

Short Form Manual
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Lithium Power Supply Autonomous Refrigeration

Safety Instructions

The Lithium Power Supply is classified as Class 9 hazardous material UN3481, a power source with high energy density and dangerous materials in a closed metal case!

Installation must strictly follow the national safety regulations in compliance with the enclosure, installation, creepage, clearance, casualty, markings, and segregation requirements of the end-use application. Installation must be performed by professional installers only. Switch off the system and check for hazardous voltages before altering any connection!

Lithium batteries must be handled only by qualified and trained personnel.

The lowest protection degree of specific parts of a lithium battery is IP20. Ensure that the installation of the lithium battery is in accordance with IP20 requirements.

Especially keep these rules:

- Do not open the Lithium Power Supply.
- Do not discharge a new Lithium Power Supply before it has been fully charged first.
- Charge only within the specified limits.
- Do not mount the Lithium Power Supply upside down or on the sides.
- Check if the Lithium Power Supply has been damaged during transport.
- Do not put Lithium Power Supplies in serial or parallel.

Dangers involved in case of fire:

- Danger of dust particle explosions
- Decomposition through fire or heat under development of toxic and cauterizing gases
- Combustion gasses which strongly irritate eyes and respiratory organs

General actions to be taken by the driver if these dangers occur:

- Turn off the engine
- Put a warning signal on the road to warn others
- Inform others about the danger and direct them to stand away from the wind direction
- Call police and fire fighters immediately and notify them that lithium batteries (UN3481) is onboard

Instruction for fire extinguishing:

- Extinguish with water, if possible cover battery completely in water
- Extinguishing with water will produce fluoride, phosphate, fluoride-oxide and carbon-oxide.
- Alternatively extinguish with a CO² extinguisher.

Note: when put to storage the battery must be fully charged and must be recharged again every 6 months.



**NON-SPILLABLE
LI-ION BATTERY**



Handling, Maintenance and Transportation

When the LPS is not used for longer periods of time it must be stored fully charged and recharged every 6 months

EMC and standards:

2006/95/EC (Safety directive);

The following harmonized standards have been applied:

EN 60950-1:2001+ A11:2004 (LVD)

2004/108/EC (EMC directive);

The following harmonized standards have been applied:

EN 61000-6-3: 2007 Emission household equipment

EN 61000-6-2: 2007 Immunity industrial

ATTENTION: Read the safety instructions before installing the Lithium Power Supply.

ATTENTION: When installing the lithium Power Supply, do not mount it upside down or on the sides. Do not cover or block the fan or the air inlet to insure the battery does not overheat.

Mounting holes are for pre-fixation, suitable fixation has to be added.

ATTENTION: Do not connect the LPS in series or parallel.

ATTENTION: Make sure the Lithium Power Supply is powered down before starting the installation and do not connect any active wakeups before end of the installation.

If a unit is to be returned or shipped it must be packaged and shipped as dangerous goods class 9 in accordance to UN3481 (Lithium Ion batteries contained in equipment).



LITHIUM POWER SUPPLY

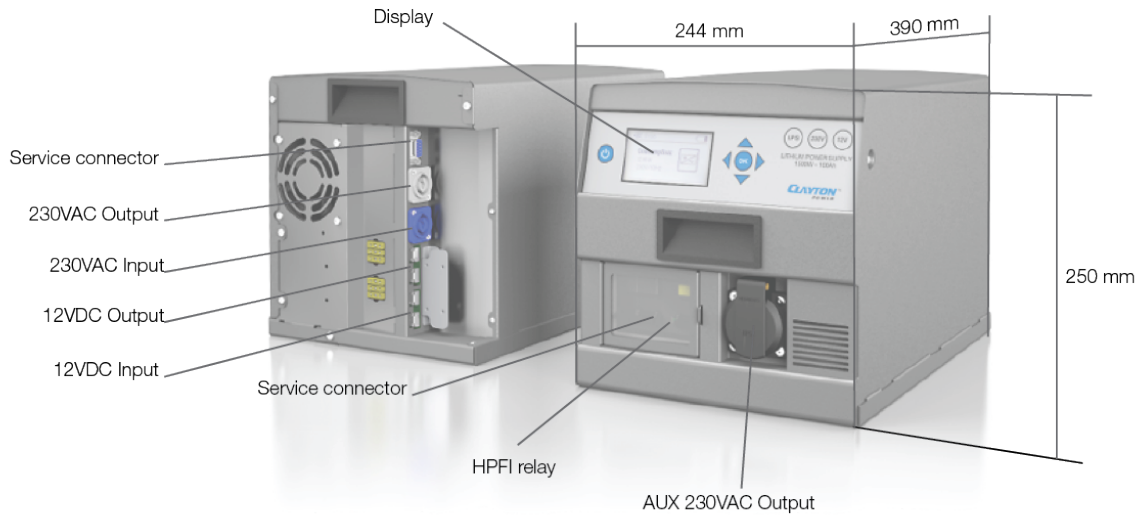


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LPS1512-100Ah Package

Included in the package:



1 pcs. LPS 1512-100Ah



1 pcs. Short form manual (this one)



1 pcs. Neutrik Input connector



1 pcs. Neutrik Output connector



1 pcs. Anderson DC Input connector



1 pcs. Anderson DC Output connector



1 pcs. Anderson SB50 pins

Lithium Power Supply - General parameters

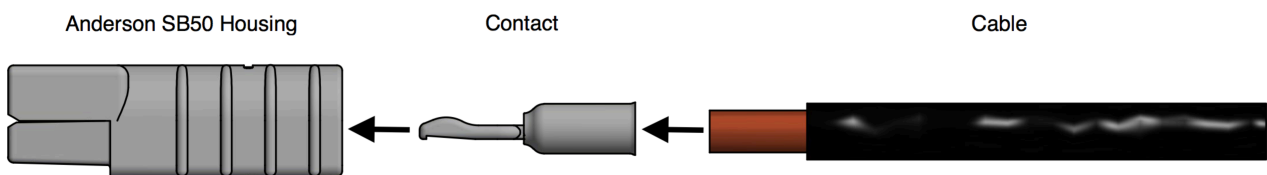
Battery type	100Ah-12V (LiFePO ⁴)	
Available capacity	80Ah	
Nominal battery voltage	12 VDC	
Operation voltage discharge	9.2 VDC	
Operation voltage charge	15 VDC	
Nominal AC voltage output	230 VAC pure sine	
Nominal AC frequency output	50 Hz	
AC frequency input	45 Hz – 65 Hz	
AC Voltage input	190 VAC – 250 VAC	
AC Voltage input (reduced charge current)	110 VAC – 190 VAC	
Continues AC output power	1500 W _{rms}	
Continues AC output power (with 230VAC input connected)	1800 W _{rms}	
Peak AC output power	3000 W _{rms}	
AC charge power	1000 W	
Cell voltage min cut-off	2.3 VDC	
Cell voltage max cut-off	4.2 VDC	
Continuous discharge current	DC output	50 ADC
	AC output	6,5 AAC
Max discharge Impulse current	10 min	100 A (temperature controlled)
	5 Sec	> 500 A
	10 μSec	> 1000 A
Cycles		
Operating temperature	-40°C~50°C	
Cooling	Forced fan	
Self-discharge rate per month (Sleep mode)	< 3%	
Operating mode consumption	350mA	
Sleep mode consumption	< 2mA	
Connection 230VAC	Neutrik and IEC	
Connection 12VDC	Anderson SB50	
IP rating	IP21	
LPS Weight	28 kg	
Dimensions in mm (H x W x L)	250 x 244 x 390	
Package weight		
Package dimensions in mm (H x W x L)		

Installation Guide

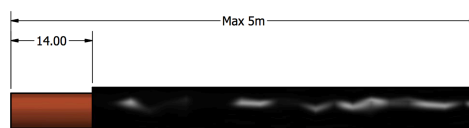
ATTENTION: Before installing, make sure that all appliances are turned off.

When installing the unit, make sure to use 15mm² cables for the DC connections.

Anderson connector assembly (DC IN/OUT)



Step 1: Use 15 mm² cable. Maximum length 5m. Strip 14 mm.

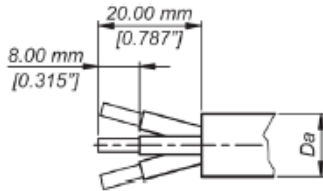


Step 2: Insert cable in contact and crimp with tool.

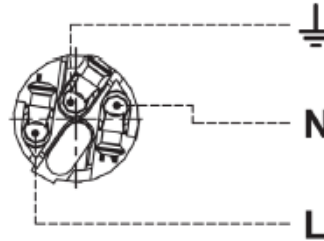
Step 3: Insert contact in housing, push until **click**.

Neutrik connector assembly (AC IN/OUT)

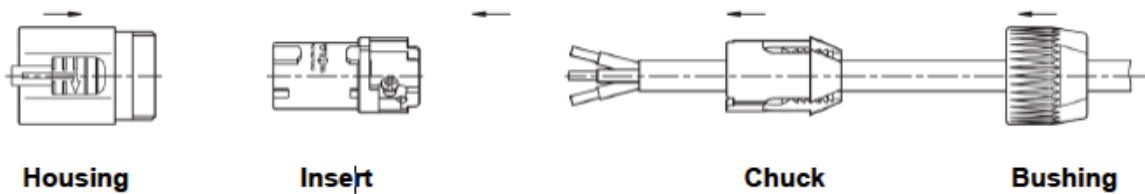
Cable Preparation



Wiring

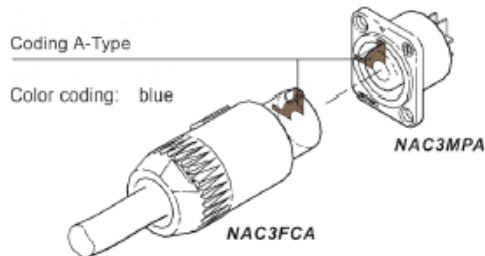


Assembling



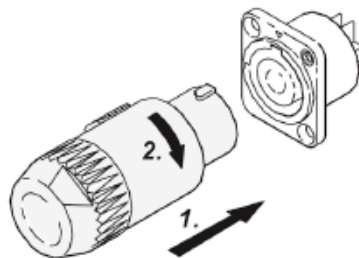
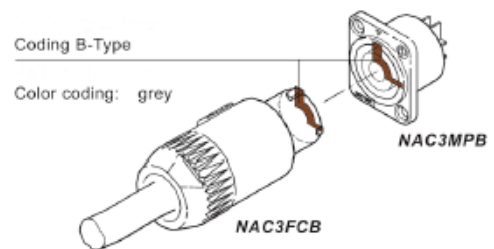
BLUE

Combination for AC Power IN (only combi models)

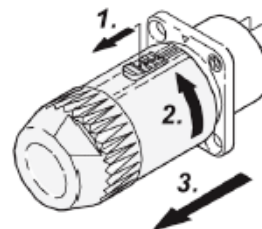


GREY

Combination for AC Power OUT



Engagement



Separation

General Installation Instructions

When installing the LPS the following connections can be used.

- 12VDC charging from the car generator (12VDC input, Grey Anderson SB50)
- 12VDC output to equipment (12VDC output, Red Anderson SB50)
- 230VAC charging from external mains plug (Blue Neutrik)
- 230VAC output to equipment (Grey Neutrik)

When installing the LPS into a vehicle the 230VAC outputs of the LPS is protected by an RCD relay.

When mounting the 230VAC charge input it is important to insure an unbroken cable from the input socket on the car and to the input Neutrik connector on the LPS as shown on Figure 1.

If the 230VAC charge wire is connected to anything else an RCD relay must be present immediately after the input socket as shown on Figure 2.

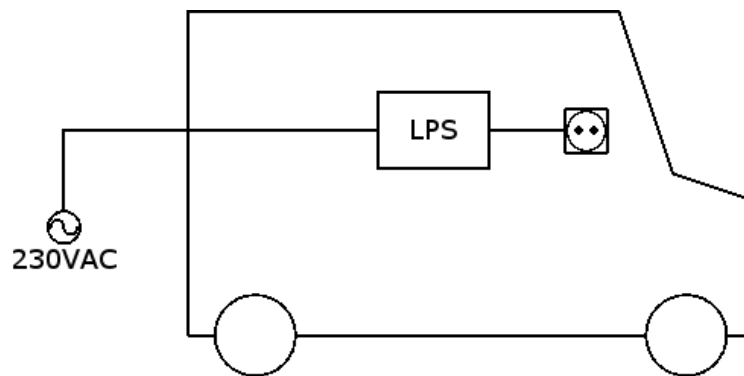


Figure 1

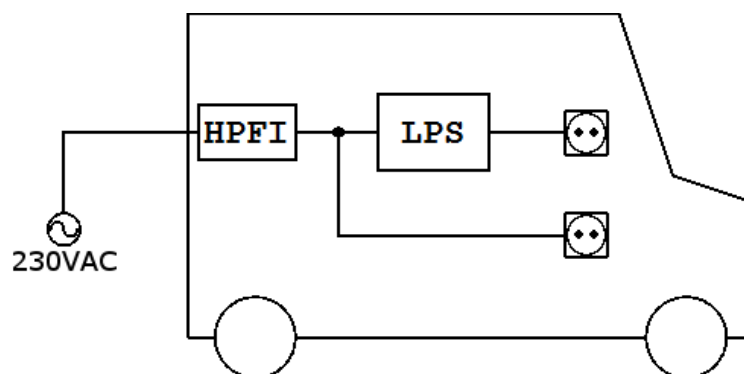


Figure 2

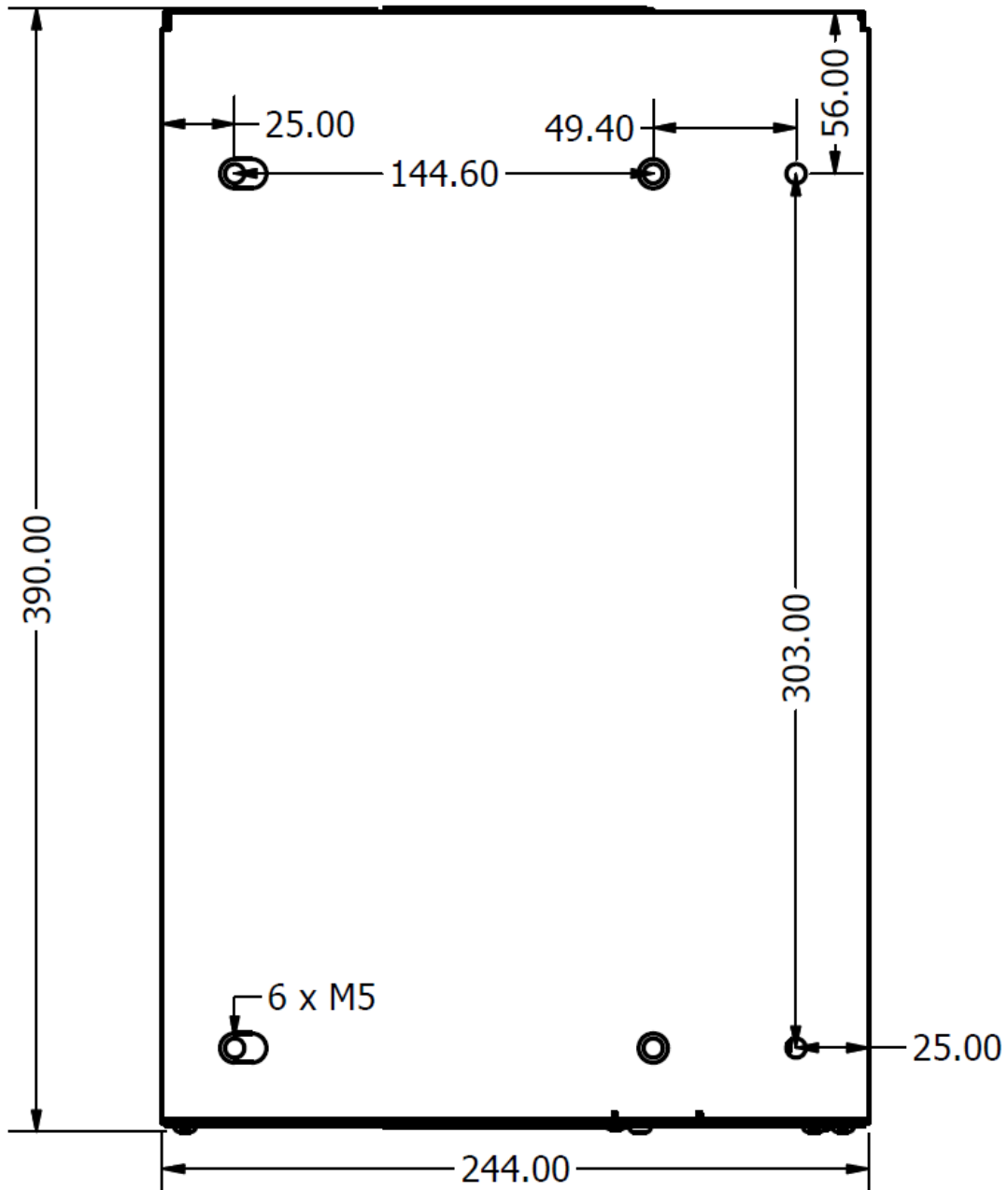
When installing fixed equipment to the 230VAC output it must be installed using the Neutrik connector on the LPS. This way it is insured that vibrations will not loosen the connection.

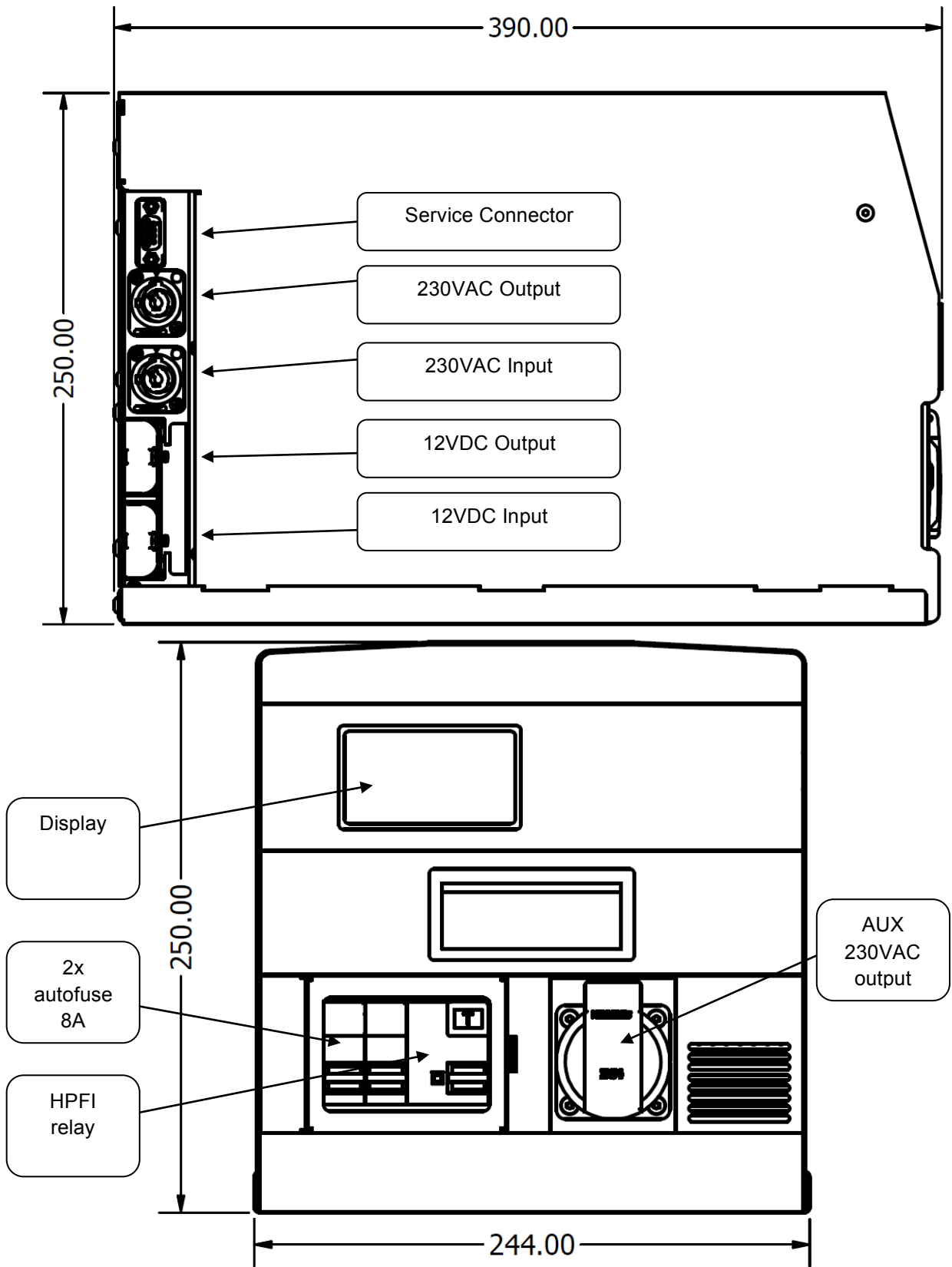
Physical dimensions and overview

ATTENTION: Mount the LPS topside up, never upside down or on the side.

ATTENTION: The LPS has forced air cooling. Make sure the air can flow freely around the unit.


The LPS has 6 M5 mounting holes in the bottom as shown in the picture below



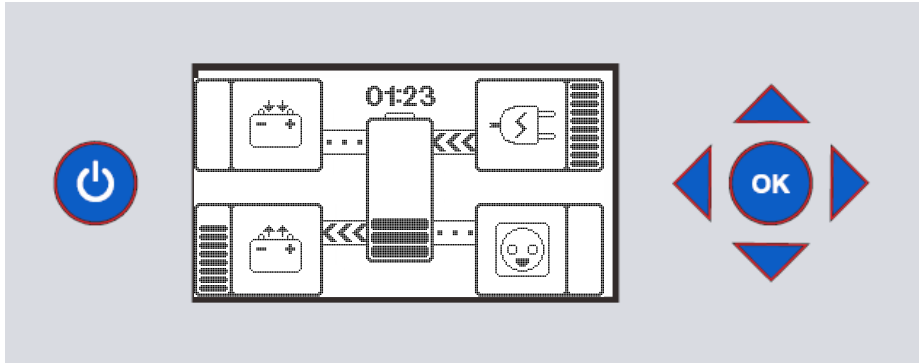


Operating the LPS

Power On/Off

To turn the unit on press and hold the power button  until the light in the display turns on.

To shut off the unit completely press the power button .



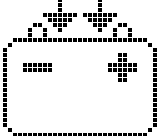
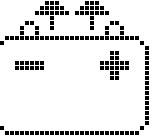
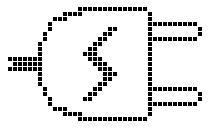
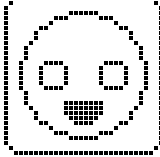
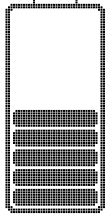
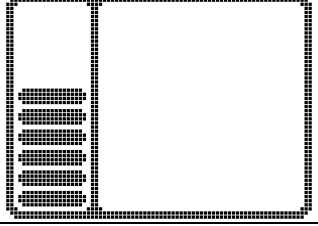
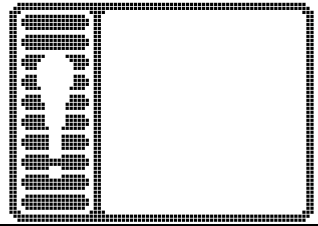
The charger and DC input is automatically turned off when they are not used.



When 230VAC, or sufficient voltage on the DC input is present, the unit will turn on and start charging the batteries.

If the LPS experience a failure or a warning it will show a short description of this on the display.



Icon description

	<p>DC input module</p> <p>Shows the status of the DC input module The power bar shows the percentage of total DC charge current.</p>
	<p>DC output module</p> <p>Shows the status of the DC output module The power bar shows the percentage of total discharge current.</p>
	<p>AC input module</p> <p>Shows the status of the charge module The power bar shows the percentage of total AC charge power.</p>
	<p>AC output module</p> <p>Shows the status of the AC output module The power bar shows the percentage of total available output power.</p>
	<p>Battery module</p> <ul style="list-style-type: none"> - Shows the battery State of Charge in 10% increments. - When the battery is charging the top most bar will flash.
	<p>Main screen info box</p> <ul style="list-style-type: none"> - Tells how many % is being used in 10% increments.
	<p>If there is an error or warning the exclamation mark will flash.</p>

	<p>Indication of power flow</p> <ul style="list-style-type: none"> - Indicates the direction of power flow.
	<p>Module is online but inactive</p>

Protections

To prevent hazardous use, the LPS can disconnect

- Overcharge
- Deep discharge
- Temperature extremes
- Short circuit / over current.

The system ensures a high level of safety by 3 measures

- Firmware control
- Internal hard switch to cut of charge / discharge current
- Internal over current fuse on inputs and outputs

Empty Battery

The Li-Ion battery will protect itself from deep discharge, by disconnecting the outputs and entering sleep mode when empty. The battery is able to startup when a charge source is detected from either the AC input or the DC input.

If the power button is pressed when the battery is empty, the display will flash an empty battery icon 3 times and shut down again.

After the LPS have had an Empty Battery failure, the Display will show the Empty Battery warning until 10% SOC has been recharged.

Failure description

If the unit detects a failure in the electronics it will display a failure code. The following table shows the failure codes and the action required to solve the problem.

Any failure code not mentioned in this table requires service.

In case the unit displays a failure code that is not listed in the table, the unit needs service.

Failure codes	Failure description	Failure level	Affected module	Solution
E001,E002	EEPROM memory failure.	Critical	All	Contact your retailer for service.
E003	Internal High Voltage communication.	Critical	Inv/Chg	Contact your retailer for service.
E004	The internal electronics is getting too cold.	Warning	Inv/Chg	Allow the unit to warm up, or place it in a warmer ambient temperature.
E005	The internal electronics is too cold.	Simple	Inv/Chg	Place it in a warmer ambient temperature.
E006	The internal electronics is getting too warm.	Warning	Inv/Chg	Allow the unit to cool down, or place it in a cooler ambient temperature.
E007	The internal electronics is too warm.	Simple	Inv/Chg	Allow the unit to cool down, or place it in a cooler ambient temperature.
E008,E009	A temperature sensor is broken.	Critical	All	Contact your retailer for service.
E010	The calculated efficiency of the unit is too low.	Critical	All	Contact your retailer for service.
E020,E21	Inverter failure	Simple	Inv	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E022	Charger failure	Simple	Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E030-E040	Missing calibration	Critical	All	Contact your retailer for service.
E049	DC Communication failure	Critical	DC in/out	Contact your retailer for service.
E050	Cell Voltage measurement failure	Critical	All	Contact your retailer for service.
E051	Battery Empty	Warning	Inv/DC out	Apply charge current from AC in or DC in.
E052	One or more cell voltage(s) is getting too low	Warning	All	Recharge the battery
E053	One or more cell voltage(s) is too low	Warning	All	Recharge the battery
E054	One or more cell voltage(s) is getting too high	Warning	All	Remove any charge inputs and allow the unit to balance the cells. Contact your retailer if the warning is still present after 24hr.
E055	One or more cell voltage(s) is too high	Warning	All	Remove any charge inputs and allow the unit to balance the cells. Contact your retailer if the warning is still present after 24hr.
E056	One or more cell temperature(s) is getting too low	Warning	All	Place the unit in warmer ambient temperature.
E057	One or more cell temperature(s) is too low	Simple	All	Place the unit in warmer ambient temperature.
E058	One or more cell temperature(s) is getting too high	Warning	All	Allow the unit to cool down or place it in a cooler ambient temperature.

E059	One or more cell temperature(s) is too high	Simple	All	Allow the unit to cool down or place it in a cooler ambient temperature.
E060	Battery voltage is too low for operation	Critical	All	Apply 230VAC input to recharge the battery.
E090	DC input voltage is too low to charge the battery	Simple	DC in	
E091	DC input voltage is too high to charge the battery	Simple	DC in	
E092	DC input charge current is too high	Simple	DC in	
E093	DC input discharge current is too high	Simple	DC in	
E094	DC output relay connect failure	Critical	DC out	Contact your retailer for service.
E095	DC output relay disconnect failure	Critical	DC out	Contact your retailer for service.
E096	DC output charge current too high	Simple	DC out	The DC output has a power source connected that generates too much charge current. Remove or adjust the power source.
E097	DC output discharge current too high	Simple	DC out	The DC output load is drawing too much current.
E101	AC current measurement failure	Critical	All	Contact your retailer for service.
E102	DC current measurement failure	Critical	All	Contact your retailer for service.
E103	PSU startup failure	Simple	Inv/Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E104	PSU short circuit	Simple	Inv/Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E105	High voltage failure	Critical	Inv/Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E106	Control circuit power supply failure	Critical	All	Contact your retailer for service.
E150	230VAC output over load	Simple	Inv	The output is over loaded. Remove some of the load on the 230VAC output.
E151	230VAC output peak current duration too long	Simple	Inv	
E152	230VAC output peak current too high	Simple	Inv	
E153	PE/N relay failure	Critical	Inv/Chg	Contact your retailer for service.
E154	PE/N relay failure	Critical	Inv/Chg	Contact your retailer for service.
E200	Charge current too high	Simple	Chg	
E201	Charge current too high	Simple	Chg	
E202	High voltage failure	Simple	Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.
E203	230VAC output over load	Simple	Chg	
E204	Transfer relay failure	Critical	Inv/Chg	Contact your retailer for service.
E205	Transfer relay failure	Critical	Inv/Chg	Contact your retailer for service.
E206	High voltage over voltage	Simple	Chg	Restart to remove failure. If a restart does not remove the failure, contact your retailer for service.

Additional information

Battery Management System

The lithium Power Supply has a built-in Battery Management System ensuring full control and safety. The BMS monitors lithium cell activity and uses the information for safety, maintenance, SOC, and interface control.

Charger Control

It is necessary to control the charging of lithium batteries in order to avoid uncontrolled disconnects and to protect the lithium cells from unstable conditions. The integrated Battery Management System always insures the lithium cells are operated within their safe operating parameters.

Cell voltage measurement

The LPS measures cell voltage with high accuracy. The accuracy is necessary to calculate the SOC as a few 1/1000 of a volt makes a big difference.

Cell temperature measurement

The LPS measures the temperature of all individual cells to ensure that none of the cells overheat or cause thermal runaway. The temperature information is also used for SOC calculations.

Shunt and current measurement

The current passes through an integrated shunt resistor so the LPS can measure the current to and from the cells and use it for protection and SOC calculation.

Integrated safety breaker

The most important part of the LPS circuit protection is the integrated safety breaker. It allows the LPS to cut off all charge and discharge currents in potentially hazardous situations.

Overload protection

The advantage of the internal safety breaker is its capability to disconnect high currents without damaging the main switch. The LPS can use the safety breaker for overload protection without damaging the cells.

Short-circuit protection

The LPS is protected against short circuits by fuses on the inputs and outputs. The 230VAC output furthermore has a built-in RCD (HPFI) relay to protect the user.

Advanced SOC calculation

The highly advanced algorithm for SOC calculation involves a combination of voltage, current, temperature and cell impedance.

Cell balancing

The advanced SOC calculation ensures that all cells are kept in a balanced condition at all times. The BMS has a high cell-balance current that reduces the need for active cell balancing and restores the cells to a balanced condition faster. The BMS is cell balancing each single cell in charge, discharge and idle mode.

Interface

Each LPS has a service interface that allows a qualified technician to analyze any failures and the general condition of the LPS. The service port also allows for firmware updates.

Power conservation

When the LPS are not in use it will enter a low power state. In this state the LPS keeps power consumption ultra-low to avoid unnecessary discharge of the battery. The LPS can be reactivated through the power switch and by applying a charge source from either the 230VAC input or the 12VDC input.

Configurable outputs

It is possible to configure the 230VAC output and the 12VDC output to not be activated if the LPS are activated from the 12VDC input. If the LPS is activated from the 230VAC charge input the 230VAC output will also be active.

Warranty

CAUTION & WARNING:

DO NOT USE OR ATTEMPT TO USE THIS PRODUCT UNTIL YOU HAVE READ THIS USER'S MANUAL IN ITS ENTIRETY. IMPROPER INSTALLATION OR USAGE OF THIS DEVICE MAY BE HAZARDOUS AND MAY CAUSE DAMAGE TO OTHER ELECTRICAL EQUIPMENT AND WILL VOID WARRANTY.

- Perpetual V2G warrants, to the original purchaser only, for a period of 48 months from the date of purchase, that the Perpetual V2G device will be in good working order when properly installed and operated as described in this manual.
- If the display fails within this time period under normal use, Perpetual V2G will, without charge, at the place of Perpetual V2Gs choosing, repair or replace the display - with new or reconditioned parts or a new or reconditioned display as Perpetual V2G deems necessary.

This warranty is void and will not be applied if:

- The inverter has been used against the recommendations of this manual.
- The inverter has been used in an application outside of general automotive, solar, industrial or marine applications without the agreement of Perpetual V2Gs.
- The inverter has been modified or repaired without written authorization of Perpetual V2G.
- Reverse polarity, excessive overloading, general abuse, neglect, wear & tear, ingress of liquids (water, oil, acid, or otherwise), foreign objects, lightning strikes, over or under voltage, RFI/EMI, etc.

Obtaining Warranty Service

To obtain warranty service, please contact the outlet at which you purchased your product. Do not contact Perpetual V2G directly. For warranty service do the following:

1. Proof of purchase
2. Get the model number
3. Get the unit serial number
4. Write a brief description of the application and problem including any failure codes displayed by the unit.
5. Contact your Perpetual V2G dealer for an authorization number prior to dispatch - do not send without authorization. Once this number has been obtained, please carefully package your unit and send (freight paid) to the Perpetual V2G dealer.
Please note the LPS contains Lithium batteries and must be shipped as dangerous goods according to UN3481 (Lithium Ion Batteries Contained in Equipment)

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