



SAFETY, INSTALLATION, AND
OPERATIONS MANUAL
(Europe)

TSC PowerXT[®] XXXR-PS Module

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Other Information

Product information is subject to change without notice. All trademarks are recognized as the property of their respective owners.

User documentation is updated frequently; Check the TSC website (tscpowerhome.eu) for the latest information.

For warranty text refer to tscpowerhome.eu

For TSC patent information refer to solaria.com/patents/

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1.0 Introduction

This general manual provides important electrical and mechanical installation information. For correct installation and stable power output, please read and understand this manual carefully before installing and maintaining the PV modules. And keep this manual properly for future reference during PV module maintenance or sales.

This manual does not constitute a warranty, expressed or implied. TSC does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with installation, operation, use or maintenance of modules.

PV module should be installed in accordance with all safety precautions in this manual and local laws and regulations, and should be installed and maintained by qualified professionals who have professional skills and knowledge and are familiar with the mechanical and electrical requirements of the system.

Any questions, please contact with the salesperson or customer service representative of TSC for further explanation.

1.1 Installation Manual Disclaimer

The installation techniques, handling and use of this product are beyond company control. Therefore, TSC does not assume responsibility for loss, damage or expense resulting from improper installation, handling, or use.

1.2 Limitation Of Liability

TSC Solar shall not be responsible for any kind of injury, including but not limited to physical injury or property damage caused by module operation, system installation error or failure to follow instructions in this manual.

2.0 General Principles Of Security

Modules rated for use in this application class may be used in systems operating at greater than 50V DC or 240W, where general contact access is anticipated. Modules qualified for safety through IEC 61730-1 and this part of IEC 61730 within this application class are considered to meet the requirements for safety class II.

No matter whether the PV module is connected to the system or not, proper protective measures should be used when touching the PV module, such as insulated tools, safety hats, insulated gloves, safety belts, and safety insulated shoes. During installing, grounding, and connecting cables, and cleaning modules, the proper electrical protection tools must be used.

Avoid direct contact with modules, which may cause electric shocks or mechanical cuts.

The installation should comply with the laws and regulations specified by the relevant region and country. If necessary, obtain the required certificates such as a building permit.

Module installation shall be carried out by qualified professionals with technical knowledge and familiarity with the

mechanical and electrical requirements of the system. Be aware of the risks of injury, including electric shock, that may occur during installation.

The modules are applied to ground-mount, roof, and other outdoor environments. Proper design of support structures is the responsibility of the system designer or installer. When applied to roof installation, the overall fire rating of the final structure needs to be considered, as well as the overall future maintenance. A roof system can only be installed on a roof that has been assessed by a construction expert with the results of a formal complete structural analysis.

Comply with safety regulations for all installed components. For wires and cables, connectors, charging controllers, inverters, batteries, etc., only the equipment, connectors, wires and brackets that match the solar power system can be used. If the photovoltaic system uses energy storage batteries, the configuration of the modules should follow the advice of the battery manufacturer. Only same size modules and specifications can be connected in series.

Meaning of crossed –out wheeled dustbin:

- Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities.
- Contact your local government for information regarding the collection systems available.
- If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging human health and well-being, and the environment.
- When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliance for disposals free of charge.



2.1 Electrical Safety

To avoid any form of electrical accident, please strictly follow these electrical safety provisions.

- Damaged modules pose a risk of electric shock and fire and should be replaced immediately.
- The installation of the module array must be carried out in isolation from direct sunlight.
- The DC voltage generated by module may exceed 30V, avoid direct contact.
- The serial voltage of modules must not exceed the maximum system voltage.
- Ensure that cables are fixed to the mounting system for installing modules.
- Do not connect modules with connectors of different models from different manufacturers.
- Protect cables with conduit in areas accessible to animals and children.
- Do not replace roofing and wall materials with modules.
- Do not modify or remove any module or label.
- Do not connect or disconnect modules when there is current or external current.
- Do not install modules without taking protective measures.
- Do not contact the surface of the module with corrosive chemicals.
- Do not use any means other than standard connectors for electrical connection.
- Do not install or operate modules in damp or windy conditions.

- Do not add any light concentrators to the module system.
- Do not touch the module when it is wet.

2.2 Fire Safety

Before installing modules on a roof, refer to local laws and regulations and comply with building fire protection requirements. The roof shall be covered with a suitable grade of fireproof material for roof installation and ensure that the modules and mounting surfaces are fully ventilated. Different roof structures and installation methods can affect the fire performance of a building. Improper installation may cause a fire.

Use appropriate components such as fuses, circuit breakers and ground connectors according to local regulations.

Do not install or use modules near open flames or flammable or explosive objects.

2.3 Transportation Safety

Do not open the packing case before the modules arrive at the installation site. Place the packing case in a dry and ventilated environment.

During all handling, ensure that the module will not be shaken, dropped to the ground, or impacted by external objects, as this will damage the module or the solar cells in the module. Do not allow children or unauthorized persons to handle modules. Improper handling and placement may result in glass breakage or loss of electrical properties, thus rendering the modules useless.

Handle and install modules with care. Under no circumstances should modules be lifted by lifting junction boxes or cables. Two or more persons must hold the edges of modules with both hands.

Do not step on, stand on or sit on modules as this can damage modules and risk injury to people.

Do not stack bare modules, do not place any heavy objects on the front or back of modules, and do not place modules on sharp objects.

2.4 Installation Safety

Comply with safety rules applicable to all installed modules. For wires and cables, connectors, charging controllers, inverters, batteries, etc., only the equipment, connectors, wires and rails that match the solar power system can be used.

If the photovoltaic system uses energy storage batteries, the configuration of the modules should follow the advice of the battery manufacturer.

Do not install or operate in damp or windy conditions, and keep the junction box cover closed.

The glass can protect the module; improper operation may cause the glass to be broken. Damaged modules pose a risk of electric shock and fire. Such modules cannot be repaired and should be replaced immediately.

When sunlight strikes the front of the module, the module generates electricity and the DC voltage may exceed 30V.

Avoid direct contact with voltage of 30V or higher to avoid danger.

To reduce or avoid the array mismatch effect, it is recommended to connect modules with similar electrical properties on the same string.

When connecting modules, ensure that the connecting cables are fixed on the support frame of the module to limit the motion of the slack part of the cable.

Comply with the minimum bending radius of the cable (at least 43mm is recommended).

3.0 Electrical Properties

3.1 Electrical Installation

The module product specification lists the specific electrical performance of photovoltaic modules in detail, and the nameplate of each module is also marked with the main electrical performance parameters under STC conditions (1000W/m², AM 1.5, cell temperature 25°C). The product specification and nameplate are also marked with the maximum system voltage of the module.

Under certain environmental conditions, the current or voltage generated by the module may be greater than the operating current or voltage for standard test conditions (STC). Therefore, when determining the current/voltage ratings and load values of electrical components, the module short-circuit current under STC should be multiplied by 1.25, and the open-circuit voltage should be corrected according to the calculation formula below:

$$\text{Maximum System Voltage} \geq N \times \text{Voc} \times [1 + \lambda_{\text{voc}} (T_{\text{min}} - 25^\circ\text{C})]$$

While,

N – Number of modules in series strings

Voc – Open circuit voltage value of module under STC (see module nameplate)

λ_{voc} – Open circuit voltage temperature coefficient of the module (see module technical specification)

T_{min} – Annual minimum temperature for module installation position (for example, -20 °C, $T_{\text{min}} = -20$)

When determining the appropriate wire and fuse specifications, the maximum fuse current rating is selected by reference to the product specifications.

The system electrical design and calculation shall be determined by a qualified electrical engineer, electrician, or equivalent.

The minimum over-current protection device specification is determined by calculating the maximum expected current of the photovoltaic system. The maximum over-current protection device specification is mandatory in IEC 61215:2016 and IEC61730:2016 standards.

If there may be a reverse current through the module that exceeds the maximum fuse current, the module must be protected by over-current protection. If the number of parallel connections is greater than or equal to 2, an over-current guard must be installed on each assembly.

Do not install in rainy weather, moisture will lead to insulation failure, especially of open connectors, and risk of safety accidents.

For specific electrical performance parameters, please refer to the product specifications.

3.2 Cables And Wires

The modules use junction boxes with protection class IP68 or above, with connected cables and connectors. The junction box system of each module is equipped with two separate wires, one positive and one negative, which can be connected in series by inserting the positive connector of one module into the socket of the negative connector of the adjacent module.

During installation, do not use lubricating oil or alkane cleaning agents to clean connectors, junction boxes, and cables.

The cross-sectional area of the cable and the capacity of the connector must meet the maximum short-circuit current of the module (for a single module, the cross-sectional area of the cable is 4mm², and the rated cable temperature ranges from -40 ° c to +90 ° c).

When the cable is fixed on the mounting system, it is necessary to avoid mechanical damage to the cable or module. The cable is fixed on the bracket with specially designed light resistant tie and cable guard. The cable is light-resistant and water-resistant, but still minimize direct sunlight and avoid water soaking the cable.

3.3 Connector

When connecting modules, ensure that the connectors of the same string of modules are from the same manufacturer, and the connection pairs the modules and the system must also be matched. Mismatching causes risk of electrical failure and risk of fire.

Keep the connectors dry and clean.

Do not connect a connector when it is damp or dirty.

Avoid long term exposure of the connectors to direct sunlight or water.

3.4 Bypass Diode

The junction box system of the TSC module contains bypass diodes and forms a parallel structure with the circuit. When the solar cells of the module are blocked or damaged, the hot spot phenomenon might occur in part of the module, the bypass diode will turn on, so that the current no longer flows through the hot spot solar cell, so as to limit the heating and performance loss of the module.

Note that the bypass diode is not an over-current protector.

3.5 Grounding

The module uses anodized corrosion-resistant aluminium alloy frames as rigid supports. To protect the module from lightning and static electricity, and for personal safety, all frames and mounting brackets of the components must be grounded. If there are no specific regulations, please follow the International Electrotechnical Commission standard or other international standards. Connect the ground cable with the recommended connection terminal and fix it to the module frame. It is recommended to use 4mm² copper core wire. Figure 1 shows the grounding hole and its identification on the assembly, and Figure 2 shows the assembly grounding method.

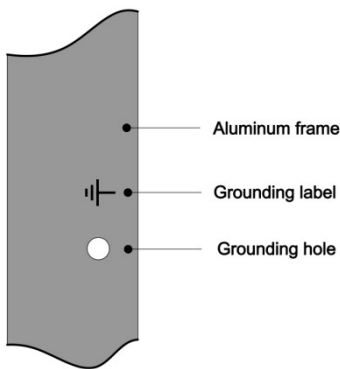


Figure 1: Ground hole and its identification

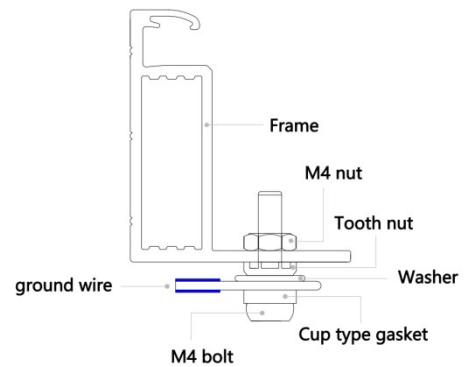


Figure 2: Grounding method

The holes are used for grounding only and cannot be used to install module. Do not drill any additional ground holes on any frame of the modules. Otherwise, the module warranty will be invalid.

When grounding, the grounding device must fully contact the interior of aluminium alloy, penetrate the oxide film on the surface of the frame, and connect the frame of the module and the supporting member to achieve good grounding effect. Use an aluminium or galvanized steel mounting system to ensure good electrical conductivity.

The ground conductor must be connected to the ground by a suitable ground electrode. You are advised to use a ground cable accessory (wiring nose) to connect the ground cable. Weld the ground cable into the socket of the wiring nose, insert the M4 screw into the ring of the wiring nose and the hole in the middle of the module frame, and secure the cable using a nut. Spring washers should be used to prevent screw loosening resulting in poor grounding.

If the module is used in a high temperature and humidity environment, it is recommended to install an inverter that can be negatively grounded (figure 3 shows the system voltage polarity configuration).

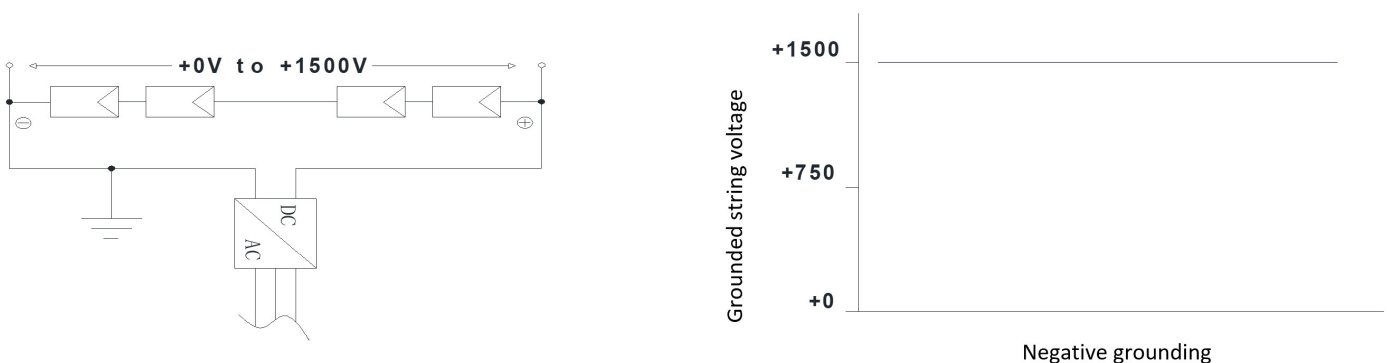


Figure 3: Schematic diagram of grounding potential of inverter

The module may be grounded using a third party grounding device, provided that the grounding device is reliable and proven and operated in accordance with the manufacturer's requirements.

4.0 Handling, Transportation, Storage, & Unpacking

TSC's module have horizontal packaging and vertical packaging for different products. There are significant differences between horizontal packaging and vertical packaging in loading, unloading, transportation and unpacking. Please be sure to follow the above operations in this manual.

The patterns of horizontal and vertical packing are as follows:

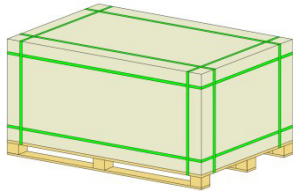


Figure 4: Horizontal packaging

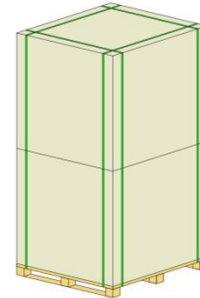


Figure 5: Vertical packaging

4.1 Handling, Transportation, & Tran-shipment

After the module arrived, please immediately check the overall status of the package. If there is any abnormal condition such as package damage, deformation or skew, please contact the customer service or logistics personnel of TSC immediately.

Place the module on flat ground after transporting it to the installation site.

Forklift to unload

If forklift tools are used, the forklift tools should be reasonably selected according to the size and weight of the goods. If the fork of the forklift is less than 3/4 of the size of the cargo, it should be covered with an extended fork assembly to avoid tipping the package when moving the forklift.

Straight-line driving speed control of forklift truck transportation $\leq 5\text{km/h}$, turning speed $\leq 3\text{km/h}$; During transportation, the spacing between goods and inserts should be adjusted to the maximum position of the spacing between pallets.

During loading and unloading, except forklift operators, other personnel should keep away by a safe distance to ensure personnel safety.

Lifting the unloading

If a crane is used to unload the package, use a dedicated hoisting tool. Select a proper hoisting tool based on the weight and size of modules. Use a fixing tool of the same size on the top of the package to prevent the lifting rope from squeezing the package or modules.

Horizontal packaging can lift up to 4 sets of modules at a time, vertical packaging can lift up to 2 sets of modules at a time.

Tran-shipment

If vertical packaging modules need to be transported to the construction project site through secondary transportation after being transported to the centralized storage site by container or flatbed vehicle, the following points should be noted:

If forklift truck is used for transport, the forklift truck shall comply with the above requirements for unloading, and the forklift truck size shall be at least $\geq 3T$;

If you use a box truck or other type of vehicle, please use a carriage with guardrail, the height of the guardrail is not less than $2/3$ of the height of the module, and use fastening straps to secure the module to the carriage; modules should be placed closely with each other, and gaps should not be left.

If the vertical package is turned to horizontal by a turning machine, please note that the flat tray structure is used as the bearing unit of the module after turning over, and only the frame surface of the module can be used as the bearing surface of the module after turning over.

Retail packaging

If the modules are not filled when they are shipped, TSC uses wooden frames of the same size as the modules as packing fillers. The wooden frames are located in the middle of the packaging body, and the scattered packaging method is exactly the same as the integral packaging method.

4.2 Storage

Please store the modules in a dry and ventilated environment and place the modules on a relatively flat ground.

Ensure that the outer package of the modules is intact. Ensure that the pallets and packages are protected from moisture and direct sunlight in the storage area, and take waterproof (rain) measures.

If the modules are stored in an uncontrolled environment, they must not be stored for more than 3 months.

Long-term storage of modules is recommended to be stored in a standard warehouse. Check for module tilt anomalies periodically.

Do not soak the tray in water. Take drainage measures on the ground to prevent the wooden pallet from rotting or the ground from sinking after a rain.

4.3 Unpacking

Please confirm the product model, power, quantity and serial number according to the shipping mark posted on the container before unpacking. For vertical packaging, please carefully read the unpacking operation instructions and unpacking support assembly operation instructions. Do not use other unpacking methods other than the unpacking operation instructions.

- Do not lift the wiring and junction box of the module, hold the frame while carrying.
- During handling, do not distort or bend modules due to operation or other weight.
- The number of modules stacked horizontally should not exceed 18.

- Do not rely on the backplane to support modules when moving or installing them.
- Do not contact the module with sharp objects to avoid damaging the module.
- Vertical packing and unpacking shall not be carried out on non-horizontal or soft ground;
- When vertical packing and unpacking, the operator shall not stand behind the reclining surface;
- After unpacking, do not place module electrical connectors near any foreign chemical substance.

Horizontal packaging

Applicable product series:

PowerXT-xxxR-PS & PowerXT-xxR-PSL

Horizontal packing and unpacking is the conventional packing method, which will not be specified here. If you have any questions in the process of unpacking, please contact TSC commercial department to provide specific information.

5.0 Module Installation

5.1 Installation Environment

- The module is recommended to be installed in an environment where the operating temperature ranges from -20°C to 50°C. The maximum operating temperature ranges from -40°C to 85°C, and the humidity is lower than 85%RH.
- When installing solar modules on a roof, it is also necessary to leave a safe working area between the edge of the roof and the outer edge of the photovoltaic module array.
- When modules are piled on the roof, the load of the roof should be rechecked, and the construction organization plan in accordance with the requirements of the code should be formulated.
- For the northern hemisphere, usually choose the light-facing south installation of the module. If you are in the southern hemisphere, you usually choose the light-facing north mounting of the module.
- When selecting module installation position, should choose full sunlight position, and avoid shade (trees, buildings, clothing, tools, packing materials and other obstacles), because the shadow will cause loss of output power.
- The module should be installed in a well-ventilated place to ensure adequate air circulation on the back and side of the module to facilitate the release of heat generated while the module is working.
- When used in areas with high wind pressure and snow pressure, support fixed structures should be designed in strict accordance with local design specifications to ensure that the external load does not exceed the mechanical strength limit that the system can bear.
- TSC's modules have passed the salt spray corrosion test of IEC61701, indicating that TSC modules can be installed in offshore or corrosive environments.
- At a locations 50m to 500m from the sea, corrosion may occur where the frame of the module is connected to the support, or where the grounding is connected. Stainless steel or aluminium materials must be used to contact the photovoltaic module, and the installation part must be treated with anti-corrosion.

- Please consult the TSC technical support department for more information on the use of modules in special climates, such as an altitude greater than 2000m, heavy snow, severe hail storm, hurricane, etc.

5.2 Inclination Choice

The inclination Angle of the photovoltaic module refers to the included Angle between the photovoltaic module and the horizontal ground. Different projects choose different installation inclination Angle according to local conditions.

Modules connected in series of the same array must be in the same direction and Angle. Different installation directions and angles cause differences in the total amount of solar radiation absorbed by modules, resulting in a loss of output power, which reduces the operating efficiency of the system.

The maximum power is generated when the sunlight directly illuminates the modules. Consider the power output of the module in winter when selecting the best installation Angle.

In order to facilitate module cleaning and wash away dust on module surface when it rains, for detailed installation Angle, please follow the advice given by experienced PV module installers.

5.3 Mechanical Installation

Ensure that the module installation strong enough, supporting system must be able to withstand the mechanical load pressure, third party testing institutions to test, using international standards or national standards.

The mounting bracket of the component must be made of materials that are resistant to corrosion, rust and UV.

Modules must be securely mounted on system supports.

Do not drill additional mounting holes in the frame or glass. Otherwise, the module warranty will be invalid.

The support structure of modules has thermal expansion and cold contraction effect. To avoid affecting the performance and use of modules, it is recommended that the minimum distance between the two module is 10mm. To ensure good ventilation of modules and reduce load, it is recommended that the installation distance between two modules is 30mm.

In areas with heavy snow in the winter, choose a high mounting bracket so that the lowest point of the module is not covered by snow for a long time, and the lowest point of the module is high enough to prevent the module from being obscured by plants or trees.

The support surface of the installation bracket must be flat, without distortion or deformation, and there is no up and down dislocation between the connected brackets.

The assembly installation method should not result in electro-chemical corrosion between the aluminium frame and different metals.

5.4 Location Choice

Roof

When installing on a roof or building, ensure that the modules are securely secured and will not be damaged or dropped by strong winds or snow. Provide a special mounting bracket for roof installation if necessary. The building code used for roof installation should be checked to ensure that the building and structure to which the modules are installed have sufficient load-bearing and watertight properties. The roof through which the fixed modules are installed should be sealed to prevent rainwater leakage.

To facilitate operation, reduce water vapor condensation, and promote ventilation and heat dissipation for modules, ensure that the modules are parallel to the surface of the wall or roof of the building. The distance between the modules and the surface of the wall or roof is at least 115mm. In this way, the air circulation at the rear of the modules facilitates heat dissipation and prevents cable damage. Ensure that the modules are installed on a fireproof roof. The module has a fire rating of C and is suitable for installation on a roof with fire rating of A or higher.

For a roof system with heavy snow or heavy snow history in the installation area, the customer shall support and reinforce the bottom module frame of the entire system to ensure that the bottom module is protected from top-down snow push and pressure damage and damage to the module caused by daytime snow melt and icing.

Ground-Mount

Select an appropriate installation height for ground installation to prevent the lower part of the module from being covered by snow for a long time in winter. Install the modules on a support of an appropriate height. Do not lay the modules directly on the ground. In addition, ensure that the minimum part of the module is not less than 900mm above the ground to avoid being obscured by plants or trees, to avoid being damaged by blown sand or being obscured by soil splashed by rain.

6.0 Installation Guide

Modules must be installed according to the installation instructions to comply with IEC requirements.

Connections between modules and support systems can be installed using mounting holes in the frame, or with clamps

If the installation method used is different from the recommended installation method, please get approval from TSC. Otherwise, modules may be damaged and the warranty may be invalid.

In extreme weather conditions or user-defined installation methods, strengthen key connections to prevent damage to modules or system connections.

The loads described in this manual are test loads. According to IEC installation requirements, a factor of 1.5 should be considered when calculating the corresponding maximum design load. The design load of the project depends on the project location, local climate, support structure and related specifications. Support suppliers and professional engineers are responsible for determining the design load. For more detailed information, follow local laws and regulations as well as instructions from structural engineers.

6.1 Installation Method: Bolting

The modules are bolted to the support structure using mounting holes of the frame.

Each module must be securely fastened at a minimum of 4 points on two opposite sides.

Bolts and nuts M8 X 1.25-Grade 8.8 hot dip galvanized or A2-70 stainless steel should be used.

The yield strength of bolts and nuts must not be less than 450MPa.

According to bolt class, tightening torque of M8 coarse tooth bolt is 16~20Nm.

Installation in heavy snow or high wind load areas, use additional mounting holes.

Use stainless steel flat washers with thickness $\geq 1.5\text{mm}$ and diameter size $\geq 18\text{mm}$. (Please refer to the frame section drawing provided by TSC Solar energy to select the upper limit flat washer that can be operated)

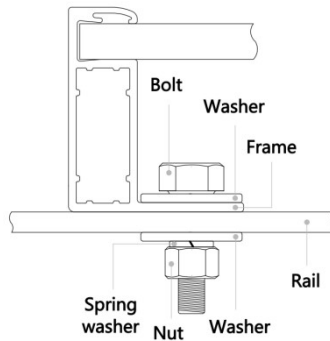


Figure 6: Bolt installation methods

Modules shall be bolted to the position of the following mounting holes according to the structure and load requirements:

Inner four mounting hole installation (mounting hole size: 9*14mm)	
Installation rail vertical to the long side of the module, applicable type:	
PowerXT-xxxR-PS	
Mechanical Load	
Front side: $\leq 5400\text{Pa}$	Rear side: $\leq 2400\text{Pa}$

Note: The height of the frame which called "B" side is 35mm.

6.2 Installation Method: Clamps

Use a certain number of clamps to secure the modules to the mounting rail. TSC recommends that fixtures be clamped to the frame of module.

The clamps shall be made of anodized aluminium alloy or stainless steel.

The length and thickness of the clamp recommended by TSC are $\geq 50\text{mm}$ and 3mm respectively.

The contact width between the clamps and the a side of the frame is in the range of 7 ~ 11 mm.

Install and tighten on the mounting rails with the torque specified by the mounting components manufacturer. The clamps is installed with M8 \times 1.25 bolts and nuts. For M8 heavy thread bolts, the tightening torque should be between 16 Nm and 20 Nm depending on the bolt grade.

When installing the clamps, do not touch the front glass, and do not scratch or deform the aluminium frame during the installation process. At the same time, the clamps cannot affect the operation of the module and make sure that the drainage hole and the grounding hole are not blocked.

Each module requires at least four clamps to be secured, and at least two clamps for each long or short frame, depending on local application conditions (wind and snow conditions) , an additional number of clamps may be required to ensure that the modules and systems bear the corresponding loads, as shown in Figures 7.

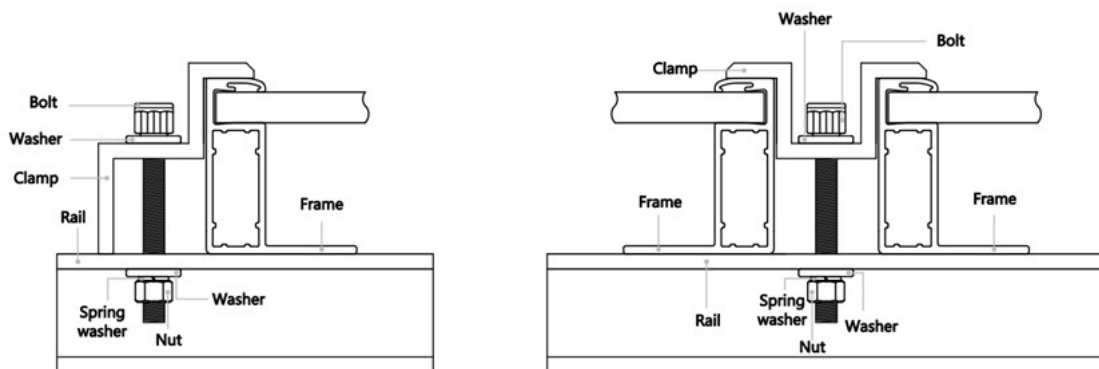
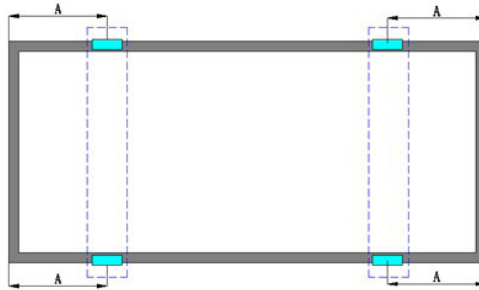


Figure 7: Specific installation of clamps

Clamp position is critical to the reliability of installation. Center line must be installed as described in the following table according to structural and load requirements.

Inner four mounting hole installation (mounting hole size: 9*14mm)



Module Type	A Range (mm)	Max Mechanical Load (Pa)
PowerXT-xxxR-PS	285-385	Front side: ≤5400Pa Rear side: ≤2400Pa

7.0 Maintenance

Modules need to be inspected and maintained regularly, especially during the warranty period. To ensure optimum performance of the modules, the following maintenance measures are recommended.

7.1 Cleaning

When modules are working, there should not be environmental influence factors to cause shadows in the modules, such as other modules, supporting rail, plants, large amount of dust etc., which may directly reduce the power output and may even cause a local hot-spot effect. Therefore clean the glass surface on a regular basis. For clean modules take measures such as:

- The frequency of module cleaning depends on the speed of accumulation of dirt, the rain on the module surface is cleansing under normal circumstances, but you may still need to use a soft sponge or cloth (either dry or damp) to clean the module, rough materials shall not be used for cleaning in any case, and acid or alkali cleaner to remove dirt is not recommended.
- Avoid local heavy weight on the module during cleaning, which will lead to module glass deformation, damage the solar cells, and lead to reduced service life of modules.
- Remove snow on modules in a timely manner to avoid damage to modules caused by long-term snow accumulation and snow melting and freezing.
- Do not pierce the back-sheet when cleaning the back of the module.
- It is recommended to clean the modules in the early morning or evening when the light is not strong and the module temperature is low, especially in locations with high temperatures.
- Do not attempt to clean modules with damage such as broken glass or with exposed wires, which may cause

electrical shock.

7.2 Visual Inspection

Please carefully check the modules of the existence of visual defects, focusing on the following items:

- Check if the module glass is broken.
- Check if the front of the module is obstructed by foreign objects or other obstacles.
- Check the module back-sheet whether there is hot, swollen region, burned through traces or other damage.
- Check whether the cell bus-bars are corroded, if encapsulation materials of the module has delamination or bubbles.
- Check the tightness of the mounting bolts and the tightness of the electrical connections at the connection points between the modules and the supporting rail.

7.3 Inspection of Connector & Cable

If safely accessible, it is advisable to carry out a preventive check every 6 months and check the following:

- Check Junction box adhesive for cracks or delamination.
- Check the connector interface sealing and whether there is loose, melt deformation, aging or corrosion.
- Check that the cable connections are secure and that the modules are properly grounded.
- When module is found to be defective, consult a qualified service technician. If servicing is required, it should be serviced by a qualified service technician.
- Module exposure generates high voltages in the sun, so cover the modules with opaque material when servicing modules to prevent electrical shock.
- **Note:**
 - ◆ If any problems are found during the maintenance, ask the professional service personnel for confirmation;
 - ◆ If using maintenance and repair measures not included in this manual, consult your local installer for professional support.



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