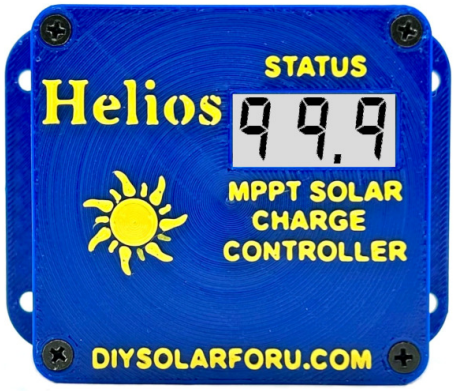
Helios 7 Amp MPPT Charge Controller

Connection Instructions

Connect wires from sides and tighten with a small Screwdriver thru the bottom access holes.
Do NOT Over Tighten Connections

1) Solar Start up 18 volts, Night shutdown 14.5 volts . Connect wires to Controller and then to the breaker / fuse rated at 10 Amps. Connect to Battery and Turn on Breaker / install fuse.
2) **Verify LCD display comes on—this indicates proper Polarity.**
3) Software version and serial number displays. Controller will then enter night mode.
4) **Turn OFF breaker / remove fuse and then connect solar panel** wires to the Ra Controller and then to the panel.
5) **LCD should start indicating proper polarity**.
6) After polarity has been verified turn on the breaker / install fuse and Ra will enter DAY mode and begin charging the battery.
7) Mounting with side tabs to a panel is optional.
8) Multiple Charge Controller boards can be parallel output connected to increase system power. There is no limit to how many can be used. Each should have its own Fuse or Breaker.

"**Hot**" Flashing indicates thermal protection is active as the board is over **180 Degrees F.** Too much solar input, or too hot of ambient air around the board can cause this to occur. Soft limit occurs at 175 F and will reduce output to keep below 180 F. Error codes are described on page 4 of this document.



****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

Panel open circuit voltage must be high enough to start charging based on battery voltage.

Maximum Solar power for full output
12 Volt output = 100 Watts STC Rating
24 Volt output = 200 Watts STC Rating

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

DISASSEMBLY WILL VOID WARRANTY

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 0.001 amps on a 12 volt Battery.

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% @ 1 Watt to about 2% @ 100 Watts.

Voltage accuracy is typically +/- 0.1 volts on Battery and +/- 0.2 volts on the Solar Input.

Note: Daily Totals are lost if Battery voltage lost with no Solar input present (Night for example).

Daytime Charge Sequence

PAn	**Solar Input Voltage**
bAt	**Battery Voltage**
A	**Output Current in Amps**
Out	**Output Power in Watts**
P-P	**Peak Power in Watts**
A-H	**Amp Hours Today**
b-t	**Board Temperature Deg. F**

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, Liquid intrusion, or accidental damage of any kind. Warranty is void if taken apart.

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.

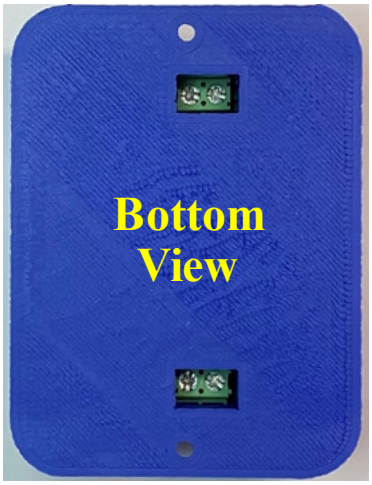
Tighten with a Small Phillips Screwdriver or small flat screwdriver.

Verify Correct Polarity to prevent damage by following the procedure on

Solar Panel V.O.C
44 Volts Max (50V)

Solar Positive (+)

Solar Negative (-)



Use #16 to #14 Wire Size for minimal Power Loss.
Low Voltage Landscape Lighting Wire works well.

Tin the leads with solder for best performance (Stranded) Wire or use Solid wire.

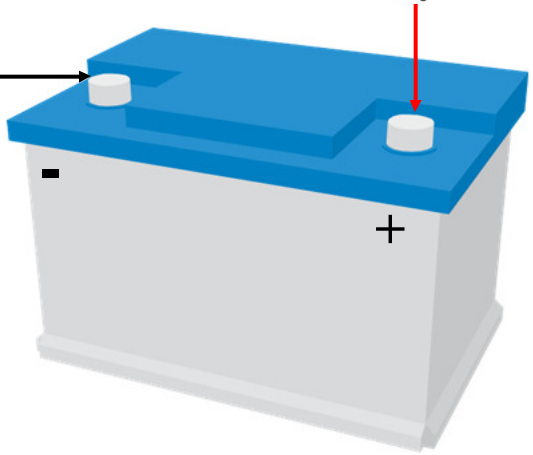
Connect Additional Charge Controllers in the same manner using one circuit breaker for each. Breaker output from each connects to Battery (+) Terminal.

Positive output to Breaker (+)

Use 10 Amp Circuit Breaker or Fuse

Fuse output to Battery (+)

Negative output to Battery (-)
This is System Ground (GND)



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 followed by Description of the error

Error Sequence Definitions:

Err, PAN, O.L. = Panel input over voltage
Err, bAt, O.L. = Battery over voltage
Err, ntc = Temperature Sensor Error out of range
Err, 5n5 = Current Sensing Error out of range
Err, bAt = Reversed or Shorted Battery
Err, O.C. = Peak Over Current Limit or Reverse Current Limit

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. Controller will automatically wake up a battery with over - discharge protection.

Theory of Operation

At the heart of the DIY Solar Charge Controller is a very efficient DC-DC Power converter which transfers over 97.5% 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 100 Watts of Output. No Adjustments are needed as the board is fully automatic and will adapt to any panel within the specification limits. Helios is compatible with SLA, Deep Cycle, AGM and Lithium Iron Phosphate or LFP.

Our customized Maximum Power Tracking routine adjusts the power transfer about **6000 times per second** to yield maximum performance 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 **2 TIMES** the Power that a PWM charge controller would deliver with the same Solar Panel. **Simple Cheap PWM Controllers DO NOT DO DC POWER CONVERSION and waste a lot of available power.**

When the solar input voltage exceeds 18 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, and Board Temperature. If the system Battery is at **14.4 volts AND the current is less than 0.5 amps for one minute** then the charger shuts off until the Battery drops below **13.5 volts**. The LCD Display will indicate **"Bat" "Full"** and display the voltage and amp hours input for the current day. See charging profile graph on the next page.

After Sunset when the panel voltage drops below 14.5 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 under 0.001 amps.

The Solar Charge Controller is designed for many years of reliable operation using parts rated for High Temperature Operation assuring long operating life. The 3D Printed case is made from Automotive Grade PETG filament and can withstand 70 degrees C or about 175 Degrees F. Dark colors in Sunlight heat up so its best to operate in the shade to prevent thermal limiting or shutdown. 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 over 60 volts** open circuit voltage. Above 50 volts Err, PAN, O.L. will display. Do Not Connect a panel with more than 44 volts open circuit rating. The Solar Charge Controller will work well with most smaller solar panels up to 100 Watts STC Rating without limiting power and can be used with higher wattages however power in full sun is limited to 7 amps output. This allows for more power in less than full sun conditions up to the 7 amp output limit. Example would be 2x 100 watt panels in parallel on 12 volt system battery. Fuse input at 5 amps also if more solar is connected than STC non limiting rating.

3 Stage Charging Profile 12 volt Example