SOLAR STIK®

Operator and Maintenance Manual for the Security Force Assistance Brigade (SFAB) Hybrid Power System

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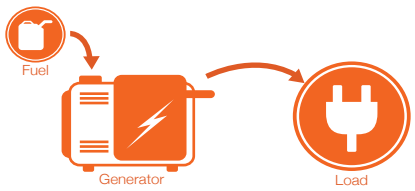
GENERAL INFORMATION, EQUIPMENT DESCRIPTION, AND THEORY OF OPERATION

The introductory parts of this Manual describe Hybrid Power Systems (HPS) composed of Solar Stik components. However, the Solar Stik architecture is modular and open allowing Operators to integrate non-Solar Stik components as part of a HPS solution. Please contact Solar Stik Technical Support for assistance in optimizing the integration of other components.

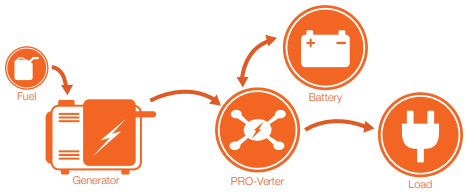
Introduction to Hybrid Power Systems

When a portable fuel-driven power generator is the primary source of power for an application, it must operate continuously to provide electricity to the load, even if the power requirements of connected loads are minimal or intermittent. Fuel energy is wasted in the production of electricity because neither the generator nor the load(s) can fully use the fuel's potential energy. This traditional power model is a low-efficiency system.

In the high-efficiency, Hybrid Power System (HPS), a battery bank supports the load. The power for the load is drawn from the batteries only as needed. Multiple sources of power generation can be used simultaneously to support the battery and ensure uninterrupted power to the loads. **The battery becomes the foundation of the HPS and the architecture is opened to allow multiple technologies to operate in concert.**



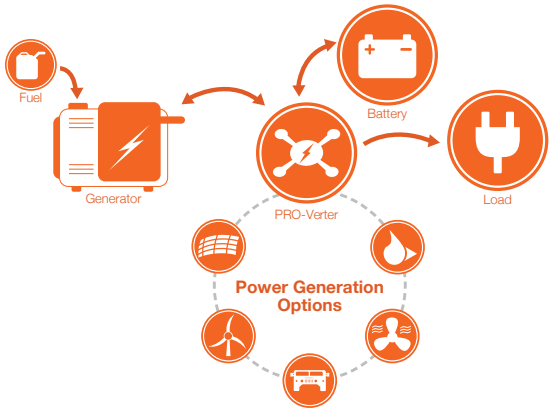
Low-efficiency
Traditional Power System



High-efficiency
HPS

The Hybrid Power System Flexible Open Architecture

The System is comprised of modular components that integrate into a flexible architecture that is configured for an application's specific mission requirements. If the application changes, the modular System architecture can be modified or scaled to meet the new requirements.



HPS with Open Architecture

Theory of Operation

The System provides power surety for applications where Hybrid, UPS, Power Conditioning, or scavenging functions are required.

Universal "rules" for operation:

- Total power INPUT to the HPS must be greater than the power OUTPUT of the HPS.
- The HyPR requires the presence of battery (bus) voltage to fully operate.
- Based on the application, the user must configure the system so that there is "balanced" operation between each individual component and the internal functions in the HyPR.

The following diagram illustrates where to connect power sources, 24VDC Li Expander Pak 1300s and loads to the HyPR. For normal operation, at least three (3) 24VDC Li Expander Pak 1300s must be connected.

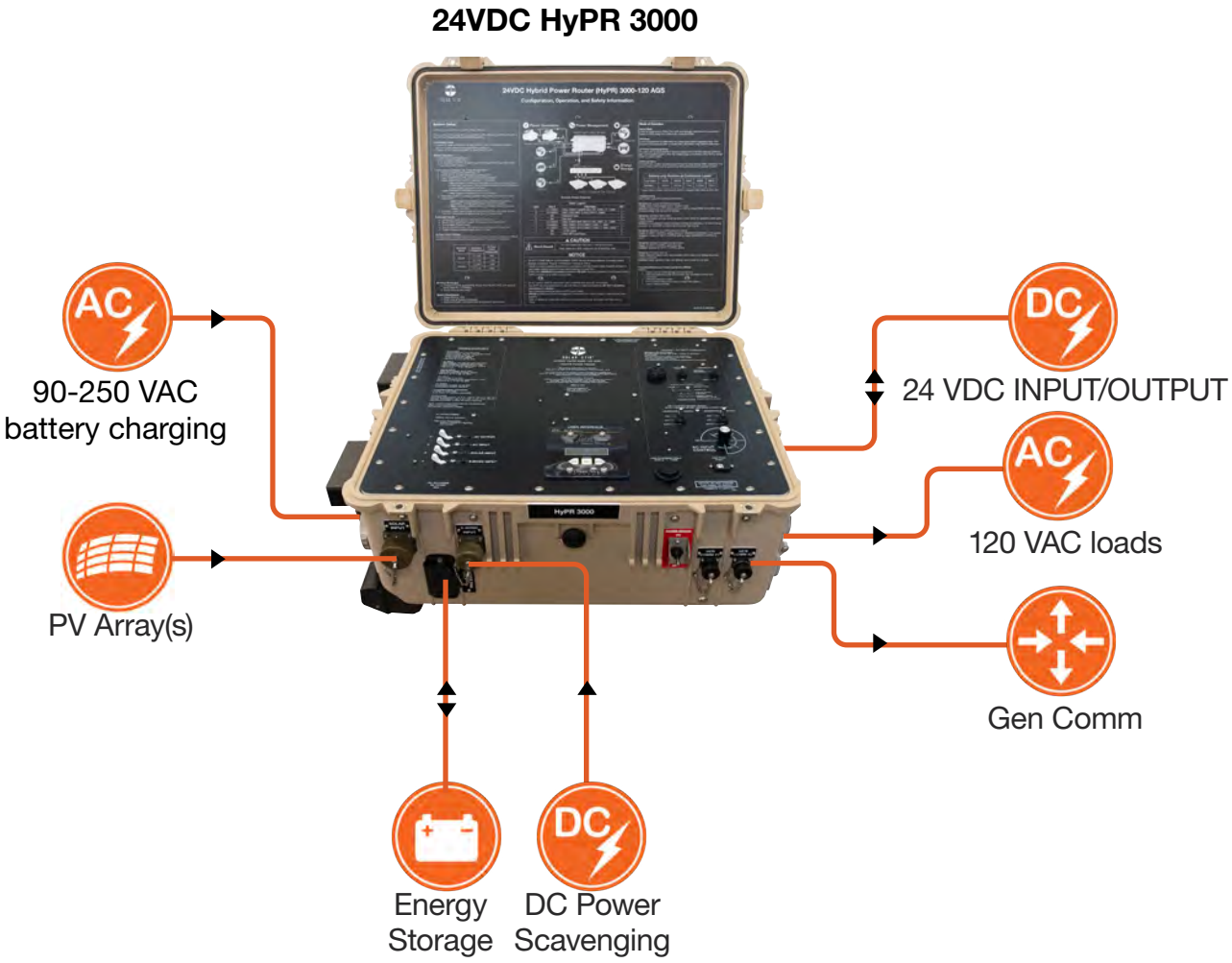


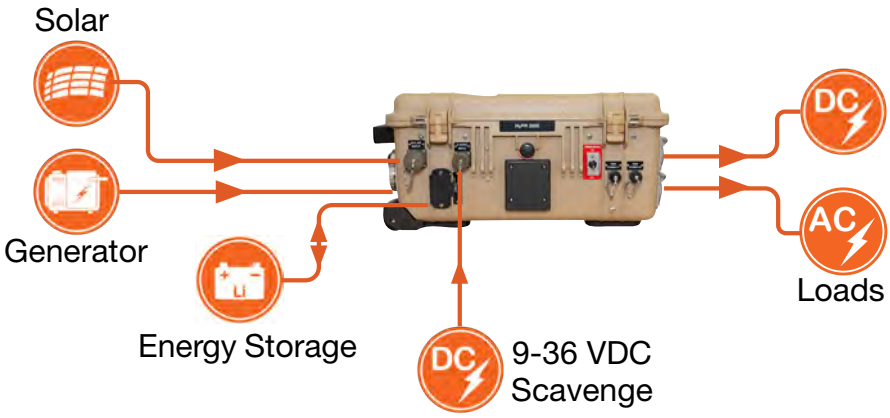
Figure 1. 24 VDC HyPR 3000 connections

Modes of Operation

There are several operational modes in which the HyPR may be configured, if required.

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 (Ranger/Defender, TQG) with ESMs
- DC power generation source (PV, scavenging) with ESMs
- AC and DC power generation sources (combinations of the above) with ESMs

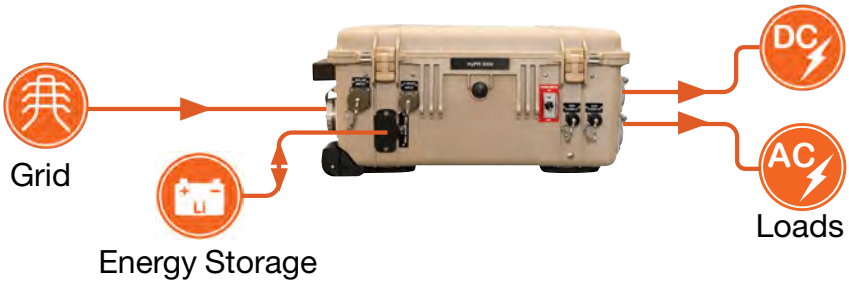


AC Power Processing Limits
3000 W AC Input from source(s)
2000 W AC Output for loads

Figure 2. Using the HyPR 3000 in Hybrid Model

UPS Mode–The HyPR 3000 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 3000 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 3000.

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

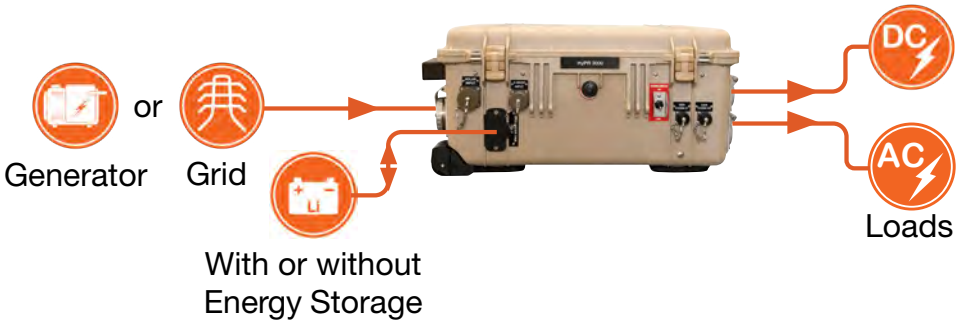


AC Power Processing Limits
3000 W AC Input from source(s)
2000 W AC Output for loads

Figure 3. Using the HyPR 3000 in UPS Model

Power Conditioning Mode–The HyPR 3000 has a power conditioning mode that stabilizes output voltage and frequency from dirty AC power sources. The HyPR will convert AC power with voltage ranging from 85-264 and frequencies between 47-63 Hz into clean, pure sine wave 120 VAC, 60 Hz power providing protection for sensitive loads:

- HyPR with ESMs between AC power sources and AC and DC loads - eliminates overloading of small expeditionary generators and increases the HyPR power output stability over longer periods of time.
- HyPR without ESMs between AC power sources and AC and DC loads - eliminates AC power source voltage and frequency fluctuations that can cause problems with sensitive electronic loads.

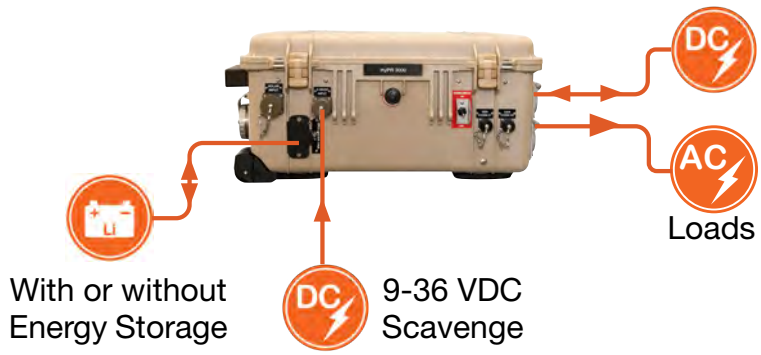


AC Power Processing Limit
1500W with ESMs
1000W without ESMs

Figure 4. Using HyPR in Power Conditioning Model

DC Scavenging Mode–The HyPR 3000 provides an energy scavenging tool to harvest power from conventional and non-conventional 9 to 36-volt power sources not integral to the Solar Stik family of products, such as a random batteries or a 12 VDC vehicle accessory outlet. The HyPR scavenging circuit automatically converts any power source voltage between 9 and 36 VDC to 28.4 VDC which is appropriate for charging ESMs and/or to support small 120 VAC or 24 VDC loads. It is not necessary for a Solar Stik ESM to be connected to the HPS to take advantage of the Scavenging circuit. If ESM's are not connected, however, the HyPR can only support loads up to the amount of power provided through the Scavenging circuit (Figure 1).

- Scavenging with ESMs connected to HyPR allows ESMs to be charged using external batteries or vehicle DC systems.
- Scavenging without ESMs connected to HyPR allows small loads to be operated directly from a connection to a 12 VDC vehicle accessory outlet.



AC Power Processing Limits
300 W with ESMs connected
150 W without ESMs connected

Figure 5. Using HyPR in Scavenge Model

Inverter Mode – The HyPR 3000 may be used in inverter mode when no AC power generation sources are available. This allows the combined total input of DC sources (including ESMs) to be dedicated to AC loads. This mode may be used when:

- Renewable power generation is abundant and stable.
- Scavengable DC power resources are available.
- Connection to a vehicle NATO port is available.

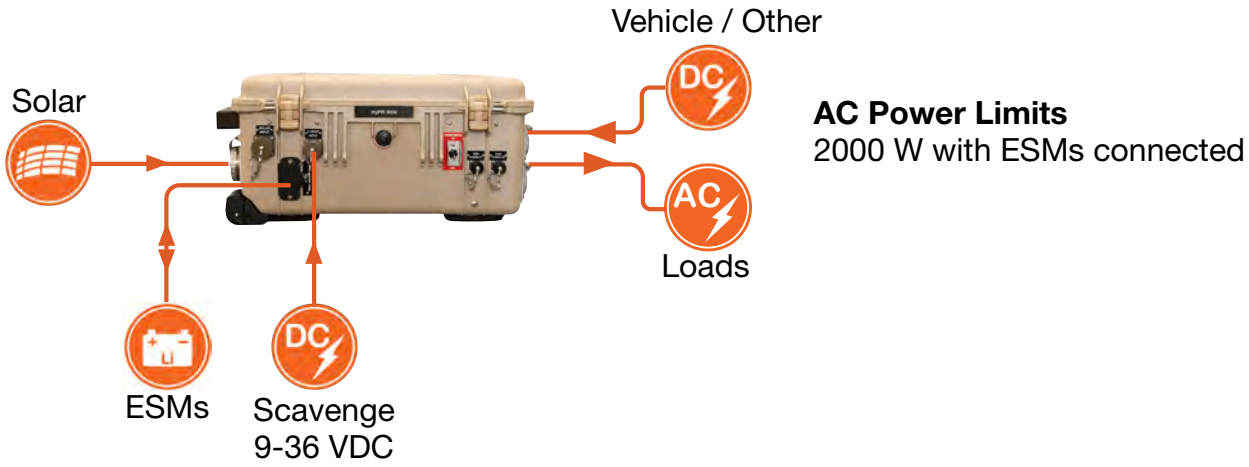


Figure 6. Using HyPR in Inverter Mode

HyPR 3000 Internal Circuits

The HyPR 3000 coordinates the support of 120 VAC and 24 VDC loads using power supplied from AC and/or DC sources. An important concept to understand is that both AC and DC power sources electrify the HyPR 3000 internal DC circuitry (DC bus) shown below as the red lines. This DC bus is also called the Inter-Connect circuit. A schematized illustration of the DC bus and its relationship to other internal components and circuits is shown below. The arrows indicate the flow of current in the circuits.

Several HyPR 3000 connectors shown below provide options to extend the DC bus by connecting another modular Solar Stik component to add functionality. This will become apparent when viewing the System Connection Diagram.

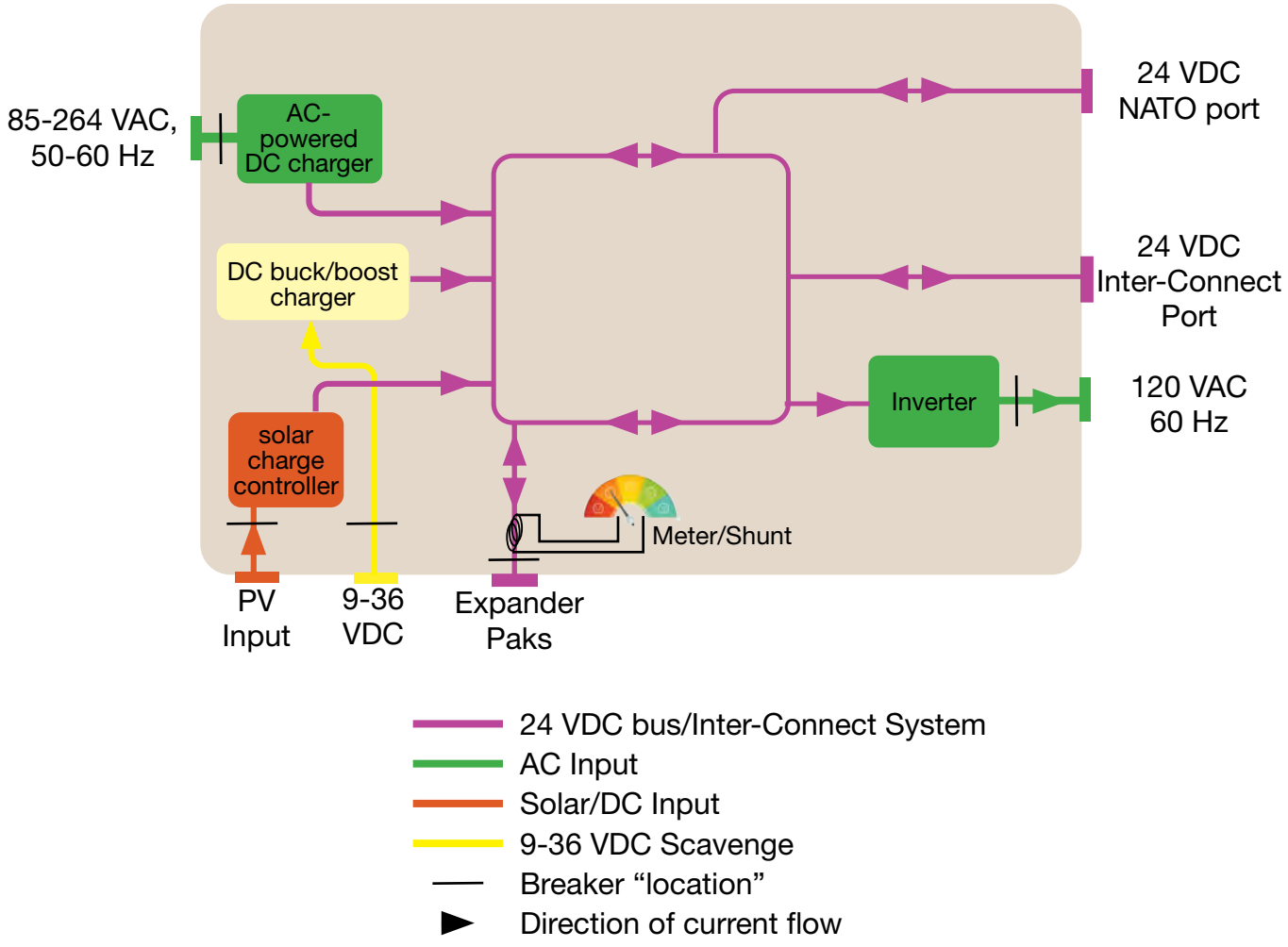


Figure 7. Schematized view of HyPR 3000 internal circuitry

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 Automatic Generator Start/Stop (AGS) function, 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 3000 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.

Energy Storage—The Foundation of a System

Batteries in a Hybrid Power System are designed to "cycle". A full cycle is defined as one complete discharge and recharge over a specific period of time. All batteries have a cycle life and therefore should be considered the "consumable" part of the System. The health of the battery can directly affect the function of the System over time, so proper cycling and cell-health management practices are strongly encouraged.

Minimum Battery Capacity Required for Optimal System Operation

Each 24VDC Li Expander Pak 1300 has a built-in 25 A circuit breaker that will trip at a value ***less than*** the maximum rated current that the HyPR 3000 can supply to a load. For this reason, multiple Li Expander Pak 1300s must be connected to a HyPR 3000 for a System to function at its full, rated power.

Connecting an insufficient number of Expander Paks to a HyPR may result in a situation where the batteries are charged or discharged too quickly. Charging / discharging ESMs too quickly may cause the battery temperature to rise to a point that the battery management system (BMS) disconnects the batteries from the whole system.

Scaling Energy Storage Capacity

Plug & Play architecture allows expansion or contraction of battery capacity when conditions warrant.

Use Inter-Connect Cables to create a "bank" of Li ESMs. **Note:** Do not mix battery chemistries in a System battery bank.

If a System needs to be downsized, due either to reductions in the load or simply to reallocate energy storage resources to other locations, then Li ESMs can be removed from service in accordance with reductions in runtime requirements.

Scaling and Modifying a HyPR-based System

When expanding or modifying the architecture, scaling and stacking may be used to provide additional capabilities that may exceed the ability of any one component to handle.

Scaling

- Power generation and energy storage connected to the HyPR 3000 can be modified in accordance with changes in load requirements. Additional generation sources should be selected based on availability of resources, logistics, and the local environment.

- Additional energy storage modules can be of a different form factor but must be of the same chemistry and voltage and have compatible charge and discharge current capabilities.

Stacking

- Capabilities including inverters, advanced power distribution and management modules can be added (or removed).
  Note: Scaling or modifying the System architecture should be done with all components in the System completely inactive and OFF.

Important Safety Information and Instructions

This manual contains important instructions that must be followed during the setup and operation of a the HyPR 3000. Read all instructions and information contained in this manual.

Important information regarding the safe setup and use of the HyPR 3000 is contained in this Manual. DO NOT begin assembly or use of the HyPR 3000 without first reading and understanding this manual.

While the HyPR 3000 designed for indoor/outdoor operation, the DC Interface (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 3000. 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 4210-00-288-7219 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

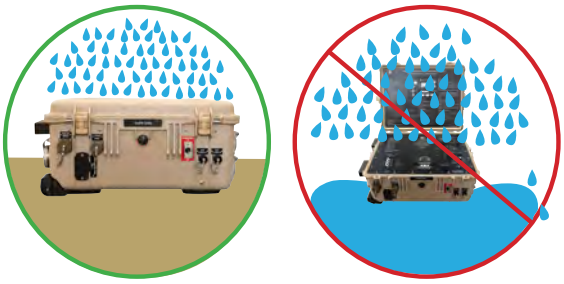
The System is NOT GFCI protected.

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.

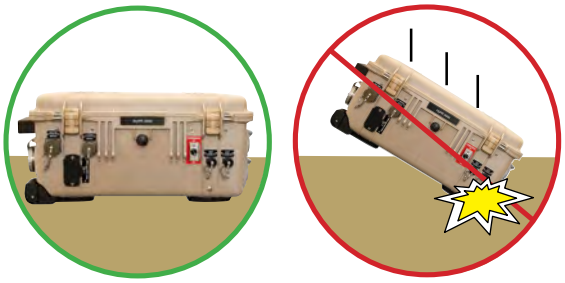
Water

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.



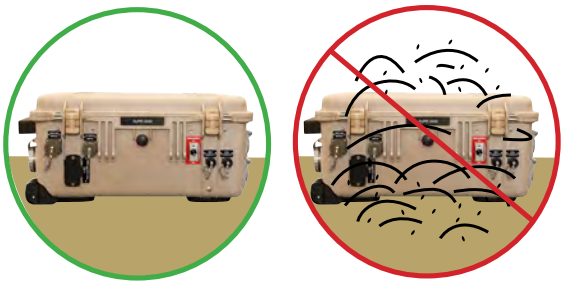
Impact

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



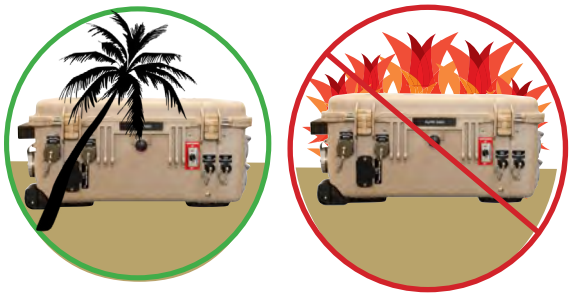
Dust/Foreign Object Intrusion

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.



EQUIPMENT DESCRIPTION

24VDC Li Expander Pak 1300

External Features

- Inter-Connect Port - Point of connection with the system 24 VDC bus, Inter-Connect network
- Stacking Locks- Provide stability and alignment for stacked Expander Paks
- Tech Port - Contact Solar Stik Technical Support for information.

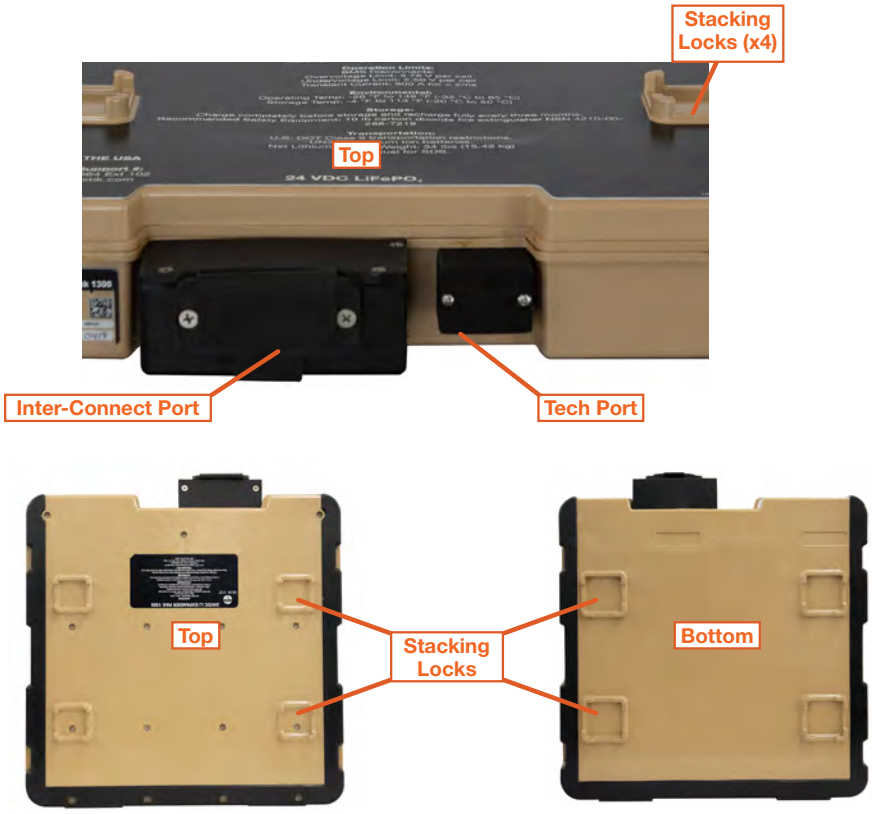


Figure 8. External features of the Expander Pak

24VDC Linear Inter-Connect Cable

Inter-Connect Cables for use with the Li Expander Pak 1300 have two types of plugs: linear and angled. The linear plug connects to the Expander Pak 1300 to facilitate stacking.

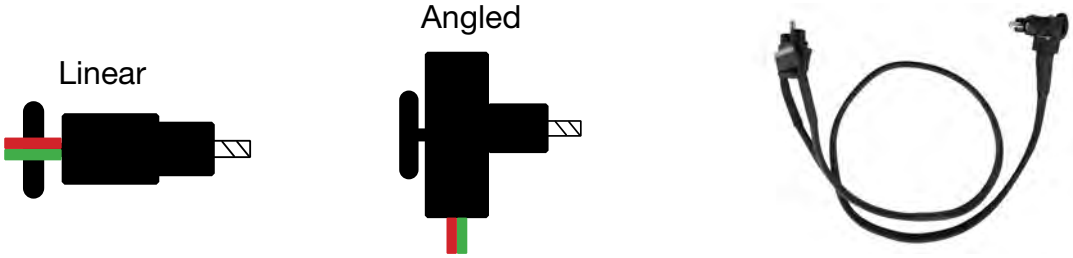


Figure 9. 24VDC Linear Inter-Connect Cable plugs

Data Plate (D-Plate)

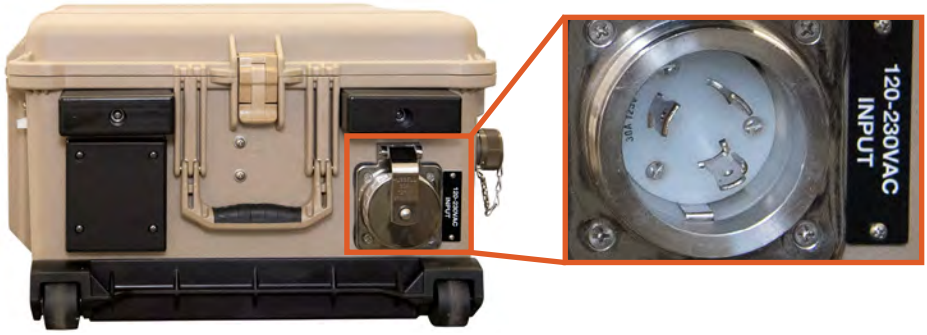
Figure 10. 24VDC Li Expander Pak 1300 D-Plate

24VDC HyPR 3000-120

The HyPR 3000 is a power management component. The MAIN POWER switch is not a “kill all” switch. This switch turns on or off the flow of energy from any ESMs connected to the HyPR.

Figure 11. HyPR 3000 exterior features

AC Power Input Port

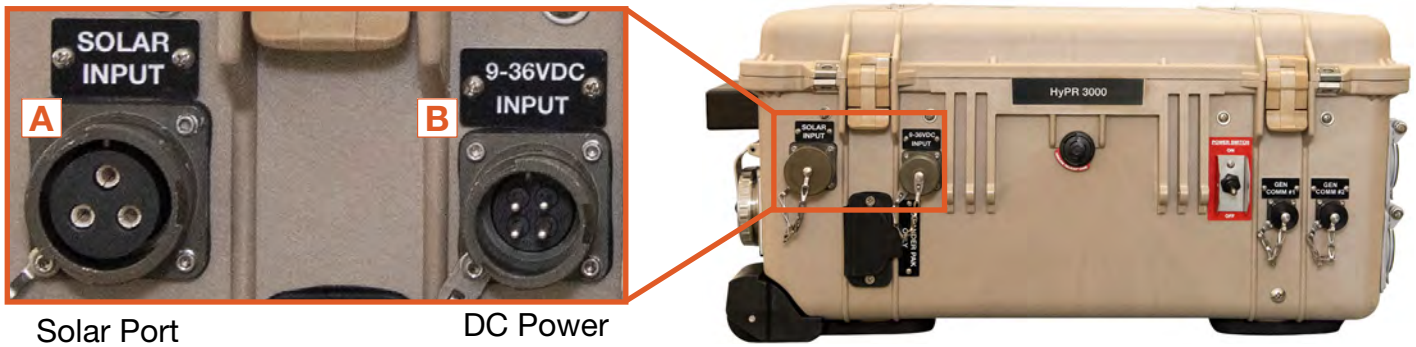


Description	Connector	Voltage	Amps
Input Connection	HBL503SS	85-264 VAC	30

Figure 12. HyPR 3000 Universal AC power input port

DC Power Input Ports - Solar and Scavenge

Each port has a unique function and requires a specific cable.



Solar Port

DC Power Scavenging Port

	Description	Connector	Watts	Amps
A	Solar Input	Cannon Bayonet Receptacle CB2-22-2SC	400 W Max	13.33 A @ 30 VDC 7 A @ 57 VDC
B	DC Power Scavenging Input		720 W Max	20 A Max

Figure 13. HyPR 3000 power input ports

NATO Port - 24 VDC Input/Output Port

Description	Connector	Amps	Voltage
24 VDC NATO Slave (unmetered)	NATO Slave	100	24 VDC

Figure 14. HyPR 3000 NATO port

Inter-Connect 24 VDC Input/Output Port

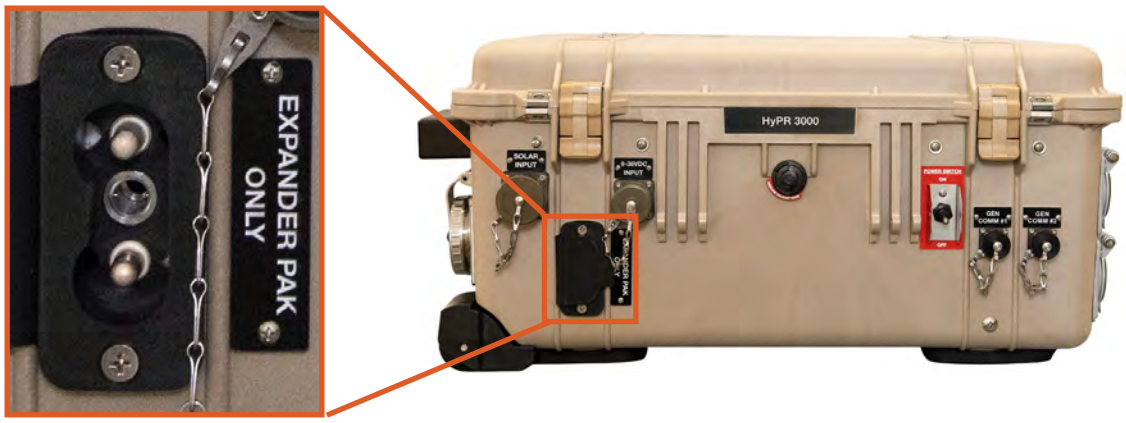
This Inter-Connect port may be used for stacking additional components to expand the capability of a System.

Description	Connector	Voltage	Amps
24 VDC Input or Output	Inter-Connect Port	24 VDC	100

Figure 15. HyPR 3000 24 VDC Inter-Connect input/output port

24VDC Expander Pak Only Port

The HyPR Inter-Connect port is an ESM-dedicated port. This is a metered port.



Description	Connector	Voltage	Amps
Battery Connection (metered port)	Inter-Connect Port	24 VDC	100

Figure 16. HyPR 3000 Expander Pak only port

120 VAC Output Ports

Each120 VAC port is equal. All four are on a single 20 A breaker. The cumulative power drawn from these ports should not exceed 2000 W continuous.

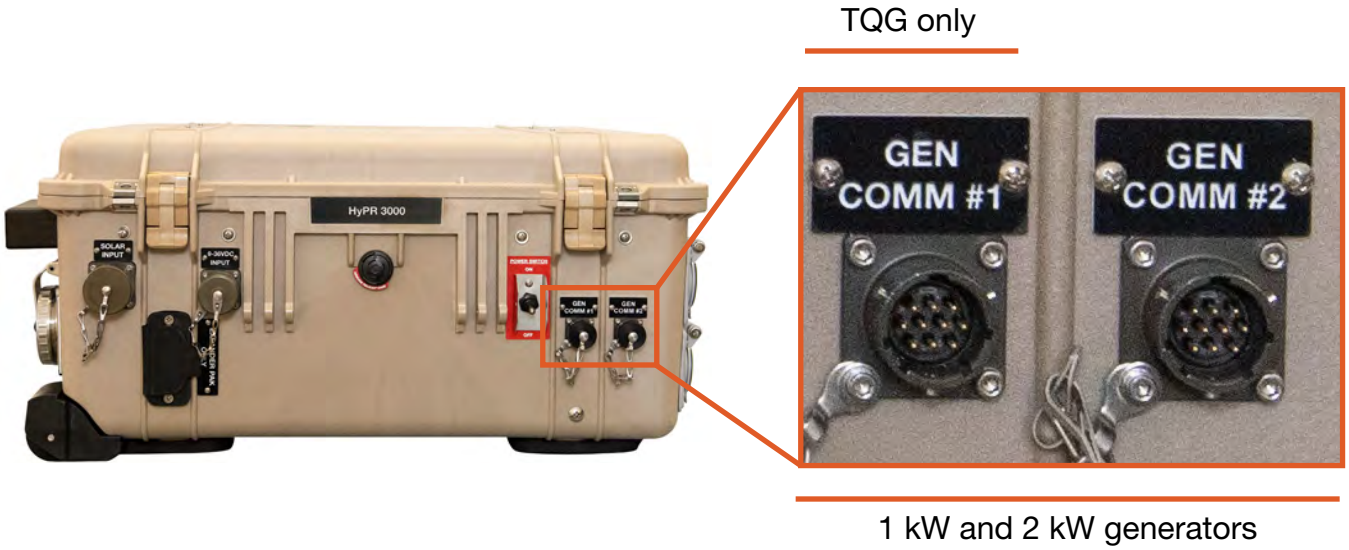
Description	Connector	Voltage	Amps
120 VAC Output (x4)	NEMA L5-15	120 VAC	20

Figure 17. HyPR 3000 120 VAC output ports

Generator Communications Ports

These connectors provide a communication link between the HyPR and auto start/stop-capable generators.

- GEN COMM #1 and GEN COMM #2 communicate with 1 kW and 2 kW generators
- GEN COMM #1 communicates with TQGs.



Description	Connector	Voltage	Amps
Gen Comm Ports	Amphenol HA100001-02-36	-	-

Figure 18. HyPR 3000 generator communications ports

Cooling Vents

The intake and exhaust vents have fans to move air through the case for cooling. **Note:** the exhaust vent may become hot to the touch during operation.

Figure 19. HyPR 3000 cooling vents

Faceplate

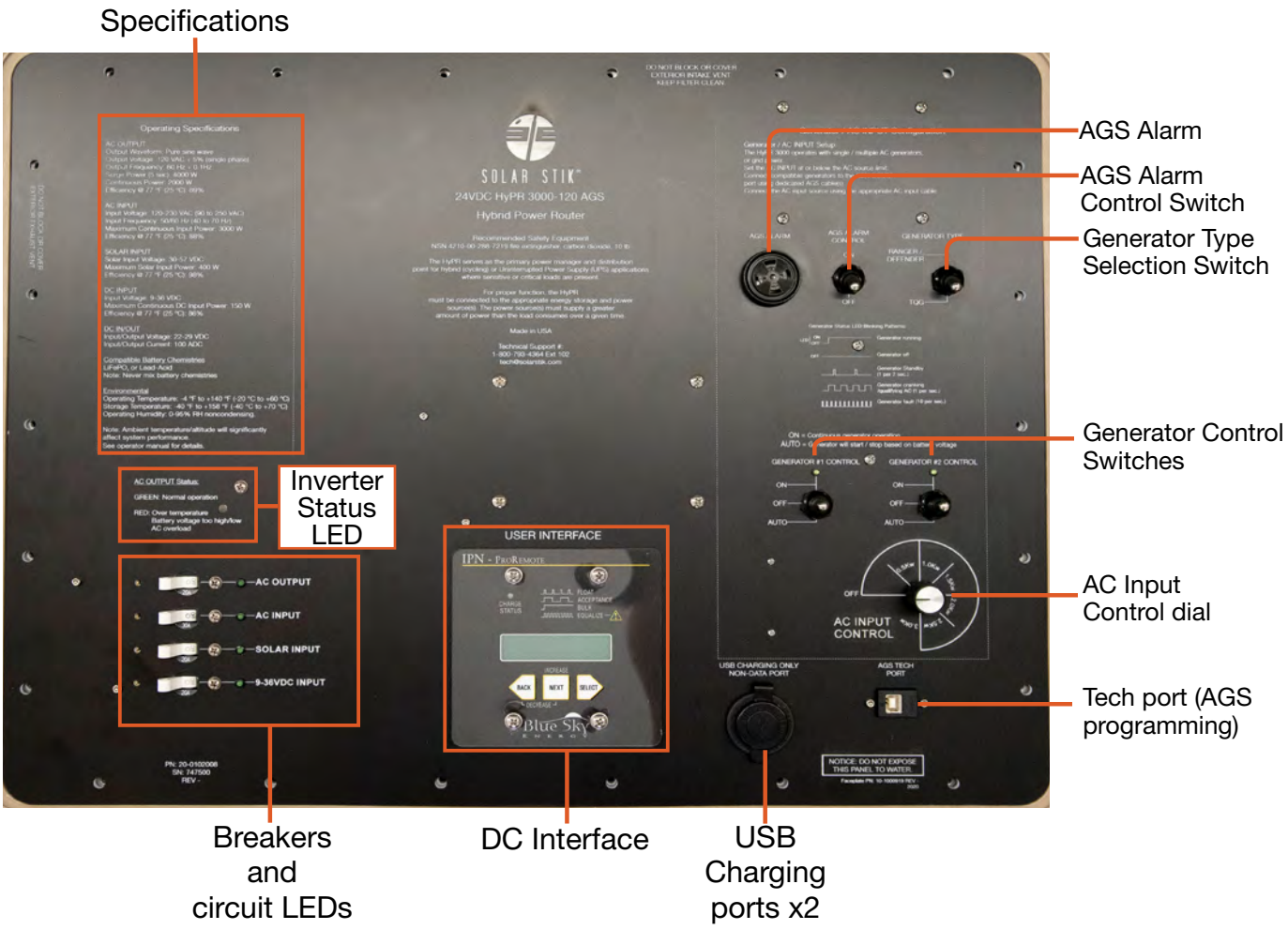


Figure 20. 24 VDC HyPR 3000 Faceplate

DC INTERFACE – When operated with a battery, the HyPR 3000 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), 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

GENERATOR TYPE selection switch – Choose "Ranger/Defender" if the HyPR is connected to Novatio 1 kW or 2 kW gensets. Choose "TQG" if connected to auto start/stop-equipped gensets (i.e., MEP-802A or MEP-831A).

GENERATOR CONTROL switches – The "ON" position manually turns on a generator; the "Auto" position automatically starts and stops the connected generator based on programmed battery voltage values. The "Off" position defeats the HyPR AGS communication with any connected genset.

Generator Status LEDs – Each displays the current status of a connected generator. A legend correlating the blinking pattern with a status is immediately above the LEDs.

AC INPUT CONTROL dial – Allows selection of AC input current limit. This must be adjusted to match the maximum recommended current output limit of the AC power source. Recommended settings are found on HyPR 3000 I-Plate.

AC OUTPUT Status LED – Green indicates the HyPR inverter is operating normally and AC power is available from the 120 VAC output ports. A red LED indicates an inverter fault.

AGS ALARM CONTROL Switch – The audible alarm indicates a connected generator is in the process of starting. This alarm may be defeated (toggle switch) when silent operation is required.

USB CHARGING Ports – The USB ports are for charging only; no data are transmitted via these ports.

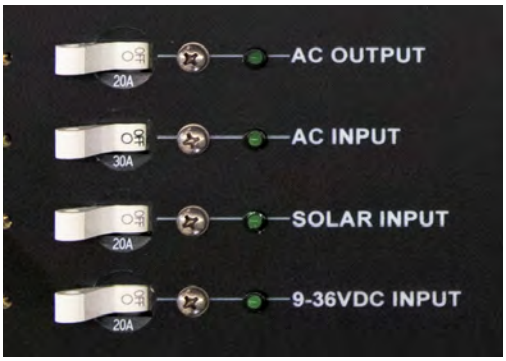
Breakers/Switches – The breakers serve as switches to activate circuits and to deactivate circuits not in use. Circuit breakers protect against overcurrent conditions in dedicated circuits. If too much amperage flows due to short-circuit, inadequate or improper loading, or component failure, these will 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.

AGS TECH PORT – This port is used to program the Auto Generator Start/Stop module and to update firmware if/when necessary. Please contact Solar Stik Technical Support for further information.

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

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

HyPR 3000 Breaker Panel



- **AC OUTPUT 20 A** – Limits flow of power from the HyPR inverter to the four (4) AC output receptacles.
- **AC INPUT 30 A** – Limits flow of power from AC power source to HyPR.
- **SOLAR INPUT 20 A** – Limits flow of power from solar array(s) to HyPR.
- **9-36 VDC INPUT 20 A** – Limits flow of power from "scavenge" sources to the HyPR .

Figure 21. HyPR 3000 breaker panel

Systems can be configured in many ways. Understanding the function of each breaker is critical to proper System operation. The switches that should be on or off depend on the circuits to be used. It is critical to understand each of these circuits and what happens when they are active. Circuit breaker panel is only for IN/OUT circuit limit protections. These are not function controls or protections.

HyPR 3000 Inverter Status

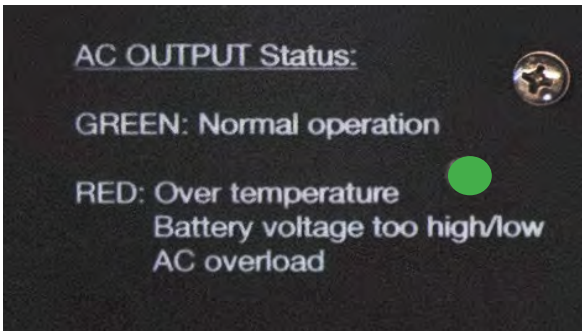


Figure 22. HyPR Inverter/AC OUTPUT status LED

The LED on the Faceplate under AC OUTPUT Status is green when the HyPR inverter is operating normally. A red LED indicates the inverter is in fault mode. The problem causing the fault must be corrected before the inverter operation can return to normal.

Possible issues leading to inverter fault include loads exceeding the maximum power output of the inverter or overdischarged Expander Paks.

HyPR 3000 AC Input Setting

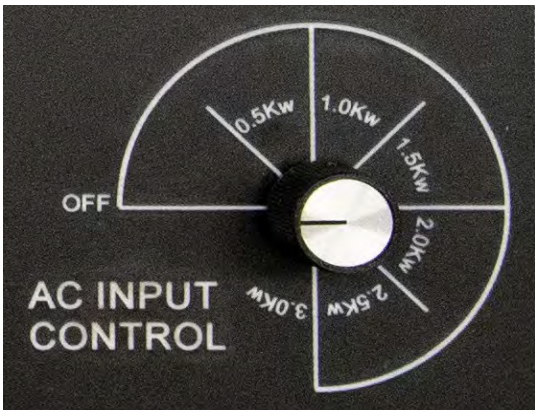


Figure 23. AC Input Control dial

Adjust this dial 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.

Programmed System Operating Parameters

Several operating parameters are programmed at Solar Stik for a specific application. The values do not need to be changed when the HyPR is used as configured in this Manual. The values may be changed if a new configuration is required (e..g., using lead acid batteries instead of $LiFePO_4$). Contact Solar Stik Technical Support for further information.

Automatic Generator Start/Stop (AGS) voltages

The HyPR AGS module is programmed to start and stop the generator(s) at voltages that allow the Expander Paks to charge and discharge over a safe and efficient voltage range.

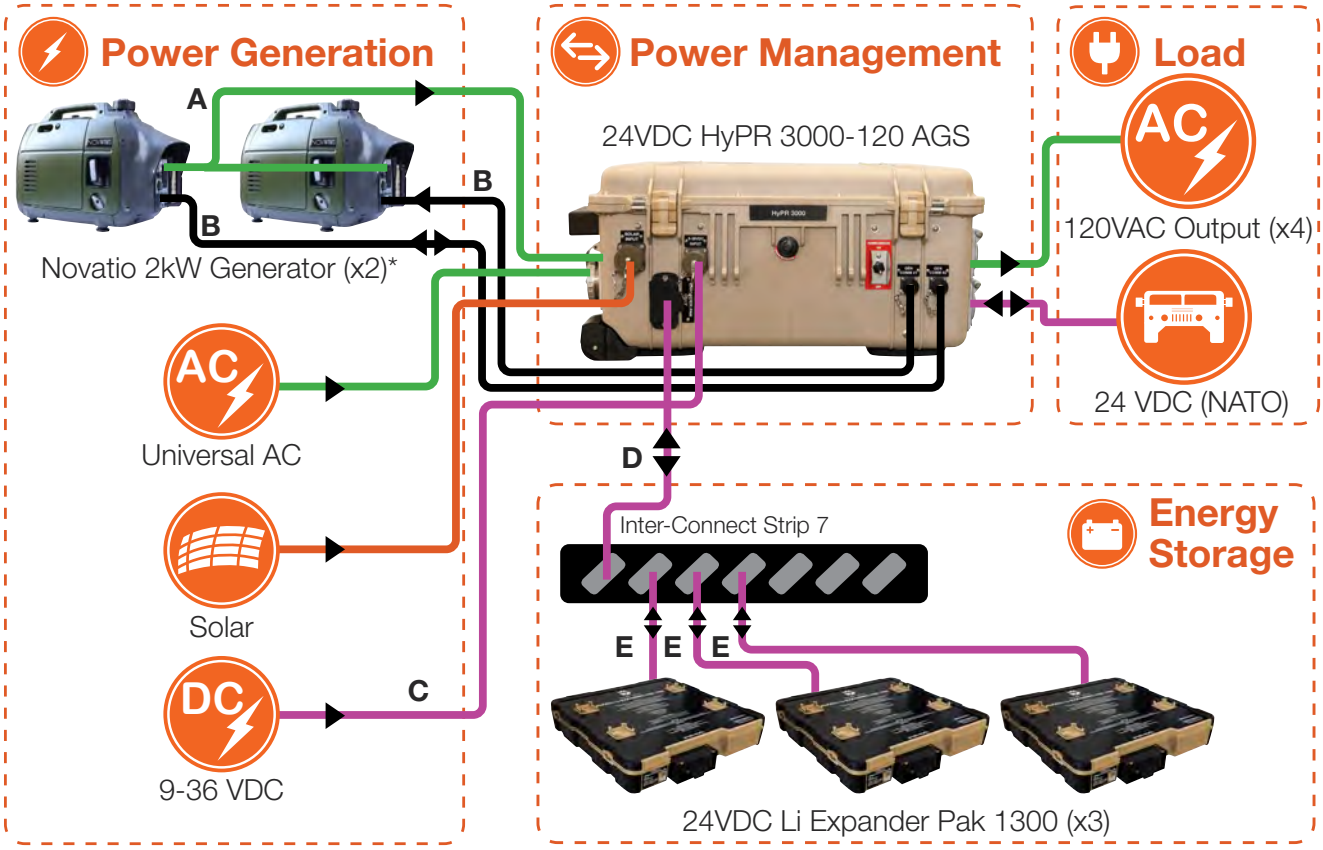
- Generator start = 25.5 VDC
- Generator stop = 29.0 VDC

Battery low-voltage cut off (LVCO)

The HyPR inverter is programmed, via the DC Interface AUX circuit, to cease AC load support before the System battery voltage drops to a critical, overdischarged level.

- The HyPR will discontinue the support of AC loads when System battery voltage drops to 25.0 VDC.
- The HyPR will resume support of AC loads when System battery voltage is charged up to 26.0 VDC.

System Connection Diagram and Inventory



Cable	Item #	Nomenclature	QTY Per System
N/A	20-0102008	24VDC HyPR 3000-120 AGS	1
N/A	21-0202316	24VDC Li EXPANDER PAK 1300	3
N/A	13-1000160	24VDC INTERCONNECT STRIP 7	1
A	13-1000293	CABLE, POWER Y, BANANA-M/L5-30P, 120VAC, 10', 10AWG	1
B	13-1000288	CABLE, GEN COMM, 10-PIN/12-PIN,10', 18AWG	2
C	13-1000334	CABLE, POWER, WHIP, CB6TA18-10SC, 24VDC, 25', 12AWG	1
D	13-0000032	CABLE, POWER, INTER-CONNECT, 24VDC, 5', 2AWG	1
E	13-1000267	CABLE, POWER, INTERCONNECT, 24VDC, 5', 4AWG, LINEAR	3

**Novatio generators and extended run fuel tanks delivered separately.*

Components listing

24VDC HyPR 3000-120 AGS
Item # 20-0102008

24VDC Li Expander Pak 1300
Item # 21-0202316

24VDC Inter-Connect Strip 7
Item # 13-1000160

Cable, Power Y, Banana-M/L5-30P, 120VAC, 10', 10AWG
Item # 13-1000293

Cable, Gen Comm, 10-PIN/12-PIN,10', 18AWG
Item # 13-1000288

Cable, Power, Whip, CB6TA18-10SC, 24VDC, 25', 12AWG
Item # 13-1000334

Cable, Power, Inter-Connect, 24VDC, 5', 4AWG, Linear
Item # 13-1000267

Cable, Power, Inter-Connect, 24VDC, 5', 2AWG
Item # 13-0000032

Information Plate

The Information Plate (I-Plate) provides concise, abbreviated information for setting up and running a System. All system components should be connected as shown in the diagram on the I-Plate. The diagram illustrates component connections but not the actual physical arrangement of the components for a specific application.

SOLAR STIK®

24VDC Hybrid Power Router (HyPR) 3000-120 AGS

Configuration, Operation, and Safety Information

System Setup

Configure System as shown in System Setup Diagram.

Ensure location of the equipment is in accordance with safety and operation protocols of Security Force Assistance Brigade (SFAB) Operations.

Connecting Loads

1. Connect AC loads to the HyPR 120 VAC OUTPUT ports. The combined output of the four (4) ports should not exceed 2000 W continuous.
2. Connect 24 VDC loads to the NATO or 24VDC IN/OUT ports.

System Operation

1. Activate the Hybrid Power System.
   a. Turn on HyPR POWER switch.
   b. Set AC INPUT CONTROL to match output limit of generator(s) (see table below).
   c. Turn ON AC INPUT switch.

2. Initiate System calibration and cycling with generator(s).
   a. Rotate generator power switch(es) to ON.
   b. Rotate vent on generator fuel cap(s) clockwise to ON.
   c. Toggle GENERATOR TYPE switch to RANGER/DEFENDER.
   d. Toggle GENERATOR CONTROL switch(es) to ON position.
      i. **Note:** Generators will start and stop before running continuously, as part of their warm-up process. Once generators are both running continuously for five minutes, proceed to next step.
   f. Toggle GENERATOR CONTROL switch(es) to AUTO.
      i. **Note:** Toggle switch(es) from ON to AUTO rapidly.
   g. Allow generator(s) to run/charge Expander Paks (ESMs) until generator stops automatically.
      i. **Note:** Charge function begins only after generator is at operating temperature. This may require several minutes of operation.
      ii. **Note:** Generator operation will stop once ESMs achieve full-charge voltage (~29.0 VDC).
   h. Automatic cycling begins: Loads are supported by ESMs until voltage reaches 25.5 VDC. Generator(s) will automatically start to recharge ESMs.

To Use with Grid AC

a. Connect AC power source to 120-230 VAC INPUT port.
b. Set AC INPUT CONTROL to match AC power source maximum limit.
c. Turn on MAIN POWER switch.
d. Turn on AC INPUT switch. LED will illuminate, confirming AC power input.
e. Confirm charging operation begins within 5 minutes.

AC Input Control Settings

The table provides recommended settings for four (4) potential generator configurations. Settings maximize ESM charging while protecting the generator from faulting due to overloading.

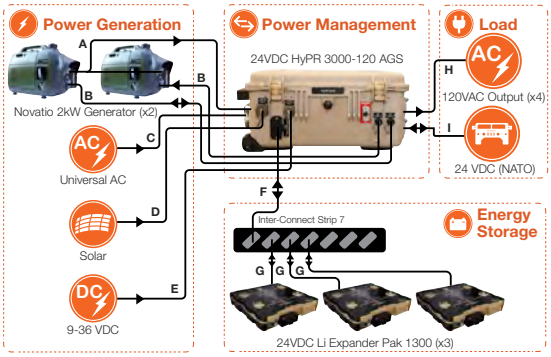
Generator Name	Generator Configuration	AC Input Control Setting (kW)
Ranger	1 x 1 kW	~900
	2 x 1 kW	~1800
Defender	1 x 2 kW	~1500
	2 x 2 kW	~3000

DC Power Scavenging

a. Connect DC power sources (9-36 VDC) to the 9-36 VDC INPUT port using DC power cable (PN: 13-1000334).
b. Turn on the 9-36 VDC switch.

System Deactivation

a. Charge ESMs to 100%.
b. Power down all System components.
c. Disconnect System components and store/transport appropriately.



System Setup Diagram

Cable Legend			
Cable	**Item #**	**Cable Name**	**QTY**
A	13-1000293	CABLE, POWER Y, BANANA-M/L5-30P, 120VAC, 10', 10AWG	1
B	13-1000288	CABLE, GEN COMM, 10-PIN/12-PIN,10', 18AWG	2
C	N/A	Universal AC Input	0
D	N/A	Solar Input	0
E	13-1000334	CABLE, POWER, WHIP, CB6TA18-10SC, 24VDC, 25', 12AWG	1
F	13-0000032	CABLE, POWER, INTER-CONNECT, 24VDC, 5', 2AWG	1
G	13-1000267	CABLE, POWER, INTER-CONNECT, 24VDC, 5', 4AWG, LINEAR	3
H	N/A	120 VAC Output	0
I	N/A	24VDC NATO Input/Output	0

⚠ CAUTION

Shock Hazard

Do not operate with lids open in wet environments.
Keep cables and other equipment out of standing water.

NOTICE

- DO NOT STORE ESM IN A DISCHARGED STATE! Always recharge batteries completely before storage or transport. Regular maintenance charging is critical.
- Failure to connect system architecture in accordance with the System Setup Diagram will result in poor system performance and inaccurate metering of power flow.
- ESMs with a **MINIMUM cumulative current of 100 ADC** must be connected to the System for the HyPR to function at its rated output power.

- Do not use the HyPR in conjunction with a modified sine wave AC input source
- The HyPR can be programmed for use with lithium or lead-acid batteries. **DO NOT mix battery chemistries in a System.**
- High internal temperatures reduce HyPR power output.
- **SHADE** all ESMs and Power Management components from direct sunlight to reduce heat when possible.
- Clean or replace air intake filters frequently for optimal performance. Store spare vent filters behind I-Plate.

Mode of Operation

Hybrid Mode
Loads are supported by ESMs. The HyPR automatically starts/stops the generator(s) based on ESM voltage and continuously cycles the ESMs.

UPS Mode
Loads are supported by ESMs when AC power source (grid or generator) fails. This process is instantaneous with no transfer time. See Battery-only Runtime table below.

DC Power Scavenging Mode
DC power can be scavenged from sources ranging from 9-36 VDC (vehicles, batteries, etc.). Scavenged DC power within this voltage range is converted to 29.0 VDC to charge ESMs or support loads.

HyPR-only Mode
The HyPR will condition and pass power through to loads without ESMs connected. The power into the HyPR must be greater than the connected loads for proper function.

Battery-only Runtime at Continuous Loads*					
Load Watts	**100 W**	**200 W**	**300 W**	**400 W**	**500 W**
Runtime	39 hrs	19.5 hrs	13 hrs	9.75 hrs	7.8 hrs

*Values reflect a System with three (3) 24VDC Li Expander Pak 1300s at 100% SOC.

Troubleshooting
(See System manual for additional information.)

Symptom: No power with ESMs connected
Cause: ESMs overdischarged and in "protect" mode
Solution: Connect AC or DC power source to HyPR to charge ESMs. Once ESMs detect charging voltage, they will return to service.

Symptom: Generator fails to start
Cause: Fuel issues; vent cap closed; generator power switch off; generator starter battery overdischarged
Solution: Once generator issues have been identified and resolved, a 15-minute manual generator run cycle (with no load) is recommended. See manual.

Symptom: Generator runs continuously (no cycling)
Cause: AC INPUT CONTROL setting too low or; GENERATOR CONTROL in ON position.
Solution: Increase AC INPUT CONTROL setting; toggle GENERATOR CONTROL to AUTO.

Symptom: Generator overloads and shuts down
Cause: AC INPUT CONTROL setting too high
Solution: Decrease AC INPUT CONTROL setting.

Symptom: AC output turns off
Cause: Generator failed to start; load exceeds inverter output; low-voltage disconnect; inverter overheated
Solution: Inspect generator, loads, and settings; allow inverter to cool down.

Preventive Maintenance Checks and Service (PMCS)
Monthly
- Inspect case for visible damage and missing items.
- Clean excessive dust or dirt accumulation from the exterior, interior, and connectors.
- Close all unused port covers.
- Remove the air intake vent covers to expose filter material.
- Clean or replace the filter.

I-PLATE PN: 10-1000935 REV –

Figure 24. HyPR 3000 I-Plate

OPERATOR INSTRUCTIONS

1. Identify Location for System Components

Component Shading

High temperatures result in derating, or diminished capacity and efficiency, of the components. The easiest way to effectively reduce heat buildup is to shade the components as much as possible.

Figure 25. Minimize solar loading

Minimize Potential for Water and Dust Intrusion

ALL Solar Stik equipment is designed for operation in adverse conditions; however, certain rules apply:

- If operating in wet environments, use common-sense placement to avoid water intrusion from flooding or precipitation.
- If operating in dusty environments, ensure good airflow by keeping air filters clean and placing unit in a location that minimizes exposure to particulates.

Solar Stik strongly encourages keeping power management or energy storage component off the ground. If no other placement options are available, preventive measures for water and dust intrusion should be taken. Consult the Maintenance section of this manual for additional details and component-specific Preventive Maintenance Checks and Service (PMCS).

2. Connect System Components

The connection diagram on the HyPR I-Plate illustrates the connections necessary to properly assemble the System.

Connect Li Expander Pak 1300s to HyPR 3000.

a. Connect the Inter-Connect Cable linear-plug to the Expander Pak. The plug and socket are polarized and can be connected only in the proper orientation.

b. After inserting the plug into the socket (B), twist the dial to lock the connection.

Note: The red wire cover denotes the positive (+) terminal, and green (or black) denotes the negative (-) terminal.

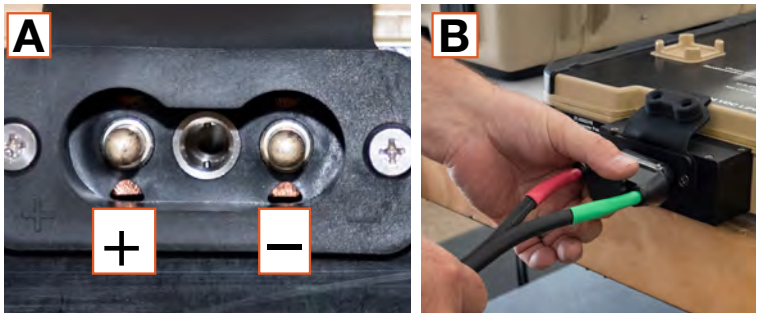


Figure 27. Connecting Inter-Connect Cable to Expander Pak

c. Connect the other end of the “Linear” 5’ Inter-Connect Cable to the Inter-Connect Strip.

d. Use “Standard” 5’ Inter-Connect cables to connect the Inter-Connect Strip to the HyPR 3000 EXPANDER PAK ONLY port.

Note: At least three (3) Expander Pak 1300s must be connected for the HyPR 3000 to operate at rated capacity.

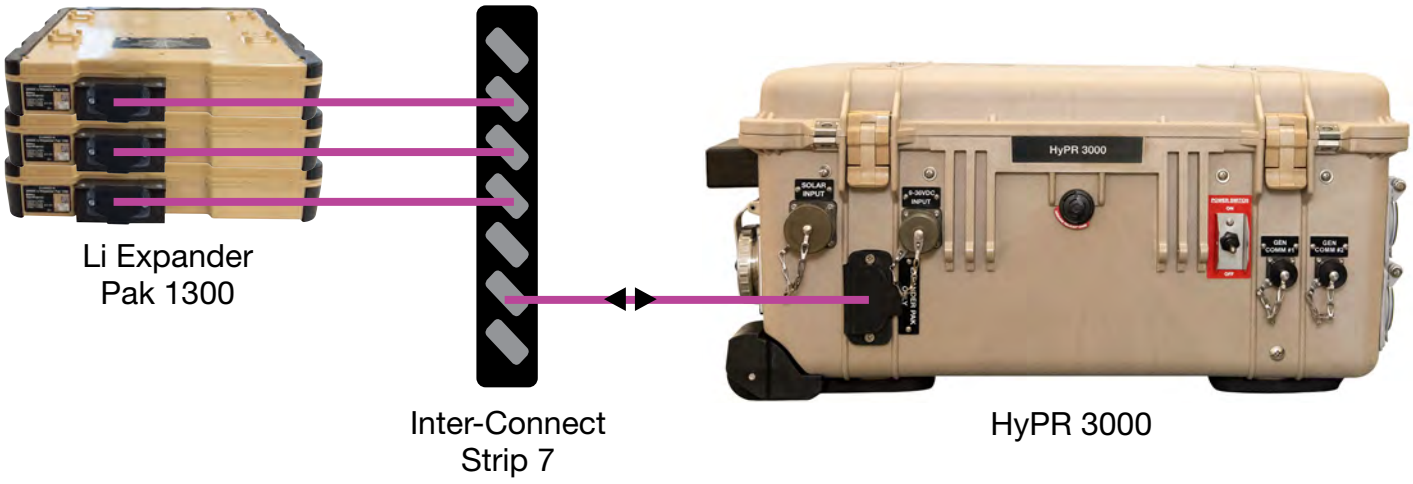


Figure 26. Connecting ESMs to HyPR 3000

Connect HyPR to AC Power Source

The HyPR 3000 accepts universal AC power from generators or the grid to charge Expander Paks. Regardless of the AC power source, the HyPR provides clean, 120 VAC, 60 Hz power to support AC loads, i.e., “power conditioning”.

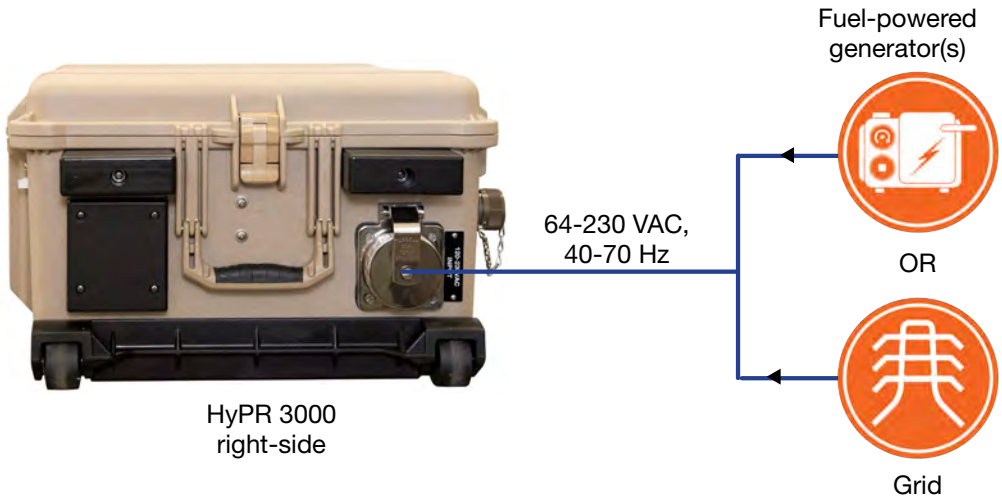


Figure 28. HyPR to AC power input options

Connect HyPR to grid power

The HyPR may be connected to AC grid power at voltages ranging from 120-230 VAC and 40-70 Hz. The cable necessary to connect to grid power is a custom cable and not described in the System inventory.

Connecting Generators

Connect HyPR 3000 to tandem 2 kW generators

a. Connect the AC Power “Y” Cable to the back of each 2 kW generator as shown in (A, B).

b. Connect the twist lock connector to the 85-264 VAC INPUT port on the left side of the HyPR 3000 (C).

The power output from the generators is merged into a single “Y” cable connected to the 120 - 230 VAC INPUT port on the left side of the HyPR.

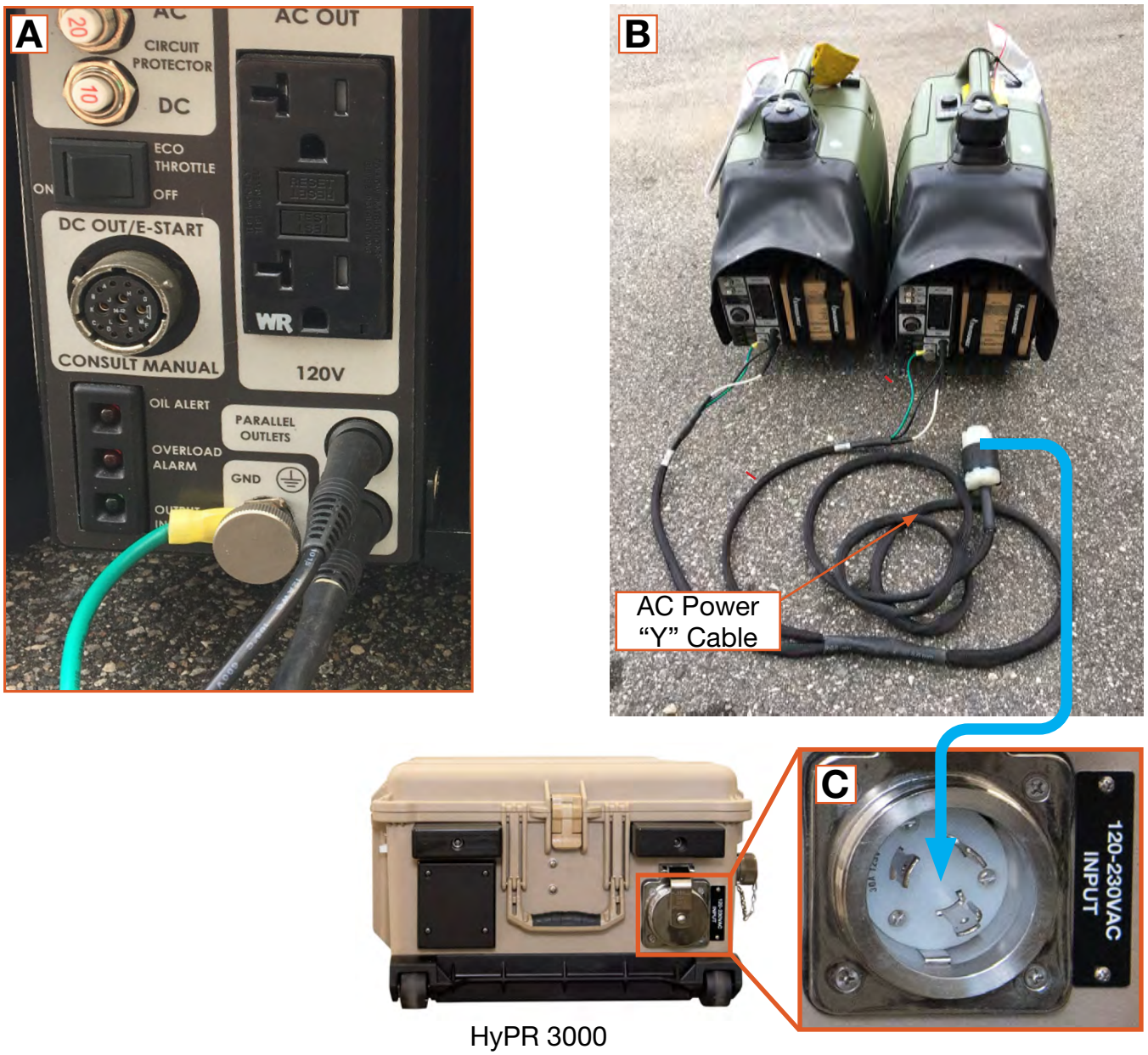


Figure 29. HyPR/generator power connections

c. Connect GEN COMM ports #1 and #2 on the front of the HyPR to the E-START ports on the generators using the 10’ Gen Comm Cable.

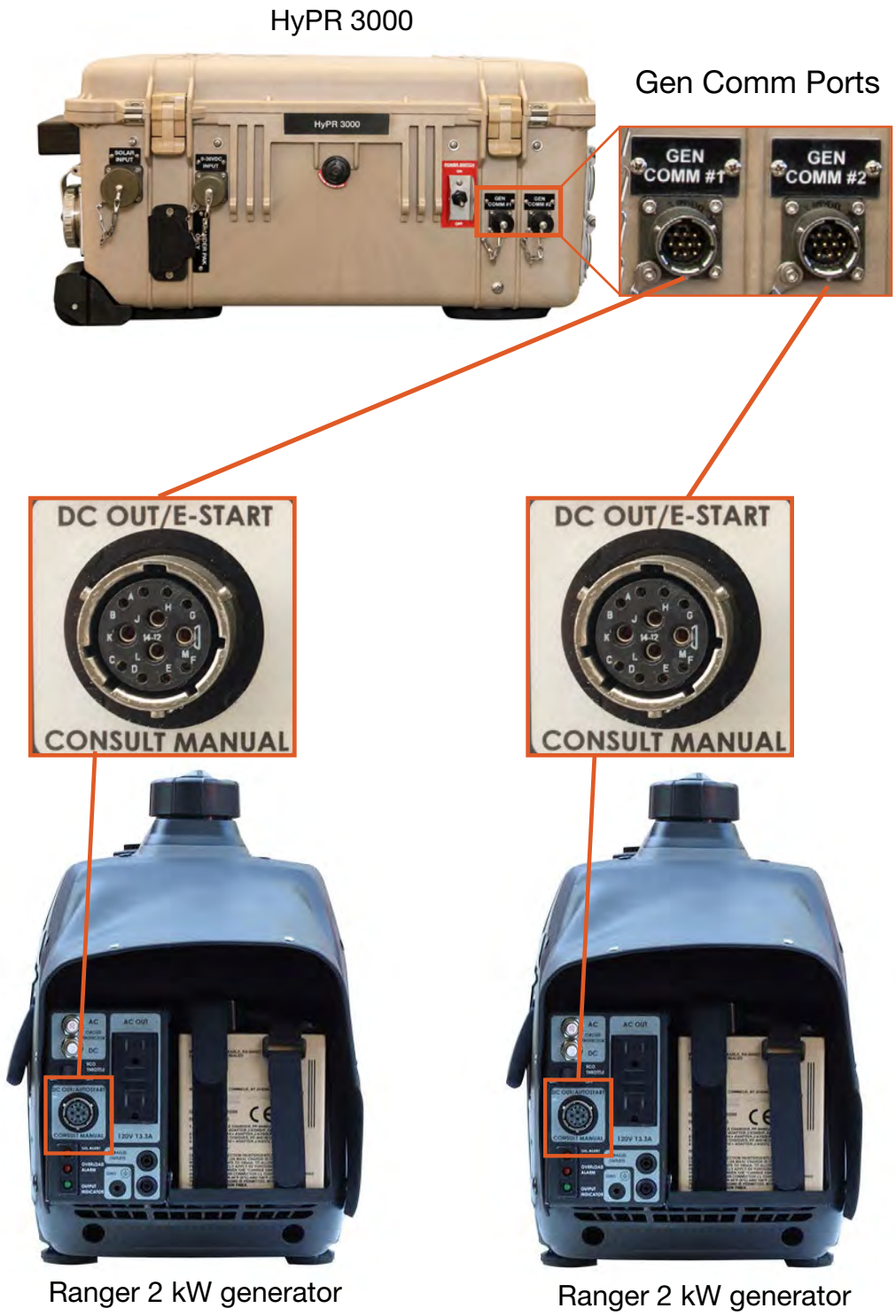


Figure 30. HyPR/generator comms connections

Optional: Connecting HyPR 3000 to a 3 kW TQG

The HyPR 3000 can remotely start/stop TQGs that have been modified with a Solar Stik Remote-start Enabling Kit (RsEK).

Note: Connect the TQG to GEN COMM #1 port. GEN COMM #2 port does not support auto start/stop of a TQG.

Figure 31. Optional connection of 3 kW TQG to HyPR 3000

Connect AC Loads to HyPR 3000

Connect AC loads to one (1) or more of the four (4) 120 VAC, 20 A receptacles. Loads connected to all of these ports should not exceed 2000 W continuous.

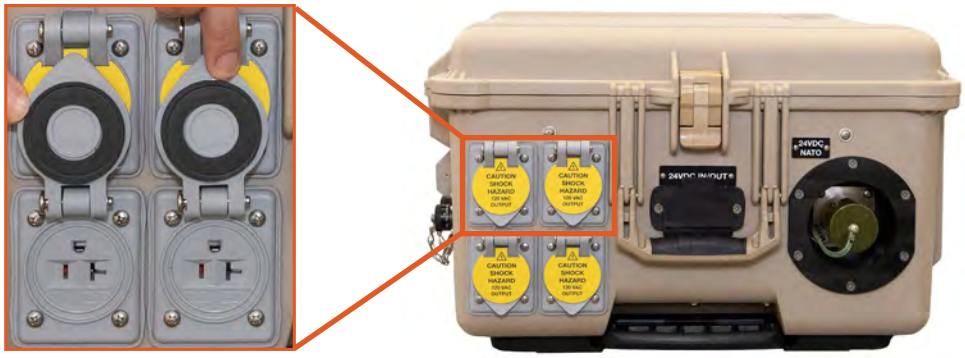


Figure 32. Connecting AC loads to HyPR 3000

Prepare 2 kW generator(s) for operation

a. Ensure generator has adequate JP-8 fuel.
b. Rotate generator power switch counterclockwise to ON position.
c. Rotate fuel tank vent valve to OPEN position.

Figure 33. Prepping the 2 kW generator for operation

Optional: Connect Solar power to HyPR 3000

Connect solar array(s) to the HyPR 3000 to charge Expander Paks and/or support loads. Specifications for the solar charge controller and compatible PV arrays are on the HyPR 3000 Faceplate. Solar arrays provided by Solar Stik will be paired with the appropriate solar cable.

Note: Solar arrays must be connected for the DC Interface to calculate and report ESM state of charge. Disconnect arrays from HyPR when not in use.

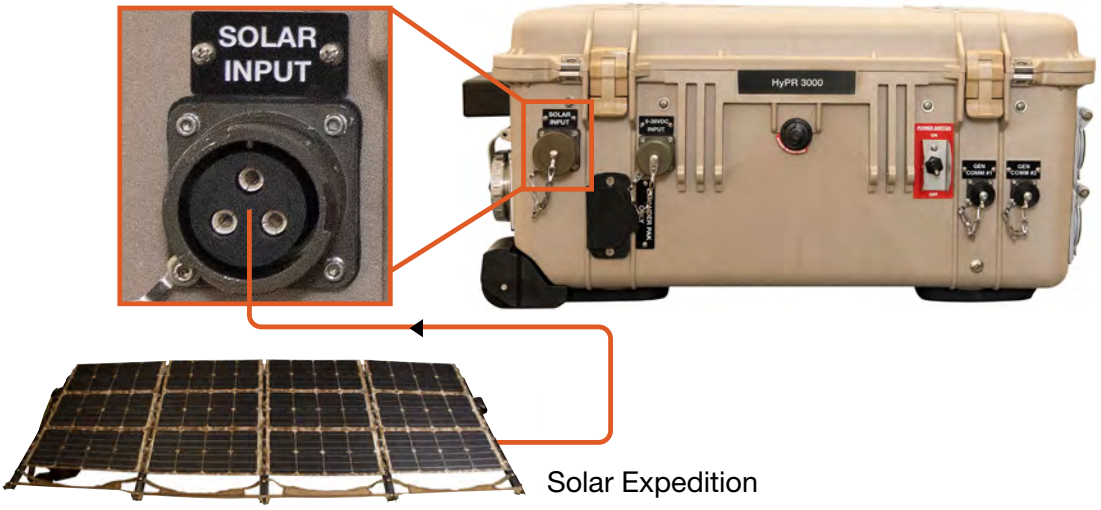
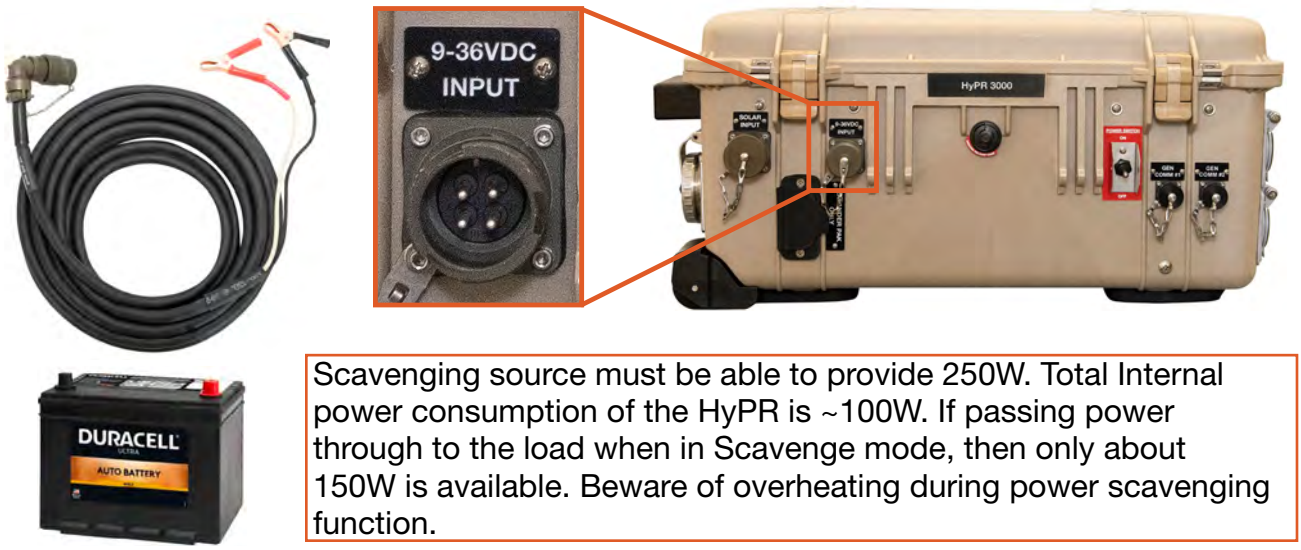


Figure 34. Connecting PV arrays to HyPR 3000

Optional: Scavenge power from nonconventional DC power sources

a. Connect DC power sources (9-36 VDC) to the 9-36 VDC INPUT port using DC power cable (PN: 13-1000334, shown below).
b. Turn on the 9-36 VDC INPUT switch.



Scavenging source must be able to provide 250W. Total Internal power consumption of the HyPR is ~100W. If passing power through to the load when in Scavenge mode, then only about 150W is available. Beware of overheating during power scavenging function.

Figure 35. Scavenge power from alternative DC sources

SYSTEM OPERATION

1. Activate the Hybrid Power System.

a. Toggle HyPR POWER switch to ON.
b. Set HyPR AC INPUT CONTROL to match output limit of generator(s) (see table below).
c. Toggle HyPR AC INPUT switch ON.

2. Initiate System calibration and cycling with generator(s).

a. Rotate generator power switch(es) to ON (Figure 33).
b. Rotate vent on generator fuel cap(s) to ON.
c. Toggle HyPR GENERATOR TYPE switch to RANGER/DEFENDER.
d. Toggle HyPR GENERATOR CONTROL switch(es) to ON.

Note: Generators will start and stop before running continuously, as part of their warm up process. Once generators are both running continuously for five minutes, proceed to next step.

f. Rapidly toggle GENERATOR CONTROL switch(es) to AUTO.
g. Allow generator(s) to run/charge Expander Paks (ESMs) until generator stops automatically.

Note: Charge function begins only after generator is at operating temperature. This may require several minutes of operation.

Note: Generator operation will stop once ESMs achieve full-charge voltage (~29.0 VDC).

h. Automatic cycling begins: Loads are supported by ESMs until voltage reaches 25.0 VDC. Generator(s) will automatically start to recharge ESMs.
i. Toggle HyPR AC OUTPUT breaker to ON to provide power to AC loads.

To Use with Grid AC

1. Connect AC power source to HyPR 85-264 VAC INPUT port.
2. Set HyPR AC INPUT CONTROL to match AC power source maximum limit.
3. Toggle HyPR MAIN POWER switch to ON.
4. Toggle HyPR AC INPUT switch to ON. LED will illuminate, confirming AC power input.
5. Confirm charging operation begins within 5 minutes.

AC Input Control Settings

The table provides recommended settings for four (4) potential generator configurations. Settings maximize ESM charging while protecting the generator from faulting due to overloading.

Generator Name	Generator Configuration	AC Input Control Setting (kW)
Ranger	1 x 1 kW	~900
	2 x 1 kW	~1800
Defender	1 x 2 kW	~1500
	2 x 2 kW	~3000

System Monitoring

The DC Interface consists of an LED that reports **solar charging status** (see Table 1 for a functional description), an LCD screen and three (3) menu navigation buttons. **This LED does not report charging by the internal, AC-powered battery charger.**

Battery voltage and System 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.

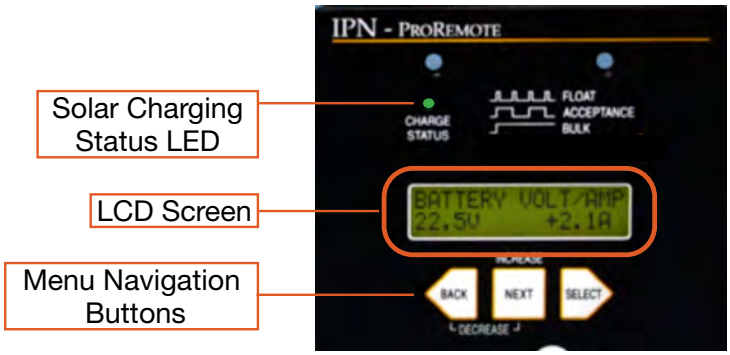


Figure 36. HyPR 3000 DC Interface

Note: the HyPR 3000 must be connected to an active solar array to access the full functionality of the settings and readouts in the DC Interface menus.

Without solar input, use the home screen to monitor battery voltage and net System current.

Note: The DC Interface charging status LED reports charging only via solar power input. The LED will not illuminate when the HyPR 3000 is using AC power to charge connected batteries.

The Solar Charging Status LED (with solar arrays connected)

Bulk Charge: During bulk mode, the charge controller can deliver full output to rapidly recharge ESMs to the established acceptance charge voltage. This stage typically takes the battery to about 75% State of Charge (SOC) and at a rate not usually exceeding 25% of the battery's amp hour capacity. This is also known as the "constant current phase".

Acceptance Charge: In this stage, the charge current gradually decreases as the batteries obtain full charge. It is also known as the "constant voltage phase". The Li Expander Pak 1300 does not require an acceptance charge.

Float Charge: This final charging stage compensates for the battery's self-discharge and temperature.

Temperature and Power Output: The HyPR 3000 charge controller charge controller can deliver full output in an ambient temperature of up to 40 °C (104 °F). If an overtemperature condition exists, the charge controller will cycle on/off, reducing average power delivery to within safe limits. During thermal shutdown, the charge status indicator will display an OFF condition.

Table 1. Charge Status Indicator—LED Status

Solar Charging Status LED	Charge Mode
Off	Charge Off
Continuously On	Bulk
Blinking – 1 second On / 1 second Off	Acceptance
Blinking – 0.2 second On / 1 second Off	Float

State of Charge (SOC) Calculation

The HyPR 3000 DC Interface home screen reports System/DC bus voltage and net current when connected to ESMs. The net current is the sum current of all charging sources minus the current drawn by the load. If more power is drawn from the System than is supplied by all power sources, this value will be negative.

The HyPR 3000 calculates and reports battery bank SOC only after they are charged to float voltage (~29.0 VDC) with solar power. The HyPR will not report an SOC if Expander Paks are not charged to float with solar power. After the SOC is determined, the DC Interface will monitor and adjust the SOC value as power flows in and out of the ESMs.

Each time the HyPR is cycled, the DC Interface is reset and it must re-learn the SOC it reports..

Note: the total amp-hour (Ah) capacity of the bank of Expander Paks must be programmed into the DC Interface for the HyPR 3000 to accurately calculate battery bank SOC. Each Expander Pak 1300 has 54 Ah capacity. To determine total amp-hours, multiply the 54 Ah capacity by the number of Expander Paks in the battery bank of the System.

Generator Status

The LED above each HyPR GENERATOR CONTROL Switch on the Faceplate blinks slowly when functioning in Auto mode, more rapidly when in manual On mode, and very rapidly when there is a generator fault. The LED does not blink when the switch is in the Off position. The chart above the GENERATOR CONTROL switches illustrates how the LED blinks in each mode.

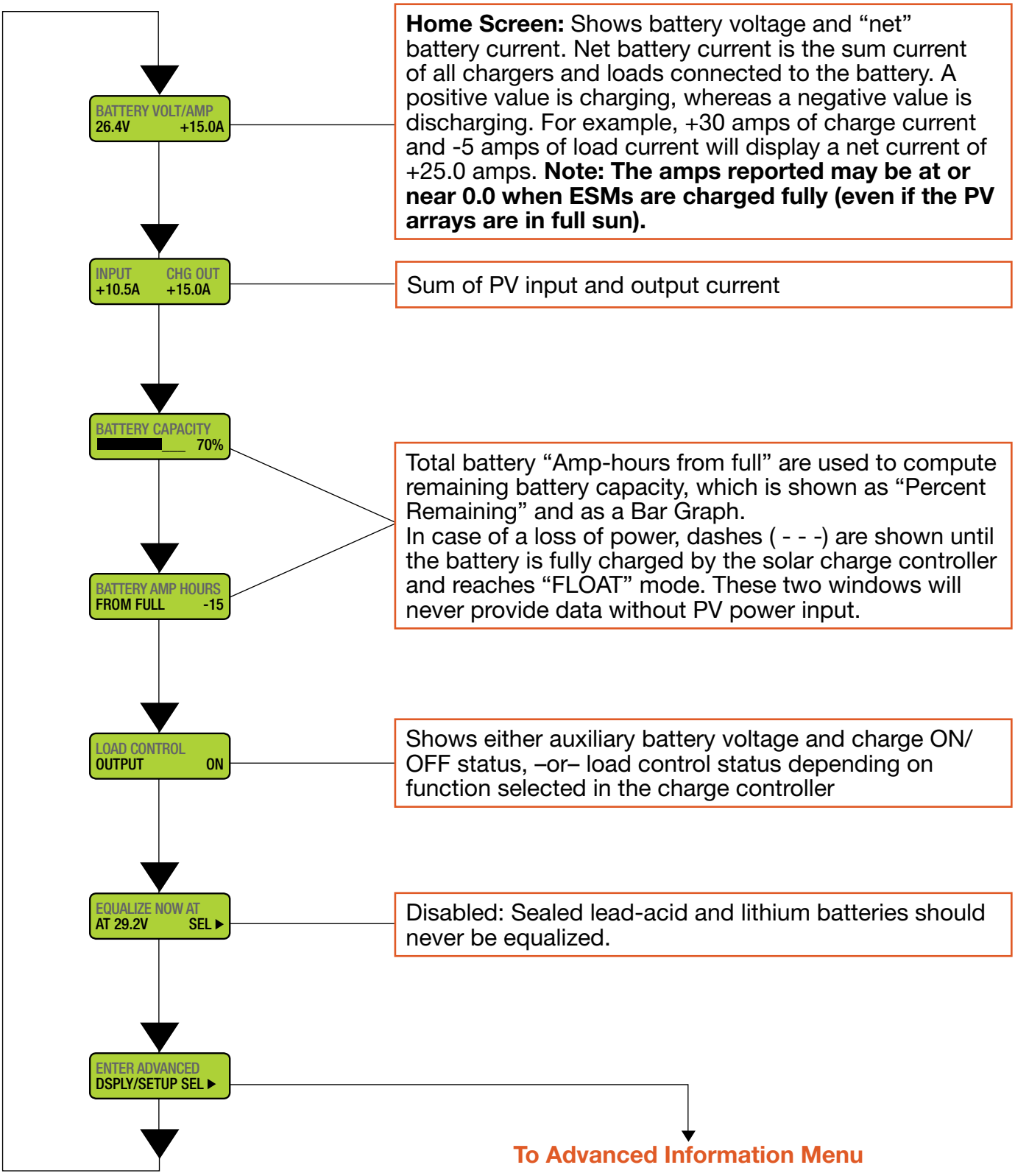
Battery Status

The battery voltage and the System net current are reported on the HyPR DC Interface home screen. **Note:** The HyPR must be connected to ESMs in order for the DC Interface to report net System current.

DC Interface Menu Windows

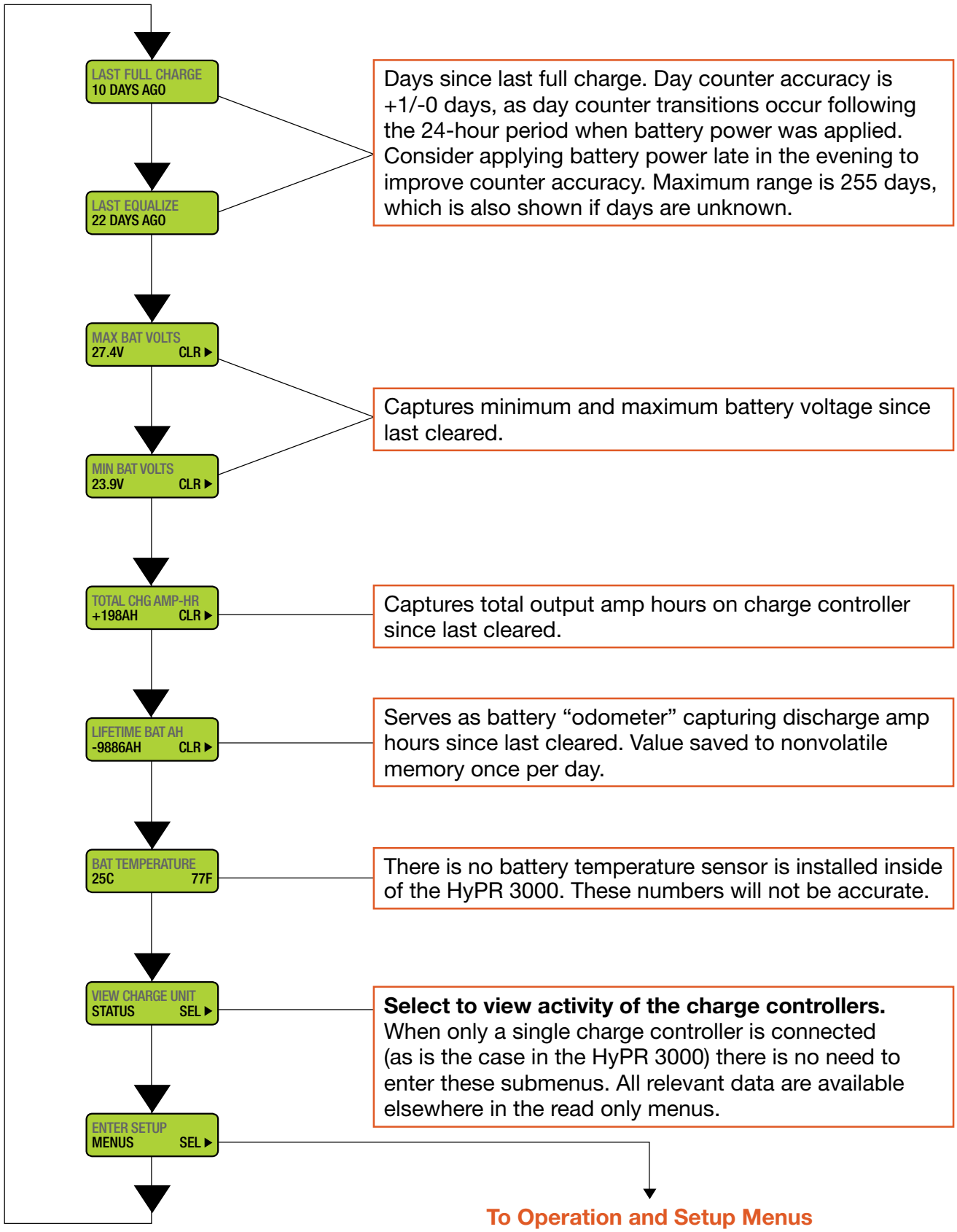
General Information Menu

Provides basic information including battery voltage, net current, and remaining capacity.



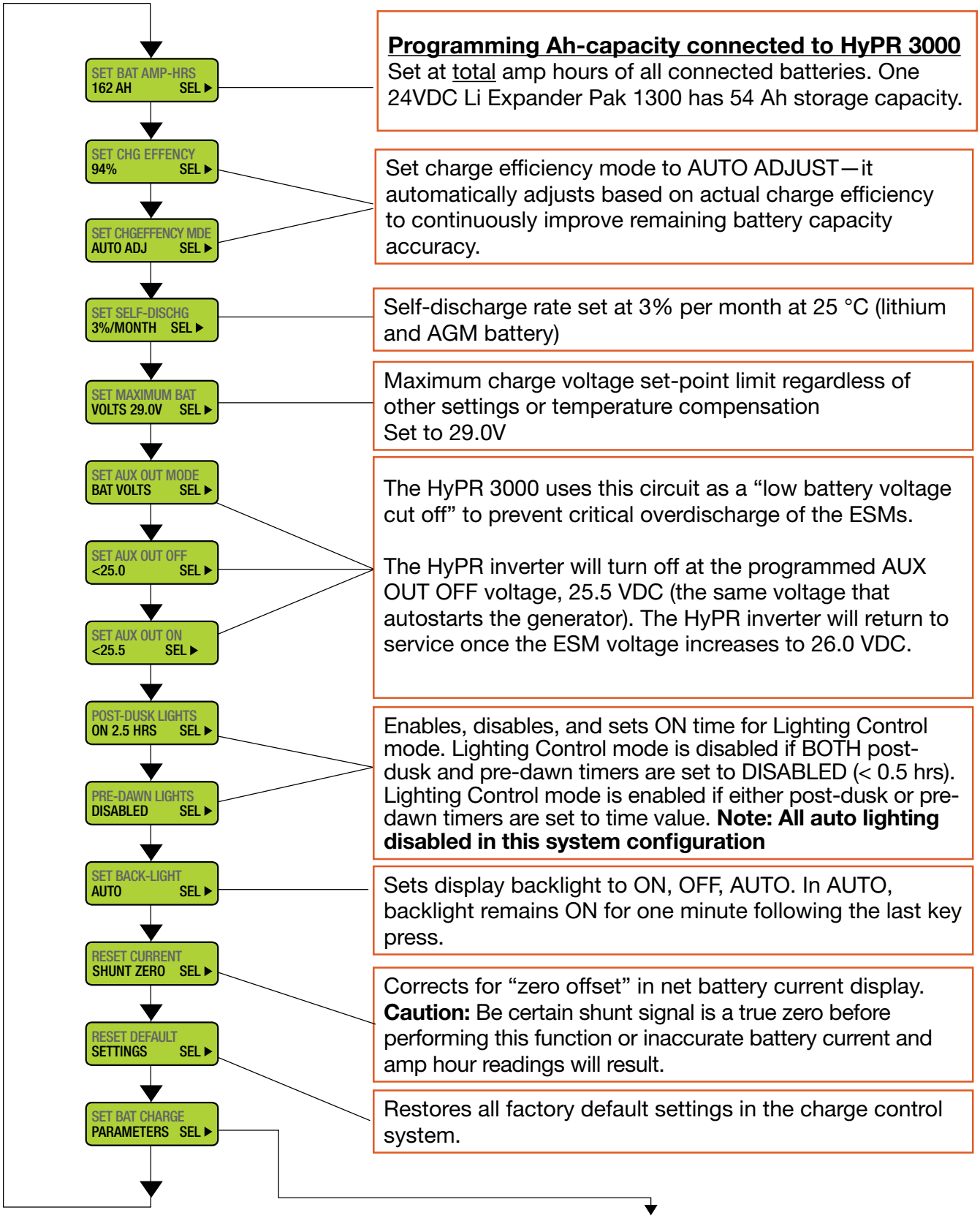
Advanced Information Menu

Provide detailed battery information including discharge cycles, temperature, battery-event tracking information, and more



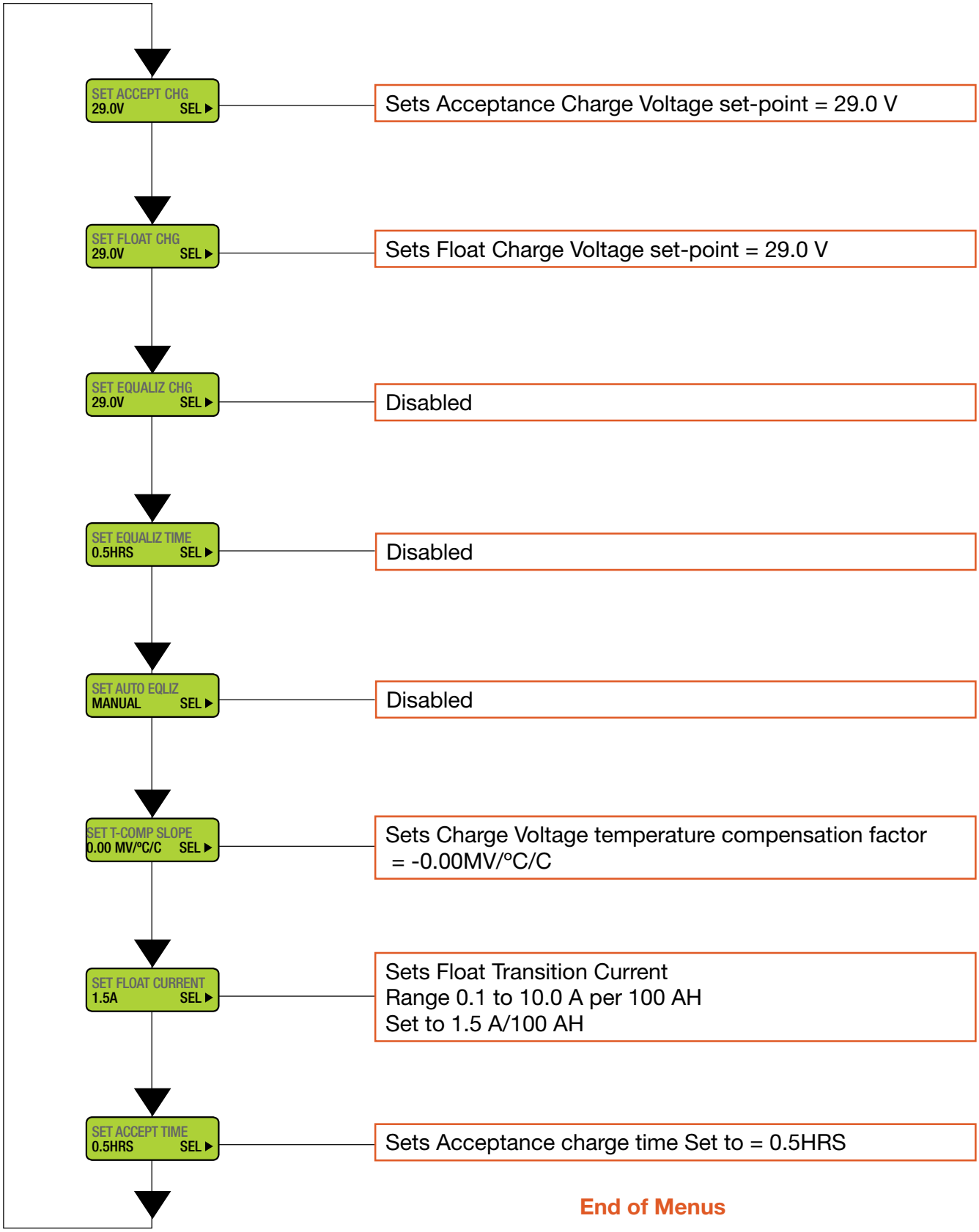
Operation and Setup Menu

Provides operational setup and auxiliary functions



Battery Charge Parameter Setup Menu

Provides access to battery charge parameters



TROUBLESHOOTING

Issues most likely to be encountered

Symptom: AC or DC circuit not operating as anticipated.
Cause: Circuit breaker not set properly.
Solution: Set circuit breaker properly.

Symptom: No power with ESMs connected
Cause: ESMs overdischarged and in “protect” mode
Solution: Connect AC or DC power source to HyPR to charge ESMs. Once ESMs detect charging voltage, they will return to service.

Symptom: Generator fails to start
Cause: Fuel issues; vent cap closed; generator power switch off; generator starter battery overdischarged
Solution: Troubleshoot generator. Once generator issues have been identified and resolved, a 15-minute manual generator run cycle (with no load) is recommended.

Symptom: Generator runs continuously (no cycling)
Cause: AC INPUT CONTROL setting too low or; GENERATOR CONTROL in ON position.
Solution: Increase AC INPUT CONTROL setting; toggle GENERATOR CONTROL to AUTO.

Symptom: Generator overloads and shuts down
Cause: AC INPUT CONTROL setting too high
Solution: Decrease AC INPUT CONTROL setting.

Symptom: AC output turns off
Cause: Generator failed to start; load exceeds inverter output; low-voltage disconnect; inverter overheated,
Solution: Inspect generator, loads, and settings; allow inverter to cool down.

PREVENTIVE MAINTENANCE CHECKS AND SERVICE (PMCS)

24VDC HyPR 3000 PMCS

Table 2. HyPR 3000 Preventive Maintenance Checks and Services

Item #	Item to be Inspected	Interval	Procedures	Non-mission Capable
1	Visual inspection of 24VDC HyPR 3000	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 three (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 3000 Air Intake Filter Maintenance*

There is one (1) air intake filter on the back of the HyPR 3000 (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**). The foam filter is attached to the case with adhesive tape (**D**). Carefully remove and clean or replace the filter then reinstall the vent assembly.

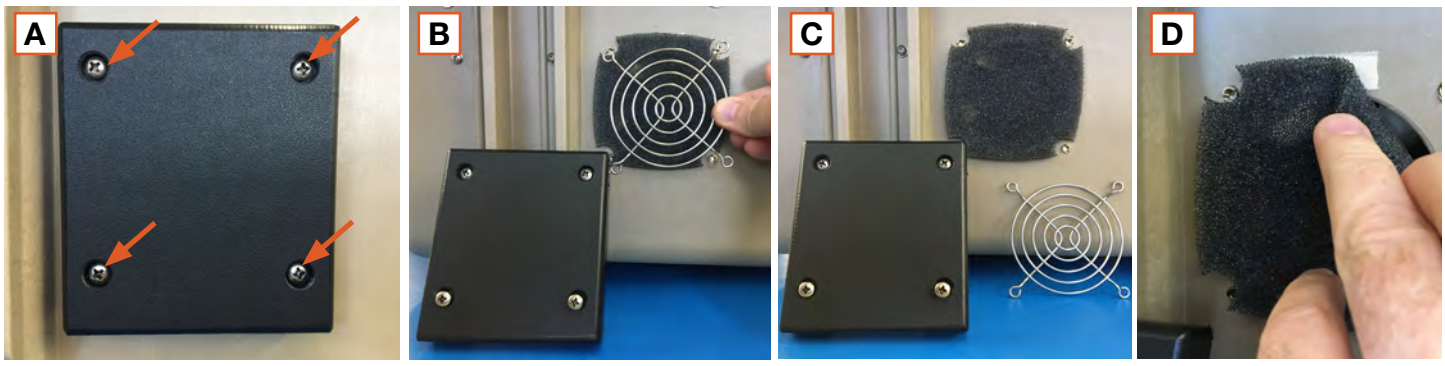


Figure 37. Cleaning/replacing HyPR 3000 air intake vent filter

*REV- versions of the HyPR 3000 may have a single (1) air intake vent on the back. REV A versions will have two (2).

24VDC Li Expander Pak 1300 PMCS

In-storage Preventive Maintenance Checks and Services

Failure to follow these instructions may result in permanent equipment failure and/or personal injury.

Required Tools

Solar Stik HyPR 3000, PRO-Verter or $LiFePO_4$ battery maintenance charger.

Table 3. 24VDC Li Expander Pak 1300 In-storage Preventive Maintenance Checks and Services

Item #	Item to be Inspected	Interval* at 91-140 °F (33-60 °C) Storage Temp	Interval* at 77-90 °F (≤ 25-32 °C) Storage Temp	Procedures	Non-mission Capable
1	Visual inspection of 24VDC Li Expander Pak 1300	M[1]	Q[2]	1. Inspect case for visible damage and missing items. 2. Clean excessive dust or dirt accumulation from the exterior and ports. 3. Close all unused port covers.	~If the case is broken or split or if the port is damaged, contact Solar Stik Technical Support.
2	In-storage maintenance charging	Q[2]	S[3]	Charge Li Expander Paks for 24 hours using a HyPR or PRO-Verter. If any other charging device is used, it must be rated for the Expander Pak storage capacity, voltage, and current limit.	If an Li Expander Pak has does not hold a charge after 48 hours of charging, contact Solar Stik Technical Support.

[1]Monthly (M)—every month [2]Quarterly (Q)—every three months [3]Semiannually (S) – every 6 months

Expander Pak Storage

There is a simple rule to remember about maintaining the Expander batteries:

> ***Never store an Expander Pak in a discharged state! Charge the Expander Pak fully before placing it in storage.***

Other than keeping the battery fully charged during storage, an $LiFePO_4$-type of battery does not require any type of maintenance by the operator.

The Expander Pak has a relatively low self-discharge rate at 77 ºF (25 ºC) and can be stored for up to one (1) year at this temperature before it needs to be recharged. However, the self-discharge rate increases as the storage temperature increases. See In-storage Preventive Maintenance Checks and Services for complete specific charging instructions for a particular Expander Pak battery chemistry.

Note: If the Expander Pak is stored at temperatures above 91 ºF (33 ºC), then the time between maintenance checks and / or charges must be reduced to three (3) months.

In-Storage Charging Procedures:

Charge one—charge all. It is important to maintain an equal level of health between all Expander Paks in a System. If one (1) Expander Pak in a System needs to be charged during storage, it is likely that any/all others will also need to be charged. Charging all of the Expander Paks until the they meet the criteria of being charged fully will maintain balance and equality among them.

⚠ CAUTION

Do NOT leave Li Expander Paks on a constant charge during long periods of storage. Cell damage may occur. Once the battery reaches 100% SOC during maintenance charging, the charging source should be removed until the next charging interval is determined.

How to Charge Expander Pak 1300s

The HyPR 3000 can charge Expander Paks using DC and/or AC power sources. The 85-264 VAC INPUT, SOLAR ONLY, 6-36 VDC INPUT and 24VDC IN/OUT. Battery charging rates among the these connections will vary. All four (4) ports many be used simultaneously. Adaptors for each connector type are available from Solar Stik.

The solar charge controller and the AC > DC converter/charger are programmed to charge batteries at 29.0 VDC while the 9-36 VDC INPUT converts DC power in this voltage rage to 29.0 VDC. Any DC charging source connected to the 24VDC INPUT/OUTPUT should have a ~ 29.0 VDC charging voltage set point. Connected batteries are charged fully when voltage is 29.0 VDC and current is less than 1 amp as reported on the DC Interface.

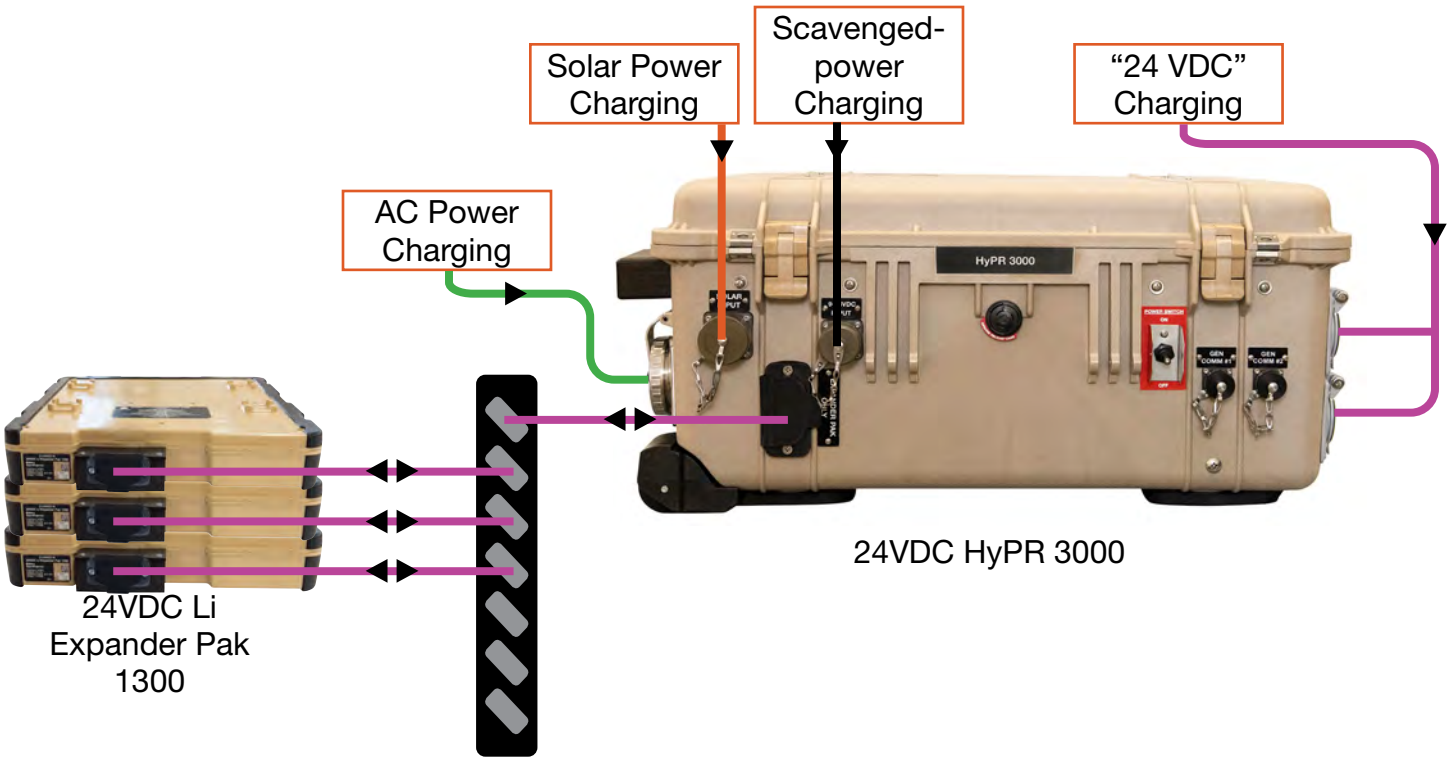


Figure 38. Charging Expander Paks with HyPR 3000

Water Intrusion Remediation

If water intrusion is suspected, and the System is still functional, disconnect power sources entering the HyPR 3000 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 3000 from the System. Do not move or relocate what may be a flooded HyPR 3000.

Keep the HyPR 3000 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 3000 slowly until no more water drains from the hole. After the water has been drained, remove the Faceplate. Place the HyPR 3000 in the driest environment possible for a period sufficient to ensure full evaporation of any remaining water. When the HyPR 3000 is completely dry, reconnect it to the System and test to determine if it is still functional.

Figure 39. Drain plug screw located under the TECH PORT

Transporting the HyPR 3000

The HyPR 3000 transports like a briefcase or rolls on wheels when transport handle is extended. It is safe for all modes of transportation, including land, sea, and air. There are no transport restrictions.

Figure 40. HyPR transport wheels and pull-handle

TECHNICAL SPECIFICATIONS

24VDC Li Expander Pak 1300

General	
Battery Chemistry	24 VDC Lithium iron phosphate
Nominal Operating Voltage Range	24 VDC to 28.8 VDC
Capacity*	1.38 kWh (54 Ah)
Max Discharge*	25 A continuous, 15-minute pulse at 50 A
Cycle Life*	> 2000 (80% depth of discharge)
Transport Case / Exterior Housing	Hard plastic; overmolded shock-absorbing corners
Transportation	• Class 9 Hazmat • UN3480, lithium-ion battery • Forbidden from transport on passenger aircraft
Certification(s)	• IP67 (intrusion protection) • UN 38.3 • Passed UNDOT38.3 T.3 Vibration and T.4 Shock
Warranty	1-year materials and workmanship

@ 77 °F (25 °C)

Safety	
Fuse(s)	200 A nonreplaceable (overcurrent in charging direction)

Battery Management System Protection	
Overvoltage Limit	3.75 V per cell
Undervoltage Limit	2.50 V per cell
Overdischarge Current Limit	36–48 A, 16ms
Overtemperature Limit	• Any supercell 158 ± 9 °F (70 ± 5 °C) • Relay heat sink 212 ± 9 °F (100 ± 5 °C)
Low-temperature Charging	• Trip -13 °F (-25 °C) • Reset 23 °F (-5 °C)
High-temperature Charging	• Trip 131 °F (55 °C) • Reset 122 °F (50 °C)
High-temperature Discharging	• Trip 194 °F (90 °C) • Reset 131 °F (55 °C)

Connections	
Input(s)/Output(s)	24 VDC Inter-Connect**

***Deltran 224-0061-BK*

Environmental	
Operating Temperature***	• -26 °F to 149 °F (-32 °C to 65 °C, discharging) • -4 °F to 122 °F (-20 °C to 50 °C, charging)
Storage Temperature****	-4 °F to 122 °F (-20 °C to 50 °C)

**** 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	34 lb (15.42 kg)
Dimensions	17.55 x 17.25 x 4.06 in (44.58 x 43.82 x 10.31 cm)

24VDC HyPR 3000-120

General	
Nominal Operating Voltage	24 VDC
Battery Chemistry	$LiPO_4$/Pb Compatible
Operational Voltage Range	25-29 VDC
Internal cooling	Convection
User Interface	IPN PRO remote manual control knobs/switches
Remote Monitoring	UCM
Case	Pelican 1610
Transportation	Any
Certification	None
Warranty	1-year materials and workmanship

Charge Controller Specifications (@ 77 °F/25 °C)	
Maximum PV Input Voltage	57 VDC
Maximum PV Input Current	12 A (@24 V Nominal)
Maximum PV Power	400 W
Efficiency	97% (typical)
Charging Stages	Bulk, Acceptance, Float
Charge Control Method	Maximum Power Point Tracking (MPPT)

DC Output	
Output Voltage	Up to 29 VDC
Output Power Rating	100 A

AC Output Specifications (@77 °F/25 °C)	
AC Output Frequency	60 Hz
AC Output Voltage	120+-2% VAC
Continuous Output Current	16.7 A (2000 W)
3 Second surge capacity	4000 W
Inverter Efficiency	87%
Transfer Time	None

AC Charger Specifications (@77 °F/25 °C)	
AC Input Frequency	47-63 Hz
AC Input Voltage	85-264 VAC
DC Output Voltage	25-29 VDC
Charging Stages	CC/CV
Continuous Output Current	~100 ADC
Charging Efficiency	87%
Transfer Time	None

Safety	
Breaker(s)	(1) 100A, (3) 20A, (1) 30 A
Fuse(s)	3 A
Certifications	Built and designed to MIL-STD-810G and IP65

Connections	
Inputs	(1) 120-230 VAC, 30 A (NEMA L5-30P) (1) Inter-Connect (Deltran 224-0061-BK) (1) Solar (CANNON CB2-22-2SC) (1) 9-36 VDC (CB2-18-10PC)
Outputs	(4) 120 VAC, 20 A (NEMA 5-15/20R)
Input(s)/Output(s)	(1) NATO (1) 24VDC Inter-Connect (Deltran 224-0061-BK) (2) Gen Comm

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 90%
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	75 lb (34 kg)
Dimensions	24.8 x 19.7 x 11.9 in (63 x 50 x 30.2 cm)

ABOUT SOLAR STIK, INC.

Mission Statement
Using American-made components and constant innovation, Solar Stik creates portable power solutions that enable self-sufficiency for the soldier, the sailor, and beyond. In doing so, we save lives, change lives, and help revive American manufacturing.

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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