SOLAR STIK®

SYSTEM SETUP, OPERATION AND MAINTENANCE MANUAL FOR THE SOLAR STIK USAF G-BOSS LIGHT HYBRID POWER SYSTEM

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Revision History

Section	Page(s)	Description	Date
		First released as a PRELIMINARY DRAFT	Feb 2020

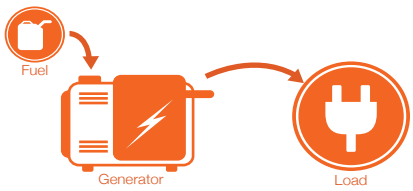
GENERAL INFORMATION, EQUIPMENT DESCRIPTION, AND THEORY OF OPERATION

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.

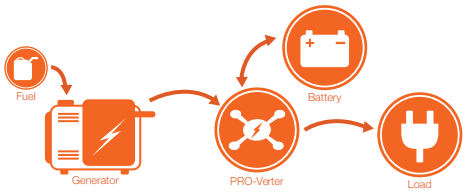
Introduction to Hybrid Power Systems

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.**



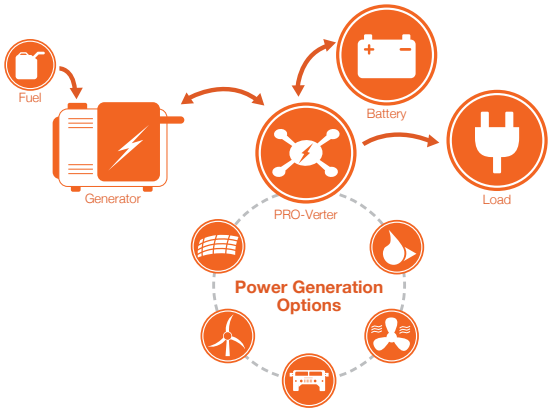
Low-efficiency
Traditional Power System



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

Important Safety Information and Instructions

This manual contains important instructions that must be followed during the installation and operation of the System. Read all instructions and information contained in this manual.

Thoroughly read and understand the operator manual for each of the components in this System PRIOR to assembly and use of this System. Important information regarding the safe setup and use of each component and this System is contained in each of the operator manuals. DO NOT begin assembly or use of this System without first reading and understanding the individual operator manuals.

While the System components are designed for indoor/outdoor operation, the User 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 System. 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

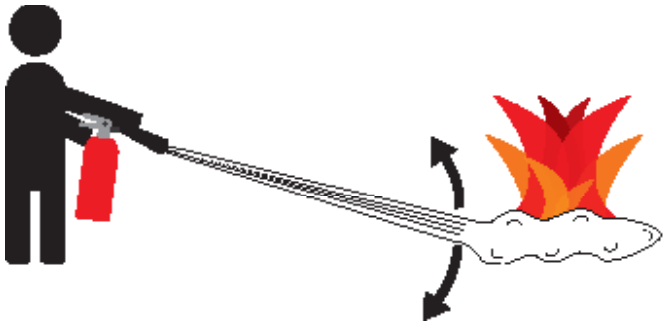
Only CO_2 (carbon dioxide) fire extinguishers should be used with this equipment.

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.



Use Sweeping Motion

These additional cautionary steps will ensure your safety:

- System components should not be operated in standing water.
- Close and latch the component lids if it is precipitating.
- System cables should not be routed through standing water.
- Cable connections should remain dry.
- Unused ports on System components should be covered when not in use to reduce the possibility of water intrusion.

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.

Grounding the System

Grounding the PRO-Verter at the grounding lug is an important safety measure. The PRO-Verter and the generator (if included) should be bonded to an earth grounding rod. When the generator is running, the AC neutral and equipment ground automatically are bonded internally at the generator. When running off battery, the AC neutral and equipment ground are automatically bonded internally at the PRO-Verter.

If the System is ever connected to grid power, the AC neutral must be bonded to the earth ground at the main breaker panel of the grid power. Any generator connected to the System must have a neutral-to-ground bond.

Figure 1. PRO-Verter grounding lug

⚠ WARNING

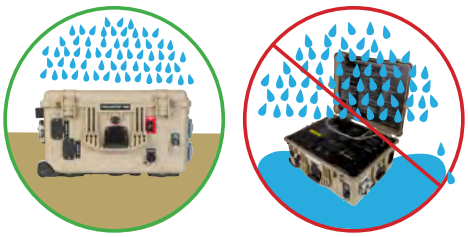
If both the MEP-831A TQG and grid AC Input sources are connected to the PRO-Verter S 3000, THE TQG GROUND WIRE MUST NOT BE CONNECTED TO THE TQG "GND" TERMINAL.

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.

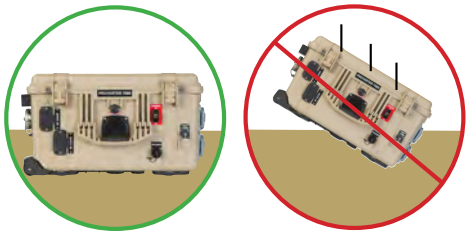
Water

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.



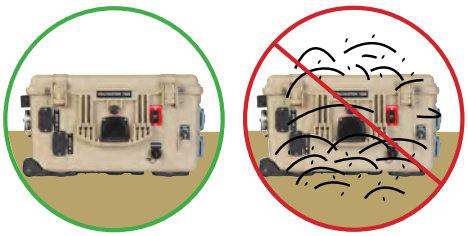
Impact

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



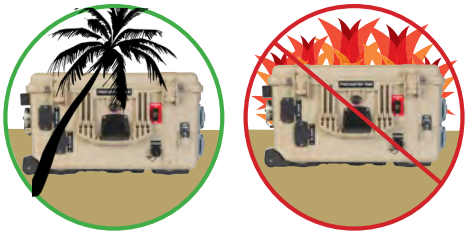
Dust/Foreign Object Intrusion

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.



THEORY OF OPERATION

Models of Operation

Depending on the application, there are several operational models that can be configured using a PRO-Verter.

Note: The PRO-Verter settings used in each Model of Operation are unique and not interchangeable. The PRO-Verter must be programmed specifically for the Model of Operation in which the System is functioning. Damage to System components may occur if a PRO-Verter is not properly programmed for the Model of Operation in which the System is functioning.

DC-only/Inverter (automatic functions)

Operating conditions – All power generated is from DC generators and AC loads are supported by the PRO-Verter's Inverter function using energy stored in batteries.

Hybrid (automatic functions)

Operating conditions – The "Continuous Load" AC power requirement is LESS than the individual Inverter or Generator/Grid AC power output ratings.

In the Hybrid model, the PRO-Verter serves as the primary power management device in a System, using either Inverter AC power or Generator/Grid AC power to maintain the load. In the Hybrid model, the batteries will cycle regularly to mitigate generator run-time and logistical support often associated with operation in remote locations. Hybrid systems also provide the operator with a flexible architecture that allows for the addition of multiple power sources, such as renewable power generation.

Load Support (automatic functions)

Operating conditions – The "Surge Load" AC requirement is MORE than the Generator/Grid AC output, but less than the Inverter AC output rating.

The Load Support model allows the use of a smaller generator based on total loads operating over 24-hour period rather than a larger generator that is required for the "peak" loads, which may only last for a brief period. The PRO-Verter can be used to provide supplemental "surge" AC power to a generator/grid AC source during brief/intermittent periods while allowing the "continuous" loads to be supported in the Hybrid model.

Peak Power Delivery (manual functions)

Operating conditions – The "Peak Load" AC requirement is MORE than the PRO-Verter AC continuous output ratings.

In the Peak Power Delivery model, the PRO-Verter combines generator/grid AC power with Inverter AC power to support "peak" AC for brief periods. This mode can only be supported for limited durations and is directly dependent on the total battery capacity and their SOC.

UPS (automatic functions)

Operating conditions – A PRO-Verter connects critical AC loads directly to grid/utility or prime AC power when it is available, and provides backup power for the load by supplying Inverter AC (using energy from a connected battery bank) when the Grid-Utility or Prime AC source is interrupted.

In the UPS model, “peak shaving” and the use of renewable power sources are also possible by connecting a Power Hub.

Note about PRO-Verter Model Programming:
The PRO-Verter is pre-programmed at the factory for use in the application in which it is to be used. It is possible for the Operator to alter any of the programmed settings when operating conditions change and/or system architecture changes are necessary. To learn more, contact Solar Stik Technical Support.

The HPS Architecture, Function and Operation

The Solar Stik Hybrid Power System (HPS) incorporates three technologies that comprise a network:

- Energy Storage
- Power Management
- Power Generation

The PRO-Verter, Power Hub and Expander Paks are designed to operate in concert and provides uninterrupted pure sine-wave AC and DC power to the loads. It is a powerful solution for the following conditions:

1. Protecting the generator from adverse operating conditions.
2. Grid or Generator AC power sources are not present or only intermittently available.
3. Power requirements for the load may exceed an existing power source’s daily power output, requiring multiple power sources to operate in concert to meet the daily demand
4. The reduction of fuel-driven generator “run-time” is necessary, due to logistics concerns or to simply to reduce the cost burdens of operating a generator.

It is important to follow two rules when configuring generation and storage technologies to serve in an application:

1. The power generated over 24 hours must be greater than or equal to the power consumed
2. The energy storage capacity must be able to power the load over 24 hours (with no recharging)

Energy Storage – The Foundation of the HPS

Operating a generator may have significant cost burdens (logistics, support, etc). The HPS alleviates those cost burdens by redirecting the financial investment into a battery-based platform.

Batteries in a hybrid system are designed to “cycle”. A full cycle is defined as one complete discharge and recharge over a specific period of time. With every cycle that occurs, the HPS is providing a return on the financial investment.

All batteries have a cycle-life, and therefore should be considered the “consumable” part of the HPS. The health of the battery can directly affect the function of the HPS over time, so proper cycling and cell-health management practices are strongly encouraged.

Minimum Battery Capacity Required for Optimal System Operation

A hybrid power system will function most efficiently when proper balance is achieved within the System’s architecture (Energy Storage, Power Management, and Power Generation). The central power management device is the PRO-Verter, so any components that are connected to it need to be rated for the amount of power that will be processed by it.

For example, PRO-Verters can require extremely high current (amperage) ***from*** the battery bank when AC loads require power from the inverter, but it can also push high current ***into*** the bank when it is in charge mode.

Each Expander Pak has a built-in circuit breaker that will trip at a value ***less than*** the maximum rated current to/from the PRO-Verter. For this reason, multiple Expander Paks must be connected to a PRO-Verter for the system to function at its rated power. **The combined values of the Expander Pak circuit breakers must be greater than the rated inverter/charger current required from the PRO-Verter**.

Connecting an insufficient number of Expander Paks (energy storage modules) to a PRO-Verter will result in a situation where the batteries are charged or discharged too quickly:

- Charging $LiFePO_4$ Expander Paks too quickly may result in an artificially high battery voltage reading and signal the PRO-Verter to turn off the generator before the batteries are actually charged sufficiently.

- Discharging $LiFePO_4$ Expander Paks 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.

Refer to the “Minimum Battery Capacity Recommendations” on the PRO-Verter I-Plate to ensure trouble-free operation.

System Cycling

During normal operation, the generator runs only to charge the ESMs and support the load while doing so; the batteries and generator will cycle 1-2 times daily.

The overall health of the HPS can be determined by the amount of cycling that occurs in a 24-hour period. If the HPS cycles more than twice daily, or is experiencing irregular cycling, there are several factors that may be causing it:

- Excessive load
- Inadequate battery capacity
- Heat-derated performance
- Disparity in battery SOC

Consult the troubleshooting sections for more details on causes of irregular or excessive cycling.

Load Prioritization

When the HPS is fully functioning, providing power to the load is always prioritized over other functions.

If renewable DC generators (i.e., PV arrays, wind, etc.) are producing power, it is immediately directed to to the load once it flows into the HPS. The batteries will ONLY begin to charge once the DC generation exceeds the demand from the load.

During periods of peak renewable DC generation, it may be exclusively used to support the load while excess energy charges the batteries simultaneously. This function reduces the demand on the batteries, prolongs battery-operation time, and promotes healthy cycling of the battery.

This same function also occurs when the HPS is connected to an AC source. If the HPS is connected to an active generator or grid-utility, the load is always supported FIRST before any AC is used for charging the HPS batteries. If the PRO-Verter is controlling a connected generator and the battery bank reaches a low state-of-charge, the PRO-Verter can be programmed to auto-start the generator to keep AC flowing to the load, only charging the connected batteries once the load is fully supported by the generator.

Real-time Load Management

When connected to an active AC source, the PRO-Verter can automatically adjust (in real time) its battery-charging rate to keep the total load value under the AC INPUT setting value.

If the load is dynamic, the PRO-Verter can make immediate adjustments and keep the total load on the AC source from exceeding the value of the AC INPUT setting while still maintaining a 100% load at the external AC source (generator or grid-utility).

It is incumbent on the operator to ensure that the sum of all loads does not exceed the limit of the AC source (generator or grid-utility) or the connections or circuit protections in the network. The AC input settings (Grid Max Current/Gen Max Current) should be set to the same value of the maximum AC output rating of the source. For example, if the generator is rated for 3000 Watts continuous output, then the AC input should be set for 25 Amps* (25A @ 120VAC = 3000 Watts)

"Overload" Conditions

Over-loading of the System can occur under the following conditions:

- Load AC power demand is greater than the inverter's rated output
- Load AC and DC power demand is greater than the connected AC source (generator or grid/ utility)
- Load AC power demand is greater than the AC Input setting, which may cause the PRO-Verter to disconnect from the AC source when in pass-through (charging) mode
- Load AC and DC power demand is greater than the output of the connected AC source (generator or grid utility) causing it to shut down

In each of these scenarios, the solution only requires a reduction in the total load demand (AC and DC). Use the User Interface Home Screen Menus (read only) to confirm the load is reduced to prescribed levels and proceed with normal operation.

Scaling and Modifying the HPS

When expanding or modifying the HPS 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 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 (fuel-driven generator, wind, fuel cell, etc.).

- 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 etc.

Stacking

- Capabilities can be added (or removed), including advanced power distribution and management modules, stacking of generators with PRO-Verters, Power Hubs and more.

Consult the individual product manuals for additional information about scaling and stacking.

Note: When scaling or modifying the HPS architecture, it should be done so with all components in the HPS completely inactive and OFF. The Initialization and Calibration step must be repeated once the modifications have been made.

PRO-Verter Stacking Example

Stacking PRO-Verters, of the same or different types, provides a mechanism to power a wide variety of AC loads from the same system. The dashed-line box surrounds the stacked PRO-Verters.

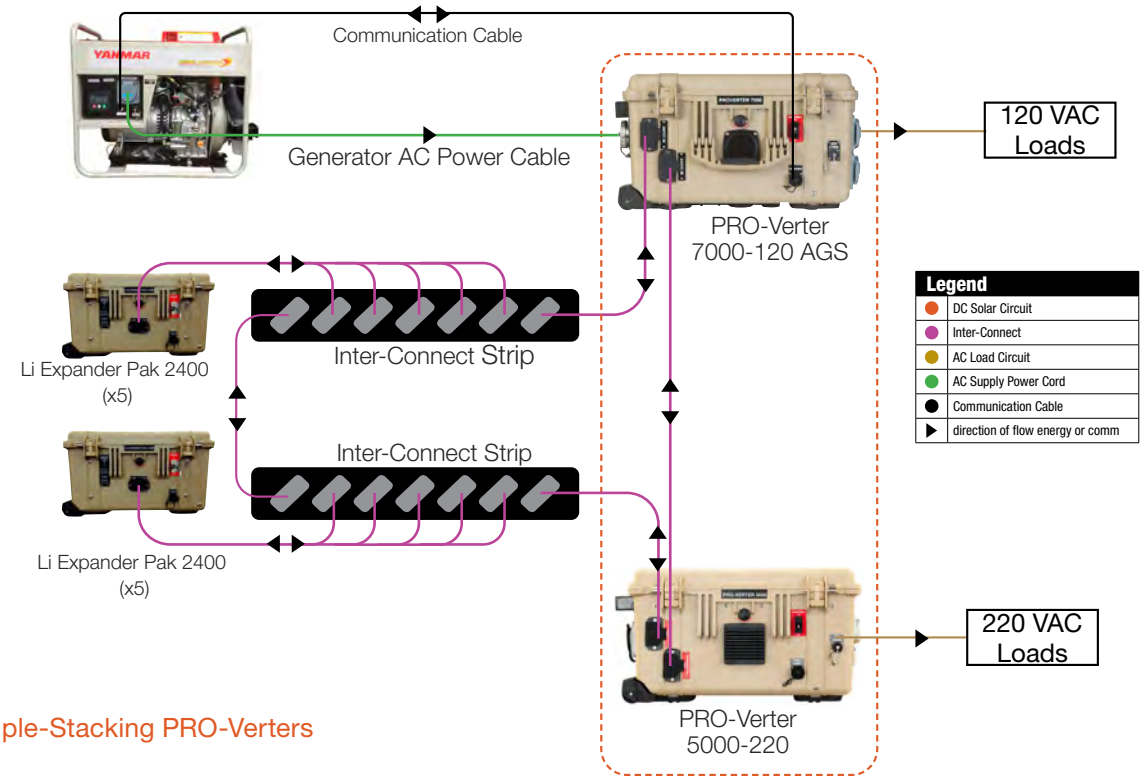


Figure 2. Example-Stacking PRO-Verters

Power Hub Stacking Example

Stacking Power Hubs, of the same or different types, provides a mechanism to add DC power sources to a system. The dashed-line box surrounds the stacked Power Hubs.

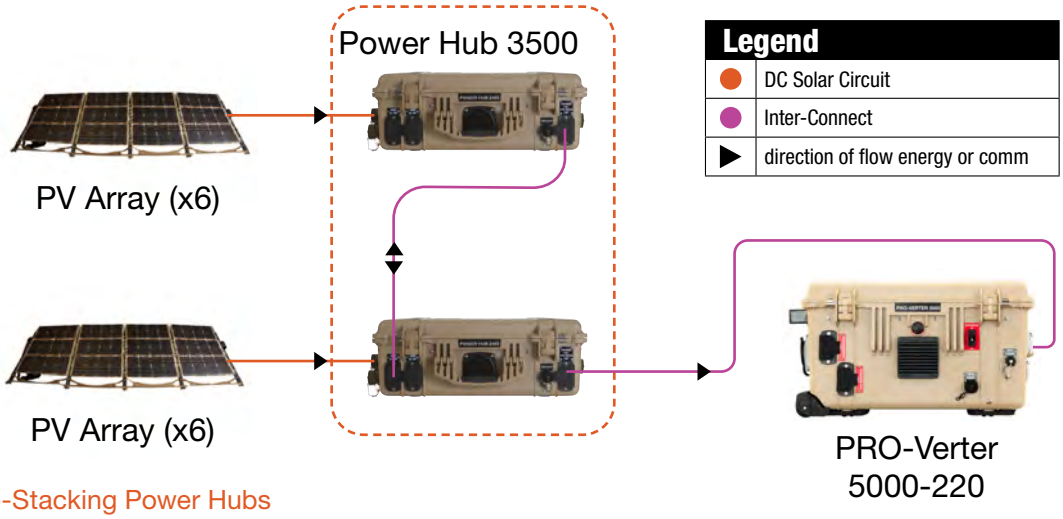


Figure 3. Example-Stacking Power Hubs

Scaling Energy Storage Capacity Example

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

Use Inter-Connect Strips and Inter-Connect Cables to create a “bank” of Li Expander Paks (Figure 19). **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 Expander Paks can be removed from service in accordance with reductions in runtime requirements.

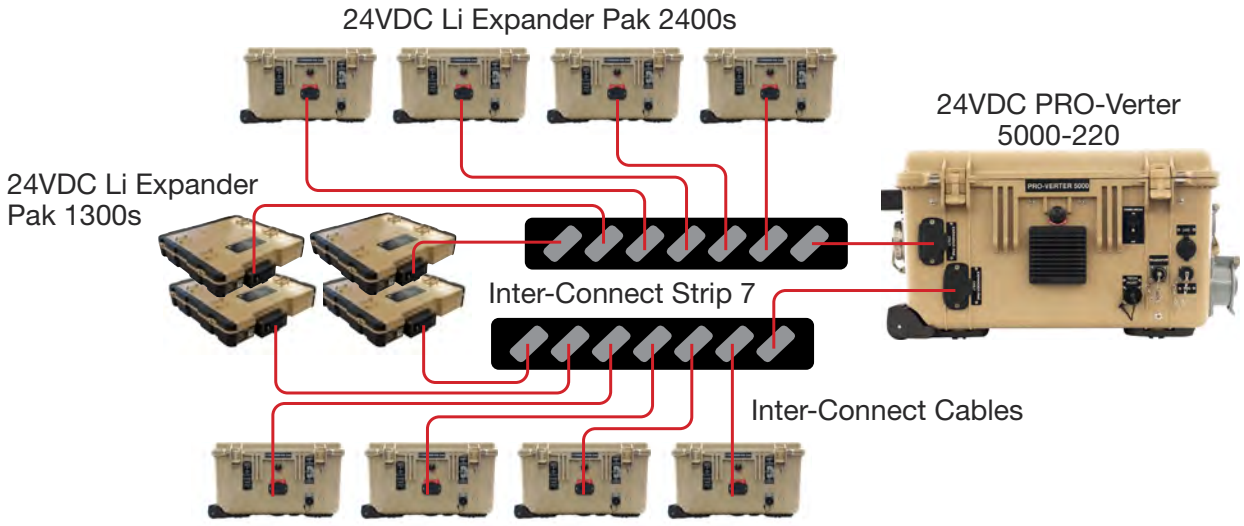


Figure 4. Connecting Li Expander Paks using Inter-Connect Strips and Inter-Connect Cables

Equipment Description

The Inter-Connect System

The 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 Power Hubs 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. The PRO-Verter S 3000 logs data via an SD Card next to the User Interface.

The Standard Inter-Connect Plug

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

Figure 5. Inter-Connect Plug

24 VDC Power Distribution (PDM) 3000

The PDM 3000 draws power from the HPS 24 VDC bus and converts it to stable, regulated 28 VDC output. The PDM protects equipment that is sensitive to voltage fluctuations.

PDM 3000 Connections

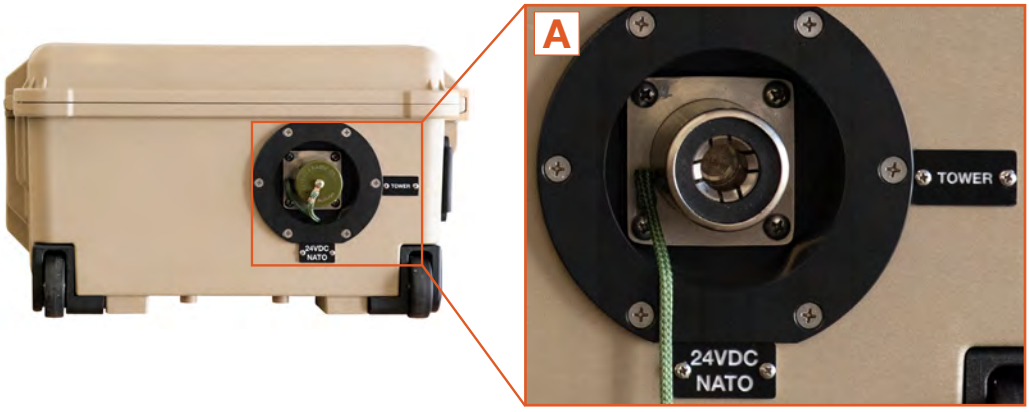
The Inter-Connect port connects the PDM 3000 to the HPS DC bus.

24VDC Inter-Connect

Figure 6. PDM 3000 front side

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

The NATO Port provides 24VDC Power to the G-BOSS tower



24VDC NATO

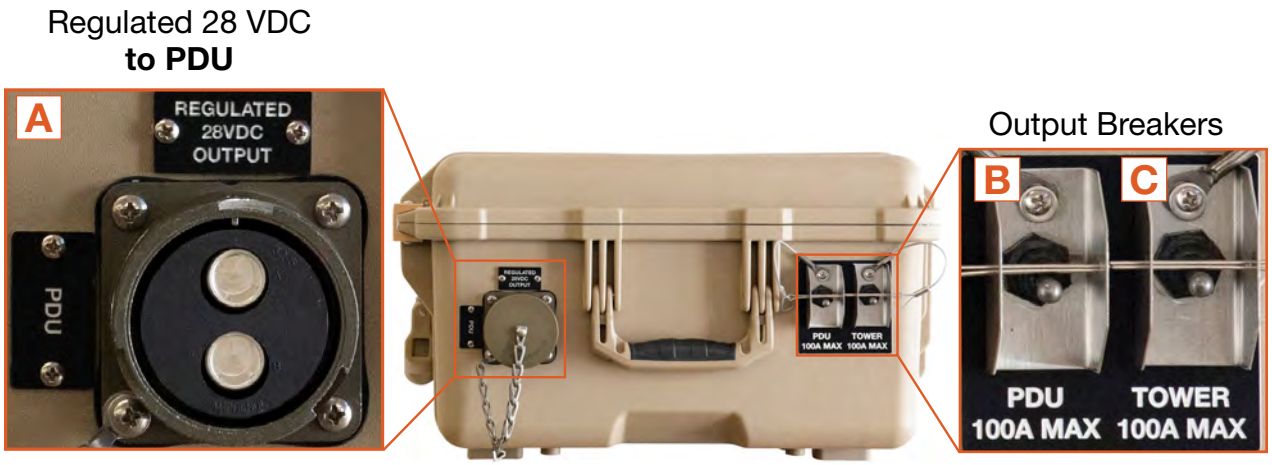
Figure 7. PDM 3000 left side

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

The 2-pin connector in the right side of the PDM 3000 provides regulated 28.0 VDC power to the G-BOSS Power Distribution Unit (PDU). The 100 A breakers on the right side also serve as power switches for engaging and disengaging power circuits to the tower and the PDU.

⚠ CAUTION

Do NOT connect a battery directly to the regulated 28 VDC output port as this will damage the PDM 3000



	Description	Connector	Voltage	Amps
A	28.0 VDC regulated output	Amphenol	28.0 VDC	100
B	Regulated 28 VDC Output to PDU	N/A	N/A	100
C	24 VDC Output to Tower	N/A	N/A	100

Figure 8. PDM 3000 right side

The bottom of the PDM 3000 case is cut away and sealed to facilitate passive heat dissipation from the internal components.

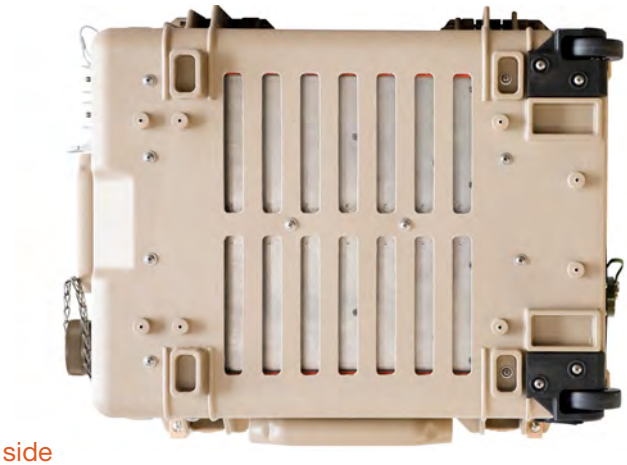


Figure 9. PDM 3000 bottom side

PDM 3000 I-Plate

Figure 10. PDM 3000 top, Faceplate, specs and cautions

24VDC PRO-Verter S 3000

Connections and Cooling

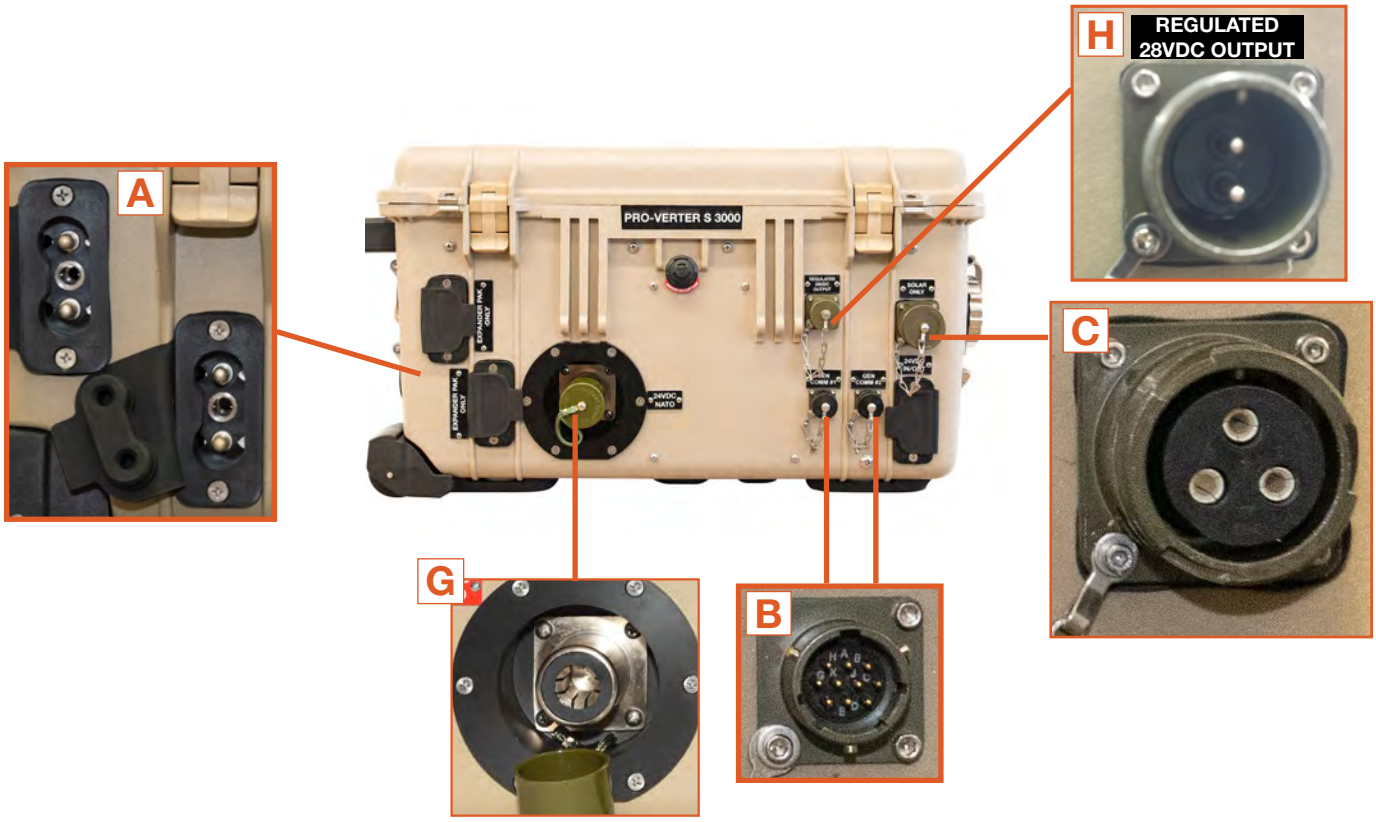


Figure 11. PRO-Verter 3000-120 AGS front exterior

	Description	Connector	Voltage	Amps
A	Battery Connection (metered port)	Inter-Connect Port	24 VDC	200
B	GEN Comm Ports	Amphenol HA100001-02-36	-	-
C	Solar Only Port	Cannon Bayonet Receptacle CB2-22-2SC		
G	24 VDC NATO Slave (unmetered)	NATO Slave	24 VDC	100
H	Regulated DC Output	Amphenol 2-pin	28.0	7.8

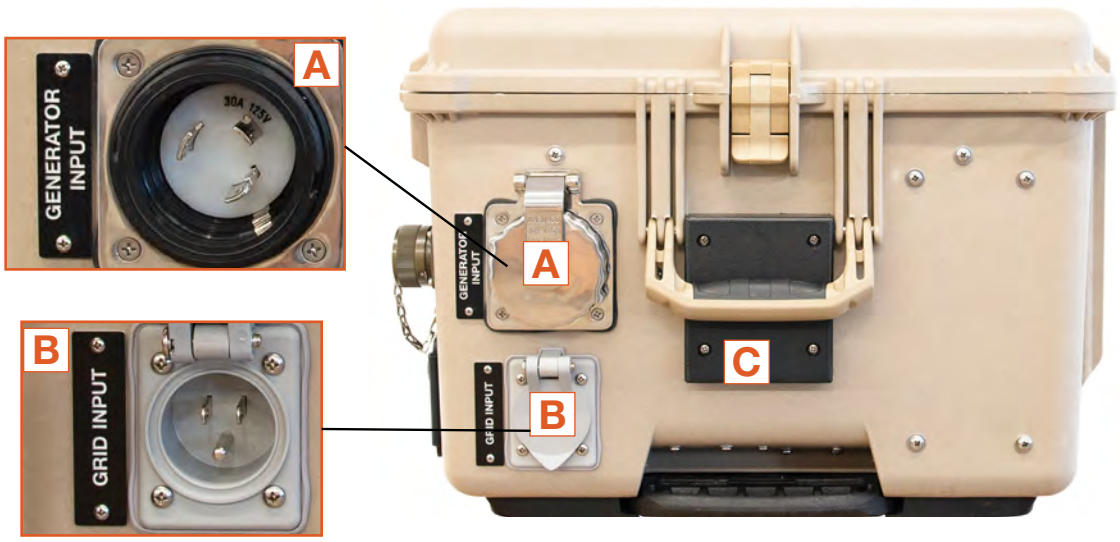


Figure 12. PRO-Verter 3000-120 AGS right exterior

	Description	Connector	Voltage	Amps
A	120 VAC GENERATOR Input Connection	Marinco	125	30
B	120 VAC GRID Input Connection	HBL61CM65	125	20
C	Exhaust Vent Cover	-	-	-

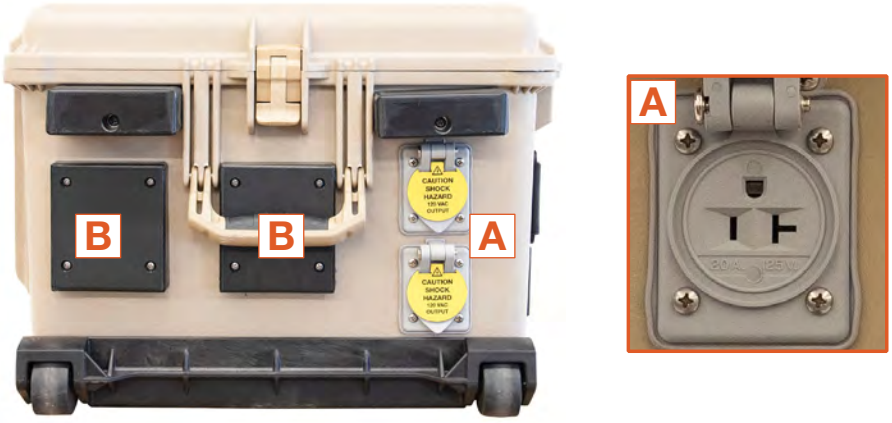


Figure 13. PRO-Verter 3000-120 AGS right exterior

	Description	Connector	Voltage	Amps
A	120 VAC Output	HBL61CM65	125 VAC	20
B	Air Intake	-	-	-

The PRO-Verter Information Plate (I-Plate)

Solar Stik System Architecture: Balanced, Open and Flexible

The I-Plate System Connection Diagram below illustrates how to connect components to build a Hybrid Power System. The Open Architecture Design of Solar Stik Hybrid Power Systems allows Power Management Components (PRO-Verters and Power Hubs) to integrate with ESMs and renewable power generation sources (e.g., PV arrays) from providers other than Solar Stik. Custom cables may be required (and can be provided by Solar Stik) to establish connections with non-Solar Stik components.

The balance of ALL System components that comprise a HPS must be maintained when substituting non-Solar Stik components into a System. Specification requirements for connected components are listed on Solar Stik Component Faceplates.

Essential HPS setup, operation, and safety information is found on the I-Plate (below).

SOLAR STIK®

24VDC PRO-Verter S 3000-120 AGS

System Configuration, Setup, Operation, and Safety Information

Quick-start Guide

Connect Hybrid System Components

Refer to diagram and cable legend for recommended setup and connections. Confirm System is connected as illustrated in the diagram.

When connecting compatible power generation sources:

- **Defender/Ranger** Man Portable Generators (MPG) single operation—Connect to GEN COMM #1 or #2 port.
- **Defender/Ranger** MPG tandem operation—Connect to GEN COMM #1 and #2 ports. (Use Parallel Power Cable.)
- **Tactical Quiet Generator** (TQG; optional)—Connect ONLY to GEN COMM #1 port.
- **Photovoltaic (PV) Arrays**—Connect to SOLAR ONLY port. Orient arrays to maximize daily PV power production. Secure PV arrays to ground after all other System Component locations have been established.

System Activation and Initialization

1. **Activate the Hybrid Power System.**
   a. Turn on energy storage module (ESM) main power switches.
   b. Turn on PRO-Verter user interface.
2. **Set PRO-Verter clock.**
   a. Press ENTER button.
   b. Press DOWN button to arrive at TIME SETTING; press ENTER.
   c. Use UP and DOWN buttons to change value of digit.
   d. Press ENTER when value is correct to move to next digit.
   e. Press ENTER to finalize setting procedure.
3. **Program AC input currents to match power source capacity. See also Hybrid System Configuration Chart to the right.**
   a. Toggle Generator Type switch to desired position.
   b. Program AC Input Currents (= generator or grid output(s)).
      i. Press ENTER button.
      ii. Press DOWN button to arrive at INPUT SETTING.
      iii. Press ENTER button.
      iv. Press DOWN button to arrive at **GRID MAX CURRENT**.
      v. Press ENTER button and hold until number flashes.
      vi. Use UP or DOWN button to change number.
      vii. Press ENTER to move to next digit.
      viii. When correct value is entered, press and hold ENTER to save.
      ix. Press DOWN button to arrive at **GEN MAX CURRENT**.
      x. Repeat steps v. through viii.
4. **Initiate System cycling.**
   a. Toggle Generator Control switch(es) to ON position. Once generator has run for two (2) minutes, AC input should be qualified.
   b. When PRO-Verter enters Charging mode, **rapidly** toggle Generator Control switch(es) to AUTO position to allow charging cycle to complete automatically.

PDM 3000: PDU and/or Tower Operation

After the Hybrid Power System is cycling, turn on PDM 3000 breaker(s) to support required circuit(s) (Tower and/or PDU). Turn off PDM 3000 breaker(s) when circuit(s) not in use.

System Deactivation

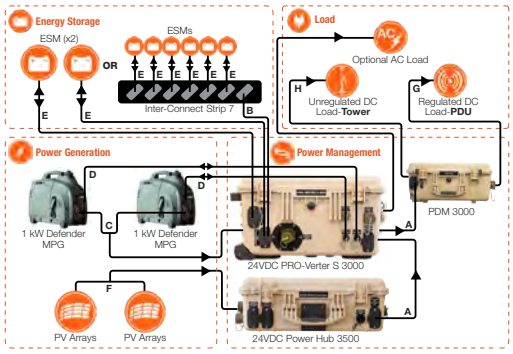
Power down PRO-Verter user interface **before** disconnecting batteries. Press and hold user interface ON/OFF button for five (5) seconds, then release. The user interface will turn off.

PRO-Verter S 3000 NATO Connection

The NATO port allows connection of a NATO 24 VDC circuit to the Hybrid System's 24 V bus. This can be in support a 24 VDC load or to allow charging from an external 24 VDC source.

Regulated 28 VDC (220 W max) Connection on the PRO-Verter

Supports modest loads with regulated DC power. Contact Solar Stik for connector information and available adapter cables. Do not attempt to power sensors from this connection.



Cable Legend	
A	24VDC 12' Inter-Connect Cable (0 AWG; P/N 13-1000292)
B	24VDC 8' Inter-Connect Cable (2 AWG; P/N 13-0000314)
C	120VAC 10' MPG Parallel Power Cable (P/N 13-1000293; includes P/N 13-1000176)
D	10' Generator Comms Cable (P/N 13-1000288)
E	24VDC 5' Inter-Connect to ESM Cable (P/N 13-1000294)
F	25' Solar Y Cable (P/N 13-
G	AIB2-32-5SS DC Output
H	NATO 24 VDC Output

⚠WARNING

Shock Hazard
Do not operate with lids open in wet environments.
Keep cables and other equipment dry.

Notice

- **KEEP IT COOL.** Shade the PRO-Verter and Power Hub to reduce solar loading and subsequent derating of their output.
- **Clean or replace PRO-Verter and Power Hub air intake filters regularly to maintain optimal performance.** Spare filters may be located behind I-Plates.
- **HEAT-RELATED DERATING:** Internal temperatures over 122 °F (50 °C) will significantly reduce the power the PRO-Verter can supply to charge batteries and to buffer surge loads.
  DO NOT STORE BATTERIES IN A DISCHARGED STATE! Always recharge batteries completely before storage or transport.
- **DO NOT USE THE PRO-VERTER IN CONJUNCTION WITH A MODIFIED SINE WAVE AC INPUT SOURCE.**
- This PRO-Verter is programmed to charge 24 VDC lithium-ion batteries using a constant current/ constant voltage (CC/CV) charging protocol. **Voltage is not an indicator of battery state of charge.**
- Contact Solar Stik Technical Support if reconfiguration to another battery chemistry is required.
- A functioning 24 V battery must be connected for the PRO-Verter and Power Hub to operate.
- Solar panels, should be oriented for maximum daily sun exposure.
- Consult the generator manual for critical generator operation information.
- The AGS Tech port is for maintenance only. Contact Solar Stik Technical Support for information.

System Configuration Requirements

Operation of a Hybrid System

When operating in a high-efficiency HYBRID model, energy from batteries is used to support the load(s). The total daily power required for the load(s) is generated by a renewable PV array and/or a fuel-driven generator. The PRO-Verter S 3000 manages all system functions, ensuring constant power to the load through proper cycling of the batteries and connected power generation sources.

The PRO-Verter S 3000 uses battery voltage to initiate generator start and stop functions. In a properly sized System, the batteries and generator should both cycle 1–2 times daily.

See Hybrid System Configuration Chart for recommended supported loads, generation requirements, and recommended battery capacities.

Configuration of a Hybrid System (See System Manual.)

1. Determine the total daily power requirements.
2. Establish the proper battery capacity.
3. Configure generator/grid AC and PV recharging.

Hybrid System Configuration Chart

Generator Configuration	Generator Output (W)[1]	AC Input Setting (A)[2]	Max Recommended Load-Hybrid (W)[3]	Minimum Energy Storage (kWh)[4]
1 x 1 kW	~600	5–7.5	300	3.9
2 x 1 kW	~1200	10–15	600	5.2
1 x 2 kW	~1500	12.5–15	750	4.9
2 x 2 kW	~3000	25–30	1500	9.8
3 kW TQG	~2800	25	1400	9.2

[1] Power output for reliable and efficient generator operation
[2] Programmable range for AC input MAX current
[3] The recommended load for cycling System 1–2 times per day
[4] Minimum energy storage requirement for recommended loads

Troubleshooting

Generator Fault/Failure

If one (1) of two (2) generators running in tandem fails:

- Restart the generator or
- If the generator will not restart immediately, reprogram the PRO-Verter AC input setting to half the value for two (2) generators in tandem. To reprogram, use the instructions in step 3 of System Activation and Initialization.

System Recovery with Overdischarged Batteries

If batteries are discharged to a "critical-low" level, the System may cease to function. There are two (2) methods to restore a System with overdischarged batteries:

1. Connect an active 120 VAC power source to the PRO-Verter 120 VAC Generator Input. Turn off all breakers EXCEPT the 120 VAC GEN INPUT 30 A breaker. Confirm LED above GEN INPUT breaker is lit. Toggle and hold System Recovery momentary switch to activate the recovery circuit; the LED above the switch will light after two (2) minutes. Continue holding the System Recovery momentary switch while pressing the user interface ON/OFF button. After the user interface powers up, release the System Recovery switch and the user interface ON/OFF button. The System will begin charging the batteries in about four (4) minutes.
2. Connect an active PV array (exposed to sun) to the PRO-Verter. Turn on the PRO-Verter user interface. The PRO-Verter will begin charging once the PV voltage is 5 volts higher than the battery voltage. Use either an active generator/grid 120 VAC source or continuous PV to charge the batteries.

I-PLATE PN: 10-1000739 REV -

Figure 14. PRO-Verter Information Plate

The PRO-Verter Faceplate

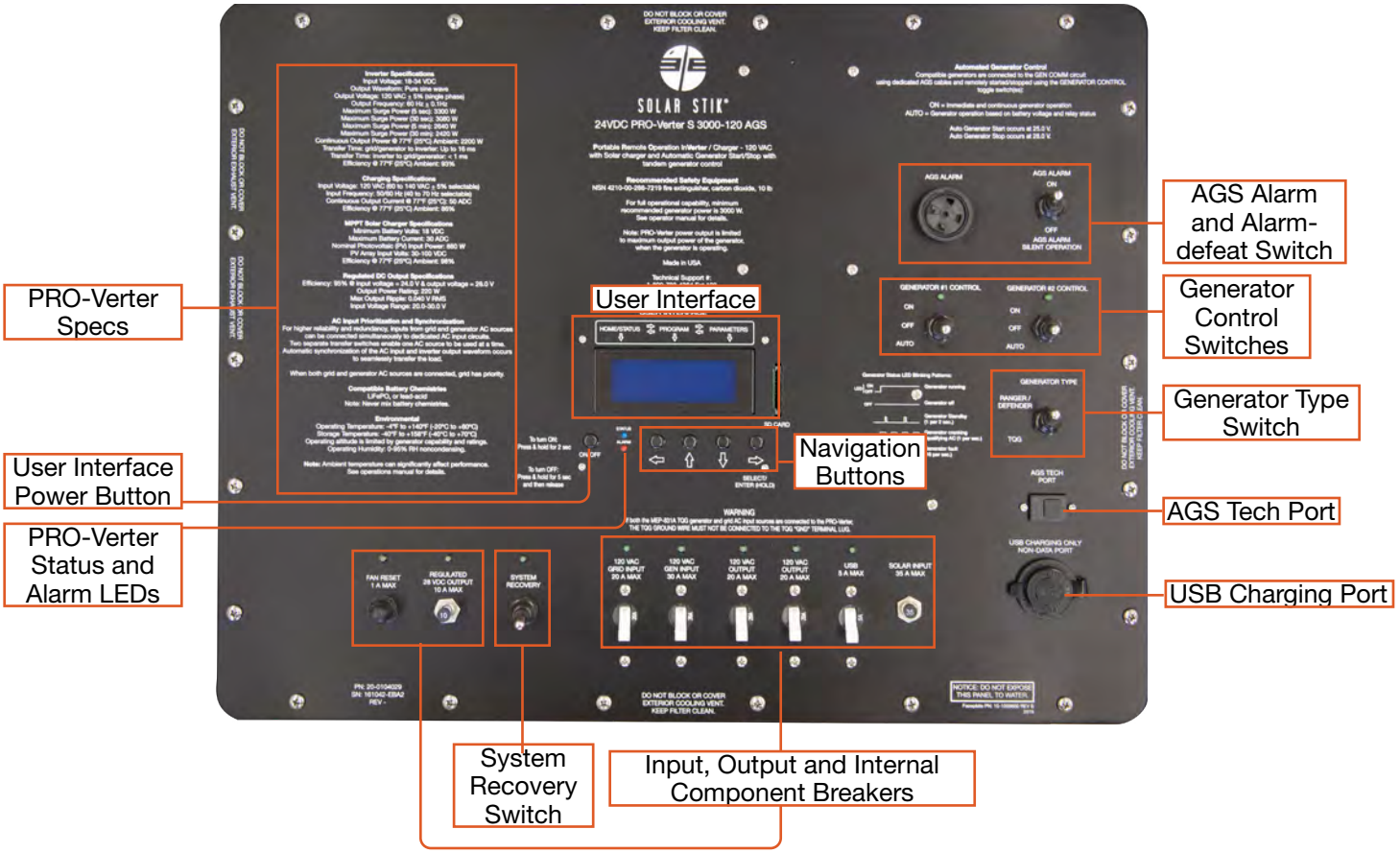


Figure 15. PRO-Verter S 3000 Faceplate features

User Interface – The User Interface is used to program and control the PRO-Verter and to monitor System status. The PRO-Verter is programmed at Solar Stik to meet the specifications of a specific application. Programming mode can be accessed if reprogramming is required. Contact Solar Stik Technical Support.

System Recovery Switch – Provides a method to start the PRO-Verter when the System batteries have been overdischarged. Connect the PRO-Verter to a 120 VAC power source. Press and hold the System Recovery button. Turn on the PRO-verter user interface. Continue pressing the System Recovery button until the user interface reports “Charging”.

Generator Type Selection Switch – Choose “RANGER/DEFENDER” if the PRO-Verter is connected to either of these gensets. Choose “OTHER” if connected to other gensets (e.g., MEP-802A or MEP-831A) that have been equipped with auto start/stop functionality.

Auto Generator Start/Stop (AGS) 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 AGS communication with any connected genset.

AGS Alarm and Defeat Switch – Audible indication that a connected generator is in the process of starting. Alarm may be defeated (toggle switch) when silent operation is required.

USB Charging Ports and 5 A Breaker – For charging only. No data are transmitted via these ports. Push to reset the breaker if either of the USB ports is not operating while the PRO-Verter is turned on.

IN/OUT Breakers/Switches – The breakers serve as switches to activate circuits and to turn off 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 over each breaker will be lit if the circuit is active and the breaker is not tripped.

Cooling Fan 1A Breaker – The internal cooling fans are audible when Push to reset the breaker if the AC Input or AC Output port is not operating while the PRO-Verter is turned on.

AGS Tech Port – Used to program the Auto Generator Start/Stop module. Please contact Solar Stik Technical Support for further information.

The PRO-Verter User Interface

- **ON/OFF Key** – The On/Off Key is used for switching on/ switching off the PRO-Verter and also to enter/exit Standby Mode.
- **Navigation Keys** – These four keys allow simple access to Menu Item that assists configuring, monitoring, and troubleshooting the PRO-Verter.
    - **Navigation Key Functions:**
        - ° Back (left arrow) – Return to previous selection
        - ° Up – Move from lower to upper Menu Screen in various Menu Maps
        - ° Down – Move from upper to lower Menu Screen in various Menu Maps
        - ° Enter (right arrow) – Select/write a particular value or option. Access programmable settings.
- **Status LED** – Blue LED indicator for indicating operating status.
- **Fault LED** – Red LED indicator for indicating fault conditions.
- **SD Card slot** – This slot supports SD memory card (up to 16GB, FAT16/32). The SD Card is used for data logging of PRO-Verter operational statistics and events and saving and uploading of programmed parameters.

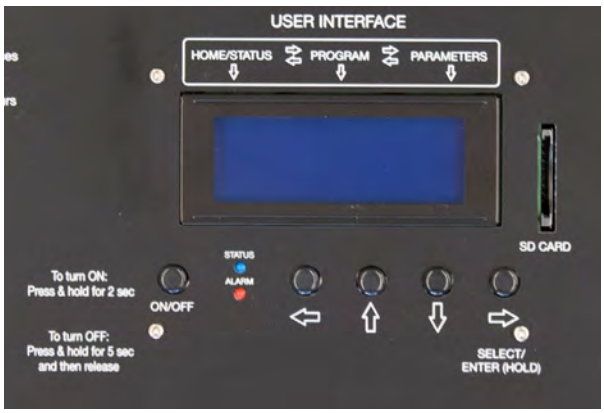


Figure 16. PRO-Verter S 3000 User Interface

Table 1. User Interface LED Indicators

LED INDICATIONS		
Status	**Blue LED**	**Red LED**
Seen during Power-On Sequence Indicates completion of Power-On Sequence after Power ON/OFF Button is pressed for 2 sec	Flash 3 times	Off
Seen during Power-Off Sequence Indicates completion of Power-Off Sequence after Power ON/OFF Button is pressed for 5 sec	On	On
Normal charging	Flash 1 time per sec	Off
Equalization charging	Flash 2 times per sec	Off
Inverting (Discharging)	On	Off
Low battery alarm	On	Flash 1 per sec
Power saving	Flash 1 time per	Off
Standby	3 sec	Off
Fault	Off	On

OPERATOR INSTRUCTIONS

1. Identify location for System components.

Survey the site where the System will be deployed.

a. Component Shading

It is critically important to shade all of the components as much as possible to reduce heat buildup inside the components (solar loading). Higher temperatures will result in derating, or diminished capacity and efficiency, of the components.

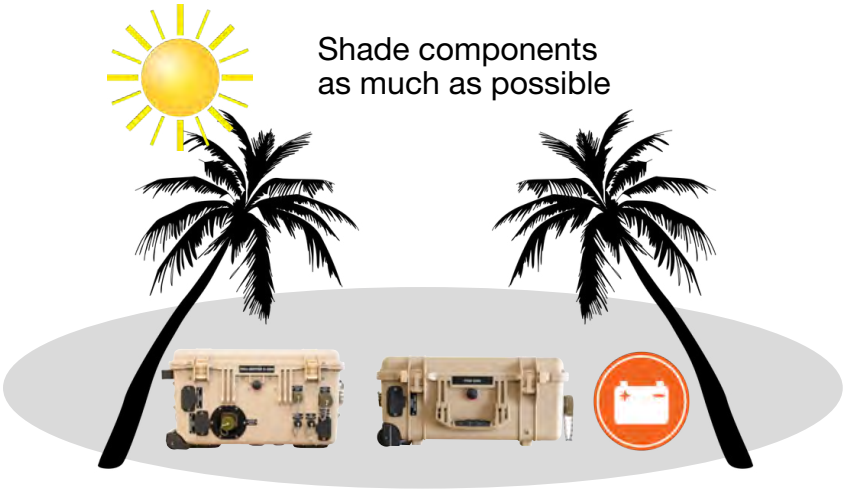


Figure 17. How to locate System

b. Minimize Potential for Water and Dust Intrusion

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

1. If operating in wet environments, use common-sense placement to avoid water intrusion by either flooding, precipitation or condensation.

2. If operating in dusty environments, ensure good airflow by keeping air filters clean and placing unit in a location that minimizes exposure to particulates.

Direct ground placement of any power management or energy storage component is generally not recommended, but possible if no other option is available. If it is necessary, preventative measures for water and dust should be taken. Consult the PMCS section of this manual for additional details.

2. Connect System Components

Use this diagram as a guide for making connections among the System components.

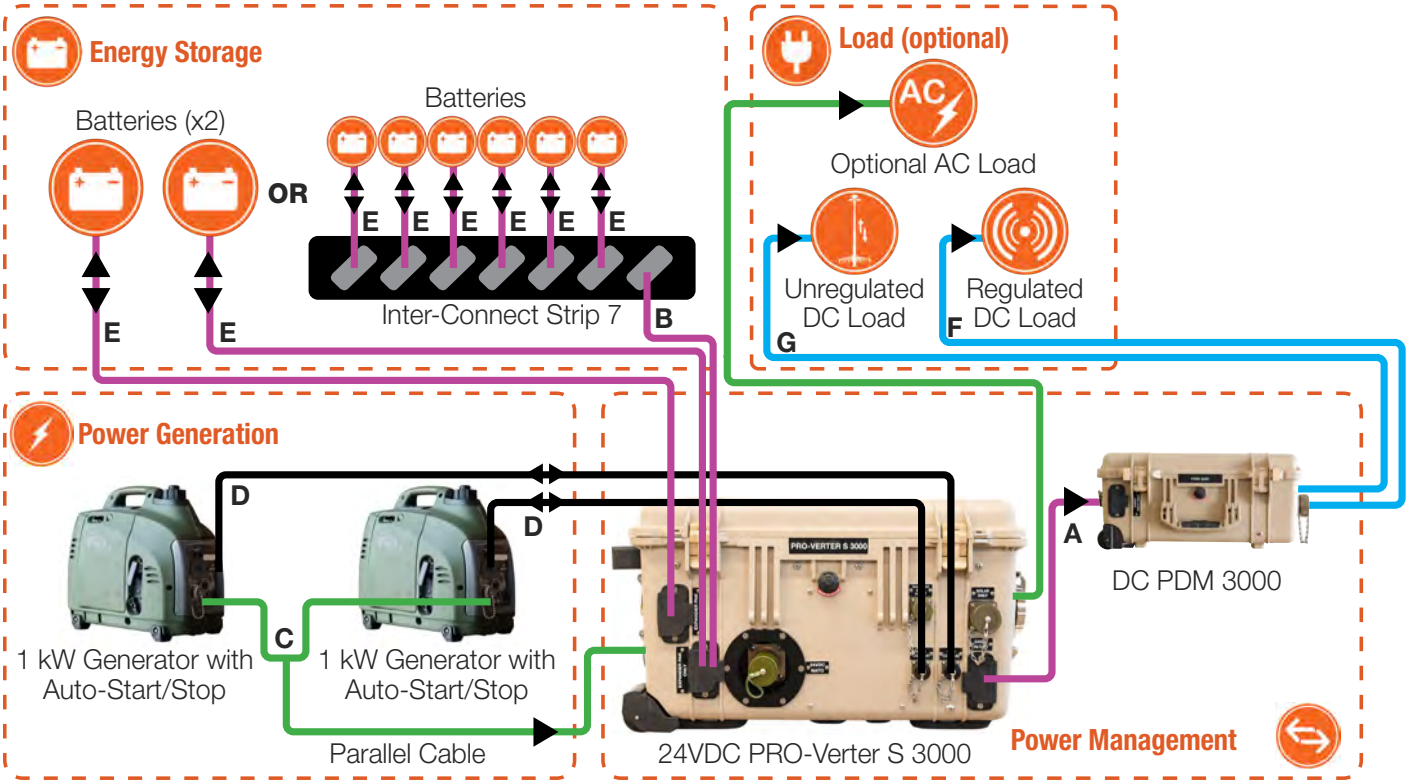


Figure 18. System connection diagram

Table 2. USAF G-BOSS Light Inventory

Cable	Item #	Component Name	QTY
A	13-1000292	24VDC 12' INTERCONNECT CABLE (0 AWG) (1)	1
B	13-1000314	24VDC 8' INTERCONNECT CABLE (2AWG)	1
C	13-1000293	NOVATIO PARALLEL CABLE (Includes PN 13-1000176)	1
D	13-1000288	GENERATOR COMMS CABLE, NOVATIO, 10'	2
E	13-1000294	24VDC INTERCONNECT CABLE	6
F		AIB2-32-5SS	
G		NATO	
N/A	13-1000160	24VDC INTERCONNECT STRIP 7	1
N/A	20-0104029	24VDC PRO-VERTER S 3000-120 EBA2	1
N/A	20-0002510	DC PDM 3000	1

Note: Cables F and G are not supplied by Solar Stik. They are referred to in the table as a reference to cables shown in the connection diagram.

a. Connect System Batteries to PRO-Verter

Two (2) battery configurations are shown below. If only two (2) batteries are to be connected to the PRO-Verter, they may be connected directly rather than via the Inter-Connect Strip.

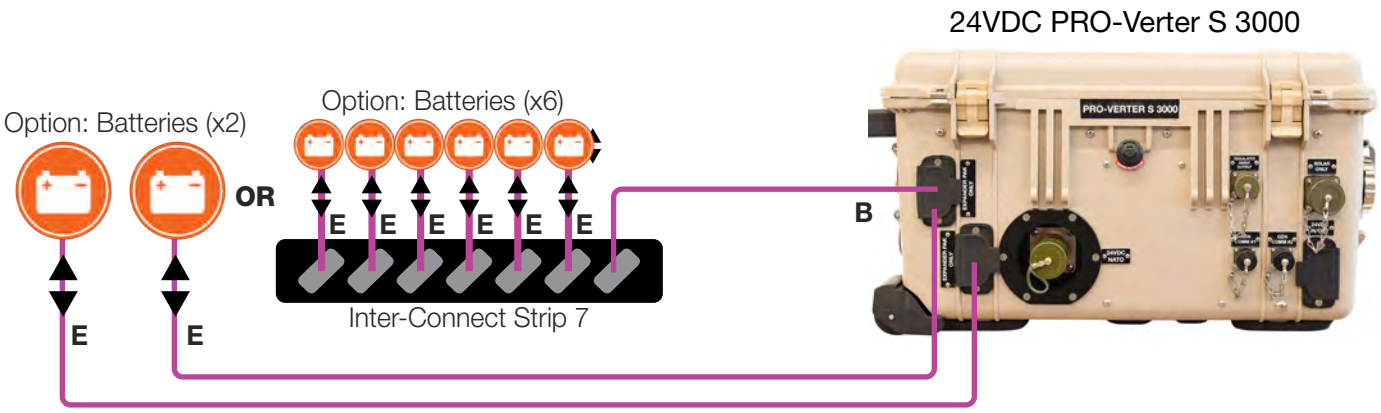
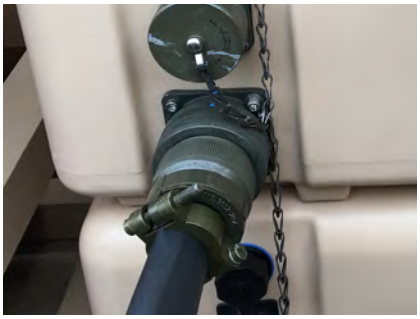


Figure 19. PRO-Verter S 3000 to Expander Pak 1300 connections

The Inter-Connect Cable (E) has a Inter-Connect connector on one end and a twist-on connector at the battery end.

Inter-Connect connector



Battery-end connector

Figure 20. Inter-Connect Cable (E) for System battery connection.

b. Connect PRO-Verter to AC power source(s)

- **Generator AC Input Power Cable:** Connect AC power output port on the generator to the "AC INPUT" port on the right-hand side of the PRO-Verter S 3000.
- **Grid AC Power Cable:** Connect AC power from the grid to the "AC INPUT" port on the right-hand side of the PRO-Verter S 3000. A custom cable may be required, depending on the grid power outlet.

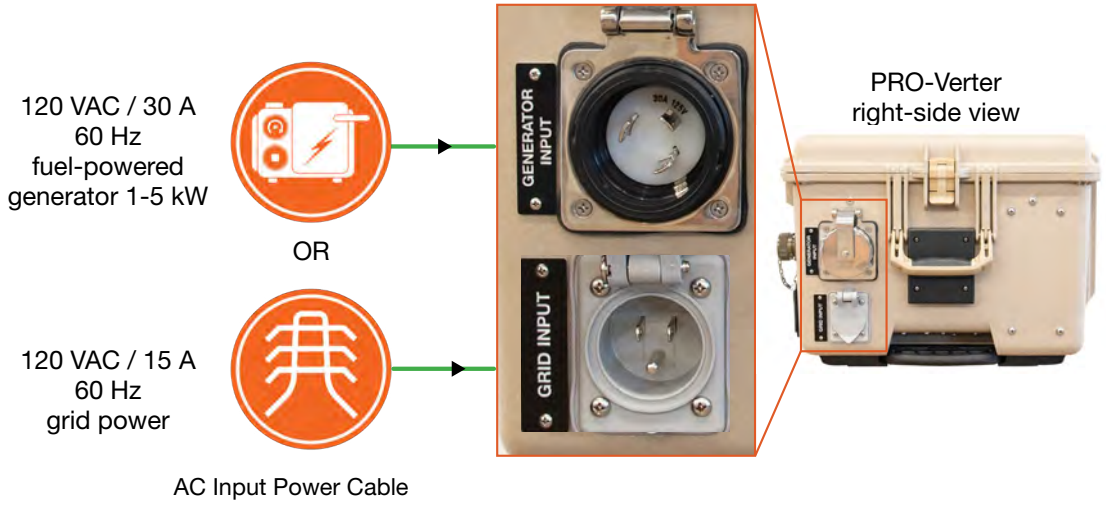


Figure 21. PRO-Verter(s) to generator connections

Note: If a generator and shore power sources are connected to the PRO-Verter, shore power will be prioritized.

Compatible Generator Options

The PRO-Verter S 3000 can remotely start/stop TQGs that have been modified with a Solar Stik Remote-start Enabling Kit (RsEK) and the 1 kW and 2 kW Man Portable Generators (MPGs) (Figure 19).

Compatible Genset Options

Tactical Quiet Generators (TQG)		Man Portable Generators (MPG)	
MEP-802A 5 kW TQG	MEP-831A 3 kW TQG	Ranger 2 kW MPG	Defender 1 kW MPG
			
		May be paralleled	May be paralleled

Figure 22. Compatible options

Note: The TQGs above must have a Solar Stik Remote-start Enabling Kit installed to be compatible with the PRO-Verter S 3000.

d. Connect PRO-Verter to Generator(s)

PRO-Verter GEN COMM port specificity

- **Defender/Ranger Man Portable Generators (MPG) single operation** – Connect to GEN COMM #1 or #2 port.
- **Defender/Ranger MPG tandem operation** – Connect to GEN COMM #1 and #2 ports. (Use 120 VAC Parallel Power Cable.)
- **Tactical Quiet Generator (TQG; optional)** – Connect ONLY to GEN COMM #1 port.

i. MEP-802A and MEP-831 TQG

Connect ONLY to GEN COMM #1 Port on the front of the PRO-Verter and the AUTO GENERATOR CONTROL port on the TQG using the 25' TQG GEN COMM Cable.

Figure 23. MEP-831A and MEP-802A Generator Communication Cable connections

ii. Defender 1 kW and Ranger 2 kW MPGs

Use GEN COMM Ports #1 and/or #2 on the front of the PRO-Verter and the communication port on the generator using the 25' Ranger/Defender GEN COMM Cable.

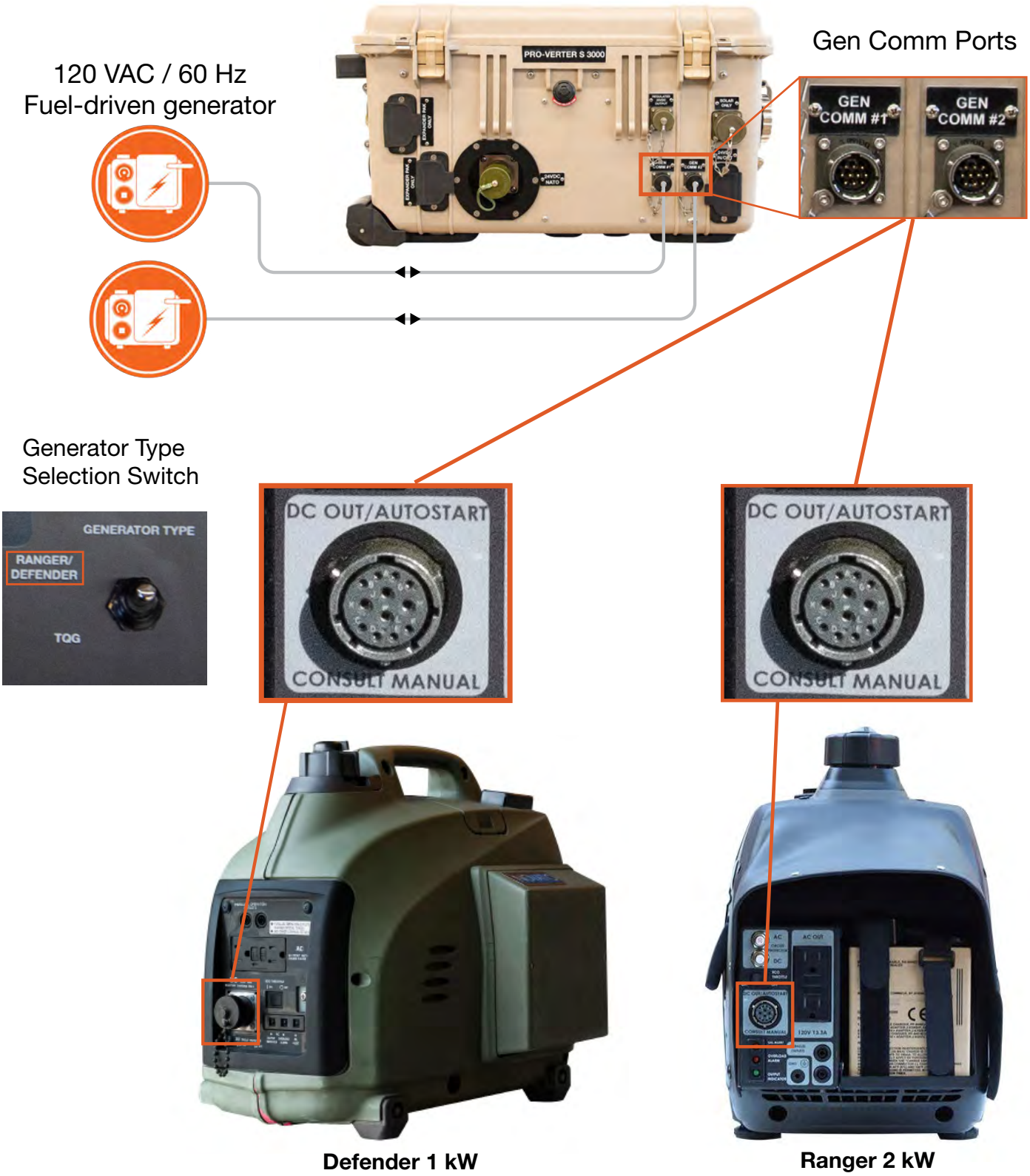


Figure 24. Defender 1 kW and Ranger 2 kW generator Communication Cable connections

How to Connect two MPGs in parallel to the PRO-Verter

The PRO-Verter S 3000 has the ability to receive power from two (2) MPGs simultaneously. The power output from each of two generators is merged into a single “Y” cable that is connected to a single power input port on the left side of the PRO-Verter (Figure 25). The mode of each generator is controlled independently (Faceplate switch; “ON, OFF, AUTO”) and each has it’s own communication cable to the PRO-Verter. The LED over each Generator Control Switch blinks slowly when functioning in AUTO mode, more rapidly when 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.

Figure 25. Connecting two 1 kW generators in parallel with the “Y” AC power cable.

e. Connect PRO-Verter S 3000 to PDM 3000

Use an Inter-Connect cable to connect the PRO-Verter to the PDM using the metered port indicated below. Current passing through this port is reported on the User Interface (“External”) as a positive (+) value and is combined with the current from the solar charge controller (ie., PV arrays/if present).

Note: The PRO-Verter NATO port allows connection of a NATO 24 VDC circuit to the Hybrid System’s 24 V bus. This can be in support a 24 VDC load or to allow charging from an external 24 VDC source.

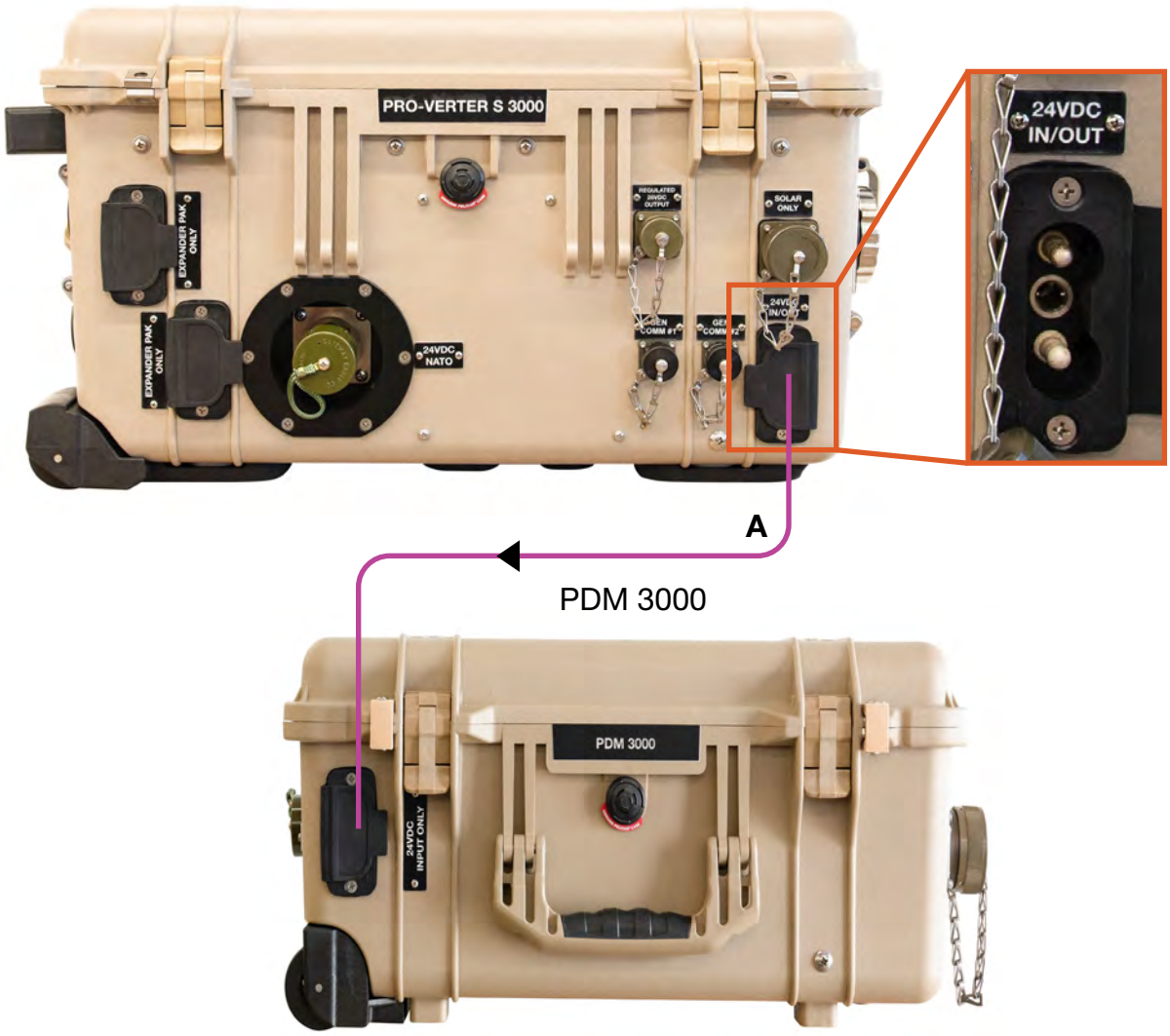


Figure 26. PRO-Verter S 3000 to PDM 3000 connection.

f. Connect PDM 3000 to PDU and Tower

Turn off the output breakers prior to connecting the PDM 3000 to loads. The cables to the tower and PDU are not provided by Solar Stik.

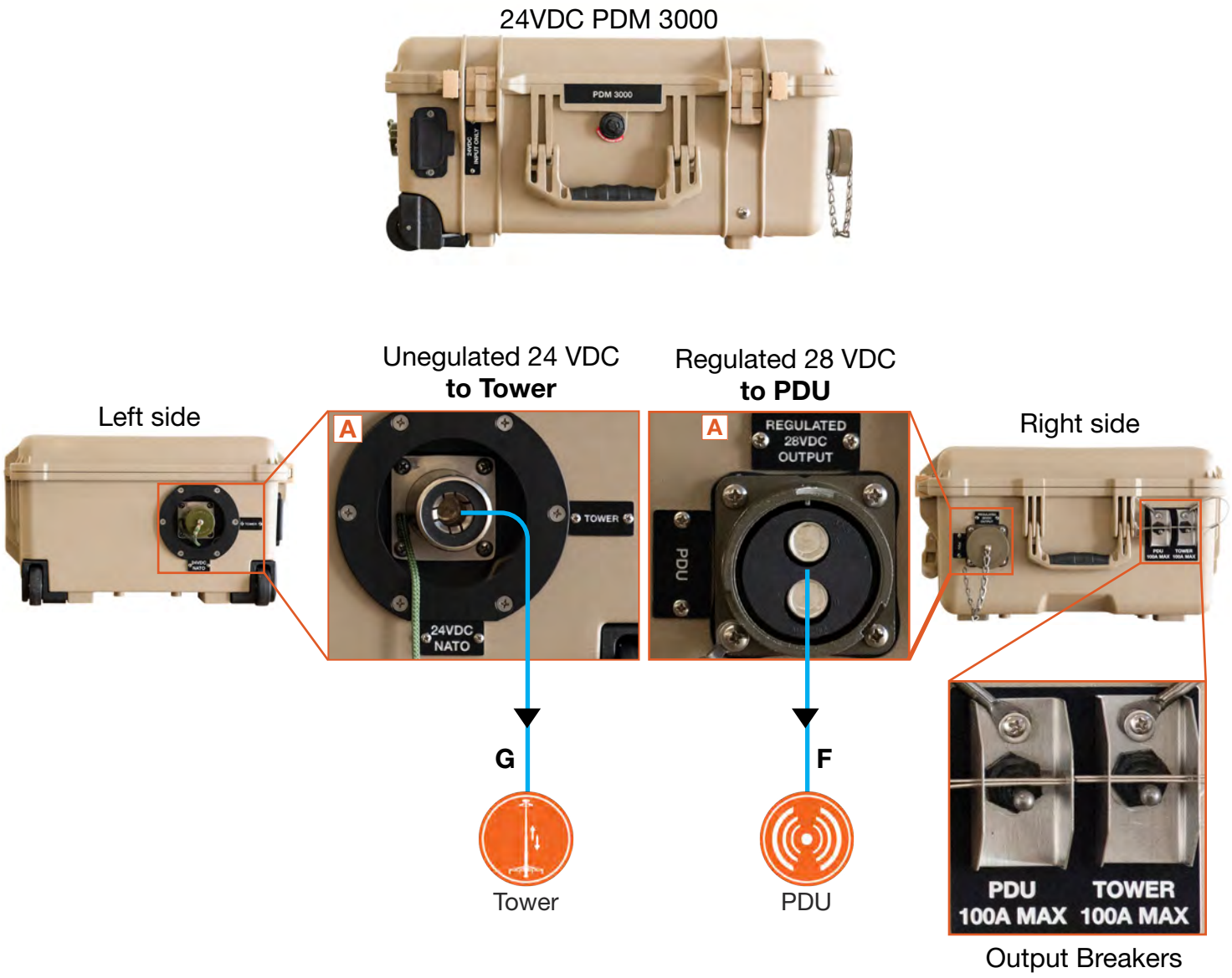


Figure 27. PDM 3000 to loads connection

g. Connect loads that require regulated 28 VDC Output (optional)

Connect loads that require regulated 28 VDC output. The maximum output from this connection is 7.8 A or 220 W. Custom cable required, Contact Solar Stik for details. Turn off load power switches to prevent them from drawing power during System setup.

Note: This connection supports modest loads with regulated DC power. Do not attempt to power sensors from this connection.

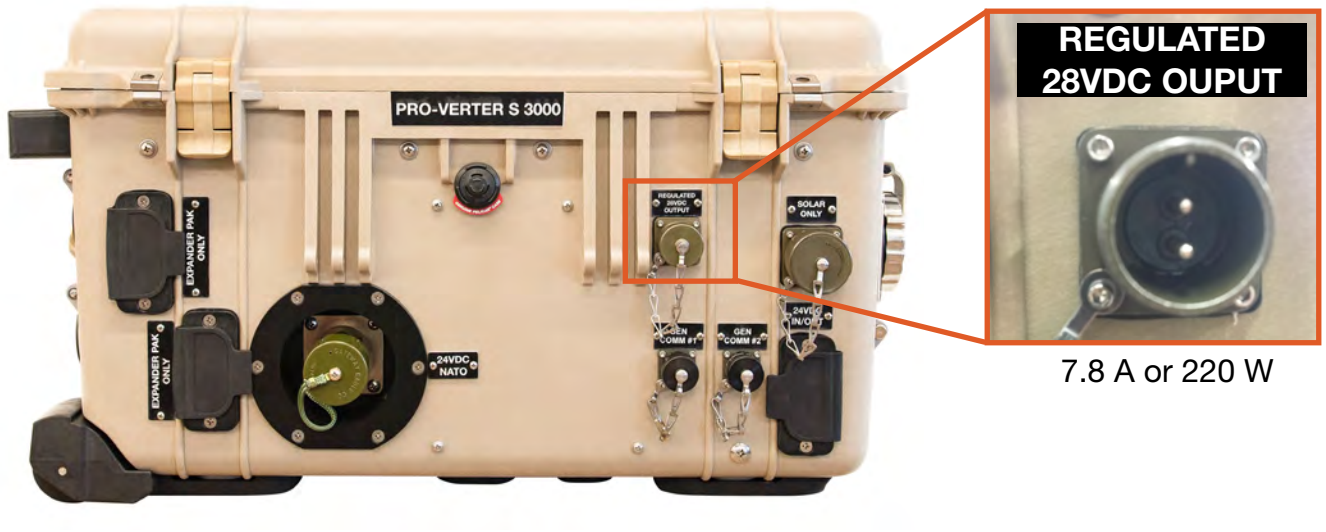


Figure 28. PRO-Verter S 3000 low-power regulated DC output connection

h. Connect PRO-Verter to 120 VAC Loads (optional)

Connect 120 VAC loads to the PRO-Verter AC outputs on the right side of the PRO-Verter. Connect loads of no more than 20 amps for one (1) outlet and no more than 25 amps total between the two (2) outlets. Turn off load power switches to prevent power draw during System setup.

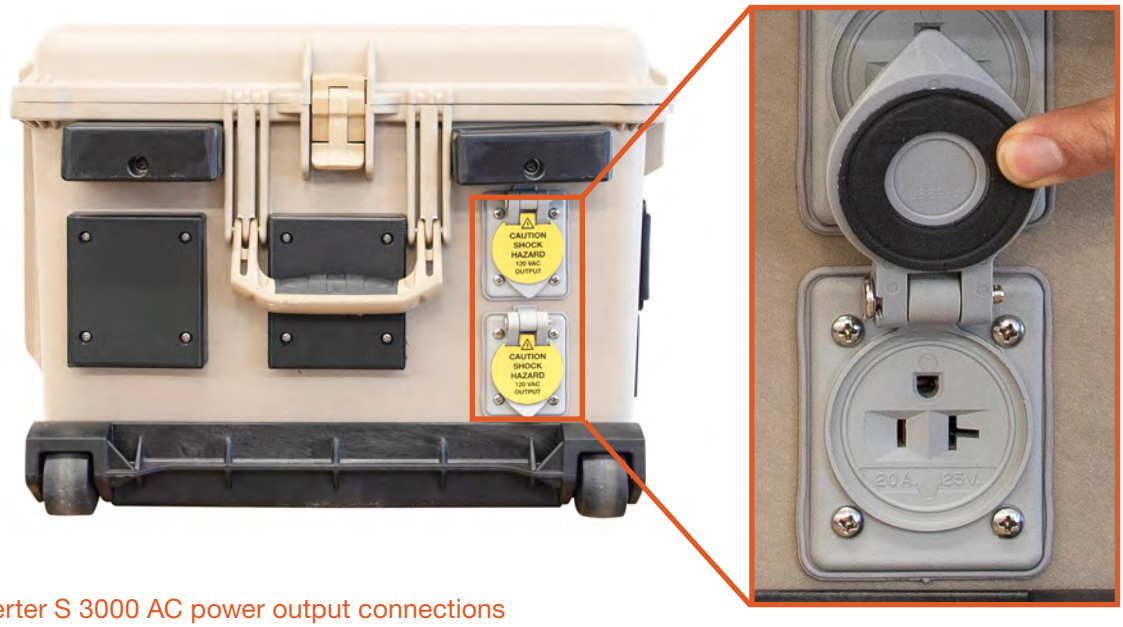


Figure 29. PRO-Verter S 3000 AC power output connections

i. Connect PV Array(s) to PRO-Verter (optional)

Connect the PV array(s)/Solar Cable to the PRO-Verter Solar Only pot on the front of the PRO-Verter.

Note: A variety of PV arrays can be connected to the PRO-Verter. See the PRO-Verter Faceplate for guidance on limits for connecting PV arrays*.

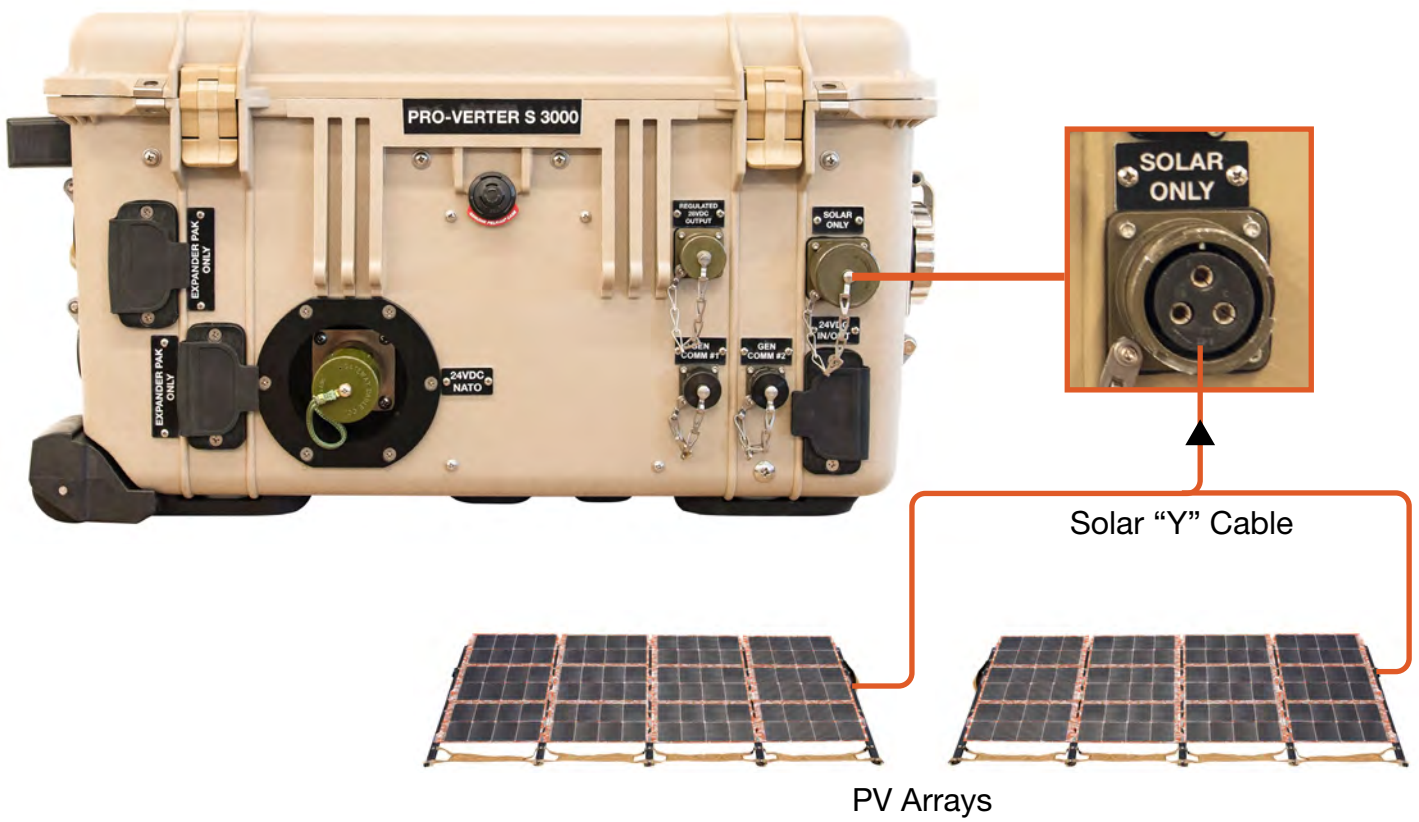


Figure 30. PV Array to PRO-Verter S 3000 connection

***System PV arrays: General Rules and Requirements**

PV arrays, other than the ones provided in the kit, can be connected to the PRO-Verter as long as the power specifications for the arrays do not exceed the specifications listed on the Faceplate.

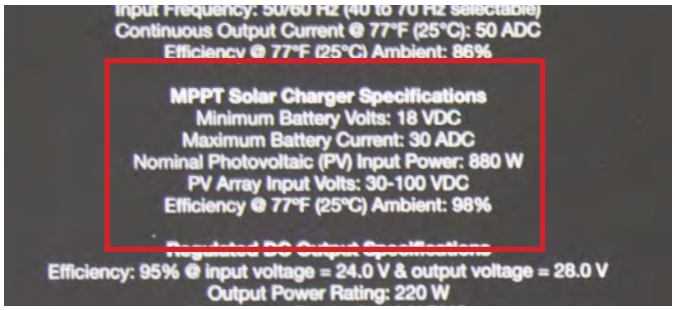


Figure 31. PRO-Verter S 3000 power specifications for PV arrays

j. Secure the PV arrays (if present) to the ground.

⚠ WARNING

Failure to properly secure the PV Arrays to the surface with sandbags could result in PV panel damage, injury, or death in high winds. Tent stakes should be used in addition to sandbags when possible. Wind damage can render panels nonfunctional or significantly reduce their functional life expectancy.

The PV arrays must be properly secured to the ground even in low-wind environments. The methods used for ground securing are determined by two (2) factors:

1. The type of surface upon which the PV arrays are to be deployed—“hard” surface (such as pavement) or “soft” surface (such as dirt or sand)

2. The environmental conditions—wind conditions that the PV arrays might encounter

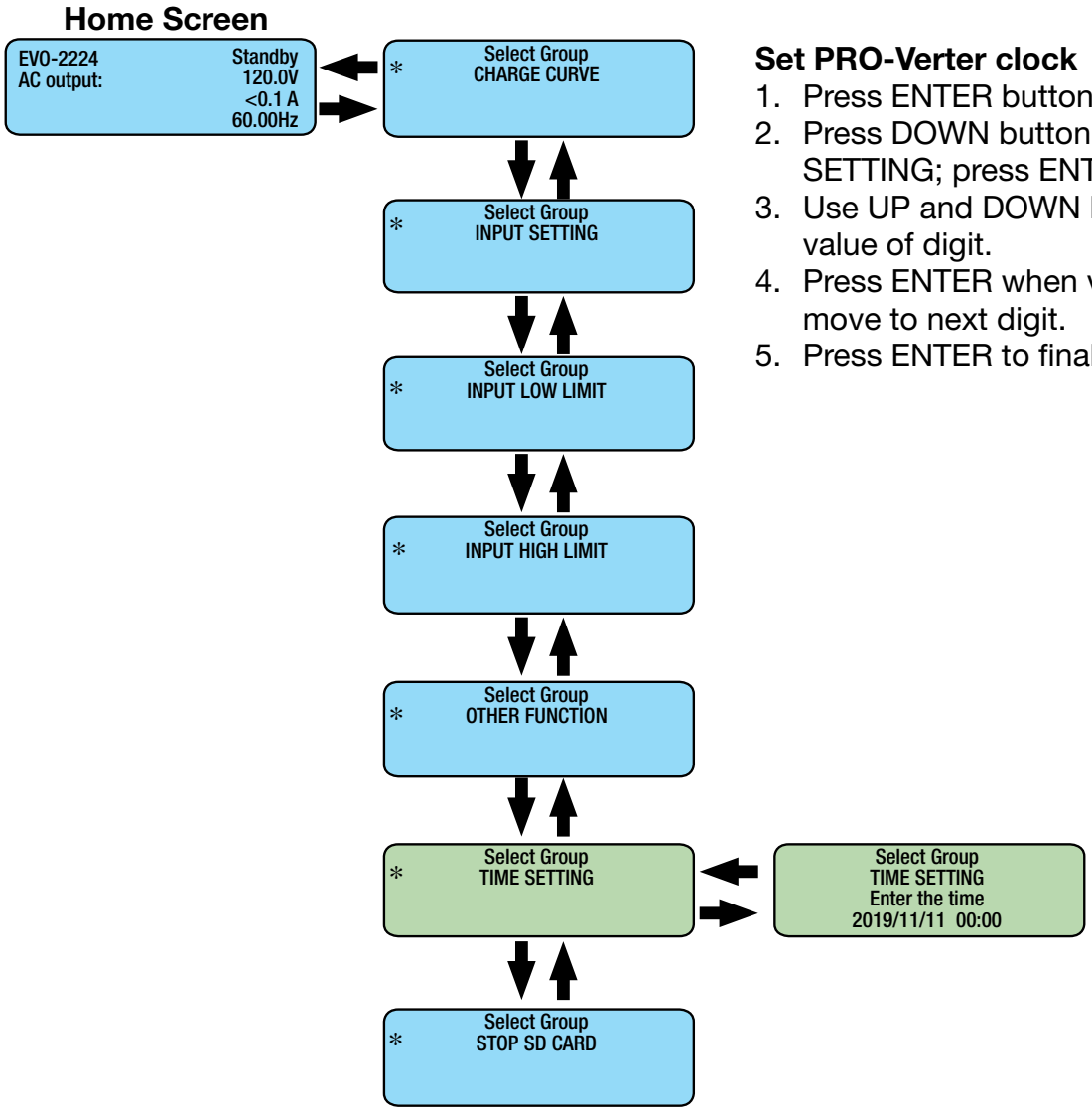
3. System Activation and Initialization

a. Activate the Hybrid Power System.

i. Turn on energy storage module (ESM) main power switches.
ii. Turn on PRO-Verter User Interface.
iii. Turn on the appropriate AC Input Breakers on the Faceplate.
iv. Ensure proper generator-type selection (Faceplate switch).
v. Turn off PDM 3000 Tower and PDU breakers until the System is initialized and cycling.

b. Set PRO-Verter date and time

The date and time format is Year/Month/Day; Hour:Minute (24 hour clock):
Note: Password is not required for setting this parameter.

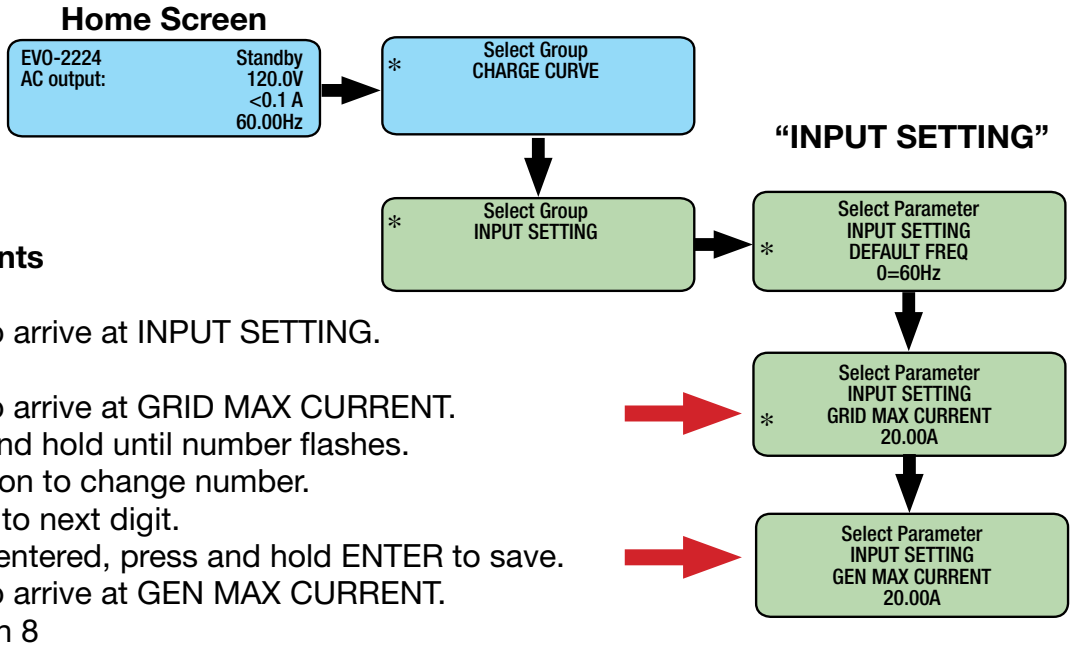


Set PRO-Verter clock

1. Press ENTER button.
2. Press DOWN button to arrive at TIME SETTING; press ENTER.
3. Use UP and DOWN buttons to change value of digit.
4. Press ENTER when value is correct to move to next digit.
5. Press ENTER to finalize setting procedure.

c. Program PRO-Verter to match the gen/grid output current

Set the “Grid Max Current” setting to the same value as the maximum continuous output current of the AC grid power source connected to the PRO-Verter. Set “Gen Max Current” value using the recommended settings in Table 1 below. These settings are required to optimize generator/PRO-Verter interactions and System performance. If the PRO-Verter current setting is greater than the power source, the source will be overloaded and fault. If the PRO-Verter current setting is lower, than the power source, System performance will be reduced; not be able to support loads that fall within the rated performance of the PRO-Verter.



Program AC Input Currents

1. Press ENTER button.
2. Press DOWN button to arrive at INPUT SETTING.
3. Press ENTER button.
4. Press DOWN button to arrive at GRID MAX CURRENT.
5. Press ENTER button and hold until number flashes.
6. Use UP or DOWN button to change number.
7. Press ENTER to move to next digit.
8. When correct value is entered, press and hold ENTER to save.
9. Press DOWN button to arrive at GEN MAX CURRENT.
10. Repeat steps 5 through 8

Table 3. AC Power input settings for generators

Recommended generator AC Input Settings and Loads

Hybrid System Configuration Chart

Generator Configuration	Generator Output (W)[1]	AC Input Setting (A)[2]	Max Recommended Load-Hybrid (W)[3]	Minimum Energy Storage (kWh)[4]
1 x 1 kW	~600	5–7.5	300	3.9
2 x 1 kW	~1200	10–15	600	5.2
1 x 2 kW	~1500	12.5–15	750	4.9
2 x 2 kW	~3000	25–30	1500	9.8
3 kW TQG	~2800	25	1400	9.2

[1] Power output for reliable and efficient generator operation
[2] Programmable range for AC input MAX current
[3] The recommended load for cycling System 1–2 times per day
[4] Minimum energy storage requirement for recommended loads

d. Initiate System cycling

1. Toggle Generator Control switch(es) to ON position to start generator(s). Once generator has run for two(2) minutes, AC input should be qualified.
2. When PRO-Verter enters charging mode, rapidly toggle Generator Control switch(es) to AUTO position to allow charging cycle to complete automatically.

What to watch for as the System is starting

The Generator Status LED blinking pattern indicates the current state of the generators(s). The graphic below the generator control switches is a key to understanding the blinking pattern.

Figure 32. Generator Mode Control Switches and LEDs

Generator Control Switches

ON – When the Generator Control switch is in the ON position, the AGS system is activated/ enabled. The PRO-Verter will signal the generator to start. Placing the Generator Control Switch in the ON position “manually” signals the generator to start using the PRO-Verter AGS controls. The green status LED will be steady ON.

OFF – When the AGS switch is placed in the OFF position, the LED status indicator will be off and all AGS functions are disabled. The green status LED will be steady OFF.

AUTO – When the Generator Control switch is in the AUTO position, the AGS will start and stop the generator based on programmed values for battery voltage. When the generator is running, the status LED will be steady ON.

Note: Move quickly when switching between ON and AUTO; do not hesitate on the OFF position. Pausing in the OFF position will inadvertently turn off the generator.

4. PDM 3000: PDU and/or Tower Operation

- After the Hybrid Power System is cycling, turn on PDM 3000 breaker(s) to support required circuit(s) (Tower and/or PDU).
- Turn off PDM 3000 breaker(s) when circuit(s) not in use.

System Deactivation

Power down PRO-Verter user interface before disconnecting batteries. Press and hold user interface ON/OFF button for five (5) seconds, then release. The user interface will turn off.

PRO-Verter Operating Modes

When the PRO-Verter is operating normally, the User Interface will display the name of the Operating Mode and values of operating parameters. As all the operating parameters associated with a particular Operating Mode cannot be displayed in one screen, multiple screens are available that can be accessed using the Up and Down Keys. Table 2 provides names and descriptions of the operating modes and Figure 33 provides System metrics available in three operating modes.

The User Interface will automatically display the current mode in which the PRO-Verter is operating. Use the UP and DOWN buttons to view the values of parameters associated with the current mode.

The Operating Modes windows and subwindows are READ ONLY.

Table 4. Operating Modes: Descriptions

Operating Mode Display	Description
Standby	**Standby Mode**: No output, No AC bypass, No Charging. The parameters available for viewing when the PRO-Verter is in standby mode are shown in this map.
Inverting	**Inverting mode** is when the PRO-Verter is supporting the load by converting energy stored in the batteries into AC power. The batteries are not being charged when the PRO-Verter is in inverter mode.
Charging	**Charging mode** is when the PRO-Verter is charging the batteries and supporting the AC load. The degree to which the batteries are charged will depend on the demand of the AC load; supporting the load is prioritized over charging the batteries.
Power Save	PRO-Verter is in Power Saving Mode
Online	PRO-Verter is in On Line Mode
Chrg Only [1]	Under “ONLINE MODE” only (Option 2=Charger Only). Provides charging and pass through when the AC input is available. No inverting when the AC input is not available.

1. It is not recommended to put the PRO-Verter into charge-only mode when the PRO-Verter is part of an functioning Hybrid Power System (HPS) with both AC and DC loads. AC loads connected to the PRO-Verter will not be supported if the AC power source connected to the PRO-Verter fails. Charge-only mode may be used in a HPS with DC-only loads. The PRO-Verter S 3000 has been programmed for charger-only mode per customer request.

Monitor System Activity

The System will be in standby, charging or inverting mode most of the time it is in operation. Scrolling down through the windows below the home screen provides additional, helpful, System status information.

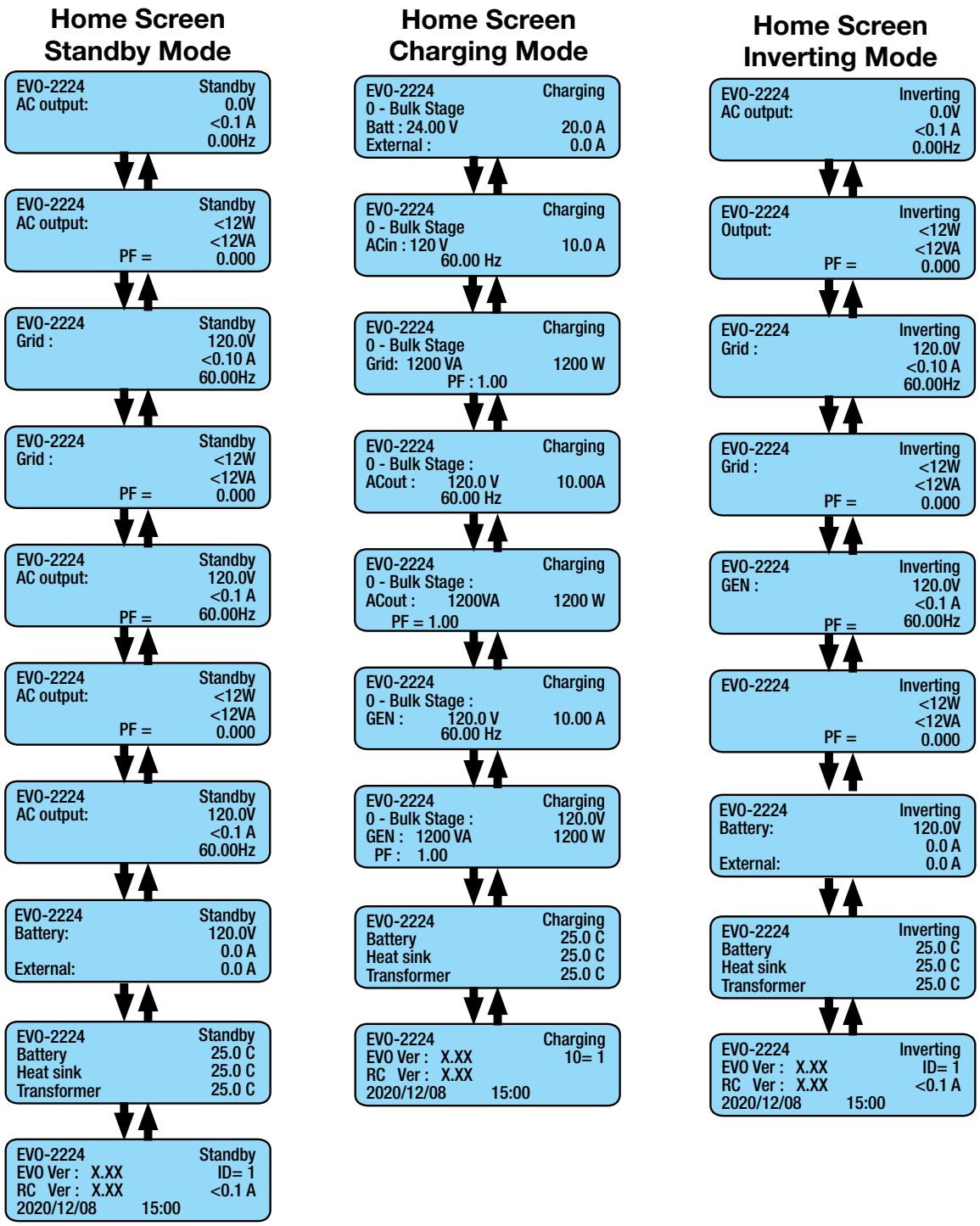


Figure 33. System metrics available in standby, charging and inverting modes

PRO-Verter Programmable Settings

Navigating "Select Group" and "Select Parameter" Menu Maps

The Enter key is used to enter "Select Group" Menu Map from any Operating Mode Screen.

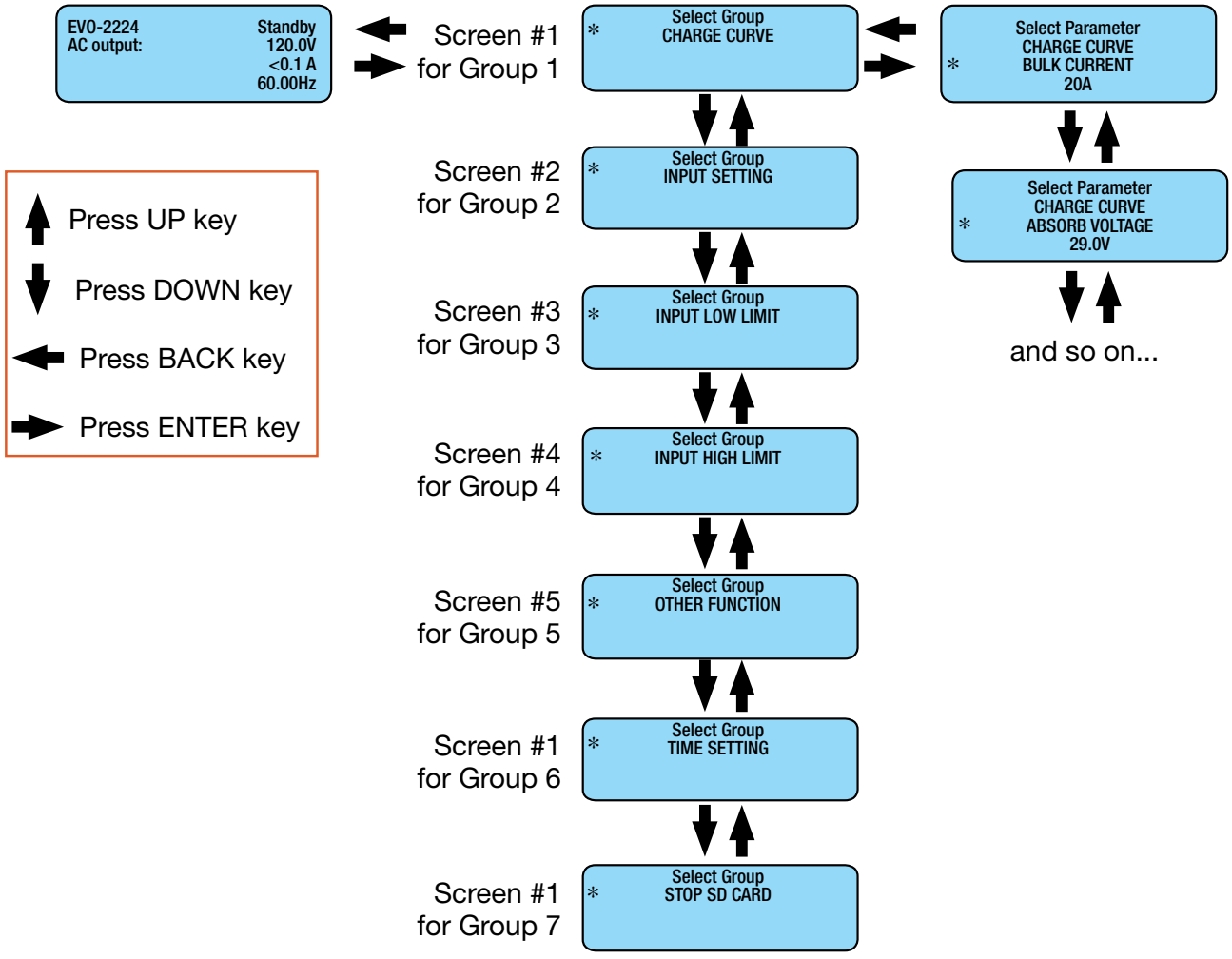
After the Enter key is pressed, the Up/Down keys are used to navigate to one of the 7 "Select Group" Screens.

When the Group for the desired setting is displayed on the LCD, the Enter Key is used again to select this Group. The Up and Down Keys are used to move to the individual screens within the Group.

The 3rd line shows the name of the name of the parameter than can be varied with an asterisk sign "*" next to it. The asterisk sign * indicates that this parameter will be selected when Enter key is pressed and the associated value can be changed.

Pressing the Back Key will exit to the previous level.

There is a 30 second timeout for setting parameters; after 30 seconds the Setting Mode will be cancelled and the display will revert to the Operating Mode Screen associated with current operation.



Parameter Groups: PRO-Verter Programmable Settings

Parameter groups are the top-level categories of PRO-Verter programming.

Table 5. Programmable Parameter Groups: Descriptions

List of Parameter Groups 1 to 7		
Parameter	**Group Name**	**Description**
Group 1	CHARGE CURVE	Parameters for battery charging/battery protection.
Group 2	INPUT SETTING	Parameters for Grid/Generator input current level, frequency range.
Group 3	INPUT LOW LIMIT	Parameters for Grid/Generator input low voltage level.
Group 4	INPUT HIGH LIMIT	Parameters for Grid/Generator input high voltage level.
Group 5	OTHER FUNCTION	Power Saving/Alarm/Remote Switch/Multi-function Relay/etc.
Group 6	TIME SETTING	Local time clock setting.
Group 7	STOP SD CARD	Shown only when SD Card is inserted. To stop SD Card accessed and to remove the SD Card.

Please contact Solar Stik Technical Support before changing settings other than the clock or the AC Input Settings.

Charge Curve programmable settings

Parameters in this group define System battery charging protocols.

Table 6. Parameters for battery charging/battery protection

GROUP 1: "CHARGE CURVE"		
Parameter	**Parameter Value**	**Description**
"BULK CURRENT"	70 A	Sets the maximum charging current during the Bulk Charging Stage.
"ABSORP VOLTAGE"	29.0 V	Sets the charging voltage in the Constant Voltage Absorption Stage.
"EQUALIZE VOLTAGE"	29.0 V	Not applicable when using $LiFePO_4$ batteries.
"FLOAT VOLTAGE"	29.0 V	Sets the charging voltage in the Constant Voltage Float Stage.
"COMPENSATE"	-3mV /°C/Cell	Sets the temperature compensation for the battery.
"BATT OVER VOLT" (Shut Down)	32.0 V	Sets the upper battery voltage threshold at which inverting / charging operations are switched OFF to protect the PRO-Verter.
"RESET VOLTAGE" (Low Voltage Reset)	29.0 V	The PRO-Verter inverter will restart when the battery voltage rises to this set value or above after "Battery low voltage!" shutdown occurs.
"LOW VOLT ALARM"	25.6 V	Battery voltage at which the "Alarm" triggers AGS to start generator.
"BATT LOW VOLTAGE"	24 V	Sets the battery low voltage threshold at which the PRO-Verter inverter will shut down to protect the battery from overdischarge.
"LV DETECT TIME"	60 sec	This is the timer for shutting off the inverter. Battery voltage must be at the low voltage set point for this period of time before the inverter shuts off.
"LV CUT OFF TIME"	3600 sec	This timer shuts off everything including the charger. (The load on the inverter will already be cut off during this time)
"EQUALIZE-4STAGES"	0=NO	Equalize disabled with $LiFePO_4$ batteries.
"ONLINE MODE"	0= Option 1 (Default) Offline	
"RESET TO BULK"	25.6 V	Sets battery voltage at which the charger will terminate current charging stage of the selected "CHARGING PROFILE" & restart charging from the beginning.
"GS DETECT TIME"	60 sec	A timer that sets the duration the battery voltage has to remain at threshold of "LOW VOLT ALARM" or lower before generator auto start/ stop.
"GEN ON TIME"	30 minutes	N/A as programmed
"GEN OFF DELAY"	1 minute	Must be in the generator-stop condition for 1 minute before opening the relay
"ABSORP TIME"	10 min	
"ABSORP EXIT AMPS"	6 A	Set to ~1-% of battery bank capacity.) Value not in play with 2 Stage Type 1 charging
"CHARGING PROFILE"	3 = 2 Stage Type 1	(mimics CC/CV-type charging)

Continued on following page.

GROUP 1: "CHARGE CURVE" (Continued from previous page)		
Parameter	**Parameter Value**	**Description**
"BATTERY TYPE"	1=lithium iron phosphate	N/A. A CC/CV charging profile appropriate for LiFePO4 batteries has been programmed. Do not change.
SAFE CHARGING	0 Min	This timer, if set, will protect a depleted battery from being exposed to potentially heavy load if AC input is intermittent when first re-acquired.
EXTERNAL CHARGER	1= NOT AFFECT	The "external charger" is PV

Input Setting programmable settings

Table 7. Parameters for Grid/Generator input current level, frequency range

GROUP 2: "INPUT SETTING"		
Parameter	**Setting Value**	**Description**
DEFAULT FREQ	60 Hz	Default frequency sets the Inverter frequency, which is also the standard frequency for AC input.
GRID MAX CURRENT	15 A	Value set to rated output current of grid power source.
GEN MAX CURRENT	13 A	Value must be set to match generator(s) output. See I-Plate
HIGH CUT OFF	65 Hz	If the AC input frequency is over the value of "HIGH CUT OFF" when in "Charging Mode", the PRO-Verter will transfer to Inverting Mode.
HIGH RESET	64 Hz	This is the reset frequency at which the unit will revert to "Charging Mode" after it has switched over to "Inverter Mode" due to input frequency rising above "HIGH CUT OFF".
LOW CUT OFF	55 Hz	If the AC input frequency is below "LOW CUT OFF" value when in "Charging Mode", the PRO-Verter will transfer to Inverting Mode.
LOW RESET	56 Hz	This is the reset frequency at which the unit will revert to "Charging Mode" after it has switched over to "Inverting Mode" due to input frequency falling below "LOW CUT OFF".
SYNC GRID	0=Fine	Sets "synching" algorithm for AC input 0= "stable AC Input"; 1= not "stable AC input"
SYNC GEN	0=Fine	Sets "synching" algorithm for AC input 0= "stable AC Input"; 1= not "stable AC input"
INPUT OC PROTECT	0=INVMODE	If the AC input current is 1A more than the programmed value of GRID MAX CURRENT / GEN MAX CURRENT for more than 5 sec, the PRO-Verter will switch over to Inverter Mode to ensure that AC power to the load is maintained. If the load reduces to 1A less than the programmed value of GRID MAX CURRENT / GEN MAX CURRENT for 5 sec, the PRO-Verter will switch back to Charging Mode
INPUT RECOVERY	DIRECT	Option 1=Direct: The PRO-Verter will start in Charging Mode

Input Low Limit programmable settings

Table 8. Parameters for Grid/Generator input low voltage level.

GROUP 3: "INPUT LOW LIMIT"		
Parameter	**Setting Value**	**Description**
RESET VOLTAGE	105.0 V	This is the reset voltage at which the PRO-Verter will revert to "Charging Mode" after it has switched over to "Inverting Mode" due to input voltage falling to "CUT-OFF VOLT 1/CUT-OFF VOLT 2/CUT-OFF VOLT3".
CUT OFF VOLT 1	100.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 1" for period > "DETECT TIME 1", the PRO-Verter will transfer to Inverting Mode from "Charging Mode".
DETECT TIME 1	300 Cycles	This is the time limit in cycles up to which low AC input voltage "CUT-OFF VOLT 1" is allowed.
CUT OFF VOLT 2	95.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 2" for period > "DETECT TIME 2", the PRO-Verter will transfer to "Inverting Mode".
DETECT TIME 2	60 Cycles	This is the time limit in cycles up to which low AC input voltage "CUT-OFF 2" is allowed.
CUT OFF VOLT 3	90.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 3" for period > "DETECT TIME 3", the PRO-Verter will transfer to "Inverting Mode".
DETECT TIME 3	1 Cycle	This is the time limit in cycles up to which the low AC input voltage "CUT-OFF 3" is allowed.

Input High Limit programmable settings

Table 9. Parameters for Grid/Generator input high voltage level.

GROUP 4: "INPUT HIGH LIMIT"		
Parameter	**Setting Value**	**Description**
RESET VOLTAGE	125.0 V	This is the reset voltage at which the PRO-Verter will revert to "Charging Mode" after it has switched over to "Inverting Mode" due to input voltage falling to "CUT-OFF VOLT 1/CUT-OFF VOLT 2/CUT-OFF VOLT3".
CUT OFF VOLT 1	135.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 1" for period > "DETECT TIME 1", the PRO-Verter will transfer to Inverting Mode from "Charging Mode".
DETECT TIME 1	60 Cycles	This is the time limit in cycles up to which low AC input voltage "CUT-OFF VOLT 1" is allowed.
CUT OFF VOLT 2	140.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 2" for period > "DETECT TIME 2", the PRO-Verter will transfer to "Inverting Mode"
DETECT TIME 2	15 Cycles	This is the time limit in cycles up to which low AC input voltage "CUT-OFF 2" is allowed.
CUT OFF VOLT 3	145.0 V	If during "Charging Mode", the AC input voltage falls below "CUT-OFF VOLT 3" for period > "DETECT TIME 3", the PRO-Verter will transfer to "Inverting Mode".
DETECT TIME 3	1 Cycle	This is the time limit in cycles up to which the low AC input voltage "CUT-OFF 3" is allowed.

Other Functions programmable settings

Table 10. Power Saving/Alarm/Remote Switch/Multi-function Relay/etc.

GROUP 5: "OTHER FUNCTIONS"		
Group	**Setting Value**	**Description**
"POWER SAVING"	0 = Disable	Enable or disable Power Saving Mode when in "Inverting Mode".
"ENTER POINT"	6 W	If the value of power drawn by AC load falls to the "ENTER POINT" value for 5 sec, the unit will enter "Power Save Mode".
"WAKE UP POINT"	7 W	If the unit is in "Power Save Mode" and the value of the AC power of the load rises to "WAKE UPPOINT", the unit will quit "Power Save Mode" and will start operating in full voltage "Inverting Mode".
"REMOTE SWITCH"	0 = Button	This selection is used when ON/OFF control of PRO-Verter is desired through external 12 VDC signal. Contact Solar Stik Technical Support
RELAY FUNCTION	2 = Generator	Ties battery voltage-related settings to generator autostart/stop
"COMM ID" (ID for User Interface)	1	Communication ID- This sets the ID number for the COMM Port and User Interface.
"BUZZER"	OFF	Set the buzzer ON/OFF.
"DISCHARGE BEEP"	0 = NO	To select the buzzer ON/OFF while in "Inverting Mode".
"DEFAULT RESET"	0 = NO	This is to reset all of the parameters to the facotry Values. The Factory Values are not the program values set by Solar Stik.
DATA LOG TIME	2 = 10 sec	A real time clock inside the User Interface records timing. The time interval between recordings is programmable. "Events" and "Errors" are recorded as soon as they are sensed.
PARAMETER SAVE	0 = NO	Save all parameters/program settings to SD Card.
TEMP UNIT	1 = deg F	Temperature display can be selected in °C or °F.
PASSWORD DISABLE	1 = Yes	The default password (8052). Password may be disabled.

PRO-Verter Clock Time Setting

Table 11. Local time clock setting.

GROUP 6: TIME SETTING"		
Group	**Setting Value**	**Description**
TIME SETTING	**Local Current Time**	24-hour clock Set to local time for accurate time stamps on logged events. Password not required.

Stop SD Card Command

Shown only when SD Card is inserted. To stop SD Card accessed and to remove the SD Card.

Table 12. Instructions to remove SD card from PRO-Verter User Interface

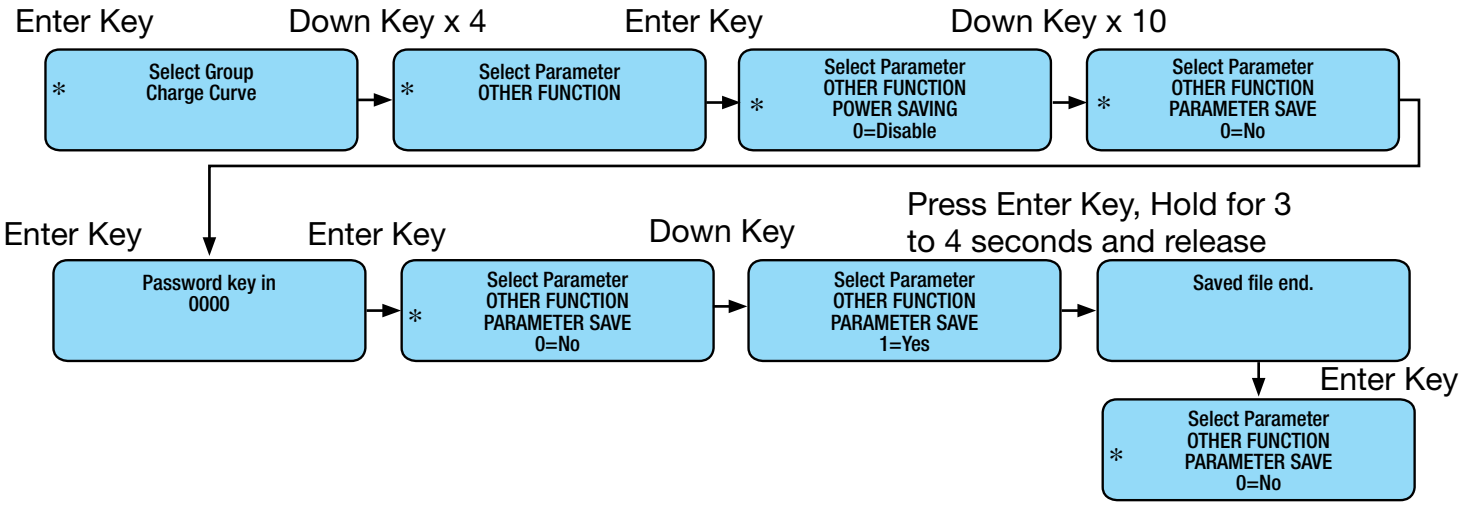
GROUP 7: "STOP SD CARD"		
"STOP SD CARD"	**1=YES to remove**	Remove/eject SD card only after the operation of the Card has been stopped.

Saving / Uploading Programmed Parameters

Saving Programmed Parameters to SD Card

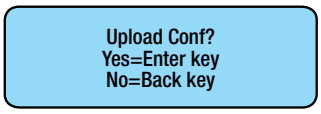
All the programmed parameters can be saved on an SD Card (FAT 16 / FAT 32 Format, up to 16 GB capacity). The parameters will be saved in File named “xxxx_yyy.cfg”, where the first group of 4 digits xxxx is the model number of the inverter charger and the second group of 3 digits YYY is the Revision #. for that Model e.g. 074.

- For saving, first insert the SD Card in the SD Card Slot.
- Then, go to “Parameter Save” Screen . Steps are given below:

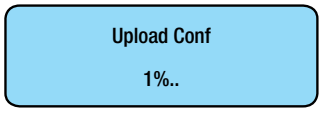


Uploading Saved Parameters from SD Card

If there is a “xxxx_yyy.cfg” file in the SD card with stored programmed parameters, then on inserting the card, the Remote Control will ask to upload the Config File. Press Enter Button to confirm or Back Key to cancel.



- Asks to confirm or cancel uploading of saved parameters.
- Choose Yes by pressing Enter Key.



Configuration uploading.

Data Logging

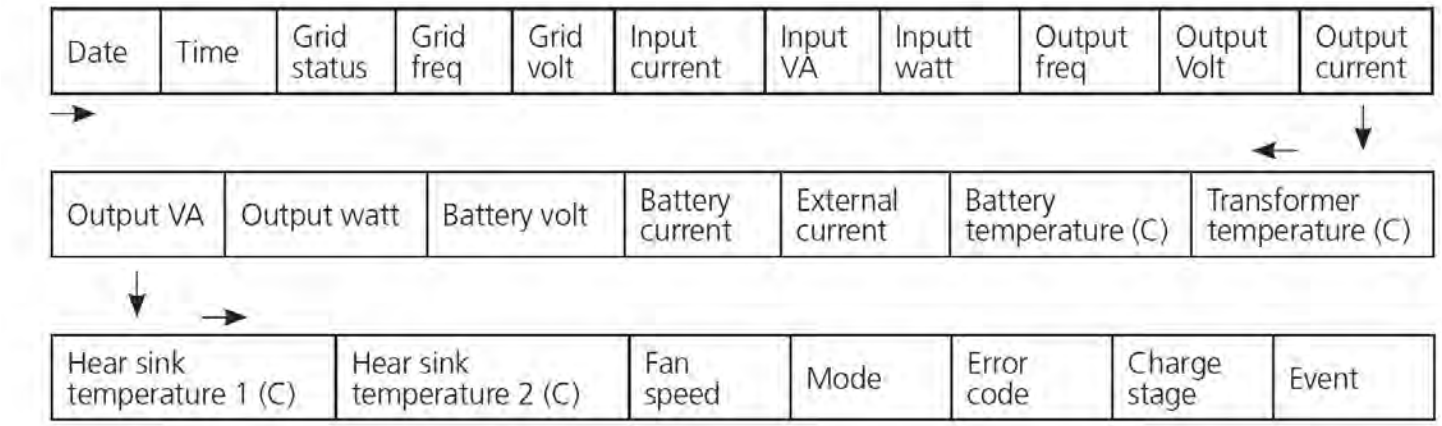
An SD Card may be used to log operating information.

- When the SD Card is inserted in the SD Card Slot, data logging is activated automatically (it will be disabled only if programmable setting has been changed to “0=Disable), Time interval between recordings (called “DATALOG TIME”) is programmable. Time stamps for each even are provided by the User Interface internal, real-time clock.

Available options for “DATALOG TIME” are:

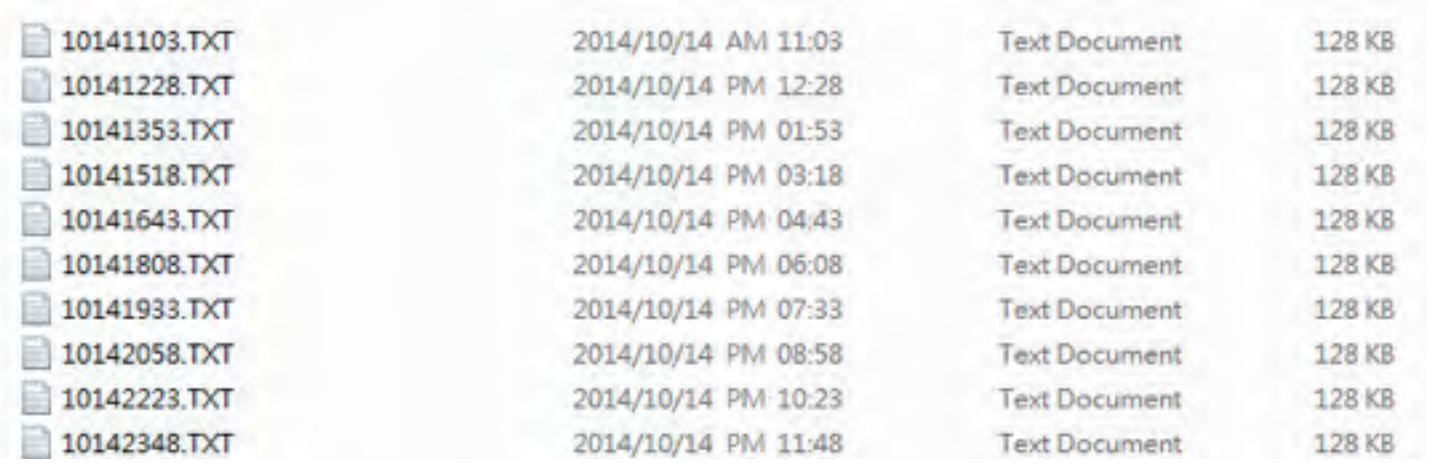
- 0=Disable ; 1=1 sec (Default); 2=10 sec; 3=30 sec; 4=60 sec; 5=5 min; 6=10 min
- “Events” and “Error Codes” are recorded as soon as they are sensed.

The following 25 Data Fields include System electrical parameters, events and error codes:



Data Log Files: Viewing Data Log Files Using Excel

The Data Log Files are written as Text Files (.txt) in the DATALOG Folder on the SD Card’s Root Directory. Below is an image of the DATALOG Folder showing example of the Data Log Files. The File Name Format is month/day/hour/minute.txt (MMDDhhmm.txt). Each file has 512 rows of records (Each row has multiple data fields). Each file size is 128KB.



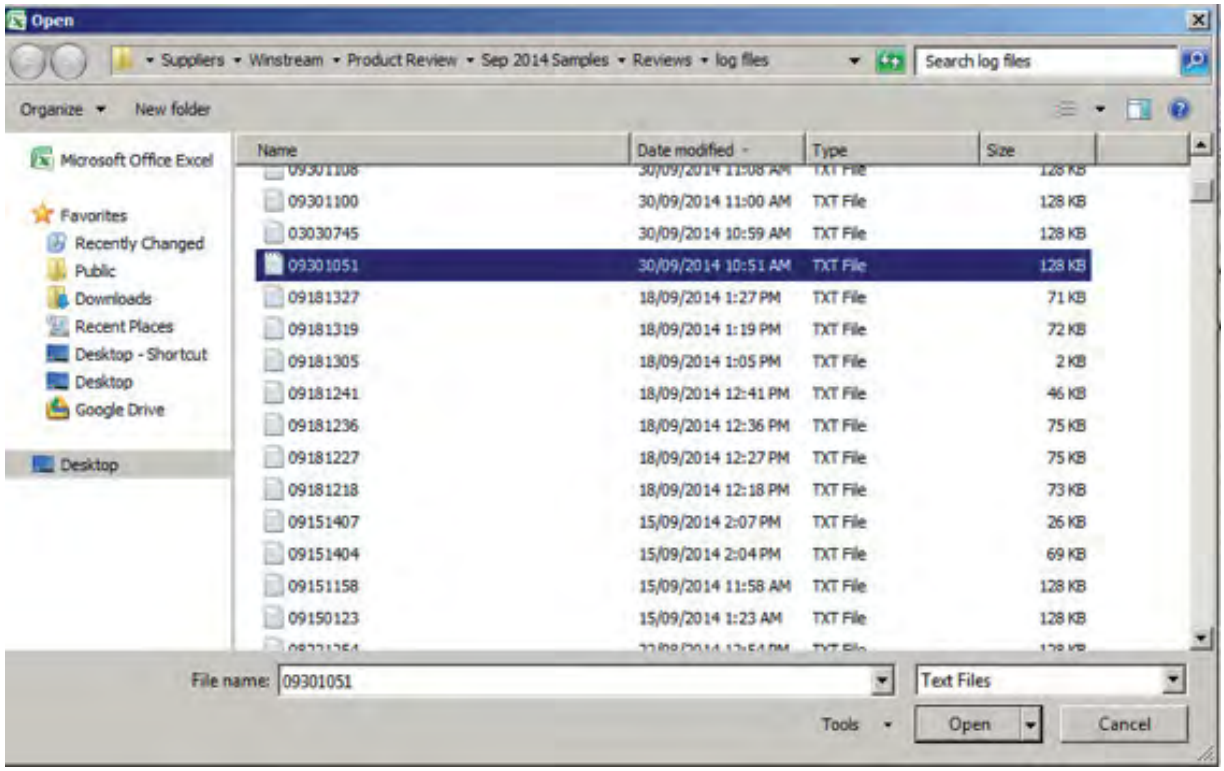
The figure below shows an example of one of the File's contents opened with a general purpose Text Reader. The 2nd Row shows Data fields separated by semicolon i.e. ";" . The 3rd Row onwards shows the status of the Data Fields at time interval equal to the programmed value of DATALOG TIME.

NOTE: Event / Error Code will be logged as soon as they occur.

```
Date;Time;Gen status;Gen freq;Gen volt;Grid status;Grid freq;Grid volt;Input current;Input VA;Input watt;Output freq;Output volt;Output current;Output VA;Output watt;Battery vo
2014/10/14;12:28:32;33340;000.00;000.62;33341;000.00;000.42;<00.10;<0012;<0012;060.00;000.42;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.7;0027.1;0;0;00000;0;
2014/10/14;12:28:42;33340;000.00;000.62;33341;000.00;000.42;<00.10;<0012;<0012;060.00;000.43;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.7;0027.1;0;0;00000;0;
2014/10/14;12:28:52;33340;000.00;000.62;33341;000.00;000.41;<00.10;<0012;<0012;060.00;000.42;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.7;0027.1;0;0;00000;0;
2014/10/14;12:29:02;33340;000.00;000.62;33341;000.00;000.42;<00.10;<0012;<0012;060.00;000.43;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.7;0027.1;0;0;00000;0;
2014/10/14;12:29:12;33340;000.00;000.62;33341;000.00;000.42;<00.10;<0012;<0012;060.00;000.43;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.7;0027.1;0;0;00000;0;
2014/10/14;12:29:22;33340;000.00;000.62;33341;000.00;000.41;<00.10;<0012;<0012;060.00;000.42;<00.10;<0012;<0012;25.002;0000.0;0000.0;0025.0;0026.0;0026.8;0027.1;0;0;00000;0;
```

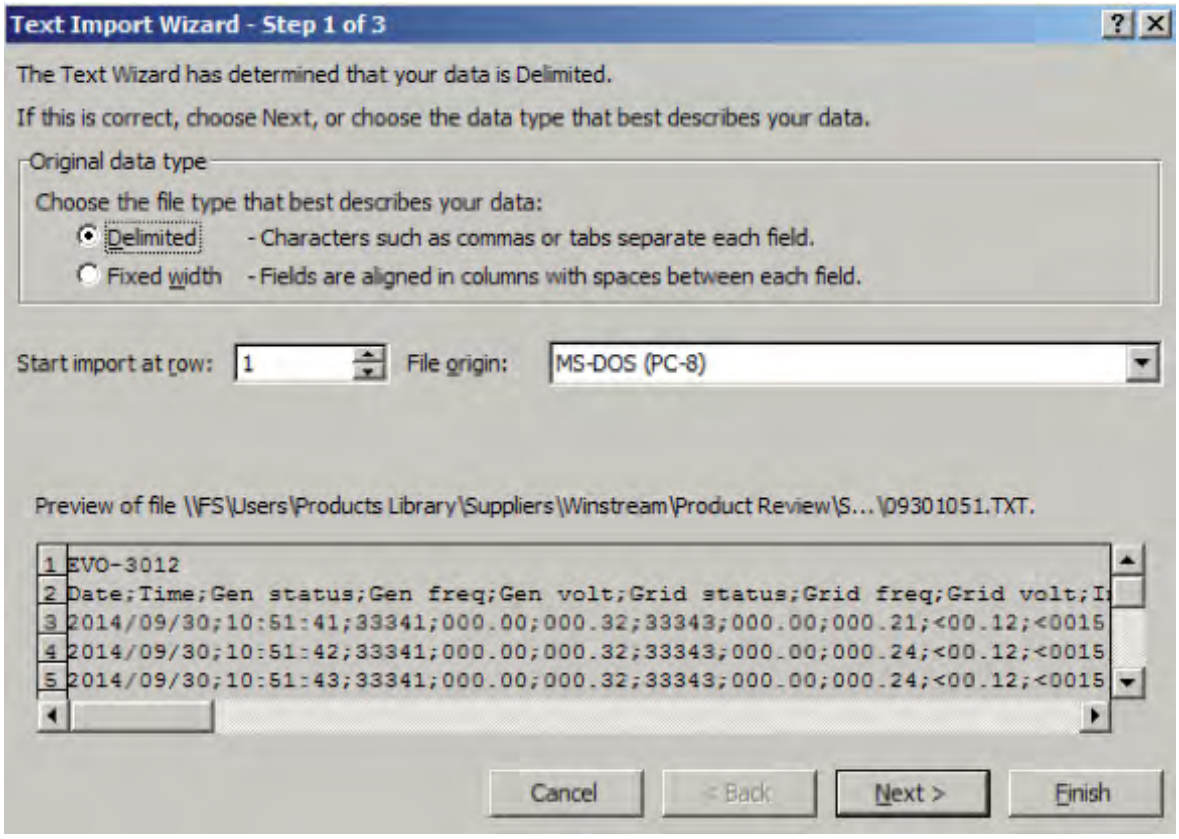
Follow procedure given below to open Data Log Files in Excel:

- Start Excel.
- Click File Microsoft Office Button on the top left hand corner.
- Click "Open" from the Drop Down Menu.
- Navigate to the Directory where the Log Files downloaded from the SD Card are located.
- Click on "File Types"selection button at the bottom right corner (shows "All Excel Files" as default) and select Text files from the Drop Down Menu.
- All Text Files (.txt) will be displayed.

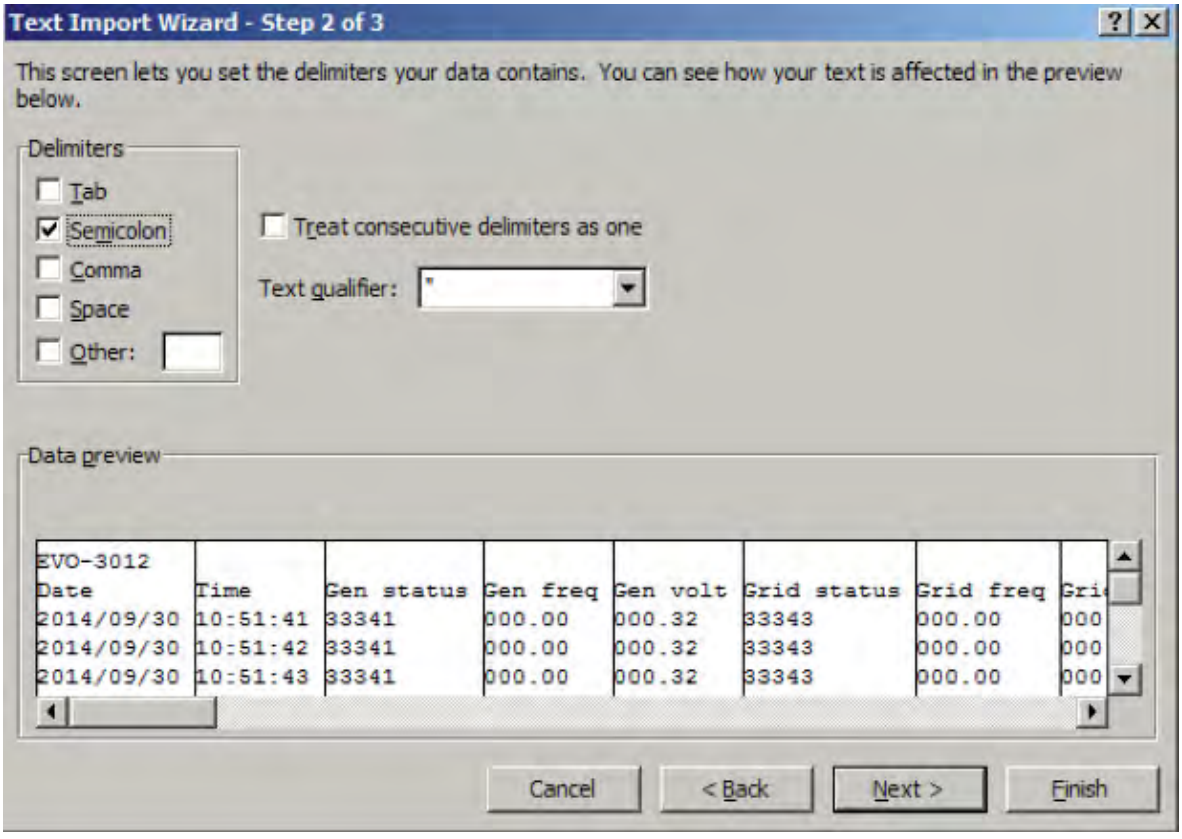


Click "Open" Button

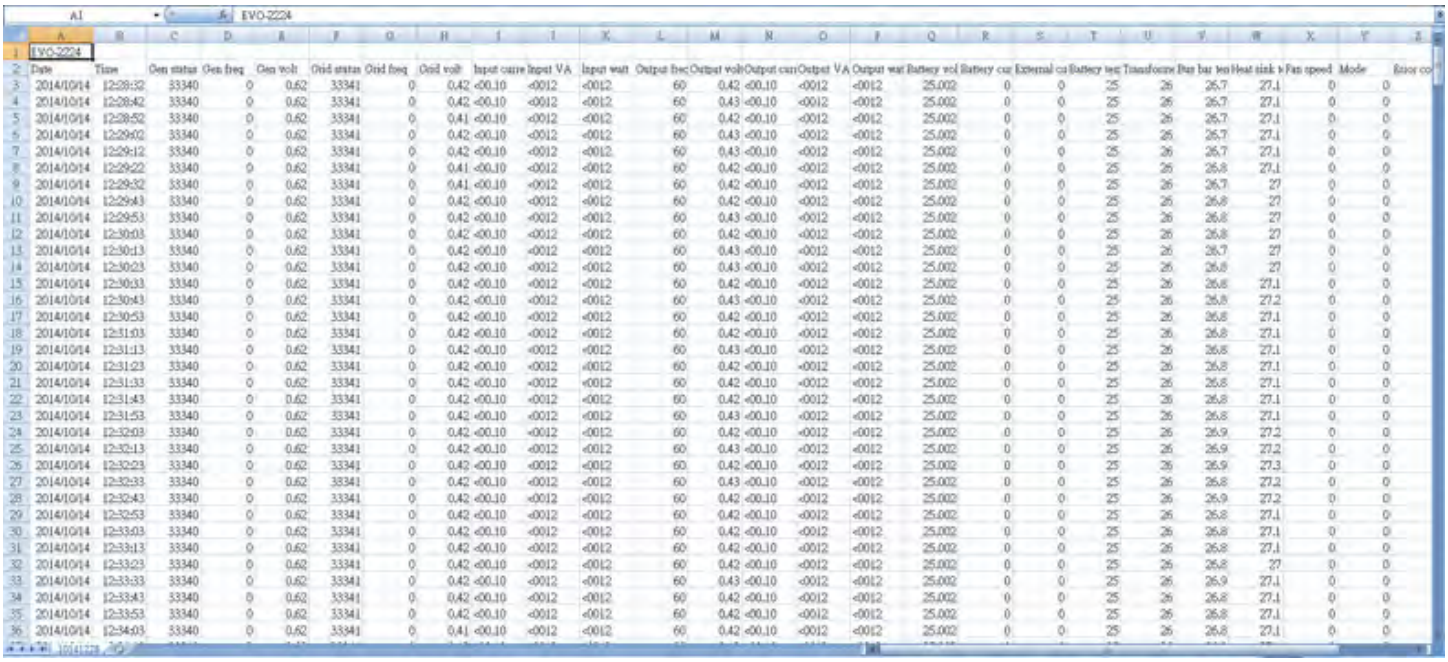
Text Import Wizard – Step 1 will be shown. Choose “Delimited”File Type”.



Text Import Wizard – Step 2 will appear. Choose "Semicolon" and click 'Finish' button.



Data will be displayed on a Worksheet, with the Log Data stored in Columns and Rows.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
1	EVO-2224																									
2	Date	Time	Gen status	Gen freq	Gen volt	Grid status	Grid freq	Grid volt	Input curre	Input VA	Input watt	Output frec	Output volt	Output curr	Output VA	Output wat	Battery vol	Battery cur	External cu	Battery tec	Transformr	Bus bar tem	Heat sink t	Fan speed	Mode	Error co
3	2014/10/14	12:28:32	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27.1	0	0	
4	2014/10/14	12:28:42	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27.1	0	0	
5	2014/10/14	12:28:52	33340	0	0.62	33341	0	0.41	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27.1	0	0	
6	2014/10/14	12:29:02	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27.1	0	0	
7	2014/10/14	12:29:12	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27.1	0	0	
8	2014/10/14	12:29:22	33340	0	0.62	33341	0	0.41	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
9	2014/10/14	12:29:32	33340	0	0.62	33341	0	0.41	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27	0	0	
10	2014/10/14	12:29:43	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27	0	0	
11	2014/10/14	12:29:53	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27	0	0	
12	2014/10/14	12:30:03	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27	0	0	
13	2014/10/14	12:30:13	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.7	27	0	0	
14	2014/10/14	12:30:23	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27	0	0	
15	2014/10/14	12:30:33	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
16	2014/10/14	12:30:43	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.2	0	0	
17	2014/10/14	12:30:53	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
18	2014/10/14	12:31:03	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
19	2014/10/14	12:31:13	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
20	2014/10/14	12:31:23	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
21	2014/10/14	12:31:33	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
22	2014/10/14	12:31:43	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
23	2014/10/14	12:31:53	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
24	2014/10/14	12:32:03	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.9	27.2	0	0	
25	2014/10/14	12:32:13	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.9	27.2	0	0	
26	2014/10/14	12:32:23	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.9	27.3	0	0	
27	2014/10/14	12:32:33	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.2	0	0	
28	2014/10/14	12:32:43	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.9	27.2	0	0	
29	2014/10/14	12:32:53	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
30	2014/10/14	12:33:03	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
31	2014/10/14	12:33:13	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
32	2014/10/14	12:33:23	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27	0	0	
33	2014/10/14	12:33:33	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.43	<00.10	<0012	<0012	25.002	0	0	25	26	26.9	27.1	0	0	
34	2014/10/14	12:33:43	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
35	2014/10/14	12:33:53	33340	0	0.62	33341	0	0.42	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	
36	2014/10/14	12:34:03	33340	0	0.62	33341	0	0.41	<00.10	<0012	<0012	60	0.42	<00.10	<0012	<0012	25.002	0	0	25	26	26.8	27.1	0	0	

Troubleshooting

Generator Fault/Failure

If one (1) of two (2) generators running in tandem fails:
- Restart the generator or
- If the generator will not restart immediately, reprogram the PRO-Verter AC input setting to half the value for two (2) generators in tandem.

To reprogram generator AC Input.

1. Press ENTER button.
2. Press DOWN button to arrive at INPUT SETTING.
3. Press ENTER button.
4. Press DOWN button to arrive at GRID MAX CURRENT.
5. Press ENTER button and hold until number flashes.
6. Use UP or DOWN button to change number.
7. Press ENTER to move to next digit.
8. When correct value is entered, press and hold ENTER to save.

System Recovery with Overdischarged Batteries:

If batteries are discharged to a “critical-low” level, the system may cease to function. There are two (2) methods to restore a System with overdischarged batteries:

1. Connect an active generator/grid 120 VAC power source to the PRO-Verter “Generator Input” connector. Turn on the 120 VAC generator Input breaker on the Faceplate. When the LED over the System Recovery switch illuminates, toggle the recovery switch while pressing the User Interface ON/OFF button. Once the User Interface powers up, release the System Recovery switch and the User interface ON/OFF button. The System will begin charging the batteries within two (2) minutes

2. Connect an active PV array (exposed to sun) to the PRO-Verter. Turn on the PRO-Verter user interface. Charging will begin when the PV input voltage is 5.0 VDC higher than the battery voltage.

Clearing PRO-Verter Faults

If any fault occurs, the User Interface will display the Fault Message and the Red “Fault” LED will be lighted. Remove cause of the fault. The unit will remain in Fault Mode until the fault is cleared.
A short press (0.1 seconds) of the On/Off key will clear the Fault Message and the PRO-Verter will return to the operational status (if the reason for the fault condition has been corrected). Refer to the section on “Fault Messages”.

PRO-Verter User Interface Fault and Status LEDs

Figure 34. PRO-Verter User Interface Fault and Status LEDs

Table 13. User Interface fault, status LED and alarm Indications

LED Alarm Indications			
Status	**Blue LED**	**Red LED**	**Alarm**
Seen during Power-On Sequence Indicates completion of Power-On Sequence after Power ON/OFF Button is pressed for 2 sec	Flash 3 times	Off	Off
Seen during Power-Off Sequence Indicates completion of Power-Off Sequence after Power ON/OFF Button is pressed for 5 sec	On	On	Off
Normal charging	Flash 1 time per sec	Off	Off
Equalization charging	Flash 2 times per sec	Off	Off
Inverting (Discharging)	On	Off	Beep per 3 second (Default Off)
Low battery alarm	On	Flash 1 per sec	Beep per 1 second
Power saving	Flash 1 time per	Off	Off
Standby	3 sec	Off	Off
Fault	Off	On	On

Fault Messages and Troubleshooting Guides

Table 14. Fault Messages Symptoms and Trouble Shooting

Fault Messages and Troubleshooting Guide	
Fault Message	**Symptoms and Trouble Shooting**
Battery low voltage!	PRO-Verter is in FAULT MODE because the battery voltage has dropped to the set lower threshold of “BATT LOW VOLTAGE” • When the battery voltage drops to the set lower threshold of “BATT LOW VOLTAGE”, activation of this fault protection is initiated. The Red “Fault” LED will flash once per second and the alarm in PRO-Verter will beep once per second. The Inverter will continue to operate normally and the Blue “Status” LED will continue to be ON steady (NOTE: Fault message “Battery low voltage!” will not be displayed during this time) • If the battery voltage stays at or below the threshold setting for a duration equal to the set “LV DETECT TIME”, only the Inverter will be switched OFF and fault message “Battery low voltage!” will be displayed. The Red “Fault” LED “will now change to steady ON, the Blue “Status” LED will switch OFF and the alarm in PRO-Verter will now beep steady. If the “Battery low voltage!” fault condition is not reset within the “LV CUT OFF TIME”, PRO-Verter will shut down completely after the “LV CUT OFF TIME” (LCD Display / LED / Alarm will be OFF) has expired. • If the batteries are being charged by the Solar Array, and the battery voltage recovers to the set “RESET VOLTAGE” before “LV CUT OFF TIME” time expires while in “Battery low voltage!” fault condition, the Inverter will restart and “Battery low voltage!” fault condition will be cleared. • While in “Battery low voltage!” fault condition, if AC input is made available before the expiration of “LV CUT OFF TIME”, the “Battery low voltage!” fault condition will be cleared. The PRO-Verter will restart in Inverter Mode, synchronize with the AC input and then, transfer to the AC input at zero crossing. It will now operate in Charging Mode
Battery ultra low voltage!	The PRO-Verter is in FAULT MODE because the battery voltage has dropped to 18 V or lower **(Note: a voltage this low will not be encountered when using LiFePO4 batteries because the battery’s own BMS will disconnect the output terminals before the voltage drops that low.)**

Continued on next page

Fault Messages and Troubleshooting Guide	
Fault Message	**Symptoms and Trouble Shooting**
Battery over voltage!	The PRO-Verter is in FAULT MODE because the battery voltage has risen to the programmed upper threshold of “BATT OVER VOLTAGE”. **(a) AC input is not available and PRO-Verter is operating in Inverting Mode:** • There will be no AC output because the Inverter will be switched OFF. The Blue “Status” LED will be switched OFF and the Red “Fault LED” will be steady ON. The alarm will beep steady. • The fault will be cleared automatically when the battery voltage drops to 0.5V below the set upper threshold of “BATT OVER VOLT”. **(b) AC input is available and PRO-Verter is operating in Charging Mode:** • There will be no AC output or charging because the Transfer Relay will be de-energized and PWM drive to the Inverter will be switched OFF. • The fault will be cleared automatically when the battery voltage drops to 0.5V below to the set upper threshold of “BATT OVER VOLT”. The PRO-Verter will restart in Inverting Mode, synchronize with the AC input and then, the Transfer Relay will be energized to transfer to AC input at zero crossing. The PRO-Verter will, thus, resume operation in “Charging Mode”,
Input over current!	The PRO-Verter is in FAULT MODE because the input current being drawn from the AC input source (Input current = Charging Current + Pass Through Current to the load) is 1A more than the set threshold of “ GRID MAX CURRENT” / “GEN MAX CURRENT” for 5 seconds (current is sampled every 33.3 µs). • There will be no AC output because the Transfer Relay will be de-energized, charging will be stopped and PWM drive to the Inverter Section will be switched OFF. The Blue LED marked “Status” will be switched OFF and the Red LED marked “Fault” will be steady ON. The alarm in PRO-Verter will beep steady. • PRO-Verter will be turned off and will require manual reset by turning OFF the main breaker, waiting for 1 minute and then turning ON the main breaker. • The set threshold of “ GRID MAX CURRENT” / “GEN MAX CURRENT” should match the breaker capacity of the AC input source / AC input Branch Circuit. If AC input current capacity cannot be increased, reduce the AC load / “BULK CURRENT” accordingly.
Output over current!	The PRO-Verter is in FAULT MODE because the instantaneous output current being drawn from the PRO-Verter inverter by the AC load is 330% of the rated value of the PRO-Verter for 2 samples (current is sampled every 33.3 µs). • There will be no AC output because the PRO-Verter inverter will be switched OFF. The Blue LED marked “Status” will be switched OFF and the Red LED marked “Fault” will be steady ON. The alarm will beep steady. • PRO-Verter will be OFF and will require manual reset by powering OFF, waiting for 1 minute and then powering ON again. • Ensure that the maximum, instantaneous surge current of the load is NOT more than 300% (30 A) of the rated current (10 A) of the inverter for more than 1 millisecond.

Continued on next page

Fault Messages and Troubleshooting Guide	
Fault Message	**Symptoms and Trouble Shooting**
Output over load!	The PRO-Verter is in FAULT MODE because of overload to the inverter: • There will be no AC output because the Inverter will be switched OFF. The Blue "Status" LED will be switched OFF and the Red "Fault" LED will be steady ON. The alarm in PRO-Verter will beep steady • PRO-Verter will shut down and will require manual reset by turning OFF the main power switch, waiting for 1 minute then turning ON the main power switch. Output voltage is less than 96 V_{rms} for 300 cycles (5 seconds at 60 Hz)
Output over load 1!	Output power demand is over the rated output by 110% for 30 min
Output over load 2!	Output power demand is 120% of rated output for 10 min.
Output over load 3!	Output power demand is 140% of rated output for 1 min.
Output over load 4!	Output power demand is 150% of rated output for 30 sec.
Output short circuit!	The PRO-Verter is in FAULT MODE because there is a short circuit on the output side in Inverter Mode. Short circuit protection is activated when: Output voltage is < 15 V_{rms} for 6 cycles and output current is more than the rated output current of 10.00 A_{rms}. • There is no AC output because the Inverter has been switched OFF. The Blue "Status" LED will be switched OFF and the Red "Fault" LED will be steady ON. The alarm will beep steady • The PRO-Verter will be turned OFF and will require manual reset by powering OFF, waiting for 1 minute and then powering ON again. **NOTE:** If there is short circuit condition in Charging Mode i.e. when AC input is available, short circuit condition on the output side will trip the AC input breaker. The load will be transferred to the Inverter and the Inverter will then see short circuit condition and will shut down as described above.
Output failure!	The PRO-Verter is in FAULT MODE because AC input from Grid / Generator has been connected to the AC Output terminals by mistake. 10 VAC or above detected at the AC Output Terminals when the PRO-Verter boots up will activate this protection. • The Blue "Status" LED will be switched OFF and the Red "Fault" LED will be steady ON. The alarm in will beep steady • The PRO-Verter will be turned OFF and will require manual reset by powering OFF, waiting for 1 minute and then powering ON again Check the connection. If there is 10 VAC or over at the output terminal, remove the connection and connect to the input terminals.
Transformer over heat!	The PRO-Verter is in FAULT MODE because the Bidirectional Transformer in the PRO-Verter has overheated to 150°C • The Blue "Status" LED will be switched OFF and the Red "Fault" LED will be steady ON. The alarm will beep steady. • If in Inverting Mode, Inverter will be switched OFF. If in Charging Mode, the Transfer Relay will be de-energized and the Inverter will be switched OFF. • Ensure that the fans are working properly, that there is no blockage of air flow, that there is adequate airflow and the ambient temperature is within the limits. Reduce the load / "BULK CURRENT". • The fault will clear when the transformer has cooled down to 80°C

Continued on next page

Fault Messages and Troubleshooting Guide	
Fault Message	**Symptoms and Trouble Shooting**
Heat sink over heat!	The PRO-Verter is in FAULT MODE because the internal heat sink in the PRO-Verter has overheated to 70°C • The Blue “Status” LED will be switched OFF and the Red “Fault” LED will be steady ON. The alarm will beep steady • If in Inverting Mode, the Inverter will be switched OFF. If in Charging Mode, the Transfer Relay will be de-energized and the Inverter will be switched OFF. • Check that the fans are working properly, there is no blockage of air suction and discharge vents, adequate cool replacement air is available and the ambient temperature is within the limits. Reduce the load and “BULK CURRENT” • The fault will be cleared when the heat sink has cooled down to 40°C
SD card unusable!	• Data logging will not start. • Check that the format is FAT16/FAT32. • Check that the capacity is less than 16 GB. • Re-format the card.
SD card read error!	• Data logging stops. • Remove and re-insert the card.
SD card write error!	• Data logging stops. • Remove and re-insert the card.
SD card full!	• Data logging stops. • Move or delete files or re-format the card.
WRITE FAILURE!	The entered value of programmable parameter could not be written.
OUT OF RANGE!	The entered value of programmable parameter is out of the programmable range. Change parameter value to within the specified range.

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.

Contact

Technical Support Line
800-793-4364 Ext. 102
(24 hours a day, 365 days a year)

Address
Solar Stik, Inc.
226 West King Street
Saint Augustine, Florida 32084

Website
www.solarstik.com