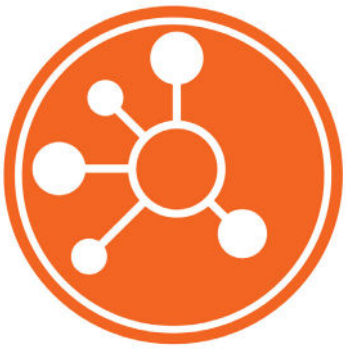
SOLAR STIK®

TROUBLESHOOTING GUIDE FOR ATSC OMAN MS3 L0



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OEM Literature Supplemental to this Manual

Reading information in the documents listed below may be necessary to identify and solve issues, especially the generators. OEM technical documentation for the generator is delivered with the generator. If they become separated from the generator, please contact Solar Stik Technical Support. They can also be found online by using the document titles as the search term.

- DSE3110-Operators-Manual
- Meccalte User manual Self-regulating Alternators Series ECP 28 Series ECP 32 Series ECP 34 Operating and maintenance instructions
- Meccalte Technical Guide: DSR Digital Regulator
- YANMAR 3TNV74F 3TNV80F, 3TNV88F, 3TNM74F OPERATOR MANUAL
- Operation Manual Yanmar Industrial Engines TNV

SYSTEM-LEVEL SYMPTOMS

System Short 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 (too few or low SOH)
- Heat-derated performance
- Disparity in battery SOC and SOH

“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 is simply a reduction in the total load demand (AC and DC). Use the PRO-Verter AC and DC METERS to confirm the load is reduced to prescribed levels and proceed with normal operation.

System and Component Monitoring

Monitoring system metrics displayed on the individual components is the most valuable source of information for tracking down and solving problems - i.e., troubleshooting. For this reason, the full menu maps for the PRO-Verter and Power Hub are included herein.

Heat and System Derating

The function and efficiency of all electronic equipment is related to and dependent upon the temperature at which it is operating. It performs optimally within a narrow temperature range and less so as the temperature exceeds the upper end of that range. Solar panel output drops off significantly in high heat as well. The Power Hub, PRO-Verter and Expander Paks generate heat as a by-product of their normal function. Under normal circumstances, the amount of heat generated in this way will not exceed the rated temperature of these components to function at their rated capacity.

Causes of Overheating

The three most common reasons for overheating are:

- **High ambient temperature**
- **Operating the equipment at or above its maximum capacity** and
- **solar loading** (heat accumulation due to the sun shining directly the a component).

These factors work together to elevate the internal operating temperature to the point where the internal subcomponents of the PRO-Verter, Power Hub and Expander Paks may automatically derate or even temporarily suspend operation to prevent damage to their internal electronics. The solar chargers in the Power Hub are rated to operate normally up to 104 ºF (40 ºC), the PRO-Verter up to 140 ºF (60 ºC) and the Expander Pak up to 149 ºF (65 ºC) Performance of the each of these components will decline as the temperature increases or is sustained above this value.

Keep the System Cool

Thermostat-controlled, internal, cooling fans in the Power Hub and PRO-Verter turn on to maintain the internal temperature within the optimal operating range. The fans are audible when operating. Clogged air intake filters can significantly exacerbate heat-related problems, so they should be cleaned as often as necessary to maintain maximum airflow. Clean or replace the air filter monthly, or more frequently if operating in very dusty environments. Do not operate the Power Hub in direct sunlight or directly on the ground. It should be placed in a shaded, well-ventilated location. Proper air filter maintenance and shading the Power Hub will help to ensure the internal temperature does not reach critical levels. Expander Paks do not have cooling fans and vents making it even more important to keep them shaded to reduce solar loading.

Power Hub Overheating and Derating

The function and efficiency of all electronic equipment is related to and dependent upon the temperature at which it is operating. It performs optimally within a narrow temperature range and less so as the temperature falls outside of that range. The solar charge controllers within the Power Hub are rated to perform at full capacity until the internal temperature reaches 104 ºF (40 ºC). At this point, the charge controller will “derate”, or reduce its level of activity, to prevent the internal temperature from rising further. When the internal temperature of the charge controller reaches 160 ºF (71 ºC) it will “shut down” to prevent damage. If this uncommon situation occurs, it is most likely to happen during the hottest, sunniest part of the day when power from the solar arrays should be producing power, but the report on the LCD User Interface may say that they are producing no power at all.

Power Hub Temperature Reports

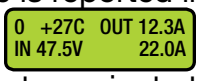
The first indication of overheating may be the appearance that the solar arrays are “not producing any power” when they should be. If this is the case, check the temperature.

> **Note:** The Power Hub User Interface will also report 0 VDC charging current when the System batteries are fully charged.

The Power Hub LCD User Interface reports two (2) temperatures:

1. The “Internal Temperature” is measured by a thermister directly on the charge controller. This value is reported in the BAT TEMPERATURE window: 

See Advanced Information Menu Windows in the Power Hub Operator Manual for directions to navigate to this window.

2. The “Battery Temperature” is measured by a Battery Temperature Sensor that is located inside the Power Hub.
   > **Note:** THIS IS NOT REPORTING THE TEMPERATURE OF THE BATTERIES but rather the temperature inside the Power Hub case. This value is reported independently for each of the three (3) charge controllers inside the Power Hub. 

   See the Power Hub Manual for instructions on how to navigate the View Charge Status submenus for instructions on how to navigate to these windows.

If either of the temperatures reported from these two sensors is greater than 104 ºF (40 ºC), the Power Hub performance will be degraded.

PRO-Verter Temperature Reports

The PRO-Verter user interface reports a range of temperatures in the first submenu after pushing the TECH button. Like the Power Hub, the battery temperature sensor (BTS) is inside the PRO-Verter case and not in the batteries.

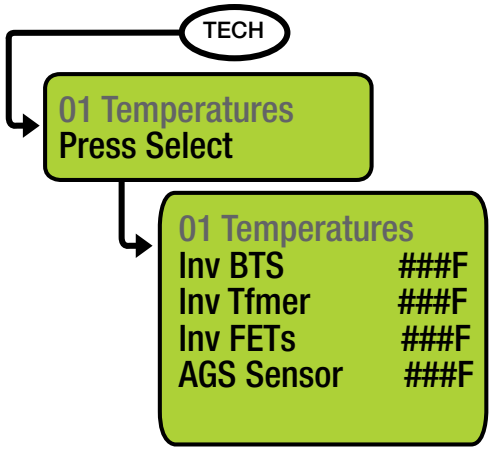


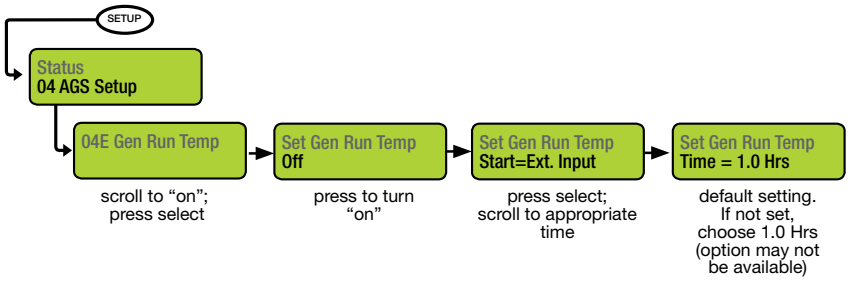
Figure 1. PRO-Verter temperature reports from the user interface

PRO-Verter High-temp Generator Auto-Start

When a heavy load (≥100% rated output) is placed on the PRO-Verter while inverting, the internal transformer temperature will rise in accordance with the amount of power it is processing. If the internal “Transformer Temperature” reaches or exceeds 221 ºF (105 ºC) the PRO-Verter will automatically start a connected generator to assume the load. This protects the PRO-Verter from damage and/or going into FAULT mode and provides continuity of operations during peak demand.

This feature has been programmed at the factory and requires no programming by the operator other than the duration of the generator run time (based on the generator fuel tank volume), if the time needed is different than what is pre-programmed.

Should the PRO-Verter go into fault mode (Overtemp or TmfrOvertemp) during peak demand, ensure that the AGS is set to Auto (FAVS 5 Menu) and that Set Gen Run Temp is set to “1.0 Hrs” (If this option is available) by following the Menu Map below:



Note: Do not change Max Gen Run Time in section 04F of the Menu. This should remain at 12 hours.

Charger Mode: PRO-Verter High-temp Protection

The PRO-Verter is equipped with a function that will temporarily reduce the amount of current that passes to the batteries should the internal “Transformer Temperature” reach or exceed a preset value during the charging process. When this is occurring, the LED charge light will blink while charging continues at a decreased rate. After the transformer cools to a temperature below the preset value, the LED will stop blinking and remain on constantly and full-capacity charging will resume.

PRO-Verter Troubleshooting

The PRO-Verter is the central management device in most Systems and as such will be the primary device to report and correct issues both within the PRO-Verter and the System.

Most faults and System failures can be caused by two factors:
- Incorrect programming values in the PRO-Verter (and possibly the Power Hub) or
- Incorrect setup.

Ensure the PRO-Verter and Power Hub programming values are set according to the Program Requirements.

Table 2 provides the faults most commonly encountered when a System is running in Hybrid mode. The source(s) of the problems that generates these faults is indicated by an “X” in the appropriate column. This information will streamline the troubleshooting process by telling the operator what to check first. Click the fault name to link to a detailed explanation of the reason(s) why the fault occurred and solutions to correct the fault. The full list of all faults and statuses is on the following page. Refer to the component Manuals if faults are not System-related.

Table 1. List of Faults and Source(s) of Problem

Fault	Excessive Load	Generator	Expander Paks	Power Hub	AGS Cable	AC Cable	Heat/ Derating
AC Overload	X						
Fault Gen Run	X	X			X	X	
Fault MaxRn	X	X	X				X
Fault VDC		X			X	X	
FET Overload	X						X
High Battery			X	X			
Low Battery	X	X	X				
Tfmr Overtemp	X						X

Troubleshooting

PRO-Verter: Quick Links to Statuses, Faults, and Resolutions

This guide is interactive if used on a computer or handheld device. Each of the faults in the lists below is touch-linked to an explanation of the fault and a solution to resolve the fault.

Quick Links to PRO-Verter Status Messages

Quick Links to Problems: Solutions and Explanations

Quick Links to Other Troubleshooting Guides

PRO-Verter Troubleshooting

The User Interface LCD Screen

Table 2. Troubleshooting the User Interface LCD Screen

Symptom	Possible Cause(s)	Solution
LCD Screen on but not responsive when buttons are pressed	Dust/dirt buildup inside of the LCD User Interface.	Remove the LCD User Interface and clean with compressed air. Please call Solar Stik Technical Support for assistance.
LCD is nonfunctional (no lights, or text on LCD screen, and no response when pressing any button).	Communications cable is bad or not connected correctly to the LCD port on the inverter.	Check communications cable from inverter to LCD; ensure (1) it is connected to the remote port and (2) the correct communications cable is used. (A four-conductor telephone cable may be substituted to determine if the cable is good).
	PRO-Verter is not connected to the batteries.	Ensure the inverter batteries are connected and the inverter is operating correctly without any AC power connected (can invert and power AC loads from batteries).
	No crossover cable or incorrect cable installed between the two ports on the RMK.	See PRO-Verter Remote Monitoring Kit (RMK) LAN Operator Manual.
Display shows unrecognized letters or symbols.	Static electricity may have been discharged into the LCD screen.	Refresh display: Press and hold the SELECT knob for 10 seconds.
LCD text is locked up; pushing any button has no response.	Connections on communication cable are not tight.	Reset LCD: (1) Disconnect remote cable from inverter for 5 seconds and then reconnect. (2) Check RJ11 cable connection on back of remote. Ensure the RJ11 connector is pushed into the correct port. There will be a “click” when the connection is made.
	LCD is not getting sufficient power from inverter.	Ensure batteries are connected and the inverter is operating correctly; the inverter should be able to invert and power AC loads from batteries. Ensure no AC power is connected to the inverter AC outputs.
LEDs and backlight are off.	LCD may be in Power Save mode.	Press any button to reactivate the LCD, or turn off Power Save mode.

Problems related to charging Expander Paks and Supporting Loads

Symptom	Possible Cause	Recommended Solution
No AC power output. Inverter LED is OFF.	Inverter is switched OFF.	Switch the inverter ON.
	Battery voltage is too low. The battery voltage level has dropped below the Low Battery Cut Out (LBCO) set-point for more than one minute.	Check fuses/circuit breakers and cable connections. Check battery voltage at the inverter's terminals. Your batteries may need to be charged, this fault condition will automatically clear when the battery voltage exceeds the LBCI voltage
	The battery voltage is too high. The inverter automatically resets and resumes operation when the battery voltage drops to the HBCI voltage or lower.	This condition usually occurs only when an additional charging source (alternator, solar panels, or other external charging sources) is used to charge the battery bank. Reduce or turn off any other charger to the inverter batteries to allow the voltage level to drop.
	Over-temperature condition: The internal temperature of the inverter has risen above acceptable limits; caused by loads too great for the inverter to operate continuously, or by lack of ventilation to the inverter. When the unit has cooled, it will automatically reset and resume operation	Reduce the number of electrical loads that you are operating. This will avoid a repeat over-temp shutdown if the cause was too many loads for the ambient conditions.
		Check ventilation around the PRO-Verter, ensure cool air is available
	AC overload condition: The inverter has turned off because the connected loads are larger than the inverter's output capacity, or the output wires are shorted.	Reduce the AC loads connected to the inverter, or remove all AC output wiring and restart the inverter.
	Internal fault: This fault occurs when an internal fault is detected.	To clear this fault, an inverter reset is required.
No AC power output. Green LED is flashing once/second.	Unit is in Search mode, which means the load is too small for Search mode circuit detection.	Turn on a load greater than 5 watts to bring the inverter to full output power.
No AC power output. Green LED is flashing quickly—fluttering.	Unit is in continuous reset.	Check that the inverter's Power ON/OFF switch is not stuck in the ON position (ensure you can feel a click when pushing). If not, inverter requires repair/service.
Low AC output or surge power. Green LED is flashing.	Loose or corroded battery cables.	Clean and tighten all cables.
	Low batteries.	Recharge or replace batteries.
	Loose AC output connections.	Tighten AC output connections.
	Battery cables are the wrong length or gauge.	Verify recommended cable lengths and gauges from the manual. Replace cables as necessary.
Low charging rate when connected to AC power.	Charge rate backing off due to high temperature inside the inverter.	Provide better inverter ventilation/cooling, or additional battery chargers needed if battery bank is very large
	Low AC voltage (<170 VAC).	Check AC input wiring.
Low charging rate when using a generator.	Generator output is too low to power both the load and charger.	Reduce the load, increase the generator's RPMs.
Charger doesn't charge.	Loose or corroded battery cables	Clean and tighten battery cables.
	Defective batteries.	Replace batteries
	Wrong AC input voltage.	Verify proper AC input voltage and frequency.

PRO-Verter Inverter-mode Status Messages

View the top line of the LCD screen and the corresponding message in this section to identify and understand the particular Inverter mode.

Inverting
The inverter is transforming battery DC into AC for the PRO-Verter Output.

Inverter Standby
The PRO-Verter is receiving AC power from an external source (utility or generator) and is passing it through to the load. The inverter function is active, but the transfer switch has it in Standby until the external source is disconnected.

No Inverter Comm
The LCD User Interface is not receiving any communication data via the PRO-Verter's Internal Circuit Network.

Solution
The inverter may need to be serviced. Contact Solar Stik Technical Support.

Off
This message indicates that there is no AC available on the inverter's AC output. The inverter function is OFF, and there is no utility or generator AC power sensed on its input.

Unknown Mode ##
This status message displays when the inverter/charger has sent an operational status code that is unrecognized.

Solution
Call Technical Support at Solar Stik for assistance.

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PRO-Verter Charge-mode Status Messages

When AC power (utility or generator) is connected to the PRO-Verter, it automatically begins to monitor the AC input for acceptable voltage. Once the AC input is accepted, the AC transfer relay (inside the PRO-Verter) closes and charge mode begins.

View the top line of the LCD screen and the corresponding message in this section to identify and understand the particular Charger mode.

Charger Standby
This indicates the charger has been disabled to prevent further charging, but the AC power (from utility or generator) to the AC input is still available on the AC output. This display is shown when the CHARGER ON/OFF button is pressed while the AC power is passing through the inverter/charger.

> **Note**: Press the CHARGER ON/OFF button to enable charging again. When enabled, the charger continues in the previous charge mode and the CHG (green) LED comes on.

Charging
Once Charger mode has been enabled, the unit waits and displays “Charging” to determine the charge routine. If the DC voltage is low (≤ 25.6 VDC), the charger initiates Bulk charging. If the DC voltage is high (≥ 25.7), the charger skips the Bulk and Absorb charging stages and go directly to the final charge stage (Float or Silent).

Secondary Scrolling Status Messages

These displays alternate with the inverter/charger status to indicate other pertinent messages.

Gen Warm-up
The AGS unit has commanded the generator to run, but the PRO-Verter will not connect to the generator’s AC output until the generator warm-up time is complete.

Gen Cool Down
The autostop setting (FAVS F5: Gen Run VDC > Set Stop Gen V= 28.0) has been met and the generator has been disconnected from the PRO-Verter. However, the generator still runs until the FAVS F5: Gen Run VDC > Set Stop Gen = 30 Minutes and cooldown (Setup: 04J) time is met.

> **Note:** Most faults (inverter, AGS, and BMK) also alternate with the inverter/charger status.

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PRO-Verter Charger Problems: Solutions and Explanations

Unit won't transfer to Charge mode when connected to generator or grid AC

Solution: Is the charge (CHG) LED on the User Interface blinking? If not, the charger does not recognize the incoming AC as being within acceptable limits. Disconnect the AC input cable from the PRO-Verter. Measure the voltage at the cable terminals—it should be 230 VAC +/- 20 VAC). Also, check that the SETUP 03B VAC Dropout setting on the User Interface is 190 VAC. If the CHG LED is blinking, the transfer relay should close within 20 seconds and begin charging. If the LED is on solid, the relay should be closed and the charger should begin charging.

Transfer relay closes, then opens and continues to cycle

Solution: Input voltage is too low or has transients that drop the voltage momentarily. Change the SETUP 03B VAC Dropout setting to 190 VAC and check for improvements. If the cycling continues, back off the charge rate from 100% to 10% (or "OFF", if available). This cycling may also be caused if the AC output of the inverter is connected to the inverter's AC input. Check for proper input and output AC wiring.

Charger not charging even though Charge LED is on steady and the unit says "Charging"

Solution: Full charge rates are not obtained in Charging mode. Full charge rates will occur only after this mode changes to Bulk charging, Absorb charging, or Float charging modes.

Charger not charging even though Charge LED is on steady and the unit says "Bulk Charging" (or "Absorb Charging")

Solution: Check the METER 01A DC Volts and METER 01B DC Amps meter values on the LCD screen. It should be close to the maximum rated (or programmed) charge current if the battery voltage is under 28.0 VDC on 24-volt models. Check the Meter SETUP 03A AC Input Amps setting and ensure that it is set in accordance with system requirements.

Charger says "Float Charging" not "Bulk Charging" when the AC is first plugged in

Solution: Check the METER 01A DC Volts meter on the LCD screen. If the battery is > 26.0 VDC then the battery was already charged and the charger automatically goes to Float charging to keep from overcharging the batteries.

Charge amps are lower than expected, or is 0 amps DC

Solution: The charge rate may have been reduced to keep the input voltage above 150 VAC. Measure input voltage and increase it if the input voltage is under 150 VAC. Also, check the 03A AC Input Amps and SETUP 03E Max Charge Rate settings to determine if the current is being limited.

Charger output voltage is different than expected

Solution: Check the Battery Temperature Sensor (BTS) temperature. The charge voltage settings will increase if the temperature around the BTS is below 77 °F (25 °C) or decrease if the temperature around the BTS is higher than 77 °F (25 °C). The BTS is located inside of the PRO-Verter. If this is occurring and the System batteries are Li-ion, it may be necessary to disconnect the BTS from the inverter. Contact Solar Stik Technical support for the protocol.

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PRO-Verter Inverter Problems: Solutions and Explanations

Most faults (inverter, AGS, and BMK) also alternate with the inverter/charger status. The FAULT LED comes on and a fault status is displayed by the LCD User Interface when an abnormal condition is detected. Use the information in this section to identify and correct the issue.

Clearing Faults

Many fault statuses clear automatically after the active fault condition is corrected. When some faults are cleared from the fault history, the Gen Run relay may open temporarily which shuts down the generator. To resume normal operation ensure that the PRO-Verter is set to autostart the generator (CTRL>03E), then press and release, the INVERTER ON/OFF button on the User Interface. Finally, if the fault will not clear, a PRO-Verter reset or power reset may be required.

AC Overload
Inverter has faulted and stopped providing power to the load.

This fault message displays when the AC load on the PRO-Verter output has exceeded the inverter's AC current protection limits. This fault may occur because the connected AC loads are larger than the inverter's output capacity due to unauthorized equipment being used on the platform, surge loads are present, there is a wiring short on the output, or the output wires are incorrectly installed.

Solution
If the overload condition lasts for less than 10 seconds, the fault automatically clears, and the unit restarts and resumes operation. However, if the overload occurs for more than 10 seconds, the unit shuts down and the fault will require a manual restart. After the AC loads are reduced, the inverter can be restarted after a manual restart (press the INVERTER button to restore inverter function).

Breaker Tripped
The AC input breaker on the PRO-Verter has opened due to excess current flow through the inverter to the AC loads. While in Charge mode, the inverter's AC input breaker could nuisance trip if the loads on the inverter's output exceeds the current rating of the inverter's input circuit breaker.

Solution
After reducing the AC loads, push in the inverter's AC input circuit breaker to reset and resume operation.

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Dead Batt Charge
This fault indicates that the PRO-Verter is connected to a 220 VAC source and is attempting to close its internal relay and begin charging, but it has detected less than 18 volts on the battery bank or determined that no battery is present.

When the Li Expander Pak is discharged below 20 V, the internal Battery Management System (BMS) will disconnect the internal cells from the battery terminals in order to protect them from further discharge. When this occurs, BATTERY STATUS LED will also be blinking red (or be off) on all of the Li Expander Pak 2400s.

It is possible that the terminals will still report a voltage ranging from 2 V to 12 V. This is known as “bleed voltage” and is the result of the BMS not being able to fully disconnect from the internal battery cell strings. As a result, there may be enough voltage present for the PRO-Verter LCD User Interface to register the “DEAD BATT CHARGE” fault; however, there will be insufficient charge remaining in the Li Expander Pak 2400s to allow the PRO-Verter to function properly or to autostart the generator.
Solution

1. Check the DC voltage at any of the PRO-Verter’s DC terminals (Inter-Connect ports) and compare it with the DC voltage at the battery bank. These two voltages should be very close (< 0.5 VDC difference). If not, ensure all connections are tight and the power switch on each Expander Pak is turned on.

2. Jump-start the Expander Paks.

This fault automatically clears once current flows into the battery from the PRO-Verter / battery charger—this may take anywhere from a few minutes to a few hours, depending on the condition of the batteries. This fault can also be cleared if the AC input is removed.

This fault automatically clears once current flows into the battery from the PRO-Verter / battery charger—this may take anywhere from a few minutes to a few hours, depending on the condition of the batteries. This fault can also be cleared if the AC input is removed.

FET Overload
This fault message indicates the PRO-Verter was running normally, but the temperature of the field effect transistors (FETs) started rising abnormally fast.

Solution
Allow the inverter to cool down, then press the INVERTER ON/OFF button (manual restart) to resume operation.

To resume normal operation, reduce the load to within normal operating parameters. Shade the PRO-Verter to reduce solar loading. If this fault does not clear after doing the power reset, the inverter will require service contact Solar Stik Technical Support.

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High Battery
The inverter has turned off because the DC bus voltage has exceeded 34 volts. This fault message displays and the FAULT (red) LED turns on when the battery voltage is above the High Battery Cut-Out (HBCO) value. This fault automatically clears and the inverter resumes operation when the battery voltage drops 0.6 VDC below the HBCO value. This fault can occur whether the inverter is "inverting", "searching", or "off".

Solution
Check the Power Hub to ensure that it is programmed and functioning properly. Refer to the Power Hub Operator Manual. Verify that connected batteries are all "in service" (flashing green BATTERY STATUS LED). If the batteries are all offline, perform a full System reset (see Dead Batt Charge Section above).

High Batt Temp
This fault message indicates the PRO-Verter has shut down because the battery temperature sensor (BTS) inside of the PRO-Verter has reached a temperature greater than 129 °F (54 °C).

Solution
Once the BTS has cooled down to less than 120 °F (49 °C), it automatically restarts and continues operation.

High Volts AC
This fault causes the AC input to be disabled because a very high voltage (> 300 VAC) has been detected on the AC input.

Solution
Remove all AC power from the PRO-Verter AC input for at least 15 minutes to clear this fault. Ensure only 230 VAC power is connected to the PRO-Verter.

Low Battery (LBCO)
No power to the loads.

The inverter has turned off to prevent the batteries from being overdischarged. The fault message displays and the FAULT (red) LED illuminates when the battery voltage drops below the SETUP: 02B LBCO Setting value for more than one minute. This fault may occur when **(1)** the generator failed to start or **(2)** the battery capacity is reduced (one or more Expander Paks is offline). The fault will clear and the inverter will automatically restart and resume operation when the battery voltage rises to 24.6 VDC.

Solution - Generator
Disconnect the Generator from the System and start it using the generator native controls. If the generator does not start, check the generator for fault codes, adequate fuel and refer to the generator Operator and Maintenance Manual. If the generator starts, reconnect it to the System and attempt to start it manually ("ON") using the PRO-Verter control (CTRL 03). If the generator does not start using the PRO-Verter controls, ensure proper electrical connections between the PRO-Verter and the generator and refer to the PRO-Verter Operator Manual.

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Power Hub
Ensure proper electrical connections between the Power Hub and the PRO-Verter and refer to the Power Hub Operator Manual.

Overcurrent
This fault may be the result of an excessive AC load and causes the inverter to shut down to protect internal power components. If the overload condition lasts for less than 10 seconds, the unit automatically restarts and resumes operation. However, if the overcurrent condition occurs for more than 10 seconds, the unit shuts down and requires a manual restart.

Solution
This fault usually occurs because the connected AC loads are larger than the inverter's output capacity, there is a wiring short on the AC output, or the output wires are incorrectly wired. Once the AC loads are reduced or the output wiring is corrected, manually restart the inverter to resume operation. If this fault condition continues, perform an inverter reset.

Overtemp
This fault message indicates the PRO-Verter has shut down because the internal power components (FETs and/or transformer) have exceeded their safe temperature operating range. Once the PRO-Verter cools down, the fault automatically clears and the unit restarts and continues operation.

Solution
If the fault occurs while inverting, reduce the load on the inverter. If it occurs while charging, turn down the charge rate. If this fault happens often, ensure the inverter is not in a hot area, has proper ventilation, and the PRO-Verter cooling fans are working and that the air filters are clean. Shade the PRO-Verter from exposure to direct sunlight. Solar loading is a major source of heat buildup inside the PRO-Verter.

Stuck Relay
This fault message displays when the inverter is "inverting", but the internal AC pass-through relay that should be open while inverting, is closed.

Solution
The AC pass-through relay is most likely stuck. A relay usually sticks because of damage to the contacts from trying to handle higher currents than that for which they are rated. This is usually caused by not protecting the relay from handling high continuous currents, or by switching high current inductive loads. The internal relay contacts are rated to handle 30 amps AC continuously and should be protected with a breaker sized no larger than 30 amps. If connected to an AC source (grid or generator) and running large inductive loads (i.e., pumps, motors, etc.) on the inverter output, turn those particular loads off prior to removing the AC input source. This fault requires an inverter or power reset to clear. If the fault persists after the resets are performed, it may be necessary to erase the memory as the fault may have cached into the programming. Clear the Fault History and reload the default menu programming. Consult the menu tree to reprogram the values for a particular application.

Tfmr Overtemp
This fault message displays when the transformer causes the inverter to shut down to protect the internal power transformer from damage. Once the transformer cools down, the inverter automatically restarts and resumes operation.

Note: A temperature sensor on the transformer will auto-start a connected generator, if the GEN CTRL is in AUTO mode, thereby transferring support of the load to the generator to maintain continuity of operations.

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Solution
Allow the inverter to cool down, then press the INVERTER ON/OFF button (manual restart) to resume operation.

To resume normal operation, reduce the load to within normal operating parameters. Shade the PRO-Verter to reduce solar loading.

If this fault does not clear after doing the power reset, the inverter will require service contact Solar Stik Technical Support.

Unknown Fault ##
This fault message displays when the inverter/charger has sent a fault code that cannot be identified by the User Interface.

Solution
Contact Technical Support at Solar Stik for more information or assistance in identifying the actual fault status.

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PRO-Verter Internal Fault Messages

The inverter continually monitors several internal components. If a condition inside the inverter occurs that does not allow proper operation, one of the following internal fault messages displays and the inverter shuts down to prevent damage. The solution to all of these faults follows.

Internal Bridge
This fault message displays when the FET bridge shuts down after the inverter has been inverting—the inverter output circuit can no longer detect any AC output voltage or current.

Internal Charger
This fault message displays when the FET bridge shuts down because the charger circuit is trying to provide maximum current, but is not detecting a current or voltage rise to the battery bank.

Internal NTC
This fault message displays when the internal negative temperature coefficient (NTC) temperature sensor suddenly causes a very large but unexpected temperature change.

Internal Relay
This fault message displays when the internal AC transfer relay is not closed while charging.

Solution
If one of these internal faults occurs, the inverter will require an inverter or power reset to clear the fault. After resetting the inverter, press the INVERTER ON/OFF button on the User Interface to turn the inverter on and then verify that the fault has cleared (i.e., manual restart). If the internal fault remains or returns, the inverter may require repair at a Solar Stik. Call Solar Stik Technical Support: 800-793-4364, Ext 102.

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PRO-Verter AGS Functional Tests

These tests are applicable when the PRO-Verter is connected to a fuel driven generator that has been modified with a Remote-start Enabling Kit (RsEK).

When the autostart/autostop settings have been established and programmed, perform the following tests to verify that the AGS system is functioning correctly and there is communication between the remote/inverter and the AGS.

> **Note:** The AGS Test Button is a momentary switch that allows the AGS system to be tested for correct wiring and generator start/stop operation.

PRO-Verter-to-Generator Communication Test

This section describes using the LCD User Interface to start the generator and to determine the AGS status.

Determining AGS Status
Use the LCD User Interface to determine the AGS's status:
1. Press the METER button until the bottom line displays "01 DC Meters".
2. Rotate the SELECT knob to the 04 AGS Meters menu, and then press the SELECT knob. The top line shows 04A AGS Status and the bottom line displays the current status of the AGS.

An AGS status of Off or Ready indicates the User Interface and the inverter is communicating with the AGS. If the AGS status is not Off or Ready, then refer to section **Resolving AGS Operational Statuses** or section **Resolving AGS Faults Using the LCD User Interface** for assistance before continuing.

Starting the Generator from the PRO-Verter User Interface
To confirm that the generator will turn on and run from the PRO-Verter, first ensure the AGS status is Off or Ready. Then:
1. Press the CTRL button, and then rotate the SELECT knob to the 03 Gen Control menu.
2. Press the SELECT knob, and then rotate it to the ON setting.
3. Press the SELECT knob to activate the generator test. The selection arrow appears to the right of the screen. The generator should start.

> **Note:** Once the generator starts, it should run until 03 Gen Control is changed to OFF.

If the AGS/generator system started, and if the STATUS LED on the AGS turns solid green after two (2) minutes, then the wiring from the AGS to the generator is correct. The AGS may now be enabled by setting the remote's 03 Gen Control setting to "AUTO".

If the LCD User Interface displays a generator fault, or if the AGS's STATUS LED continues to blink or shows a fault condition (solid red LED indication), refer to the AGS owner's manual for assistance.

AGS Start Statuses Table (Meter 04)

The following “Start” statuses identify the condition that autostarted the generator. The list below includes all possible statuses. If the autostart condition occurred sooner than expected, or it was not the intended autostart condition, refer to step 2 of System Initialization and Calibration to change (or disable) the autostart setting.

> **Note:** The PRO-Verter for this system has been set at the factory to start the generator based on the DC bus (Li Expander Pak) voltage. For this reason, “Start VDC” will be the only status reported by the PRO-Verter in this System. The Statuses in the gray box would appear only if the PRO-Verter were programmed differently. They are shown only as a reference.

Start VDC – Generator has autostarted based on the SETUP: 04A Gen Run VDC setting.

Start Amp – Generator has autostarted based on the SETUP: 04C Gen Run Amps setting.

Start Exercise – Generator has autostarted based on the SETUP: 04H Gen Exercise setting.

Start SOC – Generator has autostarted based on the SETUP: 04D Gen Run SOC setting.

Start Temp –The AGS is in Test mode. Test mode may be started from the TEST button located on the AGS.

Start Test – The AGS is in Test mode. Test mode may be started from the TEST button located on the AGS.

Start Time - Generator has autostarted based on the SETUP: 04G Quiet Time Topoff setting

Start Topoff – Generator has autostarted based on the SETUP: 04G Quiet Time Topoff setting.

Start 100% SOC – Generator has autostarted based on the SETUP: 04K Gen 100% SOC Start Days setting.

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AGS Operational Statuses (Meter 04)

AC In
The inverter/charger is connected to another source, such as a grid or an alternate generator, and is not controlled by the AGS. When AC In displays, the AGS is prevented or locked out from all autostarting conditions, except for when the generator needs to exercise—if enabled.

Gen Cooldown
The autostop setting has been met in one of the generator autostart/autostop menus and the generator has been disconnected from the PRO-Verter. However, the generator still runs until the cooldown time is met (as per the SETUP: 04J Gen Cooldown Time setting).

Gen Warm-up
The AGS is attempting to start the generator and a time period has been set from the SETUP: 04I Gen Warm-up Time menu. Once the AGS status indicates “Warm-up”, the PRO-Verter’s AC input ignores any incoming AC power. This prevents the PRO-Verter from loading the generator during warm-up. Once the AGS has determined that the generator is running, the warm-up time setting must be met before the generator can connect to the PRO-Verter.

Manual Run
Generator started manually from a start/stop switch directly connected to the generator, or from the CTRL: 03 Gen Control menu.

No Comm
The AGS is not communicating with the inverter or the LCD User Interface.

Off
The CTRL: 03 Gen Control menu is set to OFF. This setting will not allow the AGS to autostart the generator.

Quiet Time
The AGS has entered Quiet Time per the SETUP: 04G Quiet Time setting. This setting is generally not programmed in Solar Stik PRO-Verters.

Note: The generator will not autostart during Quiet Time.

Ready
The CTRL: 03 Gen Control menu is set to AUTO, and the AGS is ready to autostart the generator based on the active autostart settings under the SETUP: 04 AGS Setup menus.

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Resolving AGS Operational Statuses

No Comm
The “No Comm” status suggests that some wiring connections may be incorrect or compromised.

Solution
1. Ensure the GREEN READY indicator on the AGS controller is on (blinking or solid) to indicate that the AGS controller is getting power.
2. Ensure the correct communications cables are connected.
3. Call Solar Stik Technical Support.

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Resolving AGS Faults Using the LCD User Interface

If an AGS fault occurs, use the LCD User Interface and the information in this section to resolve the issue.

> **Note:** PRO-Verters in a Solar Stik Hybrid Power System are programmed to start and stop generators based on DC voltage. **The faults highlighted in orange are the only ones that could appear in a PRO-Verter programmed to work with the L0 System.**

Fault Gen Run
Symptoms: Generator is overloading and shutting down; the generator successfully started and ran for more than two (2) minutes, but the generator unexpectedly stopped before the active AGS autostop condition was finished.

This fault occurs when the generator is overloading as a result of (1) unauthorized equipment being used on the platform and/or (2) surge loads are present.

> **Note:** The AGS controller determines the generator is running by monitoring the Gen Run sense voltage/signal. When this Gen Run sense voltage/signal is no longer available, the AGS thinks the generator is off or has stopped.

> **Note:** Fault Gen Run detection is not active if the generator is manually started.

Solution
Ensure proper electrical connections between the PRO-Verter and the generator.

Disconnect the generator from the System and start it using the generator native controls.
If the generator starts, reconnect it to the System. Reduce the load and/or the charging rate (%) to prevent the fault from recurring

If the generator does not start, check the generator for fault codes, adequate fuel and refer to the generator Operator and Maintenance Manual.

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For these AGS faults, refer to the Solution immediately following.

Fault Test

The generator failed to autostart and run after the red TEST button is pressed on the AGS controller.

> **Note:** The LCD User Interface can be set to manually turn the generator on and off, which can be used to test the generator wiring to the AGS.

Fault VDC

The generator failed to autostart and run per the FAVS: F5 Gen Run VDC menu's start parameters (24.6 VDC).

Solution

Disconnect the Generator from the System and start it using the generator native controls.

If the generator does not start, check the generator for fault codes, adequate fuel and refer to the generator Operator and Maintenance Manual.

If the generator starts, reconnect it to the System and attempt to start it manually ("ON") using the PRO-Verter control (CTRL 03).

If the generator does not start using the PRO-Verter controls, ensure proper electrical connections between the PRO-Verter and the generator and refer to the PRO-Verter Operator Manual.

> **Note:** One of the fault messages above may display on the LCD User Interface when:

- The AGS attempts to start the generator four (4) times, but the generator failed to start and run per the specific autostart parameters; or
- The generator started, but did not provide the correct Gen Run sense signal to the AGS controller.

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Fault MaxRn
Generator turned off because the SETUP: 04F Max Gen Run Time setting had been met. This fault can occur when the autostop condition (FAVS F5: Gen Run VDC) exceeded the Max Gen Run Time setting.

> **Note:** The Max Gen Run Time menu uses the SETUP: 04B Gen Run Time display to determine the generator's runtime. Cooldown and warm-up times are not included in the Gen Run Time display.

> **Note**: see "Gen Fails to Stop" section for additional information on causes of "Max Run Fault"

Solution

Max Gen Run Setting
This should be set to the maximum "run time" that a can be achieved from the fuel reservoir before it is rendered "empty". For example, if a generator consumes 0.5 gallons per hour of fuel under full load, and the fuel reservoir maximum capacity is four (4) Gallons, then the MAX GEN RUN time should be set to eight (8) hours or less.

Load
Reduce the load to increase the power available to charge the Expander Paks. This will reduce the time required to charge the Expander Paks to within the programmed Max Gen Run Time limit of 12 hours.

Expander Pak
Ensure all Expander Pak are in normal operation (green-flash LED) and that all Inter-Connect Cables are properly connected and in good condition.

Solar Loading
High heat inside the PRO-Verter reduces the charging voltage and current resulting in the inability to charge the Expander Paks to the voltage required to stop the generator. Shade the PRO-Verter to reduce solar loading and keep the air intake filters clean to promote more efficient cooling.

> **Note:** After the fault clears and the reason for the fault is determined, be sure to enable the AGS to autostart. Go to the CTRL: 03 Gen Control menu and select AUTO. Once the fault is cleared and the reason for the fault is determined, the AGS again to see if the fault returns, or test the AGS/generator system by performing the AGS functional test.

How to Clear AGS Fault History
Go to the TECH: 04 Fault History menu, press the SELECT knob, and then turn the knob until the 04D Clear Faults screen appears. At the 04D Clear Faults screen, press and hold the SELECT knob until the "5.0 to 0.0 second" screen countdown is finished and the screen displays "HISTORY CLEARED".

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PRO-Verter Battery Monitoring (BMK) Circuit Operational Statuses

A Battery Monitor status message may be an operational or fault message. Access the METER: 05A BMK Status menu to view its current operating status. The status is important when determining if the circuit is working correctly or for troubleshooting a Battery Monitor installation.

BMK Ready
The Battery Monitor is communicating correctly with the inverter/charger.

The following "SOC" statuses indicate the battery's current state of charge (SOC). Access the METER: 05B Battery SOC menu to view the Battery Monitor's current SOC status.

Think'n
When the BMK sense module is first connected, the batteries need to be fully charged (i.e., SOC = 100%) to establish a SOC reference point.

###%
The batteries are fully charged; the display has changed from "Think'n" to "100%" and is ready to provide accurate SOC percentage values.

Resolving BMK Faults Using the LCD User Interface

For the three Battery Monitor faults that follow, refer to their respective solutions.

Factory Fault
The Battery Monitor has lost its factory-set internal calibration reference.

Solution: Reset the Battery Monitor by removing all power from the PRO-Verter. If the fault remains or returns after resetting, the unit may require repair. Contact your Field Service Representative.

Unknown Fault ##
This fault message displays when the Battery Monitor has sent a fault code that is not recognized by the user interface.

Solution: Contact your Field Service Representative

Power-up Fault
The Battery Monitor power-up sequence failed.

Solution: Restart the PRO-Verter.

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Fault History (Tech 04)

Tech 04 in the LCD user interface provide provides the fault history for the inverter (04A) and the AGS (04B). The following is an example of how to read and understand the fault history in 04B AGS Faults

Press the SELECT knob, rotate the knob until the 04B AGS Faults menu displays, and then press the SELECT knob.

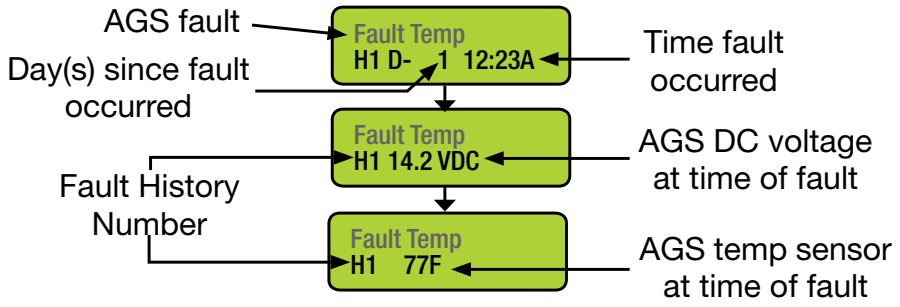
04B AGS Faults
This menu displays a history of the last nine AGS faults. Information for each fault displays from the most recent fault (H1) to the earliest/past recorded faults (H2 up to H9).

> **Note**: The 04D Clear Faults menu allows all recorded fault history information to be cleared/ erased. Refer also to the TECH: 04 Fault History/04D Clear Faults menu.

See the diagram below. Rotate the SELECT knob to display the second and third screens for the particular fault shown on the first screen. After viewing all screens for the fault, continue to rotate the SELECT knob to display earlier faults (as applicable).

- **First screen**—The top line displays the AGS fault mode. The bottom line displays the fault history number, day(s) since this fault occurred, and the time this fault occurred.
- **Second screen**—The DC voltage on the AGS at the time of this fault.
- **Third screen** – The temperature of the AGS temp sensor at the time of this fault.

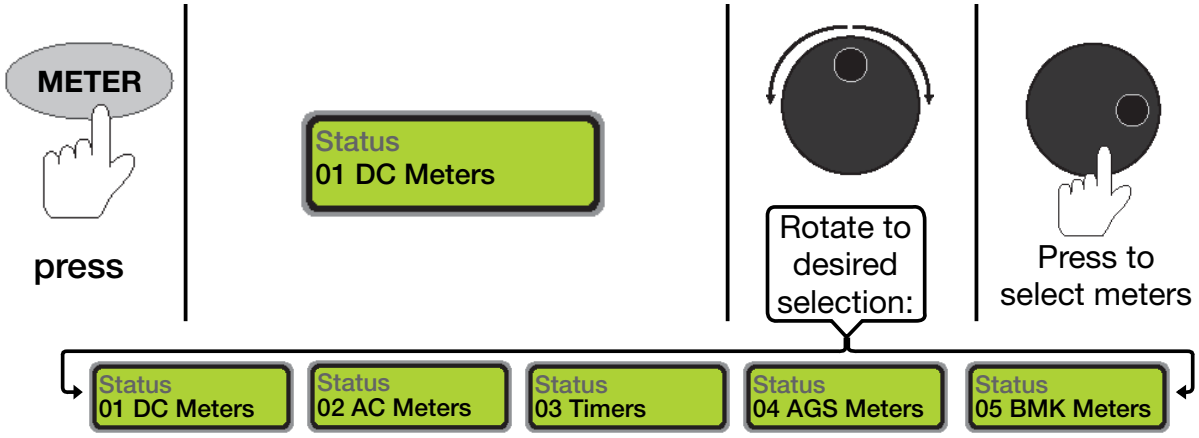
TECH: 04 Fault History
Press the SELECT knob, rotate the knob until the 04B AGS Faults menu displays, and then press the SELECT knob.



PRO-Verter: Historical Data Collection

The PRO-Verters can provide some historical data for generator and battery operation.

Press the METER button on the PRO-Verter Controller to access both the BMK and AGS functions. Scroll through 01 DC Meters, 02 AC Meters, 03 Timers until 04 AGS Meters or 05 BMK Meters is displayed. AGS and BMK Meters represent the only data sets for the generator or the battery system that is cumulative. The DC and AC meters indicate current status information only.



Auto Generator Start/Stop (AGS; Meter 04) Data

Gen Run Time
This menu displays the time the generator has been running since the AGS circuit auto started the generator. This menu does not display run time when the generator has been manually started.

This hour meter resets each time the generator is stopped. This meter is useful when trying to determine how long the generator has been running in the auto mode. This meter does not replace the hour meter for total hours the generator has run.

AGS Temp
This feature is not enabled.

Days Since Gen Run
This menu displays the number of days since the generator has last run. This menu is useful in determining if the AGS start and stop settings are set up correctly.

> **Note:** This meter resets whenever the generator is either auto started, exercised, or manually started. The meter reads the B+ signal provided by the generator to the AGS module for this meter.

Days Since 100% SOC
This read-only menu displays the number of days since the battery was at 100% SOC.

Battery Monitor (BMK) Data (Meter 05)

This section describes what battery bank information is available from the battery monitor when using the LCD user interface.

BMK Status

This menu selection offers read only displays that give the current operating status of the battery monitor. This selection also provides information to determine if there is a power-up fault condition.

Battery SOC

This read-only menu either displays the calculated battery SOC for the connected battery bank—"Think'n" (to indicate the SOC is being calculated), or identifies a fault condition. The range is 0–100%, where 100% is a fully charged battery and 0% is completely discharged. When the PRO-Verter is first connected, the display will show "Think'n", to indicate that the SOC reference point is being calculated. After the batteries are fully charged, the display changes from "Think'n" to "100%" and begins to provide accurate SOC% values.

> **Note:** If the PRO-Verter is disconnected from power, this display resets to "Think'n" and the batteries require another full charge before SOC percentage information is displayed.

DC Volts-BMK

This meter displays the DC volts at the Inter-Connect bus. The range is from 07.00 to 70.00 volts (±0.02).

DC Amps-BMK

This meter displays the real-time charge current (amps into battery) or discharge current (amps out of the battery) as measured through the PRO-Verter. Charging is shown as a positive (+) number and discharging is shown as a negative (–) number. The range is from ±0.1 to 999 amps (±1.0%).

AH In/Out

This meter displays the Ah returned to or removed from the battery. When this value is positive, it represents Ah returned to the battery during any subsequent charging. A negative value represents Ah removed from a full battery. The range is ±32,768 Ah. When using the charge efficiency's Auto setting, the AH In/Out value is recalculated after the battery has been fully charged (100% SOC) and ≥ 0.5% of the battery capacity has been discharged. If the PRO-Verter is disconnected from power, the AH In/Out value resets to zero.

Reset AH Out

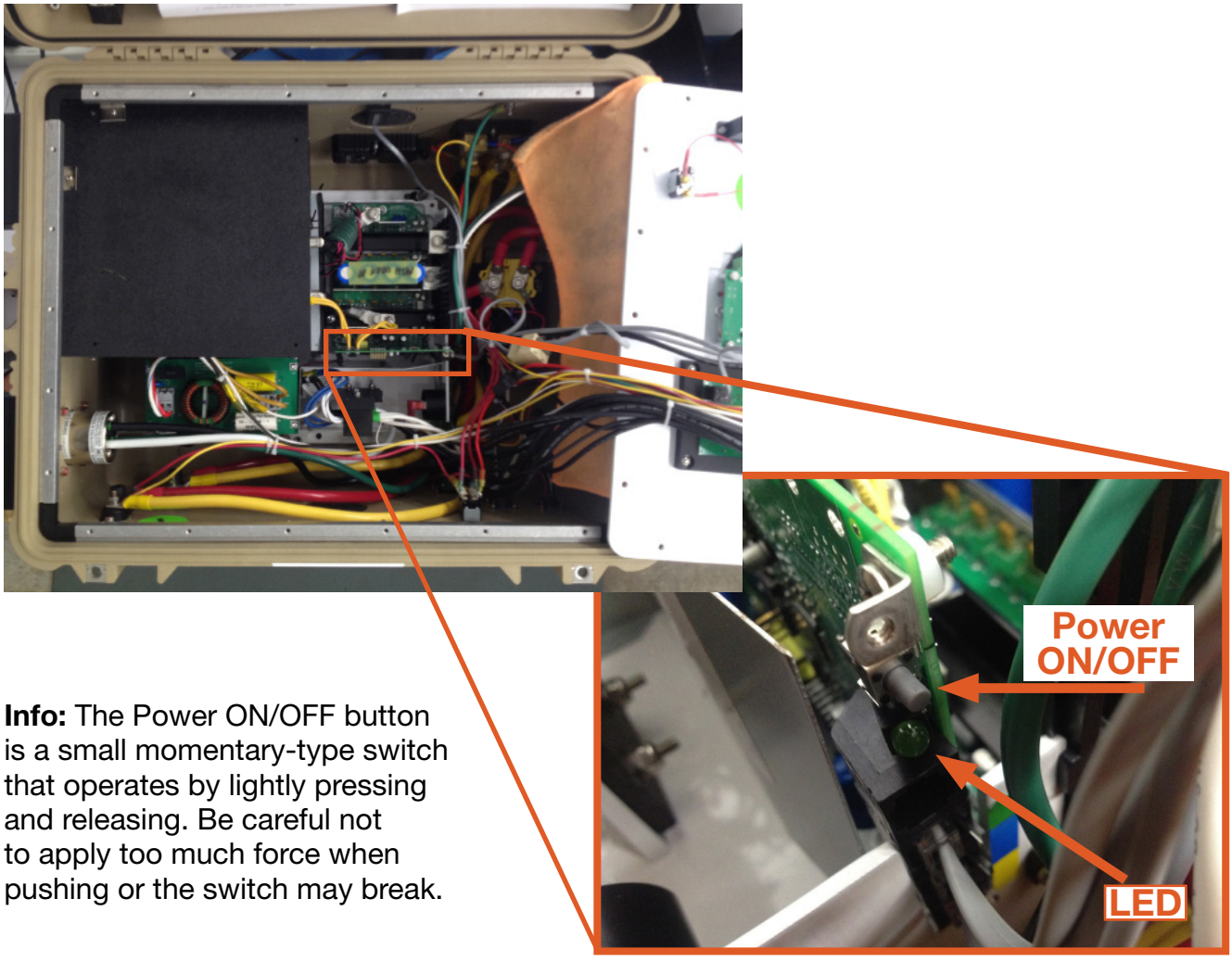
This meter displays the total amp hours removed from the battery since it was last reset. This display can be used as a battery load indicator to help determine and monitor the battery load consumption. Its range is 0 to 65,535.0 amp hours (0.1 amp hour resolution). **To reset the Ah value to zero**, press and hold the SELECT knob for three (3) seconds when the Reset AH Out display is shown. After this display has been reset, it will begin calculating and displaying new Reset AH Out values. This display automatically resets to zero if the PRO-Verter is disconnected from power.

PRO-Verter/Inverter Reset

To perform an inverter reset (also known as a “soft reset”):

1. First, ensure all AC power (i.e., shore power or generator) is removed from the PRO-Verter input.
2. Remove the PRO-Verter Faceplate.
3. Press and hold the Power ON/OFF button for approximately 10 seconds until the Charging/ Inverting Status LED comes on and flashes rapidly.
4. Once the rapid flashing has begun, release the inverter Power ON/OFF button. The Status LED will go off after the button is released.
5. After the inverter reset is completed, press the INVERTER ON/OFF button to turn the inverter on.

If fault does not clear, call Solar Stik Technical Support (800-793-4364 Ext. 102).

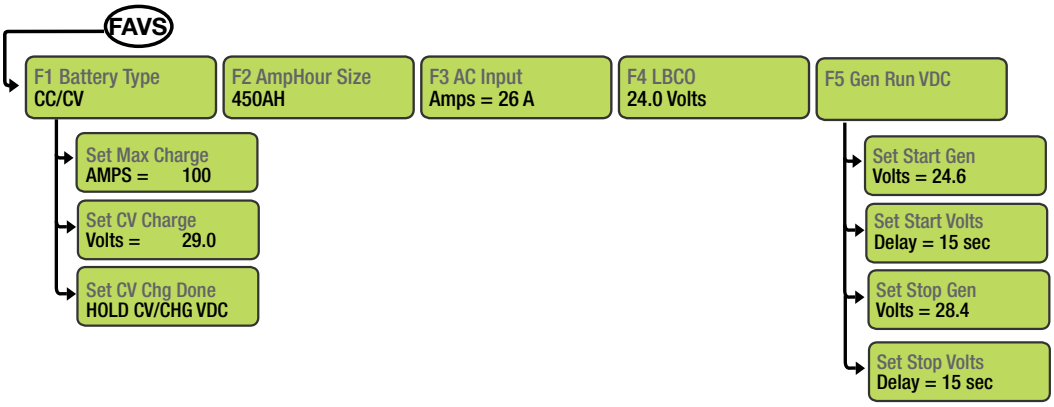


Info: The Power ON/OFF button is a small momentary-type switch that operates by lightly pressing and releasing. Be careful not to apply too much force when pushing or the switch may break.

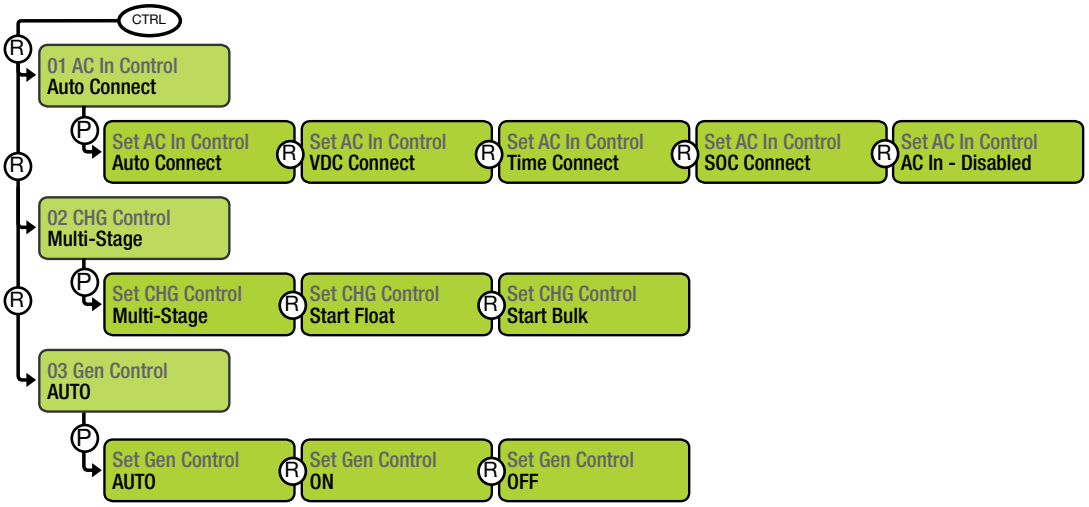
PRO-Verter Programming Menu Map

The PRO-Verter has been programmed at the factory to operate with the MS3 L0 System. The programming map on the following pages is a representation of how to navigate the information in the PRO-Verter User Interface. The color coding key below provides information that makes understanding the programming map easier.

FAVS Button Menus

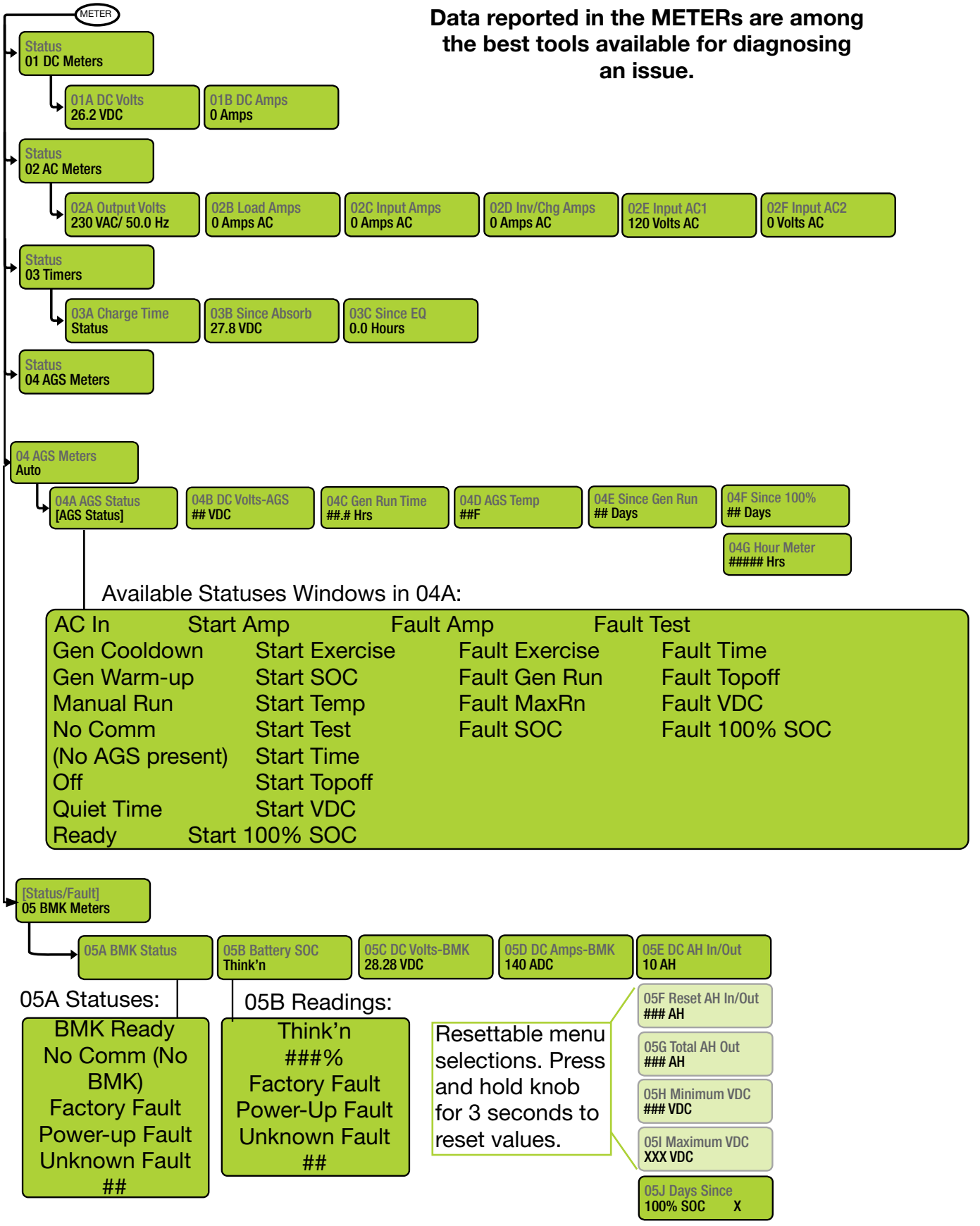


CTRL Button Menus



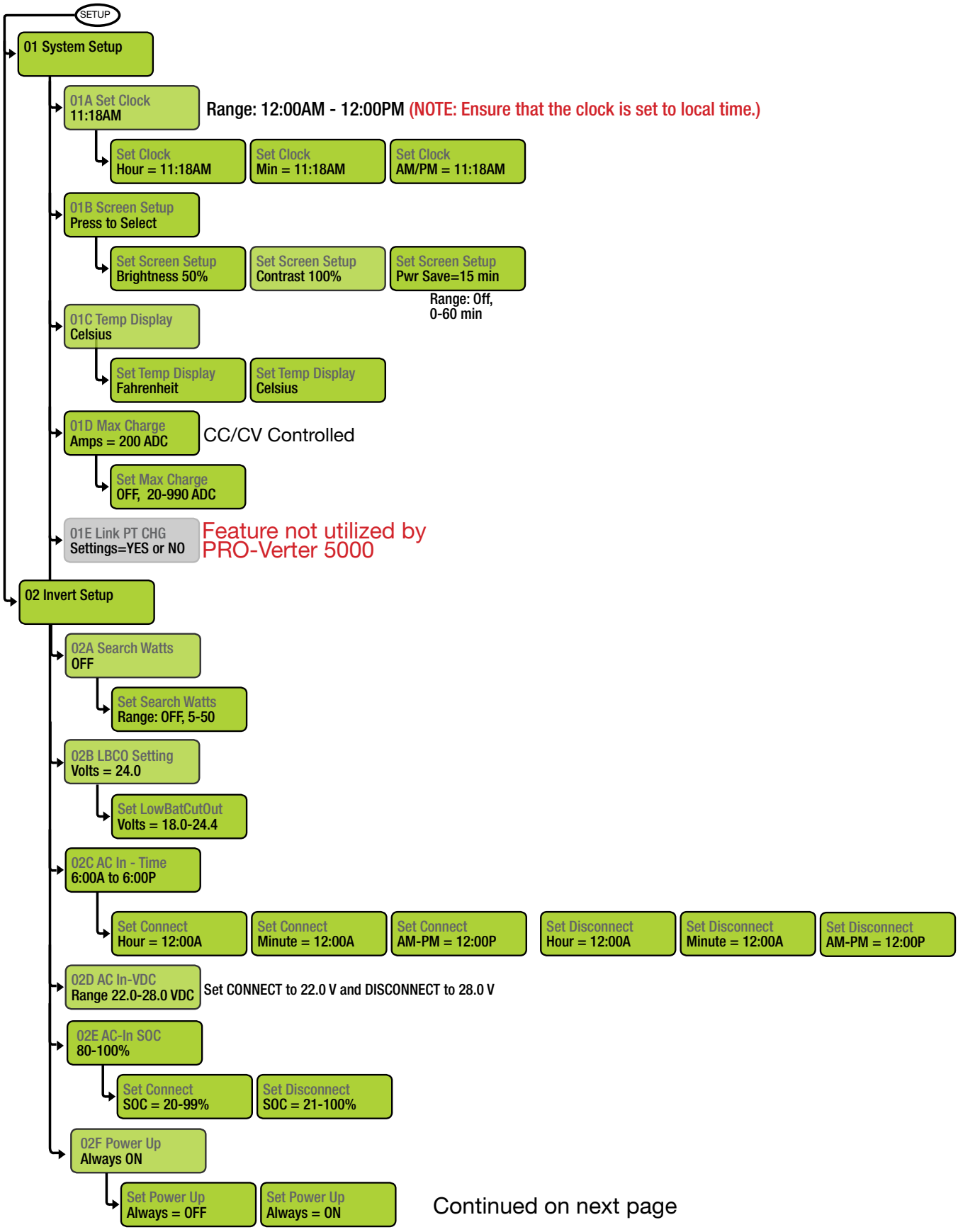
METER Button Menus: Read-only Displays

Data reported in the METERs are among the best tools available for diagnosing an issue.



SETUP Button Menus

Setup: 01 System & 02 Inverter Setup



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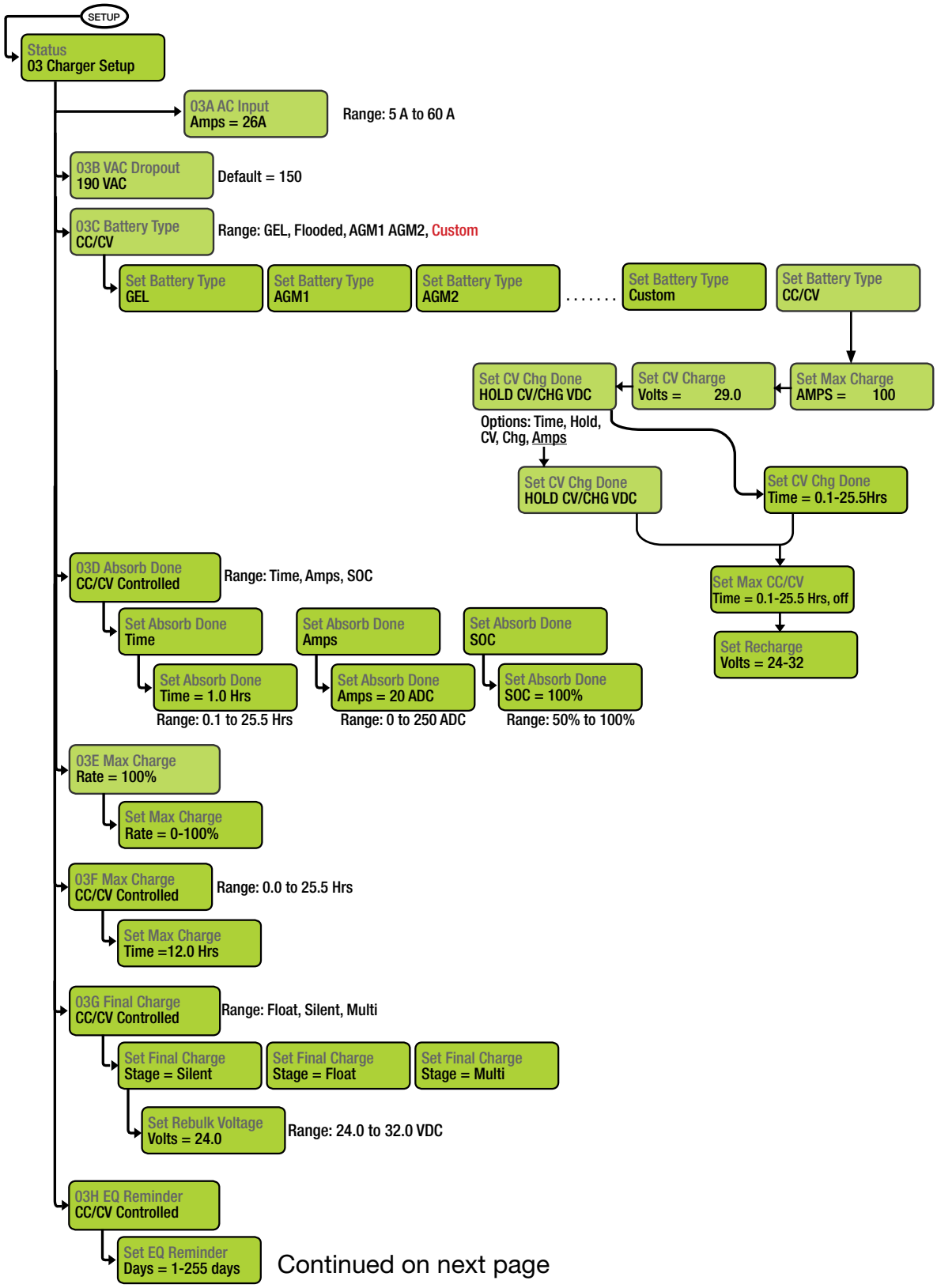
SETUP Button Menus continued

Setup: 03 Charger



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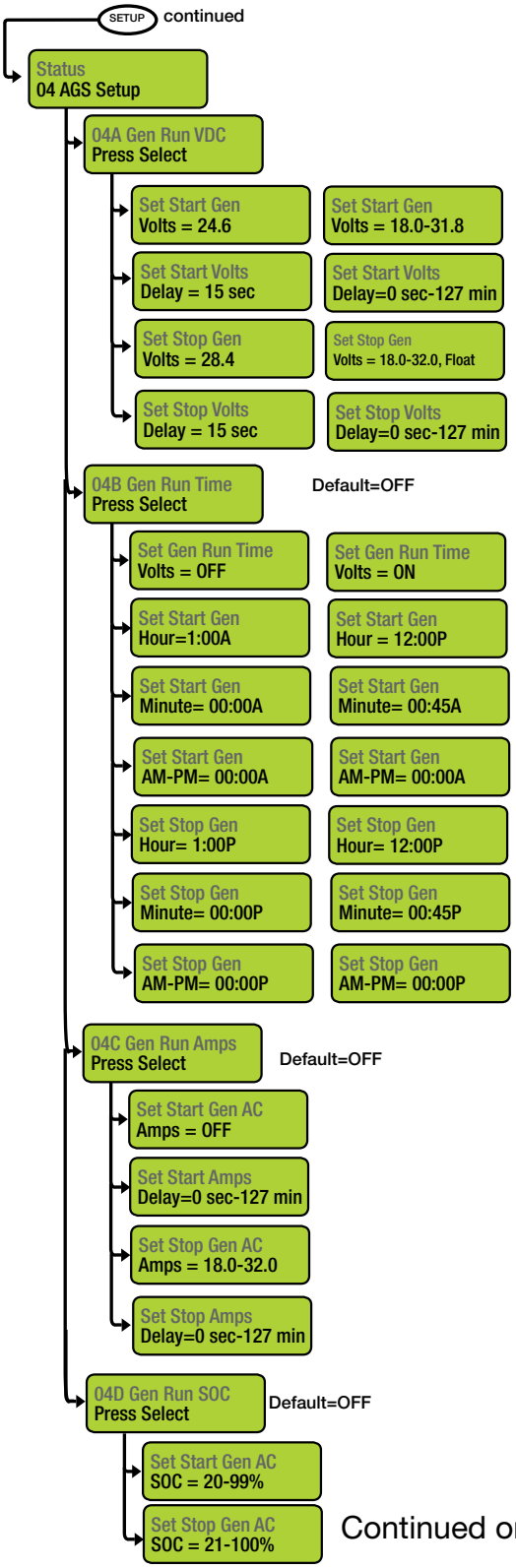
SETUP Button Menus continued

Setup: 04 AGS Setup



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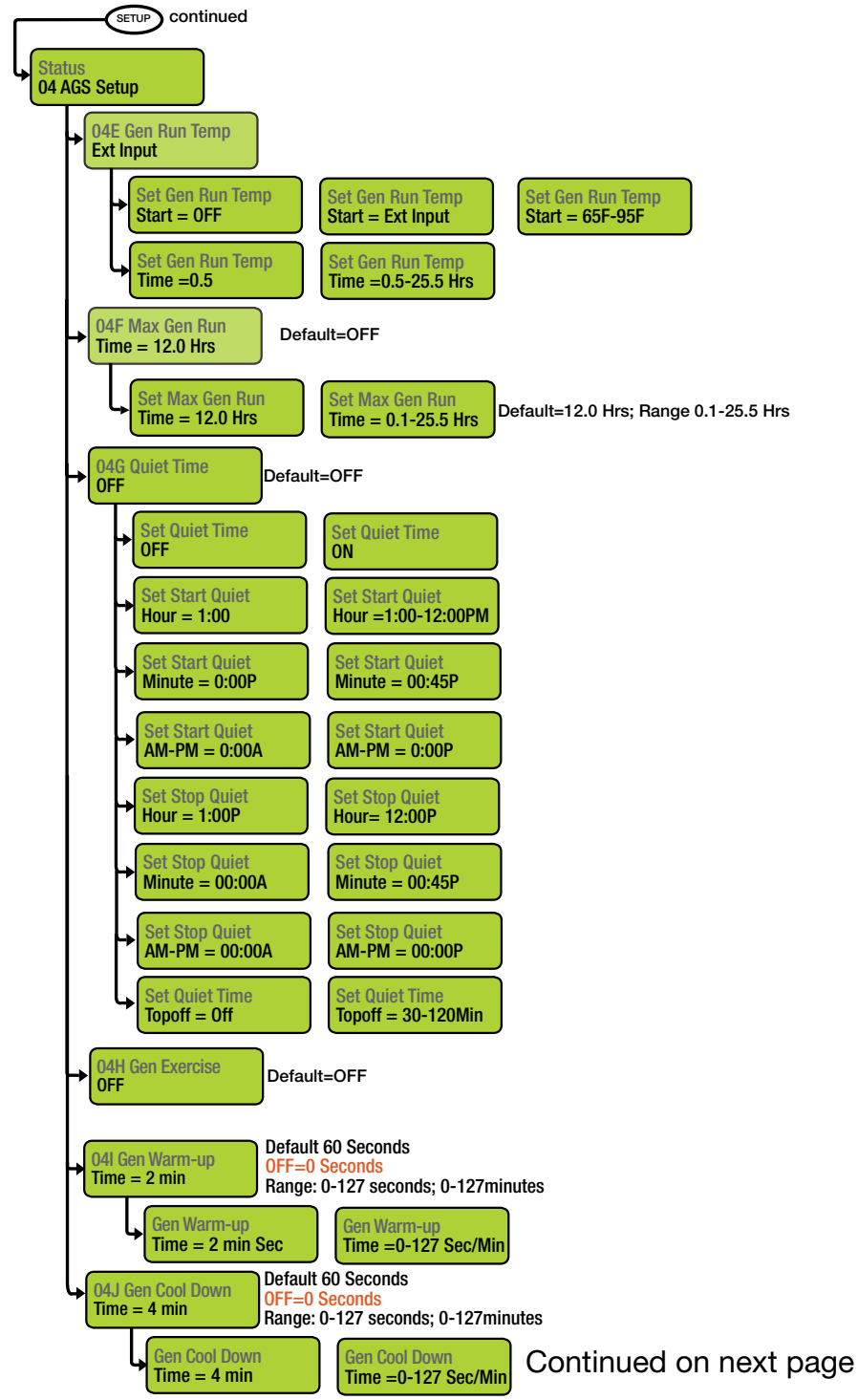
AGS Function Notes

- After 15 seconds at or below 25.0 V, the PRO-Verter sends the start signal to the Generator.
- After 1 minute at or above 28.8, the PRO-Verter turns off the Generator.
- If the Generator does not start and the battery voltage gets down to 24.4 V (LBCO), the AC Out (Inverter) turns off. This is the LBCO voltage in the menu tree.

SETUP Button Menus continued

Setup: 04 AGS Setup



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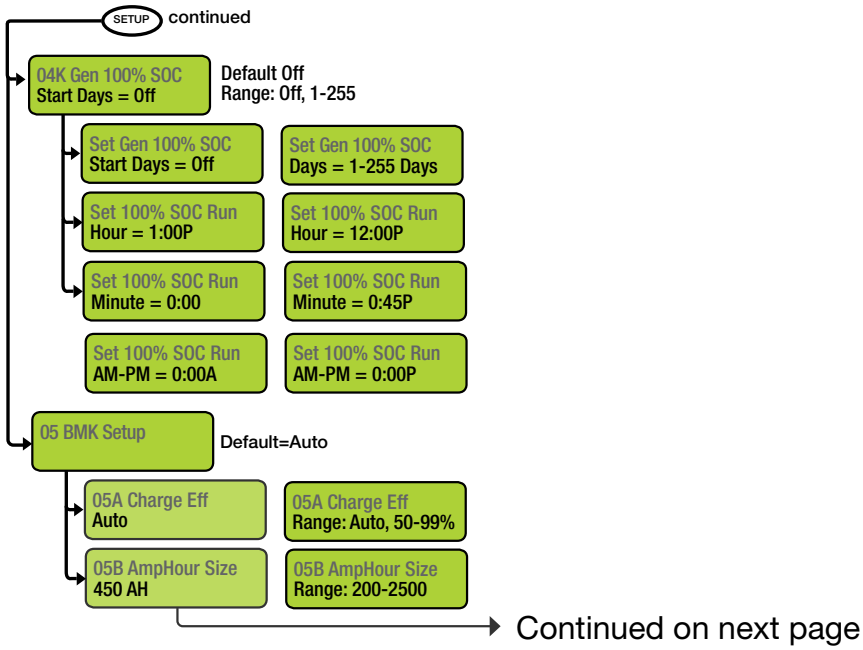
SETUP Button Menus continued

Setup: 04 AGS Setup, 05 BMK Setup



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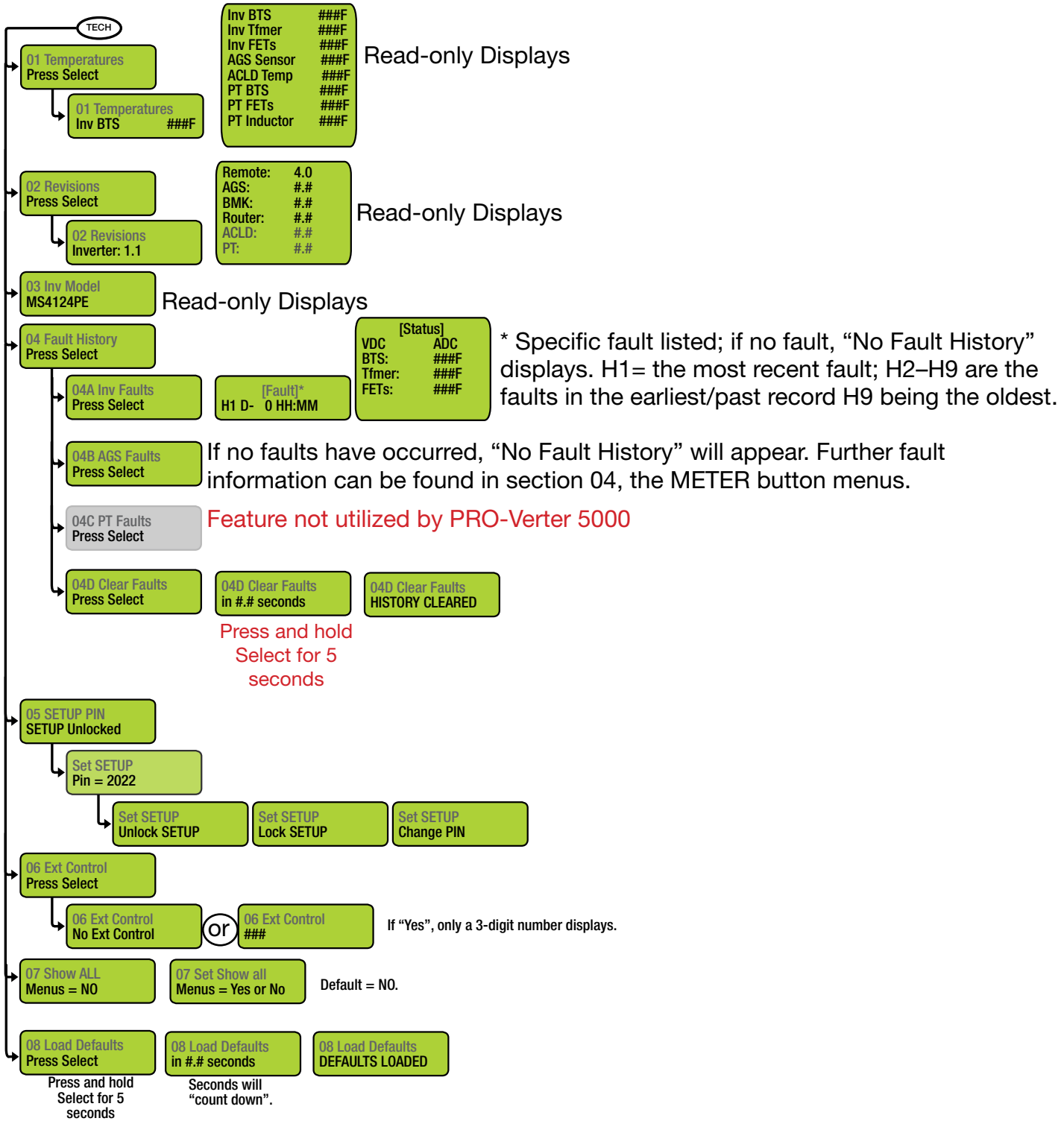
Note: The AmpHour Size value should be set according to the total capacity of the battery bank. For example, one 24VDC Li Expander Pak is 100 Ah. The minimum setting allowed is 200 Ah.

Note: The state of charge reported by the 24VDC PRO-Verter 5000-220 will be accurate only if the total battery bank size is at least 200 Ah.

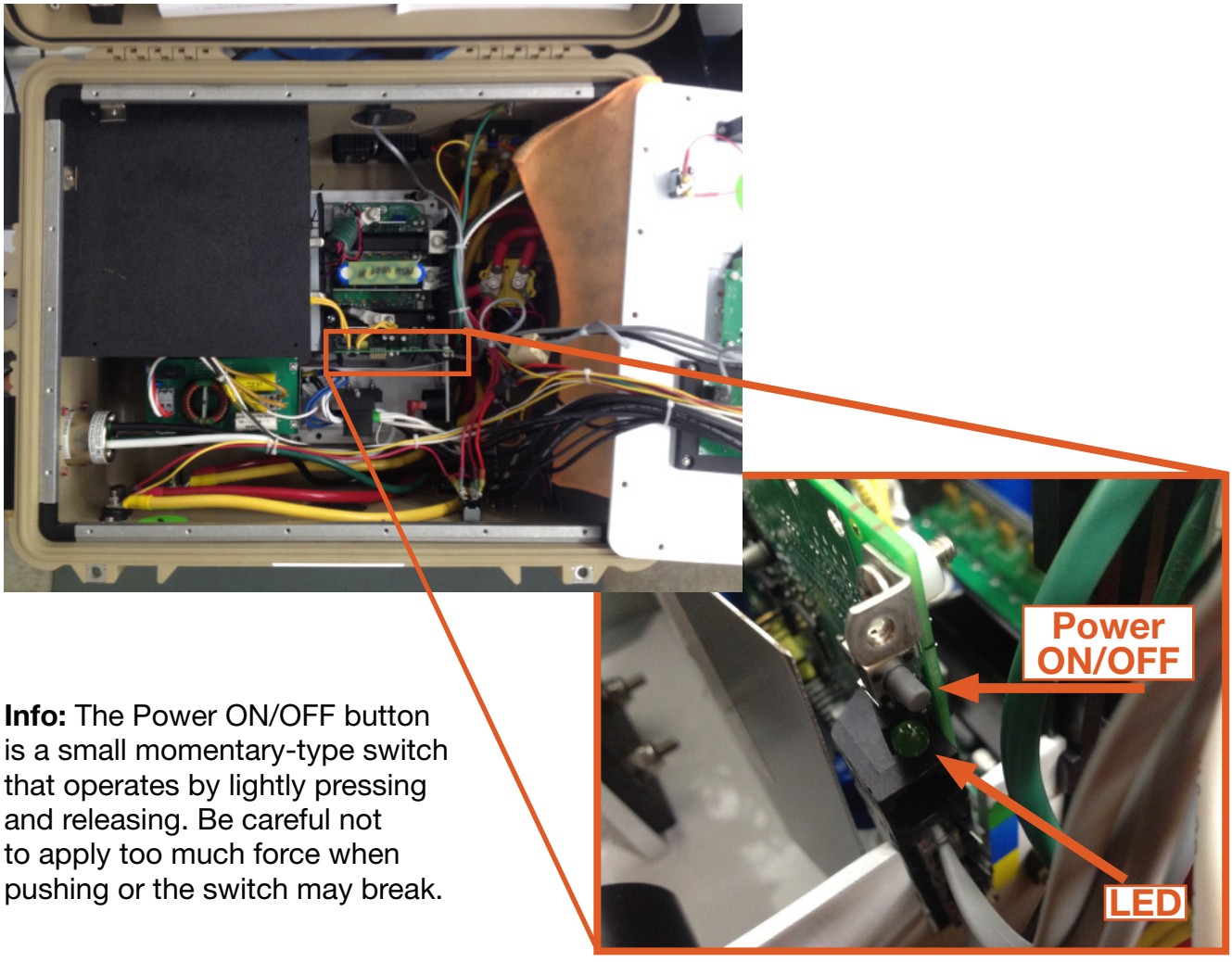
TECH Button Menus



PRO-Verter/Inverter Reset

To perform an inverter reset (also known as a “soft reset”) to clean an INTERNAL FAULT:

1. First, ensure all AC power (i.e., shore power or generator) is removed from the PRO-Verter input.
2. Remove the PRO-Verter Faceplate. The board on which the Power ON/OFF button and LED are mounted is in the center of the PRO-Verter.
3. Press and hold the Power ON/OFF button for approximately 10 seconds until the Charging/ Inverting Status LED comes on and flashes rapidly.
4. Once the rapid flashing has begun, release the Power ON/OFF button. The Status LED will go off after the button is released.
5. After the inverter reset is completed, press the Power ON/OFF button to turn the inverter on.



Info: The Power ON/OFF button is a small momentary-type switch that operates by lightly pressing and releasing. Be careful not to apply too much force when pushing or the switch may break.

POWER HUB TROUBLESHOOTING

Power Hub Will Not Power Up

If the Power Hub 2400 is not powered up, it probably is not connected to an active 24 VDC battery and/or there is no PV input. The LCD user interface will power up and be navigable when connected to either of these power sources. Power from PV arrays will charge batteries once the voltage from the arrays is 5 volts greater than the battery voltage then continue charging as long as the voltage from the PV arrays is one (1) volt higher than that of the batteries.

Performance Issues, Causes and Solutions

Table 3. Symptoms and Solutions for the Most Common Power Hub Issues

Symptom	Possible Cause(s)	Solution
Battery SOC displays “--”.	Battery not fully charged for an extended period or has not been cycled enough times for the user interface to calculate SOC.	Try to charge the battery fully often. Refer to the setup diagram to make sure that the System is assembled correctly.
Battery SOC seems inaccurate	Power Hub is not the primary power management device.	Normal operation. Read battery SOC from primary management device (e.g., PRO-Verter) or 24VDC Expander Pak 1000s
Not registering charge current with panels operating in sun	1. Power Hub overheated 2. Batteries fully charged (29.0 VDC or near to that)	1. Check internal temperature and “battery” temperature on user interface. Derating begins at 104 °F; diminishing power as temp increases. Check for dirty, blocked air filters. Shade the Power Hub to reduce solar loading. Ensure that the internal cooling fans are operating (audible when operating) 2. Normal operation.
LCD inoperative	1. No power to the Hub 2. The LCD screen is overheated/sunlight exposure	1. Check connections and make sure batteries are active. 2. Close lid and allow Power Hub to cool down.

Note: The battery SOC and related readouts on the Power Hub 2400 LCD user interface are precise ONLY if the batteries are connected directly to the Power Hub 2400. If the batteries are connected to the PRO-Verter (indirectly to the Power Hub 2500), then information about the battery SOC and other parameters should be obtained from the PRO-Verter user interface or the optional RMK.

Monitoring the Charging Status on Power Hub

Table 4. Charge Status Indicator—LED Status

Charge status LED	Charge Mode
Off	Charge Off
Continuously On	Bulk
Blinking – 1 second On / 1 second Off	Acceptance
Blinking – 0.2 second On / 1 second Off	Float

Blinking LED indicates charge control operation status

Figure 2. Power Hub User Interface

Bulk Charge: During Bulk mode, the charge controller can deliver full output to recharge the Expander Paks rapidly and drive voltage up to the acceptance charge voltage setpoint. This stage typically takes the battery to about three-quarters of full charge and at a rate that usually does not exceed 25% of the battery's amp hour capacity. This is also known as the "constant current phase".

Acceptance Charge: In this stage, the charge current gradually decreases as the batteries obtain full charge. It is also known as the "constant voltage phase". With the Li Expander Pak 2400, the acceptance charge phase is not necessary.

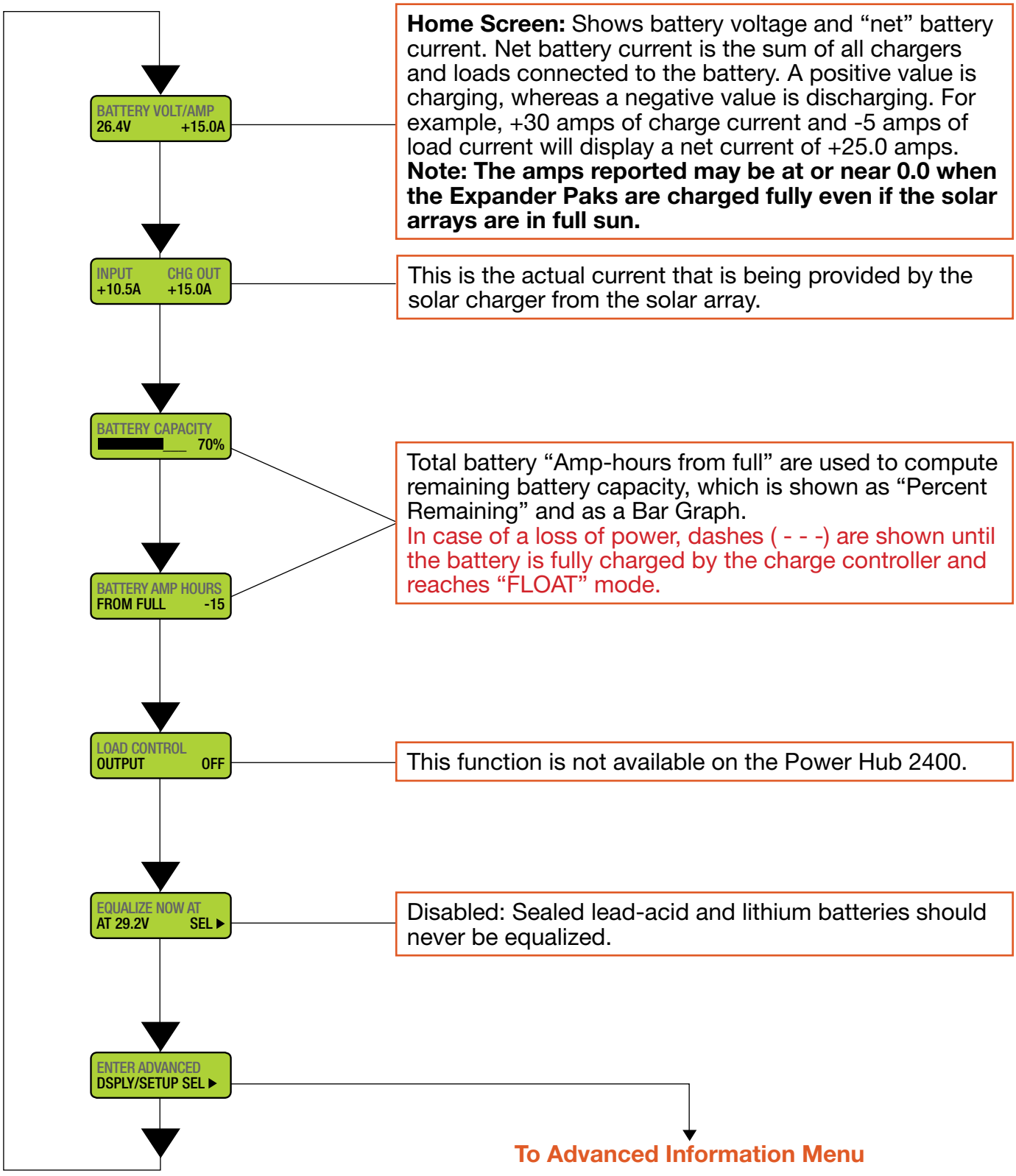
Float Charge: This final stage compensates for the battery's self-discharge and temperature.

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

Power Hub Menu Windows

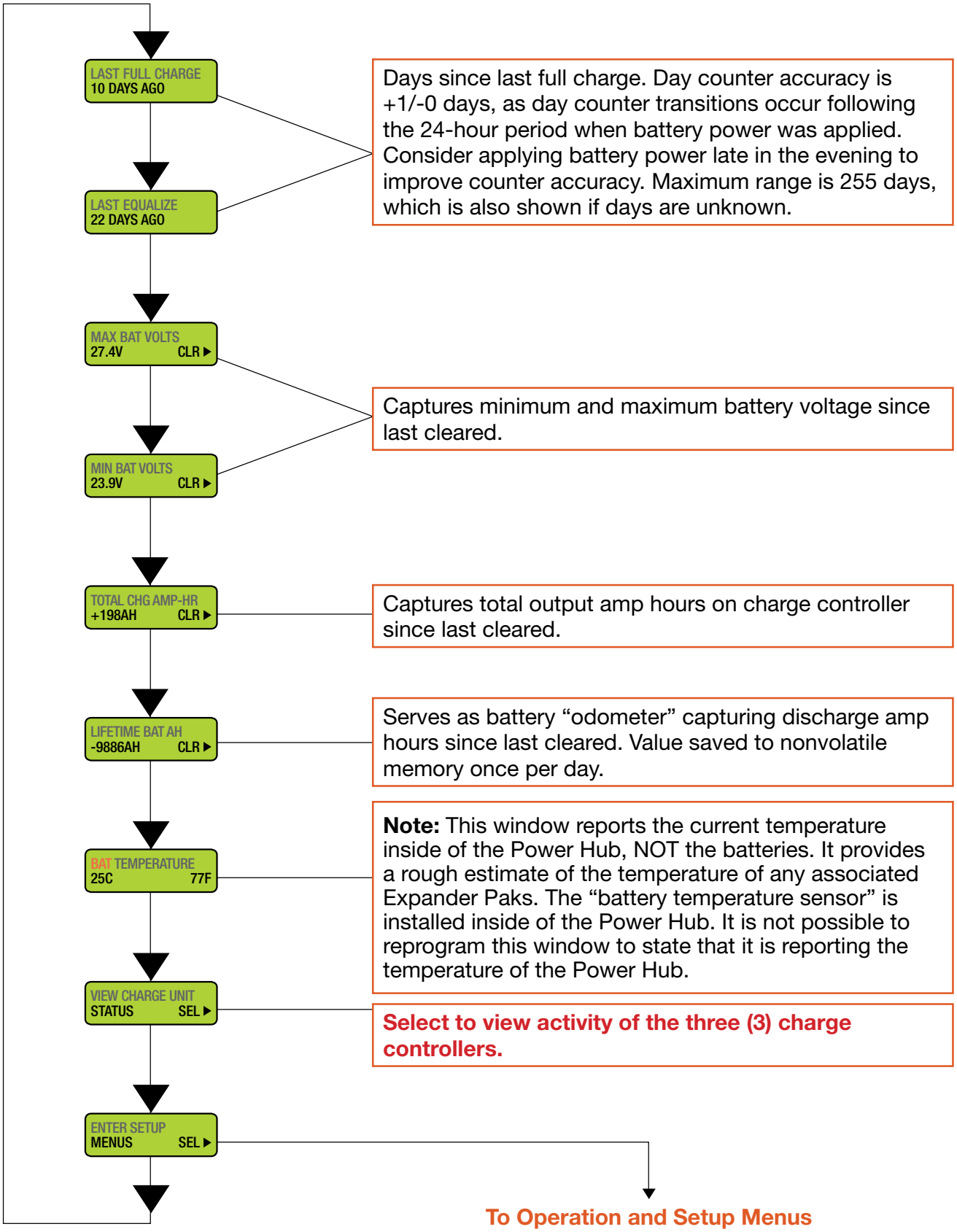
General Information Menu

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



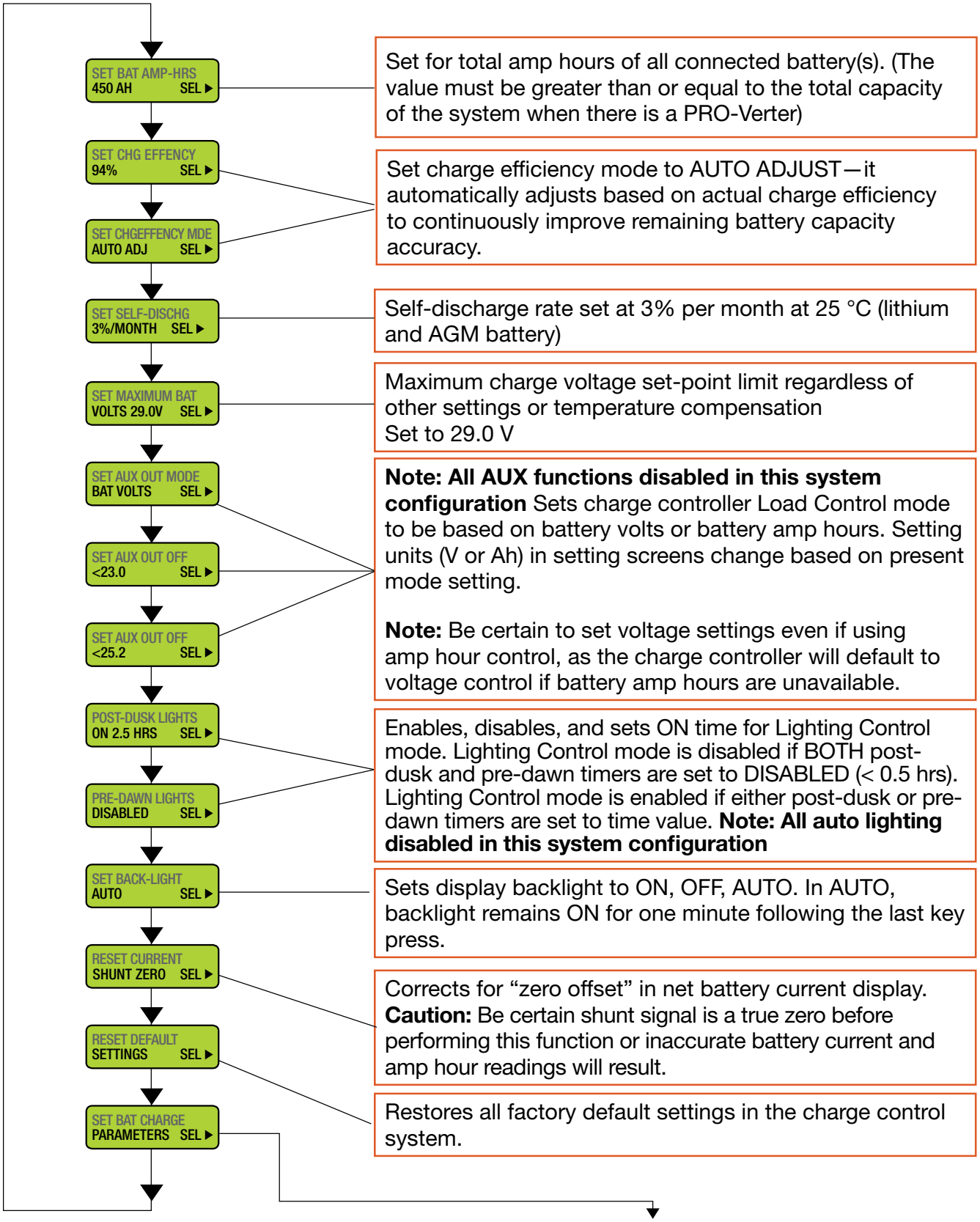
Advanced Information Menu

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



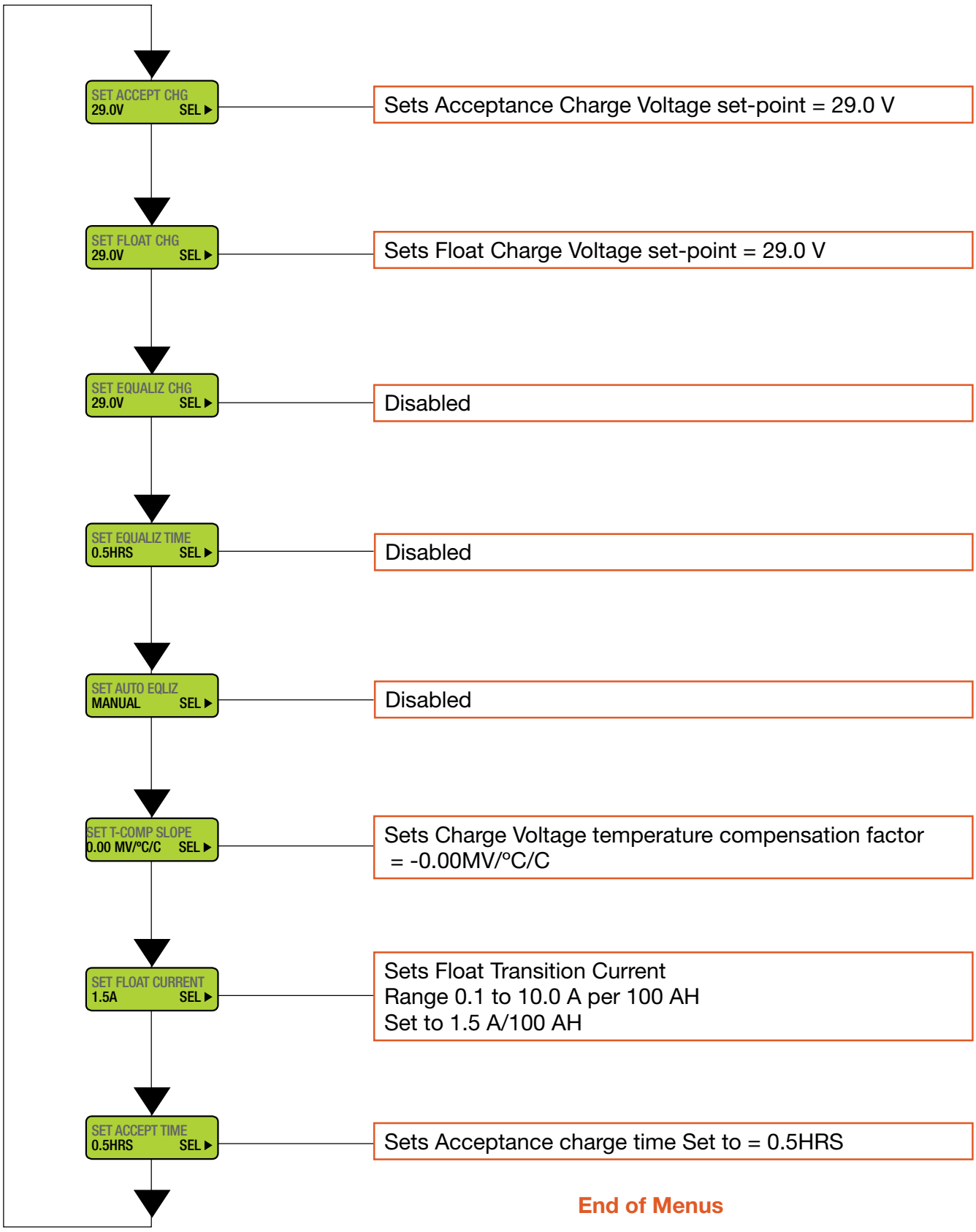
Operation and Setup Menu

Provides operational setup and auxiliary functions



Battery Charge Parameter Setup Menu

Provides access to battery charge parameters



PV Array Troubleshooting

This section contains troubleshooting information for locating and correcting operating troubles that may develop in the PV array. Each malfunction is followed by a list of tests or inspections to help you to determine probable causes and corrective actions to take. You should perform the tests/ inspections and corrective actions in the order listed. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or cannot be corrected by listed corrective actions, contact the Field Service Representative.

Equipment Condition Assumption Statement: The Power Hub is fully functional and operating normally.

Required Tools and Equipment

- Functional Power Hub 2400 connected to a 24 VDC power source such as a functional 24VDC Expander Pak/battery. Solar Power alone will not power up a 24VDC Power Hub 2400
- Digital Multimeter

Maximum Power (Vmp) and Open Circuit Voltages (Voc)

Voltage "**m**aximum **p**ower" (V_{mp}) is the voltage at which the maximum power of a panel or array is produced when connected to a charge controller, or when the panel is considered "under load" such as a charge controller (Power Hub or Power Pak).

Voltage "**o**pen **c**ircuit" (V_{oc}) is unregulated panel voltage and measured directly from the leads of a panel or an array when **not** connected to a "load" such as a charge controller (Power Hub or Power Pak).

The V_{oc} of a single PAM quarter panel is approximately 15.72 V under standard test conditions (STC). In a PAM, four (4) panels are connected in series; therefore, the V_{oc} for the four (4) panels could theoretically be as high as 62.88 V. Once the panels are connected to the Power Hub (i.e., the panels are connected to a "load"), it is more likely that the operator will see voltages around 50 V_{mp} reported on the User Interface.

The V_{oc} and V_{mp} should be measured under "ideal solar conditions" if possible. This means that the panels should be oriented directly at the sun and unshaded on a clear day to identify the maximum V_{mp} and V_{oc}.

⚠ CAUTION

- **Photovoltaic panels produce electricity when exposed to light.**
- **Live power may be present at multiple points.**
- **Never route the cables through standing water.**
- **All cables and connections should remain dry.**

No Power from the PV Array

Step 1. Verify the PV array is oriented for maximal sun exposure.
a. If the PV array is oriented for maximal sun exposure go to step 2.
b. If not, orient the PV array for maximal sun exposure.

Step 2. Check the Solar Cable connection at the Power Hub.
a. If the Solar Cable is properly connected to the Power Hub go to step 3.
b. If the Solar Cable is loose or not connected, tighten or connect properly.

Step 3. Check the connections between the Solar Cable and the PV array.
a. If connections between the Solar Cable and PV array are secure, go to step 4.
b. If connections are loose or disconnected, tighten or connect them properly.

Step 4. If the no-voltage problem persists, contact the Field Service Representative.

Lower Than Expected Voltage from the PV Array

Step 1. Verify the PV array is oriented for maximal sun exposure and is NOT shaded.
a. If the PV array is oriented for maximal sun exposure and NOT shaded, go to step 2.
b. Remove the shading obstruction or move the PV array to eliminate the shading.
c. Orient the PV array for maximal sun exposure.

Step 2. Measure PV array V_{oc} at pins A and C of the bayonet connector of the Solar Cable.
If the PV array V_{oc} at pins A and C of the bayonet connector of the Solar Cable is within acceptable limits, the PV array is operating normally.
a. If V_{oc} measured at pins A and C of the bayonet connector is below ~30 V*, go to step 3.

Step 3. Check the connections between the Solar Cable and the PV array output lead connectors.
a. If connections between the Solar Cable and PV array are connected properly, go to step 4.
b. If connections are loose or disconnected, tighten or connect them properly.

Step 4. Check the V_{oc} at the PV array output lead connectors.
a. If the V_{oc} is within acceptable limits, replace the Solar Cable.
b. If the V_{oc} at the PV array output lead connectors is not within acceptable limits*, replace the PV array.

***This value will vary depending on weather/environmental conditions (i.e., lower if overcast).**

Navigating Power Hub User Interface Menus “View Charge Unit Status” Submenus

Enter “Advanced Information Menu”. Advance to “VIEW CHARGE UNIT STATUS”.

Press and hold SELECT for 4 seconds.
The number “0” displays in the upper left corner. This is the MASTER/ CHARGE UNIT #0. This window reports solar input voltage and current, output current to batteries, and the internal temperature for the pair of solar panels connected to the ports labeled MASTER/CHARGE UNIT #0.

Press NEXT.
The number “1” displays in the upper left corner. This is SLAVE1, CHARGE UNIT#1. This window reports same as the master but for the pair of solar panels connected to SLAVE1 input ports.

Press NEXT.
The number “2” displays in the upper left corner. This is SLAVE2, Charge Unit#2. This window reports same as the master but for the pair of solar panels connected to SLAVE2 input ports.

Press NEXT.
The number “3” displays in the left corner. The rest of the screen is blank because no charge controller occupies this channel.
Note: Menu windows for Charge Units 3-7 contain only the Unit # in the upper left hand corner

Press BACK to exit this submenu.

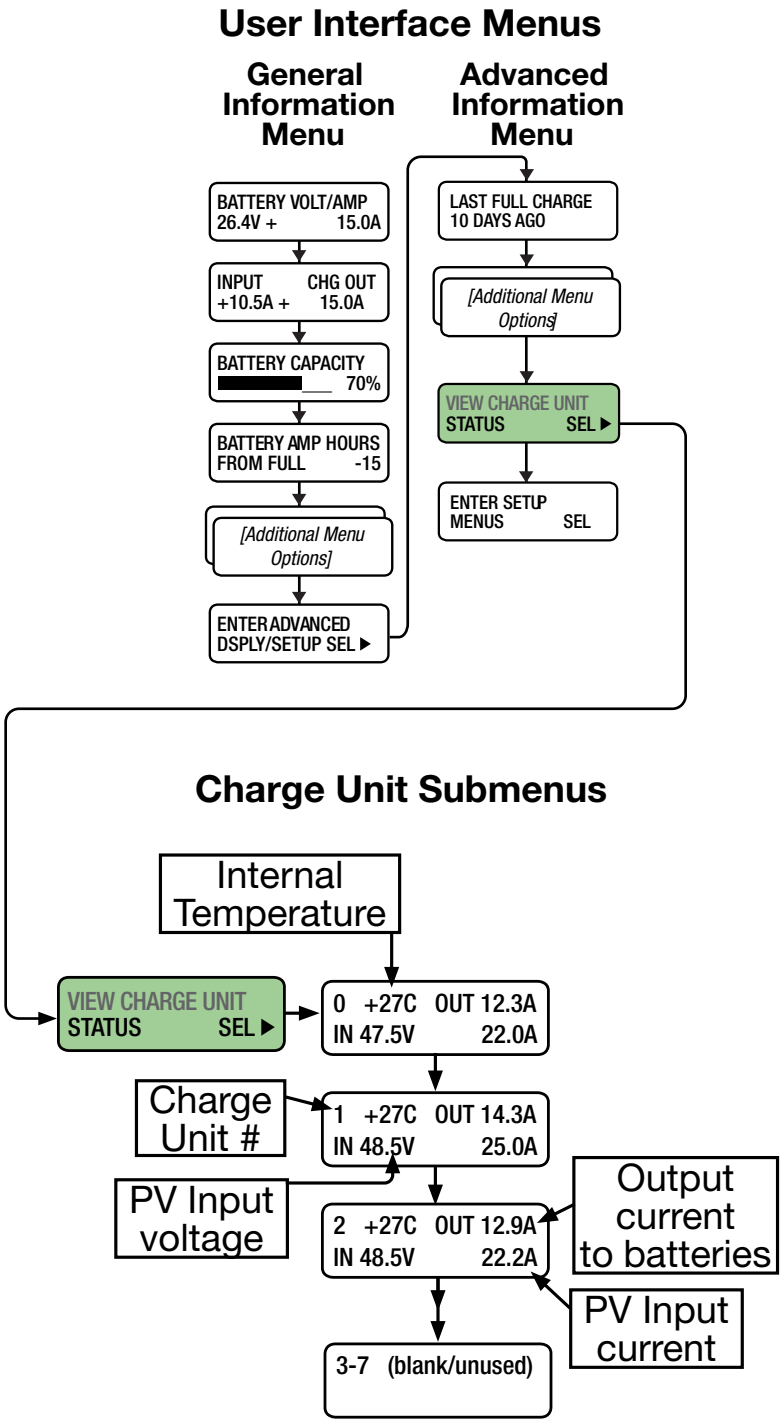


Figure 3. View Charge Unit Status submenu navigation

Procedure to Measure PV Array V_{mp} with a Power Hub 2400

1. Disconnect one (1) PV array from each of the three (3) charge controllers.

2. Read and record the performance metrics for each PV array as reported by the User Interface in charge units 0, 1 and 2. The values for the three (3) arrays should be about the same. Use the instructions in Figure 1 to navigate to the “VIEW CHARGE UNIT STATUS” submenus.

   Note: the Power Hub User Interface will report very low to no charging current, even in full sun, if the connected batteries are fully charged.

3. Disconnect two (2) of the three (3) PV arrays from the Power Hub. Leave one (1) connected as a reference standard for comparing the remaining PV arrays.

4. Connect each of the remaining PV arrays and compare the performance values to the reference standard connected to the other solar charge controller.

5. If no voltage is reported by an array, measure the V_{oc} at the array lead connectors. If a voltage cannot be measured at the lead connectors, replace the Solar Cable.

6. If a PV array appears to be under performing, measure the V_{oc} of the array. Follow the directions for measuring PV array V_{oc}, Figure 36.

Procedure to Measure PAM V_{oc}

To measure V_{oc} from a single PAM, **carefully** place the leads of the voltmeter on pins A and C in the bayonet connector at the end of the Solar Leash (DO NOT SHORT THESE PINS). Pin B is unused. The rated V_{oc} for the four-panel PAM is ~ 63; however, the voltage may vary. Under ideal-sun conditions, the reading should be 50 V or more.

Note: If the V_{oc} is significantly below (less than half) 50 V under ideal-sun conditions, measure the V_{oc} of the individual quarter panels as described in the next section (and Figure 3).

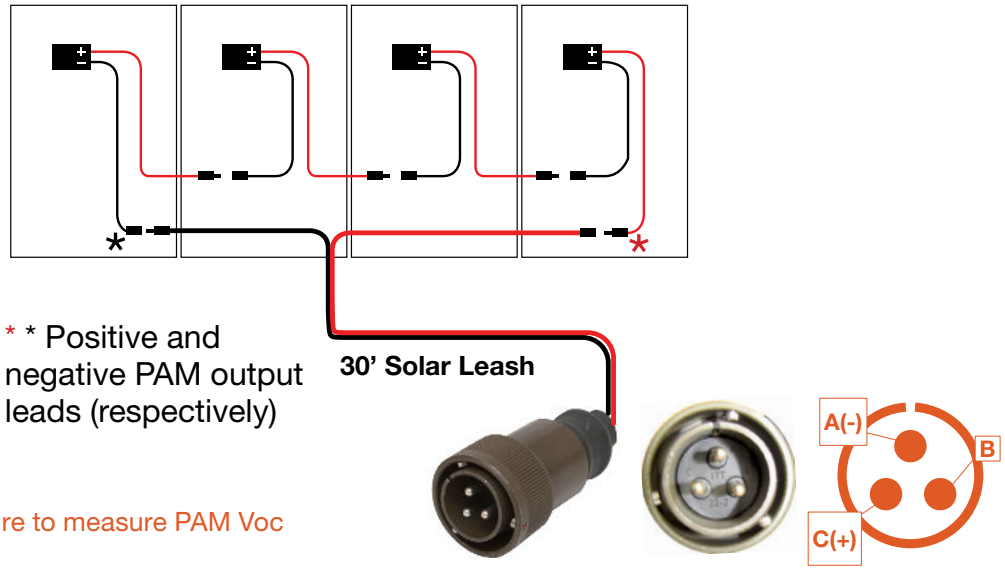


Figure 4. Procedure to measure PAM Voc

Procedure to Measure V_{oc} of a Single PAM Quarter Panel

To measure the V_{oc} of a PAM quarter panel, **carefully** place the leads of the voltmeter in/on the quarter panel positive and negative connector terminals of the (DO NOT SHORT THESE TERMINALS). The voltage measurement across the terminals of these leads is the V_{oc} of the quarter panel and should be ~15 V under ideal-sun conditions.

- If all of the quarter panels are performing up to specs, replace the Solar Cable and retest.
- If the V_{oc} of a quarter panel is significantly below (less than half) 15 V under ideal-sun conditions, replace the quarter panel.
- If a replacement quarter panel is not available, connect the remaining quarter panels to assemble a partial PAM.

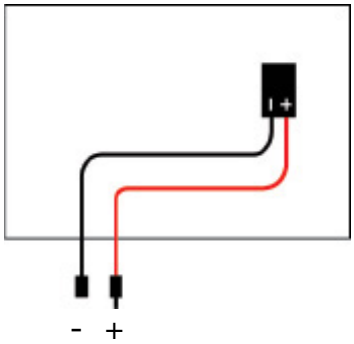


Figure 5. Procedure to measure PAM quarter panel Voc

Expander Pak Troubleshooting

General Information

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 HPS 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 connected to it need to be rated for the amount of power that will be processed by it.

For example, the PRO-Verter 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**.

In the HPS, the PRO-Verter 5000 inverter can require up to 200 A from the batteries, and the charger has a rated output of 110 A. Four (4) 24VDC Expander Paks is the MINIMUM number required to support the inverter’s full inverter output and be charged effectively and safely when the PRO-Verter 5000 is in charge mode.

Connecting an insufficient number of Expander Paks (energy storage modules, or ESMs) 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.

Expander Pak Circuit Breakers Tripping

Causes
The batteries have varying states of charge and states of health.
Several batteries are not operating because they are turned off or in fault mode.

Solution
Charge the hybrid system’s bank of batteries fully to equalize the states of charge among the Expander Paks (see: SOC Disparity Among Expander Paks).

Battery Status LED

Figure 6. 24VDC Li Expander Pak 2400

Table 5. Battery Status LED Color and Corresponding Condition

Color	Frequency	Condition
Green	Flashing	**Normal operation**
Red	Flashing	**Protection circuits engaged** 1. Cell overvoltage 2. Cell undervoltage 3. Overcurrent (charge or discharge) 4. Overtemperature (> 160 °F/71 °C) 5. An internal battery fault (such as a broken wire, dead cell, internal short circuit, etc.)
None	N/A	**Battery inoperative**

Resolving Red-flash Battery Status LED Conditions

Background

It is most important to maintain Li Expander Paks in such a way that they will never end up in a red-flash state. The Battery Status LED will flash red if any of the protection circuits engage

Instructions

1. Remove the Expander Pak from service.

Follow the instructions in the Procedure for Recovering Li Expander Pak from Red-flash Condition.

Monitoring Battery Status

Figure 11 describes how the changes in Battery Status LED color (red and green lines) relate to battery or cell voltage during charging and discharging (black arrows).

Note: The Battery Status LED does not report the state of charge (SOC).

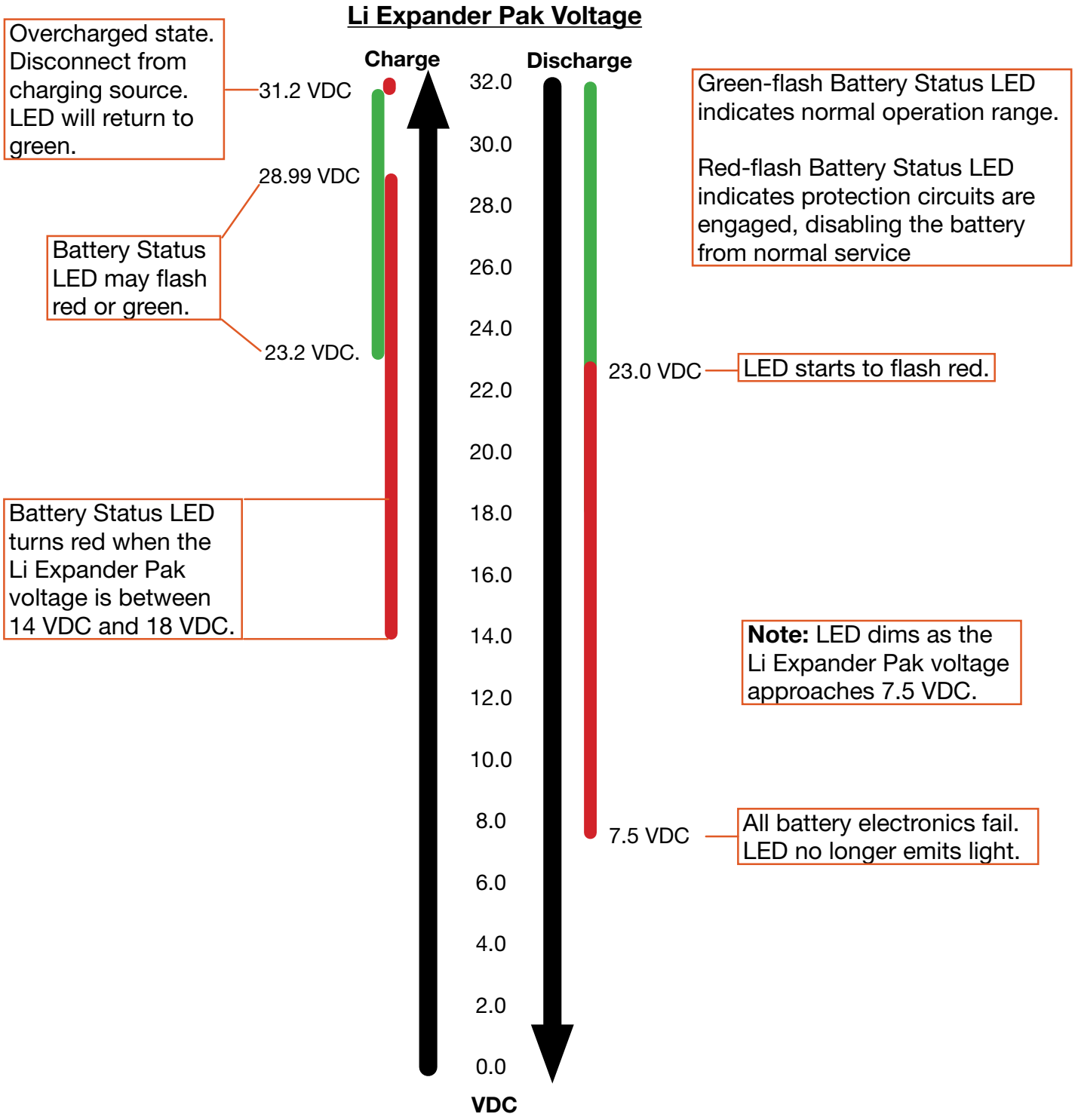
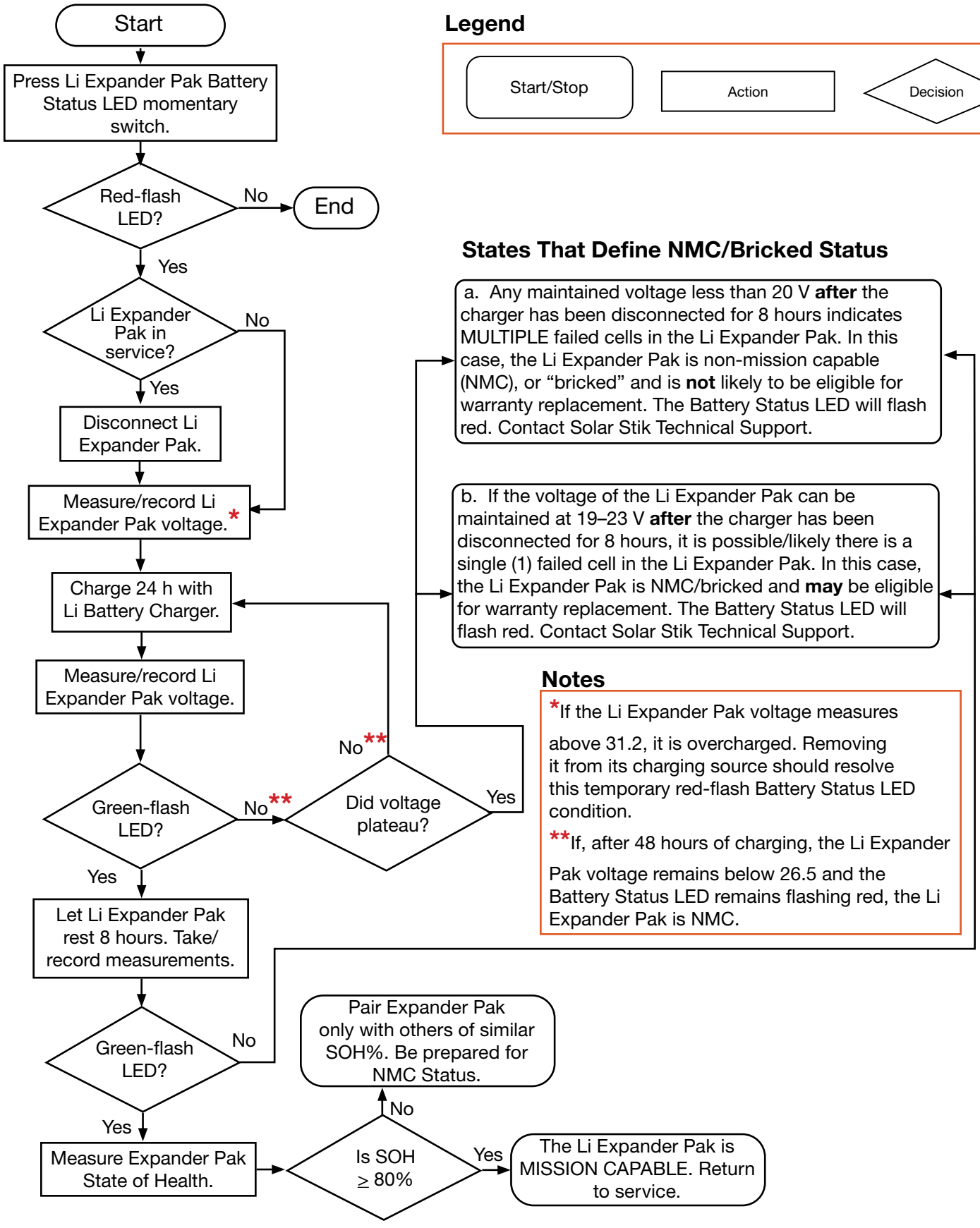


Figure 7. Battery Status LED color and Li Expander Pak voltage relationship

Procedure for Recovering Li Expander Pak from Red-flash Condition



Legend

States That Define NMC/Bricked Status

a. Any maintained voltage less than 20 V **after** the charger has been disconnected for 8 hours indicates MULTIPLE failed cells in the Li Expander Pak. In this case, the Li Expander Pak is non-mission capable (NMC), or "bricked" and is **not** likely to be eligible for warranty replacement. The Battery Status LED will flash red. Contact Solar Stik Technical Support.

b. If the voltage of the Li Expander Pak can be maintained at 19–23 V **after** the charger has been disconnected for 8 hours, it is possible/likely there is a single (1) failed cell in the Li Expander Pak. In this case, the Li Expander Pak is NMC/bricked and **may** be eligible for warranty replacement. The Battery Status LED will flash red. Contact Solar Stik Technical Support.

Notes

*If the Li Expander Pak voltage measures above 31.2, it is overcharged. Removing it from its charging source should resolve this temporary red-flash Battery Status LED condition.

**If, after 48 hours of charging, the Li Expander Pak voltage remains below 26.5 and the Battery Status LED remains flashing red, the Li Expander Pak is NMC.

SOC and SOH Disparity Among Expander Paks

When cycling multiple batteries in a bank, it is possible to see both SOC and SOH lose parity for the following reasons:

- **High-cycling** – fast charge and discharge rates with an inadequate battery bank (more than 2 cycles per day) will cause some batteries to work harder than others, creating disparity in their individual SOC and SOH.
- **Short-cycling** – the PRO-Verter's AGS is set to control the generator by either TIMED or MANUAL programming rather than the AUTO (Volts or SOC) mode. If the operator or the TIME/MANUAL AGS function turns the generator off before 100% SOC is reached, then it is likely that not all of the batteries on the bus achieved the same SOC. Repetitive cycles in this manner will cause the batteries' SOC to drift apart over time.
- **Solar loading** – Expander Paks exposed to direct sun will be hotter and will discharge more rapidly than Expander Paks that are shaded and cooler.

Expander Pak SOC and SOH disparities may cause erratic System behavior including:

- Premature termination of the AGS functions, or generator "short-cycling" (frequent start / stop)
- Expander Pak Circuit breaker tripping
- System crashes

Expander Paks will maintain parity close to 100% SOC on a regular basis if the PRO-Verter AGS is in AUTO mode using VOLTS to start/stop the generator.

Balancing SOC Among a Bank of Expander Paks

The only method of restoring parity between multiple batteries on a DC bus with varying SOCs is to manually perform a dedicated charge cycle using a reduced charge rate and the highest allowable charging voltage applied over a period of time. Once the batteries have all reached their peak voltage, the charging amperage should taper off to single digits, and the operator can have confidence that the batteries are actually all at 100% SOC. Normal cycling can then commence.

Method to Restore Expander Pak SOC Parity

1. Press SETUP on the PRO-Verter user interface (pass code may be required).
2. Scroll to 03 Charger Setup, press SELECT,
3. Scroll to 03E MAX Charge, press SELECT,
4. Reduce the charge rate to 40%, press SELECT.
5. Press CTRL and scroll to 03 Gen Control, press SELECT.
6. Scroll to Set Gen Control ON, press SELECT.
7. The "Remote Generator Start and Operation" sequence will begin (total process may take 3 minutes).
8. Charge the Expander Paks until the PRO-Verter user interface home screen reports 29.0 V and the charging current has decreased to and stabilized at 5 to 10 A.
9. Set Gen Control to AUTO.

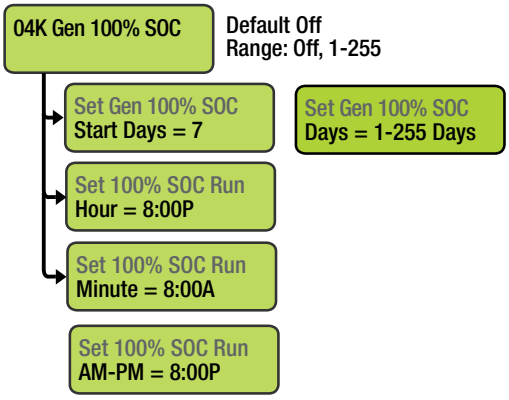
This slow charge protocol will equalize Expander Pak SOCs, eliminate the erratic System behavior and restore normal cycling of the HPS.

Maintaining SOC and SOH Equality Among Expander Paks

Method to Maintain Expander Pak SOC and SOH Parity using Gen 100% SOC

The feature “Gen 100% SOC” is designed specifically for the purpose of equalizing the SOC of all Expander Paks in an HPS to 100%. After the SOC of the bank has been below 100% for a programmable number of days (three in the example below), the PRO-Verter will start and run the generator until the bank is at 100% SOC. The time of day for this protocol to begin must also be set (see below). The length of time require to restore the bank to 100% will depend on the degree to which the bank of Expander Paks are discharged and the magnitude of the SOC difference when Gen 100% SOC starts. This feature will also help to maintain SOH equality between the Expander Paks connected in a single bank.

Setup Menu



1. Press the SETUP Button on the PRO-Verter user interface (password may be required).
2. Navigate to SETUP 04K Gen 100% SOC. Press SELECT to enter this menu.
3. Enter and save the values best suited for your application into each of the fields. Start with the frequency (e.g., every 7 days) as shown and at an appropriate time of day.
4. Confirm that the SOC of the System battery bank reported in METER 05B is 100%. .

Note:

- Ensure that the System clock is set to local time.
- Turn OFF Max Gen Run Time (SETUP 04F) to avoid generator shutdown before 100% SOC is achieved.
- The *Gen 100% SOC Start Days* setting uses information from the BMK’s *METER 05J Days Since 100% SOC* to determine how many days have passed since the battery bank has <u>not</u> been charged to 100% SOC.
- A valid SOC number must display in *METER 05B Battery SOC* for the BMK’s *METER 05J Days Since 100% SOC* menu to accumulate and display days (Think’n, No Comm, Internal Fault, Power-up Fault, or Unknown Fault ## are not valid SOC numbers).
- Once the BMK’s *METER: 05B Battery SOC* displays 100%, the AGS stops the generator and the BMK’s *METER: 05J Days Since 100% SOC* display resets to “0 days”.
- If the generator does not start at the scheduled time (i.e., AGS fault, generator runs out of fuel, etc.,), one more day must pass before another attempt is made to charge to 100% SOC.

Measuring Expander Paks SOH with PRO-Verter 5000

All Expander Paks connected in a single bank should have equivalent SOH. If SOH varies, the following System behaviors will be observed:

- Premature termination of the AGS functions, or generator “short-cycling” (frequent start / stop)
- Expander Pak Circuit breaker tripping
- System crashes

Moreover, the Expander Paks with higher SOH% will be degraded quickly to the level of the least healthy Expander Pak in the mix. For these reason, it is important to measure the SOH of Expander Paks before mixing them into a single bank. Likewise, it is important to monitor SOH over the life of the batteries to know when it is time to replace them.

Before starting, ensure Expander Pak and PRO-Verter main power switches are toggled OFF.

1. **Setup PRO-Verter to Charge and Discharge Expander Pak 2400**
   a. Connect PRO-Verter to an active AC power source.
   b. Connect an Expander Pak 2400 to one (1) of the two (2) metered Expander Pak ONLY ports PRO-Verter 5000 using Inter-Connect cable.
   c. Turn on PRO-Verter Main Power Switch. Set PRO-Verter charging voltage to 29.0 VDC. The charger menu location where this value resides may differ depending on how the PRO-Verter is programmed. It may also be a FAVs option.
   d. Set charging current to 22 A. Push SETUP, scroll to 03 Charger Setup, push select and scroll to 03E, MAX CHARGE RATE, press select, scroll to 20% and press select. Normal output of the charger is ~110 A so 20% is ~22 A charging current. (Confirm this value in DC meters while charging).
   e. Set low battery cut off (LBCO) to 24.0 VDC. This setting is likely one of the FAVS.

2. **Charge Expander Pak 2400** Charge until charging current drops to < 2A to ensure it is full. At this charging rate, it should take only 4-5 hours to completely charge a 100 Ah (when new) Expander Pak 2400. Leaving it overnight should ensure a complete, full charge.
3. **Remove PRO-Verter charging source**:
   Toggle OFF PRO-Verter 5000 AC INPUT breaker. Ensure there is no other charging source connected to PRO-Verter. The charged Expander Pak 2400 should continue to support PRO-Verter operation.
4. **Reset AH counter to zero**
   a. Press METER button and scroll to 05 BMK Meters, press rotary SELECT knob, scroll to METERS BMK 05F Reset AH In/Out.
   b. Press and hold the rotary SELECT knob for ≥ 5 seconds.
   Note: The Ah leaving the battery during discharge is reported as a positive number in BMK Meters 05F.
5. **Connect an AC load** to PRO-Verter AC output. A 500-1000 W load, something like a light bulb is a good load. Ensure AC OUTPUT breaker is ON.
6. **Discharge Expander Pak 2400 until LBCO**
   An LBCO setting of 24.0 will turn off the AC load at ~23.8-24.0 V. Once the AC load is off, voltage may raise back up to 24. 8-24.9 V.
7. **Read and record AH out**
   BMK Meter> 05F Total AH In/Out. This value is the Expander Pak 2400 storage capacity. The Expander Pak 2400 rated capacity when new is 100 Ah. The math is easy. If the discharged Ah value is 80, the battery SOH is 80%.

Note: you can only do this one Expander Pak 2400 at a time.

Battery Life Expectancy

The battery is the “consumable” part of any hybrid system... It is sacrificial. The chemical reaction in a battery never stops, but it can be controlled in ways that affect the life expectancy and the cycle-life it will provide.

Primary factors that determine battery life expectancy:

1. Cycles
   - Chemistry
   - Application (operating conditions, C-rates, etc.)
2. Environment/Abuse
   - Storing in a discharged state
   - Improper cycling
   - Operating in high heat

Terminal (End-of-Life) Battery Performance

When a $LiFePO_4$ battery has reached the end of its service life (SOH is less than 80%), it loses its ability to retain electrical energy in its cells, and the cycle performance will be severely degraded. Symptoms will include:

- Voltage will rise and fall in very short periods of time.
- Very short durations of inverter and generator run-times.
- Circuit breaker tripping.

There is one major rule to remember when using a Expander Pak:

NEVER STORE THE EXPANDER PAK IN A DISCHARGED STATE
Storing a discharged battery will cause it to “brick”

For longest service life, Expander Paks should only be discharged to 80% depth of discharge (DOD). This means that 80% of the power stored in the battery can be used to supply a load before recharging is recommended. The smaller the DOD%, the longer the battery will last.

Charging the Expander Pak fully.

Expander Paks should be charged fully at least once every 15 cycles.

Generator Troubleshooting

Please consult OEM Generator Technical Manuals for in depth genset troubleshooting information.

Testing the AGS Function

Push the red AGS Test button at the AGS interface to confirm all wiring from the generator to the AGS module is correct and the AGS circuit is configured correctly for a particular generator. When pressed, the Status LED on the AGS module will begin to blink green and the generator should start (a blinking green Status LED means the AGS has initiated an automatic generator start/stop sequence).

Once the generator starts, view the Status LED and ensure it turns solid green (a solid green Status LED means the generator has started successfully and is providing the Gen Run sense signal to the AGS module). It should run for approximately 30–60 seconds before automatically turning off.

Generator Having Difficulty Starting

Causes
1. Generator starter battery voltage too low
2. Low fuel
3. Fuel / Air filters clogged
4. Low oil

Solution
1. Charge the generator starter battery.
2. Add fuel.
3. Check air and fuel filters; replace if necessary.
4. Add or change oil

Generator Will Not Start

Causes
1. Out of gas (diesel fuel) (“OG”)
2. Auto Gen Start (AGS) control module on generator in “fault” mode
3. Gen Control (CTRL 03) function set to OFF
4. Dead generator starter battery
5. Fuel line valve turned off
6. Low oil

Solution
1. Fill fuel tank and evacuate (bleed) all air from the fuel lines.
2. Reset the AGS module by toggling the PRO-Verter power switch OFF, then ON
3. Set the Gen Control to ON or AUTO.
4. Charge or replace generator starter battery
5. Turn on fuel line valve (should be vertical for ON)
6. Add or change oil

Generator Short-cycles

The is when the generator turns on and off frequently without running very long each time it turns on.

Causes

1. Incorrect setup of the Inter-Connect Circuit
2. Expander Paks nearing end of life, i.e., very low state of health.
3. Expander Paks with disparate states of health.
4. Incorrect voltage setting in the Gen Run VDC menu
5. Expander Pak(s) not turned on
6. High heat causing AGS to trigger frequent start/stop

Solution

1. Verify the Inter-Connect Circuit is in accordance with the schematic on the PRO-Verter I-Plate.
2. Measure Expander Pak SOH.
3. Connect Expander Paks with similar SOH (< 5% difference among them if possible).
4. The Gen Run VDC should be set to values appropriate for the System.
5. Verify all Expander Pak switches are in the ON position.
6. If the internal transformer is in danger of overheating, the AGS will automatically start the generator to ensure continuity of operations. The AGS will stop the generator after temperatures have cooled.

Generator Fails to Stop

See also: Max Gen Run fault

Causes

- Charge function in standby mode
- AC circuits running at the generator's full-rated output (batteries not being charged)
- Gen Run VDC value altered from factory setting
- AC load is too high - not enough power available from generator to support both charging and load support functions.

Solution

1. Verify CHARGER LED is illuminated (not blinking)
2. Reduce AC loads
3. Ensure the Gen Run VDC is set properly (SETUP: 04A)
4. AC INPUT (FAVS 4) setting too low
5. CHARGE RATE (FAVS 5) setting too low
6. Battery capacity (FAVS 2) too large
7. Charger programming not compatible with the battery type
8. Battery Temp sensor reading high temp (clean air filters)

Generator Starts, Then Shuts Down When Load Is Transferred

Cause

1. The generator cannot sustain a significant load until the engine is fully warmed up.
2. Generator voltage or Frequency not within spec.

Solution

1. Gen warm-up and cool down phases are critical for repetitive start/stop function. Make sure the Gen Warm-up setting is at least 75 seconds in duration.
2. Adjust generator voltage and frequency (next page).

Instructions for Adjusting Generator Voltage and Frequency

Safety

- Remove jewelry.
- Use proper procedures and equipment to prevent damage from electrostatic discharge.

Tools Required

- Small thin-blade, flat-tipped screw driver
- 10 mm nut driver
- 10 mm open ended wrench

Read and understand the related information in the generator OEM documents before attempting to make these adjustments. These documents were delivered with the generator. If they are absent, please contact Solar Stik Technical Support. Doing these procedures incorrectly or attempting to adjust frequency by using the trim pot in the generator controller can cause the generator to operate improperly. Do not try to adjust RPMs/frequency by adjusting the trim pot on the digital regulator board.

Background

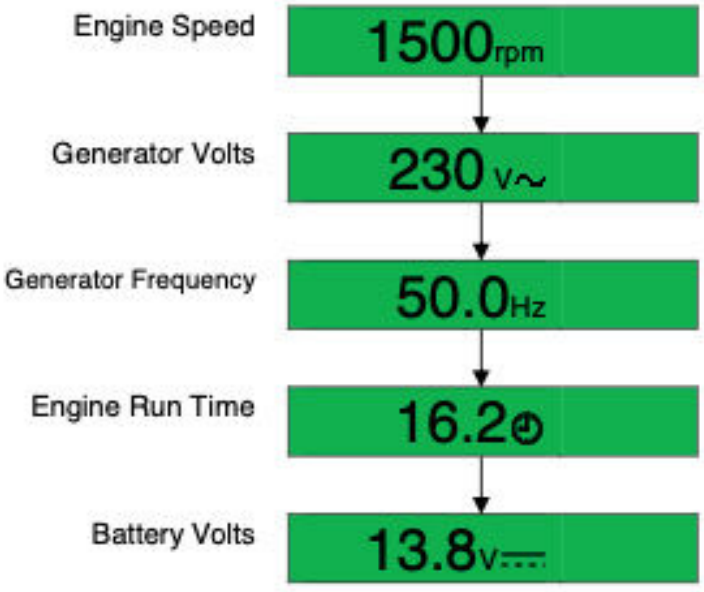
Generator frequency and voltage must be maintained at spec: 50 Hz, 230 VAC. Both values can drift out of spec over time. The output of the generator should be monitored on a regular basis to ensure it is running within spec.

The range of acceptable values for voltage and frequency of power output:

- 230.0V ± 0.5V (Range 229.5 – 230.5 V)
- 50.0 Hz ± 0.2 Hz (Range 49.8 – 50.2 Hz).

If either of these values is outside of these ranges, they should be adjusted using the following protocols.

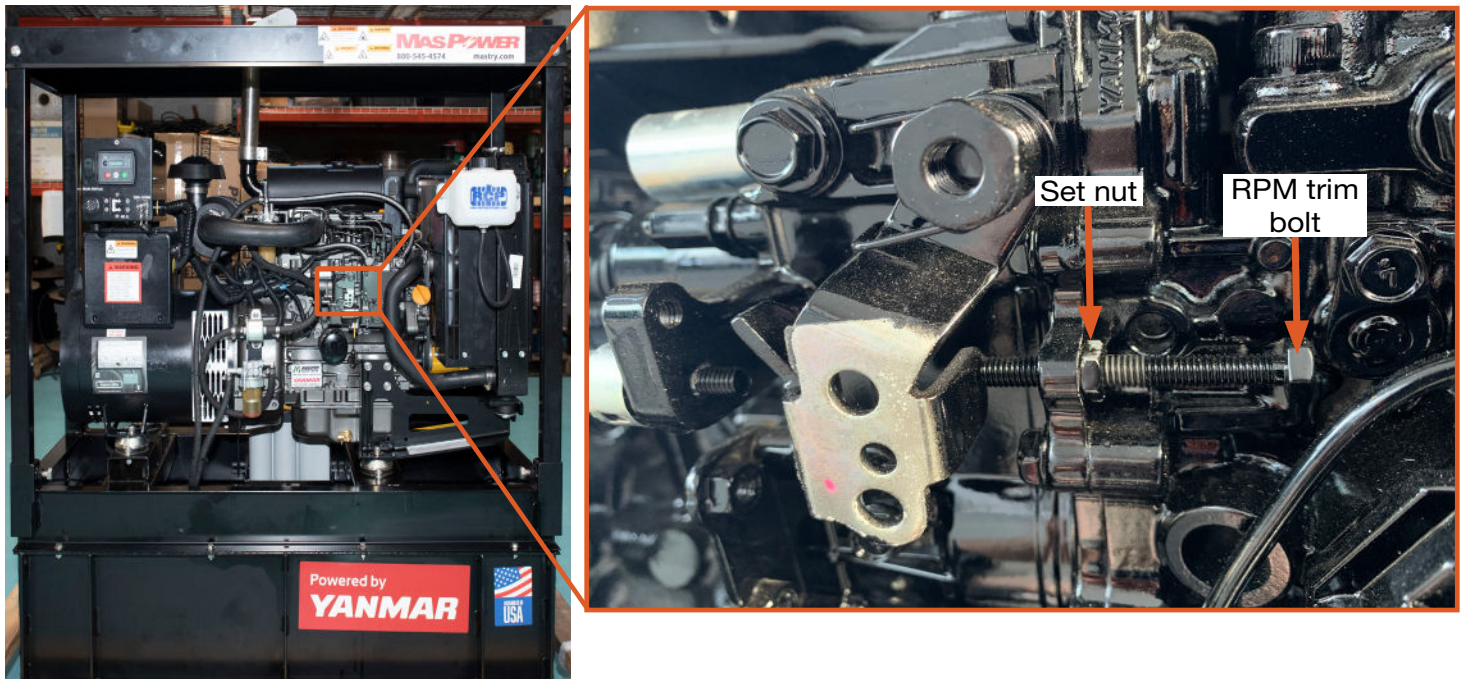
These adjustments should be made when the generator is warmed up and at idle, not under load. Values can be read on the DSE 3110 controller. The image below shows the order of the information provided by the DSE 3110 when scrolling down by pushing the black down arrow button on the controller.



Set Frequency (Hz)

Adjust RPMs via the engine governor.

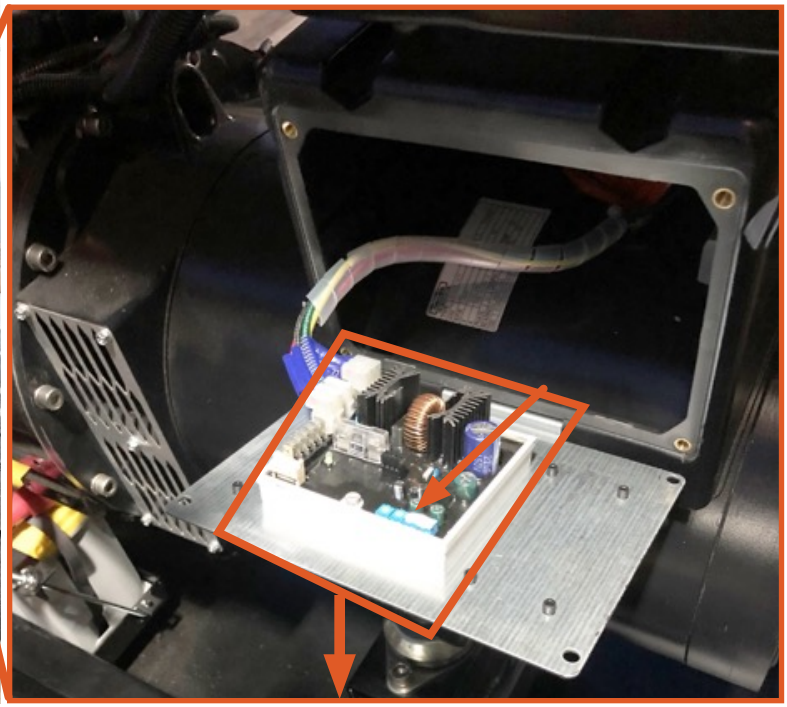
1. Use a 10 mm open end wrench to loosen the set nut.
2. Use a 10 mm open end wrench loosen or tighten RMP trim bolt to set frequency to 50 Hz. Frequency can be monitored on the DSE 3110 and/or the PRO-Verter AC Meters.
3. When the frequency is stable at 50 Hz, carefully tighten the set nut without moving the trim bolt.

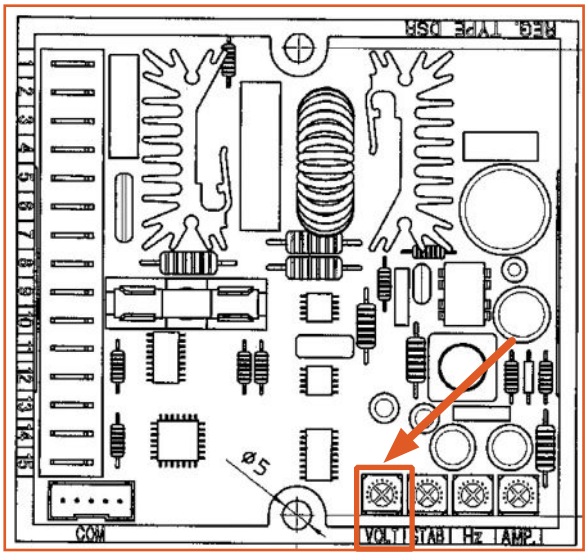


Set Voltage

Set voltage by adjusting trim pot in the DSR digital regulator. There are four trim pots along the side of the controller (see image and diagram below). The voltage trim pot is extremely sensitive. Simply applying pressure to the trim pot, apparently without movement, will result in a change in voltage. This adjustment will require two people: one to turn the trim pot and the other to watch the voltage meter on the DSE 3110.

1. Use a 10 mm nut driver to remove the control board panel. There are four (4) fasteners, one (1) at each corner.
2. Use a small flat-blade screw driver to adjust the VOLT trim pot. It is very sensitive. Do not adjust any of the other trim pots.
3. After making and adjustment that brings the voltage into spec, let the generator run for a 5-10 minutes to ensure that the trim pot adjustment has stabilized. Once stability of the setting has been confirmed reassemble the regulator panel.





Generator DSE 3110 Control Module Fault Icons

Generator faults are reported on the generator control module. The list below provides a description of the fault that is reported as an icon on the DSE 3110 display. For a full description of the fault and solutions see DSEULTRA DSE3000 Series Control Module Manual.

ICON	DESCRIPTION	
	AUXILIARY INPUTS	Auxiliary inputs can be user configured and will display the message as written by the user.
	FAIL TO START	The engine has not fired after the preset number of start attempts
	FAIL TO STOP	The module has detected a condition that indicates that the engine is running when it has been instructed to stop. **⚠NOTE:- 'Fail to Stop' could indicate a faulty oil pressure sensor - If engine is at rest check oil sensor wiring and configuration.**
	LOW OIL PRESSURE	The module detects that the engine oil pressure has fallen below the low oil pressure pre-alarm setting level after the *Safety On* timer has expired.
	ENGINE HIGH TEMPERATURE	The module detects that the engine coolant temperature has exceeded the high engine temperature pre-alarm setting level after the *Safety On* timer has expired.
	UNDERSPEED	The engine speed has fallen below the underspeed pre alarm setting
	OVERSPEED	The engine speed has risen above the overspeed pre alarm setting
	CHARGE FAILURE	The auxiliary charge alternator voltage is low as measured from the W/L terminal.
	LOW FUEL LEVEL	The level detected by the fuel level sensor is below the low fuel level setting.
	BATTERY UNDER VOLTAGE / BATTERY OVER VOLTAGE	The DC supply has fallen below or risen above the low/high volts setting level.
V↓	GENERATOR UNDER VOLTAGE	The generator output voltage has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
V↑	GENERATOR OVER VOLTAGE	The generator output voltage has risen above the pre-set pre-alarm setting.
Hz↓	GENERATOR UNDER FREQUENCY	The generator output frequency has fallen below the pre-set pre-alarm setting after the *Safety On* timer has expired.
Hz↑	GENERATOR OVER FREQUENCY	The generator output frequency has risen above the pre-set pre-alarm setting.
ECM	CAN ECU WARNING CAN ECU SHUTDOWN	The engine ECU has detected an alarm – CHECK ENGINE LIGHT **Contact Engine Manufacturer for support.**
CAN	CAN DATA FAIL	The module is configured for CAN operation and does not detect data on the engine Can datalink.
	EMERGENCY STOP	The emergency stop button has been depressed. This a failsafe (normally closed to battery positive) input and will immediately stop the set should the signal be removed. Removal of the battery positive supply from the emergency stop input will also remove DC supply from the Fuel and Start outputs of the controller. **⚠NOTE:- The Emergency Stop Positive signal must be present otherwise the unit will shutdown.**
	MAGNETIC PICKUP FAILURE	Pulses are no longer being detected from the magnetic pickup probe (3110-xxx-01 magnetic pickup version only)
	INTERNAL MEMORY ERROR	Either the configuration file or engine file memory is corrupted. Contact your supplier for assistance.

RMK Troubleshooting

RMK Status Indicator Light Not Illuminated When PRO-Verter Powers Up

Cause
Power failure or RMK malfunction

Solution
1. With the PRO-Verter on, measure voltage at the RMK power source (see PRO-Verter 5000 Operator Manual) and at an Inter-Connect port on the PRO-Verter.

    a. If the voltage is not similar to the battery bank voltage, the problem is with the PRO-Verter.

    b. If the voltage is similar to the battery bank voltage, continue with the next step.

2. Disconnect the RMK from the PRO-Verter and remove the RMK circuit board from its enclosure. **The RMK circuit board could be damaged by electrostatic discharge. Perform this operation in an electrostatic-safe environment.**

3. Remove and reinsert the coin cell battery. Reconnect the RMK to the PRO-Verter.

Cannot Communicate with RMK

Conditions Observed or Possible Causes or Inability to Communicate with RMK
Possible Causes
A. RMK does not have green light
B. RMK has not been at green light status for at least 5 minutes
C. Computer has more than one network interface set up (e.g., Wi-Fi and Ethernet)
D. Incorrect network settings in RMK interfaces file
E. No gateway set up in interfaces file on RMK or no gateway set up on DHCP server

Solution A
See solution for RMK Status Indicator Light Not Illuminated When PRO-Verter Powers Up.

Solution B
Wait for RMK to be green light for at least 5 minutes and retry.

Solution C
Disable all network interfaces except the one being used to communicate with the RMK.

Solution D
1. Verify interfaces file is in folder matching serial number.
2. Verify interfaces file does not have ASCII 10 and ASCII 13 characters at the end of any lines.
3. Verify that interfaces.bak file is being created on the USB drive after the copy process.
4. Verify the correct sequence of steps is being executed to install the file.

Solution E

1. If not using DHCP, add this line under the netmask (where [host name] is the DNS name or IP address of the gateway):
   gateway [host name]

2. If using DHCP, consult the documentation for the DHCP server.

Status Light Stays Orange after Inserting USB Drive

Cause

RMK automatically copying large number of log files to USB drive

Solution

If the data are required, wait. Otherwise, purge the log files. Contact your Field Service Representative for assistance with purging log files.

Water Intrusion—Prevention and Remediation

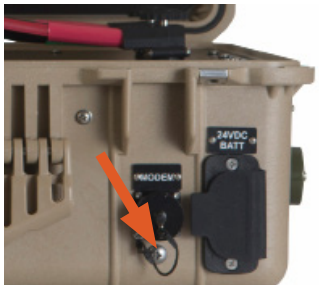
⚠ WARNING

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

- Lids on the Power Hub 2500 and the PRO-Verter should be closed whenever possible while the System is operating to prevent water and dust from entering the System.

- If water intrusion is suspected, and the System is still functional, disconnect power sources entering that component from the most distant location possible, power down the System (turn off the power switches on all of the System components) and then disconnect the component from the System. Do not to try to remove what may be a flooded component while it is still powered up.

- Remove the screw from the drain hole at the bottom edge of the component case. If water flows out of the drain hole after removal of the plug, let it flow until it stops. Then slightly and slowly tilt the case toward the drain hole to remove any remaining water. Continue to increase the angle of the component slowly until no more water drains from the hole. After the water has been drained, move the component to a safe dry location and remove the Faceplate. Place the component in the most dry environment possible for a time long enough that any remaining moisture inside will dry. When it is dry, reintegrate the component to the System and test it to determine if it is still functional.

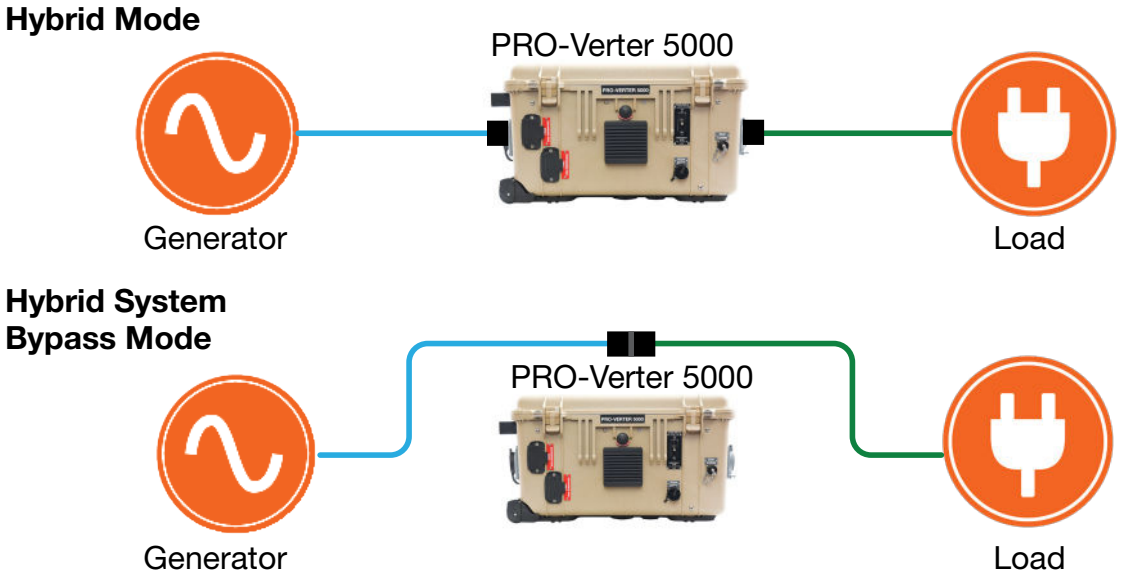


Inter-Connect Strips and Water Intrusion

The Inter-Connect Strip 7 is a DC bus for the entire System and should be placed in a protected and dry location to minimize the possibility of water intrusion. If water enters the Strip, power down the System and tilt the strip so that the drain hole (below; arrow) is a the lowest point.

Hybrid System Bypass Mode

Bypassing the Hybrid Power System may be helpful if the HPS is temporarily inoperable.



Disconnect the AC Power Cables (input–blue; output–green) from the PRO-Verter then connect and lock these two cables together.

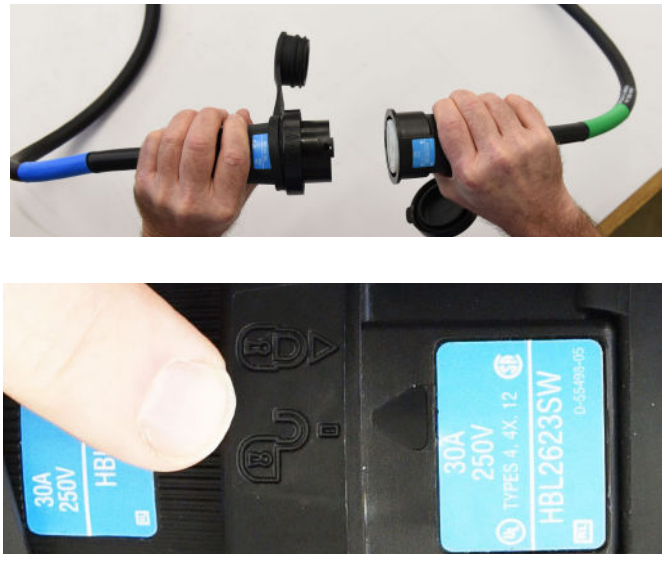


Figure 8. Hybrid Power System bypass connection

ABOUT SOLAR STIK, INC.

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

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

Solar Stik Training and Education

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

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

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

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