



SB3000i

(SOLAR BOOST™ 3000i MPPT)

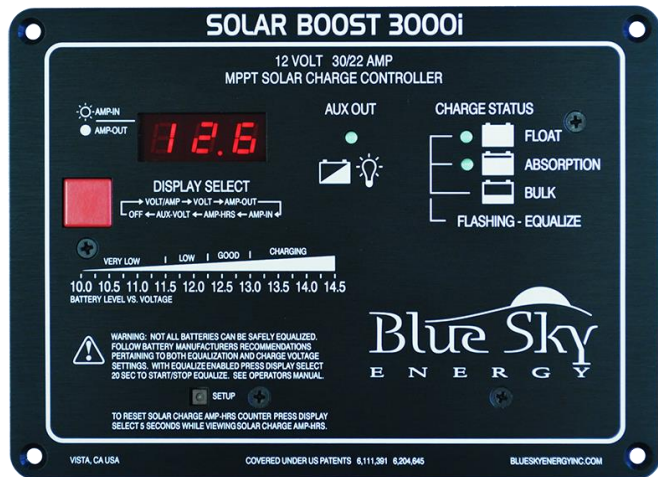
12 VOLT 30/22 AMP MAXIMUM POWER POINT TRACKING
PHOTOVOLTAIC CHARGE CONTROLLER

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 SB3000i
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 SB3000i - SAVE THESE INSTRUCTIONS

1. Refer installation and servicing to qualified service personnel. 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 12 volt (6 cell) flooded or sealed type lead-acid chemistry batteries within the range of 20 to 2,000 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 40 amp maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70 with 36 cell modules, or 30 amp maximum with 60 cell modules. Do not connect a PV array capable of delivering greater than 24 amps of short circuit current I_{sc} at STC with 36 cell modules, or 11.8 amps with 60 cell modules.
- 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 amp maximum over current protection in accordance with National Electrical Code, ANSI/NFPA 70.
- f) Insure that charge parameters are properly configured for the battery being charged as recommended by the battery manufacturer.
- 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. Tighten Battery and PV compression terminals to 15.9 in-lb (1.80 nm), battery temperature sensor and IPN Network compression terminals to 2.1 in-lb (0.24 nm), and auxiliary output compression terminals to 6 in-lb (0.67 nm).

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

The Solar Boost 3000i is a Maximum Power Point Tracking (MPPT) solar charge controller able to charge 12V batteries at up to 30 amps from 36 cell 12V PV modules. Patented MPPT technology operates the modules electrically in a manner that harvests all available PV power and can increase charge current up to 30% or more compared to conventional PWM type controllers. The voltage step-down operation of the MPPT power converter also allows use higher voltage 60 cell grid-tie PV modules at up to 22 amps of output current producing a charge current increase approaching 200% with 60 cell modules. The 3000i’s sophisticated and fully adjustable 3-stage plus equalization charge control system optimally charges flooded, GEL and AGM lead-acid chemistry batteries. Electronic protection is provided against voltage transients, over temperature, over current, short circuit, swapped battery & PV, and reverse battery & PV polarity. A very low power LED display is provided to monitor PV charge performance and includes a resettable amp-hour counter which computes total PV amp-hours produced. A user configurable auxiliary output is also provided which can serve as either a 20 amp LVD load controller, a 20 amp lighting controller with LVD, or a 2 amp auxiliary battery charger for a second battery such as the engine start battery in an RV. To allow easy system expandability the 3000i may also operate as an IPN Network Master controlling up to 7 Blue Sky Energy IPN compatible charge controllers such as the SB3024iL. Blue Sky Energy’s IPN Network allows multiple charge controllers to communicate with each other and coordinate their activities to charge the battery as a single coordinated charging machine.

PART NUMBERS AND OPTIONS

- SB3000i.....Solar Boost 3000i solar charge controller
- IPNPRO-S.....Optional IPN ProRemote battery system monitor
- UCM.....Optional Universal Communication Module for system access over the Internet
- 930-0022-20Optional battery temperature sensor
- 720-0011-01Optional wall mounting box, black powder coated

OPERATION

Basic charge control operations are fully automatic and require no operator intervention. When sufficient PV power is available the 3000i will switch to a Charge ON state and begin charging the battery. The particular charge mode the 3000i will operate in will vary depending on the needs of the battery and available PV charge current. When insufficient PV current is available to charge the battery the 3000i will switch to a Charge Off state and the PV array will be 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 3000i operates on battery power, not PV power. Insure that voltage on the battery terminals of the 3000i is always the same as actual battery voltage within a few 10^{ths} of a volt and greater than 9 volts for proper operation. Note that the front panel serves as a heatsink for power control devices and may become quite warm during normal operation.



➤ **CAUTION:** Do not disconnect the battery while the 3000i is in a Charge ON state. A healthy battery is a key component of the charge voltage control system and provides charge voltage filtering. Sudden removal of the battery while the 3000i is charging will produce voltage spikes at the 3000i’s battery terminals which may damage 12 volt appliances still connected to the 3000i, especially when using higher voltage 60 cell PV modules.

IF THE BATTERY MUST BE DISCONNECTED, REMOVE PV POWER FIRST.

CHARGE STATUS INDICATION

Present charge status of the 3000i is indicated using two charge status LED’s, Absorption & Float. If net battery charge current is greater than about 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

CHARGE STATUS LED’s	CHARGE MODE	APPROXIMATE CHARGE LEVEL
ABSORPTION & FLOAT OFF	CHARGE OFF	_____
ABSORPTION & FLOAT ON	BULK	<70% FULL
ABSORPTION ON – FLOAT OFF	ABSORPTION	70% - 95% FULL
ABSORPTION OFF – FLOAT ON	FLOAT	FULLY CHARGED
ABSORPTION & FLOAT ALTERNATELY BLINKING	EQUALIZE	_____

TABLE 1

DIGITAL DISPLAY

When the 3000i completes self-test the VOLT/AMP display mode is active. This mode displays Battery Voltage continuously if the 3000i is in a Charge Off state, or alternates between Battery Voltage & Output Charge Current if the 3000i is charging the battery. The AMPS indicator in the upper left of the display will be on solid when displaying 3000i output current, or blinking when displaying PV input current. To provide good readability yet minimize the likelihood of the display being objectionably bright at night an automatic night time dimming feature dims the display at night when the 3000i is in a Charge Off state. Other display modes may be selected using the Display Select push-button. Each brief press of Display Select selects the next display mode as shown on the front panel graphic of Figure 1. VOLT shows Battery Voltage, AMP-OUT shows 3000i Output Charge Current, AMP-IN shows PV Input Current, and AMP-HRS shows total PV Amp-Hours produced since the amp-hour counter was last cleared. If the 3000i is part of a multi-

controller system using the IPN Network the 3000i's display will show the total of all controllers on the network. AUX-VOLT shows voltage on 3000i's the auxiliary output. When the auxiliary output is configured for Auxiliary Battery Charge (factory default) and the 2 amp auxiliary charge output is connected to an auxiliary battery (such as the engine start battery in a Motorhome) the voltage of the auxiliary battery is displayed. If the auxiliary output is configured for Load Control, the voltage displayed is that applied to the load.

SOLAR CHARGE AMP-HOUR COUNTER

The battery essentially serves as a "storage tank", with the battery storing electrical energy in units referred to as amp-hours. Amp-hours are computed by multiplying *current in amps X time in hours*. For example 20 amp-hours may be a current of 10 amps flowing for 2 hours, or may be 1 amp flowing for 20 hours. The battery receives and stores amp-hours when being charged, and then delivers those stored amp-hours when being discharged. The amp-hour counter displays total solar charge amp-hours accumulated since the last time the counter was cleared up to a maximum count of 999 amp-hours. Amp-hour production varies widely with operating conditions, but as a very broad brush approximation 100 watts of PV modules can deliver up to a maximum of about 30 amp-hours per day. Any partial shading, lower sun intensity, shorter days, or time spent in Absorption or Float will decrease amp-hours produced. The present amp-hour count may be cleared by pressing Display Select for 5 seconds while viewing amp-hours on the display.

BATTERY LEVEL GRAPHIC

The 3000i provides a battery level graphic on the front panel which indicates approximate battery level versus battery voltage. Generally a higher voltage is better than a lower voltage. A battery that is being charged will typically range in voltage from about 12.5 volts after charge commences, to 14.0 volts or greater when the battery is highly charged. Once charge stops and the battery begins discharging and delivering power to a load it is normal for battery voltage to drop. A battery under a light load of about 1 amp per 100 amp-hours of battery capacity may range between about 12.5 volts when the battery is full, down to perhaps 12.0 volts when the battery is about 50% discharged. Battery voltage during discharge will tend to be higher under light load and lower under a heavier load.

Do not think of these voltage values as absolutes but rather as a broad brush indication of approximate battery charge level. Voltage at a particular state of charge will vary with battery size, age, construction, temperature, and with the level of charge or discharge current. Most battery manufacturers recommend not discharging below about 50% DOD (depth of discharge) to promote improved battery performance and life. Avoid allowing battery voltage to drop below about 11.5 volts, and NEVER allow battery voltage to drop below 10.0 volts. If a highly accurate battery charge level indication is desired, consider installing an optional IPN ProRemote display.

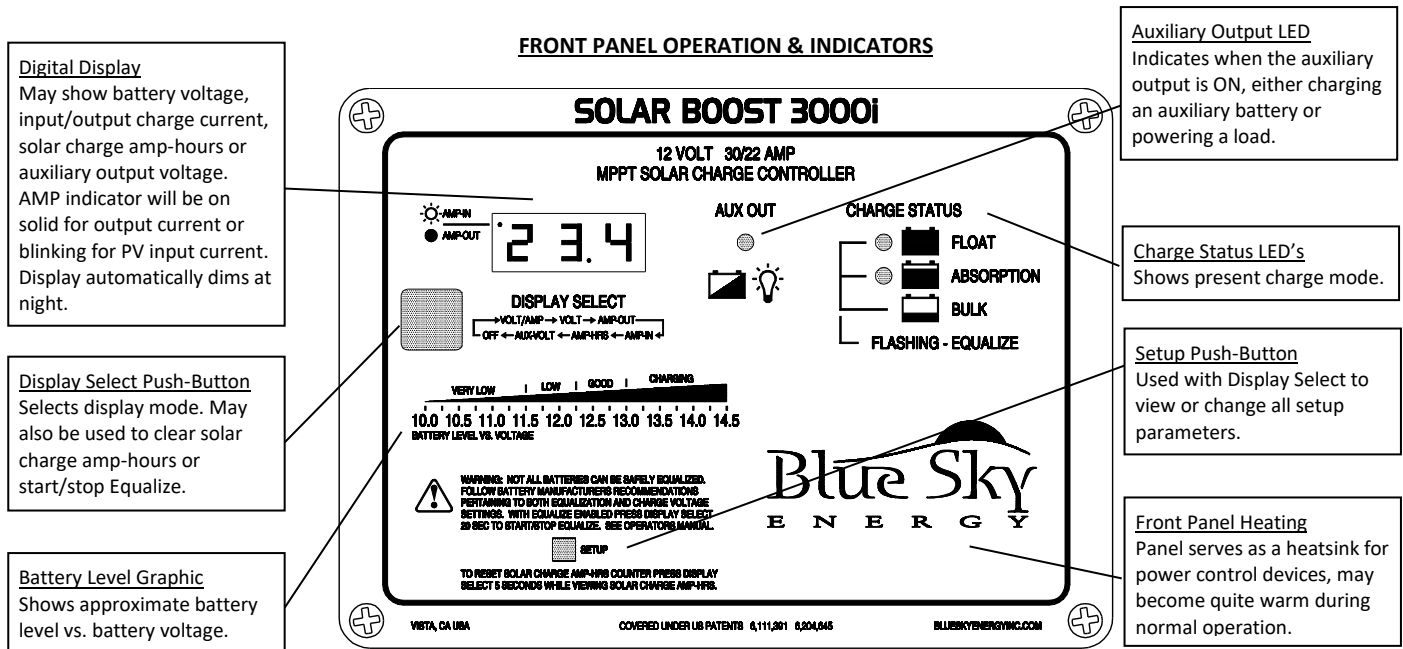


FIGURE 1

3-STAGE CHARGE CONTROL

The 3000i is factory configured for a 3-stage charging process, Bulk, Absorption and Float, which is fully automatic and requires no operator intervention. The 3-stage charge process applies a somewhat higher Absorption charge voltage to charge the battery quickly and safely. Once the battery is fully charged a somewhat lower Float voltage is applied to maintain the battery in a fully charged state without excessive water loss.



➤ The charge control system always starts in Absorption and will return to Absorption upon exiting Current Limit or Equalization. Following a 10 second delay in Absorption the 3000i may move on to other charge modes based on battery and system needs.

Bulk Charge

The 3000i will switch to Bulk charge when battery voltage remains below the present Charge Voltage setpoint. During Bulk the 3000i delivers as much charge current as possible to rapidly recharge the battery. During Bulk it is a combination of battery size, state of charge and available charge current that determine battery voltage, not the 3000i.

Absorption Charge

Once the battery recovers sufficient charge for battery voltage to rise to the Absorption Charge Voltage setpoint (factory set to 14.4V), charge current is reduced as necessary to hold the battery at the Absorption Voltage. The 3000i will return to Bulk should battery voltage remain below the Absorption Voltage setpoint for more than 10 seconds. The 3000i remains in Absorption until the battery is fully charged as determined by either;

- 1) The 3000i remains continuously in Absorption for the Absorption Charge Time period (factory set to 2 hours).
- OR –
- 2) With the optional IPN ProRemote display and battery system monitor, net battery charge current decreases to the Float Transition Current (factory set in the ProRemote to 1.5 amps 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. The 3000i will return to Absorption should battery voltage remain below the Float Voltage setpoint for more than 10 seconds.

2-STAGE CHARGE CONTROL

The 3000i may be configured for 2-stage charge control if desired by setting the Float Charge Voltage setting to “OFF” (NO Float).

OUTPUT CURRENT LIMIT

Should conditions be present where the PV modules are able to produce more than 30 amps of output current with 36 cell PV modules, or 22 amps with 60 cell PV modules, the 3000i will automatically limit output current to this value. Note that when current drops and the 3000i exits current limit it will first enter Absorption on its way back to Bulk even though battery voltage may be below the Absorption Charge Voltage setpoint.



➤ **WARNING:** Current limit should be thought of as transient PV over current protection and not a normal mode of operation. If the 3000i enters 30 amp or 22 amp current limit on a regular basis it is possible that excessive PV power is connected. Confirm that the PV modules do not exceed ratings shown in the Selecting PV Modules section.

OPTIONAL TEMPERATURE COMPENSATION

The charge voltage required by batteries changes with battery temperature. Temperature compensation of charge voltage enhances battery performance and life while decreasing battery maintenance. Temperature compensation of charge voltage can be provided using the optional battery temperature sensor (BSE p/n 930-0022-20). The default compensation factor of $-30\text{mV}/^\circ\text{C}$ ($-5.00\text{mV}/^\circ\text{C}/\text{cell}$) is typically appropriate for most lead-acid chemistry batteries including GEL and AGM. If a proper temperature sensor signal is not detected the 3000i will operate as if battery temperature is 25°C .

FACTORY DEFAULT CHARGE VOLTAGE SETPOINTS -VS.- BATTERY TEMPERATURE

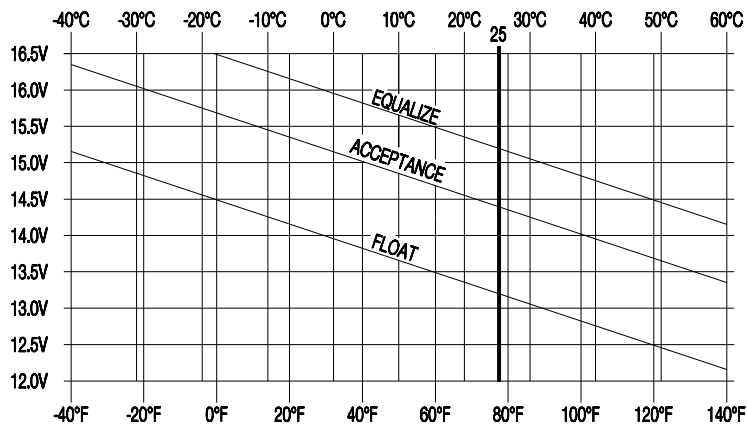


FIGURE 2

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 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 above.

Equalization is a controlled overcharge used to bring all battery cells up to the same specific gravity and state of charge. The 3000i may be configured to perform an automatic equalization on periodic basis, or a manual equalization. Since sealed batteries should not be equalized the factory default settings have Equalize Enable (EqE) set to OFF to disable automatic or manual equalization. Equalization may be enabled by setting Equalize Enable to ON as described in the Charge And Load Control Settings section. When an equalization cycle is being performed the Float and Absorption charge status

LED's will alternately blink. With equalize enabled the 3000i will perform an automatic equalization at the factory default settings of 15.2V for 2 hours every 30 days which is typically suitable for most flooded lead-acid batteries. When set for automatic equalization the cycle will begin when the set number of days since the last equalization has elapsed, and the charge control system has switched to Float. When set for manual equalization (Eqd set to 00) an automatic equalization will not occur. Whether set for automatic or manual the process may be started or stopped manually by pressing the Display Select push-button for 20 seconds. Once equalization has started the equalize timer will not count down unless battery voltage is at the equalize voltage setpoint which is temperature compensated as shown above. Therefore obtaining a proper 2 hour equalization will require longer than 2 hours to complete depending on available charge current. Note that at least 3.5 amps of net charge current per 100 amp-hours of battery capacity is typically required to properly equalize a battery. If equalization does not complete during the charging day it will resume where it left off the next charging day, but will automatically cancel if unable to complete within 24 hours. The equalize day counter is reset whenever an equalization cycle is started.

MAXIMUM SETPOINT VOLTAGE LIMIT

The maximum setpoint voltage limit places a maximum limit or ceiling on the charge voltage setpoint used by the 3000i in all charge modes to prevent inverters or other equipment from shutting down due to excess voltage. Regardless of initial setpoints, charge mode or temperature compensation the 3000i will not use a charge voltage setpoint greater than the maximum setpoint voltage limit (uPr) factory set to 15.5V. Note that voltage may briefly exceed this value by 0.1 – 0.2V as the system responds to sudden changes in load or PV power.

MAXIMUM POWER POINT TRACKING (MPPT)

The 3000i's patented MPPT technology can increase charge current up to 30% or more compared to conventional PWM controllers operating 36 cell PV modules. Principal operating conditions affecting current boost performance are PV cell temperature and battery voltage, with lower PV 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 current times the ratio of PV voltage to battery voltage. If a 60 cell module is operating at 25V with 5 amps of output, and battery voltage was 13V, output charge current from the 3000i would be about 5 amps times 25V ÷ 13V or about 9.6 amps. For a more complete MPPT description see "What Is MPPT and how does it work?" on the FAQ page at www.blueskyenergyinc.com.

PANEL TEMPERATURE AND THERMAL PROTECTION

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 3000i is operating normally. Front panel heating will be the greatest when the 3000i is processing either very high power or very low power. When mounted to a vertical surface with good ventilation, the 3000i can deliver full output in an ambient temperature of up to 45°C (113°F). If an over temperature condition exists, the 3000i will simply cycle on and off to keep internal temperature within acceptable limits.

MULTIPLE CHARGE CONTROLLERS ON THE IPN NETWORK

The 3000i may also operate as an IPN Network Master controlling up to 7 remote Blue Sky Energy IPN compatible charge controllers such as the SB3024iL or SB2512iX-HV. The IPN Network allows multiple charge controllers to communicate with each other and coordinate their activities to charge the battery as a single coordinated charging machine. The IPN Network allows an existing 3000i installation to be expanded greatly in power handling capability by adding charge additional controllers and PV modules with all controllers displaying through the existing 3000i display.



➤ When serving as an IPN network Master the 3000i's display will show the sum of all controllers on the network for input current, output current and solar charge amp-hours. If a remote Slave controller has good PV input but the 3000i does not, the 3000i's charge control system will properly direct the Slaves as indicated on the 3000i's Charge Status LED's, but the 3000i's display will be dim while the 3000i's own power controller remains off. The display will become bright once the 3000i receives good PV input.

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 40 amp maximum branch-circuit over current protection in accordance with National Electrical Code, ANSI/NFPA 70 with 36 cell modules, or 30 amp maximum with 60 cell modules. Do not connect a PV array capable of delivering greater than 24 amps of short circuit current I_{SC} at STC with 36 cell modules, or 11.8 amps 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. Figures 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 3000i 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 50VDC on the battery or PV terminals will damage the unit. Damage of either type voids the limited warranty.

CHARGE AND LOAD CONTROL SETTINGS

The 3000i contains various charge control and load control settings all of which are preconfigured at the factory to the default settings shown below. Most installations require no changes to these settings which are typically suitable for most flooded, GEL and AGM lead-acid chemistry batteries. Check with your battery manufacturer to confirm that these settings are suitable for your particular battery.



➤ **WARNING:** If charge parameter settings are changed, confirm that the new settings comply with the battery manufacturers recommendations. DO NOT enable equalization for sealed lead-acid batteries such as GEL and AGM.

As Shipped Factory Default Settings

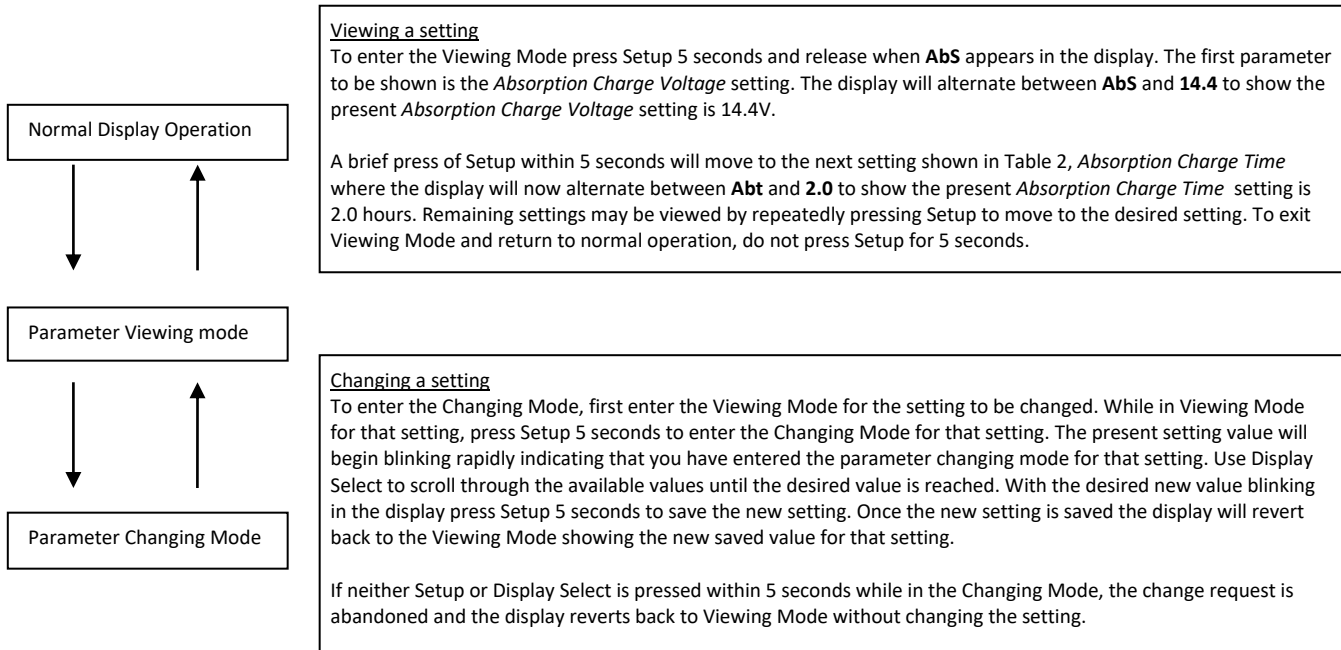
- Charge mode 3-stage
- Absorption voltage 14.4V
- Absorption time 2.0 hours
- Float voltage 13.2V
- Maximum setpoint voltage limit 15.5V
- Auxiliary output mode Aux Bat Charge
- LVD on voltage 12.6V
- LVD off voltage 11.5V
- Equalize enable Off (disabled)
- Equalize time 2.0 hours
- Equalize voltage 15.2V
- Auto equalize days 30 days
- Temperature compensation factor -5.00mV/°C/cell
- PostDusk lighting timer Off (disabled)
- PreDawn lighting timer Off (disabled)
- Middle of the night lighting control dimming... 0%

Restoring As Shipped Factory Default Settings

1. Remove both PV and battery power.
2. Apply battery power while pressing & holding the Setup push-button.
3. Following display self-test, confirm display shows software revision (e.g., r1.4) & Charge Status LED's remain on while Setup is held.
4. After at least 5 seconds, release Setup.
5. Confirm display resumes normal operation.
6. The 3000i is now set to as shipped factory defaults.

Changing Charge And Load Control Settings

3000i charge parameter settings may be viewed or changed at any time using a combination of the Setup and Display Select push-buttons. There are two modes of setup operation, **Viewing** a setting and **Changing** a setting. Basic operation is to go from Normal Operation to Viewing Mode, Viewing Mode to Changing Mode, and then from Changing mode back to Viewing mode, and Viewing Mode back to Normal Operation. All settings are stored in Flash memory and are retained if power is lost.



CHARGE AND LOAD CONTROL SETTINGS

Parameter viewing mode toggles between setting text and value of that setting		Setting Range	Setting Steps	Description
Setting Text	Default Setting			
AbS	14.4	12.0V – 17.0V	0.1V	Absorption charge voltage
Abt	2.0	0.0 – 10.0 hrs	0.5 hrs	Absorption charge time
FLt	13.2	12.0V – 17.0V	0.1V	Float charge voltage Set to oFF (one step below 12.0) for 2-stage charge
EqU	15.2	12.0V – 17.0V	0.1V	Equalize charge voltage
EqT	2.0	0.5 – 10.0 hrs	0.5 hrs	Equalize charge time

Parameter viewing mode toggles between setting text and value of that setting		Setting Range	Setting Steps	Description
Setting Text	Default Setting			
Eqd	30	10 – 400	5 days	Days between automatic equalization cycles Setting of zero (00) disables automatic equalization
EqE	oFF	on or oFF	–	Master equalize enable/disable Set to on to enable either automatic or manual equalization
uPr	15.5	12.0V – 17.0V	0.1V	Maximum setpoint voltage limit
btc	500 (–5.00mV/°C/cell)	000 – 800 (–0.00 to –8.00 mV/°C/cell)	10 (10mV/°C/cell)	Battery temperature compensation factor (decimal point missing in display such that 500 = –5.00mV/°C/cell) (default provides overall factor of –30mV/°C for 6 cell 12V battery)
↑ Charge control related items above ↑			↓ Load control related items below ↓	
out	ch9	ch9 or Lod	–	Selects Auxiliary Output functionality for Auxiliary Bat Charge (ch9), or Load/Lighting control (Lod)
Lon	12.6V	5.0V – 17.0V	0.1V	Load control LVD on threshold
LoF	11.5V	5.0V – 17.0V	0.1V	Load control LVD off threshold
PSt	oFF	0.5 – 20.0 hrs	0.5 hrs	PostDusk lighting timer, set to oFF (one step below 0.5) to disable
PrE	oFF	0.5 – 20.0 hrs	0.5 hrs	PreDawn lighting timer, set to oFF (one step below 0.5) to disable
PEr	0	0 – 90%	10%	Middle of the night % brightness (between PostDusk & PreDawn timers)

TABLE 2

SELECTING PV MODULES

The 3000i is designed to operate conventional 12V 36 cell PV modules or higher voltage 60 cell modules. It is not intended for use with 72 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 $\approx 0.5V$ 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. 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 amps (2 amps 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 $\approx 20 - 22V$ for 12V nominal 36 cell modules)
- V_{MP} Voltage where module produces Maximum Power (typically $\approx 17 - 18V$ for 12V 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	400W	30A	24A	24.0V	16.0 – 19.0V
60 Cell	290W	22A	11.8A	40.0V	24.0V – 31.0V

MOUNTING



➤ **CAUTION:** The front panel may become quite warm to the touch during normal operation. Mount the 3000i vertically to promote air flow and cooling, do not enclose in a confined space and avoid mounting in direct sunlight. The 3000i is not watertight and must be protected from rain, snow and excessive moisture. Corrosion resulting from liquid water or excessive moisture voids the limited warranty. An optional black powder coated deluxe mounting box is available as BSE p/n 720-0011-01. The optional mounting box is the same X,Y dimension as the 3000i front panel and 2.75" (7cm) deep.

DETAILED DIMENSIONAL DRAWING

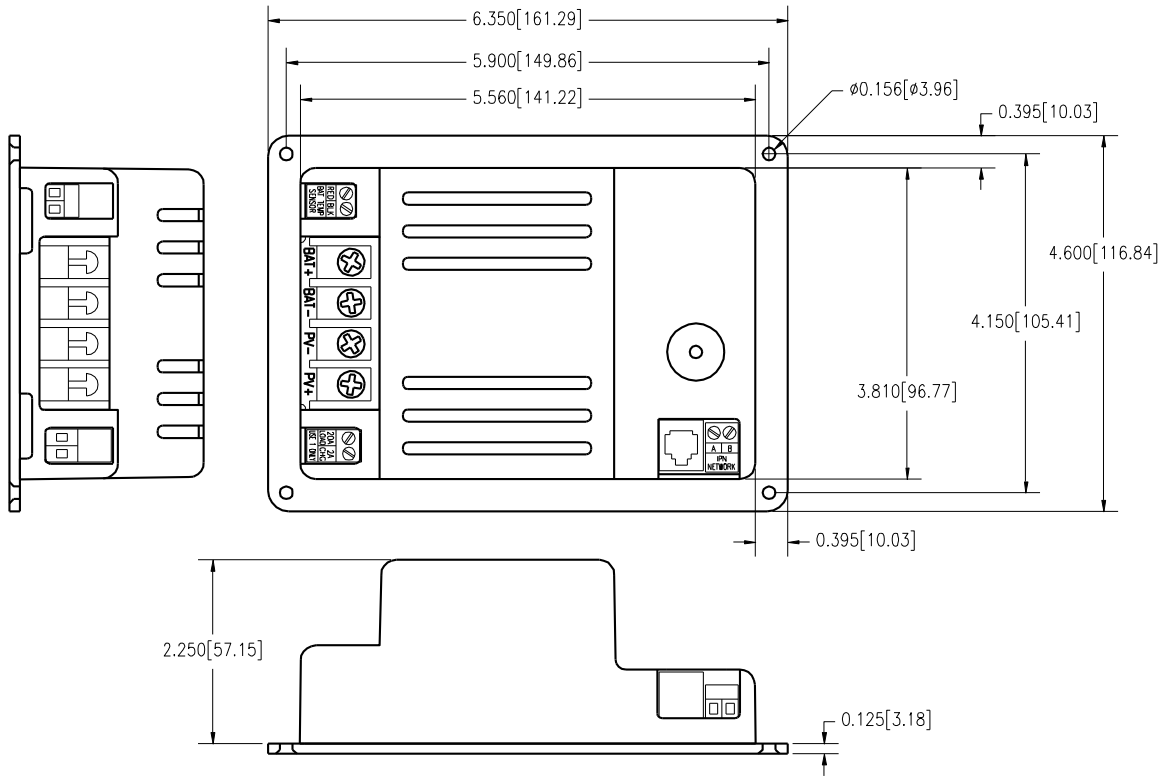


FIGURE 3

BATTERY AND PV WIRING

A desirable installation will produce a total system wiring voltage drop of 3% or less. The lengths shown in Table 3 are one way from the PV modules to the battery with the 3000i 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 two wire sizes larger than shown (e.g., 8awg rather than 12awg) for the wire section between the 3000i and the battery.

MAXIMUM CONDUCTOR PAIR LENGTH – 3% VOLTAGE DROP

WIRE GAUGE AWG	60 CELL MODULES @11.8AMP INPUT FEET / METERS	36 CELL MODULES @ 24AMPS INPUT FEET / METERS
12 AWG	17.9 / 5.5	5.3 / 1.6
10 AWG	28.5 / 8.7	8.5 / 2.6
8 AWG	45.3 / 13.8	13.5 / 4.1
6 AWG	71.2 / 21.7	21.4 / 6.5
4 AWG	114.1 / 34.8	34.0 / 10.4

TABLE 3



➤ **CAUTION:** Battery and PV compression terminals accept #16 – #8 AWG wire and are to be tightened to 15.9 in-lb (1.80 nm). Temperature Sensor and IPN Network compression terminals accept #26–16 AWG wire and are to be tightened to 2.1 in-lb (0.24 nm). Take care to route wires in a manner that does not place undue strain on the 3000i’s compression terminal blocks.

WIRING DIAGRAM

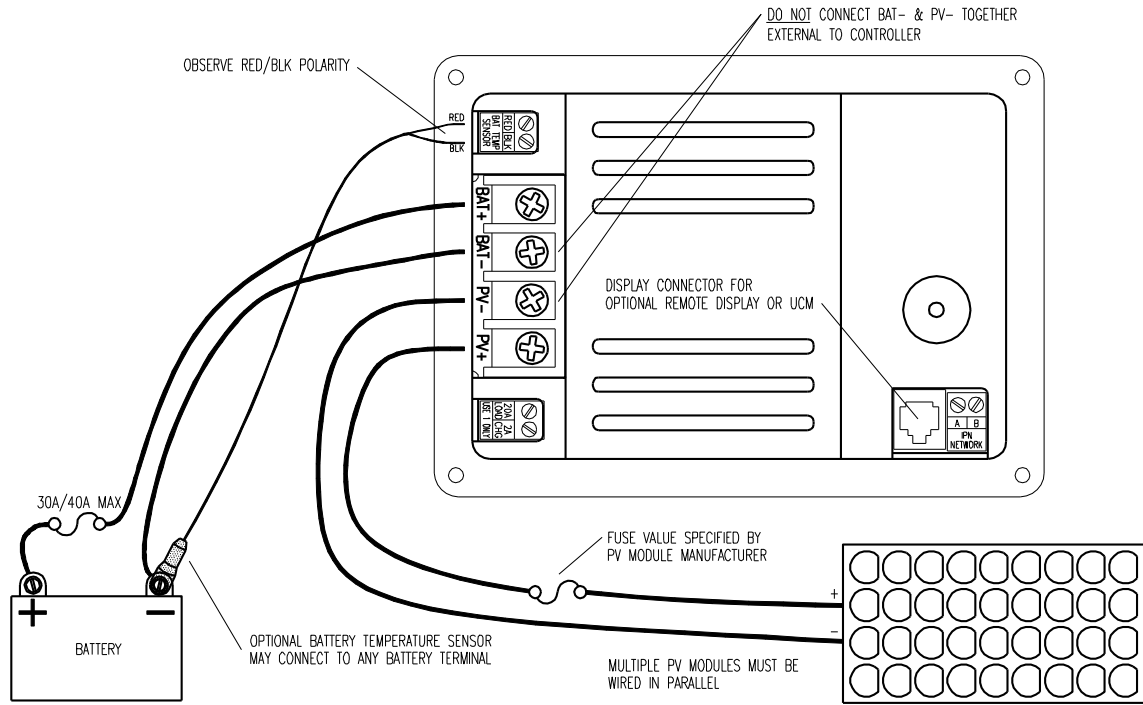


FIGURE 4

OPTIONAL BATTERY TEMPERATURE SENSOR

Install the optional battery temperature sensor as shown in Figure 4. The temperature sensor will be automatically detected by the 3000i.



➤ **WARNING:** Use only BSE temperature sensor p/n 930-0022-20. Other temperature sensors or electrical connections to the temperature sensor terminals may damage the 3000i, void the limited warranty, and may cause charge voltage to become uncontrolled. Note that temperature sensor wires are polarized RED/BLK. The sensor will not function if installed reverse polarity. The temperature sensor lug has no electrical connection to the sensor element may connect to any battery terminal.

AUXILIARY OUTPUT

The auxiliary output can serve one of two primary functions; 1) A 2 amp auxiliary battery charger (factory default setting), or 2) A 20 amp Low Voltage Disconnect (LVD) load controller which may also provide variable 3) Dusk-to-Dawn lighting control. The Charge/Load functionality is selected with the **out** (output) selector as described in the Charge And Load Control Settings section. The Aux Out indicator will illuminate whenever the auxiliary output is ON(*) regardless of whether an auxiliary battery or load is connected or not.



➤ **CAUTION:** The auxiliary output CANNOT perform both auxiliary battery charge and load/lighting functions at the same time. DO NOT use the 20 amp Load terminal for auxiliary battery charge or the 3000i may be damaged in a manner that voids the warranty. For clarity Figure 5 only shows additional wiring required for auxiliary output use and assumes basic system wiring shown in Figure 4 is complete. Auxiliary output compression terminals accept #22–12 AWG wire and are to be tightened to 6 in-lb (0.67 nm).



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

1) AUXILIARY BATTERY CHARGE – “out” setup selector set to “ch9” (charge)

The auxiliary charge function is used to charge an auxiliary battery of the same voltage as the primary battery. Its purpose is not to charge an auxiliary battery that is regularly discharged but rather to maintain a battery that is infrequently used such as the engine start battery in a Motorhome. The primary battery is first priority and the auxiliary battery is second priority. If the primary battery is charging in Absorption or Float, meaning that it does not need all available solar power, 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 DIAGRAM

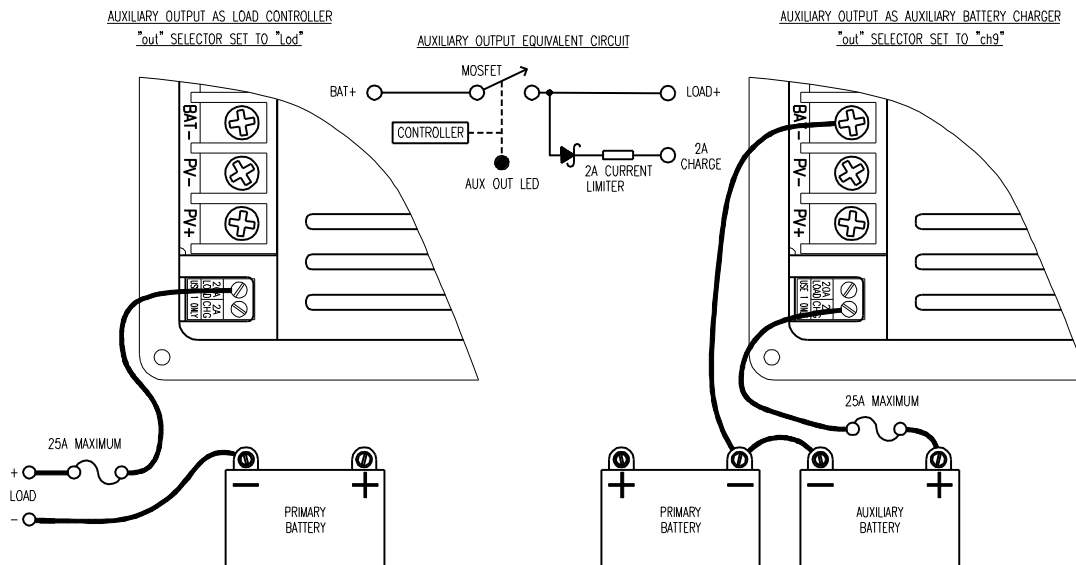


FIGURE 5

2) LOAD CONTROLLER – "out" setup selector set to "Lod" (load)

The load controller can deliver up to 20 amps of output and operates as a high side switch to battery positive. Default settings are for Low Voltage Disconnect (LVD) with ON at $V_{BAT} \geq 12.6V$, and OFF at $V_{BAT} \leq 11.5V$. ON/OFF operation may also be based on battery amp-hours from full if an IPN ProRemote display is present in the system. See the IPN ProRemote manual for more detail regarding amp-hour setup and control. The ON/OFF condition must be continuously valid for 20 seconds before switching will occur. If the higher/lower setting values are reversed, i.e., ON threshold is lower than the OFF threshold, the output control logic is inverted such that low battery voltage turns the output ON.



➤ **CAUTION:** 25 amp maximum over current protection for the load control output must be provided externally. If user supplied over current protection is not provided and the load control output is short circuited the 3000i will be damaged in a manner that voids the warranty. DO NOT use load control to directly drive ballasts, inverters, or other highly capacitive loads as this may damage the load control output in a manner that voids the warranty. Use an external mechanical or solid state power control relay driven by the 3000i's load control output to operate these difficult loads.
 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 from the IPN ProRemote, voltage based operation will resume. ON/OFF thresholds must not be the same value or improper operation will result.

3) DUSK-TO-DAWN LIGHTING CONTROL – "out" setup selector set to "Lod" (load)

The 3000i's load control output may also be configured to provide lighting control. 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 (**PS**t) or Pre-Dawn (**Pr**E) 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 $\approx 50mA$ 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 just above 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 3000i first boots it does not know when Dawn is expected to occur. As a result Pre-Dawn control will 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. To optimize battery life in lighting applications, lighting control includes a dimming feature which may be used to operate the lights at reduced brightness in the middle of the night between when Post-Dusk and/or Pre-Dawn timers are ON. When lighting control is enabled the dimming feature PWM's the load control output at 100Hz with the percent ON time being controlled by the **PER** (percent) setting (factory default = 0%).



➤ **CAUTION:** The middle of the night dimming feature is meant to be used with loads that are primarily resistive such as directly driven LED or incandescent lighting only. DO NOT use the dimming feature with ballasts, inverters, or other highly capacitive or inductive loads as this may damage the load control output in a manner that voids the warranty.

BATTERY & PV POWER CONNECT / DISCONNECT ORDER



➤ **CAUTION:** When applying power to the 3000i, battery power should be connected first followed by PV power. Disconnect PV power first when removing power. DO NOT disconnect the battery while the 3000i is in a Charge ON state with PV power connected. A healthy battery is a key component of the charge voltage control system and provides a very important charge voltage filtering function. Removal of the battery while the 3000i is charging may produce voltage spikes at the 3000i's battery terminals which may damage 12V appliances still connected to the output 3000i.

IF THE BATTERY MUST BE DISCONNECTED, REMOVE PV POWER FIRST.

Connecting the Battery

Before attaching battery wires to the 3000i confirm proper voltage and polarity. With battery power attached the 3000i should boot and self-test. All display segments and LED's will briefly illuminate during self-test, followed by a brief display of the software revision. Following self-test battery voltage will be displayed although the display will be dim due to the night time dimming function. If the display does not turn on check voltage on the 3000i's battery terminals. Voltage should be the same as present on the batteries, of the proper polarity, and greater than 9 volts for the 3000i to operate.

Connecting PV Modules

Before attaching PV wires to the 3000i confirm proper voltage and polarity. Measure PV module voltage with PV modules in the sun and disconnected from the 3000i. Confirm open circuit voltage is within the range of ≈ 18 – 35 volts and of the proper polarity. If PV open circuit voltage is outside this range confirm proper PV module selection and wiring. Attaching PV power should cause the 3000i to switch to Charge ON state.



➤ **CAUTION:** PV voltage exceeding 50 volts will damage the 3000i and void the limited warranty. The 3000i is protected against limited duration reverse PV polarity. If available PV current is high and reverse PV polarity duration is long, damage may result which voids the limited warranty. Immediately following PV power connection confirm that the 3000i display continues to operate normally and the unit switches to a Charge On state as expected. **Reverse PV connection will cause the display to continuously show the self-test indication of all display segments and LED's on, and the front panel may get hot quickly. Should this occur immediately remove PV power and correct the fault.**

INSTALLING A MULTI-CONTROLLER SYSTEM USING THE IPN NETWORK

The 3000i may also serve as an IPN Network Master controlling up to 7 remote IPN Network compatible Slaves. Any Blue Sky Energy charge controller capable of operating as an IPN Network Slave may be used, and as of this writing include; SB3024i SB3024Di, SB3024iL SB3024DiL, SB2512iX, SB2512iX-HV, and SB1524iX. Another 3000i cannot be used. Controller types and their PV modules may be different. Each controller is installed as a separate standalone charging source connected to the battery and are then networked together. The 3000i serves as the charge control and network communication Master, controls the charging process, and directs the activities of one or more Slaves. No additional communication hardware or software is required to setup or operate the network. A network 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 6. Up to 8 IPN based charge controllers can be connected together in a multi-controller system. The 3000i is fixed as device address 0 (zero) and serves as the IPN Network Master. Attached controllers are configured as Slaves set to addresses 1 through 7. If an optional battery temperature sensor is used, only one is required and it must be connected to the 3000i (Master) to be recognized and shared. Optional displays or UCM may connect to any controller on the network.

MULTI-CONTROLLER WIRING AND SETUP



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

- 1) Each controller must be a separately installed charging system and connect to and charge the same battery.
- 2) Attached Slave controllers must be set to addresses 1 – 7 with no two controllers set the same. (3000i is fixed to IPN address 0 and is the charge control Master.)
- 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 to their controller.
- 5) All controllers must be connected to the IPN network as shown in Figure 6.

IPN NETWORK WIRING

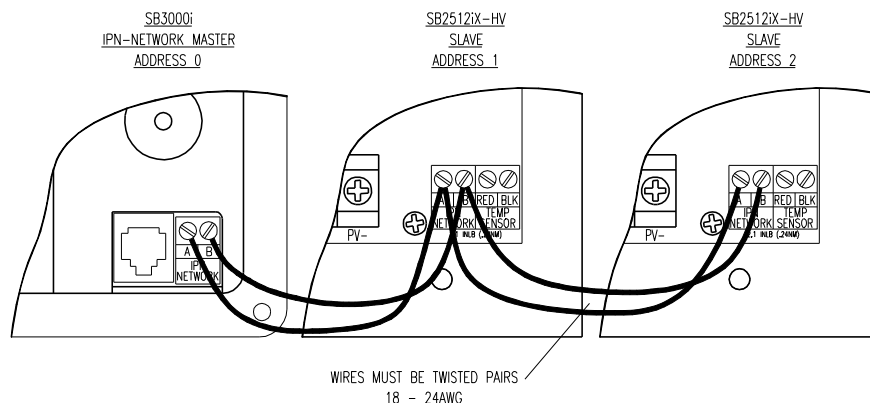


FIGURE 6

TROUBLESHOOTING GUIDE



➤ If operational problems occur the single most important troubleshooting item is to be certain that battery voltage as measured on the battery terminals of the 3000i is the same as voltage measured on the batteries themselves within a few 10^{ths} of a volt at all times. If voltages are different there is a connection problem to the battery which often resides within the battery fuse or fuse holder. The fuse holder feeling warm or hot during operation is a sure sign of a poor quality or failing fuse or fuse holder which must be corrected. Once proper battery voltage is confirmed the second most important item to check is PV voltage on the PV terminals of the 3000i. While PV voltage will vary greatly when the 3000i is in a Charge On state, the 3000i will not switch to a Charge ON state unless PV voltage is at least 0.3V higher than battery voltage with everything connected in the normal manner.

SYMPTOM	PROBABLE CAUSE	ITEMS TO EXAMINE OR CORRECT
Completely dead, display blank.	No battery power. Display mode set to OFF.	Battery disconnected, overly discharged, or connected reverse polarity. Battery powers 3000i, not PV. Voltage present on the 3000i's battery terminals must be the same as actual battery voltage within a few 10 ^{ths} and at least 9 volts. Press Display Select to select display mode other than OFF.
Display very dim.	3000i in Charge Off state	Normal operation, display automatically dims when 3000i is in Charge Off state even if Slave(s) are in charge on state causing Float/ Absorption LEDs' to be on.
All display segments & LED indicators stuck on.	PV connected reverse polarity. PV- connected to BAT- external to controller causing unexpected ground currents.	Immediately correct polarity. PV- & BAT- must be separate for proper operation. External connection prevents proper operation.
Unit will not switch to Charge ON state.	No battery power. PV disconnected or low in voltage. PV reverse polarity. Microprocessor lockup. Over temperature shutdown.	Battery disconnected, overly discharged, or connected reverse polarity. Battery powers 3000i, not PV. Voltage present on the 3000i's battery terminals must be the same as actual battery voltage within a few 10 ^{ths} and at least 9 volts. PV voltage when connected to the 3000i must be at least 0.3V greater than battery voltage for 3000i to switch to Charge On State. Reverse PV will heat front panel & force all display segments & LED's ON. Momentarily remove all power (battery & PV) to re-boot. Normal operation will resume when the 3000i cools.
Unit will not stay in a Charge ON state.	Low and changing sun intensity. PV- connected to BAT- external to controller.	Normal operation. PV- & BAT- must be separate for proper operation. External connection prevents proper operation of current measurement system.
Charge status indicator ON but no output charge current.	Battery voltage greater than present charge voltage setpoint. Battery voltage too low. Poor connection to the battery. PV- connected to BAT- external to controller.	Normal operation. Output is off due to high battery voltage which may be caused by other charging systems, or immediately following a switch to Float before battery voltage dropped and settled. Battery voltage must be at least 9 volts for the 3000i to operate. Voltage present on the 3000i's battery terminals must be the same as actual battery voltage within a few 10 ^{ths} . Examine connections and fuse & fuse holder. PV- & BAT- must be separate for proper operation. External connection prevents proper operation of current measurement system.
Charge OFF at high ambient temperature.	System temporarily shuts down due to high internal temperature.	Normal operation, improve ventilation or reduce PV power.
Charge current is lower than expected.	Battery is highly charged. User expectations too high. Worn out or very dissimilar PV modules Low sun intensity PV- connected to BAT- external to controller.	Normal operation. Current is intentionally reduced in Absorption & Float to control battery voltage at setpoint. Maximum available charge current will only be seen when the 3000i is in Bulk. Even though the PV's may be in full sun, clean, and with zero shading it is common to only see about 75 – 80% of total PV I _{MP} . Note that the smallest amount of shade can cause a large reduction in charge current. 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. External connection prevents proper operation of current measurement system.
MPPT Current boost is less than expected	PV maximum power voltage (V _{MP}) is near 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 V _{MP} ≥ 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" such that 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 % increase to drop or even go to zero as PV temperature rises. Replace, use as is, or use different controller for different PV modules.

SYMPTOM	PROBABLE CAUSE	ITEMS TO EXAMINE OR CORRECT
System appears to operate OK, but will not switch between Bulk, Absorption & Float.	<p>Not set for 3-stage charge.</p> <p>Will not switch out of Bulk.</p> <p>Will not switch from Absorption to Float.</p>	<p>Confirm Float voltage setpoint is not set to OFF.</p> <p>Available net charge current cannot bring battery voltage up to the present charge voltage setpoint. Battery state of charge may be too low, battery too large, PV power too low, and/or loads too high. PV's should produce at least 3 amps per 100 amp-hours of battery – and– daily PV amp-hours produced must be greater than daily load amp-hours consumed.</p> <p>Battery not fully charged. Unit will not switch to Float until 3000i remains in Absorption continuously for the Absorption Charge Time period. Periodic load pulls battery voltage low causing 3000i to re-enter Bulk resetting the Absorption Charge Timer. Consider using a shorter Absorption Charge Time setting. Momentary decrease in PV power allows battery voltage to drop causing 3000i to re-enter Bulk resetting the Absorption Charge Timer.</p>
Temperature compensation of charge voltage does not work.	<p>Temperature sensor missing.</p> <p>Wrong temperature sensor.</p> <p>Temperature sensor failed or installed reverse polarity.</p>	<p>Install battery temperature sensor BSE p/n 930-0022-20.</p> <p>Use only BSE battery temperature sensor p/n 930-0022-20.</p> <p>If sensor is open, short, reverse polarity or missing 3000i will operate as if battery temperature is 25°C. Proper sensor voltage when excited by the 3000i will read approximately 2.98V at 25°C, changing at +10mV/°C.</p>
Auxiliary battery not being charging.	<p>Not set for auxiliary battery charge.</p> <p>Primary battery not highly charged.</p> <p>Load on Auxiliary battery too high. Auxiliary battery not connected.</p>	<p>Confirm “out” setting is set to “ch9”.</p> <p>Auxiliary battery will not receive charge unless primary battery is in Absorption or Float.</p> <p>Maximum auxiliary charge current is roughly 2 amps. Load may need to be reduced. Confirm proper connection.</p>
Auxiliary battery voltage not displaying correctly.	Auxiliary battery not connected.	<p>Confirm proper connection.</p> <p>If auxiliary battery connection is open, value may float around a few 10ths of a volt.</p>
LVD Load control not working correctly.	<p>Auxiliary output not set for load control.</p> <p>Output may have shut off due to low battery charge.</p> <p>ON/OFF thresholds set incorrectly.</p> <p>Lighting control enabled.</p>	<p>Confirm “out” setting is set to “Lod”.</p> <p>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) for 20 seconds.</p> <p>Correct ON/OFF threshold settings.</p> <p>Load will shut off if lighting control enabled and 3000i is in Charge On state.</p>
Dusk-to-Dawn feature, lights will not turn ON or remain ON.	<p>Auxiliary output not set for load control.</p> <p>Output may have shut off due to low battery charge.</p> <p>Charge control system ON.</p> <p>Timers set incorrectly.</p> <p>Valid night time period not seen.</p>	<p>Confirm “out” setting is set to “Lod”.</p> <p>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) for 20 seconds.</p> <p>Lights will not turn on if charge control system is ON and charging as this is day time.</p> <p>Check time settings of Post-Dusk or Pre-dawn timer.</p> <p>Pre-Dawn lighting will not operate until a valid night time period of ≥4 hours detected. If PV was removed/reconnected, night time period may be inaccurate. Remove & restore battery & PV power to reboot.</p>
Dusk-to-Dawn feature, lights will not turn OFF.	<p>Auxiliary output not set for load control.</p> <p>Lighting control not enabled.</p> <p>Charge control does not turn ON.</p> <p>Middle of the night dimming feature enabled.</p>	<p>Confirm “out” setting is set to “Lod”.</p> <p>Either Post-Dusk or Pre-dawn timers must be set to time value to enable Dusk-to-Dawn feature.</p> <p>Check charge control system related items.</p> <p>Disable dimming feature or correct setting.</p>
Networked units do not seem to coordinate action or slaves do not turn on.	<p>IPN network address set wrong.</p> <p>Network wiring problem.</p> <p>Bad battery or PV power to slave</p>	<p>One unit of a multi-unit network must be set to IPN network address 0 (zero) to be charge control Master, AND all Slave units must be set to different addresses 1 – 7.</p> <p>Confirm wiring correctly in place. Use IPN ProRemote or UCM to see View Charge Unit Status screens to confirm communication with slaves.</p> <p>Check charge control related items on Slave. Consider temporarily removing Slave unit from network and setting unit to be standalone Master for troubleshooting.</p>

Specifications:	SB3000i @ 12V
Maximum PV Power:	400W with 36-cell PV panel ^(*) 290W with 60-cell PV panel ^(*)
Rated Battery (Output) Current:	30A with 36-cell PV panel ^(*) 22A with 60-cell PV panel ^(*)
Conversion Efficiency:	97% (typical @28V / 24A output)
Power Consumption:	0.36W (typical standby)
Recommended Max Panel Voc at STC:	40V (Max Panel Input 50V)
Charge Profile:	Multi-Stage plus Manual or Automatic Equalization
Absorption Voltage:	14.4V ⁽¹⁾
Float Voltage:	13.2V ⁽¹⁾
Equalization Voltage (if enabled):	15.2V ⁽¹⁾
Auxiliary Output (option A, B, or C):	A) Auxiliary Battery Charge 2A (2nd battery) B) Load Control C) Dusk-to-Dawn and PWM dimming ⁽¹⁾
Load (LVD) Disconnect/Reconnect Voltage:	11.5V/12.6 V ⁽¹⁾
Maximum Auxiliary Output current (option B or C):	20A
Display:	Yes
Temperature Compensation (by optional Battery Temp. Sensor):	-5.00mV/°C/cell correct factor (Range 0.00 to -8.00mV/°C/cell) ⁽¹⁾
Operating Temperature:	-40°C – 45°C
Maximum Full Power Ambient:	45°C
Environmental Protection:	IP20
Weight:	1.08 lb. (493 g)
Dimensions:	6.35 x 4.6 x 2.2" (16.1 x 11.7 x 5.6 cm)

^(*) 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) - ⁽¹⁾ Factory default, programmable via digital display.

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 \$30 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.