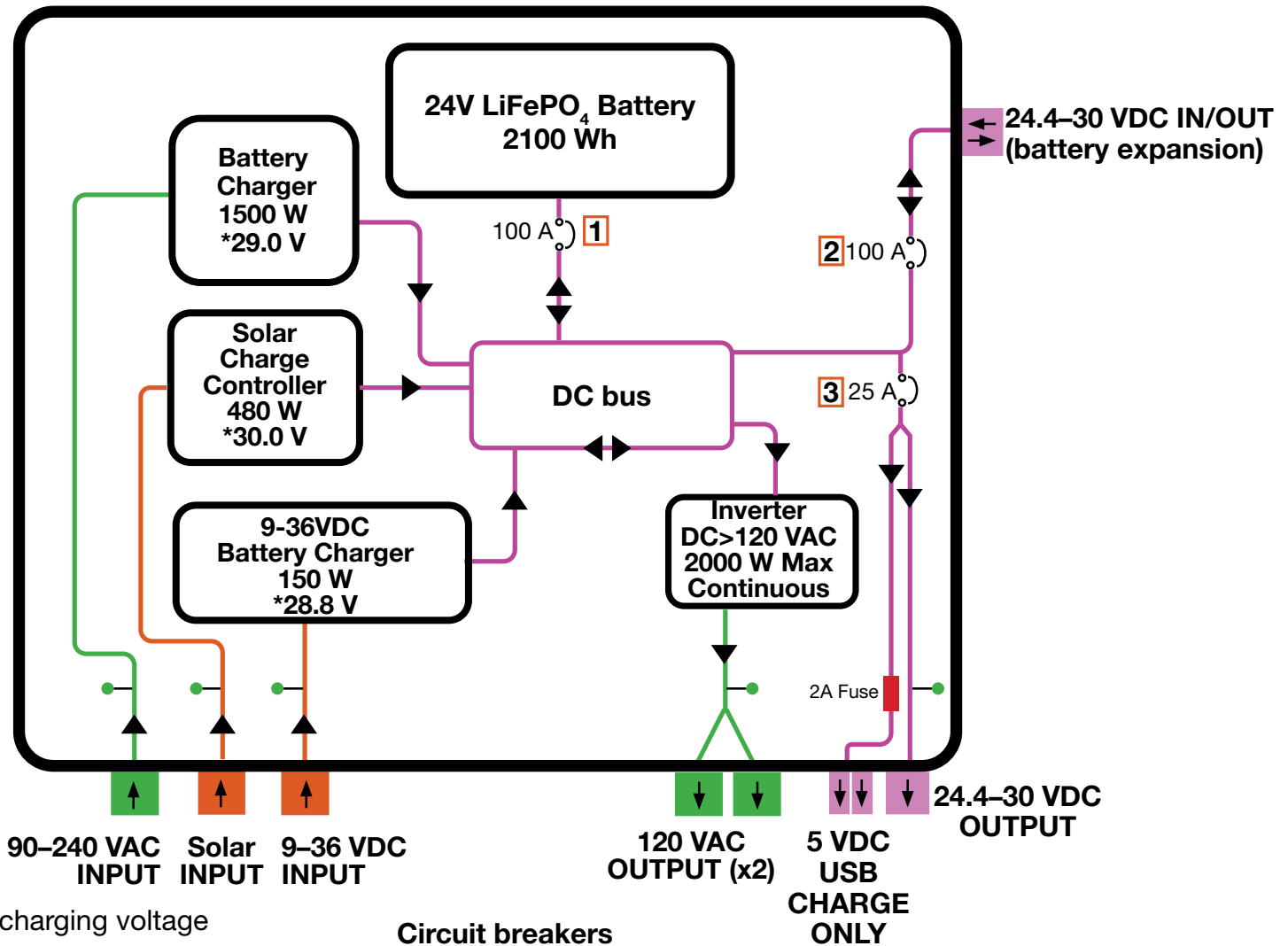# Quick-start Guide
to Set Up, Operate, and Maintain the
24VDC Li BOS 2000-120

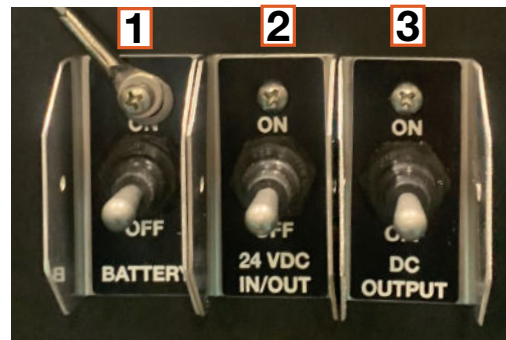P/N: 20-0205199 Rev-

BOS 2000-120-5199 Electrical Circuits

24V LiFePO$_4$ Battery
2100 Wh

Battery Charger
1500 W
*29.0 V

Solar Charge Controller
480 W
*30.0 V

9-36VDC Battery Charger
150 W
*28.8 V

DC bus

Inverter
DC>120 VAC
2000 W Max Continuous

24.4–30 VDC IN/OUT
(battery expansion)

100 A [1]

[2] 100 A

[3] 25 A

2A Fuse

90–240 VAC INPUT

Solar INPUT

9–36 VDC INPUT

120 VAC OUTPUT (x2)

5 VDC USB CHARGE ONLY

24.4–30 VDC OUTPUT

* Programmed battery charging voltage

- LED circuit activity indicator
- Circuit breaker location
- 24 VDC bus circuit
- AC circuits
- Unregulated DC power input

Circuit breakers

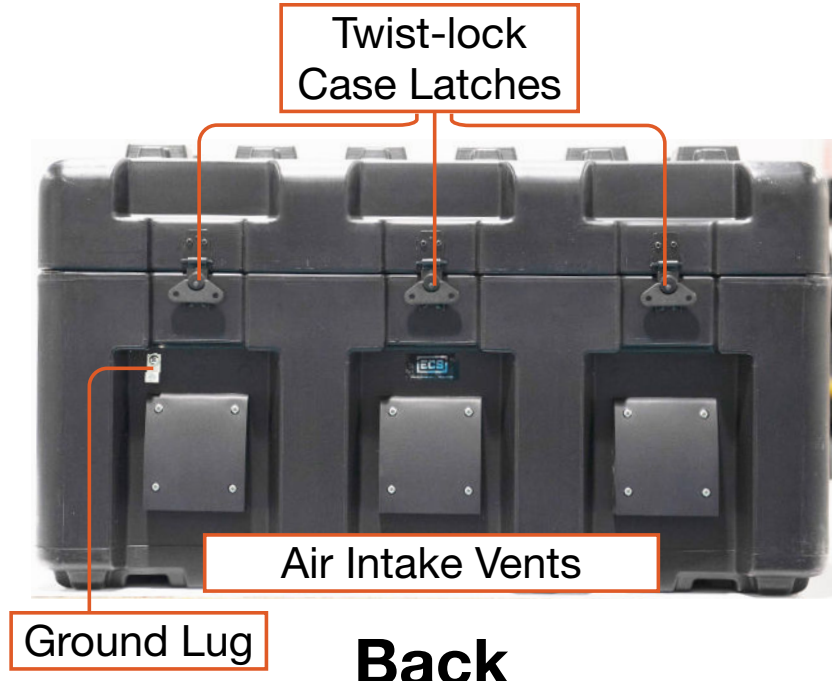[1] BATTERY
[2] 24 VDC IN/OUT
[3] DC OUTPUT

Numbers over breakers correspond to numbered breaker locations on diagram above.

2

Feature and Connections

Twist-lock Case Latches

QR Code link to this document

Operator Instructions and Specs

Operator Instructions

Power Input Connectors

Power Output Connectors

Data Port

Circuit Breaker Switches

Battery Status Monitor and Display Refresh Switch
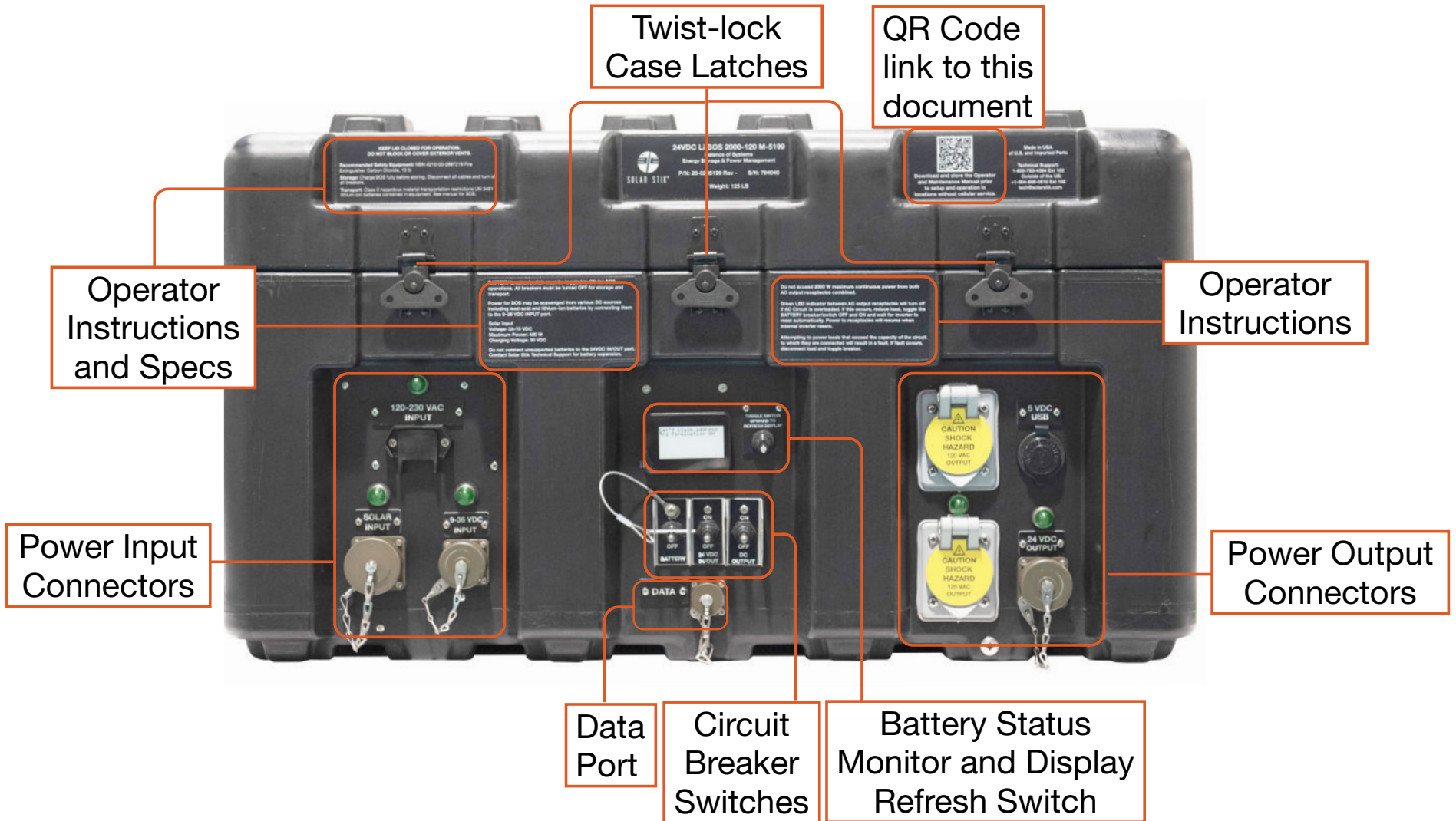
Front

Feature and Connections

Right Side

Twist-lock Case Latches

Auto-stowing Lift Handles

Air Exhaust Vent

24 VDC IN/OUT (energy storage expansion)

Back

Twist-lock Case Latches

Air Intake Vents

Ground Lug

Left Side

Twist-lock Case Latches

Auto-stowing Lift Handles

Air Exhaust Vent
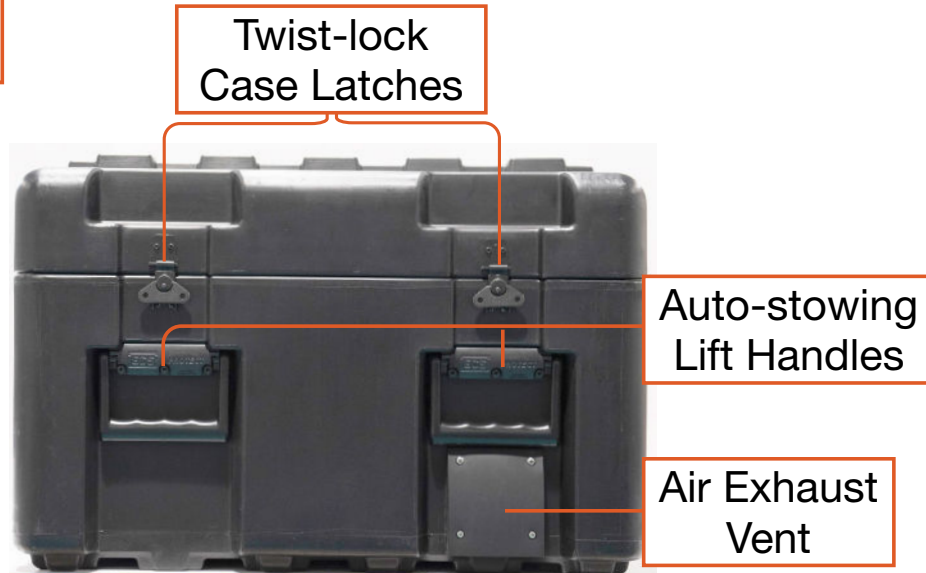
BOS Electrical / Power Connections

Power OutputConnectors

USB 5 VDC (x2): These ports are for charging only, no data.

120 VAC 2000 W continuous combined

24 VDC Output:
Pin A (+)
Pin B (-)
Pin C (unused)
DC output voltage is equal to DC bus/battery voltage.

24 VDC 30 A
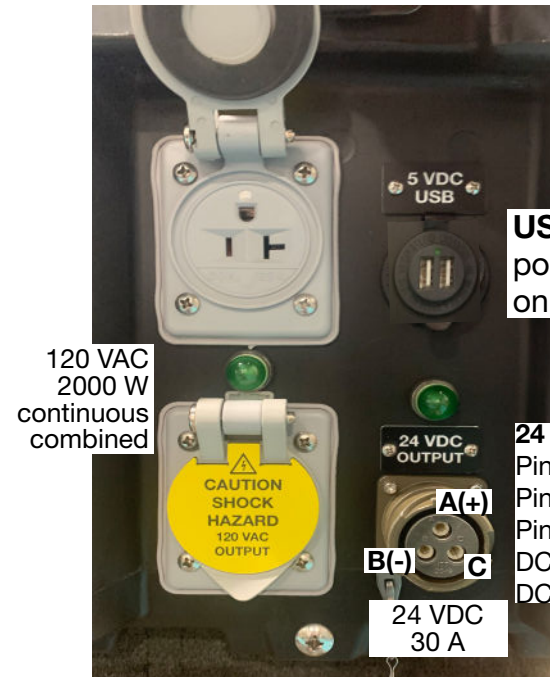
DATA connector provides CAN bus connection to internal battery (custom cable required; not i part of Operator-level maintenance).
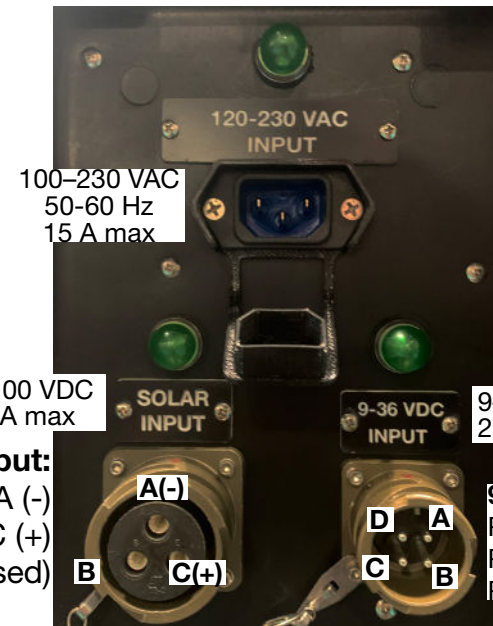
Power Input Connectors

100–230 VAC 50-60 Hz 15 A max

33–100 VDC 30 A max

9–36 VDC 20 A max

Solar Input:
Pin A (-)
Pin C (+)
Pin B (unused)

9–36 VDC Input:
Pin A (-)
Pin C (+)
Pins B & D (unused)

AC Input Limit Switch

The purpose of this switch is to prevent the BOS AC-powered battery charger from drawing more current than an AC power source can supply. If the setting chosen is too high, the BOS will overcurrent the power supply and trip the associated AC power supply breaker. For example, if a generator can provide 900 W (typical for a 1 kW generator), choose the 600 W setting because the 1000 W setting may overcurrent the generator. If an AC power source experiences an overcurrent fault at a given setting, choose a lower setting. Note that lower settings also provide less charging power to charge the internal battery, so charging will be slower.

To access the AC Input Limit Switch, remove the BOS lid by unlatching the ten (10) twist-lock latches.

There are three (3) potential settings. Choose the highest setting that does not exceed the power (watts) that can be supplied by the AC power source.

Top-down view of the AC Input Limit Switch located under the lid of the BOS.

AC INPUT
POWER LIMIT

600 W
120/208 VAC

1000 W
120/208 VAC
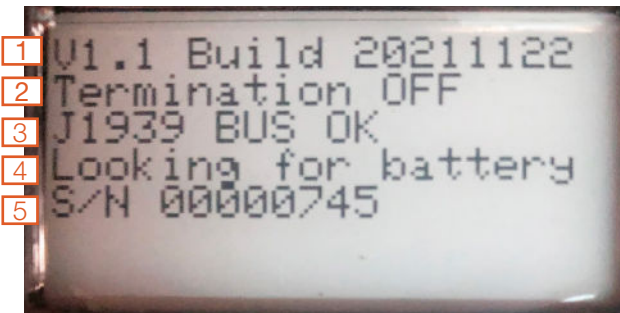
1100 W (120 VAC)
1500 W (208 VAC)
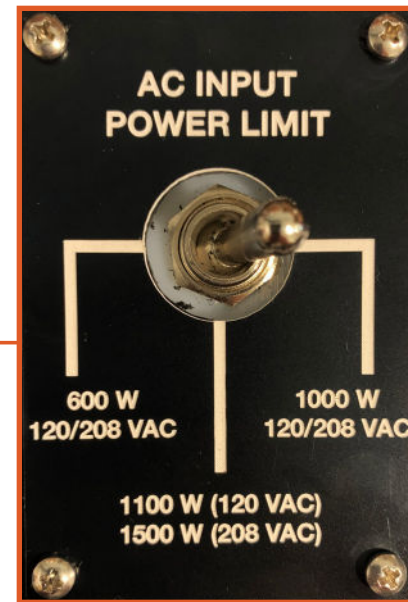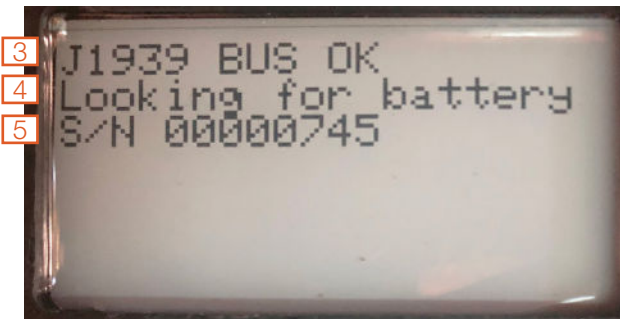
Battery Status Display Startup and Home Screen

Battery Status Monitor Startup Screens

These two screens scroll by automatically during startup, before the final status screen is populated. This is the location where the firmware version is documented. For more information on the firmware, contact Solar Stik Technical Support.
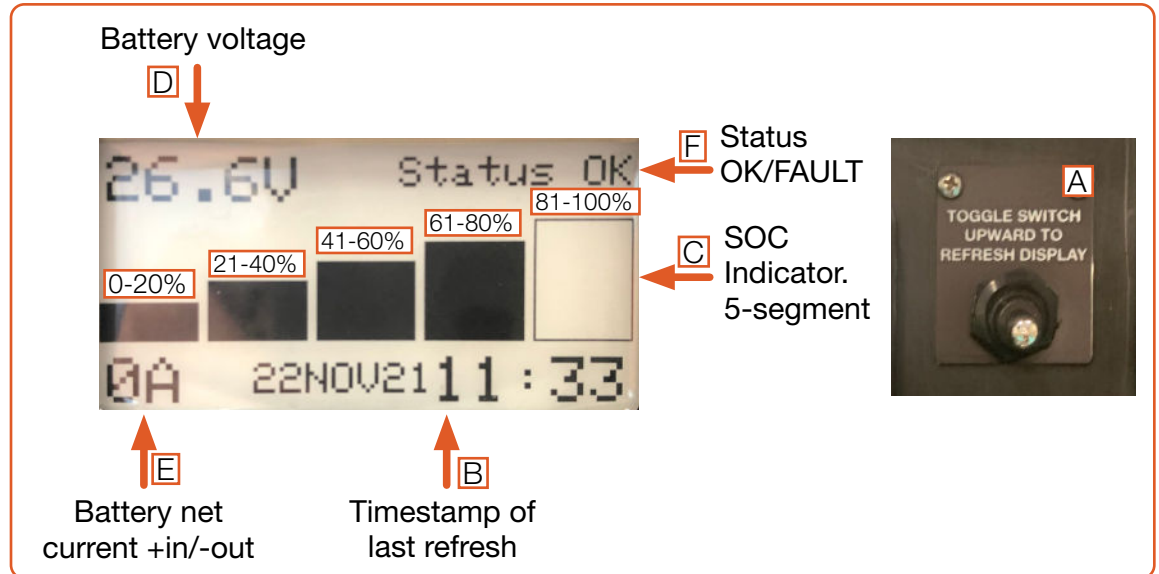
Screen 1

1 V1.1 Build 20211122
2 Termination OFF
3 J1939 BUS OK
4 Looking for battery
5 S/N 00000745

Screen 2

3 J1939 BUS OK
4 Looking for battery
5 S/N 00000745

1. Firmware version and date
2. CAN bus auto-termination status
3. CAN bus communication operational
4. Connecting to battery comms
5. Battery serial number

Battery voltage — D

Status OK/FAULT — F

SOC Indicator. 5-segment — C

26.6V   Status OK

81-100%
61-80%
41-60%
21-40%
0-20%

0A   22NOV21 11:33

Battery net current +in/-out — E

Timestamp of last refresh — B

A — TOGGLE SWITCH UPWARD TO REFRESH DISPLAY

A. During normal operation, the display is updated automatically at intervals of three (3) minutes. The DISPLAY REFRESH momentary toggle switch can be toggled and held to update the display during normal operation. The REFRESH DISPLAY switch must be toggled and held until the home page is completely repopulated. If the button is released too soon, the display will not populate. If this happens, wait five (5) seconds, toggle and hold switch until home page is repopulated.
B. A timestamp for the last "refresh" is updated and displayed, whether it occurred automatically or by toggling the refresh switch.
C. The SOC is reported visually by a five-segment "fuel gauge". Each segment represents 20% increments up to 100%.
D. Nominal voltage = 26.4 VDC; voltage @ 100% SOC ≈ 30.4 VDC; voltage @ 0% SOC ≈ 20.0 VDC.
E. The net current (A) with respect to the battery is positive when the BOS internal battery is charging and negative when discharging.
F. If / when a battery fault occurs, the word "FAULT" appears in the upper right corner of the display. If the fault is unattended for three (3) minutes, "FAULT" appears in large font, filling the screen. If the fault is not corrected within 60 minutes, the BOS will enter storage mode even with the POWER switch in the ON position.

Additional information about the fault can be found on the second "page" (diagnostic screen) of the Battery Status Display, which is accessed by toggling the Display Refresh switch twice in succession.

BOS 2000-120 Operator Instructions

BOS Setup

1. Ensure all breakers are OFF before connecting anything to BOS.
2. Set AC Input Limit Switch. Choose the highest setting that does not exceed the AC power (watts) available from the source (e.g., generator, shore power, etc.).
3. Connect peripherals to be used as part of System (e.g., grid power, solar array, generator, AC and/or DC loads). **Note:** Do not exceed load limits listed on placards and Specifications and elsewhere in this document.
4. Turn on BATTERY breaker to activate the BOS. **Note:** BATTERY breaker must be ON for BOS to operate normally.
5. After the battery startup info has finished, toggle Battery DISPLAY REFRESH switch to update Battery Status Monitor.
6. Toggle ON circuit breakers necessary to support all connected peripherals. Green LEDs above connectors will illuminate when circuit is powered.

BOS Discharging and Charging

Discharging (supporting loads)
Battery-only Run Times
The BOS internal battery stores 2.1 kWh of energy when fully charged. Starting with a brand new battery, fully charged, the BOS can support a 200 W load for ~ ten (10) hours, a 500 W load for ~ four (4) hours, or a 2000 W load for ~ one (1) hour. These times will decrease as the internal battery ages and loses storage capacity. This is normal for all batteries.

Low-voltage Cut Off (LVCO)
The BOS will disconnect AC loads, DC OUTPUT port, and USB charging port when the internal battery voltage drops to 24.4. If this occurs, charge BOS immediately. Power will return to loads automatically when battery voltage is $\geq$ 25.4.

Charging
Connect active AC and/or DC power source(s). Toggle ON corresponding power input breakers. **Note:** Lower AC INPUT LIMIT settings will increase the time required to charge the internal battery. Likewise, supporting loads while charging will also increase the time required to charge battery fully.

- **120–240 VAC Charging**: 1500 W; minimum charge time from empty is ~ 1.5 h.
- **Solar Charging**: 580 W max; minimum charge time from empty is ~ 3.5 h. Charging will begin when sufficient sunlight is present. Solar power charging speed is a function of connected solar array power output.
- **9–36 VDC Charging**: 150 W; minimum charge time from empty is ~ 14 h.

Internal battery is charged fully when charging current approaches zero (0) A (see battery status sections of this document).

Operation Considerations

Tips for successful operation:

- Attempting to power loads that exceed the capacity of the circuit to which they are connected will result in a fault. If a fault occurs, reduce the load and reset breaker as applicable. The inverter (AC output) will reset automatically after the load is reduced and the inverter cools.
- LEDs associated with AC and DC INPUT connectors will illuminate when a power source is connected. To determine the amount of power processed via each input circuit, disconnect all loads from the BOS and view the voltage and current (amps) readings on the Battery Status Monitor (volts x amps = watts). Refresh Battery Status Monitor for most up-to-date reading.
- BOS autonomous run time (supporting loads without a connected charging source) will vary according to load power demand. For example, a fully charged BOS will support a 2000 W load for ~1 hour, a 500 W load for ~4 hours or a 20 W load for ~100 hours. Ambient temperature and battery state of health also affect autonomous run time.
- Do not connect lead-acid batteries or other types of Li-ion batteries to DC IN/OUT port. Contact Solar Stik Technical Support for the necessary information for energy storage expansion.
- Orient solar panels for optimal daily sun exposure.
- Power for the BOS may be scavenged from various DC sources including lead-acid and Li-ion batteries by connecting them to the 9-36 VDC INPUT port.
- Shade the BOS to reduce the possibility of derating due to solar loading. High heat will reduce performance and shorten battery life.

Notice
• For information on expanding BOS energy storage capacity, contact Solar Stik.
• Do not connect lead-acid batteries to BOS.
• The BOS should be shaded from direct sun exposure and sheltered from the elements as much as possible during operation.
• Keep the case lid and connector covers closed when not in use to prevent water and dust intrusion.
• Check the integrity of electrical connectors on a monthly basis.
• Do not block air vents on case exterior. Clean or replace air filters for optimum cooling.

Battery Warnings and Faults Notifications
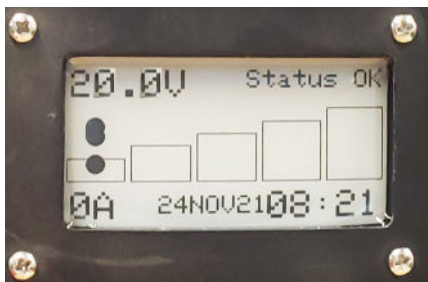
An exclamation mark ("!") will appear in the left-most bar when SOC drops to 0% (top left).


If/when an internal battery fault occurs, the word "FAULT" appears in the upper right corner of the display. If the fault is unattended for three (3) minutes, "FAULT" appears in large font, filling the screen (left). If the fault is not cleared within 60 minutes, the BOS will enter storage mode even with the POWER switch in the ON position.

Additional information about the fault(s) can be found on the second page of the Battery Status Monitor (diagnostic screen).

Diagnostic Screen

To access the diagnostic screen, toggle the refresh switch once to refresh display then a second time for the diagnostic screen. The image below is an example of the information on the diagnostic screen that is present when the BOS is operating normally. The SOC value range of a new BOS will narrow as the battery cycles.
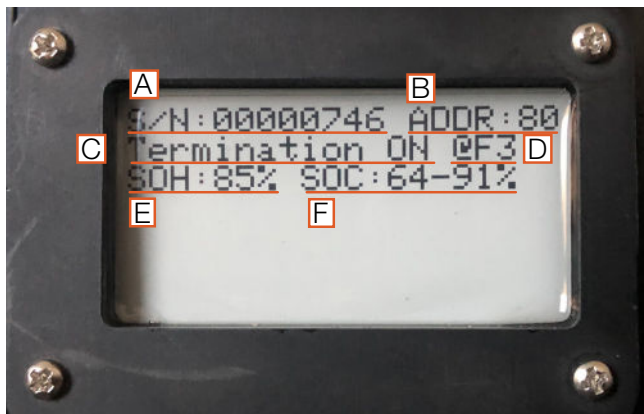
A. Battery serial number
B. CAN address for Battery Status Monitor
C. CAN bus termination status of battery
D. CAN address of battery
E. State of health
F. State of charge

BOS Internal Battery Troubleshooting

Frequent visual monitoring of BOS Battery Status Display is the best method to ensure each battery is operating normally. If a NOTIFICATION or FAULT is displayed on the screen, take the prescribed corrective action to clear it.

Notifications and Faults

Notifications and fault details are found on the diagnostic screen. To access the diagnostic screen, toggle the refresh switch once to refresh the display, then a second time for the diagnostic screen.

Notifications

Battery Offline – This notification indicates that the Battery Status Monitor lost communication with the battery. It may have taken itself offline to protect from overdischarge. Toggle the POWER switch to clear the notification. If the notification doesn't clear, apply a charging source for at least two (2) minutes. If this fails to clear the notification, contact Solar Stik.

Battery Voltage Low – "Battery voltage low" notification occurs when the BOS battery voltage falls below 20 VDC. It is only a notification. It does not cause the battery to shut off. This notification automatically clears after charging brings voltage to > 20 VDC.

Faults

The battery may report one or more faults at a time on the diagnostic screen. If a condition other than the ones shown below appears, contact Solar Stik for assistance. Faults place the BOS into Protected mode until the fault is corrected and the BOS returns to Operational mode. If the fault is not cleared in 60 minutes, the BOS will enter Storage mode even if the POWER switch remains in the ON position.

Faults reported on diagnostic screen and solutions

Fault Name	Value Exceeded	Clear Value
Critical Cell Overvoltage for 2 minutes	Max Cell V ≥ 4.2000 V	Max Cell V < 3.8000 V
Critical Cell Undervoltage	Cell Voltage ≤ 2.00 V @ ≤ 120 A discharge (battery voltage ≤ 16.0 VDC)	Automatically clears fault one time after 2-minute delay. If fault occurs again without charging battery for 2 minutes, must clear by charging for 2 minutes or toggling the POWER switch ON>OFF>ON.
Critical Cell Temp High	Max Cell Temp ≥ 169 °F (76 °C)	Reduce Cell Temp to ≤ 149 °F (65 °C)
Critical Board Temp High	Max Elec Temp 1 or 2 ≥ 248 °F (120 °C)	Reduce Max Elec Temp to ≤ 194 °F (90 °C)
Hardware Overload	Current ≥ 3000 A	2-minute cool down, followed by toggling the POWER switch ON>OFF>ON
Fast Software Overload	Current ≥ 1500A 30 ms	2-minute cool down, followed by toggling the POWER switch ON>OFF>ON
Software Overload	Max Elec Temp 3 ≥ 275 °F (135 °C)	2-minute cool down, followed by reducing Elec Temp 3 to ≤ 194 °F (90 °C)

MAINTENANCE CHARGING INSTRUCTIONS

In-storage BOS Internal Battery Status Information

The Battery Status Monitor will display the last status acquired before the POWER switch was turned OFF. However, battery voltage will decrease during storage due to self-discharge. Toggle ON the POWER switch to update in-storage battery status.

Never store a BOS in a discharged state! Charge BOS fully before placing in storage.

Never store a BOS with the BATTERY switch in the ON position.

Temperature-dependent Self-discharge

The self-discharge rate increases as storage temperature increases. If the BOS is stored at temperatures above 90 °F (32 °C), then intervals between maintenance checks and / or charges should be reduced to three (3) months.

In-storage Battery Status Refresh: Voltage, SOC, and SOH

When the BOS BATTERY switch is OFF, the Battery Status Monitor will continue to report the last-recorded battery status; it does not refresh automatically during storage. The Battery Status Monitor must be refreshed to report the current status while in storage.

1. Toggle ON BOS BATTERY switch.
2. The Battery Status Monitor Screen will populate with up-to-date information. This will take ~ one (1) min. with the several startup tests / results displayed before the Status Monitor is populated.
3. Check voltage and SOC on Home screen.
4. Toggle the REFRESH DISPLAY switch again to move to the Diagnostic Screen to check SOH.

In-storage Charging

If charging at any temperature lower than 68 °F (20 °C) the internal battery may need to heat to charge optimally. The internal heater may require 650 W. The AC charging source provides 600 W, so the BOS internal battery may use stored energy in addition to the AC power source to heat itself, effectively draining the battery instead of charging. This situation will be apparent if the Battery Status Monitor reports a negative current value during the initial phase of charging and when there is no other load connected to the BOS.

1. Connect a power source to the BOS. AC power will charge fastest, then solar power, then power supplied from 9–36 VDC sources. **Note:** If the BOS battery was previously overdischarged, it will need to be connected to the charge source for at least two (2) minutes, or power-cycled (toggling POWER switch ON>OFF>ON) before charge current will begin to flow.
2. Enable the charging source and allow the BOS to charge. Remember, the battery may heat itself before charging if the BOS internal battery is colder than 68 °F (20 °C).
3. The BOS should continue to charge, balance, and taper until it reaches the voltage setpoint at less than 0.5 A. At this point the BOS can be considered to be fully charged.