



INSTALLATION GUIDE FOR THORNOVA PHOTOVOLTAIC MODULE



TABLE OF CONTENTS

1 PURPOSE OF THIS GUIDE • 01

1.1 APPLICABLE PRODUCTS • 01

2 SAFETY • 02

2.1 GENERAL SAFETY • 02

2.2 HANDLING SAFETY • 03

2.3 INSTALLATION SAFETY • 04

2.4 FIRE SAFETY • 05

3 PRODUCT IDENTIFICATION • 05

4 MECHANICAL INSTALLATION • 06

4.1 GENERAL INSTALLATION PRINCIPLE • 06

4.2 LOCATION AND ANGLE SELECTION • 06

4.3 SCREW INSTALLATION • 07

4.4 CLAMP INSTALLATION • 08

4.5 ELECTRICAL INSTALLATION • 10

4.6 GROUNDING • 12

5 MAINTENANCE • 13

6 PARAMETERS • 14

7 ELECTRICAL PARAMETERS • 14

1 PURPOSE OF THIS GUIDE

Thanks for choosing THORNOVA Photovoltaic Modules (hereafter referred to as "PV Module"), this Guide is to give information on how to apply THORNOVA PV modules properly.

Installers must read and understand this Guide prior to installation. For any questions, please contact our technical department (info@thornovasolar.com) for further information. Installers should follow all safety precautions described in this Guide as well as local codes when installing a module.

Keep this Guide in a safe place for future reference (care and maintenance) and in case of sale or disposal of the PV modules.

1.1 APPLICABLE PRODUCTS

This document is applicable to the series of PV modules as listed below:

PV Modules with Half-cut 182mm TOPCon Mono-crystalline Silicon Solar Cells:

144 cells: TS-BBT72(xxx) (xxx = 575-585, in increment of 5)

108 cells: TS-BBT54(xxx) (xxx = 440)

PV Modules with Half-cut 182.2mm x 199mm TOPCon Mono-crystalline Silicon Solar Cells:

132 cells: TS-BBT66(xxx)-G13 (xxx = 575-585, in increment of 5)

PV Modules with Half-cut 182.2mm x 210mm TOPCon Mono-crystalline Silicon Solar Cells:

96 cells: TS-BBT48(xxx)-G11(xxx = 440-445, in increment of 5)

2 SAFETY

2.1 GENERAL SAFETY

- The PV modules are qualified for application class A, which may be used in systems operating at greater than 50V DC or 240W, where general contact access is anticipated. PV modules qualified for safety through this part of IEC 61730 and IEC 61730-2 and within this application class are considered to meet the requirements for safety class II.
- The PV modules shall be properly grounded in accordance with the instructions in this Guide or the requirements of the National Electrical Code.
- Installing PV modules requires specialized skills and knowledge. Installation should only be performed by qualified personnel, electrical connections requires a licensed electrician, where applicable according to local code and law (i.e. the NEC for the USA and CEC for Canada).
- Installers should assume all risks of injury that might occur during installation, including, but not limited to, the risk of electric shock.
- One single PV module may generate more than 30V DC when exposed to direct sunlight. Access to a DC voltage of 30V or more is potentially hazardous.
- PV modules convert light energy to DC electrical energy, which are designed for outdoor use. PV modules can be mounted onto ground, rooftop, vehicles or boats etc . The proper design of support structures lies within responsibility of the system designers and installers.
- Do not use mirrors or other magnifiers to concentrate sunlight onto the PV modules.
- When installing the PV modules, abide to all local, regional and national statutory regulations. Obtain a building permit if necessary.

- Only use equipment, connectors, wiring and support frames compatible with the PV modules.
- Do not clean the modules with chemicals.

2.2 HANDLING SAFETY

- Do not lift the PV module by grasping the module's junction box or electrical leads.
- Do not stand or step on the PV modules or place heavy objects onto it.
- Do not drop the PV module or allow objects to fall on the PV module.
- Do handle with care when move, transport and install the PV modules.
- Do not attempt to disassemble the PV modules, and do not remove any attached nameplates or components from the PV modules.
- Do not apply paint or adhesive to the PV module top surface.
- Do not scratch or hit the back sheet.
- Do not drill holes in the frame. This may reduce the frame mechanical strength and cause crack cells due to vibration.
- Do not break the anodized coating of the frame (except for grounding connection), this may cause corrosion of the frame.
- Do not use PV modules with broken glass or torn back sheet which has danger of electrical shock.
- Do not handle panels in wet condition unless has appropriate protection.
- Do not expose PV module to sunlight until installation to avoid unnecessary degradation.
- During all the transportation, please make sure there is no strenuous vibration on module. Because it may cause cell micro crack or damage the module.

2.3 INSTALLATION SAFETY

- Installation shall be in conformity with IEC standard, Safety Standard for Electrical Installations.
- Do not disconnect under load.
- Do not touch conductive parts of PV modules, such as terminals which can result in burns, sparks and lethal shock whether or not the PV module is connected.
- Do not touch the PV module unnecessarily during installation.
- Do not work in the rain, snow or windy conditions.
- Do not expose the artificially sunlight to PV modules. Completely cover the PV module with an opaque material during installation to prevent electricity from being generated.
- Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic objects while installing or troubleshooting.
- Only use insulated tools that are qualified for working on electrical installations.
- Follow the safety regulations for all other system components, including wires and cables, connectors, charging regulators, inverters, storage batteries, rechargeable batteries, etc.
- Under normal outdoor conditions the current and voltage generated will different from those listed on the datasheet. When design systems, current and short-circuit current should be multiplied by a factor of 1.25 to determine components ratings.
- Only use connectors compatible with the PV module connectors. Removing the connectors without prior authorization will invalidate the warranty.
- Do not dismantle installed modules to another project, which may invalidate the warranty.
- Do not install modules within 50m of the shoreline.

2.4 FIRE SAFETY

- The fire rating of this module is valid only this Guide is followed.
- Consult your local authority for Guidelines and requirements for building or structural fire safety.
- Do not use PV modules near equipment or in places where flammable gases may be generated.
- Follow local codes and laws when install the modules.

3 **PRODUCT IDENTIFICATION**

Each module has three Barcode stickers which have the same unique series No. of each module and one label sticker:

Barcode 1: Laminated into PV modules.

Barcode 2: Stick on the backside of PV modules.

Barcode 3: Stick on the middle location of long Frame side.

Label: Stick on the backside of PV modules , contains characteristics parameters of the PV modules.

Check the series No. in the barcode with the packing list when unpacking.

Provide PV module series No . when you need support from THORNOVA on particular PV modules.

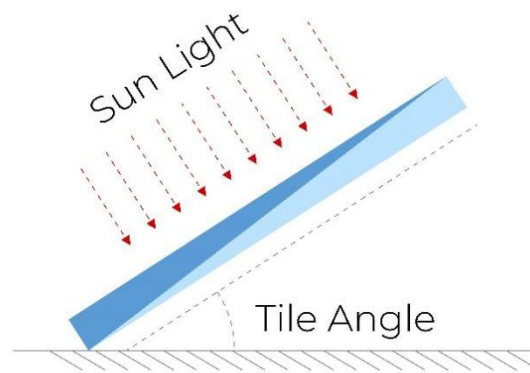
4 MECHANICAL INSTALLATION

4.1 GENERAL INSTALLATION PRINCIPLE

- Module can be installed in both landscape and portrait modes [1]
- It is recommended to install the same size and the same type of module in one PV array.
- The PV modules shall be installed high enough to keep it away from potential shading, flying sands, snow and water.
- It is recommended to install the PV modules 30 cm away from the ground/10 cm away from the rooftop to make sure ventilation.
- Appropriate installation structures shall be chosen to meet required mechanical load.
- It is recommended to install the PV modules with minimum angle of 10 degree to make the dust easily to be washed off.
- It is recommended to keep minimum 10mm gap between PV modules for thermal expansion of materials.
- Install PV modules appropriately according to corresponding mechanical load need.

4.2 LOCATION AND ANGLE SELECTION

The tilt angle of the PV module refers to the angle between the module and the horizontal ground. The tilt angle shall be selected according to the local conditions for different projects. Sunova Solar recommends that the mounting tilt angle should not be less than 10°. For specific tilt angles, it shall be chosen in accordance with the local design procedures, specifications and regulations, or following the recommendations of the experienced PV module installers.



In the Northern Hemisphere, the module should typically face south, and in the Southern Hemisphere, the modules should typically face north. The most optimistic installation angle varies according to different latitudes and longitudes. The applied condition of module installation is no above 2000m altitude. Please consult experts with appropriate knowledge background when determining the installation locations and angles.

When choosing a site, avoid trees, buildings or obstructions, which could cast shadows on the solar photovoltaic modules. Shading causes hot spot and loss of output, even though the factory fitted bypass diodes of the PV module will minimize such effect.

Do not install the PV module near naked flame or flammable materials. Do not install the PV module in a location where it would be immersed in water or constantly exposed to water from a sprinkler or fountain etc.

4.3 SCREW INSTALLATION

Each PV module has 8 mounting holes (shown as drawing 1). The downward mechanical load resistance of module would be different according to the installation holes used (shown as table 1) Please use 8 of them to secure the modules to support structure. 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 PV module. The applied torque should be big

enough to fix it steadily. The reference torque value for M8 screw is 16~20N*m.

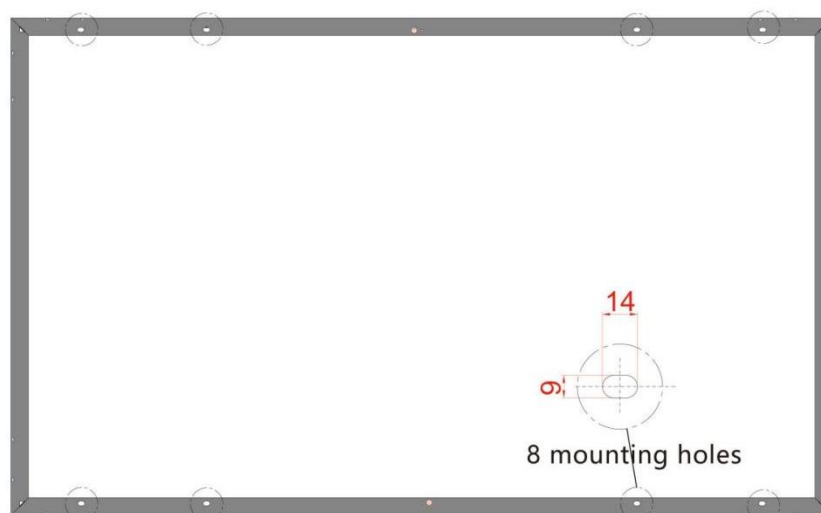


TABLE 1

| INSTALLED HOLES USED | DESIGN MECHANICAL LOAD |
|-----------------------------------|------------------------|
| 8 installation holes | 3600Pa |
| 4 installation holes (inner ones) | 1600Pa |

4.4 CLAMP INSTALLATION

The modules can be fixed on both the long and the short side of the module within the constraints shown in drawing 2 and drawing 3, using a minimum of four clamps. The modules are built to withstand a downward force of up to 5400Pa (550 kg/m²) or 2400 Pa (244 kg/m²) according to where they are clamped (shown as table2 and table3), Site-specific loads such as wind or snow which may exert forces in a different way need to be taken into consideration to ensure this limit is not exceeded for each respective mounting option.

4.4.1. Install module with clamps at long sides of frames

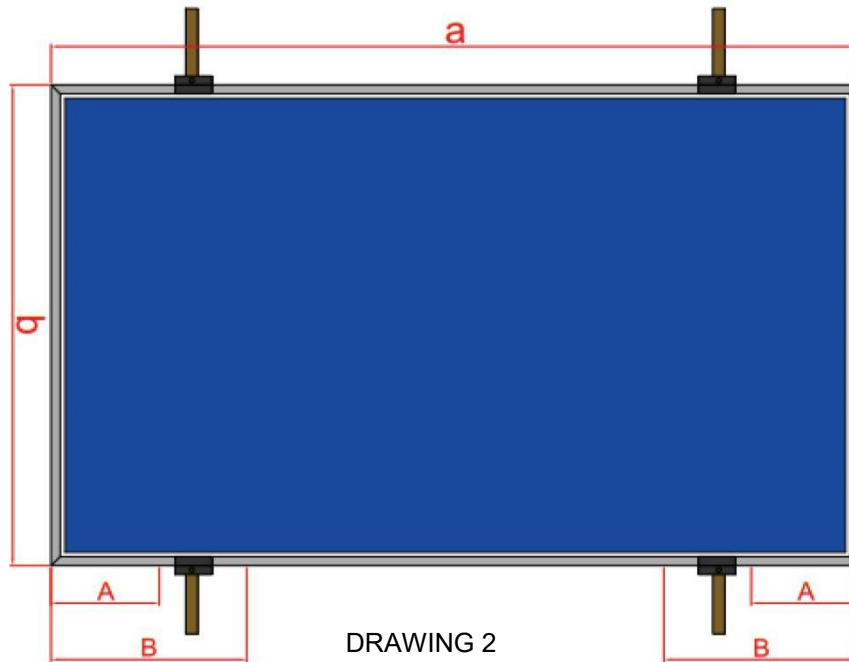


TABLE 2

| a (mm) | b (mm) | Clamp length | A (mm) | B (mm) | DESIGN Loads (Pa) | Remark |
|-----------|--------|--------------|--------|--------|--------------------------------|-------------------|
| 2464 | 1134 | ≥50mm | 532 | 682 | 3600(downward) 1600(upward) | Safety factor 1.5 |
| 2279/2278 | 1134 | ≥50mm | 440 | 590 | 3600(downward) 1600(upward) | |
| 2094 | 1134 | ≥50mm | 347 | 497 | 3600(downward) 1600(upward) | |
| 1903 | 1134 | ≥50mm | 258 | 408 | 3600(downward) 1600(upward) | |
| 1762/1722 | 1134 | ≥50mm | 184 | 434 | 3600(downward) 1600(upward) | |

4.4.2. Install module with clamps at short sides of frame

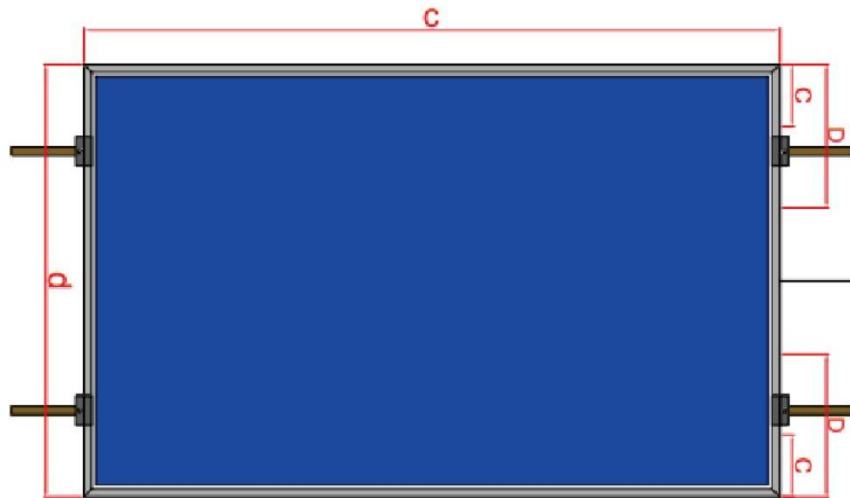


TABLE 3

| c (mm) | d (mm) | Clamp length | C (mm) | D (mm) | LOADS (PA) |
|-----------|--------|--------------|--------|--------|------------|
| 2464 | 1134 | ≥50mm | 56 | 280 | 2400 |
| 2279/2278 | 1134 | ≥50mm | 56 | 280 | 2400 |
| 2094 | 1134 | ≥50mm | 56 | 280 | 2400 |
| 1903 | 1134 | ≥50mm | 56 | 280 | 2400 |
| 1762/1722 | 1134 | ≥50mm | 56 | 280 | 2400 |

4.5 ELECTRICAL INSTALLATION



■ 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 your health and well-being.



WARNING Electrical Hazard

This module produces electricity when exposed to light. Follow all applicable electrical safety precautions.

- ONLY qualified personnel can install or perform maintenance work on these PV modules.
- BE AWARE of dangerous high DC voltage when connecting module.
- DO NOT damage or scratch the rear surface of the module.
- DO NOT handle or install module when they are wet.

When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliance for disposals at least free of charge.

The wiring components shall be compatible with the PV modules.

The PV modules connected in series shall have similar current. The Voc of one PV string shall no higher than the maximum system voltage (make reference to the maximum system voltage marked on label), the Voc temperature coefficient feature and the extreme low temperature of installation location must be taken into consideration when calculate the Voc of the PV string.

The PV modules connected in parallel shall have similar Voltage. The Isc Temperature coefficient feature and the extreme high temperature of installation location must be taken into consideration when calculate the Isc of the PV array.

When designing the system, we recommend that under 1500V circumstances, the maximum number of modules shall be no more than 12pcs if connected in series; no more than 24pcs if connected in parallel.

Please refer to local regulations to determine the system wires size, type and temperature.

The cross-sectional area and cable connector capacity must satisfy the maximum short-circuit of PV system (For a single component, we recommended the cross-sectional area of cables is 4mm² and the the rated current of connectors is more than 15A), otherwise cables and connectors will become overheating for large current . Please pay attention: the temperature limit of cables is 85°C and the temperature limit of connector is 105°C.

A qualified system designer or integrator should always be consulted.

Building permits, inspections and approvals by the local utility are generally required.

4.6 GROUNDING

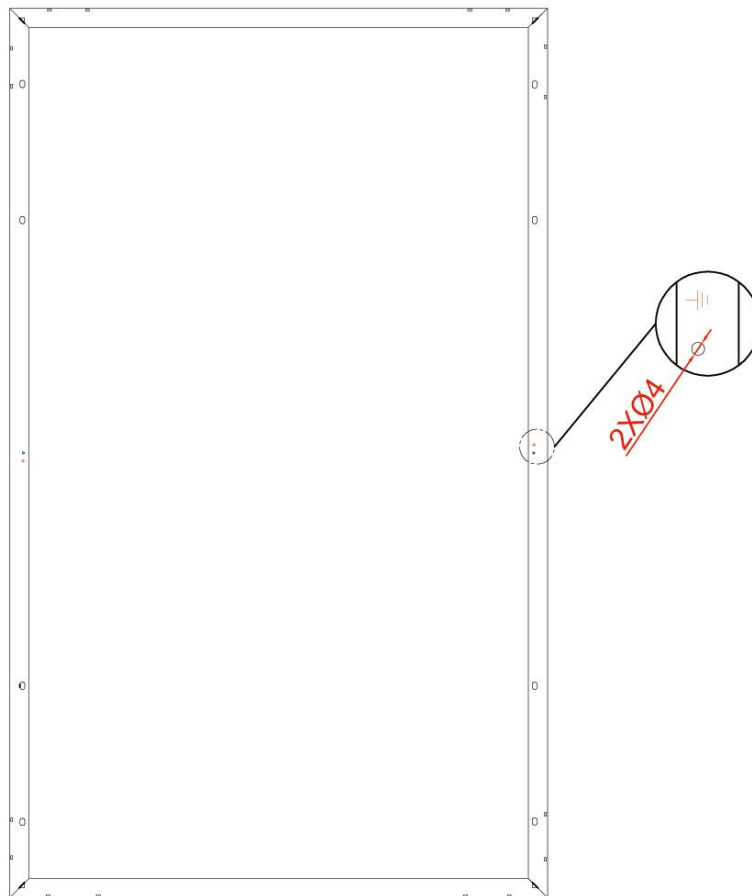
Where common grounding hardware (nuts, bolts, star washers,split-ring lock washers, flat washers and the like) is used to attach a listed grounding / bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions.

For grounding and bonding requirements, please refer to regional and national safety and electricity standards. If grounding is required, use a recommended connector type, or an equivalent, for the grounding wire.

If grounding is required, the grounding wire must be properly fastened to the module frame to assure adequate electrical connection (grounding hole shown as drawing 4).

When system operates in high humidity and high temperature circumstances, transformer-Based inverter allowing system negative grounding is highly recommended to achieve mitigating risk of higher power degradation rate.

DRAWING 4



5 MAINTENANCE

Clean the glass surface of the module regularly with clean water and a soft sponge or cloth. A mild, non-abrasive cleaning agent may be used to remove stubborn dirt. Water with high mineral content is not recommended to clean the module.

Check the electrical, grounding and mechanical connections every six months to verify that they are clean, secure, undamaged and free of corrosion.

If any problem arises, consult a professional for suggestions.

Caution: Observe the maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries, etc.

6 PARAMETERS

The parameters may be updated time to time, accurate parameters please check on our website:

www.thornovasolar.com

or email to our technical support team:

info@thornovasolar.com

Note: This version of TUV Installation Guide are effective from April, 2024, until it is replaced by new version.

7 ELECTRICAL PARAMETERS

The electrical properties of the components were measured under standard test condition. In some cases, the component may produce a voltage or current value higher or lower than the rated value.

(Note: the tolerance for Voc is $\pm 3\%$, for Isc is $\pm 3\%$ and for Pmp is $\pm 3\%$)



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