



GERMAN-based company ●●●

WATER PROOF, SUITABLE FOR ROOFTOP SOLAR PANEL INSTALLATION MANUAL





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1. INTRODUCTION

TommaTech GmbH (hereafter referred to as “TommaTech”) headquarters in Garching / Germany engages in the development, research, manufacturing, sales and service of solar panels, inverters and their required accessories.

TommaTech established strong and competitive partnerships in the photovoltaic field in Europe and in Far East with companies that value quality and reliable solar power generation. We will support you with our strong and experienced team for the purchase of solar equipment as well as turnkey projects with a wide product range and variety of methods and procedures. Our mission is to make human life more sustainable, making the difference in the industry through unique customer focus and high quality, thus progressing confidently towards becoming a world leader in our own sector.

2. CODES AND REGULATIONS

The mechanical and electrical installation of PV systems should be performed in accordance with all applicable codes, including electrical and construction codes as well as electric utility connection guidelines.

Such requirements may vary with the mounting location, such as building rooftop or motor vehicles as well as with the system voltages, and for DC or AC capacity applications. Please contact your local authorities for the corresponding governing regulations in place.

3. GENERAL

The parts of our solar panels are indicated in the cross-section figure below:

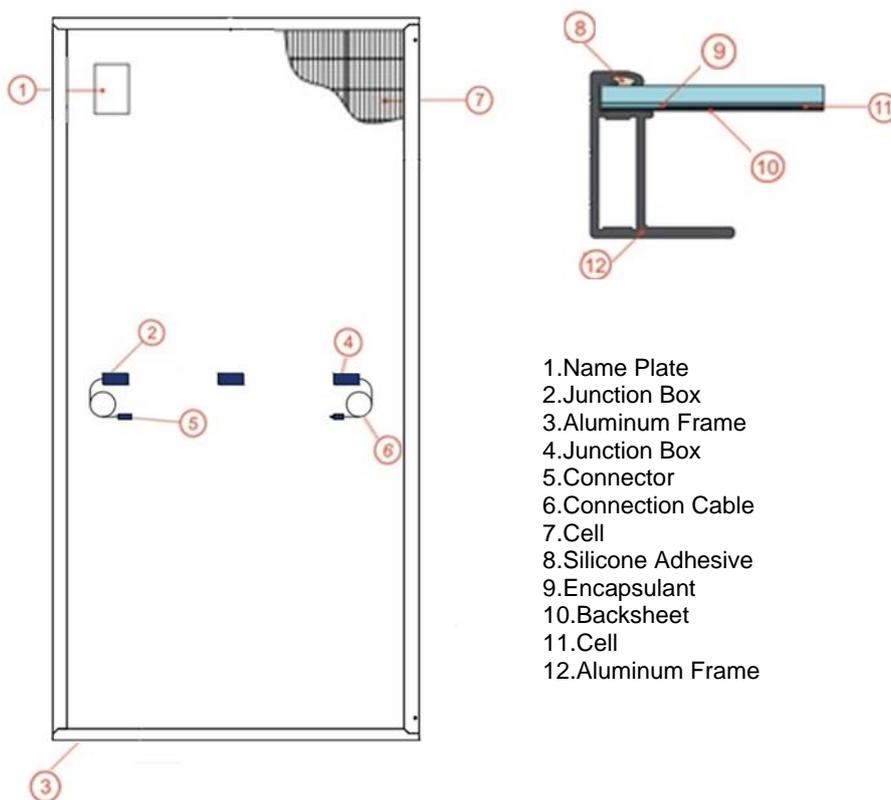


Figure 1: Modules components and cross-section of the laminated assembly

3.1 Product Identification

Each module has three labels providing the following information:

1. Nameplate. The name plate describes the product type, peak power, max. power point current, max. power point voltage, open circuit voltage, short circuit current, as measured under standard test conditions, certification marks, the maximum system voltage etc.
2. Current Classes. Solar panels are divided into three classes according to the maximum power current: 1, 2 or 3 (3 means the highest current). This class is marked as a number on the pallets of the solar panels. To achieve an optimal performance of the solar panels, it is recommended to only connect solar panels with the same current class in a string.
3. Barcode: Each individual module has a unique serial number. The serial number has 12 digits. From 1st to 2nd digits are the solar cell size code, and the 3rd and 4th are the corrected year code, from 5th and 6th are the corrected month codes, from 7th is the optional serial number and from 8th and 12th are the serial number of a module. For example, 133414000001 means the Module was assembled and tested in the January of 2021. It is permanently attached to the interior of the modules and is visible from the top front of the Module. This barcode is inserted prior to laminating. In addition, you can find a same barcode beside the nameplate and two sides of frame surfaces.

3.2 Conventional Safety

TommaTech modules are designed to meet the requirements of IEC 61215 and IEC 61730, PV module classification: Class II

Modules rated for use in this PV module classification may be used in system operating at greater than 50V DC or 240W, where general contact access is anticipated. Modules qualified for safety through IEC 61730-1 and IEC 61730-2 and within this PV module classification are considered to meet the requirements for safety class II equipment.

When modules are mounted on rooftops, the roof must have a fire-resistant covering suitable for this application. Rooftop PV systems should only be installed on rooftop that can handle the additional weighted load of PV system components, including Modules, by a certified building specialist or engineer and have a formal structure of the complete analysis result.

For your safety, do not attempt to work on a rooftop until safety precautions have been identified and taken including without limitation fall protection measures, ladders or stairways, and personal protective equipment.

For your safety, do not install or handle Modules under adverse conditions, including without limitation strong or gusty winds, and wet or frosted roof surfaces.

3.3 Electrical Performance Safety

Photovoltaic Modules can produce DC electricity when exposed to light and therefore can produce an electrical shock or burn. DC voltage of 30 Volts or higher is potentially lethal.

Modules produce voltage even when not connected to an electrical circuit or load. Please use insulated tools and rubber gloves when working with Modules in sunlight.

Modules have no on/off switch. Modules can be rendered inoperative only by removing them from sunlight, or by fully covering their front surface with cloth, cardboard, or other completely opaque material, or by working with Modules face down on a smooth, flat surface.

In order to avoid arcs and electrical shock, please do not disconnect electrical connections under load. Faulty connections can also result in arcs and electrical shock. So please keep connectors dry and clean, and ensure that they are in proper working condition. Never insert metal objects into the connector or modify them in any way to secure an electrical connection.

Also, to avoid the sand or water vapor entering which may cause the connection and safety issue, the modules need to be installed and connected to the combiner box once they are taken out from the carton box; keep the connectors dry and clean during the installing. Note that the pollution from sand, dust and water will result in arcs and electrical shock of connectors.

Reflection from snow or water can increase sunlight and therefore boost current and power. In addition, colder temperatures can substantially increase voltage and power.

If the glass or other material is damaged, please wear personal protection equipment and separated the Modules from the circuit.

Work only under dry conditions and use only dry tools. Do not handle Modules when they are wet unless wearing appropriate protective equipment. If you need to clean the Modules, please follow the cleaning requirements mentioned in the manual.

3.4 Operating Safety

Do not open packages of TommaTech solar panels during transportation and storing until they are ready to be installed.

At the same time please protect the package from damages. Do not make the pallets of solar panels fall over directly.

Do not exceed the maximum height of pallets to be stacked as indicated on the pallet packaging. Store pallets in a ventilated, rain-proof, and dry location until the solar panels are ready to be unpacked. Do not lift the solar panels by grasping the module's junction box or electrical cable under any condition. Do not stand or step on the solar panels.

Do not drop the solar panels on other solar panels.

Do not place any heavy objects on the solar panels.

Be cautious when setting the solar panels down on a surface, especially on the corner of the solar panels. Inappropriate transportation and installation may break the solar panels.

Do not attempt to disassemble the solar panels, and do not remove any attached nameplates or components from the solar panels.

Do not apply paint or adhesive to the solar panels top surface.

To avoid damage to the backsheet, do not scratch or hit the backsheet.

Do not drill holes in the frame. This may compromise the frame strength and cause corrosion of the frame.

Do not scratch the anodized coating of the frame (except for grounding connection). It may cause corrosion of the frame or compromise the frame strength.

Do not attempt to repair the solar panels with damaged glass or backsheet.

3.5 Fire Safety

Consult your local authority for guidelines and requirements for building or structural fire safety. TommaTech modules have been listed as Class C according to IEC 61730-2 standard. For roof installations, Modules should be mounted over a fire-resistant covering suitable for this application, with adequate ventilation between the Modules backsheet and the mounting surface. Roof constructions and installations may affect the fire safety of building. Improper installation may create hazards in the event of a fire.

Consult your local authority for guidelines and requirements for building or structural fire safety. TommaTech modules are listed as Class C according to the IEC 61730-2 standard.

For roof installations, Solar panels should be mounted over a fire-resistant covering suitable for this application, with adequate ventilation between the modules backsheet and the mounting surface. Roof constructions and installations may affect the fire safety of building. Improper installation may create hazards in the event of a fire.

Solar panels should not be installed on structures and products made of transparent plastic, plastic and similar materials that are resistant to fire risk and not protected.

In order to maintain the fire class rating, the distance between the modules frame surface and the roof surface shall be at least 8 cm.

Regulations, communiqués, decrees, specifications, etc., put into effect by the relevant official institutions and organizations in the region where the installation will take place. Appropriate components such as fuses, circuit breakers, surge arresters and grounding connectors must be used to meet the requirements specified in all legislation. Any string or optimizer connector to be connected with the solar panel connector must be the same brand and model as the connector on the solar panel.

Do not install solar panels in places where flammable-explosive chemical products, gases and similar products can be found.

Panels that have not been installed in accordance with these standards and conditions will be out of warranty, the installation will be installed contrary to the installation manual, and the manufacturer will not be responsible for any risks or problems that may occur. In this context, the manufacturer does not have any responsibility, including compensation for damages, for any use contrary to the installation and assembly manual and for the consequences of such use.

4. INSTALLATION CONDITIONS

4.1 Installation Position and Working/Operational Environment

TommaTech solar panels are intended for use in terrestrial applications and only for outside installation. Do not use mirrors or other magnifiers to concentrate sunlight onto the solar panels.

Solar panels must be mounted on appropriate mounting structures positioned on suitable buildings, the ground, or other structures suitable for solar panels (e.g., carports, building facades or PV trackers). Solar panels must not be installed in locations where they could be submerged in water.

The temperature limits are defined as the monthly average high and low of the installation site. The limit operating temperature should be -40°C (-40°F) and 85°C (185°F).

Ensure that the solar panels are not subject to wind or snow loads exceeding the maximum permissible loads. The solar panels should be installed in a location where there is no shading throughout the year. Ensure there is no obstacle to block light near the installation site.

Lightning protection is recommended for PV systems that are to be installed in locations with high probability of lightning strikes.

Do not use solar panels near equipment or in locations where flammable gasses may be generated or collected.

The solar panels can be installed at a maximum 2000m altitude.

TommaTech solar panels must neither be installed nor operated in areas where hail, snow, sand, dust, air pollution, soot, etc., are excessive. Solar panels must not be sited in locations where aggressive substances such as salt, salt mist, saltwater, chemically active vapors, acid rain or, any other type of corrosive agent could affect the safety and/ or performance of the solar panels.

Please implement appropriate measures to ensure the performance and safety of the solar panels when they are installed or operated in the areas with heavy snow, extremely cold climates, strong winds, on islands or in a desert where the solar panels are prone to produce salt fog, or near water.

4.2 Tilt Angle Selection

The tilt angle of the solar panels is measured between the surface of the solar panels and a horizontal ground surface. The solar panels generate maximum power output when facing the sun directly.

In the northern hemisphere, solar panels should typically face south, while in the southern hemisphere, solar panels should typically face north.

For detailed information on the best installation angle, please refer to standard solar photovoltaic installation guides or consult a reputable (local) solar installer or systems integrator.

Dust building up on the surface of the solar panels can impair with the solar panels' performance. TommaTech recommends installing the solar panels with a tilt angle of at least 10 degrees, making it easier for dust to be washed off by rain.

5. MECHANICAL INSTALLATION

5.1 Conventional Requirements

Please ensure that the installation method and support structure of solar panels is strong enough to enable the solar panels to withstand all load conditions, which must be guaranteed by the installer. The installation support structure must be tested by a third-party organization with static mechanical analysis ability, according to the local national or international standards such as DIN1055 or equivalent.

The solar panels mounting structure must be made of durable, corrosion-resistant, and UV-resistant materials.

Solar panels must be securely attached to the mounting structure.

In regions with heavy snowfall, select the height of the mounting system, so that the lowest edge of the solar panels is not covered by snow for any period of time. In addition, ensure that the lowest portion of the solar panels is placed high enough so that it is not shaded by plants or trees or damaged by flying sand.

When the solar panels are installed parallel to the surface of the building wall or roof, a minimum clearance of 10 cm between the solar panels frame and the surface of the wall or the roof is required to allow air circulation behind the solar panels and to prevent wiring damages.

Do not attempt to drill holes in the glass surface or frames of the solar panels.

Before installing solar panels on a roof, ensure that the roof construction is suitable. In addition, any roof penetration required to mount the solar panels must be properly sealed to prevent leaks.

To observe the linear thermal expansion of the module frames, you must ensure a minimum distance between neighboring frames of 10 cm.

Always keep the backsheet of the panel free from foreign objects or mounting elements, which could come into contact with the panel, especially when the panel is under mechanical load.

TommaTech solar panels have been certified for a maximum static load on the back-side of 2400 Pa (i.e. wind load) and a maximum static load on the front side of 2400 Pa (i.e. wind and snow load), depending on the solar panels type (please refer to Figure 4 for detailed installation method). These load values are maximum. The design load for 2400 Pa is 1600 Pa with a safety factor is 1.5. The mounting method must not result in the direct contact of dissimilar metals with the aluminum frame of the solar panels that will result in galvanic corrosion.

TommaTech solar panels can be mounted in landscape or portrait orientation.

5.2 Installation Method

Modules can be installed on the frame using mounting holes. Modules must be assembled from bottom to top and from right to left. For the installation of the first module, first the starting structure should be screwed to the supporting structure at the bottom row, then the first panel should be inserted into the starting structure. Modules must be installed according to the following examples and recommendation. If not mounting the Modules according to these instructions, please in advance consult Tommatech and must be approved by Tommatech, otherwise may damage modules, and void the warranty.

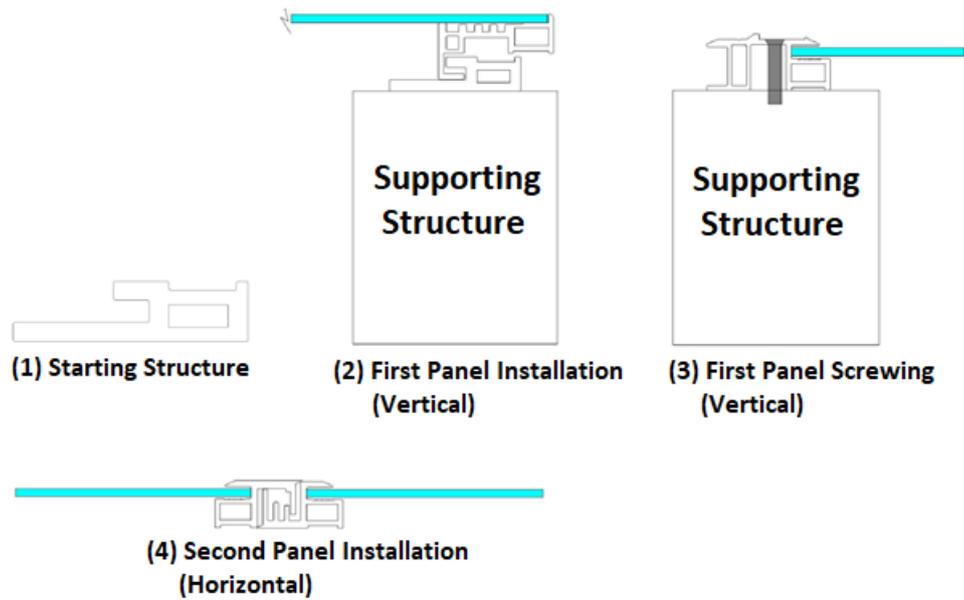


Figure 2: Installation Details

Modules should be screwed to the support structure with self-tapping screws through mounting holes located on the upper edge of the frames to the support structure at the bottom as shown in Figure 2. Panels should only be mounted horizontally.

5.3. Description of the installation position

The low/normal level of load condition is applicable to the installation in most of environmental conditions: the maximum static test load on the back of the Modules is 2400 Pa (i.e., wind load), and the maximum static test load on the front of the Modules is 2400 Pa (i.e., wind and snow load).

The high level of load condition is applicable to the installation in harsher environmental conditions such as storm, heavy snow, etc. the maximum static test load on the back of the Modules is 2400 Pa (i.e., wind load) and the maximum static test load on the front of the Modules is 2400 Pa (i.e., wind and snow load), depending on the pressure level that it would endure according to IEC standard.

For the dynamic loads, such as wind, the safety factor needs to be increased by 3 times. It means that the maximum dynamic load is 800 Pa when the wind speed is less than 130 km/h.

The mechanical load tests carried out within the certification were made in the form of a red marked assembly. It must be installed in this way for warranty coverage.

(Design load: 1600 Pa for wind load, 2400 Pa for snow load, safety factor $\gamma_m = 1.5$)

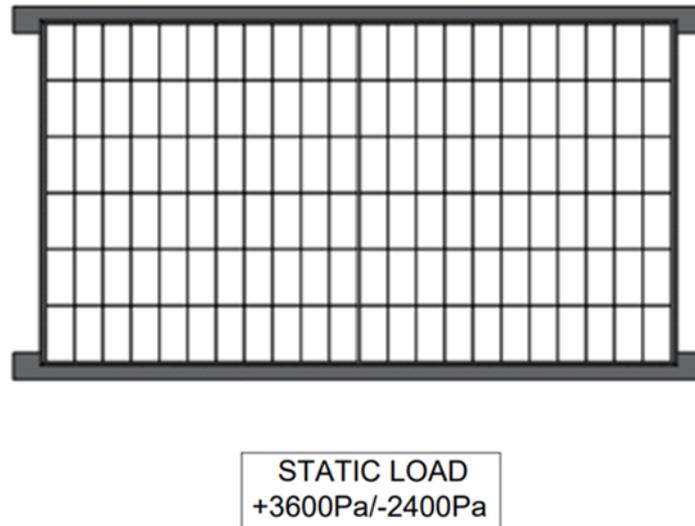


Figure 3: Installation Methods

6. ELECTRICAL INSTALLATION

6.1 Electrical Characteristics

Rated electrical characteristics such as I_{sc} , V_{oc} and P_{max} are measured within +/- 3% of measurement uncertainty at standard test condition (STC): 1000W/m² irradiance, 25°C Cell Temperature and 1.5 Air Mass.

Under normal conditions, photovoltaic solar panels may produce higher currents and/or voltages than reported at Standard Test Conditions. Accordingly, the values of short circuit current, I_{sc} , and open circuit voltage, V_{oc} , marked on solar panels should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fusing sizes, and size of controllers connected to the solar panels.

Voltages are additive when solar panels are connected in series, while the currents are additive when they are connected in parallel, as illustrated in Figure 5 on the next page.

The number of panels which can be connected to a string is calculated according to the voltage of the junction box of the panels, the NOCT value of the panel, the DC input voltage of the inverter to be used and the ambient temperature of the location of the plant. Solar panels with different electrical characteristics must not be connected directly in series.

$$\text{System Voltage} \geq N * V_{oc} [1 + TC_{Voc} * (T_{min} - 25)]$$

N = Number of panels in the series

V_{oc} = Open Circuit Voltage (data on product label or datasheet)

TC_{Voc} = Temperature coefficient of open circuit voltage (data on product label or datasheet)

T_{min} = Minimum ambient temperature

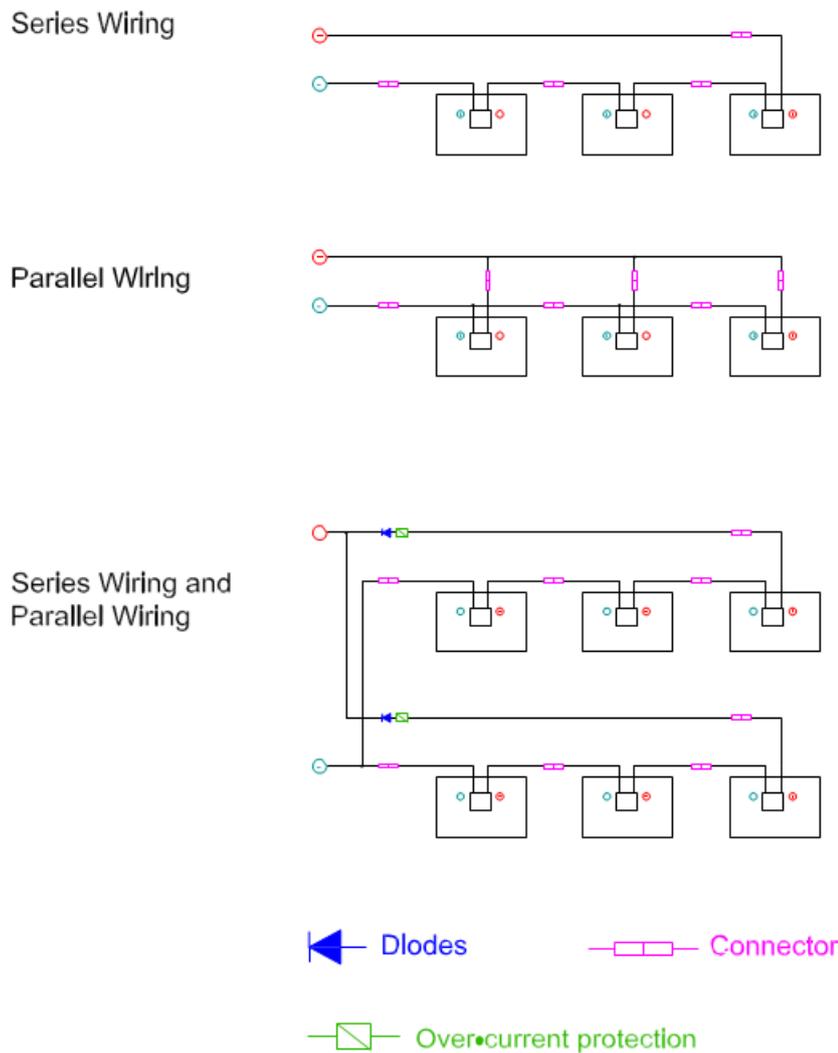


Figure 4: Electrical Diagrams of Series and Parallel Connection

Please note that the maximum number of solar panels which can be connected in a series string must be calculated in accordance with applicable regulations in such a way that the specified maximum system of the solar panels and all other electrical DC components will not be exceeded in open-circuit operation at the lowest temperature expected at the PV system location (The maximum system voltage of TommaTech solar panels is 1000VDC/ 1500VDC according to the safety standards of IEC61730). An appropriately rated over-current protection device must be used when the reverse current could exceed the value of the maximum fuse rating of the solar panels. An over-current protection device is required for each string if more than two strings are connected in parallel, as illustrated in Figure 5 above.

6.2 Cables and Wiring

Please note that the junction boxes at the back of the solar panels have been designed to enable easy and reliable connection in series with IP67 protection grade. Each module has two single-conductor wires, one positive and one negative, which are pre-wired inside the junction box. The connectors at the opposite end of these wires allow easy series connection of adjacent solar panels by firmly inserting

the positive connector of a module into the negative connector of an adjacent module until the connector is fully seated.

For field wiring please use cables with suitable cross-sectional areas that are approved for operation at the maximum short-circuit current of the solar panels. TommaTech recommends to only use UV resistant cables which are qualified for direct current (DC) wiring in PV systems. The minimum wire size should be 4mm². For example, a solar cable according to the specifications is recommended.

Testing Standard	Wire size	Temperature rating
EN 50618:2014	4 mm ²	-40 °C ile +90 °C

The cable of the junction box is in Figure 5 below.

L: Cable Length

L for TommaTech standard module is 1000/1200 mm, L for half-cut module is 300/1200 mm and L for bifacial module is 300/1200 mm. L for special modules may vary depending on the situation. Please consider the cable length before designing the wiring layout

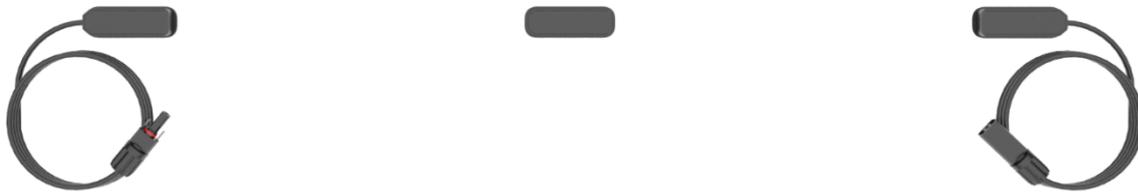


Figure 5: Junction Box Cable

Cables should be fixed to the mounting structure in such a way that mechanical damage of the cable and/or the Modules is avoided. Do not apply stress to the cables. For fixing, use appropriate means, such as sunlight resistant cable ties and/or wire management clips specifically designed to attach to the Modules frame. While the cables are sunlight resistant and waterproof, where possible, avoid direct sunlight exposure and water immersion of the cables.

6.3 Connectors

Keep connectors dry and clean. Do not attempt to make an electrical connection with wet, soiled, or otherwise faulty connectors. Avoid sunlight exposure and water immersion of the connectors. Avoid allowing connectors to rest on the ground.

Faulty connections can result in arcs and electrical shocks. Please ensure that all electrical connections are securely fastened and that all locking connectors are fully engaged and locked. The connectors can only be unlocked with the tool PV-MS-PLS. Only the same type of connectors can be used for installation.

6.4 By-Pass Diodes

The junction boxes installed at the back of TommaTech solar panels contain by-pass diodes wired in parallel with the PV cell strings. In the case of partial shading, the diodes bypass the current generated by the nonshaded cells, thereby limiting solar panels heating and performance losses.

By-pass diodes are not over-current protection devices but divert current from the cell strings in the event of partial shading.

In the event of a known or suspected diode failure, installers or maintenance providers should contact TommaTech. Never attempt to open the junction box by yourself.

7. GROUNDING

TommaTech solar panels are manufactured with an anodic oxidized aluminum frame to resist corrosion. Consequently, the frame of the solar panels must be connected to the equipment grounding conductor to prevent thunder and static damage.

The grounding device must fully contact with the inside of the aluminum alloy and must penetrate the surface of the frame oxidation film.

Please do not drill any additional grounding hole on the frame of the solar panels. The frame rails have pre-drilled holes marked with a grounding sign. These holes should be used for grounding purposes and must not be used for mounting the solar panels.

For optimal performance, TommaTech recommend the DC cathode of the solar panels arrays to be connected to ground. Failure to comply with this requirement may reduce the performance of the system.

The grounding method must not result in direct contact of dissimilar metals with the aluminum frame of the solar panels that will result in galvanic corrosion.

The following grounding methods are available.

7.1 Grounding by Using Grounding Clamps

The bonding between Modules must be approved by qualified electrician. And the bonding device must be produced by qualified electrical manufacture. As the holes drilled for installation in the module frame are drilled after anodized coating, the screws to be used for module installation will ensure grounding conduction when they contact this point. As shown in Figure 6, at least 12 AWG copper grounding cable must be mounted with a cable lug suitable for the module construction feature where it will contact the screw used for mounting, this installation must cover all modules between the modules. It must be ensured that the construction material in which the module is mounted is grounded in accordance with the standards and after installation, it must be measured with a grounding device in accordance with the standards whether the grounding is done correctly from the frame of the module.

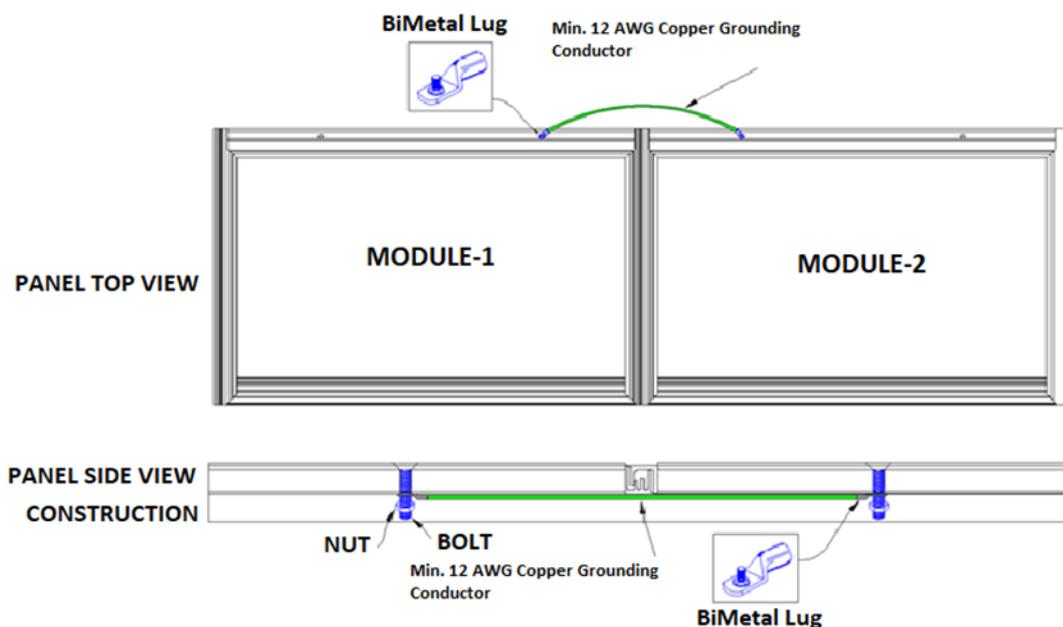


Figure 6: Grounding Wire Installation Methods

8. OPERATIONS AND MAINTENANCE

It is necessary to perform regular inspection and maintenance of the solar panels, especially within warranty scope. It is the user's responsibility to report to the supplier regarding the damages found within 2 weeks.

8.1 Cleaning

The dust accumulated on the module may reduce the power output and even cause regional hot-spot effect. The industrial effluents or bird drops may be serious, and the extent of the severity depends on the transparency of the foreign objects. Usually, the accumulated dust does not reduce the sunshine, because the light intensity is still homogeneous. Thus, the power reduction is usually not obvious.

Under operation, there should not be any environmental affects casting shadows or covering part of or even complete solar panels, such as support structure, other solar panels, bird drops, dust, clay, plants, etc. which may distinctly reduce the power output. TommaTech suggests that there should not be any obstructed objects over the solar panels surface at any time.

The frequency of cleaning depends on dirt accumulation speed. In normal situations, rainwater will clean the module surface and reduce the cleaning frequency. It is suggested to use damp clean water sponge or soft cloth to wipe the glass surface. In any case, do not use acid and alkaline detergents to clean the solar panels.

In order to avoid potential risk of electrical shock or burn, TommaTech suggests cleaning the solar panels during early morning or in the evening with less solar irradiation and lower surface temperature. In order to avoid potential risk of electrical shock, do not try to clean the solar panels with glass damages or exposed wires.

8.2 Visual Inspection of Solar panels

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

- A) Whether the glass is broken,
- B) Corrosion along the cells' busbar. The corrosion is caused by the damp infiltrated into the solar panels if the surface encapsulation materials are damaged during the installation or transportation.
- C) Whether there are burning vestiges on the backsheet.
- D) Check PV solar panels for signs of aging including rodent damage, weather damage, connection tightness, corrosion, and grounding condition.
- E) Check for any shape objects in contact with PV solar panels' surface
- F) Check for any obstacles shielding the PV solar panels
- G) Check for any loose or damage screws between the solar panels and brackets. If so, adjust or fix them on time.

8.3 Inspection of Connectors and Cables

It is suggested to carry out the following preventive inspection once every 6 months:

- A) Check connector sealings and cable connections.
- B) Look for gaps on the sealant of the terminal box and confirm whether it is cracking

9. APPLICABLE PRODUCTS

This installation manual is prepared for solar panels as listed below:

GROUP	MODULE TYPE	CELL TYPE	POWER RANGE (IN 5W INTERVALS)	NUMBER OF CELLS	PANEL DIMENSIONS (mm)	MOUNTING DISTANCE (Purlins spacing) (mm) [L ₂ -L ₁]
GROUP 1	TT-108PMCK12	PERC MONO	530W-550W	54 PCS FULL CELL	2005*1334.1	1122 mm
GROUP 2	TT-108PMBCK12	PERC MONO BIFACIAL	530W-550W	54 PCS FULL CELL	2005*1334.1	1122 mm
GROUP 3	TT-108PMFBCK12	PERC MONO FULL BLACK	530W-550W	54 PCS FULL CELL	2005*1334.1	1122 mm
GROUP 4	TT-108TNCK10	TOPCON	435W-450W	54 PCS FULL CELL	1762*1165.1	1122 mm
GROUP 5	TT-108TNBCK10	TOPCON BIFACIAL	435W-450W	54 PCS FULL CELL	1762*1165.1	1122 mm
GROUP 6	TT-108TNFBCK10	TOPCON FULL BLACK	435W-450W	54 PCS FULL CELL	1762*1165.1	1122 mm
GROUP 7	TT-144TNCK10	TOPCON	570W-595W	72 PCS FULL CELL	2318*1165.1	1291 mm
GROUP 8	TT-144TNBCK10	TOPCON BIFACIAL	570W-595W	72 PCS FULL CELL	2318*1165.1	1291 mm
GROUP 9	TT-144TNFBCK10	TOPCON FULL BLACK	570W-595W	72 PCS FULL CELL	2318*1165.1	1291 mm

GROUP 1

TT-108PMCK12					
Peak Power (P _{max})	530W _p	535 W _p	540 W _p	545 W _p	550 W _p
Maximum Power Voltage (V _{mp})	30,7V	30,9V	31,1V	31,3V	31,5V
Maximum Power Current (I _{mp})	17,27A	17,31A	17,36A	17,42A	17,46A
Open Circuit Voltage (V _{oc})	37,00V	37,20V	37,50V	37,70V	37,90V
Short Circuit Current (I _{sc})	18,28A	18,33A	18,38A	18,45A	18,49A

GROUP 2

TT-108PMBCK12 - BIFACIAL					
Peak Power (Pmax)	530Wp	535 Wp	540 Wp	545 Wp	550 Wp
Maximum Power Voltage (Vmp)	30,7V	30,9V	31,1V	31,3V	31,5V
Maximum Power Current (Imp)	17,27A	17,31A	17,36A	17,42A	17,46A
Open Circuit Voltage (Voc)	37,00V	37,20V	37,50V	37,70V	37,90V
Short Circuit Current (Isc)	18,28A	18,33A	18,38A	18,45A	18,49A

GROUP 3

TT-108PMFBCK12 – FULL BLACK					
Peak Power (Pmax)	530Wp	535 Wp	540 Wp	545 Wp	550 Wp
Maximum Power Voltage (Vmp)	30,7V	30,9V	31,10V	31,30V	31,5V
Maximum Power Current (Imp)	17,27A	17,31A	17,36A	17,42A	17,46A
Open Circuit Voltage (Voc)	37,00V	37,20V	37,50V	37,70V	37,90V
Short Circuit Current (Isc)	18,28A	18,33A	18,38A	18,45A	18,49A

GROUP 4

TT-108TNCK10				
Peak Power (Pmax)	435Wp	440 Wp	445 Wp	450 Wp
Maximum Power Voltage (Vmp)	32,54V	32,74V	32,94V	33,14V
Maximum Power Current (Imp)	13,37A	13,44A	13,51A	13,58A
Open Circuit Voltage (Voc)	38,51V	38,91V	38,91V	39,11V
Short Circuit Current (Isc)	14,17A	14,31A	14,31A	14,38A

GROUP 5

TT-108TNBCK10				
Peak Power (Pmax)	435Wp	440 Wp	445 Wp	450 Wp
Maximum Power Voltage (Vmp)	32,54V	32,74V	32,94V	33,14V
Maximum Power Current (Imp)	13,37A	13,44A	13,51A	13,58A
Open Circuit Voltage (Voc)	38,51V	38,91V	38,91V	39,11V
Short Circuit Current (Isc)	14,17A	14,31A	14,31A	14,38A

GROUP 6

TT-108TNFBCK10				
Peak Power (Pmax)	435Wp	440 Wp	445 Wp	450 Wp
Maximum Power Voltage (Vmp)	32,54V	32,74V	32,94V	33,14V
Maximum Power Current (Imp)	13,37A	13,44A	13,51A	13,58A
Open Circuit Voltage (Voc)	38,51V	38,91V	38,91V	39,11V
Short Circuit Current (Isc)	14,17A	14,31A	14,31A	14,38A

GROUP 7

TT-144TNCK10						
Peak Power (Pmax)	570Wp	575 Wp	580 Wp	585 Wp	590 Wp	595 Wp
Maximum Power Voltage (Vmp)	42,55V	42,75V	42,95V	43,15V	43,35V	43,55V
Maximum Power Current (Imp)	13,40A	13,46A	13,51A	13,56A	13,62A	13,67A
Open Circuit Voltage (Voc)	50,58V	50,78V	50,98V	51,18V	51,38V	51,58V
Short Circuit Current (Isc)	14,17A	14,23A	14,31A	14,38A	14,45A	14,53A

GROUP 8

TT-144TNBCK10 - BIFACIAL						
Peak Power (Pmax)	570Wp	575 Wp	580 Wp	585 Wp	590 Wp	595 Wp
Maximum Power Voltage (Vmp)	42,55V	42,75V	42,95V	43,15V	43,35V	43,55V
Maximum Power Current (Imp)	13,40A	13,46A	13,51A	13,56A	13,62A	13,67A
Open Circuit Voltage (Voc)	50,58V	50,78V	50,98V	51,18V	51,38V	51,58V
Short Circuit Current (Isc)	14,17A	14,23A	14,31A	14,38A	14,45A	14,53A

GROUP 9

TT-144TNFBCK10 – FULL BLACK						
Peak Power (Pmax)	570Wp	575 Wp	580 Wp	585 Wp	590 Wp	595 Wp
Maximum Power Voltage (Vmp)	42,55V	42,75V	42,95V	43,15V	43,35V	43,55V
Maximum Power Current (Imp)	13,40A	13,46A	13,51A	13,56A	13,62A	13,67A
Open Circuit Voltage (Voc)	50,58V	50,78V	50,98V	51,18V	51,38V	51,58V
Short Circuit Current (Isc)	14,17A	14,23A	14,31A	14,38A	14,45A	14,53A