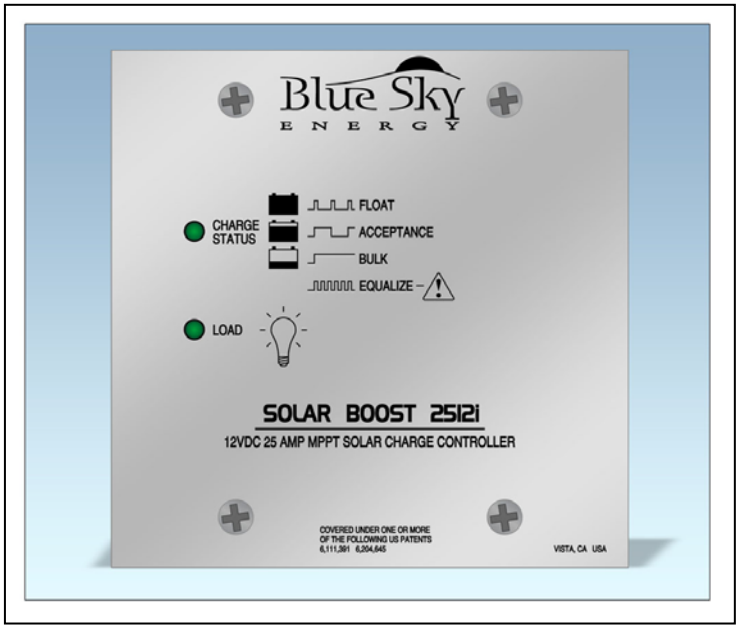
# SOLAR BOOST™ 2512i(X)

25AMP 12VDC MAXIMUM POWER POINT TRACKING
PHOTOVOLTAIC CHARGE CONTROLLER

*INSTALLATION AND OPERATION MANUAL*




THIS MANUAL INCLUDES IMPORTANT SAFETY INSTRUCTIONS FOR MODELS SB2512i and SB2512iX, SAVE THESE INSTRUCTIONS.

COVERED UNDER ONE OR MORE OF THE FOLLOWING US PATENTS
6,111,391 • 6,204,645

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## IMPORTANT SAFETY INSTRUCTIONS

This manual contains important instructions for Models SB2512i and SB2512iX
SAVE THESE INSTRUCTIONS

1. 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.
2. To reduce the risk of electric shock, fire or personal injury, the following symbols are placed throughout this manual to indicate dangerous conditions, or important safety or operational instructions.

| WARNING | CAUTION | IMPORTANT |
|---|---|---|
|  |  |  |
| Indicates dangerous conditions or electric shock potential. Use extreme caution. | Indicates items critical to safe installation or operation of the unit. | Follow these instructions closely for proper operation of the unit |

3. PERSONAL PRECAUTIONS
   a) Working in the vicinity of lead-acid batteries is dangerous. Batteries produce explosive gasses during normal operation.
   b) 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.
   c) Someone should be within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
   d) Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
   e) Wear complete eye protection and clothing protection. Avoid touching eyes while working near battery.
   f) 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.
   g) NEVER SMOKE or allow a spark or flame in vicinity of battery.
   h) 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.
   i) 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.
   j) Remove all sources of power, photovoltaic and battery before servicing or installing.
4. CHARGER LOCATION & INSTALLATION
   a) This unit is designed to charge 12V (6 cell) flooded or sealed type lead-acid chemistry batteries within the range of 20 to 10,000 amp-hours. Follow battery manufacturers charging recommendations when considering this unit for use with other battery chemistry.
   b) This unit employs components that tend to produce arcs or sparks. NEVER install in battery compartment or in the presence of explosive gases.
   c) This unit must be installed and wired in accordance with National Electrical Code, ANSI/NFPA 70.
   d) Over current protection for the battery must be provided externally. To reduce the risk of fire, connect to a circuit provided with 30 amperes maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70.
   e) 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 amperes maximum over current protection in accordance with National Electrical Code, ANSI/NFPA 70.
   f) Insure that unit is properly configured for the battery being charged.
   g) This unit is not water tight. Do not expose to rain, snow or excessive moisture.
   h) Insure all terminating connections are clean and tight. Battery, PV 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).
   i) Do not connect to a PV array capable of producing greater than 20 amperes of short circuit current @ STC.
   j) 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.
5. PREPARING TO CHARGE
   a) Never charge a frozen battery.
   b) Be sure battery is mounted in a well ventilated compartment.
   c) 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 and 2512iX are 25 amp 12 volt *Maximum Power Point Tracking* (MPPT) photovoltaic (PV) battery charge controllers. The full featured Solar Boost 2512iX includes all the features described in this manual. The Solar Boost 2512i omits certain features to reduce cost.

Through the use of patented MPPT technology the 2512 can increase charge current up to 30% or more compared to conventional controllers. The 2512's sophisticated three stage charge control system improves battery performance and life while minimizing battery maintenance. The unit is fully protected against voltage transients, over temperature, over current, reverse battery and reverse PV connections. An automatic current limit feature allows use of the full 25 amp capability without worrying about overload or nuisance fuse blow from excessive current. An environmentally sealed high current high reliability relay is used to disconnect the PV array at night to prevent unwanted current drain. An IPN Network display interface is provided in both versions of the product allow use of the available IPN-Remote or IPN-ProRemote displays.

Additional features included in the Solar Boost 2512iX 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 provide either a 2 amp battery charger for a second battery, 25 amp voltage or amp-hour based load control, or 25 amp variable Dusk-to-Dawn lighting control. The full IPN Network interface included in the Solar Boost 2512iX allows multiple IPN compatible charge controllers to communicate with each other and operate as a single charging machine rather than separate charge controllers.

### FEATURES OMITTED IN THE SOLAR BOOST 2512i

The following features described in this manual are omitted in the lower cost Solar Boost 2512i version of the product. See Figure 3 for omitted connectors and setup selectors.

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

### PART NUMBERS AND OPTIONS

- SB2512i ..... Basic Solar Boost 2512i charge controller
- IPNPRO ..... IPN-ProRemote display & battery monitor
- CS-500 ..... 500A/50mV current shunt
- 930-0022-20 ..... Battery temperature sensor
- SB2512iX ..... Full featured Solar Boost 2512iX charge controller
- IPNPRO-S ..... IPN-ProRemote with required 500A/50mV current shunt
- IPNREM ..... IPN-Remote display
- 930-0039-01 ..... Deluxe mounting box, black powder coated

## OPERATION

Charge control and MPPT operation are fully automatic. At night when PV power production stops, the PV 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.

➢ The 2512 operates on battery power, not PV power. A battery must be connected with a minimum voltage of 9V for the unit to operate.

### CHARGE STATUS INDICATOR

A charge status indicator is provided on the face of the 2512, and on the optional remote displays. If net battery charge current is greater than ≈3 to 5 amps per 100 amp-hours of battery capacity the charge status indicator can provide a rough indication of battery state of charge.

CHARGE STATUS INDICATOR

| CHARGE STATUS INDICATOR | CHARGE MODE | APPROXIMATE CHARGE LEVEL |
|---|---|---|
| OFF | CHARGE OFF | ——————— |
| CONTINUOUSLY ON | BULK | <70% FULL |
| BLINKING • 1 SEC ON / 1 SEC OFF | ACCEPTANCE | 70% - 95% FULL |
| BLINKING • 0.2 SEC ON / 1 SEC OFF | FLOAT | FULLY CHARGED |
| RAPID BLINKING • 0.2 SEC ON / 0.2 SEC OFF | EQUALIZE | ——————— |

TABLE 1

### AUXILIARY OUTPUT INDICATOR (Omitted on SB2512i)

An Auxiliary Output indicator labeled "LOAD" is provided on the face of the SB2512iX, and is omitted on the SB2512i. The indicator will be ON when the auxiliary output is ON providing power to a load, or charging an auxiliary battery. Auxiliary Output status can also be viewed on the IPN-ProRemote.

### OPTIONAL REMOTE DISPLAYS

There are two available remote displays, the low cost IPN-Remote and the full featured IPN-ProRemote. The IPN-Remote is a basic 3-digit LED type voltage, 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.

THREE STAGE CHARGE CONTROL

The 2512 is factory configured for a three stage charging process, Bulk, Acceptance and Float. The three 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. Three stage charge improves battery performance and life while minimizing battery maintenance.

*Bulk Charge*

The 2512 will be in Bulk charge when battery voltage is below the Acceptance Charge Voltage setpoint. During Bulk the 2512 delivers as much charge current as possible to rapidly recharge the battery and drive battery voltage up to the Acceptance Charge Voltage setpoint.

*Acceptance Charge*

When the battery recovers sufficient charge for battery voltage to rise to the Acceptance Charge Voltage setpoint (factory set to 14.2V) current is reduced as necessary to hold the battery at the Acceptance Voltage. The 2512 remains in Acceptance until the battery is fully charged as determined by either;

1. The 2512 has remained in Acceptance continuously for the Charge Time period (factory set to 2 hours).

– OR –

2. With the IPN-ProRemote display, net battery charge current while in Acceptance decreases to the Float Transition Current setting (factory set to 1.5A per 100 amp-hours of battery capacity).

*Float Charge*

Once the battery is fully charged a somewhat lower Float Voltage (factory set to 13.2V) 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 ≈0.1–0.2 amps per 100 amp-hours of battery capacity.

TWO STAGE CHARGE CONTROL

Certain battery types or system configurations may require two stage charge control. The 2512 can be configured for two stage Bulk/Acceptance charge control by setting the Float charge voltage setting to No Float using the IPN-ProRemote. Refer to the IPN-ProRemote operators manual.

FRONT PANEL INDICATORS

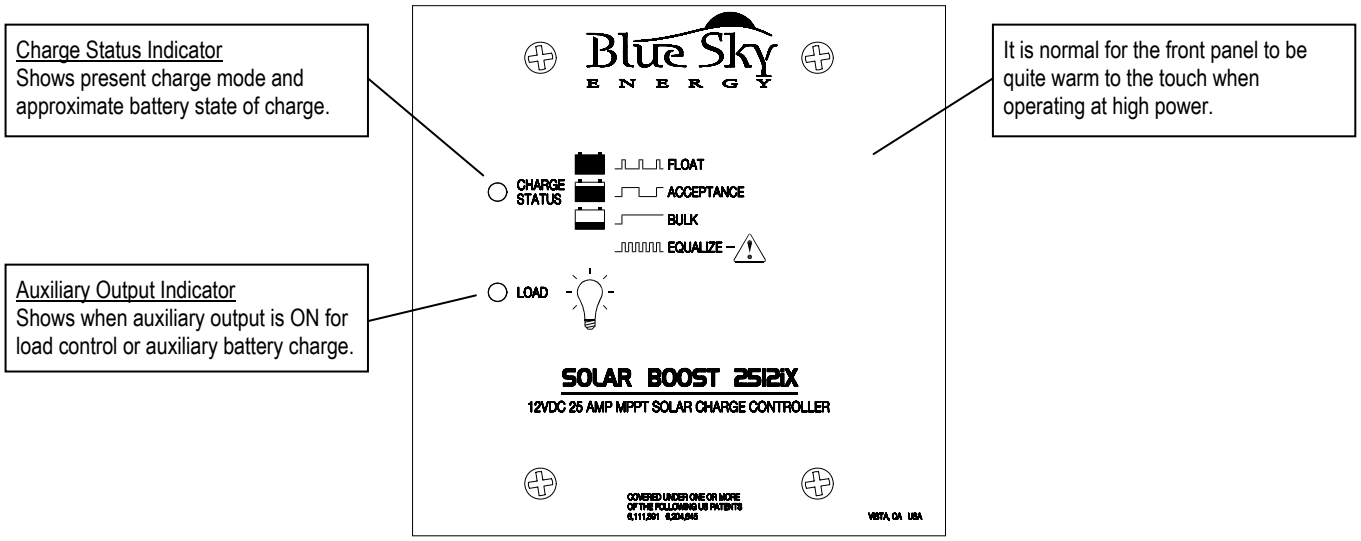



FIGURE 1

EQUALIZATION (Omitted on SB2512i)

➢ 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 voltage producing significant battery gassing. Disconnect equipment that cannot tolerate the high equalization voltage which is temperature compensated.

The SB2512iX can perform automatic equalization alone, or manual equalization via the IPN-ProRemote. Equalization is essentially a controlled overcharge which applies a relatively high voltage to bring all battery cells up to the same specific gravity and eliminates electrolyte stratification by heavily gassing the battery. While equalization parameters are adjustable with the IPN-ProRemote, factory default parameters of 15.2V for 2 hours every 30 days are suitable for most applications. A minimum net charge current of approximately 3 amps per 100 amp-hours of battery capacity is required for proper equalization.

The equalization timer is a "time at voltage" time accumulator counting in 3 minute increments. The equalization timer will not count down unless the battery reaches the equalization voltage setpoint. Unless manually canceled the 2512 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. If equalize does not complete in a reasonable period of time due to insufficient current, it should be canceled manually via the IPN-ProRemote or by momentarily removing power to reboot the SB2512iX.

CURRENT LIMIT

If PV input power is high enough to produce more than 25 amps of output current, the 2512 will automatically prevent output current from exceeding 25 amps. Note that when the 2512 exits current limit, it will briefly show Acceptance on the Charge Status Indicator even though battery voltage may be low.

OPTIONAL TEMPERATURE COMPENSATION (Omitted on SB2512i)

The charge voltage required by batteries changes with battery temperature. Temperature compensation of charge voltage enhances battery performance and life, and decreases maintenance. Automatic temperature compensation can be provided using the optional battery temperature sensor (BSE p/n 930-0022-20). The default compensation factor of –5.00mV/°C/cell is appropriate for most lead-acid batteries.

FACTORY DEFAULT CHARGE VOLTAGE SETPOINT -VS.- BATTERY TEMPERATURE

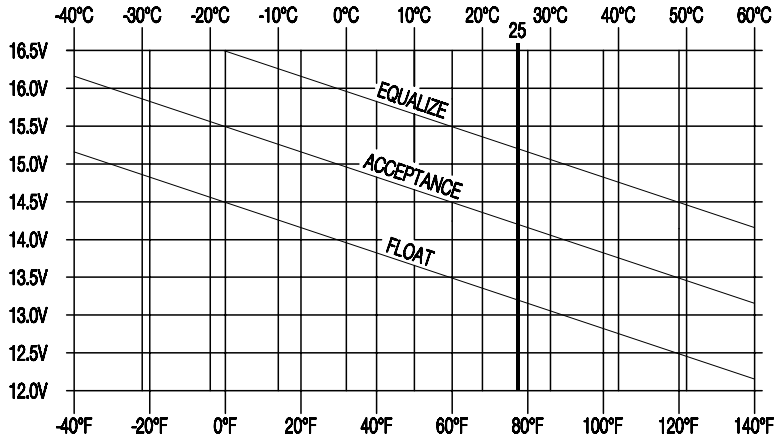



FIGURE 2

MAXIMUM SETPOINT VOLTAGE LIMIT

Regardless of setpoint values entered by the user or result from temperature compensation the 2512 will not apply a charge voltage setpoint greater than the maximum voltage setpoint limit factory configured to 15.5V. Note that actual battery voltage may briefly exceed this value by 0.1 – 0.2V as the voltage control servo responds to changes in load.

MAXIMUM POWER POINT TRACKING (MPPT)

Patented MPPT technology can extract more power and increase charge current up to 30% or more compared to conventional controllers. The principal operating conditions which affect current boost performance are PV array temperature and battery voltage. At constant solar intensity, available PV voltage and power *increase* as PV temperature *decreases* but it takes an MPPT controller to access this extra power. When PV voltage is sufficiently high in Bulk for MPPT to operate, a *constant power* output is delivered to the battery. Since output power is constant a *decrease* in battery voltage produces a further *increase* in charge current. This means that the 2512 provides the greatest charge current increase when you need it most, in cold weather with a discharged battery. In cool comfortable temperatures most systems see about 10 – 20% increase. Charge current increase can go to zero in hot temperatures, whereas charge current increase can easily exceed 30% with a discharged battery and freezing temperatures. For a more complete MPPT description see www.blueskyenergyinc.com.

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°C (104°F). If an over temperature condition exists, the unit will shut down and the Charge Status Indicator will display an OFF condition. The 2512 does not include a digital type temperature sensor and will always show the heatsink to be –55°C on the IPN-ProRemote.

MULTIPLE CHARGE CONTROLLERS ON THE IPN NETWORK (Omitted on SB2512i)

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 and battery temperature sensor. 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 charge controller.

## 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 amp maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70. Do not connect a PV array capable of delivering greater than 24 amps of short circuit current $I_{SC}$ at STC. 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 as damage resulting from shorting to the mounting box voids the limited warranty.. Figures 3, 4 and 5 show generalized connections only and are not intended to show all wiring, circuit protection and safety requirements for a photovoltaic electrical system.

➢ CAUTION: The 2512 is protected against reverse battery and PV polarity, and swapped PV and battery connections, but will be damaged by reverse battery to the PV terminals. Transient voltage lightning protection is provided, but steady state voltage in excess of 35VDC on the battery or PV 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 2512 and avoid touching components on the circuit boards. The risk of electrostatic damage is highest when relative humidity is below 40%.

SELECTING PV MODULES

Voltage, current and power produced by Photovoltaic (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 $I_{MP}$ 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 ≈20 – 22V for 12V nominal modules)
$V_{MP}$ Voltage where module produces Maximum Power (typically ≈17 – 18V for 12V nominal modules)
$I_{MP}$ Current where module produces Maximum Power
$I_{SC}$ Current with module Short Circuit

The 2512 will provide the best MPPT current boost performance if all PV modules are identical. Dissimilar modules should have $V_{MP}$ values within ≈0.5V 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. Select PV modules that do not exceed the maximum ratings shown below, and preferably produce at least 3A of $I_{MP}$ per 100 amp-hours of battery capacity.

| Maximum PV Power @ STC | Maximum PV Isc @ STC | Maximum PV $V_{OC}$ @ STC | Recommended range of $V_{MP}$ at STC |
|---|---|---|---|
| | | | Nominal 12V PV |
| 340W | 20A | 28.0V | 16.5 – 18.5V |

AS SHIPPED FACTORY DEFAULT SETTINGS

➢ The 2512 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 require the IPN-ProRemote to change and are retained if power is lost or the IPN-ProRemote is used as a setup tool only and removed.

Software programmable settings

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

DIP switch & jumper settings (All DIP's OFF, A2 open – Defaults cannot be changed on SB2512i)

- Auxiliary Output mode ..... Auxiliary battery charger
- Equalize ..... Disabled
- IPN Network address ..... 0 (zero)

EQUALIZE ENABLE (Omitted on SB2512i)

If DIP switch #4 is turned OFF, equalization is completely disabled. 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 the first automatic equalization cycle will begin immediately. Equalization can also be controlled from the IPN-ProRemote if DIP switch #4 is ON.

BATTERY TEMPERATURE SENSOR (Omitted on SB2512i)

Installation of the optional battery temperature sensor enables temperature compensation of all charge voltage setpoints. In a multi-controller system a single temperature sensor must connect to the IPN master. Do not attach a sensor or connections other than Blue Sky Energy battery temperature sensor p/n 930-0022-20. Be certain to observe proper RED/BLK polarity.

BATTERY AND PV WIRING

A desirable installation will produce a total system wiring voltage drop of 3% or less. The lengths shown in Table 2 are one way from the PV modules to the battery with the 2512 located along the path. Wire length can be increased inversely proportional to actual current. If current was reduced by ½, wire lengths could be doubled and still provide the same 3% voltage drop.

MAXIMUM CONDUCTOR PAIR LENGTH – 3% VOLTAGE DROP

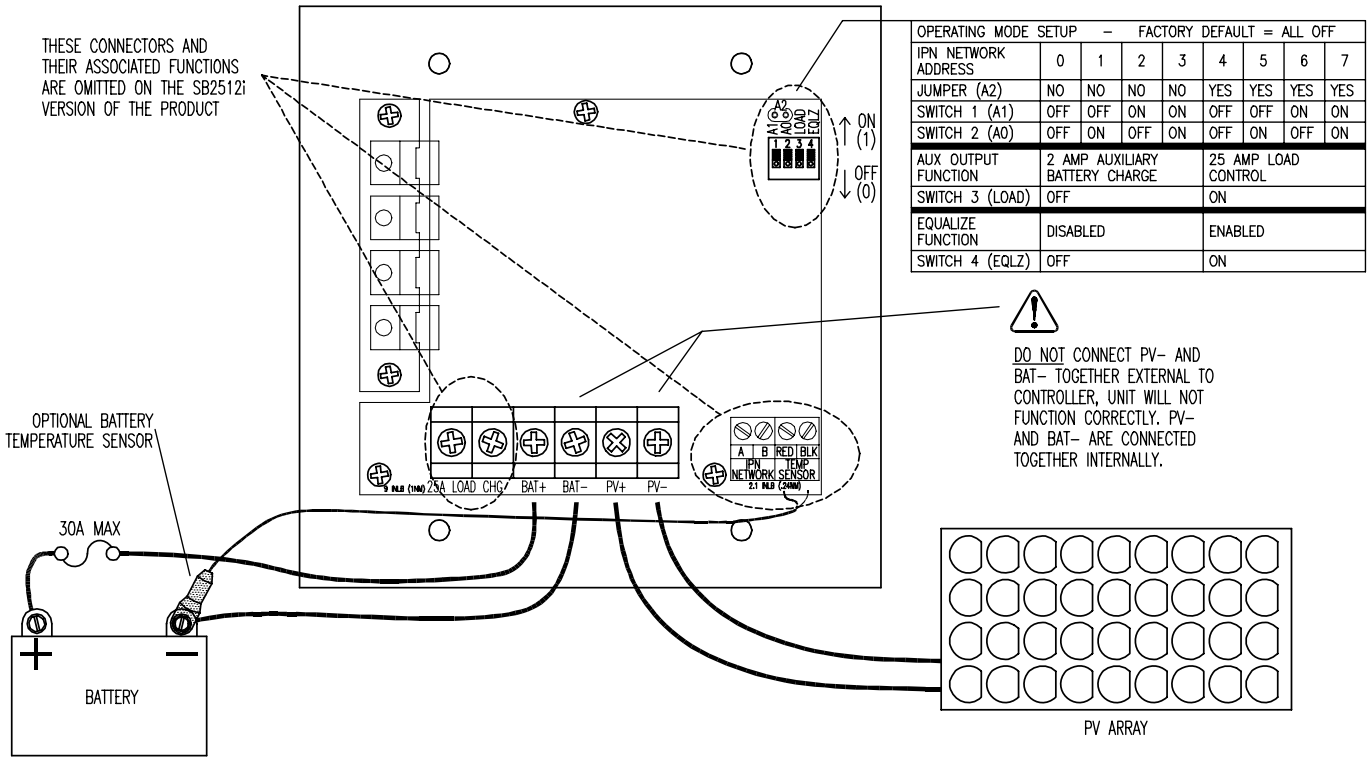
| WIRE GAUGE AWG | 12 VOLT SYSTEM @20AMPS FEET / METERS |
|---|---|
| 12 AWG | 6.4 / 1.9 |
| 10 AWG | 10.2 / 3.1 |
| 8 AWG | 16.2 / 4.9 |
| 6 AWG | 25.7 / 7.8 |
| 4 AWG | 40.8 / 12.5 |

TABLE 2

➢ CAUTION: Battery, PV 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).

➢ CAUTION: DO NOT connect Bat– and PV– together outside of the unit or improper operation will result. Bat– and PV– connect together internally.

SETUP AND WIRING DIAGRAM




| 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 AMP AUXILIARY BATTERY CHARGE | | | | 25 AMP LOAD CONTROL | | | |
| SWITCH 3 (LOAD) | OFF | | | | ON | | | |
| EQUALIZE FUNCTION | DISABLED | | | | ENABLED | | | |
| SWITCH 4 (EQLZ) | OFF | | | | ON | | | |

FIGURE 3

AUXILIARY OUTPUT (Omitted on SB2512i)

The auxiliary output can serve one of three functions; a 2 amp auxiliary battery charger, a 25 amp load controller with Low Voltage Disconnect (LVD), or a 25 amp variable Dusk-to-Dawn lighting load controller. The Charge/Load function is selected by DIP switch #3 shown in Figure 3. The IPN-ProRemote is required to adjust LVD thresholds or enable Dusk-to-Dawn lighting control. Auxiliary outputs in a multi-controller system will function normally, but only the auxiliary output in the master can be configured or monitored using the IPN-ProRemote. 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 25amp Load terminal for auxiliary battery charge.

*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 Acceptance or Float, up to 2 amps 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 amp maximum over current protection. Auxiliary battery negative must connect to primary battery negative.

AUXILIARY OUTPUT WIRING

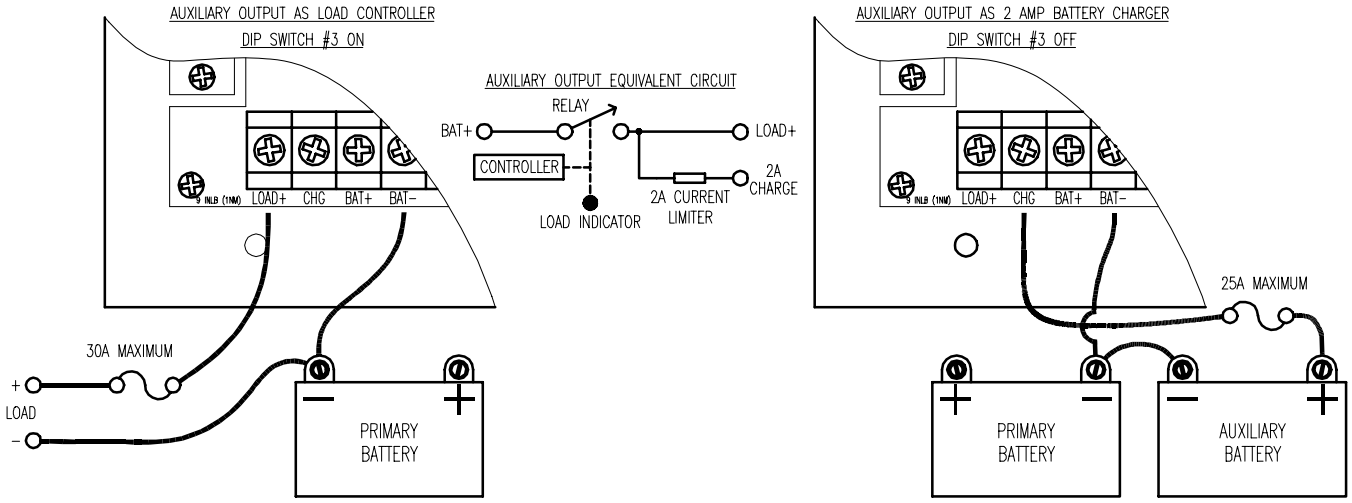



FIGURE 4

*LOAD CONTROLLER – DIP #3 ON*

The load controller can deliver up to 25 amps of output from battery positive. Default settings are for Low Voltage Disconnect (LVD) with ON at $V_{BAT}$ ≥12.6V, and OFF at $V_{BAT}$ ≤11.5V, which can be changed with the IPN-ProRemote. Operation can also be based on net battery amp-hours 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. Load negative must connect to battery negative.

➢ CAUTION: 30 amp 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*

An IPN-ProRemote with software version V2.00 or later is required to setup and enable lighting control. Refer to IPN-ProRemote 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 load 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 ≈50mA at battery voltage. Dawn or day time begins when the charge control system turns ON which occurs when PV module current rises to ≈100mA 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 SB2512iX 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.

INSTALLING A MULTI-CONTROLLER SYSTEM

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 Figure 5. 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 slaves. The master controls the charging process and directs the activities of the slaves.

*MULTI-CONTROLLER WIRING AND SETUP*

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

1) Each controller must connect to and charge the same battery.
2) 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.
3) Charge parameters are set in the master only.
4) While outputs connect in parallel to a common battery, PV inputs must be completely separate. A large PV array must be divided into sub-arrays, each with separate PV+ and PV– wiring.
5) All controllers must be connected to the IPN network as shown in Figure 5.

IPN NETWORK WIRING

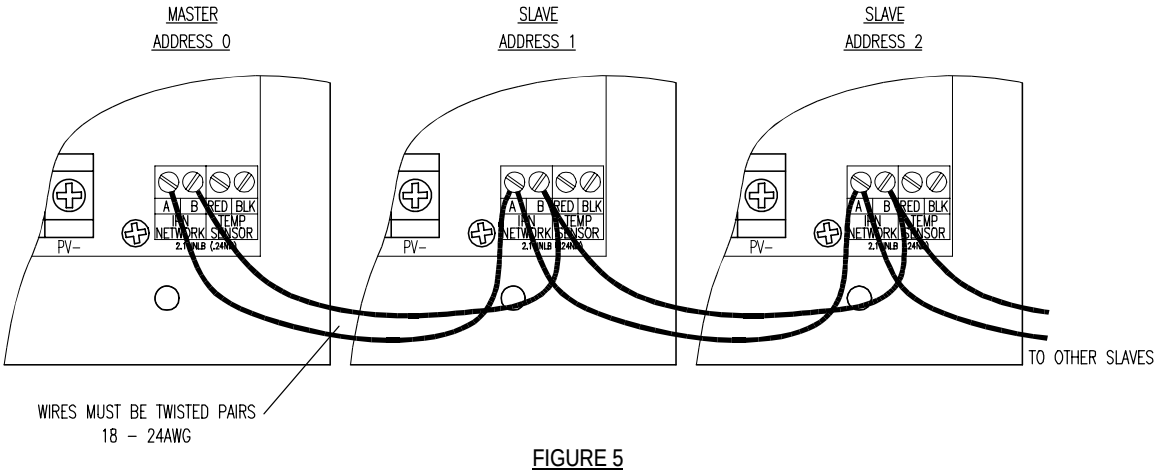



FIGURE 5

*IPN Network Address – DIP's #1, #2 & Jumper A2* (Omitted on SB2512i)

➢ 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 SB2512iX requires that a jumper be soldered across location A2 to select addresses 4 through 7.

| IPN NETWORK ADDRESS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DIP SWITCH | MASTER | SLAVES | | | | | | |
| | 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 |

MOUNTING

➢ CAUTION: Mount the 2512 vertically to promote air flow and do not enclose in a confined space. The 2512 is not watertight and must be protected from rain, snow and excessive moisture. Take care not to place mounting screws under large brown capacitor when securing mounting box to mounting surface. DO NOT remove from or install into mounting box with power applied as damage resulting from shorting to the mounting box voids the limited warranty. Optional black powder coated deluxe mounting box available.

DETAILED DIMENSIONAL DRAWING

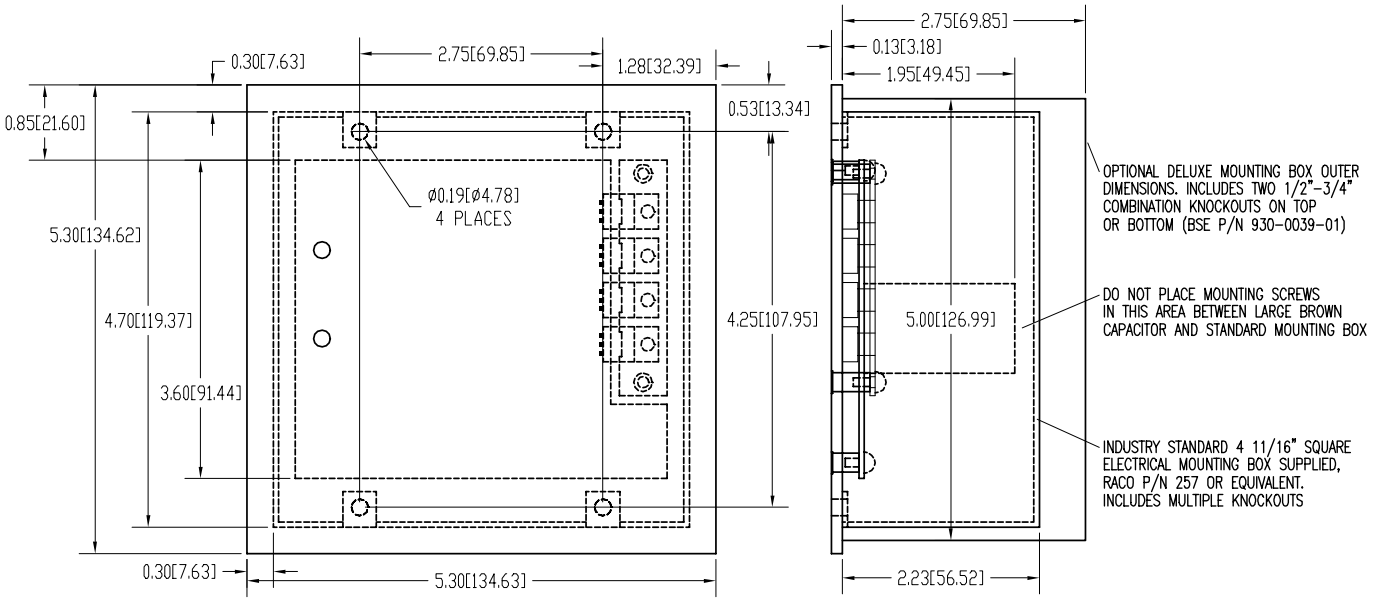



FIGURE 6

## TROUBLESHOOTING GUIDE

| SYMPTOM | PROBABLE CAUSE | ITEMS TO EXAMINE OR CORRECT |
|---|---|---|
| Completely dead, optional display blank | No battery power | Battery disconnected, overly discharged, or connected reverse polarity. Battery powers the 2512, not PV. |
| Unit will not turn ON (charge status indicator OFF), Display if attached is ON | PV disconnected or low in voltage | PV must supply 0.10 amps at greater than battery voltage to begin charge. |
| | PV reverse polarity | Reverse polarity PV 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 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 9V for the 2512 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 2512 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. See Technical Bulletin #100206. |
| Charge current is lower than expected, PV current may be low as well | Battery is highly charged | Normal operation, current is reduced if battery voltage is at setpoint. |
| | Worn out or dissimilar PV modules | Replace, or use as is. |
| | Low insolation | Atmospheric haze, PV's 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 2512 which internally connect PV- to BAT-. External connection prevents proper operation of current measurement system. |
| 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 $V_{MP} \geq$ 17V work best, PV's with <36 cells tend to work poorly. |
| | | Excessive PV 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", higher battery voltage reduces charge current increase. |
| | PV's hot | $V_{MP}$ and available power decrease with increasing PV cell temperature. Cooler PV's will produce greater boost. It is normal for boost to decrease as PV temperature rises. |
| | Worn out or dissimilar PV modules | Replace, use as is, or use different controller for different PV modules. |
| Auxiliary battery not being 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 Acceptance or Float. |
| | Load on Auxiliary battery too high | Maximum auxiliary charge current is roughly 2 amps. Load may need to be reduced. |
| System appears OK, but will not correctly switch between Bulk, Acceptance & Float | Not set for 3 stage charge | Double check Float voltage setpoint. |
| | Will not switch out of Bulk and into Acceptance or Float | Battery is so discharged that net charge current cannot bring battery voltage up to the desired charge voltage setpoint. PV power may be too low or loads too high. |
| | Will not switch from Acceptance to Float | Battery not fully charged. Unit will not switch to Float until battery voltage remains at the 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 | 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 11.5V). Once shut off, the load will not come back on until battery voltage is above ON threshold (default 12.6V). |
| | 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 11.5V). Once shut off, the load will not come back on until battery voltage is above ON threshold (default 12.6V). |
| | Charge control system ON | Lights will not turn on if charge control system is ON and charging. |
| | 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 $\geq$4 hours detected. If PV 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 |

| SYMPTOM | PROBABLE CAUSE | ITEMS TO EXAMINE OR CORRECT |
|---|---|---|
| Networked units do not seem to coordinate action or slaves 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. |
| | Network wiring problem | Confirm wiring correctly in place. Use IPN-ProRemote to view Charge Unit Status screens to confirm communication. |
| 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 inputs on slaves are disabled. |
| | Temperature sensor failed or installed reverse polarity | If sensor is open, short, reverse polarity or missing system will operate as if sensor was at 25°C. Sensor temperature can be read directly on the IPN-ProRemote. Sensor voltage when connected reads 2.98V at 25°C, changing at +10mV/°C. |

## SPECIFICATIONS

| SPECIFICATIONS | Solar Boost 2512i |
|---|---|
| Output Current Rating | 25 amp maximum, automatic 25 amp output current limit |
| Nominal Battery Voltage | 12VDC |
| PV Input Voltage | 35VDC absolute maximum (Recommend maximum $V_{OC}$ at STC ≤ 28VDC) |
| Power Consumption | 0.35W typical standby • 1.0W typical charge ON |
| Charge Algorithm | 3-stage Bulk/Acceptance/Float • Charge time in Acceptance fixed at 2 hours (Range 0 – 10 hours[3]) |
| Acceptance Voltage | 14.2VDC fixed value (10.0 – 20.0VDC[3]) |
| Float Voltage | 13.2VDC fixed value (10.0 – 20.0VDC[3]) |
| Power Conversion Efficiency | 95% @ 14 volt 20 amp output |
| Physical Configuration and Dimensions | Open frame construction with conformal coated electronics mounted to rear of 5.3" x 5.3" (13.5cm x 13.5cm) clear anodized aluminum face plate. Mounts into standard 4 11/16" (11.9cm) square electrical box which is included. |
| Analog Input Accuracy / Range | Battery and PV voltmeters, 35.0VDC ±0.50% FS • Input/Output ammeters, 30.0 amps ±0.50% FS |
| Communication | IPN Network interface for IPN displays only. Full IPN interface to allow multi-controller coordination not provided. |
| Environmental | -40 – +40°C, 10 – 90% RH non-condensing |
| | Additional Specifications for Solar Boost 2512iX |
| Equalization Voltage | 15.2VDC fixed value (range 10.0 – 40.0VDC[3]) • Automatic fixed at 2 hours each 30 days, may be disabled |
| Auxiliary Output Functionality | Single output field configurable as either: 25 amp load controller –or– 2 amp auxiliary battery charger |
| • Aux. Battery Charge | 2 amp typical, same charge voltage as primary battery |
| • Load Control | 25 amp maximum; ON @ ≥12.6VDC / OFF @ ≤11.5VDC (Range 10.0 – 40.0VDC[3]), or net battery amp-hours[3]) |
| • Lighting Control[3] | Variable Post-Dusk and Pre-Dawn timers[3], Range 0.5 – 20.0 hours |
| Temperature Compensation | Optional battery temperature sensor, -5.00 mV/°C/cell correction factor (Range -0.00 – -8.00 mV/°C/cell[3]) • sensor range -60 – +80°C |
| Auxiliary Battery Voltage | Auxiliary battery voltmeter, 35.0VDC ±0.50% FS |
| Communication | Complete IPN Network interface. Allows up to 8 IPN capable controllers to set up and operate as a single charging machine., |

As a part of our continuous improvement process specifications are subject to change without prior notice

[3] With IPN-ProRemote which may be used as a setup tool only, or permanently installed.

## FIVE YEAR LIMITED WARRANTY

Blue Sky Energy, Inc. (hereinafter BSE), hereby warrants to the original consumer purchaser, that the product or any part thereof shall be free from defects due to defective workmanship or materials for a period of five (5) years subject to the conditions set forth below.

1. This limited warranty is extended to the original consumer purchaser of the product, and is not extended to any other party.
2. The limited warranty period commences on the date the product is sold to the original consumer purchaser. A copy of the original purchase receipt identifying purchaser and date of purchase, must accompany the product to obtain warranty repairs.
3. This limited warranty does not apply to, and future warranty shall become void, for any product or part thereof damaged by; a) alteration, disassembly or application of a foreign substance, b) repair or service not rendered by a BSE authorized repair facility, c) accident or abuse, d) corrosion, e) lightning or other act of God, f) operation or installation contrary to instructions pertaining to the product, or g) cosmetic aging.
4. If BSE's examination of the product determines that the product is not defective the consumer shall be charged a test and evaluation fee of $20 and be responsible for all transportation costs and insurance related to returning the product to the consumer. The consumer is ultimately responsible for proper installation and operation of the product and BSE's prior troubleshooting assistance shall not serve as a waiver of the test and evaluation fee. The test and evaluation fee is subject to change without prior notice.
5. If within the coverage of this limited warranty, BSE shall repair or replace the product at BSE's sole discretion and return the product via standard ground transportation of BSE's choosing within the continental US. The consumer shall be responsible for all transportation costs and insurance to return the product outside the continental US, and for all transportation costs and insurance related to expedited return of the product. BSE's liability for any defective product or any part thereof shall be limited to the repair or replacement of the product. BSE shall not be liable for any loss or damage to person or property, or any other damages, whether incidental, consequential or otherwise, caused by any defect in the product or any part thereof.
6. Any implied warranty for merchantability or fitness for a particular purpose is limited in duration to the length of this warranty.
7. To obtain warranty repairs, contact BSE at 760-597-1642 to obtain a Returned Goods Authorization (RGA) number. Mark the outside of the package with the RGA number and return the product, postage prepaid and insured to the address below. The consumer is responsible for all transportation costs and insurance related to returning the product to BSE, and for any shipping damage which may void the warranty or increase the cost of repairs.

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