OWN YOUR POWER...

Installation Manual for Photovoltaic Module

SEL-QC-IM-001

SOLEX ENERGY LIMITED
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1. General Information

1.1 Overview

Thank you for choosing Solex Photovoltaic modules. This document provides information on electrical and mechanical installation of Solar PV Modules. Please read and understand the entire installation manual before installing Solex PV Modules. In addition, this manual also contains some safety precautions that you may be familiar with.

This installation manual does not stipulate responsibility for loss, damage or expense resulting from improper installation, handling or use of this product.

Solex Energy Limited reserves the right to modify the installation manual without prior notice. Visit our website at www.solex.in for the latest version of this installation manual.

If the customer fails to install the module as per requirements set forth in this manual, the warranty provided will be invalid.

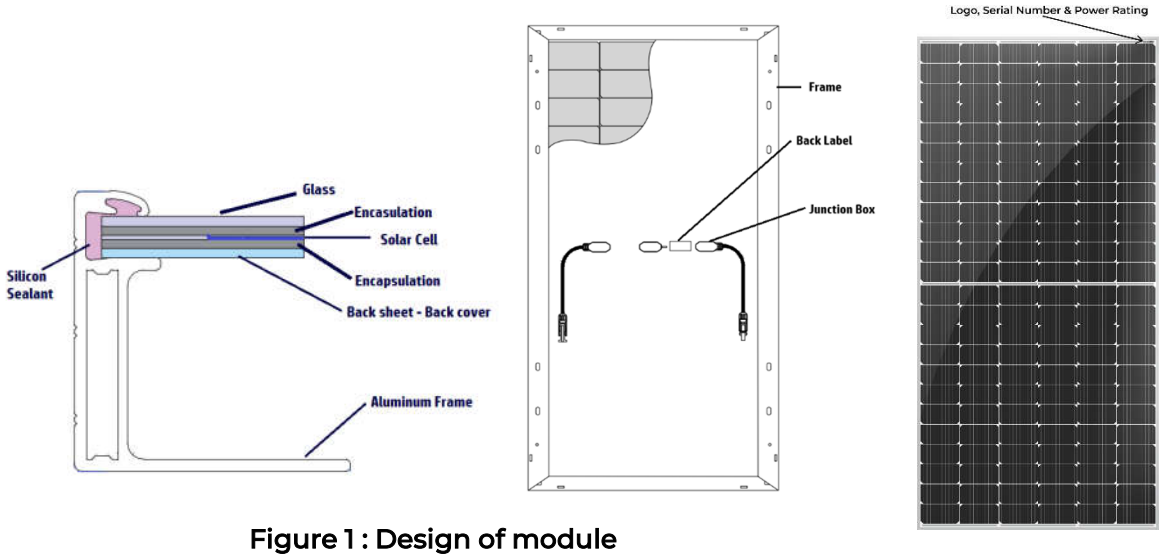


Figure 1 : Design of module

Each module is provided with 2 labels:

I. **Back Label**:
Back Label given on the back side of the module consists of: - Product Type, Rated Power, Rated Current, Rated Voltage, Open Circuit Voltage, Short-Circuit Current under standard testing conditions, Certification Indicator, Maximum System Voltage, Sorting Code respect to Imp current binning etc.

II. **Barcode Label**:
A unique serial number which is laminated inside the module permanently which can be found in the front of the module. In some cases, additionally the same label is provided on the back-side of the module also.

1.2 Warnings

Precautions:

- Modules generate DC electrical energy when exposed to sunlight or other light sources. Improper contact with live parts of the module such as terminals can result in burns, sparks, and lethal shock.

- Front glass is used for the module protection. Broken glass can cause electrical safety hazard (may cause electric shock or fire). These modules cannot be repaired and should be removed and replaced immediately.
- Breakage of the rear glass (in the case of bifacial PV modules) can also lead to the issue of electrical safety. As in the case of monofacial modules, this cannot be repaired and the modules must be disconnected and replaced immediately.
- The back-label specifications are measured under standard test conditions (Irradiance 1000W/m^2, module cell temperature 25°C, air mass=1.5). The current and voltage generated by modules in different environments are different. Therefore, when determining the specifications of the rated voltage, cable capacity, fuse capacity, controller capacity, and other output power related specifications, take the values of 1.25 times the short-circuit current and open-circuit voltage marked on the module as reference, and consult with your inverter/controller supplier for the system configuration design.
- During all deliveries, ensure that the modules are not subjected to big shocks during transportation, which may damage the assembly or cause cracks in the cell of modules.
- When the electrical load is working, do not disconnect components without authorization; if disconnecting the connector is needed, the DC and AC inverters must be turned off first or the main switch of the converter must be cut off.
- When the battery storage system is connected with the PV system, the battery must be installed correctly, so as to protect the operation of the system and ensure the user safety; Follow the battery manufacturer's instructions for installation, operation, and maintenance.

Prohibitions:

- Do not apply excessive force or objects on the surface of the module, do not impact, and do not twist the frame of the module, which may damage the cells or cause the cells to crack.
- Do not use the module to replace or partly replace roofs and walls of buildings.
- Do not remove any part installed by Solex or disassemble the module.
- Don’t lift up the modules using the attached cables or the junction box.
- Modules (glass, junction boxes, connectors, etc.) shall be protected from long-term exposure to environments containing sulfur, acid, alkaline, etc., which may pose a risk of corrosion to the product, and organic solvents which can destroy ARC coating on the front glass or have a negative impact on the polymers as junction boxes and backsheet.
- The junction box must meet IP68 (IEC60529) requirements, however they must be protected from direct sunlight and water immersion. The interconnection of female-male connectors shall meet the IP68 (IEC60529) requirements. However, it is not recommended to use the connector under water for a long time. The junction box connector should not be in contact with oily substances, organic solvents and other

corrosive materials, i.e., alcohol, gasoline, lubricants, rust inhibitors, herbicides, to avoid damage to the connector. If the connector is polluted, it needs to be replaced with a new one.

- Do not stand or step on the module like shown in the below pictures. This is prohibited and there is a risk of damaging the module and injuring the user.

- Do not touch live terminals with bare hands. Use insulated tools for electrical connections.

Others:

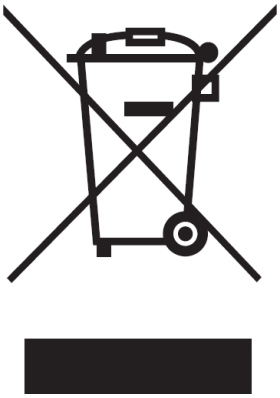
- The maximum altitude of module installation is 2000m.
- The minimum distance from the seashore is 50m
- When looking at PV modules with anti-reflection (AR) coating technology, it will be normal to see some cells with a slight color difference at different angles.
- Before the installation of modules, it is recommended to keep the modules under rainproof facility to avoid direct exposure to rain and sunlight.
- 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.

  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.



For more, please contact Solex or refer to the operation and maintenance guideline.

2. Installation

2.1 Installation Safety Instructions

The installation of PV modules requires highly skilled and qualified professionals to perform handling, installation, operation and maintenance.

2.1.1 Electrical Safety

- PV modules are Application class A, Electrical safety class II & fire safety class C.
- PV modules generate electricity when exposed to illumination, any contact of the exposed metal of the modules connection wires may result in electrical shock or burn. Any contact of 30V or larger DC Voltage can be fatal.
- Do not concentrate sunlight or other artificial light sources onto the module.
- In case of no connected load or external circuits, modules can still produce voltage. Please use insulated tools and wear insulating rubber gloves when operating in sunlight. There should not be any metallic contact on the human body.
- Generation by PV modules can be stopped by keeping them away from sunlight or by covering with hard board or UV-proof materials.
- To avoid electric arc or electric shock hazards, please do not break down electric connection in loaded conditions. Incorrect connections will also lead to electric arc or shock. Keep the connectors dry & clean and make sure that they are in good operating condition. Do not insert any metals into the connectors or carry out electric connection by any other means.
- Cover all modules in the PV array with an opaque material before making or breaking any connections.
- If module glass or other sealing materials are damaged, please wear PPE (Personal Protective Equipment) and then isolate modules from the circuit.
- Do not operate when modules are wet unless you wear PPE (Personal Protective Equipment). Please follow the cleaning requirements as described in this manual while cleaning modules.
- Take necessary measures to avoid electric discharges when installing, wiring, starting up or carrying out maintenance work on the modules.
- There are no serviceable parts within the module. Do not attempt to change or repair any part of the module.
- Do not remove or misuse module connectors, this could void module warranty.
- Do not connect or disconnect modules when current from the modules or an external source is present.
- Damaged modules (broken glass, torn back sheet, broken j-boxes, broken connectors, etc.) can present electrical hazards as well as laceration hazards. Contact with damaged module surfaces or module frame can cause electric shock. The dealer or installers should remove the module from the array and contact the supplier for disposal instructions.
- The cross section for the conductors must ensure that the voltage drop during the installation does not exceed 2% of its nominal voltage.
- Solex's PV modules are supplied with or without cables, as per customer requirement. In case, if the modules are supplied without cables, it is recommended to use cables with cross sections of $4mm^2$.
- The cables, which allows easy handling while providing high protection against overloads and short-circuits, are formed by flexible *Cu* conductors, cross-linked insulated polyethylene and coated with polyvinyl chloride or similar insulation. The insulation should provide resistance against flame, acid and alkali and should be stored in an area free from any corrosive gases with high concentration.
- Do not install or handle the modules when wet or during periods of high wind.

2.1.2 Electrical Specification

- The electrical characteristics are indicated values of I_{sc}, V_{oc} and P_{max} under standard test conditions (irradiance of 1000 W/m^2, AM 1.5 spectrum and a cell temperature of 25°C).
- Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} marked on this PV module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g. inverter) connected to the PV output."

Refer to section 690-8 of the NEC for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable. For the Safety Standard for Electrical Installations, please refer to national building codes and safety requirements.

2.1.3 Fire Safety

- Solex modules have a Class C Type 4 fire resistance rating in accordance with UL 61730 certification. The fire rating of the module is valid only when mounted in the manner specified in the mechanical mounting instructions in this manual. Rooftop installations should be placed over fire resistant roof coverings only. Roof constructions and installations may affect the fire safety of a building, and improper installation may create hazards in the event of a fire.
- A minimum slope of 5 inch/feet is necessary when mounting on a roof in order to ensure the Class C fire rating of the modules.

2.1.4 Fork Lift

- Do not exceed the rated load capacity of the forklift.
- Transport double stacked pallets only if it is well aligned.
- Do not collide with other object / pallet while transporting modules.
- Use only fork lifts with sufficient length of forks to move stacking of the pallets.
- Do not use forklift truck directly when the pallet is found broken or there are other issues with the pallet
- Do not stack more than the maximum number of allowed pallets. Never stack more than 2 pallets

Figure 2 Fork Lift

2.1.5 Lifting Support Fixture

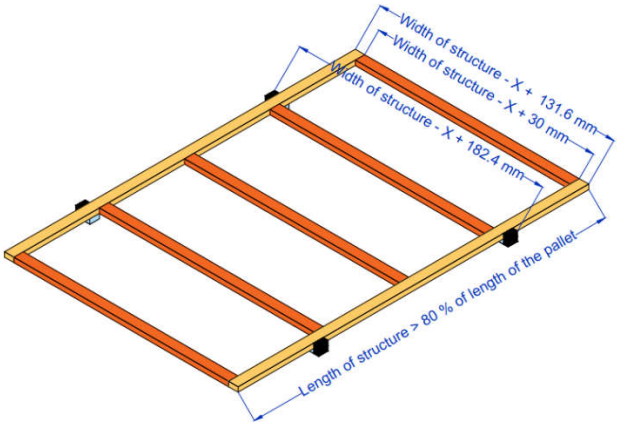


Figure 3: Design of Lifting Support Fixture

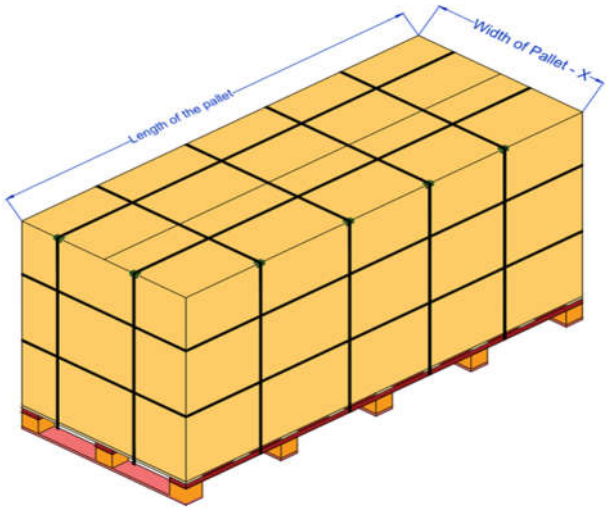


Figure 4: Pallet of packed Module

- While lifting the pallet of modules using hydra, it is mandatory to use 'Lifting Support Fixture' as per Design Provided.
- Place the fixture on top of the pallet of modules properly.
- Place the lifting belts of hydra through the gaps of blocks of wooden pallet such that the weight is distributed uniformly.
- Hang the belts to the hook of hydra.
- Lift the pallet to the desired location.

- Remove the belts & structure from the pallet.
- Repeat above steps for each pallet.

Preservation

- Open the outer packaging of modules only when installation starts.
- Do not damage the package and do not drop packaged modules on the ground.
- Do not exceed the maximum stacking limit on the packaging carton while piling modules up.
- Put package of modules in ventilated, dry and water-proof area before unpacking modules.
- Follow unpacking instructions when opening package of module.
- Do not use a knife to cut the zip-ties, but use wire cutting pliers.
- Carrying modules with junction box or cables are not allowed.
- Do not stand or walk on modules.
- Do not drop the module or throw objects on the module.
- In order to avoid damage to the glass, do not throw objects on the modules.
- Do not try to dismantle the module or remove nameplate or any part of the module.
- Do not paint or apply any other adhesive on the modules.
- Do not damage or scratch backsheet of the module.
- Do not drill holes on the frame of module, which may reduce frame loading capacity and lead to corrosion of frame and invalidation of the limited warranty provided for customers.
- Do not scratch anodic coating of aluminum frame except for grounding connection. Scratch may lead to frame corrosion and reduce frame loading capacity and long-term reliability.
- Avoid scratching the frame. Scratches to the frame will compromise protective coating and can result in corrosion or weakened structure.
- When storing modules for any period of time, cover modules to ensure protection from the elements.
- When storing the modules, make sure to keep glass side facing down. Do not allow water to accumulate inside module, as it may result in deterioration of the module connectors or sometimes in short circuit.
- When storing the modules, do not allow the anodized profiles (frames) to come into contact with contaminants such as cement or mortar, which will cause damage to the anodic oxide coatings.

2.2 Installation Condition

2.2.1 Lightning protection

Carry out lightning protection for modules installed in places with frequent lightning and thunder.

2.2.2 Climate Condition

Protective measures should be taken to ensure reliable and safe installation of modules in environments such as heavy snow, cold and strong wind or islands close to water and salt mist or desserts. Install the PV module in the following conditions:

Environment temperature: -40°C to 50°C.

Operating temperature: -40°C to 85°C.

Waterproof: Don't put the modules dipped in the water or under a water device or fountain.

The module must be installed so that air can freely circulate around it. The cells' working temperature will thus be reduced and consequently the module's performance will be enhanced.

2.2.3 Site Selection

Modules should be installed in places free from shadows throughout the year. Make sure that there are no light-blocking obstacles in the installation sites.
Do not install the modules in the premises of flammable gases or vapors, since sparks may be produced.
Do not install modules in area with possible inflammable gases.
Do not install modules on places that are possible to be flooded.
Make sure that installed modules do not suffer wind or snow pressure that exceeds the permissible maximum load limit.
Please do not use oil such as paraffin liquid, animal oil and vegetable oil from molding parts. It may lead to cracks, breakage and deteriorate performance of Junction Box and Connectors.

2.2.4 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 5). The module generates maximum output power when directly facing the sun.

For standalone systems, the tilt angle of the modules should be selected to optimize the performance based on the season and sunlight. In general, if the module output is adequate when the irradiance is low (i.e., winter), the angle chosen should be adequate during the rest of the year.
For grid-connected systems, modules should be tilted at the angle that the energy production from the modules will be maximized on an annual basis. The Fire Class Rating of a module for roof mounted system shall meet local code requirements in order to achieve the specified System Fire Class Rating for a non-BIPV module.

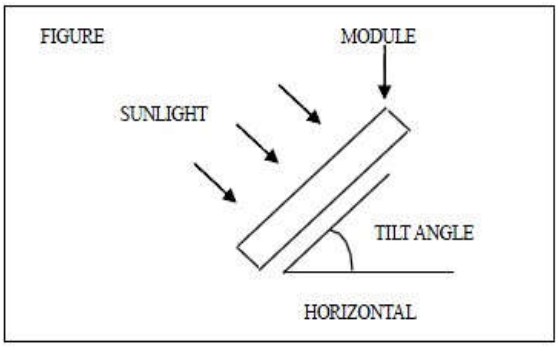


Figure 5: Schematic diagram of diagram of mounted photovoltaic module with tilt angle w.r.t. latitude

RECOMMENDED TILT ANGLES FOR A FIXED SYSTEM	
SITE LATITUDE IN DEGREES	FIXED TILT ANGLE
0^0 TO 15^0	15^0
15^0 TO 25^0	SAME AS LATITUDE
25^0 TO 30^0	LATITUDE+5^0
30^0 TO35^0	LATITUDE+10^0
35^0 TO 40^0	LATITUDE+15^0
40^0 +	LATITUDE+20^0

Figure 6: Table of tilt angles for a fixed system

2.3 Mechanical Installation

- To minimize risk in the event of an indirect lightning strike, avoid forming loops when designing the system.

- Modules must not be fitted as overhead glazing. Ensure that the mounting system can also withstand the anticipated wind and snow loads.
- Precipitation can run off through small openings on the backside of the module. Make sure that the openings are not masked after mounting.
- The maximum design load on the front side of module is 3600 Pa (75.188 lbs/ft²) for the back side 1600 Pa (33.417 lbs/ft²) [test load of 5400 Pa (112.781 lbs/ft²) for front side and 2400 Pa (50.126 lbs/ft²) back side] for IEC / UL to avoid exceeding the maximum load, site-specific live loads such as wind and snow should take into account.
- The installation of the project must be facing north in the south hemisphere, and facing south in the north hemisphere. Comparatively, there will be lower electricity when the project is facing west or east. Incorrect installation will lead to the loss of the power.
- Must Avoid installing Modules under the shadow condition, even the module is having the bypass diode to decrease the loss of energy, the shadow will lead to loss in output power & may generate hot spot in future.

The module is considered to be in compliance with this standard only when the module is mounted in the manner specified by the mounting instructions. A module with exposed conductive parts is considered to be in compliance with this standard only when it is electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017).

2.3.1 Mounting with Bolt

Install the module on the rack using Stainless steel M8 T-head bolts, Stainless steel washers Stainless-steel spring washers and stainless steel M8 nut with sufficient torque to allow the module to be properly secured. The reference value of tightening torque for M8 bolt is 22-30 N*M, and for M6 bolt is 9-12 N*M. If special mounting system or special installation method is required, please reconfirm with the supplier of the racking system regarding the torque value. See Figure 7 for detailed installation information. Minimum mechanical means for securing the PV module (as evaluated during the mechanical load test (MST 34))

See Figure 8 for the module models with corresponding installation positions for bolt installation and Table 1 lists different sizes of bolts for different mounting holes

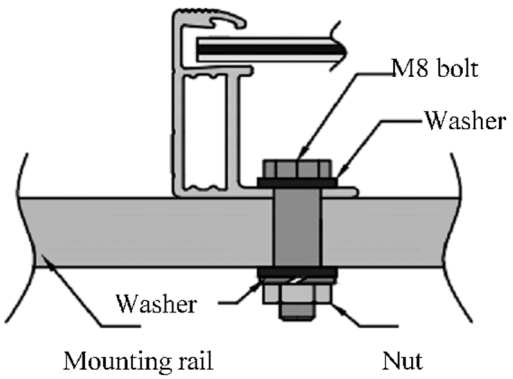


Figure 7: Mounting with bolts

Mounting hole (mm)	Bolt size
14 x 9	M8
10 x 7	M6

Table 1: Bolts for different mounting holes

2.3.2 Different installation methods using bolts

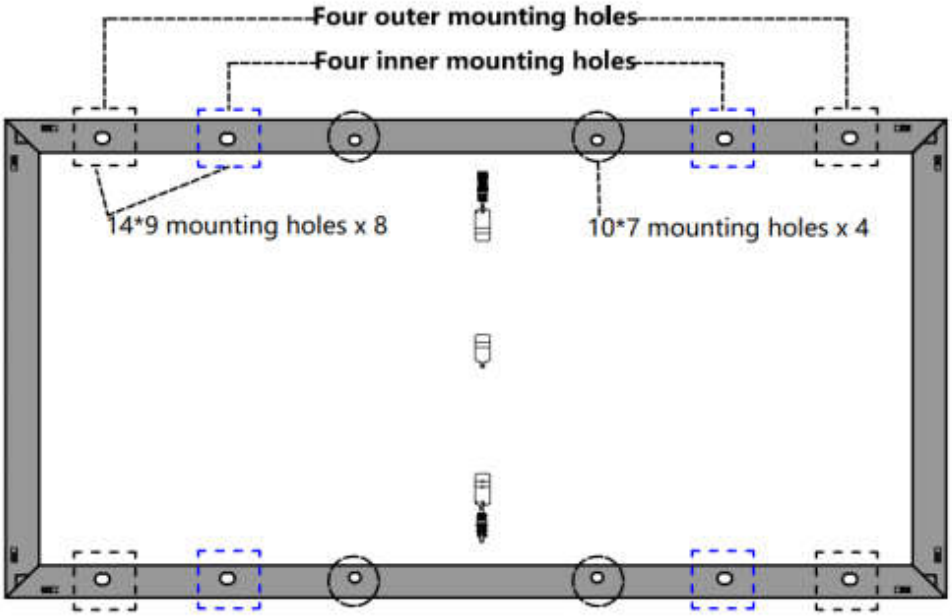


Figure 8: Installation with bolt (Four inner mounting holes)

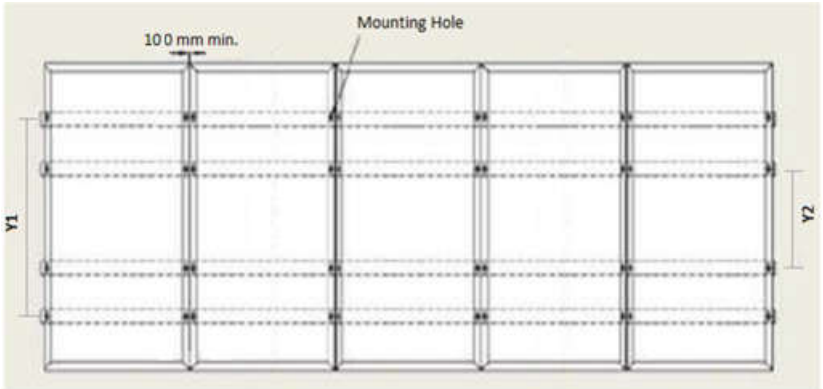


Figure 9: Mounting of modules using 8 mounting holes. Values of Y1 and Y2 are as per the Y-pitch mentioned in the module datasheet.

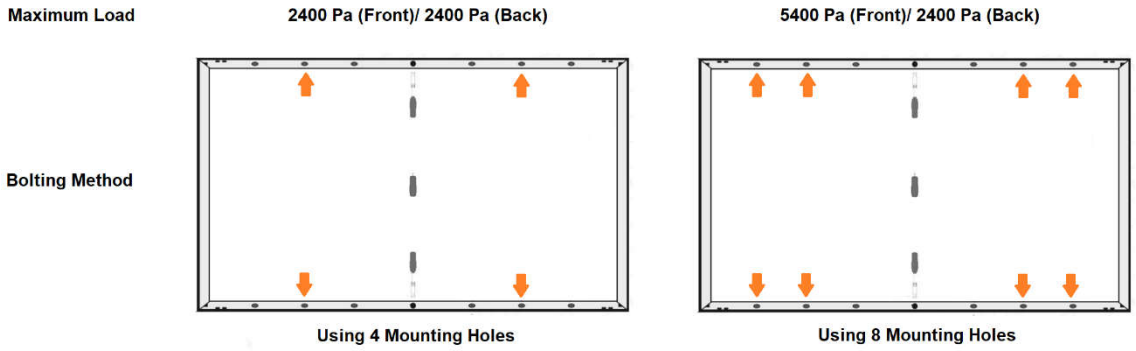


Figure 10: Recommended mounting positions for bolting

2.3.3 Mounting with Clamps

Use clamps which meet the following requirements:

- Clamp width: 40 mm.
- Clamp height for 35 mm module height.
- Clamp depth: 12 mm.
- The clamps must not touch the front glass.
- No cells must be shaded as a result of the clamps.
- The clamps must not damage or deform the module frame.
- The clamps must meet the necessary structural requirements at the installation site.
- The clamps must be fastened firmly in the assembly system.
- Use clamps which guarantee long-term stability and secure attachment of the modules to the racking.
- The clamps must be installed in accordance with the manufacturer's instructions, including any specific hardware and torque requirements. A tightening torque of 15 Nm (133 lbs-in) need to be used.
- Use M8 screw, stainless steel

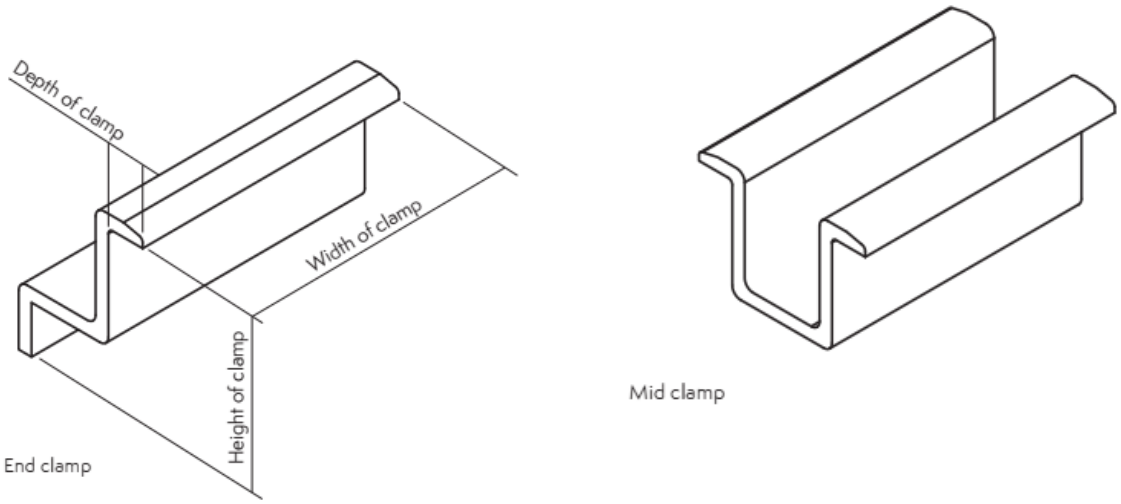


Figure 11: Design of Clamps

Detailed description of tested mounting clamp.

Type end clamp: AW 6063 T6 (Aluminium alloy 6063)

Type mid clamp: No mid clamp was used

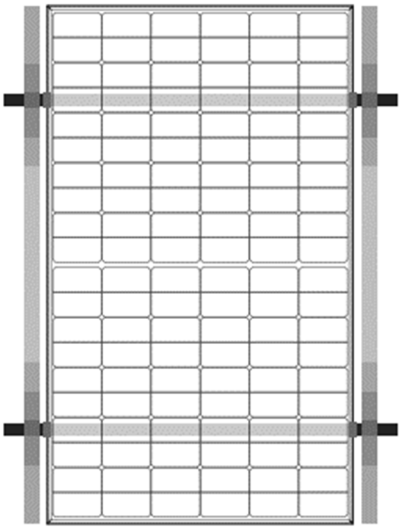
Tightening torque: 15 Nm / 133-inch Pounds

Width of clamp: 40 mm

Depth of clamp: "12 mm (over module frame)"

Height of clamp: "40 mm (designed for 35 mm module frame)"

Clamp min thickness: 2.5 mm



CP1

Figure 12: Point Mounting

Installation types

Installation type		Design load		Test load (1,5x safety factor)	
Name	Distance to module edge [mm] (L)	Push [Pa]	Pull [Pa]	Push [Pa]	Pull [Pa]
CP1	200-450	3600	1600	5400	2400

Legend: CP: Clamp poin

3. Grounding

PV modules use an anodic oxidized aluminum frame to resist corrosion. Therefore, the frame of modules should be connected to equipment grounding conductor to prevent thunder, electrical shock and fire hazards. The grounding device should fully conduct between frame, structure and earthing wire. The installer of a PV system is responsible for grounding each module frame. It is recommended to ground each module frame at the grounding holes provided. (4 mm diameter, marked with the grounding symbol).

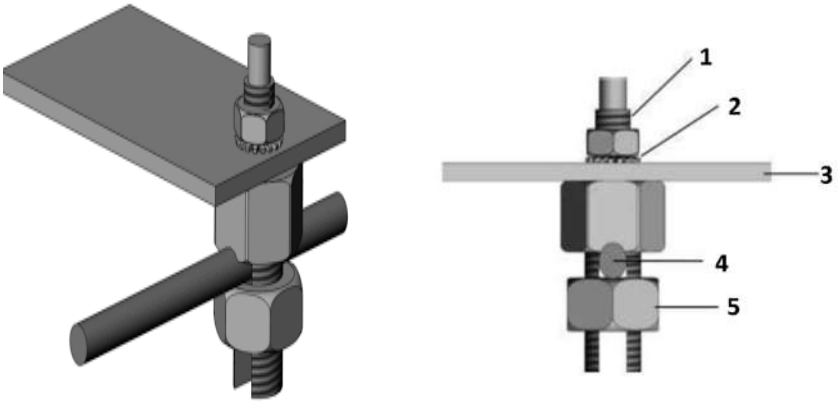
Figure 13: Grounding hole and symbol

The ground connections between modules must be approved by a qualified electrician. The main earth ground must only be connected by a qualified electrician Installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part I. OR as per the applicable local body regulations

Method: Tyco Grounding bolt #2058729-1:

Tyco grounding hardware comes in package that include the ground bolt, mounting and ground HEX nut. Use a stainless-steel bolt and nut, a star washer and a spring washer.

- Electrical contact is made by penetrating the anodized coating of aluminum frame, and tightening the mounting HEX nut (come with star washer) should be selected and installed underneath the wire binding bolt.
- The tightening torque of the grounding lug to the module frame shall be 20lbs-in (2.3 Nm).
- The tightening torque of the in-field grounding wire(12AWG) shall be 20lbs-in (2.3 Nm).



Tyco Grounding bolt#2058729-1

1. Wire bolt and slot
2. Mounting wash hex nut
3. Aluminum frame
4. 4 to 16 mm2 cable
5. HEX nut

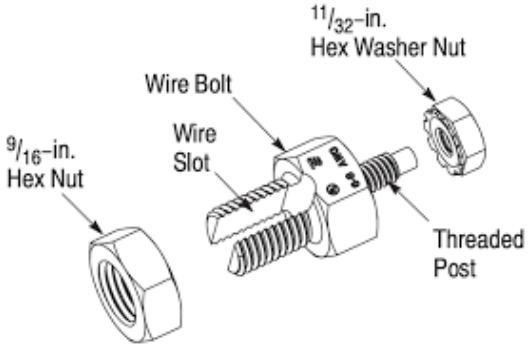


Figure 34:

Figure 14: Diagram of grounding of photovoltaic module

The grounding screw, bolt or other parts are separately used from the mounting parts of the module. The grounding is achieved through securement to the array frame. The array frame shall be grounded in accordance with NEC Article 250.

4. Wiring and Connection

The junction box comes with cable Photovoltaic wire, type single core 4 sqmm / 12 AWG with 90°C sunlight resistant rating. This box, on the back side of the module, is weatherproof and is designed to be used with standard wiring or conduit connections. Wiring methods should be in accordance with the NEC (National Electrical Code). Bypass diodes and cable clamps are included with each module when shipped from the factory. Junction box should be kept in the upper most position in order to avoid the ingress of water.

Correct wiring scheme

- When designing the system, avoid forming loops to minimize risk in the event of an indirect lighting strike. Check that wiring is correct before starting up the generator. If the measured open circuit voltage (V_{oc}) and short-circuit current (I_{sc}) differ from the specifications, then there is a wiring fault.

Correct connection of contact plug connectors

- The plug connector has its own polarity. Make sure that the connection is safe and tight. The plug connector should not receive outer stress. Otherwise, it is only used to connect the circuit!

Use of suitable material

- Use cable extensions and plugs that are designed for outdoor application. Ensure that they are in perfect electrical and mechanical condition. Use only cables having one conductor. Select the appropriate cable diameter to minimize voltage drop (to calculate the minimum cable diameter and the fuse, and to calculate controls, multiply the I_{sc} and V_{oc} by a factor of 1.25). The recommended cable size is 4mm^2 / 12 AWG.

Cable Protection

- Secure the cables to the mounting system using UV-resistant cable ties. Protect exposed cables from damage using suitable precautions. Avoid direct exposure to sunlight.
- The cable must not be bent or crushed on the direct exit of the cable screw joint. A minimum bending radius r$\geqslant$4x (static steady), r$\geqslant$5x (dynamic) cable diameter must be maintained. The cable must be routed in a way that tensile stress on the conductor or connection(s) is prevented.

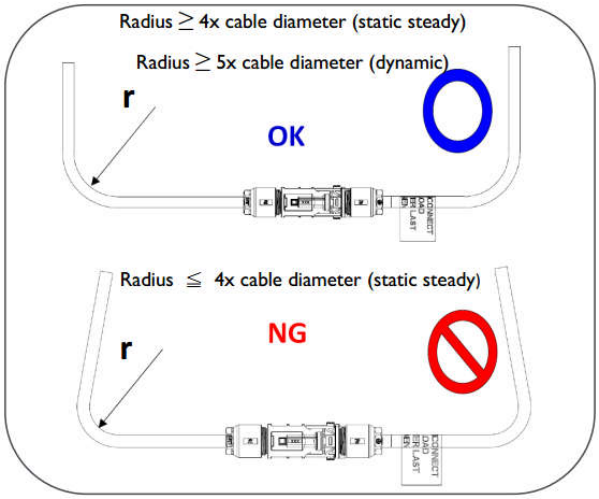


Figure 15: Minimum bending radius of cable.

To get higher current or higher voltage or both, the modules typically shall be connected into an array by field wiring. There are two methods of wiring: series wiring and parallel wiring.

4.1 The series wiring:

Figure 16: Series Wiring

4.2 The parallel wiring:

Figure 17: Parallel Wiring-1

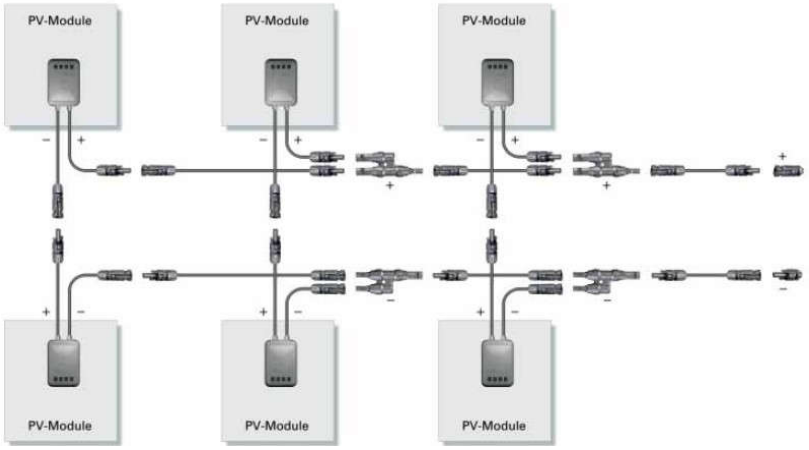


Figure 18: Parallel Wiring-2

Additional connectors and cables are required to make parallel connection. Connector shall be type MC4 compatible male and female and cable shall be type single core 4 sqmm / 12 AWG & 1500 V.
For IEC testing the recommended connectors are MC4 compatible male and female, 1500 VDC and cables are PV wire type single core 4 sqmm / 12 AWG, 1500 VDC.
The maximum voltage of the system should be lesser than the certified system voltage (typically 1500V/1000V) or maximum input voltage of the inverter.

While connected modules in parallel, the output current is equal to the current of each string. Use a fuse in each string of modules, refer application requirements locally. Recommended maximum parallel modules configuration: Fuse rating/(Isc*1.25)

Always use same type of modules in PV system. While connected in series, Voltage of each string should below maximum system voltage. Recommended maximum series module configuration :1500V/(1.25*Voc) or 1000V/(1.25*Voc)

4.3 Wiring the array to final junction box/inverter/charge controller:

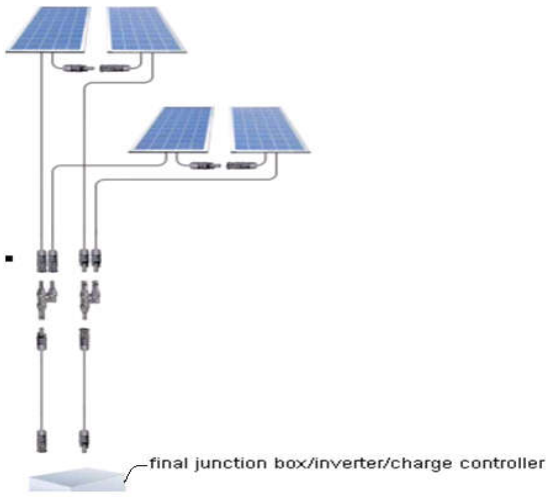


Figure 19: Connection of Array with Junction Box / Inverter / Charge Controller

According the above picture to make field wiring to final junction box/inverter/charge controller. When additional connectors and cables used, connector shall be type MC4 compatible male and female and cable shall be type single core 4 sqmm / 12 AWG & 1500 V.

4.4 Bypass diodes

- Partial shading of an individual module can cause a reverse voltage across the shaded module. Current is then forced through the shaded area by the other modules.
- When a bypass diode is connected in parallel with the series string, the forced current will flow through the diode and bypass the shaded module, thereby minimizing module heating and array current losses.
- Bypass diode model are 35SQ045 & MK5045 with Current Rating 35A & 50A receptively.

4.5 Battery

- 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. Using a charge controller is recommended.
- The battery should be kept 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 is 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.

5 Maintenance

- Yearly maintenance by a trained professional is usually advised.
- Check if the mounting structures are properly laid and the modules are held tightly and are in accordance with the mounting instructions given in the manual.
- Ensure no part of the module is shaded, any leaves / trees and other objects which causes shading have to be removed accordingly.
- Clean the modules using a soft module cleaning kit. A soft cloth with mild soft detergent can be used as an alternative. Use water that is at the same temperature as the module, else thermal shocks can be created and can damage the module.
- Checking the TDS of the cleaning water on regular basis is recommended. TDS should be maintained below 500 mg/L & total hardness shall be less than 75 mg/L.
- Do not use harsh cleaning materials such as scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the glass surface of the module. Use of such materials will void the product warranty.
- Do not open the junction box to change the diodes even if they are defective. Please contact with PV module manufacturer in case of known or suspected diode failure.
- It is recommended to have the module clean and tidy for maximum power generation from the solar PV module.
- Cover the front surface of the module with an opaque material while repairing. Modules exposed to sunlight generate high voltage and are dangerous.
- Inspect all modules annually for safe electrical connections, sound mechanical connection, and corrosion.
- Solex PV module may use anti-reflective coating (ARC) glass to enhance power output.
- In order to prevent fingerprints or smudges on the ARC, do not touch the glass surface without wearing clean gloves. Fingerprints may be removed with standard glass cleaner.
- Periodically clean glass and the module surface only with a soft cloth or sponge using mild detergent and water.
- Ensure the module is cleaned without causing any damage like micro-cracks, etc. to the module.

5.1 Module Cleaning Guidelines and Instructions

- Dirt piled up on the module's transparent surface reduces its performance and may cause module hot spot effect. This problem may become serious if industrial waste and bird droppings collect on the module surface.
- Thin layers of dust (normal soiling) that reduce the sun's intensity evenly are not dangerous and the power reduction is not as significant as other debris.
- Clean the module array regularly to address reduced production due to soiling. The frequency of cleaning depends on how quickly material accumulates. Mounting the module at or above a 15-degree angle will help prevent dust and debris from collecting on the module.
- In many cases, rainfall may reduce or remove the need to clean the modules. It is best to clean the module during early mornings, late afternoons or on a cloudy day. Do not clean the module during high temperature, temperature lower than zero degrees Celsius, or any time when there is a large temperature difference between module and cleanser.
- If it is necessary to clean the backside of the module, do not damage any components. Avoid allowing any oily liquids such as paraffin liquid, animal oil, or vegetable oil contact with the junction box, cable and connector. Solex PV modules can withstand snow pressure of 5400Pa (IEC). Please use soft brush lightly removing snow pileup. Do not try to remove frozen snow and solid ice on the module (it will eventually melt off).

Solution Mixture:
Clean water with low mineral amount, non-abrasive/ non-caustic detergent, weak acid/weak alkalescent solution, or solution of PH value ranging from 6.5 to 8.5 to clean the glass, so as not to cause damage to the glass coating layer. Do not use high pressure spray.

Cleaning Tool:
Soft brush, non-conductive brush, non-abrasive sponge, non-abrasive cloth, seamless cloth.

- Clean the module and glass surface with solution and tool described as above.
- If the dirt on the glass surface is an oily substance and is hard to clean, try to use commercial glass detergent, alcohol, isopropanol (IPA), or sodium bicarbonate solution.
- Use clean water to rinse glass and remove the cleaning solution. Dry the wet module using a clean and dry cloth. Do not leave stagnant water on glass surface.

5.2 Cleaning the Frame

- Solex PV module frames include an anodic oxide coating to increase product life. The cleaning cycle for regular anodic oxide coatings is generally every six months. When cleaning, make sure not to damage or scratch this coating.
- Dirt can generally be cleaned off using a suitable lubricant or warm, mild soapy water, and a fiber brush may be used to clean any dust that may also stick to the surface. Do not use abrasive cleaning tools like steel, wool or acidic/ alkaline chemicals to clean.

5.3 Visual inspection of the module

During regular cleaning cycles, be sure to visually inspect each module. The purpose of visual inspection is to detect possible faults or damage. Specifically:

- Possible broken glass.
- Rust on the circuits and soldering of the PV cells. Normally this is due to moisture entering the module through a breakage in the encapsulating layer during installation or transport.

- The PV modules are not shaded by unwanted obstacles or foreign material

- Check whether the back sheet is burnt.

5.4 Inspecting connections and cabling

While performing preventive maintenance every 6 months, carry out the following operations:

- Check if screws and mounting accessories are tight, adjust and tighten as necessary and condition of the connection cable junctions.
- Check the junction box sealing. Should sealing faults be observed, the items which have been affected should be replaced and cleaned. Contact Solex for additional information about resolving faults in module seal.

6 Note

- The installation and handling of PV Modules requires professional skills and should only be performed by qualified professionals.
- Installation shall be done according to updated Solex PV module installation manual available as of Sales Invoice date to avail the warranty.
- After PV module has reached its end of life, it is in sole interest of the customer to hand it over to nearby E-Waste recycling center for Re-cycling.
- Applicable model numbers & Electrical specification for Solar PV modules are as per Annexure-1 & Annexure-2 .

Annexure-1

MODULE SPECIFICATIONS UNDER STC CONDITION									
Model Type	Module Technology	Number Of Cells	Maximum Power (Pmax) [W] Tolerance ± 5%	Open Circuit Voltage (Voc) [V] Tolerance ± 5%	Maximum Power Voltage (Vmp) [V]	Short Circuit Current(A) Tolerance ± 5%	Maximum Power Current (Imp) [A]	Maximum Over Current	Protection Class
SMF72HM10-555 SMFB72HM10-555	Mono -Facial Module	144	555	50.10	42.19	13.83	13.16	25A	Class II
SMF72HM10-550 SMFB72HM10-550	Mono -Facial Module	144	550	49.97	42.06	13.75	13.08	25A	Class II
SMF72HM10-545 SMFB72HM10-545	Mono -Facial Module	144	545	49.84	41.93	13.67	13	25A	Class II
SMF72HM10-540 SMFB72HM10-540	Mono -Facial Module	144	540	49.71	41.8	13.59	12.92	25A	Class II
SMF72HM10-535 SMFB72HM10-535	Mono -Facial Module	144	535	49.58	41.67	13.51	12.84	25A	Class II
SMF72HM10-530 SMFB72HM10-530	Mono -Facial Module	144	530	49.45	41.54	13.43	12.76	25A	Class II
SMF66HM10-505 SMFB66HM10-505	Mono -Facial Module	132	505	46.18	38.68	13.73	13.06	25A	Class II
SMF66HM10-500 SMFB66HM10-500	Mono -Facial Module	132	500	46.03	38.53	13.65	12.98	25A	Class II
SMF66HM10-495 SMFB66HM10-495	Mono -Facial Module	132	495	45.88	38.38	13.57	12.9	25A	Class II
SMF66HM10-490 SMFB66HM10-490	Mono -Facial Module	132	490	45.73	38.23	13.49	12.82	25A	Class II
SMF66HM10-485 SMFB66HM10-485	Mono -Facial Module	132	485	45.58	38.08	13.41	12.74	25A	Class II
SMF66HM10-480 SMFB66HM10-480	Mono -Facial Module	132	480	45.44	37.94	13.33	12.66	25A	Class II
SMF60HM10-460 SMFB60HM10-460	Mono -Facial Module	120	460	42.31	35.21	13.69	13.07	25A	Class II
SMF60HM10-455 SMFB60HM10-455	Mono -Facial Module	120	455	42.16	35.06	13.6	12.98	25A	Class II
SMF60HM10-450 SMFB60HM10-450	Mono -Facial Module	120	450	41.99	34.89	13.52	12.9	25A	Class II
SMF60HM10-445 SMFB60HM10-445	Mono -Facial Module	120	445	41.84	34.74	13.43	12.81	25A	Class II
SMF60HM10-440 SMFB60HM10-440	Mono -Facial Module	120	440	41.67	34.57	13.34	12.73	25A	Class II
SMF54HM10-415 SMFB54HM10-415	Mono -Facial Module	108	415	39.16	32.02	13.58	12.96	25A	Class II

SMF54HM10-410 SMFB54HM10-410	Mono -Facial Module	108	410	38.99	31.85	13.5	12.88	25A	Class II
SMF54HM10-405 SMFB54HM10-405	Mono -Facial Module	108	405	38.74	31.64	13.42	12.8	25A	Class II
SMF54HM10-400 SMFB54HM10-400	Mono -Facial Module	108	400	38.57	31.47	13.33	12.72	25A	Class II
SMB72HM10-550 SMBB72HM10-550	Bi-Facial Module	144	550	49.97	42.06	13.75	13.08	25A	Class II
SMB72HM10-545 SMBB72HM10-545	Bi-Facial Module	144	545	49.84	41.93	13.67	13.00	25A	Class II
SMB72HM10-540 SMBB72HM10-540	Bi-Facial Module	144	540	49.71	41.8	13.59	12.92	25A	Class II
SMB72HM10-535 SMBB72HM10-535	Bi-Facial Module	144	535	49.58	41.67	13.51	12.84	25A	Class II
SMB72HM10-530 SMBB72HM10-530	Bi-Facial Module	144	530	49.45	41.54	13.43	12.76	25A	Class II
SMB66HM10-500 SMBB66HM10-500	Bi-Facial Module	132	500	46.03	38.53	13.65	12.98	25A	Class II
SMB66HM10-495 SMBB66HM10-495	Bi-Facial Module	132	495	45.88	38.38	13.57	12.9	25A	Class II
SMB66HM10-490 SMBB66HM10-490	Bi-Facial Module	132	490	45.73	38.23	13.49	12.82	25A	Class II
SMB66HM10-485 SMBB66HM10-485	Bi-Facial Module	132	485	45.58	38.08	13.41	12.74	25A	Class II
SMB66HM10-480 SMBB66HM10-480	Bi-Facial Module	132	480	45.44	37.94	13.33	12.66	25A	Class II
SMB60HM10-455 SMBB60HM10-455	Bi-Facial Module	120	455	42.16	35.06	13.6	12.98	25A	Class II
SMB60HM10-450 SMBB60HM10-450	Bi-Facial Module	120	450	41.99	34.89	13.52	12.9	25A	Class II
SMB60HM10-445 SMBB60HM10-445	Bi-Facial Module	120	445	41.84	34.74	13.43	12.81	25A	Class II
SMB60HM10-440 SMBB60HM10-440	Bi-Facial Module	120	440	41.67	34.57	13.34	12.73	25A	Class II
SMB54HM10-410 SMBB54HM10-410	Bi-Facial Module	108	410	38.99	31.85	13.5	12.88	25A	Class II
SMB54HM10-405 SMBB54HM10-405	Bi-Facial Module	108	405	38.74	31.64	13.42	12.8	25A	Class II
SMB54HM10-400 SMBB54HM10-400	Bi-Facial Module	108	400	38.57	31.47	13.33	12.72	25A	Class II

Annexure-2

MODULE SPECIFICATIONS CONSIDER BNPI CONDITION									
Model Type	**Module Technology**	**Number Of Cells**	**Maximum Power (Pmax) [W] Tolerance ± 5%**	**Open Circuit Voltage (Voc) [V] Tolerance ± 5%**	**Maximum Power Voltage (Vmp) [V]**	**Short Circuit Current(A) Tolerance ± 5%**	**Maximum Power Current (Imp) [A]**	**Maximum Over Current**	**Protection Class**
SMB72HM10-550 SMBB72HM10-550	Bi-Facial Module	144	605	49.97	42.06	15.13	13.08	25A	Class II
SMB72HM10-545 SMBB72HM10-545	Bi-Facial Module	144	600	49.84	41.93	15.04	13.00	25A	Class II
SMB72HM10-540 SMBB72HM10-540	Bi-Facial Module	144	594	49.71	41.8	14.95	12.92	25A	Class II
SMB72HM10-535 SMBB72HM10-535	Bi-Facial Module	144	589	49.58	41.67	14.86	12.84	25A	Class II
SMB72HM10-530 SMBB72HM10-530	Bi-Facial Module	144	583	49.45	41.54	14.77	12.76	25A	Class II
SMB66HM10-500 SMBB66HM10-500	Bi-Facial Module	132	550	46.03	38.53	15.02	12.98	25A	Class II
SMB66HM10-495 SMBB66HM10-495	Bi-Facial Module	132	545	45.88	38.38	14.93	12.9	25A	Class II
SMB66HM10-490 SMBB66HM10-490	Bi-Facial Module	132	539	45.73	38.23	14.84	12.82	25A	Class II
SMB66HM10-485 SMBB66HM10-485	Bi-Facial Module	132	534	45.58	38.08	14.75	12.74	25A	Class II
SMB66HM10-480 SMBB66HM10-480	Bi-Facial Module	132	528	45.44	37.94	14.66	12.66	25A	Class II
SMB60HM10-455 SMBB60HM10-455	Bi-Facial Module	120	501	42.16	35.06	14.96	12.98	25A	Class II
SMB60HM10-450 SMBB60HM10-450	Bi-Facial Module	120	495	41.99	34.89	14.87	12.9	25A	Class II
SMB60HM10-445 SMBB60HM10-445	Bi-Facial Module	120	490	41.84	34.74	14.77	12.81	25A	Class II
SMB60HM10-440 SMBB60HM10-440	Bi-Facial Module	120	484	41.67	34.57	14.67	12.73	25A	Class II

SMB54HM10-410 SMBB54HM10-410	Bi-Facial Module	108	451	38.99	31.85	14.85	12.88	25A	Class II
SMB54HM10-405 SMBB54HM10-405	Bi-Facial Module	108	445	38.74	31.64	14.76	12.80	25A	Class II
SMB54HM10-400 SMBB54HM10-400	Bi-Facial Module	108	440	38.57	31.47	14.66	12.72	25A	Class II

Module technology	Temperature Coefficient	NOCT
Mono- facial /Bifacial Module	α = 0.04% %/°C	45 ± 2 °C
	β = -0.24%/°C	
	γ = -0.32%%/°C	

Note: - * Please refer latest Module datasheet for more details.