

Amerisolar Flexible Light (FL) PV Modules Installation Manual for Profiled Steel Roofs (2024)

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1.0 Summary

Thankyou for purchasing Amerisolar Flexible Light (FL) PV modules. This guide contains information regarding the installation and safe handling of Worldwide Energy and Manufacturing USA Co., Limited PV system on profiled steel Roofs. Worldwide Energy and Manufacturing USA Co., Limited referred to as “Amerisolar USA”. Users and installers must read and strictly follow this Installation Manual. Failure to follow these safety guidelines can result in personal injury or property damage. The installation and operation of FL solar modules require specialized skills, and only professionals can do the job. Please read the safety and installation instructions before using and operating the FL solar modules. The installer must inform the end customer (or consumer) of the above matters accordingly.

1.1 Disclaimer

Amerisolar USA reserves the right to change this Installation Manual without prior notice. The changes and the latest installation manuals after the changes will be published in the resource center of the official Amerisolar USA website. Customers should always pay attention to the above changes. Amerisolar USA will not provide further notice.

Failure in operating according to instructions in this manual during installation (Including the changes announced on the official website of Amerisolar USA at the time of installation) will cause the warranty to be invalid.

Amerisolar does not guarantee any expressed or implied information contained in this manual.

1.2 Responsibility

Whether or not the installation of the FL modules is carried out in accordance with the instructions in this Installation Manual (including the changes announced on the official website of Amerisolar at the time of installation), Amerisolar USA shall not be held legally responsible for any damages incurred during the installation process, including but not limited to personal and property damage resulting from the operation of the modules and the installation of the system.

1.3 Copyright and Trademark Information

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1.4 Warranty Warnings

WARRANTY VOID IF NON-AMERISOLAR-CERTIFIED HARDWARE IS ATTACHED TO PV System.

1.5 For Further Information

For additional technical support documentation, please visit the Support page of Amerisolar USA website at 'www.amerisolar-usa.com'.

2.0 Safety precautions



WARNING: Please read and understand all safety instructions before installing, wiring, operating, or maintaining modules. DC power is generated when the module is exposed to sunlight or other light sources. Direct contact with live parts of the module, such as terminals, whether connected or not, may result in personal injury or death.

Safety rules

- All installation work must be in full compliance with local regulations and corresponding national or international electrical standards.
- Use insulated tools to reduce the risk of electric shock.
- Use appropriate protective measures (slip gloves, overalls, etc.) to avoid direct contact with workers at 30V DC or higher, while avoiding direct contact with sharp edges during installation to protect the operator's hands.
- Do not wear metal ornaments when installing, to avoid puncturing the modules and causing electric shock.
- If modules are installed or operated on rainy days, strong winds or dew mornings, appropriate protective measures should be taken to avoid injury to modules and workers.
- Children or unauthorized personnel are not allowed to access the installation area or module storage area.
- If the circuit breaker and overcurrent protection circuit breaker cannot be opened, or if the inverter cannot be turned off during the module installation or wiring, cover the array modules with opaque material to stop the power output.
- Do not use or install damaged modules.
- If the module surface is damaged or worn, direct contact with the surface of the module may result in electric shock.
- Do not attempt to repair any part of the module, there are no user-accessible components within the module.
- The cover of the junction box should remain closed at all times.

- Do not split the modules or move any part of the module.
- Do not artificially condense light on modules.
- Do not connect or disconnect modules when there is current in the module or external current.

3.0 Mechanical / electrical properties

The rated electrical performance data for the modules is measured under standard test conditions (STC) of irradiance of 1000 W/m², AM 1.5, and cell temperature of 25 °C. The main electrical performance parameters under STC conditions are also marked on the nameplate of each module. The maximum system voltage for all modules is 1000V.

In some cases, the current or voltage generated by the module maybe greater than the optimal operating current or voltage of its standard test condition (STC). Therefore, when determining the component rating and load value, the module open circuit voltage and short circuit current at STC should be multiplied by 1.25. Please check with your local rules and regulations.

4.0 Storage and unpacking

Precautions and general safety rules

- Store modules in a dry and ventilated environment.
- The modules must be transported in the package provided by Amerisolar and stored in the original package before installation. Care must betaken during unpacking, shipping, and storage.
- Do not apply excessive loads on the modules or twist the modules.
- Do not carry the modules through the wires or junction boxes of the modules.
- Do not stand, climb, walk or jump on modules.
- Do not allow sharp objects to touch the modules. Scratches can directly affect the safety of the modules.
- Do not place the modules in an environment where there is no reliable support or is not fixed.

- Do not change the wiring method of the bypass diode.
- Keep all electrical connections clean and dry.

5.0 Installation

Precautions and general safety rules

- Before installing the modules, please contact the relevant department to obtain information about the installation site and the construction permit, and also comply with the installation and inspection requirements.
- Check the applicable building codes to ensure that the building to be installed and its structure (roof, facade, load-bearing, etc.) has sufficient load-bearing capacity.
- During installation, make sure that the modules are installed on a fire-resistant roof. According to UL790 standards, Amerisolar Flexiblemodules are rated as fire rating C.
- The Flexible modules are compliant with application level A (equivalent to safety level II, IEC 61730-1). This type of modules can be used in systems where the public is likely to come into contact with voltages greater than 50V or power greater than 240W.

Environmental conditions

The modules are suitable for general climatic conditions, ie with reference to IEC 60721-2-1-Classification of environmental conditions Part 2-1: Environmental conditions occurring in nature - temperature and humidity.

- If the modules are used in a special installation environment, please consult the technical support department of Amerisolar in advance.
- The installation surface should be flat without bumps or pits.
- The modules must not be installed near flames or flammable objects.
- Do not expose modules to artificial condensing light sources
- The modules should not be immersed in water (pure water or salt water), installed in long-term water environment (pure water or salt water) (eg fountains, sprays, etc.) or area prone to water accumulation (eg roof drain, low-lying areas, etc.).
- Please consult Amerisolar installation manual for Flat roofs if roof area has poor drainage or extended water pooling.

- If the module is placed in a salt mist (ie marine environment) or in an environment containing sulfur (ie, sulfur sources, volcanoes, etc.), there is a risk of corrosion.
- Failure to follow the above precautions, Amarisolar Warranty will be voided.

Installation requirements

- Ensure the modules meet the overall technical requirements of the system.
- Ensure that components of other systems do not cause damaging mechanical or electrical performance effects on the modules.
- Connect modules 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 pole. When connected in parallel, the positive pole of the module is connected to the positive pole of the next module.
- The number of bypass diodes provided varies depending on the module model.
- Connect the appropriate number of modules according to the voltage specifications of the inverter used in the system. Even at the lowest local temperature conditions, the connected modules must produce no more than the voltage allowed by the system. If overcurrent protection devices (fuse) are not used in series within each string of modules, up to two strings of modules can be connected in parallel. If a suitable overcurrent protection device is connected in series with each string of modules, three strings or more modules can be connected in parallel.
- In order to avoid (or reduce) the mismatch effect of the array, it is recommended to connect modules of similar electrical performance on the same string.
- In order to reduce the risk of indirect lightning strikes, loops should be avoided when designing the system.
- The modules should be securely fastened to withstand all possible loads, including wind and snow loads.

Optimal orientation and inclination

- In order to achieve maximum annual power generation, the optimal orientation and inclination of the PV module should be determined first. The maximum electrical energy is typically generated when sunlight is directed onto the PV module.

Avoid shadows

- Even small shadows (such as dust) can cause a drop in power generation. If all surfaces of the module are uncovered throughout the year, the module is considered "no

shadow". Ensure that the sun shines on the modules even on the shortest day of radiation all through the year.

- EVA aging caused by frequent occlusion of modules and long-term heating of the diode can affect the lifetime of the module.

5.1 Module wiring

Correct electrical wiring

- Check that 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 maybe a wiring fault.

Correct connection of the MC4 connector

- Make sure the MC4 connector is secure and properly connected. The MC4 connector must not be subjected to external pressure. The MC4 connector can only be used for circuit connection functions and should not be used to turn the circuit on and off.
- The MC4 connector should be kept dry and clean to prevent rain and moisture. Avoid direct sunlight and water soaking of the MC4 connector.

Use appropriate materials

- Depending on local fire, construction and electrical standard, use dedicated solar cables and suitable MC4 connectors to ensure the electrical and mechanical performance of the cable.
- The solar cable licensed for use is a single-wire cable, 2.5- 10mm² (8-14 AWG), 90°C grade, with appropriate insulation to withstand the maximum possible system open circuit voltage. The appropriate wire size needs to be chosen to reduce the voltage drop. The wire should be made of copper.

Cable protection

- Secure the cable to the mounting system with a cable tie that is UV resistant. Appropriate measures should be taken to protect the exposed cable from damage (eg. in a plastic sleeve with UV aging resistance). Avoid direct exposure of the cable to direct sunlight

6.0 Installation instructions

6.1 Installation Methods

Flexible PV module can be installed in different ways according to different installation environments, including direct adhesive installation, support and fixture auxiliary installation, removable fixture installation, and replacement module installation.

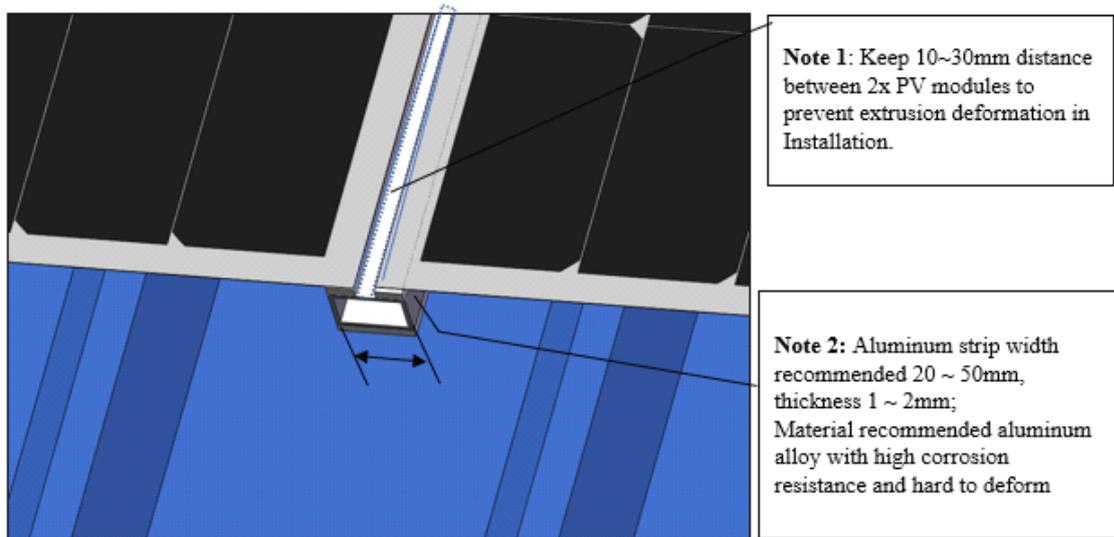
- a. Flat roof, curved surface or trapezoidal color steel tile can be directly used adhesive installation method;
- b. For uneven installation scenarios, such as Angle flanging or vertical locking type color steel tile, additional support system is required for installation;
- c. The customized module installation method is subject to the interconnection evaluation.

Common installation tools for flexible modules



Guide rail or aluminum strip width is recommended 20 ~ 50mm, thickness is recommended 1~2mm, the material is recommended aluminum alloy 6063 or equivalent material high corrosion resistance, not easy to deformation.

PVC /TPO/ asphalt/concrete/color steel tile and other metal surfaces are recommended to use Tianshan 1527, Huitian 906Z or other Sunport approved structural adhesive.



Double-sided tape recommended 3M-2204(Apply for circular surface as pre-installation)

High viscosity waterproof coating is recommended by Manbalit T401/T8000 or Tianshan P10Color steel tile and other metal surface recommended structural adhesive for Tianshan-1527 or approved structural adhesive.

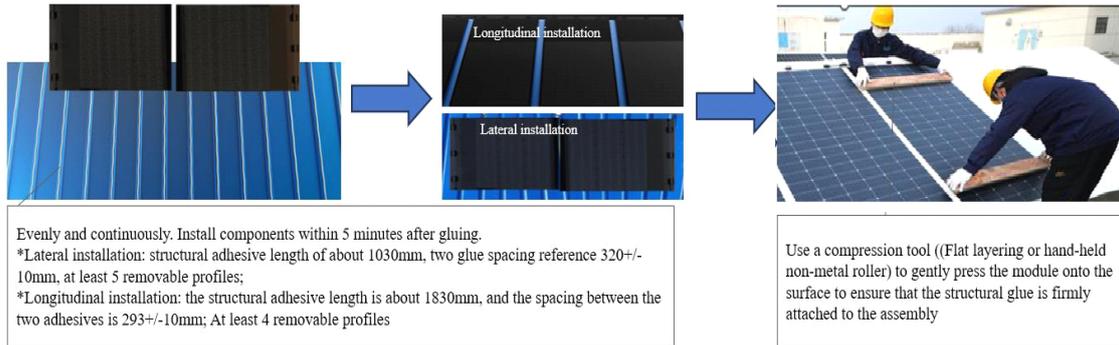
The following are the points for attention when making structural glue:

After cleaning the construction surface, the surface can be glued without water stains;

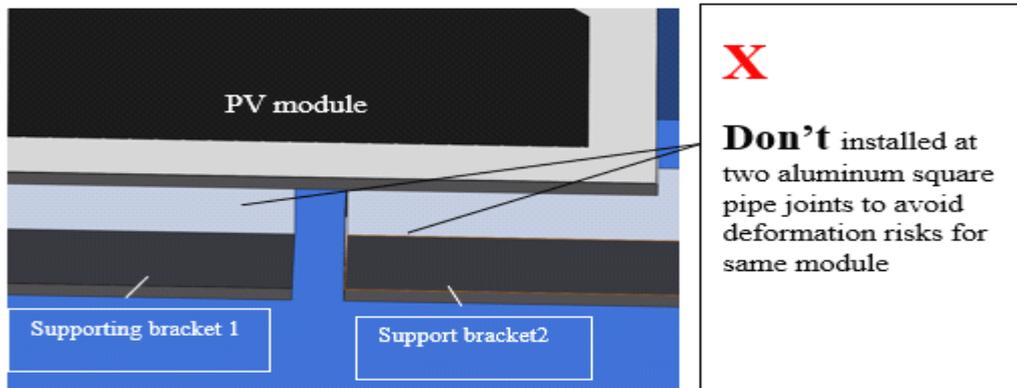
- Recommended that the spacing between two modules be 10~20mm to avoid deformation extrusion in long-term use;
- Glue along the center of the crest, glue width of 6 ~ 10mm, about 3 ~ 5mm high;
- Smear must be uniform, continuous, before pasting is not allowed to scrape the rubber strip, to rely on extrusion to make the glue spread;
- Glue and assembly time should be controlled in the shortest time (not more than 5 minutes);
- Structural adhesive in 48 hours, the colloid will be cured 2~3mm depth, not fully cured before do not force;
- The length of the structural glue is about 1030mm in the transverse direction, and the spacing between the two glue refers to 320+/-10mm. can't less 5 sets of detachable profiles;

- The length of the structural adhesive is about 1830mm in the longitudinal direction, and the spacing between the two adhesive refers to 293+/-10mm, can't less 4 sets of detachable profiles.
- After installation, press the surface of the module with a wooden strip or a hand-held roller to make the adhesive and the module tightly bonded.

Structural adhesive installation diagram



- Layout design should avoid the color steel tile joint, bracket and bracket joint easy to produce relative displacement area leading to fold or tear damage;
- module layout design should avoid the color steel tile joint (bracket and bracket joint should also be avoided), to avoid the relative displacement of the module caused by folding or tearing;



- Two adjacent flexible modules keep a distance of 10mm to 30mm to avoid deformation affect;
- Proper operation and maintenance channels should be set aside around modules. Do not step on modules.
- Recommended to test the pullout force of the gluing effect to ensure the effective binding force of installation.

- If the overhang height at both ends of the module is too long, use aluminum square strip to flatten the overhang height. The height of the aluminum strip is consistent with the height of the wave crest, and the width of the module beyond the aluminum strip is less than 50mm;

For the installation methods not mentioned above, please consult technical engineer, otherwise the loss caused by improper installation methods will not be borne.

Flat roof, curved surface or trapezoidal color steel tile can be installed by direct adhesive.

Flat and curved roof including but not limited to: PVC/TPO/ asphalt waterproof coil, metal curved surface and color steel tile or flat roof;

During installation, refer to the requirements of the installation design scheme to evaluate whether the PVC/ asphalt material needs to be undercoated first. For TPO/ concrete roofing there are possible weathering and aging problems, direct installation will affect the bonding degree of modules and other problems, the roof must be treated first. For details, see the following steps:

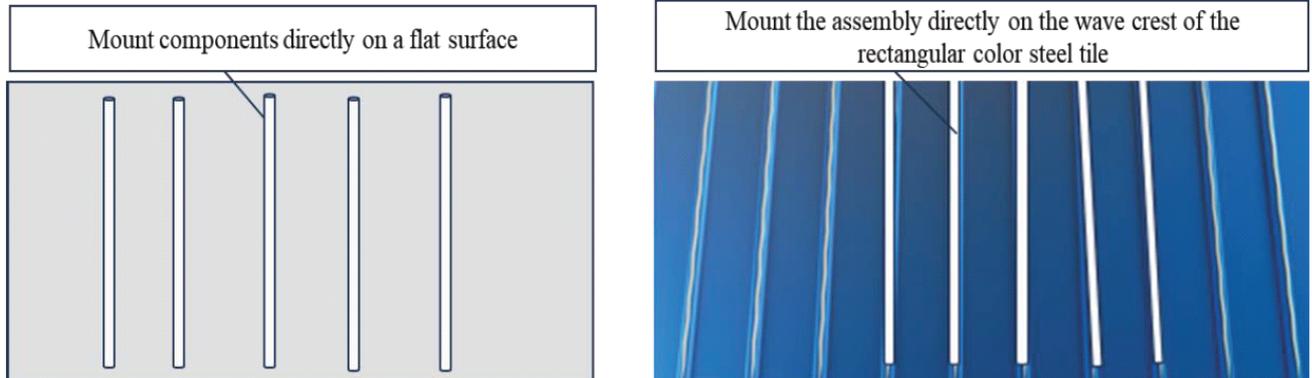
- 1) Polish the roof to remove the powdery layer;
- 2) pair the water leakage point with waterproof glue;
- 3) The module installation position should be brushed with high-stick waterproof paint;
- 4) After the coating is cured, ensure no gap, no water leakage, then install the module.

After installation, the integrated waterproof roof will ensure additional waterproof performance.

a. Plane Direct Gluing Installation

- 1) Clean up the roof and the back of the module, no particle, dust and residues on the surface;
- 2) Stick a double-side tape on the back, the distance between the double-side tape to edge around 50mm(apply for curved surface , arch surface pre-installation);
- 3) Make structural glue on the back of the module, the glue width is 6 ~ 10mm, the height is 3 ~ 5mm, should be installed within 5 minutes after gluing to prevent the silicone solidification to affect the bonding Performance;
- 4) Two people together to lift the module on face up gently on the faulty module surface;
- 5) Use press tools to slightly squeeze and fix, press tools or rollers are recommended;

a. Flat direct adhesive installation scheme reference



6.1.1 Metal Roofing of Vertical lock Type and Angle Break Type

Metal roofing, the most typical and most common is color steel tile vertical locking type, angular roof.

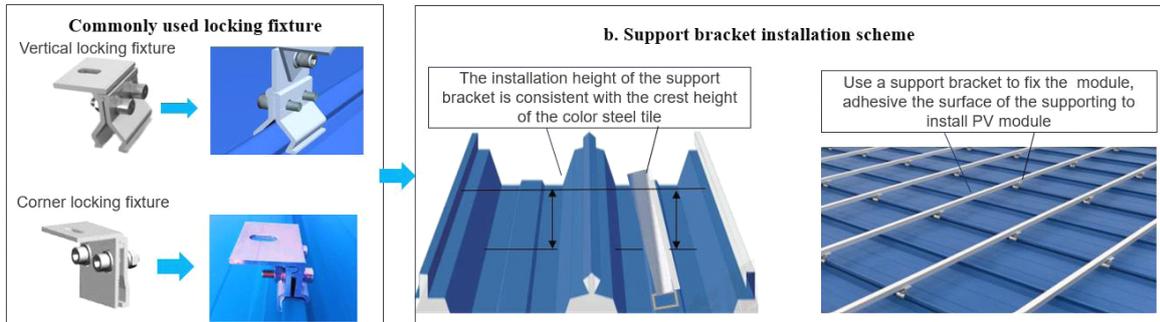
b. Auxiliary fixture and bracket installation

the aluminum bar is installed in the trough position of the color steel tile, the aluminum bar and the color steel tile are fixed with structural adhesive, the surface of the aluminum bar is flush with the surface of the color steel tile, the structural adhesive is placed on the aluminum bar, and the modules are installed. This scheme can be used alone or in conjunction with the crest guide scheme.

- 1) Use of vertical locking or special angular fixture, connect the fixture and color steel;
- 2) Connect the guide rail to the fixture and tighten it, then connect the corner code to the fixture.

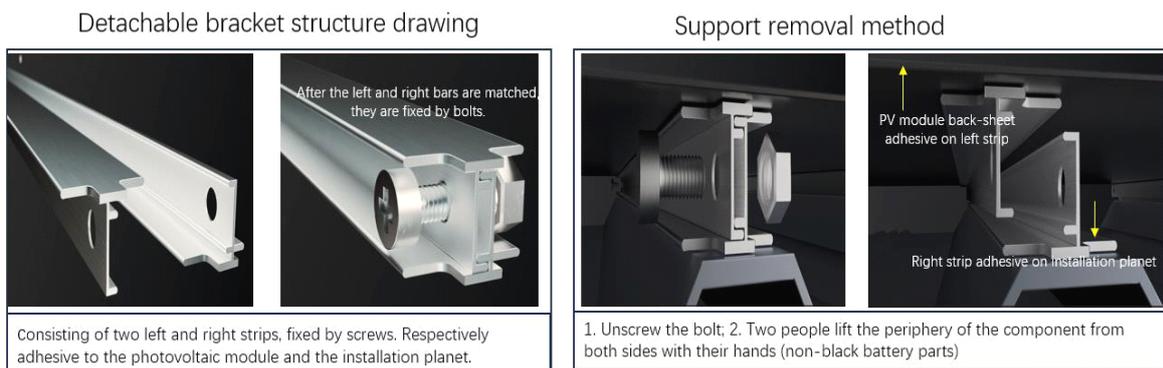
Note: The fixture should be drawn and tested on site to ensure its firmness;

- 3) Clean the surface of the guide rail, and then apply structural glue on the back of the guide rail contact module;
- 4) Put the modules on, and press the gluing position with a press tool or roller in sequence to ensure good contact between the structural adhesive and the modules and guide rail. The height of the fixture is 20 ~ 50mm.



c. Detachable Bracket Installation

Detachable aluminum profile rail (below left picture) is composed of left and right profiles, fixed by bolts. The left and right guide rails are glued to the back of the photovoltaic module and the mounting surface with structural adhesive, and the detachable profiles facilitate the flexible replacement of the photovoltaic module or the mounting surface. For details pls refer to b.



6.1.2 Module Removal, Replacement and Installation

Suitable for replacement and installation of faulty PV module. This section describes how to perform operations when some modules fail to work properly or need to be transferred for update.

The installation method of gluing new modules directly on defective one.

- 1) Should to be power off the series circuit of the module to be replaced in advance (important);
- 2) Remove the junction box on the front of the abnormal module with a tool to ensure that the front of the abnormal module is smooth;
- 3) Clean up the surface by soft cloth and dry it;

- 4) Refer to 6.1.1 installation step for add glue on the opposite of the new flexible module;
- 5) Two people lift the module together and put on faulty module, then use the roller brush to gently press the glue position to finish the installation.
- 6) After 24 hours, check sticky and connect the circuit.

Remove the defective module carrier support, and then change the module installation method (optional)

- 1) Confirm the number of modules to be replaced and remarked on surface, prepare the new modules quantity, aluminum strip or guide rails and tools;
- 2) Loosen the bolts at both ends with tools, and separate the auxiliary aluminum profiles and modules to be replaced from the connecting fixture;
- 3) Two people use steel wire or other tools at the same time to cut the adhesive of the bad module and remove the bad module after cleaning the glue on the glue base material;
- 4) Refer to 6.1.1 Aluminum profile to install the new module directly glue, and then carry the carrier support to the original position with bolts for connection;6. After 24 hours later, ensure sticky then install circuit.

Curved surface, plane, trapezoidal color steel tile installation scheme



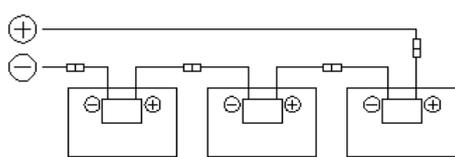
6.2 Electrical Installation

- Electrical parameters such as the I_{sc} , V_{oc} and P_{max} nominal value have deviate with the standard test conditions. Standard test conditions: irradiance $1000W/m^2$, battery temperature $25\text{ }^{\circ}C$, atmospheric quality AM1.5. When irradiance plus normal conditions, the current and voltage values generated may be higher than those obtained under standard test conditions.

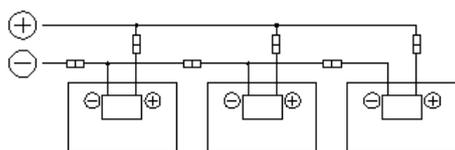
- Therefore, when determining the controller model associated with the module rated voltage, temperature at the installation site, combined with the temperature coefficient of the current in the technical manual, the short-circuit current is multiplied by the coefficient of 1.25 to calculate the short-circuit current.
- On the basis of the installation lowest temperature which combining the technical manuals to calculate the open circuit voltage. The voltages are added up when the modules is in series; current are added up when modules are connected in parallel.
- Different electrical characteristics of PV modules cannot series. It may cause electrical connections mis-match. should be carried out according to the manufacturer's installation manual.

6.2.1 Connection Type

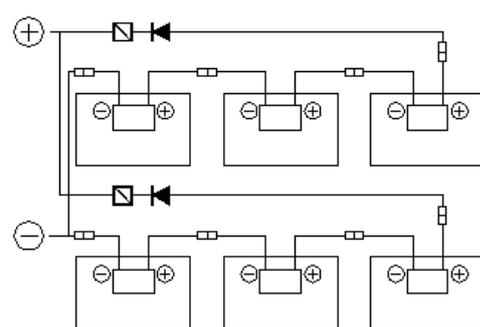
- The maximum number of modules that can be connected in a series string must be calculated in according with applicable regulations in such a way that the specified maximum system voltage (According to IEC61730 tests and appraisal, the maximum system voltage is 1000Vdc or 1500Vdc depending on the series and model.) of the modules and all other electrical DC modules will not be exceeded in open circuit operation at the lowest temperature expected at the PV system location. Variation of open-circuit voltage with temperature can be calculated based on the following formula: $V_{oc}(T) = V_{oc}(25) \times [1 - \beta \times (25 - T)]$. $V_{oc}(25)$ is open-circuit voltage at standard temperature 25°C. T is the lowest expected ambient temperature at the system location. B (%/°C) is the temperature coefficient of the selected module V_{oc} (Refer to corresponding datasheet).



Series wiring



Parallel wiring



Series wiring and Parallel wiring

 Over-current protection devices
  Diodes
  Connector protection devices

- An appropriately rated over-current protection device must be used when the reverse current could exceed the value of the maximum fuse rating of the modules. An over-

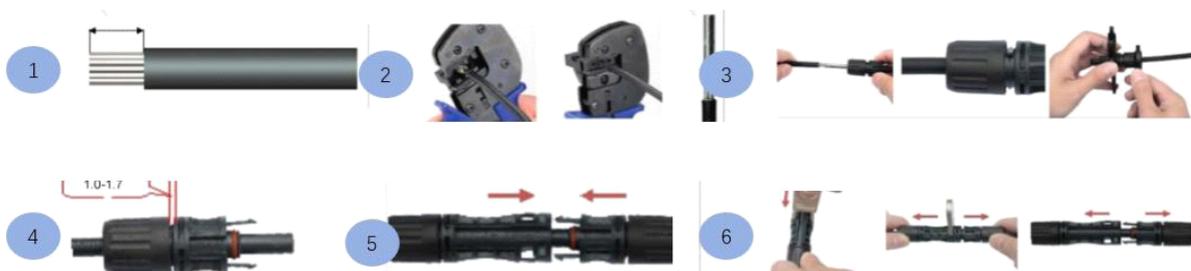
current protection device is required for each series string if more than two series strings are connected in parallel;

- In the design of the modules, field connections use sealed IP68 junction boxes to provide environmental protection for the wires and their corresponding connections and accessible;
- The junction box is provided with connected cable and IP68 connector, which is used for series between modules; Each module has two wires (a positive electrode and a negative electrode) separately connected to the junction box. The two modules can be connected in series by inserting the positive interface at the other end of the wire of one module into the jack of the negative wire of the adjacent module. The connection is successful when the clicking sound is heard.

6.2.2 Cable

- Field connection modules with cable must meet the maximum short-circuit current, use photovoltaic (pv) systems special light resistant cable.
- Recommended to fixed cable by the binding wire resistance to light and line card to fixed on the bracket;
- Avoid cable or modules by mechanical forces crushed;
- Avoid long soak in the water cables.

Precautions of connection head modulation



- 1.Strip the cable insulation layer L= 7-9mm (Figure 1)
2. Place the bare wire with the insulation layer removed into the end of the pin (or sleeve), and use the riveting pliers to rivet the pin (or sleeve) and the bare wire together; (Figure 2)
3. Assemble the negative (or positive) connector as shown below. Parts from left to right are: negative connector, inner plug, flower basket, nut; (Figure 3)
4. Turn the nut clockwise and tighten it so that the gap between the nut and the connector is controlled between 1.0-1.7mm; (Figure 4)
5. Insert the pin (or sleeve) of the riveted cable into the negative (or positive) connector. When you hear a clicking sound, pull the cable outward until it does not come out. (Figure 5)
6. Disconnect the connector, use the tool to insert the bayonet position of the connector, and pull the connector with the right hand and left hand respectively to separate the positive and negative connectors. (Picture VI)

6.2.3 Connectors

- Ensure connector is dry and clean to avoid immersion in water before installation;
- Avoid connectors falling on the ground or roof;
- A faulty connection may produce electric arcs and shocks;
- Ensure check all electrical connections for reliability;
- Ensure that all locking connectors are fully locked.

6.2.4 Bypass Diode

The junction box of modules contains a bypass diode connected in parallel to a battery string inside the module;

When hot spots occur in parts of the module, the diode will work, so that the main current will not flow through the hot spot cell, thus limiting the module heat and performance loss;

- Note that the bypass diode is not an overcurrent protection device.

6.3 Wiring and testing

- 1) The use of PV modules with different configurations in a PV system is prohibited.
- 2) Excessive cables must be organized or fixed in the proper location.
- 3) For applications requiring high operating voltages, several PV modules may be connected in series to form a PV string, then the system voltage is equal to the sum of the voltages of each PV module
- 4) For applications requiring high operating currents, several strings of PV modules can be connected in parallel to form a PV string, then the system current is equal to the sum of the currents of each PV module string.
- 5) A maximum system voltage of 1000VDC is allowed.
- 6) The maximum number of PV modules in series depends on the system design, the type of inverter used and the environmental conditions;

- 7) Depending on the maximum series fuse rating of the PV module and local electrical installation codes, if the PV module does not have any fuses or blocking diodes, make sure to connect no more than two strings in parallel;
- 8) There is no limit to the number of PV modules that can be connected in parallel (fuses per string should be considered), the number of PV modules is determined by system design parameters such as current or power output;
- 9) Please refer to local regulations to determine the size, type and temperature of the system conductors;
- 10) PV modules are equipped with connectors for system electrical connections, please refer to local regulations and data sheets that allow the use of connectors;
- 11) To ensure a reliable electrical connection and to prevent possible moisture ingress, connectors must fit and lock together until a click is heard;

The DC power generated by the PV system can be converted to AC power and connected to the public grid, as the local power company's policy for connecting renewable energy systems to the grid varies from region to region. You can ask your PV system design engineer or integrator for help in obtaining building permits, inspections and approvals from your local power company's department.

7.0 Maintenance

To ensure optimal performance of modules and maximize system power generation, the following maintenance measures are recommended:

1 Module appearance inspection, focusing on the following points:

- a) Whether the module is damaged.
- b) Whether there is a sharp object touching the surface of the module.
- c) Whether the modules are obstructed by obstacles and objects, avoiding new trees, new poles etc. to shielding the modules.
- d) Check for corrosion near the busbar. This kind of corrosion is caused by the damage of the module surface during transportation, which causes moisture to penetrate into the interior of the module.
- e) Check the adhesive between the module and the roof for looseness or damage and adjust or repair it in time.

2 Clean the modules. The accumulation of dust or dirt on the surface of the modules will reduce the power output. It should be cleaned regularly to keep the surface clean. Generally, it should be cleaned at least once a month, appropriately increase the frequency in the harsh natural environment. Pay attention when cleaning PV modules:

- a) Rinse with water first, then dry the water with a soft cloth. Do not use corrosive solvents to clean or wipe the PV modules with hard objects.
- b) The PV module should be cleaned at an irradiance of less than 200 W/m². It should be cleaned in the absence of sunlight or in the morning and evening.
- c) It is strictly forbidden to clean PV modules under meteorological conditions where the wind is greater than grade 4, heavy rain or heavy snow.

Attention: Do not walk, stand or sit on the module when cleaning.

3 Connector and cable inspection. It is recommended to conduct a preventive inspection every six months: Check for signs of aging of PV modules, including possible rodent damage, weathering, and whether all connectors are tightly connected or corroded.

(End)