BLUE SKY ENERGY
BY SUNFORGE

SB3024(D)iL - DUO Manual Addendum

For Models: SB3024iL and SB3024DiL

MADE IN USA

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BLUE SKY ENERGY DUO MANUAL ADDENDUM, REV F | 2022

This manual addendum includes important safety instructions for the SB3024iL-DUO & SB3024DiL-DUO. Save these instructions.

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". The part number of SB3024 charge controller with Duo-Option are SB3024iL-DUO and SB3024DiL-DUO. This addendum should be used in conjunction with the standard product manuals.

The DUO-Option

The SB3024 includes a 20 A auxiliary output. The basic DUO-Option is a software only upgrade which converts the auxiliary output into a separate 20 A Diversion type charge controller. The DUO-Option upgrade allows a SB3024 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.

Part Numbers and Options

SB3024iL-DUO	Solar Boost 3024iL charge controller with DUO-Option upgrade
SB3024DiL-DUO	Solar Boost 3024DiL charge controller with DUO-Option upgrade
IPNPRO	IPN ProRemote display & battery monitor
506-0003-01	500 A / 50 mV current shunt
930-0022-20	Battery temperature sensor
CBM4070	Current Booster Module to increase DUO diversion capability to 40A or LVD load output to 70A

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 (Panel) modules or a wind generator was connected directly to a battery without a charge controller, but as battery state of charge rises so does the 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 SB3024'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 (Panel) 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 a means 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 SB3024's are networked together without the Diversion control upgrade they essentially operate as separate PV (Panel) 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 (Panel) power controllers receives PV (Panel) input power the charge control system starts and directs the activities of the one or more PV (Panel) power controllers to deliver the SB3024's sophisticated multi-stage battery charge control. The Diversion control upgrade creates a completely separate 100 Hz Pulse Width Modulation (PWM) Diversion type power controller within the SB3024 using the SB3024's existing 20 A 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 V /28.8 V). When this battery voltage threshold is reached, Diversion turns on (whether PV (Panel) 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

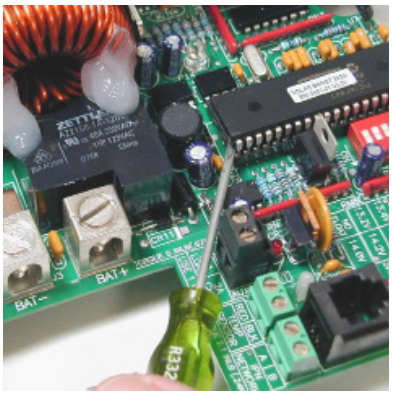
A key aspect of the Diversion control upgrade is it's coordinated interaction with PV (Panel) charge control. This interaction allows the user to select whether minimum or maximum possible power is delivered to the dump load. Note that this coordinated interaction occurs within a SB3024 only and not among multiple SB3024's on the IPN network. Min-Power / Max-Power mode is selected with SB3024 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 (Panel power controller reduces current delivered to the battery to control battery voltage in the same manner as a standard SB3024. The Diversion power controller remains off until the PV (Panel) power controller is unable to reduce current enough to control battery voltage. Once PV (Panel) 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 (Panel) 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 (Panel) power controller continues deliver maximum PV (Panel) power. While maximum PV (Panel) 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 (Panel) 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 (Panel) power alone if the user wishes to divert PV (Panel) power not required for battery charging to a useful purpose. **Note that a dump load must be present in Max-Power mode to ensure stable battery voltage control.**

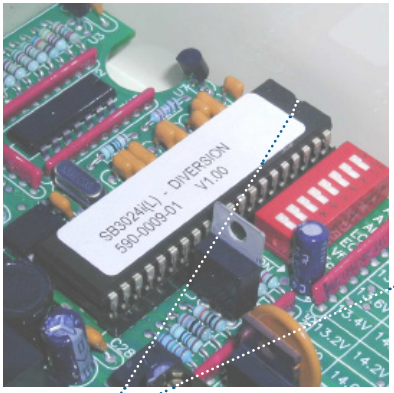
Microprocessor Installation **(required for field upgrade only)**

WARNING: The microprocessor or SB3024 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 SB3024. Touch the "BAT-" terminal in the SB3024 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%.

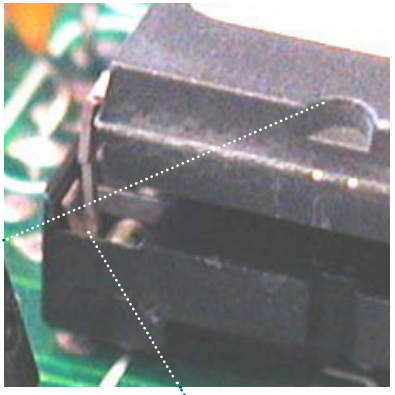
The Microprocessor must be inserted in the proper Pin-1 orientation and all pins must be properly seated into the socket.



1. Remove all sources of power, battery and PV (Panel).
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 (VCHG) as described in the SB3024 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 SB3024's auxiliary output must be provided externally. To reduce the risk of fire, connect the auxiliary output to 25 A 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 A at the highest battery charge voltage. For dump load current up to 40 A 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 A 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 A 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 SB3024 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 SB3024's auxiliary output or the CBM4070. Since any charging source that drives battery voltage up to or above the SB3024's charge voltage setpoint will cause current to be delivered to the dump load, care must be taken in the selection of both the SB3024'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 SB3024's charge voltage setpoint must ALWAYS be greater than the voltage applied by these other chargers. This may necessitate eliminating the SB3024's lower voltage Float charge stage by setting the SB3024 for 2-stage charge.

Minimum dump load resistor value may calculated as follows:

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

Where

$R_{DUMP\text{-}MIN}$ = Minimum value of dump load resistor in Ohms (Ω)

$V_{BAT\text{-}MAX}$ = Maximum expected battery charge voltage in Volts (V)

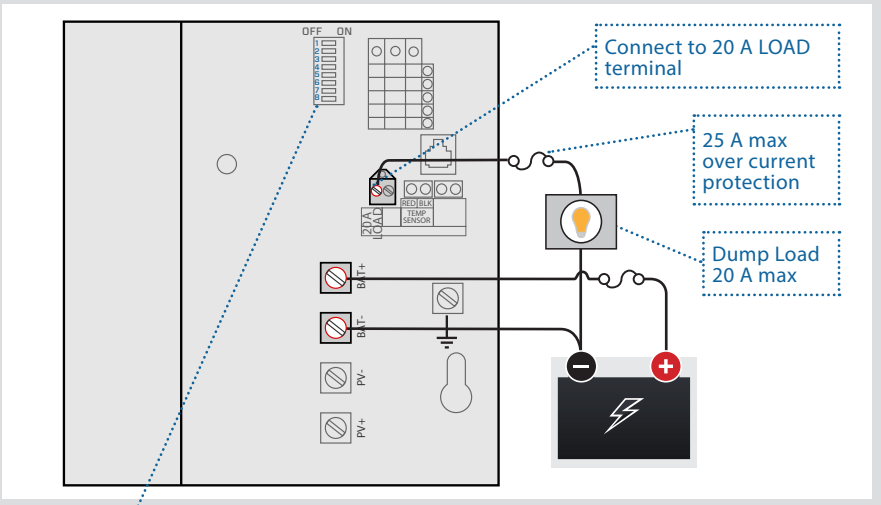
$I_{DUMP\text{-}MAX}$ = Maximum dump load current in Amperes (A)

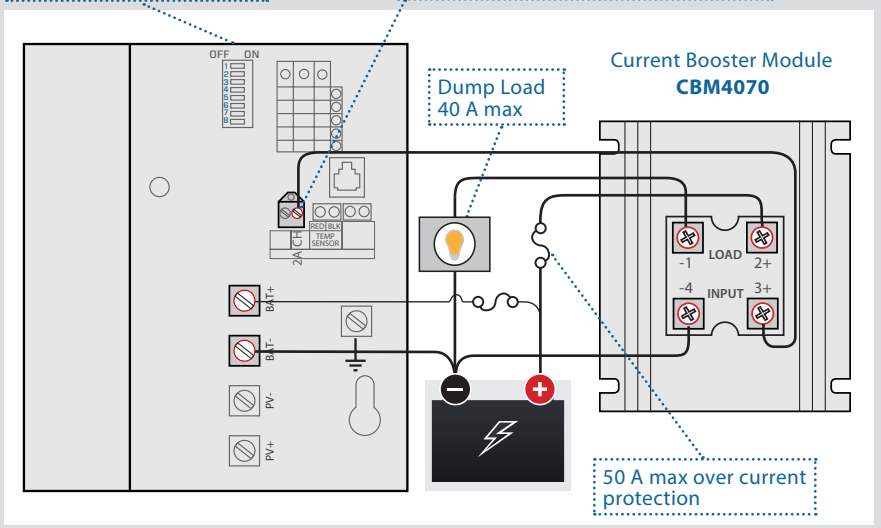
Nominal Battery Voltage	Minimum Dump Load Resistor 3024's Auxiliary Output 20 A Maximum	Minimum Dump Load Resistor CBM4070 40 A Maximum
12 V $V_{BAT\text{-}MAX}$ = 15 V	0.750 Ω	0.375 Ω
24 V $V_{BAT\text{-}MAX}$ = 30 V	1.500 Ω	0.750 Ω

Dump Load and Optional Current Booster Module Wiring

The SB3024 can directly drive dump loads up to 20 A. For dump loads of up to 40 A, 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 6 to 32 VDC drive signal is present on it's input. The SB3024's 2 A-CHG output is used as the PWM drive signal for the CBM. For dump load needs in excess of 40 A, multiple CBM's may be driven from a single SB3024. For these applications multiple CBM inputs are connected in parallel. CBM outputs must connect to separate 40 A maximum dump loads with separate 50 A maximum over current protection. Do not directly parallel outputs.

SB3024 directly driving dump load up to 20 A





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

NOTE: Generator Connection: the wind/hydroelectric generator connects directly to the battery and is intentionally omitted in this wiring diagram so as to not preempt the generator manufacturers installation and safety instructions.

WARNING: Current Booster Module part number CBM4070 must be mounted with heat-sink fins oriented vertically as shown to facilitate convection cooling. Do not separate power module from heatsink, enclose in a confined space or restrict air flow. Do not connect the input or output reverse polarity or exceed the 40 A PWM current rating.

Clamp on Ferrite Suppressor Noise

The SB3024iL/SB3024DiL 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 20 A Load output drives the dump load directly it is possible that the battery wire suppressor may emit a 100 Hz buzzing noise resulting from the 100 Hz PWM diversion current.

This noise can be eliminated by also routing the dump load wire from the 20 A 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 100 Hz 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 SB3024'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 SB3024's PV (Panel) 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 SB3024'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 14.4 V and the Auxiliary Battery Charge screen shows 7.2 V, then Diversion PWM duty cycle (% on time) = 7.2 V / 14.4 V = 50%.

Specifications

	SB3024(D)iL-DUO @12 V	SB3024(D)iL-DUO @24 V
Max. Recommended Panel Power	540 W with 36-cell PV panel [1]	800 W with 72-cell PV panel [1]
	400 W with 60/72-cell PV panel [1]	
Rated Battery (Output) Current	40 A with 36-cell PV panel [1]	30 A with 72-cell PV panel [1]
	30 A with 60/72-cell PV panel [1]	
Conversion Efficiency	97% (typical @ 28 V / 24 A output)	
Power Consumption	0.35 W (typical standby)	
Max. Recommended Panel Voc at STC	45.6 V (Max Panel Input 57 V)	
Charge Profile	Multi-Stage plus Manual or Automatic Equalization	
Absorption Voltage	14.4 V [2]	28.8 V [2]
Float Voltage	13.2 V [2]	26.4 V [2]
Equalization Voltage (if enabled)	15.2 V [2]	30.4 V [2]
Min. Battery Voltage for Operation	9 V	
Auxliary Output	20 A Diversion type charge controller	
Integrated Display	SB3024DiL-DUO version only	
Temperature Compensation (by optional Battery Temp. Sensor)	-5.00 mV/°C/cell correct factor (Range 0.00 to -8.00 mV/°C/cell) [2]	
Operating Temperature	-40 °C – 40 °C	
Maximum Full Power Ambient	40 °C	
Environmental Protection	IP 20	
Weight	3.95 lb (1.8 Kg)	
Dimensions	6.86 x 6.6 x 3.38" (17.4 x 16.8 x 8.6 cm)	

(1) 36-cell panels are typically referred to as "12 V panels" providing V_{mp}/V_{oc} of ~18 V / 22 V at STC, 60-cell panels refers to "20 V panels" (V_{mp}/V_{oc} ~30 V / 37 V), 72-cell panels refers to "24 V panels" (V_{mp}/V_{oc} ~36 V / 44 V).

(2) Factory default voltages unless programmed via DIP switches or with IPN ProRemote, ProTouch, BT Connect, or UCM.

5 year limited warranty

Visit https://sunforgellc.com/product/solar-boost-3024(d)il/ for more information.