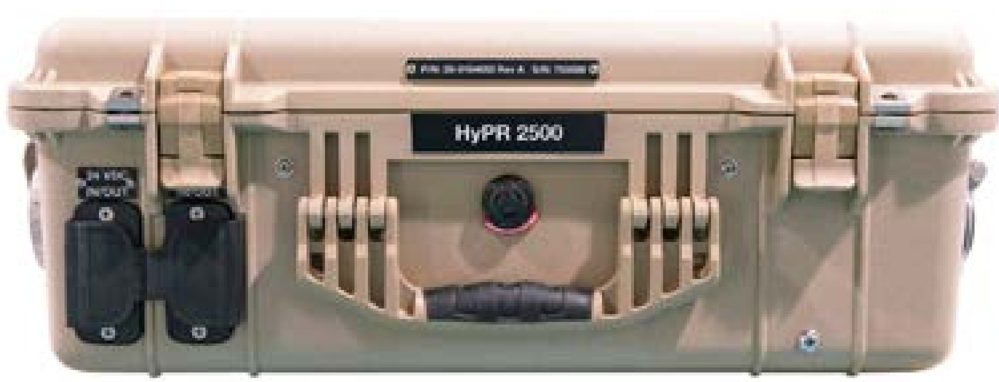
SOLAR STIK®

Operator and Maintenance Manual for the 24VDC HyPR 2500

P/N 20-0104050



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GENERAL INFORMATION, EQUIPMENT DESCRIPTION, AND THEORY OF OPERATION

Introduction

A Hybrid Power Router (HyPR) is a power management device which processes and routes a variety of power inputs to both DC and AC power outputs.

The HyPR is a modular, portable component of the Solar Stik Architecture and its design and flexible function affords the operator a "multi-tool" for applications demanding a singular power solution to meet specific, and evolving, mission requirements.

Some features of the HyPR include:

- The ability to act as the primary power management device in a Hybrid Power System (HPS) or as a supplemental power manager in AC, DC, or AC/DC systems.
- The ability to work in concert with additional power management devices when high-power or individual control over multiple loads/voltages is required (eg. PRO-Verters).
- Support of simultaneous AC and DC outputs.
- Plug and play compatibility with the Solar Stik Inter-Connect circuit.
- Efficient management of available power to loads.

This manual provides operation and safety information for the HyPR 2500. The HyPR 2500 has been designed specifically to support Hybrid, UPS, and Power Conditioning.

When operating the HyPR within a system, consult the Faceplate and the System Manual for specific operation guidelines.

Requirements for HyPR Operation

- Total power INPUT must exceed total power OUTPUT in any particular operation mode.
- The HyPR requires the presence of battery (DC bus) voltage to operate at its full rated power.
- Based on the application, the user must configure the system so there is "balanced" operation between the HyPR's internal functions.

HyPR 2500 accepts universal (120 VAC) single-phase AC input voltage, allowing connection to any generator or grid AC power source. It is ideally suited for use where available AC power quality is poor or AC line voltages vary. AC and DC cables for the HyPR are sold separately, as they must match voltage type and associated current-conducting ability.

HyPR 2500 Capabilities and Controls

The HyPR features specific capabilities for the system in which it is employed and, while many of the circuits in the HyPR are fully automatic, outside user-established limits, not every HyPR feature may be used in every application.

Most functions and modes are controlled by programmable settings at the User Interface(s).
- "Functions" are related to specific circuits or hardware in the HyPR.
- "Modes" refer to the operational employment of the HyPR circuits.

User Control Functions

The faceplate contains breakers that control the input and output of both AC and DC power. When the main power breaker switch is turned on:
- The HyPR DC INTERFACE will power up and report DC bus voltage and amperage data on the home screen located on the front of the HyPR.
- The inverter (DC>AC) will be active, but only operational once the HyPR AC OUTPUT breaker is engaged.
- The charger (AC>DC) will be active, but only operational once the HyPR AC INPUT breaker is engaged.

Data Management

- The HyPR DC Interface provides basic DC circuit data, including ESM/bus voltage and net current only when active ESMs are connected.
- If no ESMs are connected to the HyPR, then only the DC bus voltage is available from the HyPR DC INTERFACE.
- DC bus voltage is the only accurately-reported metric from the HyPR DC INTERFACE when ESMs are not connected.

Theory of Operation

The HyPR 2500 coordinates the support of AC and DC loads using power supplied from AC and/or DC sources. Both AC and DC power sources energize the HyPR 2500 internal DC circuitry (DC bus), or the “Inter-Connect” circuit. The presence of DC bus voltage (battery voltage) enables the full function of the HyPR 2500 internal circuits. System voltage and net current can be monitored on the DC User Interface.

A schematized illustration of the DC bus and its relationship to internal components, inputs and outputs is shown below. The arrows indicate the flow of current in the circuits.

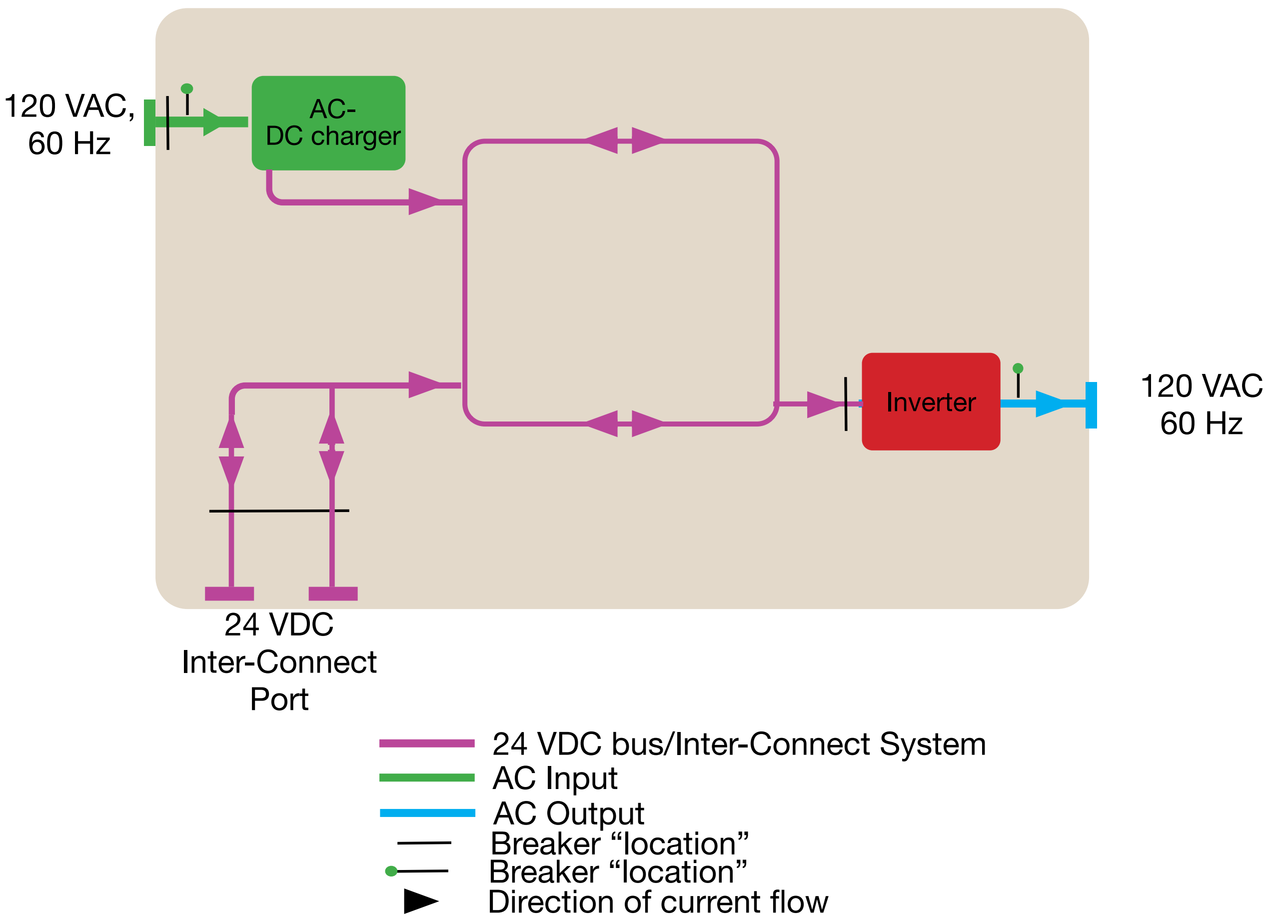


Figure 1. Schematized power flow from a top-down view of the interior of the HyPR 2500

General Information

Circuit breakers on Faceplate are only for IN/OUT circuit limit protections. They are NOT “function controls” or “function protections”.

The internal DC Bus is limited to 100 A total current flow. This may restrict some HyPR functionality in certain operating modes.

Current flow on the DC bus is controlled by voltage. Power will always be prioritized to the loads and will only cease when the voltage drops to low-voltage disconnects located within the inverter (AC loads), the ESMs and DC Interface (DC loads).

24VDC IN/OUT ports operate directly from the internal DC bus. Power in/out of these ports will only be reflected in the “net” current on the display.

System recovery from overdischarged batteries is possible using AC power or alternative 24 VDC power sources. System recovery using PV power is not an option.

Inverter “continuous AC power output” fluctuates based on conditions such as temperature (heat derating = efficiency loss).

AC Functions

The HyPR employs two (2) separate AC functions that operate on the DC bus:

Charging

AC>DC converter provides up to 100 A to the DC bus (~2000 W).

Inverting

DC>AC inverter removes up to 9 A at 120 VAC from the internal DC bus (~1100 W).

When configuring the HyPR for use, it is important to understand how to establish balance between the power available from sources and the power required by the loads.

When using AC power sources in Hybrid or UPS models, the AC INPUT setting must be set for the following conditions:

- Continuity of AC load operation
- Battery charging
- Not to exceed the power output of the AC source

When small expeditionary generators are used, the HyPR can be used for dynamic loads that would normally cause overloading of the generator.

DC Functions

The DC bus is effectively the nervous system of the HyPR. All HyPR functions are regulated directly by the DC bus voltage. The DC bus voltage is functionally equivalent to the System battery voltage. Direct connections to the DC bus can be made via the two (2) Inter-Connect ports. AC Input and AC output ports are direct connections to the DC bus (See “Figure 1. Schematized power flow from a top-down view of the interior of the HyPR 2500” on page 7).

DC power will flow into or out of the HyPR via the direct connections (Inter-Connect Port).

The indirect connections allow power to flow to the bus after being altered from its original form, for example:

- AC power converted to 28.2 VDC
- Inverter converts energy stored in batteries to 120 VAC power output.

Load Prioritization

In every operation mode, the HyPR will prioritize power to the load. It executes functions based on real-time operating conditions, which include:

- total power available at the INPUTS
- total power needed at the OUTPUTS
- battery SOC
- temperature
- user programming for special conditions

HyPRs can be used with grid-utility or generator AC power.

With load prioritization, the load will always be the first to receive power. Any incoming power not consumed by the load is stored in the batteries. Stored energy is for use to support loads when these inputs are not available (e.g., grid failure, generator maintenance periods, etc.) and to reduce reliance on fuel-powered generators.

Modes of Operation

There are several operational modes in which the HyPR may be configured, depending on the application,

Hybrid Mode–The hybrid mode allows the use of a smaller generator based on average, continuous total loads over a 24-hour period, versus a larger generator that will support “peak” loads, which are usually momentary or short in duration:

- AC power generation source with ESMs
- DC power generation source with ESMs
- AC and DC power generation sources (combinations of the above) with ESMs

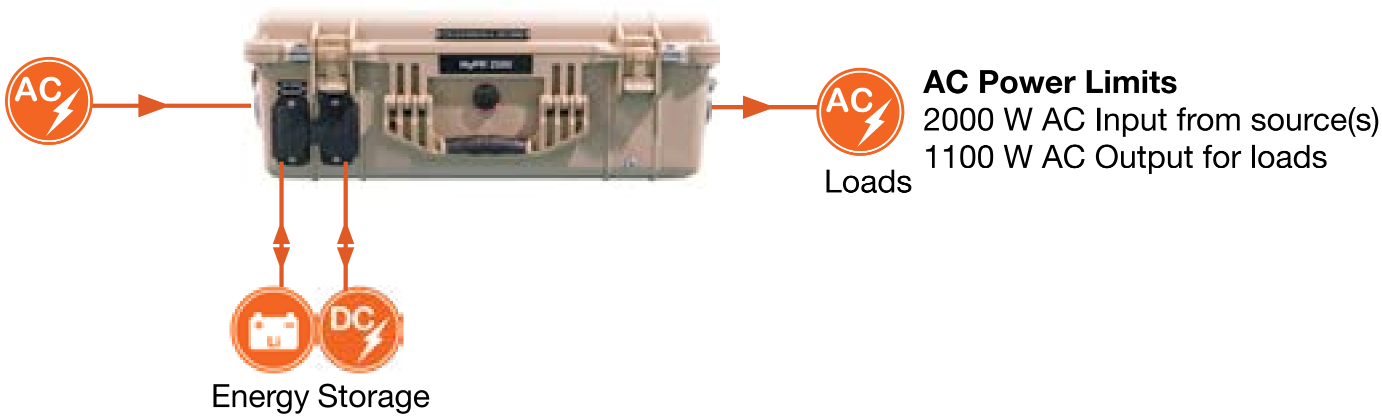


Figure 2. Using the HyPR 2500 in Hybrid Model

UPS Mode–The HyPR 2500 is capable of operating as an Uninterruptible Power Supply/Source, providing instantaneous emergency power to a load in the event that primary power source fails. In this mode, the HyPR 2500 will to provide power to the load until it can be turned off safely or until primary power is restored. In this mode, power duration is limited to that contained in the ESM’s connected to the HyPR 2500.

- AC utility / grid power sources with ESMs
- ESMs do not cycle

Figure 3. Using the HyPR 2500 in UPS Model

Selecting an AC Power Source

HyPRs can be used with grid-utility or generator AC power sources, and can easily be configured to work with the current limits of both the DC/AC power source circuits and the DC/AC load circuits. Once the input and output power limits are configured, the HyPR regulates how much power is delegated between these circuits, to prevent overload conditions.

Acceptable AC power sources for use with a single HyPR 2500 should provide the following:
- 1–2 kW of power
- Pure Sine Wave AC wave form output

When considering a fuel driven generator to pair with the HyPR, note that the maximum continuous AC load should not exceed the maximum continuous output of the AC power generator (i.e., maximum load AC power requirement ≤ generator AC power output).

Battery Current Requirements for HyPR AC Output

A bank of batteries with the capacity to provide ≥ 46 amps of current is required for the HyPR (inverter) to operate at its full rated capacity (1100 W). Battery banks with smaller current capacity are sufficient to power up the HyPR and support loads (AC and DC) that do not exceed the current capacity of the connected batteries.

Connecting ESMs with an insufficient current capacity to the HyPR may result in the batteries being charged or discharged too quickly causing the battery temperature to rise to a point that the battery management system (BMS) disconnects the batteries from the system.

Note: The total Ah capacity of all connected ESMs must be programmed, (a setting in the DC interface), for the HyPR DC interface to report accurately, the battery state of charge.

Temperature-dependent Power Processing

The performance of all electric and electronic equipment varies with temperature with the rated performance listed determined at standard testing conditions (77 °F; 25 °C). Generally performance declines or "derates" when the equipment is operating in ambient temperatures colder or hotter than STC; the hotter or colder the poorer the performance.

When the equipment itself generates heat, the temperature of the equipment will rise above ambient (and STC) in direct proportion to power being processed. This too results in derating. Internal thermostatic mechanisms are built into most equipment to reduce power processing in a heat-dependent manner to lower heat and prevent damage. Power processing vs heat curves vary widely.

They HyPR contains two (2) major subcomponents, a charger and inverter. Both of these derate at elevated temperatures but in a different manner. The inverter will provide full power up until a critical temperature and then turn off, dropping the AC load then resume support of the AC load after the inverter has cooled to a set point. The charger on the other hand, will reduce power processing at a critical, defined temperature but continue to charge the batteries at a lower rate.

Heat absorbed by the sun (solar loading) also increases the internal temperature contributing to temperature-dependent derating. Understanding how temperature-dependent derating affects HyPR power processing will enable the Operator to make adjustments to ensure continuity of operations in any environment.

Derating Specifications

The Inverter

- The inverter provides full power (1100 W) up to 86 °F (30 °C). It will decrease power output by 20% for each 18 °F (10 °C) increase over 86 °F (30 °C). The inverter will cease to process power at 176 °F (80 °C), to self-protect, and will resume providing AC power after it cools to operating temperature.
- Below 80 °F (27 °C), the HyPR can provide up to 1100 W continuous while not charging.

The Charger

- The HyPR charger provides full power (2000 W) up to ~158 °F (30 °C). At 158 °F (70 °C) it will reduce power ~30% of full-rated power until it cools and resumes normal, full-rated output.
- Below 80 °F (27 °C), the HyPR can process around 2000 W continuous for battery charging (with no loads connected).

How to Minimize Derating

- Do not overload the HyPR. Manage power processing demand by paying close attention to what is "plugged in. Prioritize critical loads.

- Shade the HyPR 2500 to reduce solar loading. Solar Stik data indicates that solar loading of a Pelican case can increase internal heat by ~40 °F (~ 22 °C) above ambient.

- Do not block airflow into or out of the HyPR; give it space to breathe.

- Clean or replace the air intake filters regularly.

Important Safety Information and Instructions

This manual contains important instructions that must be followed during the setup and operation of a the HyPR 2500. Read all instructions and information contained in this manual.

DO NOT begin assembly or use of the HyPR 2500 without first reading and understanding this manual.

While the HyPR 2500 designed for indoor/outdoor operation, the user interfaces (control panels) must not be exposed to rain, snow, moisture, or liquids. Close and latch and/or lock the cases when the components are unattended.

Exercise caution when handling or operating the HyPR 2500. Live power may be present.

Safety Information Labels

Your safety and the safety of others is very important.

Many important safety messages have been provided in this manual and directly on the System components. Always read and obey all safety messages.

This is the safety alert symbol. This symbol is an alert to potential hazards that can cause death or injury. All safety messages will follow the safety alert symbol and the word "DANGER", "WARNING", or "CAUTION". These words are defined as:

DANGER Indicates a hazardous situation which, if not avoided, **will result in death or serious injury.**

WARNING Indicates a hazardous situation which, if not avoided, **could result in death or serious injury.**

CAUTION Indicates a hazardous situation which, if not avoided, **could result in minor or moderate injury.**

All safety messages will describe what the potential hazard is, how to reduce the chance of injury, and what can happen if the instructions are not followed.

Fire Hazard

Fire Types

Class A fire - Fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics.

Class B fire - Fires in flammable liquids such as gasoline, petroleum, oil, and paint.

Class C fire - Fires involving energized electrical equipment such as motors, transformers, and appliances. Remove the power source and the class C fire becomes a class A or B fire.

Recommended Fire Extinguisher

NSN 4210-00-548-7219 Fire Extinguisher, Carbon Dioxide, 10 lb
Carbon dioxide is a liquefied gas, which is highly effective fighting class B and C fires. These extinguishers are ideal for areas where contamination and/or cleanup are a concern, such as data processing centers, labs, and telecommunication rooms.

⚠ WARNING

Only CO_2 (carbon dioxide) fire extinguishers should be used with this equipment.

Using the Fire Extinguisher

When using the extinguisher on a fire, remember PASS:

Pull the pin.
Aim the nozzle or hose at the base of the fire from a safe distance.
Squeeze the operating lever to discharge the fire extinguishing agent.
Sweep the nozzle or hose from side to side until the fire is out. Move forward or around the fire as the fire diminishes.

Watch the area for reignition until the cause has been fixed.

Electric Shock Hazard

⚠ WARNING

Standing water around the electrical equipment and/or intrusion of water into the System components can increase the risk of electrical shock.

DON'T LET THIS BE YOU!

HIGH VOLTAGE: System components, PV arrays, and generators may produce lethal line voltages. Extreme care should be taken to protect against electrocution. Always work with another person in case an emergency occurs. Disconnect power before performing maintenance. Wear safety glasses whenever working on any part of a system that requires exposure to mechanical or direct electrical contacts.

⚠ WARNING

The System is NOT GFCI protected.

Environmental and Handling Precautions

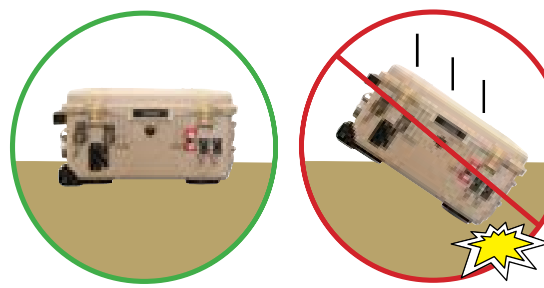
All Solar Stik components are ruggedized, yet there are a few things the operator can do to prevent failures and prolong the operational life of the Solar Stik System.

Water

If outdoor operation is necessary, the lids of all components should be closed and latched. During operation, cases should be placed upright, especially during inclement weather. Lids should be open only to access operator controls and closed at all other times.

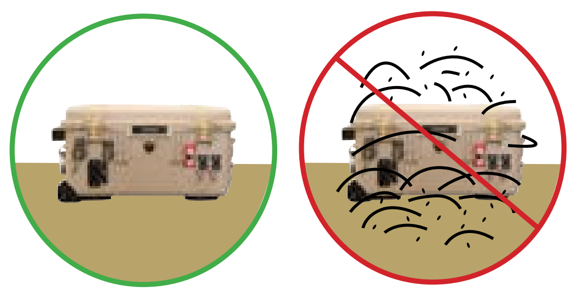
Impact

Equipment should not be dropped onto hard surfaces at a height greater than one foot when transporting or during operation.



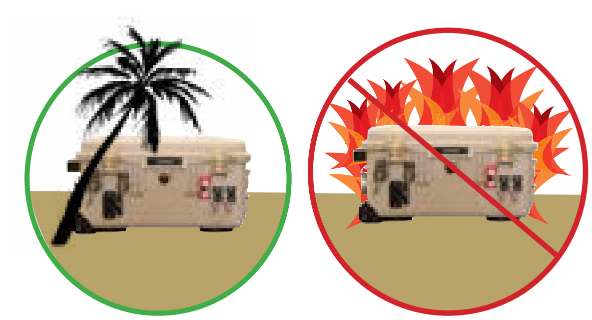
Dust/Foreign Object Intrusion

Air intake filters should be cleaned once per month, or more frequently when conditions warrant. As a general rule, minimize exposure to high levels of particulates and foreign object debris by exercising common-sense placement and protection during both operation **and** storage.



Heat

Heat and solar loading reduces efficiency and life expectancy. Shade components (except PV panels) to prevent the negative effects of heat.



The Inter-Connect System

A Solar Stik System is comprised of three (3) distinct types of technologies:

- Energy storage
- Power management
- Power generation

All of the individual components that operate in these categories utilize a unique connection architecture known as the Inter-Connect Circuit.

The Inter-Connect Circuit is the connection framework of the System's DC power network. It uses a simple, polarized, locking connection that is common throughout the architecture. All power management, energy storage, and power generation components are compatible with the Inter-Connect Circuit.

Using a common, polarized connector allows rapid "Plug & Play" scaling of components, adaptation of capabilities within the architecture, technology refreshment, and swapping of components when conditions warrant. It also ensures that there is no unsafe way to make connections.

Circuit Breaker Protections
The Inter-Connect network is protected from overloads and short circuits through a network of circuit breakers strategically placed throughout the circuit. It ensures the potential for a reverse polarity connection within the circuit is minimized. If a problem occurs in a leg of the Inter-Connect Circuit, the affected leg will disconnect from the primary network, leaving the other circuits functioning. If a major failure occurs in the circuit, then the entire network will shut down for System and Operator protection.

Operate with Voltage
The Inter-Connect Circuit communicates simple battery voltage to all components on the network, allowing them to independently coordinate their respective functions. Battery voltage is used to trigger actions such as power distribution timing, and more. Therefore, the proper setup of the Inter-Connect Circuit is critical to properly communicate voltage to all points in the System and to ensure all of the components operate together to provide seamless power to the load.

Optimize with Data
Data collection for a System occurs through the Inter-Connect network. Power management devices such as HyPR 2500s and PRO-Verters meter voltage, current and time through the circuit, providing critical real-time data the operator can use to troubleshoot and verify System performance. Data collection enables programming/architectural changes to optimize performance based on evolving conditions.

24VDC Linear Inter-Connect Cable

Inter-Connect Cables for use with ESMs have two types of plugs: straight and angled. The straight plug connects to the ESM to facilitate stacking (Figure 7).

- Polarized
- 200 A maximum current
- 24 VDC connection only
- Mechanically "locks" into place
- Rotate knob clockwise to lock, counterclockwise to release
- Can be repaired or modified in the field

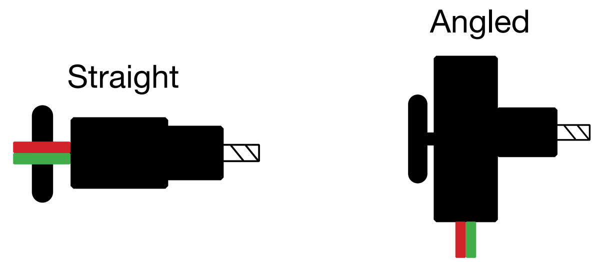


Figure 4. Linear Inter-Connect Plug

The Standard Inter-Connect Plug

- Polarized
- 200 A maximum current
- 24 VDC connection only
- Mechanically "locks" into place
- Rotate knob clockwise to lock, counterclockwise to release
- Can be repaired or modified in the field

Figure 5. Inter-Connect Plug

EQUIPMENT DESCRIPTION

Introduction

The HyPR 2500 manages power between power sources and loads. The HyPR 2500 provides both AC and DC mechanisms to charge ESMs while the system is operating or idle. The HyPR 2500 provides important battery status information and therefore increased security for continuity of operations.

The following diagram illustrates an overview or where to connect power sources, ESMs and loads to the HyPR 2500.

Figure 6. 24 VDC HyPR 2500 connections

AC Power Input Port

Connect AC power sources to the 120 INPUT port. The HyPR 2500 accepts 120 V power. Power via this connection charges batteries and supports DC loads connected the 24VDC IN/OUT ports.

Figure 7. HyPR 2500 AC power input port

Connecting Generators to HyPR

Connect generator power cables to the “AC INPUT” port on the left side of the HyPR.

Figure 8. Connecting generators to HyPR

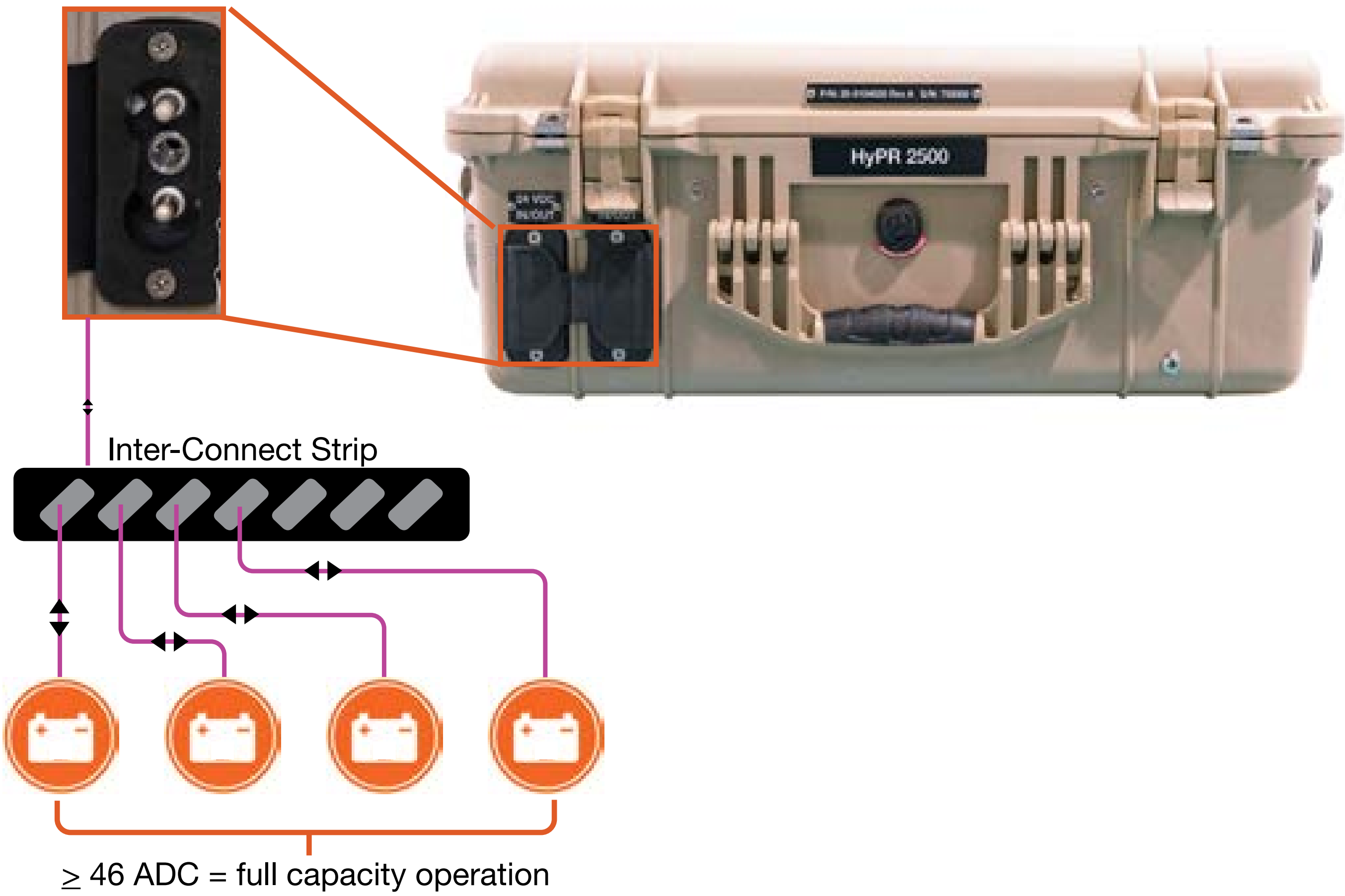
24 VDC IN/OUT Ports

Connect Energy Storage Modules(ESMs) to this metered Inter-Connect port.

Use Inter-Connect cables to connect multiple ESMs to an Inter-Connect Strip and to the HyPR 2500 24 VDC IN/OUT port.

A single battery is enough to power up the HyPR 2500 internal circuits and user interface as well as to support small loads. However, additional batteries must be connected for the HyPR to operate at its full rated capacity (see Battery Requirements for Operation).

Note: The total Ah capacity of all connected ESMs must be programmed into the HyPR, using the DC interface, for the HyPR DC interface to report battery SOC accurately.



The Inter-Connect Port is a direct connection to the HyPR DC bus. This port is not metered; may be used to parallel HyPRs or to connect additional power management components.

Figure 9. HyPR 24 VDC IN/OUT connection port

120 VAC OUTPUT Ports

Connect AC loads to the 120 VAC output ports. This port can provide 1100 W (9 A) continuous power output. Brief surges of up to 2000 W are tolerated. This port is limited to 9 A.

Figure 11. HyPR 120 VAC output port

Vents

Exhaust vents have fans to remove move air from the case. Ambient air enters the case through the intake vents. **The intake vents have air filters that must be cleaned on a regular basis, especially when operating in dusty environments.**

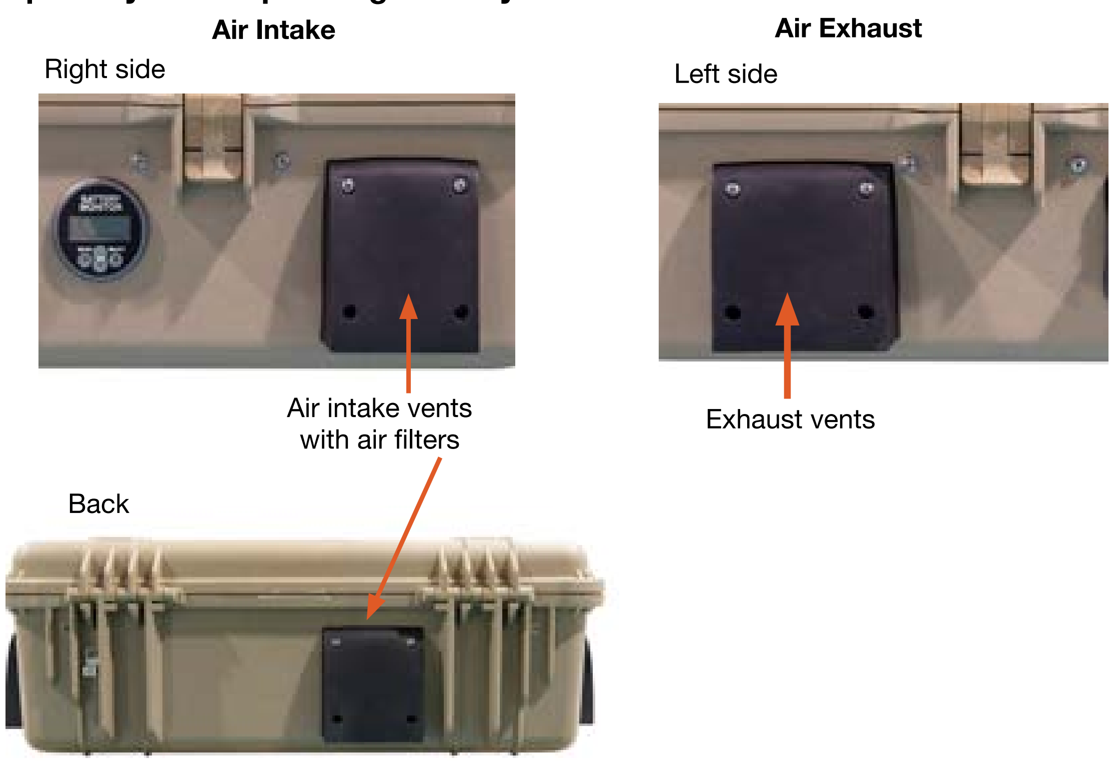


Figure 10. HyPR 2500 cooling vents

24 VDC HyPR Faceplate

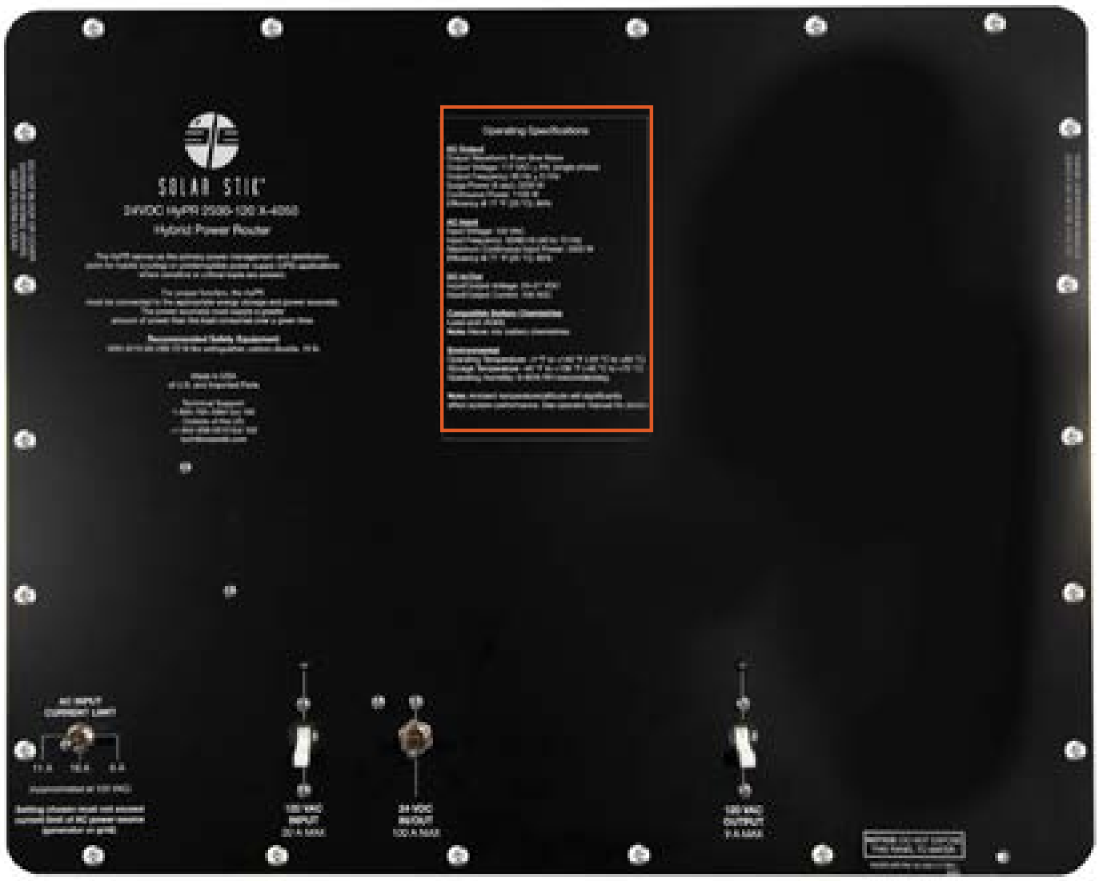


Figure 12. 24 VDC HyPR 2500 Faceplate

AC INPUT CONTROL breakers – Allows selection of AC input current limit. This must be adjusted to match the maximum recommended current output limit of the AC power source.

AC OUPUT Status LED – Green indicates the HyPR inverter is operating normally and AC power is available from the 120 VAC output ports.

Breakers/Switches – The breakers serve as switches to activate circuits and to deactivate circuits not in use. Circuit breakers also protect against overcurrent conditions. If too much amperage flows due to short-circuit, inadequate or improper loading, or component failure, these will protect the System and Operator. The green LED by each breaker will be lit if the circuit is active and the breaker is not tripped.

Specifications – A list of performance metrics and limitations for the HyPR; provides guidance when configuring a System.

AC Interface

AC Input Current Limit Switch

This switch may be thought of as the battery charging rate limiter. Toggle this switch to match the maximum output of the AC power source connected to the HyPR. Properly setting this value will prevent overloading the AC power source.

Toggling the switch to 16 A at 120 VAC is compatible with using a 2kW generator. Therefore, if the AC power source is from the grid or prime power, the current limit of the power output receptacle may be the limiting factor.

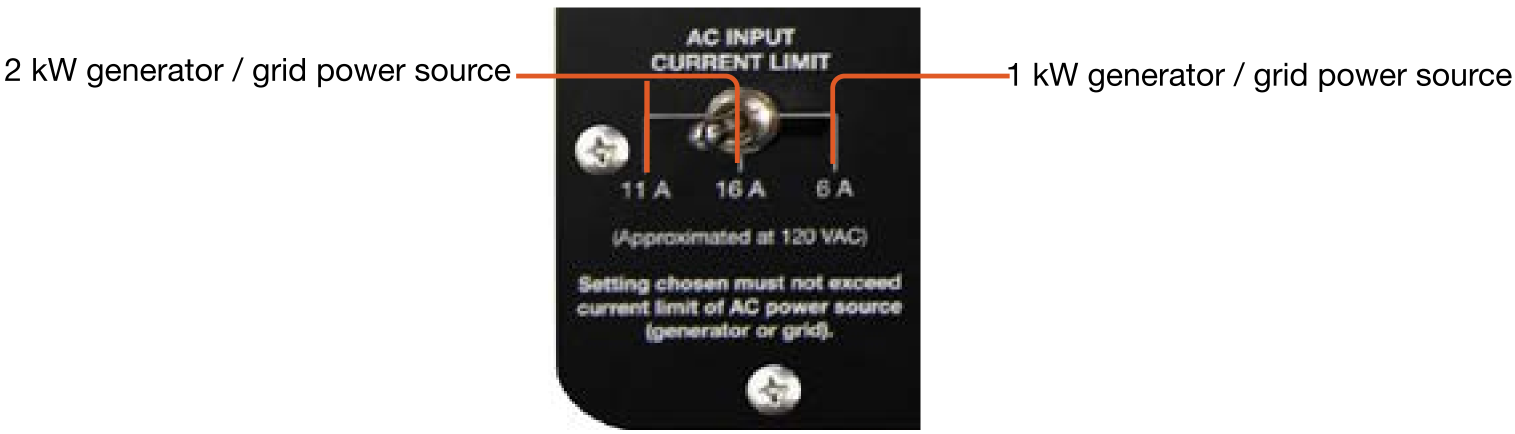


Figure 13. AC Input Current Limit Switch

AC INPUT 11 A – Limits flow of power from AC power source into HyPR.
AC INPUT 16 A – Limits flow of power from AC power source into HyPR.
AC INPUT 6 A – Limits flow of power from AC power source into HyPR.

Breakers / Switches

The HyPR can be configured into a System in many ways. Understanding the function of each breaker and its associated circuit is critical to proper operation. Circuit breaker panel is only for IN / OUT circuit limit protections.

Figure 14. HyPR 2500 breakers

AC INPUT 30 A – Limits flow of power from AC sources.
24 VDC IN/OUT 100 A – Limits flow of power into and out of HyPR.
AC OUTPUT 9 A – Limits flow of power from the HyPR inverter to AC output receptacle.

DC Interface

The DC Interface consists of an LCD screen and three (3) menu navigation buttons. System voltage and net current are reported on the DC INTERFACE home screen.

There are some programmable settings that will be important to change or confirm, depending on System configuration. A description of these settings and their locations in the menu map are shown on subsequent pages. **Note:** the HyPR 2500 must be connected to a battery to access the full functionality of the DC INTERFACE. Without battery input only the voltage and current readings on the home screen are accurate.

Battery Voltage

Current

The actual battery voltage

DC INTERFACE – When operated with a battery, the HyPR 2500 backlit LCD DC User Interface with three-key panel provides data and control for battery and PV-related functions, including battery state of charge (SOC), DC bus voltage, net (charge/discharge) current, inverter low-voltage disconnect, and more. It contains a microprocessor that allows it to learn the battery's behavior over time, increasing accuracy of reported metrics

Connecting Generators to HyPR

Connect generator power cables to the “AC INPUT” port on the left side of the HyPR.

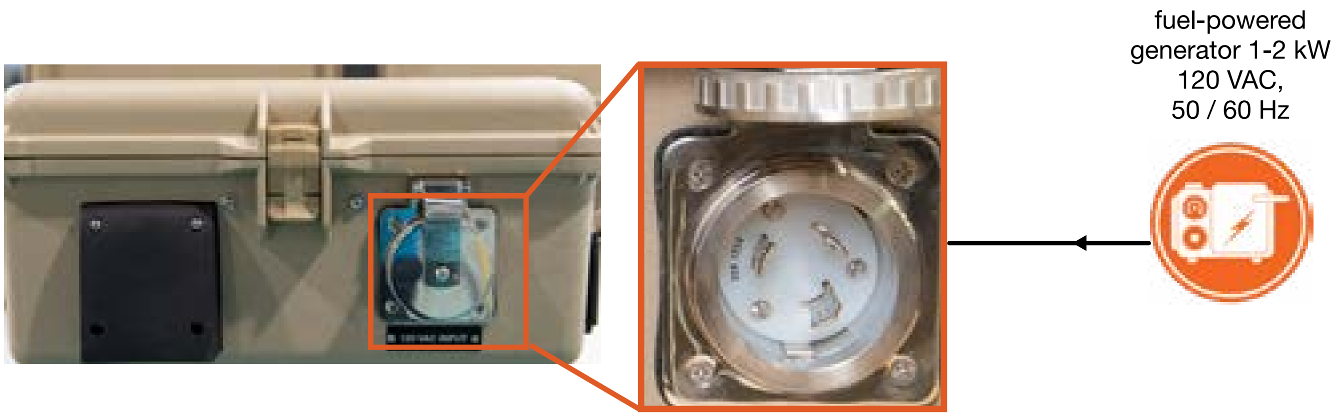


Figure 15. Connecting generators to HyPR

Operator Instructions

Specific, detailed Operator Instructions depend on the System into which the HyPR 2500 is integrated. Each HyPR 2500 Faceplate is customized with an abbreviated version of the System-specific HyPR 2500 Operator instructions. A detailed set of System-specific Operator instructions is available in the System Setup and Operation Manual. For these reasons, the HyPR 2500 Operator instructions presented in this manual are brief and general in nature.

HyPR Setup and Operation

Before starting ensure that generators (if using) are serviced and in operating condition. The Operator must understand how to operate the generator connected to the System.

Turn off all breaker switches on the HyPR 2500

1. Connect AC and / or DC loads to HyPR.
   - Ensure load power switches are OFF.
   - Load power requirements must not exceed rated output of their respective connections

2. Toggle HyPR 24 VDC IN/OUT SWITCH to ON.
   This switch, located on the inside of the HyPR, allows current to flow from connected batteries into the HyPR, energizing the internal DC bus (Figure 1 on page 7). At this point the DC Interface will power up.

3. Check/Confirm/Program total Ah capacity in HyPR DC User Interface (typically programmed at Solar Stik for the application illustrated on the HyPR 2500 Faceplate.)

4. Set HyPR AC INPUT CONTROL to match output limit of generator(s) or shore power.

5. Toggle HyPR AC INPUT breaker switch to ON

6. Toggle breaker switch(es) or circuits in use to ON.

7. Turn on loads.

Navigating DC User Interface Menus

Monitoring the Battery

The HyPR has a BATTERY MONITOR that reports any connected ESM battery status as well as all power that flows into and out of the battery. The BATTERY MONITOR constantly measures the battery voltage (V) and battery current (I). It uses this information to calculate the battery state of charge (SOC), which is often the most critical information needed. Consult the BATTERY MONITOR for information regarding the battery.

Some basic battery knowledge and good monitoring are essential for maximum productivity and life expectancy from the battery.

The life expectancy of a battery depends on many factors. Battery life is reduced by undercharging, overcharging, excessively deep discharges, rapid discharges, and excessive ambient temperatures. Monitoring the HyPR 2500 provides important feedback to the user so that corrective measures can be made when necessary.

Figure 16. Battery Monitor

BATTERY MONITOR

In normal operating mode, the BATTERY MONITOR displays battery status parameters. Press the (+) and (–) buttons for scrolling access to the read-only battery metrics (see below).

The BATTERY MONITOR has been programmed by Solar Stik for your application so under normal operating conditions, there is no reason to use the SETUP or SELECT buttons.

Touch any button to illuminate the LCD.

Battery Voltage

The actual battery voltage

Current

The actual current flowing out of the battery (negative sign) or into the battery (positive sign)

Power

The power drawn from the battery (negative sign) or flowing into the battery (positive sign)

Consumed Amp-hours

The amount of Ah consumed from the battery

Example: If a current of 12 A is drawn from a fully charged battery for a period of 3 hours, this readout will show -36.0 Ah. (-12 x 3 = -36)

State-of-charge

A fully charged battery will be indicated by a value of 100.0% and five full bars in the graphical SOC meter in the bottom right corner. A fully discharged battery will be indicated by a value of 0.0% and no full bars in the graphical SOC meter in the bottom right corner.

Synchronizing the Battery Monitor

For a reliable readout, the SOC as displayed by the BATTERY MONITOR has to be synchronized regularly with the true SOC of the battery. This is accomplished by fully charging the battery. The BATTERY MONITOR resets to “fully charged” when the following charged parameters are met: the voltage reaches or exceeds 29.0 V and simultaneously the (tail) charge current is less than 4.0% of the total battery capacity (e.g., 12 A for a 300 Ah battery) during 3 minutes.

The BATTERY MONITOR can also be synchronized (i.e., set to ‘battery fully charged’) manually if required. This can be achieved in normal operating mode by holding the + and – buttons simultaneously for 3 seconds, or in setup mode by using the SYNC option (see parameter 10, Synchronize). If the LCD user interface does not synchronize automatically, the charged voltage, tail current, and / or charged time may need adjustment. **When the voltage supply to the BATTERY MONITOR has been interrupted, the BATTERY MONITOR must be resynchronized before it can report an accurate SOC.**

Synchronizing Issues

BATTERY MONITOR Does Not Synchronize Automatically

One possibility is that the battery never reaches the fully charged state. The other possibility is that the charged voltage setting should be lowered and / or the tail current setting should be increased.

BATTERY MONITOR Synchronizes Early

In applications with fluctuating charge currents (solar), the following measures can be taken to reduce the probability for the LCD user interface to reset prematurely to 100% SOC:

- Increase the “charged” voltage to only slightly below the absorption charge voltage.
- Increase the “charged” detection time and / or decrease the tail current to prevent an early reset due to passing clouds.

Sync and Battery Icon Blinking

This means the battery is not synchronized. Charge the ESM, and the BATTERY MONITOR should sync automatically. If that doesn’t work, review the sync settings. Or, if you know the battery is fully charged but don’t want to wait until the LCD user interface synchronizes, press and hold the + and – buttons simultaneously until you hear a beep.

SOC Display Options

The BATTERY MONITOR can display both the amp hours removed (“consumed Amphours” readout, compensated for charge efficiency only) and the actual SOC in percent (“state-of-charge” readout, compensated for charge efficiency and Peukert efficiency). Reading the SOC is the best way to monitor the battery. The BATTERY MONITOR also estimates how long the battery can support the present load (“time-to-go” readout). This is the actual time left until the battery is discharged to the discharge floor. The factory discharge floor setting is 50%. If the load is fluctuating heavily, it is best not to rely on this reading too much since it is a momentary readout and must be used only as an estimate. We always encourage the use of the state-of-charge readout for accurate monitoring.

Historical Data

The BATTERY MONITOR tracks several parameters regarding the state of the battery. These can be used to evaluate usage patterns and battery health.

Enter historical data by pressing the SELECT button when in normal mode.
Press + or – to browse the various parameters.
Press SELECT again to stop scrolling and show the value.
Press + or – to browse the various values.
Press SELECT again to leave the historical menu and go back to normal operation mode.

The historical data are stored in nonvolatile memory and will not be lost when the power supply to the LCD user interface is interrupted.

Parameter	Description
A dEEPESt d ISCHArGE	The deepest discharge in Ah.
b LASt d ISCHArGE	The largest value recorded for Ah consumed since the last synchronisation.
C AUErAGE d ISCHArGE	Average discharge depth
d CYCLES	The number of charge cycles. A charge cycle is counted every time the state-of-charge drops below 65%, then rises above 90%
E d ISCHArGES	The number of full discharges. A full discharge is counted when the state of charge reaches 0%.
F CUMULAt IUE AH	The cumulative number of Amp hours drawn from the battery.
G LOWESt UOLtAGE	The lowest battery voltage.
H H IGHESt UOLtAGE	The highest battery voltage.
I dAYS S INCE LASt CHArGE	The number of days since the last full charge.
J SYnCHrOn ISAt IOnS	The number of automatic synchronisations
L LOW UOLtAGE ALArMS	The number of low voltage alarms.
M H IGH UOLtAGE ALArMS	The number of high voltage alarms.
*P LOWESt AUH UOLtAGE	The lowest auxiliary battery voltage.
*9 H IGHESt AUH UOLtAGE	The highest auxiliary battery voltage.
r d ISCHArGEd EnErGY	The total amount of energy drawn from the battery in (k)Wh
S CHArGEd EnErGY	The total amount of energy absorbed by the batteryin (k)Wh

Maintenance

Preventive Maintenance Checks and Services (PMCS)

Item #	Item to be Inspected	Interval	Procedures	Non-mission Capable
1	Visual inspection of 24 VDC HyPR 2500	M	1. Inspect case for visible damage and missing items. 2. Clean excessive dust or dirt accumulation from the exterior, interior and all connectors. 3. Close all unused connector covers.	~If the case is broken or split or if connectors are damaged, do not place into service.
2	Air Intake Filters	M[1]	1. Remove the two (2) air intake filters. 2. Wash with water and dry the filter. Reinstall. 3. If the filter is damaged or cannot be cleaned --replace it.	~If the filter cannot be cleaned, is too damaged to function properly and a replacement is not immediately available, the unit is partially mission capable. Replace the filter as soon as possible to restore the unit to fully mission capable.

HyPR 2500 Air Intake Filter Maintenance*

There is one (1) air intake filter on the back of the HyPR 2500 (the vent on the left side of the HyPR is an exhaust fan and has no vent filter). Use a #2 cross tip screw driver to remove four (4) fasteners from the vent cover (**A**). Removing these fasteners will remove the vent cover and a metal grate that prevents ingress of small critters (**B, C**). A replaceable filter is attached to the case with a clip. (**D**). Carefully remove and clean or replace the filter then reinstall the vent assembly.

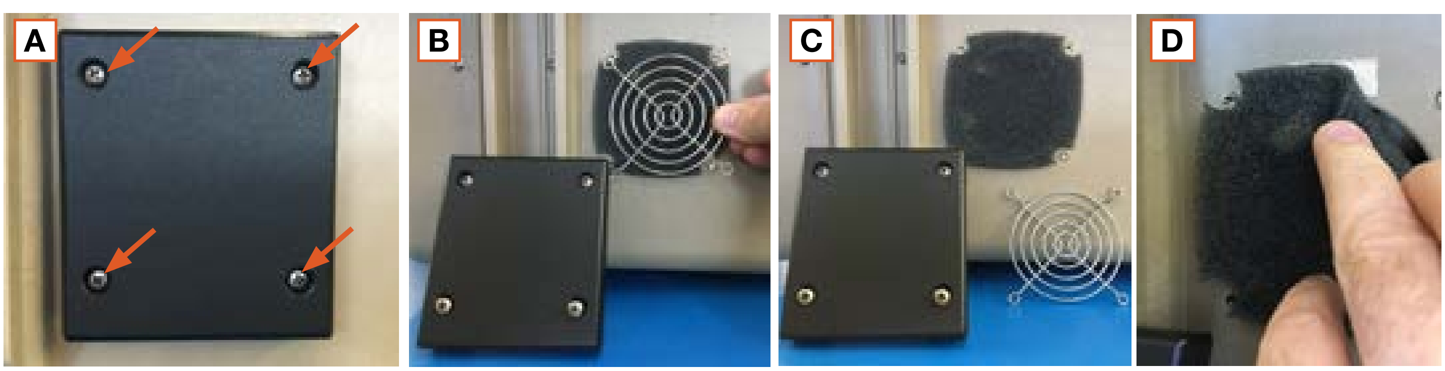


Figure 17. Cleaning/replacing HyPR 2500 air intake vent filter

Water Intrusion Remediation

If water intrusion is suspected, and the System is still functional, disconnect power sources entering the HyPR 2500 from the most distant location possible, power down the System (turn off the power switches on all of the System components) and then disconnect the HyPR 2500 from the System. Do not move or relocate what may be a flooded HyPR 2500.

Keep the HyPR 2500 as level as possible to prevent the water inside from accumulating at one end or the other and submerging the internal electronics. Remove the screw from the drain hole at the bottom edge of the case. If water flows out of the drain hole after removal of the plug, let it flow until it stops. Then slightly and slowly tilt the case toward the drain hole to remove any remaining water. Continue to increase the angle of the HyPR 2500 slowly until no more water drains from the hole. After the water has been drained, remove the Faceplate. Place the HyPR 2500 in the most dry environment possible for a time long enough that any remaining moisture inside will dry. When it is dry, reintegrate the HyPR 2500 to the System and test it to determine if it is still functional.

Figure 18. Drain plug screw located under the TECH PORT

Transporting the HyPR 2500

The HyPR 2500 is designated as a two-person lift. It also has an extendable tow handle and wheels for easy single-person transportation across appropriate surfaces.

Figure 19. HyPR human transportation.

TECHNICAL SPECIFICATIONS

General	
Nominal Operating Voltage	24 VDC
Battery Chemistry	$LiPO_4$/Pb Compatible
Operational Voltage Range	20-27 VDC
Internal cooling	Convection
User Interface	BMV
Remote Monitoring	UCM
Case	Pelican 1610
Transportation	Any
Certification	None
Warranty	1-year materials and workmanship

DC Output	
Output Voltage	Up to 20-27 VDC
Output Power Rating	100 A (Max)

AC Output Specifications (@77 °F/25 °C)	
AC Output Frequency	60 Hz+-0.1% Hz
AC Output Voltage	117+-6 % VAC
Continuous Output Current	9.5 A (1100 W)
5 Second surge capacity	2200 W
Inverter Efficiency	89%
Transfer Time	None

AC Charger Specifications (@77 °F/25 °C)	
AC Input Frequency	47-63 Hz
AC Input Voltage	120 VAC
DC Output Voltage	24-29 VDC
Charging Stages	CC/CV
Continuous Output Current	~100 ADC
Charging Efficiency	95%
Transfer Time	None

Safety	
Breaker(s)	(1) 30 A, (1) 100 A, (1) 9 A
Certifications	Built and designed to MIL-STD-810G and IP65

Environmental	
Operating Temperature*	-4 °F to 140 °F (-20 °C to 60 °C)
Storage Temperature**	-40 °F to 140 °F (-40 °C to 60 °C)
Relative Humidity	0 to 95%
Ingress Protection	IP54

**** Operating outside of range will accelerate the battery aging process*
*****Prolonged exposure to high temperatures in storage will reduce battery life*

Weights and Dimensions (L x W x H)	
Weight	70 lb (31.8 kg)
Dimensions	24.2 x 19.3 x 8.8 in (61.5 x 49 x 22.3 cm)

Connections	
Inputs	(1) 120 VAC, 30 A (NEMA L5-30P)
Outputs	(1) 120 VAC, 9 A (NEMA 5-15/20R)
Input(s)/Output(s)	(2) 24 VDC Inter-Connect (Deltran 224-0061-BK)

ABOUT SOLAR STIK, INC.

SOLAR STIK®

Mission Statement
Saving lives across the globe through innovative power solutions

STIKopedia
STIKopedia is a compilation of everything you would ever want to know about portable Hybrid Power Systems, including the philosophy and mechanics of high-efficiency circuits, and the individual technologies used to create them.

Solar Stik Training and Education

- **Solar School (St. Augustine, FL)** provides an introduction to the design and support of small-scale, renewable-energy, power generation systems, with detailed explanation of system components. Advanced configuration options with hands-on deployment of actual systems will enhance student understanding.

- **Solar Stik New Equipment Training (on site)** teaches Hybrid System configuration options with hands-on deployment of actual systems to enhance student understanding.

Solar Stik Training Courses are tailored to the specific needs of the students. To schedule Solar Stik Training or to learn more about the curriculum, please contact us.

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