

INSTALLER MANUAL

Energizer[®]

SOLAR PANELS

Beam Series Crystalline Silicon PV Modules Installation Manual

Version 1.3, Released in March 2023.

This guide describes how to install the *Energizer* Solar Beam crystalline silicon PV modules. To prevent improper operation before use, please carefully read this manual.

1 Table of contents

1	Table of contents	2
2	Important notes	3
3	Laws and regulations	3
4	Safety measures	3
5	Handling and unpacking	6
6	Mechanical installation.....	10
6.3.1	Bolting through the mounting holes.....	11
6.3.2	Clamping on the frame surface	13
7	Electrical Installation	15
8	Maintenance	19
	Modified version and date.....	20

2 Important notes

2.1 Scope

This manual describes the assembly, installation, commissioning, maintenance and troubleshooting of Energizer Solar Panels.

2.2 Target Group

This manual is for qualified personnel only. The tasks described in this manual need to be performed by professional, suitably qualified technicians only.

2.3 Safety

Please read all the instructions in this manual carefully before installation, as well as electrical and mechanical requirements.

The installation and operation of photovoltaic modules requires professional skills that only professionals can do. The installation process is strictly observed with all safety precautions in this manual and the manual is kept for further reference. At the same time, the installer must inform the end customer (or consumer) of the above accordingly.

2.4 Purpose

This manual provides detailed instructions and important safety precautions for the installation, electrical connection and maintenance of single-sided *Energizer* Solar crystalline silicon photovoltaic modules (hereinafter referred to as photovoltaic modules). This document applies to photovoltaic module types listed below.

ENSP54M2xxx	ENSP60M1xxx	ENSP72M1xxx
ENSP54MBL2xxxBF	ENSP60M2xxxBF	ENSP72M2xxx
ENSP54N2xxxBF	ENSP60MBL2xxx	ENSP72N2xxxSI
ENSP54NBL2xxxBF	ENSP60M3xxx	ENSP72NBL2xxx
ENSP60N2xxx	ENSP60NBL2xxxBF	ENSP78N2xxx
ENSP60N3xxx	ENSP66M3xxx	

Table 1: Photovoltaic module types.

2.5 Limitation of Liability

Since the use of this manual and the installation, operation, use and maintenance of photovoltaic modules are beyond the control of 8 Star Energy Proprietary Limited (hereafter “8 Star Energy”), this manual does not have any warranty meaning, whether express or implied. 8 Star Energy will not be responsible for any form of injury, including, but not limited to, damage, loss of life or additional expenses caused by incorrect installation, operation, use and maintenance of photovoltaic modules and systems.

Energizer Solar reserves the right to update this manual without prior notice. If there are inconsistencies in the descriptions between different language versions of this manual, the English version will prevail.

3 Laws and regulations

The mechanical and electrical installation of photovoltaic modules should be carried out in accordance with applicable laws and regulations, including electrical law, building law and electrical connection requirements. These regulations vary depending on the installation location, such as the roof of the building, the surface of the water, etc., or may vary depending on the installation system voltage, dc usage, or AC. Please contact your local authority for specific terms.

4 Safety measures

- *Energizer* Solar modules are designed to meet the requirements of IEC 61215 and IEC 61730, and have been qualified for application class A (equivalent to Safety Class II requirements).
- Modules rated for use in this application class may be used in system operating at greater than 50V DC or 240W, where general contact access is anticipated. The module complies with IEC61730 and UL61730 standards and meets Class C fire rating (IEC61730), and type 4 fire rating (UL61730).



All safety rules should be read and understood before installing, wiring, handling, and/or maintaining photovoltaic modules. When the photovoltaic module is exposed to sunlight or other light sources, direct current is generated. Direct contact with the live part of the photovoltaic module, such as terminals, whether or not a photovoltaic module is connected, can result in loss of life.

4.1 General safety measures

- Before installation, please contact the relevant local authority to determine the installation permit and installation inspection requirements that meet the local requirements. The installation process should comply with the safety rules applicable to all components in the system, including cables, terminals, charging monitors, batteries, inverters, etc.
- If you install or operate photovoltaic modules on a rainy day or in the morning with dew, you need to take appropriate protective measures to prevent water vapor from penetrating into the connectors.
- Unauthorized personnel are prohibited from approaching the installation area or photovoltaic module storage area.
- It is forbidden to install or use damaged photovoltaic modules.
- It is forbidden to repair photovoltaic modules by yourself, including but not limited to replacing any components of photovoltaic modules (diodes, junction boxes, connectors, etc.).
- It is forbidden to plug in connectors of different types and models.
- It is forbidden for photovoltaic modules to be used or exposed to the following substances in an environment containing the following substances: grease or organic ester compounds (such as DOP, plasticizers), aromatics, phenols, ketones, halogenated substances, mineral oil, alkanes (Such as gasoline, cleaning lubricants, electronic resurrection agents), alcohol, certain drugs (white flower oil, active oil, bone-setting water, thinner), adhesive sheets that can generate oxime gas and potting glue (only for connectors) (Such as KE200, CX-200/chemlok, etc.), TBP (plasticizer), detergent, etc., to avoid chemical damage and affect the electrical safety performance of photovoltaic modules.
- It is forbidden to install photovoltaic modules in windy weather due to safety issues.
- It is forbidden to focus sunlight on photovoltaic modules via external means.
- It is forbidden to use photovoltaic modules in relevant places such as movable platforms (except for tracking brackets).
- It is forbidden to disassemble and move any part of the photovoltaic module; if the connector of the photovoltaic module is wet, do not perform any actions to avoid the risk of electric shock.
- Do not connect or disconnect the photovoltaic module when there is current or external current from the photovoltaic module.
- The cover of the junction box should always be kept closed.
- Avoid partial shading of photovoltaic modules for a long time. Otherwise, the temperature of the shaded solar cells will rise (hot spot effect), and in severe cases, the photovoltaic modules may be burned, or even a fire may occur.
- For photovoltaic modules used in deserts or windy and sandy areas, it is recommended to use connector dust caps before installation, or take other measures to prevent sand and dust from entering the connectors, otherwise it may cause insertion problems or electrical safety hazards.

4.2 Operational safety measures

- During transportation and storage, avoid packaging damage due to falls or mis-treatment; ensure that the packaging boxes are ventilated, protected from the rain and dry; after arriving at the installation site, carefully open the outer packaging to prevent scratches and bumps on the photovoltaic modules due to improper unpacking. When stacking photovoltaic modules, the stacking requirements must be strictly followed.
- Avoid impact or scratches on any part of the photovoltaic module, otherwise the reliability and safety of the photovoltaic module will be affected; standing or walking on the photovoltaic module is prohibited; at the same time, in order to avoid glass damage, it is forbidden to apply excessive load or distort photovoltaic modules.
- Installation and carrying of photovoltaic modules must be done by more than one person. It is forbidden to pick up, drag, or move photovoltaic modules by grabbing the junction box (including the box body, cables, and connectors). When placing a photovoltaic module on a flat surface, it must be operated carefully and care must be taken to not bump the corners.
- When installing or repairing the photovoltaic system, do not wear any metal accessories to avoid the risk of electric shock; if it is installed far above the ground, please wear a safety harness.
- When operating photovoltaic modules in the sun, please use insulated tools, and wear rubber gloves and protective clothing. At the same time, in order to avoid the risk of arc and electric shock, do not directly touch the junction box and the end of the output cable (connector) with your hands.
- When the photovoltaic modules are electrically connected choose a dry and low sunlight period, preferably morning or evening; or use opaque materials to completely cover the surface of the photovoltaic modules to prevent current generation.
- A certain distance between the photovoltaic module and the installation surface should be kept to prevent the installation surface from touching the junction box.
- When installing on the roof, comply with the fire protection requirements of the building. It is recommended to install photovoltaic modules on a fireproof and insulated roof covering, and ensure adequate ventilation between the photovoltaic modules and the installation surface. In order to ensure the fire rating on the roof, the minimum distance between the frame of the photovoltaic module and the roof surface is 10 cm.
- The connector must be fully mated when wiring. If the cable is too long, it is recommended to fix the cable to the installation system with a UV resistant nylon cable tie. When fixing the cable to the bracket, the bending radius of the cable should not be less than 48mm.
- Avoid directly exposing cables and connectors to sunlight. Please use anti-ultraviolet cables.
- Do not disconnect the electrical connection when there is a load.
- It is strictly forbidden to try to disassemble the photovoltaic module, and it is strictly prohibited to remove the nameplate of the photovoltaic module or other parts on the photovoltaic module; it is strictly forbidden to paint or apply any adhesive on the surface of the photovoltaic module.
- It is strictly forbidden to drill holes in the frame of the photovoltaic module.
- It is strictly forbidden to scratch the anodized layer on the surface of the aluminum alloy

frame, except when it is connected to the ground. Scratches may cause corrosion of the frame, affecting the frame's load-bearing capacity and long-term reliability.

- If the photovoltaic module glass or other packaging materials are damaged, please wear personal protective equipment to separate the photovoltaic module from the site or the circuit. It is strictly forbidden to touch wet photovoltaic modules, unless you are wearing electric shock protection equipment that meets the requirements.
- When professionals replace or repair photovoltaic modules, do not damage the surrounding photovoltaic modules or their support structures.
- When cleaning photovoltaic modules, you must follow the cleaning requirements of photovoltaic modules.
- The connectors must be kept dry and clean to ensure that they are in good working condition. Do not insert other metal objects into the connector or make electrical connections in any other way.

5 Handling and unpacking

If the photovoltaic module is not in use, please do not open the product packaging. The goods should be stored in a dark, dry and ventilated place. If the photovoltaic modules are stored in an uncontrollable environment, the storage time must be less than 3 months when the outer packaging of the photovoltaic modules is kept intact.

It is recommended to take appropriate amount of photovoltaic modules for unpacking according to the project progress every day, and the unpacked photovoltaic modules should be installed within a day. After unpacking, the photovoltaic modules are stacked on the ground. In severe weather such as heavy rain, the photovoltaic modules may be immersed in water for a long time and affect the reliability of the product. In severe weather such as

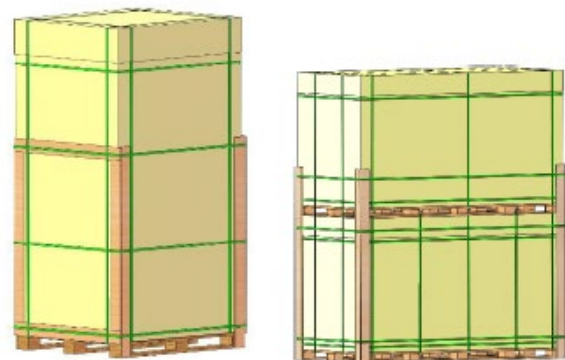
typhoons, photovoltaic modules that have not been installed may also be scraped away.

5.1 Transport

When the photovoltaic modules are transported to the project site, they must be transported in the packaging box provided by 8 Star Energy, and should be stored in the original packaging box before installation. Please protect the packaging from damage.

It is necessary to protect the safety of photovoltaic modules when unloading, especially when hoisting roof projects. It is forbidden to use lifting straps directly on the pallet for hoisting. The photovoltaic modules should be placed in a protective device and then hoisted to the roof to prevent the packing box from deforming and bumping against any walls during the hoisting process.

There are two packaging methods for 210mm-wafer modules, vertical portrait package and vertical landscape package. The requirements for unloading and unpacking are also different. The packaging method is as follows:



Vertical portrait package

Vertical landscape package

When unloading with a crane please adhere to the following:

1. Use specialized equipment for crane operation. Select suitable hoisting equipment with enough strength according to the weight and the size of

the load. Adjust the position of the sling to ensure the center of gravity is stable and keep moving at a stable speed. Place the package lightly on a flat ground and right the package.

2. Do not unload the modules under conditions of wind over class 6, rain and snow.
3. For vertical portrait packages, do not lift up more than 2 pallets of modules at once. For vertical landscape packages, do not lift up more than 2 pallets of modules at once. For lateral unloading, remove the pallet stacking belts before unloading.



Hoisting equipment



Vertical portrait package unloading with crane



Vertical landscape package unloading with crane

When unloading with a forklift please adhere to the following:

1. Unload from both sides of the truck.

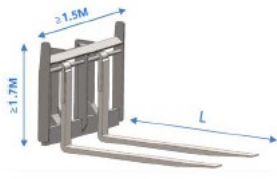
2. Select a suitable tonnage forklift according to the module weight, the fork distance should be adjusted to the maximum position without any interference to the pallet, the forks should go into the pallet at least 3/4 of the pallet depth during unloading (the forks length must be \geq 3/4 of pallet length), the backrest height should be no less than 1.7m and the backrest width should be not less than 1.5m.
3. The contact position between the backrest and the module package should be fixed with a buffer material (preferably silicone, rubber, EPE) to prevent the forklift from damaging the modules.
4. Since the packing box will block the sight of the forklift driver, it is recommended to drive backwards whilst moving a pallet, and arrange for special supervision and command to prevent bumping into people or items causing personal injury or damage to the modules.



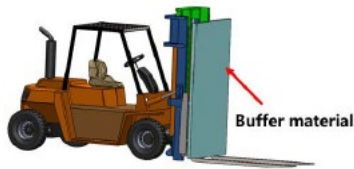
Vertical portrait package unloading with forklift



Vertical landscape package unloading with forklift



Backrest: height $\geq 1.7\text{m}$, width $\geq 1.5\text{m}$



Cushion materials in front of the backrest



Due to the limitation of the height of the container, when the photovoltaic modules are removed from the container, the distance between the upper surface of the forklift tines and the ground should be less than 50mm, otherwise collisions may easily occur, which may damage the photovoltaic modules.



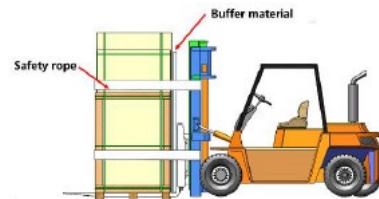
Unloading from container

Packaging turnover points are as follows:

1. When transporting the vertical portrait packages, the entire module package shall prop against the backrest, backrest shall be perpendicular to the fork, and the structure must be firm (withstand pressure ≥ 1.5 tonnes). When the entire module package leans on the backrest, the backrest shall not be deformed due to the pressure. The package must be fixed using a safety rope with tensile strength of $\geq 2000\text{kg}$, and you must place safety guardrails on both sides of the forklift.
2. The forklift should be driven at a controlled speed of ≤ 5 km/h in straight, and ≤ 3 km/h for

turning, so as to avoid sudden stop and rapid start.

3. When using the hydraulic vehicle to transport the modules, the distance between the upper surface of the fork and the ground should be less than or equal to 75mm.



Forklift operation



Distance between the upper surface of the forklift tines and the ground.

5.2 Unpacking

Before unpacking, please make sure that the packaging box is in good condition, it is recommended to use an art knife to remove the packing belt and wrapping film. When unpacking, you need to remove the stretch film first, then use a knife to cut the binding tape, and remove the packing box cover.

It is strictly prohibited to unload modules under the weather conditions of wind speed greater than Level 6, heavy rain or heavy snow.

If the inner packaging is fixed with anti-falling tape, a group of two should hold the frame with both hands in the same direction and take out the photovoltaic modules one piece at a time, and remove the photovoltaic module by tearing off a piece of fixing glue. The photovoltaic modules in the box will fall; if the internal packaging is fixed by the internal packing belt, first cut the internal packing belt, use anti-inverted sticks and other non-sharp and reliable

items to hold one side of the long side frame, and then cut the other side. Two people can then move and take out the photovoltaic modules one by one around the frame; the whole handling process needs to be handled with care, and you must make sure to not collide with any hard objects or allow any part of the frame to touch the ground or be dragged.



If the unpacked modules are not installed immediately, they should be fixed to the stand supporter with a safety rope. When the modules need to be temporarily stored after unpacking, they should be neatly and stably stacked on two pallets of appropriate size, the number of stacked modules should not exceed 14.

1. Prepare the following tools before unpacking: art knife (scissors), safety hat, stand supporter, safety shoes and anti-cutting gloves.



Safety helmet



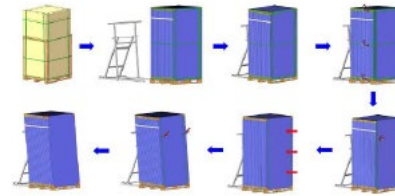
Pen knife



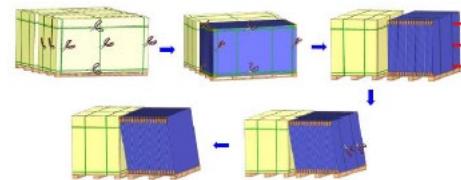
Stand supporter

2. Stand supporter must be used for vertical portrait package unpacking, and the steps are as follows:
 3. Remove the packing belts, wrapping film, top cover and carton box.
 4. Place the stand supporter into the bottom of the pallet from the glass or backsheet side
 5. Insert fixed bolts into the front hole of the support.
 6. Cut off the horizontal packing belts.
 7. Cut off the vertical packing belts excepting two inner belts.
 8. Push the module gently to tilt towards the stand supporter.
 9. Cut the remaining packing belts.

10. Tear off the anti-fallen tape on the first module in the front, and then take out the modules in order



11. Vertical portrait package unpacking steps
12. A fixed support (wall, rack, stable unpacked module pallets, etc.) must be ready for vertical landscape package unpacking, and the steps are as follows
 13. Remove the packing belts, wrapping film, top cover and carton box.
 14. Cut off the horizontal packing belts.
 15. Cut off the vertical packing belts excepting two inner belts, then push the module gently to tilt towards the stand supporter.
 16. Cut the remaining packing belts.
 17. Take out the modules in order.



Vertical landscape package unpacking steps

5.3 Stacking of photovoltaic modules

When taking out the photovoltaic module from the packing box, you need to lay the cardboard on the ground first to prevent the photovoltaic module from colliding and scratching with any cement surface or hard object such as the ground, color steel, tiles, metal corrugated roofing, etc.

When the photovoltaic modules are stacked, they must be neatly and stably stacked on a horizontal surface, and stacked with the glass side facing down and the back side facing up. At the same time, there

must be cardboard bedding under the photovoltaic modules. For example, when installing photovoltaic modules on the roof, the number of modules stacked up on a pile should not exceed 20. For roofs with poor load-bearing capacity, it is recommended that the designer or installer evaluate the load-bearing capacity of the roof and reduce the load-bearing unit area of the roof by reducing the number of piles. At the same time, avoid placing any installation tools or other objects on the surface of the photovoltaic module.

Energizer Solar PV modules adopt high and low current bins, and the handlers need to place them separately and mark them according to the markings on the power list of the PV modules outer packaging (for example, 270W-L means low current gear; 270W-H means high current gear position; the current division method required by other customers is similar). According to the system design requirements, the same current gear position is usually required in the same array during installation. If the customer requires PV modules to be distinguished by color, the outer packaging box shall be marked accordingly, and the PV modules shall be marked to prevent confusion when they are taken out of the packaging box and stacked. According to the system design requirements, the color of photovoltaic modules in the same row or square array should be the same.

6 Mechanical installation

6.1 Installation conditions

- Recommended ambient temperature: -20°C to +50°C;
- Extreme working environment temperature of photovoltaic modules: -40°C to +85°C.
- *Photovoltaic modules mechanical load:* Under standard installation conditions, the maximum test snow/wind load is 5400Pa/2400Pa, and the design load (considering a safety factor of 1.5) is 3600Pa/1600Pa.

For specific installation methods and mechanical load values of photovoltaic modules, please refer to Table 2 for detailed installation instructions for photovoltaic modules.

Photovoltaic modules are strictly prohibited to be installed and used in excessive environments such as hail, snow, hurricane, sandstorm, dust, air pollution, and soot. It is strictly forbidden to install or use photovoltaic modules in an environment with strong corrosive substances (such as salt, salt spray, salt water, active chemical vapor, acid rain, strong steam, or any other substances that will corrode photovoltaic modules and affect the safety or performance of photovoltaic modules.).

If photovoltaic modules will be installed in special environments such as high temperature and high humidity environment, wet salt fog environment (C3 and above areas specified in ISO 9223), water and breeding farms, etc., the purchaser or user must inform 8 Star Energy in advance. The types of photovoltaic modules, BOM, and quality assurance issues shall be decided by the two parties through a joint agreement and understanding.

If the above precautions are not followed, the warranty will be invalid.

6.2 Installation angle selection

- The tilt angle of the modules is measured between the surface of modules and a horizontal grounding face, as shown in figure 1. The modules generate maximum power output when it faces the sun directly.
- In the northern hemisphere, modules should typically face south, and in the southern hemisphere, modules should typically face north. Dust building up on the surface of the modules can impair module performance, 8 Star Energy recommends installing the modules with a tilt angle of at least 10 degrees, making it easier for dust to be washed off by rain. At the same time, it is conducive to the flow of accumulated water on the surface of the

module, and avoids long-term large amounts of accumulated water leaving marks on the glass surface, thereby affecting the appearance and performance of the module.

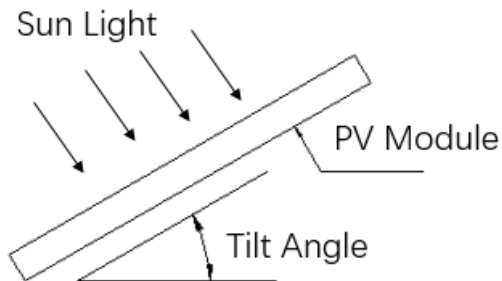


Figure 1: Schematic diagram of tilt angle

- PV modules connected in series should be installed in the same orientation and angle. If the orientation and angle are different, the solar radiation received by each module may be different, resulting in power loss.

6.3 Installation Method

- The photovoltaic module mounting bracket must be made of durable, corrosion-resistant, and UV-resistant materials. The mounting bracket must be inspected and tested by a third-party testing organization with static mechanical analysis capabilities to meet the country, region, or corresponding international standards.
- The photovoltaic module must be firmly fixed on the mounting bracket. If the photovoltaic module is installed in a snow-covered area, the height of the support should ensure that the lowest point of the photovoltaic module will not be covered by snow. In addition, it should be ensured that the lowest point of the photovoltaic module will not be blocked by surrounding trees or other plants.
- When the photovoltaic module is installed on a bracket parallel to the roof, the minimum gap between the frame of the photovoltaic module

and the roof is 10cm, and air circulation is required to prevent damage to the wiring of the photovoltaic module.

- The frame of the photovoltaic module will have the effect of thermal expansion and contraction, and the spacing between the two adjacent photovoltaic module frames should not be less than 10mm during installation.

For specific installation methods, please refer to the following installation specifications.

6.3.1 Bolting through the mounting holes

All modules must be securely fastened with at least 4 bolts (As shown in Figure 2, 3, 4, 5, 6, 7, 8, 9).

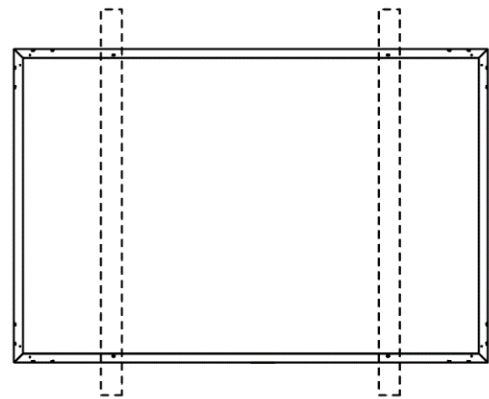


Figure 2: Bolt installation for 54 cell

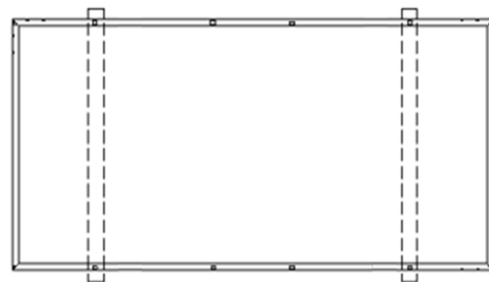


Figure 3: Bolt installation for 60 cell



Figure 4: Bolt installation for 66 cell

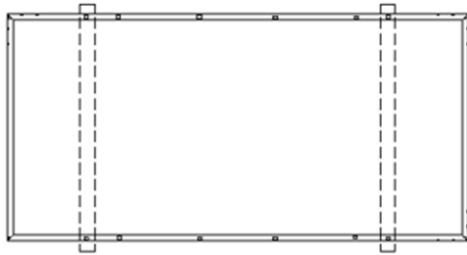


Figure 5: Outer four-hole bolt installation
for 72cell

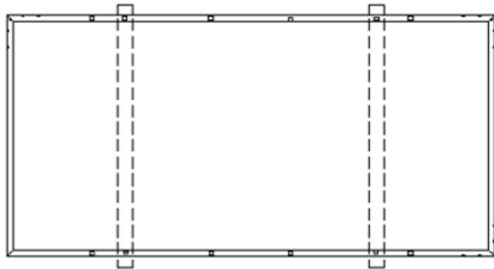


Figure 6: Internal four-hole bolt installation for 72cell

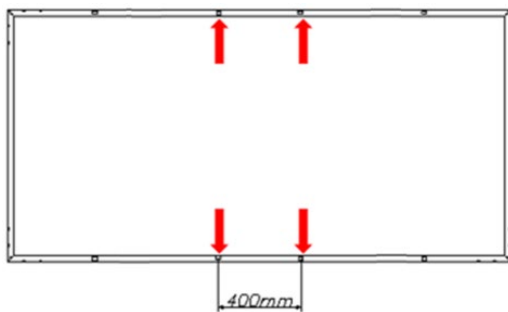


Figure 7: 400mm spacing bolt installation
for 60 cell

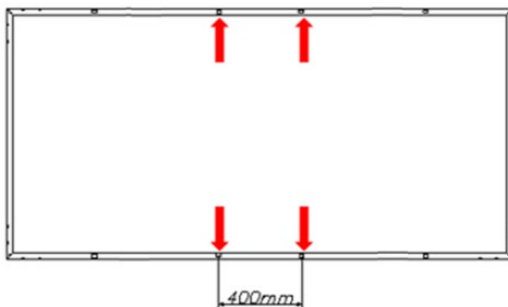


Figure 8: 400mm spacing bolt installation
for 66 cell

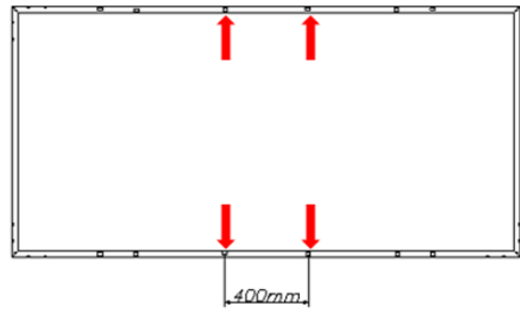


Figure 9: 400mm spacing bolt installation
for 72 cell



In order to achieve maximum safety precautions against wind and snow loads, it is recommended that all available mounting holes should be used.

Bolts are inserted as described in the process below.

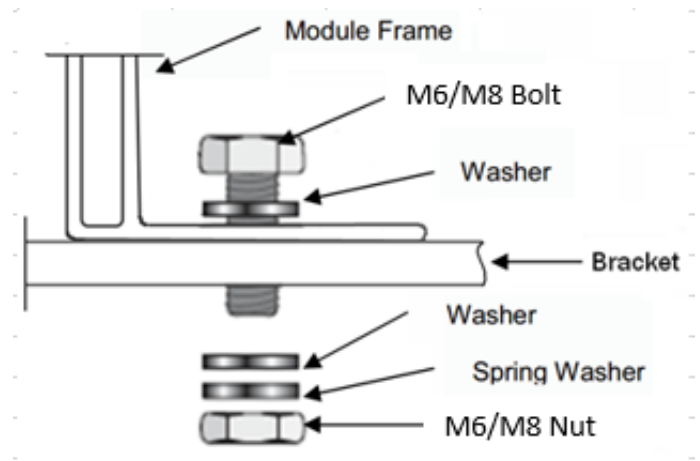


Figure 10: Schematic diagram of bolt
installation process

- ① Place the module on the supporting bars underneath.
- ② Insert the four stainless-steel bolts (M6) through the holes (7x11.5mm) or stainless-steel bolts (M8) through the holes (9x14mm) in the frame according to the Figure 2, 3, 4, 5, 6, 7, 8, 9. The 400mm spacing bolt hole size is 7x10mm, and 4

x M6 stainless steel bolts are required (Figure 5).

- ③ Secure each bolt to the frame with stainless-steel washers, one for each side of the mounting structure; and screw on either a stainless-steel spring washer or a toothed lock washer. Finally, secure with a stainless steel nut.
- ④ The reference value of tightening torques should be within 9~12Nm & 17~23 Nm respectively for M6 & M8 bolts, depending on bolt class. For the bolt grade, the technical guideline from the fastener suppliers should be followed. For the torque value, recommendations from specific clamping hardware suppliers should prevail.

6.3.2 Clamping on the frame surface

Photovoltaic modules can be installed across the support frame (Figure 11) or parallel to the frame of the photovoltaic module (Figure 12). When using clamps to install, each photovoltaic module must be fixed with at least 4 clamps.

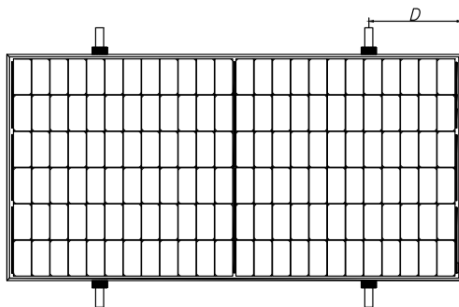


Figure 11: Rail vertical long frame installation

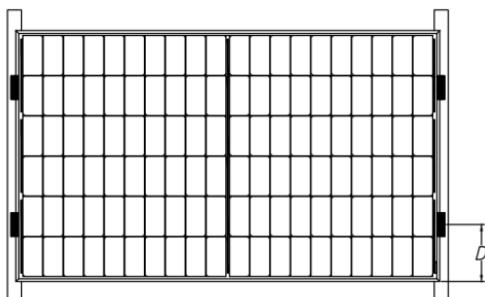


Figure 12: Rails overlapping for the short-side of frame

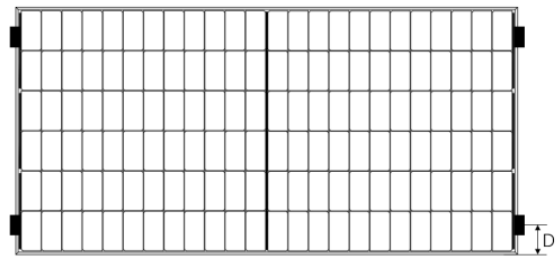


Figure 13: Four clamp mounting on short side of frame.



The length of supporting bars must be longer than the length of module frame, otherwise please confirm with our product team to get approval.

- The above three diagrams show the installation method using aluminum clamps (also called fixtures). "D" indicates the allowable installation range of the aluminum press block. Please refer to Table 2 for the specific recommended installation location and corresponding load ("---" indicates that the photovoltaic module does not apply to the above installation methods).
- Each aluminum pressure block is equipped with an M8 bolt, a flat washer, a spring washer and an M8 nut. The fixing steps are as follows:
 - ① Place the module on the two supporting bars (not provided). The bars should be made with stainless material and treated with an anti-corrosion process (e.g., hot dipped galvanizing). Each PV module needs at least four clamps to fix. Do not make the clamp have contact with the glass directly and do not make the aluminum frame distort as part of the installation process. Avoid shadowing of the solar PV modules, otherwise this may affect the modules operation or performance.
 - ② Be sure to avoid shadowing effects from the module clamps. Weep holes on the module frame must not be closed or obscured by the clamps.

The clamp must overlap the module frame by at least 8mm but no more than 11mm (The clamp section can be changed under the premise of ensuring the reliable installation of the components).

- ③ The bar's top surface contacted with module frame should come with grooves compatible with an M8 bolt.
- ④ If the bars do not come with grooves, holes of a suitable diameter may need to be drilled to allow bolts to be attached to the bars at the same locations as mentioned above.
- ⑤ Secure each clamp by attaching plain washer, spring washer, and nut, in that order.
- ⑥ Both close-ups in Figure 10, indicating the middle clamps and Figure 9, indicating the side clamps are for reference. Suggested dimensions for middle clamps are: $a \geq 40$ mm, $b \geq 26$ mm, $c \geq 5$ mm, $d \geq 28$ mm, and $\varnothing = 9$ mm. The torque for tightening the nut and bolts are recommended

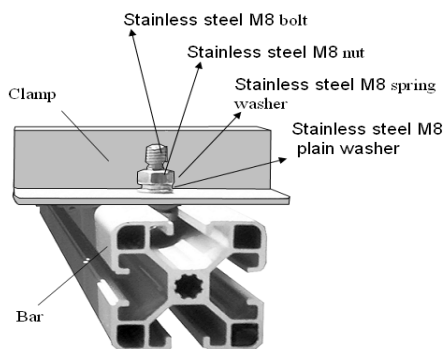


Figure 13: Schematic diagram of side pressing block

17~23Nm when the property class of bolts and screws is Class 8.8.

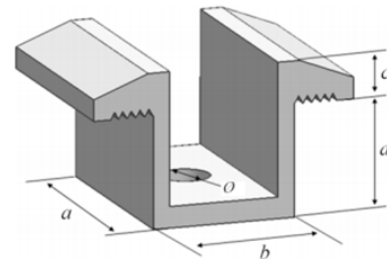


Figure 14: Schematic diagram of intermediate pressing block

- ⑦ For the installation method shown in Figure 8, the modules need to be fixed with professional solar pressure blocks (as shown in Figure 11), and the overlap between the C surface of the module and the guide rail should be ≥ 15 mm. If improper fixtures or incorrect installation methods are used, the limited warranty will be invalid.

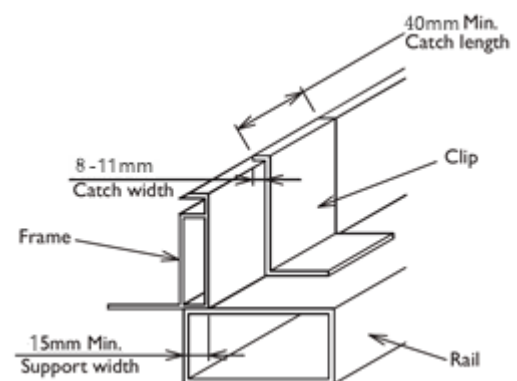


Figure 14: Requirements for mounting clamps when the guide rails coincide with the long frame, overlap with the short sided frame

Table 2 Installation range and corresponding values

Module type	Dimensions L*W*H (mm)	Installation method					
		Figure 2, 3, 4, 5	Fig 6	Fig 11	Fig 12	Fig 13	Fig 7,8,9
ENSP54M2 ENSP54M2BL ENSP54N2 ENSP54NBL2	1708*1133*30 1708*1133*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 309~409mm	+1800/-1800Pa Installation scope 150~250mm	+1800/-1800Pa Installation scope 0~250mm	---
	1722*1134*30 1722*1134*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 316~416mm	+1800/-1800Pa Installation scope 150~250mm	+1800/-1800Pa Installation scope 0~250mm	---
ENSP60M1 ENSP60M2 ENSP60NBL2	1755*1038*30 1765*1048*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 400±50mm	+1800/-1800Pa Installation scope 200±50mm	---	---
	1755*1038*30	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 350~400mm	---	---	---
	1903*1134*30	+5400Pa -2400Pa	+5400Pa -2400Pa	+5400/-2400Pa Installation scope 320~520mm	+1600/-1600Pa Installation scope 150~250mm	---	---
	2172*1303*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 375~425mm	---	---	+1800Pa -1800Pa +Bumper
ENSP72M1 ENSP72M2 ENSP72N2	2094*1038*35	+5400Pa -2400Pa	+2400Pa -2400Pa	+5400/-2400Pa Installation scope 400±50mm	---	---	+2400Pa -2400Pa +Bumper
	2094*1038*30	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 400~450mm	---	---	---
	2256*1133*35	+5400Pa -2400Pa	+2400Pa -2400Pa	+5400/-2400Pa Installation scope 400~500mm	---	---	+1800Pa -1800Pa +Bumper
	2278*1134*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 400~500mm	---	---	+1800Pa -1800Pa +Bumper
	2278*1134*35	+5400Pa -2400Pa	---	+5400/-2400Pa Installation scope 430~530mm	---	---	+1800Pa -1800Pa

7 Electrical Installation

7.1 Installation Conditions

Module electrical ratings are measured under Standard Test Conditions (STC: 1000W/m² irradiance, AM1.5 spectrum and a cell temperature of 25°C). Please refer to the datasheet or the product nameplate for the main electrical

characteristics, maximum system voltage and tolerance of I_{sc}, V_{oc} and P_{mp}.

Under certain conditions, the output current and/or voltage of the PV module may be higher than the value under standard testing conditions. Therefore, the value of I_{sc} marked on the module should be multiplied by 1.25, and V_{oc} on the module should be multiplied by a correction factor (see table 3 below) when determining component

ratings and capacities. Depending on your local regulations, an additional 1.25 multiplier for the I_{sc} (giving a total multiplier of 1.56) may be applicable when sizing conductors and fuses.

Table 3 Correction factor of V_{oc} at low temperature

Lowest Estimated Ambient Temperature(°C)	Correction factor
24 ~20	1.02
19 ~15	1.04
14 ~10	1.06
9 ~5	1.08
4 ~0	1.10
-1 ~-5	1.12
-6 ~-10	1.14
-11 ~-15	1.16
-16 ~-20	1.18
-21 ~-25	1.20
-26 ~-30	1.21
-31 ~-35	1.23
-36 ~-40	1.25

Alternatively, a more accurate correction factor for the V_{oc} can be calculated using the following formula:

$$C_{Voc} = 1 - \alpha_{Voc} \times (25 - T_{min})$$

Where: C_{Voc} is the correction factor of V_{oc} . α_{Voc}

(%/°C) is the open-circuit voltage temperature coefficient of the selected module (refer to corresponding datasheet). T_{min} (°C) is the expected lowest ambient temperature at the system installation site.

The string voltage must not be higher than the maximum system voltage, as well as the maximum input voltage of the inverter and other electrical equipment installed in the system. To ensure the above requirements, the open-circuit voltage of the string needs to be calculated using the following formula:

$$\text{Maximum system voltage} \geq N * V_{oc} * C_{Voc}$$

Where: N is the number of PV modules in a single string. V_{oc} is the open-circuit voltage of each PV module (refer to the nameplate or product datasheet).



Depending on the maximum fuse ratings of the PV module, and the local electrical installation standards, the connection of parallel strings of PV modules needs to be equipped with suitable fuses or preventive diodes for circuit protection purposes. Electrical calculations and design must be performed by a competent engineer or consultant.

The IEC & UL standard maximum system voltage for the regular module series is 1500V according to the requirements. The IEC & UL standard maximum system voltage for half-cell module series is 1500V. The maximum voltage of the system must be less than the maximum certified voltage and the maximum input voltage of the inverter and of the other electrical devices installed in the system.

To calculate the maximum number of connections of a series of PV modules in parallel, the following formula can be used:

$$N = 1500V / (V_{oc} * (1 + (T_{min} - 25^\circ C) * \alpha_{Voc}))$$

which shall consider the lowest on-site temperature. In the formula, 1500V is the system voltage, V_{oc} is

the corresponding open-circuit voltage of the module under STC condition, and $T_{min}(^{\circ}C)$ is the lowest on-site temperature. $25^{\circ}C$ is the standard cell temperature, and $x\%$ is the temperature coefficient corresponding to the open-circuit voltage from the panel spec sheet.



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} marked on this module should be multiplied by a factor of 1.25 when determining component conductor ampacities, fuse sizes, and size of controls connected to the PV output.

- Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125% (80% derating) which may be applicable. That means, when determining the voltage rating, conductor capacity, fuse rating, and photovoltaic output control size, the parameters need to be multiplied by the square of 1.25.
- According to the max fusing rate of modules and local electrical installation standard, the parallel connection of PV module arrays should use the proper fuse to protect the circuit.

7.2 Installation conditions

In order to ensure the normal operation of the system, when connecting photovoltaic modules or connecting loads (such as inverters, batteries, etc.), observe to ensure that the polarity of the cable is connected correctly. If the PV module is not connected correctly, the bypass diode may be damaged. Figure 12 shows the connection of photovoltaic modules in series and parallel. PV photovoltaic modules can be wired in series to increase the voltage. The series connection is to connect the wiring from the positive terminal of one photovoltaic module to the negative terminal of the next photovoltaic module. PV photovoltaic modules

can be connected in parallel to increase current. Parallel connection is to connect the wiring from the positive terminal of one photovoltaic module to the positive terminal of the next photovoltaic module. If the PV module is not connected correctly, the bypass diode may be damaged.

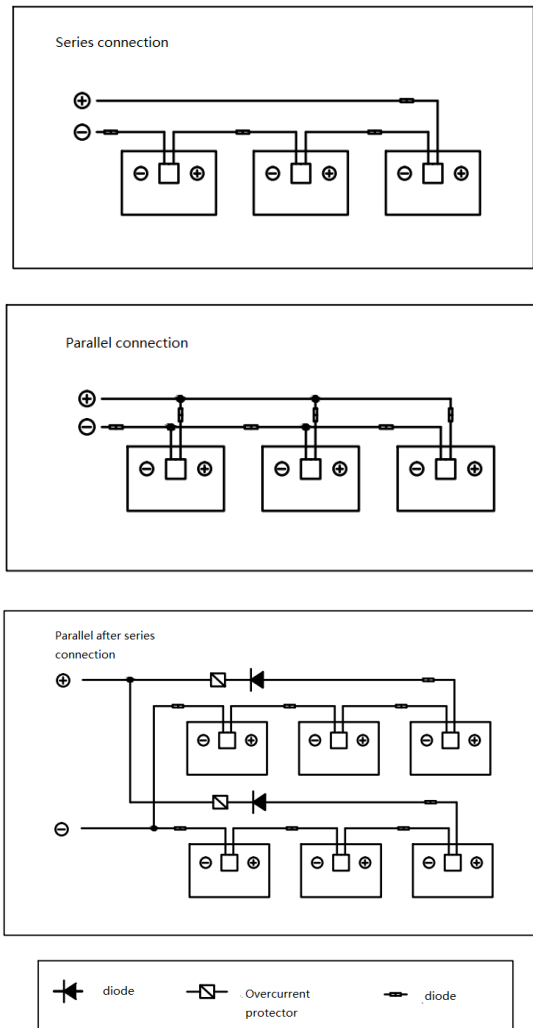


Figure 17 Schematic diagram of electrical connection



- If one set of arrays is connected to another with the opposite polarity, it will cause irreparable damage to the product. Before connecting in parallel, be sure to confirm the voltage and polarity of each column. If the measurement finds that the polarity between the columns is reversed or the voltage

difference is greater than 10V, you must check the structure and configuration before making the connection.

- The number of photovoltaic modules in series and parallel must be designed reasonably according to the system configuration.
- Photovoltaic modules of different electrical performance models cannot be connected in a string.
- Special solar cables and connectors should be used in the system, and all connections should be securely tightened. The cable size should be 4mm² (12 AWG) and must be able to withstand the maximum open circuit voltage of the photovoltaic system.
- When the cable is fixed on the bracket, it is necessary to avoid mechanical damage to the cable or photovoltaic module, and do not press the cable with force. To fix the cable through the proper way, a specially designed tying coil and wire clip must be used to fix it on the bracket. Avoid direct sunlight and water soaking cables.
- Please keep the connector dry and clean, and make sure that the nut of the connector is tightened before connecting. Do not connect the connector when it is found that the connector is wet, dirty, or in other bad conditions. Avoid direct sunlight and immersion of the connector in water. Avoid the connector falling on the ground or roof.
- When the photovoltaic module is in a live state, please do not plug or unplug the connector. When it is necessary to open the connector, ensure that the photovoltaic module is in a non-working state, and must use professional unlocking tools and safety protection measures. It is forbidden to pull or damage the locking structure.
- The junction box of the photovoltaic module contains bypass diodes connected in parallel to the battery string of the photovoltaic module. The bypass diode in the junction box can avoid the

degradation of photovoltaic module performance caused by shading or covering. Please refer to the junction box diode specifications provided in the relevant product specifications.

- When a local hot spot phenomenon occurs due to partial shading or covering of the photovoltaic module, the diode in the junction box will start to work, so that the photovoltaic module current will no longer flow through the hot spot cell, thereby limiting the heating and performance loss of the photovoltaic module. When you suspect or find that the diode is malfunctioning, please contact 8 Star Energy, please do not try to open the junction box cover by yourself.

7.3 Grounding

Energizer Solar modules use an anodic oxidized aluminum frame to resist corrosion. So the frame of modules should be connected to the equipment grounding conductor to prevent electrical shock. The grounding device should fully make contact with the inside of the aluminum alloy, and penetrate the surface of the frame oxidation film.

The following is the specific grounding method, as shown in Figure 13.

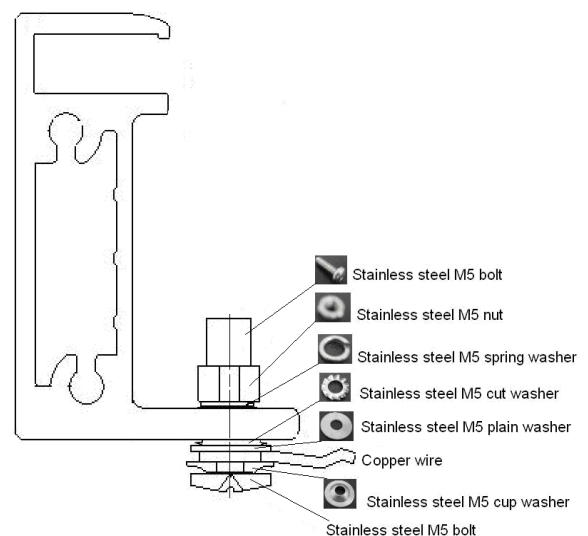


Figure 18 Use copper cables to ground the aluminum frame

- The grounding requirements must be checked in accordance with the applicable regulations and standards before work is started.
- Use the marked 5.5 mm grounding holes to ground the anodized frame. Use one M5 nut, two M5 cut washers, one M5 plain washer, one M5 spring washer, and one M5 bolt and the copper wire. All nuts, bolts, and washers are type M5 and should be made of stainless steel.
- Put the bolt through the cup washer and wrap the copper wire around the bolt. (Note that the copper wire cannot be attached directly to the aluminum.)
- Put the bolt through the cut washer and then through the hole in the aluminum frame.
- Add the spring washer and nut on the other side of the bolt and tighten to secure all parts. The tightening torque should be 4~4.5 N•m.



Approve the use of UL-467 certified bonding and grounding devices, including Burndy (formerly Wiley Electronics) Washer Electrical Equipment Bonding (WEEB) and similar devices, such as barbed washers, that meet the requirements of UL-467 as suitable for electrical bonding and grounding PV modules to PV mounting systems.

- Other grounding methods may be allowable when tested with the racking system per UL 2703 requirements.
- Please don't drill any additional grounding hole on the frame of the modules.
- The frame rails have pre-drilled holes marked with a grounding sign. These holes should be used for grounding purposes and should not be used for mounting the modules.

8 Maintenance

It is required to perform regular inspection and maintenance of the modules, especially within warranty scope. It is the user's responsibility to the report to the supplier regarding the damages found in time.

8.1 Routine inspection

Regular inspections should be made to see if the photovoltaic modules in the photovoltaic array are damaged, such as glass breakage, cable breakage, junction box damage, cell damage, backplane breakage and other factors that lead to functional and safety failures of photovoltaic modules. When the above problems occur, the supplier must be notified in time to replace the same type of photovoltaic modules.

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

Routine maintenance measures should be taken to keep the photovoltaic modules free of snow, bird droppings, seeds, pollen, leaves, branches, dust, stains, etc.

8.2 Photovoltaic module cleaning

If the PV module has a sufficient tilt angle (at least 15°), it is usually not necessary to clean the PV module (rain will have a self-cleaning effect). If there is a lot of dirt on the surface of the photovoltaic module, which has seriously affected the power generation, use water without detergent and a soft sponge or brush to rinse the photovoltaic module array when it is cool throughout the day. Do not scratch or wipe the dust when it is dry, otherwise it will cause tiny scratches. If there is snow, you can

use a brush with soft bristles to clean the surface of the photovoltaic module.

For more detailed instructions related to cleaning and maintenance, please refer to the "Photovoltaic Module Cleaning Manual".

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