Crystalline silicon PV Shingled double glass modules Installation manual (UL1703 Version)
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Crystalline silicon PV Shingled double glass modules
Installation manual (UL1703 Version)

1 General Information

1.1 This installation manual specifies the installation and maintenance requirements for crystalline silicon PV shingled double glass modules (hereinafter referred to as "modules") manufactured by Tongwei Solar (Hefei) Co., Ltd. (hereinafter referred to as "Tongwei").

1.2 This manual does not have any warranty significance. Expressed or implied. Installers must read and understand the manual before installation. The installer should conform to all safety precautions in the manual and local laws & regulations when installing module; before installing a solar photovoltaic system, installers should become familiar with the mechanical and electrical requirement for such a system.

1.3 This manual is intended for use with the following conventional modules:

Monocrystalline PV shingled modules: 72 version of the series, 60 version of the series;
Monocrystalline PERC PV shingled modules: 72 version of the series, 60 version of the series;

1.4 Conventional single glass assembly type coding rules

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The first part: 2 letters, on behalf of the company referred to as: TH (Tong Wei Hefei, The first letter of the Chinese phonetic alphabet).
The second part: 3 digits, represents the maximum power of the PV module under standard test conditions, such as: 400, said PV module power 400W.
The third part: a letters, which represents the technology of the cell in the component, C represents the conventional cell; P represents the PERC cell, H represents the black silicon cell, and J represents the diamond cell.
The fourth part: a letters, on behalf of the PV module of the cell in the crystal type: M (Monocrystalline), P (polycrystalline), G (cast-mono).
The fifth part: No or 1 letters, representing a special kind of cell chip in a component, without letters indicating
conventional cell; B means double sided cell
The sixth part: 1 digit or 1 letters represent the number of components in the cell line the main gate, the 1 gate represents a cell, 2 cell, 3 said two gate three gate cell - - - 9 said nine gate cell; A ten cells, B said eleven gate
gate cell C said, twelve grid cells and so on.
The seventh part: 1 bit characters, using fixed characters: -.The eighth part: the 2 digit number represents the module version, such as 60 represents the 60 version module, and the 72 represents the 72 version module.
The Ninth part: the 2 digit number represents the module version, such as 60 represents the 60 version module, and the 72 represents the 72 version module.
The Tenth part: 1 letters represents the tile assembly: S (the first letter of the English Shingle stack).The Tehth part: 1 letter, on behalf of double glass: D (English Double the first letter).

1.5 Keep this manual in a safe place for future reference (care and maintenance) and in case of sale or disposal of the modules. Any questions, please contact with the salesman or customer service personnel of TW solar for further explanations.

2 Disclaimer of Liability

2.1 Because using of this manual and the conditions or methods of the module installation, handling, use and maintenance are beyond the control range of TW solar, so If the conditions or methods of the module installation, handling, use and maintenance of the customer are beyond the range specified in this manual and cause damage, TW solar does not assume responsibility for any loss, damage or expense thus caused.

2.2 TW solar has the right to refuse to compensate for the product damage due to construction or design defects of the solar photovoltaic system.

2.3 No responsibility is assumed by TW solar for any infringement of patent right or other rights of third parties, which may result from the customer’s use of the TW solar’s modules. No patent license or patent rights is granted to customer, express or implied, due to its use of TW solar’s modules.

2.4 Failure to comply with the requirements listed in this manual will invalidate the 《Limited Warranty for PV Modules》 provided by salesman of TW solar. Meanwhile, recommendations provided in this manual are in order to improve the security of installation.

2.5 The information in this manual is based on TW's best knowledge and experience and is believed to be reliable; but such information including product specification (without limitations) and suggestions do not give any guarantee, Expressed or implied.

2.6 TW solar reserves the right to make changes to the product specifications or installation manual without prior notice.

3 Safety Precautions

3.1 General Safety

3.1.1 TW solar’s modules have been evaluated by according to UL1703, application class A, fire class
rating: C, modules rated for use in this application class may be used in system operating at greater 
than 50V DC or 240W, The fire rating of this module is valid only when mounted in the manner 
specified in the mechanical mounting instructions. The module is considered to be in compliance with 
UL 1703 only when the module is mounted in the manner specified by the mounting instructions below. 
A module with exposed conductive parts is considered to be in compliance with UL 1703 only when it 
is electrically grounded in accordance with the instructions presented below and the requirements of 
the National Electrical Code. Any module without a frame (laminate) shall not be considered to comply 
with the requirements of UL 1703 unless the module is mounted with hardware that has been tested 
and evaluated with the module under this standard or by a field Inspection certifying that the installed 
module complies with the requirements of UL 1703.

3.1.2 The installer should abide by the relevant local laws and regulations when installing module. It is 
need to obtain the required certificates in advance when necessary, such as the building permit, 
please don’t work under no protective measures.

3.1.3 Installing solar photovoltaic systems require specialized skills and knowledge. Installation should 
be performed only by qualified persons. Installers should assume the risk of all injuries that might 
occur during installation, such as electric shock.

3.1.4 Photovoltaic modules are designed for outdoor use. Modules may be mounted on ground, 
rooftops, vehicles or boats. Proper design of support structures is the responsibility of the system 
designers or installers. When modules are mounted on rooftops, fire-protection rating of the final 
structure should be consideration, and also the later maintenance. The rooftops and support structure 
for PV system should only be certified by architectural experts or engineer, which have a formal 
complete structure analysis results.

3.1.5 For your safety, Do not install or handle the modules under wet or adverse environment, 
including but not limited to strong wind, gusty wind, frosted roof surfaces, wet environment). 
3.1.6 Open voltage or nominal system voltage is greater than the largest component of 45 v, near the 
connection device to have eye-catching warning of "shocking danger” logo.

3.2 Electrical Properties Safety

3.2.1 When exposed to direct sunlight, one individual PV module may generate DC voltages greater 
than 30 volts, so it is extremely dangerous to contact the metal part of the wire, which may be cause 
shock, burn and kill. And do not touch or lean on a working module.

3.2.2 In order to avoid arcs and electric shock, please do not disconnect electrical connections under
load, Keep all electrical connectors dry and clean, and ensure that they are in proper working condition. Never insert metal objects into the module connector.

3.2.3 Do not apply paint or adhesive to module surface.

3.2.4 Do not use mirrors or other magnifiers to focus sunlight on the modules. Do not expose the backside of modules directly to sunlight for a long time.

3.2.5 Do not change the configuration of the bypass diodes, Do not disassemble the modules or remove any attached nameplates or components from the modules.

3.2.6 Do not contact with module surface when the module is wet unless to clean the modules, please following requirements mentioned in this manual when cleaning.

3.3 Handling Safety

3.3.1 Store pallets in a ventilated, rain-proof and dry location until the modules are ready to be unpacked, Keep children and unauthorized persons away from the modules while transporting or installing them. Improper transportation or placing may lead to glass breakage or power loss of the modules, resulting in the loss of the use value of modules.

3.3.2 Handle modules with care, Lift and put down modules gently. It is forbidden to carry or lift the modules by grabbing the junction box or cables. Carry a module by its edges with two or more persons.

3.3.3 To avoid module damage, do not place excessive loads on the module. Do not stack the modules horizontally for transportation.

3.3.4 Pay more attention not to collide, scratch or press the module backside when transporting or installing.

3.3.5 To avoid module damage, do not stand or step on the module. Do not drop or place objects on the modules. Do not put tools on the module. Do not put the module on any hard surface, which maybe cause the cells broken.

3.3.6 Inappropriate transportation may damage the module. Control the vehicle speed when the road condition is relatively poor.

3.4 Installation Safety

3.4.1 Abide by the safety regulations for all other components used in the PV system, including wiring and cables, connectors, controller, inverters, storage batteries, etc., and use suitable equipment, connectors, wiring and mounting system for a PV system. It is better to use the same type modules in one system.
3.4.2 Do not install or handle the modules when they are wet or during strong wind. Keep the junction box’s cover closed.

3.4.3 The front side of modules is constructed with tempered glass, which shall be handled with care. Improper operations may cause the tempered glass breakage. If the front glass or back glass is broken is damaged, contact with any module surface can produce electrical shock, particularly when the module is wet. Broken or damaged modules must be disposed properly by professional.

3.4.4 When exposed to direct sunlight, one individual solar module may generate DC voltages greater than 30 volts. It is extremely dangerous to contact it.

3.4.5 Completely cover the module with an opaque material during installation to prevent electricity generation. Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or repairing photovoltaic systems. Use insulated tools that are approved for working on electrical installations and always keep them dry.

3.4.6 The maximum system voltage indicated in the rating label is 1000V. Attention: During the system Installation, the maximum open circuit voltage in series cannot exceed the maximum system voltage.

3.4.7 During modules interconnection, ensure to fix the connecting cables to supporting bracket, so as to restrict the swing amplitude of the slack part of the cables.

3.4.8 Abide by the allowable minimum bending radius of the cables (suggest no less than 43mm).

3.4.9 Always protect the cable with conduit where animals or children can touch it.

3.4.10 Please use the connector which is specially designed for photovoltaic system, and assemble it with the tools recommended or specified by the manufacturer. In case that the connector applicable to the solar photovoltaic system is required, please contact the local supplier.

3.4.11 Make sure that the polarity is correct when connecting the module with inverter, storage battery or combiner box to avoid the damage of bypass diodes in the modules due to incorrect polarity.

4 Module specifications

4.1 Electrical Characteristics

4.1.1 The deviation of electric characteristics between the measured value and nominal value is within ±3% (the electric characteristics including Isc, Voc and Pmax tested Under Standard Test Conditions 1000W/m², AM1.5 and 25ºC (77°F)). Refer to the following table for electrical performance parameters.
<table>
<thead>
<tr>
<th>Module Type</th>
<th>Pmax</th>
<th>Tolerance of Pmax</th>
<th>Voc</th>
<th>Tolerance of Voc</th>
<th>Isc</th>
<th>Tolerance of Isc</th>
<th>Vsys</th>
<th>Fuse rating</th>
<th>Application Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH415PM5-72SD</td>
<td>415W</td>
<td>0~+5W</td>
<td>45.4</td>
<td>±3%</td>
<td>11.47</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH410PM5-72SD</td>
<td>410W</td>
<td>0~+5W</td>
<td>45.3</td>
<td>±3%</td>
<td>11.43</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH405PM5-72SD</td>
<td>405W</td>
<td>0~+5W</td>
<td>45.3</td>
<td>±3%</td>
<td>11.39</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH400PM5-72SD</td>
<td>400W</td>
<td>0~+5W</td>
<td>45.2</td>
<td>±3%</td>
<td>11.35</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH395PM5-72SD</td>
<td>395W</td>
<td>0~+5W</td>
<td>45.2</td>
<td>±3%</td>
<td>11.31</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH390PM5-72SD</td>
<td>390W</td>
<td>0~+5W</td>
<td>45.1</td>
<td>±3%</td>
<td>11.27</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH340PM5-60SD</td>
<td>340W</td>
<td>0~+5W</td>
<td>45.2</td>
<td>±3%</td>
<td>9.51</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH335PM5-60SD</td>
<td>335W</td>
<td>0~+5W</td>
<td>45.2</td>
<td>±3%</td>
<td>9.49</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH330PM5-60SD</td>
<td>330W</td>
<td>0~+5W</td>
<td>45.1</td>
<td>±3%</td>
<td>9.45</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
<tr>
<td>TH325PM5-60SD</td>
<td>325W</td>
<td>0~+5W</td>
<td>45.1</td>
<td>±3%</td>
<td>9.42</td>
<td>±3%</td>
<td>1500A</td>
<td>20A</td>
<td>A</td>
</tr>
</tbody>
</table>

Note: Temperature Coefficient of Pm: -0.43 %/℃; Temperature Coefficient of Voc: -0.30 %/℃; Temperature Coefficient of Isc: 0.05%/℃.

4.1.2 The maximum nominal voltage for all module series is 1500V according to IEC standards.

4.2 Product Identification

Each PV module is affixed with two kinds of labels, providing the following information:

a) Nameplate: Describes the product name, PV module model, nominal power, rated voltage, rated current, open circuit voltage, short circuit current, maximum system voltage, PV module size and weight under standard test conditions.

b) Barcode: Each module has a unique bar code number. The bar code is permanently encapsulated inside the module, as can be seen clearly from the top right corner of the module.

The bar code number allows you to trace information about the module production process.

5 Installation Conditions

5.1 Operating Environment

Installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part I. This product must be installed by a licensed electrician in accordance with the applicable electrical code (i.e. the NEC for the USA and CEC for Canada).

TW solar’s PV module should operate in the following environmental conditions:

- Ambient temperature: -20℃ to +45℃
- Operating temperature of the module: -40℃ to +85℃
Humidity: <85%RH

Mechanical load pressure: The front design load of the module is 2400Pa and the back design load of module is 2400Pa. It corresponds to factor of safety is 1.5 (only for module models covered in this manual).

Notes: Professional system installers are responsible for mechanical load calculations when Design photovoltaic systems.

5.2 Installation location

5.2.1 In most applications, PV modules should be installed in a location where they will receive maximum sunlight throughout the year. In the northern hemisphere, modules should typically face south, and in the southern hemisphere, modules should typically face north.

5.2.2 The module shall be installed in the place where the sunshine is adequate. the module surface shall not be partly shaded by trees, building, clothes, tools, packaging materials, etc. because these objects will form shadow in the module surface leading to loss of system output power.

5.2.3 The module shall be installed in the well-ventilated place; meanwhile, enough space for airiness shall be sated at the back and sides of the module, so that the heat generated during operation can be radiated in time.

5.2.4 Modules must not be installed nor operated in locations with serious salt mist, hail, snow cover, sandstorm, smoke dust, air pollution, acid rain, soot, etc. and harsh environments. We suggest that the module shall be installed in dry areas with the moderate climate.

5.2.5 Never place the module near a naked flame or inflammable gas.

5.2.6 TW solar’s modules must be installed on suitable buildings with appropriate mounting structures, or other place suitable for modules installation, such as ground, carports, building facades, rooftops, PV trackers.

5.2.7 Lightning protection is necessary for PV systems in this area with high probability of lightning strikes.

5.2.8 Do not install the modules in this location with water immersion or near the sprinkler.

5.2.9 Modules must not be sited in locations with strong corrosive substances, such as salt, salt mist or other type of corrosive agent, which could affect the safety and/or performance of the modules. In case of the special installation environments such as the seaside, farm, high humidity environment and sandstorm environment, please contact the local dealer for professional support and confirmation.
5.3 Tilt Angle Selection

5.3.1 The tilt angle of the Modules is measured between the surface of the modules and a horizontal ground surface, the modules generates maximum power output when it faces the sun directly.

5.3.2 Modules connected in series should be at the same tilt and azimuth. Differing tilt or azimuth may cause mismatch of power output due to differing amount of sunlight exposure for each module and reduce the efficiency of the PV system.

5.3.3 Do consider the power output in winter when choosing the optimal tilt angle for the module, which will lead to enough power output throughout the year.

5.3.4 For detailed information on the best installation angle, please refer to standard solar photovoltaic Installation guides or consults a reputable solar installer or systems integrator.

6 Installation Instructions

6.1 Conventional Requirement

6.1.1 Ensure that the installed modules and supporting system of modules are strong enough, the entire PV system consisting of modules must be able to withstand anticipated mechanical pressure. The installer must provide the guarantee. The installation supporting system must be tested by the third-party organization with the analysis ability of Static Mechanical according to the local national or international standards.

6.1.2 The supporting system must be made of environmental corrosion, anti-rust and UV-resistant materials.

6.1.3 Modules must be securely fastened to the supporting system.

6.1.4 Drilling holes on the surface of module glass may void the warranty.

6.1.5 Forces generated during thermal expansion and contraction of the supporting system may influence the performance and use of the module, so make ensure that the minimum distance between two neighboring modules is 10mm, but in order to ensure good ventilation. Suggest this distance between two neighboring frames is 30mm.

6.1.6 Dust gathering on the surface of module will reduce the power output, so solar system installer should calculate the optimal tilt of the module to make it easier for dust to be washed off by rain.

6.1.7 The bearing surface of the supporting system must be smooth without any twist or deformation, and all of them shall be at the same height without dislocation.
6.2 Module installation

6.2.1 General rules

6.2.1.1 The connection between the module and the system bracket can be installed by fixture or bracket hooks, or by flexible special hooks between the module and the tightwires. If customers have special clamping and installation schemes that are not included in this manual, please consult local distributors for professional support. Module installation must be carried out in accordance with the following methods, otherwise the quality assurance will fail.

6.2.1.2 Tongwei modules have reached the IEC standard on the mechanical load requirements. Tongwei module can withstand the wind pressure of 2400Pa and the snow pressure of 5400Pa (Only the module models covered in this manual are available), it is recommended that the system designer or installer perform the load calculations.

6.2.1.3 The supporting rail and other materials required (such as screw) shall be made of durable, resistance to environmental corrosion, anti-rust and UV-resistant materials.

6.2.2 Fixture installation

6.2.2.1 Fixture installation is suitable for modules without hook as shown in Figure 1. Fixture recommended aluminum alloy material or with the performance of metal material. A suitable cushion is required between the fixture and the module glass. EPDM rubber is recommended.

6.2.2.2 Each module is recommended to be fixed with 8 clamps, 4 clamps on each side of the module. According to local Environment (depending on wind power and snow loads), additional clamps may be required to ensure modules and PV system to withstand anticipated mechanical pressure. We recommends using the following clamps (as shown in Figure 2, Figure 3), or approved by reputable solar installer or systems integrator.
6.2.2.3 The fixed clamp is clamped on the long side of the module, use the spring washers, flat washers and bolts to fix the modules to the mounting bracket. Note that both ends should be in the center symmetrical position. It is recommended to use the M8/ bolts and the matching screws to fix the screws. Tightening torque of the size of 17 ~ 23N • m.

6.2.2.4 Do not bend the modules while installing the modules. The mounting parts can not block the cells, do not scratch the glass surface of the module. It is recommended that the overlapping part of the module and the clamp should be 11-15mm in width, the length of the fixture should be at least 200mm, and the minimum thickness of the fixture should be at least 3mm.

6.2.2.5 The position of the clamp is critical to the reliability of the installation. The recommended clamping range is shown in Table 1:

<table>
<thead>
<tr>
<th>Module type</th>
<th>Design Mechanical Loading/Pa (Positive/ Negative)</th>
<th>A/mm</th>
<th>B/mm</th>
<th>C/mm</th>
<th>D/mm</th>
<th>E/mm</th>
<th>F/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>72 version type</td>
<td>2400/2400</td>
<td>1959</td>
<td>1076</td>
<td>392±50</td>
<td>784±50 (Mandatory)</td>
<td>11~15</td>
<td>≥200</td>
</tr>
<tr>
<td></td>
<td>3600/1600</td>
<td></td>
<td></td>
<td></td>
<td>784±50 (Mandatory)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 version type</td>
<td>2400/2400</td>
<td>1639</td>
<td>1076</td>
<td>339±50</td>
<td>678±50 (Mandatory)</td>
<td>11~15</td>
<td>≥200</td>
</tr>
<tr>
<td></td>
<td>3600/1600</td>
<td></td>
<td></td>
<td></td>
<td>678±50 (Mandatory)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Note:** Tongwei limited warranty will be void in cases where improper clamps or installation methods deviating from this manual are used. When using clamps to fasten the modules, pay attention to the following requirements:
(a) Take care of the module frames, not to twist or deform them.
(b) Avoid the clamps’ shading influence the module.

### 6.2.3 installation of flexible system

6.2.3.1 the installation of flexible system is applicable to the components with flexible backbars as shown in fig.9. Each component has 6 backbars on the back, and the minimum distance between the two components is 20mm. This component is applicable to the 1*7 (7-core) low-relaxation hot-dip galvanized or low-relaxation Galfan steel cables with a diameter of 12.7mm. This assembly is not intended for epoxy or PE protected cables or other construction (such as 1*19) cables. Cables shall meet the specification GB/T 5224-1995. This installation manual has no specific requirements for the bearing capacity of steel cables; however, the axial tensile elastic modulus (E) of the steel cable shall not be less than 170GPa.

![FIG. 9 is suitable for the imbricated double glazing assembly with flexible backing](image-url)
6.2.3.2 Installation steps:

A) carry the components to the installation position (do not slide along the cable), and install a clamp under the groove on the back to the parallel cable;

B) mounting and pressing:

C) install locking bolt (tightening torque: 50 N•m (about 5 kg force)):
6.2.3.3 When the number of components on a cable is less than 2, or the cable tensioning force cannot meet the requirement of 170GPa, avoid excessive deformation of the component under pressure, and add support beams on the support deck and the beams are in contact with the front or back surface of PV modules.

Supporting beams size: 1000mm*150mm*120mm, made of high-density black EVA

<table>
<thead>
<tr>
<th>Module type</th>
<th>Design Mechanical Loading/Pa</th>
<th>A/mm</th>
<th>B/mm</th>
<th>C/mm</th>
<th>D/mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>72 version type</td>
<td>2400/2400</td>
<td>235±30</td>
<td>585±30</td>
<td>980±30</td>
<td>150±5</td>
</tr>
<tr>
<td></td>
<td>3600/3600</td>
<td>/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 version type</td>
<td>2400/2400</td>
<td>235±30</td>
<td>620±30</td>
<td>/</td>
<td>150±5</td>
</tr>
<tr>
<td></td>
<td>3600/3600</td>
<td>/</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7 Electrical Installations

7.1 General With Regard to Electrical Installation

7.1.1 Under normal outdoor conditions, a module is likely to produce different current and voltage than the values measured under STC in the specification of TW solar’s module. Therefore, when determining the parameters (for example, nominal voltage, conductor capacity, fuse capacity and controller capacity, etc.) related to the power output of the PV system, the values of short-circuit current and open circuit voltage of the modules should be multiplied by a factor of 125% during design and installation.

7.1.2 Try to use the modules with the same configuration in the same PV system. If the modules are connected in series, the total voltage is the sum of voltages of all the modules. The maximum voltage of string does not exceed the maximum system voltage of the modules (the maximum system voltage of TW solar’s modules is 1500V), the maximum number of modules that can be connected in a series string must be calculated in accordance with applicable regulations, make sure the open circuit voltage of string does not exceed the maximum system voltage of the modules and the other electrical DC components required at the minimum temperature at the PV system location. Using the following formula:

$$\text{System voltage} = N \times \text{Voc} \times [1 + \lambda_{\text{voc}} (25 - \text{Tmin})]$$

- $N$: number of modules in series
- Voc: open circuit voltage at STC (refer to product label or data sheet)
- $\lambda_{\text{voc}}$: Thermal coefficient of Voc of each module (refer to product data sheet)
- Tmin: Minimum ambient temperature at the PV system location

7.1.3 If the PV system requires the installation of high current, several PV modules can be connected in parallel, and total current is the sum of current of all the modules. The maximum parallel number of the modules $N = \frac{\text{Imax (fuse rating)}}{\text{Isc}}$

7.1.4 An over-current protection device with appropriately rated must be used when reverse current could exceed the value of the maximum fuse rating of the module, an over-current protection devices is required for each series string if more than two series strings are connected in parallel.

7.1.5 When installing the module, place the end with the junction box up and try to avoid the rain.

7.1.6 Do not carry out installation in rainy weather, because humidity will void the insulation protection, Thus cause safety accidents.
7.2 Cables and wiring

7.2.1 The junction boxes with IP67 protection class have been designed to be easily interconnected in series by the connectors. Each module has two single-conductor wires, one positive and one negative, which are pre-wired inside the junction box. Installers can connect two modules by firmly inserting the positive connector of a module into the negative connector of the other module.

7.2.2 Never perform pretreatment to modules including connector, junction box and cable with lubricating oil or cleaning agent made of alkanet materials during installation.

7.2.3 The cross section area of the cable and connector capacity selected must satisfy the maximum short-circuit current of the system (It is recommended that the cross section area of the cable used for the single module is 4mm², Please note that the temperature limit range of the cable is -40°C ~ +90°C).

7.2.4 When fastening the cables to the supporting system, pay attention to avoiding mechanical damage to the cables or modules, and also making a special design to protect the cables from environmental corrosion and direct sunshine, for example, put the cable into the supporting beam or special pipes with UV-resistant materials.

7.2.5 The cables designed are sunlight resistant and waterproof, but also to avoid direct sunlight exposure and water immersion of the cables.

7.3 Connectors

7.3.1 When connecting modules, make sure that the connectors of the same series module shall come from the same manufacturer or totally be compatible with each others, and the same requirements shall go to the connection terminals of series string and PV system, because the connectors from different manufacturers may not be compatible with each others, which easily leads to mismatch risk.

7.3.2 Ensure that connector caps are tightened before connecting the modules, keep connectors dry and clean. Do not attempt to make an electrical connection when the connectors are wet, soiled, or otherwise faulty conditions. Avoid sunlight exposure and water immersion of the connectors.

7.4 Bypass diodes

The junction boxes of TW Solar’s modules contain bypass diodes wired in parallel with the PV cell strings. In case of partial cell shading or damaged, the parallel diodes will bypass the current generated by the non-shaded cells, thereby limiting modules heating and performance losses. Take care, the bypass diodes are not over-current protection devices.
8 Maintenance

8.1 Usual maintenance

8.1.1 In the warranty period, the user must carry out regular inspection and maintenance of the modules, which is the user’s responsibility. And the user must inform the supplier within one week when founding the damages modules.

8.1.2 When modules are working. There should not be environmental influence factors to cast shadows in the modules, such as other modules, supporting system, plants, large number of dust etc., which may distinctly reduce the power output and may even cause regional hot-spot effect. Therefore clean the glass surface on a regular basis, clean modules take measures so as:

1. In general, normal rainfall can keep the glass surface clean. If the dirt accumulated too much, using water and a soft sponge or cloth for cleaning. If necessary, a mild, non-abrasive cleaning agent can be used to remove stubborn dirt.

2. Avoid pressing part of the module hard during cleaning, which may cause glass deformation, cell damage and reduction of the module’s life.

3. Remove the snow covered on the module in time to avoid the module damage caused by long-term accumulation of snow cover and freezing of melted snow.

4. Do not clean module with cold water when the module temperature is highest in the daytime, and the thermal shocks might damage the module.

5. When cleaning the back of the module needs to avoid piercing back-sheet, module needs to be often cleaned for horizontal installation (the cleaning frequency depends on the degree of dirt).

8.2 Visual inspection of modules

Inspect the modules visually to find whether there are appearance defects, the following need special attention:

1. Check whether the module glass is broken;

2. Check whether there is burning vestige or back up on the back-sheet;

3. Check whether there is corrosion along the cell bus-bar or damaged of encapsulation materials or a large area of the bubbles etc.

4. Check aluminum frame holes are normal; the screws of installation are tightness and electrical cables are situation.
8.3 Check cables and connectors

8.3.1 Carry out regular inspection of mechanics and electric, ensure the cleaning of the connector and be reliable connected.

8.3.2 Check weather all electrical connections are tight or corrosion free.

8.3.3 Maintenance should be carried out at least once a year.

8.3.4 Completely cover the module with an opaque material during repairing the module to prevent electric shock. When exposed to direct sunlight, one individual PV module may generate high DC voltages, so please caution of repairing. And repairing modules must be disposed properly by professional.

* If any problem arises, have it investigated by a competent specialist.

* If the maintenance measures are not included in this manual, please contact the local dealer for professional support.