

Please read this manual carefully before proceeding towards installation of solar modules.

USER MANUAL

2017

User Manual

■ Safety Note

- Before installation, please read this installation manual and all the instructions of the components carefully. This manual contains the important information for the installation and maintenance of solar systems.
- In order to avoid the potential risks of installing a solar system, this must be handled by a certified or specialized personnel.
- Before installation, the installation personnel should be an expert in the mechanical and electrical requirements of the PV system. During the installation, the installation personnel should obey the safety instructions.
- During the installation, the installation personnel should observe the local laws and the related certifications of a particular area.
- If you have any requirements or questions, please contact Sun Earth , Or you can visit on Sun Earth official website : <http://www.sunearthpower.com>
- Please keep this manual for future use.

■ Disclaimer

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■ Instruction

1、 Summary

Solar cells (also called PV cells) are semiconductors which convert sunlight directly into electricity. The solar module is the equipment that is assembled by the solar cell in certain ways, and sealed by special packaging material that provides DC power.

When connecting solar modules in a series, the total voltage is the sum of the voltage of the serial modules. When connecting solar modules in parallel, the total current is the sum of the current of the parallel modules.

The solar module is designed for outdoor use, it should be equipped with proper support structures. Designing the proper support structures is the responsibility of the system designer and the installation personnel.

When the sunlight is irradiated on the surface of a solar module, it will generate more than 50V DC voltage, it is dangerous to exposure the electric over 50V. The installation personnel should know the potential dangers associated with installing a solar system.

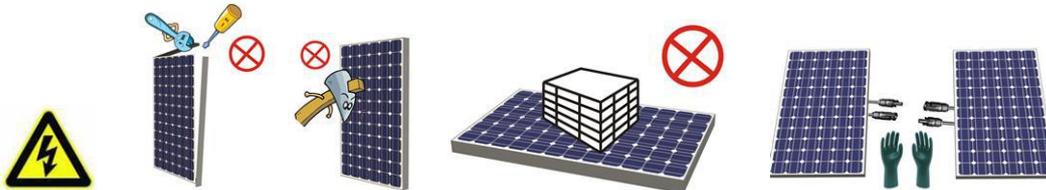
The application level of Sun Earth solar modules is A class, satisfied the class A safety level requirement.

For easy to install, each solar module comes with a junction box, cables and connectors. Do not damage or drag the cable. Do not connect or disconnect the connector while it is connected with load. Otherwise, it may cause combustion or other safety problems.

During the installation, the installation personnel should obey the operating requirements and not touch the live end with bare hands. Use the insulated tool to connect the electric equipment. When hands on the solar module are wet, do not touch the surface of the module. Do not wear metal rings, watchbands, earrings, nose rings, lip rings or any other metal accessories during the PV system installation and maintenance.

Electric performance parameters on the label of the solar panels are nominal value which is acquired under the STC standard(Irradiation:1000W/m², AM:1.5, Tc: 25°C). Usually, the solar panel performance (current and voltage) under the outdoor environment will be different than the nominal value.

Under the normal use situation, the PV module may produce higher current/voltage than the STC value. During the system design, the system equipment's nominal value(ISC & VOC) such as the cable, fuse, and the control equipments, should be 1.25 times higher than the solar module nominal value. Please refer to the details of NEC chapter 690-8.



- Do not disassemble the module, move any label or any parts stacked on the module.
- Do not paint or put any adhesive on the surface of the module.
- Do not use mirror or lens to focus the sunlight to the modules.
- Do not expose the back sheet of the solar module to the sunlight
- Do not damage the back sheet of the module.
- Do not drop anything on the solar module. Lift and move the panel carefully.
- Do not place heavy things on the solar module.
- The improper freight and installation may damage the glass and the frame of the modules.
- Do not stand on the solar module.
- Keep children far away during the installation.
- When any service of maintain is done, please ask the installation personnel or the service staff to do the routine inspection, so to ensure the PV module is in a safe and proper operating situation.
- When there are component needs to be replaced, please ensure the replacement parts are specified by the manufacturer, or is the same standard of the original one. Unaccredited replacement may lead to fire, shock or other dangerous consequences.
- During the installation, please consult with your local construction and safety department about the permission and proper regulations. The approval certificate should be gained when it is

needed.

·During the installation, the materials should cover the surface of the module to prevent it produce electric.



Note: High Voltage! Don't touch!

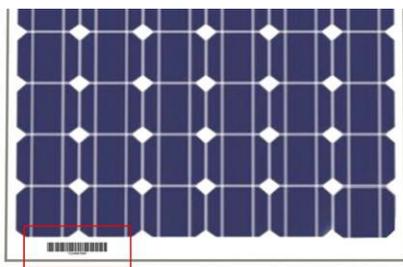


2、Product Identification

Every module has two identifications.

Label: Describes the information of the module description, including product type, rated power, voltage, and current, the weight, dimension; the fuse capacity, the maximum system voltage and other company information.

Bar code: every module has one unique serial number. It is sealed inside of the module, during the lamination process. There is another same bar code on the back sheet and the frame of the module for scanning.



3、System installation

3.1 Choose installation area

Choose a proper place for a system installation. One should consider the factors may affect the solar panel, such as the terrain, sunlight radiation, wind speed, thunder, hailstone, drainage, snow accumulation, and corrosion.

To let the solar panel gain more sunlight, the solar module should be installed in proper direction and tilt angle. For example, in the northern hemisphere, the module should face to south and in southern hemisphere, the module should face to north. Please refer to the standard PV system installation guide or consult with a local PV system installation company.

Reference for installation dip angle in difference latitude:

| Latitude of Installation position | 0°-15° | 15°-25° | 25°-30° | 30°-35° | 35°-40° | Upon 40° |
|-----------------------------------|--------|----------------------|-------------|-------------|-------------|-------------|
| Dip Angle | 15° | Same as the latitude | Latitude+5° | Latitude+5° | Latitude+5° | Latitude+5° |

The solar module should be installed in a proper place where the module can be fully exposed under the sunlight and couldn't be shaded. This is especially true for the winter.

The installation ground should be flat; the base should be 300mm higher than the surrounding area and easy to drain. It shouldn't be installed near corrosive material and dust.

3.2 Choose the proper mounting system

Usually the solar module is installed on the mounting system. The mounting system could be installed in fixed mode or tracking mode. The material of the mounting system should be durable, with high mechanical strength, anticorrosive and uv-resistant.

No matter what kind of installation mode, the mounting system should be able to bear the total weight of the solar panels, should be able to bear the local maximum wind speed, the maximum mechanical load pressure of the snow, should be fit for the local earthquake resistant requirement, should have proper lightning protection and grounding system, and the mounting system should have enough mechanical stiffness to prevent the effect of the vibration caused by external force.

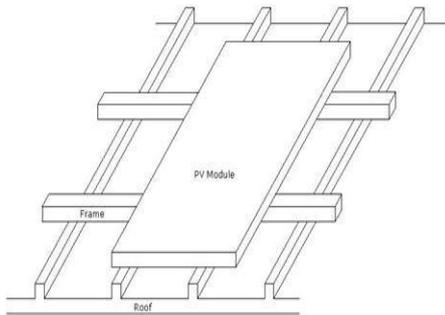
The installation personnel should follow the installation guide and the safety standards of the mounting system, during the installation process.

When the solar panel is installed on the ground, there must be enough space from the ground to the bottom of the solar panel, to prevent the effects caused by accumulated snow or water.

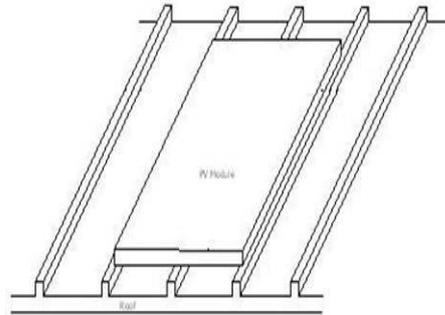
When the solar panel is installed on the roof or the top of the building, one needs to ensure the roof and the building structures are proper for installation. If the installation structure needs to get through the roof or the top of the building, it must be sealed to prevent the leakage of water.

When the solar panel is installed on the roof, the slope of the square array shouldn't be more than 5in/ft(416mm/m) and the distance from the solar panel lower limb to the outer edge of the roof should be more than 10cm.

When the solar panel is installed on the roof, the back of the solar panel should have adequate ventilation. We suggest using the roof installation structure in picture 1 instead of picture 2.



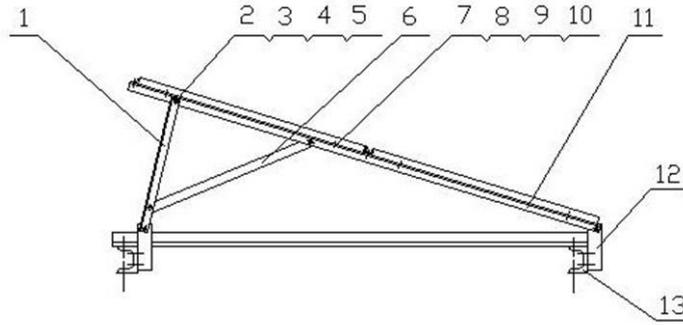
P1 Suggestion



P2 Not Suggestion

The fire rating of Sun Earth solar panel is C class. Please consider the local requirements, install the solar panel on the roof, which has proper fire rating. The roof fire rating may be affected by installed the solar panel, please consult with your local system design and installation company.

Other installation is also accepted if it is fit for the system requirement. The mounting system design suggestion is in picture 3.



P3 Suggestions for the mounting system

- | | | |
|-------------------------|--------------------------|--------------------------|
| 1. 40mm×40mm Angle iron | 2. M16×35 Screw | 3. M16 Screw |
| 4. M16 Flat Gasket | 5. M16 Spring Gasket | 6. 40mm×40mm Angle iron |
| 7. M16×16 Screw | 8. M6 Screw | 9. M6 Flat Gasket |
| 10. M6 Spring Gasket | 11. 40mm×40mm Angle iron | 12. 40mm×40mm Angle iron |
| 13. 100mm channel bar | | |

3.3 Solar Module Installation

The position and connected mode (in series or in parallel) for solar module installation should follow the construction drawings (mechanical drawing and electric drawing).

The edge of the module with the junction box should be turned upward, to avoid the rain and splashed water. The drainage holes shouldn't be jammed.

There are four installation holes (diameter 8.5mm) on the solar module frame, each side has two holes. The modules can be installed on the mounting system through these holes. The module assumed load is 30Ibs/ft², tested by UL.

Considering the local wind speed and the snow pressure, the extra-reinforced structure could be used to strengthen the fixed structure. The system designer and installation personnel should be responsible for the calculation of the mounting system loading capacity.

Please put the flat gasket on the screw, then put the screw through the solar module and the mounting system installation hole from the inner side of the module. Then put another flat gasket and spring gasket on the screw, tighten the nuts. The picture 4 is the installation draw for TPB156×156-72-P solar module.

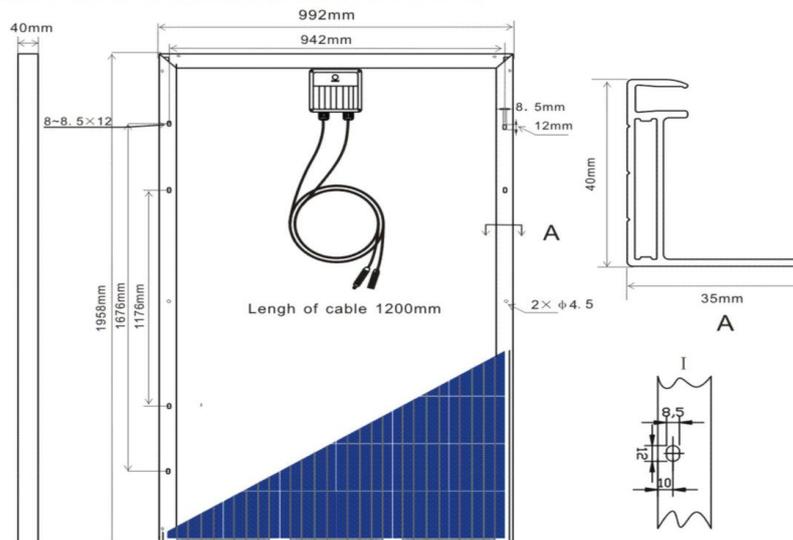


Chart 4 Panel Installation Dimension



- Do not drill holes on the glass surface of the module. Otherwise the product warranty will become invalid.
- Do not drill extra mounting holes on the framework of the module. Otherwise the product warranty will become invalid.
- Do not move modules by using the junction box or the cable.
- Do not stand or step on the modules.
- Do not drop module or allow objects to fall on module.
- Do not put any heavy objects on the modules.
- Inappropriate transport or installation may damage the glass or framework of modules.

4. Electrical Installation

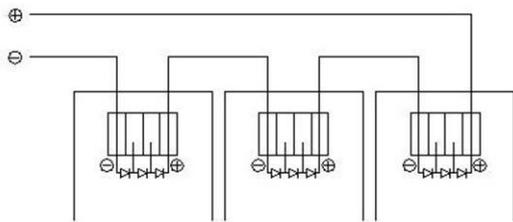
4.1 Electrical Connection

Do not use modules of different configurations in the same system. The maximum number of modules is $(N) = V_{\text{max system}} / [V_{\text{oc(at STC)}}]$.

Modules in different quantities are connected in series or in parallel according to the voltage and current of the power system. For application with a high operation voltage, modules are connected in series, the total voltage is equal to the sum of individual voltages. For applications requiring high currents, several photovoltaic modules can be connected in parallel; the total current is equal to the sum of individual currents.

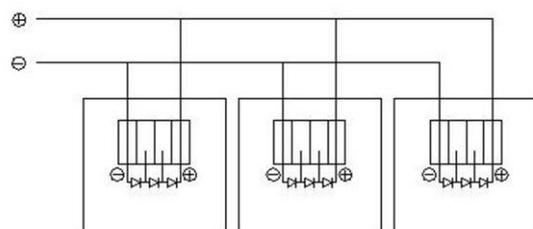
In a circuit branch of modules connected in series, the maximum number of modules $(N) = V_{\text{max. system}} / V_{\text{oc @STC}}$. In a circuit branch of modules connected in parallel, the maximum number of modules is $(P) = 2$.

Modules are supplied with junction boxes, cables and connectors to use for system electrical connections. Chart 5 shows modules connected in series while chart 6 for modules connected in parallel.



Module Series Connection

Chart 5 Modules connected in series.



Module Parallel Connection

Chart 6 Modules connected in parallel.

The cross section area of cable and the capacity of connector must be selected to suit the maximum system short circuit current. The cross section area of cable must be larger than 12AWG or 4mm² for a single module. Insulation temperature cannot be less than 90°C. Rated current of a connector is 16A and rated operating temperature is 100°C. Otherwise, the cable and connector will be overheated under large current. Consult local wiring regulations to determine

system wire size, type, and temperature.

4.2 Blocking diodes

Blocking diodes is also called as isolation diodes. Blocking diodes are typically placed between the PV module and the power generation and thus able to conduct the current from the solar cells, which are exposed to the sun, to the power generation. But it can prevent current conducted from the generation to solar cells when output voltage of the cell string is lower than the generated voltage.

Typical blocking diodes are highly reliable regular commutation diode with appropriate current rating value, which is usually installed in charging controller. It is recommended to use blocking diodes when a charging regulator is not used. Your specialist dealer can advise you on the suitable types.

4.3 Bypass diodes

Bypass diodes are also called shunt diodes. It is usually connected in parallel to solar cells or solar modules. Bypass diodes suffer back bias voltage when solar cells get illuminated.

When a cell string is shaded partially or broken or the open circuit model is ineffective, bypass diodes will automatically become forward biased. Thus this allows the other cells in this cell string exposed to the sun to deliver the current to the power generated through bypass diodes.

Schottky diode are also typical bypass diodes. All modules rated greater then 55 Watt have bypass diode already integrated in the junction box.

Typical Bypass Diodes Electrical Characteristics

| Type | | 10SQ050 | 15SQ045 | UNITS |
|--|-----------------|-------------|-------------|-------|
| Maximum Repetitive Peak Reverse Voltage | V_{RRM} | 50 | 45 | V |
| Maximum RMS Voltage | V_{RMS} | 35 | 31.5 | V |
| Maximum DC Blocking Voltage | V_{DC} | 50 | 45 | V |
| Maximum Average Forward Rectified Current | $I_{F(AV)}$ | 10 | 15 | A |
| Peak Forward Surge Current 8.3ms single half sine-wave Superimposed on rated load (JEDEC method) | I_{FSM} | 275 | 300 | A |
| Peak Forward Voltage @15A DC(Note 1) | V_F | 0.7 | 0.5 | V |
| Maximum DC Reverse Current @ TA=25°C | I_R | 0.5 | 0.5 | mA |
| at Rated DC Blocking Voltage @ TA=100°C | | 50 | 50 | mA |
| Typical Thermal Resistance (Note 2) | $R_{\theta JC}$ | 3 | 2.2 | °C/W |
| Junction temperature range at reduced reverse voltage | T_J | -50 to +150 | -50 to +150 | °C |
| $V_R \leq 80\% V_{RRM}$ | | ≤ 175 | ≤ 175 | |
| $V_R \leq 50\% V_{RRM}$ In DC forward mode | | ≤ 200 | ≤ 200 | |
| Storage Temperature Range | T_{STG} | -50 to +150 | -50 to +150 | °C |
| NOTES: 1. 300us Pulse Width. 2% Dudy Cyote. | | | | |
| 2. Thermal Resistance Junction to Case. | | | | |

4.4 Grounding

Must abide by electrical regulations of the local country and region while installing modules to assure all the module frames and supports are grounded properly For detailed information on grounding, please turn to the related electrical regulation for installation or insult reliable solar

system installation company.

Use electroplated support frame to assure good circuit break-over.

There are grounding holes on the frame of modules and all the frames should be properly grounded. Correct and reliable grounding connection of oxidation frames needs a reinforced or jagged gasket. Confirmed and listed equipment allows to be grounded as the metal framework of solar modules.

Chart: Grounded connection component

| No. | Items | Specification | Requirement |
|-----|-----------------------------|---------------|--------------------|
| 1 | Screw bolt | M4×20 mm | Stainless steel |
| 2 | Flat washer | M4×14 mm | Stainless steel |
| 3 | Double-color grounded cable | BVR 450/750V | 2.5mm ² |
| 4 | Star washer | M4 mm | Stainless steel |
| 5 | Flange nut | M4 mm | Stainless steel |

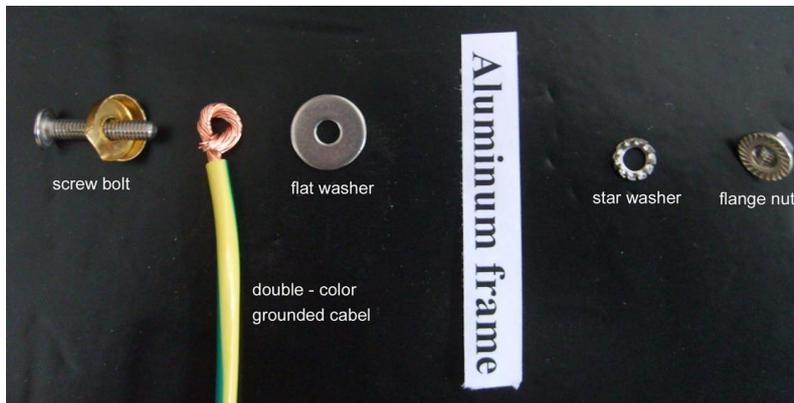


Chart 7 Grounded operation figure

The grounded cable should be multicore copper with colors of yellow and green. The wire across section area must be larger than 12AWG or 2.5 mm²

First strip 16mm insulating jacket from the end of the grounded wire carefully to avoid nicking or cutting conductors. Be careful not to damage the wire core. Wrap the stripped cable head to the shape as shown in the chart above. In order to resemble the chart above, successively insert the stainless M4 screw into the cup-shaped M4 copper washer, grounded wire and flat M4

stainless washer and then into star-shaped M4 stainless washer through the framework of the module. Finally screw in the stainless steel M4 butterfly-shaped nut. The recommended torque of stainless steel M4 butterfly-shaped nut is 1.5 NM. Check the connection of grounded cable and support frame.

As for the grounding method and detailed requirements for arrangement of wires, please abide by the related regulation for installation, such as National Electrical Code, NEC Article 250, Canadian Electrical Code, CEC Part 1, International Electrotechnical Commission, IEC and CENELEC, etc.



4.5 Testing, commissioning and troubleshooting

Protect yourself from electric shock when troubleshooting or maintaining the solar system.

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

4.5.1 Testing modules connected in series before they are connected to system.

Check the open-circuit voltage of every series module by a digital multimeter. The measured values should correspond to the sum of the open-circuit voltage of the individual module. You will find the rated voltage in the technical specifications of the type of the module used. If the measured value is significantly lower than the expected value, please proceed as described under “Troubleshooting an excessively low voltage.”

Check the short-circuit current of every series circuit. It can be measured directly by a digital multimeter connected in the two terminals of series circuit or module. Attention, the rated scale of the rated current of load should more than 1.25 times of the rated short-circuit current of series module. You will find the rated current in the technical specifications of the type of module used. The measured value can vary significantly, depending on weather conditions, the time of day and shading of the module.

4.5.2 Troubleshooting low voltages

Identify the commonly low voltage and excessively low voltage. Typically, the 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 at the terminals or defective bypass diodes.

First, check all wiring connections to make sure it is not open-circuit or is not connection well.

Second, check the open-circuit voltage of each module.

Third, Fully cover the modules with an opaque material. Disconnect the wiring at both terminals of the modules. Remove the opaque material from the module to be checked and measure the open-circuit voltage at its terminals.

If the measured voltage is only half of the rated, this indicates a defective bypass diode. Refer to "Testing and replacing bypass diodes".

In the case of not very low irradiance, if the voltages across the terminals differ from the rated value by more than 5 percent, this indicates a bad electrical connection.

5. Maintenance

Sun Earth recommends the following maintenance in order to ensure optimum performance of the module:

Clean the glass surface of the module as necessary. Always use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove stubborn dirt. Detergent for dishwasher is not recommended.

Check the electrical and mechanical connections every six months to verify that they are clean, secure and undamaged.

If any problem arises, have them investigated by a competent specialist. Should obey the maintenance instruction for related components as to the maintenance instructions for all components used in the system.

6. Demolishment of the system

When disassembling conductors, one must fully cover the modules with a material to avoid electricity.

When disconnecting the system from the power source, every single component used in the system should comply with the operating instruction.

Disassembling is allowed only when the system stops operating. In the process of operation, abide by all the safety operation instruction applicable to the installation,



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