



**ECO-WORTHY**

# 2000W COMPLETE OFF GRID SOLAR PANEL KIT



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## Safety Caution

Working with and installing electrical equipment is dangerous. Potential risks include hazards, electrocution and electrical fires.

Solar panels generate electricity as soon as being exposed in sunlight. To avoid a shock hazard, it's better to keep the panel covered with something during installation and avoid direct contact with the output terminals.

- Observe correct polarity with all interconnections between the solar-panel, charge controller, and the battery. Reverse polarity may causedamage
- Make sure all wire connections are tight and secure, loose connections may cause sparks and intermittent behavior
- Do not perform installation in the presence of any flammable materials
- Make sure you work in a well-ventilated area
- Use properly insulated tools: adjustable wrench, wire stripper, screw-driver, wire crimping tool, insulation gloves
- Remove metal items such as rings, bracelets, and watches

# Product Overview

ECO-WORTHY 2000W Off-Grid Solar Power System, an electricity supply project, which is clean, quiet, and compatible with shed and house roof.

## The complete kit contains:

- 10PCs 12V 195W Monocrystalline Solar Panels
- 1PC 3500W 24V Pure-sine-wave Inverter
- 1PC 60A PWM Solar Charge Controller
- 2PCs 24V 100Ah Lithium Batteries
- 1PC 6-String PV Combiner Box
- 5 pairs of 16ft 11AWG Solar Extension Cable
- 1 pair of 16ft 8AWG Solar-Controller Cable
- 1 pairs of 1.14ft 5AWG Lithium Battery Cable
- 1 pair of 4.9ft 5AWG Battery-Inverter Cable
- 10 set of Z-Bracket
- Necessary bolts and nuts designed for plane installation



# Components Description

## Solar Panel

The solar panel is a set of solar photovoltaic modules that generate electricity based on sunlight. This system contains 20 pieces of 195W panels with monocrystalline solar cells.



Electrical Data	
Maximum Power at STC <sup>o</sup>	195W
Optimum Operating Voltage (Vmp)	19V
Optimum Operating Current (Imp)	10.27A
Open Circuit Voltage (Voc)	22.8V
Short Circuit Voltage (Isc)	12.28A
Module Efficiency	19.41%
Maximum System Voltage	1000v
Maximum Series Fuse Rating	8-10A

Junction Box	
IP Rating	IP68
Diode Type	blocking bypass diodes
Output Cables	12AWG (2.9 ft long)

Solar Cable Connectors	
Rated Current	30A
Maximum Voltage	1000V
Maximum AWG Size Range	10AWG ~ 14AWG
Temperature Range	-40 C ~ +85 C
IP Rating	IP67

## Pure-sine-wave Inverter

The inverter transforms 24V battery DC power into 110/120V AC power, and directly supply for home appliances with the socket on bottom. It's able to run devices with total power of 3500W.



3500W 24V Inverter	
Model	3500W 24V-110V
Input Voltage	24V
Rated Power	3500W
Peak Power	7000W
Output Waveform	Pure Sine Wave
Extension Cable	16mm <sup>2</sup> ,5AWG,0.5 meter
Output Voltage	110Vav
Output Frequency	60HZ ± 0.3HZ
Cooling	Cooling fan control by temperature
AC Output Sockets	2
Temperature	-20 C -40 C

## Batteries

The complete system includes 2\*24V 100Ah rechargeable lithium batteries. Since the inverter requires 24V DC input, the batteries should be wired as a 24V battery bank. The total capacity of the battery bank is about 4800Wh.



24V 100Ah LiFePO4 Battery	
Battery Capacity	100ah
Battery Power	2560W-h
Battery Voltage	25.6V
Maximum Charge/ Discharge Current	80A/100A
Charge Temperature Range	32°F~131°F / 0°C~55°C
Disharge Temperature Range	-4°F~-131°F / -20°C~-55°C
Screw size	M8
Battery Size	343*188*245mm/ 13.5*7.4*9.6 inch
Battery Weight	18.3kg/40.3lbs

## Solar Charge Controller

The 60A PWM solar charge controller turn the wavy current from solar panel into stable 24V DC current for battery bank, make the charging process safe and effctive.



## Combiner Box

The 6 string combiner box is designed for orderly arranging those wires from the solar panels array. In such a big system, there usually be many cables come from each individual solar panel, to reduce the difficulty of connection and future maintenance, a combiner box is



## 16.4ft MC4-MC4 Cable

11 AWG cable with double MC4 connectors for solar array - combiner box connection

## 16.4ft Extension Cable

8 AWG MC4-copper cable for combiner box - inverter connection



16.4ft MC4-MC4 Cable



16.4ft Extension Cable

## Ring Cable



## Inverter Cable

5AWG cable for battery bank - inverter connection



## Z Mounting Brackets

Mounting brackets for fixing panel to a flat surface. There are 4 brackets for each solar panel



# Installation Guide

## -Setup the battery bank

The inverter in this system requires a 24V battery bank for running. With 2 pieces of batteries, the connection should be:

Connect 2 batteries in series to form a 24V battery bank.

Method: hook up each battery's positive terminal to the other's negative terminal.

The diagram as below:



## -Connect solar charge controller with battery

The solar charge controller should be put indoor. After the battery bank setup accomplished, wire the controller with battery bank. The controller has 3 parts of ports, middle ports are for connecting with battery.

Wiring method: Use the controller-battery cable for connection, battery + port to one battery's positive terminal, battery - port to the other's negative terminal



### -Mount the solar panels

Determine a location for the solar panel that is exposed in direct sunlight and clear of any shading such as trees, roof overhangs, etc. Ideally, the panels should be positioned to minimize the wiring distance between the solar panel and the combiner box.

For Northern Hemisphere installations, the solar panels should be mounted at an angle facing true south (true north for Southern Hemisphere installations). The mounting angle should be equal to the latitude location of where you are installing the solar panels. For example, the latitude of Miami, Florida, USA is 25 degrees. Therefore, solar panels installed in this area should ideally be facing true south at a tilt angle of 25 degrees.



When mounting a panel using Z-Brackets, a well-nut (also known as “expansion nut”) is often used on a pre-drilled hole. This procedure safely secures the panel on thin cabin roofs or RV roofs. Using a well-nut is recommended, as the rubber expansion prevents water leakage. (The Z-Bracket set does not include well nuts)

Step1: Attach the Z-brackets to the panels

Attach the Z-Bracket to the solar panel by the pre-drilled mounting holes on the back of the solar panel. Solar Panels have two mounting holes on each side.



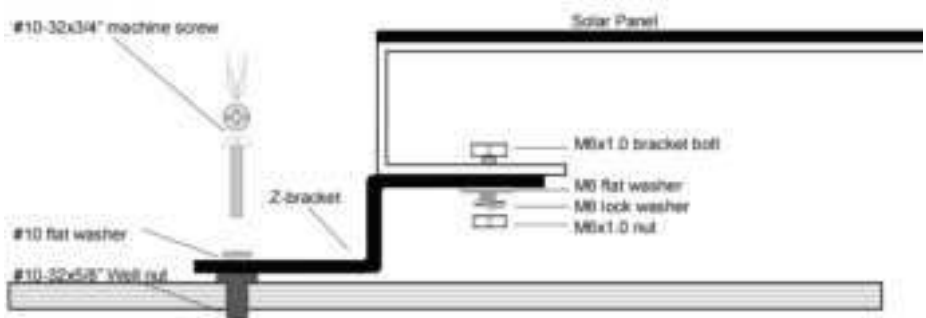
Step2: Mark and drill holes

With the Z-Brackets attached to the frame, the panel can be laid on a mounting surface, making it easier to mark the holes for the well-nut.

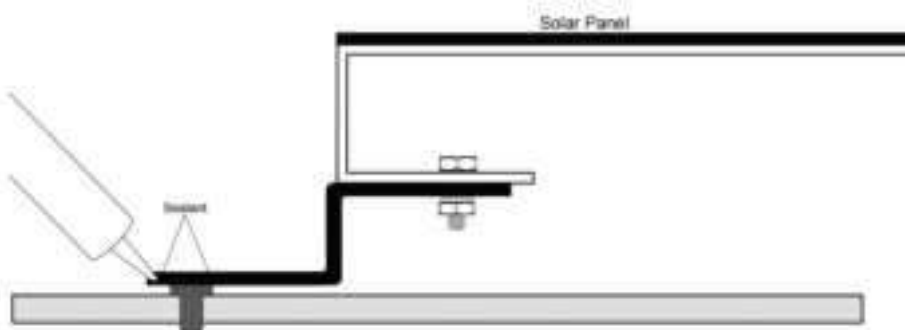


### Step3: Install the panel on the roof

The picture below illustrates the correct way to use the well-nut. The rubber flange has to be flushed on the roofline. The Z-Bracket, along with the flat washer and lock washer, holds the well-nut in place when the screw is fastened.



Gently insert the well-nut into the drilled hole. Be careful not to push the well-nut flange completely into the holes. Make sure the flange is flushed on the roofline. Before attaching the panel to the roof, a film of caulk can be laid between the roof and the Z-Bracket. Even though the well-nut provides a watertight bond, this provides additional sealant.



## -Setup the panels array

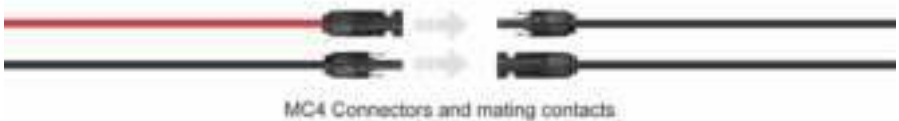
The hybrid inverter requires 24V input from the solar panels array. So the 10 panels should be wired into a 24V array.

### Wiring method:

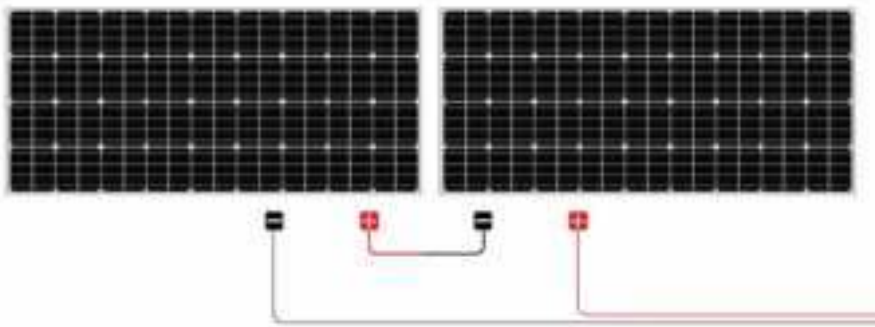
1. Connect every 2 panels in series to make a 24V string

Each ECO-WORTHY Solar Panel has a pair of MC4 solar cable at the back of panel that consists of male and female connectors. This type of connector uses a “snap-in” type of safety locking clips to lock the two mating connectors, making it easy to install.

For series connections, just plug one panel’s male and the other’s female MC4 connectors together.



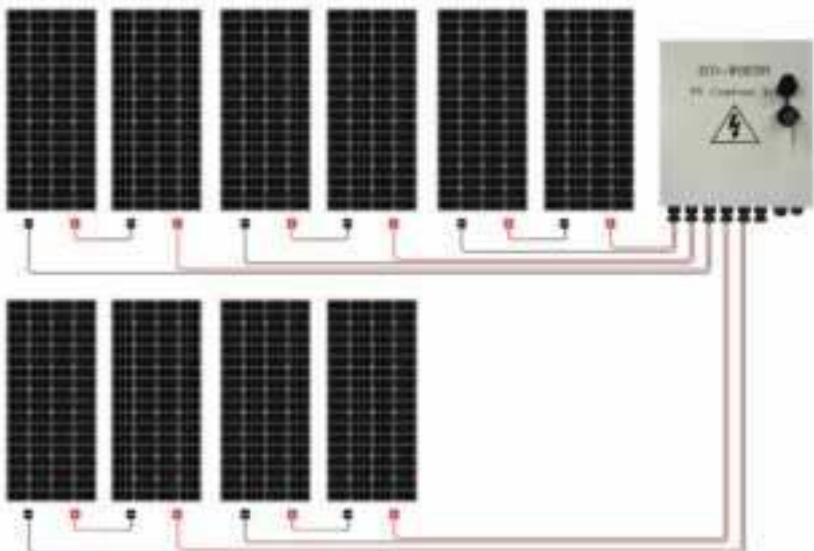
2. Do the same to the other 8 pieces, so there will be 5 groups of 24V 195W solar panels total. Each group has 2 rest wires, one positive and one negative, they are the outlet cables of the string.



### -Connect solar strings to combiner box

Use each string's outlet cables to wire with the input ports of combiner box. There are 5 pairs of extension cable, use them to connect with the box ports. The combiner box has totally 6 string ports, only 5 ports should be occupied by the strings.

Connect the 5 solar panel groups to the PV input port of the 6 string pv combiner box



## -PV output to controller

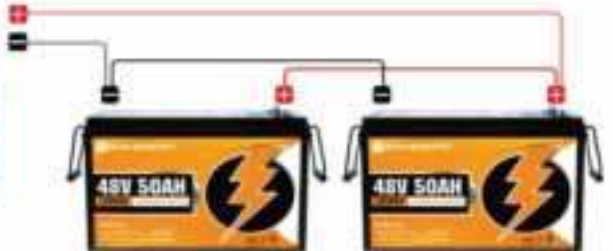
After all the solar array cables get arranged into the combiner box, connect the combiner box outlet to the solar charge controller.

Use the solar-controller cable for the connection. One head to plug the combiner box's output port, and the copper terminals to the inverter PV input port.



## -Inverter to appliances

Before booting the inverter, the AC OUT ports should be wired with the home socket or appliances first.



## -Turn on the inverter

When all wirings are done, check if the battery type switcher is at Li-ion, since it's connected with lithium battery bank. The final step is to boot the hybrid inverter by pressing the switch on its bottom.



LCD display screen info: battery present voltage

(Note: the inverter only works when 24V battery bank connected)



## Fusing and Setting

### -Fusing position

The combiner box has built-in fuses for each string, so there is no need to add extra fuse in between the solar panels and combiner box, neither from the combiner box to inverter.

Even though the hybrid inverter has built-in fuse, it's better to add one fuse in between it and the battery bank. For a 24V 3500W inverter, the current it can take from the battery bank should be about 146A, so a 180A fuse is recommended.



## Testing and Troubleshooting

### Testing

Test all electrical and electronic components of your system before commissioning it. Follow the instructions in the guides supplied with the components and equipment.

- Test modules connected in series before they are connected to the system.
- To determine  $V_{oc}$  and  $I_{sc}$  in the following tests, the module(s) must be exposed to the sun and not connected to a load. Observe personal safety when making these measurements.

·Check the open-circuit voltage ( $V_{oc}$ ) of every series module using a digital multimeter. The measured system  $V_{oc}$  should correspond to the sum of the  $V_{ocs}$  of the individual module. You will find the rated voltage in the technical specifications of the specific module. If the measured value is significantly lower than the expected value, proceed as described under “Troubleshooting an low voltage”.

·Determine the short-circuit current ( $I_{sc}$ ) of every series circuit. It can be measured directly by connecting the digital multimeter to the two terminals of the series circuit or module. Attention, the rated scale of the ammeter or the rated current of load should be more than 1.25 times of the rated short-circuit current of the series module. You will find the rated current data in the technical specifications sheet. The measured value can vary significantly, depending on weather conditions, the time of day, and the shading of the module.

### **Troubleshooting a low voltage**

To identify the commonly low voltage and excessively low voltage, the commonly low voltage mentioned here is the decrease of open-circuit voltage of the module, which is caused by the temperature rising of solar cells or lower irradiance. Excessively low voltage is typically caused by improper connections of the terminals or defective bypass diodes.

·First, check all wiring connections to see if it is not open-circuit or is not connected well.

·Check the open-circuit voltage of each module

·Disconnect the wiring at both terminals of the modules.

·If the measured voltage is only half of the rate, this indicates a defective bypass diode. By replacing or remove the diode, the issue may be sorted. Removing the bypass diodes should only be done by a competent PV technician and the module has to be disconnected from the system.

In the case of fine irradiance, if the voltage across the terminals differs from the rated value by more than 15%, this indicates a bad electrical connection.

## FAQ

A1: The hybrid inverter is not working. The screen is not showing anything.

Q1: For this situation, there are 3 things to check:

(1) Check for loose, broken or corroded connections in the cables between the inverter and battery bank.

(2) Check the fuses/breakers in the combiner box.

(3) Verify battery voltage is sufficient to power up the inverter

A2: Everything is hooked up correctly. The sun is shining directly onto the solar panels but no charge is going to the batteries.

Q2: Check the voltage of the battery bank. The battery bank is most likely fully charged and the solar charge controller inside the hybrid inverter has disconnected the solar panels from the battery. The solar charge controller will reconnect the solar panels to the battery bank when it requires charging.

## Maintenance

The following maintenance is recommended to ensure optimum performance and longevity of the solar panel:

- Clean the glass surface of the solar panel when necessary. Always use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove dirt.
- Check the electrical and mechanical connections every six months to verify that they are clean, secure and undamaged.
- Inspect the solar panels and make sure the surfaces are free from dust, dirt, and other debris; clean with a wet cloth or glass cleaner if necessary.

- Check to make sure all structural components, mechanical fasteners, and electrical connections are secure, clean, and corrosion-free.
- Check and replace damaged components if necessary

## Support

For the use of this manual and the conditions or methods of installation, operation, use, and maintenance of photovoltaic (PV) product are beyond ECO-WORTHY's control, ECO-WORTHY does not accept responsibility and expressly disclaims liability for any loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance.

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This product is covered by a 1 year warranty provided by ECO-WORTHY Ltd. We will refund or partial refund or replace any products with defects due to our imprudence.

If you are experiencing technical problems and cannot find a solution in this manual, please contact ECO-WORTHY for further assistance.

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