



SpolarPV
Easy Invest, More Returns



INSTALLATION MANUAL



1. General Information

1.1 Overview

Thanks for choosing SPV SOLAR PV modules. In order to ensure the PV modules are installed correctly, please read the following installation instructions carefully before modules are installed and used. Please remember that these products generate electricity and certain safety measures need to be taken to avoid danger.

Make sure the module array is designed in such a way not to exceed the maximum system voltage of any system component such as connectors or inverters and only use compatible connectors of the same type.

The assembly is to be mounted over a fire resistant roof covering rated for the application. Before mounting the module, please consult your local building department to determine approved roofing materials.

The modules are qualified for Class II: which can be used in systems operating at 50 V DC or >240W.

Where general contact access is anticipated; When the modules are for rooftop application, it is necessary to take the overall fire rating of the finished structure as well as operation and maintenance into account. The roofing PV system shall be installed after being evaluated by construction experts or engineers and with official analysis results for the entire structure. It shall be proved capable of supporting extra system bracked pressure, including PV module weight.

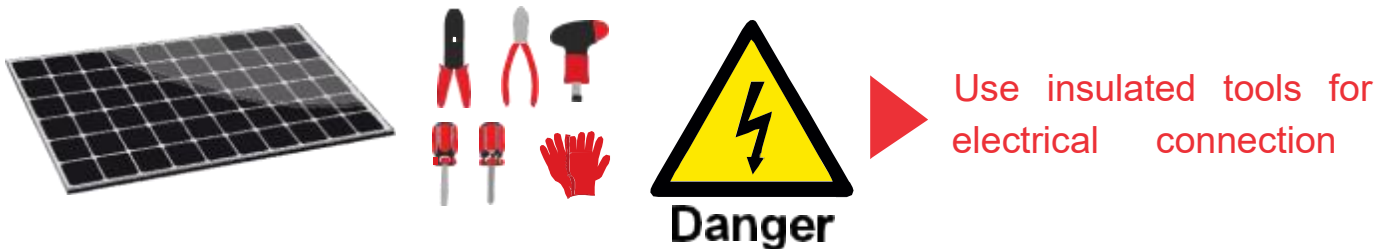
1.2 Warnings



- PV modules generate DC electrical energy when exposed to sunlight or other light sources. Active parts of module such as terminals can result in burns, sparks, and lethalshock.
- Artificially concentrated sunlight shall not be directed on the module or panel.
- Front protective glass is utilized on the module. Broken solar module glass is an electrical safety hazard (may cause electric shock or fire). These modules cannot be repaired and should be replaced immediately.
- To reduce the risk of electrical shocks or burns, modules may be covered with an opaque material during installation to avoid injury.
- The installation work of the PV array can only be done under the protection of sun-sheltering covers or sunshades and only qualified person can install or perform maintenance work on this module.
- Follow the battery manufacture's recommendations if batteries are used with modules.
- Do not use this module to replace or partly replace roofs and walls of livingbuildings.
- Do not install modules where flammable gas may be present.
- Do not remove any part installed by SPV Solar or disassemble themodule.



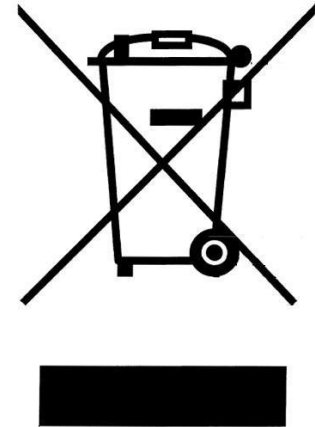
- All instructions should be read and understood before attempting to install, wire, operate and maintain the module.
- Don't lift up PV modules using the attached cables or the junction box.
- Do not touch live terminals with bare hands. Use insulated tools for electrical connections.



- All PV systems must be grounded to earth. If there is no special regulation, please follow the National Electrical Code or other national code.
- Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the value of I_{sc} and V_{oc} marked on the module should be multiplied by 1.25 when determining PV system component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.
- Once the PV module has been shipped to the installation site, all of the parts should be unpacked properly with care.
- Only the modules with the same type and the capacity should be connected in series inside the string.
- During transporting modules, please attempt to minimize shock or vibration to the module, as this may damage the module or lead to cell micro cracks.
- During all transportation situations, never drop the module from a vehicle, house or hands. This will damage module.
- Do not clean the glass with chemicals. Only use tap water. Make sure the module surface temperature is cool to the touch. Cleaning modules with cool water when module surface temp is high may result in glass breakage.
- Do not stand or step on the PV module like below pictures show. This is prohibited and there is a risk of damage to the module and cause injury for you.



- Do not disconnect modules from the circuit, when they are operating in the system and deriving electrical load.
- When looking at PV modules with anti-reflection (AR) coating technology, it will be normal to see some cells with a slight color difference at different angles. Modules with LRF (light reflective film) and without LRF should not be built in the same array or roof.
- Connector of junction box cannot be contacted with oily substances, for example, lubricant, rust inhibitor etc.
- The maximum altitude the PV module is designed for $\leq 2000\text{m}$.
- Do not carry a module on your head, with the backsheet facing towards to your helmet, if it is not avoidable, please make sure that, the module is facing with the glass side to your helmet.
- The maximum irradiance is $1300\text{W}/\text{m}^2$ for module with transparent and white backsheet rear.
- 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 foodchain, damaging your health and well-being.
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.



2. Installation

2.1 Installation Safety

- Always wear protective head gear, insulating gloves and safety shoes (with rubber soles).
- Keep the PV module packed in the carton until installation.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frame may be hot. There is a risk of burns and electric shock.
- Do not work in rain, snow or windy conditions.
- Due to the risk of electrical shock, do not perform any work if the terminals of the PV module are wet.
- Use insulated tools and do not use wet tools.
- When installing PV modules, do not drop any objects (e.g., PV modules or tools).
- Make sure flammable gasses are not generated or present near the installationsite.
- Insert module connectors fully and correctly. An audible "click" sound should be heard. This sounds confirms the connectors are fully seated. Check all connections.
- The module leads should be securely fastened to the module frame, Wire Management should be

done in a way to avoid the connector from scratching or impacting the back sheet of the module.

- Do not touch the junction box and the end of the interconnect cables (connectors) with bare hands during installation or under sunlight, regardless if the PV module is connected to or disconnected from the system.
- Do not expose the PV module to excessive loads on the surface of the PV module or twist the frame.
- Do not hit or put excessive load on the glass or back sheet, this may break the cells or cause micro cracks.
- During the installation or operation, don't use sharp tools to wipe the back sheet and glass. Scratches can appear on the module.
- Do not drill holes in the frame. It may cause corrosion of the frame.
- When installing modules on roof mounted structures, please try to follow the "from top to bottom" and/or "from left to right" principle, and don't step on the module. This will damage the module and would be dangerous for personal safety fire tested [Class C] according to ANSI-UL-790:2004.

2.2 Installation Condition

2.2.1 Climate Condition

Please install the modules in the following conditions:

- a) Operating temperature: within -40°C (-40°F) to 70°C (185°F)
- b) Humidity: $< 85\text{RH}\%$

* Note: The mechanical load bearing (include wind and snow loads) of the module is based on the approved mounting methods. The professional system installer must be responsible for mechanical load calculation according to the system design.

2.2.2 Site Selection

In most applications, SPV Solar PV modules should be installed in a location where they will receive maximum sunlight throughout the year. In the Northern Hemisphere, the module should typically face south, and in the Southern Hemisphere, the modules should typically face north. Modules facing 30 degrees away from true South (or North) will lose approximately 10 to 15 percent of their power output. If the module faces 60 degrees away from true South (or North), the power loss will be 20 to 30 percent. When choosing a site, avoid trees, buildings or obstructions, which could cast shadows on the solar photovoltaic modules especially during the winter months when the arc of the sun is lowest over the horizon. Shading causes loss of output, even though the factory fitted bypass diodes of the PV module will minimize any such loss.

Do not install the PV module near open flame or flammable materials.

When solar modules are used to charge batteries, the battery must be installed in a manner, which will protect the performance of the system and the safety of its users. Follow the battery manufacturer's

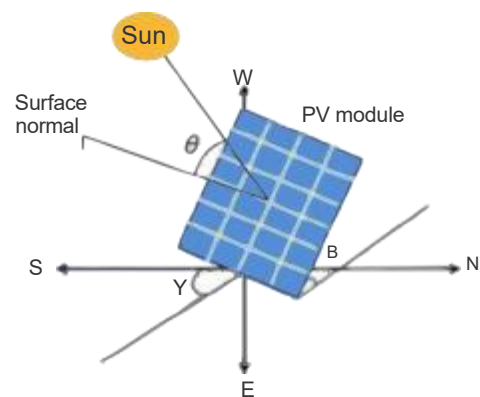
guidelines concerning installation, operation and maintenance recommendations. In general, the battery (or battery bank) should be away from the main flow of people and animal traffic. Select a battery site that is protected from sunlight, rain, snow, debris, and is well ventilated. Most batteries generate hydrogen gas when charging, which can be explosive. Do not light matches or create sparks near the battery bank. When a battery is installed outdoors, it should be placed in an insulated and ventilated battery case specifically designed for the purpose.

Do not install the PV module in a location where it would be immersed in water or continually exposed to water from a sprinkler or fountain etc.

2.2.3 Tilt Angle Selection

The tilt angle of the PV module is measured between the surface of the PV module and a horizontal ground surface (Figure 1). The PV module generates maximum output power when it faces the sun directly.

For standalone systems with batteries where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be selected to optimize the performance based on seasonal load and sunlight. In general, if the PV output is adequate when irradiance is low (e.g., winter), then the angle chosen should be adequate during the rest of the year. For grid-connected installations where the PV modules are attached to a permanent structure, PV modules should be tilted so that the energy production from the PV modules will be maximized on an annual basis.



2.3 Mechanical Installation Introduction

Solar PV modules usually can be mounted by using the following methods: bolts and clamps.

Note:

- 1) All installation methods herein are only for reference, and SPV solar will not provide related mounting components, the system installer or trained professional personnel must be responsible for the PV system's design, installation, and mechanical load calculation and security of the system.
- 2) Before installation, the following items should be addressed:
 - a) Visually check the module for any damage. Clean the module if any dirt or residue remains from shipping.
 - b) Check if module serial number stickers match.
- 3) SPV Solar modules are designed to meet a maximum positive (or downward) pressure of 3600Pa (Only

referring to the mentioned module type in this manual) and negative (or upward) pressure of 1600Pa. This design load was then tested with a safety factor of 1.5 times. SPV Solar modules are tested under a maximum downward pressure of 5400Pa and upward pressure of 2400Pa. When mounting modules in snow-prone or high-wind environments, special care should be taken to mount the modules in a manner that provides sufficient design strength while meeting local code requirements.

Please take in note, that the limitation of Tilt angle / slope is maximum 60 °. According to IEC61215, solar modules are rated as a class C Flame-Spread Ratings product according to NSF/ANSI342standards



2.3.1.Fixed mountingsystem

The mounting of the modules onto a support structure can be done using one of the approved methods described below. For information about other installation methods, please contact your local representative. Failure to use a recognized installation method will void the SpolarPV limited warranty.

2.3.1.Mounting with Bolts

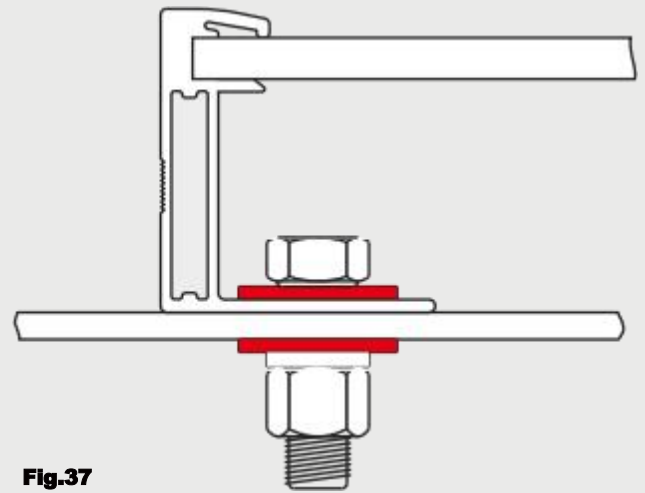
The mechanical load tests with the following mounting methods were performed according to complete the IEC 61215-2:2021 standard. To maximize the mounting structure's lifetime, SpolarPV recommends using corrosion-proof (stainless steel) fixtures.

The frame of each module has mounting holes placed to optimize the load handling capability, to secure the modules to the mounting structure. Please refer to the module datasheet for the number of holes, dimensions and placement.

Each module must be securely fastened at a minimum of 4 points on two opposite sides. Secure the module in each fixing location with an M8 bolt and a flat washer, spring washer, and a nut as shown in the figure and tighten to a torque of 16-20 Nm. The yield strength of bolt and nut should not be less than 450 MPa. The applied torque value should be big enough to fix the modules steadily. For special support systems or special installation requirements, please confirm with the mounting structure supplier the ideal torque value.

PV modules can be mounted onto the substructure using either corrosion-proof M8 bolts placed through the mounting holes on the rear of the modules or with specially designed module clamps.

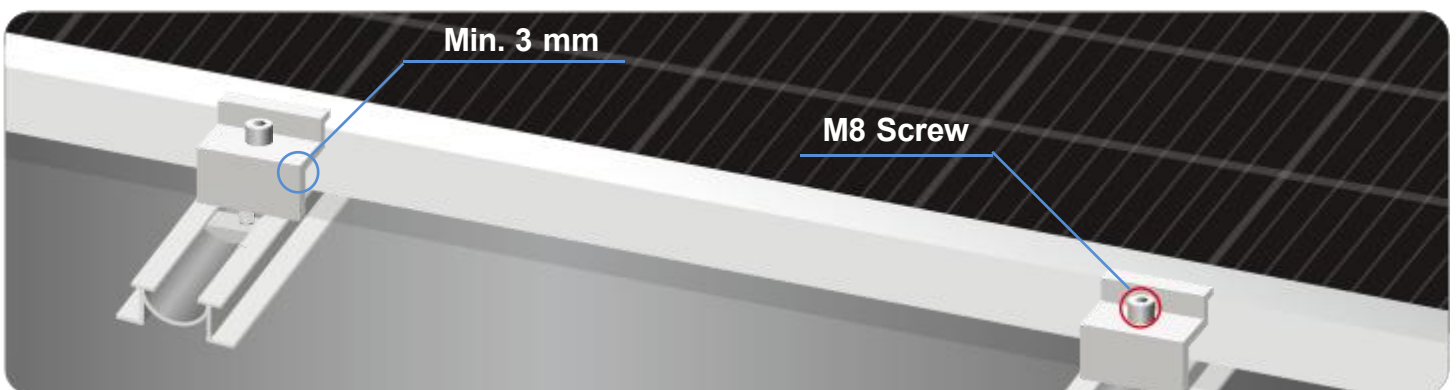
All parts in contact with the frame should use flat stainless-steel **washers of at least 1.8 mm** thickness.



2.3.2.Mounting with Clamps

Please ensure the clamp thickness is at least 3mm and made of anodized aluminum alloy or stainless steel. AE Solar recommends using clamps with an EPDM or similar insulating washer, and at least M6 fixing bolts.

Top or bottom clamping methods will vary and are dependent on the mounting structures. Always follow the mounting guidelines recommended by the mounting system supplier.



When fastening the clamps, they should not come into contact with the module's front glass or deform the frame. Please ensure there is no shading onto the module from the module clamps. The module frame is not to be modified under any circumstances. When installing with the clamp-mounting method, please be sure to use at least four clamps on each module. The clamps should

overlap the module frame by at least 10 mm but no more than 11 mm. A minimum of 4 clamps should be used to fix modules onto the mounting rails. Two clamps should be attached on each long side of the module (for portrait orientation) or each short side of the module (for landscape orientation). The clamps should be positioned symmetrically and in accordance with the authorized position ranges.

If excessive pressure loads are expected due to local wind and snow conditions, additional clamps or support may be required to ensure the modules can bear the respective loads. The applied torque value should be big enough to securely fix the modules. Please consult with the clamp or support supplier for the required torque values. The system designer and the installer are responsible for correctly calculating the loads and ensuring that the supporting structure meets all the applicable requirements.

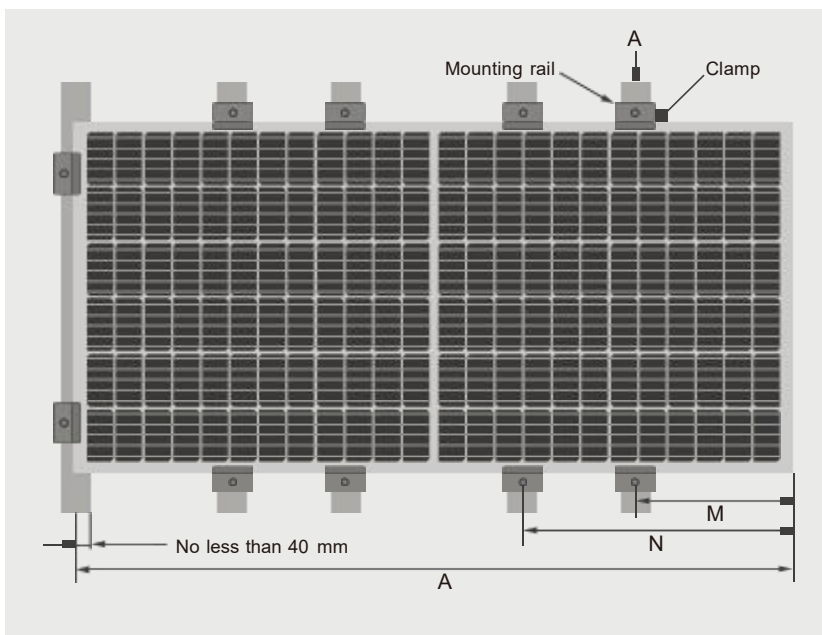
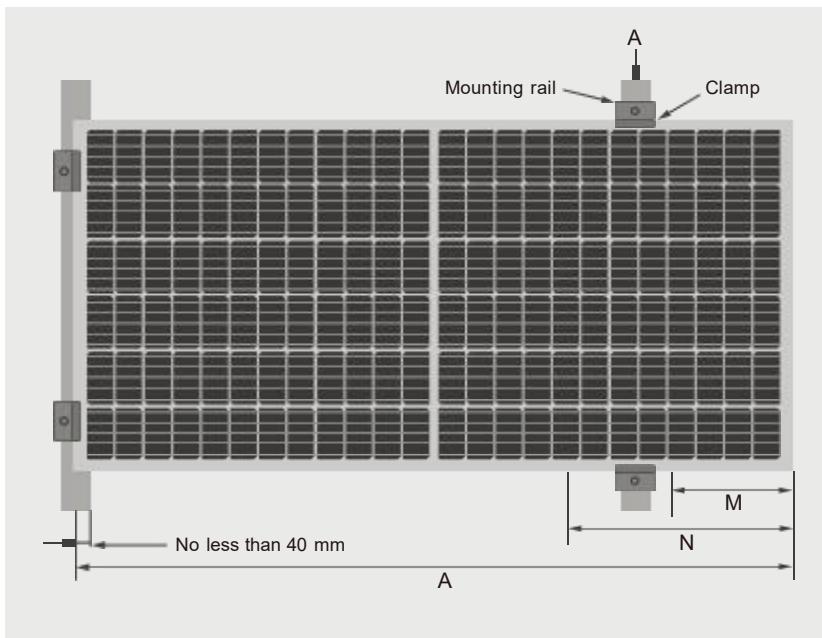
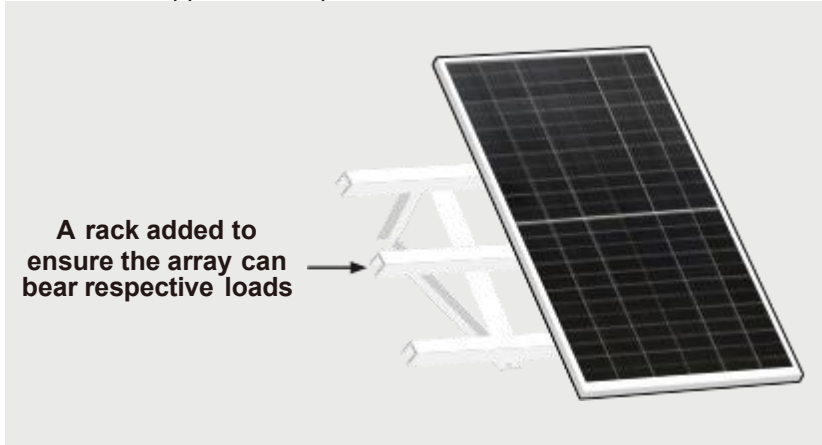
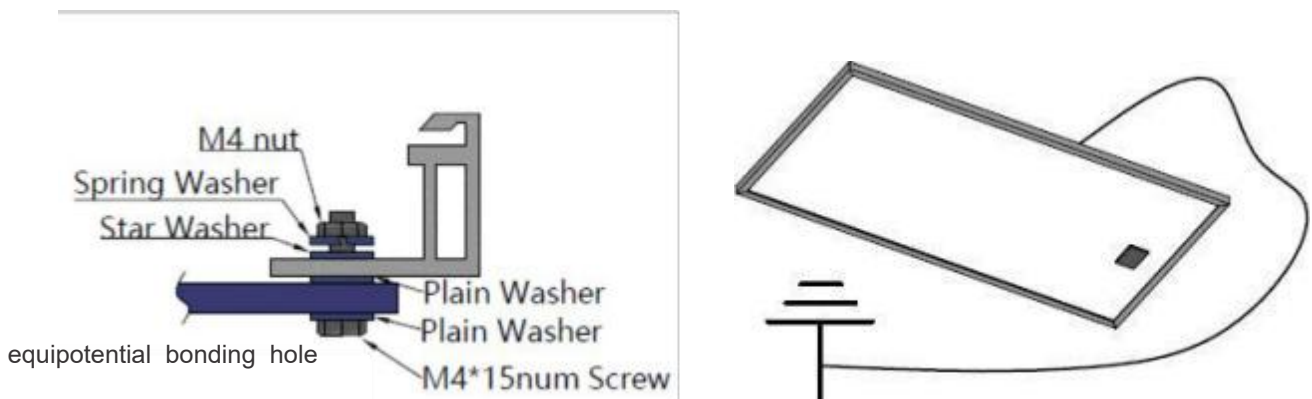


Table 1

Module Sizes (mm)	Mechanical loads:	
	Max. Long side Design Pressure: 3600 Pa (positive) & 1600 Pa (negative) with safety factor 1.5.	
	Max. Short side Design Pressure 1600 Pa (positive) & 1600 Pa (negative) with safety factor 1.5.	
	M (mm)	N (mm)
a)1724x1133x30	181	431
b)1752x1144x30	195	445
c)1755x1038x30	198	448
d)1910x1133x30	117	407
e)2094x1038x30	212	502
f)2094x1133x30	213	503
g)2172x1303x30	251	541
h)2278x1133x30	305	595
i)2384x1303x30	357	647
Module Sizes (mm)	Module Types	
a)1724x1133x30	SPV410-PM10-108 SPV400-PM10-108 SPV330-PM10-108 SPV280-PM10-108 SPV220-PM10-108	
b)1752x1144x30	SPV315-PM10-108	
c)1755x1038x30	SPV375-PM6-120	
d)1910x1133x30	SPV450-PM10-120 SPV440-PM10-120 SPV350-PM10-120	
e)2094x1038x30	SPV450-PM6-144 SPV440-PM6-144	
f)2094x1133x30	SPV500-PM10-132 SPV390-PM10-132	
g)2172x1303x30	SPV600-PG12-120 SPV595-PG12-120	
h)2278x1133x30	SPV550-PM10-144 SPV540-PM10-144 SPV430-PM10-144	
i)2384x1303x30	SPV660-PG12-132	

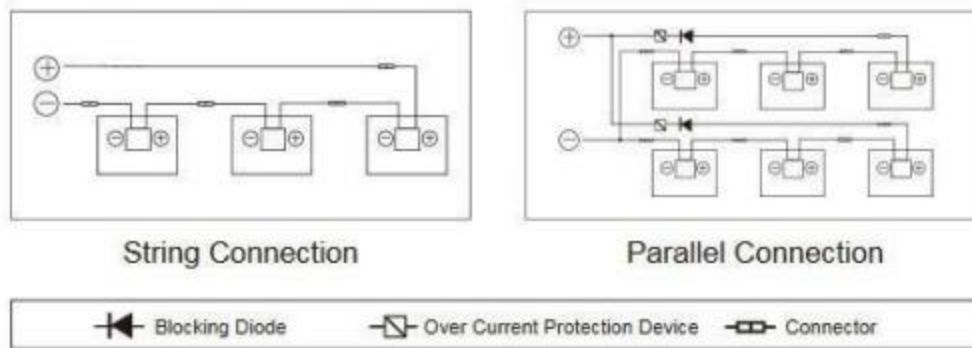
3. Wiring and Connection

- a) Before this procedure, please read the operation instructions of the PV system carefully. Make wiring by multi-connecting cables between the PV modules in series or parallel connection, which is determined by user's configuration requirement for system power, current and voltage.
- b) PV modules connected in series should have similar connectors of identical type current, and modules must not be connected together to create a voltage higher than the permitted system voltage. The maximum number of modules in series depends on system design, the type of inverter used and environmental conditions.
- c) The maximum fuse rating value in an array string can be found on the product label or in the product datasheet. The fuse rating value is also corresponding to the maximum reverse current that a module can withstand, i.e., when one string is in shade then the other parallel strings of modules will be loaded by the shaded string and the current will pass through to create a current circuit. Based on the maximum series fuse rating of module and local electrical codes and standards, make sure the modules strings in parallel are protected with the appropriate in-line string fusing.
- d) Open the combiner box of the control system and connect the conductor from the PV arrays to the combiner box in accordance with the design and local codes and standards. The cross-sectional area and cable connector capacity must satisfy the maximum short-circuit of the PV system (for a single component, we recommended that the cross-sectional area of cables current will be 4mm^2 and the rated current of connectors be more than 10A), otherwise cables and connectors will become overheating for large current. Please pay attention to the temperature limit of cables is 85°C .
- e) All module frames and mounting racks must be properly equipotential bonded in accordance with module frame using the local and national electrical codes. Attach the equipment equipotential bonded conductor to the hole and hardware provided. Note that a stainless-steel star washer is used between the ground wire and module frame (see Figure 10 below). This washer is used to avoid corrosion due to dissimilar metals. Tighten the screw securely.



Equipotential bonding installation of PV modules

When modules are in series connection, the string voltage is sum of every individual module in one string. When modules are in parallel connection, the current is sum of the individual module. Modules with different electric performance models cannot be connected in one string.



The maximum allowed quantity of modules in string connection shall be calculated according to relative regulations. The open circuit voltage value under the expected lowest temperature shall not exceed the maximum system voltage value allowed by modules and other values required by DC electric parts (maximum system voltage is DC1000V/DC1500V— actually system voltage is designed based on the selected module and inverter model.)

The VOC factor can be calculated by the following formula. $V_{oc} = 1 - \beta V_{oc}^* (25 - T)$

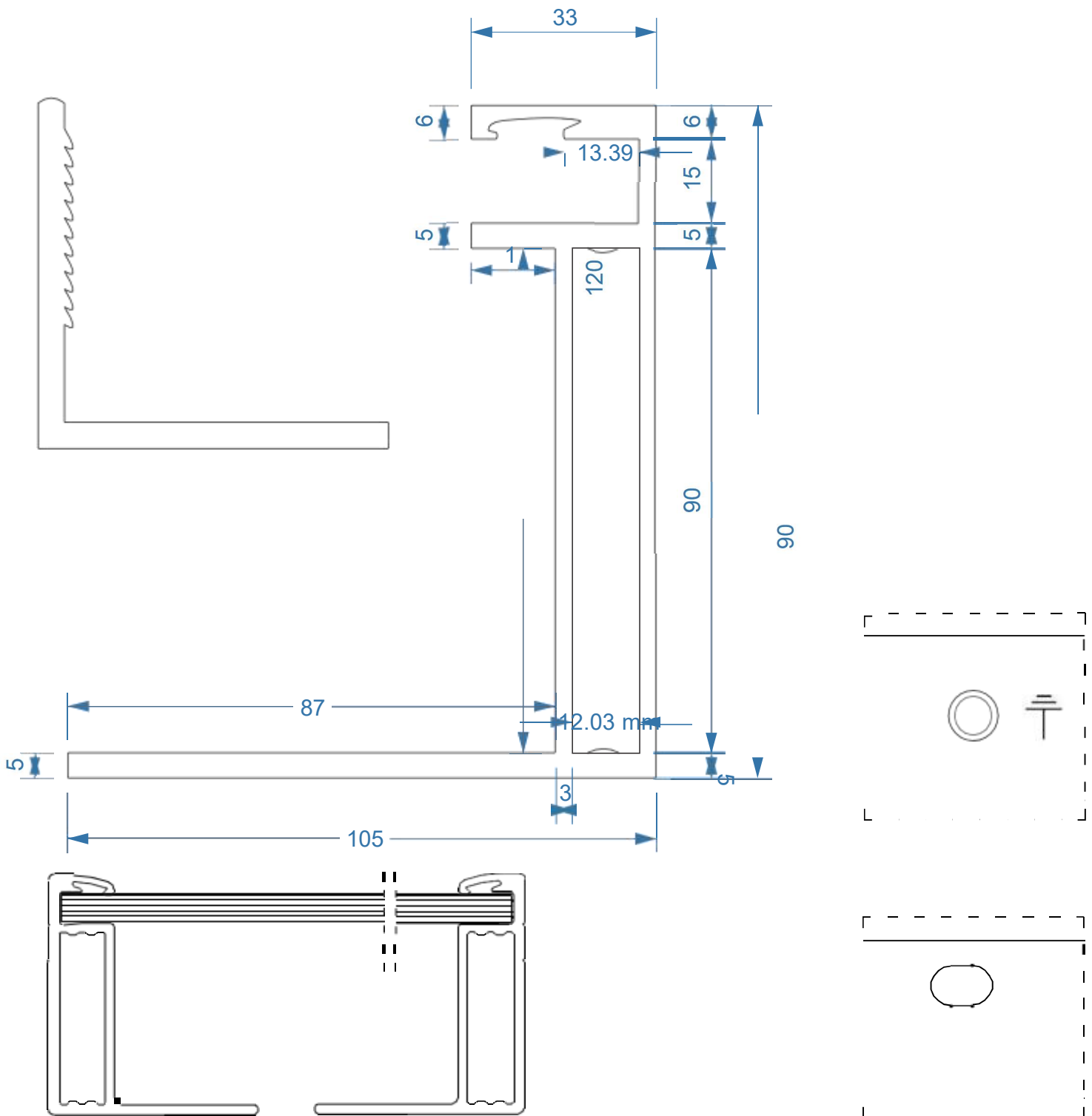
T: The expected lowest temperature of the installation site,

β ; VOC temperature coefficient (%/C) (refer to modules data sheet for further detail)

if there is reverse current exceeding the maximum fuse current flowing through the module, use overcurrent protection device with the same specifications to protect the module; if the parallel connection is more than 2, there must be an overcurrent protection device on each string of module.

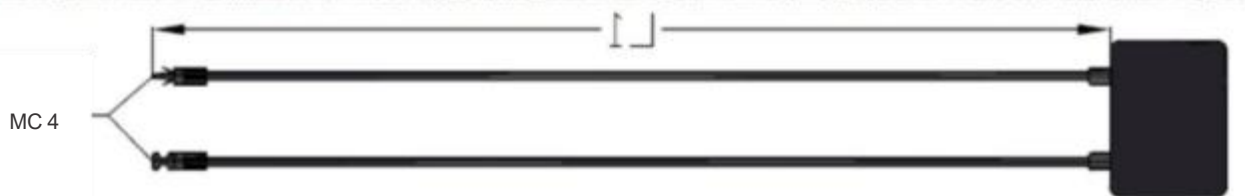


FRAME





- f) Follow the requirements of applicable local and national electrical codes.
- g) These modules contain factory installed by pass diodes. If these modules are incorrectly connected to each other, the bypass diodes, cable or junction box may be damaged.
- h) The cable of the junction box is defined as L, as showed below in Figure 11. For SPV Solar standard full cell module, L is 900/1200mm; for SPV Solar standard half-cell module, L is 350mm; and for customized module, L can be based on your condition. Please take the cable length into consideration before



designing the wiring layout.

- i) It is recommended to use negatively grounded inverters to avoid the PID effect for non-PID free modules.
- j) If modules are connected in series, and the Connector type: PV-XT101.1, PV-KST4-EVO 2/xy_UR (male);PV-KBT4-EVO2/xy_UR (female),the total voltage is equal to the sum of individual voltages. There commended as below,
System voltage $\geq N \cdot V_{oc} [1 + TCV_{oc} \cdot (T_{min} - 25)]$ Where

N module numbers in series

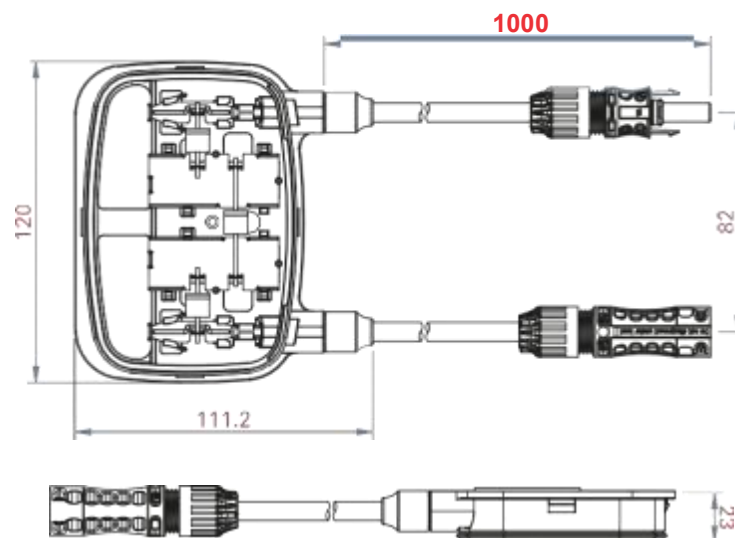
V_{oc} Open circuit voltage (refer to product label or data sheet)

TCV_{oc} Temperature coefficient of open circuit voltage (refer to product label or datasheet)

T_{min} Minimum ambient temperature

3. Maintenance and Care

It is required to perform regular inspection and maintenance of the modules, especially during the warranty period. To ensure optimum module performance,SPV Solar recommends the following maintenance measures:



3.1 Visual Inspection

Inspect the modules visually to find if there are any visual defects, if there are, the following items should be evaluated:

- a) If modules are observed having slight cell color differences at different angles, this is a normal phenomenon of modules with anti-reflection coating technology.
- b) Whether the glass is broken.
- c) No sharp objects are in contact with the PV module surfaces.
- d) PV modules are not shaded by unwanted obstacles and; or foreign material.
- e) Corrosion along the cells' bus-bar. The corrosion is caused by moisture intrusion through the module back sheet. Check the back sheet for damage.
- f) Check whether the back sheet is burn out.
- g) Check if screws and mounting brackets are tight, adjust and tighten as necessary.

3.2 Cleaning

- a) A buildup of dust or dirt on the module(s) front face will result in a decreased energy output. Clean the panel(s) preferably once per annum, if possible (depend on site conditions), using a soft cloth dry or damp, as necessary. Water with high mineral content may leave deposits on the glass surface and is not recommended.
- b) Never use abrasive material under any circumstances.
- c) In order to reduce the potential for electrical and thermal shock, SPV Solar recommends cleaning PV modules during early morning or late afternoon hours when solar radiation is low and the modules are cooler, especially in regions with hotter temperatures.
- d) Never attempt to clean a PV module with broken glass or other signs of exposed wiring, as this presents a shock hazard.
- e) Never use chemicals when cleaning modules as this may affect the module warranty and energy output.

3.3 Inspection of Connector and Cable

It's recommended to implement the following preventive maintenance every 6 months:

- a) Check the sealing gels of the junction box for any damage.
- b) Examine the PV module(s) for signs of deterioration. Check all wiring for possible rodent damage, weathering and that all connections are tight and corrosion free. Check electrical leakage to ground.

4. Electrical Specification

The module electrical ratings are measured under Standard Test Conditions, which are 1000W/m², irradiance with AM 1.5 spectrum and 25 deg (77F°) ambient temperature.

The module might produce more or less voltage or current than rated value in uncertainty condition.

5. Disclaimer of Liability

Because the use of the manual and the conditions or methods of installation, operation use and maintenance of photovoltaic (PV) product are beyond SPV Solar's control SPV Solar does not accept responsibility and expressly disclaims liability for loss, damage, or expense

arising out of or in any way connected with such installation, operation, use or maintenance.

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