

# PV Module Installation Manual

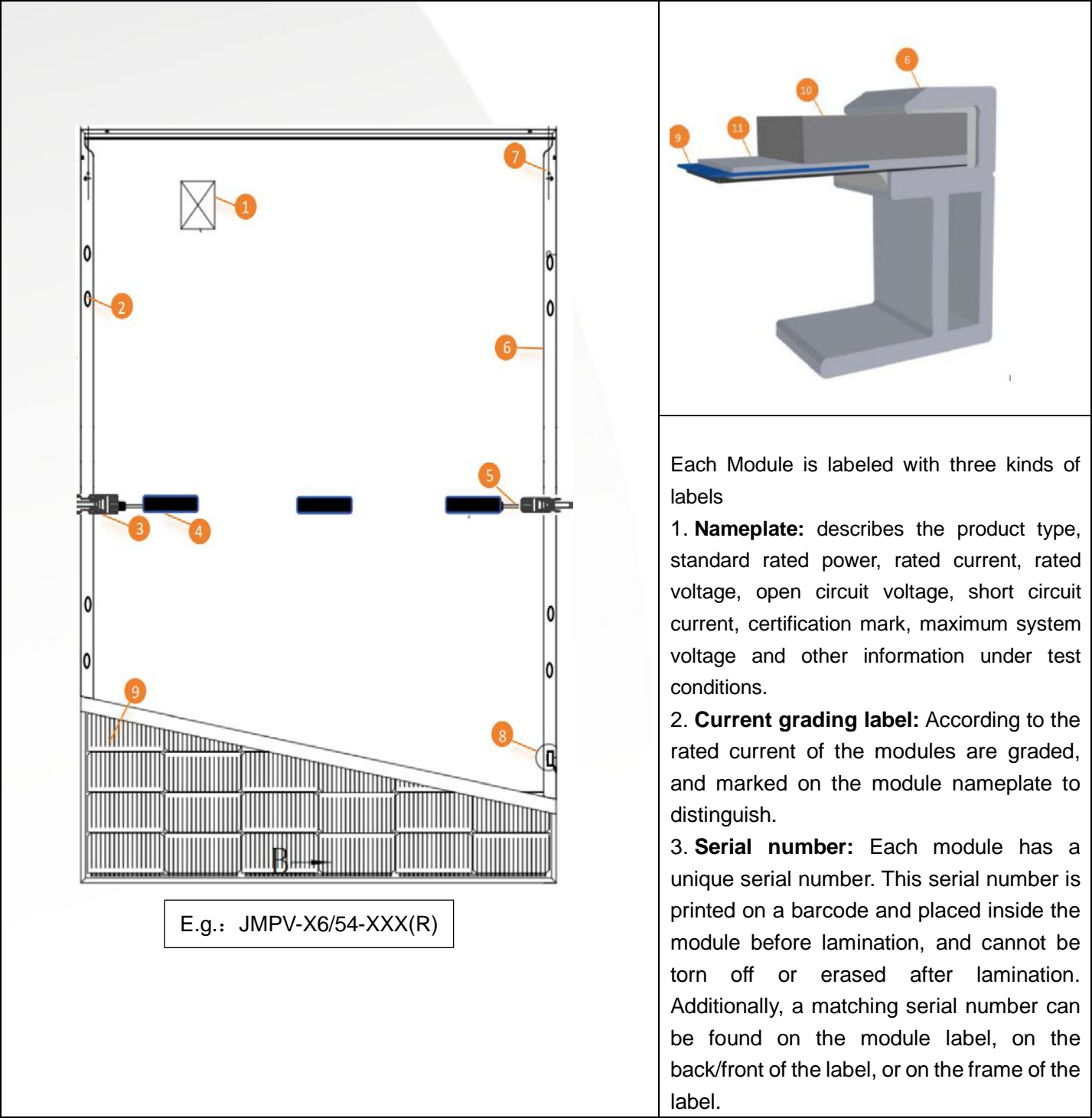
Make the World a Better Place  
V1.7.3



**This manual is only applicable to the photovoltaic modules produced by Solargiga Energy in the following table:**

Monocrystalline silicon module				
Cell	Single Glass		Double Glass	
<b>G12</b>	Perc	JMPV-T1/66-XXX(R)	Perc	JMPV-TV2/66-XXX(R)
	Perc	JMPV-T1/60-XXX(R)	Perc	JMPV-TV2/60-XXX(R)
			Topcon	JMPV-TV6/66-XXX(R)
			Topcon	JMPV-TV6/60-XXX(R)
			Topcon	JMPV-TV7/66-XXX(R)
<b>M10</b>	Perc	JMPV-X1/78-XXX(R)	Perc	JMPV-XV2/78-XXX(R)
	Perc	JMPV-X1/72-XXX(R)	Perc	JMPV-XV2/72-XXX(R)
	Perc	JMPV-X1/54-XXX(R)	Perc	JMPV-XV2/54-XXX(R)
	Topcon	JMPV-X6/72-XXX(R)	Topcon	JMPV-XV6/78-XXX(R)
	Topcon	JMPV-X6/54-XXX(R)	Topcon	JMPV-XV6/72-XXX(R)
			Topcon	JMPV-XVT6/54-XXX(R)
<b>G12R</b>			Topcon	JMPV-XVT6/66-XXX(R)
			Topcon	JMPV-XVT6/48-XXX(R)

Drawings:



1. Nameplate	2. Mounting hole	3. Connector	4. Junction box	5. Cable
6. Frame	7. Ground hole	8. Water leaking hole	9. Cell	10. Glass
11. Eva				

Figure 1 Module profile structure and description

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# 1. Introduction

## 1.1 General Information

This manual is applicable to the installation, maintenance and application of solar energy photovoltaic modules. Users and installers must read it carefully and follow it strictly. Failure to follow these safety guidelines may result in injury, death 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 modules. 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 login in our website <https://WWW.solargiga.com> for the latest version of the installation manual.

## 1.2 Disclaimer

- ① Solargiga serves the right to update this installation manual without prior notice.
- ② This manual does not contain any warranty, whether expressed or implied.
- ③ Due to the installation, operation and use of photovoltaic modules beyond the control of the company, Solar Energy does not assume any responsibility for losses, damage, casualties or additional costs caused by incorrect installation, operation, use and maintenance.
- ④ Solargiga shall not be liable for any infringement of patent rights or any other rights of third parties arising from the use of solar photovoltaic modules. Operation and use are beyond the control of the Company, and Solargiga shall not be liable for any loss, damage, injury or additional costs caused by incorrect installation, operation, use or maintenance.
- ⑤ Solargiga is not responsible for any form of injury, including but not limited to physical injury, injury and property damage arising from the operation of modules, system installation and whether or not the instructions in this manual are followed. Liability for infringement of patent rights or any other rights of third parties arising from the use of solar photovoltaic modules. Operation and use are beyond the control of the Company, and Solargiga shall not be liable for any loss, damage, injury or additional costs caused by incorrect installation, operation, use or maintenance.
- ⑥ Failure by the customer to install the PV module in accordance with the requirements in this manual may result in the invalidation of the limited warranty provided to the customer.



## 2. Safety Precautions

### 2.1 Warning

- ① Any electrical maintenance must first turn off the photovoltaic system, and improper system maintenance can lead to fatal hazards such as electric shock and combustion.
- ② Read and understand all safety instructions before installing, wiring, operating or servicing modules. When the battery surface of a module is directly exposed to sunlight or other optical sources, direct current is generated. Direct contact with the live parts of a module, such as wiring terminals, may result in injury or death.

### 2.2 General Safety Rules

- ① All installation work must be carried out in full compliance with local and local regulations and corresponding national or international electrical standards.
- ② The installation personnel should be familiar with the mechanical and electrical requirements of the photovoltaic system, have the professional skills and knowledge of installing the photovoltaic system, and have the qualification of installing the photovoltaic system.
- ③ Protective measures such as protective clothing (protective head cover, insulation gloves and insulation shoes) must be worn during installation, and electrical insulation tools must be used to avoid direct contact with 30V DC or higher voltage.
- ④ Do not allow children or unauthorized persons near the installation site or module storage area.
- ⑤ Do not wear metal ornaments, so as not to puncture the modules, causing the risk of electric shock. Close to the installation site or module storage area.
- ⑥ (Single glass Module) Backsheet is easy to damage, and contact with hard objects is easy to cause damage, which can easily lead to accidents.
- ⑦ Avoid direct contact with sharp edges during installation to protect the installer's hands.
- ⑧ If the assembly is installed or operated on a dewy morning, appropriate protective measures need to be taken to avoid moisture penetration into the connector. Sharp edges to protect the installer's hands.
- ⑨ If the circuit breaker and overcurrent protection device (OCPD) cannot be turned on or the inverter cannot be powered off during module installation or wiring, use an opaque material to cover the array modules (both front and back) to stop the power output.

NOTE: The nameplate is located on the back of the module, and the side without the nameplate is the front.

- ⑩ If the surface glass is damaged or worn, direct contact with the module surface may result in electric shock. Please wear personal protective equipment and replace the damaged modules immediately.



Meaning of cross-wheeled bin: Do not dispose of electrical appliances as unsorted municipal waste, use a separate collection facility. For information on available collection systems, please contact your local government. If appliances are discarded in landfills or dumps, hazardous materials can seep into groundwater and enter the food chain, harming your health and well-being. When replacing an old appliance with a new one, the retailer is legally obligated to take back your old appliance for disposal at least free of charge.

## 2.3 Prohibitions

- ① Do not install or handle modules in adverse weather conditions such as wet, rain, snow, or strong wind.
- ② It is forbidden to gather light on the modules artificially.
- ③ Do not connect or disconnect modules when there is current or external power supply. The cover of the junction box should be kept closed at all times.
- ④ Do not split the module or move any part of the module.
- ⑤ Do not attempt to repair any part of the module, there are no usable modules in the module.
- ⑥ 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 Safety Level: According to IEC 61730, this module conforms to the Application Class A (equivalent to safety class II).
- ② Fire safety level: According to IEC 61730 standard, the fire rating of this module is Class C.



## 3. Package/Unload/Storage/Unpacking

### 3.1 Package

3.1.1 Solargiga modules are vertically packed with long side and short side according to the product type. The patterns are shown in Figure 3-1 and Figure 3-2:

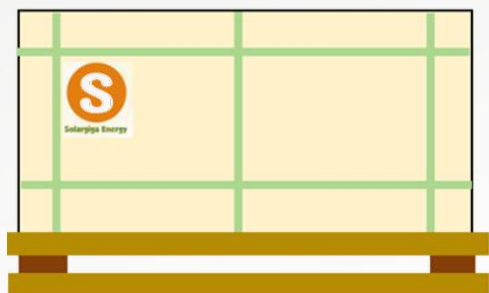


Figure 3-1

Vertical packing on the long sides of modules

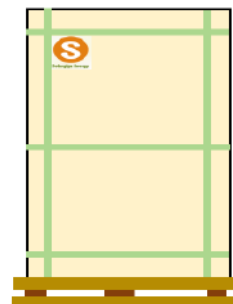


Figure 3-2

Vertical packing of the short sides of modules

3.1.2 Packing case labels, as shown in Figure 3-3




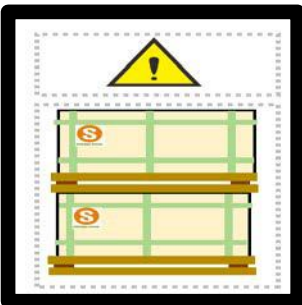

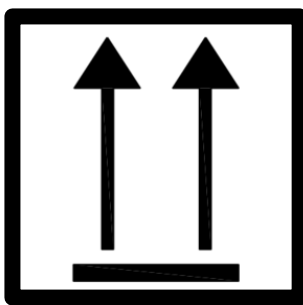
<p>1. Do not get caught in rain or damp</p> 	<p>2. Avoid tumbling and tipping. Please fasten the packing case to the transport platform.</p> 	<p>3. The modules in the carton are fragile, so handle them with care</p> 
<p>4. Do not stack more than two layers</p> 	<p>5. Do not step on the packing case or modules</p> 	<p>6. The package should be shipped straight up</p> 

Figure 3-3 Label on the packing case

## 3.2 Unload

When the modules arrive, please timely check whether the outer packing box is intact, and check whether the module model and quantity on the outer packaging of the modules are consistent with the delivery list. If any abnormality is found, please contact the logistics personnel and Jinzhou Solargiga site/customer service personnel immediately before unpacking.

### Crane unloading

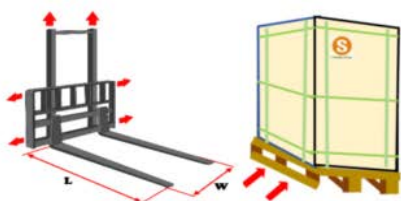
Before hoisting, select a lifting tool with sufficient tension based on the weight and size of the modules. During hoisting, adjust the position of the hoisting belt to keep the center of gravity of the modules stable. Use wooden panels or other fixed devices of the same width on the top of the packing case to prevent the hoisting belts from crushing the packing case and damaging the modules. Please operate the spreader at a constant speed. When the lifting is close to the ground, straighten the carton gently on a relatively flat position.



Note: A maximum of 4 supporting modules can be lifted at one time for long side vertical packaging, and a maximum of 2 supporting modules can be lifted at one time for short side vertical packaging.

**⚠ Strictly prohibited:** In the wind greater than 6 (Beaufort wind), heavy rain or snow under meteorological conditions.

### Forklift unloading



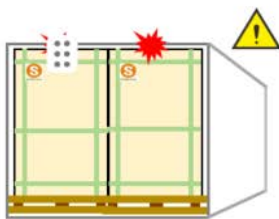
1. The fork slowly enters between the bottom plate and the panel of the pallet from the direction of the long side of the pallet, do not collide with the modules, and both sides of the door frame are tightly pressed against the pallet



2. Put the packing box on the ground smoothly



3. Drawing out forklift slowly



4. Top collision prevention



5-1 It is recommended to use a safety rope to secure the forklift

5-2 Do not stand on either side of the forklift



6. Please control the speed to prevent the module from tipping, the linear driving speed is <5km/h, the turning speed is <3km/h, and the emergency stop and rapid start should be avoided to prevent the module from tipping and causing injury to personnel.

**Suggestion:** If the packing case obstructs the sight of the forklift driver, it is recommended to reverse the truck during the forklift transport, and arrange special personnel to supervise and command it to prevent injuries or damage to the falling modules of the packing case. After transporting to the installation site, select a flat hard surface for placement.

#### Standard Warehouse Forklift

Please choose the appropriate forklift by weight of the modules being handled. The depth of the fork insertion into the pallet should not be less than three-quarters of the pallet length ( $L > 3/4$  pallet length). It is recommended to extend the height or width of the forklift's blockage bar to prevent the forklift from directly touching the module glass. To ensure better stability during handling, avoid brushing the corner posts when entering and exiting the pallet. In this case, the fork spacing  $W$  should be adjusted to the maximum. Operate slowly and avoid hitting the carton or pallet with the fork. Please place cushioning protective materials in advance (recommended: silicone, rubber, EPE).

## 3.3 Transportation

It refers to the transportation of the supporting modules between the storage place and the construction site after reaching the project storage place.



Figure 3-4

Forklift requirements: As shown in Figure 3-4. Please use a forklift truck with a rated lifting weight of N3.5 tons to load and transport modules. Do not let the raised part of the forklift directly touch the carton or modules.

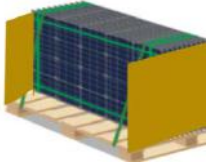

A. Fork length (L) N1.0m, spacing (W2) adjusted as close as possible to the two corner piers of the tray.

B. Gantry height (H) N1.5m, or width (W1) N2.5m.

C. The door frame should be perpendicular to the fork, the door frame structure should be strong (can withstand pressure N1.5 tons), and the door frame will not be deformed due to pressure when the supporting assembly leans against the door frame.

## 3.4 Transport Packing

The packaged product can be transported by land, sea, or air. During transportation, secure the package on the transportation platform to ensure that it will not tip over or shift.

<p>① If the unpacked modules need to be transferred to another project site, it is recommended to combine the scattered modules according to the number of modules on a single pallet before unpacking, and use internal packing belts (Pulling force 2100N recommended). Finally, put on the outer packing carton, and then pack the modules and pallets with packing tape. The number of packing tape is referred to before unpacking. Figure 3-5</p>	 <p>Figure3-5</p>
<p>② If the modules are less than one pallet, refer to the following figure to place the modules in the center (distribution packaging is placed on the right side of the following figure), and play the internal packing belt (tensile force is recommended at 2100N). Finally, put on the outer packing carton, and then pack the modules and pallets with packing belts. Refer to the number of packing belts before unpacking. Do not put down the layer when the supporting modules are insufficient for transportation. Figure 3-6</p>	 <p>Figure 3-6</p>

### Prohibited :

- It is prohibited to carry out secondary transportation of single glass modules packaged horizontally. When

transported by small trucks, horizontal packaging is only allowed to be placed in a single layer, and the safety rope is fixed on the vehicle around the packaging. The safety rope is separated from the contact part of the carton by paper sheathing or other buffer materials, and the driving speed is controlled according to road conditions.

- When transporting modules by box-type or non-box-type truck, pallets should be placed closely with each other without leaving any gap. Empty Spaces at the rear of the car should be filled and reinforced to prevent modules from moving to the rear of the car during transportation. When non-box-type truck is used, each supporting module should be fixed with ropes to the transport vehicle. Pallets are prohibited from exceeding the loading area of the transport vehicle.
- The use of tricycles is prohibited.



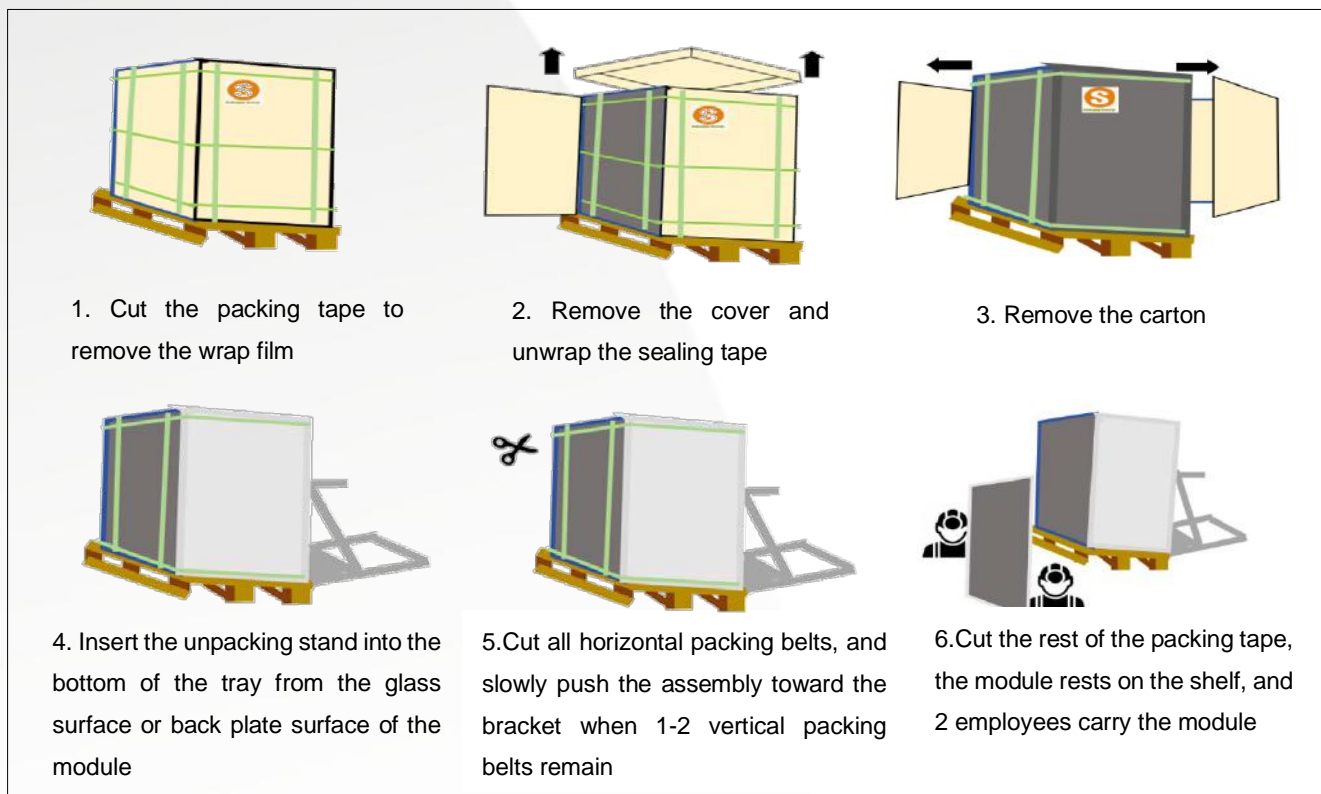
Figure 3-7



Figure 3-8

## 3.5 Unpacking

- 1) In the process of transportation and storage, in order to ensure the safety of modules, after arriving at the installation site, open the package of modules.
- 2) Open the solar energy packing box, please follow the "Solar energy photovoltaic module module standard Packing Instructions" operation.
- 3) Equipment and tools for unpacking: scissors (knives), gloves, forklift. Personnel: Minimum 2 persons.
- 4) Please wear protective gloves during unpacking to avoid scratching your hands and leaving fingerprints on the glass.
- 5) The working ground needs to ensure that the packing box can be placed horizontally and stably to avoid tipping.



### 3.6 Carry

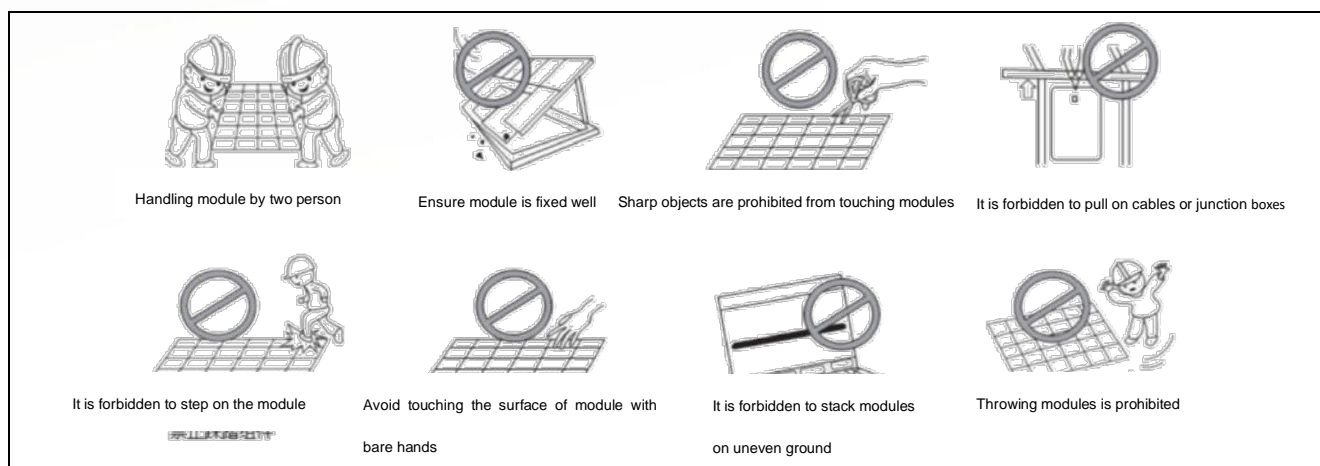


Figure 3-9: Module carrying instruction


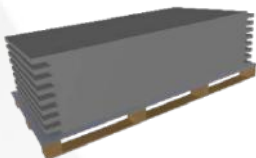

#### Announcements:

- ① When moving a single module, ensure that two or more personnel move it at the same time.
- ② After the assembly is disassembled, if it is not installed immediately, please change from vertical to flat. Please place a lid on the pallet, as shown in 3-10. Then control one module glass is placed face up, and the remaining modules are stacked face down. The maximum number of stacking pieces is 1/2 boxes of modules stacked together. The number of



modules lying flat shall not exceed 16 pieces.

③ Module must be cross-aligned after stacking; otherwise, Modules will tilt and fall during transportation. As shown in 3-11.

		
Fig 3-10 Place the box on the pallet	Fig 3-11 Modules are cross-aligned and stacked	Fig 3-12 Modules are covered with a rainproof cloth

④ If there is wind on site, pay special attention to safety, especially in the case of strong winds, it is recommended not to move modules, and properly fix unpacked modules.

⑤ If the modules will not be installed more than 15 days after they arrive at the project site, they need to be prepared for long-term storage on site.

⑥ It is necessary to place the modules in a flat open space to reduce product anomalies caused by long-term stress of the lower supporting modules caused by palletizing storage, and thus the risk of module dumping.

⑦ Modules are covered with a rainproof cloth, like Fig 3-12, please avoid sunlight and rain from polluting the module packaging material, thereby reducing the support strength of the packaging material.

⑧ Keep away from flammable and explosive materials.



#### Prohibitions:

① It is forbidden to use the wires or junction boxes of the modules to transport the modules.

② It is forbidden to unpack outdoors when it rains. Because the packing box will soften and spread out after rain, the photovoltaic modules inside will fall out and cause damage or smash people.

③ It is forbidden for all external forces and foreign objects to impact and bump the single point of the module glass to prevent the module from bursting, and Solargiga Energy is not responsible for the compensation of the bursting module under such circumstances.

④ It is forbidden to apply excessive loads or twist modules on the modules; Over head module handling is prohibited.

⑤ It is forbidden to place the modules in an environment without reliable support or without fixation.

⑥ It is forbidden to drop or stack items (such as installation tools) on the modules; It is forbidden for the module to come into contact with sharp objects, as scratches will directly affect the safety of the module.



- ⑦ It is forbidden to change the wiring method of the bypass diode; All electrical connections need to be kept clean and dry.
- ⑧ When unpacking modules, operators are not allowed to stand behind the leaning surface.

## 3.7 Storage

### Storage Recommendations:

Please store the modules in a dry and ventilated environment, and place the modules on a relatively flat ground (if there is an inclination angle in the vertical packaging storage area, the inclination angle is required to be  $\leq 8^\circ$ ) to avoid packaging damage or tipping due to ground deformation or collapse.

- A. Storage requirements: humidity <85%, temperature range of  $-40^\circ\text{C}$ ~ $50^\circ\text{C}$
  - B. There is a risk of tipping over if it is placed outdoors for a long time, so it is recommended to store the Modules in a standard warehouse
  - C. The modules shall avoid direct sunlight and moisture if they are stored in an uncontrolled environment such as an outdoor environment
- ① They should be stacked in single layers.
  - ② Once the packing box is found to be damp, please carefully open the packing box, lift the modules out, and place them in a ventilated place to avoid mildew of the modules.



### Prohibited matters:

- ① It is prohibited to store the packaged finished products together with corrosive chemicals or gases, and pay attention to fire prevention.
- ② Do not stack in more than one box of disassembled modules.

## 4. Installation Preparation

### 4.1 Preventive Measures and General Safety Rules

- ① Before installing the modules, contact the relevant department to obtain the information about the installation site and the construction permit, and shall comply with the requirements of the installation and inspection.
- ② Check the applicable building codes to ensure that the buildings to be installed and their structures (roof, exterior facade, bearing, etc.) have 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 Ambient 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 modules in -40°C to +40°C with relative humidity: <85% RH; the extreme work environment temperature is -40°C to 85°C; the Module (T98) Max is 70°C.

**NOTE:**

- Modules can be installed in any region worldwide if mounted with unrestricted airflow.
- It is possible that modules mounted with restricted airflow are not allowed for use in certain high-temperature regions, depending on the system design parameters. The project team should assess whether the system design at a specific geographic location will result in a 98th percentile module operating temperature exceeds 70°C. Additionally, the following factors must be considered in the system design (for further details, refer to IEC TS 63126):
  - Site specific environmental conditions: irradiance, ambient temperature, wind speed;
  - System design: mounting distance, array size, array spacing, anti-nesting features that may reduce airflow.

- ② When the module is installed on the roof, the roof must be covered with at least one layer of fire retardant material suitable for the fire rating of the module (please consult the local installer).

- ③ Ensure the fire rating of the modules on the roof. It is recommended that the minimum spacing between the modules and the roof is 10cm, which is also conducive to the ventilation and heat dissipation of the Module, and should

be prepared keep room for cleaning, repair and maintenance. For the photovoltaic systems installed on the roof, please try to follow the "top to bottom" and "left to right" safety principles.

Coastal installations of photovoltaic systems are usually divided into three categories based on the distance to the coast:

- From 00 meters to 50 meters, due of concern about salt spray corrosion, it is recommended to contact the Solargiga to evaluate the solution.
- From 50 meters to 500 meters, Solargiga Energy believes it can be installed in freshwater fishing light, floating projects, and land 50—500m away from the sea, but the connector requires protection or dust plugs when installing modules in the area within this distance range. After removing the dust plug, it must be connected immediately, and other anti-corrosion measures should be taken to prevent related parts from rust.
- At 500 meters and above, Solargiga Energy believes that the risk of salt spray corrosion is low, which only requires annual preventive maintenance.



#### Prohibited matters

- 1) The modules shall not be installed in the flame or the combustible object accessories.
- 2) Do not expose the modules to an artificial poly light source
- 3) Modules are not installed or used in an environment of strongly corrosive substances (such as salt, salt spray, brine, active chemical steam, acid rain, or any other substances that will corrode the modules and affect the safety or performance of the Module).
- 4) If you do not comply with the above precautions, the energy warranty will be invalid.

## 4.3 Installation Requirements

- 1) Ensure that the modules meet the overall technical requirements of the system.
- 2) Ensure that modules from other systems do not have a damaging mechanical or electrical impact on the Module.
- 3) Allows modules to be connected in series to increase voltage or in parallel to increase current. When connected in series, the positive pole of the module is connected to the next negative electrode. When connected in parallel, the positive pole of the module is connected to the positive pole of the next module.
- 4) The number of bypass diodes supplied varies depending on the module model.
- 5) Connect the appropriate number of modules according to the voltage specifications of the inverter used in the system. Even under the worst local temperature conditions, the modules connected together must not produce voltages higher than the allowable voltage values of the system.
- 6) Up to two strings of modules can be connected in parallel if an over current protection device (fuse) is not used in

series within each string of Module. Three or more strings of modules can be connected in parallel if a properly validated overcurrent protection device is connected in series on each string of Module. The PV system design must ensure that the reverse current of each string of modules is in any case less than the maximum fuse current of the module.

- 7) To reduce the risk of indirect lightning strikes, the system should be designed to avoid loops with wiring.
- 8) The modules should be securely fastened so that they can withstand all possible loads, including wind and snow loads.
- 9) Taking into account the effect of thermal expansion between modules, the minimum clearance between modules is 6.5 mm, of which 10 mm is required for frameless double-glass modules. This gap is the minimum straight-line distance between the plastic corners of two adjacent module.
- 10) When installing a solar single-glass module, do not damage the backsheet film on the back.
- 11) The maximum altitude of the PV module is designed: 2000 m. Meanwhile, Please be aware that the increase of altitude will be with higher irradiance and lower temperature, which may have impact on power rating.

## 4.4 Optimal Position and Angle

The same string of modules should be mounted at the same angle. modules installed at different angles will receive different amounts of irradiation, causing a current mismatch that will reduce the operating efficiency of the system. In order to achieve maximum annual power generation, the optimal orientation and inclination of the PV module should be determined. Typically, maximum electrical energy is generated when sunlight hits the PV module vertically. As shown in Figure 4-1

Northern hemisphere, the modules are preferably facing south

Southern hemisphere, the modules are preferably facing north

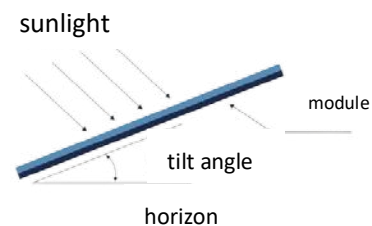


Figure 4-1

Local latitude	mounting angle	Note: It is recommended that the installation inclination angle should not be less than $10^{\circ}$ , so that the surface dust of the module is easily carried away by the rain when it rains, so as to reduce the frequency of module cleaning; At the same time, it is conducive to the flow away of water on the surface of the module, so as to avoid a large amount of water
$0^{\circ} \sim 15^{\circ}$	$15^{\circ}$	
$15^{\circ} \sim 25^{\circ}$	Local latitude	
$25^{\circ} \sim 30^{\circ}$	Local latitude + $5^{\circ}$	

30° ~ 35°	Local latitude + 10°	accumulation leaving marks on the glass for a long time, which will affect the appearance and performance of the module.
35° ~ 40°	Local latitude + 15°	
>40°	Local latitude + 20°	

In accordance with local laws and regulations, if the PV module is installed in North America or other countries where UL standards apply, there should be a minimum clearance of **155mm** (recommended) between the PV module (backsheet surface) and the wall or roof surface. If other installation methods are used, it may affect the UL certification or fire rating of the PV modules.

For detailed installation angles, please refer to the advice given by an experienced PV module installer.

## 4.5 Avoid Shadows

- 1) Even the slightest shade, such as dust, can cause a drop in power generation. A module is considered "unshaded" if all surfaces are not occluded throughout the year. This ensures that even on the shortest days of the year, sunlight can still reach the modules.
- 2) On the premise of ensuring maximum frontal power generation, obstacles between the module and the mounting surface should be avoided as much as possible.
- 3) The encapsulation film aging caused by the frequent occlusion of the module and the long-term heating of the diode will affect the service life of the module.
- 4) There should be enough space (at least 10 cm) between the back of the module and the mounting surface to ensure that cooling air can circulate in the space at the rear of the module while also allowing condensation or moisture to dissipate.

## 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 be in accordance with local electrical and building codes.
- 2) Solargiga energy does not provide installation Module. Please prepare all necessary installation components for installation purpose by yourself.
- 3) For installations conforming to IEC 61215-1&-2: 2021 and UL1703, a factor of 1.5 should be considered when calculating the maximum allowable design factor of safety. Project design loads depend on the structure, application criteria, location of installation and local climate. And based on the mechanical test loads specified in this manual, the professional engineer will install the module. For details, please follow the local building code or contact the professional building engineer.
- 4) Use suitable fasteners with corrosion resistance. All fasteners (e. g. Bolts, springs, washers, plain washers, nuts, etc.) are recommended to be hot-dip galvanized or stainless steel.
- 5) Install the assembly using a torque wrench according to the torque requirements specified by the system installer. The recommended tightening torque is  $16 \sim 20 \text{ N} \cdot \text{m}$  (M8 small hexagon bolt, Bolt Grade 8.8) , and the yield strength of the fastener should not be less than 450MPa.
- 6) It is forbidden to drill holes or change the frame structure of the module, otherwise the limited Solargiga Energy warranty will be invalid.
- 7) The fixture shall be made of aluminum alloy or metal material with equivalent performance. Proper cushioning is required between the fixture and the module glass. EPDM is recommended for solar energy.
- 8) The position of fixture is very important to the reliability of installation. The fixture center line must be in the permitted range according to different loads and installation methods.

### 5. 2 Mechanical Installation

#### 5.2.1 Mounting Method For Mounting Holes (Bolts)

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

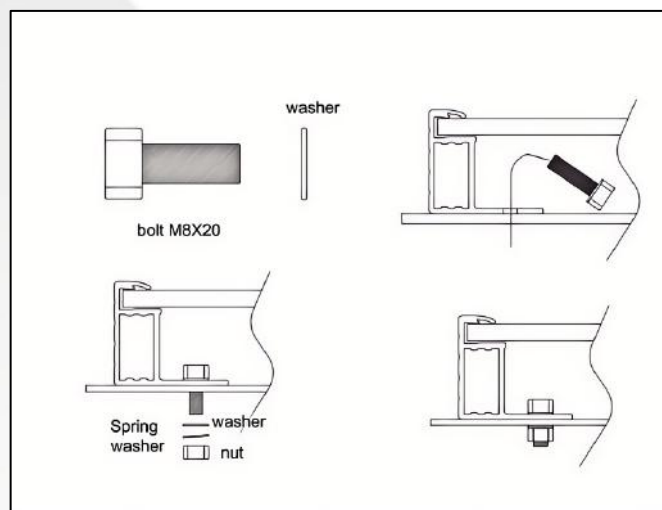


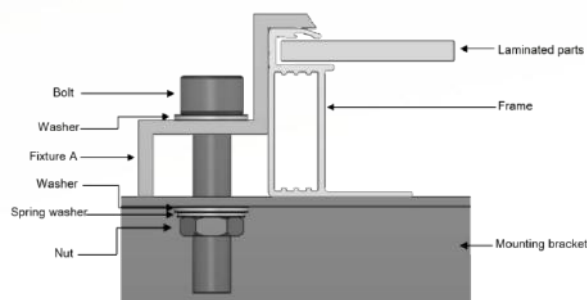
Fig. 5-1 detail diagram of bolt installation

★ **Suggestion:** use installation screws of the following specifications. Recommended installation torque: 16 N • m)

Fittings	Material	Specifications	Description
Bolt and Nut	304 Stainless Steel	Bolt M8, Nut M8	Bolt 4xM8x20mm, Nut 4xM8
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

## 5.2.2 Method of Fixing (Press) Using a Fixture

The method of fixing the long border of a module with a fixture is shown in figures 5 -2 and 5 -3.



5-2 fixture fixing method

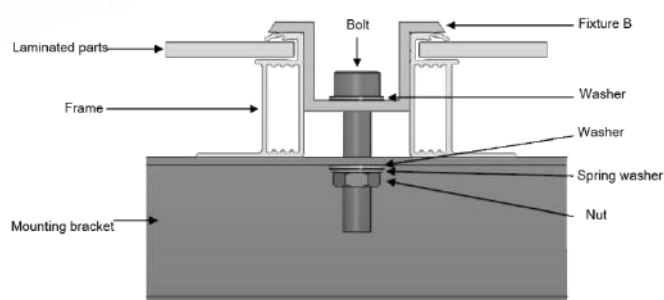


Fig. 5-3 fixture fixing method

The fixture specifications are as follows:

- Materials: aluminum alloy products with thickness  $\geq 3.3$  mm
- Fixture length:  $\geq 50$ mm
- Lap length: 9mm—12mm
- Fixing method: M8 Bolt is recommended
- The module's long border is mounted vertically to the bracket as shown. Recommended fixture installation torque: 16N.M -- use M8 bolts

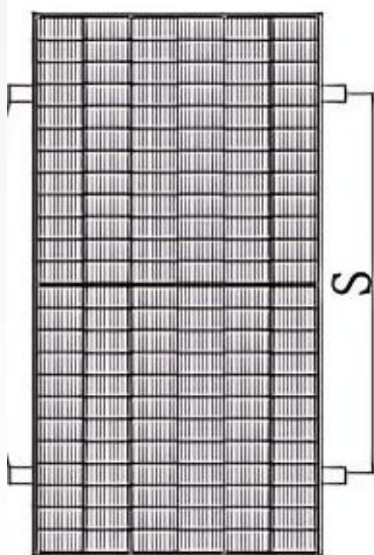


- The installation of the intermediate fixture is shown in the figure. Recommended fixture installation torque: 16N.M

-- use M8 bolts

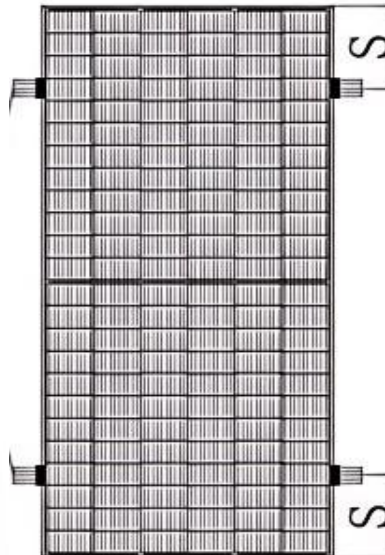
**Note:** do not allow the fixture to come into direct contact with the glass. In addition, the fixture used must be strong enough to meet the load-carrying performance of the module.

### 5.2.3 Installation Figures and Corresponding Load Values



**Figure 5-4**

Vertical long side four point bolt mounting



**Figure 5-5**

Vertical long side four point press block mounting

Installation mode Module Model	Installation method of mounting hole (figure 5-4)		Installation method of clamp mounting (figure 5-5)	
	Installation location (mm)	Mechanical test load : front/back	Installation location (mm)	Mechanical test load : front/back
JMPV-T1/66-XXX(R)	S=1400	5400/2400Pa	S=450-540	5400/2400Pa
JMPV-T1/60-XXX(R)	S=1400	5400/2400Pa	S=345-450	5400/2400Pa
JMPV-TV2/66-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
	S=790	2800/2500Pa		
	S=400	2200/2200Pa		
JMPV-TV2/60-XXX(R)	S=1400	5400/2400Pa	S=345-450	5400/2400Pa
JMPV-XV2/78-XXX(R)	S=1500	5400/2400Pa	S=485-600	5400/2400Pa
JMPV-XV2/72-XXX(R)	S=1400	5400/2400Pa	S=440-550	5400/2400Pa
JMPV-XV2/54-XXX(R)	S=1150	5400/2400Pa	S=250-350	5400/2400Pa

JMPV-X1/78-XXX(R)	S=1500	5400/2400Pa	S=435-540	5400/2400Pa
JMPV-X1/72-XXX(R)	S=1400	5400/2400Pa	S=415-435	5400/2400Pa
JMPV-X1/54-XXX(R)	S=1150	5400/2400Pa	S=250-350	5400/2400Pa
JMPV-X6/72-XXX(R)	S=1400	5400/2400Pa	S=415-435	5400/2400Pa
JMPV-X6/54-XXX(R)	S=1150	5400/2400Pa	S=250-350	5400/2400Pa
JMPV-XV6/78-XXX(R)	S=1500	5400/2400Pa	S=485-600	5400/2400Pa
JMPV-XV6/72-XXX(R)	S=1400	5400/2400Pa	S=440-550	5400/2400Pa
JMPV-XV6/54-XXX(R)	S=1150	5400/2400Pa	S=250-350	5400/2400Pa
JMPV-XVP6/72-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
JMPV-XVT6/66-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
JMPV-XVT6/48-XXX(R)	S=1100	5400/2400Pa	S=350-400	5400/2400Pa
JMPV-XVT6/54-XXX(R)	S=1150	5400/2400Pa	S=360-445	5400/2400Pa
JMPV-TV6/66-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
	S=400	2200/2200Pa		
JMPV-TV6/60-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
JMPV-TV7/66-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa
	S=400	2200/2200Pa		
JMPV-TV7/60-XXX(R)	S=1400	5400/2400Pa	S=440-540	5400/2400Pa

**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 Electrical Performance

#### 5.3.1.1 Electrical Performance

There is  $\pm 3\%$  error between the nominal value of P<sub>MAX</sub> and the standard test condition,  $\pm 3\%$  error of V<sub>OC</sub> and  $\pm 5\%$  error of I<sub>SC</sub>. Standard test conditions for the module: Irradiance 1000 W/m<sup>2</sup>, cell temperature 25 °C, atmosphere quality AM1.5. module maximum system voltage refer to the module specification or nameplate in some cases, the module may produce a current or voltage greater than its standard test environment (STC) optimal

operating current or voltage. Therefore, when determining module ratings and load values, the module short-circuit current under the STC should be multiplied by 1.25, and the open-circuit voltage should be multiplied by a correction factor (see Table 1 below) , in determining the proper wire and fuse specifications, the short-circuit current needs to be multiplied by 1.25(that is, the total times 1.56) according to the local regulations.

Table 1-open circuit voltage low temperature correction factor table

Predicted minimum ambient temperature (° C)	Correction Factor
24~20	1.02
19~15	1.04
14~10	1.06
9~5	1.08
4~0	1.10
-1~ -5	1.12
-6~-10	1.14
-11~-15	1.16
-16~-20	1.18
-21~-25	1.2
-26~-30	1.21
-31~-35	1.23
-36~-40	1.25

When connected in series, the positive terminal of the former module is connected with the negative terminal of the next module. Electrical wiring, in order to prevent the current to the direction of the solar cell module counter-current, need to prevent the circuit counter-current processing. To prevent backflow, during the connection of the solar modules, anti-counter-current diodes shall be installed in cables (connected to solar modules) , in junction boxes (with bypass diodes to prevent counter-current) , in junction boxes or power regulators (anti-counter-current function) .

TYPE	(P <sub>max</sub> )	(V <sub>mpp</sub> )	(I <sub>mpp</sub> )	(V <sub>oc</sub> )	(I <sub>sc</sub> )	BNPI			BSI
						(P <sub>max</sub> )	(V <sub>oc</sub> )	(I <sub>sc</sub> )	(I <sub>sc</sub> )
JMPV-XV6/72-585(R)	585	43.37	13.49	52.76	14.09	647	52.95	15.59	17.47
JMPV-XV6/72-580(R)	580	43.19	13.43	52.55	14.03	642	52.8	15.55	17.4
JMPV-XVT6/66-615(R)	615	40.73	15.10	48.75	16.06	680	48.92	17.77	19.91
JMPV-XVT6/66-610(R)	610	40.56	15.04	48.54	16.00	674	48.71	17.70	19.84
JMPV-XVT6/66-605(R)	605	40.39	14.98	48.36	15.93	669	48.53	17.62	19.75
JMPV-XVT6/66-600(R)	600	40.22	14.92	48.18	15.86	663	48.35	17.55	19.67
JMPV-XVT6/54-525(R)	525	34.03	15.43	40.74	16.39	580	40.88	18.13	20.32

JMPV-XVT6/54-520(R)	520	33.88	15.35	40.53	16.32	575	40.67	18.06	20.24
JMPV-XVT6/54-515(R)	515	33.71	15.28	40.35	16.24	569	40.49	17.97	20.14
JMPV-XVT6/54-510(R)	510	33.54	15.21	40.17	16.16	564	40.31	17.88	20.04
JMPV-XVT6/54-505(R)	505	33.38	15.13	39.97	16.08	558	40.11	17.79	19.94
JMPV-XVT6/54-500(R)	500	33.21	15.06	39.77	16.01	553	39.91	17.71	19.85
JMPV-XVT6/54-495(R)	495	33.05	14.98	39.57	15.93	547	39.71	17.62	19.75
JMPV-XVT6/54-490(R)	490	32.89	14.90	39.37	15.85	542	39.51	17.54	19.65
JMPV-XVT6/54-485(R)	485	32.71	14.83	39.17	15.77	536	39.31	17.45	19.55
JMPV-XVT6/54-480(R)	480	32.55	14.75	38.97	15.69	531	39.11	17.36	19.46
JMPV-XVT6/48-435(R)	435	29.22	14.89	34.98	15.84	481	35.10	17.53	19.64

In the junction box, bypass diodes are well equipped (Please refer to the rating table for specific series below). Please do not try to open the junction box to change diode even when the diode goes wrong. Such work should be done by the professional.

Hersteller / Manufacturer	Typ / Type	Bemessungswerte / Ratings
Holysun	GFT4050SM	25 A, Tj 200°C
	GF5045	25 A, Tj 200°C
	GF6045	30 A, Tj 200°C
	GFT5050CT	30 A, Tj 200°C
	40SQ045	25 A, Tj 200°C
	50SQ045	30 A, Tj 200°C
	60SQ045	35 A, Tj 200°C
GOOD-ARK	GFT4050SM	25 A, Tj 200°C
	GFT5050CT	30 A, Tj 200°C
	MK4050	25 A, Tj 200°C
PAN JIT	GF5045	25 A, Tj 200°C
	GF6045	30 A, Tj 200°C
Forsol	MK4050	25 A, Tj 200°C
	FSL-4050	25 A, Tj 200°C
	FSL-5050	30 A, Tj 200°C
Greenteent	GT-J-4050	25 A, Tj 200°C
	GT-J-5050	30 A, Tj 200°C
Yangjie	30SQ045	22 A, Tj 200°C
	30SQ045-SL	25 A, Tj 200°C
	40SQ045	30 A, Tj 200°C

### 5.3.1.2 Maximum Number of String & Parallel Module

The maximum number of module that can be connected in series shall be calculated in accordance with the requirements of relevant regulations, the value of its open-circuit voltage at the locally predicted minimum temperature conditions shall not exceed the maximum system voltage (as determined by the IEC 61730 safety test) required for the

solar module and other DC electrical Module.

- The open-circuit voltage correction factor can be calculated from the following formula:

$$CVoc = 1 - \beta Voc \times (25 - T)$$

When

$T$ : expected minimum ambient temperature at the system installation location

$\beta$ (%/°C) : selected module

$VOC$ : temperature coefficient (refer to the corresponding module parameter table)

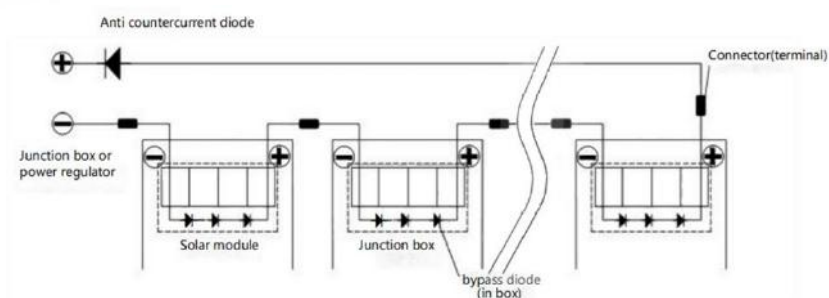
① Under normal conditions, the current and voltage values generated by the module product may be higher than the values obtained under standard test conditions for the module. So when determining the parameters associated with PV system module, such as rated voltage, conductor capacity, fuse capacity and module power output, the corresponding short-circuit current ISC and open-circuit voltage vocx 1.25 times should be applied.

② When the module are connected in a series, the final voltage is the sum of the single module, and when the module are connected in parallel, final current is the sum of the current passing by all parallel-connected modules, module of different electrical performance types can not be connected in a series.

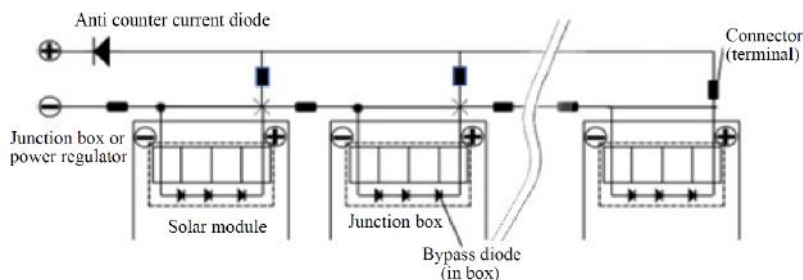
③ If a reverse current, which exceed module's maximum fuse rating current, may pass through the module, an equivalent overcurrent protection device must be used to protect the module.

④ If the number of parallel branches are more than or equal to 2 branches, each branch must have an overcurrent protection device.

series connection



parallel connection



5-6 module wiring diagram

- Reference formula for maximum series number of module:

$$\text{module maximum system voltage}/(1.25 * \text{open-circuit voltage})$$

The open-circuit voltage of PV modules decreases with increasing temperature. Therefore, when calculating the number of PV modules in series, it is necessary to take into account the increase in open-circuit voltage caused by temperature drop in extreme photovoltaics in winter, the maximum number of photovoltaics in series can be calculated using the following formula:

Formula	Maximum system voltage $V \geq N * Voc * [1 + \beta * (T_{min} - 25)]$
N	Maximum number of solar PV modules in series
Voc	Open-circuit voltage under STC conditions (refer to product datasheet or nameplate)
$\beta$	Temperature coefficient of Voc (refer to product datasheet or nameplate)
$T_{min}$	Minimum ambient temperature

- Reference formula for maximum parallel number of module:

$$\text{Maximum Protection Current}/(1.25 * \text{short circuit current})$$

When modules are connected in parallel, the string current is the sum of the individual currents of each module. When connected in parallel, the output current of the entire string of module is equal to the current of each branch module or module string and each string of module should be fitted with a fuse, please refer to the national or local specifications. The recommended maximum number of parallels can be calculated using the following formula:

Formula	$N \leq \text{Maximum Series Fuse Rating}/I_{sc} + 1$
N	Maximum number of solar PV modules in parallels
Fuse rating	The maximum rating of fuses in the array string (refer to product datasheet or nameplate)
Isc	Short Circuit Current (refer to product datasheet or nameplate)

### 5.3.1.3 Bypass Diodes and Anti-reflective Diodes

In a system with two or more series module, if some of the modules are shaded and the others are facing the sun, a very high reverse current will pass through the partially or completely covered cells, which can cause the cells to overheat and potentially damage the module. By bypassing the diode, the module is protected from such risks. There are bypass diodes in the junction box to reduce local shading effects. It is forbidden to remove the junction box to replace the diode, even if the diode is damaged. Such work should be carried out by professionals. In a system with a battery, if the controller does not have backswing protection, an anti-reverse diode mounted between the battery and the module

can prevent reverse current from damaging the module.

### 5.3.1.4 Dust Plug (If Any)

In order to avoid the entry of foreign objects such as sand or water vapor and cause connection safety problems, once the module are taken out of the box and installed, it is necessary to interconnect the connectors between the module in time, and keep the connectors dry and clean during the installation process. Before connecting the module at both ends of the string to the combiner box or inverter, plug the connectors with dust plugs to avoid contamination of the connectors. Please note that contamination such as sand, dust and water will cause arcing, electric shock or difficulty in plugging the connector, etc., we recommend adding a connector dust plug as a temporary protective measure in areas with heavy dust, high salinity and serious pollution, and it is not recommended to use it for a long time (within 1 month). Before and after the installation of the dust plug, as shown in Figure 5-7 and Figure 5-8 below.



Figure 5-7 Before installation

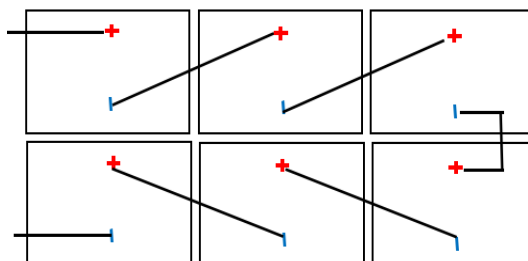


Figure 5-8 After installation

## 5.3.2 Module Wiring

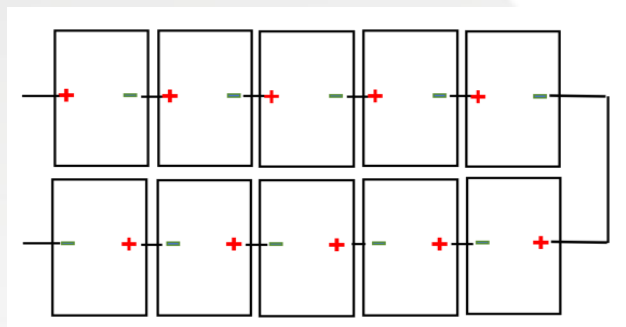
### 5.3.2.1 Horizontal Installation & Vertical Installation

Recommended wiring method for three-point wire box:

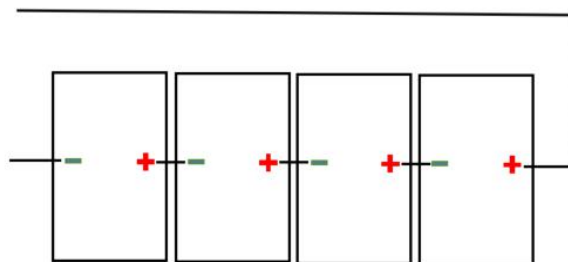


A. Module transverse double-row installation:





B. Vertical double-row installation of module:  
short-wire sequential connection - C type  
**(recommended)**



C. Vertical single-row installation of module:  
short-wire sequential connection - in-line type  
**(recommended)**

It is recommended to use the vertical short sequential connection C type and in-line type method: the component cable is connected left and right, the cable length cost is optimal, and it is recommended to use the positive electrode 300mm and the negative electrode 200mm to meet the installation requirements; For installation, the upper and lower module of each string head are connected by extension cables. In order to ensure the correctness of the installation, the upper and lower rows of module are installed in the way of "head to head" and "tail to tail", and the short side of the module is marked by the barcode.



#### Notes:

- 1) Check whether the wiring is correct before starting the system. If the measured open-circuit voltage (Voc) and short-circuit current (Isc) do not match the specifications provided, there may be a wiring fault.
- 2) Before the module are connected to the grid, appropriate protective measures need to be taken to prevent moisture and dust from penetrating into the connectors.
- 3) The cable should be fixed on the frame of the module or the mounting rail to avoid blocking the back of the module.
- 4) If the connector is not connected positively and negatively, the connector does not have waterproof function. Once installed, the module need to be connected as soon as possible or appropriate measures should be taken (e.g. with connector end caps) to avoid water vapor and dust.
- 5) In accordance with local fire, building and electrical codes, use dedicated solar cables and suitable connectors, and ensure that the electrical and mechanical properties of the cables are good.
- 6) Only single-wire solar cables, not less than 4mm<sup>2</sup> (12 AWG), 90° C rating, and with appropriate insulation to withstand the maximum possible system open-circuit voltage (if IEC62930 approved). When the extension cable is long, there is a significant loss of power (decrease in power generation) due to the small cross-sectional area of the conductor and the resistance of the wire. Please consider this and select the appropriate conductor size to reduce the voltage drop.

\*The above conclusion is based on the correct installation of the "O-ring gasket" of the terminal.

- 7) Use UV-resistant cable ties to secure the cable to the mounting system. Appropriate measures should be taken to protect exposed cables from damage (e.g. in a special sleeve for PV cables with UV ageing resistance) and to avoid direct exposure of the cable to direct sunlight.
- 8) When fix the junction box conductor to the bracket, the cable used in connection with terminal and cable used in connection with junction box cannot be bent to angle greater than 45° and the cable can only be bent after 50mm or more length count from the connection point.
- 9) Appropriate measures should be taken to protect exposed connectors from weather-related damage, avoid direct exposure to direct sunlight, and do not place connectors in places prone to water accumulation.

### 5.3.2.2 Cables and Connectors

- 1) In order to ensure the normal operation of the system, when connecting module or connecting loads (such as inverters, batteries, etc.), it should be observed to ensure that the polarity of the cable is connected correctly. If the module are not connected correctly, the bypass diode may be damaged.
- 2) When the cable is fixed on the bracket, it is necessary to avoid mechanical damage to the cable or module, and do not press the cable too hard. The minimum bend radius of the cable for the module is 38.4mm, which will not be covered by the warranty due to cable damage caused by excessive bending of the cable or the use of an unsuitable cable management system.
- 3) Before connecting, please cut the cable tie with diagonal pliers, and be careful not to scratch the cable and backsheet. Before the commissioning and operation of the power station, it is necessary to conduct electrical inspection on the module and strings to confirm that the polarity of the strings is correct and that the open-circuit voltage meets the requirements of the acceptance specification.
- 4) Keep the connector dry and clean, and make sure the nut of the connector is tightened before connecting. Do not double-click the connector if it is wet, dirty, or otherwise.
- 5) Avoid direct sunlight and rain, and keep away from waterlogged areas. Avoid dropping connectors on the ground or roof.
- 6) It is forbidden to contact with organic solvents and other corrosive materials in the connection and use environment of the connector, such as: alcohol, gasoline, pesticides, herbicides, etc., otherwise the sun will not be responsible for the problem of connector cracking caused by this aspect.
- 7) Connector Model:

Manufacturer	Connector
--------------	-----------

Jinzhou Yangguang	C1xyz
Holysun	C1xyz/C2xyz
Minghe	PV-MH5

- 8) 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 5-9, 5-10 and 5-11.



Figure 5-9 Wire strippers



Figure 5-10 Crimping pliers



Figure 5-11 Torque wrench

- 9) Photovoltaic modules for solar energy use special photovoltaic cables with a cross-sectional area greater than or equal to  $4 \text{ mm}^2$  and UV protection. All other cables used to connect DC systems should be of similar (or higher) specifications. The open-circuit voltage of the array needs to be calculated at the lowest expected ambient temperature at that location. The PV cable with a minimum of  $90^\circ\text{C}$  temperature resistance, light resistance and no less than  $4 \text{ mm}^2$  cross-section should be used as the PV connection line in the field. It is recommended to use 4-6  $\text{mm}^2$  PV cable when installing module on the roof, The bending radius of the cable should be minimum 43mm, as shown in figure 5-12.

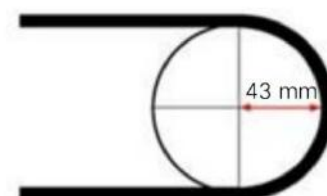
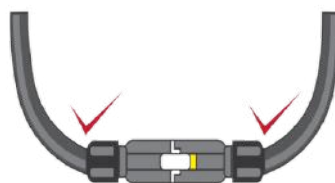
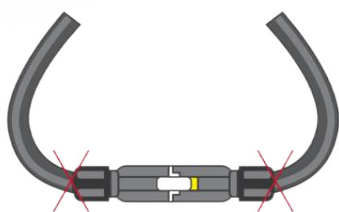


Figure 5-12

**Prohibition:**

- 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 high wind conditions. 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

### 6.1 Introduction to Grounding

In order to use safely and avoid lightning and electrostatic damage, the module frame must be grounded, and the module needs to meet safety level II, and ensure that the grounding method meets local electrical directives and regulations.

### 6.2 Grounding Guidelines

① The grounding hole of the long frame of the solar cell module is crimped with a bolt and a crimp terminal, and the nut of M4 is used for installation. In addition, water may enter the frame of the module of the ground wire mounting part, so it is recommended to use a high ground hole when grounding the wire. Figure 6-1 shows the ground wire connection, and Figure 6-2 shows the size and location of the ground hole. All conductive connection points must be securely connected.

② When grounding, the grounding device must be in full contact with the inside of the aluminum alloy to penetrate the oxide film on the surface of the frame.

③ The method of module grounding should not result in electrochemical corrosion between the aluminum frame of the module and different metals. UL 1703 standard, "Flat Plate Photovoltaic Modules and Panels," Appendix recommends that the electrochemical potential difference between contacting metals not exceed 0.6V.

If the grounding requirements cannot be met, and any problems related to grounding occur, Solargiga will not be responsible for such related problems.

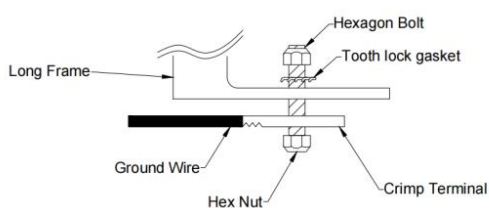


Figure 6-1 Connecting the module to the map

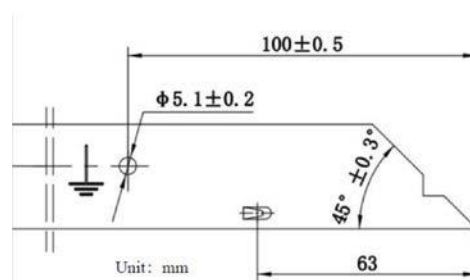


Figure 6-2 Grounding hole on the long side of the module

#### 6.2.1 Miscellaneous

- ① Personnel requirements: Grounding connection operations should be carried out by qualified electricians.
- ② Note: Do not drill additional grounding holes in the module, or the Solargiga Limited Warranty will be void.

③ Grounding parts: Solargiga Energy does not provide grounding parts. The choice of grounding parts can be suggested according to the local installer. Installer must follow the instructions provided by the grounding parts manufacturer.

## 7. Module Maintenance

Module must be inspected and maintained regularly, especially during the warranty period, which is the responsibility of the user, and the supplier is notified within two weeks of any damage to the module.

### 7.1 Visual Inspection of Modules

#### 7.1.1 Visual Inspection of Modules

- ① The glass of the module is shattered.
- ② Corrosion at the weld of the cell busbar: Caused by damage to the surface encapsulation material during installation or during transportation, causing moisture to enter the module.
- ③ Check the backsheet of the module for burn marks.
- ④ Make sure that the modules are free of snow, bird droppings, seeds, pollen, leaves, branches, dust, stains, etc.

### 7.2 Cable and Connector Inspection

#### 7.2.1 Preventive Check-ups Every Six Months

- ① Check whether the sealing of the connector and the cable connection are firm.
- ② Check whether the sealant at the junction box is cracked and whether there are gaps.
- ③ Check that the support structure of the component is intact.
- ④ If you need to inspect or maintain electrical or mechanical properties, it is recommended that the inspection or maintenance be carried out by a qualified professional to avoid electric shock or casualties.



Prohibitions: Do not replace PV modules (diodes, junction boxes, connectors, etc.) without authorization.



## 8. Module Cleaning Guidelines

This manual contains the requirements for PV module cleaning, and the purpose of this cleaning guide is to provide a general description of Solargiga's module cleaning work. System users and professional installers should read these guidelines carefully and follow them carefully. Failure to follow these instructions could result in death, injury, or property damage to the PV module. Damage caused by improper cleaning procedures will void the Solargiga's Limited Warranty.

### 8.1 Precautions Before Cleaning

- 1) Cleaning creates a risk of damage to modules and a range of modules, as well as an increased risk of electric shock.
- 2) Cracked or damaged modules are at risk of electric shock due to leakage current, and this risk of electric shock is exacerbated by moisture in the modules. Before cleaning, the modules need to be thoroughly inspected for cracks, damage, and loose joints.
- 3) During the day, the voltage and current present in the array are sufficient to cause a fatal electric shock.
- 4) Since touching the exposed part of the live part can cause injury, make sure the circuit is disconnected before cleaning.
- 5) Before cleaning, make sure that the array is disconnected from the live parts such as the inverter and combiner box.
- 6) Wear appropriate protective clothing (clothing, insulating gloves, etc.)
- 7) Use an appropriate detergent and appropriate cleaning equipment.
- 8) Please take care to avoid contact between the module backsheet or frame and sharp objects, as scratches will 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 glass, EPDM, silicon, aluminum alloy, or steel.
- 11) Avoid cleaning during the hottest time of the day to avoid thermal stress on the modules.
- 12) If the module has a sufficient angle of inclination (at least  $10^{\circ}$ ), it is usually not necessary to clean the module (rain will have a self-cleaning effect). If there is a lot of dirt accumulation, rinse the assembly array with water without detergent and a gentle sponge or brush during the cooler part of the day (early morning or late afternoon). Do not scratch or wipe dust while dry, as this will cause microscopic scratches.
- 13) The modules should be cleaned in the early morning or evening when the light is not strong and the temperature of the modules is low, and make sure that the circuit is disconnected before cleaning.
- 14) If there is too much stain on the surface of the module, you can carefully use an insulating brush, sponge or other soft cleaning tool.
- 15) Ensure that any brushes or agitation tools are constructed of insulating material to minimize the risk of electric shock and that these tools do not create a glass or aluminum alloy frame scratches.
- 16) If oil stains are present, use an environmentally friendly cleaner with caution.
- 17) Remove the snow on the module in time to avoid damage to the module caused by long-term accumulation of snow and melting and icing of the snow, but do not clean the group in extreme weather situation.
- 18) The accumulation of foreign objects or obstacles on the surface of the module will reduce the power output of the module for a long time, so it is necessary to clean the glass surface of the module regularly. Although in most cases,

a normal amount of rainwater is sufficient to keep the module glass clean, but it is still recommended to clean the module at least once a year in a dusty environment. The number of cleanings should be increased.

## 8.2 Cleaning Method

### Method A: High-pressure water cleaning, as shown in Figure 8-1

- Water quality requirements ;PH:5 ~7
- Chloride or salt content:0 - 3,000 mg/L
- Turbidity:0-30 NTU
- Electrical conductivity:1500~3000  $\mu$  s/cm
- Total dissolved solids: $\leq$ 1000 mg/L
- Water hardness:0-40 mg/L
- Non-alkaline water must be used, and demineralized water high-pressure water flow is used for cleaning when available (the recommended maximum water pressure is 4MPa [ 40bar ])



Figure 8-1

### Method B: Wet test cleaning, as shown in Figure 8-2

If there is too much stain on the surface of the module, you can carefully use an insulating brush, sponge or other soft cleaning tool. Ensure that any brushes or agitation tools are constructed of insulating material to minimize the risk of electric shock and that these tools do not scratch the glass or aluminum alloy frame. If oil stains are present, it is prudent to use an environmentally friendly cleaner.



Figure 8-2

### Method C: Compressed air cleaning, as shown in Figure 8-3

It is recommended to use air pressure to clean soft stains (such as dust) on modules. As long as the on-site cleaning effect is good enough, this technology can be applied.



Figure 8-3

### Method D: Cleaning robot is cleaning, as shown in Figure 8-4

If the cleaning robot is used for dry cleaning, the brush material is required to be soft plastic, and the cleaning process and cleaning will not cause scratches to the glass surface and aluminum alloy frame of the module, and the weight of the cleaning robot is not easy to be too



Figure 8-4

large, and the module damage and power attenuation caused by improper cleaning by the cleaning robot are not within the scope of a warranty.	
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## 8.3 Inspect the Modules After Cleaning

- ① After the cleaning of the modules is completed, the modules need to be inspected.
- ② Visually see whether the overall appearance of the module is clean, bright and free of stains.
- ③ Sampling to check whether there is dust on the surface of the module.
- ④ Check whether there are obvious scratch marks on the surface of the module.
- ⑤ There is no man-made cracking on the surface of the module.
- ⑥ Whether the module bracket is tilted or bent after cleaning.
- ⑦ Whether the terminal blocks of the module are loose or fall off after cleaning.

### Prohibitions:

- ① Do not partially or completely immerse the modules in water or any kind of washing liquid.
- ② Do not use rough cleaning equipment on the module to avoid damaging the surface of the module.
- ③ Do not use scrubs, degreasers, and other unauthorized chemicals (e.g. oils, lubricants, pesticides) on modules.
- ④ Do not use corrosive cleaning solvents, including hydrofluoric acid, alkali, acetone, or industrial alcohol. Only substances allowed by Solargiga can be used to clean modules.
- ⑤ Do not use the cleaning method of rotating brushes, as this may cause microcracks in the module cells.
- ⑥ Do not scrape or grind off the surface when the module is dry, as this will cause small scratches on the surface.

## 9. Troubleshooting

If the PV system does not work properly after installation, notify the installer immediately. It is recommended to perform a preventive inspection every 6 months and not to replace the modules of the modules without authorization. If electrical or mechanical properties need to be inspected and maintained, they need to be operated by qualified and professionally trained professionals to avoid electric shock or casualties.



## Contact Us

Solargiga Energy Holdings Limited (Listed Company)

Address: 1402 Harbour Centre, 25 Harbour Road, Wanchai, Hong Kong, China

Tel: (852)3416 2000

Email: [info@solargiga.com](mailto:info@solargiga.com)

Jinzhou Yangguang Energy Co., Ltd. (Headquarter)

Address: Xihai Industry Park, Economic and Technical Development Zone 121007 JINZHOU Liaoning CHINA

Tel: (86)0416 508 1136

Fax: (86)0416 718 8277

Jiangsu Yueyang Photovoltaic Technology Co., Ltd.

Address: No.777 Tangqiao Rd., HTDZ, Jianhu County, Yancheng, Jiangsu Province, China

Tel: (86)515 8656 5777

Jiangsu New Sunshine Zhiding Technology Co., Ltd.

Address: Floor 2, Building A4, Intelligent Industrial Park, HTDZ, Jianhu County, Yancheng, Jiangsu Province, China

Tel: (86)515 8628 0015

Suzhou Office

Address: Floor 4, Section N3, Sungent I-Park, SIP, Suzhou, China

Japan Office

Contact: Sato Masanobu

Address: Takasu 6-Chome 14-25, Habikino, Osaka, Japan

Tel: (81)80 8461 1567

Taiwan Office

Contact: Steven Wang

Address: 17F-2, No. 118, Songjiang Rd., Taipei City, 10491, Taiwan, China

Tel: (886) 2 2507 7757

Fax: (886) 2 2517 5678



@Solargiga Energy