

PV Module Installation Manual

Make the World a Better Place

2023 V1.2



Applicable Module Type:

1. JMPV	T1/66	XXX
2. JMPV	T1/60	XXX
3. JMPV	TV2/66	XXX
4. JMPV	TV2/60	XXX
5. JMPV	XV2/78	XXX
6. JMPV	XV2/72	XXX
7. JMPV	X1/78	XXX
8. JMPV	X1/72	XXX
9. JMPV	X1/54	XXX
10. JMPV	HM6HBM1/72	XXX
11. JMPV	HM6HBM1/60	XXX
12. JMPV	HM6VHBM2/72	XXX
13. JMPV	HM6VHBM2/60	XXX
14. JMPV	X6/78	XXX
15. JMPV	X6/72	XXX
16. JMPV	X6/54	XXX
17. JMPV	XV6/78	XXX
18. JMPV	XV6/72	XXX

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1. Introduction

1.1 General Information

This manual is applicable to the installation, maintenance and application of Solargiga's series photovoltaic modules. Users and installers must carefully read and strictly observe. Failure to follow these safety guidelines may result in personal injury or property damage.

The guideline for installation and handling of solar modules in this manual requires skills in mechanical and electrical operation, and is intended for professional use only. Please read the installation instructions and understand this manual before using and operating the components. The installer must inform the end customer (or consumer) of the above matters accordingly.

Please keep this instruction manual for future reference. We recommend you to check the official website of Solargiga: <https://www.solargiga.com> for the latest version of the installation manual.

1.2 Disclaimer

Solargiga reserves the right to update the installation manual without prior notice. In case of inconsistency between the descriptions in different language versions of this manual, the Chinese version shall prevail.

The direct or implied information mentioned in this manual has nothing with the products' warranty.

If the installation, operation and use of PV modules are beyond the control of the company, Solargiga will not be responsible for any loss, damage, casualties or additional costs caused by incorrect installation, operation, usage and maintenance.

Solargiga does not assume any liability for infringement of the patent rights or any other rights of third parties from the use of its product.

Solargiga is not responsible for any form of damages, caused by module operation, installation and including but not limited to bodily harm, personal injury and property loss due to incompliance with the instructions of this manual.

Failure of conforming to this manual from the client when installing the PV module will invalidate the limited warranty provided by Solargiga.

2. Safety Precautions

2.1 Warning

Please read and understand all safety rules before installing, wiring, operating or maintaining modules. The cell surface of the module will generate direct current when directly exposed to sunlight or other light sources. Regardless of whether the module is connected or has direct contact with the active parts of the module, such as the terminal block, it might result in casualties.

2.2 General Safety Rules

All installation work must fully comply with local regulations and corresponding national or international electrical standards.

- 1) The installation personnel should be familiar with the mechanical and electrical requirements of the photovoltaic system, have the professional skills, knowledge and qualification to install the photovoltaic system.
- 2) During installation, protective measures such as helmet, insulating gloves and insulating shoes must be worn, and electrical insulating tools must be used to avoid direct contact with 30V DC or higher voltage.
- 3) Do not allow Children or unauthorized personnel to approach the installation site or module storage area.
- 4) Do not wear metal ornaments to avoid puncturing the module and electric hazard.
- 5) The backsheet of the monofacial module can be easily damaged, especially contact with hard objects, which can lead to accidents.
- 6) Avoid contacting with sharp edges during installation to protect your hands.
- 7) If the modules are installed or operated in the morning, appropriate measures should be taken to prevent water vapor penetrating the connector.
- 8) During module installation or wiring, if the circuit breaker and the over-current protection device (OCPD) cannot be activated or the inverter cannot be shut down, opaque materials should be used to cover the module arrays (including front and back) to stop power output.
- 9) If the surface glass is damaged or worn, direct contact with the module surface may cause electric shock. Please wear personal protective equipment and replace the damaged modules immediately.

2.3 Prohibitions

- 1) Do not install or handle modules under severe weather conditions such as high humidity,, rain and snow or strong wind.
- 2) Do not artificially focus light on modules when there is current or external power supply in the modules.
- 3) Always keep the cover of the junction box closed. Do not disassemble the module or move any part of the module.
- 4) Do not attempt to repair any part of the module without authorization. There are no available spare components in the module.
- 5) Do not use or install damaged modules.

2.4 Applicable Level and Fire Safety Level

Please refer to local laws and regulations and comply with building fire protection requirements before installing the PV modules.

1) According to IEC61730, this module conforms to the Application Class A (equivalent to safety class II).

2) Fire safety level

According to IEC61730 standard, the fire rating of this module is Class C.

3. Transportation/Storage/Unpacking

3.1 Transportation

1) The packaged finished products can be transported by land, sea or air.

During transportation: please ensure that the packaged finished products will avoid rolling around or toppling over. It is best to place the packaged goods on the transportation platform in a fixed position. Avoid the packaged goods falling from a high place due to module fragility. And it is necessary to prevent the packaged goods from being subjected to intense vibration and turbulence.

2) The packing box is not completely damp-proof. The structural strength of the damp package could reduce, which may result in danger. During transportation and storage, the packaged goods shall not be exposed to rain or moisture. Please place the packaged modules in a ventilated, rain-proof and dry place. If the modules are to be in transport for a prolonged period of time, cover the modules with rain-proof cloth to prevent the modules from getting damp, and do not remove the packaging. As shown in Figure 3-1.



Figure 3-1 Notes during transportation

3) The packaged modules can be stacked on top of each other for transportation or storage purposes, but only up to two layers, as shown in Figure 3-2.

4) Do not step on the packaging box and modules as shown in Figure 3-3.

5) Use a forklift to move the packed products with pallet to the operation area, and avoid severe turbulence and vibration when moving the modules. Forklift forearm shall not be too short to prevent the pallet from tipping backward during transportation. If it is a manual forklift, it is better to enter from the short side of the pallet.

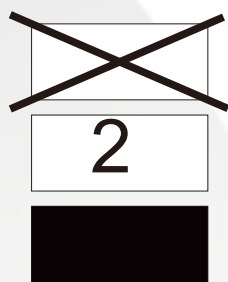


Figure 3-2 Do not stack multiple layers



DO NOT STEP ON

Figure 3-3 Do not step on

3.2 Storage

- 1) The modules should be stored in a dry and ventilated environment to avoid direct sunlight and humidity. If the modules are stored in an uncontrolled environment, the storage time should not exceed 3 months, and additional measures should be taken to prevent the connector from being wet and the modules from being exposed to the sun.
- 2) Please protect the package from damage.
- 3) Do not store packaged finished products together with corrosive chemicals or gas, and make sure to take the necessary precautions against fire prevention.
- 4) Do not stand, climb, walk or jump on the module under any circumstances. Heavy load on part of the module may cause micro-cracks on the cell, which will reduce the reliability of the module.
- 5) Once the outside package is found to be damp, please carefully open the packing case, lift out the modules and place them in a ventilated area to avoid molding.
- 6) The disassembled modules should not be stacked with more than one pallet's amount.

3.3 Unpacking

- 1) During transportation and storage, in order to ensure the safety of the modules, open the package of the modules after arriving at the installation site.
- 2) Open the packaging box of Solargiga, please operate according to the "unpacking instructions for standard packaging box of Solargiga photovoltaic module".
- 3) Equipment and tools for unpacking are scissors (knives), gloves, forklift; There are at least 2 personnel to unpack modules.
- 4) Please wear protective gloves during unpacking to avoid hand injuries and leaving fingerprints on the glass.
- 5) The working area needs to ensure that the packing box can be placed horizontally and stably to avoid toppling.
- 6) Operation steps:
 - a) Remove the protective film first using knife or other hard objects to cut the protective film outside the packaging box and avoid damaging the packing box during this process.
 - b) After the above step, then remove the innermost packing belt. During the unpacking process of modules, it is necessary to lean against the unpacking support.

Attention:

- 1) In the process of handling a single module, ensure that two or more people operate on the module at the same time.
- 2) If the modules are not to be installed immediately after unpacking, ensure that the modules are kept in a horizontal position. Keep a box cover on the tray, as shown in Figure 3-4. Then place the

first module's glass face up, and stack the remaining modules' glass face down. The maximum number of stacked pieces on the tray should be no more than 1/2 of a pallet's stacked amount. After stacking, the modules must be aligned crosswise, as shown in Figure 3-5, otherwise the modules will tilt and fall during transportation.



Figure 3-4 Place the packing box on the tray

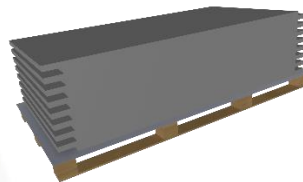


Figure 3-5 Cross-align and stack modules

3) If it is windy onsite, special attention should be taken to ensure safety. Especially in the case of strong wind, we recommend not to move the modules under such condition, and properly fix support for the unpacked modules.

4) After reaching the project site for more than 15 days, modules which haven't been installed yet need to be properly prepared for long-term storage on site. It is necessary to keep the modules flat on a flat open ground in single pallet in order to reduce the abnormality caused by long-term stress on the lower support modules due to stacking and storage, and thus cause the risk of module toppling. The modules should be covered with rain-proof cloth to prevent the package materials from being polluted by sunshine and rain and thus avoid support strength reduction of the package materials. Keep away from flammable and explosive materials.

Prohibition:

- 1) Do not handle or move the modules with their wires or junction boxes.
- 2) Do not perform unpacking work outdoors on rainy days. The outside modules packaging will soften and lose its structural strength after being exposed to rain, and the PV modules inside will fall out and cause damages or injuries.
- 3) All external forces and objects are prohibited from hitting and bumping the single point of the module glass to prevent the module from bursting. Solargiga will not be liable for compensation of the broken module under these specific circumstances.
- 4) Do not exert excessive load or twist the modules in any way; carrying modules with your head is prohibited.
- 5) Do not place the modules in an environment without reliable support or in a non-fixed position. As shown in Figure 3-6.

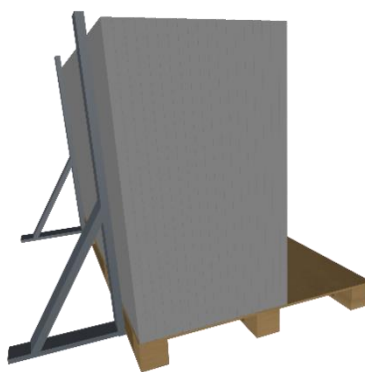


Figure 3-6 Modules placement

- 6) Do not drop or stack objects (such as installation tools) on the modules.
- 7) Do not contact the modules with sharp objects. Scratches will directly affect the safety of the modules.
- 7) Do not change the wiring of the bypass diodes. It is necessary to keep all electrical interfaces under clean and dry conditions.

4. Installation Preparation

4.1 Preventive Measures and General Safety Rules

- 1) Before modules installation, contact the relevant departments to obtain information about the installation site and construction permit, and comply with the installation and inspection procedures.
- 2) Check the applicable architecture regulation to ensure that the building to be installed with the modules, and its structure (roof, exterior facade, bearing capacity, etc.) has sufficient load bearing capacity.
- 3) Ensure that the modules are properly installed on the fireproof roof at work. According to the provisions of IEC61730, monofacial modules of Solargiga are identified as fire protection class C. The fire protection of modules shall also meet the relevant local architecture regulation .
- 4) Monofacial solar modules comply with application class A (equivalent to safety class II). Such modules can be used in systems whose voltage is greater than 50V or power is over 240W with possible access to the public.

4.2 Environment Condition

The modules are suitable to use under general conditions , please refer to IEC 60721-2-1 - Classification of environmental conditions - Part 2-1: Environmental condition in nature - temperature and humidity.

- 1) It is recommended to install the module in an environment temperature from - 40 °C to 40 °C, but under extreme conditions, the module can operate in an environment temperature from - 40 °C to 85 °C.
- 2) If the modules are to be installed in a special environment, you need to consult the Solargiga's technical support department in advance for inquiry.
- 3) Modules can not be installed near flammable or combustible objects.
- 4) Do not expose the modules to artificial light source.
- 5) Do not immerse the modules in water (pure water or salt water) or in an environment with long-term exposure to water (such as fountain, beach, etc.)
- 6) If the modules are exposed to salt mist environment (i.e. marine environment) or sulfuric environment (sulfur mine, volcano, etc,) there will be corrosion risks.
- 7) It is prohibited to expose the modules or their electrical interfaces to unauthorized chemicals (such as oil, lubricants, pesticides) to avoid modules damage.

If the above precautions are not observed, the warranty of Solargiga will be invalid.

4.3 Installation Requirements

- 1) Ensure that the modules meet the overall technical requirements of the PV system.
- 2) Ensure that other components of the PV systems will not cause destructive mechanical or electrical performance impacts on the modules.
- 3) Increase voltage by connecting modules in series or increase current by connecting modules in parallel is allowed. In series, the positive electrode of the module is connected to the next negative electrode. In parallel, the positive electrode of the assembly is connected to the positive electrode of the next PV module.
- 4) The number of bypass diodes provided will vary depending on the module model.
- 5) Connect an appropriate number of modules according to the voltage specification of the inverter used by the system. Even under the worst local temperature conditions, the voltage generated by total connected modules can not be higher than the system voltage .
- 6) In each string of modules, if the Overcurrent Protection Device (fuse) is not used in series connection, at most two strings of modules can be connected in parallel. If an appropriate verified Overcurrent Protection Device is connected in series on each string of modules, three or more modules can be connected in parallel. The PV system design must ensure that the reverse current of each string of modules is less than the maximum fuse current of the module under any circumstances.
- 7) In order to avoid (or reduce) the mismatch effect of the array, it is recommended to connect modules with similar electrical performance rating on the same string.
- 8) In order to reduce the risk caused by indirect lightning strike, avoid designing the system and the wiring into a circuit.
- 9) The modules shall be firmly fixed to withstand all possible loads, including wind and snow loads.
- 10) (For monofacial module only) Taking the thermal expansion effect between modules into consideration, the minimum gap distance between modules is 6.5 mm. This gap refers to the minimum linear distance between the plastic corner protectors of two adjacent modules.
(For bifacial module only) Taking the thermal expansion effect between modules into consideration, the minimum gap between frameless modules is 10mm. This gap refers to the minimum linear distance between the plastic corner protectors of two adjacent modules. The minimum gap between framed modules is 6.5 millimeters.
- 11) (For monofacial module only) Please do not damage the backsheet film when installing the solar module.

4.4 Optimum Position and Angle

In order to achieve the maximum annual power generation, the optimal position and inclined angle of the PV modules should be determined first. Usually, when sunlight is vertically projected onto the PV module, maximum electric energy can be generated.

For installation in the northern hemisphere, the modules should preferably face south; and for installation in the southern hemisphere, the modules should preferably face north.

It is recommended that the module installation angle should be no less than 10 °, so that the dust on the surface of the module can be easily washed away by rain and reduce the cleaning frequency of the module accordingly. It is also beneficial for the remaining water on the module surface to drain itself, preventing a large amount of long-term remaining water from leaving traces on the glass and affecting the appearance and performance of the module.

For a more detailed installation angle, please refer to the suggestions given by experienced PV module installers.

4.5 Avoid Shadings

- 1) Even a small amount of shadings (such as dust) will cause a reduction in power generation. If all surfaces of the module are not covered throughout the year, the module can be considered as "shadeless". Ensure that the sunlight can still be projected onto the PV module even on the shortest day with least sunlight exposure during the whole year
- 2) On the premise of ensuring the maximum positive power generation, obstacles between the modules and the installation surface should be avoided as much as possible.
- 3) The aging of the packaging film caused by the frequent shading on the module and the long-term diode heating will negatively affect the module lifespan.
- 4) There should be enough space (at least 10 cm) between the back of the module and the mounting surface to ensure that the cooling air can circulate at the back of the module space. Meanwhile the condensate or moisture can be dissipated.

5. Module Installation

5.1 Installation Instructions

- 1) The installation design must be verified by a registered professional engineer. The installation design and process shall comply with local electrical and architecture regulations.
- 2) Solargiga does not provide installation components.
- 3) The load mentioned in this manual corresponds to the test load. For the installation mode complying with IEC61215-2:2016 and UL1703, Solargiga's 1.5 times safety coefficient factor needs to be considered when calculating the maximum allowable design load. The design load of the project depends on the structure, application standard, installation site and local climate. The design load shall be determined by the professional supplier or professional engineer. For details, please follow the local architecture regulations or contact the professional architecture engineer.
- 4) Use suitable fasteners with corrosion resistance. It is recommended that all fasteners (such as bolts, elastic washers, flat washers, nuts, etc.) should be hot-dip galvanized or stainless steel.
- 5) According to the torque requirements specified by the system installer, install the modules with a torque wrench. The recommended tightening torque of Solargiga is 16~20Nm (M8 small hexagon bolt, bolt grade 8.8), and the yield strength of fasteners should not be less than 450MPa.
- 6) Do not drill additional holes or attempt to change the frame structure on the module, otherwise the limited warranty of Solargiga will be invalid.
- 7) The clamp should be made of aluminum alloy or metal material with equivalent performance. There should be a suitable cushion between the fixture and the module glass. Solargiga recommends using EPDM.
- 8) The position of the clamp is crucial for the reliability of installation. The center line of the clamp must be within the corresponding allowable range according to different loads and installation methods.

5.2 Mechanical Installation

5.2.1 Installation Method of Mounting Hole (Bolt):

Note: Please carefully confirm the position of the installation hole in the specification before installation. As shown in Figure 5-1.

The following installation screws are recommended. (Recommended installation torque: 16N. m)

Fittings	Material	Specifications	Description
Bolt and Nut	304 Stainless Steel	Bolt M8, Nut M8	Bolt M8x20mm, Nut M8
Washer	304 Stainless Steel	M8	Bore Size 8.5/ External Diameter 15.5mm, Thickness 1.6mm
Spring Washer	304 Stainless Steel	M8	Bore Size 8.5/ External Diameter 15.5mm, Thickness 1.6mm

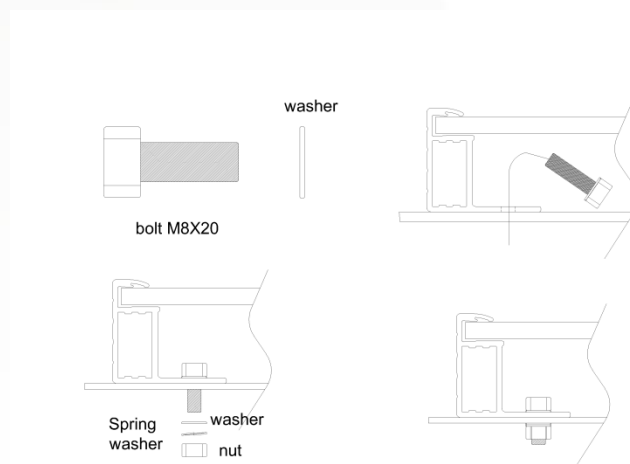


Figure 5-1 Detailed drawing of bolt installation

5.2.2 Fixing Method Using Clamps

The method of fixing the long side frame of the module with the clamp is shown in Figure 5-2 and Figure 5-3.

The specifications of the clamp are as follows:

- Material: aluminum alloy products with thickness greater than 3.3mm.
- Clamp width: 60mm and above (M6)/100mm and above (M10)
- Lap width: 12mm and above
- Fixing method: M8 bolts are recommended

Note: Please do not let the clamp contact the glass directly. In addition, the strength of the clamp used must meet the load performance of the module.

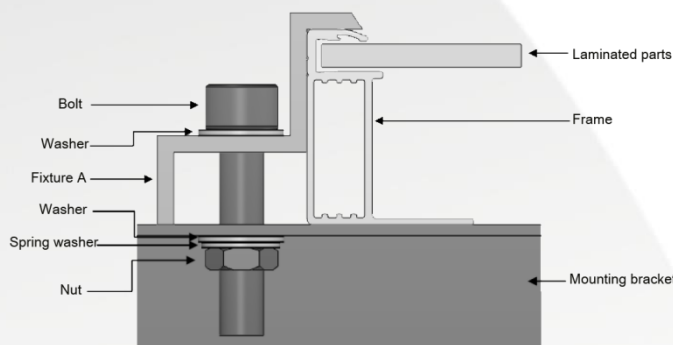


Figure 5-2 Fixture fixing method 1

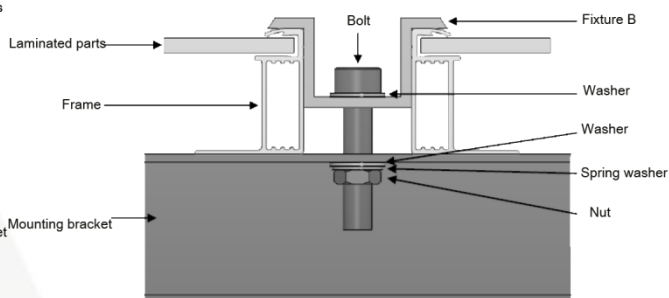
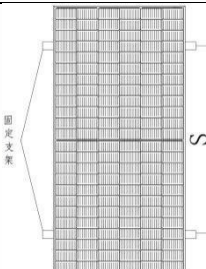
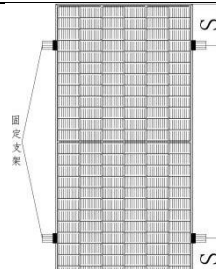


Figure 5-3 Fixture fixing method 2

- The long side frame of the module is vertically installed with the mounting structure as shown in the figure. (Recommended installation torque of clamp: 16N. m - use M8 bolt)
- The installation of intermediate clamp is shown in the figure. (Recommended installation torque of clamp: 16N. m - use M8 bolt)

5.2.3 Installation Figures and Corresponding Load Values

 <p>Figure 1 Vertical long side four-point bolt installation</p>	 <p>Figure 2 Vertical long side four-point clamp installation</p>
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Installation method Module Type	Installation method of mounting hole (Figure 1)		Fixing method with Clamps (Figure 2)	
	Installed Position (mm)	Design load (Front/Back)	Installed Position (mm)	Design load (Front/Back)
JMPV-T1/66-XXX	S=1400	3600/1600Pa	S=450	3600/1600Pa
JMPV-T1/60-XXX	S=1400	3600/1600Pa	S=450	3600/1600Pa
JMPV-TV2/66-XXX	S=1400	3600/1600Pa	S=450	3600/1600Pa
JMPV-TV2/60-XXX	S=1400	3600/1600Pa	S=450	3600/1600Pa

JMPV-XV2/78-XXX	S=1500	3600/1600Pa	S=482.5	3600/1600Pa
JMPV-XV2/72-XXX	S=1400	3600/1600Pa	S=440-550	3600/1600Pa
JMPV-X1/78-XXX	S=1500	3600/1600Pa	S=482.5)	3600/1600Pa
JMPV-X1/72-XXX	S=1400)	3600/1600Pa	S=415-435	3600/1600Pa
JMPV-X1/54-XXX	S=1150	3600/1600Pa	S=250-350	3600/1600Pa
JMPV-HM6HBM1/72-XXX	S=1400	3600/1600Pa	S=300-400	3600/1600Pa
JMPV-HM6HBM1/60-XXX	S=1000	3600/1600Pa	S=300-400	3600/1600Pa
JMPV-HM6VHBM2/72-XXX	S=1400mm	3600/1600Pa	S=350-450	3600/1600Pa
JMPV-HM6VHBM2/60-XXX	S=1280	3600/1600Pa	S=300-400	3600/1600Pa
JMPV-X6/78-XXX	S=1500	3600/1600Pa	S=482.5)	3600/1600Pa
JMPV-X6/72-XXX	S=1400	3600/1600Pa	S=415-435	3600/1600Pa
JMPV-X6/54-XXX	S=1150	3600/1600Pa	S=250-350	3600/1600Pa
JMPV-XV6/78-XXX	S=1500	3600/1600Pa	S=482.5	3600/1600Pa
JMPV-XV6/72-XXX	S=1400	3600/1600Pa	S=440-550	3600/1600Pa
Note: the module's commitment load is the design load multiplied by a safety factor of 1.5 times				

5.3 Module Wiring

5.3.1 Wiring

The solar cell module is connected in series with the power regulator.

In series connection, the positive terminal of the previous module is connected with the negative terminal of the next module. In addition, during electrical wiring, in order to prevent the current from flowing to the solar cell module reversely, the circuit needs to be treated to prevent the counterflow

current. In order to prevent counter currents, in the process of connecting solar modules, the cable (connecting solar modules), the junction box (with bypass diode to prevent counter current), the junction box or the power regulator (with counterflow prevention functions) should have diodes to prevent counter currents. As shown in Figure 5-4.

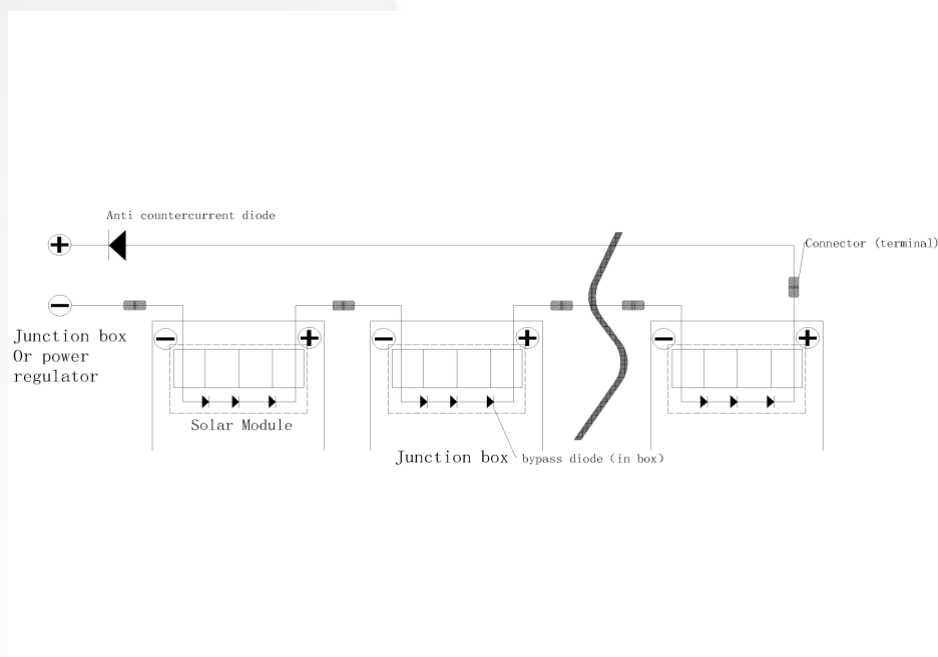


Figure 5-4 Module Wiring

Attention:

- 1) Check whether the wiring is correct before starting the system. If the measured open circuit voltage (Voc) and short circuit current (Isc) are not consistent with the specifications provided, there may be a wiring fault.
 - 2) Before the modules are connected to the grid, appropriate protective measures should be taken to prevent water vapor and dust from seeping into the connectors.
 - 3) The cable shall be fixed on the module frame or mounting rail to avoid blocking the back of the module.
 - 4) If the connector is not connected from positive terminal to negative one, the connector will not be waterproof. After installing the modules, it is necessary to connect them as soon as possible or take appropriate measures (such as using connector end caps) to avoid water vapor and dust infiltration.
 - 5) Specialized solar cables and appropriate connectors should be used to ensure good electrical and mechanical properties of cables in accordance to local fire protection, building and electrical standards.
 - 6) Only single-wire solar cable with not less than 4mm² (12 AWG), 90 °C grade, and appropriate insulation performance to withstand the maximum possible system open-circuit voltage (as approved by IEC62930) can be used. When the extension cable is longer than normal, serious power loss (power generation reduction) will occur due to the reduction of the conductor cross-section area and the additional wiring distance resistance. Please take this into full consideration and select appropriate conductor parameters to reduce voltage drop.
- *The above conclusion is based on the correct installation of the "O-ring gasket" of the terminal.
- 7) Fix the cable on the installation system with a UV resistant stripe. Appropriate measures should be taken to protect the exposed cable from damages (For example, it should be placed in the special sleeve of PV cable with UV aging resistance) to avoid exposure of the cable to sunlight.
 - 8) When fixing the wire of the junction box to the mounting structure, the connection between the terminal and the cable, and the connection between the junction box and the cable can not be overloaded, and the cable shall not be bent to more than 45 °, and the point of bending should be

at least more than 50 mm from the starting point.

9) Appropriate measures should be taken to protect the exposed connector from weather caused damages, avoid direct exposure to sunlight, and do not place the connector in a place prone to water accumulation.

10) Crimping is the best way to connect connectors and cables. It is difficult to ensure the quality of crimping by using inferior or general tools (pliers, etc.), which is easy to cause poor crimping, such as bending of the cable copper wire at the junction, partial copper wire not crimped in or wrong crimping of the cable insulation layer. Therefore, please use professional installation tools. As shown in Figures 5-5, 5-6 and 5-7.



Figure 5-5 Wire stripper



Figure 5-6 Crimping pliers



Figure 5-7 spanner

11) Ensure that the 20mm cable from the cable seal is not bent or pressed. For cable routing, refer to the cable manufacturer's minimum bending radius instructions. Non-standard wiring will lead to the existence of stress, which will lead to connector sealing failure in long term situations. As shown in Figure 5-8.



Figure 5-8 Cable routing

Prohibitions:

- 1) It is prohibited to clean the connectors with lubricants or other unauthorized chemicals.
- 2) Ensure that the connector is fixed tight and correctly connected, and not bearing external pressure. The connector can only be used for the circuit connection function, and cannot be used to turn on or turn off the circuit.
- 3) It is forbidden to plug connectors from different manufacturers with each other. The specifications, dimensions, and tolerances of connectors from different manufacturers are not consistent, so a 100% matching cannot be guaranteed. If forced interconnection occurs, it will lead to problems such as temperature rise, contact resistance and the IP grade protection level cannot be guaranteed, which will seriously affect the power generation efficiency and power station safety.
- 4) The connector shall not be connected in the air. Shaking due to the wind and collision with the backsheet or mounting structure will cause the body to be easily damaged. If the connection is not tightened in the early stage, the connector might break off more easily. It is recommended to fix the connector on the mounting bracket.

6. Module Grounding

- 1) In order to meet level II safety, the modules need to be grounded. Ensure that the grounding method meets the local electrical directives and regulations.
- 2) The grounding connection work should be carried out by qualified electricians.
- 3) Do not drill additional grounding holes on the modules, otherwise the limited warranty of Solargiga will be invalid.
- 4) Solargiga does not provide grounding components.
- 5) The grounding hole on the long side frame is crimped with bolts and crimping terminals, and installed with M4 nuts. In addition, water may leak into the module frame at the ground wire installation part, so it is recommended to use a higher positioned grounding hole when grounding. (Grounding hole ϕ 5.1) Ground wire connection is shown in Figure 6-1. All conductive connection points must be firmly connected. If the grounding requirements of Solargiga cannot be met and any problems related to grounding occur, our company will not be liable.

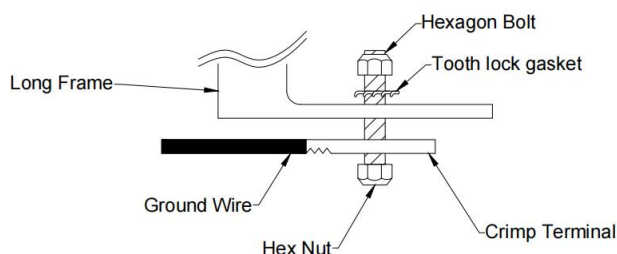


Figure 6-1 Module Grounding

7. Module Maintenance

- 1) Do not replace any PV components (diodes, junction boxes, connectors, etc.) without authorization from Solargiga.
- 2) Routine maintenance measures includes keeping the modules free from snow, bird droppings, seeds, pollen, leaves, branches, dust, stains, and etc.
- 3) If the module has sufficient inclination angle (at least 10 °), it is usually unnecessary to clean the module (rainfall will have self-cleaning effect). Should there be dirt on the surface of the module, wash the module array with water without detergent and use soft sponge or brush during the cooler time of the day (such as morning or sunset). Do not scrape or wipe the dust in dry condition, otherwise it will cause small scratches.
- 4) If there is snow, a brush with soft furs can be used to clean the surface of the module.
- 5) Check the system regularly to ensure that the wiring and supporting structure are intact.
- 6) If you need to inspect or maintain the electrical or mechanical properties, it is recommended that qualified professional personnel conduct the inspection or maintenance to avoid electric shock or personnel casualty.

8. Module Cleaning

This manual contains the following requirements for cleaning Solargiga photovoltaic modules. The purpose of this cleaning guide is to provide an overall summary of Solargiga module cleaning work. System users and professional contractors should carefully read these guidelines and strictly follow these instructions. Failure to follow these instructions may result in death, injury, or property damage of the PV modules. Damages due to improper cleaning procedures would not be a viable claim under the limited warranty of Solargiga.

- 1) Cleaning work poses a risk of damage on the modules and a series of components, as well as increases the risk of electric shock.
- 2) Broken or damaged modules can present electrical hazards due to current leakage, and moisture in the modules can exacerbate this risk. Before cleaning, it is necessary to thoroughly inspect the modules for cracks, damages, and loose connections.
- 3) During the daytime, the electric voltage and current existed in the PV array are enough to cause a lethal accident of electrical shock.
- 4) Since contacting exposed live parts of the module can cause injury, ensure that the electric circuit is disconnected before cleaning.
- 5) Before cleaning, make sure that the array is disconnected from live electrical devices such as inverters and combiner boxes.
- 6) Wear suitable protective gears (clothing, insulating gloves, and etc.)
- 7) Use suitable cleaning agent and cleaning equipment.
- 8) Please pay attention to avoid sharp objects contact with the module backsheet or frame, as scratchings can directly affect product safety.
- 9) Obvious stains must be cleaned with a soft cleaning tool (soft cloth, sponge, or brush with soft bristles).
- 10) Ensure that the brushes or other cleaning tools used do not wear out the glass, EPDM, silicon, aluminum alloys, or steel.
- 11) Try not to clean during the hottest hours of the day to avoid thermal stress on the modules.
- 12) Requirements for cleaning water used:
 - Water with low mineral content
 - PH value close to neutral
 - Non alkaline water must be used, and softened water should be used when conditions permit.
 - Chloride or salt content: 0-3000 mg/L
 - Turbidity: 0-30 NTU
 - Conductivity: 1500~3000 $\mu\text{S}/\text{cm}$
 - Total dissolved solids: $\leq 1000 \text{ mg/L}$
 - Water hardness: 0-40 mg/L
 - The recommended maximum water pressure is 4MPa (40bar)
- 13) If there are too many stains on the module surface, carefully use an insulating brush, sponge, or other soft cleaning tool.
- 14) Ensure that any brushes or stirring tools are made of insulating material to minimize the risk of electric shock, and that these tools do not scratch the module glass or the aluminum alloy frame.
- 15) If there are oil stains, use an environmentally friendly cleaning agent with caution.
- 16) After cleaning the modules, it is necessary to inspect the modules:
 - Visually inspect whether the overall appearance of the module is clean, bright, and free of stains;
 - Sample and check whether there is dust accumulation on the surface of the module;
 - Check the module surface for obvious scratches;
 - Check whether if there are man-made cracks on the module surface;
 - Check whether the module mounting structure is tilted or bent after cleaning;

- Check whether the module wiring terminals are loosened or peeled off after cleaning.

Prohibitions:

- 1) Do not immerse the module partially or completely in water or any kind of washing liquid.
- 2) Do not use rough cleaning equipment to avoid damaging the surface of the modules.
- 3) Do not use cleaning agents, degrease agents, and other unauthorized chemicals (such as oils, lubricants, pesticides and etc.) on the modules.
- 4) Do not use corrosive cleaning solvents, including hydrofluoric acid, alkali, acetone, or industrial alcohol. Only substances permitted by Solargiga can be used to clean modules.
- 5) Do not use an electric rotating brush, this method may cause micro cracks in the module cells.
- 6) Do not scrape or grind off the dirt on the surface of a dry module, as this can cause small scratches on the module surface.

9. Troubleshooting

A preventive inspection every 6 months is recommended. If the photovoltaic system does not function properly after installation, please notify the installer immediately. Do not replace the components of the PV module without authorization from Solargiga. If it is necessary to inspect and maintain electrical or mechanical properties, it is necessary to have qualified and professionally trained operators conduct the work in case it leads to electric shock or personnel casualty.



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