



Installation Manual of Solar Module



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1. General Information

This manual contains information regarding the installation and safe handling of AFTOsolar photovoltaic modules. Installers should read this manual carefully and strictly follow the instructions before installing the modules. Failure to follow these instructions may result in death, bodily injury, or property damage.

The installation of modules requires specialized skills and should only be performed by qualified, licensed professionals. If you have any questions about installation, please contact us for further information.

2. Safety Precautions

- AFTOsolar modules have passed all required safety tests according to the IEC 61730 and are rated with Application Class A. The application class modules are considered to meet the requirements for Safety Class II.
- All installations must be performed in compliance with all local and national applicable standards, codes, and regulations.
- Installers should assume all risks of injury that might occur during installation, including, but not limited to, the risk of electric shock.
- Do not use mirrors or other magnifiers to concentrate sunlight on the modules artificially.
- Do not attempt to disassemble the modules or remove any components from the modules.
- Do not install the module in the rain, snow, or windy conditions.
- Use insulated electrical tools and appropriate protective equipment to reduce the risk of electric shock.
- Cover the module with an opaque material during installation to keep electricity from being generated.
- Do not disconnect under load.
- Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the value of I_{sc} and V_{oc} marked on the module should be multiplied by 1.25 when determining PV system

component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.

- Only PV modules with the same cell size should be connected in series.
- Do not clean the glass with chemicals. Only use tap water. Make sure the module surface temperature is cool to the touch. Cleaning modules with cool water when module surface temp is high may result in glass breakage.

3. Storage and Unpacking

- Once the PV module has been shipped to the installation site, all of the parts should be unpacked properly with care.
- Store modules in a dry and ventilated room.
- Do not stack packing cartons more than two layers high.
- Unpack module pallets with care and follow the unpacking steps. Be careful when unpacking, transporting, and storing the modules.
- Do not lift the module by grasping the module's junction box or electrical leads.
- Do not place modules on top of each other.
- Do not stand or step on the module.
- Do not drop the module or allow objects to fall on the module.
- Do not leave the module unsupported or unsecured.
- Keep all electrical contacts clean and dry.
- During transporting modules, please attempt to minimize shock or vibration to the module, as this may damage the module or lead to cell micro cracks.
- During all transportation situations, never drop the module from a vehicle, house or hands. This will damage module.

4. Product Identification

Each AFTOsolar module has two identical barcodes with 15 digits for its unique identification (one is in the laminate, and the second is on the back sheet).

A nameplate is affixed on the backside of the module. This nameplate describes the module's main characteristics, including the product type, maximum power, open circuit voltage, short circuit current, maximum power voltage, maximum power current, all as measured under standard test conditions; maximum system voltage, weight, and dimensions, etc. Do not remove any labels from the module. If the label is moved out, the module will void the warranty.

5. Mechanical Installation

5.1 Climate Condition

AFTOsolar modules should be installed in the following conditions:

- Ambient temperature: -20°C to $+40^{\circ}\text{C}$
- Operating temperature: -40°C to $+85^{\circ}\text{C}$
- Storage temperature: -40°C to $+40^{\circ}\text{C}$
- Humidity: below 85RH%
- Wind load: below 2400Pa
- Snow load: below 5400Pa

5.2 Site Selection

- AFTOsolar modules should be installed in a location where they will receive maximum sunlight throughout the year. The modules should typically face south in the northern hemisphere. Otherwise, the modules should typically face north in the southern hemisphere.
- When choosing a site, avoid trees, buildings, or obstructions, which could cast shadows on the modules, especially during the winter months when the sun's arc is lowest over the horizon. Shading causes loss of output, even though bypass diodes have been fitted in the module's junction box to minimize any such loss.
- AFTOsolar modules have a Class C fire-resistance rating under the IEC61730-2 standard. Modules should be mounted over a fire-resistant covering for roof installation, with adequate ventilation between the module back sheet and the mounting surface. In order to maintain the fire class rating, the distance between the modules frame and the roof surface shall be at least 100mm.
- Do not install the module near a naked flame or flammable materials.

- Please do not install the module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain, etc.

5.3 Module Tilt Angle

Modules connected in series should be installed at the same orientation and angle. Different orientations or angles may cause a loss of output power due to the difference in the amount of sunlight exposed to the module.

Modules produce the most power when they are pointed directly at the sun. For installations where the modules are attached to a permanent structure, the modules should be tilted for optimum winter performance. As a rule, if the system power production is adequate in winter, it will be satisfactory during the rest of the year. The optimal tilting of the module is roughly the same as the latitude of the installation location.

5.4 Installation Methods

The modules can be installed on the frame using screw mounting and clamp mounting methods, as shown in Fig.1.

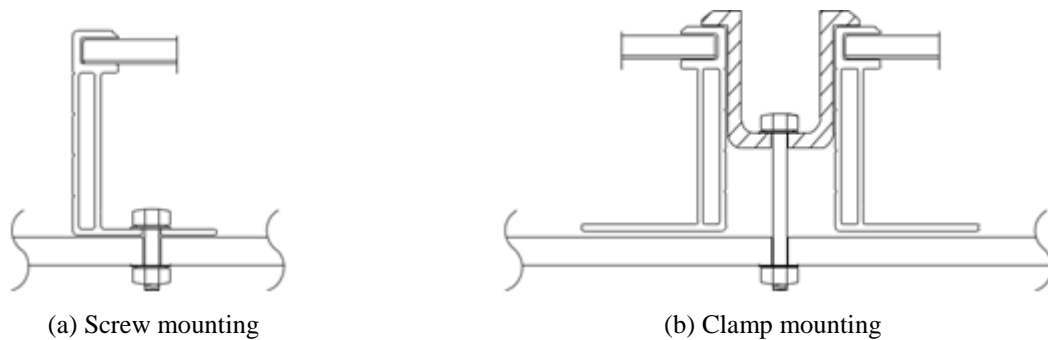


Fig.1: The module installed with (a) screw mounting, (b) clamp mounting

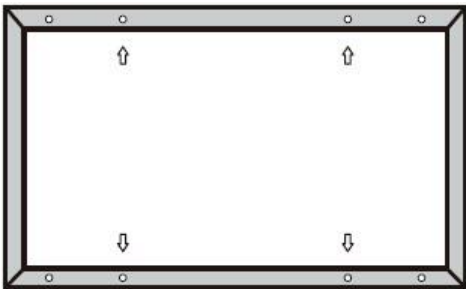
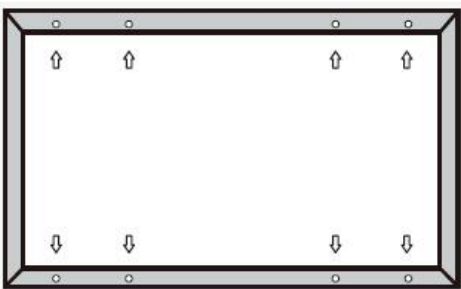
5.4.1 Screw Mounting Installation

The frame of each module has eight mounting holes used to secure the modules to the support structure. If the wind or snow load is less than 2400Pa, you can use the four symmetry holes close to the inner side of the module frame, as shown in Fig.2. If the wind or snow load exceeds 2400Pa, you must use all the eight mounting holes. The module frame must be attached to a mounting rail using

M8 corrosion-proof screws together with spring washers and flat washers in eight symmetrical locations on the module. The applied torque should be 16~20 N.m (140-180 lbf.in.).

For a precise screw mounting method, please refer to Table 1.

Table 1: Detailed Screw Mounting

Loads	Wind Loads: 2400Pa Snow Loads: 2400Pa	Wind Loads: 2400Pa Snow Loads: 5400Pa
	Using 4 mounting holes	Using 8 mounting holes
Screw Mounting		
	○ Mounting holes	○ Mounting holes

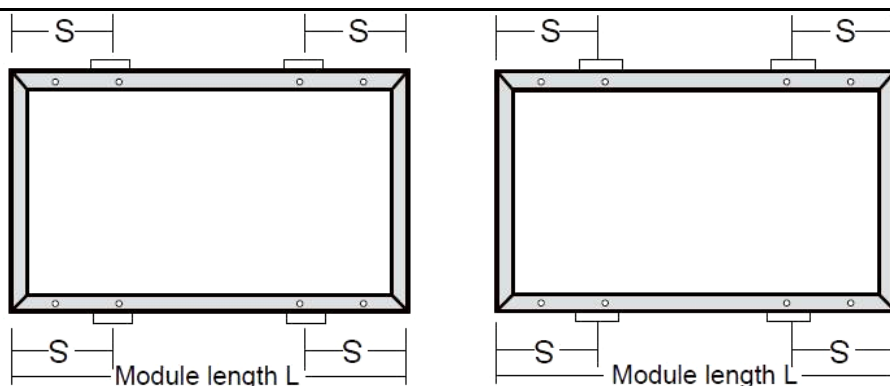
5.4.2 Clamp Mounting Installation

- The modules can be installed in both landscape (clamping on the short frame) and portrait (clamping on the long frame) modes by clamp mounting.
- The module clamps should not contact the front glass and must not deform the frame.
- Be sure to avoid shadowing effects from the module clamps.
- The module frame is not to be modified under any circumstances.

For detailed clamp mounting on the long and short frames, please refer to Table 2.

Table 2: Detailed Clamp Mounting

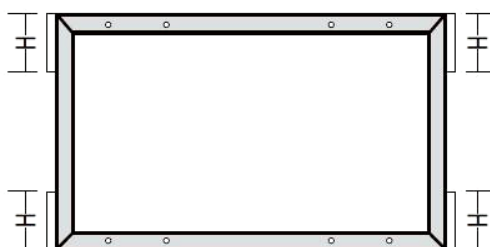
Loads	Wind Loads: 2400Pa Snow Loads: 2400Pa	Wind Loads: 2400Pa Snow Loads: 5400Pa
Clamp Mounting on Long Frames	$0 < S < 1/4L$ (L: Module length)	$1/4L - 50\text{mm} < S < 1/4L + 50\text{mm}$



Permissible Clamp Range Permissible Clamp Range

$$1/5W < H < 1/4W \text{ (W: Module width)}$$

Clamp Mounting on Short Frames



Permissible Clamp Range

6. Electrical Installation

6.1 Module Wiring

Modules are supplied with cables and connectors for system electrical connections. It is not recommended to use modules with different configurations and electrical characteristics in the same system.

Modules can be connected in series to obtain a high operating voltage. The system voltage is equal to the sum of the voltage of each module. Modules can also be connected in parallel to obtain a high operating current. The systems current is equal to the sum of the current of each string of modules.

Under normal conditions, a module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. The suggested fuse must be used for overcurrent protection. Accordingly, the I_{sc} and V_{oc} marked on this module should be multiplied by a factor of

1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.

The maximum number of series-connected modules depends on system design, the type of inverter used, and environmental conditions. It should be noted that modules must not be connected to create a voltage higher than the permitted system voltage. There is no limitation on the number of modules that can be connected in parallel; the number of modules is determined by system design parameters such as current or power output.

The maximum number of modules to be installed in series on the installation, N^{\max} , is calculated using the following formula:

$$N^{\max} = \frac{V_{system}^{\max}}{V_{OC}^{stc}}$$

The maximum voltage supported on an installation (V_{system}^{\max}), with AFTOsolar's photovoltaic modules is presented in the following table:

Table 3: Detailed Clamp Mounting

	IEC	UL
Maximum System Voltage (V)	1000/1500	1000/1500

6.2 Grounding

Grounding modules are necessary to reduce or eliminate shock and fire hazards. All module frames and mounting racks must be properly grounded in accordance with local and national electrical codes. Proper grounding is achieved by respectively connecting the module frames and mounting racks using a suitable grounding conductor. The grounding conductor or strap could be copper, copper alloy, or other material acceptable for electrical conductors.

6.2.1 Grounding by using Grounded Clamp

There are two grounding holes with 4.0 mm diameter in the middle of the long frames of the modules. A qualified electrician must approve the grounding between modules. Moreover, the grounding device must be produced by a qualified electrical manufacturer. The recommended twist torque value is 2.3 N.m. A copper core size of 12 AWG can be used as a grounding clamp. The copper wire should not be compressed during the installation. Note: The figure is using TYCO. 1954381-1 (recommended).

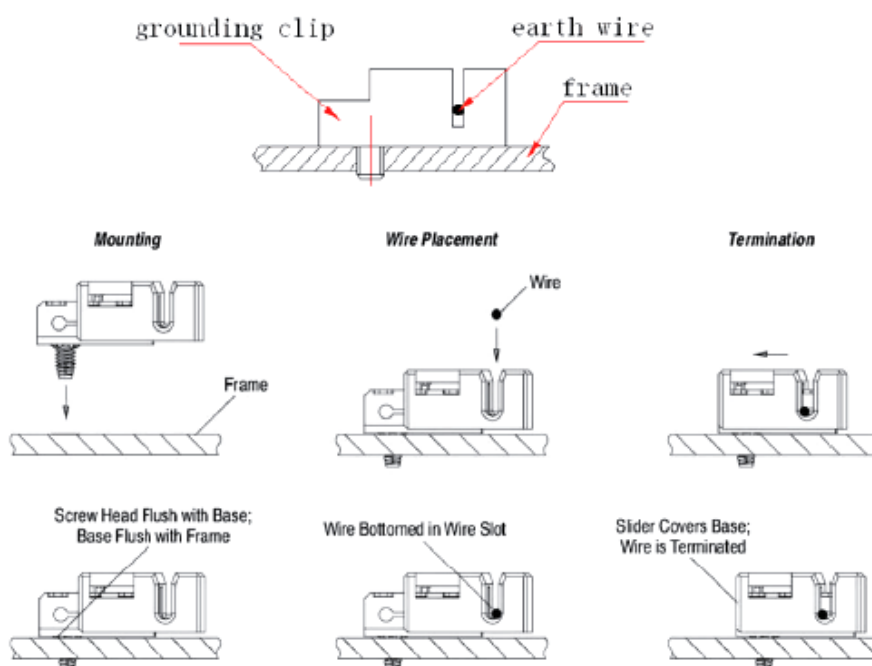


Fig.2: Grounding method

6.2.2 Grounding by using Unused Grounding Hole

The existing grounding holes that have not been used can be used for grounding.

- 1) Direct the grounding clamp to the mounting hole on the frame. Thread the grounding clamp and the frame with the grounding bolt.
- 2) Put the toothed gasket into the other side, then tighten and lock the nut. The recommended torque for locking the nut is 2.0 N.m ~ 2.2 N.m.
- 3) Thread the grounding clamp with grounding wire. The material and size of grounding wire should meet the national, regional and local rule, laws, and standard requirements.
- 4) Finish the mounting by tightening the binding bolt of the grounding wire.

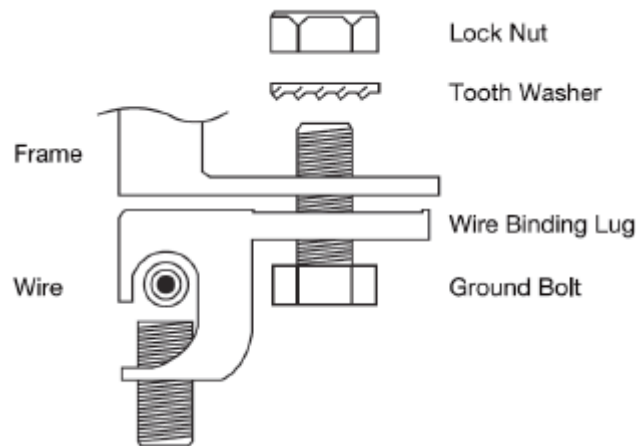


Fig.3: Grounding method

6.2.3 Additional Third-Party Grounding Devices

The modules can be grounded using third-party grounding devices so long as they are certified for grounding modules and the devices are installed according to the manufacturer's specified instructions.

6.3 Inverters Configuration

When installed in PV systems, AFTOsolar modules usually do not need to be connected to the earth and, thus, can be operated together with either galvanically isolated (with transformer) or transformerless inverters. However, if the system is located in a hot, humid climate and the maximum voltage is greater than 600Vdc, then galvanically isolated inverters incorporating a transformer are recommended to be used, and the negative pole of the array should be connected to the earth.

7. Maintenance

In order to ensure optimum performance of the modules, it is required to perform regular inspection and maintenance of the modules. The following maintenance measures are recommended to be performed.

7.1 Visual Inspection

- Perform a comprehensive inspection of the modules every six months.
- Check whether there are visual defects in the components of the modules.

- If the front side of the modules is shaded by vegetation and other foreign materials, trim the vegetation and remove other foreign materials due to the shading on the modules.
- Check whether mounting hardware is tightened correctly, and adjust and tighten as necessary.
- If the tempered glass of modules is broken, the affected modules need to be replaced. Only qualified professionals can perform the replacement of modules.
- Do not try to change the components of modules (Junction box, bypass diode, and connector).

7.2 Connector and Cable Inspection

- Check the electrical connections between connectors and cables to ensure that all connections are tight, secure, intact, and free of corrosion.
- Check the torque of terminal bolts at least once a year, and tighten them as necessary.
- If the connectors and cables are damaged, the damaged parts need to be replaced by qualified professionals.

7.3 Cleaning

- Dirt and dust may accumulate on the glass surface of the modules and reduce the power output of the modules. It is recommended to clean the modules regularly to ensure maximum power output, especially in low rainfall areas.
- In order to reduce the potential for electrical and thermal shock, the modules should be cleaned during the early morning or late afternoon when solar radiation is low, and the modules are cooler, especially in regions with high temperatures.
- Use a soft sponge or cloth together with a mild detergent and clean water when cleaning the modules. Take care to avoid severe thermal shocks that may damage the modules by using water and having a similar temperature to the cleaned modules.
- It is not allowed to use metal tools such as blades, knives, steel wool, and other abrasive materials.
- Conventional household glass cleaning agents can be used for greasy dirt or other substances on the surface of the modules that are difficult to clean. Do not use alkaline and strong acid solvents, which may cause glass corrosion.
- The pressure of the cleaning water should be less than 690KPa. It is not recommended to use water with high mineral content as it may deposit on the glass surface when the water is dry. Most municipal water is suitable to clean the modules.

- Do not use steam or corrosive chemicals to speed up the cleaning.
- Do not try to clean broken glass or modules with broken lines or exposed wires, as it may cause electric shock.
- When cleaning the modules, do not step on the modules; do not spray water on the backside of the modules or the cables; do not clean the backside of the modules; keep the connectors clean and dry; prevent fire and electrical shock.
- AFTOsolar modules are designed to be able to withstand high snow pressure. If you need to clear snow to improve the output power of the modules, use a hairbrush to gently remove the snow and use the gas to blow the snow. Do not try to remove frozen snow or ice on the modules, which may cause damage to the modules.

8. Disclaimer of Liability

Since the use of this manual and the conditions or methods of installation, operation, use and maintenance of the product are beyond AFTOsolar's control, AFTOsolar does 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.

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