



## SB1524iX

(SOLAR BOOST™ 1524iX MPPT)

15 AMP 24VDC / 20 AMP 12VDC MAXIMUM POWER POINT TRACKING  
PHOTOVOLTAIC CHARGE CONTROLLER

### INSTALLATION AND OPERATION MANUAL



**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.



THIS MANUAL INCLUDES IMPORTANT SAFETY INSTRUCTIONS FOR MODEL SB1524iX  
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 Model SB1524iX - 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) or 24V (12-cell) flooded or sealed type lead-acid chemistry batteries within the range of 10 to 5,000 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 25 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 25 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 16A short circuit current for 12V systems, or 12A short circuit for 24V systems. Limit input short circuit current to 6A if the 24V input 12V output mode is used or 8A if the 18V input 12V output mode is used.
- 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™ 1524iX is a 12V or 24V multi-stage *Maximum Power Point Tracking* (MPPT) photovoltaic battery charge controller capable delivering up to 15 amps or 20 amps depending on PV modules and battery voltage. An auxiliary output can serve as either a 2A auxiliary battery charger, or as a load controller with or without variable Dusk-to-Dawn lighting control. The 1524 includes an IPN Network interface which allows multiple charge controllers to communicate with each other and operate as a single charging machine.

Through the use of patented MPPT technology the 1524 can increase charge current up to 30% or more compared to conventional controllers. The 1524’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.

**PART NUMBERS AND OPTIONS**

- SB1524iX .....Solar Boost 1524iX charge controller
- IPNPRO .....IPN ProRemote display & battery monitor
- CS-500 .....500A/50mV current shunt
- 930-0022-20 ....Battery temperature sensor
- 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 eliminating the need for external blocking diodes. There is a 5 second turn-on delay, and a 45 second turn-off delay.



➤ The 1524 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 1524, and on the optional remote displays. If net battery charge current is greater than  $\approx 3$  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	ABSORPTION	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**

An Auxiliary Output indicator labeled LOAD is provided on the face of the 1524. 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 low power 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 1524 is factory configured for a three stage charging process, Bulk, Absorption 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 1524 will be in Bulk charge when battery voltage is below the Absorption Charge Voltage setpoint. During Bulk the 1524 delivers as much charge current as possible to rapidly recharge the battery and drive battery voltage up to the Absorption Charge Voltage setpoint.

**Absorption Charge**

When the battery recovers sufficient charge for battery voltage to rise to the Absorption Charge Voltage setpoint (factory set to 14.2/28.4V) current is reduced as necessary to hold the battery at the Absorption Voltage. The 1524 remains in Absorption until the battery is fully charged as determined by either;

1. The 1524 has remained in Absorption continuously for the Charge Time period (factory set to 2 hours).

– OR –

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

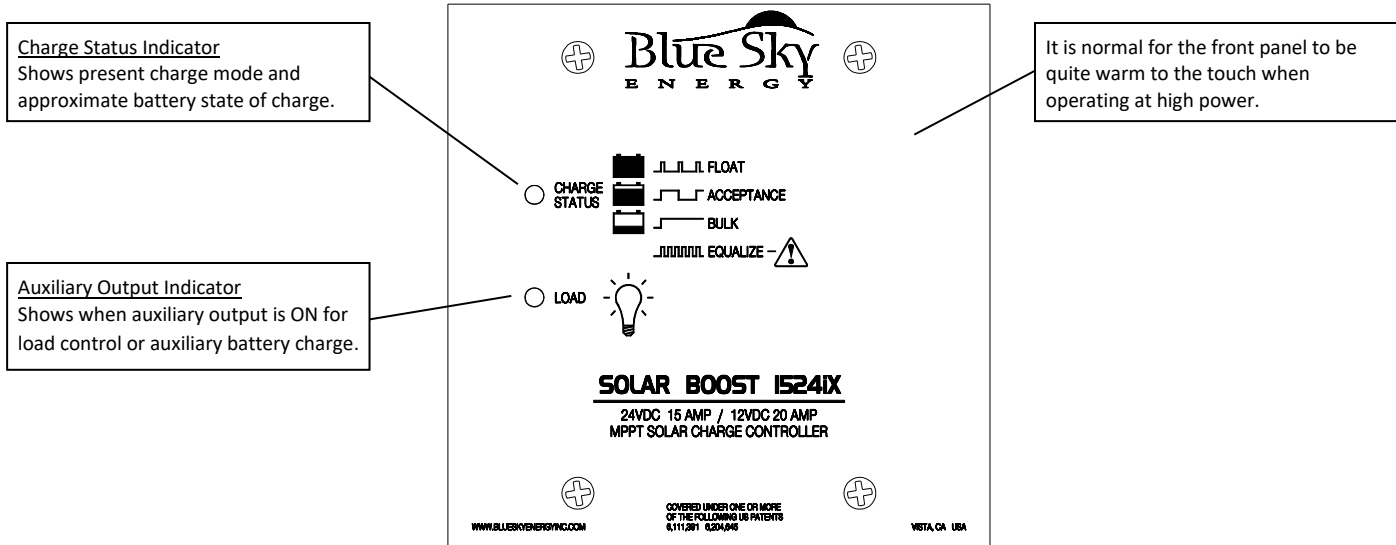
**Float Charge**

Once the battery is fully charged a somewhat lower Float Voltage (factory set to 13.2/26.4V) 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 which eliminates the Float charge stage. The 1524 can be configured for two stage Bulk/ Absorption charge control by setting the Float charge voltage setting to “No Float” using the IPN ProRemote or the UCM. Refer to the IPN ProRemote or UCM operators manual.

**FRONT PANEL INDICATORS**



**FIGURE 1**

**EQUALIZATION**



**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.

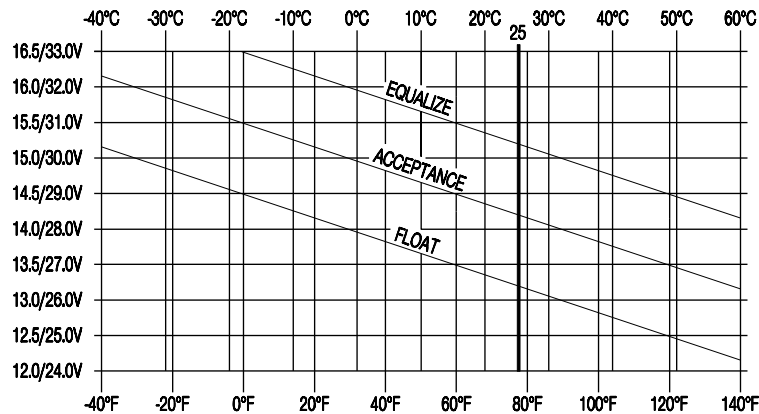
The SB1524 can perform automatic equalization alone, or manual equalization via the IPN ProRemote. Equalization is essentially a controlled overcharge which applies a relatively high voltage to bring all battery cells up to the same specific gravity and eliminates electrolyte stratification by heavily 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 3.5 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 1524 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 1524.

**CURRENT LIMIT**

Automatic current limit prevents output current from exceeding 20A with 12V batteries and 12V PV’s. If PV open circuit voltage (V<sub>oc</sub>) ever exceeds 30V which would occur with PV voltage greater than 12V nominal, current limit will become 15A until the 1524 reboots. Note that when the 1524 exits current limit the charge control system will briefly enter Absorption on it’s way back to MPPT even though battery voltage may be low.

**OPTIONAL TEMPERATURE COMPENSATION**

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 1524 will not apply a charge voltage setpoint greater than the maximum voltage setpoint limit factory configured to 15.5/31.0V. 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 1524 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](http://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 50°C (122°F). If an over temperature condition exists, the unit will shut down and the Charge Status Indicator will display an OFF condition. The 1524 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**

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 20A maximum branch-circuit over current protection (25A with 12V battery and 12V PV modules) in accordance with National Electrical Code, ANSI/NFPA 70. Do not connect a PV array capable of delivering greater than 12A of short circuit current  $I_{SC}$  at STC (16A with 12V battery and 12V PV modules). Do not connect BAT– and PV– together external to the unit. The 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 NEC for the installation location. To reduce risk of electric shock, remove all sources of power before installing or servicing. 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 1524 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 57VDC 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 1524 and avoid touching components on the circuit boards. The risk of electrostatic damage is highest when relative humidity is below 40%.

**BATTERY AND PV VOLTAGE**

Nominal battery voltage and PV voltage are determined automatically. The battery is considered to be 12V if battery voltage following boot is less than 16V, or 24V if battery voltage is greater. If the battery is determined to be 24V all 12V voltage setpoints are doubled. PV voltage is also determined automatically. If nominal PV voltage is changed following installation power must be momentarily removed to reboot the 3024 to reconfigure PV voltage.

**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  $\approx 20 - 22V$  for 12V modules)
- $V_{MP}$  Voltage where module produces Maximum Power (typically  $\approx 17 - 18V$  for 12V modules)
- $I_{MP}$  Current where module produces Maximum Power
- $I_{SC}$  Current with module Short Circuit

The 1524 will provide the best MPPT current boost performance if all PV modules are identical. If module types are mixed, do not put dissimilar modules in series. Dissimilar modules in parallel should have  $V_{MP}$  values within  $\approx 0.5V$  or better for 12V modules, 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.

Nominal Battery Voltage	Automatic Current Limit	Maximum PV Power @ STC	Maximum PV Isc @ STC	Maximum PV Voc @ STC	Recommended range of $V_{MP}$ at STC		
					Nominal 12V PV	Nominal 18V PV	Nominal 24V PV
12V	20A*	270W	16A*	24.0V*	16.5 – 18.5V	-	-
12V	15A	200W	8A	45.6V	-	24.8 – 27.8V	-
12V	15A	200W	6A	45.6V	-	-	33.0 – 37.0V
24V	15A	400W	12A	45.6V	-	-	33.0 – 37.0V

(\*)Current rating and current limit are 20A when charging a 12V battery from nominal 12V PV modules. If PV  $V_{oc}$  ever exceeds 30V (>12V nominal PV modules) current rating and current limit become 15A.

**AS SHIPPED FACTORY DEFAULT SETTINGS**



➤ The 1524 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
- Absorption voltage ..... 14.2/28.4V
- Float voltage ..... 13.2/26.4V
- Charge time ..... 2.0 hours
- Float Transition Current ..... 1.5A/100 amp-hours
- Load control ON voltage ..... 12.6/25.2V
- Load control OFF voltage ..... 11.523.0V
- Equalize voltage ..... 15.2/30.4V
- Equalize time ..... 2.0 hours
- Auto equalize days ..... 30 days
- Maximum voltage setpoint limit ..... 15.5/31.0V
- Temperature compensation factor ..... -5.00mV/°C/cell
- Dusk-to-Dawn lighting control ..... Disabled

DIP switch & jumper settings (All DIP's OFF, A2 open)

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

**EQUALIZE ENABLE**

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 1524 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 automatic equalization cycle will begin immediately. Equalization can also be started and stopped from the IPN ProRemote if DIP switch #4 is ON.

**ELECTROMAGNETIC COMPATIBILITY (CE and FCC Marks)**

To comply with electromagnetic compatibility requirements, the SB1524iX must be installed with as many as two ferrite suppressors . Clamp one suppressor (supplied with SB1524iX) 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**

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. The cable may be lengthened or shortened if necessary. 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 1524 located along the path. Wire length can be increased inversely proportional to actual current. If current was reduced by 1/2, wire lengths could be doubled and still provide the same 3% voltage drop.



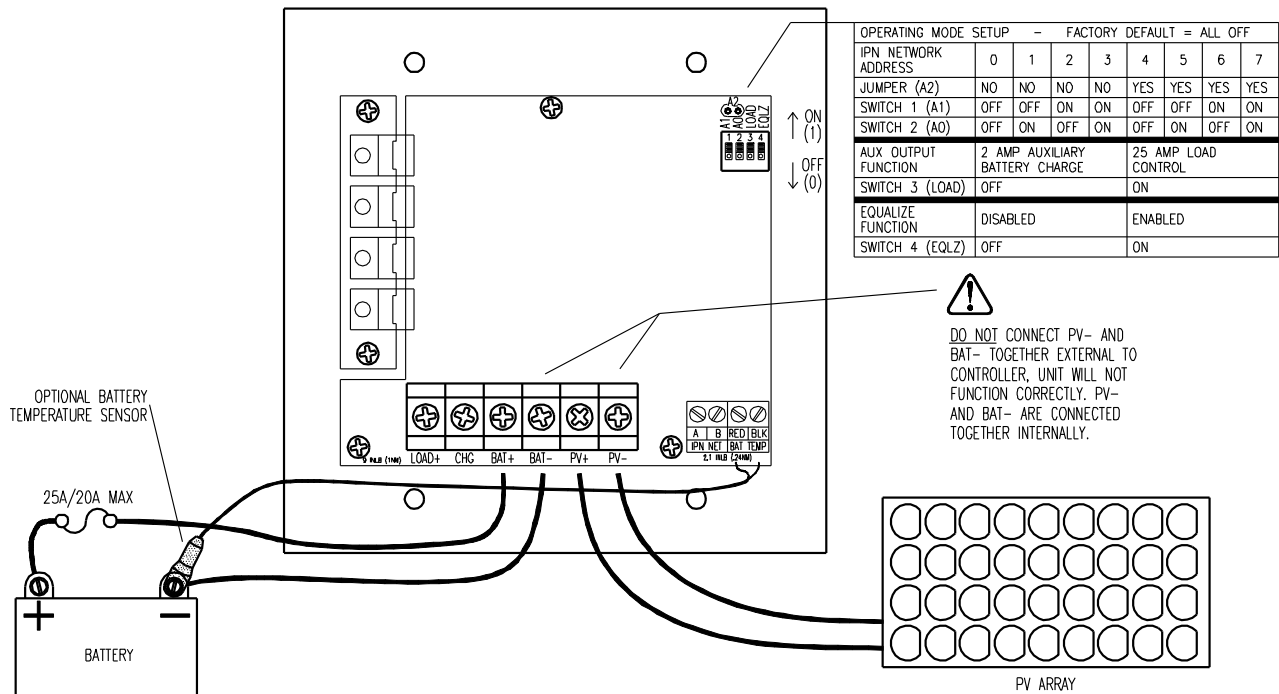
➤ **CAUTION:** Battery, PV and Auxiliary Output terminal block accept #20–10 AWG wire and are to be tightened to 9 in-lb (1 nm). IPN Network and Temperature Sensor compression terminals accept #24–14 AWG wire and are to be tightened to 2.1 in-lb (0.24 nm). DO NOT connect Bat– and PV– together outside of the unit or improper operation will result. Bat– and PV– connect together internally.

**MAXIMUM CONDUCTOR PAIR LENGTH - 3% VOLTAGE DROP**

WIRE GAUGE AWG	12 VOLT SYSTEM @16A FEET / METERS	24 VOLT SYSTEM @12A FEET / METERS
12 AWG	8.0 / 2.4	21.4 / 6.6
10 AWG	12.8 / 4.0	33.8 / 10.4
8 AWG	20.2 / 6.2	53.8 / 16.4
6 AWG	32.4 / 9.8	85.6 / 26.0
4 AWG	51.0 / 15.6	136.2 / 41.4

**TABLE 2**

**SETUP AND WIRING DIAGRAM**



**AUXILIARY OUTPUT**

The auxiliary output can serve one of three functions; 1) a 2 amp auxiliary battery charger, 2) a 20 amp 12V or 15 amp 24V load controller with Low Voltage Disconnect (LVD), or 3) a 15/20 amp variable Dusk-to-Dawn lighting 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 networked 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 Load+ terminal for auxiliary battery charge.



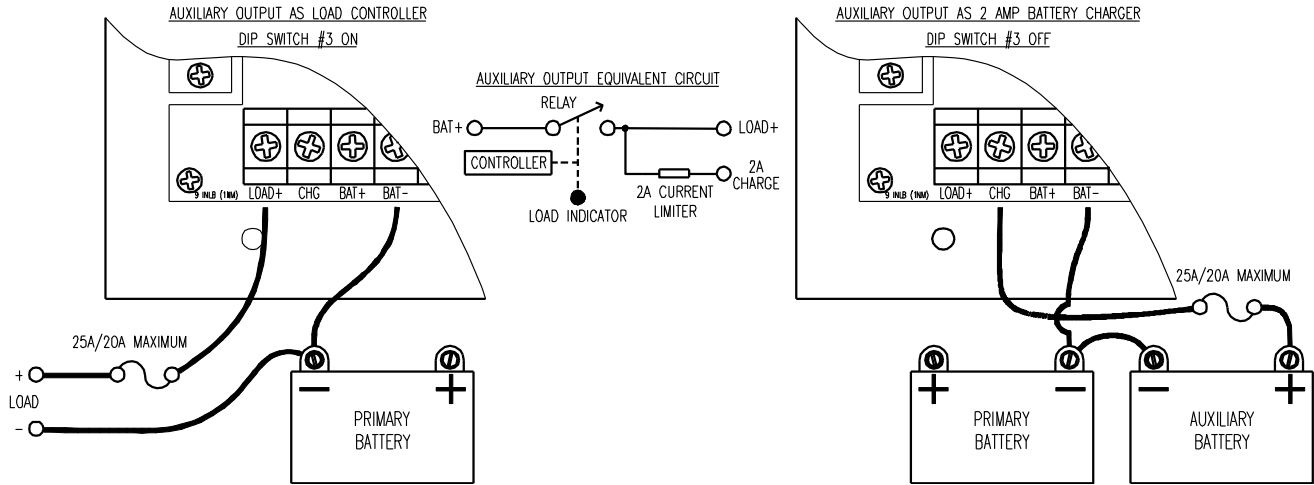


➤ (\*) The LOAD indicator light will be ON whenever power is available at the Load and Auxiliary Battery Charge terminals.

**1) 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 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 10 or 12 awg wire to minimize voltage drop and the same 25/20 amp over current protection shown in Table 4.

**AUXILIARY OUTPUT WIRING**



**FIGURE 4**

**2) LOAD CONTROLLER – DIP #3 ON**

The load controller operates as a high side switch from battery positive. Default settings are for Low Voltage Disconnect (LVD) with ON at  $V_{BAT} \geq 12.6/25.2V$ , and OFF at  $V_{BAT} \leq 11.5/23.0V$ . Adjusting these thresholds requires the IPN ProRemote as a setup tool. Load ON/OFF operation can also be based 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.



➤ **WARNING:** Over current protection for the load control output must be provided externally. Maximum load current and required over current protection is specified in Table 4. If the load control is configured to operate based on battery amp-hours from full 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 set to the same value or improper operation will result.

**LOAD CONTROL RATINGS & OVER CURRENT PROTECTION**

Nominal Battery Voltage	Maximum Load Current	Maximum Switched Load Power	Maximum Over Current Protection
12V	20A	300W	25A
24V	15A	450W	20A

**TABLE 4**

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

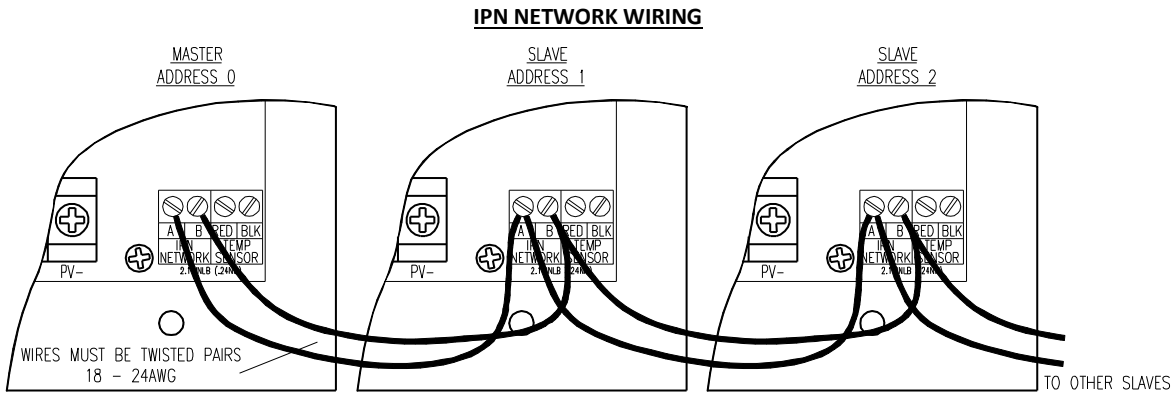
An IPN ProRemote with software version V2.00 or later is required to setup and enable lighting control. Refer to IPN ProRemote operators manual for lighting control setup instructions. Variable time settings are available to turn lighting ON after Dusk (Post-Dusk timer) and/or ON before Dawn (Pre-Dawn 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  $\approx 50mA$  at battery voltage. Dawn or day time begins when the charge control system turns ON which occurs when PV module current rises to  $\approx 100mA$  at battery voltage. If the Post-Dusk timer is set to 1.0 hour and the Pre-Dawn timer is 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 1524 first boots it does not know when Dawn is expected to occur so the 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.



- **CAUTION:** A multi-controller system requires the following specialized installation and setup:
- 1) Each controller must connect to and charge the same primary battery.
  - 2) One controller must be set to address 0 (zero, Master) 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 and wiring to each controller must be completely separate.
  - 5) All controllers must be connected to the IPN network as shown in Figure 5.



**FIGURE 5**

**IPN Network Address – DIP's #1, #2 & Jumper A2**



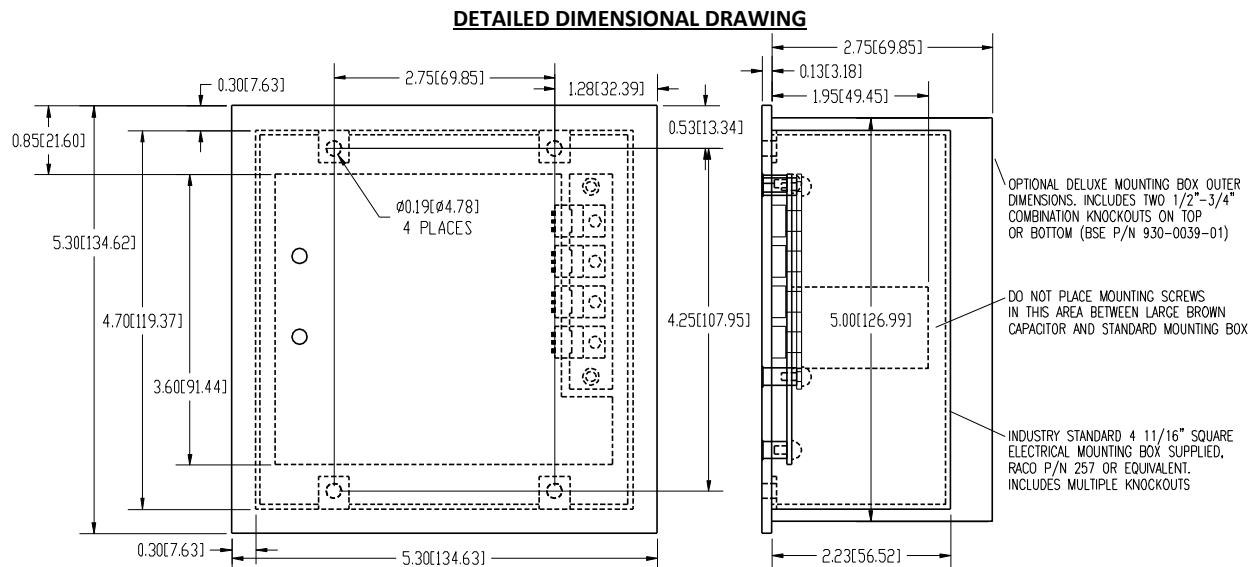
- A single controller must be set to IPN network address 0 (zero). In a multi-controller system one controller must be set to address 0 (zero) to serve as the master. The other controllers must be set to address 1-7 with no two controllers set the same. The 1524 requires that a jumper be soldered across 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 SB1524 vertically to promote air flow and do not enclose in a confined space. The SB1524 is not watertight and must be protected from rain, snow and excessive moisture. Included with the SB1524 (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.



**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 1524, not PV.
Unit will not turn ON (charge status indicator OFF), Display if attached is ON	PV disconnected or low in voltage PV reverse polarity  IPN network address set wrong Microprocessor lockup	PV must supply 0.10 amps at greater than battery voltage to begin charge. Reverse polarity PV will cause front to heat.  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. Momentarily remove all power to re-boot.
Charge status indicator ON., but no output charge current	Battery voltage greater than charge voltage setpoint  Battery voltage too low  PV- connected to BAT- external to controller	This is normal operation. Output is off due to high battery voltage which may be caused by other charging systems.  Battery voltage must be at least 9V for the 1524 to operate.  PV- & BAT- must be separate for proper operation. PV- must receive earth ground via shunts inside the 1524 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  Worn out or dissimilar PV modules  Low insolation  PV- connected to BAT-	Normal operation, current is reduced if battery voltage is at setpoint.  Replace, or use as is.  Atmospheric haze, PV's dirty or shaded, sun low on horizon, etc.  PV- & BAT- must be separate for proper operation. PV- must receive earth ground via shunts inside the 1524 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 hot  Worn out or dissimilar PV modules	PV's with low $V_{MP}$ . PV's with higher $V_{MP}$ 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.  $V_{MP}$ 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.  Replace, use as is, or use different controller for different PV modules.
Auxiliary battery not being charging	Not configured for auxiliary battery charge  Primary battery not highly charged  Load on Auxiliary battery too high	Confirm dip switch #3 is OFF.  Auxiliary battery will not receive charge unless primary battery is in Absorption or Float.  Maximum auxiliary charge current is roughly 2 amps. Load may need to be reduced.
System appears OK, but will not switch between Bulk, Absorption & Float	Not set for 3 stage charge  Will not switch out of Bulk and into Absorption or Float  Will not switch from Absorption to Float	Double check Float voltage setpoint.  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.  Battery not fully charged. Unit will not switch to Float until battery voltage remains at the Absorption 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  Output may have shut off due to low battery charge  ON/OFF thresholds set incorrectly	Confirm dip switch #3 is ON.  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).  Correct ON/OFF threshold settings.
Dusk-to-Dawn feature, lights will not turn ON or remain ON	Auxiliary output not set for load control  Output may have shut off due to low battery charge  Charge control system ON  Timers set incorrectly Valid night time period not seen	Confirm dip switch #3 is ON and Dusk-to-Dawn enabled.  Load turns off if battery voltage below OFF threshold (default 11.5/23.0V). Once off, the load will remain off until battery voltage is above ON threshold (default 12.6/25.2V).  Lights will not turn on if charge control system is ON and charging.  Check time settings Post-Dusk or Pre-dawn timer. 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  Timers set incorrectly  Charge control does not turn ON	Confirm dip switch #3 is ON and Dusk-to-Dawn enabled.  Either Post-Dusk or Pre-dawn timers must be set to time value to enable Dusk-to-Dawn feature.  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 Network wiring problem	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. 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 failed or installed reverse polarity	Temperature sensor must be installed on the master in a multi-controller system. Temperature sensor inputs on slaves are disabled. 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:	SB1524iX @12V	SB1524iX @24V
Maximum PV Power:	270W with 36-cell PV panel <sup>(*)</sup> 200W with 60/72-cell PV panel <sup>(*)</sup>	400W with 72-cell PV panel <sup>(*)</sup>
Rated Battery (Output) Current:	20A with 36-cell PV panel <sup>(*)</sup> 15A with 60/72-cell PV panel <sup>(*)</sup>	15A with 72-cell PV panel <sup>(*)</sup>
Conversion EffConversion Efficiency:	97% (typical @28V / 12A output)	
Power Consumption:	0.20W (typical standby)	
Recommended Max Panel Voc at STC:	45.6V (Max Panel Input 57V)	
Charge Profile:	Multi-Stage plus Manual or Automatic Equalization	
Absorption Voltage:	14.2V <sup>(1)</sup>	28.4V <sup>(1)</sup>
Float Voltage:	13.2V <sup>(1)</sup>	26.4V <sup>(1)</sup>
Equalization Voltage (if enabled):	15.2V <sup>(1)</sup>	30.4V <sup>(1)</sup>
Auxiliary Output (option A, B, or C):	A) Auxiliary Battery Charge 2A (2nd battery)	
	B) Load Control	
	C) Dusk-to-Dawn (by IPN ProRemote)	
Load (LVD) Disconnect/Reconnect Voltage:	11.5V/12.6V <sup>(1)</sup>	23.0V/25.2V <sup>(1)</sup>
Maximum Auxiliary Output current (option B or C):	20A	15A
Display LCD:	optional IPN ProRemote or IPN Remote	
Temperature Compensation (by optional Battery Temp. Sensor):	-5.00mV/°C/cell correct factor (Range 0.00 to -8.00mV/°C/cell) <sup>(1)</sup>	
Operating Temperature:	-40°C – 50°C	
Maximum Full Power Ambient:	50°C	
Environmental Protection:	IP20	
Weight:	1.15 lb. (525 g)	
Dimensions:	5.3 x 5.3 x 2.75" (13.5 x 13.5 x 6.9 cm)	

<sup>(\*)</sup> 36-cell panels are typically referred to as "12V panels" providing Vmp/Voc of ~18V/22V at STC, 60-cell panels refers to "20V panels" (Vmp/Voc ~30V/37V), 72-cell panels refers to "24V panels" (Vmp/Voc ~36V/44V) - <sup>(1)</sup> Factory default voltages unless programmed with an IPN ProRemote display or UCM.

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

**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 or techsupport@blueskyenergyinc.com 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.