Installation manual of PV module

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1 Basic Information

1.1 Preface Introduction

The PV modules in this manual refer to the standard conventional PV modules manufactured and sold by our company, excluding special modules such as lightweight modules, 1.6mm+1.6mm dual-glass modules, etc.

This manual contains the information of installation and safe operation of PV modules (hereafter referred to as“module”).

All instructions should be read carefully before installation. Please contact our sales department for more information if you have any question.

The installer should be familiar with the mechanical and electrical requirement of PV system. The installer should comply with safety precautions listed in this manual and local law regulations when installing the modules.

According to IEC61730 standard, the safety class of solar module is class II; the fire protection grade of single glass solar module is class C, the fire protection grade of Dual-glass solar module is class C(refer to UL790).

1.2 Warnings

1.2.1 It requires specialized skills and knowledge for installation of solar photovoltaic systems. It should be operated by professional installation personnel who have qualified licensed.

1.2.2 When the modules are exposed to sunlight or other light sources, DC current is generated in the modules. At this time, if touching the electrical part of the modules, it may happen electric shock hazard.

1.2.3 The modules could be installed in outside environment, such as ground, roofs etc. Please refer to local laws and requlations before instaling modules and abide by reguirements on building fire protection.If the modules are installed on the roof, the roof should have a certain fire protection capability. It can consult the local construction department to decide the roof material. Do not use this module to replace the whole or partial roofs/walls of living buildings. The system designer or installer have responsible for reasonable support structure. When the module is installed on a bracket parallel to the roof or wall. The minimum gap between the module frame and the roof or wall is 10cm, and air circulation is

required to prevent damage to the wiring.

Different roof structures and installation modes wil affect fireproof performance of buildings. lmproper installation maylead to the risk of fire.When module catches fire, first cut off the inverter's power supply to prevent the fire from spreading.Personnel with adequate protective gear (including insulated boots and gloves rated for electrical safety) must disconnect the wires at the connection terminal of the burning module using a PV connector disassembly wrench.Evacuate all personnel immediately, notify the fire department, and activate emergency protocols.Before firefighters arrive, use dry chemical fire extinguishers or sand for fire suppression to contain small flames.

1.2.4 Do not disconnect any of the module connecters during work.

1.2.5 Do not disassemble modules or move nameplate or any adhesion parts of modules.

1.2.6 Do not place the modules near a supply/storage of combustible gases.

1.2.7 Do not use Artificially concentrated sunlight on the module. Do not expose the back of the module to sunlight for a long time.

1.2.8 Avoid dropping or covering on the modules. Do not tread, stand or walk on modules, because there is a risk of damage to the module and harm to person.

1.2.9 Avoid moving the modules by pulling cables or the junction box.

1.2.10 Keep children away from modules during transportation and installation.

1.2.11 Avoid wearing metal rings, bracelet, earrings, nose rings, lip rings or any metal accessories during transportation and installation of the modules. Do not touch electrical part of the modules by hand without any insulated protection. Use insulated tools which satisfy electrical requirement to connect electrical parts of the modules.

1.2.12 During transportation of the modules, please make sure that any impact and strenuous vibration should be avoid. The impact and strenuous vibration have possible to lead cracks of solar cell in the modules. When the modules arrive the destination, before installation, the module should be placed on the flat ground with protection which has ability to avoid moisture, wind, rain and snow. Please unpack carefully.

1.2.13 Avoid any damage of the glass of the module, which can protect the modules. Avoid any damage of the seal on the edge of the modules. Without seal protection, the modules have risk of destroy. The damage modules have risk of electric shock or fire. The damage module can't be repaired. If there is any damage on the modules, please replace the modules immediately.

1.2.14 In order to reduce the risk of electric shock or combustion, opaque material can be used to cover the front surface of the modules during installation.

1.2.15 Installers should make sure firm connections between the rack and PV module without loose connections.

1.2.16 The frame and support of all modules should be grounded correctly, according to "National Electrical Code".Adopt proper module accessories such as fuse, circuit breaker and grounding connector according to local regulations.

1.2.17 Do not clean the modules with corrosive chemicals.

1.2.18 It is possible to affect fire resistance of the house if roof-mounted. For roof application, the estimate of fire control level of module system should combine module and roof condition. Only correct installation, which accords to installation instruction, the fire resistance of module system is effective.

1.2.19 During the storage, transportation, installation and maintenance of modules, it is strictly prohibited to contact with any form of oil stain or corrosive chemical reagent.

1.3 Product Identification

1.3.1 Each module has a label on the back, generally containing following information: product type, weight, size, fuse current, the system max voltage, rated power measured under standard test conditions, rated current, rated voltage, open circuit voltage, short circuit current.

1.3.2 Serial Number and Bar Code Label: Each module has a unique serial number and bar code as a unique identifier,which is laminated inside the module permanently. This label can be normally found in the front side of its corners,and in the middle of the rear side of the module.

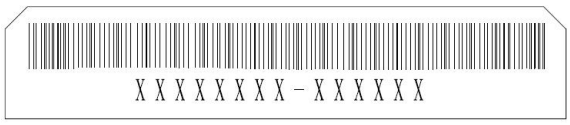


Figure 1 Bar Code

1.3.2.1 The barcodes of the conventional modules consist of 14 characters and underlines with unique module numbers, whose definition is as below: the first 8 characters are made up of factory code with 2 characters, date code with 3 characters and order serial number with 3 characters and followed by a dash. The 6 characters after dash are module production serial numbers. The module number of one work order cannot exceed 999,999 pieces.

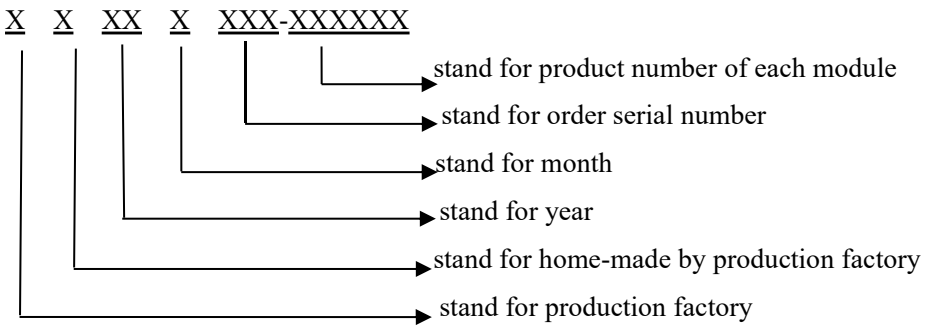


Figure 2 Bar code meaning

2 System Design

2.1 Climatic Conditions

2.1.1 Relative humidity: < 85%.

2.1.2 The operating temperature of the module is - 40 ℃ - 70 ℃.

Note: When calculating the mechanical load of modules (including the pressure of wind and snow), the installation method and installation site should be considered. The calculation of mechanical load must be carried out by professional personnel according to the design requirements of the system.

2.2 Location Selection

2.2.1 The maximum altitude for PV module is 2000m.

2.2.2 At standard test conditions (1000W / m² irradiance, AM 1.5 spectrum, 25 ° C (77 ° F) ambient temperature), the test error of module electrical performance parameters of modules, such as Isc, Voc, and Pmax, is ±3% for Pmax and ±5% for Voc and Isc.

2.2.3 In the northern hemisphere, it advises that the modules face to south direction. In the southern hemisphere, it advises that modules face to north direction.It is possible that modules installed with restricted airflow are not allowed for use in some hot locations, dependincon system design parameters. lnstallers should assess if the system design at a specific geographic location will resulin a 98th percentile module operating temperature’ greater than 70° c, and must consider and avoid these factors indesign of systems.

2.2.4 The tilt angle of the PV module is the angle between the surface of the PV module and a horizontal ground surface (as shows in Figure). The PV module generates maximum output power when it faces the sun vertically. It is recommended that the installation angle of the module is bigger than 10 degrees. If you want the specific information of the best install tilt angle, please consult reliable local photovoltaic system installation companies.

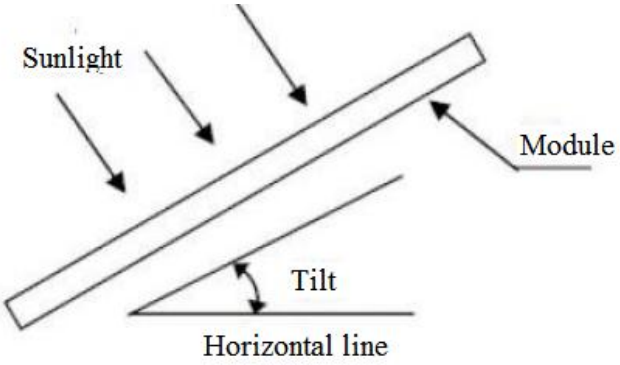


Figure 3 PV module tilt angle

2.2.5 The modules should be installed in the position where is full of sun exposure without shadow at any time.

2.2.6 The double-glass modules are suitable for installation on land located 50 to 500 meters from the seaside. However, when installing the modules within this distance range, relevant components such as connectors must be subject to appropriate anti-corrosion protection.

For installation within 50 meters of the coast, it is recommended to use floating photovoltaic modules. For further details, please contact local representative office.

2.2.7 When a storage battery is used in the photovoltaic system, the battery must be installed correctly. Therefore, it can protect the safety of photovoltaic system. The installation of the storage battery should follow the instructions of storage battery manufacturer.

2.2.8 It is recommended that the height of the module is 0.3-1m higher than actual environment.

2.3 Installation Inclination Angle Selection

2.3.1 PV modules connected in series should be installed in the same orientation and angle.

2.3.2 If connected to an independent photovoltaic system, the installation angle of the module should be based on the season and light conditions to achieve the maximum power output. At the lowest illumination intensity, if the power generated by module with certain angle can satisfy the lowest power generation, it is think that the modules with the certain angle can satisfy the power generation all year around. For grid-connected system, the installation angle of modules depends on the max power generation all year around.

2.4 Choose the Photovoltaic Support

The system designer or installer have responsible for calculation the system load to make sure all module can support the estimated load. The module support manufactures should supply qualitied module supports. The support, which is used for photovoltaic system, should has the third test institution certification about static mechanical analysis ability.

2.5 Choose the Photovoltaic Inverter

When choosing photovoltaic inverter, it needs consider the power, open-circuit voltage, short-circuit current of PV modules array. The minimum voltage of the module array should be higher than the threshold voltage of inverters to guarantee the inverters regular work.

2.5.1 Calculation of modules' number in series array

Please use the suitable equipment, connectors, wires and rack which match with solar power system. Please make sure the type of the modules is same in a single PV system. When determining rated voltage, wire capacity, fuse, the controller capacity and module output power of relevant parts of PV system, please accord to the short-circuit current (Isc) and open circuit voltage (Voc) showing on modules' label to determine suitable parameters.

In normal outdoor conditions, the current and voltage generated by module may be different from the parameters listed in Table. The parameter list in table is measured under standard test conditions (STC). In different outside climate surrounding, because of different power generation coefficient, the actual parameters, including rated voltage, wire capacity, fuse, the controller capacity and module power output, is different if modules working in different area. In order to get the actual module's electrical parameters, usually, the photovoltaic system designers or installers can use short-circuit current (Isc) and open circuit voltage (Voc) noted on modules' label multiply by 1.25 as a reference, consult your inverter/controller supplier for system configuration design. If the bifacial modules are installed at high reflective surrounding, the redundant value can increase suitably.

Please make sure the system voltage of each modules' array is lower than the maximum voltage of photovoltaic system, rated voltaic of inverter and controller. The system current of each modules' array is less than maximum current of photovoltaic system, rated current of inverter and controller.

The connection of modules: According to the system requirement of output voltage and current, modules are connected in series or parallel. The maximum number of modules in series (N) is equal to the number of the maximum system voltage (Vmax) divided by the open circuit voltage (Voc) of each module. The number of modules in parallel has relate to the parameters of electrical equipment (such as inverter and controller) in STC.

$$N \leq \frac{Vmax}{Voc * [1 + Tc(voc) * (Tmin - 25)]}$$

N Number of modules in series.

Vmax Maximum system voltage

Voc Open circuit voltage of each module(refer to product label or data sheet).

Tc(voc) Thermal coefficient of open circuit voltage for the module(refer to data sheet).

Tmin The lowest ambient temperature.

3 Installation

3.1 Installation Safety

3.1.1 Wear protective headgear, insulating gloves and rubber shoes when modules are installed.

3.1.2 During installation, avoid standing on the modules, which will lead to damage of modules, or hazard human safety. Avoid unnecessary touching of modules. The surface and frame of modules may be very hot, which may lead to burn or electric shock.

3.1.3 Don’t unpack the outside packing of modules except to install immediately. Avoid installing in rainy, snowy or windy weather.

3.1.4 In order to reduce hazard of electric shock, if the junction box connecters are wet, stop installing.

3.1.5 During installing, do not throw anything, including modules and installation tools.

3.1.6 Do not connect different connectors (brand and model) together. Please make sure connecting junction box correctly. Confirm that you hear a "click" to indicate that the connection is successful. Checking wiring status to ensure that all strong connection without broken. Take adequate measure to avoid any scratch which may damage the cables or pressure which may damage the module.

3.1.7 During installation or sunshine, avoid touching the junction boxes or connectors no matter what the modules are connecting with photovoltaic system or not.

3.1.8 Avoid pressing or putting something heavy on the module’s surface or distorting the module’s frame.

3.1.9 Avoid setting overweight things or hitting on the module’s surface glass, which may lead damage or microcrack of the solar cell.

3.1.10 Avoid cleaning the modules with sharp tools, which may lead to scratch on the surface of

modules.

3.1.11 Avoid digging holes on the module's frame without permission.

3.1.12 For BIPV or roof application, our company has special modules and installation instructions. If you need it, please contact us.

3.1.13Anti-tilting measures should be taken. It is prohibited to unpack on nonhorizontal or soft grounds to avoid personal injury or even death.

3.2 Modules Unpacking

3.2.1 When the modules arrival to destination, avoid unpacking modules in humid and rainy weather.

3.2.2 After unpacking, the modules should be placed horizontally. Avoid tilt, pressure, leaning on the wall of the modules.

No tilting No stacking No leaning on the wall

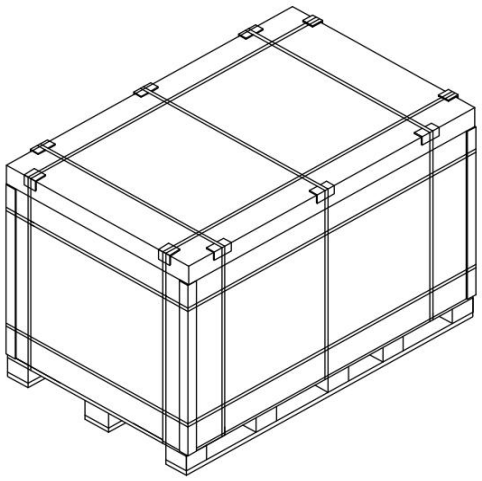
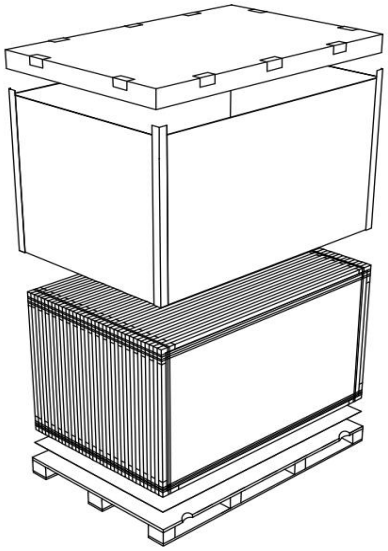
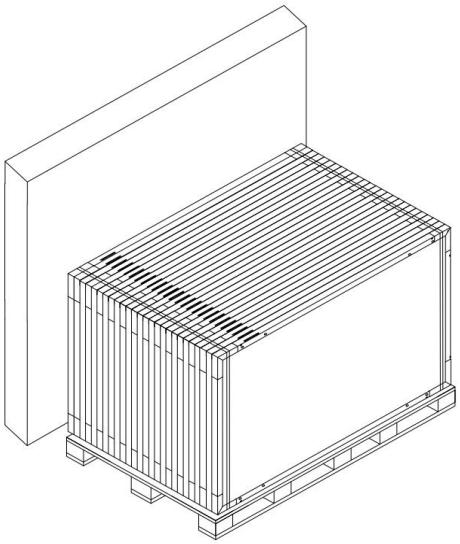
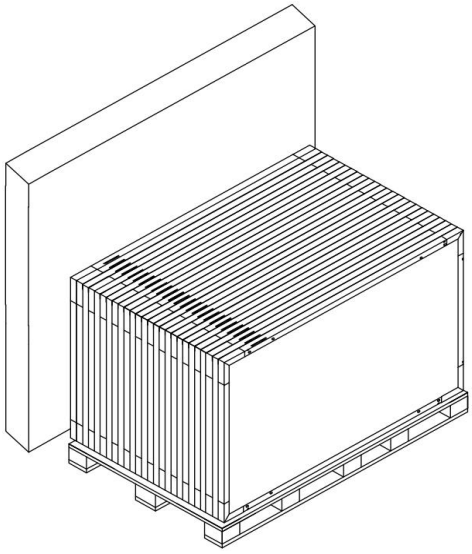
Figure 4 Modules stack illustration

3.2.3 The modules of two batches are separated and stacked neatly. Stacking of modules should be limited to no more than 16 modules and frames should be aligned with one another on the pile.

3.2.4 Unpacking process should follow the instructions as the figure below. Avoid rude operation or using crowbar to open the boxes. Pay attention to person and modules safety during unpacking.

3.2.5 After unloading, the modules' box should be placed on dry and flat ground, without wet, muddy and uneven ground condition.

3.2.6 After arriving the destination, the upper and lower modules' boxes should be separated and placed separately without stack. If the modules cannot be installed immediately, it should be care to protect the package of modules' boxes. Avoid any packing damage from natural disasters such as rain, snow, hail, typhoon, etc.Unpacking process(Horizontal type)

	
1. Remove the wrapping film and packing belts.	2. Remove the top cover and the cartons.
	
3. Find a stable support, cut the horizontal strapping, and slowly push the module to tilt at a suitable angle to the stable support, pay attention to the protection of the module frame and glass, etc.	4. Cut off the remaining packing belts, take out the modules in order.

Unpacking process(Vertical type)

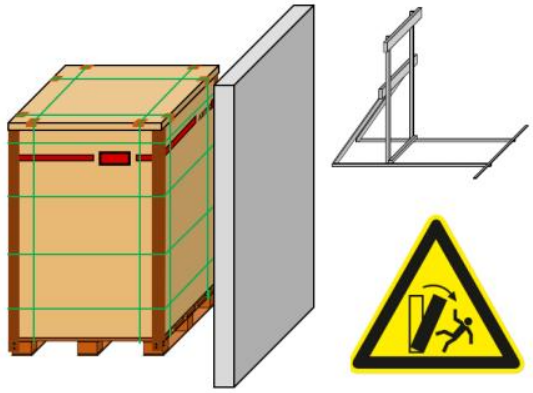
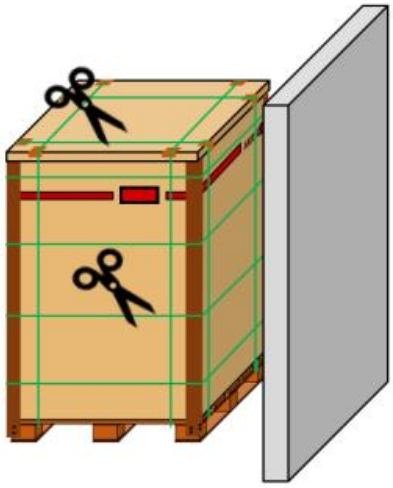
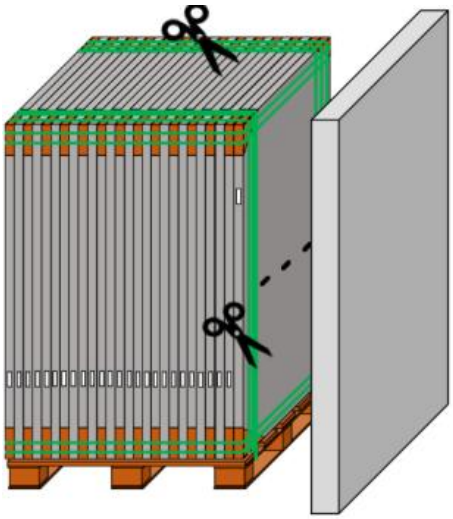
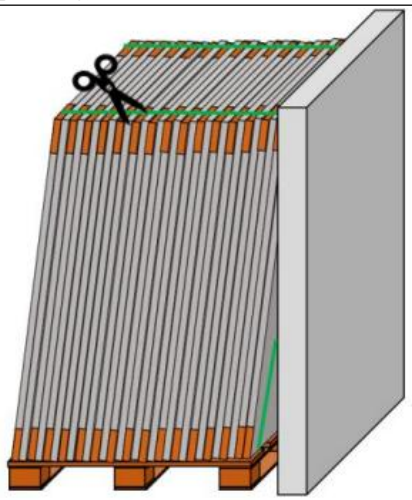
	
1. Place the pallet on a flat ground next to a solid wall or other support possibility.	2. Remove strapping and packaging box(There are velcro strips on the diagonal of the packing case to facilitate quick unpacking).
	
3. Remove strapping from modules(leave two straps on the module package, see next picture).	4. Lean the banded module package against the support / wall. Remove last strapping. Modules can be taken individually from the pallet.

Figure 5 Upacking process

3.3 Introduction of Installation Method

The modules can be installed in the following methods: bolt installation and clamp installation.

3.3.1 All installation methods described in this instruction are only for reference. Our company is not responsible for providing relevant installation parts, design and installation of module system. Mechanical loading and safety should be finished by a professional photovoltaic system installer or PV system technicians.

3.3.2 Before installation, the following important items need to be confirmed:

a) Before installation, it is necessary to check than if there is any defects or other foreign matter which is related with appearance and the safety performance of the junction box. If there is any problem, please solve the problem.

b) Please make sure that the serial number of the module is correct.

3.3.3 The applicable regulations pertaining to work safety, accident prevention and securing the construction site must be observed. Workers and third party personnel shall wear or install fall arrest equipment. Any third party need to be protected against injuries and damages.

3.3.4 The mounting design must be certified by a registered professional engineer. The mounting design and procedures must comply with all applicable local codes and requirements from all relevant authorities. Incorrect installation will void the limited warranty.

3.3.5 Use appropriate corrosion-proof fastening materials. All mounting hardware (bolts, spring washers, flat washers, nuts) should be hot dip galvanized or stainless steel.

3.3.6 Use a torque wrench for installation.

3.3.7 Do not drill additional holes or modify the module frame. Doing so will void the warranty.

3.3.8 Depending on local weather, such as wind and snow condition, additional clamps may be required to ensure that modules have enough support. (In case of severe environment such as storm and heavy snow, it is recommended to use extra clamps for installation. Please contact with our technical support for further information.)

3.3.9 The loads described in this manual correspond to test load. For installations complying with UL 61730 and IEC 61215-2, a safety factor of 1.5 should be applied for calculating the equivalent maximum authorized design loads(test load=1.5*design load). Project design loads depend on construction,

applicable standards, location and local climate. Determination of the design loads is the responsibility of the racking suppliers and/or professional engineers. For detailed information, please follow local structural code or contact your professional structural engineer.

3.3.10 Modules may have thermal expansion and contraction effects, and the spacing between adjacent modules during installation should not be less than 10mm.

3.3.11 The guide rail should not be directly under the junction box, it needs to avoid the junction box.

3.4 Installation of Bolts

Bolt installation method is only suitable for aluminum alloy frame modules.

These mechanical loads are based on IEC61215 standard certification or internal testing.

Modules should be bolted to supporting structures through the mounting holes in the rear frame flanges only.

Each module must be securely fastened at a minimum of 4 points on two opposite sides. According to the diagram below, spring washers, flat washers must be used. The size and thickness must be no less than the standard size of the national standard.

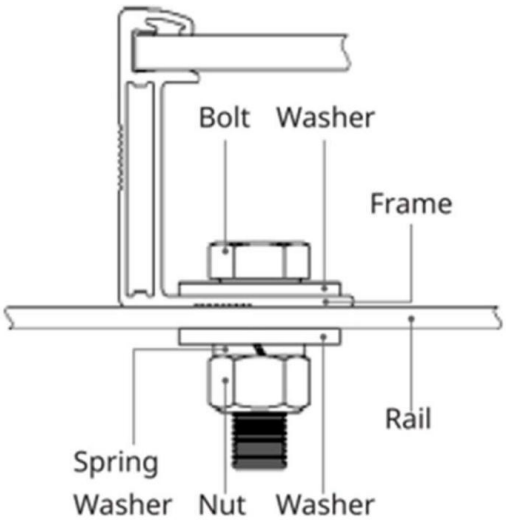


Figure 6 Schematic diagram

M8 × 1.25 - Grade 8.8 (5/16”-18 Grade B7) galvanized or A2-70 stainless steel bolt and nut should be used.

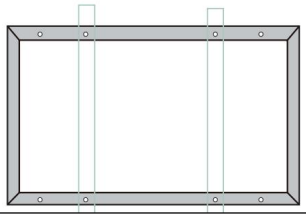
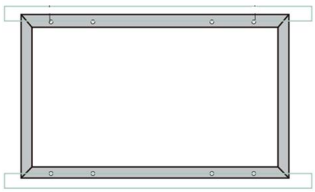
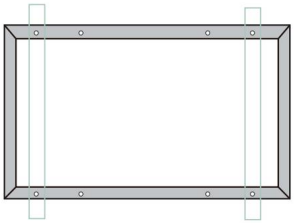
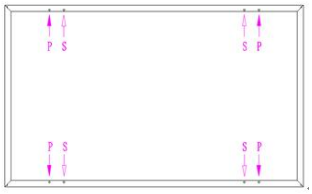
The yield strength of bolt and nut should not be less than 450MPa.

Tightening torques should be within 16~20 Nm (This is the reference value, and the applied torque

should refer to the mechanical design standards. Please consult the installer for specific torque values) for M8 (5/16”) coarse thread bolts, depending on bolt class.

In areas with heavy wind loads, additional mounting points should be used. The system designer and the installer are responsible for correctly calculating the loads and ensuring that the supporting structure meets all the applicable requirements.

Modules should be bolted at the following hole locations depending on the configuration and loads:

A: Inner four holes	B: Outer four hole method 1
	
C: Outer four hole method 2	D: Eight holes
	

Module Type	A: Inner four holes	B: Outer four hole method 1	C: Outer four hole method 2	D: Eight holes
HT32-18X(N)-265	+2400/-1800	N/A	+2400/-1800	+5400/-2400
HT48-210R(N)-440 HT48-210R(N)-450 HT48-210R(N)-460 HT48-210R(N)-475	+2400/-1800	N/A	+2400/-1800	+5400/-2400
High transparency HT40-18X(ND)-F-330 High transparency HT40-18X(ND)-330	+2400/-1800	N/A	+2400/-1800	+5400/-2400
High transparency HT48-18X(ND)-F-395 High transparency HT48-18X(ND)-395	+2400/-1800	N/A	+2400/-1800	+5400/-2400
High transparency HT32-18X(ND)-265	+2400/-1800	N/A	+2400/-1800	+5400/-2400

High transparency HT32-18X(ND)-F-265				
HT66-210(ND)-F-715 HT66-210(ND)-F-720	N/A	+2400/-2400	+5400/-2400	N/A
HT48-210R(ND)-F-440 HT48-210R(ND)-F-450 HT48-210R(ND)-F-455 HT48-210R(ND)-F-460 HT48-210R(ND)-F-465 HT48-210R(ND)-F-470 HT48-210R(ND)-F-475	+2400/-1800	N/A	+2400/-1800	+5400/-2400
HT72-18X(ND)-F-600	+2400/-1800	N/A	+2400/-1800	+5400/-2400
HT60-210R(ND)-F-565	+2400/-1800	N/A	+2400/-1800	+5400/-2400
HT66-210R(ND)-F-625	+2400/-1800	N/A	+2400/-1800	+5400/-2400

The above inner and outer holes do not include installation holes for installation of single-axis tracking system.

3.5 Installation of Clamps

The clamps installation method is suitable for aluminum alloy frame modules and composite frame modules.

These mechanical loads are based on IEC61215 standard certification or internal testing.

Each module must be securely fastened at a minimum of four points on two opposite sides. The clamps should be positioned symmetrically. The clamps should be positioned according to the authorized position ranges defined in table below.

Under no circumstances should the fixture come into contact with glass or deform the module's frame. The torque applied during fixture installation should be large enough to firmly secure the module. The applied torque should refer to mechanical design standards and depend on the bolts used by the customer (please consult the installer or support supplier for specific torque values), such as:

M8-16-20 N · m (reference value).

When installing inter-modules or end-type clamps, please take the following measures into account:

1. Do not bend the module frame.

2. Do not touch or cast shadows on the front glass.

3. Do not damage the surface of the frame (to the exception of the clamps with bonding pins).

4. Ensure the clamps overlap the module frame by at least 10 mm (0.4 in).

5. Overlap in length by at least

a) 80 mm when 2400 Pa < uplift load is required.

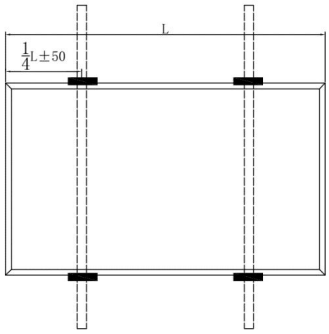
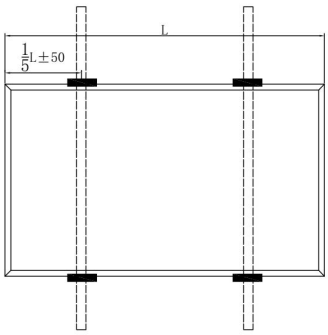
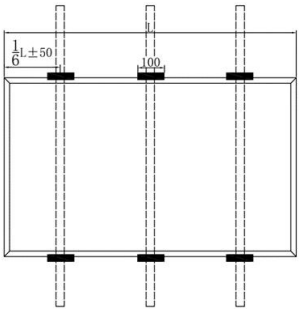
b) 60 mm when uplift load ≤ 2400 Pa is required.

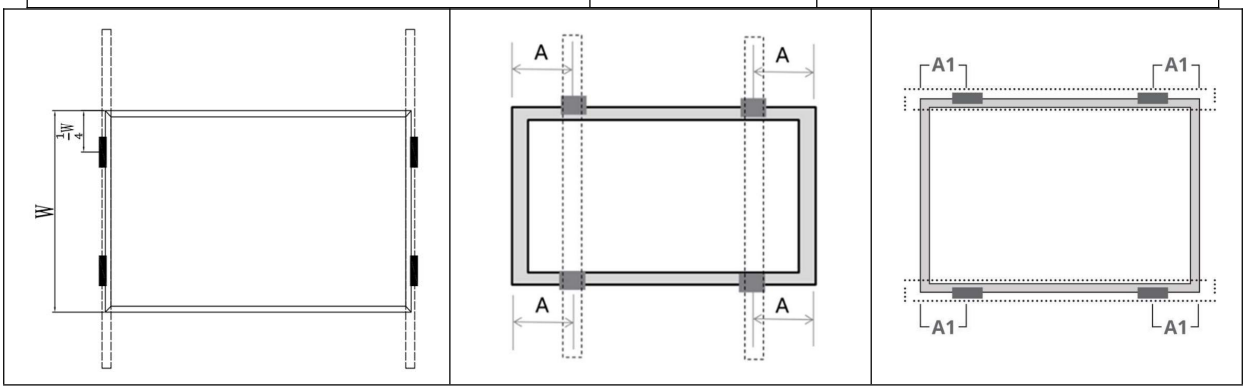
6. Ensure the clamp thickness is at least 3 mm (0.12 in). Clamp material should be anodized aluminum alloy or stainless steel.

Clamp positions are of crucial importance for the reliability of the installation. The clamp centerlines must only be positioned within the ranges indicated in table below, depending on the configuration and load.

For configurations where the mounting rails run parallel to the frame, precautions should be taken to ensure the bottom flange of the module frame overlaps the rail by at least 15 mm.

Improper clamps or unsuitable installation methods will void the limited warranty.

A: long side with 4 clamps 1/4L	B: long side with 4 clamps 1/5L	C: long side with 6 clamps 1/6L
		
D: short side with 4 clamps 1/4W	E：long side with 4 clamps method 1	F：long side with 4 clamps method 2



L is the length of PV module. W is the wide of module. The black shadow is the area of installation.

Module Type	A: long side with 4 clamps 1/4L	B: long side with 4 clamps 1/5L	C: long side with 6 clamps 1/6L	D: short side with 4 clamps 1/4W
HT32-18X(N)-265	+5400/-2400	N/A	N/A	+2400/-2400
HT48-210R(N)-440 HT48-210R(N)-450 HT48-210R(N)-460 HT48-210R(N)-475	+5400/-2400	N/A	N/A	+2400/-2400
High transparency HT40-18X(ND)-F-330 High transparency HT40-18X(ND)-330	N/A	+3600/-2400	+5400/-2400	N/A
High transparency HT48-18X(ND)-F-395 High transparency HT48-18X(ND)-395	N/A	+3600/-2400	+5400/-2400	N/A
High transparency HT32-18X(ND)-265 High transparency HT32-18X(ND)-F-265	N/A	+3600/-2400	+5400/-2400	N/A
HT48-210R(ND)-F-440 HT48-210R(ND)-F-450 HT48-210R(ND)-F-455 HT48-210R(ND)-F-460 HT48-210R(ND)-F-465 HT48-210R(ND)-F-470 HT48-210R(ND)-F-475	+5400/-2400	N/A	N/A	+2400/-2400
HT72-18X(ND)-F-600	+5400/-2400	N/A	N/A	+2400/-2400
HT60-210R(ND)-F-565	N/A	+3600/-2400	+5400/-2400	N/A
HT66-210R(ND)-F-625	N/A	+3600/-2400	+5400/-2400	N/A

Module Type	E：long side with 4 clamps method 1	F：long side with 4 clamps method 2
HT66-210R(ND)-F-715 HT66-210R(ND)-F-720	+5400/-2400 A range（450-550）	+2800/-2400 A1 range（400-500）

3.6 Installation of Single-axis Tracking System

Some modules have installation holes on the frame, which use for installation of single-axis tracking system. These installation holes, including normal holes and single-axis tracking holes, is good for press distribution and achieve strong support structure. With help of installation holes on the aluminum frame of the module, bolts can be used to connect module and support. The detail of installation is showed in follow figure. Use M6 bolt and flat washers, spring washer and nut for connection between modules and supports. Tighten the bolts until the torque reach 16-20N.m (This is the reference value, and the applied torque should refer to the mechanical design standards. Please consult the installer for specific torque values). The modules connected with single-axis tracking system needs special stainless-steel washers with a minimum thickness of 1.5mm and an external diameter of 16-20mm. In this install method, the maximum payload of the front is 1800pa, the payload of the back is 1800pa.

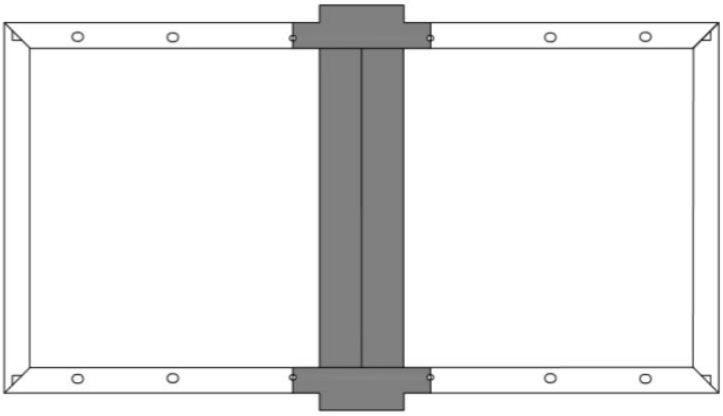


Figure 7 Installation diagram of module with single-axis tracking system

4 Electrical Connection

4.1 Precautions for Electrical Connection

4.1.1 Please read the electrical wiring drawings carefully before wiring. The wiring should accord to local law and program and be operated by certificated electricians. The maximum voltage of the system must be lower than the maximum certified voltage and the maximum input voltage of the inverter and other electrical devices installed in the system.

4.1.2 The connection between module and junction box: the module is connected with junction box by the dc cable. The cross-sectional area of cable and the connector capacity must be satisfied with the system's short circuit current. use single-conductor cable listed and labeled as PV wire which is 90°C wet

rated and single conductor cable with a cross section area of at least 4 mm² (12 AWG), 90°C wet rated in other areas (i.e. IEC 62930: 2017 approved), with proper insulation which is able to withstand the maximum possible system open-circuit voltage. Only copper conductor material should be used. The cable's cross-sectional area for a single module is recommended to be 4mm^2 at least. Please refer to the corresponding datasheet for the fuse current. The correction factor of a fuse shall be determined by an authorized professional electrical engineer in accordance with the relevant design regulations and system simulation results. The maximum series fuse rating value provided by our company is for reference only. We do not responsible for determining the minimum rating of fuse. Otherwise, the cables and connectors will overheat due to high current. Please note that the highest temperature of cable is 90 ℃, and the highest temperature of connector is 125 ℃.

4.1.3 The aluminum frame and support of the module must be grounded, as shown in Figure. Each module has a grounding hole and is marked on the frame (it is recommended that the series / parallel connection of each module must be grounded once). The installation method of grounding bolt is shown in FIG. 10. The grounding wire and frame can be reliably grounded by the prepared grounding hole. And the flat washers, spring washers and nuts are matched by installing bolts M5 × 10 ~ 15. The modules and the earth wire shall be perfectly connected by connecting plugs. Negative grounding inverter can be installed to prevent PID phenomenon.

In principle, the composite frames and support of the module do not need to be grounded. If grounding is required for local regulations or industry regulations, please refer to the grounding method of the aluminum frame and support of the module.

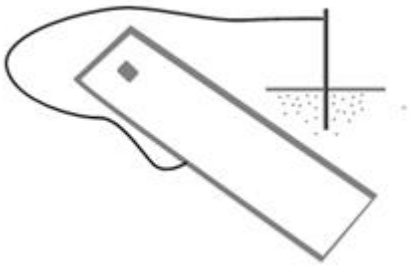


Figure 8 Module grounding circuit

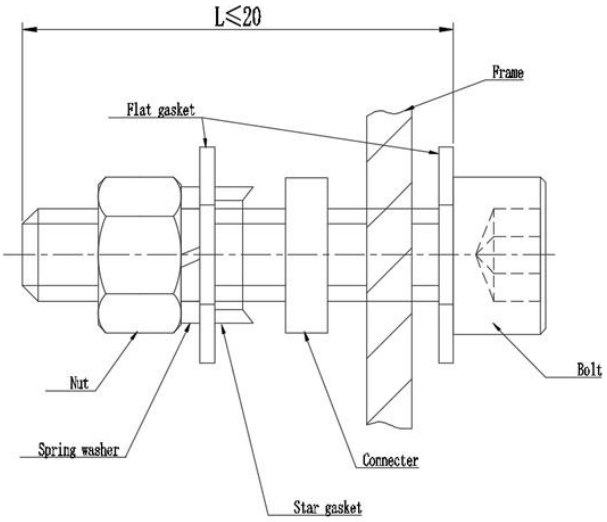


Figure 9 Installation diagram of grounding bolt

4.1.4 Common hardware parts, such as nuts, bolts, star washers, lock washers, flat washers, are used for grounding/connecting. The installation of such hardware parts should comply with instructions of manufacturers.

4.1.5 The common grounding parts, such as nuts, bolts, star washers, lock washers, which have not been evaluated for electrical conductivity, are only to use for mechanical connection. And the grounding parts of the module should keep suitable conductivity. These grounding parts, which supply the evaluation of UL 1703 as the same as modules, can use for module's installation according to installation instruction.

4.1.6 The electrical connection shall conform to local electrical laws and regulations. Avoid "Y" type electrical connection mode in module system electrical connection.

4.1.7 Modules are equipped with bypass diodes.Their wiring method cannot be changed.

4.1.8 If the modules unpack without installation immediately, please protect module connectors in order to avoid damage due to wind or rain. Avoid lubricant on module's connectors. The connector needs to be properly secured in a suitable location after the module is installed.The connectors shall not be placed on the roof or other places that are easily exposed to sunlight or rainwater.

4.1.9 Avoid removing the waterproof rubber rings out from the junction box or connectors.

4.1.10 Avoid using diesel oil to keep warm in installation site, because the gas generated by diesel oil or other petroleum products may destroy module's connector.

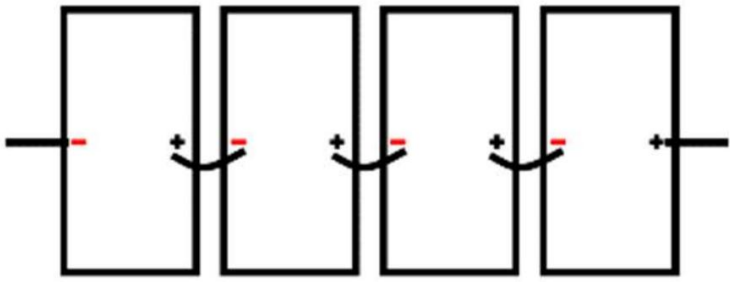
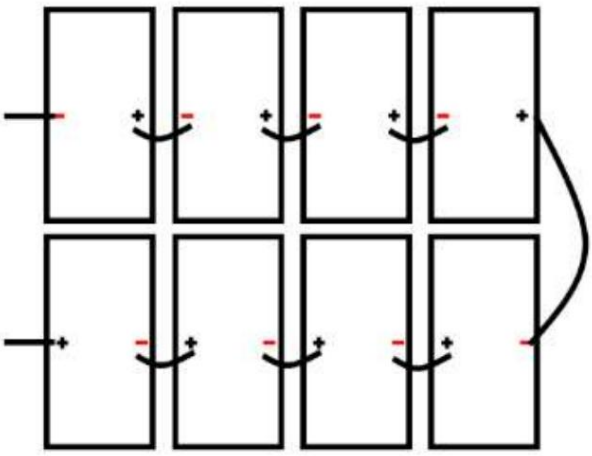
4.1.11The minimum bending radius cables should be 43mm.

4.2 Wiring and Connections

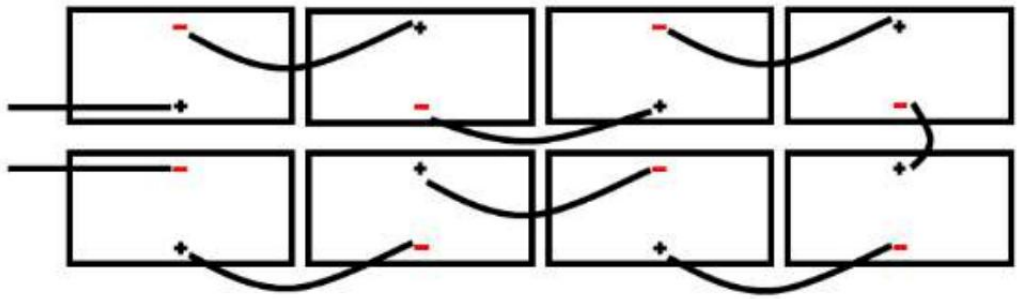
Ensure that the wiring is correct before starting up the system. If the measured open circuit voltage (Voc) and short-circuit current (Isc) differ from the specifications, this indicates that there is a wiring fault.

When modules have been installed, but the system has not been connected to the grid yet, each module string should be kept under open-circuit conditions and proper actions should be taken to avoid dust and moisture penetration inside the connectors.

Recommended wiring method：

Single Portrait Installation

Double Portrait Installation

Landscape Installation

（Need to customize cable length or add extension cable）



When modules are in series connection, the string voltage is sum of every individual module in one string. When modules are in parallel connection, the current is sum of the individual module. Modules with different electric performance models can not be connected in one string.

If there has reverse current exceeding the maximum fuse current flowing through the module, use overcurrent protection device with the same specifications to protect the module. If quantity of parallel connection is more than 2, there must be an overcurrent protection device on each string of module.

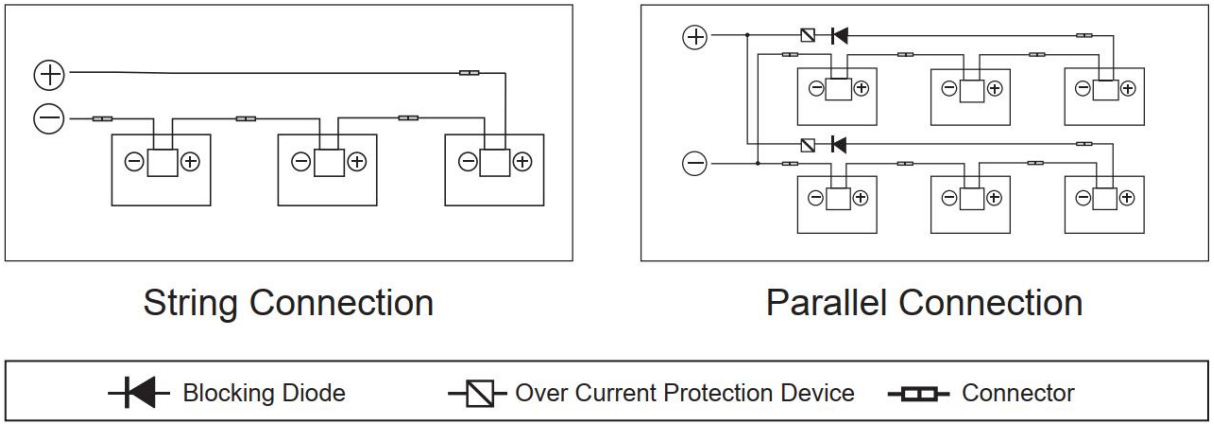


Figure 10 Series connection and parallel connection circuit diagram

HT-SOLAR does not guarantee the safety of products and technical parameters consistency if the connecting heads and tools used are not officially specified by HT-SOLAR or are not installed according to the official requirements.

Before the commissioning and operation of the power station, verify the electrical connection of modules and strings,ensuring all connections and polarities are correct, and the open circuit voltage meets the reguirements of the acceptance criteria. lncorrect connections may lead to electric arc and electric shock, Please always check that all.

electric connections are reliable and that all connectors are fully locked.

Open the combiner box of the control system and connect the conductor from the PV arrays to the combiner box in accordance with the design and local codes and standards.Three split junction boxes (see in figure 11) with lP68 installed in HT-SOLAR modules provide the necessary safety protection for cable and wiring connections, including contact protection of non-insulating electric parts.The length of each junction box is given at the component specifications.

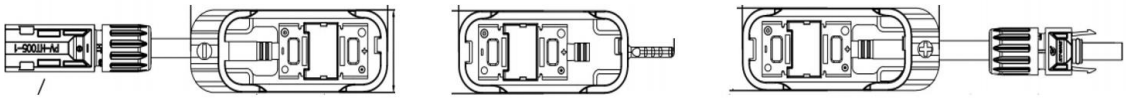


Figure 11 module junction box

Prohibit modules, junction boxes and connectors from coming into contact with unapproved chemicals: e.g., petrol,oil, acetone, alcohol, film strippers, potting compounds, TBP, cleaning agents, herbicides, rust inhibitors, descaling agents, etc. For more information, please contact HT-SOLAR technical support department.

After the modules are taken out of the box and installed, the connectors between the modules need to be connectedin time and kept in a dry and clean condition to prevent the ingress of pollutants such as dust and water vapor.

In areas with heavy dust, high salinity, or severe pollution, dust plugs must be installed on the connectors to prevent contamination before the connectors are mated. Prior to purchasing the modules, it is necessary to communicate with HT-SOLAR about the project site conditions to ensure the provision of dust plugs. However, please note that the exposure time of dust plugs to the environment should not exceed one month.

In the case modules are installed within 50m to 500m from the seashore, the connectors shall be protected, i.e.adding dust plugs. After removing the dust plugs, connect the connectors immediately and take other anti-rust measures to prevent rust. Offshore PV modules are recommended if installation within 50 metres is required, please consult HT-SOLAR for details.

Before connecting the male and female connectors, ensure that the contacts are free of corrosion, clean, and dry and check the wiring status. When connecting, insert the male and female connectors until

they engage, then gently pull to check if the engagement is secure. The correct/incorrect engagement visual diagram is shown in Figure 12 (for reference only; the actual connectors shall be based on the ones received on-site).

Figure 12: Schematic Diagram of Correct/Incorrect Engagement of Connectors

HT-SOLAR does not guarantee the safety of the product or the consistency of the technical parameters if the connectors and tools used are not officially designated by HT-SOLAR or are not installed according to specifications.After connection, connectors should meet the lP68 (lEC60529) reguirements, but long-term use underwater is prohibited.

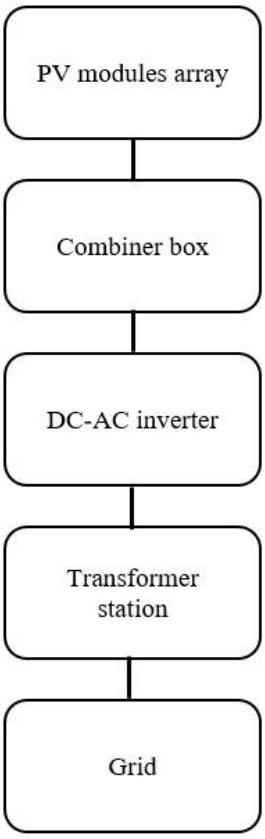
The following table shows the connector manufacturers and models that can be used by our company.

Object	Manufacturer	Type
Connectors1	Shanghai Aerospace Automobile Electromechanical Co., Ltd.	PV-HT005-1
	Stäubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR; PV-KBT4-EVO 2/xy_UR PV-KST4- EVO2A/xy; PV-KBT4-EVO2A/xy
Connectors2	QC Solar (Suzhou) Corporation	QC4.10-cd
	Changzhou Greateen New Energy Technology Co., Ltd	GT4
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR; PVKBT4-EVO 2/xy_UR PV-KST4- EVO2A/xy; PVKBT4-EVO2A/xy
		PV-KST4/xy-UR; PV-KBT4/xy-UR
	Jiangsu Runergy New Energy Technology Co., Ltd.	RY01
Connectors3	Amphenol Technology (Shenzhen) Co., Ltd.	UTXCFabcde; UTXCMabcde (a=A, b=4, c=A, d=A to Z, e=Blank

		or A or Z)
	Stäubli Electrical Connectors AG	PV-KST4-EVO 2/xy; PV-KBT4- EVO2/xy
	Changshu Tlian Co., Ltd.	T4-PPE-1
Connectors4	Haiying New Energy Technology (Kunshan) Co., Ltd.	HYG-01x
	Stäubli Electrical Connectors AG	PV-KST4-EVO 2/xy; PV-KBT4- EVO2/xy
Connectors5	Taizhou Chuangda Electronic Co., Ltd	PV-TT02 (TT02)
	Stäubli Electrical Connectors AG	PV-KST4- EVO2/6II-UR; PV-KBT4- EVO2/6II-UR
	QC Solar Corporation	QC4.10-351
Connectors6	Zerun Co., Ltd.	Z4S-abcde
	Stäubli Electrical Connectors AG	PV-KST4-EVO 2/xy_UR; PV-KBT4-EVO 2/xy_UR ; PV-KST4- EVO2A/xy; PV-KBT4-EVO2A/xy

4.3 Structure of PV station

The following figure shows the structure of a simple PV station. The mounting design must be certified by a registered professional engineer. The mounting design and procedures must comply with all applicable local codes and requirements from all relevant authorities.



5 Maintenance

The modules need to be inspected and maintained regularly by qualified personnel only, Wearing safety protection articles. including visual inspection and all electrical connections to ensure that there is stable connection without any broken.

If the components of the modules (diodes, junction boxes, connectors, etc.) are not replaced without authorization, it is recommended to replace the entire modules.

Do not make modifications to any component of the PV module (diode, junction box, connectors or others).

Regular maintenance is required to keep modules clear of snow, bird droppings, seeds, pollen, leaves, branches, dirt spots, and dust.

Modules with sufficient tilt (at least 15°), generally may not require cleaning (rain will have a self-cleaning effect). If the module has become soiled, wash with water and a non-abrasive cleaning implement (sponge) during the cool part of the day. Do not scrape or rub dry dirt away, as this may cause

micro scratches.

Periodically inspect the system to check the integrity of all wiring and supports.

To protect against electric shock or injury, electrical or mechanical inspections and maintenance should be performed by qualified personnel only. It's recommended that adopt the following maintenance to ensure the modules maintain the best performance:

Check whether the modules have any appearance defect: such as surface damage, abnormal or shadow. Make sure that the module support system is stable without any loose part. If finding any abnormal situation, please contact professionals to adjust or repair.

Clean modules at least one time each year, depending on local conditions. If the surface of the module becomes dirty, the power generation of the modules reduces. In this situation, you can use soft sponge or water to clean the surface glass of the module. Mild, non-abrasive chemical cleaners can be used to help washing modules. In order to reduce electric shock or burns, it is recommended to clean modules in the morning or evening.

Do not use abrasive cleaners, de-greasers or any unauthorized chemical substance (e.g. oil, lubricant, pesticide, Gasoline, white flower oil, active oil, mold temperature oil, machine oil (such as KV46), grease (such as Molykote EM-SOL, etc.), lubricating oil, anti rust oil, stamping oil, butter， cooking oil, propyl alcohol, ethyl alcohol, essential oil, bone-setting water, Tianna water, mold release agent (such as Pelicoat S-6, etc.), glue and potting glue that can generate oxime gas (such as KE200, CX-200, Chemlok, etc.), TBP (plasticizer), cleaning agents, pesticide, paint strippers, adhesives, antirust agent, disincrustant, emulsifying agent, cutting oils and cosmetics, etc.) on the module. Do not use cleaning corrosive solutions containing hydrofluoric acid, alkali, acetone, or industrial alcohol.

Perform regular mechanical and electrical checks to ensure that the modules are clean and connected reliably, the module electrical connections are good, the support structure is intact, and that there is no corrosion.

Please note that all maintenance instructions, such as brackets, charging rectifier, inverters and batteries, should be complied.

6 Disclaimer

Because the use of the manual and the conditions or methods of installation, operation, use and

maintenance of photovoltaic (PV) product are beyond the control of Shanghai Aerospace Automobile Electromechanical Co., Ltd. We do not accept responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance.

No responsibility is assumed by Shanghai Aerospace Automobile Electromechanical Co., Ltd. for any infringement of patents or other rights of third parties, which may result from use of the PV product. NO license is granted by implication or otherwise under any patent or patent rights.

The information in this manual is based on our knowledge and experience and is believed to be reliable, but such information including product specification (without limitations) and suggestions do not constitute a warranty, expresses or implied. We reserve the right to change the manual, the PV produce, the specifications, or product information sheets without prior notice.

Our Compony shall not be held responsible for damages of any kind, including but not limited to, bodily harm, injury and damage to property as a result of handling modules, installing systems, or compliance or non-compliance with the instructions set forth in this manual.

Our company reserves the right of final interpretation if there is any discrepancy.

For more information, please log in to our official website: http://www.ht-saae.com.au/