

KOHLER®

UNINTERRUPTIBLE
POWER



KOHLER ELMOD SERIES

4-24kVA

Technical Specification

Document Control

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CHAPTER 1 – GENERAL DESCRIPTION

1.1 INTRODUCTION

The ELMOD is a high performance Emergency Lighting Static Inverter (SI) system, 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
- 10min, 1 hour & 3 hour battery test key-switch
- 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.

Optional features

- Input/output transformer
- Load distribution
- Internal maintenance bypass switch
- DC Earth leakage protection
- High IP rating
- Other voltage options

Model Range

	ELMOD 04	ELMOD 08	ELMOD 12	ELMOD 16	ELMOD 20	ELMOD 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	220/230/240 (1Ph + N + PE)		220/230/240 (1Ph or 3Ph+ N + PE)	220/230/240 (1Ph + N + PE)		
Battery	internal	External				

1.2 FUNCTIONAL DESCRIPTION

The ELMOD is a modular Static Inverter (SI) comprising a control module and 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 ELMOD system can provide an output rated between 4kVA and 24kVA in 4kVA increments.

Each 4kVA module contains a rectifier, charger and inverter.

The Control module contains the static switch power section and monitoring sections

The modules are all accessed from the front of the cabinet with all power connections located on the back of the ELMOD 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.

RECTIFIER: In ELMOD Series EL INVERTERS, a controlled IGBT rectifier with PWM technique is used to increase input power factor (PFC) and to decrease input current harmonics (THDI). The IGBT rectifier accepts AC input and produces a dual polarity DC voltage for both supplying the inverter and charging the batteries.

BATTERIES: Batteries are used as reserve DC power supply for the Inverter in case of mains failure. Batteries are connected in series with a centre-tap output to obtain a dual polarity DC supply. Batteries are discharged by the inverter during mains failure. The discharged batteries are re-charged by the IGBT Rectifier on a constant voltage / current limiting basis, if AC mains power is available.

INVERTER: It is manufactured by using the latest IGBT and DSP (Digital Signal Processing) technologies, and Pulse Width Modulation (PWM) technique. The Inverter converts the DC BUS voltage supplied by the IGBT Rectifier and / or the batteries into a well-regulated, fully digital controlled AC voltage with fixed voltage and frequency.

The output of the inverter is used to supply the critical loads connected to the EL INVERTER output.

STATIC TRANSFER SWITCH (STS): This is an electronically controlled transfer switch, which enables the critical load to be connected either to inverter output or to by-pass power source. During normal operation, the load is supplied by the inverter output, but in case of an overload or a EL INVERTER failure it is automatically transferred to the bypass source without any interruption.

1.2 MODES OF OPERATION

The ELMOD 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 SI OUPUT to the AC INPUT via the internal bypass line.

If the utility supply fails, the static switch will transfer the SI 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 1.4).

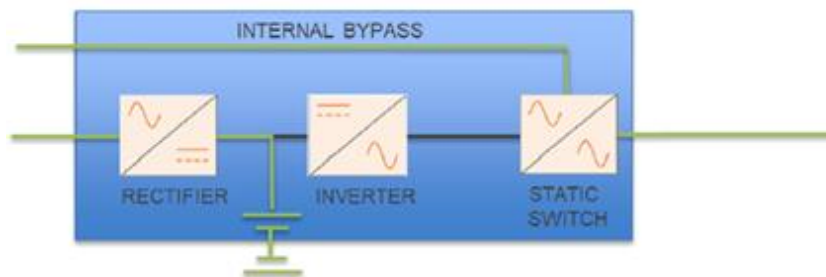


Figure 1.1

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 and the inverter-side of the static switch is turned on to connect inverter to the SI OUPUT.

The emergency luminaires are powered from the regulated inverter output.

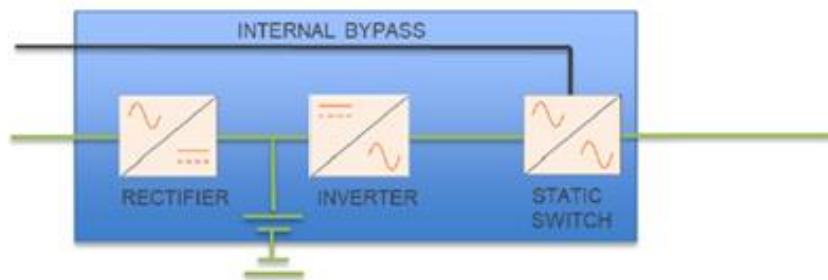


Figure 1.2

Non-Maintained mode

In this operating mode the unit can be viewed as operating purely as a 'standby' power supply as the ELMOD is not called upon to provide any SI 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 and both the inverter and bypass sides of the static switch are turned off, so the SI OUTPUT is not live.

If the mains supply fails, the static switch immediately closes its inverter-side switch which connects the inverter to the SI 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 1.4).

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 ELMOD will revert to its stand-by function.

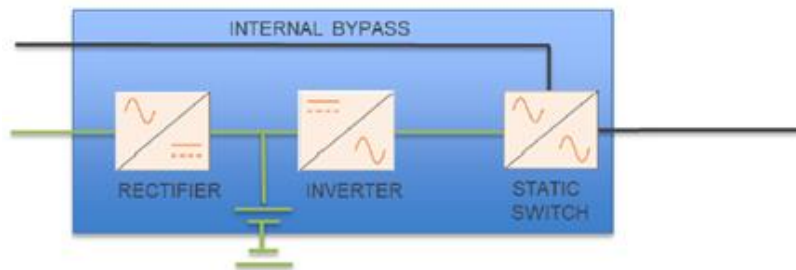


Figure 1.3

On battery operation

If the mains supply fails, the rectifier will turn 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 SI 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.

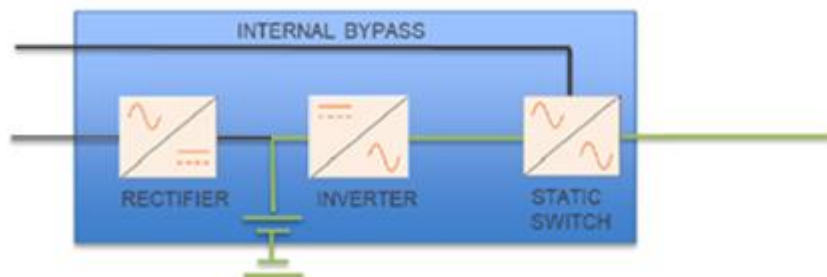


Figure 1.4

1.3 COMPONENT DESCRIPTION

1.3.1 CABINET

The ELMOD cabinet, shown in Figure 1.5, comprises up to six, 4kVA modules and a single control panel assembled in a purpose-designed chassis. The modules and the control module 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' ELMOD cabinet so suitable switching and protective devices must be fitted externally for ALL the input and output power cables.

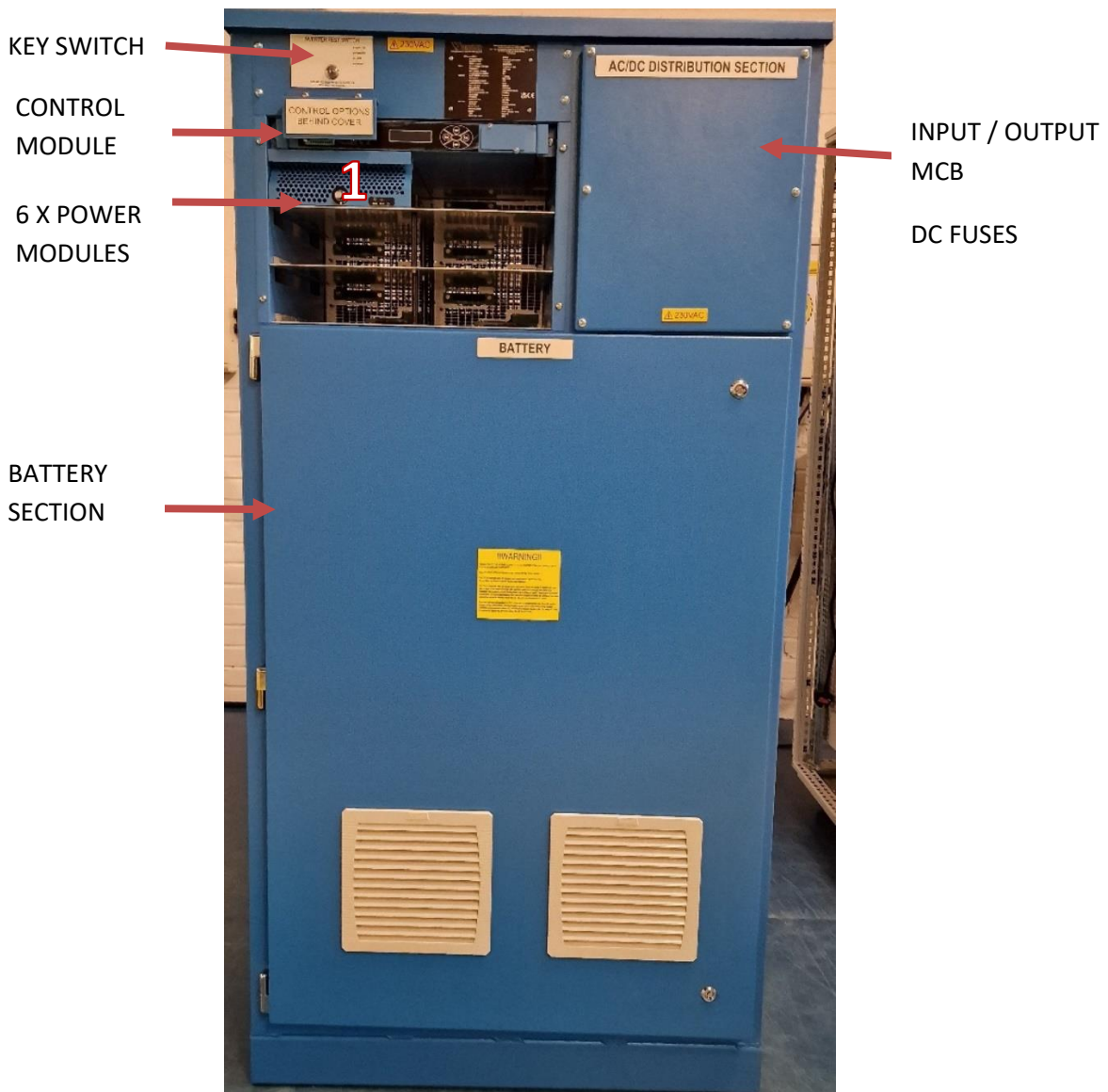


Figure 1.5A – 4kVA

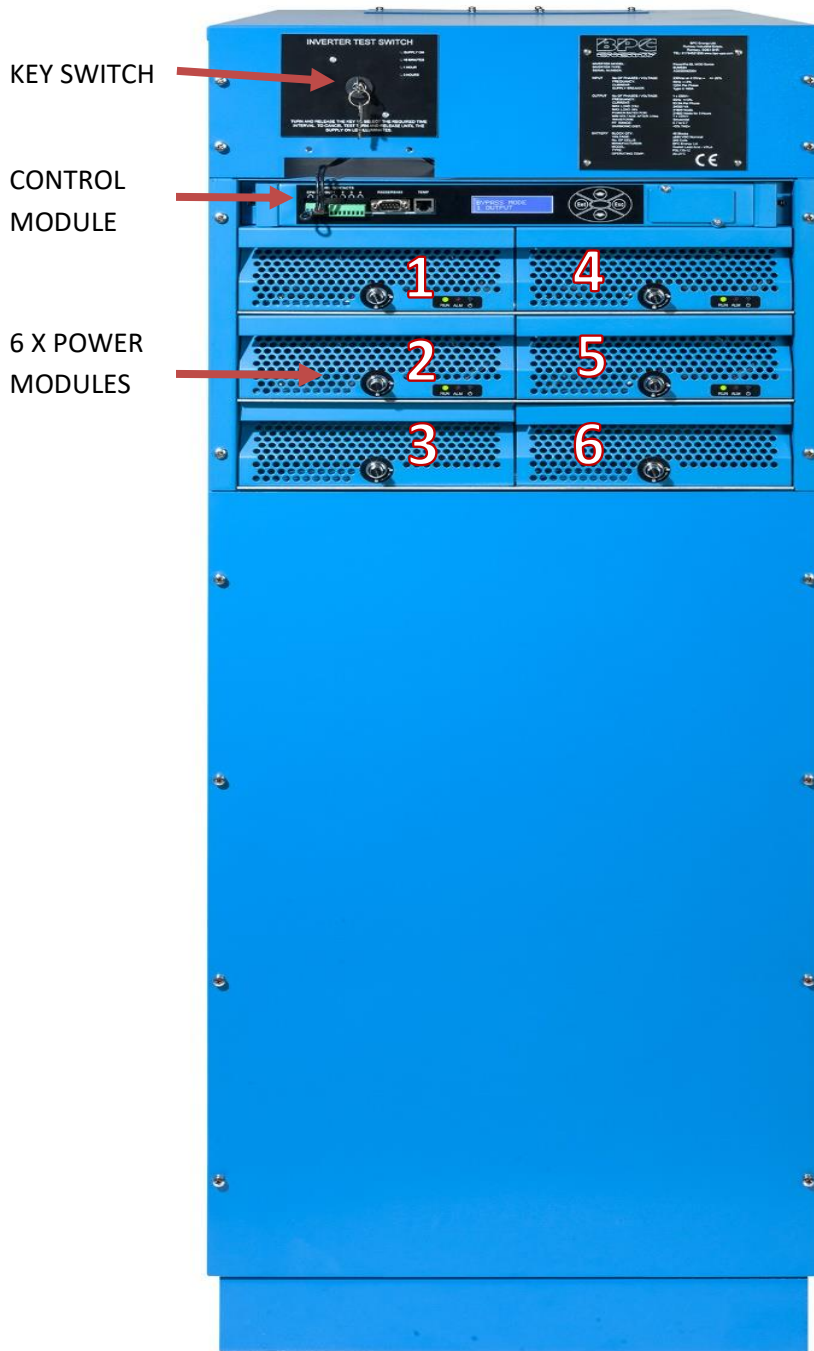


Figure 1.5B – 8 – 24Kva

1.3.2 4kVA POWER MODULES

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 2.5 shows the designated module numbers.

The ELMOD 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 12kVA (3 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 2.6.

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.

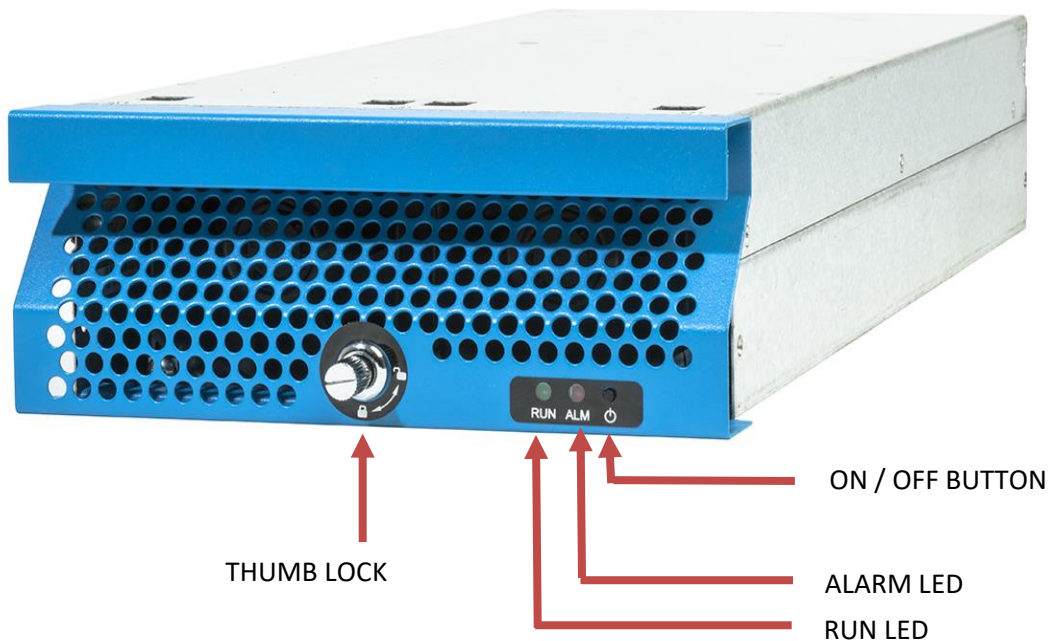


Figure 1.6

1.3.3 CONTROL MODULE

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 1.7.

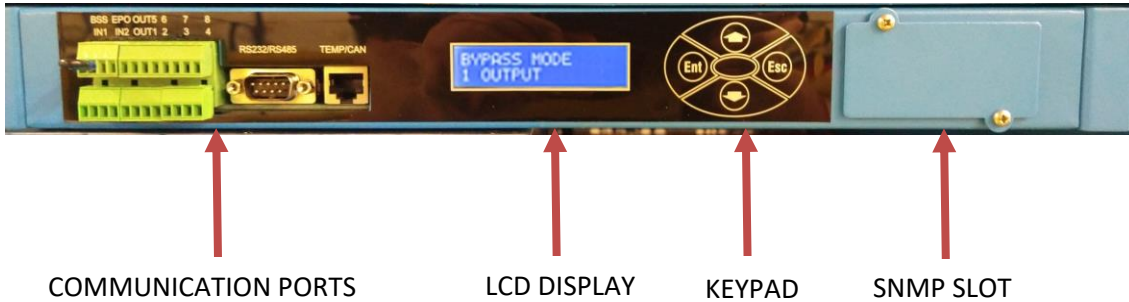


Figure 1.7

SNMP Slot

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.

NOTE: 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

CHAPTER 2 – COMMUNICATION

2.1 INTRODUCTION

The ELMOD 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 previously in Figure 2.1. 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.

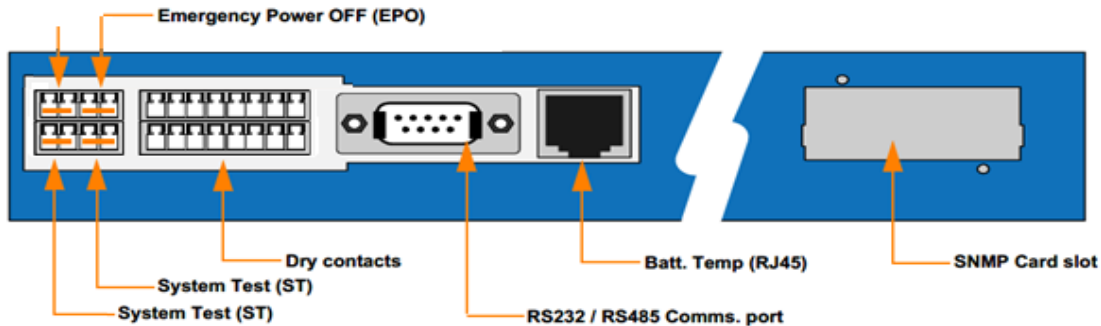


Figure 2.1

2.2 TERMINAL BLOCK CONNECTIONS

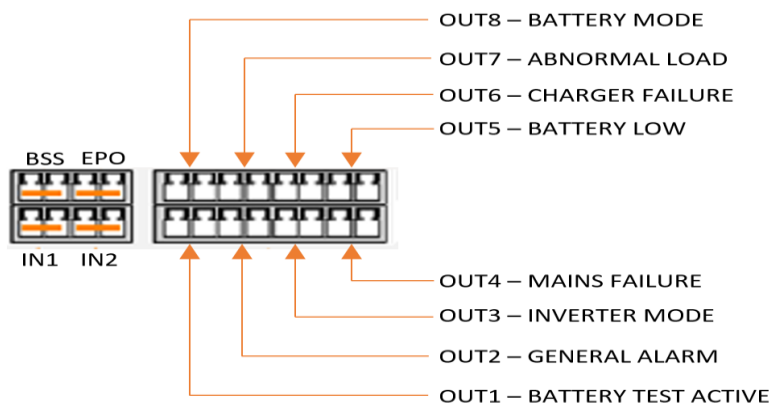


Figure 2.2

2.2.2 EMERGENCY POWER OFF

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 ELMOD 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).

2.2.3 IN1 & IN2

NOTE: INPUT1 used for the key-switch as detailed in Section 4.4

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 ELMOD 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.

2.2.4 DRY PORT CONTACTS

The ELMOD 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 closed (open on activation). The contacts are rated for 24VDC @ 0.5A.

As shown in Figure 2.2, the eight switched alarm outputs are:

- **OUT 1 – BATTERY TEST ACTIVE**
IN1 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.

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

2.3 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 ELMOD 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 a battery temperature indication on the control panel menu.

2.4 SNMP 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 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 ELMOD to be connected to a network using a standard CAT-5 network cable. Once connected, the system management software agent that is preinstalled in the SNMP adapter monitors the ELMOD operation and outputs its data in SNMP format to the connected network.

The communication exchanged between the ELMOD 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.

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.

CHAPTER 3 – TECHNICAL SPECIFICATION

3.1 EL POWER MODULE TECHNICAL SPECIFICATION

Model	ELM-04
Capacity	4KVA
Input / Output mode	1/1
Input PF	≥ 0.99
THDI (%)	≤ 3%
Overload ability	Comply to system overload requirement
Charging power	1600W
Weight (kg)	7

3.2 ELMOD SYSTEM TECHNICAL SPECIFICATION

3.2.1 Input

	Single Phase Input	Three Phase Input
MAINS INPUT		
Input Mode	1-phase +N +E	3-phase +N +E
Input voltage	220V / 230V / 240V ±25%	220V / 230V / 240V ±25%
Input frequency	50Hz±10%, 60Hz±10%	
Input Current	Refer to table 3.2	
Power woke-in (Sec.)	60secs	
THDI (%)	< 3%	
Input PF	≥ 0.99	

3.2.2 Bypass

	Single Phase Input	Three Phase Input
BYPASS INPUT		
Input Mode	1-phase +N +E	1-phase (L1) +N +E
Input voltage	220V / 230V / 240V ±25%	220V / 230V / 240V ±25%
Input frequency	50Hz±4%, 60Hz±4%	

3.2.3 Battery

DC INPUT	
Rated Input voltage	±240VDC
Input voltage tolerance	±216V~±246VDC

3.2.4 Charger

BATTERY CHARGING	
Charging current limited	YES
Charging ability	12 hours (3 hours back up)
Stability of charging voltage	±1%

3.2.5 Output

AC OUTPUT	
UPS power factor	0.9
Output voltage	220,230,240VAC
Output frequency	±4%; ±0.2%(battery supply)
Output voltage stability	±1%
Output voltage recovering time	20ms (load 0~100% change)
Output Current	Refer to table 3.2
Overload ability	120% Continuous, 150% for 10mins, 175% for 1 min
Transfer from mains to battery	0ms
Transfer from bypass to	<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

3.2.6 Environmental

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	Air cooling
Applicable safety standards	EN62040-1-1:2003 IEC60950-1:2001
Electromagnetic compatibility	EN62040-2:2006
Acoustic noise	≤ 55DB
Heat Dissipation	Changeover Mode = 120W per module Inverter Mode = 280W per module

3.2.7 Mechanical

OTHERS	
Interface	RS232, RS485, 2 dry contact, TCP/IP
Display	LCD/LED
4kVA Dimension (mm)	W900 x D750 x H1685
8-24kVA Dimension (mm)	W510 x D850 x H1340
4kVA Weight	250kgs per cabinet +7kg per module fitted
8-24kVA Weight	100kgs per cabinet +7kg per module fitted