PowerWAVE EL 100XA

(500–3000 VA)

User Manual

KOHLER POWER uninterruptible

SAFETY

IMPORTANT NOTICES

1. Read the instructions carefully before installing and starting the UPS.
2. All warnings in the manual should be adhered to.
3. All operating instructions should be followed.
4. The unit should be supplied by a grounded outlet. Do not operate the unit without a ground source.
5. Power cables of the UPS should be routed carefully so that they are not to be walked on.
6. Please save this manual.
7. Please save or recycle the packaging materials.

WARNING!

- Do not insert any object into the ventilation holes or other openings.
- To reduce the risk of fire or electric shock, install in a temperature and humidity controlled indoor area free from conductive contaminants.
- To reduce the risk of fire, replace fuses with the same type and rating when necessary.

CAUTION!

- **Only qualified personnel should install or service the UPS/batteries.**
- **Risk of electric shock, do not remove covers. There are NO user serviceable parts inside the UPS, refer servicing to qualified service personnel.**
- **The output may be energized even when the unit is not connected to a mains supply.**
- **Risk of electric shock! Hazardous live parts inside. This unit is energized from the battery supply even when the input AC power is disconnected.**
- **To reduce the risk of electric shock, disconnect the UPS from the mains supply before installing a computer interface signal cable. Reconnect the power cables only after signaling interconnections have been made.**

CAUTION **Units are designed to operate on the concrete floor.**

ABOUT THE BATTERIES

CAUTION: RISK OF ELECTRIC SHOCK

The battery circuit is not isolated from the mains voltage. Hazardous voltages may occur between the battery terminals and the ground!

- A battery can present a risk of electric shock or burn from high short circuit currents. The following precautions should be taken when working on batteries :
  * Remove watches, rings or other metal objects.
  * Use tools with insulated handles.
- The batteries in this UPS are recyclable. Batteries must be disposed of according to local environmental laws. The batteries contain lead and pose a hazard to the environment and human health if not disposed of properly.
- Do not dispose of batteries in a fire as 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 does come into contact with the skin the affected area should be washed immediately.
- The internal energy source (the battery) cannot be de-energized by the user.
- When replacing the batteries, install the same quantity and the same type of batteries.

I. GENERAL DESCRIPTION

1.1 Introduction

EL-100XA Series units are 1-phase in / 1-phase out devices and they are installed between a single phase emergency lighting distribution system and a single phase +N mains supply.

ELXA Emergency Lighting Inverters (EL-Inverter) are an advanced static inverter system which produces pure sine wave power to your equipment. Each model is microprocessor controlled and designed for ultra-fast changeover to battery operation in the event of a mains supply failure.

Basic Features:

- Microprocessor Controlled
- Automatic restart of load after inverter shutdown
- Smart AVR function (Two buck / boost modes)
- Wide input range 184V~285V
- Pure Sine Wave Output
- High overload capacity (120% continuous)
- Overload and Short Circuit Protection
- Over temperature protection
- Generator compatible & Cold-start capable
- Full function of LCD display with Audible Alarm
- Smart battery management with large charger; wet battery compatible
- Intelligent double stages of charging control
- System and battery test ability
- High battery recharging current
- Battery current-limit
- Deep discharge protection
- Alarm relay contacts
- RS232 communication port
- Remote Monitoring Panel (Optional)
- SNMP Adapter (Optional)
- MODBUS Adapter (Optional)
- AS400 Card (Optional)

1.2 DESIGN CONCEPT:

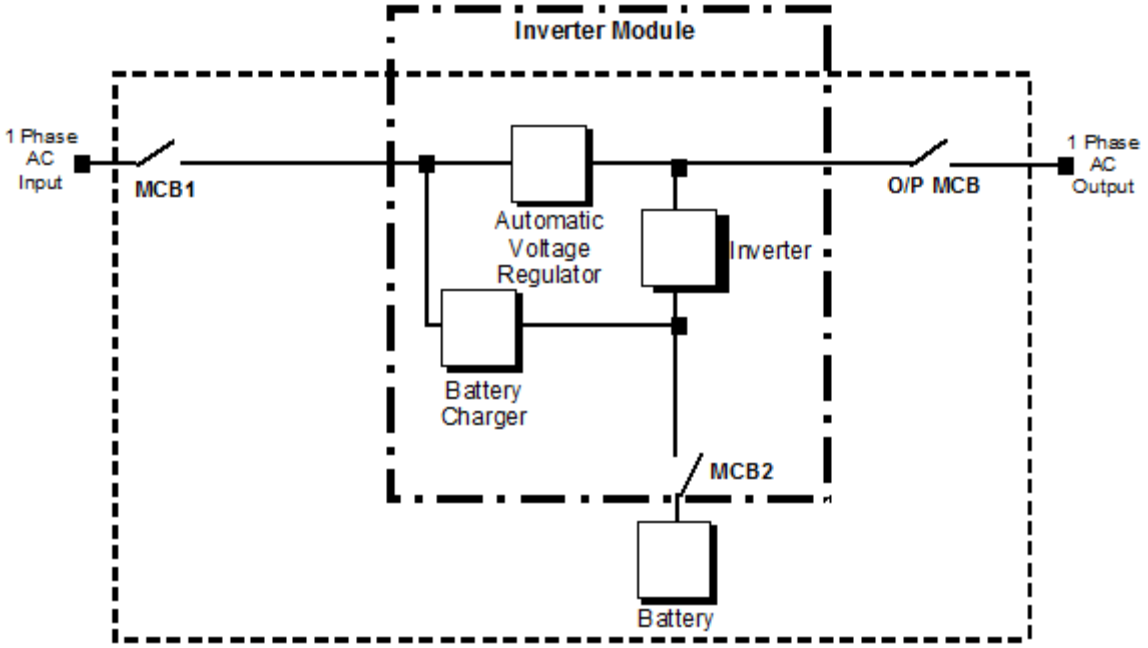


Figure 1. Electrical Block Diagram

MCB1	: Mains Input Circuit Breaker.
MCB3-8	: Output Circuit Breaker.
MCB2	: Battery DC Circuit Breaker.

1.2.1 DESCRIPTION OF BLOCKS:

AUTOMATIC VOLTAGE REGULATOR: The first stage of the concept uses a single phase controlled automatic voltage regulator as a form of surge protector. An AVR monitors the voltage constantly to deal with both dips and spikes. This feature includes “Buck” and “Boost” technology to output regulated and controlled voltage at a selectable figure.

BATTERY CHARGER: It produces a well-regulated DC voltage suitable for charging the batteries.

BATTERIES: Batteries are used as reserve DC power supply for the Inverter in case of mains failure.
Batteries are discharged by the inverter during mains failure. The discharged batteries are recharged by the battery charger on a constant current / constant voltage basis, if AC mains power is available.

INVERTER: The inverter converts the DC bus voltage supplied by the batteries into a well-regulated AC voltage with stable voltage and frequency.

The output of the inverter is used to supply the Emergency Lighting Equipment in case of a mains failure.

1.2.2 OPERATING MODES OF EL-INVERTER:

A. Normal Operation (If mains supply is available)

The normal operation mode of EL-INVERTER is changeover mode. In this mode, 1-phase mains supply is available at the output terminals of the unit and the load is supplied by clean mains voltage supplied through an Automatic Voltage Regulator (AVR). During normal operation, the Battery Charger supplies DC power to the batteries, charging them at the same time.

B. Battery Operation

The batteries are connected to the inverters input. In case of mains failure, the AVR stops operating and the batteries supply DC voltage necessary for the inverter operation. As soon as the mains failure is sensed by the control circuitry, the load is transferred to Inverter.

This way it is possible to keep the lights energised which have already been turned on (MAINTAINED Operation). It is also possible to turn on the Emergency Lighting system only if the mains voltage is not available (NONE-MAINTAINED Operation). With optional control circuits.

1.3 TECHNICAL SPECIFICATIONS

MODEL	EL1005XA	EL1012XA	EL1030XA
Power Rating VA / W	500 / 400	1250 / 1000	3000 / 2400
Power Factor	0.8		
INPUT			
Voltage / Tolerance	230VAC Single phase ± 25%		
Frequency	50Hz ±5%		
Max. RFI	EN50091-2 CLASS A		
OUTPUT			
Voltage	230VAC Single phase		
Voltage Stability	Changeover mode ±10% / Battery mode ±3%		
Voltage Recovery Time	After step load 0-100%. Max. 20ms.		
Frequency	50Hz		
Frequency Tolerance	±1% in battery mode		
Efficiency at 100% Load	>97%		
Crest Factor	3:1		
Short Circuit Protection	Electronic short circuit		
Overload Capacity	120% continuous, 150% alarm load		
BATTERIES			
Type	Sealed lead acid – maintenance free		
Number of 12V Blocks (Internal)	4	4	8
Float Charging Voltage	54VDC	54VDC	54VDC
End of Discharge Voltage	42VDC	42VDC	42VDC
Battery Ambient Temperature	20°C	20°C	20°C
Battery Protection	Double Pole Circuit Breaker		
Battery Test	Automatic Battery Test / Smart Battery Management		
GENERAL			
Serial Communication	Dry contacts plus RS232		
Software	Optional monitoring & shutdown / optional SNMP module		
Protection Degree	IP21		
Ambient Operating Temperature / Altitude	0° C to 40° C / <1000m above sea level		
Standard	Emergency Lighting EN50171		
Ventilation	Forced air cooling		
Acoustic Noise at 1m Distance	<56 dbA		
Dimensions (mm) W x D x H	750 x 250 x 850	750 x 250 x 1250	750 x 400 x 1250

II. EL-INVERTER INSTALLATION

2.1 INTRODUCTION

WARNING!!!

- Do not apply electrical power to the EL-Inverter equipment before the arrival of an authorised service personnel.
- Qualified service personnel should install the EL-Inverter equipment.
- Qualified service personnel should carry out the connection of the batteries and the maintenance.
- Do not make short- circuit to the batteries poles. Because of the high short-circuit current; there is a danger of electrical shock or burn.
- Eye protection should be worn to prevent injury from accidental electrical arcs. Remove rings, watches and all metal objects. Only use tools with insulated handles. Wear rubber gloves.

This chapter contains location installation information of the EL-Inverter and the batteries. All the establishments have their own specialties and needs. So in this part the installation procedure is not being explained systematically. Instead, general procedure and the applications are explained for the technical personnel.

2.2 UNPACKING

The EL-Inverter is packed and enclosed in a structural cardboard carton to protect it from damage. The equipment will arrive in three sections, the Cabinet Chassis, the Inverter Module and the Batteries.

1) Inspect for damage that may have occurred during the shipment if any damage is noted, call the shipper immediately and retain the shipping carton and the EL-Inverter.
2) Carefully open the carton and take the EL-Inverter out.
3) Retain the carton and packing material for future use.

Unit package contents:

1) A User manual
2) Battery Cable Kit
3) Optional Equipment

Shipping Contents:

1) Cabinet Chassis
2) Inverter Module
3) Batteries

Note. In some cases, items could be shipped separately.

2.3 EQUIPMENT POSITIONING

1. The equipment's installation place must be easily accessible.
2. Install the EL-Inverter in a protected area with adequate airflow and free of excessive dust.
3. You must therefore allow for a minimum gap of 250 mm between both sides of the unit to allow adequate air flow
4. Select a suitable location for the equipment; ensure ambient temperature is between 0°C and 40°C, relative humidity 90% max.
5. It is recommended to air-conditioned the room (20°C)
6. Temperature is a major factor in determining the battery life and capacity. Battery manufacturers quote figures for an operating temperature of 20°C. On a normal installation the battery temperature is maintained between 15°C and 25°C. keep batteries away from main heat sources or main air inlets etc.
7. When operating the EL-Inverter in a dusty place, clean the air with a suitable air filtration system.
8. Do not position the equipment near any explosive and flammable items.
9. Avoid exposure to direct sunlight, rain, and high humidity.
10. The Equipment must be mechanically fixed to the wall using the fixing holes provided, this is important to maintain the stability of the machine.

WARNING Check the capacity of the forklift if it is available for lifting.

DO NOT MOVE THE EL INVERTER WHILE THE BATTERIES ARE INSTALLED.

2.4 CONNECTING THE EL-INVERTER POWER CABLES

WARNING A separate supply should be used to supply the EL-Inverter AC input. It is advised to use an MCCB suitable for the input current on the EL-Inverter's input line. The EL-inverter must be supplied from a suitably earthed source.

Descriptions of the EL-Inverter input output cable connection terminals are shown in figure 2.

Recommended input line cable and fuse ratings are given in the table below.

EL-INVERTER Power (VA)	**NOMINAL CURRENT : Amperes / Recommended cable cross-section (mm^2)**		
	AC Input line (Full capacity recharge)	**Output** (At full load)	**Battery**
	230V	230V	
	A / mm^2	A / mm^2	mm^2
500	13.5A / 6 mm^2	2A / 4 mm^2	11A / 10 mm^2
1250	13.5A / 6 mm^2	5A / 4 mm^2	28A / 10 mm^2
3000	25A / 6 mm^2	10.5A / 4 mm^2	100A / 16 mm^2

Figure 2. Recommended Cable Cross-Section

Warning: These recommendations are for guideline purposes only and are superseded by local regulations and codes of practice.

2.4.1 SAFETY EARTH

The safety earth cable must be connected to the earth terminal and bonded to each cabinet in the system, the earthing and neutral bonding arrangements must be in accordance with the local regulations.

ATTENTION: Failure to follow adequate earthing procedures can result in electric shock, hazard to personnel, or the risk of fire.

2.4.2 INVERTER MODULE CONNECTION PROCEDURE

1. Unpack the inverter module from its transportation box.
2. Ensure the module is in good condition and was not damaged during transportation.
3. Screw the M5 thread of the supplied anti vibration fixtures into the base of the Inverter Module.
4. Position the module into the location holes on the Chassis Cabinet top shelf.
5. Bolt the module to the shelf using the supplied washer, spring washer and nut.
6. Connect the mains input, output, Battery and LCD (RJ45) cable to the Inverter Module

WARNING When making electrical connections ensure all inputs are disconnected from mains supply and batteries. All MCB breakers should be in the "OFF" position.

2.4.3 CABLE CONNECTION PROCEDURE

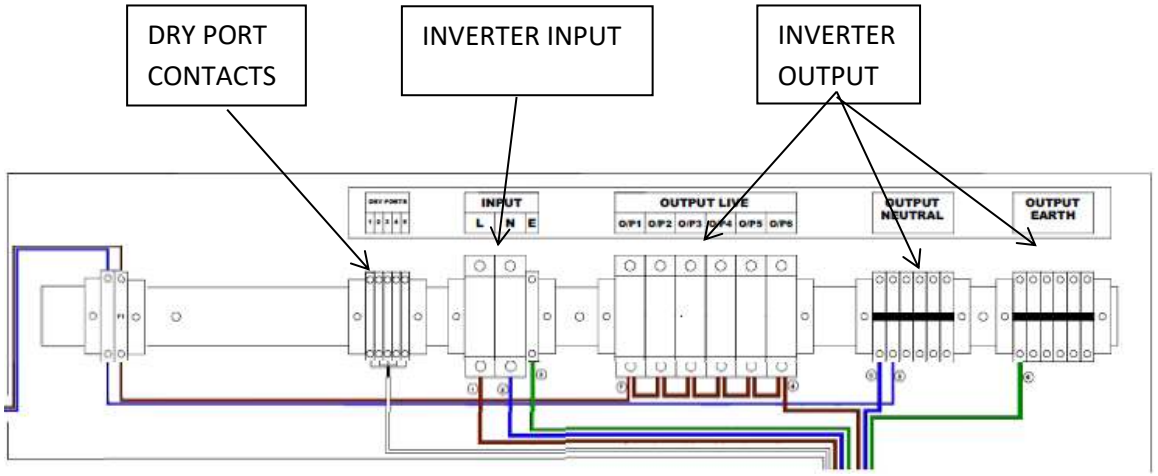
WARNING Qualified service personnel must do all connections of the EL-INVERTER.

After positioning the EL-Inverter and the Inverter Module is in place, the cables must be connected as described below:

1. Verify all switches of the EL-Inverter in **"OFF"** position.
2. Connect the AC input coming from the mains distribution panel to the AC input terminals.
3. Connect the output of the EL-Inverter to the load distribution panel or luminaires.
4. Connect the battery group. Refer to battery installation section.
5. Make all the earth connections to the protective earth stud.

Note: The earth and the neutral connections must be in accordance with local regulations.

2.4.4 DESCRIPTION OF CONNECTION TERMINALS OF THE EL-INVERTER:



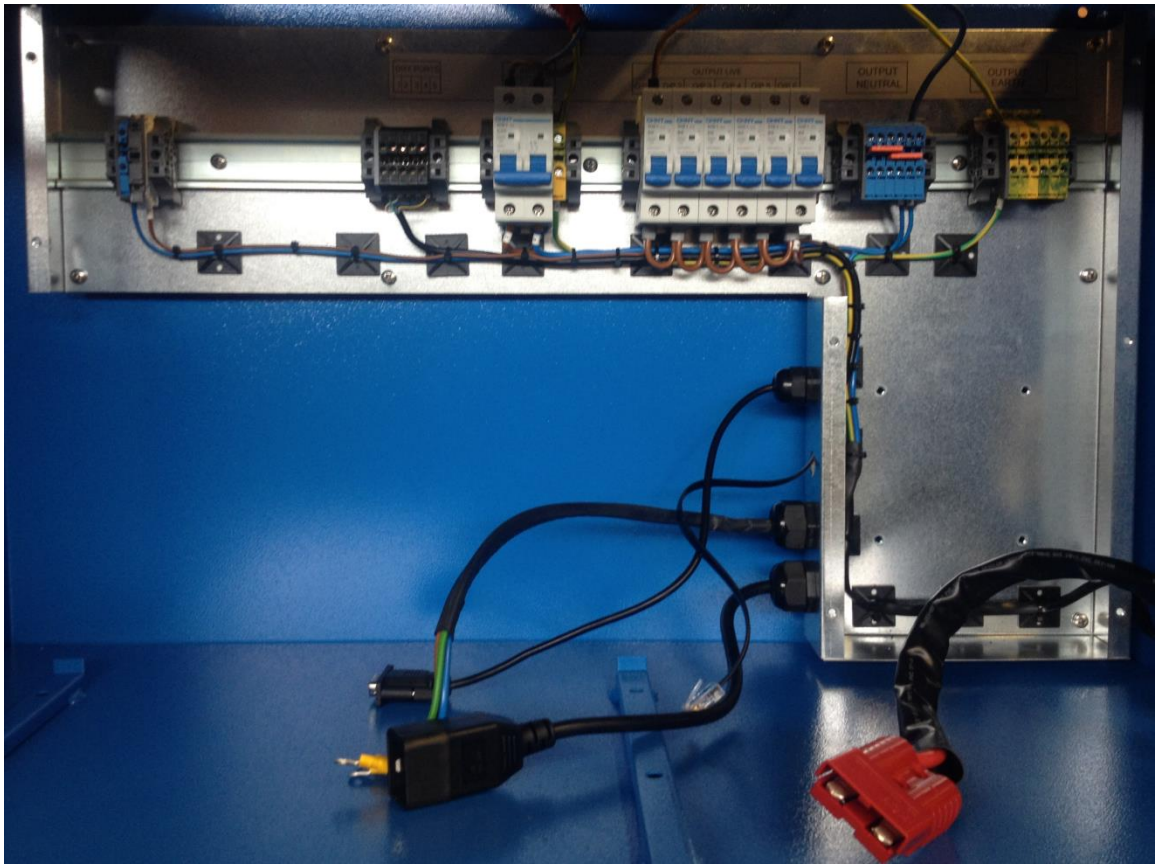


Figure 3. Input and Output Connections

2.4.5 BATTERY INSTALLATION

WARNING **Be careful while connecting batteries.**

ATTENTION Ensure the battery circuit breaker is in the "0" position before making the connection for the battery instillation.

The batteries associated with the EL-Inverter equipment are usually mounted on purpose-built battery shelves within the Chassis Cabinet. Sealed, maintenance-free batteries are normally used in this type of installations.

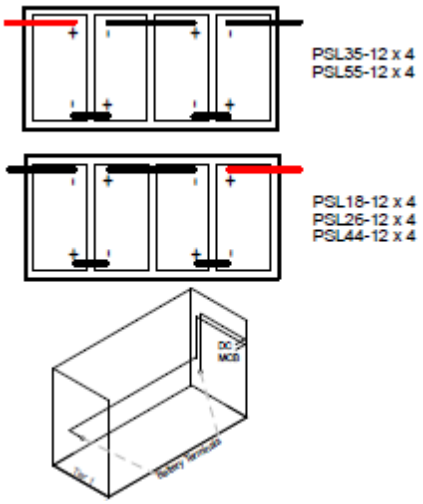
Where battery racks are used, they should be sited and assembled in accordance with the battery manufacturer's recommendations. In general, batteries require a well-ventilated, clean and dry environment at reasonable temperatures to obtain efficient battery operation.

In general, a minimum space of 10 mm must be left on all vertical sides of the battery block. A minimum clearance of 10 mm should be allowed between the cell surface and any walls. A clearance of minimum 100 mm should be allowed between the top of the cells and the underside of the shelf above (this is necessary for monitoring and servicing the cells). All metal racks and cabinets must be earthed. All live cell connections must be shrouded.

1. Unpack each battery and check its terminal voltage. If any battery has terminal voltage less than 12.5VDC, it must be charged before continuing.
2. Please check the battery connecting hardware and continue the following in respect to the battery cable kit drawing.
3. Ensure the insulating membrane is in place on each shelf.
4. Please locate suitable number of batteries at each shelf.
5. Start locating the batteries from bottom to the top of the chassis.
6. Be careful about the connection between the batteries polarities.
7. After interconnecting the batteries, connect the (+) and (-) poles to the battery DC MCB1 & 2 inside the EL-Inverter. Be careful to connect the batteries correctly and ensure the following:
    a. Check the voltage and polarity of the battery at the input of DCMCB 1 & 2 before it is closed.
    b. Close MCB3 before starting the EL-Inverter.

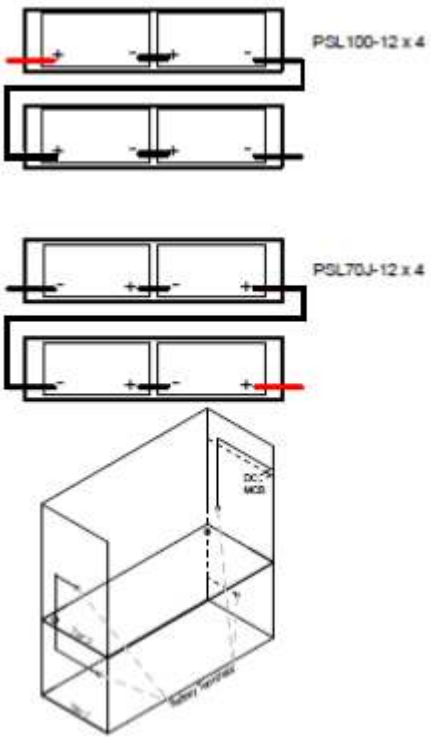
EL1005 BATTERY INSTALLATION

The ELXA 1005 system can only contain 1 x string of 4 x 12Volt batteries on one shelf. The drawing below shows the typical layout of the shelf inside the unit.



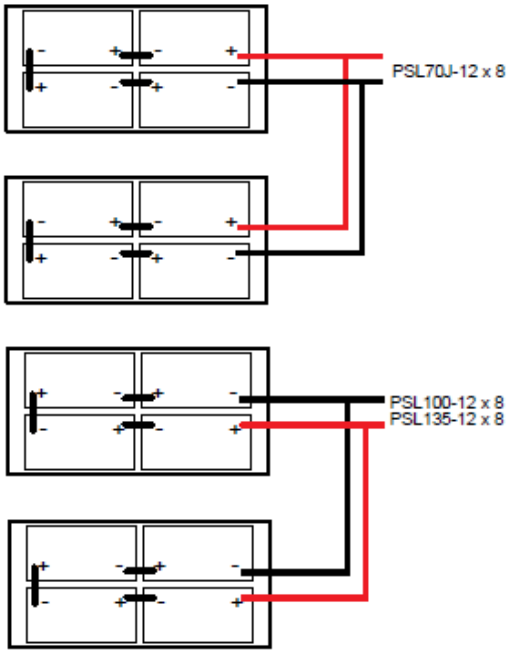
EL1012 BATTERY INSTALLATION

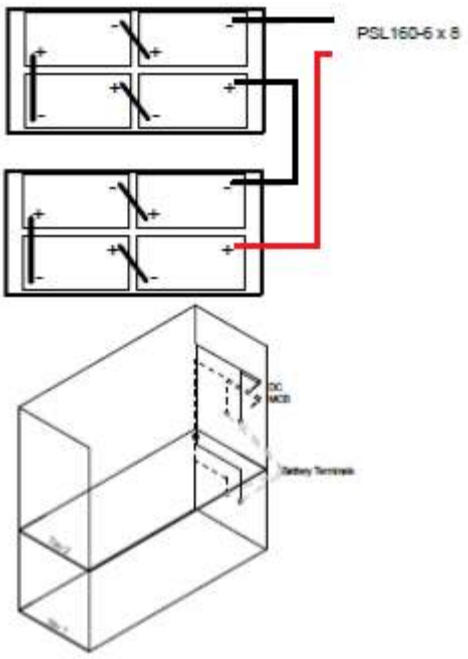
The ELXA1012 system can only contain 1 x string of 4 x 12Volt batteries located on two shelves. The drawing below shows the typical layout of the shelf inside the unit.



EL1030 BATTERY INSTALLATION

The ELXA 1030 system can only contain 2 x string of 4 x 12 Volt batteries or 1 x string of 8 x 6 Volt batteries. The drawing below shows the typical layout of the shelf inside the unit.





III. FRONT PANEL

3.1 INTRODUCTION

The front panel of EL-Inverter, consisting of a LCD display, 3 function keys, TEST ON LED, Test key switch, allows the complete monitoring of the EL-Inverter status. By using the function keys operator can move on menus.

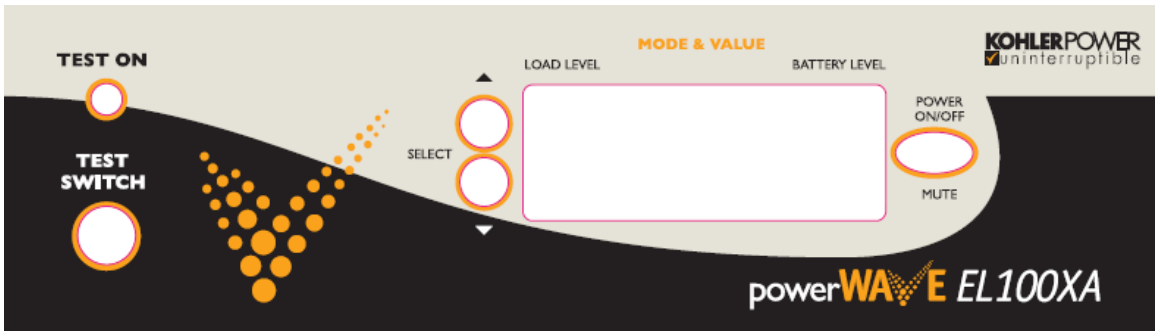


Figure 4. Front Panel

LED : If “Test On” lamp is lit maintenance test is active.

There are three function keys on front panel these are MAIN CONTROL ON/OFF BUTTON, UP/DOWN SELECT keys help moving on menus.

NOTE : The main control on/off button will provide test function at normal mode, but will become the alarm-reset function in battery mode.

3.2 FRONT PANEL MENU DESCRIPTIONS

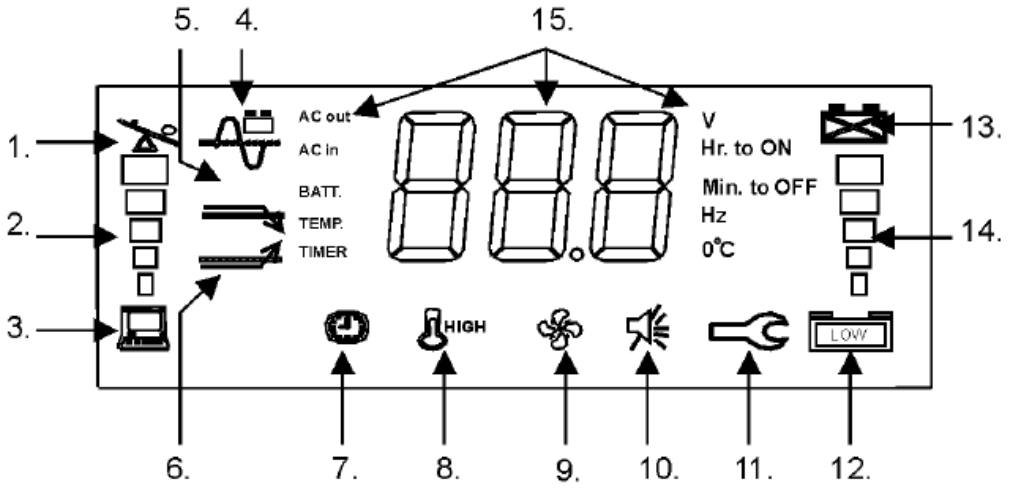
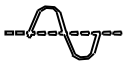
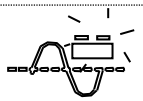
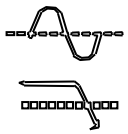
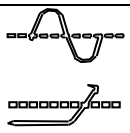
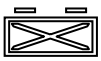


Figure 5. LCD Display

No.	Symbol	Indication	Description
1.		Over load	The loading exceeds the rating of Inverter.
2.		Load level	The higher the loading, the more bars will illuminate.
3.		Inverter is loaded	The Inverter is supplying a load.
4.		Normal mode	1) The sine wave symbol will display steadily without battery symbol when Inverter is in the normal mode.
		Battery mode	2) The sine wave symbol and battery symbol will blink when the Inverter is in back-up (inverter) mode.
		Test mode	3) The sine wave symbol will display steadily with blinking battery symbol when the Inverter is in testing mode.
5.		Buck mode	The AVR (Auto Voltage Regulator) is reducing the output voltage of the Inverter (when the input voltage is too high), and the sine wave symbol, as mentioned in item 4, will also display steadily to indicate that the output is in the normal mode.
6.		Boost mode	The AVR is increasing the output voltage of the Inverter (when the input voltage is too low), and the sine wave symbol, as mentioned in item 4, will display to indicate it is in the normal mode
8.	 HIGH	Thermal alarm	The temperature inside the Inverter is over 55°C. If the user does not reduce the load, the temperature will continue to rise and the Inverter will shut down automatically at 60°C.
9.		Fan is in "High speed"	The symbol will display whenever the cooling fan is running (or high speed), and will disappear when it is off (or low speed).
10.		Silence mode	The audible alarm has been silenced. To reset the alarm in Back-up mode, push the control button (not available during low battery level or abnormal condition).
11.		Inverter fault	The Inverter has failed and must be repaired. Contact a qualified service person.
12.		Battery normal	1) In normal operation, this symbol indicates a charged battery.
		Battery low	2) When the battery charge level is low, the word "LOW" will be added to the symbol.
13.		Battery replacement	The battery has failed and must be replaced. The battery is checked each time the Test Function is executed.

14.		Battery voltage level	1) The higher the battery voltage, the more bars will illuminate. 2) When the Inverter is charging the battery, the battery symbol and the level indicator will blink together.

15.	**Mode**	**Value**	**Description**
	AC out	V	AC output voltage.
	AC in	V	AC input voltage.
	AC out	Hz	AC output frequency.
	BATT.	V	DC battery voltage.
	TEMP.	°C	Inverter internal temperature.
	Selection Button for mode & value All the operation data will be displayed on LCD screen. By selecting the required mode (upward or downward), the related value will be displayed.		

Figure 6. LCD Screen Function and Description

3.2.1 AUDIBLE ALARM

During a utility failure or fault operation, the EL-Inverter a emits beeping sound for warning. In back-up mode, the alarm can be silenced by pushing the “MAIN CONTROL ON/OFF BUTTON” button. However, the warning of low battery will still sound urging user that load will be lost.

Basic Indication Table:

	STATUS	ALARM
Idle mode	Utility Good	No Beep
	Utility outage	No Beep
	Timer on, (refer to Item 5.5)	No Beep
Normal / Back-up mode	Normal (Utility good)	No Beep
	Back-up (No load) Back-up (Loaded)	One beep every 4 sec (alarm can be silenced). 2 beeps every 8 sec. (alarm can be silenced).
	Battery Low	4 beeps per sec (alarm can Not be silenced).
Abnormal Condition	Over load	Continuous alarm (alarm can Not be silenced).
	UPS fault	Every other 2 sec., 32 beeps in 2 sec (alarm can Not be silenced).
	Thermal alarm	Every other 2 sec., 32 beeps in 2 sec (alarm can Not be silenced).

Figure 7. Alarm Table

3.2.2 AUTO SELF-TEST FUNCTION

In normal operation, turn on load and push the button on the front panel for 1 second for self-test.
The EL-Inverter will simulate a power outage and transfer to battery mode. If low battery warning sounds during the test, it means that the battery has low charge or is reaching the end of its serviceable life and should be replaced.

3.2.3 REMOTE CONTROL

The EL-Inverter can be set for daily shutdown/wake up. This command must be set through the RS-232 interface. When this function is set, the timer inside the Inverter will begin to run, and the load will be turned off by the shutdown / wake-up schedule. During the period of turn-off to the next turn-on, the time period to next turn-on will be shown on LCD panel by hour.

3.2.4 RESETTING THE INVERTER MODULE

If any abnormal condition occurs, please unplug the line cord and push "MAIN CONTROL ON/OFF BUTTON" for at least 15 sec, which will reset the inverter module.

3.3 QUICK TROUBLESHOOTING

Problem	Possible Cause	Action to Take
Inverter has no reaction while AC is connected	1. No AC input 2. Fuse on inverter module tripped. 3. Fuse on rear signal plate blown.	1. Test and check the external AC circuit. 2. Re-engage fuse. 3. Replace fuse.
Power output is normal; Inverter emits continuous beep, status LCD shows "overload".	Inverter is over loaded.	Shut down Inverter system and remove load.
No power output, Inverter emits continuous beep, LCD shows "over load".	Inverter has shut down due to severe overload.	Remove loads from the Inverter system, press button to reset the buzzer, and restart the Inverter.
Inverter does not provide expected run time.	1. Excessive loads connected at Inverters output. 2. Battery is weak and cannot provide enough capacity.	Do not operate the Inverter, and leave the Inverter on AC supply for 10 hours. Retest the run time, if the Inverter system still cannot provide expected run time, battery should be replaced.
Main Control Button on front panel does not work.	1. The CPU inside Inverter is not running correctly. 2. Button damaged.	1. Disconnect AC input using MCB1 & push the "Main Control" button for 15 seconds to reset the UPS. 2. Shut down all loads, Battery and AC input to the Inverter system to let it shut down automatically, and call for service.
To push button for testing under AC mode, Inverter emits urgent beep and LCD display shows "battery replacement" at the same time.	Battery is weak and should be replaced.	Replace batteries.
Inverter cannot be turned on.	1. Battery polarity wrong. 2. Inverter fault.	1. Check battery connection. 2. Call for service.
Inverter starts but LCD screen doesn't work.	1. Front display inactive.	1. Restart the machine disconnecting mains and battery at least three times. 2. Call for service.

Figure 8. Troubleshooting Guide

IV. OPERATING INSTRUCTIONS

4.1 OPERATION INSTRUCTIONS

4.1.1 POWER ON:

1. Battery switch MCB2 must be on. ("ON" position).
2. Turn MCB1 (Input) switch into "ON" position.
3. Turn required output MCB's (Output) switches into "ON" position.
4. The equipment will start automatically when AC input is detected.

WARNING: Mains voltage will now be present at the output.

4.1.2 POWER OFF:

1. Hold the front screen MAIN CONTROL ON/OFF BUTTON for 4 seconds, this will shut the equipment off and display "off" on the front display.

Note: When the equipment is switched off, if mains are still available the batteries will continue to charge.

2. Turn all Output MCB's (Output) switches into "OFF" position.
3. Turn MCB2 (Battery) switch into "OFF" position.
4. Turn MCB1 (Input) switch into "OFF" position.

4.1.3 OPERATION INSTRUCTIONS FOR USING THE EMERGENCY LIGHTING SYSTEM MAINTENANCE TEST SWITCH

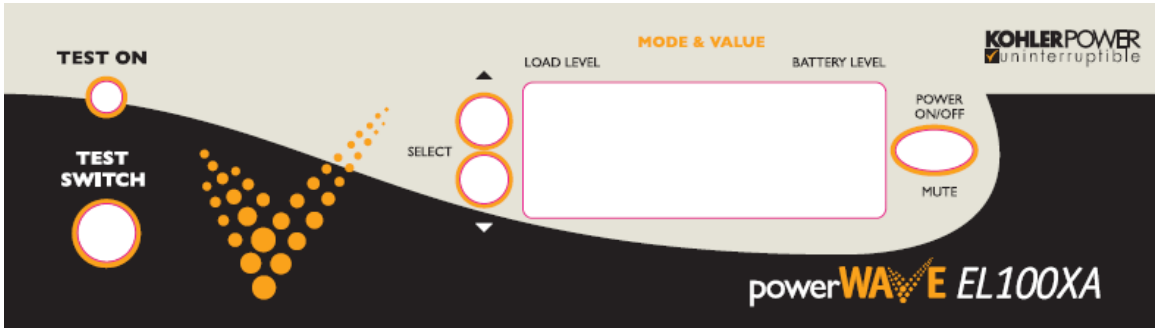
If the EL-Inverter is in normal operation it is supplying the load by the incoming utility supply. In the case of a failure in this supply, the output is connected to the static inverter output. This transfer operation is performed internally by the control logic of the Inverter.

The operation of the EL-Inverter can be controlled externally; the unit can be forced to supply the output by the Inverter and batteries. This can be achieved by turning the key switch of the Maintenance Test Switch (MTS).

Note: When the equipment is switched into the Maintenance Test mode, the red "TEST ON" LED will be lit.

The MTS can be used for testing the machine's operation and performance; it can also be used to maintain the EL-Inverter's loads.

WARNING: When the MTS has been used, it is important that it is switched off so the EL-Inverter can return to a standby operation and the batteries are recharged.



4.2 OPERATION AND TEST CONTROL OPTIONS OF THE EMERGENCY LIGHTING SYSTEM

4.2.1 COMMUNICATION INTERFACE

The EL-Inverter provides two computer interfaces, smart software (RS-232).

There are also dry contacts (DB-9) for different monitoring application.

4.2.2 THE DEFINITION AND SETUP FOR RS-232

Baud Rate : 2400 dps

Data Length : 8 bits

Stop Bit : 1 bit

Parity : None

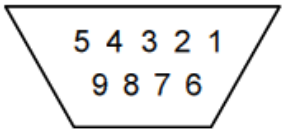


Figure 9. DB9 Layout

Pin #6 : RS-232 data Tx out.

Pin #7 : Common of Pin #6 and Pin #9

Pin #9 : RS-232 data Rx In

4.2.3 THE DEFINITION AND SETUP FOR DB-9/AS400 VOLTAGE FREE DRY-CONTACTS

Dry port control terminals

1. **Common for Relays** (Connected to pin 5 of AS400)
2. **Mains Failure, will not initiate if key switch is operated** (Connected to Pin 9 of AS400)
3. **Common Alarm (Connected to pin 1 of AS400)**
4. **Low Battery** (Connected to pin 7 of AS400)
5. **On Bypass** (Connected to pin 6 of AS400)

The EL-Inverter has voltage free dry-contact (Binary) signals for programmable controllers and managements systems.

Located on the signal board inside the inverter there are 5 terminals that are connected to the AS400 inside the inverter module, all diagrams below/above show the functionality of the AS400 terminals.

AS400 Pin Definition and Function Description

Pin Assignment	Function Description	I/O
Pin1	Inverter Failure	O/P
Pin2	Summary Alarm	O/P
Pin3	Remote Shutdown (-)	I/P
Pin4	Remote Shutdown (+)	I/P
Pin5	Common for Relays	I/P
Pin6	Bypass Active (Inverter off)	I/P
Pin7	Battery Low	O/P
Pin8	Inverter ON	O/P
Pin9	Utility Failure	O/P

Phenomenon	Reason
Pin1 short to Pin5	Inverter internal failure
Pin2 short to Pin5	Inverter Failure, Utility Failure, Battery Low, Bypass Active
Pin6 short to Pin5	Bypass Active (Inverter off)
Pin7 short to Pin5	Battery voltage is low
Pin8 short to Pin5	Inverter working in Inverter (AC) mode
Pin9 short to Pin5	Utility Failure

Figure 11. AS400 Pin Definition

Internal Circuit of AS400 Port

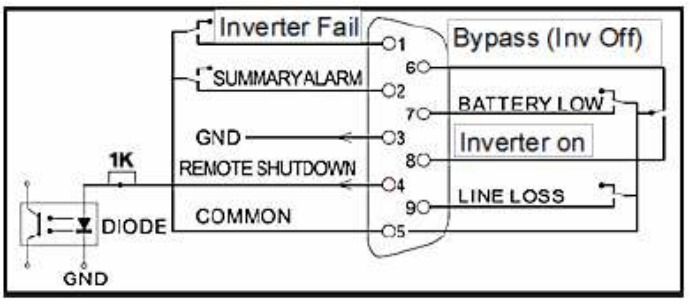


Figure 12. AS400 Internal Circuit

Electric Parameter of AS400 Port

Parameter		SYMBOL	MAX.	UNIT
Diode	Reverse Voltage	V_R	6	V
	MIN, Forward Current	$I_{F,\ min}$	2	Ma
	Peak Forward Current	$I_{F(PEAK)}$	1	A
Relay	DC Voltage	V_{DC}	24	V
	DC Current	I_{DC}	2.0	A

Figure 13. AS400 Electric Parameters

V. MAINTENANCE

WARNING DO NOT OPEN the cover of the EL-Inverter because there is no part that can be maintained by the user. DO NOT TOUCH battery leads. There is high voltage even if the EL-Inverter is off. Therefore, no one should open the cover of the EL-Inverter except for service personnel. Otherwise, serious injuries may occur.

5.1 SCHEDULED MAINTENANCE

Some semiconductor devices inside the EL-Inverter do not require any maintenance. Only cooling fans are moving parts. If the environment is clean and cool enough, the planned maintenance program will be at minimum level. Even though periodic checks and maintenance based on a well prepared schedule will increase the performance of the EL-Inverter and prevent minor faults becoming serious problems.

The equipment was designed to require minimal maintenance but a competent person should carry out the following checks.

5.2 DAILY CHECKS

Check the EL-Inverter every day paying attention to the following items:

1. Check the operator control panel. Verify that all LEDs and parameter measurements are normal and there is no alarm message on the indicator panel.
2. Check if the device is overheating.
3. Check the cooling fans' rotation.
4. Check if there is any change in the equipment's noise level.
5. Check if there are any obstructions in the ventilation path. If so, clean the dust using a vacuum cleaner.
6. Make sure that there is nothing placed on/around the EL-Inverter.

5.3 WEEKLY CHECKS

1. Record the results on the indicator panel.
2. Measure and record voltages output voltage.
3. Measure and record currents on the output of the EL-Inverter.
4. Check batteries' status by performing a manual battery test. Use a dry cloth to clean the cover of the EL-Inverter.

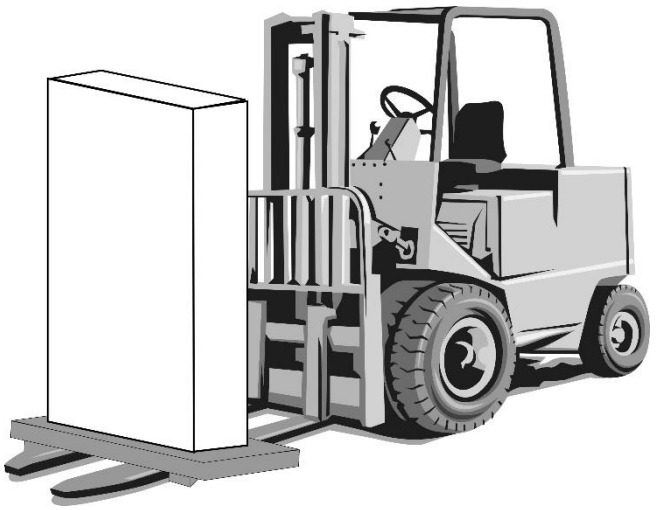
Record the observations if possible. Check if there is any difference with the previous records (observations). If the last recorded values are significantly differ from previous records, please check If the load has been changed, and if so please record the type, size, and position of this load. This information will be very valuable in helping the service personnel in determining any probable errors.
If there is a significant change in the parameter values without any reason please immediately call qualified service personnel.

5.4 ANNUAL MAINTENANCE

To obtain reliable and efficient performance from the EL-Inverter, please have the unit serviced at least a year by qualified service personnel.

5.5 EL-INVERTER STORAGE AND TRANSPORTATION

1. Check the batteries' charge by performing manual battery test before storage. If the charge level is insufficient, charge the batteries at least for 12 hours.
2. Qualified service personnel should disconnect the connections
3. Batteries should be charged every six months during storage period.
4. Keep the EL-Inverter and batteries in dry and cool place.
5. EL-Inverter ideal storage temp.: 0 ^{0}C ~ 40 ^{0}C max.
6. Battery ideal storage temp.: 10 ^{0}C ~ 35 ^{0}C max.
7. The EL-Inverter must be placed on a suitable pallet for transportation purposes.



VI. FAULTS AND TROUBLESHOOTING

6.1 GENERAL PROCEDURE FOR FAULT CHECKING AND TROUBLESHOOTING

EL-Inverter contains complicated electronic control circuits. In order to locate any fault occurring circuits, an advanced knowledge about the circuitry and its operation principles must be known. The aim of this section is to give the knowledge required at the first intervention.

There is no practical way to locate any possible fault. Most of the faults do not cause a loss of supply to the loads. Generally, the EL-Inverter operates normally or switches into by-pass mode. But in order to determine any change in load or the system the parameters must be recorded regularly as mentioned previously.

Generally, the output voltage can deviate 2% from the predefined values. If values differ more than this percentage then reasons must be investigated.

The following general structure must be systematically followed while trying to indicate the error:

Fault determination: First step is to record the messages, indicator panel LEDs, operating parameter values and last status of switches. This must be done before attempting to press any button.

Fixing interventions: After recording all indications, check the meaning of the fault and alarm messages using “The operator control indicator panel”. If anything relates, follow the related procedure.