried out by the commissioning engineer.

CAUTION: *Only use interconnecting cables provided by Kohler Uninterruptible Power.*

A simplified block diagram illustrating the effects of the multidrop cable on the UPS system external communications is shown in Figure 9.2. This diagram depicts a two-cabinet parallel system with three UPS modules installed in each cabinet.

With the multidrop cable installed, all the communication outputs on the customer interface board in UPS cabinet 2 are shown inhibited. Without the multidrop cable fitted, all the interfaces shown in both cabinets would be active with the data sourced from their respective cabinets.

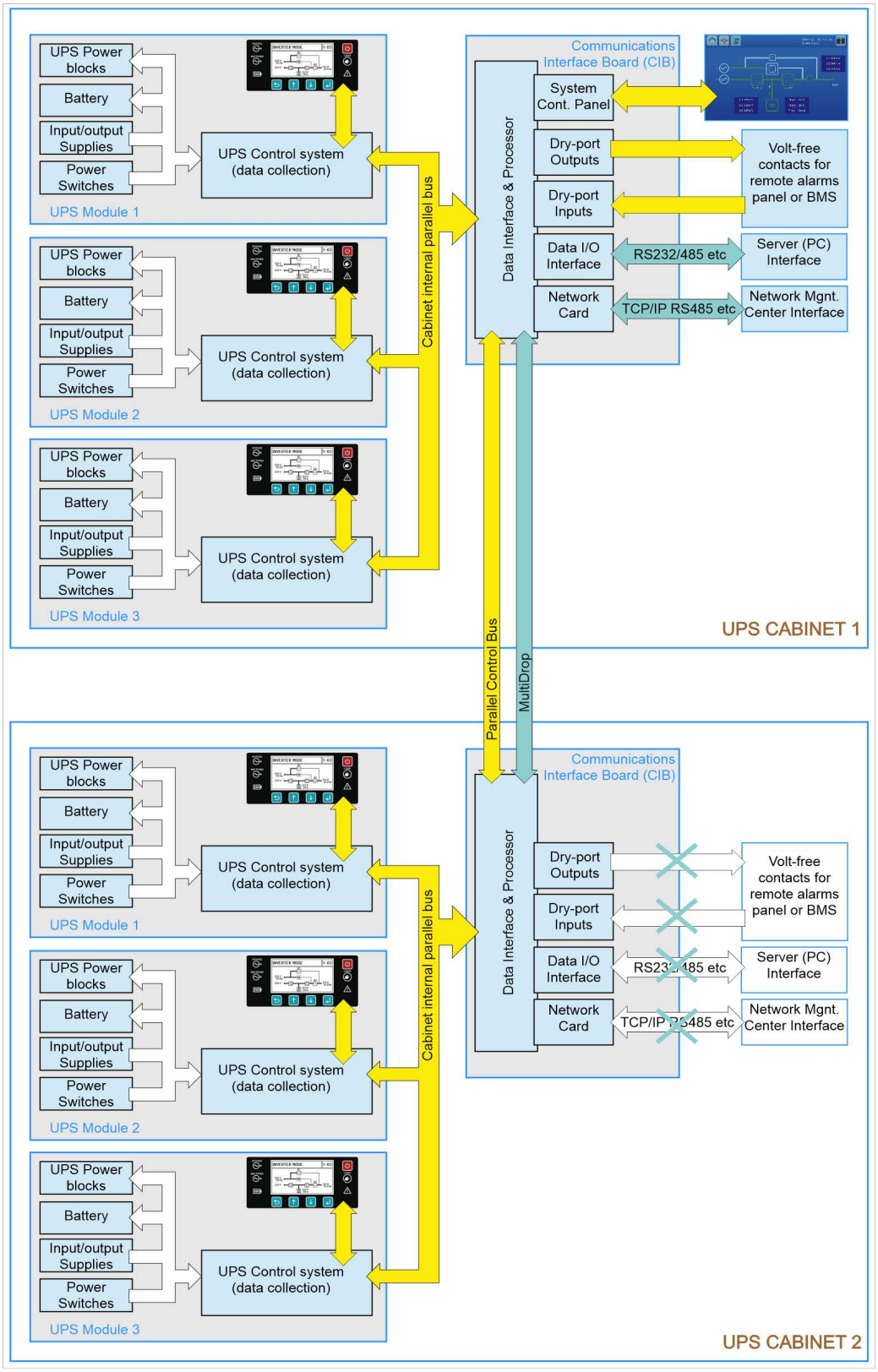


Figure 9.2 Inter-cabinet parallel connections

9.1.4 Dry port output connections (X1 / X2)

Term	Contact	Signal	Display	Function
X2 / 18		ALARM		Common
X2 / 17				Function on request (to be defined)
X2 / 16				
X2 / 15		ALARM	**COMMON_ALARM**	Common
X2 / 14				No Alarm Condition
X2 / 13				Common Alarm (System)
X2 / 12		Message	**LOAD_ON_MAINS**	Common
X2 / 11				Load NOT On Mains
X2 / 10				Load On Mains
X2 / 9		ALARM	**BATT_LOW**	Common
X2 / 8				Battery NOT Low
X2 / 7				Battery Low
X2 / 6		Message	**LOAD_ON_INV**	Common
X2 / 5				Load NOT On Inverter
X2 / 4				Load On Inverter
X2 / 3		ALARM	**MAINS_OK**	Common
X2 / 2				Mains NOT Present
X2 / 1				Mains Present
X1 / 2		-	**EXT_MAN_BYP** Interlock Function. Max. 30VDC/2A; 60VDC/0.7A (EXT MANUAL BYPASS) / 2AT	
X1 / 1		-		

Figure 9.3 Dry port outputs

All the dry port output terminals (X2) can accept cables from 0.2 mm² to 1.5 mm².
X2 outputs are switched by volt-free contacts and are rated at a maximum of 30 VAC/6A or 60 VDC/0.7A.

In a multi-cabinet system the dry-port outputs are affected by ‘multidrop.’

- In a multi-cabinet UPS system where ‘multidrop’ **is not** used:
  – the dry-port outputs are produced independently in each cabinet and the outputs from each cabinet must be connected individually to the external BMS/Monitoring facility.
- In a multi-cabinet system where ‘multidrop’ **is** used:
  – the dry-port outputs on the customer interface boards fitted in the ‘slave’ cabinet(s) are inhibited.
  – the customer interface board fitted in the ‘master’ cabinet receives the signals generated on ‘slave’ boards and provides summary outputs for all the cabinets connected to the system.
  – in this case it is only necessary to connect the external BMS/Monitoring facility to the customer interface board fitted in the ‘master’ cabinet.

9.1.5 Dry port input connections (X3)

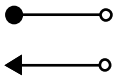
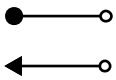
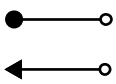
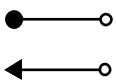
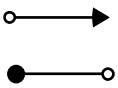
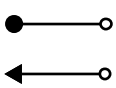
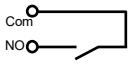
Term	Contact	Signal	Function
X3 / 14 X3 / 13		GND +3.3 VDC	**Battery temperature** (Only compatible with the optional battery sensor from Kohler Uninterruptible Power)
X3 / 12 X3 / 11		GND +12 VDC	**Generator ON** Generator Operation (N.O.) Min. contact load 12V / 1mA (Programmable +12V = Generator ON or OFF)
X3 / 10 X3 / 9		GND +12 VDC	**External Output Breaker** External Output Breaker (N.O.) Min. contact load 12V / 20mA. (Programmable +12V = Breaker CLOSED or OPEN)
X3 / 8 X3 / 7		GND +12 VDC	**External maintenance bypass** External Manual Bypass (N.O.) Min. contact load 20mA (Programmable +12V = Bypass CLOSED or OPEN)
X3 / 6 X3 / 5		+12 VDC GND	+ 12 VDC source (UPS protected) (Max. 200mA)
X3 / 4 X3 / 3		+GND +12 VDC	**Remote shutdown (+12V switched)** Default setting: disabled. Can be enabled and set it to be NO or NC using the UPS service/communication tool.
X3 / 2 X3 / 1		- -	**Remote shutdown (volt free)** For external switch Max. 250VAC/8A; 30VDC/8A; 110VDC/0.3A; 220VDC/0.12A

Figure 9.4 Dry port inputs

All the dry port input terminals (X1-X3) can accept cables from 0.2 mm² to 1.5 mm².
All cables connected to X3 are inputs and the connected cables should be rated at ≥20 mA and <50 Ohms impedance, except for X3 terminals 5/6 which is a UPS-protected 12V (200 mA max) power source that can be connected to the external devices.

In a multi-cabinet system the dry-port inputs are affected by 'multidrop.'

- In a multi-cabinet UPS system where 'multidrop' **is not** used:
  – the dry-port inputs operate independently on the customer interface board fitted to each cabinet and must be connected individually to the external BMS/Monitoring facility.
  – if the optional battery temperature sensor is connected to X3 13/14 it affects the charger operation on every UPS module within the cabinet.
- In a multi-cabinet system where 'multidrop' **is** used:
  – the dry-port inputs on the customer interface boards fitted in the 'slave' cabinet(s) are inhibited except for the external output breaker input (X3 9/10) and the external maintenance bypass switch inputs (X3 7/8).
  – the generator on input (X3 11/12) and remote shutdown input (X3 1/2), (X3 3/4) must be connected to the customer interface boar in the 'master' cabinet only. When activated, these inputs will operate on the entire system.
  – the optional battery temperature sensor input is inhibited.

Key Point: It is not possible to use the battery temperature sensor option if multidrop is installed.

Battery temperature sensor (X3 14/13)

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 provides two functions:

- it allows the battery temperature to be displayed on the system control panel, as shown in Figure 3.6
- it 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:

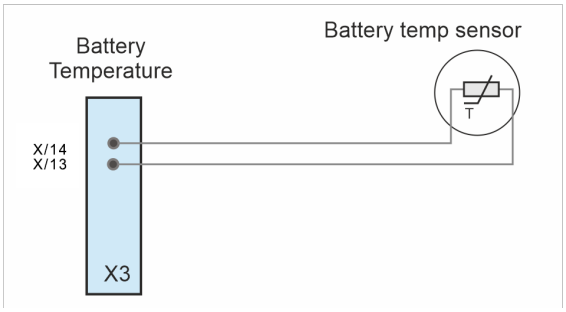


Figure 9.5 Battery temperature sensor

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 X3 terminals 13/14 as shown in Figure 9.5. These connections are not polarity sensitive.

Generator ON (X3 12/11)

The generator ON input requires a normally-open contact which closes when the (optional) standby generator is operating 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.

Once again this is configure via the password-protected `SETUP SERVICE` menu and is usually set by the commissioning engineer as part of the 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.

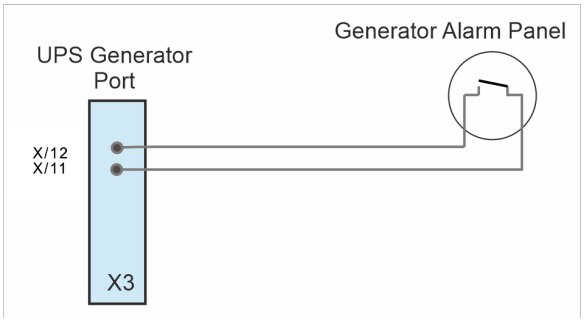


Figure 9.6 Generator ON Connection

To fit an ‘on generator’ 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 9.6.

External parallel output switch (X3 10/9)

This switched +12V input is activated by the operation of an optional external parallel switch connected between the UPS output and the load. If an external parallel switch option is used, this will be connected by the commissioning engineer.

External maintenance bypass interlock (X3 8/7)

This switched +12V input is activated by the operation of the external maintenance bypass switch and provides an interlock which prevents the UPS from operating in inverter mode if the external maintenance bypass switch is closed. This will be connected by the commissioning engineer.

+12V Supply source (X3 6/5)

The UPS-protected +12V power source available between X3 terminals 6 & 5 can be used as a power source for the switched +12V inputs on terminals 11, 9, 8 and 3. That is, the 12V source can be connected to the auxiliary contacts of the switching devices used to generate the generator ON, external parallel switch, external maintenance bypass and remote shutdown inputs to the communications interface board.

Remote shutdown (+12V Switched) (X3 4/3)

Figure 9.4 shows a switched +12V remote shutdown input connected between X3/3 - X3/4.

This input is normally disabled but it can be configured to be normally 'closed' (+12V = Run) or 'open' (+12V = Shutdown). Once again this is configured via the password-protected `SETUP SERVICE` menu and is usually set by the commissioning engineer as part of the 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.

Remote shutdown (volt free) (X3 2/1)

The remote shutdown circuit comprises a normally-closed switch connected between terminal X3/1 and X3/2 *(see Figure 9.7)*.

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

We recommend that a terminal block with linking facilities is installed between the UPS and the remote shutdown switch, as shown. This allows the removal, maintenance or testing of the remote circuit without affecting the UPS operation if the temporary like (shown) is connected.

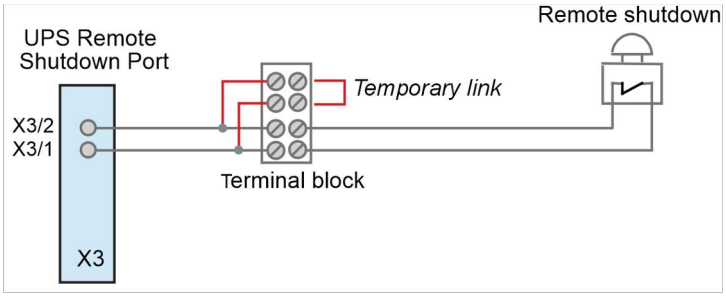


Figure 9.7 Remote emergency stop cabling

On a standard UPS module the remote shutdown (RSD) is disabled by a bridging link fitted between X3/1-X3/2.

If the remote shutdown option is required, this link must be removed and the remote shutdown function must be activated by a hardware code in. As the `SETUP SERVICE` menu is password protected this must be configured by a qualified engineer and will normally be done as part of the 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 9.7.

WARNING: The remote shutdown function only serves to disconnect the output supply from the UPS to the load and it does not totally shut down the UPS. If you want the remote shutdown facility to totally shut down the UPS system you must install a contactor in the UPS input/bypass mains supply that is also controlled from the remote shutdown function.

Key Point: In a multi-cabinet system the remote shutdown device is only connected to the 'master' module.

9.1.6 Serial RS232 Computer interface – USB & J1 (Smart Port)

A serial RS 232 interface is available through a standard 9-pin D-Type female socket (J1) or via the USB port. A USB port can also be provided on the optional relay card fitted to card slot 2.
Note that only one of these ports can be active at a time with the USB port being given the priority.

The RS232/USB interface allows the UPS to be connected to a computer and when used with appropriate power management software it 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.

J1 RS232 Port

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

Figure 9.8 shows the connector pin-out for a 9-pin and 25-pin.

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

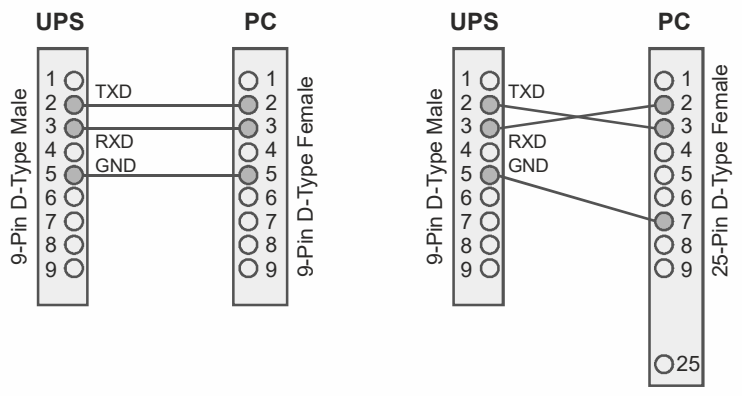


Figure 9.8 Connector Cable - PC Serial Port

9.1.7 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 be chosen to enable the UPS to be monitored and interrogated by means 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 PW9250DPA 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 (J1).

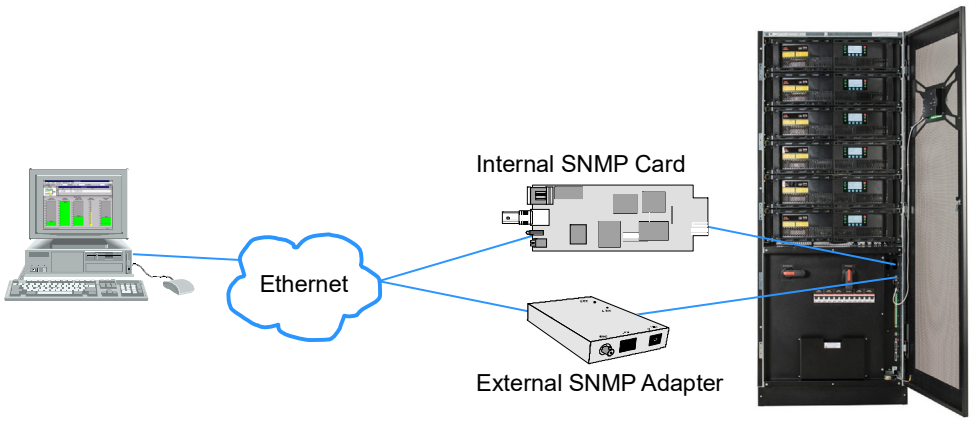


Figure 1 SNMP Connection

9.2 UPS Monitoring and automated control software

9.2.1 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 PW9250DPA 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 9250DPA (50-300 kW) 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

9.2.2 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.

9.2.3 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 PW9250DPA 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.

9.2.4 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.

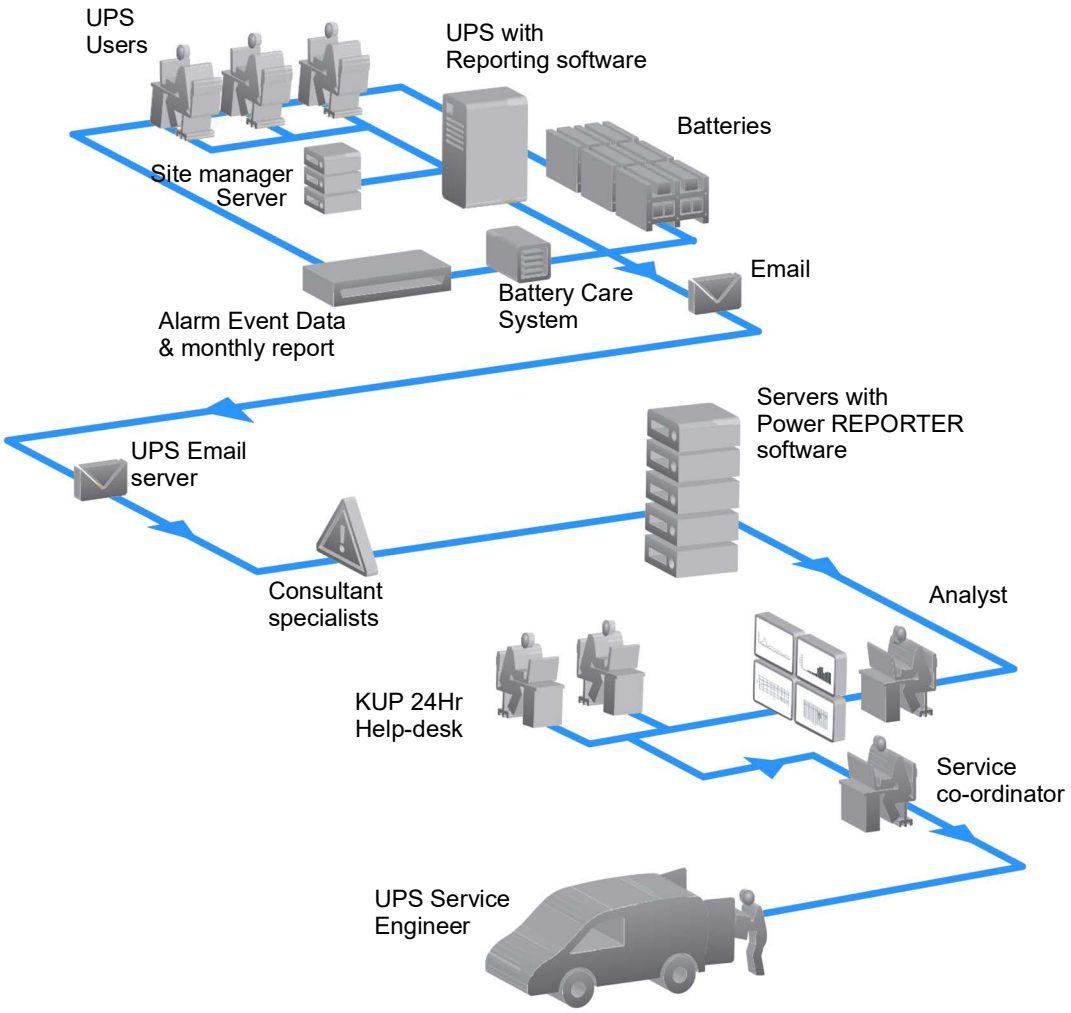


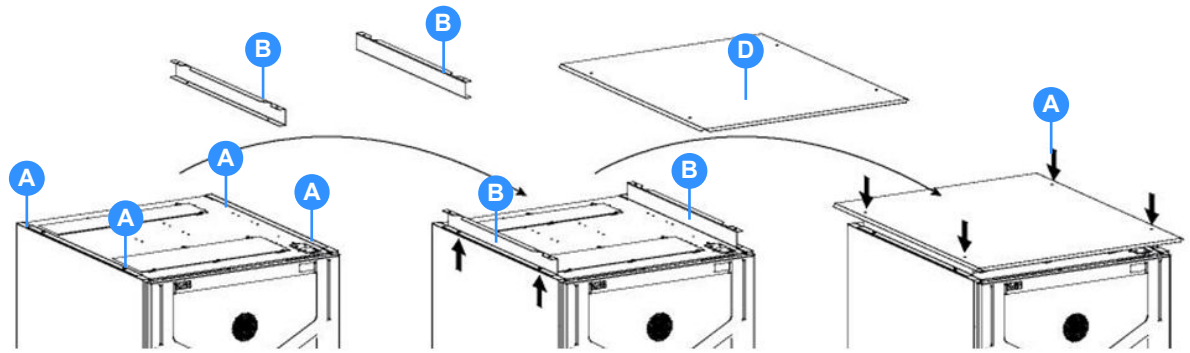
Figure 2 Remote monitoring communications chain

9.3 Optional IP21 cabinet top panel

9.3.1 Introduction

This is a hardware kit option comprising an additional top panel together with two support brackets that can be fitted above the standard UPS cabinet to bring it up to IP21 standards.

When used, the IP21 optional hardware must be fitted after the cabinet has been fully installed – and electrically connected when applied to a top-cable entry cabinet.Optional IP21 cabinet top panel



9.3.2 Installation instructions

1. Remove four screws from the top left and right sides of the cabinet (A).
2. Locate the support brackets (B) on the top left and right sides, with the angled edges of the brackets facing outwards, as shown.
3. Secure the brackets in place using the four screws removed in step 1.
4. Fit the new top panel on top of the support brackets and secure in place using the four nuts (supplied).

9.4 Elevation kit

9.4.1 Introduction

This hardware kit option comprises four leg extensions and additional side panels that can be attached to the base of a bottom-cable entry UPS cabinet in order make it possible to route cables through the cabinet base sides when it is mounted on a solid floor.

The elevation kit has a height of 170 mm, which increases the overall cabinet height to 2148 mm when fitted.

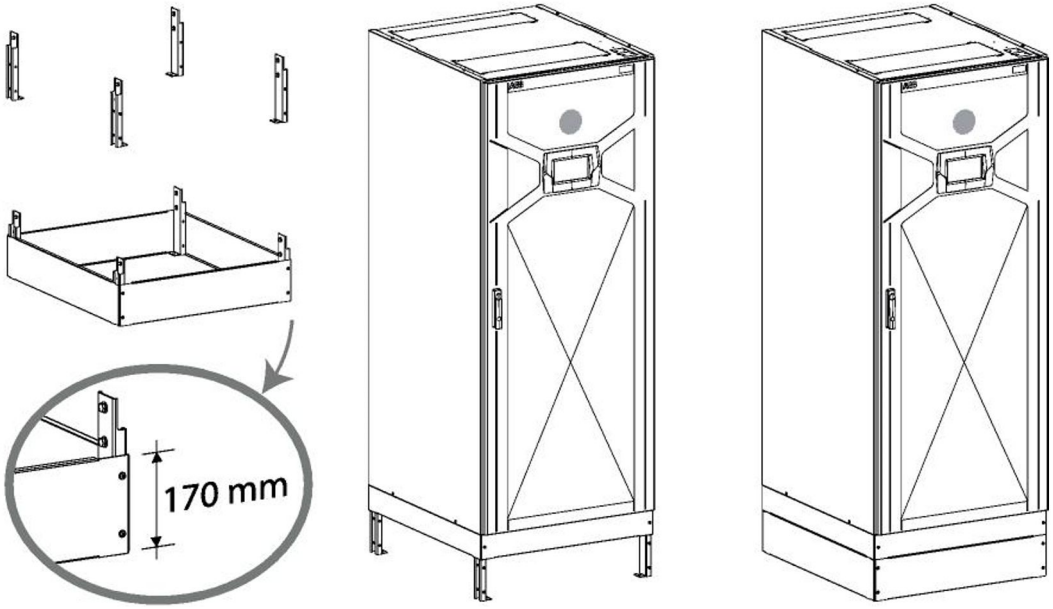


Figure 9.9 Elevation kit

9.4.2 Installation instructions

This is a factory-fitted option and should be requested when ordering the main equipment. Retrospective fitting is possible on site but must be carried out by a Kohler Uninterruptible Power approved engineer.

10 Specification

10.1 UPS Cabinet

NUMBER OF MODULES		1	2	3	4	5	6
Dimensions height x width x depth	mm	1978 x 795 x 943 (standard)					
Mass	kg	345	409	474	538	603	667
Acoustic noise at 1m from front of cabinet:	dBA	<65 dB – Normal mode @ 50% load					
IP Rating		IP 20 (IP21 option available)					
Service access		Front service access (recommended front clearance must be provided)					
Cable entry		Top or Bottom (factory built option, cannot be changed at installation site.)					
UPS Cabinet frame colour		Black (RAL 9005)					

10.2 Input characteristics

NUMBER OF MODULES		1	2	3	4	5	6
Input AC power distribution system compatibility (earthing system)		TN-S, TN-C, TN-C-S, TT					
Input AC power distribution system wiring		3ph + Neutral + PE					
Input rated short-time withstand current (Icw)	kA	65 kA					
Additional information		Single or dual input feed for rectifier and bypass					
Input voltage	VAC	380, 400, 415 V ph-ph 220, 230, 240 V ph-N					
Input voltage tolerance (@40°C)	%	(-10% to +15%) ≤ 100% load (-20% to +15%) ≤ 80% load (-30% to +15%) ≤ 60% load					
Input voltage tolerance (@30°C)	%	(-20% to +15%) ≤ 100% load (-30% to +15%) ≤ 80% load (-40% to +15%) ≤ 60% load					
Input rated frequency	Hz	50 or 60					
Input frequency tolerance	Hz	35-70					
Input rated current (with batteries charged) – @ nominal input voltage 380V/400V/415V	A	78 75 72	157 150 144	235 225 215	313 300 287	391 374 359	470 449 430
Input rated current (with batteries charging) – @ nominal input voltage 380V/400V/415V	A	83 78 75	166 157 151	249 236 226	332 314 301	415 393 376	498 471 451
Max Input rated current (with batteries charging) Minimum input voltage	A	99	198	297	396	495	594
Input distortion THDI – 100% load (linear) normal mode	%	<3% [at 400V I/P voltage <2% tolerance ±0.3% may apply]					
Input distortion THDI – 100% load (non-linear) normal mode	%	<4% [at 400V I/P voltage <2% tolerance ±0.3% may apply]					
Rectifier input power factor		0.99 @ 100% rated linear/non-linear load					
Overvoltage category		II (2500Vpk)					
		III (4000Vpk) with Internal and External SPD					

10.3 Output characteristics

NUMBER OF MODULES		1	2	3	4	5	6
Output AC power distribution system		TN-S, TN-C, TN-C-S, TT					
Output AC power distribution system wiring		3 ph + Neutral + PE					
Output Rated Voltage	VAC	380, 400, 415 V ph-ph 220, 230, 240 V ph-N					
Output voltage variation – normal or battery operation	%	± 1%					
Output voltage harmonic distortion – normal or battery operation	%	< 2% With Linear Load < 4% With Non-linear Load (EN62040-3:2001)					
Voltage unbalance and phase displacement, with 100% load imbalance	%, °	1%, < 1°					
Voltage transient and recovery time – 100% step load (linear)	%, s	4%, recovery within 2s					
Voltage transient and recovery time – 100% step load (non-linear)	%, s	4%, recovery within 2s					
Voltage transient and recovery time – transfer from Normal to Battery mode	%, s	1%, recovery within 2s					
Output rated frequency	Hz	50 or 60 Hz					
Output frequency tolerance (normal)	%	< ±2% or < ±4% selectable (synchronized with mains)					
Output frequency tolerance (on battery)	%	± 0.1% of rated frequency (free-running)					
Maximum phase error when in sync with bypass	°	2°					
Output rated current – 380V / 400V / 415V configuration	A	76 72 69	151 144 139	227 216 208	303 288 278	379 360 347	455 433 417
Output overload (% of rated current / time duration) at 40 °C, 380/ 400 / 425 V rated voltage	% / s	150% / 1 minute 125% / 10 minutes 110% / continuous					
Output current limit, “short-circuit current” (% or rated current /time duration), 400V rated voltage	% / s	2.9 x In / 150 ms 3.2 x In / 40 ms					
	A	231	462	693	924	1155	1386
Fault clearing capability (Normal and Battery mode)	A gL	20	40	63	80	100	125
Load power factor - rated		1.0					
Load power factor - displacement (permissible lead/lag)		0.6 lag to 0.8 lead					

10.4 Static bypass

NUMBER OF MODULES		1	2	3	4	5	6
Rated current	A	76	152	228	304	380	456
Bypass overload (% or rated current/time duration)	% / s	> 190% / 10s 190% / 2 min 140% / 10 min 110% / continuous					
Bypass fault clearing ability (% of rated voltage @ 400V)	% / s	10 In / 20 ms					
Bypass voltage tolerance (% of rated voltage @ 400V)	%	-20% to +15%					
Bypass protection fuse or circuit breaker rating	A	80					

10.5 Efficiency

NUMBER OF MODULES		1	2	3	4	5	6
Double conversion efficiency –100% load	%	96.9	96.9	96.9	96.9	96.9	96.9
Double conversion efficiency –75% load	%	97.3	97.3	97.3	97.3	97.3	97.3
Double conversion efficiency –50% load	%	97.4	97.4	97.4	97.4	97.4	97.4
Double conversion efficiency –25% load	%	97.3	97.3	97.3	97.3	97.3	97.3

10.6 Battery

NUMBER OF MODULES		1	2	3	4	5	6
Energy storage type		No integrated batteries, external storage needed. Matching battery cabinets available as accessory.					
Technology		VRLA, NiCd, Li-ion,					
Design life, or float service life		Refer to battery manufacture for information					
Quantity of cells and strings	Pcs	VLRA 12V: 40-50 blocks / 240-300 cells per string NiCd 12V: 40-50 blocks / 400-500 cells per string Li-ion (Samsung SD1: 17 modules / 136 cells)					
Nominal voltage	VDC	480V - 600V					
Nominal Ah capacity (C10)		Battery type dependant					
Stored energy time (back-up time @ 100% rated load)	min	Up to any autonomy values without derating.					
Restored energy time (re-charge time to 90% capacity)	hr	VLRA –10 hours NiCd – 10 hours Li-ion – 3 hours					
Recommended temperature for max service life)	°C	Battery type dependant. For VLRA, 20°C; for LIB, 18-28°C					
Nominal discharge current	ADC	110-90	220-175	330-260	440-350	550-435	660-525
Fault rating current	ADC	5 kA					
Float charge voltage	VDC	VLRA – 2.23 V/cell (535V for 40 blocks to 669V for 50 blocks) NiCd – 1.4 V/cell (560V for 40 blocks to 700V for 50 blocks) L-ion – 4.20 V/cell (571.2V for 17 modules/136 cells)					
End of discharge voltage	VDC	VLRA – 1.68 V/cell (403V for 40 blocks to 504V for 50 blocks) NiCd – 1.05 V/cell (420V for 40 blocks to 525V for 50 blocks) Li-ion – 3.00 V/cell (408V for 17 modules/136 cells)					
Charge current limit (or range)	ADC	38	76	114	152	190	228
Charge power limit	kW	15	30	45	60	75	90
Battery temperature compensation	Supported. With optional temperature sensor.						
Battery test	Automatic battery test facility included with standard UPS						

10.7 Environmental

NUMBER OF MODULES		1	2	3	4	5	6
UPS Cabinet operating temperature range	°C	0-40°C					
Relative humidity range	%	< 95% non-condensing					
Battery temperature	°C	VLRA, 20°C LIB, 18-28°C					
Storage temperature	°C	-25 to +70°C Ideally storage between +5°C and +35°C at RH up to 75%					
Maximum altitude without derating	m	1000m					
Maximum altitude with derating	m	2000m					
Vibration		IAW EN60721-3-2					
Heat Dissipation with 100% Non-linear Load per Module (N+0) (EN 62040-1-1)	W	2100	4200	6300	8400	10500	12600
Heat Dissipation with 100% Non-linear Load per Module (N+0) (EN 62040-1-1)	BTU	7165	14330	21495	28600	35826	42990
Heat Dissipation without load	W	160	320	480	640	800	960
Airflow (25° - 30°C) with Non-linear Load per Module (EN 62040-1-1:2003)	m3/h	460	920	1380	1840	2300	2760

10.8 Compliance Standards

Safety	IEC/EN62040-1
EMC	IEC/EN62040-2
Performance	IEC/EN62040-3
Manufacturing	ISO 9001:2015, ISO 14001:2015, OHSAS 18001

10.9 Standard options

System graphical display	Available for single or multi-cabinet system. Factory fitted only
Top or bottom cable entry	Factory fitted only – not reversible in the field
Single or dual input feed	Field-configurable using links. To suit a common or separate input/bypass mains supply.
Separate or common battery connection	Field configurable by service engineer
Common connectivity option	Customer selected external communications facilities
Maintenance bypass switch	Internal maintenance bypass switch can be fitted in a single cabinet system only.