



SOLAR STIK®

OPERATOR AND MAINTENANCE MANUAL FOR 24 VDC LI BOS 2000-120



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Revision History

Section	Page(s)	Description	Date
ALL		First draft	2024 APR 08

Important Product Safety Information and Instructions

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

While this product is designed for indoor/outdoor operation, the user interface (control panels) must not be exposed to rain, snow, moisture, or liquids. Close and latch and/or lock the cases when the equipment is unattended.

The equipment is field serviceable to a limited degree. If repair is needed, contact Solar Stik, Inc. or your field service representative (FSR) for assistance in diagnosis and identification of the proper repair and parts.

Exercise caution when handling or operating equipment. Live power may be present.

Safety Information Labels

Your safety and the safety of others is very important.

Always read and obey all safety messages.



This is the safety alert symbol. This symbol alerts you to potential hazards that can kill you or hurt you and others. All safety messages will follow the safety alert symbol and the word “DANGER”, “WARNING”, or “CAUTION”. These words are defined as:



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

All safety messages will tell you what the potential hazard is, tell you how to reduce the chance of injury, and tell you what can happen if the instructions are not followed.

Limitations on Liability

Since the use of this manual and the conditions or methods of operation, use, and maintenance of this product are beyond the control of Solar Stik, this company does not assume responsibility and expressly disclaims liability for loss, damage, or expense—whether direct, indirect, consequential, or incidental—arising out of or anyway connected with such operation, use, or maintenance.

Due to continuous improvements and product updates, the images shown in this manual may not exactly match the unit purchased.

This equipment **CAN BE USED FOR CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT** or devices; however, without limiting the generality of the foregoing, Solar Stik makes no representations or warranties regarding the use of the System in connection with life support systems or other medical equipment devices.

Fire Hazard

Fire Types

Class A fire - Fires in ordinary combustibles such as wood, paper, cloth, trash, and plastics.

Class B fire - Fires in flammable liquids such as gasoline, petroleum, oil, and paint.

Class C fire - Fires involving energized electrical equipment such as motors, transformers, and appliances. Remove the power source and the class C fire becomes a class A or B fire.

Recommended Fire Extinguisher

NSN 4210-00-288-7219 Fire Extinguisher, Carbon Dioxide, 10 lb

Carbon dioxide is a liquefied gas, which is highly effective fighting class B and C fires. These extinguishers are ideal for areas where contamination and/or cleanup are a concern, such as data processing centers, labs, and telecommunication rooms.

⚠️ WARNING

Only CO₂ (carbon dioxide) fire extinguishers should be used with Solar Stik equipment.



Using the Fire Extinguisher

When using the extinguisher on a fire, remember PASS:

Pull the pin.

Aim the nozzle or hose at the base of the fire from a safe distance.

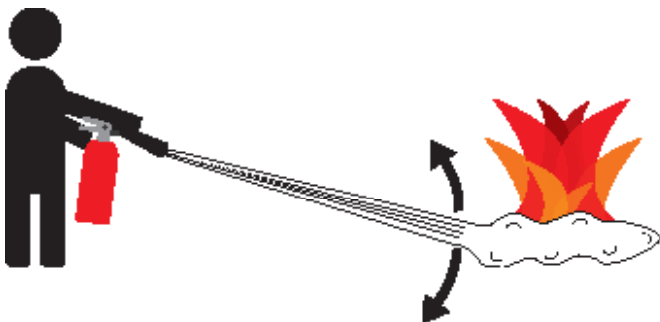
Squeeze the operating lever to discharge the fire extinguishing agent.

Sweep the nozzle or hose from side to side until the fire is out. Move forward or around the fire as the fire diminishes.

Watch the area for reignition until the cause has been fixed.

These additional cautionary steps will ensure your safety:

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



Use Sweeping Motion

Electric Shock Hazard



WARNING

The [product] is NOT GFCI protected.

DON'T LET THIS BE YOU!



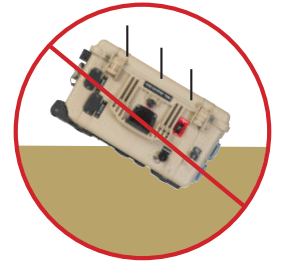
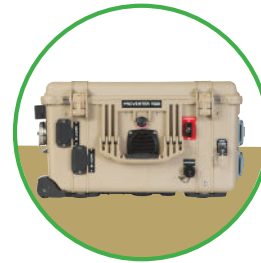
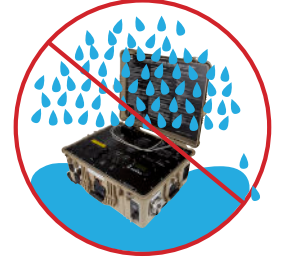
HIGH VOLTAGE: System components, solar arrays, and generators may produce lethal line voltages. Extreme care should be taken to protect against electrocution. Always work with another person in case an emergency occurs. Disconnect power before performing maintenance. Wear safety glasses whenever working on any part of a System that requires exposure to mechanical or direct electrical contacts.

Environmental and Handling Precautions

All Solar Stik components are ruggedized, yet there are a few things the operator can do to prevent failures and prolong the operational life of the product.

Water

- All Solar Stik equipment is designed for outdoor operation, even during periods of inclement weather.
- If outdoor operation is necessary, the lids of all components should be closed and latched whenever possible.
- The user interfaces (inside Faceplates or panels) are NOT waterproof. However, they can withstand light exposure to moisture for short durations (dew, mist, light rain).
- Do not operate equipment in or around standing water.
- Do not lay power distribution cords (extension cords) in standing water.

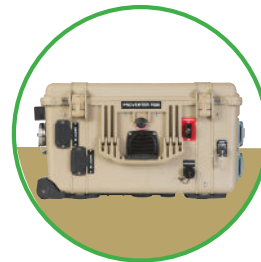


Impact

- All Solar Stik equipment is ruggedized for punishing conditions; however, as a general rule, hard impacts should be avoided.
- Equipment should not be dropped onto hard surfaces at a height greater than one foot when transporting or during operation.

Dust

- All Solar Stik equipment is designed for operation in climates where high levels of dust or other particulates may exist.
- Air intake filters should be cleaned once per month, or more frequently when conditions warrant.
- As a general rule, minimize exposure to high levels of particulates by exercising common-sense placement.



Heat

- Heat and solar loading reduce efficiency and life expectancy. Shade products (except solar panels) to prevent the negative effects of heat.



The Inter-Connect System

The Solar Stik System is comprised of three distinct types of technologies:

- Energy Storage
- Power Management
- Power Generation

All of the individual Solar Stik components that operate in these categories utilize a unique connection architecture, known as the Inter-Connect Circuit.

The Inter-Connect Circuit is the skeletal backbone of the Solar Stik System's DC power network, and it uses a simple, polarized, locking connection that is common throughout the architecture. All Solar Stik components, including Power Managers, Energy Storage, and Generation are compatible with the Inter-Connect Circuit.

Using a common, polarized connector allows rapid "Plug & Play" scaling of components, adaptability of capabilities within the architecture, technology-refreshment, and swapping of components when conditions warrant.

Communicating Voltage

All Solar Stik components that operate on the Inter-Connect Circuit use one value to successfully operate in concert – Battery Voltage.

The Inter-Connect Circuit communicates Battery Voltage to all of components on the network, allowing them to independently coordinate their respective functions. Voltage is used to trigger actions such as Automatic Generator Start/Stop (AGS) function, renewable power delegation, power distribution timing, and more.

The Importance Of Proper Setup

While there is no "unsafe" way to make connections using a common polarized connector, proper setup of the Inter-Connect Circuit is critical in order to properly communicate Voltage to all points in the System, ensuring all of the components can operate in concert to provide seamless power.

Setup can also directly impact how power is metered in the network. Several Power Management devices such as Power Hubs and PRO-Verters will meter current as it flows through the circuit, providing critical real-time data for the operator that can be used to troubleshoot, verify system performance, and make programming/architectural changes based on evolving conditions. Consult the System Operator Manual for a connection schematic specific for a particular application.

Circuit Breaker Protections

The Inter-Connect network is protected from overloads and short circuits through a network of circuit breakers strategically placed throughout the circuit. It ensures that the potential for a reverse polarity connection within the circuit is minimized. If a problem occurs in a leg of the Inter-Connect Circuit, the affected leg will disconnect from the primary network, leaving the other circuits functioning. If a major failure occurs in the circuit, then the entire network will shut down.

The Inter-Connect Plug

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



Figure 1. Inter-Connect Plug

Li BOS 2000 Manual Overview

This guide is crafted to provide the user with a comprehensive understanding of the principles of operation, proper setup & use, operational tips, and safety procedures for the Li BOS 2000. Successful operation and maintenance depends on a complete understanding of how the BOS works, and how to effectively integrate the BOS into a given situation.

A BOS is a Balance of Systems, that includes power management and energy storage. As a module it includes a self-contained battery and the ability to charge and discharge the battery. The BOS is part of Hybrid Power Systems(HPS) that allow for scalable, and modular open architecture technology. The 24 VDC Li BOS provides multi-faceted power storage and management, and can manage several power sources at once including solar and AC power.

Some features of the 24VDC Li BOS 2000 include:

- 82 Ah (2.0 kWh) of energy storage capacity
- 100 A battery voltage output 1 AW MIL-STD-1275E
- 100 A Input/Output port for energy storage expansion/charging or optional accessories interface
- LiFePO₄ cell chemistry
- High cycle life > 3000 cycles (80% depth of discharge; at 25 °C)
- Networkable battery monitoring via J1939 CAN bus
- 5-stage State of Charge (SOC) indicator on Battery Status Display (only reads the internal battery)
- Battery built-in-test (BIT) at start up and operation
- Battery has internal protection for overcharge, over-discharge, overload and short circuit
- High energy density—twice that of lead-acid (double the energy for its weight)
- Rapid and deep discharges (can go to near 0% without damaging the cells)
- Rapid recharges
- AC charger accepts 15 A, 28.8 V of Universal AC power
- Solar charge controller accepts 20 A, 33.0- 100 V of DC power
- DC/DC converter accepts 9-36 V of DC power
- Multiple power scavenging capabilities to charge internal batteries
- Plug & Play connection
- Serves as a power filter/conditioner by cleaning up dirty power
- Internal circuit protections
- Two-person lift
- Inert and nonhazardous when 100% discharged
- Ruggedized for extreme conditions
- Transportable by land, sea, and cargo air
- Designed to MIL-STD-810H and ruggedized for operation in harsh environmental conditions

Specifications

General

Battery	LiFePO ₄
Nominal Voltage	24 VDC
Nominal Capacity	2.0 kWh (82 Ah)
Max Charge/Discharge Rate	100 A continuous
Self-discharge Rate*	<5% per month
Cycle Life*	≥ 3000 Cycles to 80% State of Health
Shelf Life*	<ul style="list-style-type: none"> • 5.6 years to 80% State of Health • 7.0 years to 75% State of Health
Battery Voltage Range	24.4 - 29.9 VDC (Programmable)
Internal cooling	Forced convections with internal fans; (2) Intake and (2) Exhaust
User Interface	E-Ink Display
AGS Compatibility	Honda
Case**	Pelican 1620
Transportation	UN3481 Lithium-ion battery contained in equipment
Warranty	1-year materials and workmanship

*@ 77 °F/ 25 °C

Charge Controller Specifications (@77 °F/25 °C)

Maximum PV Input Voltage	100 VDC
Maximum PV Input Current	20 A
Maximum PV Power	580 W
Efficiency	98% (peak)
Charging Voltage	29.5 V (Programmable)
Charging Stages	Bulk, absorb, float
Charge Control Method	Maximum Power Point Tracking (MPPT)

Inverter (@77 °F/25 °C)

Nominal AC Output Voltage	120 VAC
Rated Current	16.7 A AC
Output frequency and accuracy	60 Hz
Continuous Output Power	2000 W
Surge Power	4000 W
Input Voltage	24 VDC
Efficiency	>88%
Waveform	Pure Sine Wave

Safety

Battery and User	Multiple battery internal SW and HW protections
Breaker(s)	<ul style="list-style-type: none"> • (1) Battery Breaker (ON/OFF), 2P 100 A • (1) DC In/Out Expansion, 1P 100 A • (1) Solar Input, 1P 30 A • (1) 9 – 36 VDC Input, 1P 20 A • (1) Universal AC Input, 1P 15 A • (1) AC Output, 2P 20A • (1) DC Output, 1P 50 A
Fuse(s)	2A for USB output
Ground Fault	Grounding lug for connection to earth ground
Certifications	<ul style="list-style-type: none"> • UN 38.3 • Designed to MIL-STD-810H • Compatible with MIL-STD-1275E

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

Input Voltage	90-264 VAC
Input Frequency	47–63 Hz
Charging Stages	CC/CV
Continuous DC Output Current	42 A
Charging Efficiency	95%

Connections

Input(s)	<ul style="list-style-type: none"> • (1) 9-36 VDC, 150 W (Cannon CB2-18-10PC) • (1) Solar (2 SAE Connectors) • (1) Universal AC (Schurter 6100-3300-32)
Output(s)	<ul style="list-style-type: none"> • (1) 24 VDC, 50 A, 3P, Socket, Bayonet (MIL-SPEC) • (1) USB 5V, 2.1 A (type-A) • (2) 120 VAC, 20 A
Input/Output(s)	<ul style="list-style-type: none"> • (1) ESM Expansion, 24 VDC, 100 A (Deltran 224-0061-BK) • (1) Gen Comm port for generator interface • (1) Tech port for battery communication

Environmental

Operating Temperature***	-4 °F to 122 °F (-20 °C to +50 °C)
Storage Temperature****	-50.8 °F to 159.8 °F (-46 °C to 71 °C)

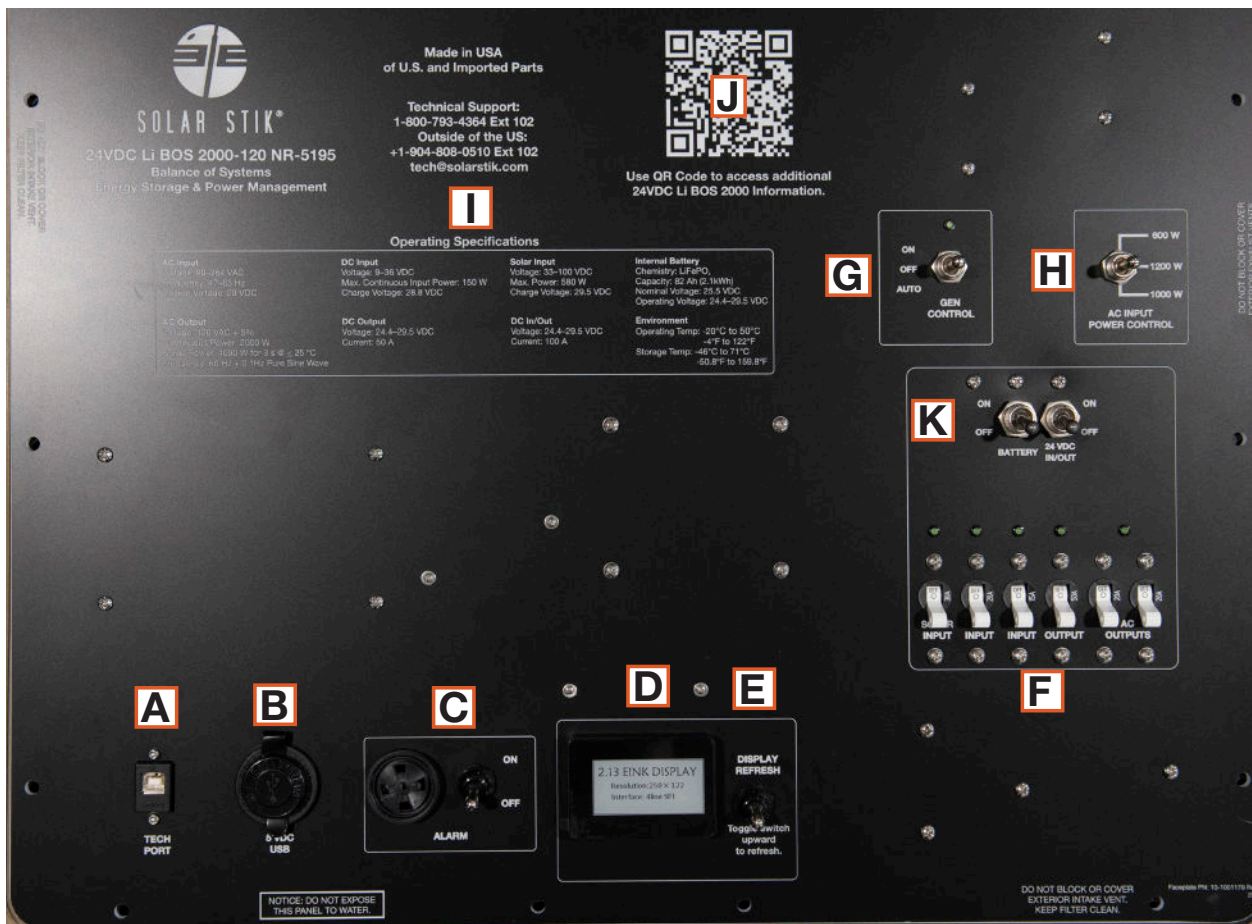
***Chargers derate above 30 °C

****Sustained high temperature storage will reduce battery life

Weights and Dimensions (L x W x H)

Weight	112 lb (50.8 kg)
Dimensions	26.0 x 19.6 x 13.9 in (66.0 x 49.8 x 35.3 cm)

BOS 2000-120 Faceplate

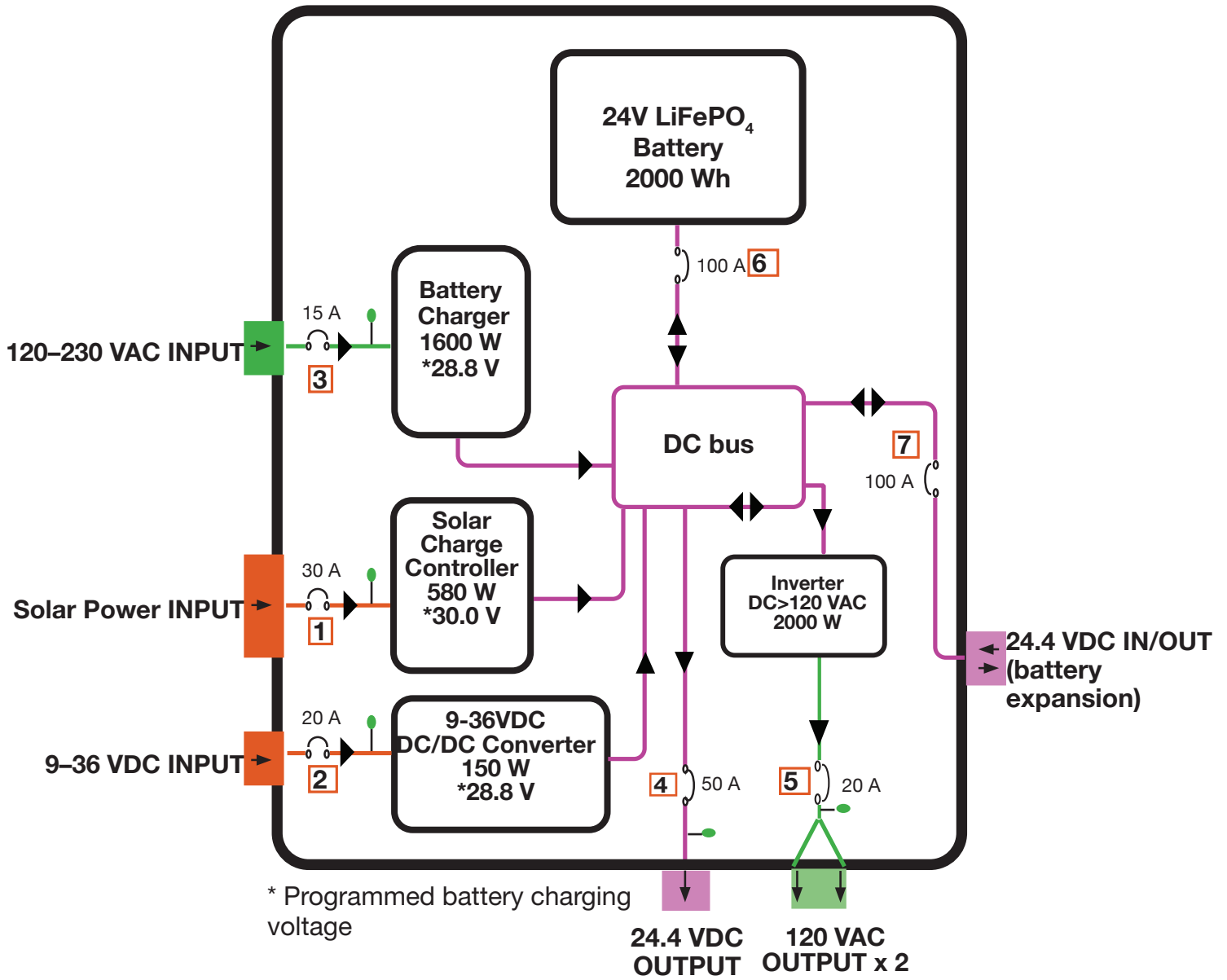







Information on BOS setup and operation is provided via a QR code on the BOS Faceplate

- A.** The Tech Port provides programming access to generator auto start/stop circuit. Contact Solar Stik for further information.
- B.** 5 VDC USB charging port does not transmit data (for device charging only).
- C.** AGS Alarm provides audible warning of pending generator start. Alarm may be silenced.
- D.** Internal battery status display reports battery voltage, current (A), state of charge, status (fault or OK), date, and time of day.
- E.** Battery status display refresh toggle switch
- F.** Breaker switch panel and circuit-activity LEDs.
- G.** Generator auto start/stop and manual-run switch. Programmed to work with Honda Generators only.
- H.** AC Input Power Control - Choose a setting that does not exceed the output, in watts, of the power source.
- I.** Operational specifications. Provides limits for BOS AC and DC circuits and internal battery specifications.
- J.** QR Code link to this manual
- K.** Battery ON/OFF toggle switch, 24 VDC IN/OUT ON/OFF toggle switch

Figure 2. BOS 2000 Faceplate

BOS 2000-120 Electrical Circuits



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

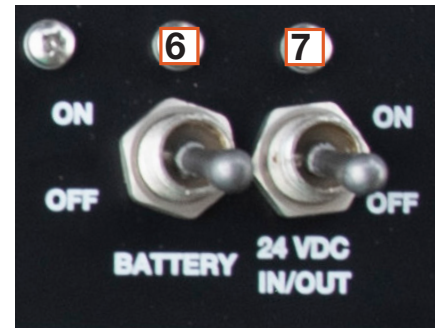
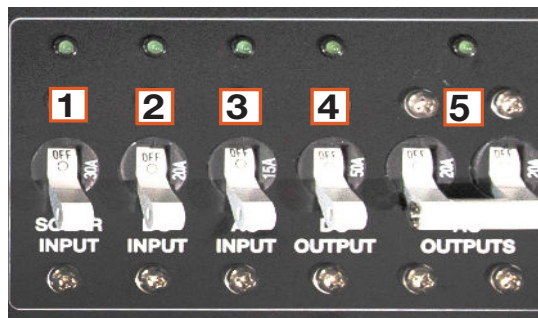


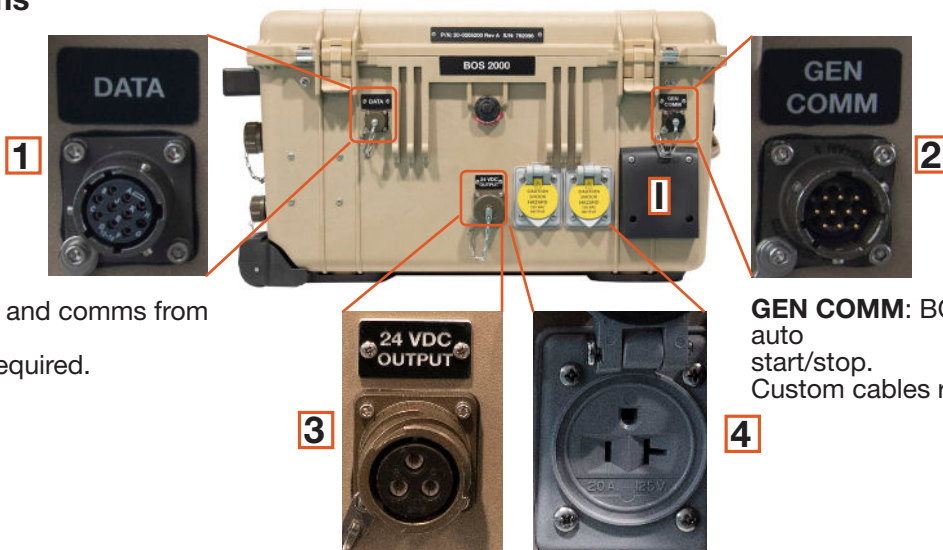
Figure 3. Diagram of internal BOS 2000 circuits

BOS Electrical / Power Connections and Ventilation

Power Input/Output Front Side



Data and Comms Front Side



DATA: CAN data and comms from internal battery. Custom cables required.

GEN COMM: BOS control of generator auto start/stop. Custom cables required.

24 VDC Output: DC output voltage is equal to DC bus voltage.

120 VAC Output: 2 Outputs at 120 VAC each

I = Air intake (vent has filter); E = Air exhaust (vent has no filter)

Description	Connector	Voltage	
1. DATA	P/N 07-1001636 Data Connector		
2. GEN COMM port for Generator Interface Auto Start/Stop	P/N 13-1000070 Gen Comm Connector for use with 1 kW and 2 kW Honda Generators		
3. 24 VDC OUTPUT	P/N 07-1001630 DC Output Conn 3P Socket, Bayonet	24 VDC	100 A
4. 120 VAC Output (2)	P/N 07-1001787 Connector, IEC 60309, 6H, 3 PIN	120 VAC	20 A

Power Input/Output Right Side



Power Input/Output Right Side



24.4 VDC
100 A max
2440 W max

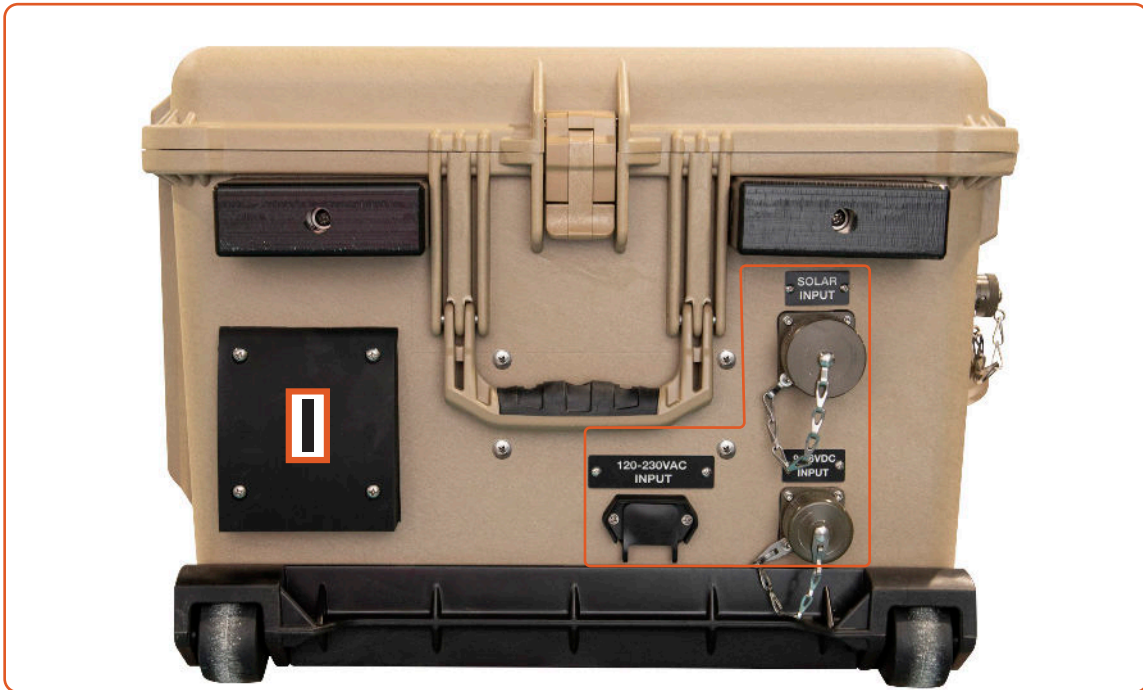


24 VDC
100 A
~2440 W

I = Air intake (vent has filter); E = Air exhaust (vent has no filter)

Description	Connector	Voltage	Amps
24 VDC IN/OUT	P/N 07-1000009 24VDC Marine Receptacle w/cover	24-29 VDC	100 A

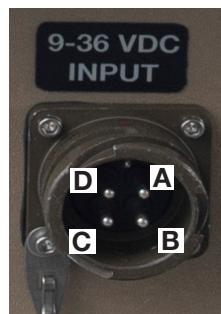
Power Input Left Side



Power Input



120–230 VAC, 50-60 Hz
15 A max
1600 W max



9–36 VDC
20 A max
150 W max



38 VDC
15 A max
580 W max

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

Description	Connector	Voltage	Amps
1. 120-230 VAC INPUT	P/N 07-1000023	120-230 VAC	20 A
2. 9-36 VDC INPUT	P/N 07-1001659 DC INPUT Connector	9-36 VDC	20 A
3. SOLAR INPUT	P/N 07-1000314 SAE Connector	30 VDC	30 A

Operation Instructions

BOS Connections and Activation

1. Ensure all breakers are OFF before connecting anything to BOS.
2. Connect peripherals to be used as part of System (e.g., grid power, solar array, Honda 1 or 2 kW generator, AC and/or DC loads). Use Cable 13-10000473, included with your BOS, to connect external AC power.
Note: Do not exceed load limits listed on Faceplate Specifications and elsewhere in this document.
3. Turn on BATTERY breaker to activate the BOS.
Note: BATTERY breaker must be ON for BOS to operate properly.
4. After the battery self tests have finished, toggle Battery DISPLAY REFRESH switch to update Battery Status Monitor.
5. Toggle ON circuit breakers necessary to support all connected peripherals. Green LED above breaker will illuminate when circuit is powered.

Notice
<ul style="list-style-type: none">• For information on expanding BOS 2000 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 form optimum cooling. Spare filters are attached to the inside of the BOS lid.

BOS Charging and Discharging

Battery-only Run Times

The BOS internal battery stores 2 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 ≥ 25.4 .

BOS Charging

Connect active AC and / or DC power source(s). Toggle ON corresponding power input breakers.

120–230 VAC Charging: 1600 W; minimum charge time from empty is ~ 1.25 h. If AC power source is a Honda generator use cable P/N 13-1000473 listed as cable, power, c13/5-15P, 125 VAC, 10', 14 AWG.

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 ~ 10 h.

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

Battery Status Display Home Screen

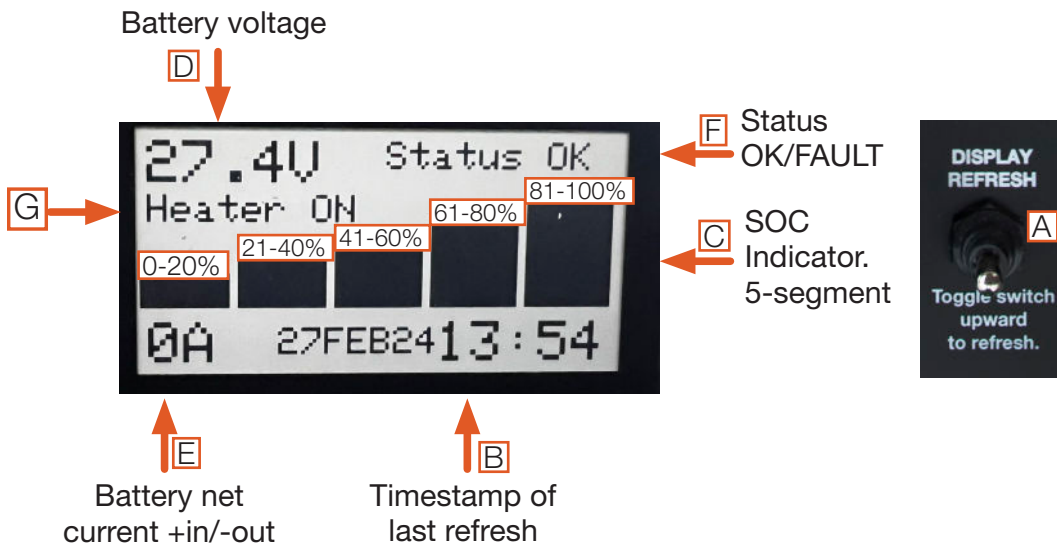


Figure 4. Battery Status Display and Display Refresh momentary switch

- A.** During normal operation, the display is updated automatically at intervals of three (3) minutes. The DISPLAY REFRESH momentary toggle switch can be pressed and held to update the display during normal operation. The REFRESH DISPLAY switch must be pushed 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, press and hold button until home page is repopulated.
- B.** A timestamp for the last “refresh” is updated and displayed, whether it occurred automatically or by pushing the refresh button.
- 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 \approx 30.4 VDC; voltage @ 0% SOC \approx 24.4 VDC.
***Note these are approximate values.**
- 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.
- G.** Indicates that the internal battery heater is operating. This feature is available on all BOS 2000’s with Serial Number S/N 792099 and above.

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-service Battery Status Information

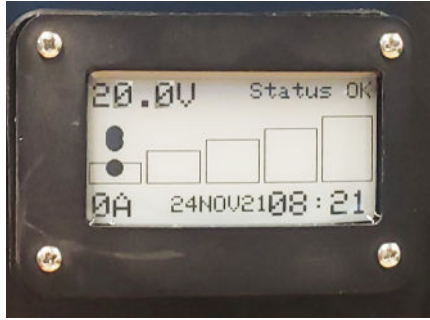


Figure 5. Battery Status Indicator home page “dead battery”

The Battery Status Indicator automatically refreshes at three (3)-minute intervals when it the BOS is operating normally. The “REFRESH DISPLAY” momentary button can be pressed to update the display at any time while the BOS 2000 is operating.

See Figure 4 for a detailed description of the Battery Status Indicator information fields.

An exclamation mark (“!”) will appear in the left-most bar when SOC drops to 0% (Figure 5).



Figure 6. Battery Status Indicator - home page unattended fault warning

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 (Figure 6). 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 Indicator.

Diagnostic Screen

To access the diagnostic screen, push the refresh button once to refresh display then a second time for the diagnostic screen.

Figure 7 is an example of the information on the diagnostic screen that is present when the BOS 2000 is operating normally. The SOC value range will narrow as the battery cycles.

Table 1 on page 22 lists the faults that may appear and procedures to clear them.

- A. Battery serial number
- B. CAN address for Battery Status Indicator
- C. CAN bus termination status of battery
- D. CAN address of battery
- E. State of Health
- F. State of Charge

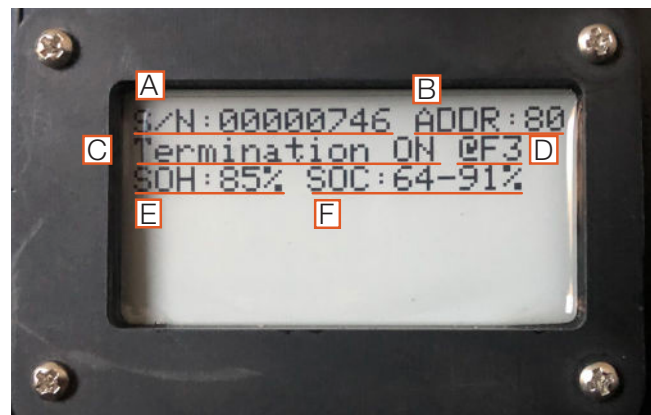


Figure 7. Battery Status Indicator diagnostic screen

Battery Status Information on BOS 2000 models with SN 792099

BOS 2000 modules with serial numbers 792099 and above will have additional information displayed on the Battery Status Indicator. The firmware update to these units features an indicator that states “Heater ON” which specifies if the battery’s internal heater is active (Figure 9).

An additional feature included allows the Battery Status Indicator to read “Unbalanced” (Figure 8) in the upper right corner of the display indicating when the battery cells are unbalanced. A further warning will occur on the second screen when the battery cells are balancing and will read “CELLS ARE BALANCING”(Figure 10).

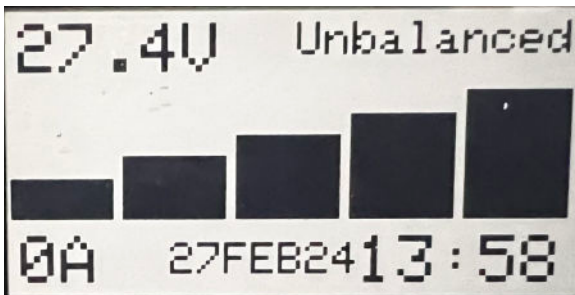


Figure 8. Battery Status Indicator - home screen Unbalanced indicator

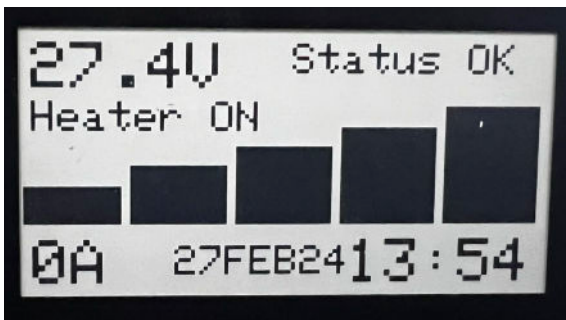


Figure 9. Battery Status Indicator - home page Heater ON indicator

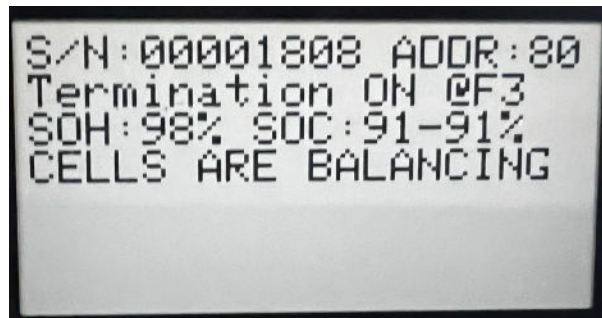


Figure 10. Battery Status Indicator - diagnostic screen CELLS ARE BALANCING

Contact Solar Stik for information on how to update BOS firmware. This update requires access to a Windows laptop, a USB Type A to USB Type mini B cable, AVRDUDESS programming software and the current Solar Stik firmware.

BOS Internal Battery Troubleshooting

Frequent visual monitoring of BOS 2000 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 2000 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 2000 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 \geq 4.2000 V	Max Cell V < 3.8000 V
Critical Cell Undervoltage	Cell Voltage \leq 2.00 V @ \leq 120 A discharge (battery voltage \leq 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 \geq 169 °F (76 °C)	Reduce Cell Temp to \leq 149 °F (65 °C)
Critical Board Temp High	Max Elec Temp 1 or 2 \geq 248 °F (120 °C)	Reduce Max Elec Temp to \leq 194 °F (90 °C)
Hardware Overload	Current \geq 3000 A	2-minute cool down, followed by toggling the POWER switch ON>OFF>ON
Fast Software Overload	Current \geq 1500A 30 ms	2-minute cool down, followed by toggling the POWER switch ON>OFF>ON
Software Overload	Max Elec Temp 3 \geq 275 °F (135 °C)	2-minute cool down, followed by reducing Elec Temp 3 to \leq 194 °F (90 °C)



Safety Data Sheet

Rechargeable lithium-ion cells, modules, and battery systems

Saft rechargeable Li-ion cells, modules and battery systems are manufactured articles which contain hazardous chemicals. Saft batteries are manufactured to specific shapes and designs and have end use functions that are dependent in whole or in part upon those shapes and designs. Under normal conditions of use, Saft batteries do not release hazardous chemicals and do normally not pose a physical hazard or health risk to the end user.

Under situations involving neglect, misuse, abuse, and/or improper handling and storage, exposure to hazardous chemicals normally contained inside the batteries can result.

1. IDENTIFICATION

1.1 Product

Lithium-Ion rechargeable cells and modules or battery systems composed of these cells

1.2 Supplier

Headquarters Address Phone/Fax	Saft S.A.S. 26 Quai Charles Pasqua, 92300 LEVALLOIS-PERRET – France Phone/Fax: +33 (0)1 58 63 16 00 /+33 (0)1 58 63 16 50
Factory Address Phone/Fax	Saft Bordeaux 111-113, boulevard Alfred Daney, 33074 BORDEAUX - France +33 (0)5 57 10 64 00 /+33 (0)5 57 10 68 77
Factory Address Phone/Fax	Saft Jacksonville 13575, Waterworks street, JACKSONVILLE, FL 32221 - USA +1 904 861 1501/+1 904 772 1463
Factory Address Phone/Fax	Saft Nersac Zone industrielle, 16440 NERSAC - France +33 (0)5 45 90 50 26 /+33 (0)5 45 90 50 71
Factory Address Phone/Fax	Saft Raskovice Raskovice 247, 73904 PRAZMO - Czech Republic +420 558 426 257/+420 558 692 226
Factory Address Phone/Fax	Saft Poitiers Rue Georges Leclanché – BP n°1039, 86060 POITIERS Cedex 9 - France +33 (0)5 49 55 48 48 /+33 (0)5 49 55 48 50
Factory Address Phone/Fax	Saft Cockeysville 107 Beaver Court, COCKEYSVILLE, MD 21030 - USA +1 410 771 3200/+1 410 771 1144
Factory Address Phone/Fax	Saft Valdese 313 Crescent Street, VALDESE, NC 28690 - USA +1 828 874 4111/+1 828 874 2431
Factory Address Phone/Fax	Friemann & Wolf Batterietechnik GmbH (a company of the Saft Group) Industriestrasse 22, 63654 BÜDINGEN - Germany +49 (0)6042 954 150 / +49 (0)6042 954 490
Factory Address Phone/Fax	Saft Urja Plot No. 10/1 A, 1B & 1C, Abbanakuppe, Bidadi Industria Area, Bangalore 562109 Karnataka – India +91 80 2728 7947/+91 80 2728 7716



1.3 Emergency contact

Chemtrec US Service within USA-Canada: +800 424 93 00/outside: +1-703-527-3887

In case of an incident and/or accident involving the battery, this telephone number is available 24 hours a day and is monitored at all times by a person who has comprehensive emergency response and accident mitigation information for the battery or can immediately call upon a person who possesses such knowledge and information.

If needed, the fire brigade may also be called in case of an incident/accident involving the battery.

2. HAZARD IDENTIFICATION

2.1 Electrolyte contained in individual cells

Electrolyte Globally Harmonized System (GHS) classification:

Flammable liquids (category 3), acute toxicity -oral (category 4), eye damage (category 1), skin sensitization (category 1), specific target organ toxicity –repeated exposure (category 1)

Electrolyte GHS label elements:

- **Pictograms:**



- **Signal word: Danger**

- **Electrolyte hazard statements:** Flammable liquid and vapour. Harmful if swallowed. May cause an allergic skin reaction. Causes serious eye damage. Causes damage to organs through prolonged or repeated exposure
- **Electrolyte physical hazard:** thermal decomposition generates corrosive vapours
- **Electrolyte ecological hazard:** harmful to aquatic life with long lasting effects

2.2 At cell level

Not chemically dangerous during normal use in accordance with Saft recommendations as stated in the user manuals or other similar documentation. In particular, the battery should not be opened or burned. Exposure to the ingredients contained inside the cells or combustion products could be harmful.

EYE CONTACT: contents of an opened cell inside a battery can cause eye irritation. Dust may cause inflammation of eyelids

SKIN CONTACT: Electrolyte solution contained inside cells can cause skin irritation. Contact with positive active material may in addition cause allergic dermatitis or irritation to skin.

INHALATION: Contents of an opened cell can cause respiratory tract and mucus membrane irritation. Overexposure to lithiated nickel compounds may cause an allergic response. If gas is generated during battery disassembly, throat irritation may occur.

2.3 At module and battery system level



HIGH VOLTAGE: Always use the large battery systems in a restricted access area. Only authorized people aware of high voltage hazards and trained to work on such systems are allowed to enter in the battery area.

TEMPERATURE: Do not place the batteries on or near fires or other high-temperature locations (> 70°C for VL and VES cells, and > 85°C for extended temperature range MP cells with “xtd” extension). Doing so may cause the batteries to overheat or ignite. Using the batteries in this manner may also result in a loss of performance and a shortened battery life.



3. COMPOSITION, INFORMATION, OR INGREDIENTS

3.1 At cell level

Component	CAS Number	EINECS/ELINCS	Content * (wt%)
Positive Active Materials: among			
LiNiCoAlO ₂ (NCA)	177997-13-6	700-042-6	25-35
LiNiCoMnO ₂ (NMC)	182442-95-1	480-390-0	
LiFePO ₄ (LFP)	15365-14-7	476-700-9	
LiCoO ₂ (LCO)	12190-79-3	235-362-0	
Conductor: Carbon black	1333-86-4	215-609-9	0.5-4
Negative Active Materials: among			
Graphite	7782-42-5	231-955-3	15-30
Li ₄ Ti ₅ O ₁₂ (LTO)	12031-95-7	619-916-2	
Organic Electrolyte: among			
LiPF ₆	21324-40-3	244-334-7	15-25
PC	108-32-7	203-572-1	
EC	96-49-1	202-510-0	
DMC	616-38-6	210-478-4	
EMC	623-53-0	433-480-9	
VC	872-36-6	212-825-5	
Separator	NA	NA	2-8
Aluminium	7429-90-5	231-072-3	5-20
Copper	7440-50-8	231-159-6	1-20
Others: inert material, mechanical parts	NA	NA	Remainder

* Quantities may vary a little with cell model

In the course of battery production, active substances detailed in the previous table are embedded in a mechanical substrate to form electrodes. These electrodes are then further assembled with the other battery components such as separator, electrolyte, connectors, and casing to obtain a finished battery. This battery is defined in OSHA and REACH regulations as “an article with no intended release” meaning that, **under normal and reasonably foreseeable conditions of use, no end-user of this battery will be exposed to any chemical substances** (summarized as **not anticipated under normal use** in the rest of the document).

3.2 At module and battery system level

Depending on the type of battery system, the battery may contain either a glycol ethylene-based coolant or a refrigerated coolant.

4. FIRST AID MEASURES **not anticipated under normal use**

EYE CONTACT: Immediately flush eyes with copious amount of water for at least 15 minutes. Seek immediate medical attention.

SKIN CONTACT: Remove contaminated clothing and flush affected areas with plenty of water for at least 15 minutes. Wash skin with soap and water. If skin irritation persists, call for a medical attention.

INHALATION: Remove to fresh air and seek immediate medical attention. Obtain medical advice.

INGESTION: Clear mouth with water and afterwards drink plenty of water. Do not induce vomiting. Seek immediate medical attention.



5. FIRE FIGHTING MEASURES **[not anticipated under normal use]**

EXTINGUISHING MEDIA:

- Small fires: use B or C type fire extinguisher, inert gas (for instance blend of argon and nitrogen), CO₂, dry chemical powder, or foam extinguishers
- Large fires: use large quantities of water for the surrounding fire and to prevent propagation. If water is used on batteries, caution should be taken to avoid the electrical hazard that may be present.
- In all cases, the fire extinguisher must be compatible with the level of voltage.

SPECIAL FIRE FIGHTING PROCEDURES: Fire fighters should wear self-contained breathing apparatus.

Use approved / certified vapour respirator to avoid breathing toxic fumes. Wear protective clothing and equipment to prevent potential body contact with electrolyte solution.

PARTICULAR HAZARDS RESULTING FROM EXPOSURE TO THE SUBSTANCE/PREPARATION, TO COMBUSTION AND GAS PRODUCTS: The cell or battery can spout vaporized or decomposed electrolyte fumes with fire when being heated over +100°C (+212°F) or disposed in fire. Solvents within the electrolyte are flammable liquids and must be kept away from any kind of ignition source.

6. ACCIDENTAL RELEASE MEASURES **[not anticipated under normal use]**

INDIVIDUAL PRECAUTIONS: Evacuate the employees from the contaminated area until fumes dispersal. In case of electrolyte leakage from a cell or battery, do not inhale the gas as possible. In case of skin or eye contact, inhalation or ingestion, follow the measures described in section 4.

ENVIRONMENTAL PRECAUTION: Avoid sewage, surface water and underground water contamination. Avoid ground and atmosphere contamination.

CLEANING PROCEDURE: Use protective glasses and gloves, use absorbent material (sand, earth or vermiculite) to absorb any exuded material. Seal leaking battery (unless hot) and contaminated absorbent material in plastic bag and dispose of as Special waste in accordance with local regulations.

7. HANDLING AND STORAGE

IMPORTANT NOTICE: The battery should not be opened without Saft approval. The battery should not be destroyed or incinerated since the battery may cause fire or the ingredients contained in the cells could be harmful if exposed.

STORAGE: Store in a cool, dry and ventilated area. Elevated temperatures can shorten battery life. Since short circuit can cause burn hazard, leakage or venting hazard, keep batteries in original packaging until use and do not jumble them.

HANDLING:

- Do not short (+) and (-) terminal with conductors.
- Do not short (-) terminal and the can of aluminium can cells with conductors
- Do not short (+) terminal and the can of stainless steel can cells with conductors
- Do not reverse the polarity
- Do not mix different type batteries or mix new and old ones together.
- Do not open the battery system or modules
- Do not use the unit without its electronic management system.
- Do not submit to excessive mechanical stress.








- Do not expose the unit to water or condensation
- Do not directly heat, do not solder, or throw into fire. Such unsuitable use can cause leakage or spout vaporized electrolyte fumes and may cause fire or explosion.
- Immediately disconnect the batteries if, during operation, they emit an unusual smell, feel hot, change shape, or appear abnormal in any other way. Contact Saft if any of these problems are observed.

CHARGING/DISCHARGING: Charge with charger designed specifically for this battery. Do not overcharge as venting and combustion can occur. Do not over-discharge. Discharge limits are dependent on the specific product. Refer to Saft Instructions.

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION





8.1 Leaking or ruptured cells **(not anticipated under normal use)**

Handle an opened battery only in a well-ventilated place.

	Respiratory protection	In case of incident or after an abusive use, in case of leaking or ruptured cells, use a gas mask which covers the whole face and equipped with ABEK type filters or an escape mask such as a Self-Contained Breathing Apparatus. Fire fighters should wear self-contained breathing apparatus.
	Hand protection	Use polypropylene, polyethylene, rubber, or Viton gloves when handling leaking or ruptured cells.
	Eye protection	In case of incident or after an abusive use, in case of leaking or ruptured cells, wear safety glasses with protected side shields or a mask covering the whole face when handling leaking or ruptured cells
	Other	In the event of leaking or ruptured cells, wear a rubber apron and protective clothes.
	High voltage	Use tools and protective equipment suitable with live working

8.2 High voltage batteries

Use tools and protective equipment suitable with live working when operating and when connecting high voltage batteries:

WHEN OPERATING		WHEN CONNECTING	
			
Safety shoes	Overall	Protective visor	Insulated gloves

9. PHYSICAL AND CHEMICAL PROPERTIES

The lithium-ion cell or battery described by this Battery Information Sheet is a sealed unit when offered for sale. It is a manufactured "article" and does not expose the user to hazardous chemicals when used in accordance with the manufacturer specifications.

Boiling Point – Not applicable

Vapor Pressure – Not applicable

Specific Gravity – Not applicable

Melting Point – Not applicable

Vapor Density – Not applicable



10. STABILITY AND REACTIVITY – the battery system is stable when handled and stored according to section 7

MATERIALS TO AVOID: Oxidizing agents, acids, bases and reducing agents.

CONDITIONS TO AVOID: Avoid exposing battery to fire or high temperature. Do not disassemble, crush or short or install with incorrect polarity. Avoid mechanical or electrical abuse. Do not repair or maintain when not authorized.

HAZARDOUS DECOMPOSITION PRODUCTS: Lithium hexafluorophosphate may react with water in the atmosphere and produce some traces of hydrogen fluoride, which do not worsen the gas toxicity. Thermal decomposition of the cell may release electrolyte liquid and vapour, harmful materials, and dusts.

11. TOXICOLOGICAL INFORMATION

Risk of irritation occurs only if the cell is mechanically, thermally, or electrically abused to the point of compromising the integrity of the enclosure. If this occurs, irritation to the skin, eyes and respiratory tract may occur.

12. ECOLOGICAL INFORMATION

None known if used/disposed of properly.

13. DISPOSAL CONSIDERATIONS

Battery recycling is recommended and may be mandatory in some jurisdictions. Recycle or dispose in accordance with local laws and regulations.

Batteries should be fully discharged prior to sending for recycling or disposal and terminals should be protected.

The recycling of batteries must only be conducted by fully trained personnel of licensed recyclers. Attempting to dismantle batteries or modules into individual cells may lead to serious injuries or death due to high electrical voltage and/or energy.

Store material being held for recycling or disposal as indicated in Section 7.

Do not dispose in fire. Do not dump into any sewers, on the ground or into any body of water.

See the section on “Environmental Responsibility” on <https://www.saftbatteries.com/about-us/environmental-responsibility>

14. TRANSPORTATION INFORMATION

The regulations that govern the transport of rechargeable lithium-ion batteries include US Department of Transportation (DOT) CFR 49 Part 171 – 180 of the US Hazardous Materials Regulations (HMR), the International Civil Aviation Organization (ICAO) Technical Instructions, the International Air Transport Association (IATA) Dangerous Goods Regulations and the International Maritime Dangerous Goods (IMDG) Code. Persons engaged in the transport of dangerous goods are required to be trained in the contents of dangerous goods requirements commensurate with their responsibilities (see 49 CFR 171.8 and Chapter 1.3, UN Recommendations on the Transport of Dangerous Goods Model Regulations).



14.1. UN Proper Shipping Name, Class, and Number

Shipment of new and used Lithium-ion cells and batteries are classified as Dangerous Goods¹ under the UN model regulation.

Proper shipping Name	Class	UN N°
LITHIUM-ION BATTERIES	9	3480
LITHIUM-ION BATTERIES CONTAINED IN EQUIPMENT	9	3481
LITHIUM-ION BATTERIES PACKED WITH EQUIPMENT	9	3481
BATTERY-POWERED VEHICLE OR BATTERY-POWERED EQUIPMENT	9	3171

NB: When Li-ion batteries are installed in cargo transport unit, the UN number is UN 3536.

14.2. International Regulations

Persons offering Lithium cells or batteries for transport need to properly determine the applicable provisions and instructions. More information is available in the official documentation for this purpose (<http://www.unece.org/trans/danger/danger.html>).

By Air International: IATA/ICAO Technical Instructions

By Sea International: IMDG Code

European road transportation: ADR

European rail transportation: RID

14.3 UN Tests Summary Report

Except cases of prototype stage or short production run, Saft cells or batteries have been tested for transport according to the UN Recommendations On the Transport of Dangerous Goods, Manual of Tests and Criteria, Part III. subsection 38.3. To access to the UN38.3 Tests Summary report please perform the below two steps.

1. Go on-line to <https://customerportal.saftbatteries.com/tsr> or scan the QR Code:
2. Enter the cell or battery part number from the transport documents (Waybill or Packing Slip) and click "Search" to receive a PDF copy of the relevant UN 38.3 Test Summary Report for the product being shipped.



15. REGULATORY INFORMATION

Marking Consideration

European Union: According to directive 2006/66/EC, the batteries must be marked with the crossed-out wheel bin symbol. Lithium-ion batteries, which contain electronic modules (e.g., PCM) and which are subject to the EMC directive 93/97/EEC, must be approved and must be marked with the CE marking.

Depending on the application, lithium-ion batteries may be subject to CE marking according to European Regulation N°765/2008 or E marking according to UNECE Regulations N° R10/R100.

¹ Dangerous Goods Regulations – 62nd Edition Effective 1 January 2021 (or any further last applicable edition): International Air Transport Association (IATA)



16. OTHER INFORMATION

This information has been compiled from sources considered to be dependable and is, to the best of our knowledge, accurate and reliable as of the date compiled. However, neither complete exhaustiveness nor perfect reliability can be granted. The communication of this information does not constitute an implicit or specific warranty.

This information relates to the specific products it is applicable to and may be invalid for these products when used in combination with any other equipment or in any process. It is the user's responsibility to satisfy himself as to the suitability and completeness of this information for his particular use.

Saft does not accept liability for any loss or damage that may occur, whether direct, indirect, incidental, or consequential, from the use of this battery information sheet provided as a service to our customers. Saft does not offer warranty against patent infringement.



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ABOUT SOLAR STIK, INC.



SOLAR STIK®

Mission Statement

Saving lives across the globe through innovative power solutions

STIKopedia

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

Solar Stik Training and Education

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

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

Contact

Technical Support:

1-800-793-4364 Ext 102

Outside of the US:

+1-904-808-0510 Ext 102

tech@solarstik.com

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