

# Installation Manual for Crystalline Silicon Photovoltaic Modules

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## Contents

<b>1</b>	<b>Manual introduction.....</b>	<b>1</b>
1.1	DISCLAIMER.....	1
1.2	LIMITATION OF LIABILITY.....	1
<b>2</b>	<b>Safety measures.....</b>	<b>1</b>
2.1	WARNING.....	1
2.2	GENERAL SAFETY.....	1
2.3	SAFE OPERATION.....	2
<b>3</b>	<b>Unloading, transportation and storage.....</b>	<b>3</b>
3.1	PACKAGING LABEL DESCRIPTION.....	3
3.2	PRECAUTIONS FOR UNLOADING.....	4
3.3	SECOND TRANSPORTATION AND PRECAUTIONS.....	4
3.4	STORAGE.....	6
<b>4</b>	<b>UNPACKING INSTRUCTIONS.....</b>	<b>7</b>
4.1	UNPACKING AND INSTALLATION: .....	7
4.2	UNPACKING STEPS: .....	8
<b>5</b>	<b>SITE SELECTION.....</b>	<b>9</b>
<b>6</b>	<b>ANGLE SELECTION.....</b>	<b>10</b>
<b>7</b>	<b>INSTALLATION.....</b>	<b>10</b>
7.1	INSTALLATION SAFETY.....	10
7.2	INSTALLATION METHOD.....	11
7.2.1	Mechanical installation and precautions.....	11
7.2.2	Grounded .....	16
7.2.3	Electrical Installation.....	17
<b>8</b>	<b>MAINTENANCE OF MODULES.....</b>	<b>20</b>
8.1	MODULE VISUAL INSPECTION AND REPLACEMENT.....	20
8.2	CONNECTOR AND CABLE INSPECTION.....	21
8.3	CLEANING.....	21
8.3.1	Water quality requirements.....	22
8.3.2	Inspection after cleaning.....	23
8.3.3	Troubleshooting.....	23
8.3.4	Disposal after the end of the life of the modules.....	23

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# Installation Manual for Crystalline Silicon Photovoltaic Modules

## 1 Manual introduction

The manual is applicable to the installation, maintenance and use of the frame series solar modules produced by Anhui Zhonghan Solar Technology Co Ltd (hereinafter referred to as Zhonghan). Failure to follow these safety guidelines may result in personal injury or death or property damage. Installing and operating solar modules requires professional skills, and only professionals can do this work. Please read the safety and installation instructions carefully before using and operating the modules. The installer must inform the end customer (or consumer) of the above matters accordingly.

The "module" or "PV module" in this manual refers to one or more frame series solar modules. Please keep this manual for future reference.

### 1.1 Disclaimer

Zhonghan reserves the right to change this installation manual without prior notice. Failure to follow the requirements listed in this manual during the installation of modules, it will result in the invalidation of the limited product warranty provided to the customer.

### 1.2 Limitation of Liability

Zhonghan is not responsible for any form of injury, including but not limited to module operation, system installation errors, and physical injury, injury and property damage caused by failure to follow the instructions in this manual.

## 2 Safety measures

### 2.1 Warning

Before installing, wiring, operating or maintaining modules, you should read and understand all the safety rules. When the battery surface of the module directly exposed to sunlight or other light sources, direct current (DC) will be generated. Whether the module is connected or not, direct contact with the live parts of the module, such as the terminal, may cause casualties.

## 2.2 General Safety

- All installation work must fully comply with local regulations and corresponding international electrical standards.
- It is recommended that the installation should be carried out by personnel with experience in installing photovoltaic systems. It will be very dangerous if operated by personnel who are not familiar with the corresponding safety procedures.
- Unauthorized personnel are not allowed to approach the installation area or module storage area.
- Please do not install modules with damaged glass or damaged backsheet.
- Do not disassemble or move any part of the modules.
- Do not artificially condense light on the modules.
- Do not connect or disconnect the module when there is current or external current.

## 2.3 Safe operation

- It is forbidden to stand, step on, walk or jump directly on the packaging or modules.



- Please do not damage or knock the glass and backsheet surface of the module.
  - Do not pull, scratch, or bend the output cable forcibly, otherwise the insulation of the cable will be damaged and cause current leakage or electric shock.
  - Please do not use water to extinguish the fire when the power is not disconnected.
  - Please do not install or dispose of modules during periods of humidity or strong wind.
- At the installation site, please keep the electrical components of the module clean and dry. If the cable plugs touch each other in wet conditions, they will corrode. Any corroded modules cannot

be used.

- Please do not loosen or unscrew the screws of the module, it may cause the load of the module to drop or even fall.
- Do not let objects hit the module directly or fall directly on the module.
- Under the sun, please do not directly touch the junction box, connector, cable and other charged objects of the module without any protection, regardless of whether the module is connected to the system.

### 3 Unloading, transportation and storage

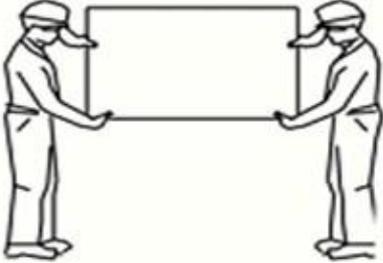
Precautions and general safety rules:

- The modules should be stored in the original packaging box before installation. Please protect the packaging from damage. Follow the recommended unpacking steps to unpack the modules. Be careful during opening, transportation and storage;
  - It is forbidden to stand, climb, walk or jump on the unopened packing box and modules;
  - Before installation, ensure that all modules and electrical contacts are clean and dry;
  - If you need to store modules temporarily, they should be stored in a dry and ventilated environment;
  - When unpacking, it must be operated by 2 or more people at the same time. It is forbidden to pull the wire or junction box of the module to carry the module. When moving the module, it should be carried by more than 2 people with non-slip gloves while holding the module; it is prohibited to carry the module overhead; Do not stack modules;
  - It is forbidden to place the modules in an environment without reliable support or unfixed;
  - It is forbidden for the modules to come into contact with sharp objects or scratches, so as not to directly affect the safety of the components;

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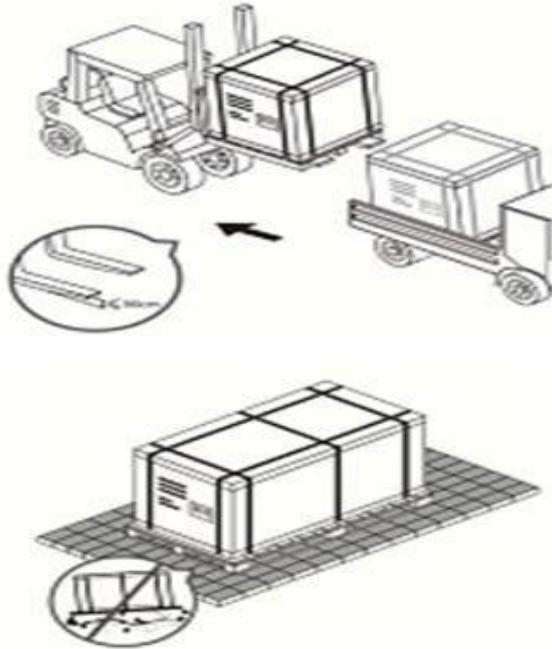
#### 3.1 Packaging label description

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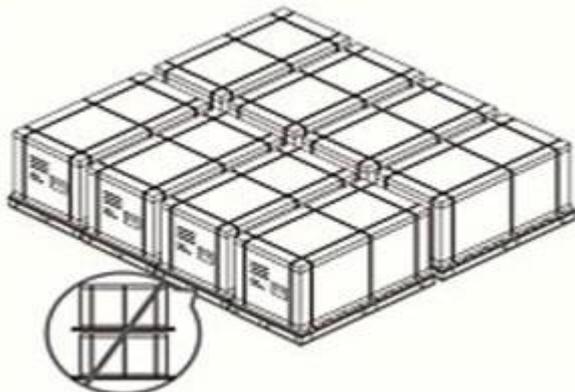
	<p>Forbidden to discard, and special recycling is required</p>		<p>Prohibit from being exposed to rain or moisture</p>
<p>EU-28 WEEE COMPLIANT</p>			
	<p>The modules in the carton are fragile and should be handled carefully</p>		<p>The packaging should be upright during transportation</p>
	<p>Forbidden to step on the packaging box or modules</p>		<p>Cartons can be recycled</p>
	<p>Stacking modules, please do not exceed the limit of the maximum number of layers printed on the outer packaging box, (code 2 layers; when n=3, stack up to 3 layers)</p>		<p>A module needs to be carried by 2 people at the same time</p>



Use reasonable hoisting jigs, hoisting allows up to 2 supporting modules at a time. Before hoisting, confirm whether the pallets and cartons are damaged and whether the hoisting ropes are strong and firm. When the hoisting is about to touch the ground, two of them will straighten the carton and gently place it on a relatively flat position



Please use a forklift to unload the modules from the truck, and place it on a level ground in a ventilated and dry place

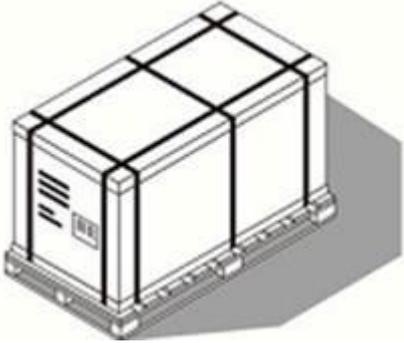
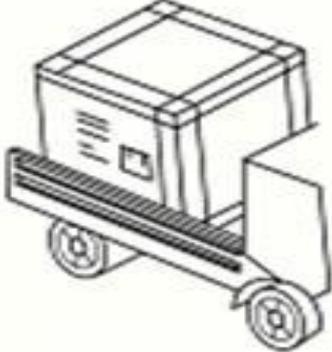
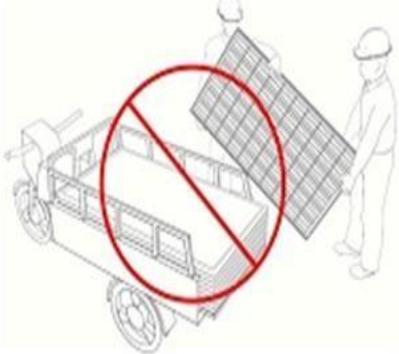
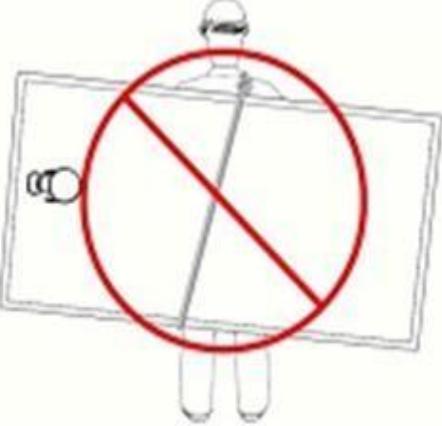


Forbidden to stack modules at the project site



Use rain cloth to cover the modules to prevent from getting wet

### 3.3 Second transportation and precautions

	<p>Do not remove the original packaging, if the modules need long-distance transportation or long-term storage,</p>		<p>The packaged products can be transported by land, sea, or air. During transportation: please fix the packing box on the transportation platform to ensure that the packing will not roll over. During normal truck transportation, up to 2 layers can be superimposed.</p>
	<p>Consignments at the project site, only 1 layer is allowed.</p>		<p>Prohibition of the transfer of incomplete modules on tricycles</p>
	<p>Do not use rope to carry modules</p>		<p>Prohibition of single to carry modules</p>

### 3.4 Storage

- Forbidden to be exposed to rain or moisture. Please place the packaged product in

a ventilated, rain-proof and dry place.

- If the module needs long-distance transportation or long-term storage, please do not remove it.
- Warehouse storage at the project site (humidity <85%; temperature: -20°C ~+50°C): 60 frame modules and 72 frame modules are statically stacked 2 trays



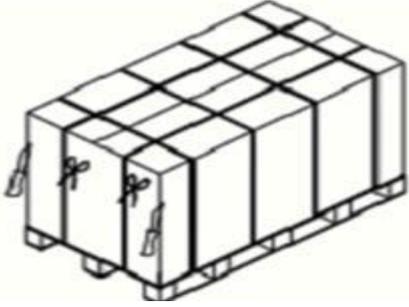
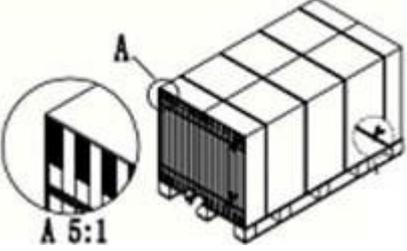
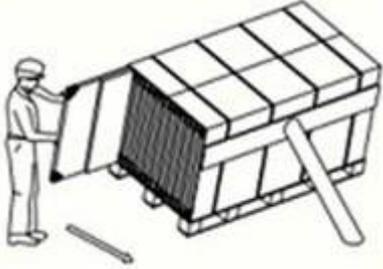
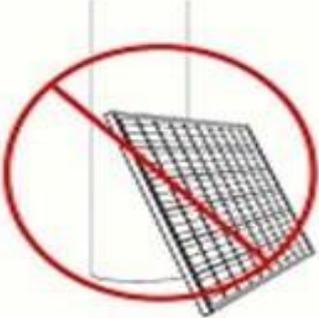
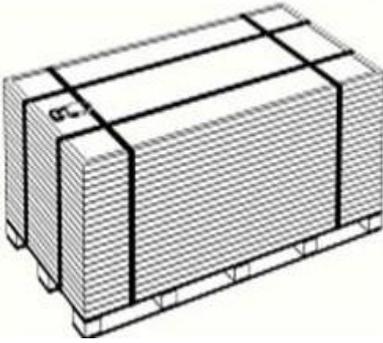
storage floor should be flat

## 4 Unpacking instructions

### 4.1 Unpacking and installation

- When unpacking outdoors, it is forbidden to work in rainy days. The carton will become soft and disperse after being exposed to the rain, the photovoltaic modules (hereinafter referred to as "modules") inside will fall out, causing damage or injuring people.
- If there is wind, you need to pay attention to safety, especially in the case of strong wind, it is recommended not to move the modules, and properly fix the unpacked modules.
- The working floor needs to ensure that the packing box can be placed horizontally and stably to avoid tipping.
- Please wear protective gloves during unpacking to avoid hurting your hands and leaving fingerprints on the glass surface.
- You can query module information and unpacking instructions on the outer packaging. Please read the unpacking instructions carefully before unpacking.
- Each module needs to be lifted by 2 people. When lifting the module, do not pull the junction box; do not grab the long side to take out the module.

## 4.2 Unpacking steps

	<p>Use a blade or scissors to cut the two straps on the short side of the tray, and cut the side carton in the vertical direction</p>		<p>Cut off the short-side tape, grasp the bottom edge of the cut cardboard and lift it 90°, and pull out the cardboard to expose the modules.</p>
	<p>Cut the upper and lower horizontal packing belts inside the carton, cut the two packing belts near the tray from the bottom of the tray, and take out the packing belt</p>		<p>If unpacking on a level ground, take out the modules one by one from one side of the package to the other, and two people carry it. If you unpack on a non-level ground, you need to take anti-tilting measures, as shown in the red part of the figure below..</p>
	<p>Forbidden to lean the module against the mounting post</p>		<p>If all the modules are not taken out after unpacking, put the remaining components flat and repack them to prevent from tipping over and place them horizontally. The number of modules stacked: 60 frame modules not more than 20pcs, 72 frame modules not more than 16pcs</p>

## 5 Site selection

- It is recommended to install solar modules with an optimized tilt angle to maximize energy output. In general, it is roughly equivalent to the latitude of the project location, facing the equator. However, in the actual design, always to find the best tilt angle according to the local conditions.

- When installing solar modules on the roof, the roof must be covered with a layer of fireproof material suitable for this level, and sufficient ventilation between the backplane and the installation surface should be ensured, with a safe work area between the edge of the roof and the outer edge of the solar array.

- If the residential facility is on the ground, the installation of modules should be carried out in accordance with local regulations, for example, fences are required for installation.

- Position the modules to minimize the possibility of shading at any time of the day.

- It is recommended that the module be installed in an environment where the working environment temperature is  $-20^{\circ}\text{C}\sim 46^{\circ}\text{C}$ , and the extreme working environment temperature of the module is  $-40^{\circ}\text{C}\sim 85^{\circ}\text{C}$ .

- Try to install the module in a location where there is rarely sunshade during the year.

- If you plan to use photovoltaic modules in a place where water damage may occur (humidity:  $>85\text{RH}\%$ ), please consult our technical support team to determine the appropriate installation method or whether it can be installed.

- If the module is installed in a place with frequent lightning activities, the module must be protected against lightning strikes.

- Do not install near flammable gas.

- The salt spray corrosion test results of photovoltaic (PV) modules carried out in accordance with the requirements of IEC 61701 show that our solar modules can be installed in corrosive salt-alkali areas near offshore or sulfite areas. The modules must not be immersed in water or long-term exposure to water (pure water or salt water) (such as fountains, waves, etc.). If the modules are placed in a salt spray (ie, marine environment) or an environment containing

sulfur (ie, sulfur sources, volcanoes, etc.), there is a risk of corrosion.

- At a place 50m~500mm away from the sea, stainless steel or aluminum must be used to contact the photovoltaic module, and the installation site must with anti-corrosion measures.

- The results of IEC62716:2013 "Ammonia Corrosion Test of Photovoltaic (PV) Modules" and DLG Fokus ammonia resistance test show that our solar modules can be safely installed in environments with heavy ammonia, such as farm buildings.

## 6 Angle selection

- The inclination measurement of photovoltaic modules refers to the angle between the module and the horizontal ground. There are different installation inclination angles for different projects. The recommended installation angle of the modules is not less than 10°, or according to local regulations or the recommendations of experienced photovoltaic module installers.

- Acquire the inclination angle of the PV module by measuring the angle between the PV module and the horizontal ground

- For installation in the northern hemisphere, the modules should better face south, and in the southern hemisphere, the modules better face north

- There should be a gap of at least 115mm (4.5 inches) (recommended) between the module frame and the wall or roof surface. If other installation methods are take, it may affect the UL certification or fire proof level.

## 7 Installation

Our frame series modules can be used for more than 25 years installed with the following conditions. Beside the required IEC and UL certifications, our products have been tested to verify their resistance to ammonia that may exist near the cowshed, and whether they are suitable for installation in humid (coastal) areas and areas with frequent sandstorms.

### 7.1 Installation safety

- Our solar modules can be installed horizontally or vertically, but the horizontal installation method can minimize the impact of dust on solar panels.

- Please use dry insulation protection measures: such as insulated tools, safety helmets, insulated gloves, safety belts and safety shoes (rubber soles).
- Do not wear metal ornaments during installation, so as not to puncture the modules and cause electric shock.
- Do not install the module under rain, snow or strong wind.
- Please keep the connector dry and clean during installation to avoid the risk of electric shock. Please install it immediately after unpacking.
- If the terminals of the PV module are wet, no work can be done to avoid electric shock. Please install it immediately after unpacking.
- The application level of the modules is Class A, which can be used in systems > DC 5V or 240W.
- Before installation, keep the PV modules in the carton.
- During the installation and wiring of PV modules, please use insulating materials to completely cover the surface of PV modules.
- If the system circuit is connected to the load, please do not unplug the connection plug.
- Do not stand on the glass during work, otherwise the glass may break and cause injury or electric shock.
- Do not work alone (always keep working in teams of 2 or more people).
- When fastening the PV module to the bracket by bolts, do not damage the backplane of the PV module.
- When replacing PV modules, do not damage the surrounding PV modules or installation structure.
- The cable should be fixed or tied up so that it will not be exposed to direct sunlight after installation, which can prevent the cable from aging. Leading out cables from under the junction box may cause various problems, such as leakage of electricity of water and cause fire.
- Do not install modules of different colors in the same array or roof.

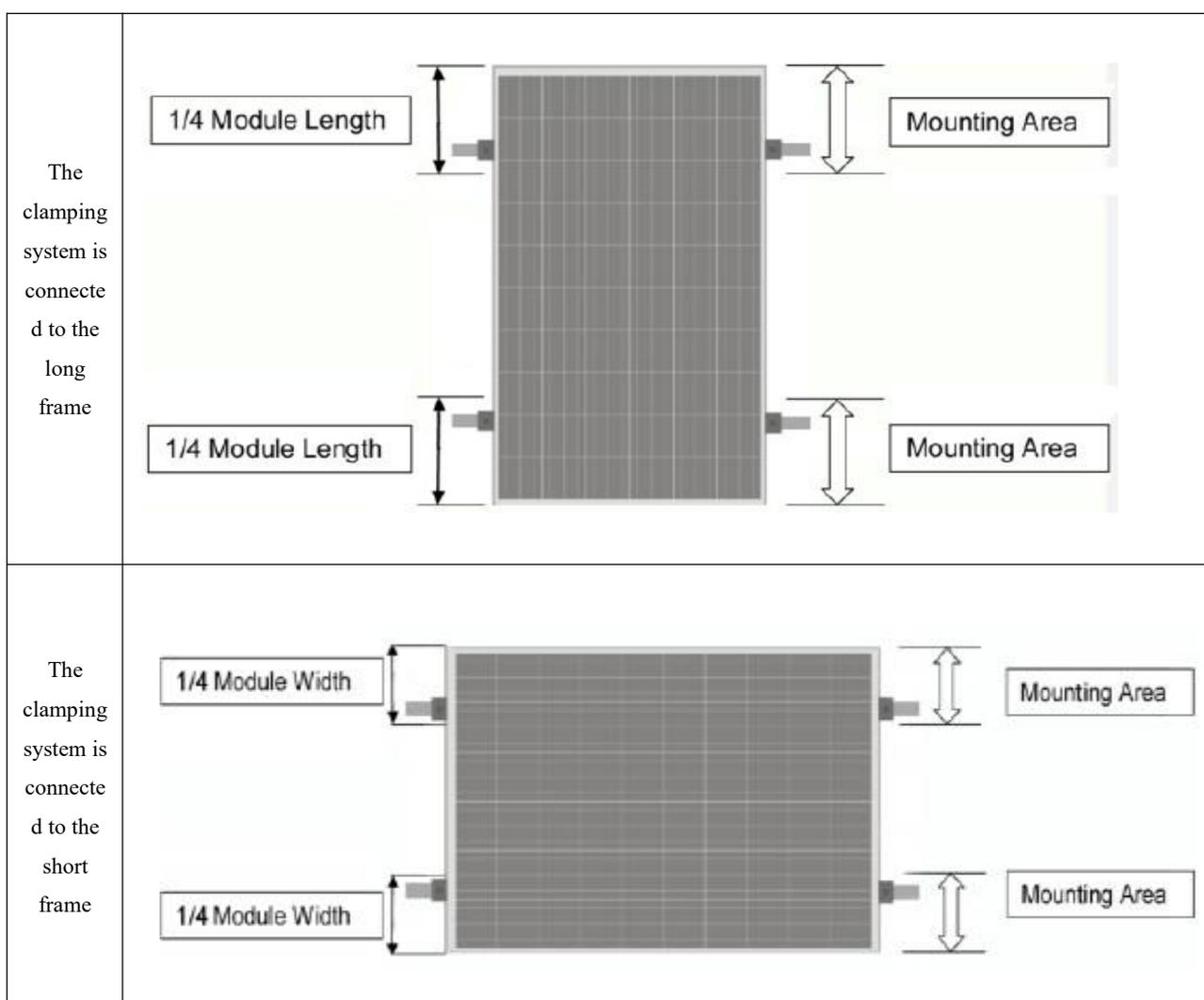
## 7.2 Installation method

### 7.2.1 Mechanical installation and precautions

The connection between the modules and the bracket system can be installed using mounting holes, clamps or embedded systems on the frame. The installation of the modules must be carried

out according to the following examples and suggestions. If the installation way is different from our company, please consult our technical support or after-sales service, and acquire our consent, otherwise the modules will be damaged and the warranty will be invalidated.

- The minimum distance between two modules is 10mm (0.4 inches)
- The baffle cannot withstand the impact of a snowstorm that exceeds the maximum allowable load, nor can it withstand the excessive force caused by the thermal expansion of the supporting structure.
- During installation or use, the drain hole should not be blocked under any circumstances.

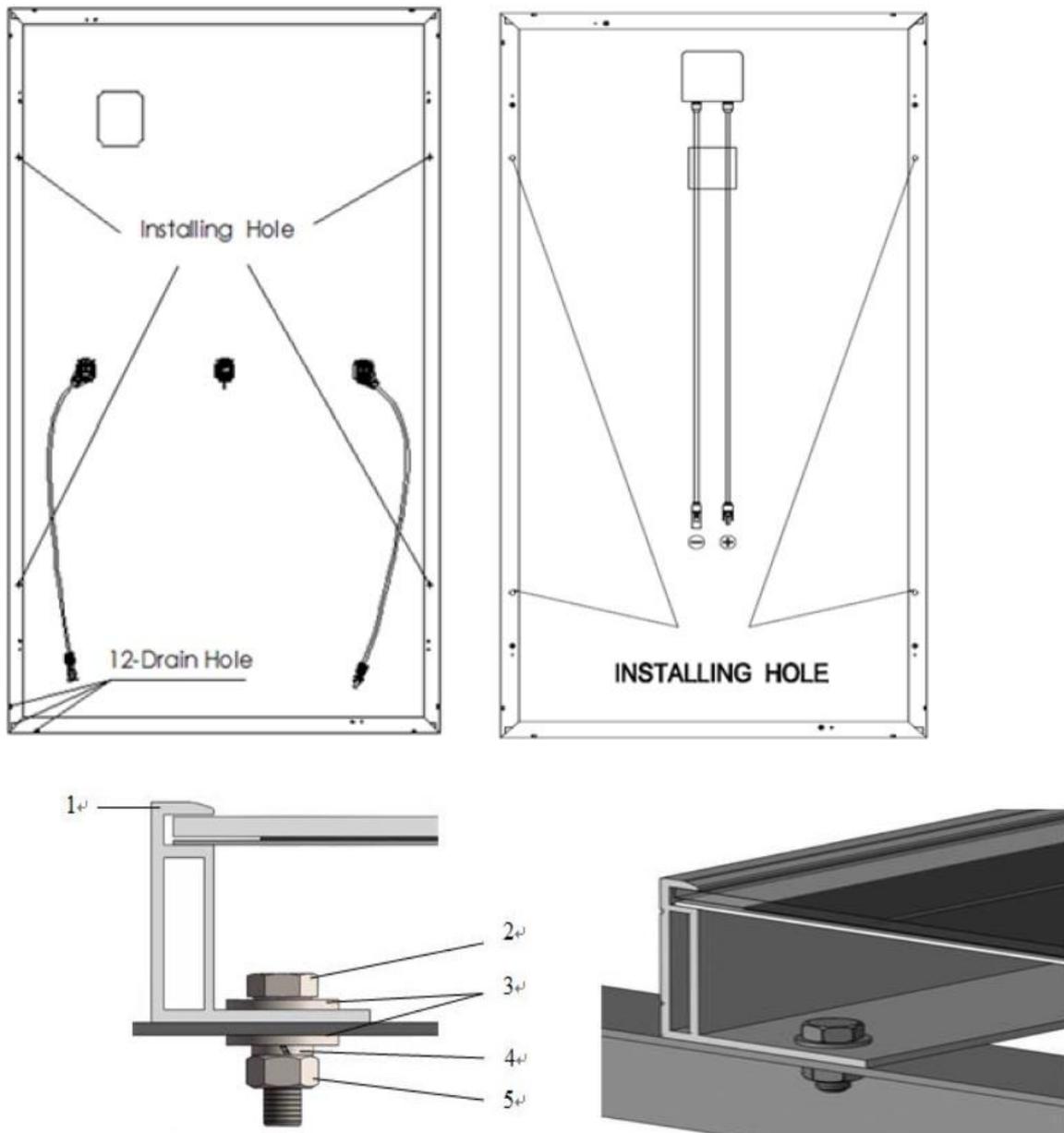


### A. Mounting hole installation

Use bolts to fix the module on the bracket through the mounting hole on the back frame of the module. The installation details are shown in the figure below. There are 4-9\*14mm mounting holes on the frame of each module, through which the module can be well fixed to the

supporting structure to optimize its load bearing capacity.

- In order to maximize the installation life, it is strongly recommended to use anti-corrosion (stainless steel) fixtures
- As shown in Figure 1, use M8 bolts, flat washers, spring washers and nuts to fix the modules at each fixed position and tighten them to a torque of 16-20 N.m (140-180lb.in).
- All parts in contact with the frame should use flat stainless steel washers with a minimum thickness of 1.8mm and an outer diameter of 20-24mm (0.79-0.94 inches).



1.PV modules installed using bolt embedding method

- 1— Aluminum frame
- 2— M8 Stainless steel bolt

- 3—Flat stainless steel washers
- 4—Spring stainless steel washer
- 5—Hexagonal stainless steel nuts

### B. Fixture installation

- After our company has tested its modules with different fixtures from many manufacturers, it is recommended to use a fixture with EPDM or similar insulating washers that can at least fix M8 bolts.

- The clamp must maintain an overlap of at least 7mm (0.28 inches) but not more than 10mm (0.39 inches) with the module frame.

- Use at least 4 clamps to fix the module on the mounting rail.

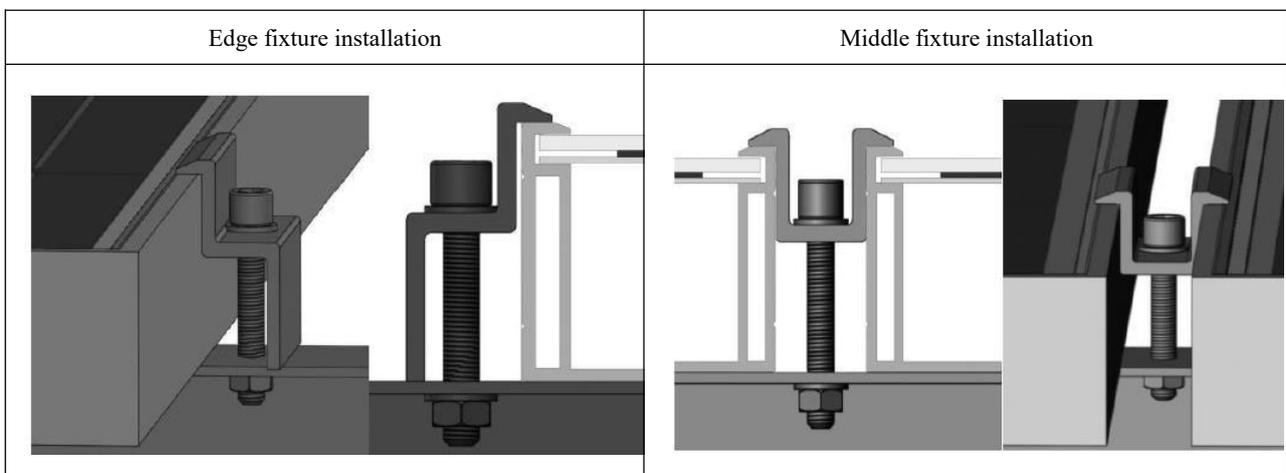
- The module fixture must not be in contact with the glass on the front side, and the frame must not be deformed.

- Be sure to avoid the shading effect of the module fixture.

- The module frame cannot be adjusted under any circumstances

- When choosing this type of fixture installation method, at least four fixtures are required on each module. Install two clamps on each long side (longitudinal) or each short side (horizontal) of the module. Depending on the local wind, snow and weather conditions, determine whether additional fixtures are needed to ensure that the modules can withstand the load.

- The applied torque should be determined according to the mechanical design standard of the bolt used by the customer, for example: M8----- 16-20N.m



### C. Single-axis tracking installation

This installation method is only used for 72 frame modules.

Single-axis tracking method: The module is fixed on the shaft by bolting the long frame.

There are 4-7\*10mm (0.28\*0.39 inches) mounting holes on the frame of each module.

The specific location is shown in Figure 3.

Use M6 bolts, two flat washers, a spring washer and a nut to fix the modules at each fixing position as shown in Figure 3.

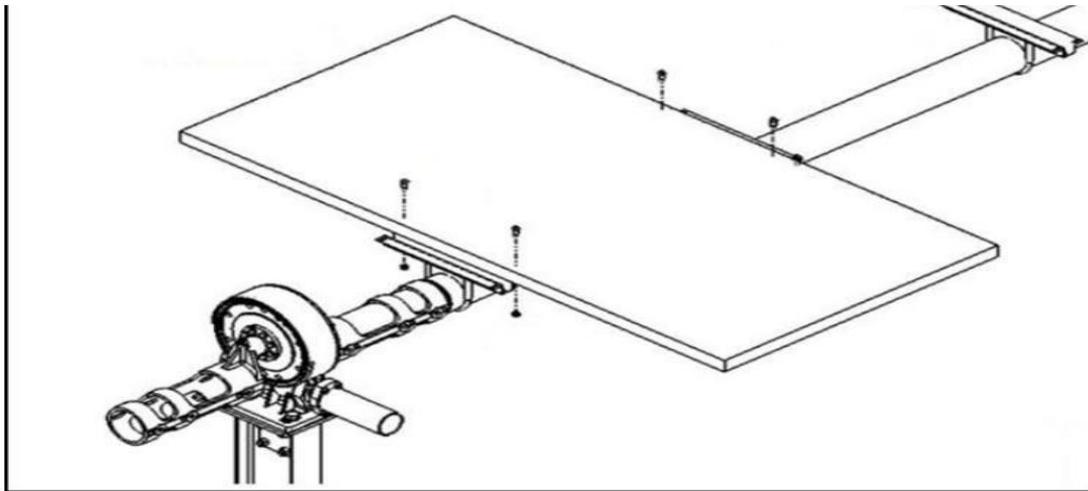
If other bolts similar to M6 are used, they need to be tightened with a torque of 9~12N.m. (80~120lb.in).

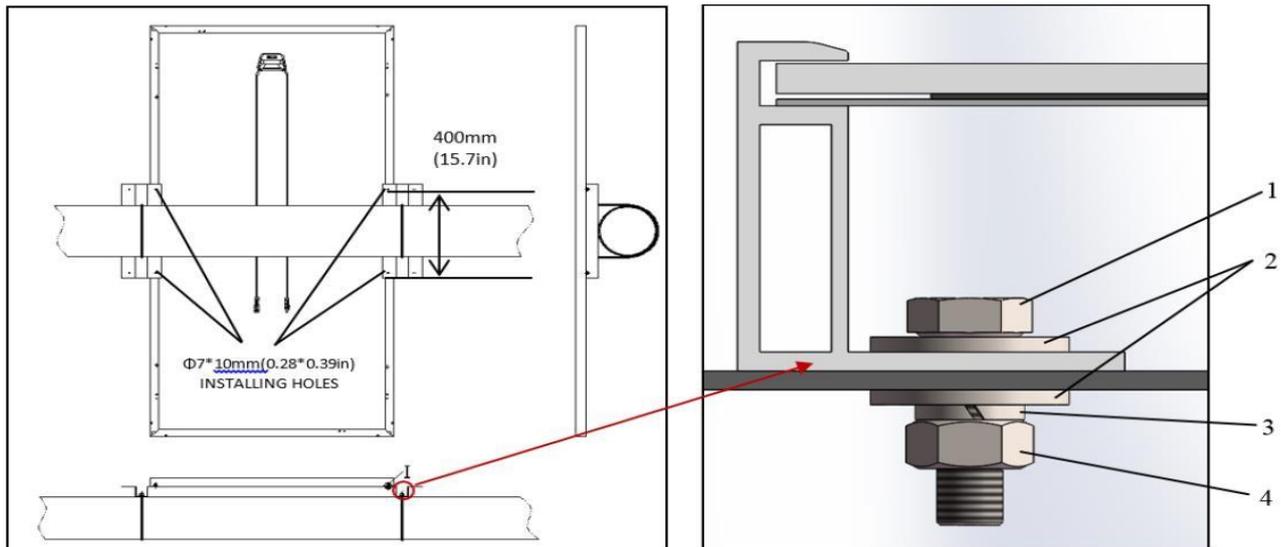
All parts in contact with the frame should use flat stainless steel washers with a minimum thickness of 1.5mm and an outer diameter of 16-20mm (0.63-0.79 inches).

The bolts should be made of stainless steel or other corrosion-resistant materials.

The mechanical load pressure installed by this method: According to UL1703, the maximum value of the front side is 2400Pa (snow),

The maximum value on the rear side is 2400Pa (wind).





PV modules installed by single-axis tracking

1—Stainless steel bolt    2—Flat stainless steel washers    3—Spring stainless steel washer  
4—Hexagonal stainless steel nuts

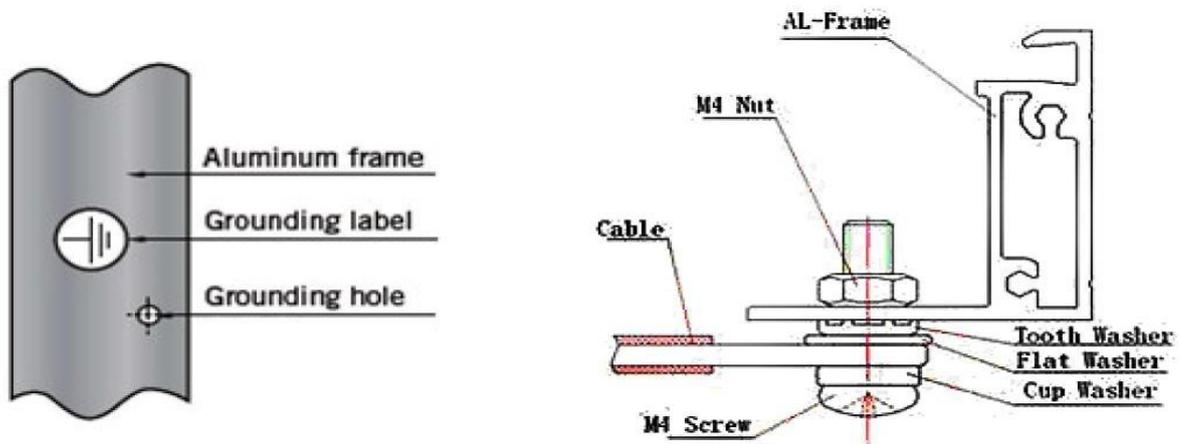
### 7.2.2 Grounded

All module frames and mounting frames must be properly grounded in accordance with the corresponding National Electrical Code. Connect the module frame and all metal structural parts continuously by using a suitable grounding conductor to achieve proper grounding. The grounding conductor or grounding wire can be copper, copper alloy or any other material used as an electrical conductor that meets the requirements of the corresponding "National Electrical Code". The grounding conductor must be connected to the earth through a suitable grounding electrode. You can use a third-party listed grounding device to ground the metal frame of the PV module. The equipment must be installed in accordance with the instructions specified by the grounding equipment manufacturer.

- All module frames and mounting brackets must be grounded. Use the recommended connection terminal to connect the grounding cable and fix it to the module frame.
- Use a support frame that has been electroplated to ensure good conduction.
- Use a suitable grounding conductor to connect the module frame and the supporting member to achieve a good grounding effect.
- The grounding conductor must be connected to the ground through a suitable ground electrode. It is recommended to use a grounding wire accessory (terminal lug) to connect the grounding cable. Solder the grounding cable into the socket of the lug,

then insert the M4 screw into the ring of the lug and the grounding hole of the module frame, and fasten it with a nut. A star-shaped spring washer should be used to prevent the screw from loosening and causing poor grounding. As shown in Figure 4

- The grounding resistance of modules must be less than 10 ohms.
- If the modules are used in a high-temperature and high-humidity environment, it is recommended that customers configure an inverter with an isolation transformer that can be negatively grounded



Grounding mark and screw connection on the module

### 7.2.3 Electrical Installation

- All wiring should be carried out by qualified installers in accordance with local regulations and procedures.
- The modules can be connected in series, and the working voltage can be increased by inserting the positive plug of one module into the negative socket of the next module. Before connecting modules, always make sure that the contacts are corrosion-free, clean and dry.
- If one set of arrays is connected to another with the opposite polarity, it will cause irreparable damage to the product. Before connecting in parallel, be sure to confirm the voltage and polarity of each column. If the measurement finds that the polarity between the columns is reversed or the voltage difference is greater than 10V, check the structural configuration before making the connection.
- Our solar modules use stranded copper cables with a cross-sectional area of  $4\text{mm}^2$  ( $0.006\text{in}^2$ ) suitable for rated parameters of 1000V D C and a temperature of  $90^\circ\text{C}$  and anti-ultraviolet rays. All other cables used to connect to the DC system should have similar (or higher) specifications. It is recommended that all cables should be laid in appropriate pipes and

away from places where water is easy to accumulate.

- Each module has two standard 90°C shading output cables and plug -and-play connectors are connected to each terminal. The type and specification of the output cable is a 1000V rated PV conductor cable with a cross-sectional area of 4mm<sup>2</sup>. This cable is suitable for the case where the wiring is directly exposed to the sun. Our company requires all wiring and electrical connections to comply with the requirements of the corresponding "National Electrical Code".

- The outer diameter of the cable ranges from 5 to 7mm (0.038~0.076 in2)

- For field wiring, use a copper wire with a temperature resistance of at least 90°C, ~~light~~ resistance, and a cross section of not less than 4mm<sup>2</sup> as the PV connection wire.

- The minimum bending radius of the cable should be 43mm (1.69 inches).

#### 7.2.3.1 Wiring

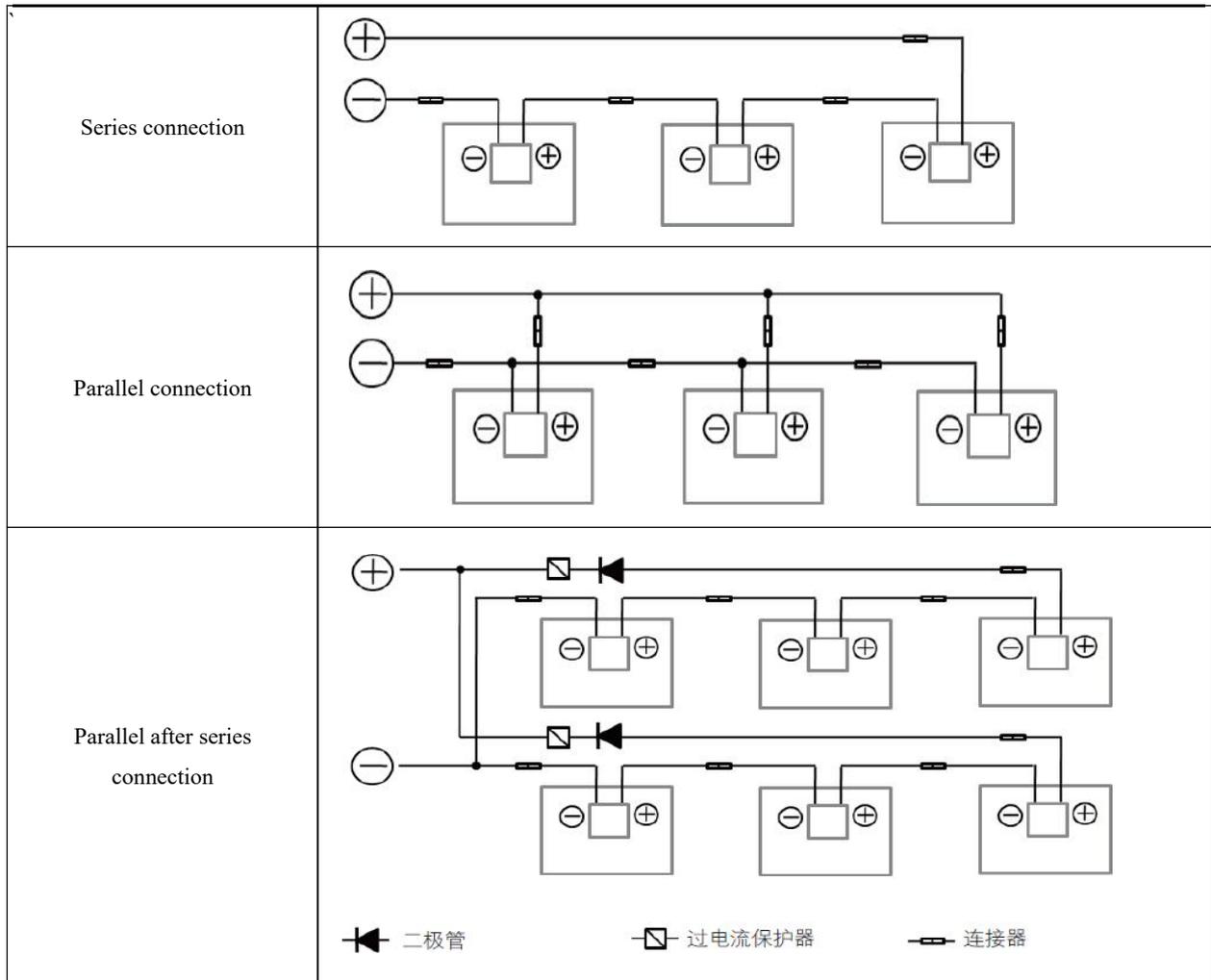
- In order to ensure the normal operation of the system, when connecting modules or connecting loads (such as inverters, batteries, etc.), observe to ensure that the polarity of the cable is connected correctly. If the modules are not connected correctly, the bypass diode may be damaged.

- PV modules can be connected in series to increase the voltage. The series connection is to connect the wiring from the positive terminal of one module to the negative terminal of the next module. PV modules can be connected in parallel to increase current. Parallel connection is to connect the wiring from the positive terminal of one module to the positive terminal of the next module.

- The number of modules in series and parallel must be designed reasonably according to the system configuration.

- Different types of modules cannot be connected in a string.

- After the modules are connected, the voltage is relatively high. It is strictly forbidden to directly touch the positive and negative poles of the modules at the same time, otherwise it will cause the risk of electric shock.



### 7.2.3.2 Fuse

- When installing the fuse, it should be rated for the maximum DC voltage and connected to each non-grounded electrode of the array (in other words, if the system is not grounded, the fuse should be connected to the positive and negative poles).

- The maximum rating of the fuse connected in series with the array is usually 15A, but the actual module-specific rating can be obtained on the product label and product data sheet.

- The rated value of the fuse also corresponds to the maximum reverse current that the module can withstand (when an array is shielded, the array will be loaded into other parallel module arrays to generate current), so it will affect the number of parallel connected arrays influences.

- It is forbidden to connect the fuse after two or more series are connected in parallel.

## 8 Maintenance of modules

### 8.1 Module visual inspection and replacement

Regular inspections should be made to see if the modules in the photovoltaic array are damaged. For example, the functional and safety failures of the modules such as broken glass, broken cables, damaged junction boxes, etc., must be replaced with modules of the same model.

- It is recommended to perform preventive inspections every 6 months, and do not replace components of modules without authorization. If electrical or mechanical performance inspection or maintenance is required, it is recommended that qualified professionals perform the operation to avoid electric shock or personal injury

- Remove all vegetation that may shade the solar array and affect its performance.
- Check whether the installed hardware is fastened in place.
- Check whether all the array fuses in each non-grounding electrode are working

properly.

- The modules must be replaced with the same type. Do not touch the live parts of cables and connectors. Appropriate safety protection devices (insulating tools, insulating gloves, etc.) should be used when handling modules.

- Use opaque material to cover the front surface of the module when repairing. Modules exposed to the sun will generate high voltage, which is extremely dangerous.

- The junction box of the photovoltaic module is equipped with a bypass diode, which minimizes the heating and current loss of the module.

- Do not try to open the junction box to replace the diodes, even if they fail.

- In systems using batteries, blocking diodes are usually placed between the battery and the PV module output device to prevent battery discharge at night.

- If the modules are damaged (glass broken or scratches on the backplane), they need to be replaced.

- Please pay attention to the safety precautions listed in the front of this manual.

- Wear cut-resistant gloves and other personal protective equipment during special installation.

- Before attempting to remove modules, be sure to isolate the affected array to prevent

current generation.

- Use the relevant disconnect tool provided by the supplier to disconnect the connector of the affected module.
- Replace damaged modules with new modules of the same type.
- Check the open circuit voltage of the array and verify whether the open circuit voltage of other arrays connected in parallel with it is within 10V.
- Close the circuit breaker again.

## 8.2 Connector and cable inspection

- Check all cables to verify that they are firmly connected; avoid direct sunlight and keep them away from areas with water.
- It is recommended to check the torque of terminal bolts and all aspects of wiring at least once a year. In addition, check whether the installed hardware is fastened in place. Loose connections can cause damage to the array.

## 8.3 Cleaning

The amount of electricity generated by the solar module is proportional to the light falling on it. The modules whose batteries are shaded produce relatively little energy, so keeping the modules clean is very important.

- The photovoltaic modules should be cleaned when the irradiance is lower than 200W/m<sup>2</sup>. It is not advisable to use liquids with large temperature differences to clean the modules;
- It is strictly forbidden to clean photovoltaic modules under weather conditions with wind greater than level 4, heavy rain or heavy snow;
- When cleaning with pressure water flow, the water pressure on the glass surface of the module must not exceed 700 kPa (14619.80 lb/ft), and the module is strictly forbidden to withstand additional external force;
- During the cleaning of photovoltaic modules, it is strictly forbidden to step on the modules, do not splash the back of the modules and cables, and clean the back of the modules. Ensure that the connectors are clean and dry to prevent electric shock and fire hazards; do not

use steam cleaners;

- The vegetation should be cut regularly to avoid vegetation covering the photovoltaic modules.

- When cleaning the modules, use a soft cloth, mild detergent and clean water. Take care to avoid severe thermal shock that may damage the modules. When cleaning the modules, ensure that the temperature difference between the water and the modules is not large.

- Use dry or damp soft and clean cloth to wipe photovoltaic modules, and it is strictly forbidden to use corrosive solvents or hard objects to wipe photovoltaic modules;

- There are oily dirt and other difficult-to-clean substances on the surface of the photovoltaic module. You can use conventional household glass cleaners; be careful not to use alkaline and strong acid solvents.

- When cleaning the back of the module, take care to prevent the cleaning fluid from leaking into the bottom layer of the material. Modules installed horizontally ( $0^\circ$  tilt angle) should be cleaned slightly frequently, because these modules will not have the "self-cleaning" function like those installed at  $10^\circ$  tilt angle or greater.

- If you are not sure whether you need to clear the array or section, first select a particularly dirty array to start.

- Measure and record the feedback from the inverter to the column current

- Clean all modules in the column

- Re-measure the feedback current of the inverter and calculate the improvement percentage after cleaning.

- The rear surface of the module usually does not need to be cleaned; however, when it is deemed necessary to clean it, all sharp objects that may cause damage or penetrate the base material should be avoided.

### 8.3.1 Water quality requirements

- PH: 5 ~7;

- Chloride or salt content: 0-3,000 mg/L

- Turbidity: 0-30 NTU

- Conductivity: 1500~3000 s/cm

- (TDS) Total dissolved solids: 1000 mg/L

- Water hardness: 0-40 mg/L
- Non-alkaline water must be used, softened water should be used when conditions are available

### 8.3.2 Inspection after cleaning

- Visually observe that the overall appearance of the modules is clean, bright and free of stains;
- Sampling check whether there is dust accumulation on the surface of the modules;
- There is no obvious scratch on the surface of the module;
- The cracking phenomenon caused by no one on the surface of the module;
- Whether the module bracket is tilted or bent after cleaning;
- Whether the module terminals are falling off, etc.;
- After the photovoltaic module is cleaned, complete the written record of the photovoltaic module cleaning.

### 8.3.3 Troubleshooting

If it fails to work normally after installation, please notify the installer immediately. It is recommended to perform preventive inspections every 6 months, and do not replace components of modules without authorization. If electrical or mechanical performance inspection or maintenance is required, it is recommended that qualified professionals perform the operation to avoid electric shock or personal injury

### 8.3.4. Disposal after the end of the life of the modules

Crystalline silicon photovoltaic modules have a lifespan of 25 years. After 25 years, photovoltaic modules will still have a certain amount of power and still generate electricity. When it needs to be dismantled and scrapped, please transfer it to a qualified company for disposal. Remember not to discard or disassemble it by yourself, which will cause environmental pollution and waste of resources. The main modules of scrap crystalline silicon photovoltaic modules: 3.101% silicon, 54.721% glass, 0.03% silver, 0.451% copper, 12.771% aluminum, etc. It can be seen that scrap crystalline silicon photovoltaic modules have a high Economic recovery value.