PowerWAVE ELMOD

User Manual

KOHLER POWER
uninterruptible

Document Control

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IMPORTANT NOTE

The technical description, specification, installation instructions, and operating and maintenance procedures contained in this User Manual refer to a standard PowerWAVE EL MOD static inverter cabinet.

The PowerWAVE EL MOD equipment is often modified to enable it to be more easily integrated into a wider power control and distribution system. This may include, but is not limited to, integral power switching and distribution facilities that are not described in this manual.

Details of any modifications that have been applied to the standard equipment will be provided as addendums to this manual.

The content of an addendum document has overriding authority if it conflicts with this User Manual.

Useful Contacts

www.kohler-ups.co.uk	Kohler Uninterruptible Power Ltd. web site
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ukservicesales.ups@kohler.com	Extended warranty agreements etc

1 Safety Warnings

Read the following safety information carefully before you install or operate the PowerWAVE EL MOD Static Inverter (SI) equipment and keep this manual within easy access of the equipment for future reference.

1.1 Description of symbols used in this manual

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

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

1.1.1 General warnings

WARNING: Be aware that the output from this equipment can be energized when the unit is not connected to a mains supply, even when the input AC power is disconnected.

WARNING: The PowerWAVE EL MOD assembly and peripheral equipment must be installed and commissioned by suitably qualified and trained personnel who are aware of the potential shock hazards.

WARNING: The PowerWAVE EL MOD must be supplied by a grounded outlet. Do not operate the unit without a ground source.

WARNING: To reduce the risk of electric shock:

- Do not insert any object into ventilation holes or other openings.
- Do not remove any equipment cover – the unit does not contain any user-serviceable parts. Refer all servicing requirements to qualified service personnel.
- Always disconnect the PowerWAVE EL MOD from the mains power supply before you install a computer interface signal cable. Reconnect the power only after the signalling interface connections have been made.

WARNING: To reduce the risk of fire:

- Install this equipment in a temperature and humidity controlled indoor area free of conductive contaminants.
- If a fuse ruptures always replace it with a fuse of the same type and rating.

1.1.2 Battery safety

WARNING: The battery is not isolated from the mains voltage. Hazardous voltage may occur between the battery terminals and ground.

WARNING: A battery can present a risk of electric shock or burn from high short circuit currents.
Always take the following precautions when working on batteries:

- Remove watches, rings or other metal objects.
- Use tools with insulated handles.

WARNING: The PowerWAVE EL MOD system uses recyclable batteries:

- The batteries contain lead and pose a hazard to the environment and human health if not disposed of properly.
- If you replace the batteries you must dispose of the used batteries in accordance with local environmental laws and regulations.

WARNING: Heed the following warnings concerning battery handling:

- Do not dispose of batteries in a fire. The batteries may explode.
- Do not open or mutilate the batteries. They contain an electrolyte which is toxic and harmful to the skin and eyes.
- If electrolyte comes into contact with the skin, the affected area should be washed immediately with clean flowing water.
- The internal energy source (the battery) cannot be de-energized by the user.

WARNING: When changing the batteries, install the same number and same type of batteries.

2 General Description

2.1 Introduction

Congratulations on your purchase of the PowerWAVE EL MOD series Emergency Lighting product.

This high performance Emergency Lighting Static Inverter (SI) system, is designed to deliver complete emergency lighting protection for a range of applications, in accordance with European BS EN50171 specification.

Key features

High performance, single or three phase input and single phase output, modular static inverter system ranging from 4kVA to 24kVA.

- Power cabinet, comprising up to six 4kVA power modules
- Selectable single-phase or three-phase input supply configuration
- Hot-swappable power modules reduce mean-time-to-repair (MTTR)
- Manufactured with the latest IGBT devices and PWM technology
- Fully DSP (Digital Signal Processor) controlled, pure sine wave output
- Output configurable to 3 modes of operation (Changeover/ Inverter/ Non-Maintained)
- No-break load transfer for use with discharge lamps
- Deep discharge battery protection
- Battery reverse polarity protection
- Battery short circuit protection
- Front access for all maintenance and repair
- Battery discharge management, auto-transfer between floating and equalisation charging with optional temperature compensation
- Inverter modules automatically share the input and output current, and battery charge/discharge current
- Multiple communication options RS232, RS485, dry-contacts, TCP/IP adapter for local and remote communication
- Compliant to BS EN50171.

Figure 2.1 System cabinet

Optional features

- Input/output transformer
- 10min, 1 hour & 3 hour battery test key-switch
- DC Earth leakage protection
- Other voltage options
- Load distribution module
- Internal maintenance bypass switch
- High IP rating

Model range

MODEL	EL MOD/4	EL MOD/8	EL MOD/12	EL MOD/16	EL MOD/20	EL MOD/24
Power Rating kVA / kW	4 / 3.6	8 / 7.2	12 / 10.8	16 / 14.4	20 / 18	24 / 21.6
Input AC voltage (VAC)	220/230/240 (1Ph + N + PE)		220/230/240 (1Ph + N + PE)/ (3Ph + N + PE)	220/230/240 (1Ph + N + PE)		220/230/240 (1Ph + N + PE)/ (3Ph + N + PE)

2.2 Functional description

2.2.1 Introduction

The PowerWAVE EL MOD is a modular Static Inverter (SI) comprising up to six, hot-swappable, 4kVA power modules. It produces a single phase output and can be configured to operate with either a single-phase or three-phase input supply.

Depending on the number of fitted power modules, the PowerWAVE EL MOD system can provide an output rated between 4kVA and 24kVA in 4kVA increments.

Each 4kVA module contains a rectifier, inverter and static switch power sections, as shown in Figure 2.2

This diagram shows that the power module is connected to the AC INPUT, DC INPUT and UPS OUTPUT power connections. These are all located on the back of the PowerWAVE EL MOD cabinet.

Note: The input and output power connections are not switched within the standard cabinet so suitable external power switches and protective devices must be provided as part of the cabinet installation – as described in Chapter 3.

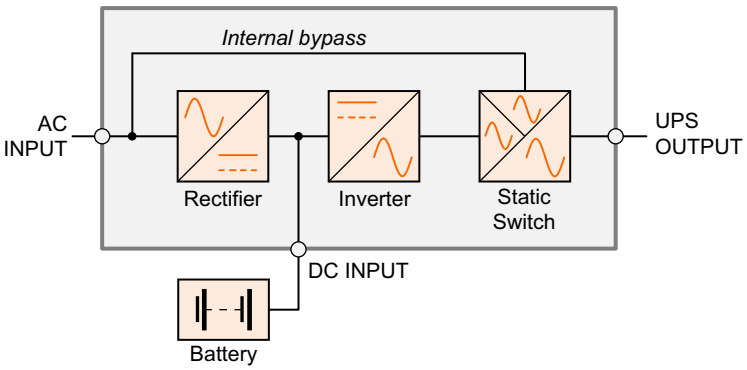


Figure 2.2 4kVA Module power sections

Rectifier

The PowerWAVE EL MOD employs a PWM-controlled booster rectifier using IGBT devices. This results in a high input power factor, approaching unity, together with low input current harmonics.

The rectifier is powered from the utility mains supply connected to the AC INPUT terminals and produces a well regulated DC voltage that is suitable for supplying the inverter and charging the batteries. The rectifier produces a dual-polarity output which is required by the inverter in order for it to generate a 'neutral-referenced' output waveform.

Note: The AC INPUT neutral must be permanently connected and unswitched.

Batteries

Batteries provide a reserve DC power supply for the inverter to allow it to continue to operate in the event of a mains supply failure – whereupon the rectifier will shut down. A number of battery blocks (typically 40) are connected in series to provide the terminal voltage required by the inverter. The mid-point of the battery string is connected to the AC INPUT neutral in order to provide the inverter with its necessary dual-polarity DC input – for this reason the battery string must contain an even number of cells.

Note: In practice the number of installed batteries depends on the battery capacity and the required battery back-up time.

The batteries will begin recharging from the rectifier immediately when the mains supply is restored following an outage.

Inverter

The PWM-controlled inverter uses the latest IGBT devices and DSP technology to convert its input DC voltage (provided by the rectifier and/or batteries) into a digitally controlled AC voltage, with fixed voltage and frequency. The inverter output directly supplies the emergency luminaires connected to the UPS OUTPUT terminals.

Static Switch

A solid-state static switch enables the UPS OUTPUT terminals to be connected to either the inverter or the internal bypass power source. The static switch will transfer the output between these two supply sources in a controlled manner depending on the selected operating mode, load demand and prevailing mains supply conditions.

2.2.2 Modes of operation

The PowerWAVE EL MOD can be configured to operate in one of three modes to suit the degree of supply integrity required for a particular lighting application.

Changeover mode

When operating in the 'changeover' mode:

- the rectifier is turned on to provide battery charging
- the inverter is turned on and operating on standby (off load)
- the bypass-side of the static switch is turned on to connect the UPS OUPUT to the AC INPUT via the internal bypass line.

If the utility supply fails, the static switch will transfer the UPS OUPUT to the inverter within 10ms. However, as the utility supply is in a failed state the rectifier is inoperative and the inverter will be powered solely from the batteries (see Figure 2.5).

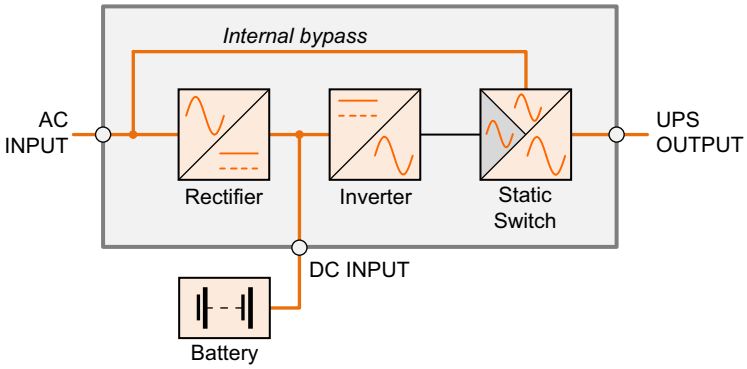


Figure 2.3 'Changeover' mode

Inverter mode

When operating in the 'inverter' mode:

- the rectifier is turned on to power the inverter and provide battery charging
- the inverter is turned on
- the inverter-side of the static switch is turned on to connect inverter to the UPS OUPUT.

The emergency luminaires are powered from the regulated inverter output.

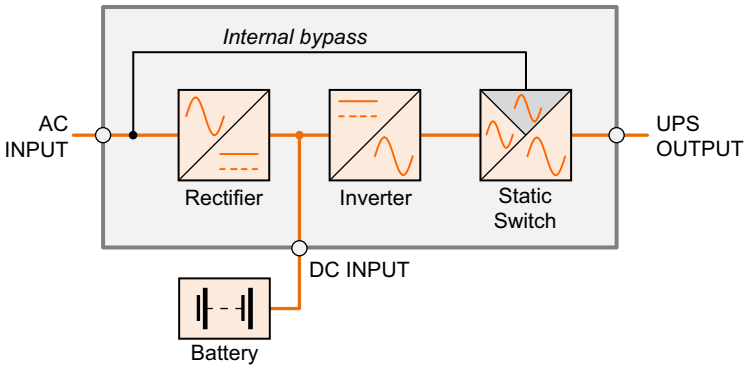


Figure 2.4 'Inverter' mode

On battery operation

If the mains supply fails, the rectifier turns off but the inverter will continue to operate from battery power until the batteries reach their end-of-discharge voltage; at which point the inverter will shut down and disconnect the UPS OUTPUT supply.

If the AC INPUT supply is restored before the batteries are fully discharged, the rectifier will turn on automatically to once again power the inverter and recharge the batteries.

The whole process of switching between rectifier and battery power is totally transparent to the emergency luminaires.

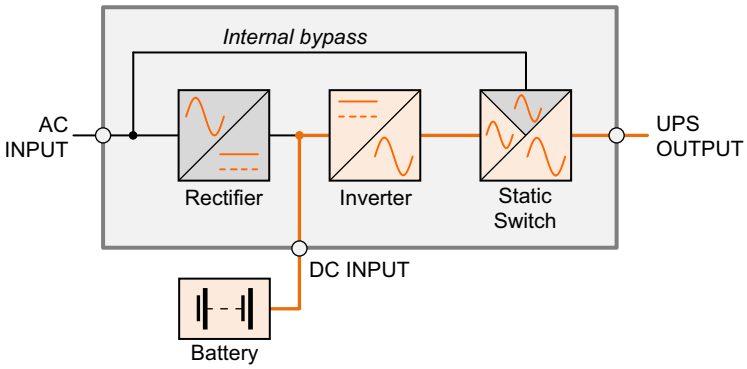


Figure 2.5 'On Battery'

Non-Maintained mode

In this operating mode the unit can be viewed as operating purely as a ‘standby’ power supply as the PowerWAVE EL MOD is not called upon to provide any UPS OUTPUT power under normal circumstances.

When the mains supply is available:

- the rectifier is turned on to power the inverter and provide battery charging
- the inverter is turned on
- both the inverter and bypass sides of the static switch are turned off, so the UPS OUTPUT is not live.

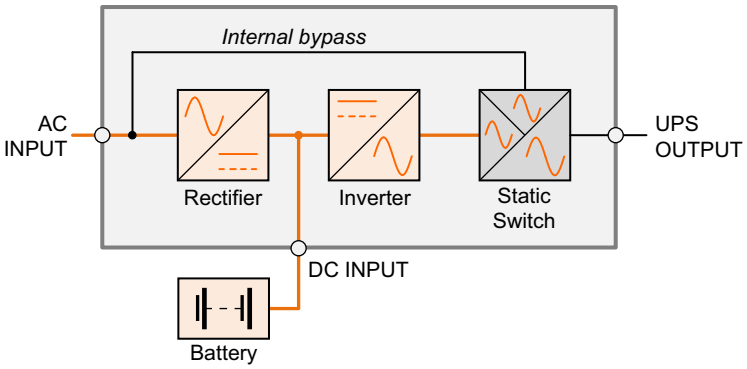


Figure 2.6 ‘Non-Maintained’ mode

If the mains supply fails, the static switch immediately closes its inverter-side switch which connects the inverter to the UPS OUTPUT; however, as the utility supply is in a failed state the rectifier is inoperative and the unit immediately enters its ‘on battery’ operation (see Figure 2.5).

If the utility mains is restored before the batteries are fully discharged, the system will revert to its normal operating state; the rectifier will turn on to recharge the batteries but the static switch will once again turn off both ‘sides’ and effectively once more disconnect the UPS OUTPUT. That is, the PowerWAVE EL MOD will revert to its stand-by function.

Operating mode comparison

Mode	Efficiency	Summary
Changeover	98%	The lighting load is normally powered from the raw utility supply and will be subject to any supply aberrations. This mode of operation is recommended for loads that do not require a continuously regulated and processed power supply.
Inverter	93%	The lighting load is normally powered from a continuously regulated and processed power supply and protected from any supply aberrations present on the raw utility supply. Although it is less efficient to operate in this mode than the others, it is recommended for use with any load that is supply-sensitive.
Non-Maintained	93%	This mode is intended to be used in a ‘stand-by’ situation – for example to power an emergency lighting system that is required to turn on only when the main lighting system fails. Although the efficiency is shown as 93%, this is only applicable when the inverter is on line (providing load power). During normal operation the rectifier/inverter losses will be minimal (see specification).

In all three operating modes the system eventually operates from battery power when called upon; and the duration for which the PowerWAVE EL MOD is able to maintain the load supply from battery power depends on the installed battery capacity and the applied percentage load.

In some installations a standby generator can be used to provide an alternative AC INPUT supply following a utility mains failure. When used, the standby generator usually runs up automatically following the utility mains failure and is connected to the PowerWAVE EL MOD though some form of automatic input supply changeover switch.

Irrespective of whether or not a standby generator is used, battery sizing is an extremely important system design factor.

2.3 Mechanical description

2.3.1 Cabinet

The PowerWAVE EL MOD cabinet, shown in Figure 2.7, comprises up to six, 4kVA modules and a single control panel assembled in a purpose-designed chassis. The modules and the control panel can be fitted/removed from the front of the cabinet, making side and rear access unnecessary for servicing or repair.

All the AC and DC power cables are connected to terminals located on the rear of the cabinet and gland plates are provided to enable top or bottom cable entry. There are no power switches fitted to the 'standard' PowerWAVE EL MOD cabinet so suitable switching and protective devices must be fitted externally for ALL the input and output power cables.

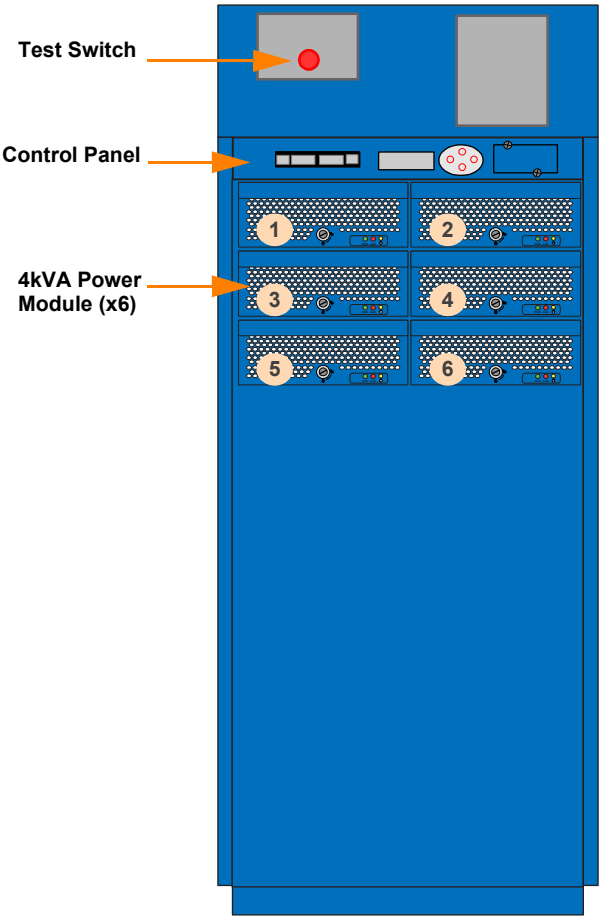


Figure 2.7 EL MOD Cabinet

2.3.2 4kVA Power module

The power modules are shelf-mounted and secured in place by a knurled, thumb-screw catch. Each module is assigned an ID number by the control system in order to identify a particular module for alarm and monitoring purposes. Figure 2.7 shows the designated module numbers.

The PowerWAVE EL MOD system is expandable so, if the cabinet is not fully populated initially, additional power modules can be added to match any load expansion. When dealing with a single-phase fed system, the modules should be added in the order shown. Three-phase fed systems are rated for either 12kVA (3 modules) or 24kVA (6 modules), and in the case of a 12kVA installation the three modules should be installed in positions 1, 3 and 5.

The power module contains two led indicators, as shown in Figure 2.8.

As its name suggests, the red alarm (ALM) led illuminates when the module detects an abnormal utility mains input, inverter output, overload, DC, fan failure, etc. The control panel display screen will indicate the exact nature of a fault.

The ALM led is off during normal module operation.

The green RUN led flashes for up to 2 minutes when the module goes through its start-up initialisation, and illuminates fully when the module is operating with the inverter turned on. When the module is not working, the RUN light will be off.

The ON/OFF button is used to turn the module On/Off when inserting/removing it from a working system.

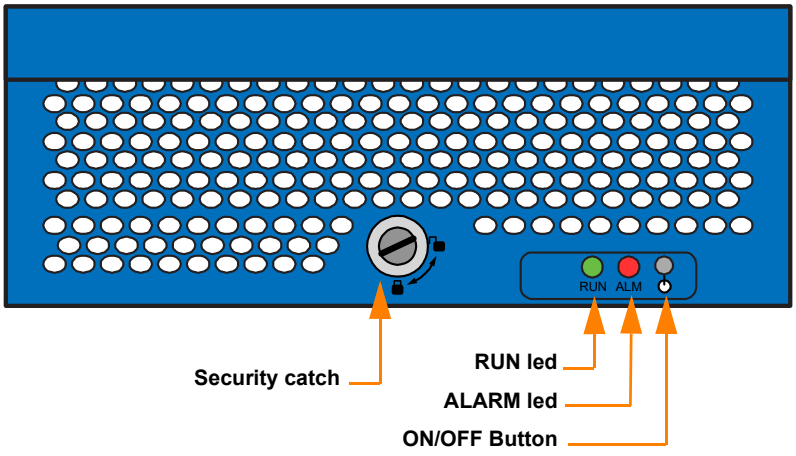


Figure 2.8 4kVA Power Module

2.3.3 Control panel

The 4kVA power modules are controlled from a central control panel installed on the top shelf of the cabinet. The control panel can be powered from either the mains supply or DC (battery) supply.

The control panel can be split into four areas, as shown in Figure 2.9.

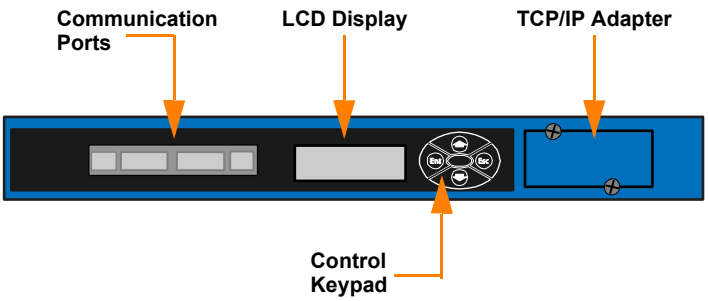


Figure 2.9 Control Panel

TCP/IP Adapter

A range of SNMP/Ethernet communication interface cards can be plugged in to the TCP/IP adapter to provide communication with a remote computer or network. This is described in more detail in the Options chapter of the manual.

Communication ports

Several optional communication ports are provided on the left-hand side of the control panel. These are described in detail in the Options chapter of the manual, but include:

Dry contact terminal blocks:

- external emergency stop input
- system test input
- operating status/alarm outputs; mains failure, common alarm, system on battery, low battery voltage.

RS232/RS485 interface:

- Standard 9-pin D-type connector provides RS232/RS485 computer communication over a range of approximately 50m at 9600 baud.

RJ45 Port:

- RS485 port used for battery temperature monitor.

Key Point: Only one communication port (SNMP, RS232 or RS485) can be used at any time. The active port is selected in the control panel SETUP screen as shown in the menu map in Figure 2.11

Control keypad

The PowerWAVE EL MOD is controlled via a 4-button keypad working in conjunction with a multi-level menu system that is displayed on the LCD.

On the keypad, the `UP` and `DOWN` arrow buttons are used to scroll through the presented menu options. The Enter button (`Ent`) is used to 'select' the current menu item, and the Escape button (`Esc`) returns the LCD Display to the top level menu from anywhere within the menu tree.

The `Esc` button is also used to cancel the audible alarm when activated.

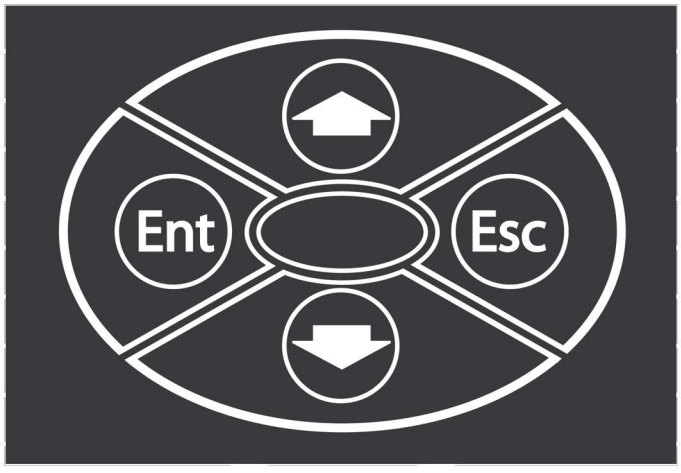


Figure 2.10 Control Keypad

LCD Display

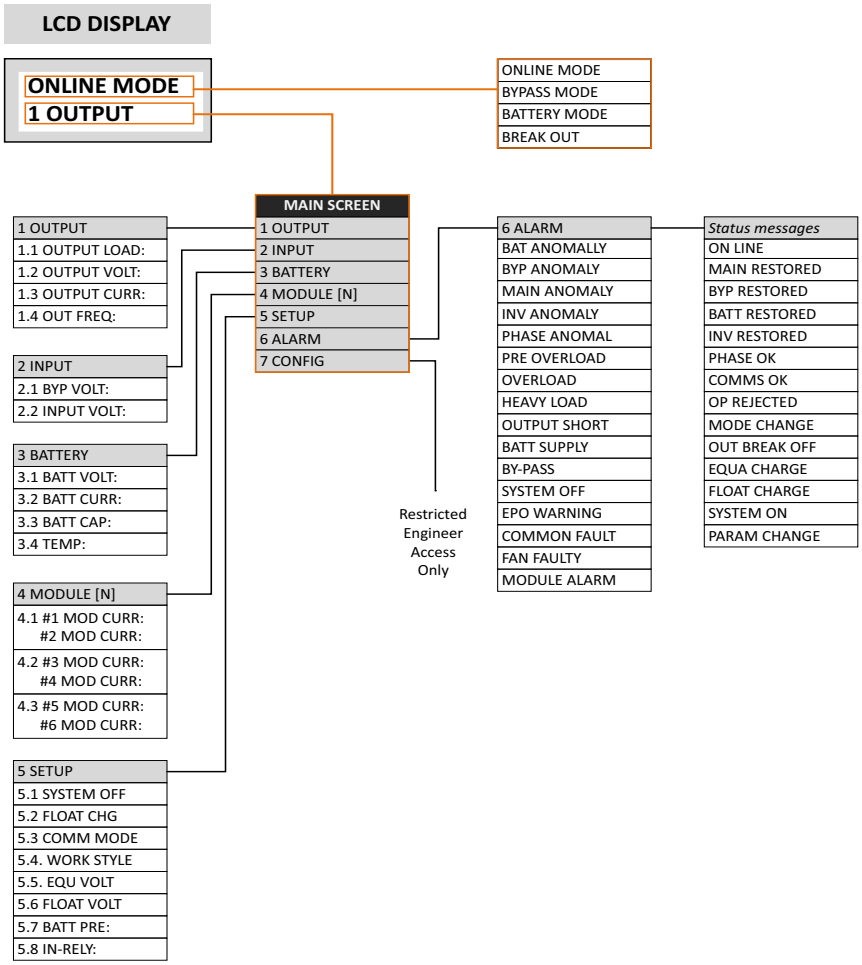


Figure 2.11 LCD Display

The top line of the LCD Display panel indicates the system's current operating mode: `ONLINE`, `BYPASS`, `BATTERY` or `BREAK OUT`. The bottom line indicates a range of monitoring, set-up, alarm and configuration data, as shown in Figure 2.11.

Note: The CONFIG menu is provided for service use only and is hidden at 'Operator' permission level.

As described above, the control keypad is used to navigate through the sub-menus; for example, to monitor the current being supplied by module number 5:

1. From the main screen press the `DOWN` key three times to display `[4 MODULE N]`.
2. Press the `Ent` key to select the `[4 MODULE N]` sub-menu.
3. Press the `DOWN` key twice to highlight `[4.3 #5 MOD CURR.]` then press the `Ent` key to select it.
4. The LCD display will now display module 5 output current.
5. To navigate back to the `MAIN SCREEN`, press the `Esc` key.

Key Point: The LCD display indicates 3-phase parameters. If the unit is connected to a single-phase supply the parameter value is shown in the left-most figure.

2.3.4 Sub-menu details

The following sub-menus can be used by the operator to monitor and manage the system operation.

1 OUTPUT

1.1 OUT LOAD:	Displays the percentage load current – e.g. [**010%** 000% 000%]*****
1.2.OUT VOLT:	Displays the output voltage (V) – e.g. [**230V** 000V 000V]*****
1.3 OUT CURR:	Displays the output current (A) – e.g. [**010A** 000A 000A]*****
1.4 OUT FREQ	Displays the output frequency (Hz) – e.g. [50.0Hz]

**Only the left hand meter digits are used in a single-phase output system (by default in the PowerWAVE EL MOD)*

2 INPUT

2.1 BYP VOLT:	Displays the bypass voltage (V) – e.g. [**230V** 000V 000V]*****
2.2 INPUT VOLT:	Displays the input voltage (V) – e.g. [**230V** 000V 000V]*****

**Only the left hand meter digits are used when the PowerWAVE EL MOD is connected to a single-phase mains input.*

3 BATTERY

3.1 BATT VOLT:	Displays the battery voltage for both positive and negative DC busbars – e.g. [+270V -270V]
3.2 BATT CURR:	Displays the battery current for both positive and negative DC busbars – e.g. [00.2A 00.2A] on float charge
3.3 CAPA:	Displays the remaining battery capacity – e.g. [3.3 CAPA:60AH]
3.4 TEMP:	Displays the battery temperature – e.g. [3.4 TEMP:20.0C] (With optional battery temperature sensor fitted)

4 MODULE [N] (where N = the number of fitted modules)

4.1#1 230V 10.0A #2 230V 10.0A	Displays the output voltage and current of modules 1 and 2*
4.2#3 230V 10.0A #4 230V 10.0A	Displays the output voltage and current of modules 3 and 4*
4.3#5 230V 10.0A #6 230V 10.0A	Displays the output voltage and current of modules 5 and 6*

**See Figure 2.7 for module positional identification*

5 SETUP

5.1 SYSTEM OFF	Displays when the system is `ON` – [YES NO] Select `YES`, and `Ent`, to turn `OFF` the system
5.1 SYSTEM ON	Displays when the system is `OFF` – [YES NO] Select `YES`, and `Ent`, to turn `ON` the system
5.2 EQU CHG	Displays when the system is on float charge – [YES NO] Select `YES`, and `Ent`, to activate Equalization mode
5.2 FLOAT CHG	Displays when the system is on Equalization charge – [YES NO] Select `YES`, and `Ent`, to activate Float mode
5.3 COMM MODE	Displays the communications mode – e.g. [RS232] Press `Ent` and scroll to select [RS485] or [SNMP]
5.4 WORK STYLE	Displays the work style – e.g. [CHANGEOVER] Press Ent and scroll to select [INVERTER] or [BREAK OUT]
5.5 EQU VOLT:	Displays the battery preset battery equalization charge voltage – e.g. [282V]***** (range 240-290V)
5.6 FLOAT VOLT:	Displays the battery preset battery float charge voltage – e.g. [270V]***** (range 240-290V)
5.7 BATT PRE:	Displays the battery preset 'Low Voltage' alarm level – e.g. [230V]***** (range 240-290V)
5.8 IN-RELY:	Displays the function assigned to the remote-operated input relay – e.g. [BATT TEST] by default

****To adjust these levels press** `Ent`, **change the value using the** `scroll` **keys, then press** `Ent` **again to accept the indicated value.***

2.4 Warranty

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

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

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

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

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

2.5 Extended Warranty

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

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

Contact the Service Support Hotline on 0800 731 3269 (24Hr.) for further details

2.6 Additional Service/Maintenance Support

If you are interested in obtaining an extended warranty for your PowerWAVE EL MOD, or require service/maintenance support for any other UPS you may have, please contact Kohler Uninterruptible Power Ltd. at the following address:

Kohler Uninterruptible Power Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire, United Kingdom
RG27 9XA

Tel:	+44 (0)1256 386700 0800 731 3269 (24Hr.)
Email:	ukservicesales.ups@kohler.com

3 Installation

3.1 Introduction

This chapter contains essential information concerning the unpacking, installation planning and cabling of the PowerWAVE EL MOD system.

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

WARNING: All the operations described in this chapter must be supervised by suitably qualified personnel and all aspects of the electrical installation must be carried out by an authorised electrician.
Kohler Uninterruptible Power Ltd. will take no responsibility for any personal injury or material damage caused by incorrect cabling or operation, or any installation activities that are not carried out in strict accordance with the instructions contained in this manual.

WARNING: Once the PowerWAVE EL MOD system is installed it must be commissioned by an engineer approved by Kohler Uninterruptible Power Ltd., or one of its service agents, before it is powered-up. Kohler Uninterruptible Power Ltd. will take no responsibility for any personal injury or material damage caused by the application of electrical power to this equipment before it has been fully commissioned.

3.2 Taking receipt of the system

The PowerWAVE EL MOD cabinet is shipped on a purpose-built pallet that is easy to move with a forklift or a pallet jack. The power modules, batteries and other accessories are shipped separately.

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

- *Always keep the packages in an upright position.*
- *Do not drop the equipment.*
- *Do not stack the pallets.*

The cabinet is bolted to the shipping pallet and packed in a cardboard sleeve that is 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 ensure that the received package(s) correspond to the description shown in the delivery documentation and carefully examine the packing containers for signs of physical damage.

3.2.1 Reporting transportation damage

WARNING: DO NOT connect the system to the mains electricity supply if there is any sign of mechanical damage.

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 cabinet and these too should be checked for damage.

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

3.2.2 Weight and dimensions

Dimensions (W x D x H)	mm	510 x 850 x 1340
Unpacked weight	kg	100kg cabinet + 7 kgs for each power module (i.e. 107 kgs to 142 kgs)
Packed weight	kg	Cabinet is shipped without modules fitted

3.2.3 Local transportation

When you transport the equipment after it has been off-loaded please observe the following precautions.

CAUTION: *Local transportation:*

- *When moving the cabinet using a forklift or pallet jack, insert the lifting equipment forks fully under the shipping pallet to lift the cabinet securely and prevent it from toppling over.*
- *Do not tilt the cabinet by more than 10° from vertical.*

WARNING: The cabinet weight can cause serious personal injury and/or structural damage to the surrounding area if dropped in transit. Always take extreme care when moving the equipment.

3.2.4 Storage

If you plan to store the PowerWAVE EL MOD prior to its installation it should be kept upright (preferably in its original shipping packaging) in a clean, dry environment with a temperature between -25°C to +60°C and RH <93%. If the storage period is likely to exceed seven days the packaging should be removed and the cabinet inspected for shipping damage before it is placed into storage. If there is no apparent damage you should refit the packaging or cover the cabinet with a dust-cover to prevent the ingress of dust and dirt.

Batteries that are intended for external rack-mounting will be shipped in a separate package and should be stored under the environmental conditions stipulated above.

3.2.5 Unpacking instructions

WARNING: The cabinet, battery cabinet (optional) and battery packages are heavy and may tip during unpacking unless the unpacking instructions are not followed closely.

If the shipment is received in good order then unpack the PowerWAVE EL MOD cabinet as follows:

1. Remove the plastic sheeting and cardboard sleeve covering the cabinet.
2. Remove the anchor bolts securing the cabinet to the pallet then lift and remove the cabinet from the pallet.
3. Retain the packaging materials for possible future shipment.
4. Examine the cabinet for any sign of damage and notify your supplier immediately if any damage is found.
5. Remove any internal protective packaging.
6. When the cabinet is placed in its final location, install the 4kVA power modules and secure them in place.
7. Install a blanking plate to the front of any shelves that have no power module fitted.

Batteries

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

The batteries are shipped in a separate package and should remain in their packing until required by the Kohler Uninterruptible Power Ltd. service engineer when the system is commissioned.

Battery life depends very much on the ambient temperature, and optimum battery life will be obtained if the batteries are stored and operated at a temperature of 20°C.

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

3.3 Installation planning (environmental & mechanical)

3.3.1 Environmental considerations

A certain amount of pre-planning will help provide a trouble-free installation process. You should consider the following guidelines when planning the installation 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 support the weight of the cabinet/battery equipment, plus fork lift or trolley jack during transit.
3. The cabinet requires sufficient front and rear clearance to enable cooling airflow, as described below.
4. All maintenance, servicing and user operation can be carried out from the front of the cabinet, but rear access is required for connecting the AC and DC power cables.
5. An ambient temperature of 20°C is necessary to achieve the recommended battery life span.
6. The cooling air entering the cabinet must not exceed +40°C.
7. The floor material should be non-flammable and strong enough to support the heavy load.
8. In summary, the system should be installed in a location where:
   a) Humidity (< 93%) and temperature is ideally 20°C.
   b) Fire protection standards are respected.
   c) Cabling can be performed easily.
   d) A minimum 600mm front accessibility is available for service or periodic maintenance.
   e) Adequate cooling air flow is available.
   f) The air conditioning system can provide a sufficient amount of air cooling to keep the room at, or below, the maximum desired temperature (where used).
   g) No dust or corrosive/explosive gases are present.
   h) The location is vibration free.

3.3.2 Clearances

Cooling air enters the front of the power modules and force ventilate through the cabinet rear.

a) You should provide a minimum of 600mm clearance at the front of the cabinet to allow the power module(s) to be removed/installed.
b) You should provide a minimum of 300mm at the rear of the cabinet and 700mm above the cabinet.
c) The cabinet does not require any side clearance for cooling purposes so it can be installed immediately adjacent to another cabinet, battery enclosure or wall; however rear access is necessary for cabling purposes.

The battery installation is bespoke, and specific access clearances will by specified by the battery installation designer.

3.4 Installation planning (cabling considerations)

3.4.1 General requirements

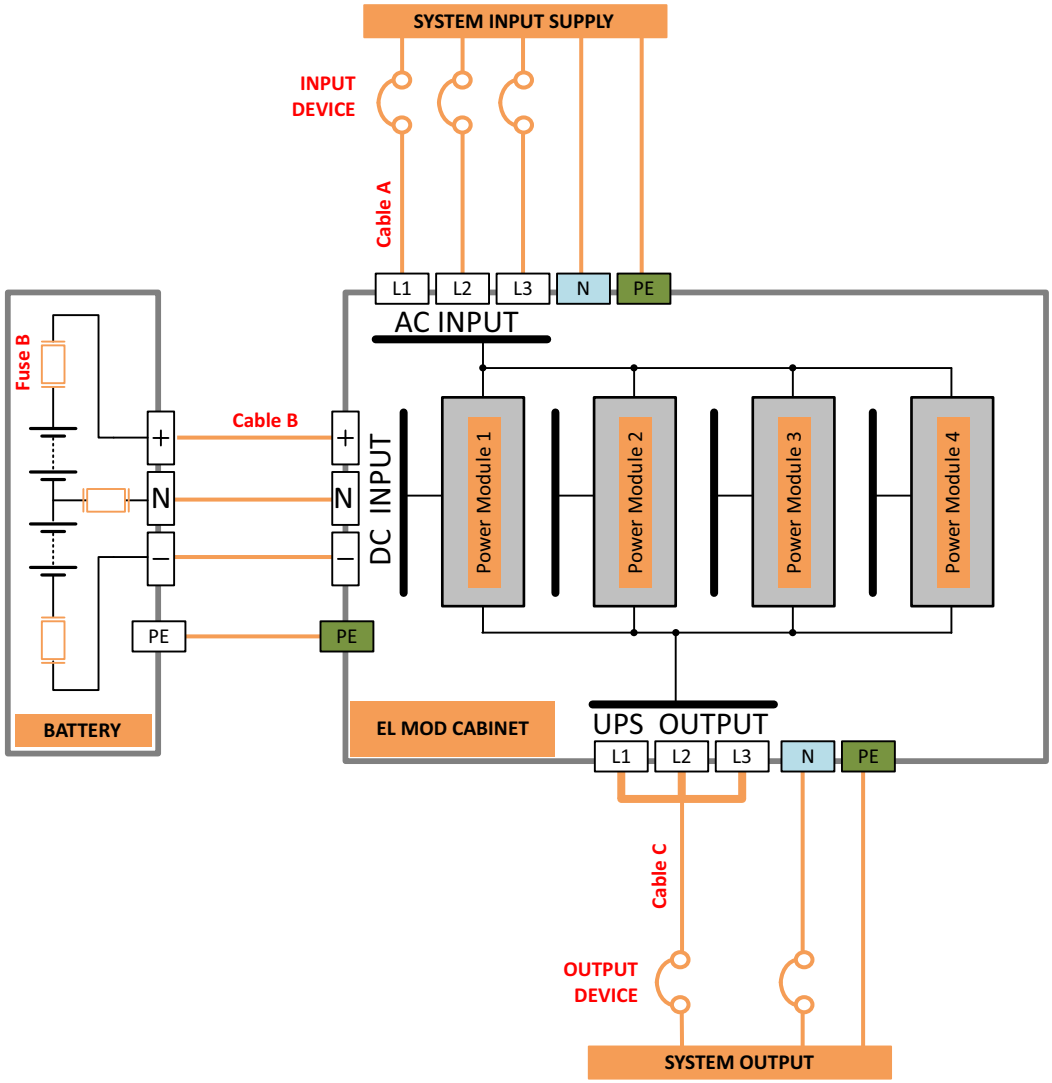


Figure 3.1 Power cabling connections and protection

It is the customer's responsibility to design and install the PowerWAVE EL MOD supply and distribution circuits, and provide all the external fuses, switchgear and cables required to connect the cabinet's AC INPUT, DC INPUT and UPS OUTPUT supplies. The information provided in this section should assist you in the planning and preparation of the power cabling.

As shown in Figure 3.1, the AC INPUT terminals should be connected to a utility mains LV-switchgear panel and protected by a circuit breaker or fused isolator. The protective device not only offers overload protection but also provides a means of disconnecting the mains supply from the PowerWAVE EL MOD, as there is no input supply switch fitted to the standard cabinet.

A fused battery isolator must be fitted inside the external battery cabinet – or immediately adjacent to the battery installation if a purpose-designed battery cabinet is not used. This requires a three-pole device, connected to the battery positive, negative, and mid-point (neutral), as shown. Kohler Uninterruptible Power Ltd. can supply a matching battery cabinet containing the necessary fuses and switchgear.

Similarly, the UPS OUTPUT terminals should be connected to the load equipment via a suitably protected load distribution panel. The recommended output circuit breakers are specified in the following table.

Output circuit breaker recommendation

Depending on the number of installed modules, we recommend that the EL loads are protected using the circuit breaker types specified in this table.

Number of Modules	System Rated Output Current	Output Device(s)						
		B4	B6	B10	B16	C10	C16	C20
1	15.6A	X						
2	31.2A	X	X	X				
3	46.8A	X	X	X	X	X		
4	62.4A	X	X	X	X	X		
5	78.0A	X	X	X	X	X	X	
6	93.9A	X	X	X	X	X	X	X

3.4.2 Inrush Current

Special Consideration should be taken when installing luminaires with very high inrush characteristics.

The Inrush Current of LED Luminaires is determined by the driver (s) and is not proportional to the luminaire wattage or running current, LED luminaire inrush currents can be as high as 400 times the running current for a very short period of time.

Further information regarding LED inrush currents can be found by accessing the “LIA Technical Statement LIA TS35” from the LIA website (www.thelia.org.uk).

The table below provides some details regarding the maximum recommended inrush currents for luminaires:

Number of Modules	Maximum Inrush Current
1	35A
2	70A
3	105A
4	140A
5	175A
6	210A

If higher inrush levels are expected Kohler Uninterruptible Power Ltd. can provide Inrush Current Limiter for LED lighting Drivers.

Rated at maximum 16A continuous power they can be installed within lighting distribution panels.

3.4.3 Cable specification

All cables and protective devices must be selected in accordance with national and local regulations and codes of practice (e.g. BS7671) to suit the maximum capacity of the system, as shown in the table below.

Key Point: If you install a system containing fewer than six power modules with a view to increasing the system capacity it at a later date as your load increases, you should consider using cables rated for the maximum system rating at the outset. This will simplify the future update process and avoid having to shut-down the system at a later date to replace the power cables. ALL power modules have internal fuse protection.

	PowerWAVE EL MOD 1:1 & 3:1					
	1 MOD 4kVA	**2 MOD 8kVA**	**3 MOD 12kVA**	**4 MOD 16kVA**	**5 MOD 20kVA**	**6 MOD 24kVA**
AC INPUT *(Cable A)*	26 A	52 A	78 A	104 A	130 A	156 A
DC INPUT *(Cable B)*	12 A	24 A	36 A	48 A	60 A	70 A
UPS OUTPUT *(Cable C)*	19.2 A	38.4 A	57.6 A	76.8 A	96 A	115 A
GROUND (PE) (mm²)	10 mm²	10mm²	25mm²	35mm²	50mm²	70mm²

3.4.4 Electrical planning

All electrical power connections are made to terminals located on the rear of the cabinet near the top. Gland plates are fitted to the top and bottom of the cabinet immediately above the power terminals to allow either top or bottom cable entry. If the cabinet is to be installed in a location with restricted rear access, you should ensure that suitably-contained power cables are available before the cabinet is moved to its intended final position

CAUTION: *When using bottom-entry, if the cables run across the floor they should be suitably constrained so that they do not present a trip hazard.*

3.5 PowerWAVE EL MOD cabling procedure

3.5.1 Safety notes

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

1. All the operations detailed in this section must be performed or supervised by a qualified, authorised electrician.
2. Once the electrical installation is completed the initial system start-up must be performed by a qualified engineer, trained and authorised by Kohler Uninterruptible Power Ltd.
3. Do not connect the system if there is water or moisture present.
4. When working on the input power cables, you must ensure that the AC INPUT supply is isolated at the mains switchgear panel and, where possible, locked out. Warning notices should be posted where applicable to prevent the inadvertent operation of the LV supply isolator(s).
5. Ensure the following conditions are met prior to starting work on the equipment:
   a) No mains voltage is present from the mains switchgear panel.
   b) All loads are shut down and disconnected.

3.5.2 Preparing the power cabling

1. Prepare the top/bottom cable gland plates.
2. Ensure the cabinet is fully installed mechanically at its intended final location.
3. Ensure that the provided fuses, cables and protective devices are in accordance with the prescribed IEC Standards or local regulations (e.g. BS7671).
4. We recommended that the system output is connected to the EL loads using the circuit breakers shown on page 16.

3.5.3 Connecting the power cables

Figure 3.2 Power connections

Input cables

CAUTION: *The input Neutral cable must be unswitched and permanently connected.*

1. For a single-phase input supply:
   a) Fit link bars to the AC INPUT terminals L1, L2, L3 and the three Neutral (N) terminals, as shown in Figure 3.2.
   b) Connect an earth cable between the utility supply earth and terminal PE.
   c) Connect the utility supply live cable to the (linked) AC INPUT terminal.
   d) Connect the utility supply neutral cable to the (linked) N terminal.
2. For a three-phase input supply:
   a) Remove the link bars from the AC INPUT terminals L1, L2, L3.
   b) Connect an earth cable between the utility supply earth and terminal PE.
   c) Connect the three-phase utility supply live cables to the AC INPUT terminals L1, L2, L3, taking care to observe the correct phase rotation.
   d) Connect the utility supply neutral cable to the (linked) N terminal.

Output cables

1. Fit a link bar to the UPS OUTPUT terminals L1, L2, L3.
2. Connect the protective earth cable from the load distribution board to the protective earth PE terminal.
3. Connect the output supply live cable to the (linked) UPS OUTPUT terminal.
4. Connect the output supply neutral cable to the (linked) N terminal.

Battery cables

The DC cabling for the battery system(s) must be completed by a Kohler Uninterruptible Power Ltd. engineer or one of its approved service agents. The customer installation team is only responsible for providing any necessary containment for the DC cables.

WARNING: Do not attempt to fit the batteries, complete the battery wiring, or close the battery isolators.

3.5.4 Customer interface cabling

A number of interface facilities are provided to allow external monitoring and control of the PowerWAVE EL MOD. These facilities, which are described in Chapter 7, are optional and will vary from site to site, and should be connected before power is applied to the system.

4 Operating Instructions

4.1 Starting the system

Note: When you turn on the PowerWAVE EL MOD system its initial operating mode depends on the working conditions that were present when the system was previously shut down. This procedure covers the complete sequence of actions required to turn on the system from a fully powered-down state and then select the wanted operating mode.

1. Turn on the input mains supply:
   a) The cooling fans will operate.
   b) The red alarm led (ALM) will illuminate on every power module.
   c) The green RUN led will flash on every power module, accompanied by the sound of clicking relays, as the modules run through their start-up checks.
   d) The audible alarm will sound. This can be cancelled by pressing the Esc key.
2. As each power module completes its start-up checks the green RUN led on the front of the module will change from flashing to solid green. This may take around two minutes to complete for all the power modules.
3. When the RUN led is fully illuminated on every power module, close the battery fuses/breaker:
   a) The ALM led should extinguish on every power module.
   b) If the ALM led does not extinguish, the control system has detected a fault – refer to the alarms identification and troubleshooting information beginning on page 24.
4. When the system is first powered up, its operating state can be either ON or OFF depending on the conditions that were present when the unit was powered down. You can change the current operating state by selecting menu 5.1 in the SETUP menu *(see Figure 2.11)*:
   a) If the top line in menu 5.1 shows [5.1 SYSTEM OFF] it indicates that the system is currently ON and you can turn it OFF by pressing the Ent key twice.
   b) If the top line in menu 5.1 shows [5.1 SYSTEM ON] it indicates that the system is currently OFF and you can turn it ON by pressing the Ent key twice.
5. When the system is first powered up, its operating mode will be the same as it was when the unit was powered down. You can view and change the current operating mode by selecting menu 5.4 in the SETUP menu. The top line in menu 5.4 shows [5.4 WORK STYLE] and the second line shows the currently selected mode – either CHANGEOVER, INVERTER, or NON-MAINTAINED:
   a) If you want to change the operating mode, select it using the UP and DOWN scroll keys, then press Ent.
6. Observe the system output voltage using menu 1.2.
7. If the output voltage is correct, close the output circuit breakers to connect power to the emergency luminaires.
8. The PowerWAVE EL MOD is now fully operational.
9. With the system now running, the input, output and battery operating parameters can be monitored at any time using the Control Panel menus as described on page 8.

4.2 Shutting down the system

1. Open the output circuit breakers to disconnect the supply to the emergency luminaires.
2. Open the battery fuses/breaker:
   a) The ALM led should illuminate on every power module accompanied by an audible warning alarm.
3. Turn off the input mains supply.
4. The PowerWAVE EL MOD is now fully shut down.

4.3 Testing the inverter on battery

The Inverter Test Switch allows you to test the inverter battery operation. When the SUPPLY ON led is lit on the top of the test switch panel you can select battery operation for 10 minutes, 1 hour, or 3 hours by momentarily operating the test switch to the right.
That is, operate the switch once to select a 10 minute test, twice for a 1 hour test and three times for the full 3 hour test. If you operate the switch for a fourth time it will cancel the test that is currently running.

Figure 4.1 Battery test switch

5 Maintenance

5.1 Introduction

WARNING: All the operations described in this chapter must be performed by trained personnel.

The PowerWAVE EL MOD does not contain any user-serviceable parts, however the UPS contains life limited components that require to be replaced at regular intervals, so day-to-day maintenance requirements are minimal other than to ensure that the operating environment is kept cool and dust free, 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. A clean operating environment will help maximise the useful working life and reliability of both the PowerWAVE EL MOD and its batteries.

5.2 Emergency Lighting maintenance

The PowerPro EL MOD system should be maintained as per the regulations set out in EN50172 Standards:

- Log Book Should be kept on site indicating all testing / inspection reports as detailed within the standard.
- Daily – Indicators of central power supply should be visually inspected for operation
- Monthly – All luminaires and exit signs should be put into test and transferred to the central battery supply. The Central Battery system should be put into test and all luminaires checked for operation.
- After return to normal operation the central battery system should be checked for normal operation.
- Annually – The specific Monthly test should be conducted for the full duration of the system.
- After restart the charging of the batteries should be fully checked for operation. Certificate /Test sheet should be recorded within the logbook.

5.3 Scheduled maintenance

It is essential that the PowerWAVE EL MOD cabinet and batteries receive regular preventative maintenance to maximise both the useful working life and system reliability. When the system is commissioned, the commissioning engineer will leave a service record book with the customer that will be used to log its full service history.

We recommend that the system is maintained every six months by a Kohler Uninterruptible Power Ltd. trained engineer, or approved service agent, who will complete the following:

5.3.1 Preventative maintenance inspection

Preventative maintenance inspections form an integral part of all Extended Warranty Agreements (maintenance contracts) offered by Kohler Uninterruptible Power Ltd.

During a preventative maintenance inspection the engineer will check and validate:

- site environmental conditions
- integrity of electrical installation
- cooling airflow
- load characteristics
- integrity of alarm and monitoring systems
- operation of all installed options.

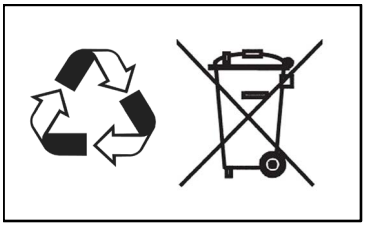
5.3.2 Battery maintenance and testing

The battery installation should be inspected on a regular basis, not exceeding 6-months. Traditional VLRA battery testing and maintenance consists of:

- checking and recording the open-circuit battery voltage
- verifying that the float charging voltage is correct
- inspecting all battery terminals and connections for corrosion
- inspecting all batteries for cracks, leaks or swelling
- checking the integrity of the inter-cell connections
- removing any materials and cleaning around the equipment
- carry out a full battery check.

Battery disposal and recycling

Batteries contain dangerous substances that can harm the environment if disposed of carelessly. If you have reason to change the batteries, always consult with your local environmental waste disposal organisations to obtain the recommended disposal and recycling information.



6 Troubleshooting

6.1 Alarm indications

The PowerWAVE EL MOD will generate an audible warning if a fault or abnormal operating condition is detected, and indicate the source of the alarm trigger on the LCD panel.

If the alarm is generated by a fault within a power module the red alarm (ALM) led will illuminate on the front of the affected module to identify the module at fault. If the alarm is not specifically due to a module fault (e.g. input supply failure) the module ALM LED(s) will remain OFF.

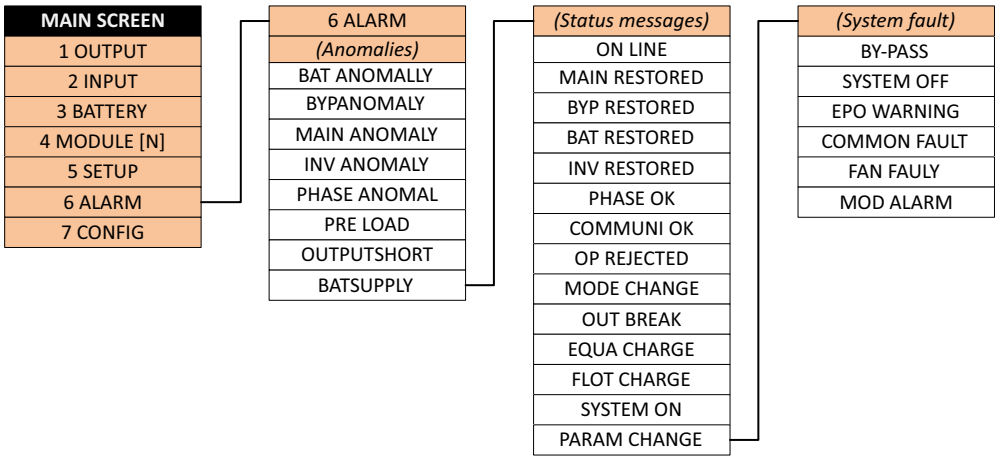


Figure 6.1 LCD Alarm indications

You can interrogate the active alarm(s) and machine status by navigating to the [6 ALARM] sub-menu from the LCD MAIN SCREEN, as shown in Figure 6.1 (see the full menu map in Figure 2.11 for details of the navigation process).

The alarm indications are functionally arrange in three groups – i.e. *Anomalies*, *Status messages*, and *System faults* – and as you scroll through the [6 ALARM] sub-menu the indications are presented in the sequence shown in Figure 6.1.

6.2 Troubleshooting procedure

There are no user-serviceable parts in the PowerWAVE EL MOD cabinet, so the degree of rectification that can be carried out by the operator is minimal, apart from ensuring that the system's AC and DC power supplies are available and within specification, and the load connected to the UPS OUTPUT is within the cabinet rating.

An internal fault can usually be attributed to a faulty power module, control panel or an ancillary assembly such as the cooling fan, all of which require the attention of a trained engineer who will exchange the faulty assembly in most instances.

From an operator perspective, if you encounter a system malfunction or alarm condition you should do the following:

1. Silence the audible warning by pressing the Esc key.
   Note that the alarm cannot be silenced if a FAULT condition is still present
2. If an Alarm (ALM) led is lit on one power module only (i.e. not illuminated on all modules) then seek immediate advice from your nearest service centre.
3. Scroll through the ALARMS sub-menu shown in Figure 6.1 and record the presented alarm and status data.
4. Interpret the alarm and status data following the tables shown below and seek assistance from your nearest service centre if the cause of the alarm is beyond simple rectification.

6.2.1 Alarm interpretation tables

ALARM (Anomalies)	SUGGESTED SOLUTIONS
BAT ANOMALY	Battery anomaly: 1. Check the direct current and voltage of the monitor overview screen is normal. 2. Ensure the battery fuses are intact and the battery isolator is turned on. 3. Check the voltage at the DC INPUT terminals on the back of the cabinet. 4. Check the DC voltage at the battery positive and negative terminal are correct.
BYP ANOMALY	Bypass anomaly: 1. Check the AC incoming utility supply isolator is turned on. 2. Check the mains voltage at the AC INPUT terminals (single or three-phase).
MAIN ANOMALY	Mains supply anomaly: 1. Same problem as the bypass supply anomaly described above. Both share the same supply.
INV ANOMALY	Inverter anomaly: 1. Check the OUTPUT voltage when the unit is operating on inverter power.
PHASE ANOMAL	Incoming phase rotation anomaly: 1. When the AC INPUT is connected to a single-phase supply, check the input L-N voltage on all phases that the input phase rotation is correct
PRE LOAD	Sustained 100% overload: 1. Reduce the load connected to the system if it exceeds the system rating. 2. Seek trained assistance if the warning persists but the system is not being overloaded.
OVERLOAD	Overload >120%: 1. Reduce the load connected to the system if it exceeds the system rating. 2. Seek trained assistance if the warning persists but the system is not being overloaded.
OUTPUT SHORT	Output short circuit (on inverter or bypass operation): 1. Check if there is short in the load. 2. Check if there is short in the output terminals.
BAT SUPPLY	Load is operating on battery power: 1. Check that the incoming AC supply isolator is turned on. 2. Check that the mains voltage at the AC INPUT terminals (single or three-phase).

ALARM (Status)	INTERPRETATION
ON-LINE	The inverter is on-line and supplying load power
MAIN RESTORED	The utility mains supply has been restored following an outage.
BYP RESTORED	The utility mains supply has been restored following an outage.
BAT RESTORED	Battery charging / fully charged.
INV RESTORED	Inverter turned on and operating but is not on-line (load on bypass).
PHASE OK	Applicable to 3-phase output unit only and does not apply to EL MOD product.
COMMUNI OK	Communications interface functions working correctly
OP REJECTED	Operation Rejected in response to an incorrect configuration setting change.
MODE CHANGE	Operation confirmation that the number of modules has been changed.
OUT BREAK	System output is OFF.
EQUA CHARGE	Batteries on equalisation charge.
FLOT CHARGE	Batteries on float charge.

ALARM (Status)	INTERPRETATION
SYSTEM ON	The static inverter is providing the output supply.
PARAM CHANGE	Confirmation that a system parameter setting has been accepted. Will self clear.

ALARM (System fault)	INTERPRETATION
BY-PASS	The bypass is providing the output supply.
SYSTEM OFF	The system is shut down.
EPO WARN	External Emergency Power Off circuit has operated and shut down the system. 1. Investigate the cause of the activation and rectify if possible. 2. If you are unable to rectify the cause of the activation, or the EPO circuit appears to be intact then please contact your supplier.
COMMON FAULT	Common alarm output operates in conjunction with any active alarm.
FAN FAULT	Fan failure may need replacement fan – Please contact your supplier.
MOD ALARM	Power module needs replacing – Please contact your supplier.

6.3 Contacting service

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

Kohler Uninterruptible Power Ltd.
Woodgate
Bartley Wood Business Park
Hook
Hampshire, United Kingdom
RG27 9XA

Tel: +44 (0)1256 386700
0800 731 3269 (24Hr.)

Email: ukservicesales.ups@kohler.com

We recommend that your PowerWAVE EL MOD system is protected by an extended warranty agreement (see Chapter 2 for details). These agreements assist us in caring for your equipment and ensure that it is well maintained and attended to promptly should any problems occur.

7 Options

7.1 Introduction

The PowerWAVE EL MOD system offers a range of interfaces that can be connected to external facilities management and monitoring systems. All the interface connections are located on the system control panel as illustrated in Figure 7.1. The terminal blocks, RS232/RS485 and RJ45 connectors are protected by a removable cover plate which is secured to the cabinet top panel by two screws. The SNMP card slot is fitted with a separate cover plate.

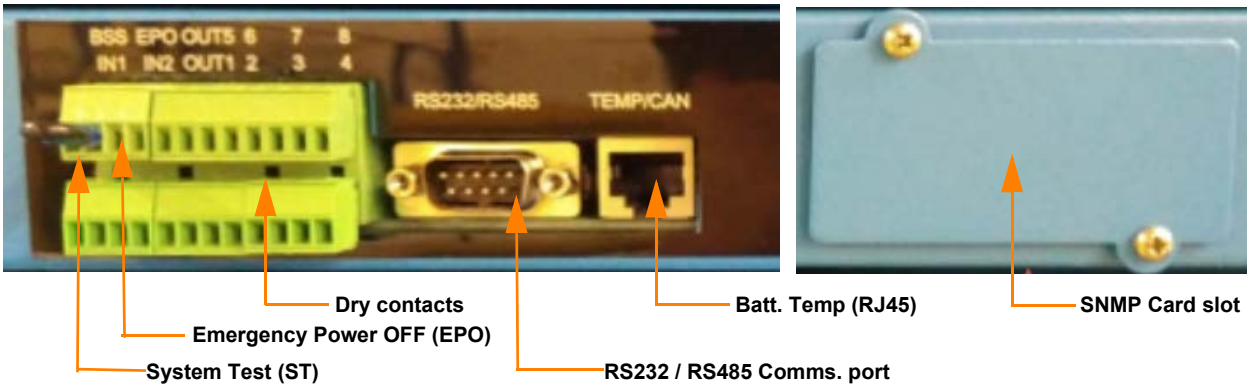


Figure 7.1 EL MOD Customer interface options

7.2 Terminal block connections

7.2.1 Emergency power off (EPO)

An external EPO circuit can be connected to the two left-most terminals on the 4-way terminal block. The external circuit must be 'normally closed' to effectively short-circuit the EPO terminals. If the EPO circuit is operated (open-circuit) the PowerWAVE EL MOD will shut-down and disconnect the load power.

The EPO terminals are volt-free and should be connected using a screened cable with 1 pair (0.5 mm²) and maximum length of 100m.

Note: If an external EPO circuit is not connected, a shorting link must be connected to the EPO terminals (as shown).

7.2.2 IN1 & IN2

INPUT 1 and INPUT 2 can be changed to provide 4 different functions:

MANUAL BYPASS

If external Maintenance Bypass Switch is installed, auxiliary can be connected to this section. In normal operation input should be NO, on contact closure system is forced to Bypass Mode. When released system automatically transfers back to Normal Operation.

UPS OFF

Contact should be Normally Closed in Normal Operation. If contact is Closed Inverter is turned off fully and system is forced to Bypass Mode. When released system automatically transfers back to Normal Operation.

EQUALISATION CHARGE

Contact should be Normally Closed in Normal Operation. If contact is opened the charger forces the DC voltage to the selected equalization charge voltage.This is held for 10 hours even if the contact is changed to Normally Open.

BATTERY TEST

The battery test facility is used to test the PowerPro EL MOD operation on battery power the two Input (IP) terminals must be normally closed. In this case, if the connection between the IP terminals goes open-circuit it turns off the rectifier and the load is operated from the inverter using the standby battery power.

The Battery test function can be connected to a local or remote operating device (switch). The Battery Test terminals are volt-free and when using a remote test facility, they should be connected using a screened cable with 1 pair (0.5 mm²) and maximum length of 100m.

Note: If an external Battery Test circuit is not required, a link must be fitted to the IP terminals, or none selected for the input selection.

7.2.3 System test (BSS)

The System Test (BSS) facility is used to test the PowerWAVE EL MOD operation on battery power and is similar to the EPO circuit in that the two ST terminals must be normally closed. In this case, if the connection between the ST terminals goes open-circuit it turns off the rectifier and the load is operated from the inverter using the standby battery power.

The BSS function can be connected to a local or remote operating device (switch). The BSS terminals are volt-free and when using a remote test facility they should be connected using a screened cable with 1 pair (0.5 mm²) and maximum length of 100m.

Note: If an external BSS circuit is not required, a link must be fitted to the BSS terminals, as shown

7.2.4 Dry contact terminal block

The PowerWAVE EL MOD provides eight hard-wired 'system status' outputs that can be used to drive remote signalling and/or monitoring facilities. These output are switched by volt-free relay contacts and are normally open (closed on activation). The contacts are rated for 110VAC (0.5A) or 24VDC.

As shown in Figure 7.2, the eight switched alarm outputs are:

- Battery Test Active
- General Alarm
- Inverter Mode
- Mains Failure
- Battery Low
- Charger Failure
- Abnormal Load
- Battery Mode

Connections to these terminals should be made using a screened cable with 1 pair (0.5 mm²) and maximum length of 100m.

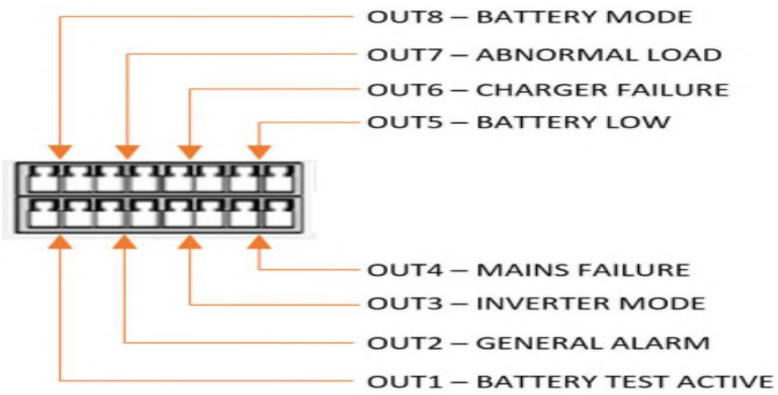


Figure 7.2 Dry contact alarm outputs

- OUT 1 – BATTERY TEST ACTIVE

  N1 or IN2 are selected as "Battery Test", changes state to NO when battery test is activated.Not Activated during a Mains Failure

- OUT 2 – GENERAL ALARM

  Changes state to NO on any internal alarm including Mains failure.Not activated during a Battery Test from IN1 or IN2

- OUT 3 – INVERTER MODE

  Changes state to NO if Output is being fed from Inverter.

- OUT 4 – MAINS FAILURE

  Changes state to NO if the input voltage or frequency is out of tolerance Not activated during a Battery Test from IN1 or IN2

- OUT 5 – BATTERY LOW

  Changes state to NO if the battery voltage goes below its set value

- OUT 6 – CHARGER FAILURE

  Changes state to NO if any of the modules indicates a charger fail alarm

- OUT 7 – ABNORMAL LOAD

  Changes state if the total system load is over 100%

- OUT 8 – BATTERY POWER

  Changes state to NO if the load is being fed from the Battery Source and not the mains.

All Dry Port Alarms are designed to be FAIL SAFE Operation. Dry ports are in NO state when the System is deactivated. When the system is running in Normal Operation all alarms are NC Alarm changes state to NO on activation of Alarm.

7.3 Battery temperature sensing

The battery temperature can be measured by a thermocouple sensor that is attached to the battery and connected to the RJ45 connector on the front of the PowerWAVE EL MOD via a purpose-designed adapter. The temperature sensing signal is monitored by the battery charger control system to provide a temperature-compensated battery charging profile and also provides battery temperature indication on the control panel menu.

7.4 SNMP Communications card slot

Simple Network Management Protocol (SNMP) is a world-wide, standardised communication protocol that 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/CS141 card slot, designed to house a Modem/Ethernet SNMP adapter card, is located behind a cover plate on the right hand side of the control panel. To fit the card, you must remove the cover plate, insert the card into its connector then secure it in place using the screws that you removed when taking off the cover plate.

The SNMP adapter card contains an RJ-45 Ethernet connector which allows the PowerWAVE EL MOD to be connected to a network using a standard CAT-5 network cable. Once connected, the system management software agent that is pre-installed in the SNMP adapter monitors the PowerWAVE EL MOD operation and outputs its data in SNMP format to the connected network.

The communication exchanged between the PowerWAVE EL MOD and network enables event/alarm emails, server shut down (with optional licenses) and other tasks to be performed. It can also be integrated with BMS software over a local area network (LAN) for SNMP or Modbus information over IP.

The SNMP adaptor requires a PC with terminal connections, and for normal operation at least one Ethernet connection.

Note: SNMP connectivity can also be implemented using an external SNMP adapter connected to the RS232 output.

8 Specification

8.1 Power module

POWER MODULE	ELM-04
Capacity	4 kVA
Input / Output mode	Single phase input/output
Input PF	≥ 0.99
THDI (%)	≤ 3%
Overload ability	Comply to system overload requirement
Charging power	1600W
Weight(kg)	7 kg

8.2 System cabinet

SYSTEM CABINET	Single-phase Input	Three-phase Input
MAINS / BYPASS INPUT		
Input Mode	1-phase +N +E	3-phase +N +E
Input voltage	220V / 230V / 240V ±25%	380V / 400V / 415V ±25%
Input frequency	50Hz±10%, 60Hz±10%	
Input Current	26A ~ 156A (26A per fitted power module)	78A (12 kVA system) 156A (24 kVA system)
Power walk-in (Sec.)	60secs	
THDI (%)	< 3%	
Input PF	≥ 0.99	
DC INPUT		
Rated DC Input voltage	±240VDC	
DC Input voltage tolerance	±216V~±246VDC	
DC Input current	10A ~ 60A (10A per fitted power module)	30A (12 kVA system) 60A (24 kVA system)
BATTERY CHARGING		
Charging current limited	Yes	
Charging ability	12 hours (3 hours back up)	
Stability of charging voltage	±1%	
AC OUTPUT		
Maximum Power	4 kVA to 24 kVA in 4 kVA steps (1 to 6 Power modules fitted)	12 kVA (3 modules fitted) OR 24 kVA (6 modules fitted) only
Power factor	0.9	
Output voltage	220 / 230 / 240VAC	

SYSTEM CABINET	Single-phase Input	Three-phase Input
Output frequency	50 Hz / 60 Hz nominal	
Output frequency sync	Nominal ±4%; ±0.2% (on battery)	
Output current	19.2~ 115.2A (19.2A per fitted module)	57.6A (12 kVA system) 115.2A (24 kVA system)
Output voltage stability	±1%	
Output voltage recovering time	20ms (load 0~100% change)	
Overload ability	120% Continuous, 150% for 10mins, 175% for 1 min	
Transfer from mains to battery supply	0ms	
Transfer from bypass to inverter supply	<1ms	
Peak factor	3:1	
Waveform distortion	≤ 1% (linear load), ≤ 3%(non-linear load)	
Overall efficiency	≥ 93% (AC~AC), ≥ 98% (DC~AC)	
Load share precision	≤5%	
Output Short Circuit	3 x Output Current for 120ms	
ENVIRONMENTAL		
Ambient temperature	-25°C ~ 60°C	
Operating temperature	-5°C ~ 40°C	
Maximum operation altitude	≤ 1500m	
Relative humidity	≤ 95% non-condensing	
Protection degree	IP30	
Cooling	Fan-assisted air cooling (front entry / rear exhaust)	
Applicable safety standards	EN62040-1-1:2003 IEC60950-1:2001 EN50171	
Electromagnetic compatibility	EN62040-2:2006	
Acoustic noise	≤ 55 dBA	
Heat dissipation	Changeover mode: 120W (per power module) Inverter mode: 280W (per power module) Non-maintained mode: 120W (per power module)	
COMMUNICATIONS		
External Interface	RS232, RS485, 2 dry contact, TCP/IP adapter	
Display	LCD/LED	
MECHANICAL		
Cabinet dimensions (W x D x H)	510 x 850 x 1340 mm	
Cabinet weight	100kg cabinet + 7 kg for each power module (i.e. 107 kg with one power module up to 142 kg with six modules)	