



SOLAR MODULE INSTALLATION MANUAL

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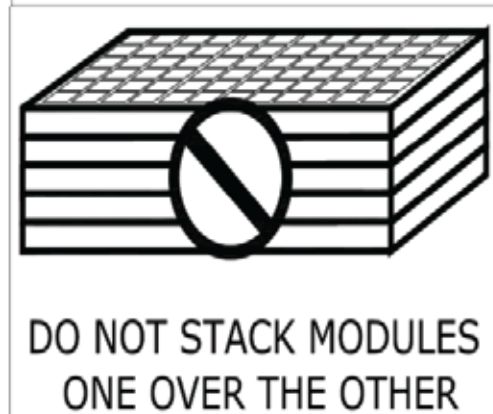
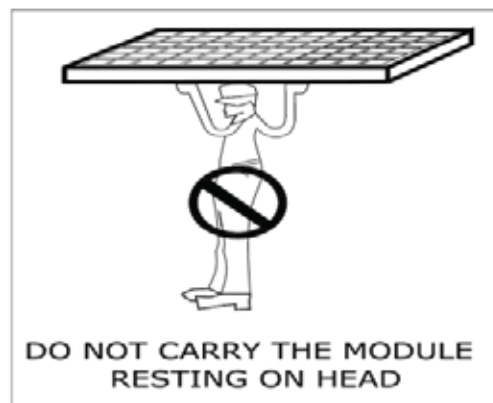
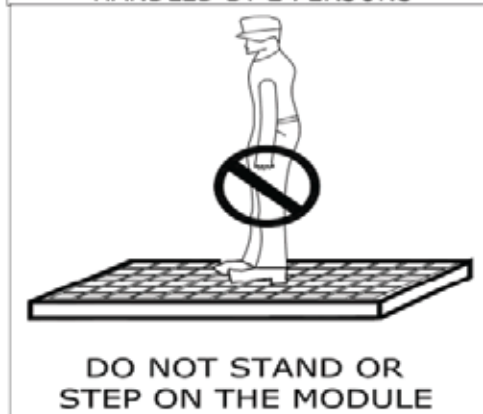
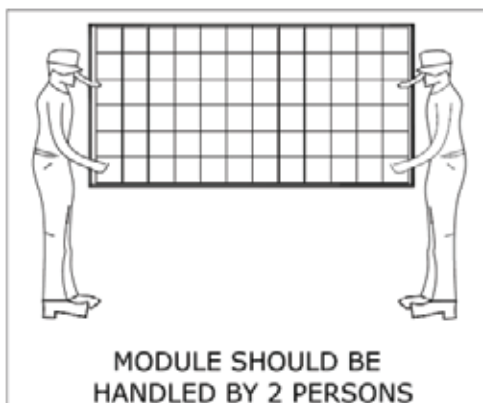
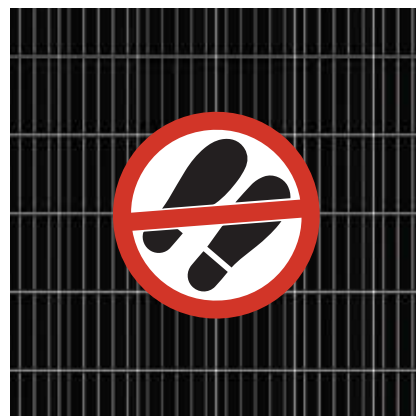
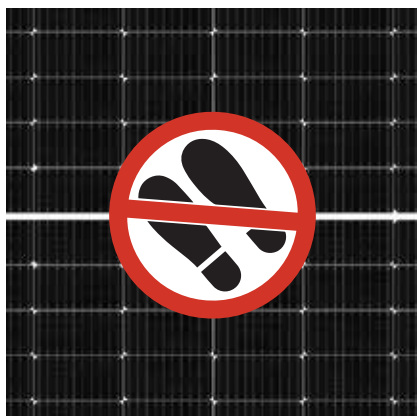
WARNING



DO NOT CONNECT OR DISCONNECT THE MODULES UNDER LOAD



NEVER STAND OR STEP ON THE MODULES



Thank You for selecting Blue Bird Solar Private Limited. Please read and comprehend this manual completely before installing the Solar PV Modules.

In order to obtain a trouble free operation it is necessary to follow the instructions described in this manual. Any non-adherence to the instructions will not make modules eligible for warranty claims.

A. LIMITATION OF LIABILITY

Blue Bird Solar Private Limited shall not be held responsible for damages of any kind, including without limitation bodily harm, injury and property damage, relating to module handling, system installation or compliance or non-compliance with the instructions set forth in this manual.

B. SAFETY PRECAUTIONS

Warning: All instructions should be read and understood before attempting to open the box and install, wire, operate and/or maintain the module. Module interconnects pass direct current (DC) when exposed to sunlight or other light sources. Contact with electrically active parts of the module, such as terminals, can result in injury or death, whether the module is connected or disconnected.

The details described in this manual are applicable for the photovoltaic modules of family type:

BBSXXX

The families mentioned above are having the following codification,

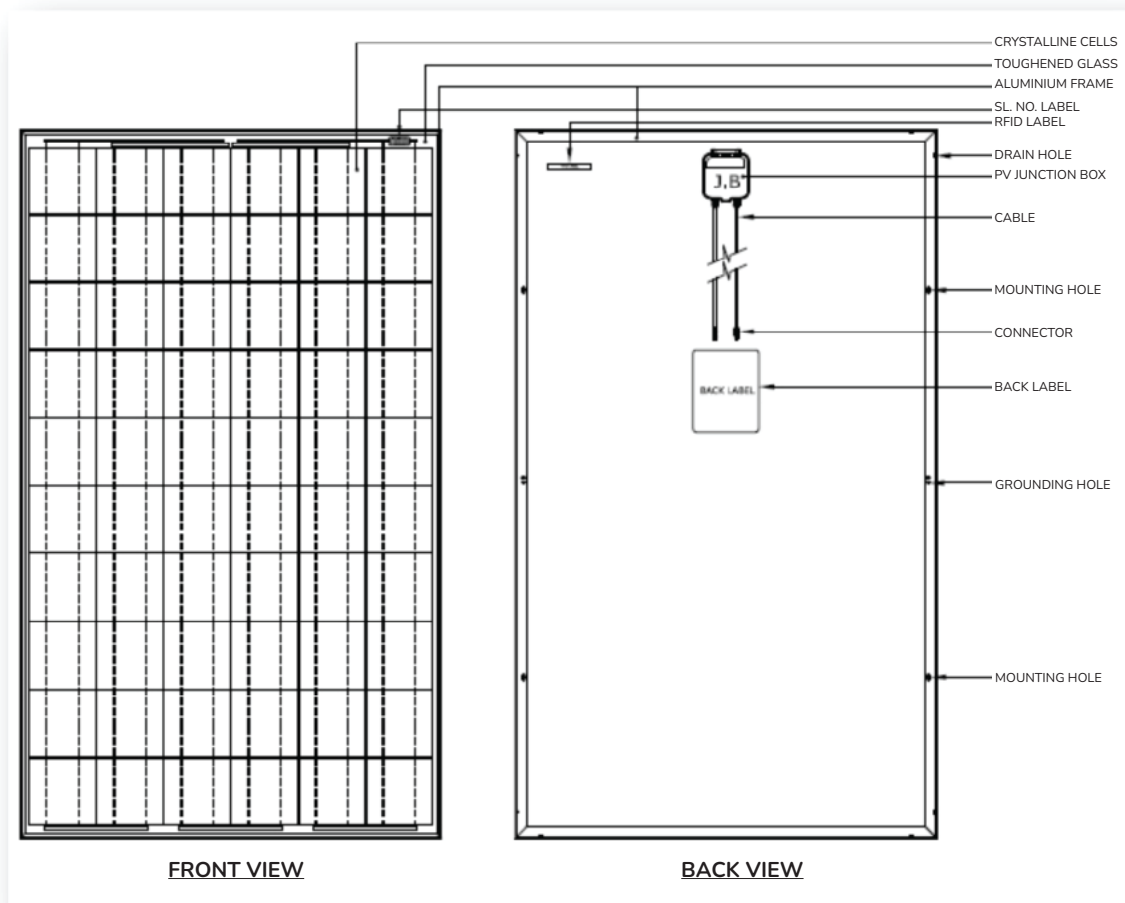
Example:

B	B	S	XXX
Company Name			Module Wattage

Serial Number:

Format	X	X	X	X	X	XX	X	XX	XXX	XXXX
Decoding	Company Name			Cell Size	Cell Type (Cut/Full)	No. Of Cells	Poly	Year of Manufacturing	Julian Day	Serial No.
Example	B	B	S	6	F	72	P	16	025	0001
Meaning	Company Name			Cell Size	Cell Type (Cut/Full)	No. Of Cells	Poly	Year of Manufacturing	Julian Day	Serial No.

Note: The information provided in this manual is subject to revision without prior notice for continual improvement.



C. Components of a Solar Module

The Modules are classified for the application Class –A:

- Hazardous voltage (IEC 61730: higher than 50V DC ; EN 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (modules qualified for safety thorough EN IEC 61730-1 and -2 within this application class are considered to meet the requirements for safety class II)
- The objective of this manual is to provide the customer(s) clear instructions on how to mount the PV modules to ensure compliance with certification and regulatory requirements.
- Further, please also consult the local authorities (if there any statutory requirement) before taking up or mounting of the PV modules and ensure that the mounting instructions described in this manual meet their requirements.

D. Electrical Specifications

- Rated electrical characteristics are within 10 percent of measured values at Standard Test Conditions of: 1000 W/m², 25°C cell temperature and solar spectral irradiance per ASTM E 892.
- Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. The requirements of the National Electrical Code (NEC) in Article 690 shall be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of ISC and VOC marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output.

E. General Safety

- All installations must be performed in compliance with all applicable regional and local codes or other national or international electrical standards.
- Wear suitable protection (non-slip gloves, clothes, etc.) to prevent direct contact with 30VDC or greater, and to protect your hands from sharp edges during the installation.
- Use electrical insulated tools to reduce the risk of electric shock.
- Remove all metallic jewelry prior to installation to reduce the chance of accidental exposure to live circuits.
- Cover the front of the modules in the PV array with an opaque material to halt production of electricity when installing or working with a module or wiring.
- Do not install or handle the modules when they are wet or during periods of high wind.
- Do not use or install broken modules.
- If the front glass is broken or the back sheet is torn, contact with any module surface or the frame can cause electric shock.
- There're no serviceable parts within the PV module. Do not attempt to repair any part of the module.
- Keep the junction box cover closed at all times.
- Do not disassemble a module or remove any module part.
- Do not artificially concentrate sunlight on a module.
- Do not connect or disconnect modules when current from the modules or an external source is present.

F. Unpacking and Storage

Precautions and General Safety

- Store modules in a dry and ventilated room.
- Do not allow children and unauthorized persons near the installation site or storage area of modules.
- Unpacking module pallet with care and follow the unpacking steps marked on the pallet. Be careful when unpacking, transporting and storing the modules.
- Do not carry a module by its wires or junction box. Carry a module by its frame with two or more people.
- Do not place modules on top of each other.
- Do not place excessive loads on the module or twist the module frame.
- Do not stand, step, walk and/or jump on the module.
- Do not carry the module on head.
- Do not drop or place objects on the modules (such as tools.)
- Do not mark the modules with sharp instrument. Particular attention should be taken to avoid module back-sheet to come in contact with sharp objects, as scratches may directly affect product safety.

- Do not leave a module unsupported or unsecured.
- Do not change the wiring of bypass diodes.
- Keep all electrical contacts clean and dry.

G. Module Installation

Precautions and General Safety

- When installing modules, please ensure the assembly is mounted over a fire resistant roof covering rated for the application. Blue Bird Solar Private Limited modules have been listed as Type 1 rating according to UL1703 standard.



In any circumstances, **DO NOT STAND OR STEP** on the modules, as localized high loads may induce severe micro-cracks in the cells, which in turn may compromise module reliability. Failure to comply with this caution will void Blue Bird Solar Private Limited warranty.



Improper handling of modules may lead to micro-cracks and any consequences arising out of that will not be covered under warranty terms.

Environmental conditions

- Do not install modules near naked flames or flammable materials.
- Do not expose modules to artificially concentrated light sources.
- Do not immerse modules in water or constantly expose modules to water (either fresh or salt) (i.e. from fountains, sea spray).
- Exposing modules to salt (i.e. marine environments) and sulfur (i.e. sulfur sources, volcanoes) risks module corrosion.

H. Requirements for Installation

- Connect the quantity of modules that match the voltage specifications of the inverters used in the system. Modules must not be connected together to create a voltage higher than the permitted maximum system voltage, even under the worst local temperature conditions.
- A maximum of 17 samples of 300W can be connected in series. In order to protect the module from short circuits it is recommended to install a series fuse of 15 A. This over current rating has been decided based on the I_{sc} and V_{oC} of the module marked multiplied by a factor of 1.25.
- A maximum of one string can be connected in parallel without using over-current protection device (fuses...) incorporated in series within each string. Modules with similar electrical performance should be connected in same series to avoid or minimize mismatch effects in arrays.
- Cover the module surface (glass side) with an opaque material so that no light shines on the glass surface and ensure that there is no electricity production from the module before making any electrical connections.
- Be sure to disconnect Photovoltaic module from any other electrical sources like batteries, inverters, electrical grid etc. before working on the module.

- Ensure that only people qualified in handling electrical equipments are installing these modules.
- Broken glass on the module is electrical safety hazard. Please replace the module immediately in case you discover a broken module.
- Under some conditions the photovoltaic module produces electrical current /voltage more than specified on the rating plate. Please take appropriate measures to size the other equipments you intent to connect to this module.
- Please note there are no user serviceable parts inside the module and it is advised not to disassemble the module.
- The front surface of the module is made from high transmission tempered/toughened glass but also could break easily if it is not handled properly. The special textured structure on the glass ensures high light absorption at low incidence angle. Please protect this glass surface during transportation and handling.
- Please store the module in such a way that it does not fall off or come under falling objects.
- Please do not allow children and unauthorized persons near the installation site.
- Do not install broken or damaged module(s).
- Before installing the modules on the building or any other structure make sure that the installation meets the requirements of the local building codes and regulations.
- Be sure that the construction of the structure (Roof, facade etc.) where the modules are being installed has enough strength.
- A special construction may be required for the modules mounted on roof to help proper installation.
- Both roof construction and module installation should have effective fire resistant materials.
- In order to cool the modules, a minimum clearance of about 100 mm must be provided between the back of the modules and the roof.

Optimum Orientation and Tilt

- Find out the optimum orientation and tilt of the PV modules for your region to achieve the maximum annual yield. Generation of maximum power occurs when sunlight shines perpendicularly onto the PV modules.

Reliable Ventilation

- Sufficient clearance (at least 10 cm) between the module frame and the mounting surface is required to allow for cooling to circulate around the back of the module. This also allows for condensation or moisture to dissipate.

1. Sufficient clearance (at least 10mm) between the module to module frame considering linear thermal expansion of the module frames.

Correct connection of plug connectors

- Make sure that the connection is safe and tight. The plug connector should not receive outer stress. The connector should only be used to connect the circuit. It should never be used to turn the circuit on and off.

Use of suitable materials

- Use special solar cable and suitable plugs only (wiring should be placed in conduit that is sunlight-resistant or, if exposed, should be sunlight-resistant) in accordance with local fire, building and electrical code. Ensure that they are in perfect electrical and mechanical condition.
- The permitted type of solar cable is single conductor, 4 mm² (12 AWG), 90°C wet rated, with proper insulation to withstand the maximum possible system open-circuit voltage. The conductor material should be copper only. Select a suitable conductor gauge to minimize voltage drop.

No Shading on module

- Utmost care to be taken while designing the modules' layout to avoid slightest of partial shading on the module in any point of the day in the whole year cycle.

Lightning Arrestor

- Any installation should be supported by a properly designed appropriate Lightning Protection System and Surge protection Device.

I. Fire Safety

- The devices of on-roof systems can affect the fire safety of the building, improper installations can result in a hazard in case of fire.
- Roof to be mounted PV modules mounted over fire resistant roof.
- Improper installation may contribute to fire hazards. Additional devices such as ground fault indicator, fuses etc., may be required.
- The PV module is declared as non-explosion-protected equipment and must not be installed near open flames, flammable materials and vapors.
- The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.”
- “The module is considered to be in compliance with UL 1703 only when the module is mounted in the manner specified by the mounting instructions below.”
- “A module with exposed conductive parts is considered to be in compliance with UL 1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.”

- The System Fire Class Rating of the module or panel in a mounting system in combination with a roof covering complete with requirements to achieve the specified System Fire Class Rating for a non-BIPV module or panel.
- Any module or panel mounting system limitations on inclination required to maintain a specific System Fire Class Rating
- For UL listed products only the modules with the specified construction in below table, when used with a listed mounting system that has been rated as a Class A System when installed with a type 2 modules, is suitable to maintain the System Class A Fire Rating is suitable to maintain the System Class B or C Fire Rating.

<p>BBS300, BBS290, BBS280, BBS270, BBS250, BBS240, BBS230, BBS220, BBS210, BBS200 and BBS190</p>	<p>Superstrate: 3.2 mm thick; EVA: 0.45 mm thick; Substrate: 0.295 mm thick; Frame: Cross sectional dimension: 40 x 35mm, Height: 40mm, Thickness: 1.7 mm</p>	<p>Module Fire Performance: Type 2</p>
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- For UL listed products only:

Fire class rating: C
- The fire rating of the module is valid only when mounted in the manner specified in the mechanical mounting instructions.
- The module is considered to be in compliance with UL 1703 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 UL 1703 only when it is electrically grounded in accordance with the instructions and the requirements of the National Electrical Code.
- Any module without a frame (laminated) shall not be considered to comply with the requirements of UL 1703 unless the module is mounted with hardware that has been tested and evaluated with the module under this standard or by a field inspection certifying that the installed module complies with the requirements of UL 1703

J. Junction Box

- Blue Bird Solar Private Limited modules of type BBS6F72P/60P/54P/48P are factory-fitted with Renhe Solar made junction boxes with approved UV resistant cables of size 4.0mm² / 12AWG and terminated with the press-fit type factory-fitted connectors, fitted by the junction box manufacturing company. Please do not open the junction box, cables or connectors as there are no user serviceable parts inside.

Table 1: Details of Junction Box used in different family of modules:

Module Wattage range	Junction Box Brand	Manufacturer		
		Junction Box	Cable	Connector
300W-190W	PV-RH 701L, 4 Rail3 Diode, 14 Amp Box Rating, IP 65, 25Amp Diode	Renhe Solar(China)	Renhe Solar(China)	Renhe Solar(China)
150W-40W	PV-RH 06-70D, 3 Rail-2 Diode, 12 Amp Box Rating, IP 65, 25Amp Diode	Renhe Solar(China)	Renhe Solar(China)	Renhe Solar(China)
150W-40W	PV-RH 06-60, 2 Rail-1 Diode, 6.5 Amp Box Rating, IP 67, 10Amp Diode	Renhe Solar(China)	Renhe Solar(China)	Renhe Solar(China)

- The module wiring MUST NOT be opened under load. Any connection and disconnection must be made only when the current is not flowing in the module.
- The cables are of equal lengths which are appropriate for series connection of the modules. The cables are marked on them (+) and (-) for easy identification of the terminals.

K. By Pass Diodes

The bypass diodes are factory fitted inside the junction box. Please do not remove these bypass diodes. These diodes help in by-passing the shaded strings of the cells and thereby preventing the modules from heating.

Table 2: Details of Diodes used in Junction Box in different family of modules

Junction Box Brand	Diode Type	V (Volt)	I (Amp)	Configuration
PV-RH 06-60	SILICON RECTIFIERS	10	10	2-terminals & 1 diodes
300W-190W	SCHOTTKY PS4025	40	25	4-terminals & 3 diodes and 3 terminals & 2 diodes

L. Series Fuse

In order to protect the module from short circuits it is recommended to install a series fuse of 15 A. A maximum of two strings can be connected in parallel without using over-current protection device (fuses...) incorporated in series within each string. Three or more strings can be connected in parallel if an appropriate and certified over-current protection device is installed in series with each string.

M. Module Mounting

Blue Bird Solar Private Limited, modules can be mounted on the rails using 4 innermost mounting holes which are located at the back of the module frame. The mounting rails must be positioned perpendicular to the length of the module. The rails must be strong enough to support the weight of the module and forces generated by the high wind load. The modules have to be secured using the 4 innermost mounting holes and 8 mm stainless steel bolts and nuts. Locking washers must be included between the frame and the bolt as shown in the Figure1.

Table 3: Bolting Method

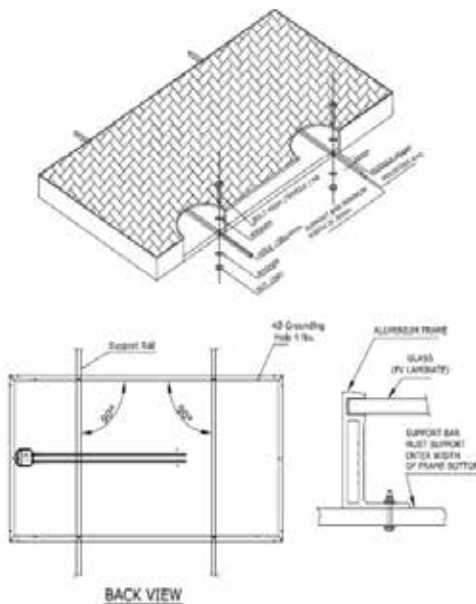
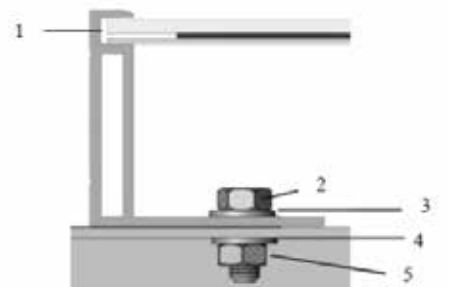


Figure - 1

Module installed with bolt fitting method



1. Aluminum Frame
2. M8 Stainless Bolt
3. Flat stainless washer
4. Spring stainless washer
5. HEX stainless Nut

Figure - 2

NOTE: Mounting at each fixing location as shown in figure and tighten with torque 15 NM – 18 NM.

N. Mechanical Loading

- The module must be mounted on secure and rigid Aluminum frames as shown in the fig -1. This mounting will ensure that the modules are able to withstand a minimum static load of 30 lbs/ft²

O. Array Wiring

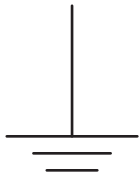
- Several PV modules can be connected in series or parallel combination to get the desired voltage and current. While connecting in series, voltage becomes additive i.e. the string voltage is the cumulative voltage of all individual module's voltage. The maximum allowed system voltage is 1000VDC. By connecting the modules in series, the maximum system voltage of 800V considering the 1.25 multiple factor for 1000V must not be exceeded. Make sure all the modules are having same current ratings.
- While connecting in parallel, current of the modules becomes additive. When the modules are connected in parallel, ensure that the current is not exceeding the maximum allowable limit(12A) considering the multiple factor of 1.25 for 15A of Fuse rating. Make sure all the modules are having same voltage ratings.
- While connecting multiple modules in stings all modules should be of same specifications and variation in PV parameters should not exceed more than 3% among all the modules.
- Please check the specification of the inverter and ratings. Total string output voltage and current should not exceed the inverter limit.
- For installation, the required extra wire for connecting the arrays, inverters etc, it is recommended to use PV Wire rated for min. 90°C, UV resistant, Copper only, 12 AWG.
- Please note that the interconnecting of more than two strings requires the installation of string fuses (15A). The maximum series fuse rating has been rated to 15 A, if more than two strings are connected in parallel, this value might be exceeded if there is a fault.
- It is strongly recommended to use copper wire that has a very good insulation and resistant to sunlight. The wire diameter and insulation must be suitable for maximum possible system voltage.

P. Maximum System Voltage

- The modules of the type described in this manual are designed for a Maximum system voltage of 1000 VDC. Please note that the module open circuit (Voc) increases with decrease in temperature and therefore allowable maximum system voltage must take into account the lowest temperature that is attainable in the area where the module is intended to be used.

Q. Grounding

All modules have to be electrically grounded as per the National Electrical Code (USA) or in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1. Modules are provided with grounding holes at the back of the module frames and the below symbol also been printed/marked near the hole for identification.



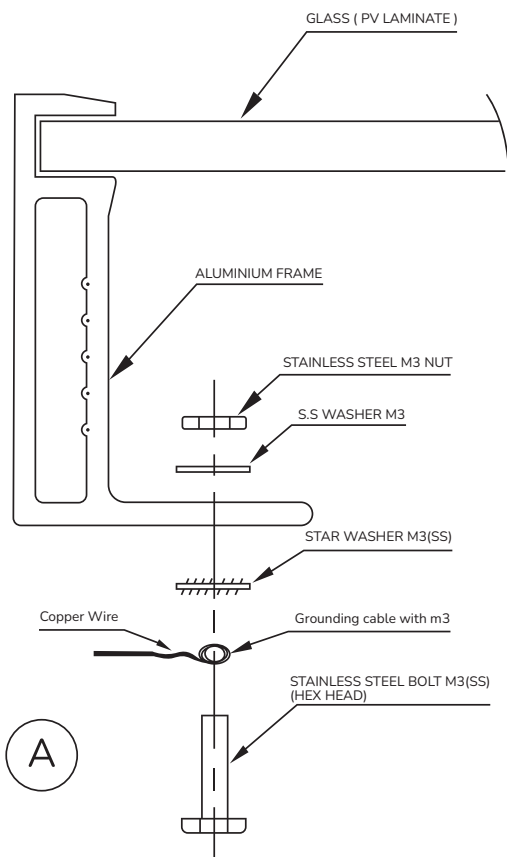
Please ensure that the modules are earthed/grounded properly as per the local requirements. The grounding wire can be attached to the modules using stainless steel bolts (M3) & washers. Also ensure that the grounding wire is secured tightly to the module frame. The grounding wire size and earthing method must be in accordance to the local requirements. In order to achieve proper grounding, the star washers must go through the anodized surface of the frame to create a conductive connection and the modules frames must be connected using a copper or copper alloy conductor which in turn has to be connected to the earth ground electrode.

“Common hardware items such as nuts, bolts, star washers, lock washers and the like have not been evaluated for electrical conductivity or for use as grounding devices and should be used only for maintaining mechanical connections and holding electrical grounding devices in the proper position for electrical conductivity. Such devices, where supplied with the module and evaluated through the requirements in UL 1703, may be used for grounding connections in accordance with the instructions provided with the module.”

“Details for wiring in accordance with the NEC, and that the grounding method of the frame of arrays shall comply with the NEC, article 250.”

Please see the drawing below for one of the correct grounding method:

Note : The star washer shown above must go through the anodized surface of the frame to create a conductive path.



Proper grounding can also be achieved by using self-tapping screw with a stainless steel washer to hold the wire under the washer very firmly. It is highly recommended to use at least two self-tapping screws per module in order to get adequate grounding contact. Stain steel bolts and nuts, washer only to be used to corrosion.

The screw of **diameter 4.17 mm** can be used and it should at least have two full turn of threads embedded into Aluminum frame.

Figure -A (Grounding using stainless steel hardware with star washers)

Note: Grounding bolt fitting / tightening torque 3NM – 4 NM.

IMPORTANT

It is always important to ensure that the grounding hardware used must not corrode itself or induce corrosion (Galvanic effect) in the parent material.

The standard hole provided in the module frame is 4 mm.

R. Cleaning/Maintenance

All solar modules of the types described in this manual are designed to operate in the outdoor conditions for long periods. However it is recommended to follow the basic procedures that are described below to get the best performance from the solar photovoltaic modules;

- Regular maintenance is required to keep modules clear of dust, bird droppings, seeds, pollen, leaves, branches, dirt spots and snow.
- When there is a noticeable buildup of soiling deposits on the module surface, wash the PV array with water and a gentle cleaning implement (a sponge) during the cool part of the day. Dirt must never be scraped or rubbed away when dry, as this will cause micro-scratches.
- The power output from the module is strongly influenced by the transparency of the Cover/front glass. Over a period of time dust could accumulate on the glass and reduce the solar light passing through the glass which in turn reduces the performance of the module. In order to restore the module performance, clean the glass with plain water. In most cases plain water clean is just adequate. However if there are any hard stains they could be easily removed by gentle wiping/mopping with soft cotton/sponge.
- Check the hardness/TDS of water; preferably it should be below 150; more than 250 to be avoided;
- When under load, modules to be cleaned either in the early morning or after Sunset.
- Aluminum frames could get discolored due to bird droppings. It is recommended to use mild soap or detergent to clean the Aluminum surface. Wear gloves while cleaning, as sharp edges on the Aluminum module can cause injury.
- While cleaning be careful not to drop any objects on the module surface. The module surface is made from glass and could get easily damaged. The damaged module increases the risk of electrical shock. The damaged module must be immediately replaced with a new module.
- Periodic inspection of the mounting structure and electrical connections must be carried out and any loose connections must be corrected immediately.

IMPORTANT

All cleaning and maintenance operations are to be done by a trained person only. If the modules are mounted on high roof or on an area which is at a height from the ground level, person involved in cleaning operations must wear appropriate safety harness.

The standard hole provided in the module frame is 4 mm.

S. Disposal

If the modules need to be disposed of, kindly contact the manufacturer or can be done in accordance with the local law of land, in either case, customer is requested to intimate the manufacturer.

ELECTRICAL RATINGS:

Module	Open Circuit Voltage @ STC, (V dc)	Rated Voltage @ STC, (V dc)	Maximum System Voltage, (V dc)	Rated Current @ STC, (A)	Short Circuit Current @ STC, (A)	Rated Maximum Power at STC, (Watts)	Module Efficiency (%)	Module Fill Factor (%)	Maximum Series Fuse, (A)	Module Weight (Kg)
Family Name (72 cell)										
300	44.61	36.41	1000	8.24	8.69	300	15.29	77.39	15	27.5
290	44.26	36.16	1000	8.02	8.52	290	14.78	76.90	15	27.5
280	44.13	36	1000	7.79	8.32	280	14.29	76.38	15	27.5
270	43.85	35.63	1000	7.58	8.21	270	13.76	75.02	15	27.5
Family Name (60 Cell)										
250	37.65	30.58	1000	8.18	8.73	250	15.44	76.10	15	18.5
240	37.18	30.23	1000	7.95	8.51	240	14.84	75.96	15	18.5
230	36.87	29.81	1000	7.73	8.30	230	15.72	77.82	15	16.5
Family Name (54 Cell)										
220	33.22	27.3	1000	8.07	8.69	220	15.05	76.32	15	16.5
210	32.86	26.95	1000	7.80	8.38	210	16.04	78.85	15	14.5
Family Name (48 Cell)										
200	29.71	24.38	1000	8.21	8.69	200	15.29	77.53	15	14.5
190	29.42	24.05	1000	7.9	8.39	190	14.51	76.97	15	14.5



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