

Purpose

This manual addendum applies to the Solar Boost 3024i family of charge controllers which have received the DUO-Option upgrade part number Upgrade/3024DUO. This addendum should be used in conjunction with the standard product manuals.

The DUO-Option

The 3024 includes a 20 amp auxiliary output. The basic DUO-Option is a software only upgrade which converts the auxiliary output into a separate 20 amp *Diversion* type charge controller. The DUO-Option upgrade allows a 3024 to provide Diversion type charge control for hydroelectric, wind or similar unregulated DC generator type power sources while at the same time providing MPPT type PV charge control.

What is Diversion type charge control?

The core purpose of any charge controller is to prevent battery voltage from exceeding a certain charge voltage setting during charging by reducing charge current delivered to the battery. A battery will charge if PV modules or a wind generator was connected directly to a battery without a charge controller, but as battery state of charge rises so does battery voltage. Without a charge controller voltage can rise so high once the battery is charged that the battery or attached systems may be damaged. The *Series Pass* type charge control in the 3024's MPPT system reduces current delivered to the battery when necessary to control battery voltage by reducing the current it draws in from the PV and "passes through" to the battery. By contrast *Diversion* type charge control has the power source connected directly to the battery. When charge current needs to be reduced to control battery voltage the Diversion controller "diverts or redirects" a portion of the power source charge current away from the battery as the means it uses to limit net battery charge current and control battery voltage. The diverted current is typically dissipated as heat in a resistive dump load.

Diversion charge control operation

When multiple 3024's are networked together without the Diversion control upgrade they essentially operate as separate *PV power controllers* under the direction of a single *charge control system*. Charge voltage setpoints and all charge control "smarts" reside within the charge control system. If one or more PV power controllers receives PV input power the charge control system starts and directs the activities of the one or more PV power controllers to deliver the 3024's sophisticated multi-stage battery charge control. The Diversion control upgrade creates a completely separate 100Hz Pulse Width Modulation (PWM) Diversion type power controller within the 3024 using the 3024's existing 20 amp auxiliary output. The Diversion power controller has it's own turn on criteria which is when battery voltage reaches the present charge voltage setpoint (typically 14.4/28.8V). When this battery voltage threshold is reached Diversion turns on (whether PV power is present or not) and the Diversion power controller as directed by the charge control system begins to divert current to a resistive dump load as necessary to reduce net charge current and control battery voltage. The charge control system then progresses through it's normal multi-stage charge process to precisely control battery charge.

Min-Power / Max-Power modes

A key aspect of the Diversion control upgrade is it's coordinated interaction with PV charge control. This interaction allows the user to select whether minimum or maximum possible power is delivered to the dump load. Note that this coordinated interaction occurs within a 3024 only and not among multiple 3024's on the IPN network. Min-Power / Max-Power mode is selected with 3024 Dip #4.

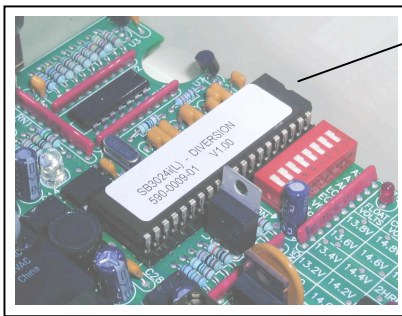
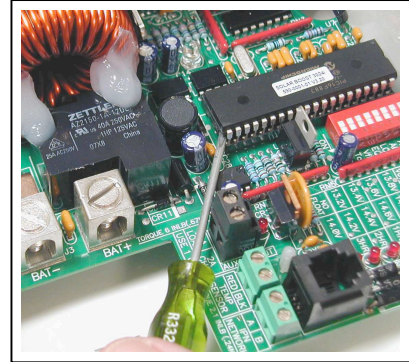
Diversion Operating Mode	DIP Switch #4	Diversion Control Operation
Min-Power Mode	OFF (formerly Aux Bat Chg)	When battery voltage climbs to the present charge voltage setpoint in the Min-Power mode the PV power controller reduces current delivered to the battery to control battery voltage in the same manner as a standard 3024. The Diversion power controller remains off until the PV power controller is unable to reduce current enough to control battery voltage. Once PV output is at a minimum, the Diversion power controller begins to divert current to the dump load to further reduce net charge current and control battery voltage. Min-Power mode is typically selected when dump load power is not directed towards a useful purpose and minimum dump load heating is desired. If no generator is present in Min-Power mode a dump load is unnecessary as the PV power controller alone controls all charge current.
Max-Power Mode	ON (formerly Load Control)	When battery voltage climbs to the present charge voltage setpoint in the Max-Power mode the PV power controller continues deliver maximum PV power. While maximum PV power production continues, the Diversion power controller diverts current to the dump load to reduce net charge current and control battery voltage. If the Diversion power controller is unable to divert enough current to control battery voltage, the PV power controller will reduce current to assist in controlling battery voltage while the system as a whole delivers as much power as possible to the dump load. Max-Power mode is typically selected when dump load power is directed towards a useful purposes such as heating water. The Max-Power mode may be used with PV power alone if the user wishes to divert PV power not required for battery charging to a useful purpose. <u>Note that a dump load must be present in Max-Power mode to ensure stable battery voltage control.</u>

Microprocessor installation (required for field upgrade only)



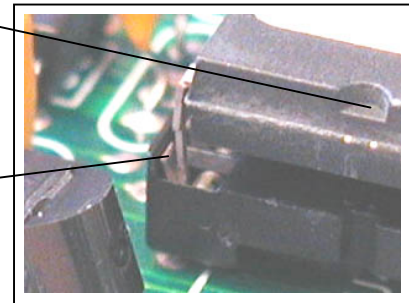
➤ **WARNING:** The microprocessor or 3024 may be damaged by static electricity. Observe industry standard electrostatic handling precautions. At a minimum discharge yourself by touching grounded metal prior to handling the microprocessor or touching circuits in the 3024. Touch the “BAT-” terminal in the 3024 just prior to removing the old microprocessor or inserting the new microprocessor. The risk of electrostatic damage increases greatly if relative humidity is below 40%.
The Microprocessor must be inserted in the proper Pin-1 orientation and all pins must be properly seated into the socket.

1. Remove all sources of power, battery and PV.
2. Carefully remove the old microprocessor with a suitable tool. Take care not to damage the microprocessor socket or other components.
3. Carefully place the new microprocessor p/n 590-0009-01 onto the socket, but do not press into place. Confirm that the Pin-1 end of the microprocessor is in the proper orientation closest to the case wall and that all pins are properly placed into the socket.
4. With one finger on each end of the microprocessor, carefully and evenly press the microprocessor to fully seat it into the socket. Confirm all pins are properly seated into the socket with no bent pins, and again confirm Pin-1 orientation.
5. Reapply battery power. Confirm that the microprocessor operates by viewing the charge voltage setting value (V_{CHG}) as described in the 3024 manual.



Place Microprocessor into socket with Pin 1 orientation where shown.

Confirm that each pin is properly placed into socket prior to pressing microprocessor into place.



Dump Load selection and installation



➤ **WARNING:** Over current protection for the 3024's auxiliary output must be provided externally. To reduce the risk of fire, connect the auxiliary output to 25 ampere maximum over current protection in accordance with National Electrical Code, ANSI/NFPA 70. Do not connect the auxiliary output to a dump load capable of drawing more than 20 amperes at the highest battery charge voltage. For dump load current up to 40 amperes use current booster module part number CBM4070. Over current protection for CBM4070 must be provided externally. To reduce the risk of fire, connect CBM4070 to 50 ampere maximum over current protection in accordance with National Electrical Code, ANSI/NFPA 70. Do not connect CBM4070 to a dump load capable of drawing more than 40 amperes the highest battery charge voltage. Install and wire the dump load in accordance with the dump load manufacturer's installation and safety instructions and National Electrical Code, ANSI/NFPA 70. For dump load wiring clarity these instructions omit standard 3024 installation. These instructions show generalized connections only and are not intended to show all wiring, circuit protection and safety requirements.

For proper battery voltage control the dump load resistor value should be just low enough consume full generator current, but not so low as to exceed the maximum current ratings of the 3024's auxiliary output or the CBM4070. Since any charging source that drives battery voltage up to or above the 3024's charge voltage setpoint will cause current to be delivered to the dump load, care must be taken in the selection of both the 3024's charge voltage setpoints and the charge voltage setpoints of other charging sources. To prevent the Diversion control system from diverting current to the dump load from other charging sources such as an AC powered charger or engine driven alternator, the 3024's charge voltage setpoint must ALWAYS be greater than the voltage applied by these other chargers. This may necessitate eliminating the 3024's lower voltage Float charge stage by setting the 3024 for 2-stage charge.

Minimum dump load resistor value may calculated as follows:

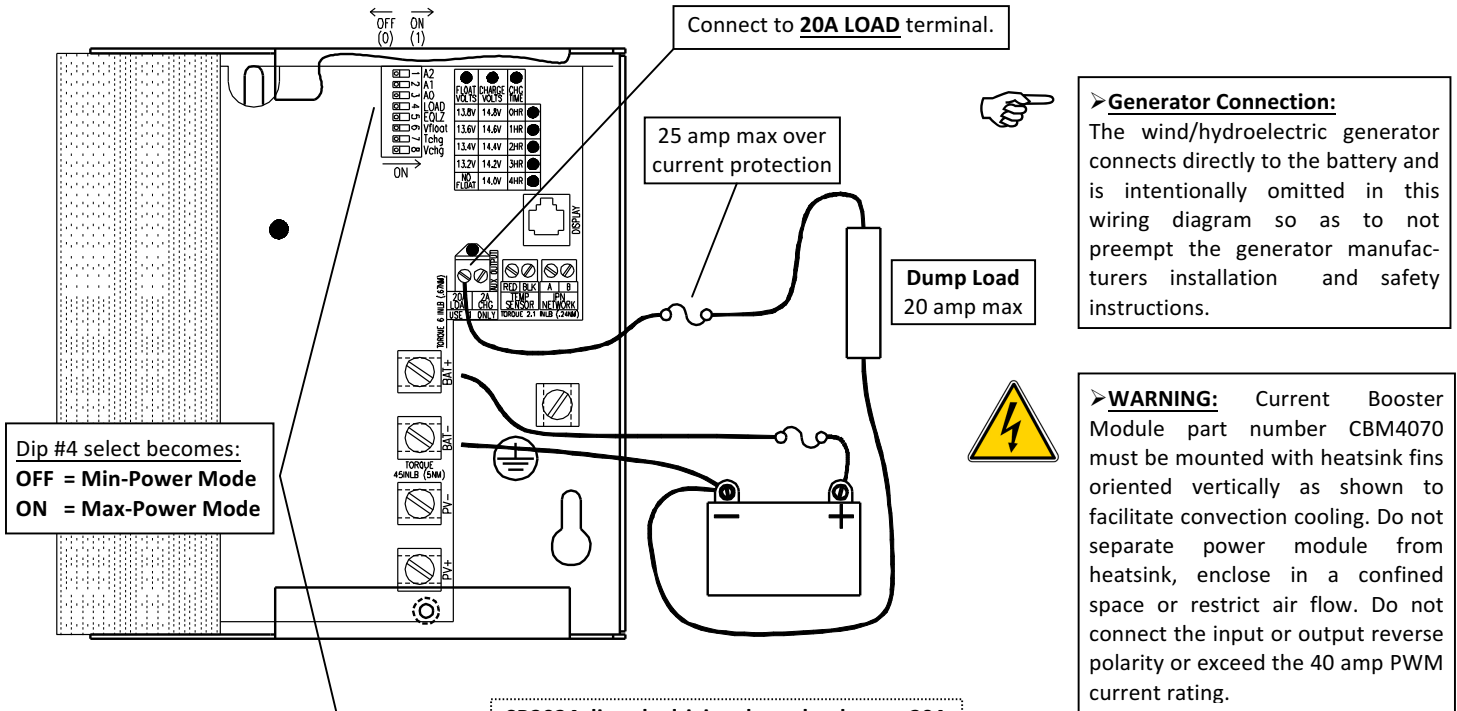
$$R_{DUMP-MIN} = V_{BAT-MAX} \div I_{DUMP-MAX}$$

Where: $R_{DUMP-MIN}$ = Minimum value of dump load resistor in Ohms (Ω)
 $V_{BAT-MAX}$ = Maximum expected battery charge voltage in Volts (V)
 $I_{DUMP-MAX}$ = Maximum dump load current in Amperes (A)

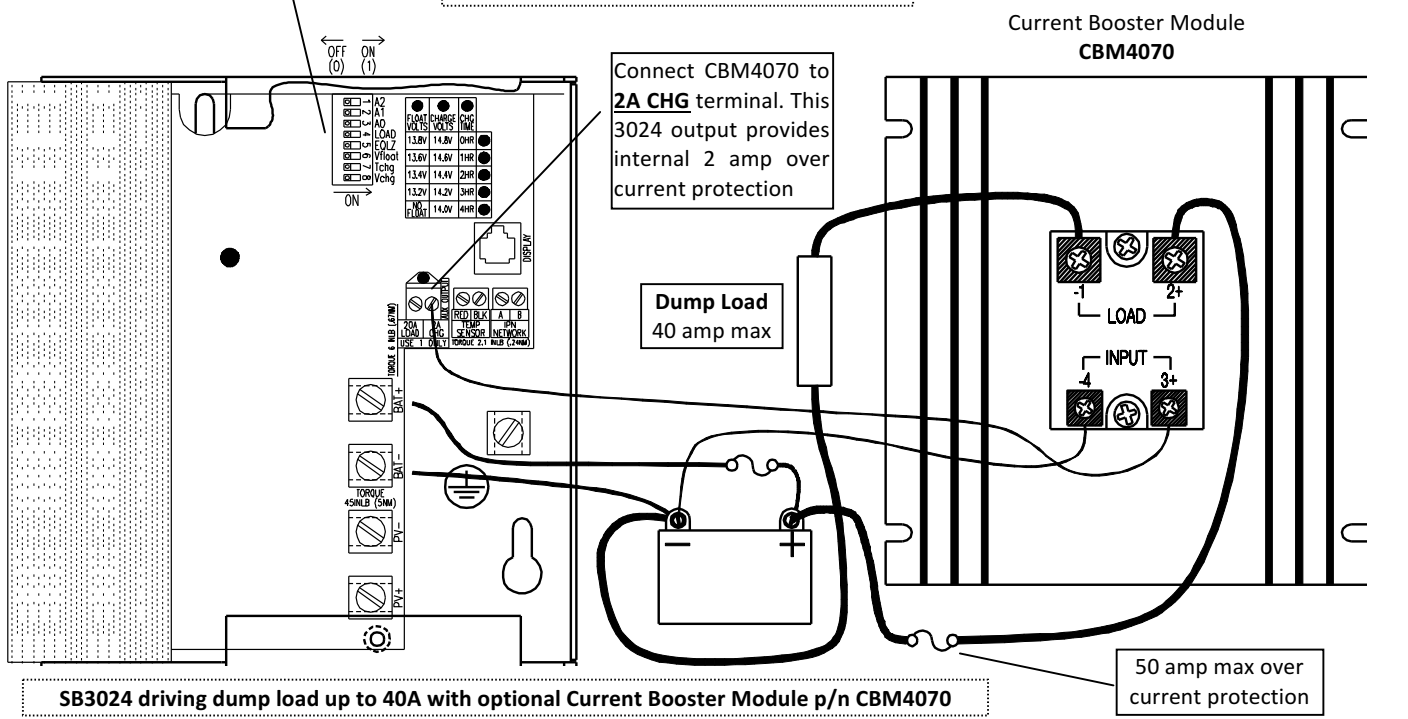
Nominal Battery Voltage	Minimum Dump Load Resistor 3024's Auxiliary Output 20 Amp Maximum	Minimum Dump Load Resistor CBM4070 40 Amp Maximum
12V $V_{BAT-MAX} = 15V$	0.750 Ω	0.375 Ω
24V $V_{BAT-MAX} = 30V$	1.500 Ω	0.750 Ω

Dump Load and optional Current Booster Module wiring

The 3024 can directly drive dump loads up to 20 amps. For dump loads of up to 40 amps the optional the Current Booster Module (CBM) part number CBM4070 may be used. The CBM consists of a large optically isolated MOSFET output stage which turns on when a 3 to 32VDC drive signal is present on it's input. The 3024's 2A-CHG output is used as the PWM drive signal for the CBM. For dump load needs in excess of 40 amps multiple CBM's may be driven from a single 3024. For these applications multiple CBM inputs are connected in parallel. CBM outputs must connect to separate 40 amp maximum dump loads with separate 50 amp maximum over current protection. Do not directly parallel outputs.



SB3024 directly driving dump load up to 20A



SB3024 driving dump load up to 40A with optional Current Booster Module p/n CBM4070

Clamp on ferrite suppressor noise

The 3024iL is shipped with two clamp on ferrite suppressors to minimize EMI radiation and susceptibility. One is placed around both battery wires, and the second is placed around the battery temperature sensor and remote display wires. If the 20A Load output drives the dump load directly it is possible that the battery wire suppressor may emit a 100Hz buzzing noise resulting from the 100Hz PWM diversion current.

This noise can be eliminated by also routing the dump load wire from the 20A Load output through the battery wire suppressor in the same direction as the battery wires. If wire size is such that all three wires cannot fit through the existing battery wire suppressor an additional suppressor may be used. One suppressor should be placed around the BAT- wire alone. The other should be placed around both the BAT+ wire and the dump load wire. Routing both the BAT+ wire and the dump load wire through the same suppressor in the same direction cancels 100Hz magnetic field in the suppressor which eliminates the noise. Additional suppressors may be ordered as BSE part number 523-0005-01.

Wind/Hydroelectric generator installation and wiring

The DUO-Option is normally suitable for use with DC generators requiring diversion type charge control. If the generator includes a voltage regulator it's setpoint must be set slightly higher than the 3024's maximum charge voltage setpoint including the effects of temperature compensation.



➤ **WARNING:** The generator DC output must be connected to the battery in accordance with the generator manufacturers installation and safety instructions. The generator is intentionally omitted in the preceding drawing so as to not preempt the generator manufacturers installation and safety instructions. DUO-Option diversion operation and associated dump load must meet the generator manufacturers diversion charge control requirements. Do not connect the generator to the 3024's PV inputs.

Diversion power controller indicators

As the Diversion power controller increases or decreases it's PWM "on time" to adjust how much average current is diverted, the 3024's auxiliary output LED indicator will vary in brightness in proportion to PWM percent on time. The LED will be brighter when more current is diverted and will be completely off when no current is being diverted. If an IPN ProRemote is present in the system it's auxiliary output screen in the Top Menu will always show Auxiliary Battery Charge. The auxiliary battery voltage displayed in this screen will be the average voltage applied to the dump load and will vary with PWM percent on time. If actual battery voltage was 14.4V and the Auxiliary Battery Charge screen shows 7.2V, then Diversion PWM duty cycle (% on time) = $7.2V \div 14.4V = 50\%$.

Five year limited warranty

Blue Sky Energy, Inc. (hereinafter BSE), hereby warrants to the original consumer purchaser, that the product or any part thereof will be free from defects due to defective workmanship or materials for a period of five (5) year subject to the conditions set fourth below. If within the coverage of this limited warranty, BSE will repair or replace the product at BSE's discretion. The original consumer purchaser is responsible for all transportation costs and insurance related to returning the product to BSE. BSE will cover standard ground transportation costs and insurance to return the product to the original consumer within the continental US.

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 original consumer purchaser.
3. This limited warranty does not apply to any product or part thereof damaged by; a) alteration or disassembly, 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, or f) operation or installation contrary to instructions pertaining to the product.
4. BSE's liability for any defective product or any part thereof shall be limited to the repair or replacement of the product, at BSE's discretion. BSE will 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. Some states do not allow exclusions or limitations of incidental or consequential damages, so the above limitation may not apply to you.
5. Any implied warranty for merchantability or fitness for a particular purpose is limited in duration to the length of this warranty. Some states do not allow exclusions or limitations on how long an implied warranty lasts, so the above limitation may not apply to you.
6. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.
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.

DO NOT INCLUDE THIS PAGE WITH BOUND MANUAL

Revision control --- 430-0027

REV	DATE	DESCRIPTION
A	9/17/09	INITIAL RELEASE
B	9/29/09	Swap min/max Dip #4, add ferrite discussion
C	6/22/17	General Updating
D	1/26/19	Updated Logo