BLUE SKY ENERGY
BY SUNFORGE

SB2512i-HV / SB2512iX-HV Manual

Solar Boost™ 2512i(X)-HV MPPT
Solar Boost™ 2512iX-HV-Li MPPT

25 A @12 V (36-CELL PANEL) | 20 A @12 V (60-CELL PANEL)

MAXIMUM POWER POINT TRACKING PHOTOVOLTAIC CHARGE CONTROLLER

MADE IN USA

BLUE SKY ENERGY
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VISTA, CA 92081 • USA
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BLUE SKY ENERGY SB2512i(X)-HV(-LI) MANUAL, REV F | 2022

This manual includes important safety instructions for the SB2512i-HV and SB2512iX-HV. Save these instructions.

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Safety Instructions

Refer installation and servicing to qualified service personnel. High voltage is present inside unit. Incorrect installation or use may result in risk of electric shock or fire. No user serviceable parts in this unit.

PERSONAL PRECAUTIONS

- Working in the vicinity of lead-acid batteries is dangerous. Batteries produce explosive gasses during normal operation.
- To reduce risk of battery explosion, follow these instructions and those published by battery manufacturer and manufacturer of any equipment you intend to use in vicinity of battery.
- Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
- Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
- Wear complete eye protection and clothing protection. Avoid touching eyes while working near battery.
- If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters eye, immediately flood eye with running cold water for at least 15 minutes and get medical attention immediately.
- NEVER SMOKE or allow a spark or flame in vicinity of battery.
- Be extra cautious to reduce risk of dropping metal tool onto battery. It might spark or short circuit battery or other electrical part that may cause explosion.
- Remove personal metal items such as rings, bracelets and watches when working with a lead-acid battery. A lead-acid battery can produce a short circuit current high enough to weld a ring or the like to metal, causing a severe burn.
- Remove all sources of power, photovoltaic and battery before servicing or installing.

CHARGER LOCATION & INSTALLATION

- This unit is designed to charge 12 V nominal lithium, flooded, or sealed type lead-acid chemistry batteries within the range of 10 to 2,000 amp-hours. Follow battery manufacturers charging recommendations when considering this unit for use with other battery chemistry.
- This unit employs components that tend to produce arcs or sparks. NEVER install in battery compartment or in the presence of explosive gases.
- This unit must be installed and wired in accordance with National Electrical Code, ANSI/NFPA 70.
- Over current protection for the battery must be provided externally. To reduce the risk of fire, connect to a circuit provided with 30 A maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70.
- Over current protection for the auxiliary load control output or auxiliary battery charge output must be provided externally. To reduce the risk of fire, connect to load or auxiliary battery with 30 A maximum over current protection in accordance with National Electrical Code, ANSI/NFPA 70.
- Insure that unit is properly configured for the battery being charged.
- This unit is not water tight. Do not expose to rain, snow or excessive moisture.
- Insure all terminating connections are clean and tight. Battery, PV (Panel), and Auxiliary Output terminals are to be tightened to 9 in-lb (1 nm). IPN Network and battery temperature sensor compression terminals are to be tightened to 2.1 in-lb (0.24 nm).
- Do not connect to a PV (Panel) array capable of producing greater than 20 A of short circuit current @ STC.
- This unit is not provided with a GFDI (ground-fault detector/interrupter) device and must be used with an external GFDI device as required by Article 690 of National Electrical Code for the installation location.

PREPARING TO CHARGE

- Never charge a frozen battery.
- Be sure battery is mounted in a well ventilated compartment.
- Add distilled water in each cell of a lead-acid battery until battery acid reaches level specified by battery manufacturer.

Product Description

Solar Boost™ 2512i(X)-HV are improved versions of the original SB2512i and SB2512iX Maximum Power Point Tracking (MPPT) photovoltaic (PV) battery charge controllers. The new HV versions retain their original 25 A 340 W rating when used with conventional 12 V 36-cell PV modules, but are also able to operate up to 270 W of higher voltage 60-cell (residential) type modules.

The full featured SB2512iX-HV(-Li) includes all the features described in this manual. The SB2512i-HV omits certain features and capabilities. The SB2512's patented MPPT technology can increase charge current up to 30% or more compared to conventional controllers. MPPT also allows the use of higher voltage 60-cell modules by converting higher PV (Panel) voltage down to charge a 12 V battery. The SB2512's sophisticated 3-stage charge control system improves battery performance and longevity while minimizing battery maintenance. The SB2512i(X)-HV optimally charge flooded, GEL and AGM lead-acid chemistry batteries and the SB2512iX-HV-Li charges $LiFePO_4$ batteries. The SB2512's can be also programmed through a remote display or BT Connect, for a 2-Stage or Multi-Stage charge control for any type of battery.

The unit is fully protected against voltage transients, over temperature, over current and reverse polarity. The IPN Network display connector provided in both versions allow use of optional remote displays, BT Connect, or a UCM. Additional features included in the SB2512iX-HV version of the product include a battery temperature sensor input, equalization capability, full IPN Network interface, and an auxiliary output. The versatile auxiliary output can operate as either a 2 A battery charger for a second battery, or serve as a 25 A load controller or 25 A variable Dusk-to-Dawn lighting controller. The full IPN Network interface included in the SB2512iX-HV(-Li) allows multiple charge controllers to communicate with each other and coordinate their activity to charge the battery as a single coordinated charging machine.

FEATURES OMITTED IN THE SOLAR BOOST 2512i-HV (Discountinued)

- Battery Temperature sensor input
- Full IPN Network interface (multi-controller)
- Battery equalization capability
- Auxiliary Output (25 A load & lighting control, or 2 A auxiliary battery charge)

Part Numbers and Options

SB2512i-HV	Basic Solar Boost 2512i-HV	**IPN ProRemote**	Display & battery monitor
SB2512iX-HV	Solar Boost 2512iX-HV for Lead Acid	**930-0022-20**	Battery temperature sensor
SB2512iX-HV-Li	Solar Boost 2512iX for $LiFePO_4$	**BT Connect**	Bluetooth adaptor
506-0003-01	500 A / 50 mV current shunt	**ProTouch**	3.5" Touch-Screen display
UCM	Universal Communication Module		
IPN ProRemote-S	Display & battery monitor w/shunt		

Product Certifications

CONFORMS TO:

EN 61000-6-2:2005 (*) EN 61000-6-3:2007 + A1:2011(*) AS/NZS 60000-6-3:2012 (*)

FCC CFR 47 Part 15 Subpart B (*)

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference, and 2) This device must accept any interference received, including interference that may cause undesired operations.

COVERED UNDER ONE OR MORE OF THE FOLLOWING US PATENTS

6,111,391 • 6,204,645

(*) See Electromagnetic Compatibility at page 11.

Operation

Charge control and MPPT operations are fully automatic. At night when PV (Panel) power production stops, the PV (Panel) array is disconnected from the battery to prevent unwanted current drain. There is a 5 second turn-on delay, and a 45 second turn-off delay.

WARNING: The SB2512 operates on battery power, not PV power. A battery must be connected with a minimum voltage of 9 V for the unit to operate. Battery voltage on the battery terminals of the SB2512 must be the same as actual battery voltage within a few 10ths of a volt for proper operation. DO NOT disconnect the battery with PV (Panel) power applied as appliances still attached to the output of the SB2512 may be damaged by voltage spikes resulting from sudden removal of the battery, particularly when used with higher voltage 60-cell PV modules. ALWAYS remove PV (Panel) power first before disconnecting the battery.

Charge Status Indicator

Charge Off: Off

Bulk (<70 % Full): Continuously On

Absorption/Acceptance (70%-95% Full): Blinking - 1 SEC ON / 1 SEC OFF

Float (Fully Charged): Blinking - 0.2 SEC ON / 1 SEC OFF

Equalize: Rapid Blinking - 0.2 SEC ON / 0.2 SEC OFF

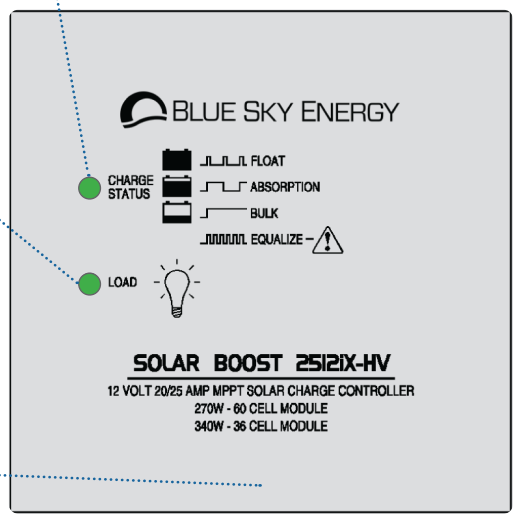
A charge status indicator is provided on the face of the SB2512, and on the optional remote displays. If net battery charge current is greater than about 3 to 5 A per 100 amp-hours of battery capacity, the charge status indicator can provide a rough indication of battery state of charge.

Auxiliary Output Indicator

(Omitted on SB2512i-HV)

An Auxiliary Output indicator labeled "LOAD" is provided on the face of the SB2512iX-HV, and is omitted on the SB2512i-HV. The indicator will be ON when the auxiliary output is available to provide power to a load, or charging an auxiliary battery. Default operation of the auxiliary output is Auxiliary Battery Charge and the indicator may turn ON even though an auxiliary battery may not be connected. Auxiliary Output status can also be viewed on the IPN ProRemote or BT Connect.

The front panel serves as a heatsink for power control devices. It is normal for the front panel to be quite warm to the touch when operating at high power.



Optional Remote Display, Bluetooth adapter, or UCM

There are three available remote displays, the **IPN Remote** , the full featured **IPN ProRemote**, and the **ProTouch** 3.5" touch-screen. The IPN Remote is a basic 3-digit LED type displaying battery voltage, output current, and charge mode display without setup or control capability. The full featured IPN ProRemote provides setup capability and enhanced monitoring of charge controllers on the IPN network. It also provides a complete battery system monitor with various amp-hour counters and a highly accurate "fuel gage" type battery level indicator. The ProTouch 3.5" touch-screen display provides enhanced monitoring of charge controllers and setup capability by 5 preset configurations (Lead-Acid and Lithium, , as well as basic battery state of charge monitoring when utilized in conjunction with an external current shunt.). The **BT Connect** provides setup capability and monitoring through a detailed app (Android and iOS). A Universal Communication Module (**UCM**) may also be used for communication with other devices or to access the charge control system remotely over the Internet.

SB2512iX-HV Multi-Stage for Lithium (Li-ion or $LiFePO_4$) Battery

The SB2512iX-HV-Li is programmed with a multi-stage charge profile for a 4S $LiFePO_4$ batteries while the SB2512iX-HV can be programmed for any type of Lithium battery with one of the following accessories: IPN ProRemote display, BT Connect, ProTouch display, or UCM. Consult the manual of the battery manufacturer for the appropriate charge profile. When programming the SB2512iX-HV for Lithium, the battery temperature compensation must be disabled and/or the Battery Temperature Sensor (p/n 930-0022-20) removed. See the manual of the specific accessory for more information.

SB2512i(X)-HV Multi-Stage for Sealed Lead-Acid batteries (Default)

The SB2512i(X)-HV is factory configured for a 3-stage charging process, Bulk, Absorption and Float. The 3-stage charge process provides a somewhat higher charge voltage to charge the battery quickly and safely. Once the battery is fully charged, a somewhat lower voltage is applied to maintain the battery in a fully charged state without excessive water loss. 3-stage charging improves battery performance and longevity while minimizing battery maintenance.

BULK CHARGE

The SB2512i(X)-HV will be in Bulk charge when battery voltage is below the Absorption (Acceptance) Charge Voltage setpoint. During Bulk, the SB2512i(X)-HV delivers as much charge current as possible to rapidly recharge the battery and drive battery voltage up to the Absorption (Acceptance) Charge Voltage setpoint.

ABSORPTION CHARGE

When the battery recovers sufficient charge for battery voltage to rise to the Absorption (Acceptance) Charge Voltage setpoint (factory set to 14.2 V), current is reduced as necessary to hold the battery at the Absorption (Acceptance) Voltage. The SB2512 remains in Absorption (Acceptance) until the battery is fully charged as determined by either:

- The SB2512i(X)-HV has remained in Absorption (Acceptance) continuously for the Charge Time period (factory set to 2 hours), or
- With the IPN ProRemote display, net battery charge current while in Absorption (Acceptance) decreases to the Float Transition Current setting (factory set to 1.5 A per 100 amp-hours of battery capacity).

FLOAT CHARGE

Once the battery is fully charged a somewhat lower Float Voltage (factory set to 13.2 V) is applied to maintain the battery in a fully charged state without excessive water loss. During Float, a healthy fully charged lead-acid battery will draw about 0.1–0.2 A per 100 amp-hours of battery capacity.

2-STAGE CHARGE CONTROL

Certain battery types (including Lithium) or system configurations may require 2-stage charge control. The SB2512i(X)-HV can be configured for two stage Bulk/Absorption charge control by setting the Charge Voltage to "No Float" using the IPN ProRemote, BT Connect, or the UCM. Refer to the IPN ProRemote , BT Connect, or UCM operators manual for their settings.

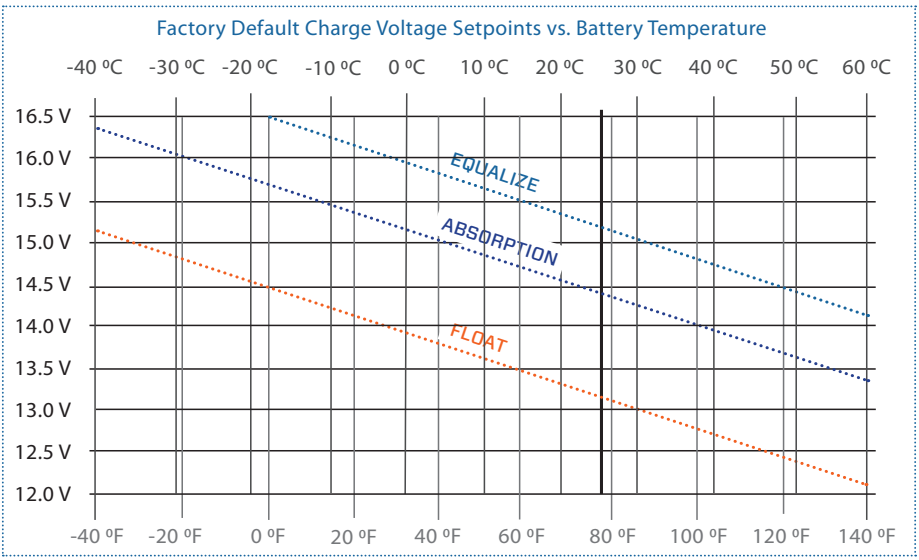
Equalization (only for lead-acid battery) **(Omitted on SB2512i-HV)**

WARNING: Not all batteries can be safely equalized. Equalization should be performed only on vented liquid electrolyte lead-acid batteries. Always follow battery manufacturers recommendations pertaining to equalization. Equalization applies a relatively high charge voltage producing significant battery gassing. Prior to performing equalization, disconnect equipment that cannot tolerate the high equalization voltage which is temperature compensated as shown below in the graph Factory Default Charge Voltage Setpoints vs. Battery Temperature.

The SB2512 can perform automatic equalization alone, or equalization may be controlled manually via the IPN ProRemote, BT Connect, or UCM. Equalization is essentially a controlled overcharge which applies a relatively high voltage to bring all battery cells up to the same specific gravity. While equalization parameters are adjustable with the IPN ProRemote, BT Connect, or UCM, factory default parameters of 15.2 V for 2 hours every 30 days are suitable for most applications. A minimum net charge current of approximately 3.5 A per 100 Ah of battery capacity is required for proper equalization. The equalization timer is a "time at voltage" time accumulator. The equalization timer will not count down unless battery voltage reaches the equalization voltage setpoint. Unless manually canceled, the SB2512 will stay in equalize for as long as necessary to accumulate the required time at voltage. If equalize does not complete by end of the charging day it will resume where it left off the next charging day, but will automatically cancel cycle if unable to complete within 24 hours.

Optional Temperature Compensation (only for lead-acid battery)

The charge voltage required by batteries changes with battery temperature. Temperature compensation of charge voltage enhances battery performance and life, and decreasing battery maintenance. Temperature compensation of charge voltages can be provided using the optional battery temperature sensor (BSE p/n 930-0022-20). The default compensation factor of –30 mV/ºC (–5.00 mV/ºC/cell) is typically appropriate for most lead-acid chemistry batteries including GEL and AGM. If a proper temperature sensor signal is not detected the SB2512 will operate as if battery temperature is 25 ºC.



Current Limit

If PV (Panel) input power is high enough to produce more than 25 A of output current with 36-cell PV modules, or 20 A with 60-cell PV modules, the SB2512 will automatically limit output current to this maximum rating. Note that when the SB2512 exits current limit, it will briefly show Absorption (Acceptance) on the Charge Status Indicator even though battery voltage may be low. If changing from 60-cell to 36-cell modules, reboot the SB2512 to restore 25 A current limit.

Maximum Setpoint Voltage Limit

Maximum voltage setpoint limit places a ceiling or upper limit on the maximum charge voltage. Regardless of setpoint values entered by the user or result from temperature compensation, the SB2512 will not apply a charge voltage setpoint greater than the maximum voltage setpoint limit (factory configured to 15.5 V). Note that actual battery voltage may briefly exceed this value by 0.1 – 0.2 V as the voltage control system responds to changes in load.

Maximum Power Point Tracking (MPPT)

The SB2512's patented MPPT technology can increase charge current up to 30% or more compared to PWM controllers operating 36-cell PV modules. Principal operating conditions affecting current boost performance are PV (Panel) cell temperature and battery voltage, with lower PV (Panel) temperature and lower battery voltage producing greater charge current increase. In cool comfortable temperatures most systems see about 10 – 20% increase. Increase may go to zero in hot temperatures, whereas charge current increase may easily exceed 30% with a discharged battery and freezing temperatures. MPPT also allows efficient use of higher voltage 60-cell modules by converting their much higher voltage down to battery voltage. Ignoring conversion losses the conversion process produces an output current roughly equal to PV (Panel) current times the ratio of PV (Panel) voltage to battery voltage. If a 60-cell module is operating at 23 V at 5 A and battery voltage was 14 V, output charge current would be about 5 A times 23 V – 14 V or about 8 A. For a more complete MPPT description see "What Is MPPT and how does it work?" on the FAQ page at https://sunforgellc.com/learning-center.

Panel Temperature And Output Power

Internal power control devices use the front panel as a heatsink. It is normal for the front panel to become quite warm to the touch when the unit is operating at high power. When mounted vertically as described in the installation section, the unit can deliver full output in an ambient temperature of up to 40 ºC (104 ºF). If an over temperature condition exists, the unit will shut down, the Charge Status Indicator will display an OFF condition, and a remote display will turn off. The SB2512 does not include a digital type temperature sensor and will always show the heatsink to be –55 ºC on the IPN ProRemote, BT Connect, or UCM.

Multiple Charge Controllers On The IPN Network **(Omitted on SB2512i-HV)**

The IPN network architecture allows multiple charge controllers to operate as a single charging machine. Up to 8 IPN compatible charge controllers can reside on a single network and can share a single display, battery temperature sensor, and UCM. Charge controllers can be added to grow a small system into a large system and have this large system operate from the users standpoint as a single charging machine.

Installation

WARNING: Read, understand and follow the Important Safety Instructions in the beginning of this manual before proceeding. This unit must be installed and wired in accordance with National Electrical Code, ANSI/NFPA 70. Over current protection must be provided externally. To reduce the risk of fire, connect to a circuit provided with 30 A maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70 with 36-cell modules, or 25 A maximum with 60-cell modules. Do not connect a PV (Panel) array capable of delivering greater than 20 A of short circuit current I_{SC} at STC with 36-cell modules, or 11 A with 60-cell modules. Do not connect BAT– and PV– together external to the unit. To reduce risk of electric shock or product damage, remove all sources of power before installing or servicing. The wiring diagrams show generalized connections only and are not intended to show all wiring, circuit protection and safety requirements for a photovoltaic electrical system.

CAUTION: The SB2512 is protected against reverse battery and PV (Panel) polarity, and swapped PV (Panel) and battery connections, but will be damaged by reverse battery to the PV (Panel) terminals. Transient voltage lightning protection is provided, but steady state voltage in excess of 50 VDC on the battery or PV (Panel) terminals will damage the unit. Damage of either type voids the limited warranty.

Electrostatic Handling Precautions

All electronic circuits may be damaged by static electricity. To minimize the likelihood of electrostatic damage, discharge yourself by touching a water faucet or other electrical ground prior to handling the SB2512 and avoid touching components on the circuit boards. The risk of electrostatic damage is highest when relative humidity is below 40%.

Selecting PV Modules

The SB2512 is designed to operate conventional 12V 36-cell PV modules or higher voltage 60-cell modules. If multiple PV modules are used best MPPT current boost performance will be obtained if all PV modules are identical. Dissimilar modules should have V_{MP} values within about 0.5 V or better and be of the same basic cell technology so their V_{MP} will tend to track as operating conditions change. If module types are very different, consider using a separate charge controller for each module type to obtain the best MPPT current boost performance. When multiple controllers are used on the IPN Network each controller independently MPPT's their modules to their best. Do not mix 36-cell and 60-cell modules on the same controller. Select PV modules that do not exceed the maximum ratings shown below, and preferably produce I_{MP} of at least 3.5 A (2 A with 60-cell modules) per 100 amp-hours of battery capacity. Voltage, current and power produced by PV modules fluctuate widely with operating conditions. As a result a set of test conditions referred to as **Standard Test Conditions (STC)** are used to rate modules in a meaningful manner and accurately predict real world performance. STC ratings are not maximum or optimal ratings. Conditions can be present where V_{OC} and I_{SC} approach 1.25 times STC ratings which is why National Electrical Code and our recommendations call for 1.25 derating of both V_{OC} and I_{SC}. Yet in real world conditions I_{MP} actually seen is commonly only about 75 – 80% of I_{MP} at STC.

Key PV module specifications

P_{MAX}	Maximum power in watts ($P_{MAX} = V_{MP} \times I_{MP}$)
V_{OC}	Voltage with module open circuit (typically about 20 – 22 V for 12 V nominal 36-cell modules)
V_{MP}	Voltage where module produces Maximum Power (typically about 17 – 18 V for 12 V nominal 36-cell modules)
I_{MP}	Current where module produces Maximum Power
I_{SC}	Current with module Short Circuit

PV Cell Count	Maximum PV Power @ STC	Automatic Output Current Limit	Maximum PV I_{sc} @ STC	Maximum PV V_{OC} @ STC	Recommended range of V_{MP} @ STC
36-Cell	340 W	25 A	20 A	24.0 V	16.0 – 19.0 V
60-Cell	270 W	20 A	11 A	40.0 V	24.0V – 31.0 V

As Shipped Factory Default Settings

NOTE: The SB2512i(X)-HV contains various user configurable settings all of which are preconfigured at the factory. Most installations require no changes to these settings which are typically suitable for most lead-acid batteries including sealed lead-acid batteries such as Gel and AGM. All software programmable settings, as for example Lithium batteries, require an IPN ProRemote, BT Connect, ProTouch, or UCM to change and are retained if power is lost or the IPN ProRemote, BT Connect, ProTouch, or UCM are used as setup tools only and removed.

SB2512i(X)-HV Software Programmable Settings

Charge mode	3-stage	**Equalize voltage**	15.2 V
Absorption voltage	14.2 V	**Equalize time**	2.0 hours
Float voltage	13.2 V	**Auto equalize days**	30 days
Charge Time	2.0 hours	**Maximum voltage setpoint limit**	15.5 V
Float Transition Current	1.5 A / 100 Ah	**Temperature compensation factor**	-5.00 mV/ºV/cell
Load control ON voltage	12.6 V	**Dawn-to-Dusk lighting control**	Disabled
Load control OFF voltage	11.5 V		

SB2512iX-HV-Li Software Programmable Settings

Charge mode	3-stage	**Equalize voltage**	Disabled
Absorption voltage	14.4 V	**Equalize time**	Disabled
Float voltage	13.6 V	**Auto equalize days**	Disabled
Absorption Time	0.5 hours	**Maximum voltage setpoint limit**	15.5 V
Float Transition Current	0.0 A / 100 Ah	**Temperature compensation factor**	Disabled
Load control ON voltage	12.0 V	**Dawn-to-Dusk lighting control**	Disabled
Load control OFF voltage	11.0 V		

SB2512iX DIP Switch & Jumper Settings (All DIP's OFF, A2 open – Omitted on SB2512i-HV)

Auxiliary Output Mode	Auxiliary battery charger
Equalize	Disabled
IPN Network address	0 (zero, IPN Master)

Equalize Enable SB2512iX-HV **(Omitted on SB2512i-HV)**

If DIP switch #4 (see Setup and Wiring Diagram on page 12) is turned OFF, equalization is completely disabled regardless of other equalization settings. If DIP switch #4 is turned ON prior to the application of battery power, automatic equalization is enabled and the SB2512iX will perform automatic equalization after the set number of Auto Equalize Days has elapsed. If DIP switch #4 is turned ON, after battery power is applied an equalization cycle will begin immediately. Equalization start/stop may also be remotely controlled from the IPN ProRemote, BT Connect, or UCM if DIP switch #4 is ON.

Electromagnetic Compatibility (CE and FCC Marks)

To comply with electromagnetic compatibility requirements, the SB2512i(X)-HV must be installed with as many as two ferrite suppressors . Clamp one suppressor (supplied with SB2512) around both PV+ and PV– cables twisted and looped to pass through the core 2 times. Clamp the second suppressor (supplied with either one of our optional remote displays) around the IPN cable , looped to pass through the core 2 times.A single suppressor is included with each product. (BSE p/n 523-0005-01).

Battery Temperature Sensor (only for lead-acid battery)

(Omitted on SB2512i-HV)

Installation of the optional battery temperature sensor enables temperature compensation of all charge voltage setpoints in order to improve performance and extend the battery longevity. In a multi-controller system a single temperature sensor must connect to the IPN master. Do not attach sensors or components other than the Blue Sky Energy battery temperature sensor (p/n 930-0022-20) to the temp sensor terminal block. Be certain to observe proper RED/BLK polarity. If a valid temperature sensor signal is not detected the SB2512 will operate as if battery temperature is 25 °C.

Battery and PV Wiring

A desirable installation will produce a total system wiring voltage drop of 3% or less. The lengths shown in below are one way from the PV modules to the battery with the SB2512 located along the path. Length can be increased inversely proportional to actual PV I_{MP} such that if current was reduced by 1/2 wire lengths could be doubled and still provide the same 3% voltage drop. For 60-cell modules use one wire size larger than shown (smaller awg #) for the wire section between the SB2512 and the battery.

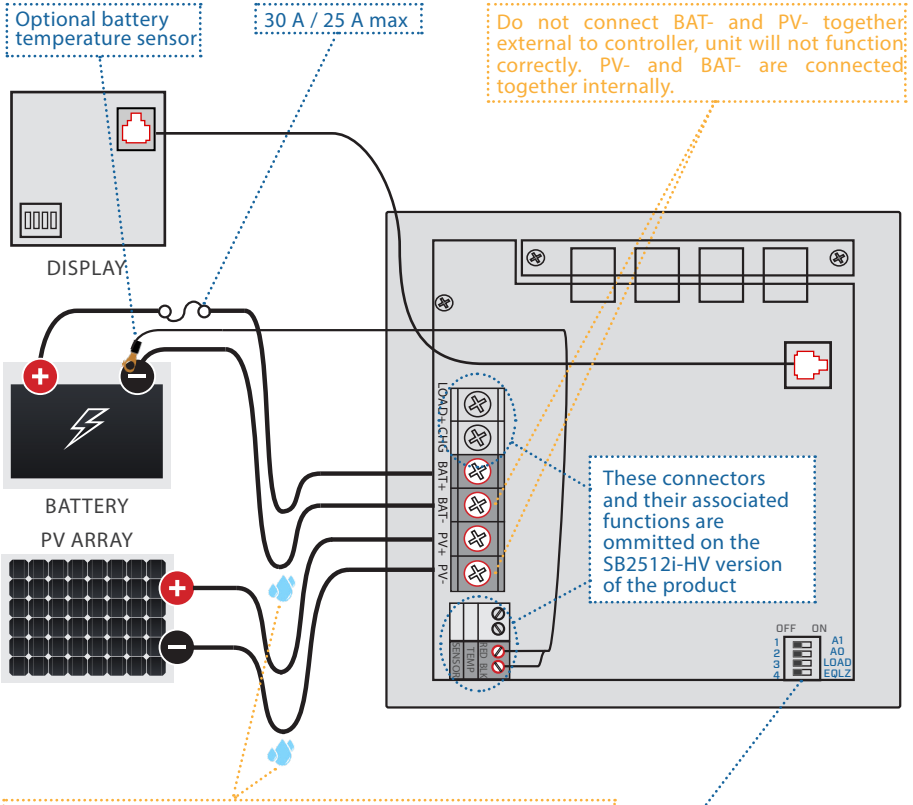
Maximum Conductor Pair Length - 3% Voltage Drop

Wire Gauge AWG	60-Cell Modules @ 11 A Input FEET/METERS	36-Cell Modules @ 20 A Input FEET/METERS
12	19.2 / 5.7	6.4 / 1.9
10	30.6 / 9.3	10.2 / 3.1
8	48.6 / 14.7	16.2 / 4.9
6	77.1 / 23.4	25.7 / 7.8
4	122.4 / 37.5	40.8 / 12.5

Setup and Wiring Diagram

CAUTION: Battery, PV (Panel) and Auxiliary Output terminal block accept #20–10 AWG wire and are to be tightened to 9 in-lb (1 nm). IPN Network and Temperature Sensor compression terminals accept #24–14 AWG wire and are to be tightened to 2.1 in-lb (0.24 nm).

DO NOT connect Bat– and PV– together outside of the unit or improper operation will result. Bat– and PV– connect together internally. PV– must connect directly into the SB2512 and not to other negative buss bars or grounds.



Operating Mode Setup - Factory Default = All Off								
Ipn Network Address	0	1	2	3	4	5	6	7
Jumper (A2)	NO	NO	NO	NO	YES	YES	YES	YES
Switch 1 (A1)	OFF	OFF	ON	ON	OFF	OFF	ON	ON
Switch 2 (A0)	OFF	ON	OFF	ON	OFF	ON	OFF	ON
Aux Output Function	2 A Auxiliary Battery Charge				25 A Load Control			
Switch 3 (Load)	OFF				ON			
Equalize Function	Disabled				Enabled			
Switch 4 (Eqlz)	OFF				ON			

Auxiliary Output (Omitted on SB2512i-HV)

The auxiliary output can serve one of three functions: 1) a 2 A auxiliary battery charger, 2) a 25 A Low Voltage Disconnect (LVD) load controller, or 3) a 25 A variable Dusk-to-Dawn lighting load controller with LVD. The Charge/Load function is selected by DIP switch #3 shown in the Setup and Wiring Diagram. The IPN ProRemote, BT Connect, or UCM are required to adjust LVD thresholds or enable Dusk-to-Dawn lighting control. Auxiliary outputs in a multi-controller system will function separately, but only the auxiliary output in the master can be configured or monitored. The auxiliary output Load Indicator will illuminate whenever the auxiliary output is ON(*).

CAUTION: The auxiliary output cannot perform both auxiliary battery charge and load control functions at the same time. Do not connect to the 25 A Load terminal for auxiliary battery charge or the SB2512 may be damaged in a manner that voids the warranty.

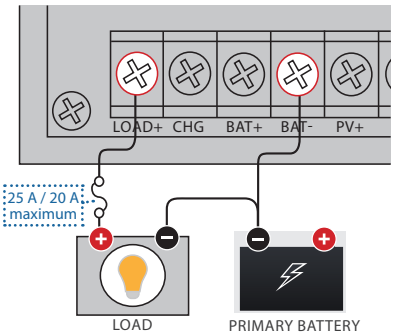
NOTE (*): The LOAD indicator light will be ON whenever power is available at the Load and Auxiliary Battery Charge terminals.

AUXILIARY BATTERY CHARGE – DIP #3 OFF

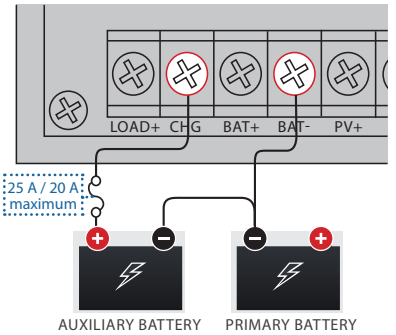
The auxiliary charge function is used to charge an auxiliary battery of the same voltage as the primary battery. If the primary battery is charging in Absorption (Acceptance) or Float, up to 2 A is diverted to the auxiliary battery at the same charge voltage. Auxiliary battery charge is disabled during Bulk or Equalization. Use 14 awg wire to minimize voltage drop and 25 A maximum over current protection. Auxiliary battery negative must connect to primary battery negative.

Auxiliary Output Wiring

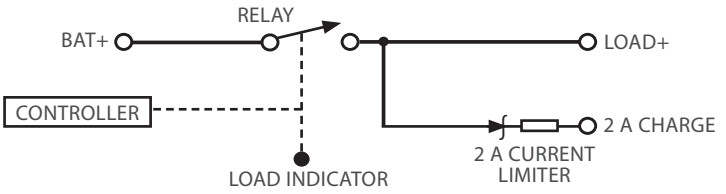
Auxiliary Output as Load Controller
DIP Switch #3 ON



Auxiliary Output as Auxiliary Battery
DIP Switch #3 OFF



Auxiliary Output Equivalent Circuit



LOAD CONTROLLER – DIP #3 ON

The load controller can deliver up to 25 A of output and operates as a high side switch to battery positive. Default settings are for Low Voltage Disconnect (LVD) with ON at V_{BAT} ≥12.6 V, and OFF at V_{BAT} ≤11.5 V, which can be changed with the IPN ProRemote, BT Connect, or UCM. ON/OFF operation can also be based on battery amp-hours from full if an IPN ProRemote is permanently installed. The ON/OFF condition must be valid for 20 seconds before switching will occur. If the higher/lower values are reversed the output control logic is inverted.

CAUTION: 30 A maximum over current protection for the output must be provided externally. If the load control is configured to operate based on net battery amp-hours, configure ON/OFF voltage thresholds as well. If amp-hour from full data is not available, voltage based operation will resume. ON/OFF thresholds must not be the same value or improper operation will result.

DUSK-TO-DAWN LIGHTING CONTROL – DIP #3 ON

A BT Connect, or UCM, or IPN ProRemote with software version V2.00 or later is required to setup and enable lighting control. Refer to IPN ProRemote, BT Connect, or UCM operators manual for lighting control setup instructions. Variable time settings are available to turn lighting ON after Dusk (Post-Dusk timer) and/or ON before Dawn (Pre-Dawn timer). If both timers are set to DISABLED (factory default), the lighting control feature is disabled. If either the Post-Dusk or Pre-Dawn timers are set to a time value the lighting control feature is enabled. When lighting control is enabled the Load output is controlled by both the normal LVD control function and the lighting control function such that whichever function wants the Load output OFF prevails. Dusk or night time begins when the charge control system turns OFF which occurs when PV module current drops below about 50 mA at battery voltage. Dawn or day time begins when the charge control system turns ON which occurs when PV module current rises to about 100 mA at battery voltage. If the Post-Dusk timer was set to 1.0 hour and the Pre-Dawn timer was set to 2.0 hours, lights would turn ON at Dusk, remain ON for one hour, and then turn OFF. Two hours before Dawn the lights would again turn ON and remain ON until Dawn. For full Dusk to Dawn lighting set the Post-Dusk timer to 20 hours. When the SB2512 first receives battery power it does not know when Dawn is expected to occur. As a result Pre-Dawn control does not operate for the first night. Once a night time period of 4 hours or more is detected this night time period is stored and Pre-Dawn control will operate. Each subsequent night time period greater than 4 hours is added to a filtered average of night time so that the predicted night time period automatically adjusts to changing seasons.

Installing A Multi-Controller System **(Omitted on SB2512i-HV)**

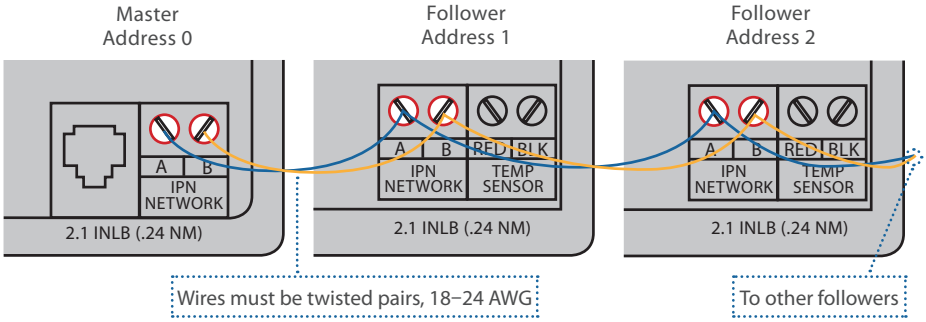
A communication link is established between controllers by daisy chaining a twisted pair cable from the IPN Network terminal block, controller to controller (A-to-A, B-to-B) as shown in IPN Network Wiring Diagram. Up to 8 IPN based charge controllers can be connected together in a multi-controller system. Device address 0 (zero) is the master and 1 – 7 are followers. The master controls the charging process and directs the activities of the followers.

MULTI-CONTROLLER WIRING AND SETUP

CAUTION: A multi-controller system requires the following specialized installation and setup:

- Each controller must connect to and charge the same battery.
- One controller must be set to IPN address 0 (zero) and the others be set to addresses 1 – 7 with no controllers set the same.
- Charge parameters are set in the master only.
- While outputs connect in parallel to a common battery, PV (Panel) inputs must be completely separate. A large PV (Panel) array must be divided into sub-arrays, each with separate PV+ and PV– wiring.
- All controllers must be connected to the IPN network as shown in the IPN Network Wiring Diagram.

IPN Network Wiring



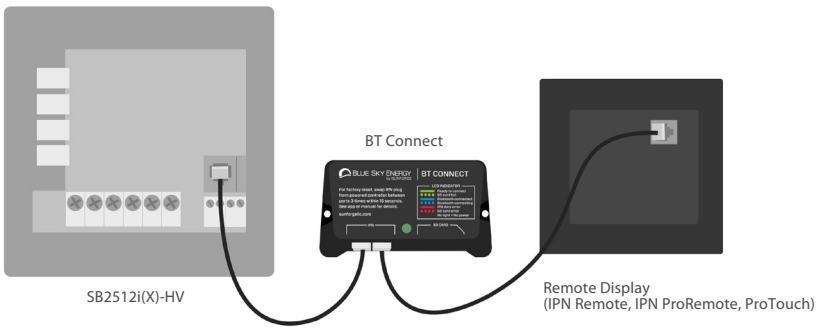
IPN Network Address -- DIPs #1, #2, & Jumper A2

NOTE: A single controller must be set to IPN network address 0 (zero). In a multi-controller system one controller must be set to address 0 (zero) to serve as the master. The other controllers must be set to address 1-7 with no two controllers set the same. The SB2512 requires that a jumper be soldered across location A2 to select addresses 4 through 7.

IPN Network Address								
Dip Switch	Master	Followers						
	0	1	2	3	4	5	6	7
JUMPER (A2)	NO	NO	NO	NO	YES	YES	YES	YES
# 1 (A1)	OFF	OFF	ON	ON	OFF	OFF	ON	ON
# 2 (A0)	OFF	ON	OFF	ON	OFF	ON	OFF	ON

Installing Optional Accessories (Remote Displays and BT Connect)

The SB2512 can communicate via IPN cable with different accessories for full monitoring and advanced programming. More accessories with different capabilities can be connected simultanelly to the SB2512 via RJ-11 cables (see figure below), as for example, a remote display (IPN Remote, IPN ProRemote, or ProTouch), the Bluetooth adapter BT Connect, and the UCM.

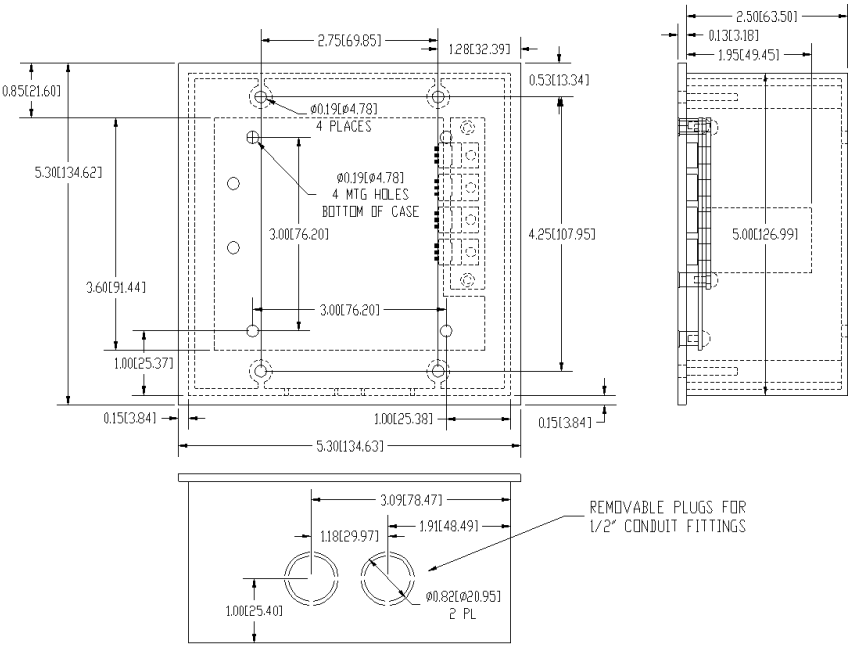


	IPN Remote	IPN ProRemote	ProTouch	BT Connect
Description:	1-Line LED Display	2-Line LCD Display	3.5" Touch-Screen Display	Bluetooth Adapter
Monitoring:	Basic	Full	Full	Full w/ historical graphs
Programming:	-	Full	5 Preset Charge Profiles	Full
Interface:	RJ-11	RJ-11	RJ-11	RJ-11, Bluetooth
Mounting:	Flush Mounting	Flush Mounting	Flush Mounting	Surface Wall Mounting

Mounting

CAUTION: Mount the SB2512 vertically to promote air flow and do not enclose in a confined space. The SB2512 is not watertight and must be protected from rain, snow and excessive moisture. Included with the SB2512 (Retail package) is an optional plastic mounting box, it may also be installed in a standard 4 11/16" square galvanized electrical box. If a metal box is used DO NOT remove or install into mounting box with power applied as damage resulting from shorting to the mounting box will void the limited warranty.

Detailed Dimensional Drawing



Troubleshooting Guide

Symptom	Probable Cause	Item to Examine or Correct
Completely dead, optional display blank	No battery power	Battery disconnected, overly discharged, or connected reverse polarity. Battery powers the SB2512, not PV (Panel).
Unit will not turn ON (charge status indicator OFF), Display if attached is ON	PV (Panel) disconnected or l ow in voltage	PV (Panel) must supply 0.10 A at greater than battery voltage to begin charge.
	PV (Panel) reverse polarity	Reverse polarity PV (Panel) will cause front to heat.
	IPN network address set wrong	A single unit must be set to IPN network address 0 (zero). One unit of a multi-unit network must be set to IPN network address 0 (zero), AND all other units must be set to different addresses.
	Microprocessor lockup	Momentarily remove all power (battery and Panel) to re-boot.
Charge status indicator ON, but no output charge current	Battery voltage greater than charge voltage setpoint	This is normal operation. Output is off due to high battery voltage which may be caused by other charging systems.
	Battery voltage too low	Battery voltage must be at least 9 V for the SB2512 to operate.
	PV- connected to BAT- external to controller	PV- & BAT- must be separate for proper operation. PV- must receive earth ground via shunts inside the SB2512 which internally connect PV- to BAT-. External connection prevents proper operation of current measurement system.
Charge status indicator blinks rapidly	System in equalize mode	Disable equalize via IPN ProRemote, or by turning DIP switch #4 off.
Charge OFF at high ambient temperature	System temporarily shuts down due to high heat sink temperature	Improve ventilation or reduce PV power. Sufficient ventilation to prevent over temperature shut down will improve reliability.
Charge current is lower than expected, PV (Panel) current may be low as well	Battery is highly charged	Normal operation, current is reduced if in Absorption or Float to control battery voltage.
	Worn out or dissimilar PV modules	Replace, or use as is.
	Low insolation	Atmospheric haze, PV (Panel) is dirty or shaded, sun low on horizon, etc.
	PV- connected to BAT-	PV- & BAT- must be separate for proper operation. PV- must receive earth ground via shunts inside the SB2512 which internally connect PV- to BAT-. External connection prevents proper operation of current measurement system.

Symptom	Probable Cause	Item to Examine or Correct
MPPT Current boost is less than expected	PV maximum power voltage (V_{MP}) is not much higher than battery voltage, leaving little extra power to be extracted	PV's with low V_{MP}. PV's with $V_{MP} \geq 17$ V work best, PV's with <36-cells tend to work poorly.
		Excessive PV (Panel) wiring voltage drop due to undersize wiring, poor connections etc.
		Battery is nearly charged and battery voltage is high. Output during MPPT operation is "constant power" such that higher battery voltage reduces charge current increase.
	PV (Panel) is hot	V_{MP} and available power decrease with increasing PV (Panel) cell temperature. Cooler PV's will produce greater boost. It is normal for % increase to drop or even go to zero as PV (Panel) temperature rises.
	Worn out or dissimilar PV modules	Replace, use as is, or use different controller for different PV modules.
Auxiliary battery not charging	Not configured for auxiliary battery charge	Confirm dip switch #3 is OFF.
	Primary battery not highly charged	Auxiliary battery will not receive charge unless primary battery is in Absorption or Float.
	Load on Auxiliary battery too high	Maximum auxiliary charge current is roughly 2 A. Load may need to be reduced.
System appears OK, but will not switch between Bulk, Absorption (Acceptance) & Float	Not set for 3-stage charge	Double check Float voltage setpoint.
	Will not switch out of Bulk and into Absorption (Acceptance) or Float	Battery is so discharged that available net charge current cannot bring battery voltage up to the desired charge voltage setpoint. PV (Panel power may be too low or loads too high.
	Will not switch from Absorption (Acceptance) to Float	Battery not fully charged. Unit will not switch to Float until battery voltage remains at the Absorption (Acceptance) voltage setpoint continuously for the Charge Time period (or net battery current drops to the Float Transition Current setpoint if using IPN ProRemote).
Load control not working properly	Auxiliary output not set for load control	Confirm dip switch #3 is ON.
	Output may have shut off due to low battery charge	Load will shut off if battery voltage drops below OFF threshold (default 11.5 V). Once shut off, the load will not come back on until battery voltage is above ON threshold (default 12.6 V).
	ON/OFF thresholds set incorrectly	Correct ON/OFF threshold settings.

Dusk-to-Dawn feature, lights will not turn ON or remain ON	Auxiliary output not set for load control	Confirm dip switch #3 is ON and Dusk-to-Dawn enabled.
	Output may have shut off due to low battery charge	Load will shut off if battery voltage drops below OFF threshold (default 11.5 V). Once shut off, the load will not come back on until battery voltage is above ON threshold (default 12.6 V).
	Charge control system ON	Lights will not turn on if charge control system is ON and charging as this is day time.
	Timers set incorrectly	Check time settings Post-Dusk or Pre-dawn timer.
	Valid night time period not seen	Pre-Dawn lighting will not operate until a valid night time period of ≥ 4 hours detected. If PV (Panel) was removed/reconnected, night time period may be inaccurate. Remove & restore power to reboot.
Dusk-to-Dawn feature, lights will not turn OFF	Auxiliary output not set for load control	Confirm dip switch #3 is ON and Dusk-to-Dawn enabled.
	Timers set incorrectly	Either Post-Dusk or Pre-dawn timers must be set to time value to enable Dusk-to-Dawn feature.
	Charge control does not turn ON	Check charge control system related items.
Networked units do not seem to coordinate action or followers do not turn on	IPN network address set wrong	One unit of a multi-unit network must be set to IPN network address 0 (zero), AND all other units must be set to different addresses 1 – 7.
	Network wiring problem	Confirm wiring correctly in place. Use IPN ProRemote, BT Connect, or UCM to see View Charge Unit Status screens to confirm communication with followers.
Temperature related functions do not work.	Temperature sensor not installed on master	Temperature sensor must be installed on the master in a multi-controller system.
	Temperature sensor failed, reverse polarity, or not BSE sensor p/n 930-0022-20.	If sensor is open, short, reverse polarity, wrong sensor or missing system will operate as if sensor was at 25 °C. Sensor temperature can be read directly on the IPN ProRemote, BT Connect, or UCM. Proper sensor voltage when excited by the SB2512 will be 2.98 V at 25 °C, changing at +10 mV/°C.

Specifications

SB2512**	i-HV	iX-HV	iX-HV-Li
Max. Recommended Panel Power	340 W with 36-cell PV panel (1)		
	270 W with 60-cell PV panel (1)		
Rated Battery (Output) Current	25 A with 36-cell PV panel (1)		
	20 A with 60-cell PV panel (1)		
Min. Battery Voltage for Operation	9 V		
Conversion Efficiency	96% (typical @14 V / 20 A output)		
Power Consumption	0.3 W (typical standby)		
Max. Recommended Panel Voc at STC	40 V (Max Panel Input 50 V)		
Display	w/IPN ProRemote, IPN Remote, BT Connect, or ProTouch		
Charge Profile	Multi-Stage charging (2)		
Battery Chemistry	Lead Acid		4S $LiFePO_4$
Absorption Voltage	14.2 V (2)		14.4 V (2)
Absorption Time	2.0 Hr (2)		0.5 Hr (2)
Float Voltage	13.2 V (2)		13.6 V (2)
Equalization Voltage (if enabled)	--	15.2 V (2)	--
Auxliary Output (option A, B, or C)	--	A) Auxiliary 2 A Battery Charge (2nd battery)	
	--	B) Load Control w/LVD	
	--	C) Dusk-to-Dawn w/LVD (by IPN ProRemote or BT Connect)	
Load (LVD) Disconnect / Reconnect Voltage	--	11.5 V / 12.6 V (2)	11.0 V / 12.0 V (2)
Maximum Auxiliary Output current (option B or C)	--	25 A	25 A
Temperature Compensation (by optional Battery Temp. Sensor)	--	-5.00 mV/°C/cell correct factor (Range 0.00 to -8.00 mV/°C/cell) (2)	Disabled
Operating Temperature	-40 °C – 45 °C		
Maximum Full Power Ambient	45 °C		
Environmental Protection	IP20		
Weight	0.87 lb. (395 g)		
Dimensions	5.3 x 5.3 x 2.5" (13.5 x 13.5 x 6.35 cm)		

(1) 36-cell panels are typically referred to as "12 V panels" providing V_{mp}/V_{oc} of ~18 V / 22 V at STC, 60-cell panels refers to "20 V panels" (V_{mp}/V_{oc} ~30 V / 37 V).
(2) Factory default voltages unless programmed with an IPN ProRemote display, BT Connect, ProTouch, or UCM.

5 year limited warranty

Visit https://sunforgellc.com/solar-boost-2512i-hv/ for more information and terms of the warranty.