SOLAR STIK®

Operator and Maintenance Manual for the 24VDC HyPR 6000

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GENERAL INFORMATION, EQUIPMENT DESCRIPTION, AND THEORY OF OPERATION

General Information

A Hybrid Power Router (HyPR) is a power management device which processes and routes a variety of power inputs to DC 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 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 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 6000. The HyPR 6000 has been designed specifically to support Hybrid, UPS, and Power Conditioning requirements.

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

General 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.
- The battery bank connected to the HyPR must be able to provide a combined 100 A current to support the rated demand from the DC-DC converter (See Figure 1)
- Based on the application, the user must configure the system so there is “balanced” operation between the HyPR’s internal functions.

The HyPR 6000 accept universal (85–264 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.

Theory of Operation

The HyPR 6000 coordinates the support of DC loads using power supplied from AC and/or DC sources. Both AC and DC power sources energize the HyPR 6000 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 6000 internal circuits. System voltage and net current can be monitored on the User Interface.

A schematized illustration of the DC bus and its relationship to internal components, inputs, outputs, shunts (meters) and breakers is shown below. The arrows indicate the flow of current in the circuits. When the HyPR DC bus is powered from an AC source, output to regulated and unregulated DC power outputs is 28.5 VDC. If no AC power is present, regulated DC power output is 27.5 VDC and unregulated DC power output follows battery (ESM) voltage.

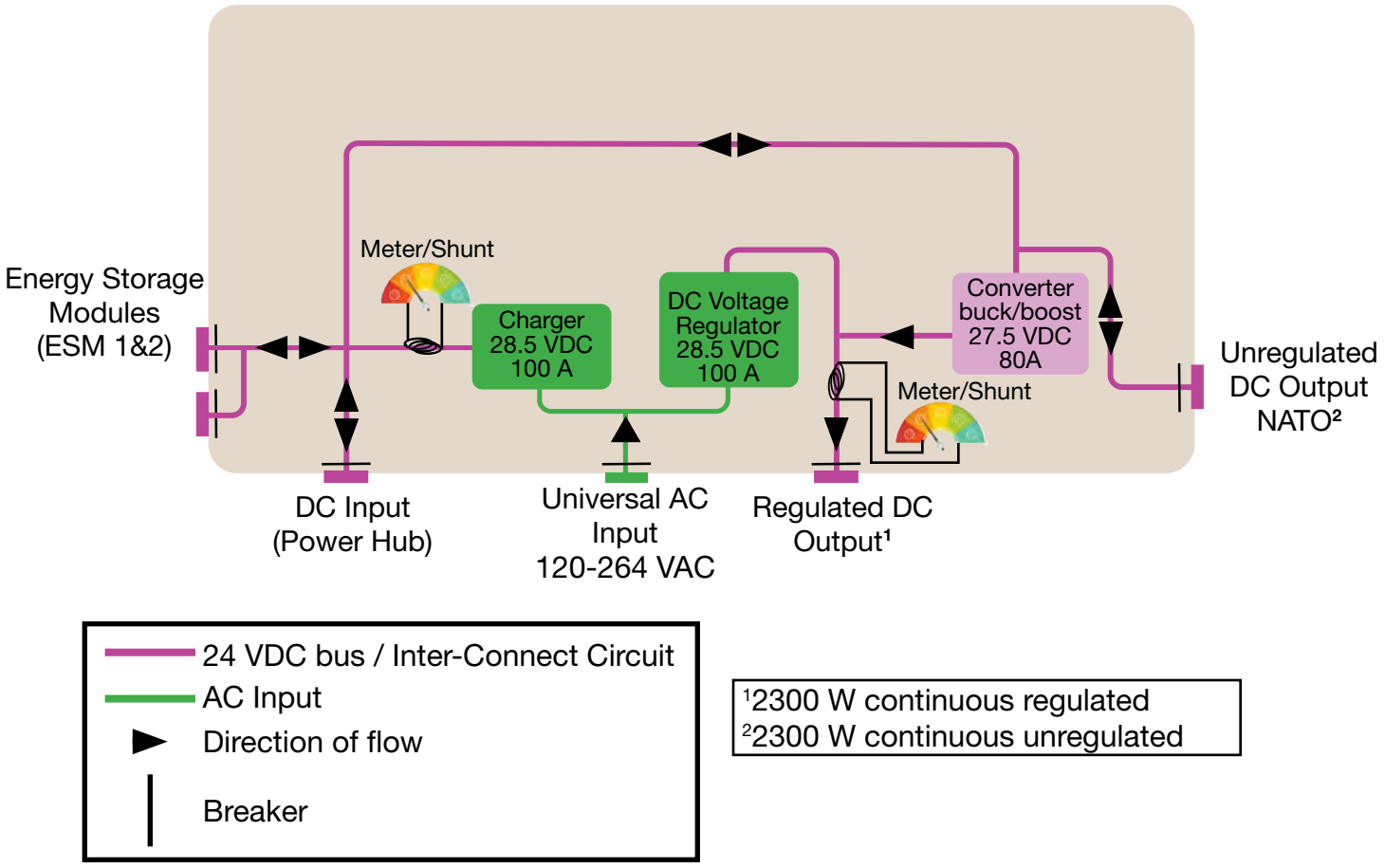


Figure 1. Schematized power flow from a top-down view of the interior of the HyPR 6000

HyPR 6000 Functions and Modes

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.

HyPR Circuits and Functions

A HyPR is a power management device that can serve multiple roles in a battery-based Hybrid or high-efficiency electrical system.

HyPR Primary Circuits:
- Converter (AC to DC) - Converts AC from generator or grid to DC for loads and batteries
- Regulators (x2) (DC to DC) - Provides constant-voltage DC power output. With AC power input, 28.5 VDC, and 27.5 VDC when System is operating from power drawn exclusively from ESMs (no AC power input).

HyPR Support Circuits:
- Automatic generator start/stop (AGS) controls
- Regulated DC outputs
- AC-powered System recovery (overdischarged batteries)
- Low-voltage cut off (LVCO) protects System ESMs from overdischarge

The primary circuits operate in concert with the support circuits to provide the operator with a multifaceted solution and seamless power for an application.

AC Functions

Charging
The HyPR accepts universal (85-264 V, 47-63 Hz) AC power input and provides up to 100 A charging current to the DC bus. The charger provides constant current and as such, the actual charging voltage to batteries will be lower at the beginning of the charging cycle, moving toward 28.5 VDC as the batteries reach full charge.

Source of Power for Regulated DC Power Output
The HyPR DC voltage regulator converts incoming AC power to a constant 28.5 VDC power output.

DC Functions

All HyPR functions are regulated directly or indirectly by the DC bus voltage. The DC bus voltage is functionally equivalent to the System battery voltage.

Regulated DC Power
Voltage-regulated DC power output (from the REGULATED DC OUTPUT port; see Figure 24) is provided from two (2) sources in the HyPR:
1. A DC voltage-regulator converts incoming AC power to DC power at a constant, regulated voltage of 28.5 VDC. This circuit functions only when an active AC power source is connected to the HyPR.
2. A DC/DC converter converts battery/bus voltage (which varies) to a constant 27.5 VDC. This circuit is active only when there is no AC power to the HyPR.

Low-voltage Cut Off (LVCO)
To protect System batteries from overdischarge, a relay disconnects them from the DC bus at a programmable, voltage set point. When LVCO is activated, neither regulated nor unregulated DC power output is available from the HyPR to support loads.

The LVCO value is set in accordance with the requirements of the System, battery chemistry, and the ESM battery management system (BMS). The value should not be reprogrammed without consulting Solar Stik Technical Support. DC power output is available once System batteries are charged to one-volt higher than the programmed LVCO value for the HyPR to resume support of loads. This one-volt difference is hard coded into the HyPR master controller.

Auto Generator Start / Stop
The HyPR Auto Generator Start/Stop (AGS) functions are controlled using the GENERATOR CONTROL functions in the user interface (see USER INTERFACE OPERATION; GEN CONTROL).
- The ON option turns on a connected generator regardless of the DC bus voltage.
- The AUTO option automatically starts and stops a connected generator based on DC bus (battery) voltage.
- The OFF option stops the generator(s) if it is running or prevents the generator from turning on.

AGS start / stop voltages
The HyPR is programmed to start and stop the generator(s) at voltages that allow the ESMs to charge and discharge over a safe and efficient voltage range.
- Generator start set point = 25.0 VDC
- Generator stop set point = 28.5 VDC

The generator start and stop voltage set points are programmable via a user interface. Contact Solar Stik Technical Support for assistance if reprogramming is required.

DC Startup
Provides a mechanism to power up HyPR when it is connected to batteries that are within normal operating voltage but no AC or DC power sources are connected or available.

Solar Power
Solar power, via a Solar Stik 24VDC Power Hub, may be connected to DC INPUT port using an Inter-Connect Cable. The Power Hub converts solar power to regulated 29.0 VDC charging current and as such is prioritized for battery charging and load support over AC power input (28.5 VDC).

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 brief:

- AC power generation source (AMMPS, TQG) with ESMs
- DC power generation source (e.g., solar) with ESMs
- AC and DC power generation sources with ESMs

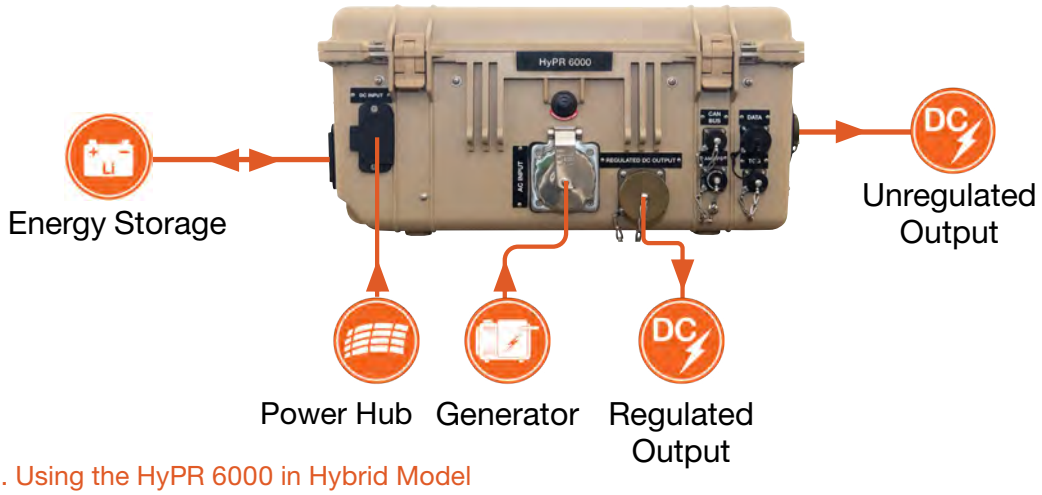


Figure 2. Using the HyPR 6000 in Hybrid Model

UPS Mode–The HyPR is capable of operating as an Uninterruptible Power Supply/Source, providing instantaneous emergency power to loads in the event that primary power source fails. In this mode, the HyPR will to provide power to the load until it can be turned off safely or until primary power is restored. In this mode, power for loads is limited to what is contained in the System ESMs

- AC utility / grid power sources with ESMs
- ESMs do not cycle
- Please contact Solar Stik Technical Support for information if using as a UPS.

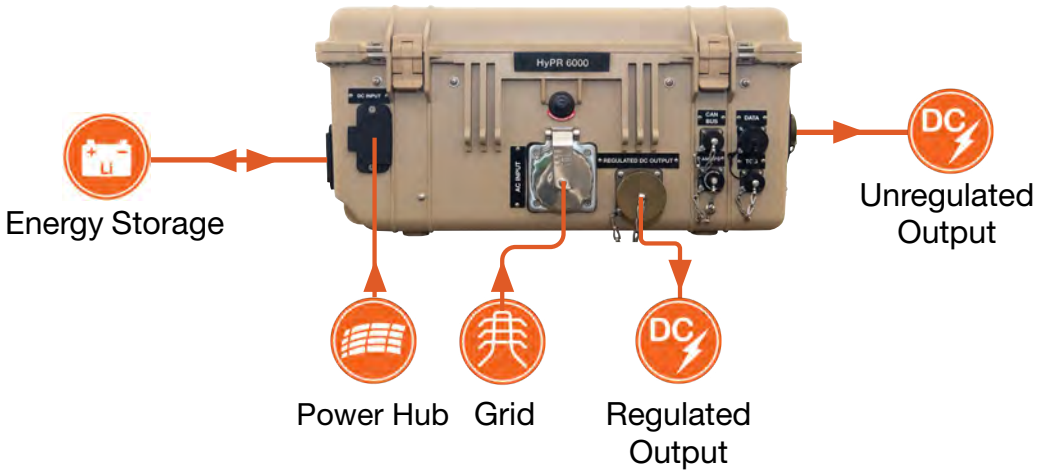


Figure 3. Using the HyPR 6000 in UPS Model

DC Power Conditioning Mode–The HyPR stabilizes DC power output voltage to protect sensitive electronic loads. Batteries connected to the HyPR operate between 24.4 VDC and 29.0 VDC; the voltage range of the LVCO and charging circuits (28.5 VDC if no solar).

The HyPR REGULATED DC OUTPUT port provides a constant 28.5 VDC when the HyPR is connected to an active AC power source and 27.5 VDC when operating only on energy stored in the ESMs.

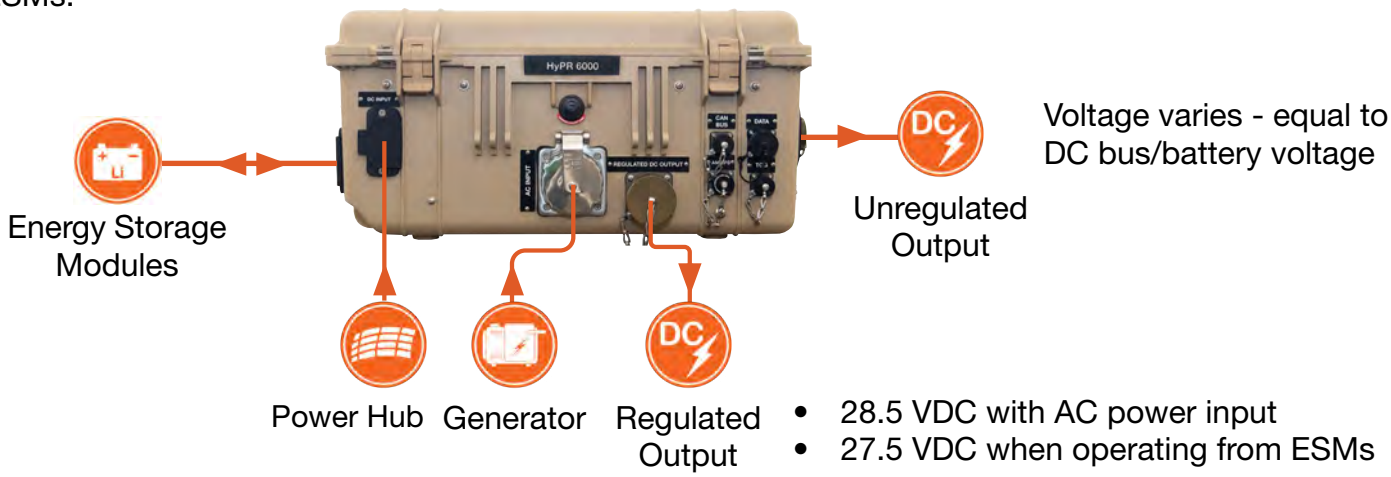


Figure 4. Using HyPR in Power Conditioning Model

Scaling and Modifying a HyPR-based System

Hybrid systems also provide the operator with a flexible architecture that allows for the addition of multiple power sources, such as renewable power generation.

In the Hybrid model operation, System batteries will cycle regularly to reduce generator runtime and logistical support often associated with operation in remote locations.

In a Hybrid Power System (HPS), the “continuous load” power requirement must always be LESS than the total power generation that occurs over a period of time.

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 6000 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.

Energy Storage Requirements for Operation

The quantity of energy storage capacity connected to the HyPR is System dependent on and must be balanced with load power demand and charging source(s) power output so the battery bank cycles 1.5 - 2 times per day. Insufficient storage capacity results in excessive generator run times and the associated problems. A complete and thorough understanding of the System load profile and power generation sources is required to properly balance a System.

The HyPR is compatible with lead-acid and lithium battery chemistries. However, battery chemistries should never be mixed within a 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.

Selecting an AC Power Source

The HyPR 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 AC power source and the DC 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 6000 should provide the following:
- 3–5 kW of power
- Pure Sine Wave AC wave form output

To use the HyPR in hybrid mode, a fuel-powered generator must be compatible with Solar Stik auto generator start / stop capabilities.

AC Power Source Voltage Options

If a power source has the option to supply power at either 120 or 240 VAC, use the 240 VAC option. The HyPR will operate more efficiently at the higher voltage.

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 state of charge (SOC)
- Temperature
- User programming for special conditions

HyPRs can be used with grid-utility or generator AC power, and can easily be adjusted to operate within the current limits of the HyPR AC and DC circuits and the external AC power source.

When operating a HyPR with DC power sources connected (e.g., PV, Wind, vehicular, fuel cells, etc.), all incoming power will be prioritized to the load, reducing consumption of energy stored in the batteries, thereby extending battery-only runtime and the reducing need for AC power from a grid-utility or generator source.

When operating a HyPR with a fuel-driven generator, the AGS can be used to start the generator(s) when the battery voltage is low and no other power sources are currently available (e.g., solar). Once the battery voltage reaches a user-determined setpoint, the HyPR AGS circuit will start the generator, ensuring power to the load. Likewise, when System batteries are charged to the user-determined voltage setpoint, the AGS circuit will automatically turn off the generator(s). In effect, the HyPR uses a connected generator as the last line of defense against mission failure.

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 supports loads when these inputs are not available (e.g., grid failure, generator maintenance periods, etc.) and to reduce reliance on fuel-powered generators.

Important Safety Information and Instructions

This manual contains important instructions that must be followed during the setup and operation of a the HyPR 6000. Read all instructions and information contained in this manual.

DO NOT begin assembly or use of the HyPR 6000 without first reading and understanding this manual.

While the HyPR 6000 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 6000. 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

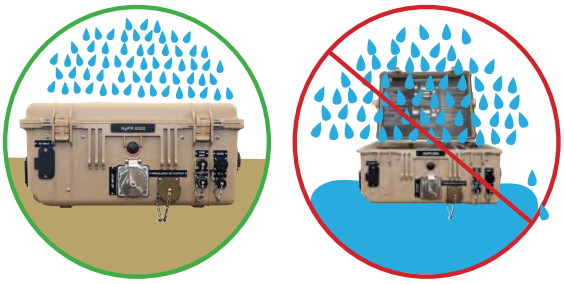
The System is NOT GFCI protected.

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.

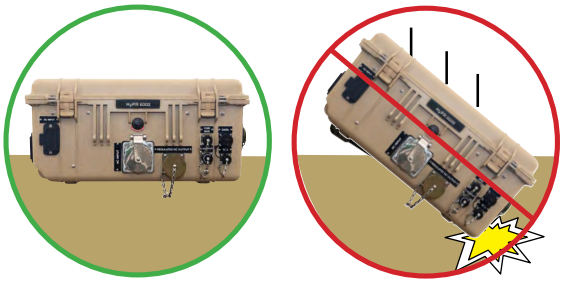
Water

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.



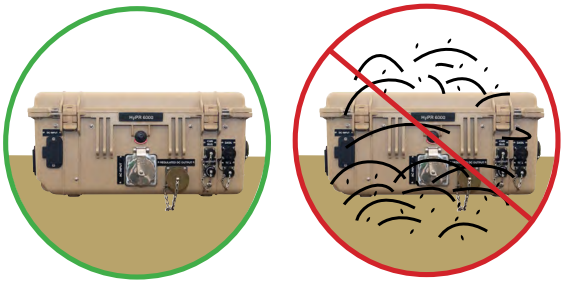
Impact

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



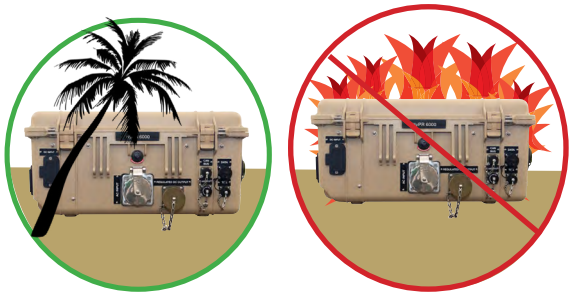
Dust/Foreign Object Intrusion

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 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 6000s 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 the Li Expander Pak 1300 have two types of plugs: straight and angled. The straight plug connects to the Expander Pak 1300 to facilitate stacking (Figure 5).

- 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

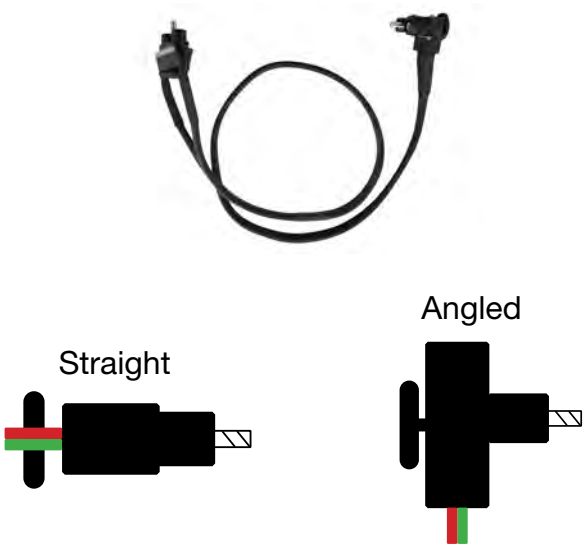


Figure 5. Linear Inter-Connect Plug

Standard Inter-Connect Cable

- 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 6. Inter-Connect Plug

EQUIPMENT DESCRIPTION

Connections Overview

The HyPR 6000 manages power between power sources and DC loads. It provides AC and DC mechanisms to charge ESMs while the system is operating or idle. The HyPR 6000 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 6000.

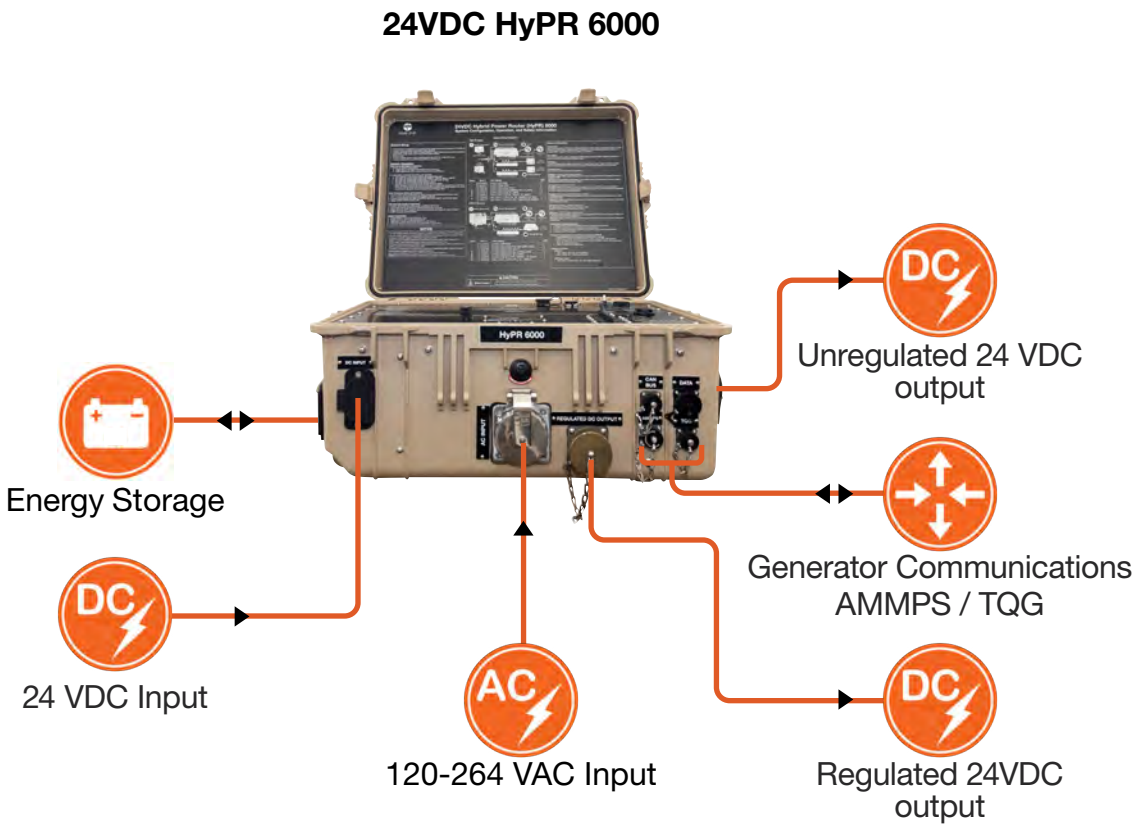


Figure 7. 24 VDC HyPR 6000 connections

Information Plate (I-Plate)

The I-Plate is an application-specific part of the HyPR. It provides condensed instructions for deploying and operating a System that includes a HyPR as manager of power within the System.

Detailed information about deployment of a specific System including a HyPR is found in System Setup and Operation Manuals.

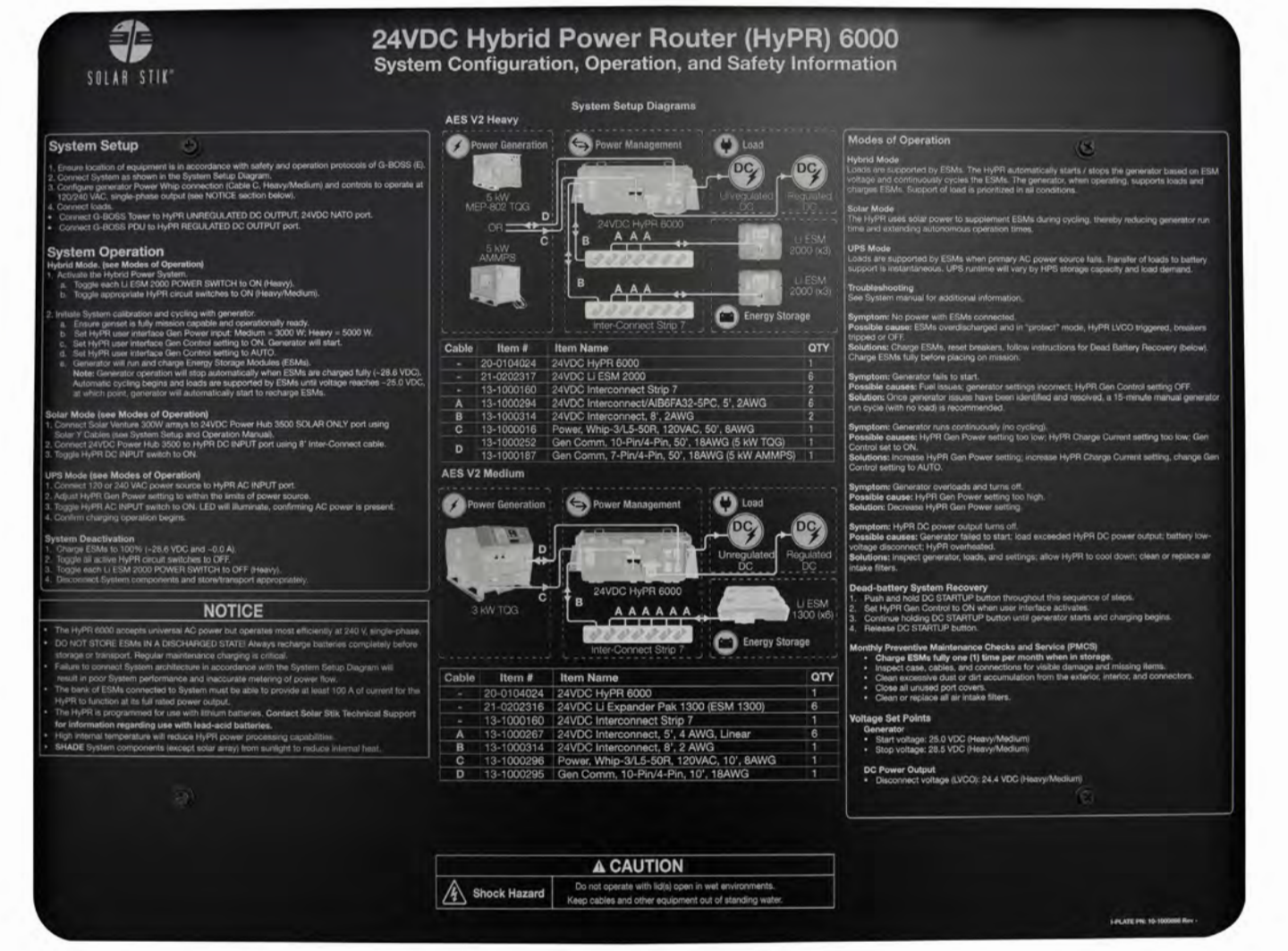


Figure 8. The HyPR 6000 I-Plate

AC Power Input Port

Connect AC power sources to the AC INPUT port. The HyPR 6000 accepts “universal” (85 - 264 V) AC power. Power via this connection charges batteries and supports DC loads connected the 24VDC IN/OUT, NATO and REGULATED DC OUTPUT ports.

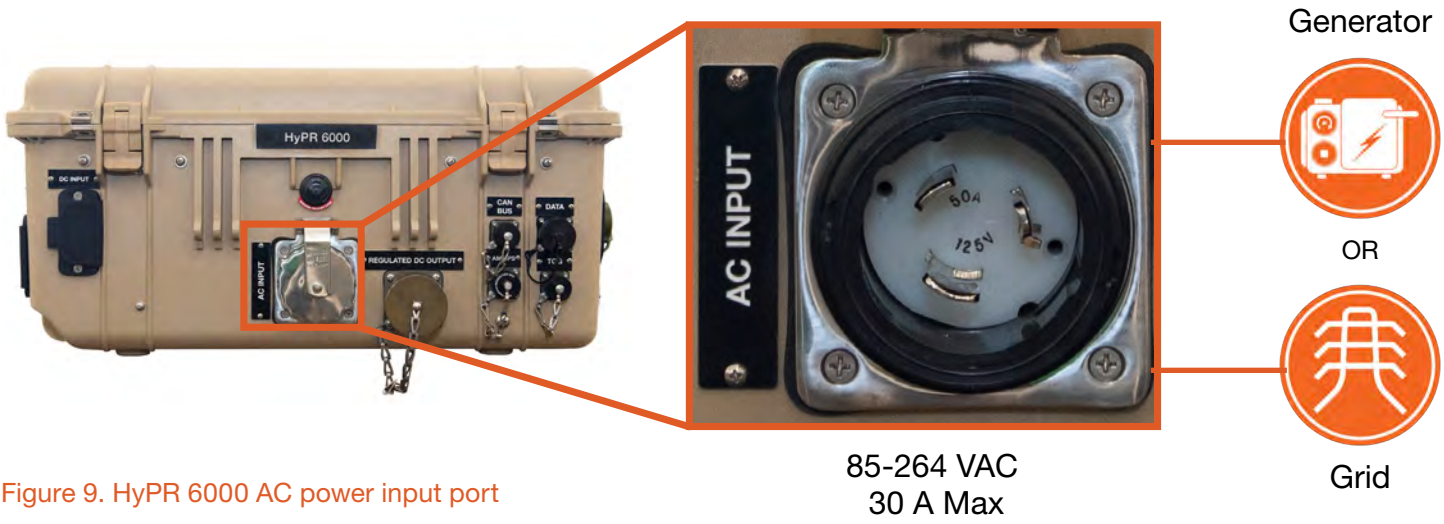


Figure 9. HyPR 6000 AC power input port

DC INPUT Port

This Inter-Connect port provides circuit-protected (100 A), direct access to the HyPR internal DC bus. DC power can flow either in or out of the HyPR at this connection. It may be used to parallel HyPRs or to connect additional power management components such as a Solar Stik 24VDC Power Hub.

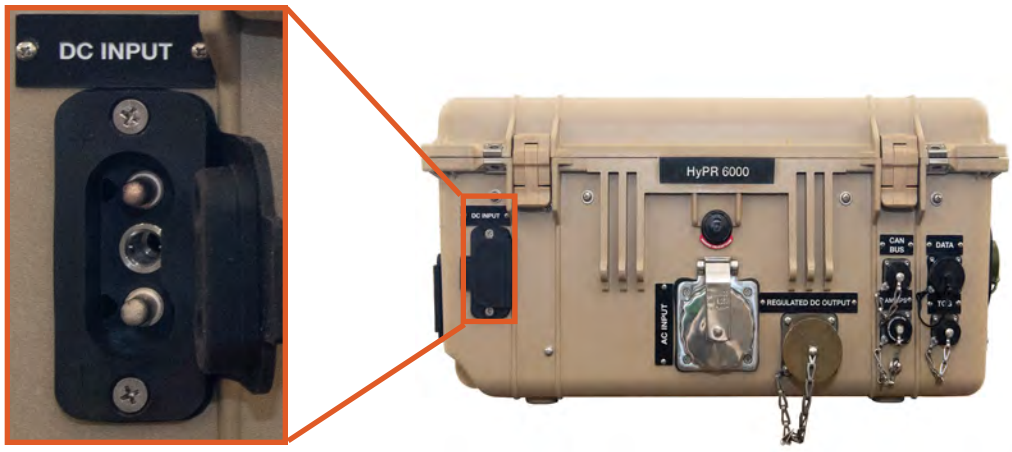


Figure 10. HyPR DC INPUT port

ESM 1 and ESM 2 Ports

These two (2) Inter-Connect ports are dedicated to ESM connections. Individual ESMs may be connected to each or multiple ESMs connected to each (using Inter-Connect Strips) as shown in figure below.

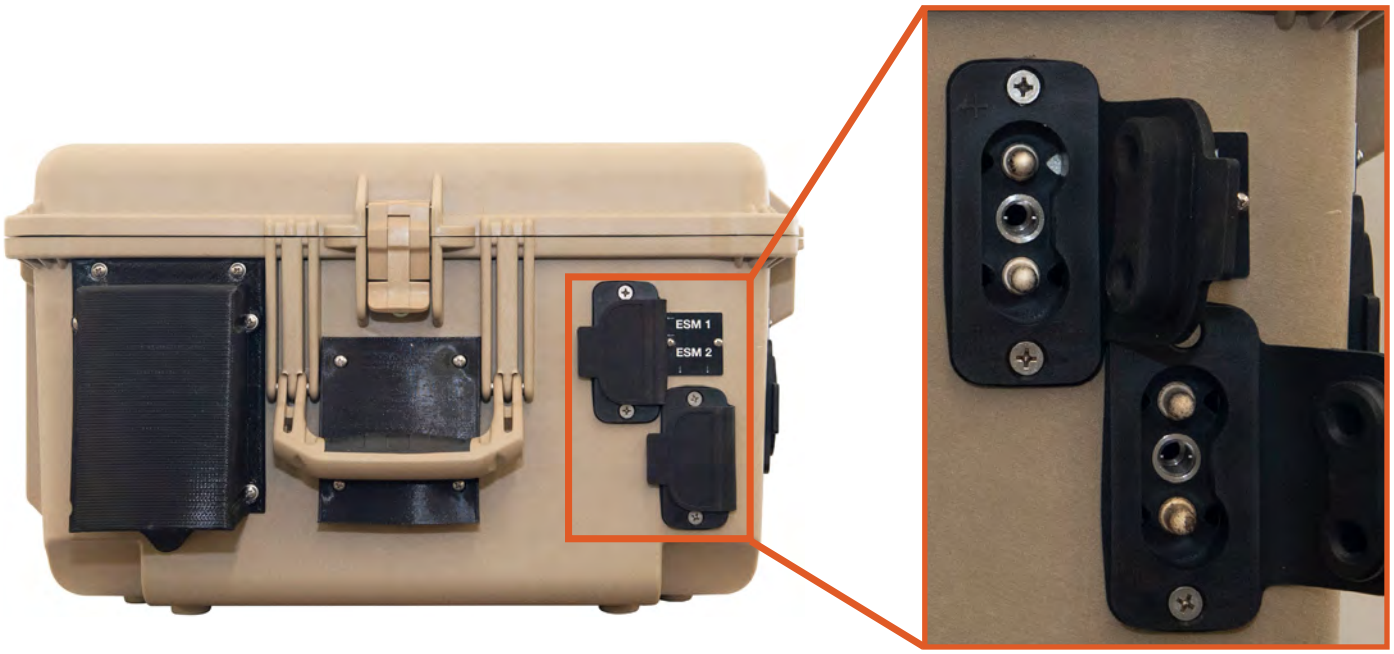


Figure 11. HyPR ESM connection ports

Regulated DC Power Output Port

The REGULATED DC OUTPUT port is a 2-pin connector that provides regulated DC power. The regulated voltage is 28.5 VDC when the HyPR is receiving AC power and 27.5 VDC when HyPR is operating solely from battery (ESM) power.

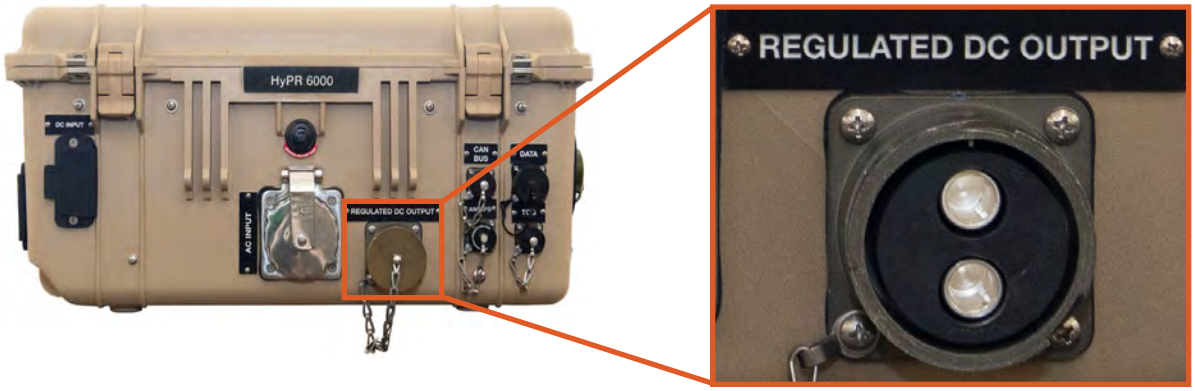


Figure 12. HyPR regulated DC power output connector

Unregulated DC Power Output Port

The UNREGULATED DC OUTPUT NATO port provides DC power at battery/bus voltage. This port is a direct connection to the internal DC bus. Power output from this port is subject to LVCO protections to prevent overdischarge of connected batteries.

Figure 13. HyPR unregulated DC power output connector

GEN COMM Ports

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

The connector labeled “AMMPS” automatically starts and stops all AMMPS generators equipped with advanced digital control system (aDCS). See AMMPS generator: DCS or aDCS? to see difference between DCS types.

The connector labeled TQG communicates with with MEP-831A and MEP-802A gensets modified with a Solar Stik Remote-start Enabling kit (RsEK).

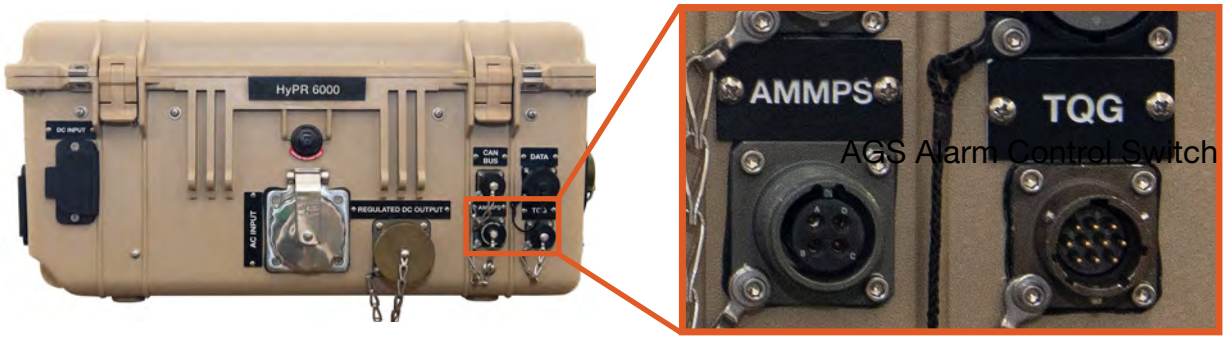


Figure 15. Expander Pak generator communications ports

CAN bus and DATA Ports

These ports will provide additional, future capabilities.

DATA port - is for communication between the HyPR Remote Monitor and the PDU or other customer device. It is an RS485 Modbus server.

CAN BUS - Intended for communication among power system components in general, and in particular is for the batteries to communicate with the Remote Monitor, so that the Remote Monitor can forward those messages to the PDU. The protocol is J1939 CANBus.

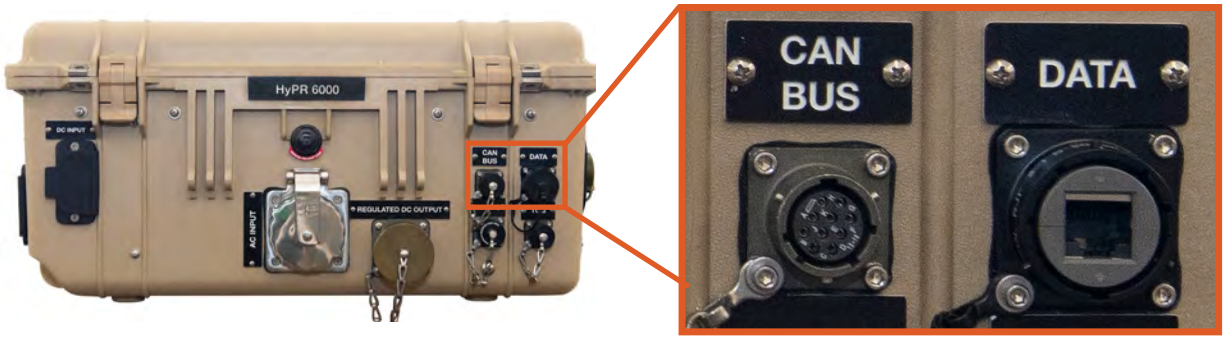


Figure 16. HyPR CAN but and DATA ports

Faceplate

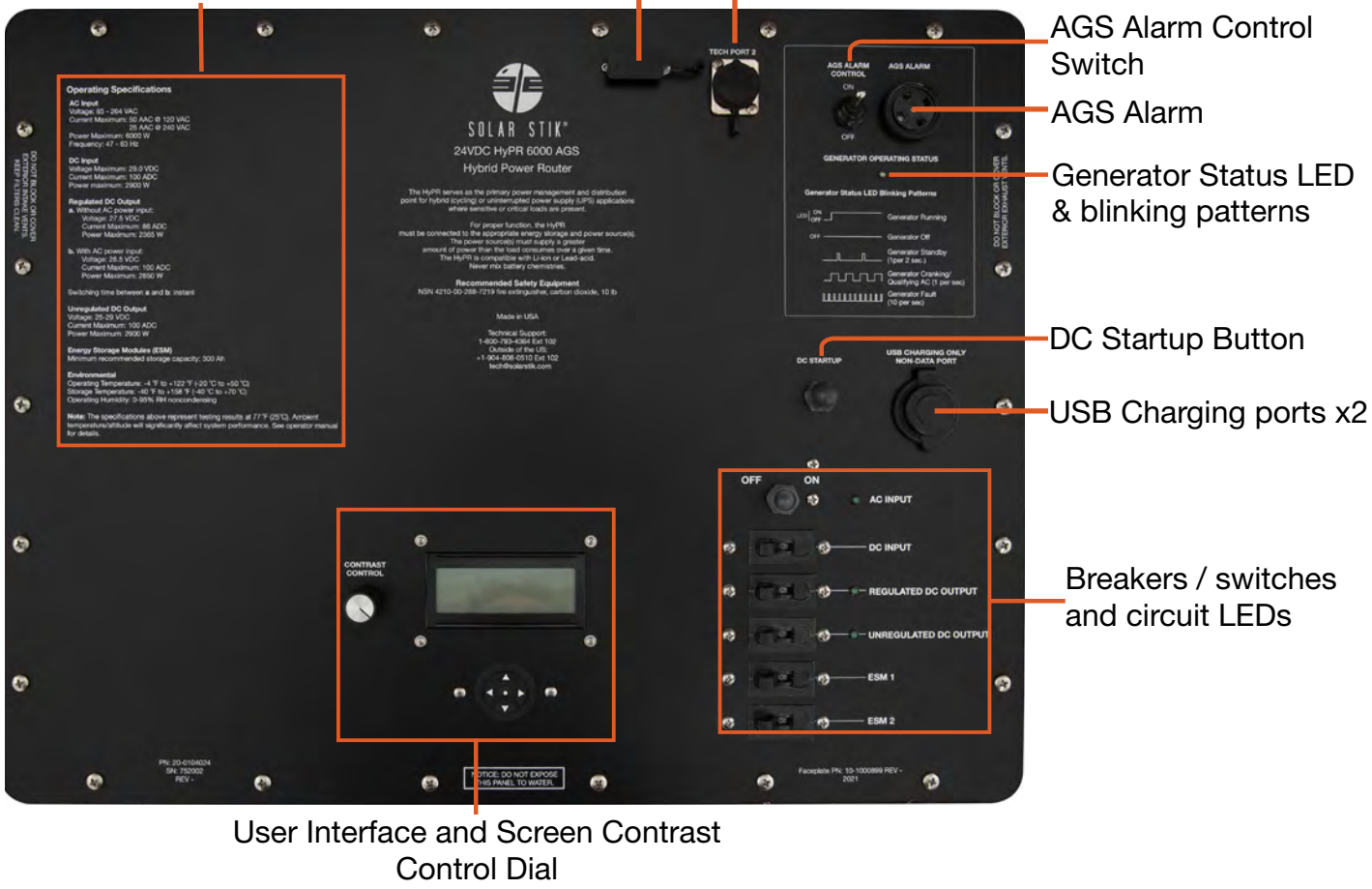


Figure 17. 24 VDC HyPR 6000 Faceplate

USER INTERFACE – The Home Screen provides read-only System status data including charging current, bus (battery) voltage, regulated-DC output voltage and current. Submenus contain settings that provide control for DC output, generator type and control and auto generator start/stop settings. Adjusting the CONTRAST CONTROL dial to the left of the screen can improve screen visibility in any light.

Generator Status LED – Displays the current status of connected generator. A legend correlating the blinking pattern with a status is immediately below the LED.

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.

TECH PORTs – Tech ports 1 and 2 are for updating the firmware and advanced diagnostics of the Controller and AGS/Remote Monitor, respectively. 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.

DC Startup Button - Provides a mechanism to power up HyPR when it is connected to batteries that are within normal operating voltage but no AC or DC power sources are connected.

Breakers/Switches – The breakers serve to protect their associated circuits from excessive current and as switches to activate circuits and to deactivate circuits not in use. 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.

User Interface Description

The user interface consists of an LCD screen, five (5) navigation buttons and a contrast control dial that allows users to adjust screen contrast to optimize viewing in any light.

The Home Screen provides read-only System status data including charging current, bus (battery) voltage, regulated-DC output voltage and current. Submenus contain settings that provide control for DC output, generator type and control and auto generator start/stop settings. Adjusting the CONTRAST CONTROL dial to the left of the screen can improve screen visibility.

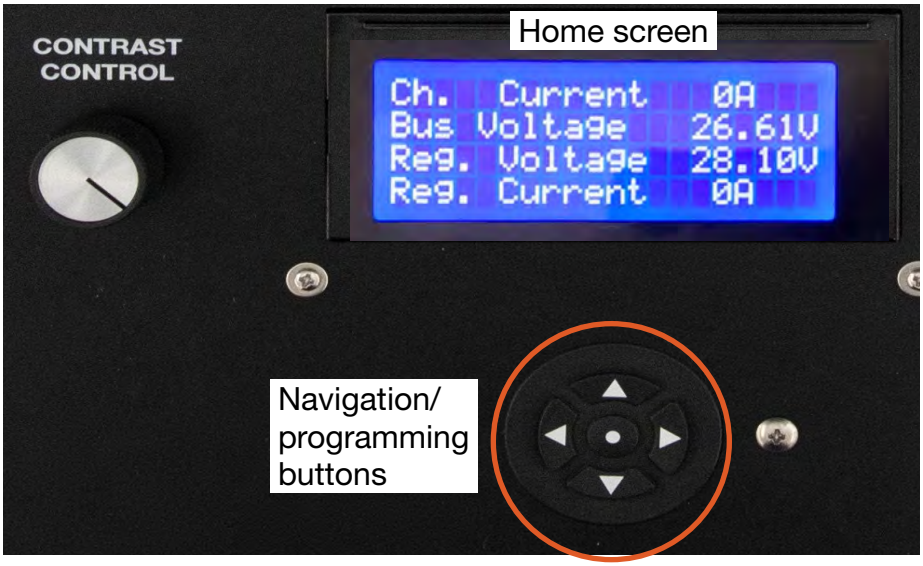


Figure 18. User Interface features

Breakers and LED Functions

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. See (Figure 1) for a diagram illustrating the location of each breaker. Circuit breakers are for IN / OUT circuit limit protections. The LED associated with each breaker is illuminated when the circuit is active.

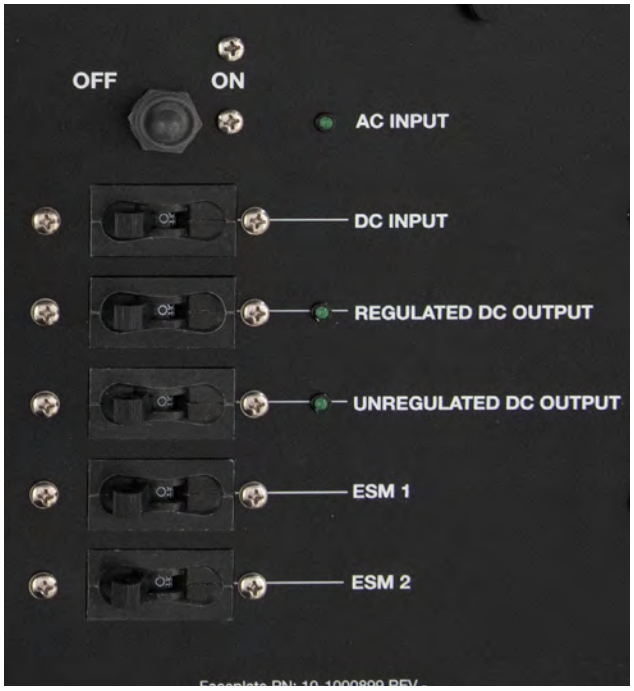


Figure 19. HyPR 6000 circuit breakers

AC INPUT - 30 A hooded toggle switch. Limits current from AC power source into HyPR. Must be on to charge System batteries using AC power source and for HyPR to provide 28.5 VDC regulated DC power output. LED is illuminated when circuit is active.

DC INPUT - 100 A toggle switch. Limits current flow from external DC power sources connected to DC INPUT connector. Must be on for external DC power source to charge batteries via DC INPUT connector.

REGULATED DC OUTPUT - 100 A toggle switch. Limits current flow to loads connected to REGULATED OUTPUT connector. Must be on to support loads from REGULATED DC OUTPUT connector. LED is illuminated when power is available from REGULATED DC OUTPUT connector.

UNREGULATED DC OUTPUT - 100 A toggle switch. Limits current flow from HyPR via NATO port. Must be on to support loads connected to UNREGULATED DC OUTPUT NATO port. LED is illuminated when power is available from NATO connector labeled UNREGULATED DC OUTPUT.

ESM 1 and 2 - 100 A toggle switch, one per ESM Inter-Connect connection. Limits current flow to and from System batteries. Breaker switches must be on to charge or discharge connected ESMs.

See Figure 1 for diagrammatic location of breakers within circuit

OPERATOR INSTRUCTIONS

The instructions that follow describe how to connect the HyPR 6000 to other components to construct a Hybrid Power System. The actual configuration constructed will reflect mission requirements. All Solar Stik components are plug and play enabling the Operator to easily alter the System configuration to meet changing requirements.

Connecting ESMs to HyPR

The two (2) Inter-Connect ports labeled ESM 1 and 2 are dedicated ESM connections. Individual ESMs may be connected to each ESM port using an Inter-Connect cable or multiple ESMs connected to each (using Inter-Connect Strips) as shown in figure below. These are metered ports and the current measured is reported on the Home Screen: “Charging Current”

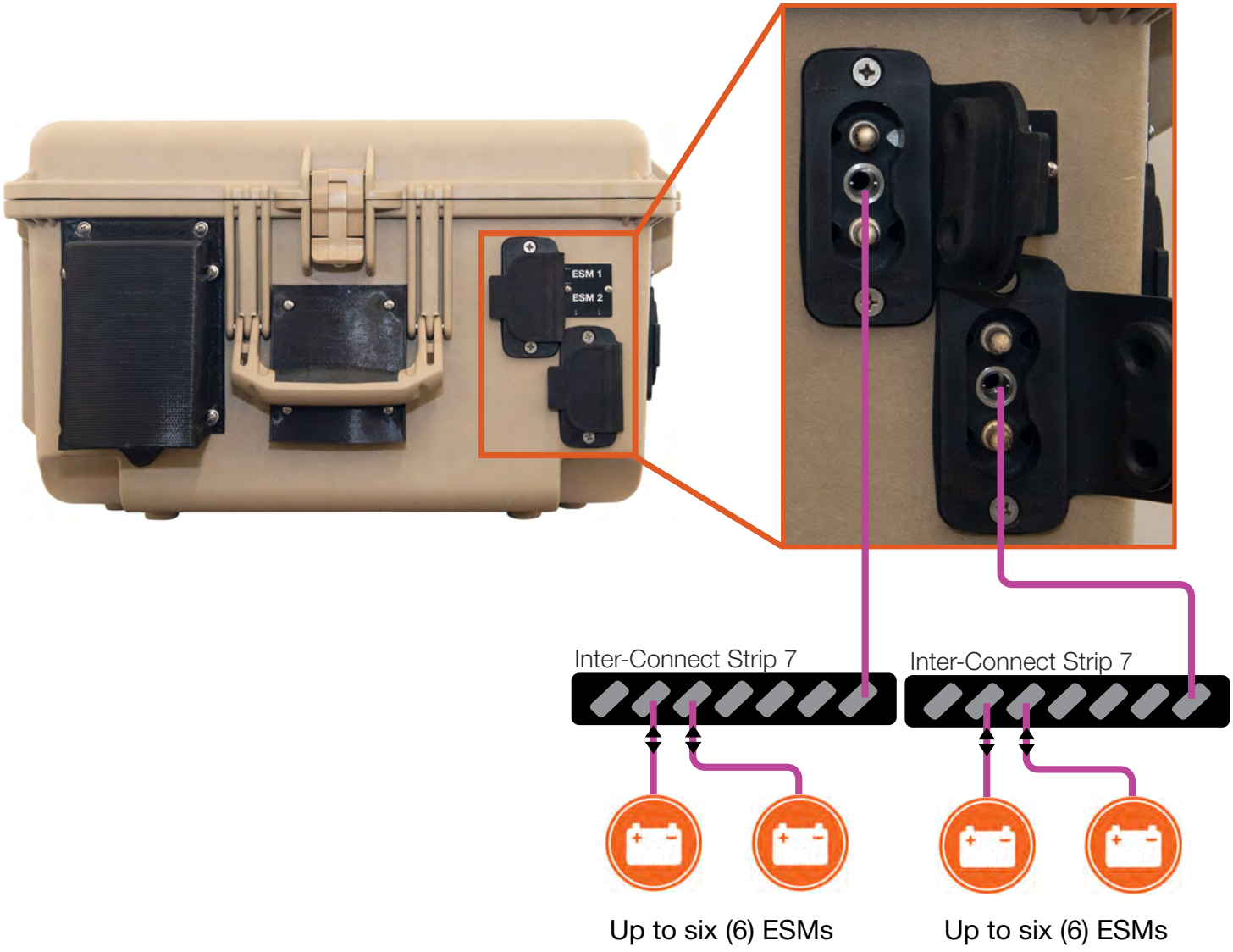


Figure 20. Connecting ESMs to HyPR

Connecting Generators to HyPR

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

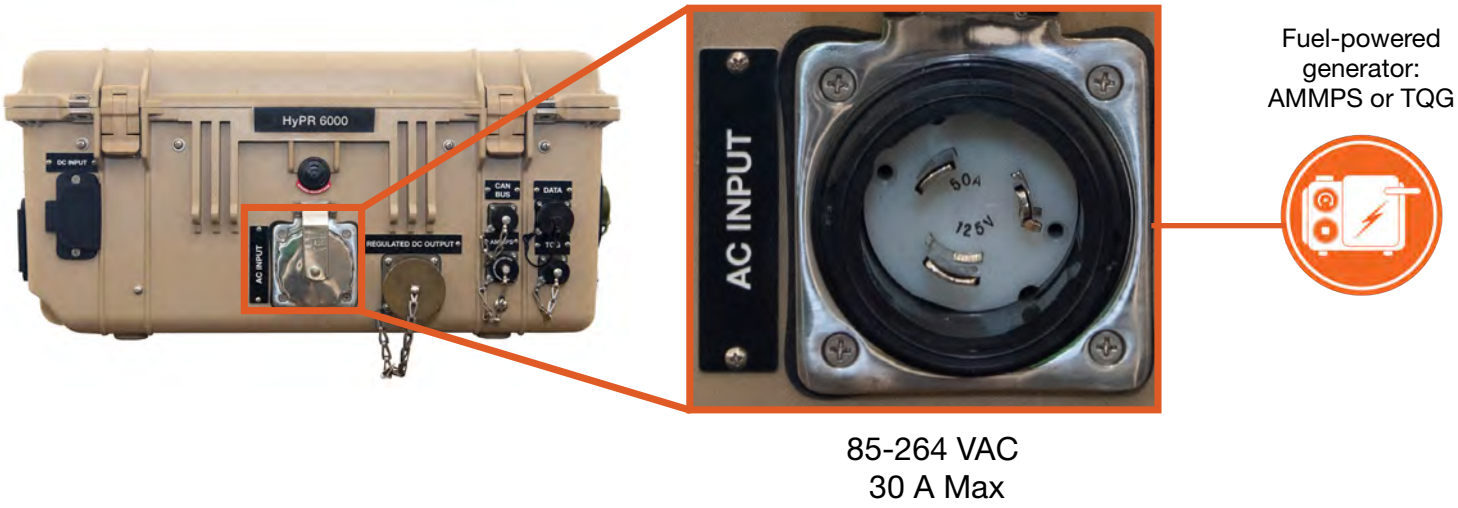


Figure 21. Connecting generators to HyPR

Compatible Generator Options

The HyPR can remotely start/stop TQGs that have been modified with a Solar Stik Remote-start Enabling Kit (RsEK) and AMMPS generators with the aDCS upgrade.

AMMPS Generator

MEP-1030 5 kW TQG

Tactical Quiet Generators (TQG)

MEP-802A
5 kW TQG

MEP-831A
3 kW TQG

Each of the generators above has the capability to provide power at either 120 or 240 VAC. Choose the 240 VAC option as the HyPR 6000 will operate more efficiently at 240 VAC.

GEN COMM Port Specificity

The two (2) GEN COMM ports are different and not cross-functional. Their specificity is as follows:

- **TQG Gen Comm port:** TQG: MEP-831A, MEP 802A
- **AMMPS Gen Comm port:** AMMPS: MEP-1030 (All AMMPS gensets equipped with aDCS are comms-compatible however, larger AMMPS gensets are not an ideal match for the HyPR 6000 in terms of power output/processing).

MEP-831A or MEP-802A TQG

Connect HyPR TQG port to the Auto Generator Control port on the TQG using a TQG Gen Comm Cable. A Solar Stik Remote-start Enabling Kit (RsEK) must be installed on TQG to communicate with the HyPR.

Figure 22. MEP-831A and MEP-802A Gen Comm Cable connection

AMMPS Generators

Connect to AMMPS Gen Comm port on the front of the HyPR to the NETWORK port on the AMMPS generator using an AMMPS Gen Comm Cable.

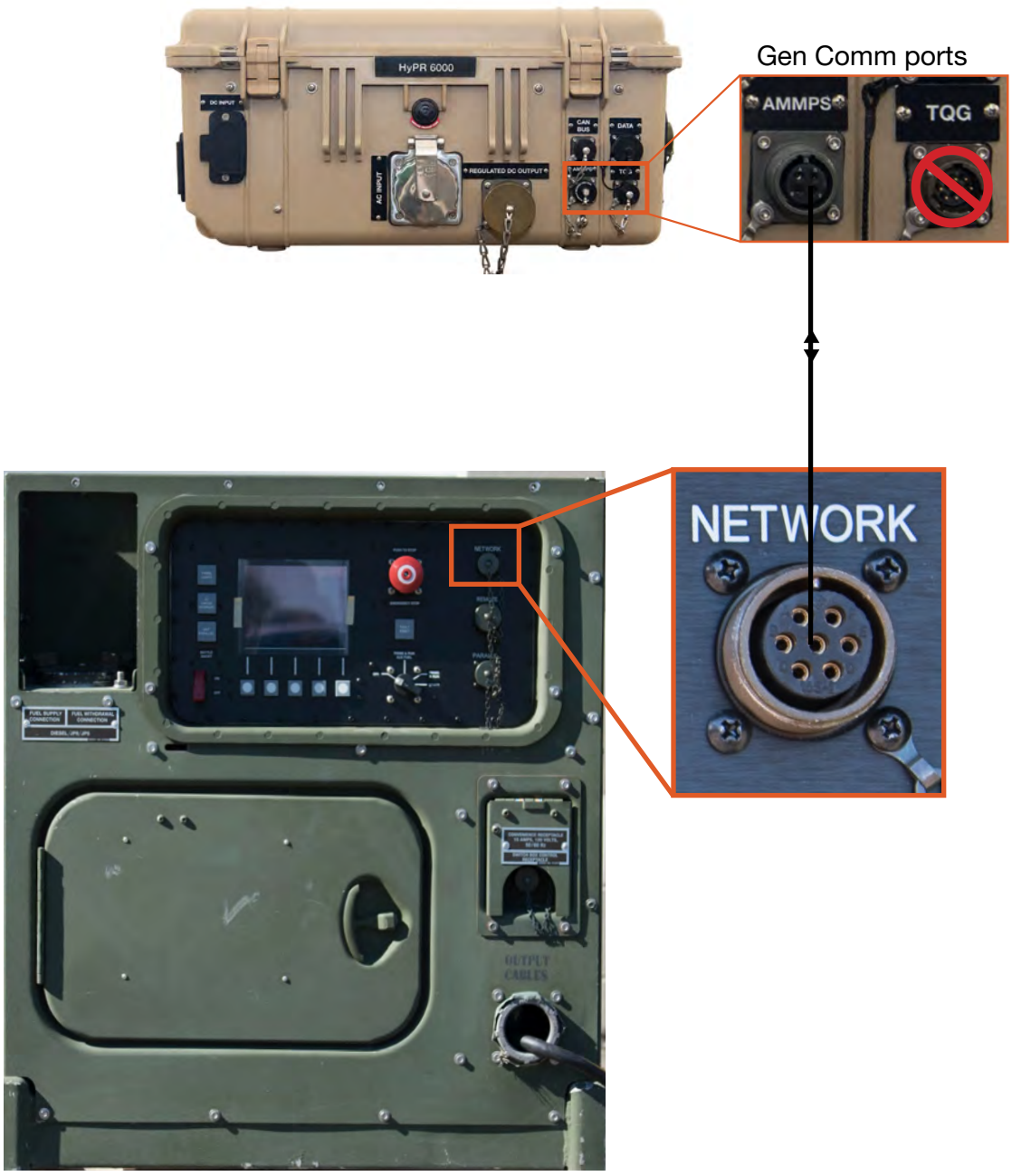


Figure 23. AMMPS generator GEN COMM Cable connection

Connecting Loads to HyPR

Regulated DC Power Output

The REGULATED DC OUTPUT port is a 2-pin connector that provides regulated DC power. Connection is ideal for sensitive electronic equipment. The regulated DC voltage is 28.5 when the HyPR is receiving AC power and 27.5 when HyPR is operating solely from connected batteries.

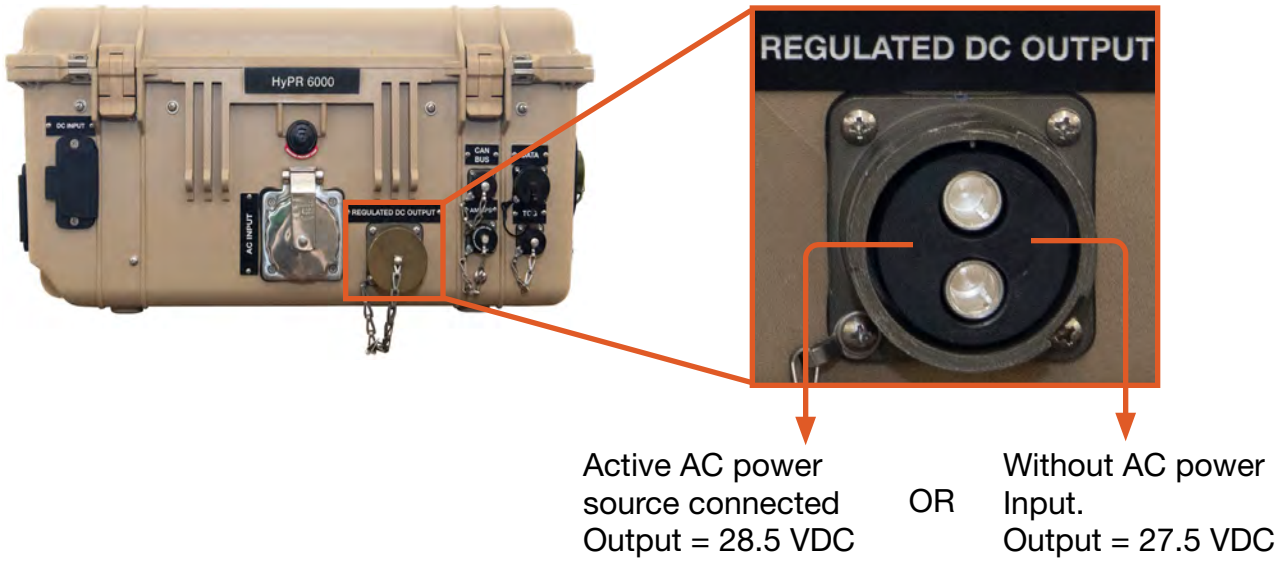


Figure 24. HyPR regulated DC power output connector

Unregulated DC Power Output

The UNREGULATED DC OUTPUT NATO port provides DC power with a voltage equal to battery voltage. This port is a direct connection to the HyPR internal DC bus. Power output from this port is subject to LVCO protections to prevent System battery overdischarge. **Note:** While labeled DC OUTPUT, this port may also be used to charge System batteries using an appropriate charging source such as a 24 VDC vehicle charging system.

Figure 25. HyPR unregulated DC power output NATO connector

User Interface Operation

The menus and submenus of the user interface are illustrated below in the order or their occurrence. Read and understand how to navigate these menus and submenus, how to change and save settings and how to configure and control the connected generator using GEN CONTROL.

GEN CONTROL will likely be the most frequently-accessed menu to start and stop a connected generator. Do not change programmed values in other submenus without consulting Solar Stik Technical Support.

After System has been connected, and the appropriate breakers have been toggled to ON, turn ON user interface display by pressing the center button.

Home Screen

Charger Status Indications

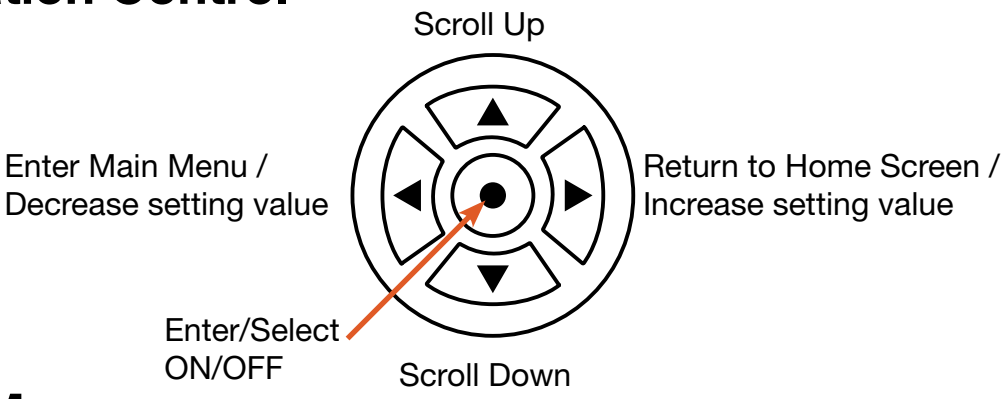
"**--**" - off or standby,
"**CC**" - constant current,
"**CV**" - constant voltage,
"**.***" - waiting for generator warmup
"**nn**"**%** - ramping up charging current

Read Only
System Status Values

Ch. Current	100A – –
Bus Voltage	26.61V
Reg. Voltage	28.10V
Reg. Current	10A

Press ◀ to enter Main Menu

Navigation Control



Main Menu

1. DC Output
2. Gen Control
3. System Info
4. AGS Settings

The Setting Screen lists the types of settings available to change. Use the up ▲ and down ▼ buttons to select the category of settings then press enter/select ●.

Submenus

DC OUTPUT
Ch. Current: 100A
LVCO: 24.4V

Use the up ▲ and down ▼ buttons to select either Ch Current or LVCO. Then Use the left ◀ and ▶ right to decrease or increase the value, respectively. Press enter ●, select Save Settings "Yes", press enter ●

Ch. Current = current from battery charger to the DC bus.
Range: 0-100 A; increment: 10 A

LVCO = Battery Low Voltage Cut Off. The voltage at which the HyPR disconnects the batteries from the DC bus. Prevents battery overdischarge.
Range: 20.0 - 30.0 V; increment 0.1 V

Gen Control
ON/OFF/AUTO
Gen Power
5000W

Use the up ▲ and down ▼ buttons to select either Gen Control or Gen Power. Use the left ◀ and ▶ right to decrease or increase the value, respectively or to toggle between ON/OFF/AUTO. Press enter ●, select Save Settings "Yes", press enter ●
ON/OFF/AUTO = Automatic generator control setting.
ON= generator ON, OFF= generator OFF, AUTO = generator runs automatically, starting and stopping at programmed voltages.
Gen Power = The nominal power output of the connected generator in watts. For example, MEP-802A or MEP-1030/AMMPS = 5000 W; MEP-831A = 6000 W.
Range: 1000 - 5000 W; increment: 500 W

System Info

Zero Shunt?	Yes/No
Firmware Rev.	1.2

Use the left ◀ and ▶ right to select Yes/No. Press enter ●.
Yes = Set current meter report (Home Screen) to zero (0) amps ONLY when zero (0) current flowing out of HyPR*.
No = Return to Main Menu.
Toggle AC Input to ON (with active AC power source connected); Toggle ALL other breakers to OFF.

AGS Settings

Start Voltage	26.5V
Stop Voltage	28.5V
Start Delay	15s
Stop Delay	60s

Use the up ▲ and down ▼ buttons to select AGS Start Voltage, Stop Voltage, Start Delay or Stop Delay. Use the left ◀ and ▶ right decrease or increase the value, respectively. Press enter ●, select Save Settings "Yes", press enter ●
Start Voltage = Battery voltage at which HyPR starts generator to charge batteries.
Range: 20.0-30.0 V; increment: 0.1 V
Stop Voltage = Battery voltage at which HyPR stops the generator due to batteries being charged fully.
Range: 20.0-30.0 V; increment: 0.1 V
Start Delay = Time delay after batteries reach generator start voltage.
Range: 0-127 s ; increment: 1 s.
Stop Delay = Time delay after batteries reach generator stop voltage.
Range: 0-127 s ; increment: 1 s.

Saving Settings and / or Returning to Main Menu

Save Settings?
Yes (press enter to save)
No (returns to settings)

Selecting "NO" results in returning to the selected setting. Select "YES" to return to Main Menu even if no change in setting value. Yes simply means that the setting is OK to be saved as is.

General System Operation Instructions For Hybrid Mode

Detailed Operator Instructions depend on the System into which the HyPR 6000 is integrated. Each HyPR 6000 I-Plate is customized with an abbreviated (but sufficient) version of the System-specific HyPR 6000 Operator instructions. The HyPR 6000 Operator instructions below are general and common to integrating the HyPR 6000 into almost any Hybrid Power System.

Before beginning:

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

- **HyPR AGS and DC output settings have been programmed by Solar Stik for the application and should not be changed.**

- **Turn off all breaker switches on the HyPR 6000.**

1. Connect the System according to the Connection Diagram on the HyPR 6000 I Plate.

2. Connect loads to HyPR.
   - Ensure load power switches are OFF.
   - Load power requirements must not exceed rated output of their respective connections.

3. Toggle ESM 1 and ESM 2 (as appropriate) to ON.
   - These switches allow current to flow from connected batteries into the HyPR, energizing the internal DC bus.

4. Set HyPR GEN POWER (user interface> Gen Control) to match output limit of generator.

5. Toggle HyPR AC INPUT breaker button to ON.

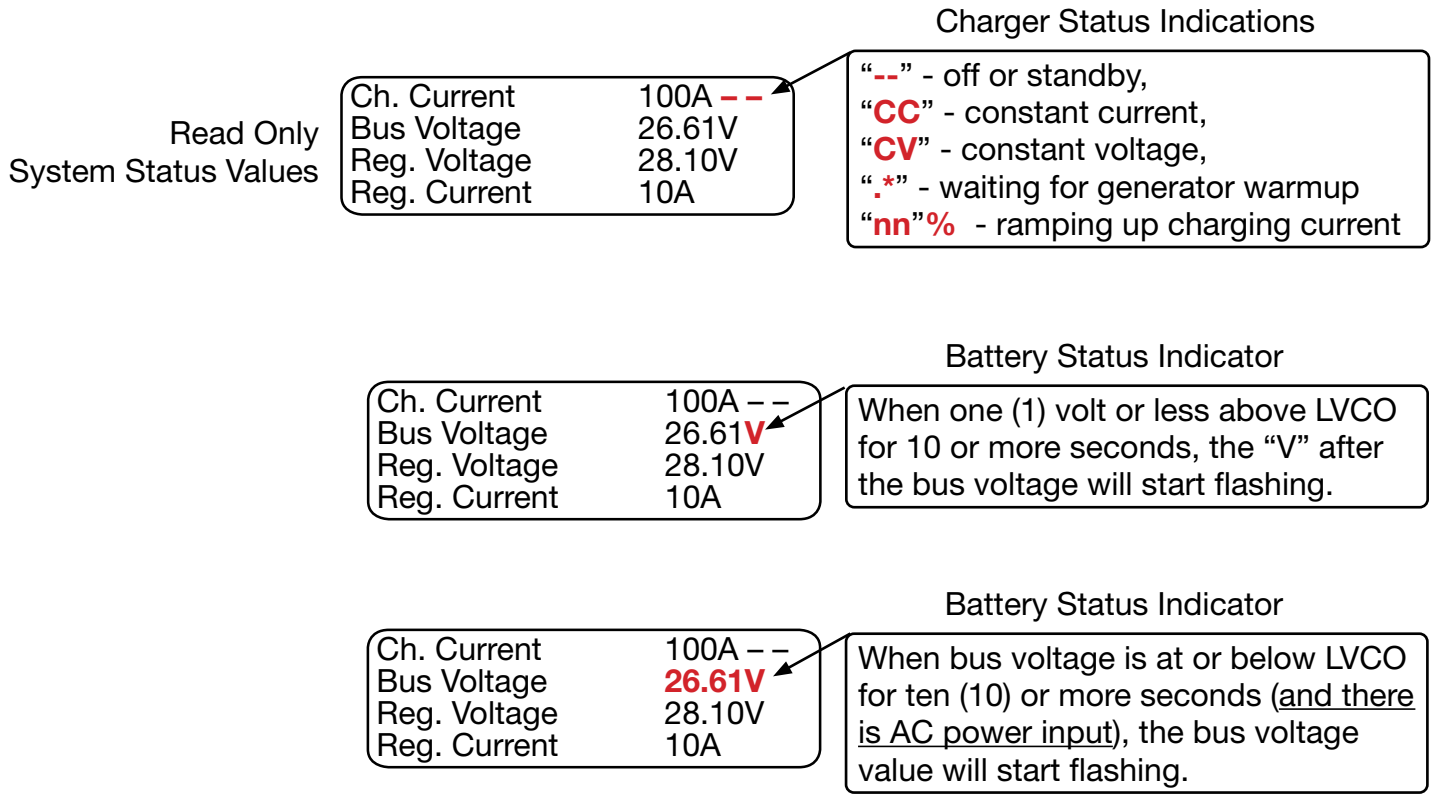
6. Set HyPR Gen Control (user interface>Gen Control) to ON to start connected generator.
   - Charge function begins after 30 seconds of generator warm up time. When charger comes on it ramps from 0 to 100% current over 25 seconds instead of coming on all at once. The progress of the ramp up is reported.

7. Change HyPR Gen Control to AUTO.
   - Allow generator(s) to run and charge ESMs until generator stops automatically.
   - Generator operation will stop when ESMs achieve full-charge voltage (~28.5 VDC).

8. Toggle breaker switch(es) for circuits in use to ON.

9. Toggle OUTPUT breakers to ON to activate loads.

Home Screen Status Indications



When the HyPR 6000 is connected to an active AC charging source, it will charge connected batteries at CV for 60 minutes, then the charger is shut off. The charger comes back on when the voltage equals CV set value minus 2 volts.

The HyPR 6000 disconnects System batteries when the bus voltage is below the LVCO setting value for 10 seconds.

DC Startup Button

Use the DC STARTUP button to startup/activate the HyPR when
- Batteries (with a normal operating voltage) are connected to HyPR
- No AC or DC (e.g., solar) power inputs are connected or available.
- HyPR is OFF and not responding when ON/OFF user interface button is pushed.

To power up the HyPR under these circumstances:

1. Push and hold the DC STARTUP button until the display turns ON.
2. Release DC STARTUP button.
3. User interface remains ON if battery voltage is > LVCO.

If the display turns off after releasing the DC STARTUP button, the voltage of the connected batteries is less than LVCO and the batteries must be charged to the restart voltage.

Applying a charging source, AC or DC, will automatically power up the System without the use of the DC Startup Button. The conditions that would cause the necessity of using the DC Startup Button should be fairly rare.

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 ºF; 25 ºC). 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 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.

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.

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 6000 to reduce solar loading. Solar Stik data indicate that solar loading of a Pelican case can increase internal heat by ~40 ºF (~ 22 ºC) 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.

MAINTENANCE

Preventive Maintenance Checks and Services (PMCS)

Item #	Item to be Inspected	Interval	Procedures	Non-mission Capable
1	Visual inspection of 24VDC HyPR 6000	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 6000 Air Intake Filter Maintenance

There are two (2) air intake filters on the left side of the HyPR 6000. The vents on the right side of the HyPR are an exhaust vents and have no vent air filters.

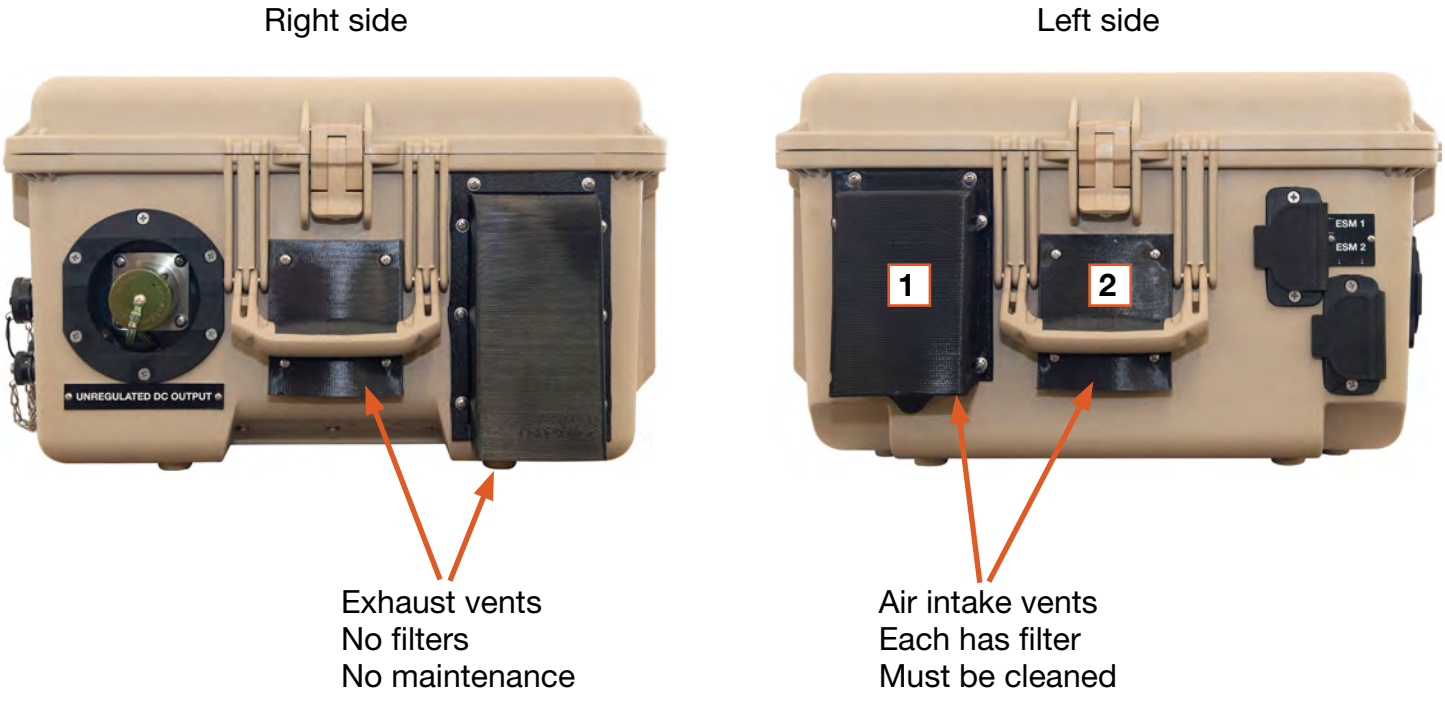


Figure 26. Location of HyPR 6000 air intake and exhaust vents

Cleaning or replacing large air intake filter

Grasp and pull down on tab (**A**) at bottom of air filter cassette and slide out (**B**) of vent shroud. Open cassette and remove old filter (**C**). Place new or cleaned filter into cassette (**D**). Ensure proper alignment of filter within cassette (**E**). Slide back into vent shroud (reverse of [**B**]).

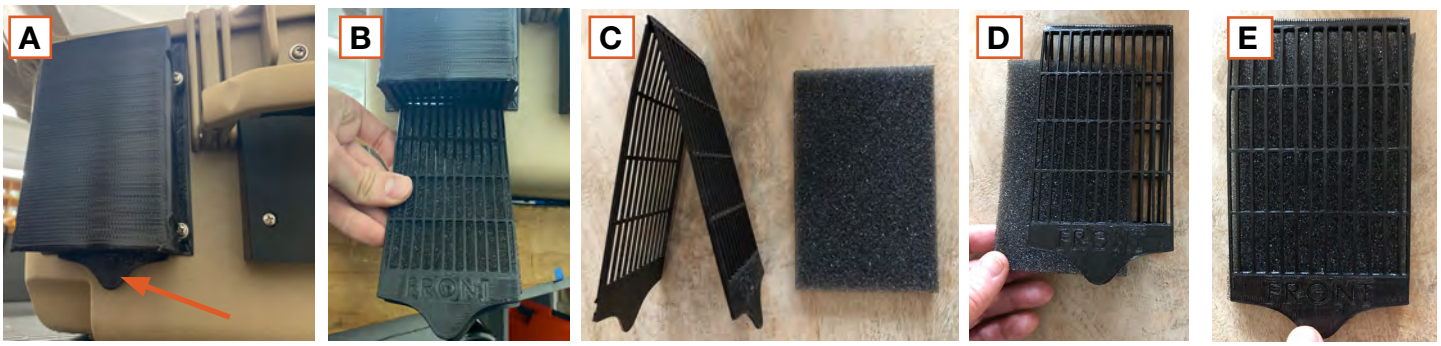


Figure 27. Cleaning or replacing large (Figure 26 “Left side, 1”) air intake filter.

Cleaning or replacing small air intake 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 guard that prevents ingress of small critters The guard will likely stay embedded in the plastic vent shroud (**B**). The foam filter is attached to the case with adhesive tape (**arrow**). Carefully remove and clean or replace the filter then reinstall the vent assembly.

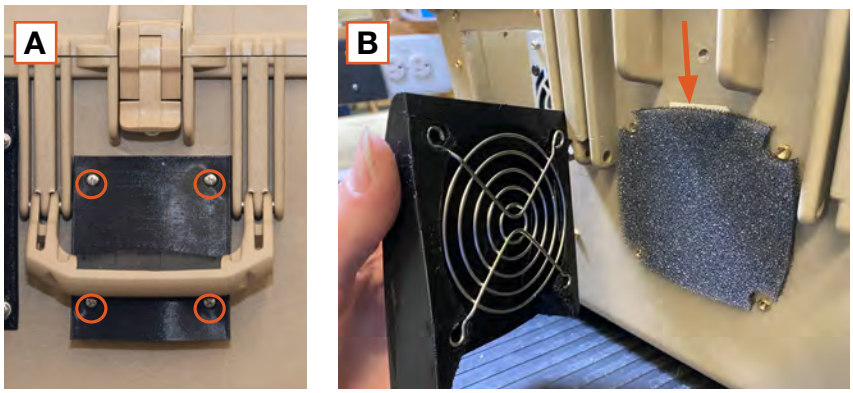


Figure 28. Cleaning or replacing small (Figure 26 “Left side, 2) air intake filter.

Water Intrusion Remediation

If water intrusion is suspected, and the System is still functional, disconnect power sources entering the HyPR 6000 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 6000 from the System. Do not move or relocate what may be a flooded HyPR 6000.

Keep the HyPR 6000 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 6000 slowly until no more water drains from the hole. After the water has been drained, remove the Faceplate. Place the HyPR 6000 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 6000 to the System and test it to determine if it is still functional.

Figure 29. Drain plug screw located under the TECH PORT

Transporting the HyPR 6000

The HyPR 6000 is designated as a two-person lift (**A**). It also has an extendable tow handle and wheels (**B**) for easy single-person transportation across appropriate surfaces.

A

B

Figure 30. HyPR human transportation.

TROUBLESHOOTING

Nuisance activation of LVCO during surge loads

If nuisance activation of LVCO is observed during brief surge loads, contact Solar Stik Technical Support for a firmware update.

TECHNICAL SPECIFICATIONS

General

Nominal Operating Voltage	24 VDC
Internal cooling	Thermostatically controlled forced convection
User Interface	LCD and navigation keys
Data	Modbus/RS-485
Case	Pelican Protector 1610
Warranty	1-year materials and workmanship

DC Output

Output Voltage	(1) Regulated 27.5 to 28.5 VDC (2) Unregulated bus voltage (NATO)
Output Current	80 A (Regulated Output)
Output Power Rating	(1) 2300 W continuous regulated (2) 2300 W continuous unregulated

AC Charger Specifications (@77 °F/25 °C)

AC Input Voltage	120-264 VAC
Continuous Output Current	100 A
AC Input Frequency	47-63 Hz
Charging Stages	CC/CV
Charging Efficiency	• 84% (typical) at 100 VAC • 87% (typical) at 200 VAC
Compatible Battery Chemistries	24 VDC (nominal) $LiFePO_4$; 24VDC Pb-acid

Power Generation Options

Grid	47-63 Hz, 120-264 VAC
Generator	3 kW TQG/5 kW TQG/5 kW AMMPS
Auto Generator Start Conditions	Voltage, adjustable
Renewable Energy	For solar, wind, etc. via 24 VDC bus

Safety

Breaker(s)	• AC Input: 50 A, 2 Pole • DC Input (PowerHub): 100 A, 1 Pole • Regulated DC Output: 100 A, 1 Pole • Unregulated DC Output: 100 A, 1 Pole • ESM 1: 100 A, 1 Pole • ESM2: 100 A, 1 Pole
Certifications	Built and designed to MIL-STD-810G and IP65

Connections

Input(s)	(1) 120-264 VAC/50-60 Hz and 208 VAC/60 Hz (1) 24 VDC DC Input/Power Hub
Output(s)	(1) 28 VDC U10-580902-323 (mates with AIB6FA32-5P) (1) NATO Receptacle
Input(s)/Output(s)	(2) 24 VDC ESM (1) Generator (TQG) Communication (MS3122F12-10P) (1) AMMPS Generator Communication (MS3452W14S-2S) (1) Data (RJ45) (1) CAN Bus

Environmental

Operating Temperature*	-32 ºC (-25 ºF) to +49 ºC (+120 ºF)
Storage Temperature**	-33 ºC (-28 ºF) to +71 ºC (+160 ºF)

*** 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	77 lb (35 kg)
Dimensions	29 x 20 x 12 in (74 x 51 x 30 cm)

ADDITIONAL INFORMATION

AMMPS generator: DCS or aDCS?

The Advanced Digital Control System (aDCS) Module provides automatic, remote start/stop capability to the AMMPS generator when it is connected to an appropriate power management device such as a Solar Stik HyPR 6000. The DCS does not provide this capability. The images below show how to identify the DCS type installed in an AMMPS genset.

- The Advanced DCS with Autostart capability has a “NETWORK” port in the upper-right-hand corner
- A DCS with a “USB” port in the upper-right-hand corner does NOT have autostart capability.

DCS without aDCS remote start/stop capability: USB connector.

Advanced DCS with aDCS remote start/stop capability: Multi-pin NETWORK connector

Figure 31. Distinguishing AMMPS generator DCS from aDCS

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 support American innovators and manufacturers.

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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