



Philadelphia Solar

Installation & Operational Manual

PV SOLAR MODULES

Applied for Standard Module, Bifacial and Half-Cell
Modules With Maximum System Voltage 1500V



This manual contains important safety instructions for the PV module that must be followed during the maintenance of PV modules. To reduce the risk of electric shock, **do not** perform any servicing unless you are qualified to do so. "PV equipment on the DC side shall be considered to be energized, even when the system is disconnected from AC side and isolated from PV Inverter", "PV modules will be producing dangerous levels of voltages and current».

- The installation must be performed by a certified installer/servicer.
- The installation is only allowed after referring and understanding of Installation on manual.
- Installation and commissioning shall be done in accordance with IEC 62446 & IEC60346 and their associated codes.
- **Do not** pull the PV cables.
- Protect PV Modules cables from direct sunlight.
- **Do not** strain junction box conductors.
- **Do not** touch any surface of module.
- **Do not** place/drop objects onto the PV module.
- **Do not** disassemble or attempt to repair the PV module by yourself.
- **Do not** damage, pull, bend or place heavy material on cables.
- **Do not** use stainless wire ties or any other sharp material to tight the PV Modules cables directly.
- Protect PV Cables from Pests and small animals is essential.
- Upon completion of any service or repairs, ask the installer /servicer to perform routine checks to determine that the PV modules are in safe and proper operating condition.
- When replacement parts are required, be sure the installer /servicer uses parts specified by the manufacturer with same characteristics as the original parts unauthorized substitutions may result in fire, electric shock, or another hazard.
- Consult your local building and safety department for required permits and applicable regulations.

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1. GENERAL INSTRUCTIONS:

This installation manual contains essential information for the electrical and mechanical installation that you must know before installation modules. This also Contains safety information you need to be familiar with. All information described in this manual are intellectual property and based on technologies and experiences that have been acquired and accumulated throughout years, that it is enough to prepare such comprehensive report about installation.

Philadelphia Solar does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with installation, operation, use or maintenance of PV modules. No responsibility is assumed by Philadelphia Solar for any infringement of patents or other rights of third parties that may results from use of PV module. Philadelphia Solar reserves the right to make changes to the product, specifications, or installation manual without prior notice.

2. GENERAL INFORMATION:

The installation of PV modules requires a great degree of skill and should only be performed by a qualified licensed professional, including licensed contractors and licensed electrifications. Please be aware that there is a serious risk of various types of injury occurring during the installation including the risk of electric shock. All modules are equipped with a permanently attached Junction box that will accept variety of wiring applications or with a special cable assembly for ease of installation, and they do not require special assembly.

3. GENERAL INSTRUCTIONS

- 1- PV modules are heavy. Handle with care, each module shall be handled by two persons.
- 2- Before you attempt to install, wire, operate and maintain the PV module, please make sure that you completely understand the information described in this installation manual.
- 3- Contact with electrically active parts of a PV module such as terminals can result in burns, sparks, and lethal shock whether the PV modules is connected or not.
- 4- PV modules produce electricity when the enough sunlight or other sources illuminate the module surface.

- 5- Use a single safety locking clip MC4 style connector for connecting solar cables.
- 6- Follow the connector manufacturer's assembly instructions when preparing and assembling connectors in the field.
- 7- Use specified crimp tool and ensure that it is set appropriately for the conductor gauge and type, Conductors slipping out of connector fittings are a common cause of arc faults.
- 8- When the modules are connected in series, voltage is cumulative. When the modules are connected in parallel current is cumulative. As a result, a large scale PV system can produce high voltage and current which could present an increased hazard and may cause serious injury or death.
- 9- Do not connect PV modules directly to the loads such as motor since the variation of the output power depending on the solar irradiation causes damage for the connected motor.

In case of a brushless motor, the lock function becomes active, and the hall IC is most likely to be damaged.
In the case of a brush type motor, the coil is most likely to be damaged.

4. GENERAL SAFETY

- Consult local codes and other applicable laws concerning required permits on regulations concerning installation and inspection requirements.
- Before installing a PV module, contact appropriate authorities to determine permit, installation and inspection requirements that should be followed.
- Install PV modules and ground frame in accordance with applicable rules and regulations.
- PV modules should be installed and maintained by qualified personnel. Only installer/service personnel should have access to the PV modules installation site.
- No matter where the PV modules are installed either roof mounted construction or any other types of structures above the ground, appropriate safety practices should be followed and required safety equipment should be used in order to avoid possible safety hazards. Note that the installation of some PV modules on roofs may require the addition of fire proofing, depending on local building/ fire codes.
- In case that PV modules are non-integral type, the modules must be mounted over a fire-resistant roof.

- Please use PV modules with same cell size within series. Follow all safety precautions of other components used in the system.
- In order to avoid a risk of injury or electrical shock, do not allow anyone to approach the PV module if the person has little knowledge on PV module or on the measures that should be taken when PV modules are damaged.
- Do not shade portions of the PV modules surface from the sunlight for a long time. The shaded cell may become hot (hot spot phenomenon) which results in solder joints peeling off.
- Do not clean the glass surface with chemicals. Do not let water stay on the glass surface of PV modules for a long time. This creates a risk of white efflorescence (glass disease) which may result in the deterioration of energy generation.
- Purity degree of washing water shall be considered to avoid any chemical reaction with PV Modules glass cover.
- Do not install the PV module horizontally. it may cause dirt or white efflorescence (glass disease) due to water.
- Do not cover the water drain holes of the frame. There is a risk of frost damage when the frame is filled with water accumulation.
- When sliding snow load has to be considered, an appropriate measure has to be taken so that PV module frames on lower edge of PV modules will not be damaged.
- Do not expose PV module to concentrated sunlight with mirrors, lenses or similar means.
Turn off inverters and circuit breakers immediately, if any problem occurred.
- In case the glass surface of a PV module is broken, wear goggles, gloves and tape the glass to keep the broken pieces in place.
- A defective PV module may generate power even if it is removed from the system. It may be dangerous to handle the PV while exposed to sunlight. Place a defective PV module in a carton so PV cells are completely shaded.

- In case of series connection, Number of Series Modules shall be determined according to the minimum design temperature for installation location and not to exceed 1000Vdc/1500Vdc for the string of series PV Modules at any time. The maximum open circuit voltage must not be greater than the specified maximum system voltage as per below equation:

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

N : number of modules,

TC_{voc}: Thermal Coefficient of open circuit voltage for the module as per data sheet.

T_{min}: refer to the lowest ambient Temperature.

- The voltage is proportional to the number of series. In case of parallel connection please be sure to take proper measure (e.g. fuse for protection of module and cable from over current, and /or blocking diode for prevention of unbalanced strings voltage) to block the reverse current flow. The current may easily flow in a reverse direction.
- If more than 2 PV Modules or string of Modules connected in parallel a PV Fuse with a rating of 15A shall be used for both negative and positive side and in accordance with IEC 62446 & IEC60346 and their associated codes.
- Be careful! Always check the module label to confirm the actual rating of your product before making connections whether it is 1000Vdc or 1500Vdc.
- It is recommended to use a suitably rated isolator (DC switch) to interrupt the current flow before disconnecting the connectors.

4.1. Handling Safety

- Do not cause an excessive load on the surface of PV module or twist the frame. The glass surface can easily break.
- Do not stand or step on the PV module. The glass surface of PV is slippery and that would cause microcracks in cells which affect the power generation.
- Do not hit or put excessive load on the glass or in the Backsheet, it is vulnerable.
- Do not hit the terminal box or do not pull the cables. The terminal box can crack and break.

- Never touch the terminal box or the end of output cables with bare hands when the PV module is irradiated. Cover the surface of PV module with clothes or other suitable sufficiently opaque material to isolate the PV module from incident light and handle the wires with rubber-gloved hands to avoid electric shock.
- To make positive electrical contact with the frame. The ground wire must be considered within the requirement of local and regulation at the site of installation.
- The ground wire cross-sectional area (4-14) mm², the minimum size of ground wire (6-12) AWG (solid bare copper) per Table 250.122 of NEC code. Conductor Type: Copper Material-Color of wire: green color with yellow stripe.
- Do not drill holes in the frame. It may compromise the frame strength and cause corrosion of the frame.
- Do not scratch the insulation coating of the frame (except for grounding connection. it may cause corrosion of the frame or compromise the framework strength.
- Do not loosen or remove the screws of the PV module. It may compromise the joint strength of PV module and cause corrosion.
- Do not touch the PV module with bare hands. The frame of PV module has sharp edges and may cause injury.
- Do not drop PV module or allow objects to fall on the PV module.
- Do not try artificially to concentrate sunlight on the PV module.
- Do not grab the PV module at one side only. The frame may bend. Grab the PV module at two sides facing each other.
- When installing PV modules far above ground do not drop any object (e.g. PV module or any tool).
- Make sure flammable gases are not generated near the installation site.
- Completely cover the PV module surface with an opaque material during PV module installation and wiring.
- Plug in the connector tight and ensure the wiring work.
- Due to the risk of electrical shock do not perform any work if the terminals of PV module are wet.
- Do not touch the terminal box and the end of output cables the cable ends (connectors) with bare hands during installation or under sunlight, regardless of whether the PV module is connected to or disconnected to a load.
- Do not stomp on the glass at work. There is a risk of injury or electric shock if glass is broken.
- Do not work alone and work as a team.
- Wear a safety belt if working far above the ground.
- Do not wear metallic jewelry which can cause electric shock during installation.
- Do not damage the back sheet of PV modules when fastening the PV modules to a support by bolts.
- Do not damage the surrounding PV modules or mounting structure when replacing a PV module.
- Bind cables by the installation locks. Drooping down of cables from the terminal box could possibly cause various problems such as animal biting, electricity leakage in puddle.
- Take proper measures for preventing the laminate (consisted of resin, cells, and glass, back sheet ...etc.) from dropping out of the frame in case the glass is broken.
- Cables shall be located so that they will not be exposed to direct sunlight after installation to prevent degradation of cables.

4.2. Installation Safety

- Always wear protective head gear, insulating gloves and safety shoes (with rubber soles).
- Keep the PV module packed until installation.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frames get hot. There is a risk of burn, or you may collapse because of electric shock.
- Do not work under rain, snow or windy conditions.
- Use insulated tools.
- Do not use wet tools.
- Do not drop tools or hard objects on PV modules.

5. SITE SELECTION

In most applications, the PV modules should be installed in a location where there is no shading throughout the year. The PV panels face south In the Northern Hemisphere.

Please make sure that there are no obstructions in the surroundings of the site of installation. Take proper steps in order to maintain reliability and safety, in case the PV modules are used in areas such as: Heavy snow areas/Extremely cold areas/strong wind areas/installation over, or near, water/Areas where installations are prone to saltwa-

saltwater damage/small islands or desert areas. Lightning protection is recommended for PV systems that are to be installed in locations with high probability of lightning strikes.

5.1 For Bifacial Modules

- The energy output of bifacial module can be affected by albedo of the ground that module installed on, height of module, Ground coverage Ratio (GCR), and Diffused horizontal irradiance.



Snow / White Paint
Albedo 80-95%
Expected Yield Gain 15-25%



Green Grass / Gravel
Albedo 10-20%
Expected Yield Gain 6-7%



Desert Sand
Albedo 22-25%
Expected Yield Gain 10-15%

- Installation height of bifacial module is recommended to be higher than 1 meter in order to harvest maximum available reflected and diffused radiation and to reduce shading on the backside.
- Structure, cables and any other component of installation should not cause shading on the backside of the modules.

5.2. Tilt Angle

The tilt angle of the PV module is the measured between the PV module and a horizontal ground surface. The PV module generates the maximum output power when it faces the sun directly. 5 degrees or more is recommended for the tilt angle of the PV module for the maintenance. For the stand-alone systems with a battery where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be determined to optimize the performance when the sunlight is the scarcest, In general, if the electric power generation is adequate when the sunlight is the scarcest, 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, it is

recommended to tilt the PV module at the angle equal to the latitude of the installation site so that the power generation from the PV module will be optimum throughout the year.

Artificially concentrated sunlight shall not be directed to the panel, or module

6. WIRING

PV modlues junction boxes with the IP68 protective level To ensure proper system operation and to maintain your guarantee, observe the correct cable connection polari-ty (Fig 1 and 2) when connecting the modules to a battery or to other modules. If not connected correctly, the bypass diode could be destroyed. PV module scan be wired in series to increase voltage. Connect wires from the positive terminal of one module to the negative terminal of the next module. Connect PV modules in parallel to increase current. Con-nect wires from the Positive terminal of one module to the positive terminal of the next module.

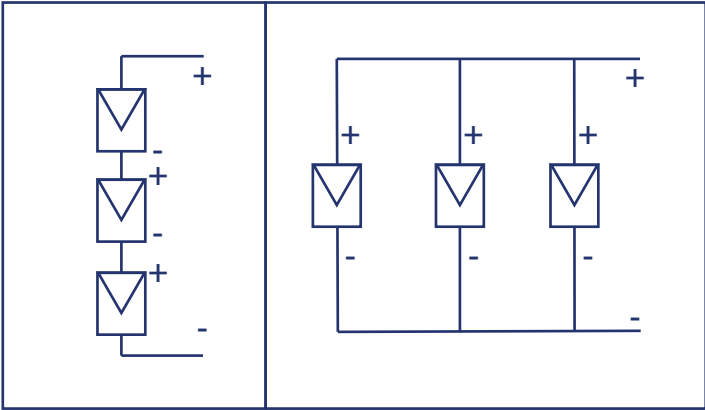


Fig 1: Shows modules connected in series. Fig2: Shows modules connected in parallel.

Bypass diode
Type : MK4050 , Rating (A) : 40A 50V , Max.temp : 200c°
Connector
Type : Staubli , MC4

6.1. Grounding

Earthling & Insulation for DC cables according to IEC712-7-60364

The frame grounding must consider the local require-ments and regulations at the site of installation.The grounding hole on the frame is marked with typical grounding symbol (⏏) according to IEC 61730_1stan-dard When grounding is required, please refer to the below example connection (Fig3). Please be careful in arranging the system ground so that the removal of one module from the circuit will not interrupt the grounding of any other modules. The modules should be grounded to the same electrical point as described below. Each PV module has a hole on the side frame for a bolt,

nut and washer retaining a ground lug. In a connection of this type, the hardware (such as toothed locked washer/Star washer) must score the frame surface. The hardware components (Toothed washer, cup washer, flat washer and hexagon unit) as mentioned in the drawing below must be fit to 4mm hole. Torque Value: < (2.82 – 7) N-m, (2.07-5.2) ft- lbs. > on 4 mm size bolt and nut necessary to secure grounding connection.

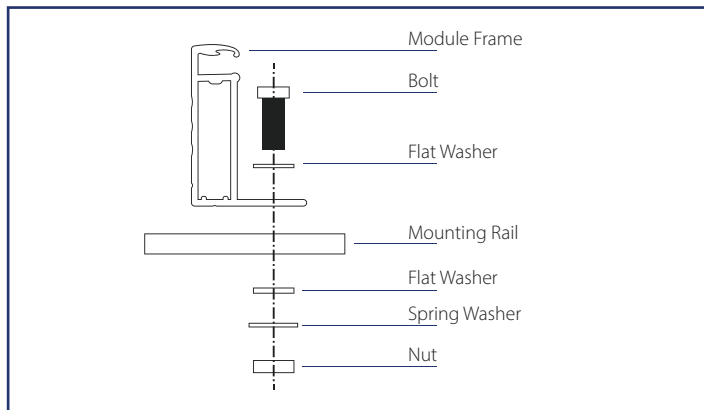


Fig 3: Four M8(5/16inch) stainless bolts, four nuts, four spring washers, and eight flat washers are recommended per solar module

Where common grounding hardware (nuts, bolts, star washers, spilt-ring lock washers, flat washers, and the like) is used to attach a listed grounding/ bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions. 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 61730, may be used for grounding connections in accordance with the instructions provided with the module.

7. GENERAL MOUNTING INSTRUCTIONS

The module follows UL 61730 only when the module is mounted in the manner specified by the mounting instructions below.

- 1- Support structures that PV modules are mounted on should be rigid. The modules are designed to secure their electric performance under the condition they are mounted on rigid support structures.
- 2- Deformation of support structure may damage PV module with its electric performance.
- 3- The modules shall be mounted so that the junction box shall be in the uppermost position to minimize the ingress of water.

- 4- Do not stand or step on the PV module, Glass, Frame, Backsheet, and Junction Box.
- 5- Ensure modules are not subjected to wind or snow loads exceeding the maximum permissible loads. (M108: 5400Pa Wind load-rear side, 5400Pa snow load- front side, M144: 2400Pa Wind load-rear side, 5400Pa snow load- front side)
- 6- A clearance of at least 10cm between the module frame and surface of the wall or the surface to allow air to circulate behind the modules.
- 7- The minimum distance between two modules is at least (1.5 cm).
- 8- Make sure that drain holes should not be blocked in any case.

7.1 Mounting Using Frame Bolt Holes

7.1.1 Half-Cell 144 Modules

There are six holes on each long side of the module's frame used to accommodate dedicated bolts. The modules must be fastened to a support using the two bolt holes in the frame. The module should be fastened with M8x L50, flat washer, spring washer and hex nut tighten to torque 11.65 – 16.9 ft.lb (15.8 – 23 N.M). All fittings should be made of stainless steel.

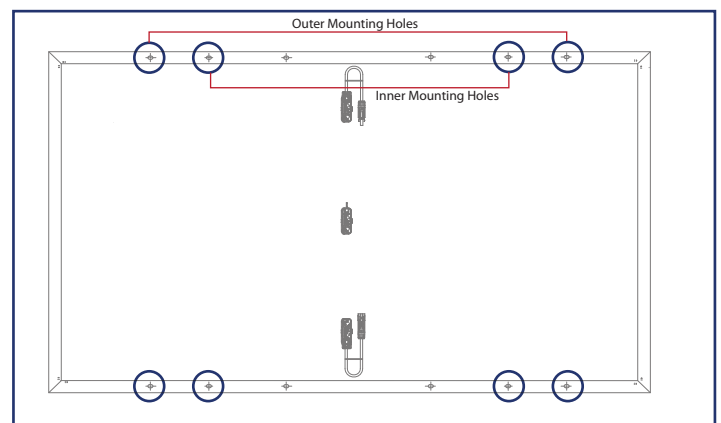
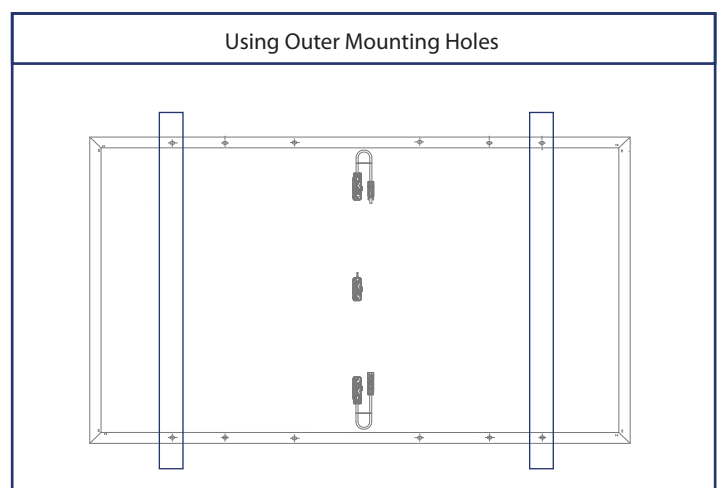
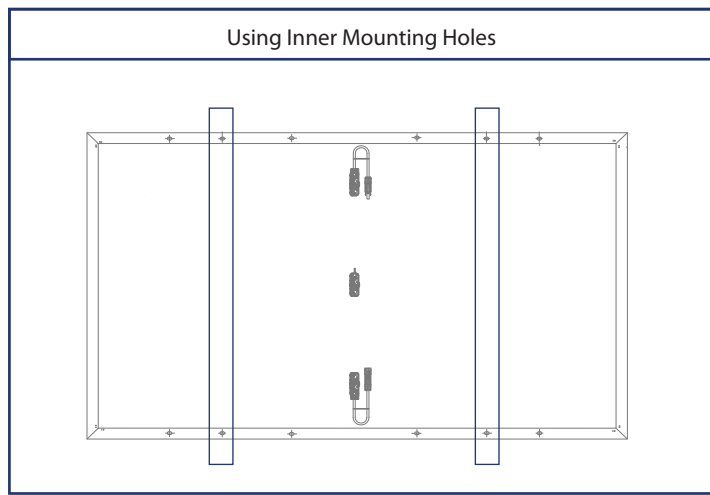


Fig 5: Half-Cell Modules, use four mounting holes



Front Static Load 5400 Pa, Rear Static Load 2400 Pa



Front Static Load 5400 Pa, Rear Static Load 2400 Pa

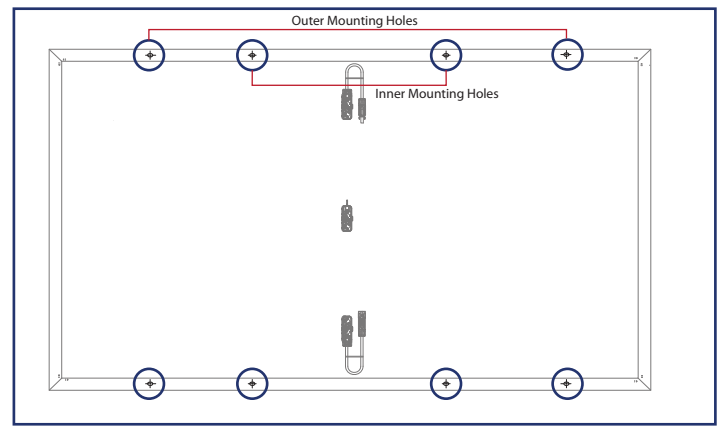
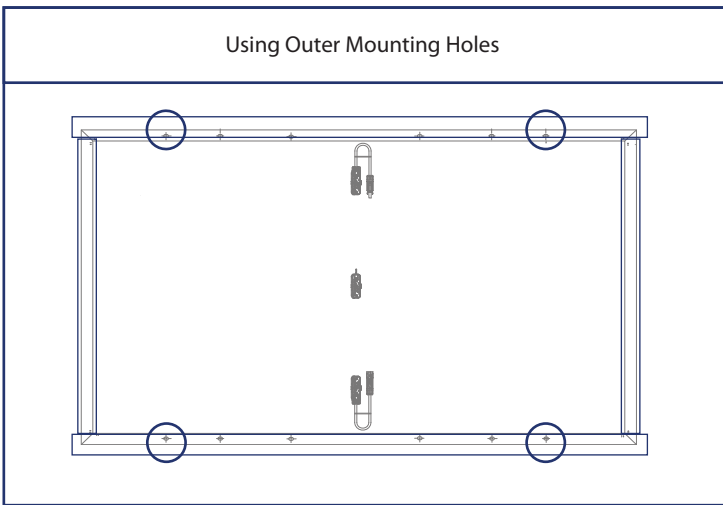
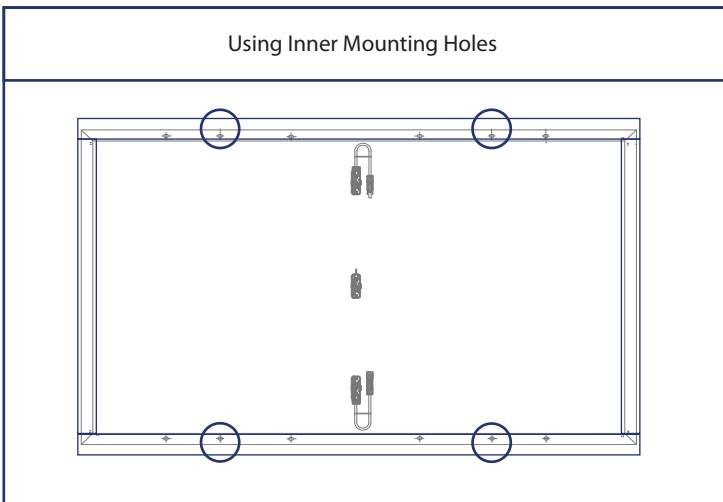


Fig 6: Half-Cell Modules, use four mounting holes



Front Static Load 5400 Pa, Rear Static Load 2400 Pa

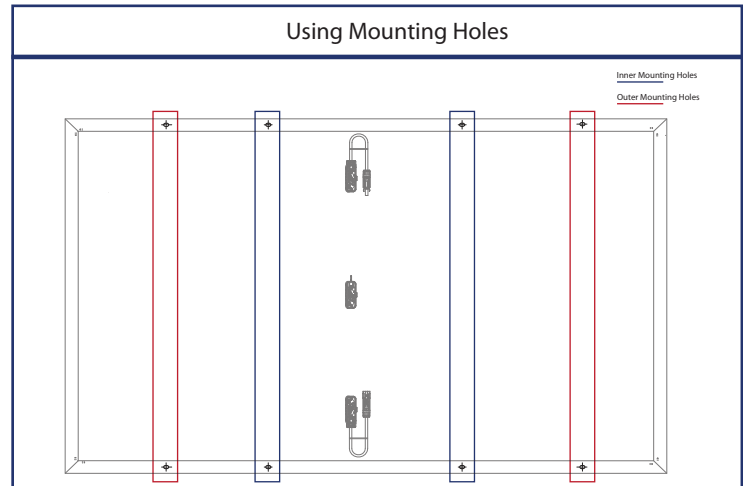


Front Static Load 5400 Pa, Rear Static Load 2400 Pa

7.1.2 Half-Cell 108 Modules

There are two holes on each long side of the module's frame used to accommodate dedicated bolts.

The modules must be fastened to a support using the two bolt holes in the frame. The module should be fastened with M8x L50, flat washer, spring washer and hex nut tighten to torque 11.65 – 16.9 ft.lb (15.8 – 23 N.M). All fittings should be made of stainless steel.



Front Static Load 5400 Pa, Rear Static Load 5400 Pa

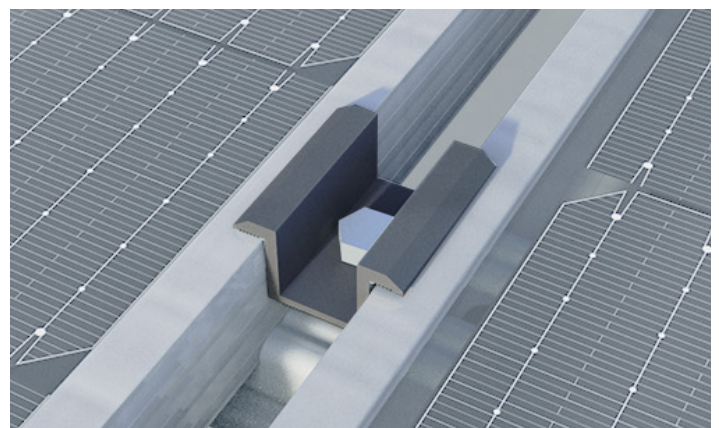
7.2. Mounting Using Clamps

Mounting using clamps is the only method evaluated by the testing and certifying laboratory.

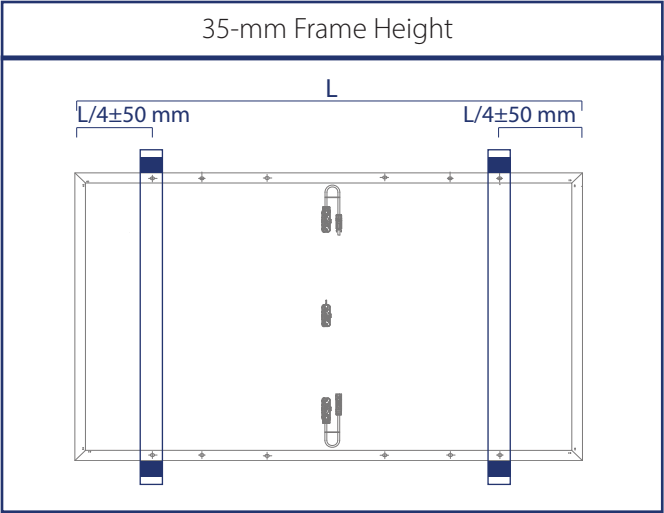
- 1- Modules clamps should not contact module's glass or deform module's frame.
- 2- Make sure to avoid shadowing from using clamps.
- 3- Use four clamps on the long side of each module.
- 4- Applied torque is referring to the bolts that customer use, M8* L50 fully threaded:
(11.65 – 16.9 ft.lb: 15.8 - 23 N.m).
- 5- Never use middle clamp instead of edge clamp.
- 6- Clamp position "C" should be $L/4 \pm 50$ mm. where L is the length of the module.

Clamp Position C = $L/4 \pm 50$ mm

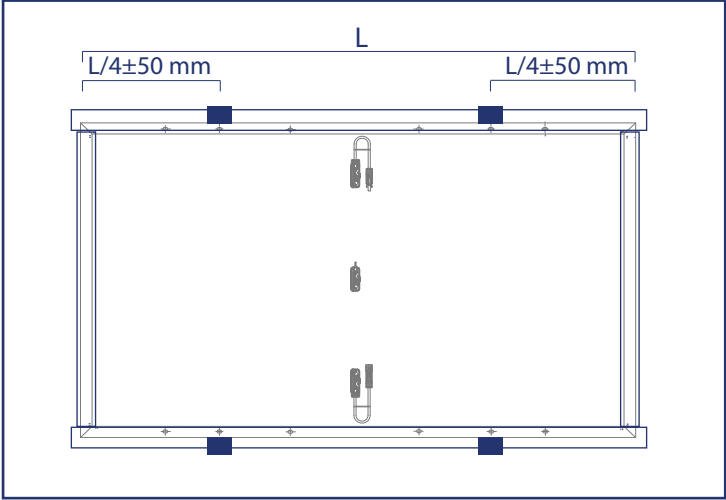
L : Module Length



7.2.1 Half-Cell 144 Modules

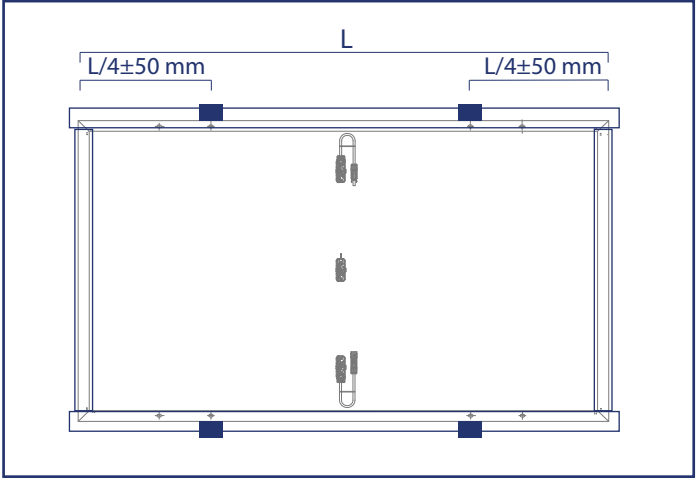


Front Static Load 5400 Pa, Rear Static Load 2400 Pa

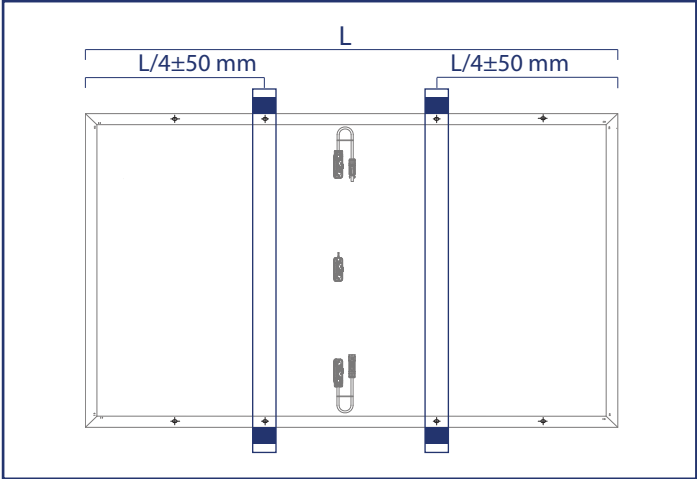


Front Static Load 5400 Pa, Rear Static Load 2400 Pa

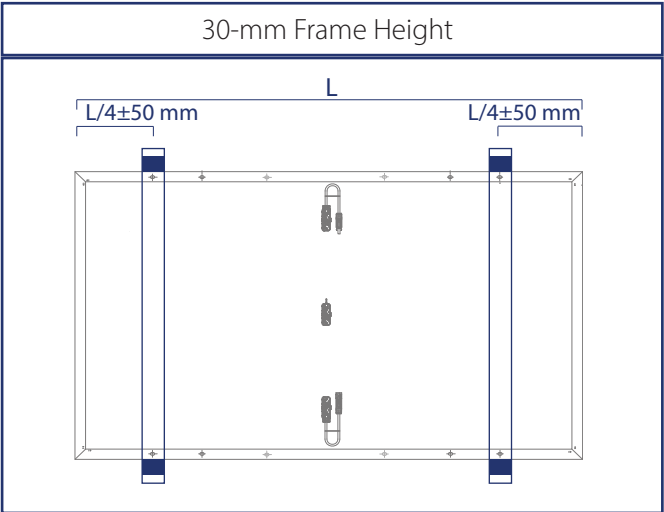
7.2.2 Half-Cell 108 Modules



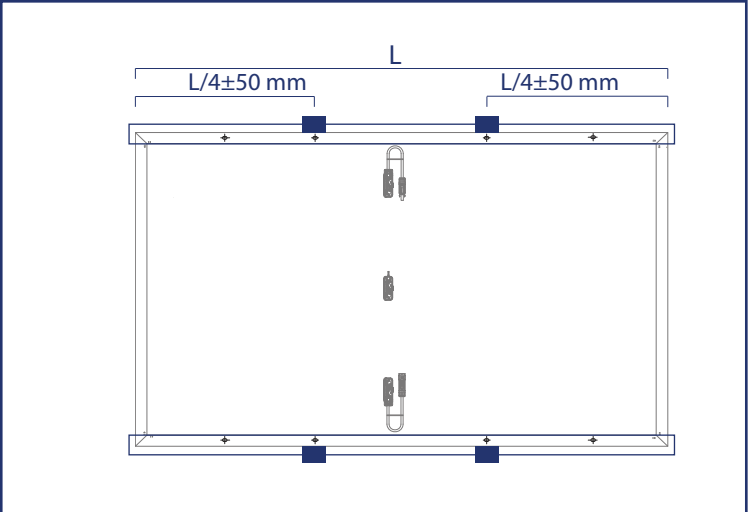
Front Static Load 5400 Pa, Rear Static Load 2400 Pa



Front Static Load 5400 Pa, Rear Static Load 5400 Pa



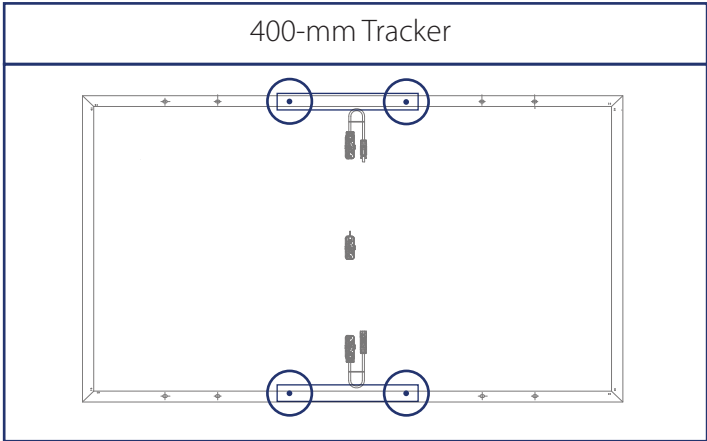
Front Static Load 5400 Pa, Rear Static Load 2400 Pa



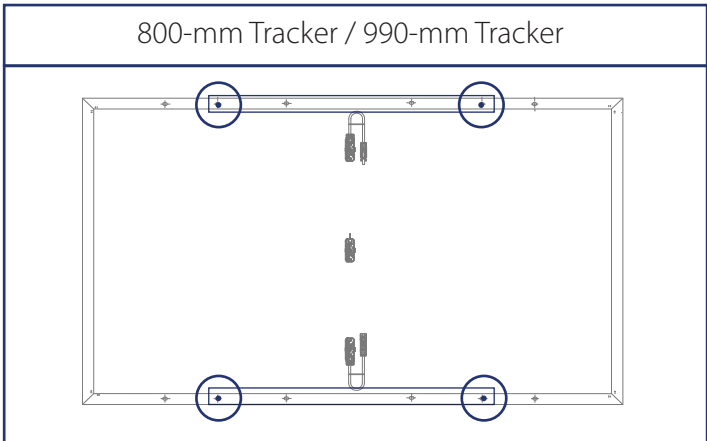
Front Static Load 3600 Pa, Rear Static Load 3600 Pa

The module follows this standard only when the module is mounted in the manner specified by the mounting instructions. A module with exposed conductive parts follows 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).

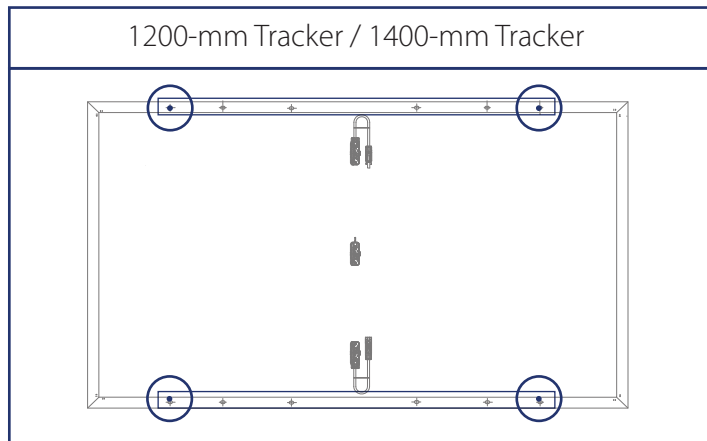
7.3. Mounting on Tracker 144 Modules



Front Static Load 1000 Pa, Rear Static Load 1300 Pa, fastening Fixtures set of stainless-steel Bolt M6x20mm, torque 4.42 ft. lb (6 N.M)



Front Static Load 1800 Pa, Rear Static Load 2250 Pa, fastening fixtures set of stainless-steel Bolt M8x25mm, torque 10.69 ft. lb (14.5 N.M)



Front Static Load 2600 Pa, Rear Static Load 3800 Pa, fastening Fixtures set of stainless-steel Bolt M8x25mm, torque 10.69 ft. lb (14.5 N.M)

8. MAINTENANCE

The modules are designed for long life and require little maintenance. If the angle of the PV module is 5 degree or more, normal rainfall is sufficient to keep the module glass surface clean under most weather conditions. If dirt build-up surface becomes excessive, clean the glass surface with a soft cloth using water. If cleaning the back of the module is required, take utmost care not to damage the back-side materials. In order to ensure the operation of the system, please check the connection of wiring and the state of the jacket of wires every now and then.

Trim vegetation from project site which may shade solar array and reduce performance.

For Cleaning Follow (Philadelphia Solar Cleaning Guidelines)

9. ELECTRICAL CHARACTERISTICS

Rated Electrical Characteristics of I_{sc} , V_{oc} max are within ($\pm 5\%$) under STC conditions, Irradiance of $1000W/m^2$, Am 1.5 spectrum, and ambient Temperature of $25C^\circ$.

The operating Temperature range: $-40C^\circ$ to $+85C^\circ$ under IEC standards: $-40C^\circ$ to $+90C^\circ$ under UL 61730 standard.

Under Normal Conditions, a photovoltaic module is likely to experience more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the module output. Per NEC, Section 8-690 circuit conductors and over- current devices.

shall be sized to carry not less than %125 of the maximum current as calculated in above component voltage ratings, conductor ,capacities, fuse sizes and size of controls connected to the module output.

Per NEC, Section 8-690 circuit conductors and over-current devices shall be sized to carry not less than %125 of the maximum current as calculated in above.

Electrical Installation Instruction
Cable Characteristics:

- Cross section: $4.0mm^2$
- Cable Type: PV cable (H1)
- Rated Voltage : 1500V
- RTI : 120 C

10. FIRE RATING

Module Fire Performance: Type 1. The fire rating of module is valid only when mounted in the manner specified in the mechanical mounting instructions. The assembly is to be mounted over a fire-resistant roof covering rated for the application.

11. APPLICATION CLASS

Rated as Application Class II per IEC 61730-1:2016 Hazardous voltage (IEC61730:Higher than 50V DC, EN61730:Higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (modules qualified for safety through EN IEC 61730-1 and IEC 61730-2 within this application class are considered to meet the requirements for safety class II).

12. FUSE

The max rating of a fuse connected in series with an array string is 30 A. Fuse rating corresponds to max reverse current that the module can withstand, when one string is shaded then the other parallel strings of modules will be loaded by the shaded string and current will flow therefore affects the number of parallel strings.

Caution!

For Any Electrical Maintenance, PV system must be first shut down, improper maintenance can cause electric shock or burns. Be careful Failure to comply with the above recommendations will result to situations do not be covered by the guarantee.

13. UNPACKING AND STORAGE

- 1- Leave the product on its original box until you need to install.
- 2- Store packages in a clean, dry area with relative humidity below %85 and ambient temperatures between (-20 to 40) C°.
- 3- Do not stack more than the allowable limits of pallets over each other. Which are two pallets over each other.
- 4- At installation side, keep electrical contacts clean and dry to avoid corrosion, any module with corroded contacts should not be used.
- 5- If pallets are stored outside, use protective covers to protect them from different weather conditions.
- 6- Two people are required to unpack modules from packing pallet.
- 7- Use wire cutting pliers to remove plastic straps on pallets.
- 8- Do not place modules directly over each other.

14. ENVIRONMENTAL CONSIDERATIONS CLIMATE CONDITIONS

PS modules are designed and tested to withstand harsh conditions for more than 30 years. In addition to the required IEC certification to meet European standards. PS products have also been tested to verify resistance to ammonia fumes, further the suitability of installation in humid areas such as coastal and areas of high sandstorms

• Summary of Environmental Parameters:

- 1- Ambient Temperature: -40°C to +40°C. (-40°F to +104°F).
- 2- Operating Temperature: -40°C to +85°C (-40°F to +185°F) IEC standards.
- 3- Operating Temperature: -40°C to +90°C (-40°F to +194°F) UL61730 standards.
- 4- Storage Temperature: -20°C to +40°C. (-4°F to +104°F)
- 5- Humidity: ≤ 85% RH
- 6- Mechanical Load Pressure: Maximum snow load 5400 Pa/ 0.783 psi which is equivalent to (550 Kg/m²) from the front side.
- 7- Wind load: Maximum 2400 pa / 0.348 psi which is equivalent to 240kg /m² from the rear side
- 8- Please consult PHS technical team for more information on the use of modules in special climates, such as an altitude greater than 2000 m.

15. Electrical and Thermal Data					
Module Model	PS-MN156(HCBF)-xxxW	PS-MN144(HCBF)-xxxW	PS-MN132(HCBF)-xxxW	PS-MN120(HCBF)-xxxW	PS-MN108(HCBF)-xxxW
Power Range at STC in Watt	605-625	560-580	510-530	460-480	415-435
Open Circuit Voltage VOC at STC (V)	55.17	50.67	46.18	42.05	37.90
	-	-	-	-	-
Short Circuit Current ISC at STC (A)	55.72	51.47	47.05	42.71	38.82
	-	-	-	-	-
Maximum Power Voltage Vmpp at STC (V)	13.95	14.13	13.58	13.99	14.00
	-	-	-	-	-
Maximum Power Current Impp at STC (A)	14.278	14.37	13.78	14.31	14.33
	-	-	-	-	-
Nominal Operation Cell Temperature (NOCT) (c°)	45.42	41.95	39.28	34.72	31.31
	-	-	-	-	-
TEMPERATURE COEFFICIENT FOR VOC (%/C)	46.10	42.59	40.08	35.38	32.07
	-	-	-	-	-
TEMPERATURE COEFFICIENT FOR PMP (%/C)	13.32	13.35	13.00	13.25	13.25
	-	-	-	-	-
TEMPERATURE COEFFICIENT FOR ISC (%/C)	13.56	13.62	13.22	13.57	13.56
	-	-	-	-	-
STC	45	45	45	45	45
NOCT	1000 W/m², 25 c° and AM 1.5 according to IEC TS 61836				
Tolerance	800 W/m², 20 c° , AM 1.5 and Wind Speed 1m/s				
	Tolerance of Power Measurement is +3% While for Current and Voltage(VOC,ISC) ±5%				

For more details please refer to the latest datasheets uploaded at our website: www.philadelphia-solar.com