

Sól 48 Volt Buck Boost Solar Charge Controller Connection & Operation V5.xx

Connection Instructions

Remove Bottom 4 cover to attach wires to terminal blocks then attach cover and flip over for mounting to a panel or wall.

*****DO NOT LOOSEN 4 SCREWS ON FRONT FACE*****

Warranty is void if the board mounting is tampered with

- 1) Solar Start up 16 volts, Night shutdown 15 volts. **Do NOT Over Tighten Connections. Non Oxidation grease is also a good idea to prevent corrosion over time.**
- 2) **Important to ALWAYS connect battery first. Best to use a resistor across a FUSE / Breaker to limit surge current then install FUSE / turn on breaker 3 seconds later. 1K ohm 1/2 watt will work well for this purpose. See note on wire size and length.**
- 3) **Verify LCD display comes on—this indicates proper Polarity.**
- 4) Software version and serial number displays then “b48” indicating battery voltage. Controller will enter night mode.
- 5) **Connect solar panel wires to the Panel Input and then to the Solar Panel.** Controller will enter DAY mode and begin charging the battery if the battery is below 54 volts otherwise the controller will enter battery Full display sequence.
- 6) Re-install cover and screws. You can now mount controller to a panel.
- 7) When disconnecting **ALWAYS remove panel first then battery** to prevent possible transient voltage damage to the controller. Transient voltage damage is not covered under warranty.

“Hot” Flashing indicates thermal protection is active as the board is over **170 Degrees F**. Too much solar input, or too hot of ambient air around the board can cause this to occur. Error codes are described on the last page of this document.

LCD Display Information

The LCD Display scrolls through the items about every 15 seconds. Title is displayed, then the number follows. Last 7 days totals display after sunset and until the next daylight. At night the CPU slows to conserve power and minimize battery drain below 0.0015 amps (1.5 milliamps typical for 54 volts).

The LCD Display is not a high precision meter however it's designed to show relative levels so the user can determine how well the system is working at any given time. Accuracy is better at higher power levels and ranges from about 10% at 10 Watts to about 2% above 200 Watts.

Note: Totals are lost if Battery connection removed.

WARRANTY: DIY Solar warranties the charge controller against defects in materials or workmanship for a period of FIVE YEARS from the date of purchase. DIY Solar's only remedy is to repair or replace at our discretion a defective product. User must obtain an RMA by contacting us at: diysolarforu@gmail.com. User assumes all risks associated with the use of this product and agrees to hold harmless DIY Solar for U. It's up to the user to properly install and use the product with safety over current fuse or circuit breaker. This Warranty does NOT cover misuse, neglect, Acts of God, Modifications, Disassembly, Tampering, or accidental damage of any kind. Warranty is void if taken apart.



****IMPORTANT****

Use a Voltmeter and be certain of the Polarity PRIOR to connection

DO NOT GROUND solar panel wires as they MUST remain floating. Frame can be Grounded

**Maximum Solar power (54 volt VOC Limit)
48 Volt output = 800 Watts STC Rating
See Page 3 for Details**

15 amp Output Fuse or Circuit Breaker is required to prevent a fire from abnormal operation and meet Safety Standards.

5 feet of #12 size wire on battery side to minimize peak surge currents — do not use shorter / larger gauge wires as this can damage the controller

P A N

Solar Input Voltage

b A t

Battery Voltage

A

Output Current in Amps

O u t

Output Power in Watts

P - P

Peak Power in Watts

A - H

Amp Hours Today

b - t

Board Temperature Deg. F

b 4 8

Battery Detected

LCD Display Information

Night display sequence

Panel Voltage

Battery Voltage

All Time Peak Power

Amp Hours Today

Amp Hours 2 Days Ago

Amp Hours 3 Days Ago

Amp Hours 4 Days Ago

Amp Hours 5 Days Ago

Amp Hours 6 Days Ago

Amp Hours 7 Days Ago

Battery Full Sequence

Battery Charged Voltage

Amp Hours Today

Over Temperature Shutdown — Flashing

Error Code

Error Codes:

Err + PAN + O.L. = Solar Over 60 volts input - WARNING Damage can occur

Err + Ntc = Temperature Sensing Error out of range

Err + A = Current Sensing Amplifier Error

Err + Fb + bat = Loss of voltage feedback or battery shorted error

Err + neg + bat = Reversed Battery—this can also give no LCD indication if reversed

Hot Flashing indicates thermal shutdown due to excessive heat (Charger OFF)

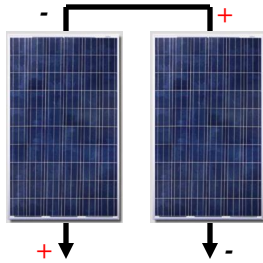
Constant cycling thru Serial number and version indicates not enough power present to operate (No Battery and Low Solar Voltage). If your battery pack has built in over-discharge protection and it cuts off the battery this display pattern can happen until there is enough Solar Power present to operate and begin charging the battery again.

Some Solar Panel Connection Examples

48 Volt Output

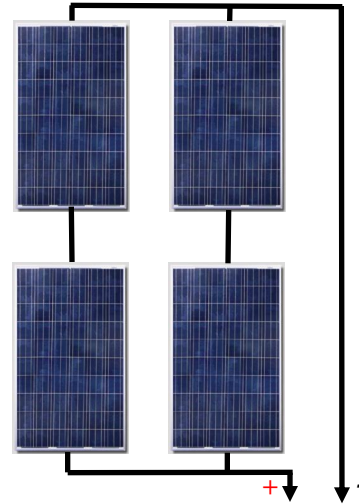


One Large Panel
Up to 54 volts open circuit VOC
Up to 800 Watts
Minimum VOC of 18 volts to start up
Two 400 watt panels can be parallel connected



Two Smaller Panels—
Matched Pair
Up to 400 Watts Each
Series Connected
28 volts Max VOC rated
54 volts total maximum

Up to 800 Watts Total



Four Small Panels
In a series / parallel array 2 x 2
**** Series Pairs Must Be Matched****
54 volts Maximum Open circuit VOC
Up to 800 Watts Total

Larger number of small panels can also be used as long as ratings are not exceeded (8x 100 watt in 4x2 array)

Because S6L is a Buck-Boost design almost any panel can be used for 48 volt batteries however maximum power is achieved with panels that have a maximum power point voltage (MPP) of about 45 volts *AND* no more than a 54 volt VOC rating. This 54 volt rating allows for cold weather voltage rise of up to 10% to stay below the 60 volt maximum rating.

Note: In 99% of applications the controller will operate as a boost converter so the input current limit of 14 amps will dominate operation. Output current is ALWAYS less when boosting. Output current is 12 amps maximum but can only be reached if the solar panels and battery are close in voltage or panel is higher.

Most installations will see power levels in the 450-550 watt range with XL size solar panels operating near 36 volts maximum power voltage. Panels can be paralleled to achieve maximum performance even when cloudy conditions exist.

DIY Solar for U recommends panels with a bit higher voltage to get the maximum power possible. 45 volts maximum power point is the sweet spot with 54 volt maximum open circuit (VOC) rating.

System Connection Diagram

IMPORTANT:

Do NOT Ground solar panel wires—Frame only can be tied to Earth Ground
Each Solar Input MUST be electrically Isolated. Tie the Battery (-) to Earth Ground and Solar Panel Frame to Earth Ground only.

Each Charge controller input should be connected to its own solar panel (s).

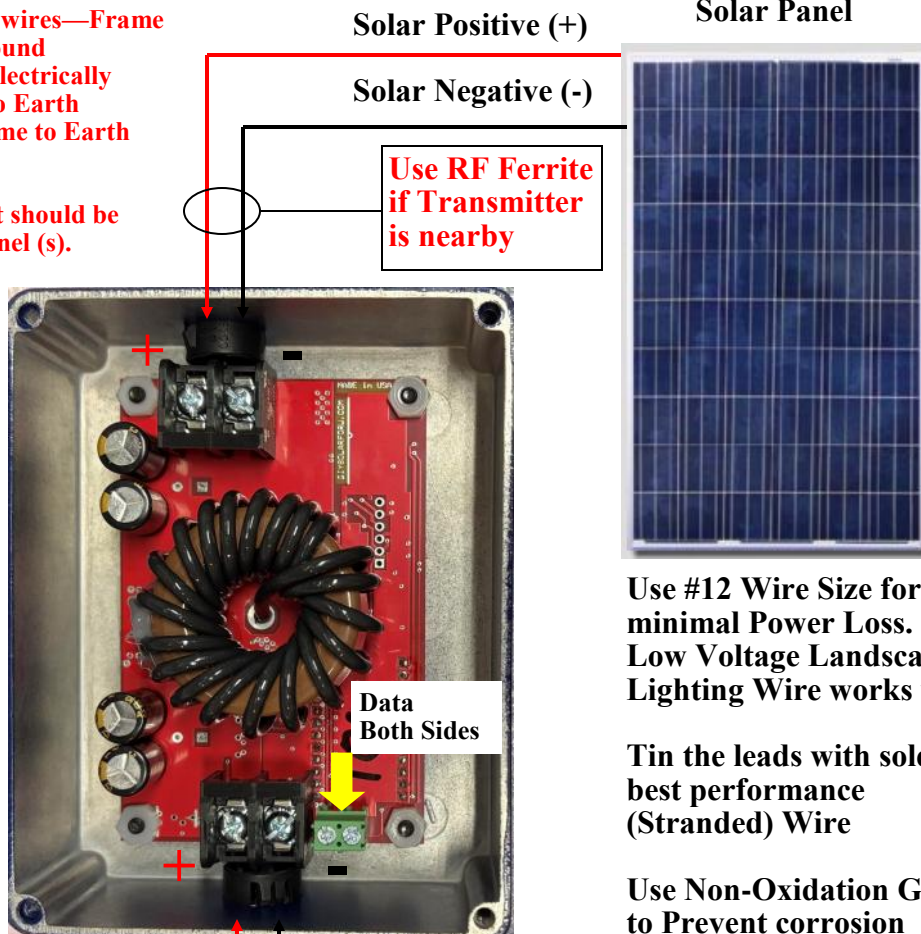
IMPORTANT:

Board contains Ceramic SMD capacitors that can crack / short circuit if too much flexing of the board occurs.

When connecting DO NOT BEND the board by using excessive downward force to prevent capacitor failure.

Tighten with a #2 Phillips Screwdriver

Verify Correct Polarity to prevent damage by following the procedure on Page #1



Use #12 Wire Size for minimal Power Loss. Low Voltage Landscape Lighting Wire works well.

Tin the leads with solder for best performance (Stranded) Wire

Use Non-Oxidation Grease to Prevent corrosion

Connect Additional Charge Controllers in the same manner using one circuit breaker for each. Breaker output from each connects to Battery (+) Terminal.

Power DC-AC Inverter if used is connected to the Battery and can be fed from a larger amperage circuit breaker.

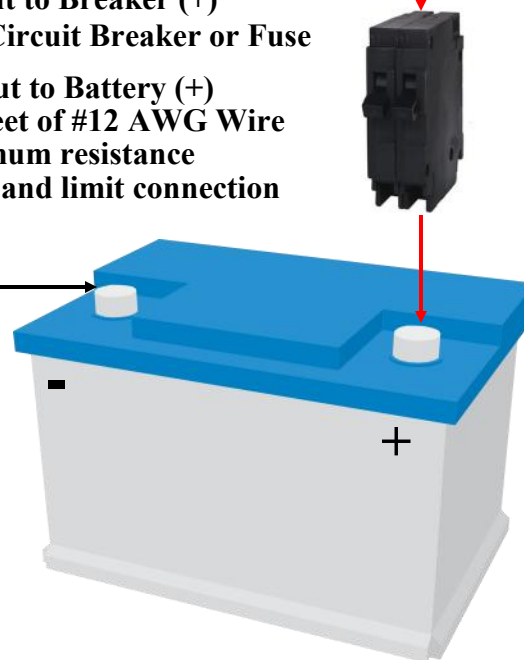
Positive output to Breaker (+)
Use 15 Amp Circuit Breaker or Fuse

Breaker output to Battery (+)
Minimum 5 feet of #12 AWG Wire to meet minimum resistance requirements and limit connection surge

Negative output to Battery (-)

A Multiple Charger Board System could use a 100 Amp or 200 Amp Home Breaker Panel as a DC Power Distribution Box. The 100/200 Amp Main Breaker would connect to the Battery Bank (+) and the Neutral to the Battery Bank (-). **Size your wire for the maximum current of your system and check your Electrical Codes for wire sizing.**

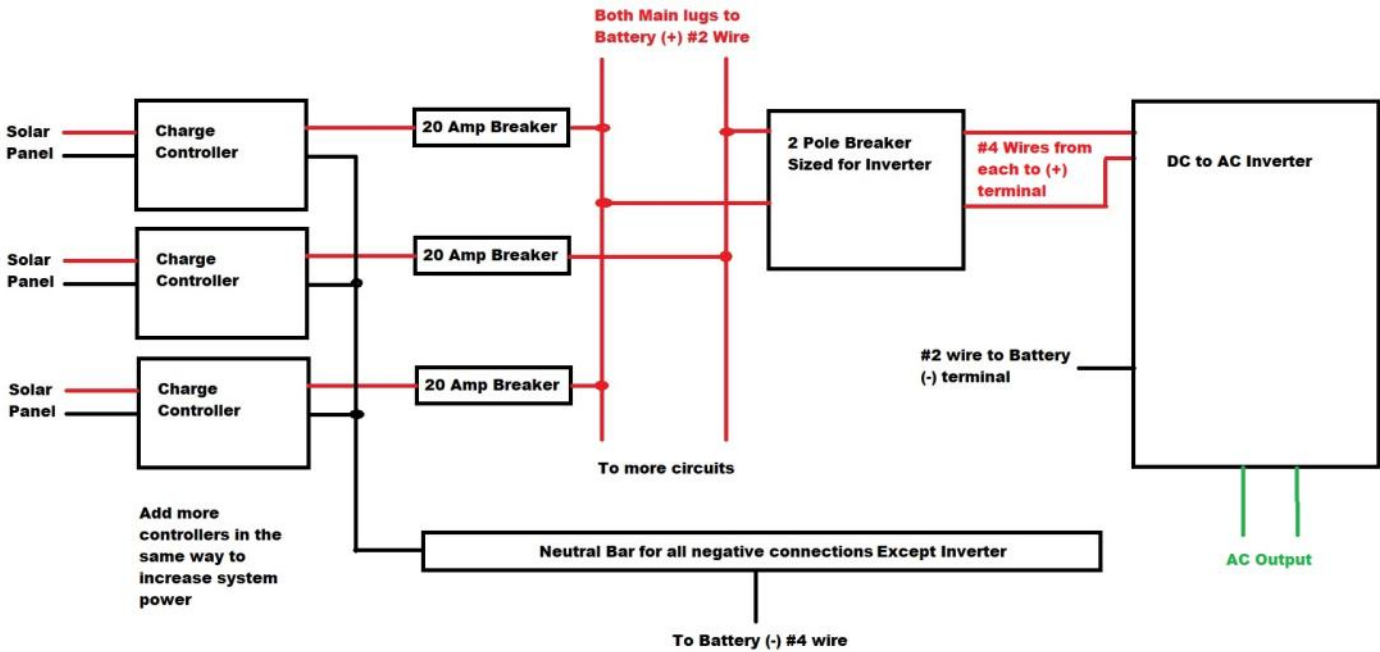
Each Charge Controller would connect to a 20 Amp Breaker. Inverter can use 2 Pole Breakers to feed their (+) Terminal. 20 to 100 Amp 2 Pole breakers sized to match inverter power with BOTH wires used. A good rule is 5 amps per 400 watts inverter power... 1600 Watts = 20 Amp 2 pole. Very large 48 volt inverters might use a 100 amp 2 pole breaker.



System DC Connection Diagram Power Distribution Box using off the shelf Breaker Box

Black is Negative wire
Red is Positive Wire

For use with Breaker Box with Main Lugs
100 or 200 amp typical ratings
6 or more "SPACES" for Breakers



Theory of Operation

At the heart of the DIY Solar Charge Controller is a very efficient DC-DC Power converter which transfers over 99% of the Panels energy to the system. The Power Converter is controlled by a Microprocessor which performs the Maximum Power Tracking, collects and tabulates data, and drives the LCD display. The Solar Charge controller works from below 1 Watt to 650 Watts of Output (800 Maximum Watt STC rated Solar Panel). No Adjustments are needed as the board is fully automatic and will adapt to any panel within the specification limits.

Our customized Maximum Power Tracking routine adjusts the power transfer about **6000 times per second** to yield maximum performance. The Buck Boost power converter has extended operation even in partial shading of the Solar Panels from shadows (Trees, Utility Poles ect.). Rapid Sunlight changes on a partly sunny day are not a problem either. The Microprocessor monitors input and output parameters while always seeking the maximum power possible. There are 2 control loops working together to get every last watt of power from the Solar Panel resulting in up to **218% MORE Power that a PWM charge controller would deliver with the same Solar Panel.**

Cheaper PWM Controllers DO NOT DO DC to DC POWER CONVERSION.

When the solar input voltage exceeds 16 volts at sunrise the Solar Charge Controller switches from NIGHT mode to DAY mode and transfers the previous day's totals to memory. The Power Stage is turned on and Solar energy begins to charge the system battery. The LCD display cycles through the daytime parameters... Battery Voltage, Panel Voltage, Amps output, Power Output, Peak Power, Amp Hours, Board Temperature, and Battery Detected. If the system Battery is at **57.6 volts AND the current is less than 1.5 amps** then the charger shuts off until the Battery drops below **54 volts**. The LCD Display will indicate **"Bat"** **"Full"** and display the voltage and amp hours input for the current day.

After Sunset when the panel voltage drops below 15 volts the Power Stage is turned off and the LCD Display switches to NIGHT mode. The LCD Display cycles through the Panel Voltage, Battery Voltage, all time MAX Power (P.P.1), and the last 7 Days Amp Hour Totals. The Processor slows to keep Battery Drain to minimum.

The Solar Charge Controller is designed for many years of reliable operation using parts rated for High Temperature Operation assuring long operating life. The Board is protected from reverse battery, input short circuit, reverse power flow, over current, over temperature, and reversed Solar Panel connections. **It is NOT however protected from excessive input voltage or transients over 60 volts.** Above 60 volts error message will display. Do Not Connect a panel with more than 54 volts open circuit or a combination of series connected panels that exceeds 54 volts open circuit. The Solar Charge Controller will work well with common **33, 36, 54, 60 and 72** cell count Solar Panels. **96 Cell Panasonic / Sanyo panels have too much voltage DO NOT USE.** Do not use panels with a Open Circuit Voltage rating over about 54 volts to allow for cold weather operation when used in a cold climate because voltage increases when colder.

Do NOT connect a solar panel until battery polarity is verified correct by LCD operation.