

# **PV MODULE INSTALLATION MANUAL**



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## 1. DISCLAIMER OF LIABILITY

- This Installation Manual is applicable for Mundra Solar Energy Limited (MSEL) / Mundra Solar PV Limited(MSPVL) PV Modules. MSPVL is referred to as Adani / Adani Solar in the Installation Manual as MSPVL is part of Adani Group.
- This manual is for authorized & trained users only. ADANI will not entail explicit or implicit quality warranty and does not set forth on any compensation scheme for any type of Loss, Damage, Hazard, Injury, Expense or Revenue because of improper installation, Handling, Usage & Maintenance process.
- Adani Solar assumes no responsibility for the infringement of intellectual property rights or other rights of third parties that may result from use of the module. No license is granted in this regard, either expressly or implicitly, or under any patent rights.
- Information contained in this instruction manual is based on ADANI Information and expertise. If customer fail to install modules as per requirement stipulate in this manual, the limited warranty provided for customer will be invalid. This manual and specification can be changed by the Adani without giving any prior information. Adani has rights to amend this document any time including PV module specification without prior notification.

## 2. SAFETY MEASURES

### 2.1 General Safety Instruction

- On direct exposure to sun light PV module produces electricity, which can result in electric shock or while working with module exposed under direct sunlight, it is advised to use installation tools and for precaution wear hand gloves to protect from electrical hazards. Also it is advised to keep away from any metallic contact touching the human body.
- Standing on module is strictly prohibited as it can impact the module's performance. Uneven pressure developed while standing on it can damage Solar cell. It is not applicable for warranty claims if it is discovered that anyone have stood on PV Modules,
- Module's front surface is made of tempered or semi tempered glass and has an ARC coating, so it needs special care in handling. If glass breaks due to any reason, it is advised to keep human contact away. At ambient wet condition any human contact with the broken glass surface may lead to electrical shocks. Once module glass breaks it has to be scrapped or disposed after removing it from string after string is disconnected from the load.
- For cleaning modules with water, use water which has temperature similar to module being cleaned. It is to avoid any thermal shock & damage to module.
- Do not damage or scratch the front or backsheet surfaces of the module.
- Do not punch or drill holes in the frame, it may cause corrosion to the frame.
- The maximum altitude the PV module is designed for  $\leq 2000\text{m}$ .

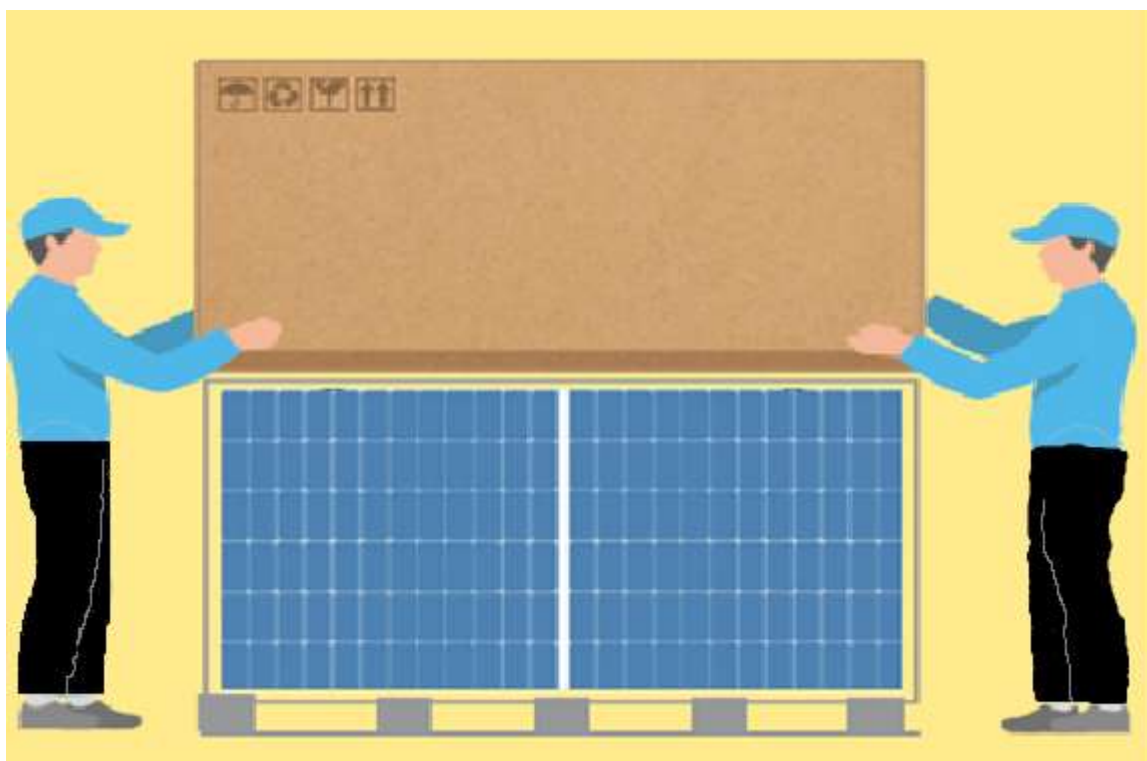
- The maximum irradiance is 1300W/m<sup>2</sup> for module with transparent rear.
- Any loose connection in connectors of PV module can cause electrical arcing and can lead to fire hazard. It is recommended to not keep any gap in connectors. Also ensure all the connectors should be corrosion free and protected against corrosion and soiling. It is strictly prohibited to remove or cut any connector of PV Module for installation easiness by the installer / customer and the module is deemed out of warranty.
- Do not install or handle any PV Modules in unfavorable environmental condition like high flow winds, rain, storm and wet snowy roof surfaces for personal safety. Ensure modules should always be dry while installing.
- Please Ensure the polarity of the modules or strings is not reversed in relation to the other modules in the string.
- Any artificial sunlight focusing on PV module is not recommended as it can reduce its performance and life cycle.
- Adani PV modules are certified to operate in Class A condition installed below voltage level 1500 Vdc. Consider this voltage range while designing the power plant. This value should be taken into consideration when designing the power plant, as should the temperature ranges present at the site.
- At different environmental conditions, PV module can produce high current and voltage than the measured in STC condition. Snow and water causes sunlight reflection which can increase the flow of current and Power output. The value of Isc and Voc marked on the module should be multiplied by 1.25 when determining PV system component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.
- The maximum rating of a fuse connected in series with an array string typically 25/30A the actual module specific rating can be found on the product label and in the product data sheet. Refer Article 690, Solar Electric Systems of National electric code (module under UL scope) for installation.

## 2.2 Fire Safety

- The modules are qualified for 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 Fire safety class C and safety through EN IEC 61730 -1 and - 2 within this application class are considered to meet the requirements for Safety Class II.
- Consult your local authorities for guidance and requirements for installation or building fire safety.
- The top structure and installation may affect the building fire safety; improper installation may lead to fire hazards.
- As required by the local authorities, use such devices as ground fault cut-outs and fuses.
- Please do not operate the panel in the environment vulnerable to combustible gases or near any equipment.
- Prohibited to use water fire extinguishers on charged PV module or electrical origin fire.

### 3. PV MODULE UNPACKING AND STORAGE

- After receiving the PV Modules, Customers are requested to match the product specification as it had been ordered. All the module serial number and other details are present on the box of the PV modules.
- Do not stack packing boxes (pallets) more than 2 boxes high. If pallets are temporarily stored outside, an external protective cover should be placed over them and the stack height should not be more than 1 pallet high. Do not expose the packing boxes to rain or moisture.
- Ensure the packing boxes storage should be in well ventilated, waterproof, dry and smooth place before unpacking modules.
- During unpacking there should be two people to unpack from vertical side as shown in figure below.



**Fig1: Method of module unpacking**

**Note:** Please note the Modules will not be *INSIDE* the box in this case. First the box will be removed and then the Modules are removed one-by-one from the pallet using a side support.

### 3.1 Important Instructions

- For unloading Panels from vehicle (ref: MSEL/MSPVL unloading document)
- During transportation, please aim to minimize the shock and vibration to the modules. The shock and vibration may lead to micro cracks in modules.
- For side support details (ref: MSEL/MSPVL unpacking document), which need for supporting the Modules on one-side, before cutting the straps.
- Improper handling of PV module may cause scratches and damage to module. It is not recommended to apply adhesive or paints on the surface of the module.
- Do not short the –Ve & +Ve terminal of the Junction box of the PV Module at any time.
- Always use cutting pliers to cut the cable tie of the PV module. Do not use any knife as it can damage the PV Module.
- It is not recommended to place modules directly on another module.
- **Module Identification**–Every module has a unique serial number & company logo, which is laminated behind the glass. *Please do not tamper with the serial number of the module and always record all serial numbers in an installation for your future reference.*

## 4. ENVIRONMENTAL CONSIDERATIONS

### 4.1 Climate Conditions

All Adani Solar modules are tested for IEC 61215, IEC 61730-I & II, IEC 61701, IEC 62716, IEC 62804, IEC 60068. The modules are qualified for application Class A. Modules are qualified for safety as per IEC 61730 within this application class are considered to meet the requirements of Safety Class II. Adani PV modules meet the requirement of European standards as they are also tested for the Ammonia fumes that may be present in Barns sheltering Cattle, Pigs, as well as sustainability for Installation in Humid (Coastal) Areas of high Sandstorms. Adani module passed in testing of Salt mist IEC 61701 Salt mist corrosion test (Severity VI) with a salt concentration of 5% by weight, Usage of dissimilar metals in direct contact with module aluminum frame is not recommended for seaside installations to avoid metal corrosion.

### 4.2 Environmental Condition: -

Ambient temperature	-40°C to +55°C
Operating temperature	-40°C to +85°C.
Storage temperature	-20°C to +50°C.
Humidity	≤85 RH%
Mechanical Load Pressure	Design Load: 3600 Pa Front & 1600 Pa rear, Safety Factor for Mechanical Load: 1.5 Mechanical load: 5400 Pa Front and 2400Pa back

## 5. SITE SELECTION

- PV modules should be installed in a place where no shading occurs throughout the year. Front and rear shading can be minimized by ensuring that the distance between an obstruction and the solar array is more than three times the height of the obstruction.
- PV module should be installed minimum 500m away from the ocean side, stainless steel or aluminum materials are need to be used to contact the PV modules, and the connection point should be protected with anti-corrosion measures.
- PV modules can be installed in portrait or landscape orientation; impact of dirt shading can be minimized by orienting the PV modules in portrait. The module facing should be south in northern hemisphere and north in southern hemisphere.
- For installing solar modules on a roof, the roof must be covered with a layer of fire proof material applicable to the class, and sufficient ventilation must be ensured between the backsheet and the installation surface. A safe working area also must be left between the edge of the roof and the external edge of the solar array.
- Sufficient row to row gap has to be chosen and PV modules should be spaced between two rows appropriately such that no shadows appear on the PV module at any part of the day during 365 days due to inter row spacing.
- For optimum energy production, solar modules should normally be mounted facing the equator at an angle to the horizontal plane equivalent to the latitude of the installation. If the PV module is placed at a different angle or orientation, this could have a direct impact on the power output.
- Please do not install the modules near any fire source or flammable object.
- To maintain the fire class rating a slope of 1: 2.4 is require is required
- At any condition PV module should not be installed by immersing the module under water.
- To gain better output from rear side from Bifacial modules prefer Albedo table while installing PV modules.

Surface type	Typical Value
Fresh asphalt	0.03 – 0.04
Sand	0.15 – 0.18
Agricultural crop	0.18 – 0.25
Bare soil	0.17
Green grass	0.20 - 0.25
Desert sand	0.30 – 0.40
Snow	0.40 – 0.90
Fresh snow	0.80 – 0.90
Ocean Ice	0.50 – 0.70

## 6. MOUNTING INSTRUCTION

### 6.1 Stability of structure

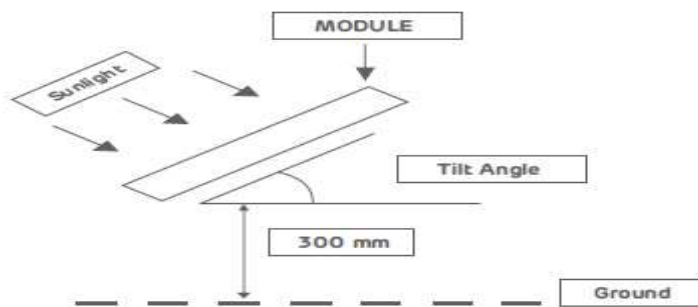
The Fixed structure or Axis tracker should be coated to survive in external environment till lifecycle of PV module. Please consult the MSEL/MSPVL technical support department for more information on the use of modules in special climates, such as an altitude greater than 2000 m. The mechanical load bearing capacity depends upon the installer's mounting methods and failure to follow the instructions in this manual may result in different capabilities to withstand snow and wind loads. The system installer should ensure that the installation methods used meet these requirements as well as any local codes and regulations.

### 6.2 Important instruction for Mounting

- Always avoid loop formation during designing, to minimize the risk during indirect lightning strike.
- Confirm mounting system withstands the loads anticipated by wind and snow.
- Loads of wind & and snow should not cross the maximum rated load bearing capacity of PV module. Adani advises the customer to choose the modules carefully considering the environmental conditions.
- Adani Modules design, safety factor is certified under IEC conditions, snow load of 5400 Pa and wind load of 2400 Pa.
- Module installation in projects must face north while being installed in the southern hemisphere and the modules should be south facing while being installed in the northern hemisphere. Electricity generation reduces when the module installed at site facing west or east. Failure to follow this instruction will lead to lesser power generation.
- When the modules are connected in series, the angle at which it is installed should be the same for all the modules. If modules in series connected system are installed at different angles, the radiation of sun becomes uneven which will result in different fluctuating current across the string and will lead to loss in Power Output.
- PV module facing directly to sun produces more power. When solar modules are installed on permanent structure it is recommended to tilt the PV modules for optimum performance during winter season. Measurement of tilt angle done between the solar module and the ground.
- Adani recommends a minimum clearance between the modules and the roof or the ground surfaces of at least 300mm for better generation from rear, and also the surfaces be treated with light-colored and high reflective materials, such as white membrane or aluminum foils, the bifacial modules can bring 10%~30% more considerable additional power generation from the rear side.
- PV modules should not be installed under shade or shadow under any conditions as it may lead to current mismatch across the solar cells leading to damage of the solar module.
- Never disconnect module cables when it is connected with load. The mechanical load bearing capacity depends upon the installer's mounting methods and failure to follow the instructions in this manual may



result in different capabilities to withstand snow and wind loads. The system installer should ensure that the installation methods used meet these requirements as well as any local codes and regulations.

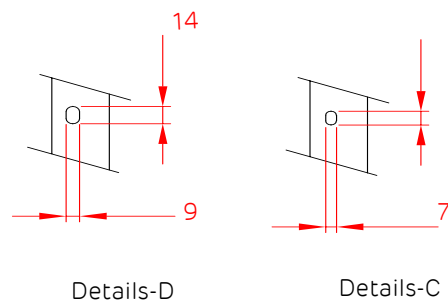
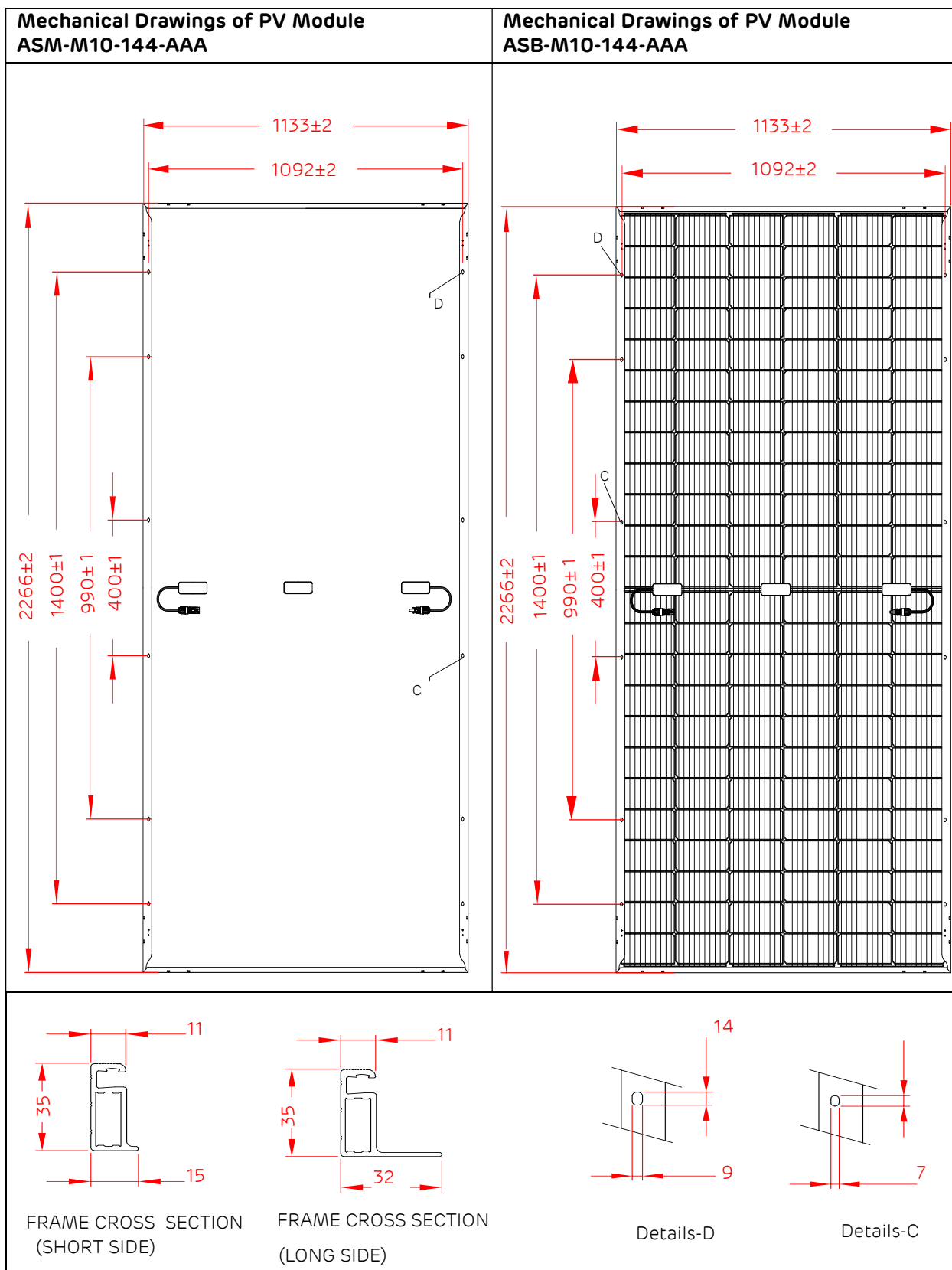


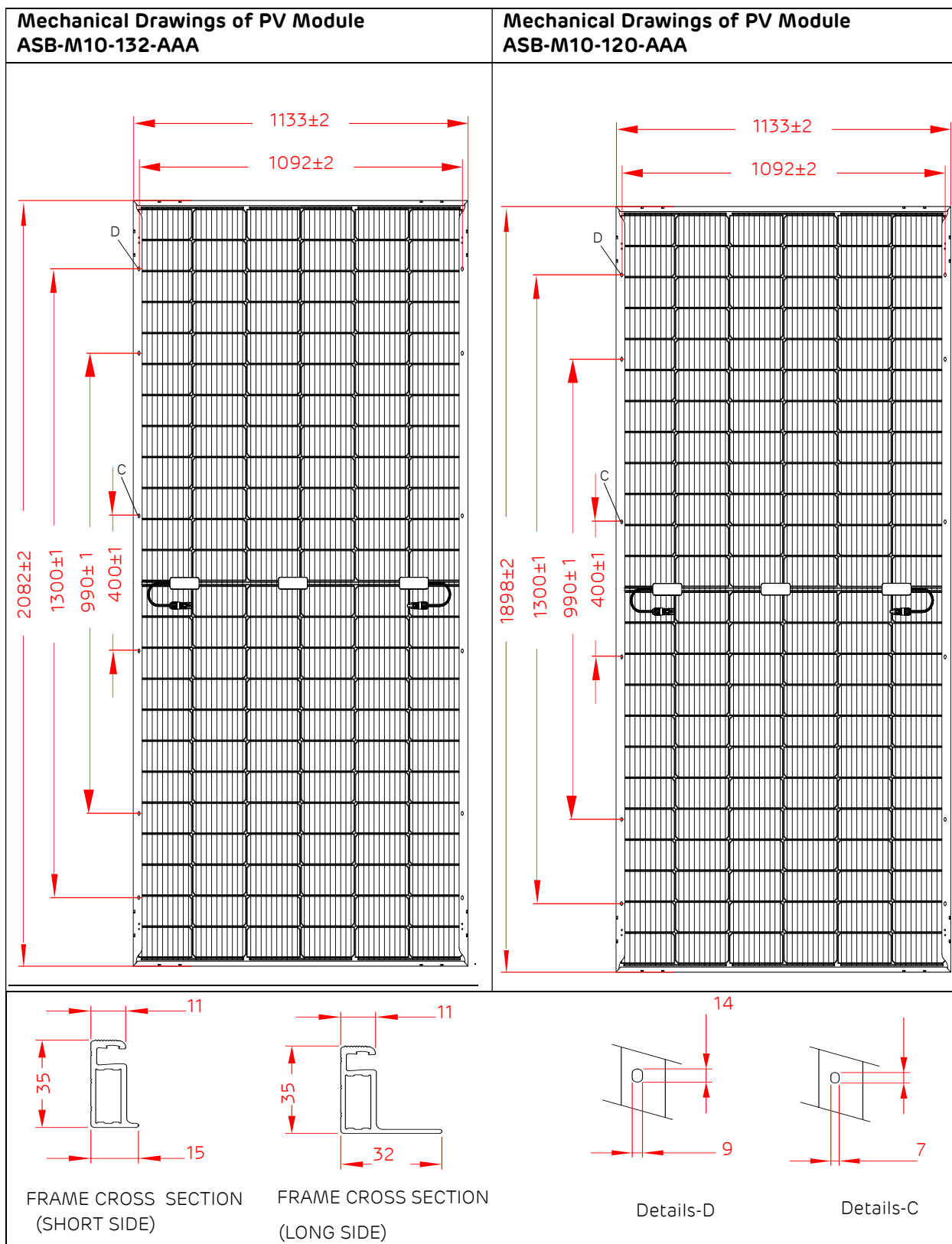
**Fig2: Tilt angle of Module**

### 6.3 Mounting Methods

- PV modules can be installed or fixed by clamp method.  
For bolts type fixing corrosion resistive M8 bolts to be used, mounting methods should ensure following things: -
  - a) Minimum clearance required between module edge and surface of the roof or wall should be according to the local regulations. It is generally around 300mm (space between the unit) for better ventilation.
  - b) Minimum distance between each Solar PV Module should be 10 mm.
  - c) Use durable, rust-proof and ultraviolet resistant materials to fabricate the modules support structure and please use such support structures already tested, certified and approved.

PV modules are not to be subjected to wind or snow load exceeding the maximums permissible loads and should not be subjected to excessive forces due to the thermal expansion of support structures, careful consideration has to be shown during system design and installation such that thermal expansion of support structures do not cause any breakage of PV modules which will not be part of Adani Solar's Warranty Document. When modules are ground mounted, select the height of the mounting system in such a way as to prevent the lowest edge of the module from being covered by snow for a long time in winter in areas that experience severe snow fall. If snow settles on the PV modules, the regular clearing of snow and other foreign particles and dust and dirt is highly recommended to ensure the long-term reliability of the PV modules. Failure to comply may result in damage to the module and lead to deformation or drop in power output which will not be covered under warranty.





**Fig 3: M10 Modules Mechanical Drawings**

Module Technology	Model type	Size
Adani Solar Monofacial framed Module (Glass to white back-sheet)	ASM-M10-144 -AAA	2226 X 1133 X 35 mm
Adani Solar Bifacial Framed Module (Glass to Glass & Glass to Transparent back-sheet)	ASB-M10-144-AAA	2266 X 1133 X 35 mm
	ASB-M10-132-AAA	2082 X 1133 X 35 mm
	ASB-M10-120-AAA	1898 X 1133 X 35 mm

*\*Please refer the Appendix 1 for Model details as well as electrical values.*

### 6.3.1 Monofacial assembly mechanical installation

#### A) Bolts Mounting Monofacial Modules

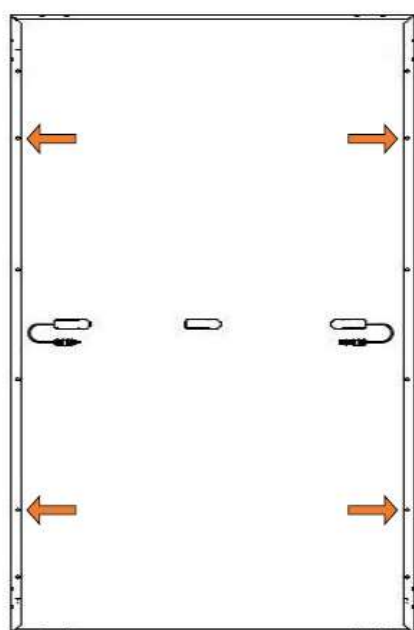
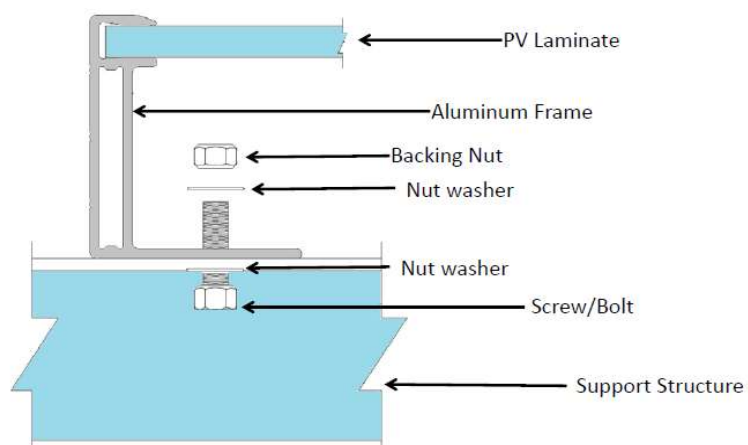


Fig (a) : Use Four Mounting Hole

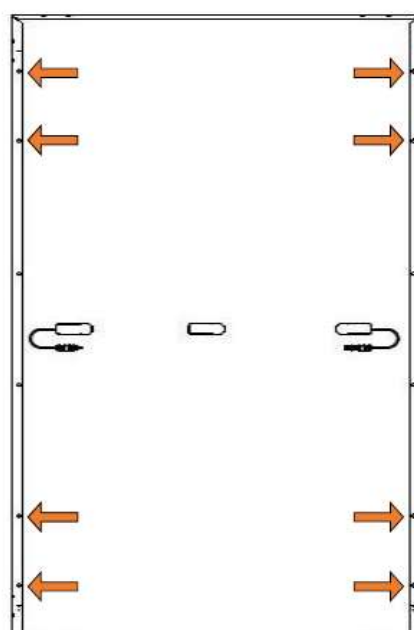


Fig (b) : Use Eight Mounting Hole



**Fig 4: PV Modules Installed with screw/Bolt fitting method**

Accessories	Model	Material	
Bolt	M8	Q235B/SUS304	Accessories material selection should be based on application environment.
Washer	2*8		
Spring washer	8		
Nut	M8		

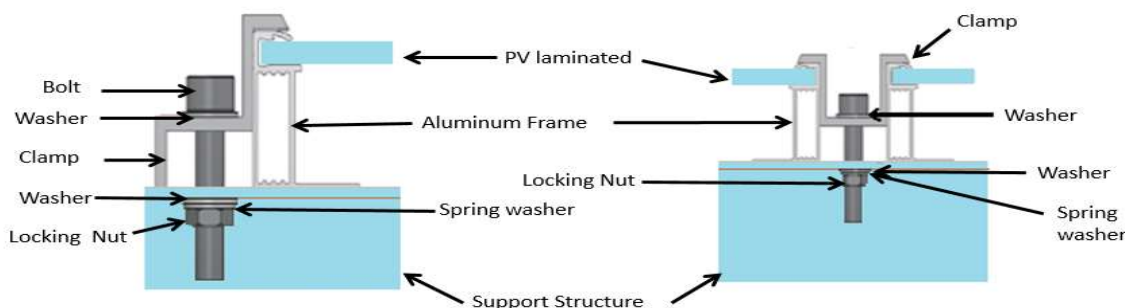
Suggestion:

- (1) M8 bolt tightening torque range: 14Nm to 18Nm.
- (2) When using MSEL/MSPVL 35mm height frame module, it is recommended to select  $L \leq 20\text{mm}$  length fasteners.

## B) CLAMP TYPE FIXING Monofacial MODULES

ADANI Solar has done number of tests on clamps and on the basis of that test results, it is recommended to use clamps with EPDM only.

- At least 4 numbers of clamps are required to fix the PV module on structure or mounting rail. The clamp must maintain an overlap of 8-11 mm with the frame of the module (you can change the cross section of the clamp if the module is securely installed).
- To avoid any kind of breakage of glass, clamps should not touch the glass and the shadow of clamp should not come on the module cell surface.
- Use appropriate corrosion-proof fastening materials. All mounting hardware (bolts, spring washers, flat washers, nuts) should be hot dip galvanized or stainless steel. Prevent the fixtures shading the modules front or rear side.
- The modules can be installed horizontally and vertically and must be firmly fixed on its holder during installation, so as to bear the corresponding load, including the wind uplift; the installation personnel must undertake to ensure that the fixture for fixing the modules has enough strength.
- It is recommended that the torque of 16~20 Nm be used to tighten the bolts.
- When fixtures are used for installation, use at least four on each module; when installed horizontally, the modules shall have its each short side provided with two fixtures. Depending on the local blizzard load, more fixtures can be added to ensure that the modules could withstand the load.

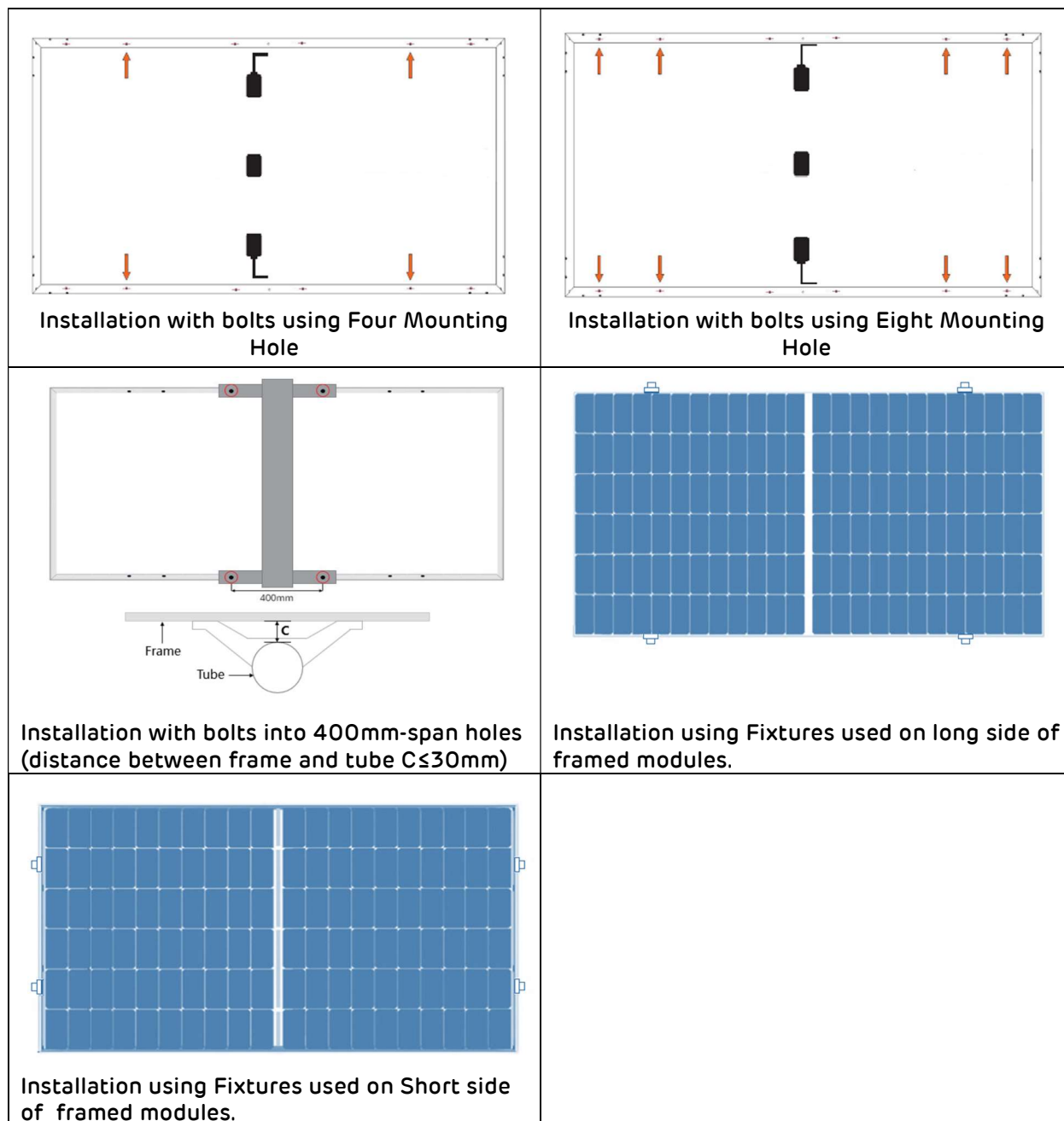


**Fig (a):** PV Modules Installed with Fringe Clamping Method

**Fig (b):** Middle Modules Installed with Clamping Method

**Fig 5: PV Modules Installed with Clamp method**

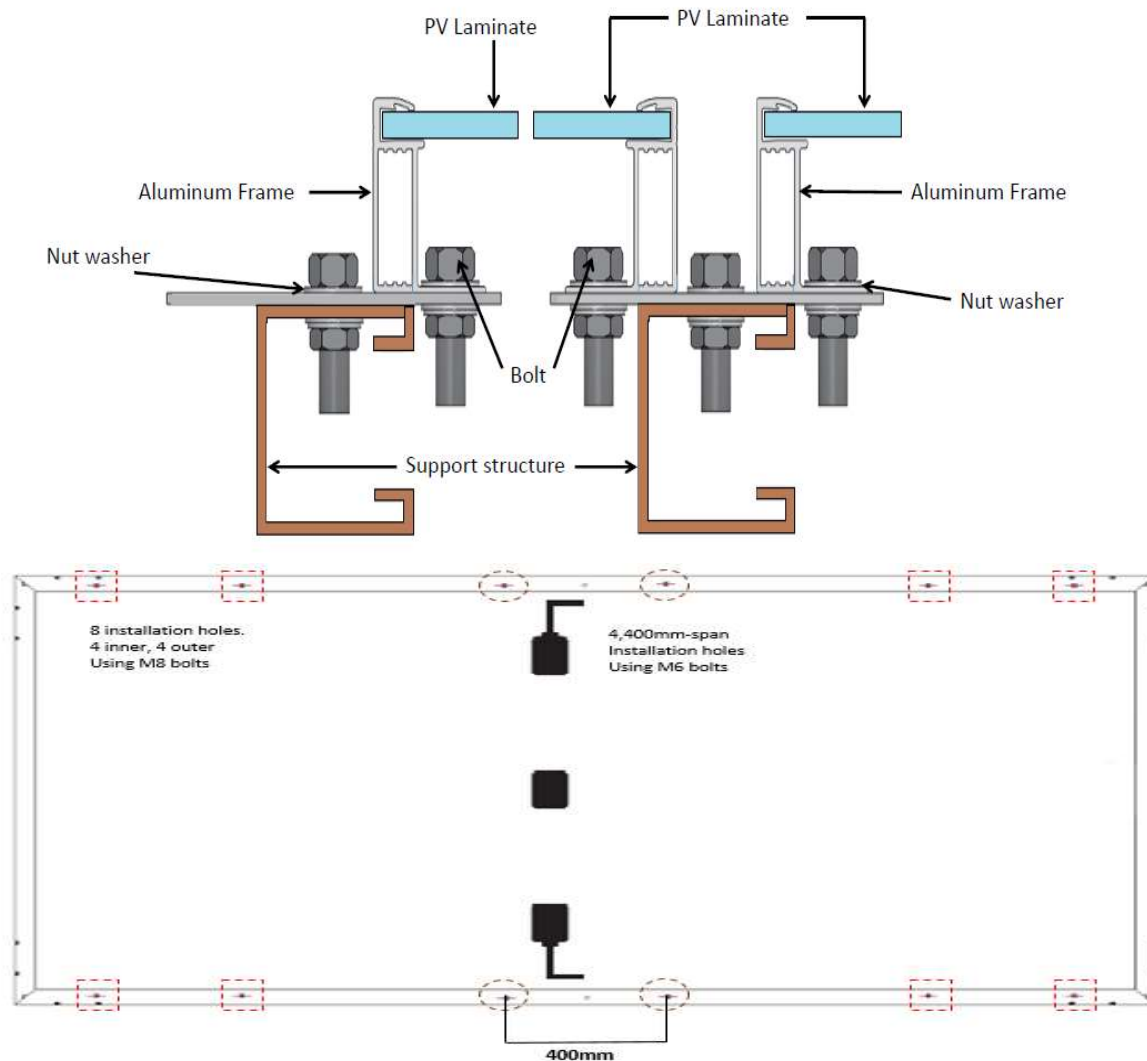
**C) Installation and Mechanical Load of Monofacial Module**



*\*Note: For mounting hole/structure Please refer the desired PV module datasheet.*

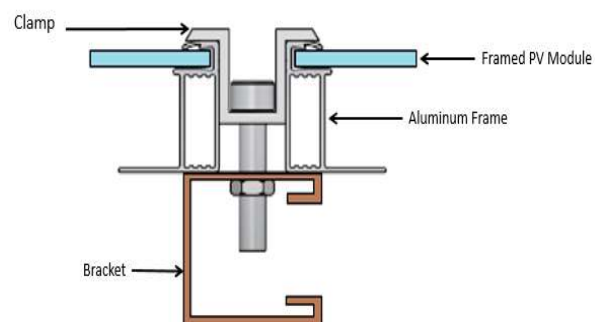
## 6.3.2 Bifacial module Mechanical Installation

### A) Bolts Mounting

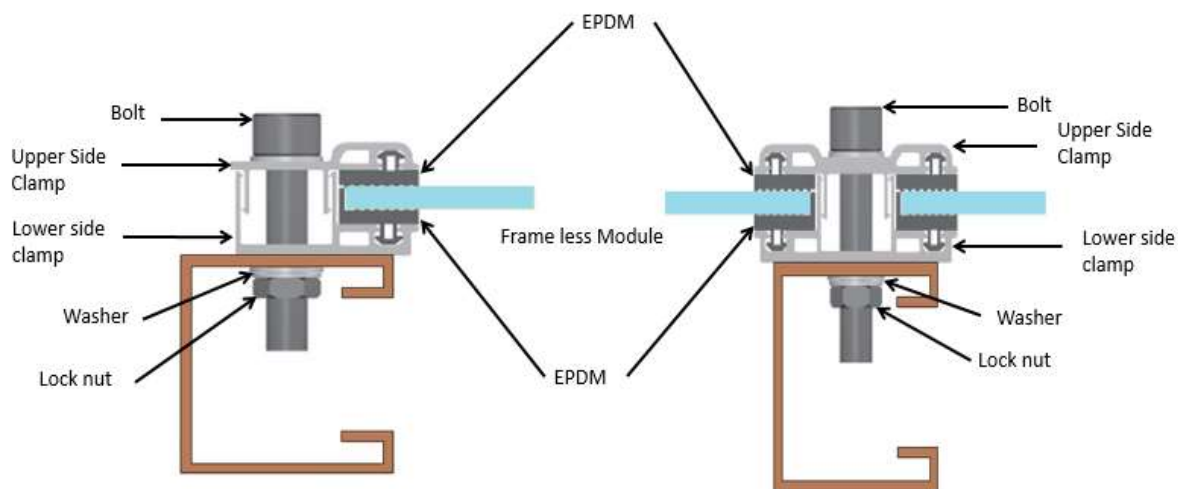


**Fig 6: Bolt Installation of Bifacial Module**

### B) Clamps Installation



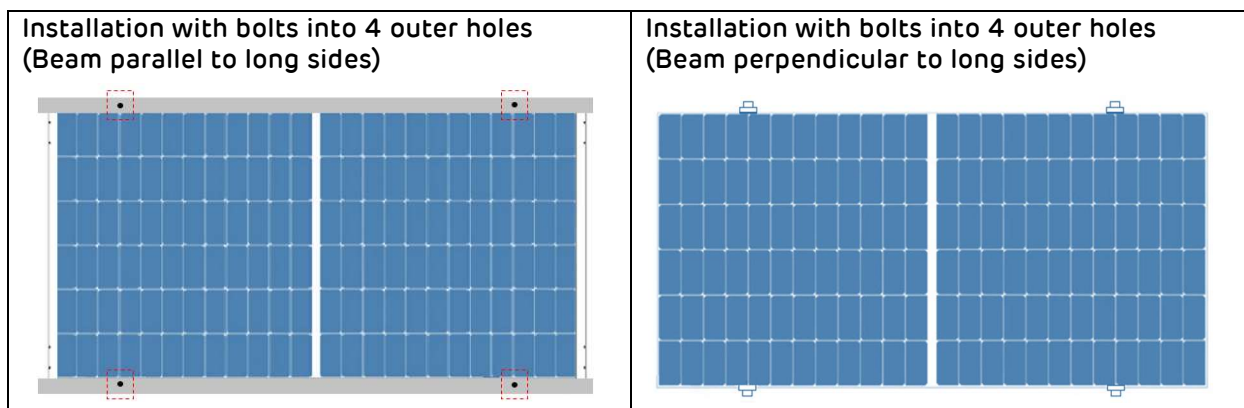
**Fig(a): Framed PV Module**



**Fig(b) Clamp installation for frameless Modules**

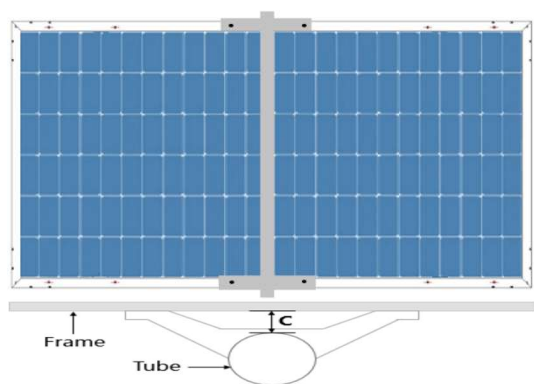
**Fig 7: Clamp Installation of Bifacial Module**

### C) Installation and Mechanical Load of Bifacial Module

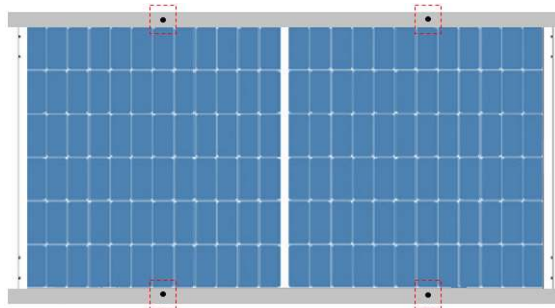




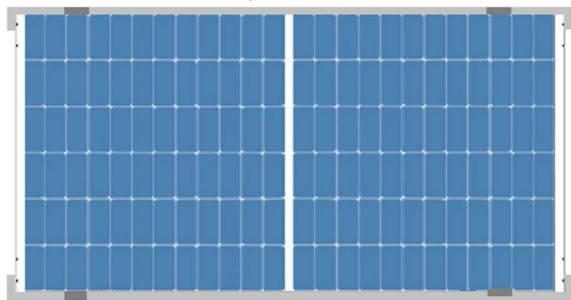
**Installation with bolts into 400mm-span holes  
(distance between frame and tube  $C \geq 55\text{mm}$ )**



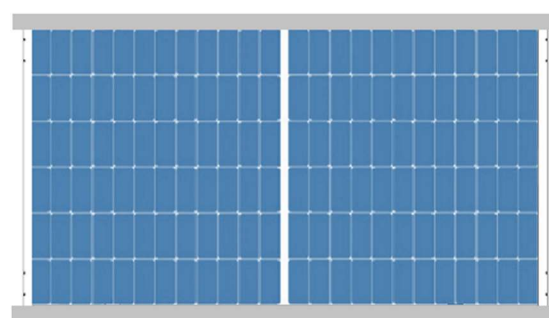
**Installation with bolts into 4 inner holes  
(Beam parallel to long sides)**



**Installation of framed modules with fixtures  
on long side (beam parallel to long side)**



**Installation of frameless modules with fixtures  
on long sides**



*\*Note: For mounting hole/structure Please refer the desired PV module datasheet. The Proposed Clamping Mechanism for Bifacial and Monofacial modules is not part of the IEC 61215:2021 Ed. testing. However, Customer can select the type of mounting system based on the system design requirements and in consent with Adani.*

## 6.4 Electrical Wiring

All wiring should be performed by well-trained installers as per the local codes and regulations.

- It is recommended to connect only that number of modules in series only such that the system voltage should not exceed the rated value at any time of the year. The EPC to choose the appropriate design based on the Inverter MPPT ratings and operating voltage conditions and the environmental conditions considering the lowest temperature at the site.
- To increase the operating voltage, PV module have to connect in series and for connecting modules in series positive connector of one module is connected to the negative terminal of another module. During series connections, please ensure the sound of click should come. Click sound shows the proper connectivity between the two terminals.
- If any module/array/string is connected in reverse polarity, in that case product can be damaged permanently and repair is not possible and Warranty will not render to those modules. Before making parallel connection always verify voltage level and polarity of the string. If during measurement any reverse polarity or a voltage difference of 10V found between the strings, then check the strings circuit or string configuration before making connection. All the wiring should be performed by well trained and qualified technicians only.
- It is highly recommended and advised for the EPC to use Blocking diodes of appropriate specifications in String Combiner boxes to prevent any reverse current arising out of parallel strings due to voltage mismatch across strings in Grid Scale utility power plants or from Storage devices if used with Storage solutions.
- Cables should always be fastened on module frames or mounting rails, in order to avoid shading on module rear side.

## 6.5 PV Module Grounding



- ADANI Solar modules contains copper cables with 4mm<sup>2</sup> cross-sectional area with voltage rating 1500 (IEC) and 1500 V (UL) for maximum system voltage, 90° C and are also UV Resistant. Do not expose cable in water logged place.
- Max. system voltage should be less than the rated system voltage of 1500V or the maximum input voltage of the inverter.  $V_{oc} \propto (1/T)$  so the open Circuit Voltage require to calculated at the lowest Ambient temperature for the location Power generation unit.

For this below formula can be used: -

### Max. System voltage =

$X \cdot V_{oc} \cdot [1 + TC_{voc} \cdot (T_{min} - 25)]$  Where;

X - No: modules which are connected in series.

V<sub>oc</sub> - Open circuit voltage of each module (Refer to the Data Sheet)

T<sub>α-voc</sub> - Thermal coefficient of open circuit voltage for the module in Percentage

T<sub>min</sub> - Minimum ambient temperature of the location of the plant.

- In field application it is recommended to use 4mm<sup>2</sup> cables insulated for minimum of 90°C and designated as PV wire.

Please refer below figure



*\*Please refer the Appendix 2 for connector specifications.*

- As per National Electrical code (NEC Guidelines) all the PV Module (modules under UL spec) frames and mounting structures must be properly grounded for Safety of people on the site. The module frame must be properly grounded (refer to NEC clause 250).
- Appropriate grounding is done by bonding the module frames and all the metallic structure together with the help of a grounding conductor made of copper, copper alloy or other material as per the

electrical conductor perspective of respective national standards. The grounding connector should be connected to earth with the help of earth ground electrode.

- In case of metallic support, the surface of the frame must be electroplated.
- First, carefully strip 16mm of the insulating jacket from the end of grounding wire to avoid nicking or cutting conductors, insert the wire into the slot of the lug (see picture), and screw down the slotted screw.
- To fulfil the grounding & bonding requirements, please refer to the regional and national safety and electrical standards. Always use recommended type of connectors or similar for grounding.
- A module with exposed conductive parts is considered to be in compliance with UL 61730 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.
- If grounding is required, the grounding wire must be properly fastened to the module frame to ensure.
- Screw must be tightening with torque of 2.3 to 2.8 Nm [20 and 25 in. - lbs.]. The head of the screw must be flushed with the base and base must be flush with the frame.
- Appropriate grounding is done by bonding the module frames and all the metallic structure together with the help of a grounding conductor made of copper, copper alloy or other material as per the electrical conductor perspective of National Electrical Codes. The grounding connector should be connected to earth with the help of earth ground electrode.
- ADANI solar modules can be installed by using any third party listed grounding devices to connecting grounding terminals. As per instruction manual of grounding device manufacturer, the grounding device should be installed. It is recommended to ground every module at the provided grounding holes (4 mm or 5/32-inch diameter) marked with ground symbol.
- For grounding hole location and its size please refer to the product catalogue.
- Adani recommends following grounding procedures for the proper groundings.





- A module with exposed conductive parts is considered to be in compliance with UL 61730 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.

#### Procedure 1:- Grounding by bolts: 2058729-1



**1) Wire bolt and slot 2) Mounting wash hex nut 3) Aluminium frame 4) 4 to 16mm2 cable 5) HEX nut**

- Tyco made grounding hardware comes with grounding bolt, mounting and grounding hex nut inside the package.
- Electrical contact developed by penetration of anodized coating of the aluminum frame and tightening the mounting.
- Grounding wire dimension should be considered of 6 to 12 AWG solid bar copper and installed under the wire binding bolt.
- Tightening of wire binding bolt must be done at proper torque level 45 in lb.

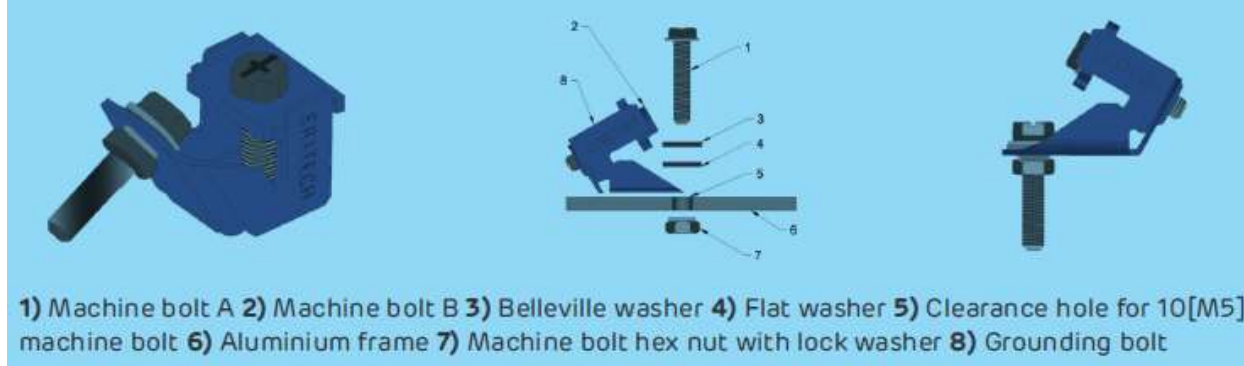
#### Procedure 2:- Grounding by bolts: # 2058729-1



**1) Wire slot (available for 4-6 mm2 cable) 2) Slider 3) Bolt 4) Base 5) Nut**

- Tyco made grounding hardware comes with grounding bolt, mounting and grounding hex nut inside the package.
- Electrical contact developed by penetration of anodized coating of the aluminum frame and tightening the mounting hex nut by applying proper torque of 25 in lb. Hex nut comes with a star washer.
- Grounding wire dimension should be considered of 6 to 12 AWG solid bar copper and installed under the wire binding bolt.
- Tightening of wire binding bolt must be done at proper torque level 45 in lb.
- Tyco grounding bolt is only recommended to use with 6 to 12 AWG solid copper wire.

**Procedure 3: ERICO grounding bolt EL6CS14-6**



It is recommended that lug should be installed on a surface that is larger than the bottom surface of the lug.

- Lug should be fixed on the grounding hole present on the PV module.
- To secure grounding bolt to the module frame machine bolt A should be torqued to 35 in lb,
- Grounding bolt can be used with only 6-12 AWG bare copper wire.
- Machine bolt must be torqued up to 35 in lb for the proper wire binding.

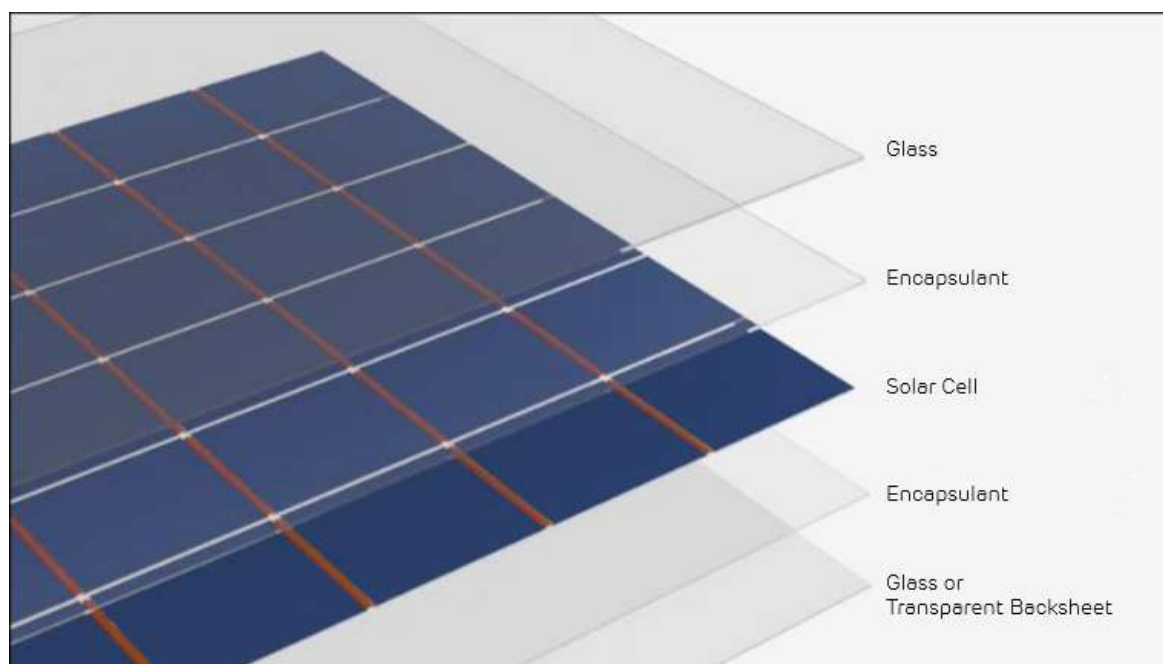
"Where common grounding hardware (nuts, bolts, star washers, split-ring lock washers, flat washers and the like) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions."

"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."

**Note:** A stainless steel star washer is used between the ground wire and module frame. This washer is used to avoid corrosion due to dissimilar metals. Tighten the screw securely.

## 7. ELECTRICAL CONFIGURATION

- A solar array generates DC electricity when sunlight falls on the modules and the inverter is in active mode. Once the minimum voltage and current requirements are met, this is converted into AC power accordingly.
- Adani ASM & ASB series modules are made of high efficiency solar cells. Cell circuit is laminated with superstrate, encapsulant and substrate to provide electrical insulation and environmental protection. In bifacial modules superstrate are fully/semi tempered glass and substrate are transparent backsheet/tempered glass. In Monofacial modules superstrate are fully tempered glass and substrate are white backsheet. The laminates are supported with aluminum frame and on backside IP68 rated junction box made of plastic material which is resistant to high temperature contains connection terminals and bypass diodes.
- The module electrical rating are measured under Standard Test Conditions, which are 1000W/m<sup>2</sup> , irradiance with AM 1.5 spectrum and 25 deg ambient temperature. The module might produce more or less voltage or current than rated value in uncertainty condition.



Products are made as per the standards of IEC 61215/IEC 61730-i&II/IS 14286 and product has passed from TUV Rheinland/UL Laboratory for the aforementioned tests. This product can be used in Grid Connected Utility & standalone system in houses, rooftop, PV stations, Communication stations, Petrol, Ocean, metrological, traffic and solar building etc. ASM-M10-AAA Monofacial & ASB-M10-AAA Bifacial series modules with the maximum power range as per IEC 61215-2 with tolerance. So the EPC / Customer is advised to not to mismatch any modules & strings with different currents and different voltages which can lead to adverse effects of performance generation of the entire PV Power Plant.

**CAUTION:**



The modules are rated to operate at potentially dangerous voltage level of just under 1500V; coming in contact of this high voltage may cause electrical hazards, Arcing and Fire hazards. It is recommending that all the solar Module, Module array and the DC combiner box should be handled by only trained person. Adani is not responsible for any hazards on the site and to the trained manpower in event of any safety hazard or causality. While disconnecting the array from the circuit, use rated Isolator or DC switch. DC power after disconnection may be active for some time and hence it is recommended only trained person should operate or handle upon Panels, string Combiner Box etc. ADANI solar is not responsible for any type of accident occurring in Power plant using ADANI panels.

There is always a risk of Lightening to PV Power plants and PV modules and Adani Solar requests the EPC Installer and the customer to analyses the risk of lightening as per IEC 62305-2 or NEC code/UL61730 and install lightening arrestors and SPD's such that no part of PV system and PV Module is affected by Lightening or any other high voltage surges. To ensure effective protection for entire power plant along with PV modules, a lightning protection system with optimally coordinated elements with air termination system, earth-termination system, lightning equipotential bonding, surge protective devices for any DC input/output devices as per IEC 61643-11 NEC code/UL61730. Consistent lightning and surge protection for all systems allows to considerably increasing the performance ratio of Solar PV power plants.

## 7.1. Fuse Selection

Connect Fuse in non-grounded pole of solar array. Maximum fuse rating connected in series 25A/30A. Actual fuse rating is mentioned in PV module specification sheet and on the PV Module's back label. Fuse rating value also indicate the maximum current reverse current that can flow from the module. i.e. when one string is in shade then the other parallel strings of modules will be loaded by the shaded string and the current will pass through to create a current circuit. Based on the maximum series fuse rating of module and local electrical codes and standards, make sure the modules strings in parallel are protected with the appropriate in-line string fusing.



## 7.2 Selection of Inverter and compatibility

Only connect the quantity of modules that corresponds to the voltage specifications of the inverters used in the system. When installed as per the IEC/UL standards and regulations, can operate with either galvanic alloy isolated (with transformer) or transformer less inverters.

PV Modules installed under high humidity, high temperature and high voltage conditions may appear Potential induced degradation (PID). To reduce the risk of PID, on the modules DC connection site, it is mandatory to do the following

- To connect the negative to ground in Case of P-type module.
- To connect the positive ground in case of N-type module.

**(Or)**

Any other mechanism to mitigate PID at system levels as advised by inverter manufacturer

*Note: Grounding method guidance from the inverter manufactures are usually needed.*

## 8. PERIODIC MAINTENANCE AND CARE

### 8.1 Maintenance and Inspection

For better performance and reliability of the system, the following maintenance is required in well-designed PV plants.

- It is recommended to do yearly plant maintenance by trained professionals. Complete everyday tracking of PV Module's performance through SCADA or through string performance should be noted and tracked and analyzed and in case of any discrepancy from normal behavior, it should be immediately notified to Adani Solar.
- Check the mounting structure status and ensure any all the modules should be tightly fitted on the structure and should be as per the mounting instruction provided above.
- Check for any shading on PV module, area of module on which light is falling should not be shaded by any trees, objects and leaves. All these obstructing objects should be removed immediately.
- Ensure all cable assemblies are tightly fitted and no part of the cable is immersed or exposed to water logging.
- Check if any crack or gap of silicone nearby the junction box.
- Check whether there are traces of burning mark on the module back sheet.
- Check all the strings fuses of each non earthed pole are working properly and in operation.

## 8.2 Cleaning

- To clean the module always use soft module cleaning kit or do cleaning with soft cloth and slight detergent as an alternate solution.
- Cleaning can be performed by Wet Cleaning, Soft Cleaning, Compressed Air cleaning, rotating brush, Dry Brush cleaning.
- Cleaning should be performed in a way that no stress on PV modules is caused and no cracks on solar cells to be caused out of cleaning.
- Water used for cleaning should be of same temperature as of module, and water should be regularly Checked for the TDS, it is immediately recommended to install RO at the site if the TDS of the water is deviating from appropriate standards and acceptable limit of less than 500mg/l. Water used for cleaning should be of the same temperature as of the module and if not used, temperature difference can create thermal shocks by which PV module can be damaged and will not be a part of the Warranty. During cleaning, always ensure at all condition module should not be damaged from micro crack and other type of defects. Climbing of personal on the PV modules is strictly prohibited as it can cause irreversible damage to the solar cells of the PV modules. The PV Modules are advised to be cleaned regularly ensuring dust/dirt free and devoid of any bird droppings. Failing to clean the same can cause damage to the solar cells of the PV modules.
- For maximum power output and generation and best reliability, it is recommended to keep modules clean and tidy.
- It is recommended that you clean the modules in (the morning or evening) when the temperature remains between 10°C~30°C please do not contact with any conductive part or clean any damaged modules; otherwise, electrical shocks may happen.

**Note: For cleaning module better and safely ref: MSEL/MSPVL document**

## 9. PRODUCT RECYCLING & END OF LIFE

Product should be recycled in useful renewable method after end of its life cycle. Please contact Adani Solar after the end of product life cycle for recycling procedure. Module disposal will be under the customer scope and Module should be disposed as per applicable law

## 10. WARNING

While performing any type of electrical maintenance, all the system should be isolated / shutdown and maintenance should be performed by well trained professionals only. Any failure to follow instruction may results in lethal electric shocks, burns, other injuries and some time may death also. ADANI solar is not responsible for any type of accident occurring in Power plant using ADANI panels.

## 11. CONTACT DETAILS

PV modules do not contain any serviceable parts. If customer has any doubts that installation is not working properly, please contact your installer / EPC / O&M. Immediately and at the same time please leave a note to the Adani's Customer Service Team.

1. Contact ADANI Solar sales and service team at [cs@adani.com](mailto:cs@adani.com)
2. Email customer feedback at [cs@adani.com](mailto:cs@adani.com)

## Appendix 1 : Electrical Specifications

Module type	Pmax (W)	Vmp (V)	Imp (A)	Voc (V)	Isc (A)
ASM-M10-144-520	520	41.18	12.65	48.60	13.41
ASM-M10-144-525	525	41.34	12.72	48.78	13.55
ASM-M10-144-530	530	41.49	12.79	48.95	13.55
ASM-M10-144-535	535	41.64	12.86	49.32	13.63
ASM-M10-144-540	540	41.80	12.93	49.32	13.71
ASB-M10-144-520	520	41.18	12.65	48.60	13.41
ASB-M10-144-525	525	41.34	12.72	48.78	13.55
ASB-M10-144-530	530	41.49	12.79	48.95	13.55
ASB-M10-144-535	535	41.64	12.86	49.32	13.63
ASB-M10-144-540	540	41.80	12.93	49.32	13.71

*Electrical specification in this manual is indicative only and subjected to change without notice*

## Appendix 2 : Connector Specifications

Manufacturer	Type/Model	Specification
QC Solar (Suzhou) Corporation	QC4.10-cd	Max. Voltage: 1500VDC Max. Current: 36/41/46A Max Temp: 100°C
Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.,	PV-JM608	Max. Voltage: 1500VDC Max. Current: 30 A Max Temp: 100°C

## Appendix 3 Mesures de sécurité

### 1.1 Consignes générales de sécurité

- Lors d'une exposition directe à la lumière du soleil, le module PV produit de l'électricité, ce qui peut entraîner un choc électrique ou lors de l'utilisation d'un module exposé à la lumière directe du soleil, il est conseillé d'utiliser des outils d'installation et, par précaution, de porter des gants pour se protéger des risques électriques. Il est également conseillé de se tenir à l'écart de tout contact métallique touchant le corps humain.
- Il est strictement interdit de se tenir debout sur le module car cela peut avoir un impact sur les performances du module. Pression inégale développée en se tenant dessus peut endommager la cellule solaire. Il ne s'applique pas aux réclamations de garantie s'il est découvert que quelqu'un s'est tenu debout sur des modules PV. La surface avant du module est en verre trempé ou semi-trempé et a un revêtement ARC, il a donc besoin d'un soin particulier lors de la manipulation. Si le verre se brise pour une raison quelconque, il est conseillé d'éviter tout contact humain. À condition ambiante humide tout contact humain avec la surface de verre brisée peut entraîner des décharges électriques. Une fois que le verre du module se brise, il doit être mis au rebut ou éliminé après l'avoir retiré de la chaîne une fois la chaîne déconnectée de la charge.
- Pour nettoyer les modules avec de l'eau, utilisez de l'eau dont la température est similaire à celle du module à nettoyer. Il est d'éviter tout choc thermique et tout dommage au module
- Ne pas endommager ou rayer les surfaces avant ou arrière du module
- Ne percez pas ou ne percez pas de trous dans le cadre, cela pourrait provoquer de la corrosion sur le cadre
- L'altitude maximale pour laquelle le module PV est conçu est  $\leq 2000$  m.
- L'irradiance maximale est de  $1300\text{W/m}^2$  pour le module avec arrière transparent.
- Toute connexion desserrée dans les connecteurs du module PV peut provoquer un arc électrique et entraîner un risque d'incendie. Il est recommandé de ne laisser aucun espace dans les connecteurs. Assurez-vous également que tous les connecteurs doivent être corrodés libre et protégé contre la corrosion et les salissures. Il est strictement interdit de retirer ou de couper tout connecteur du module PV pour faciliter l'installation par l'installateur / client et le module est considéré comme hors garantie.
- N'installez ni ne manipulez aucun module PV dans des conditions environnementales défavorables telles que des vents à fort débit, la pluie, la tempête et les surfaces de toit enneigées mouillées pour la sécurité personnelle. Assurez-vous que les modules doivent toujours être secs pendant l'installation.
- Veuillez vous assurer que la polarité des modules ou des chaînes n'est pas inversée par rapport aux autres modules la cellule

- Toute lumière solaire artificielle se concentrant sur le module PV n'est pas recommandée car elle peut réduire ses performances et cycle de vie.
- Les modules PV Adani sont certifiés pour fonctionner dans des conditions de classe A installés en dessous du niveau de tension 1500 Vdc. Tenez compte de cette plage de tension lors de la conception de la centrale électrique. Cette valeur doit être prise en considération lors de la conception de la centrale, de même que les plages de température présentes sur le site.
- Dans différentes conditions environnementales, le module PV peut produire un courant et une tension élevés par rapport au mesuré en condition STC. La neige et l'eau provoquent la réflexion de la lumière du soleil, ce qui peut augmenter le flux de courant et puissance de sortie. La valeur de Isc et Voc marquée sur le module doit être multipliée par 1,25 lors de la détermination des tensions nominales des composants du système PV, des courants nominaux des conducteurs, des tailles de fusibles et de la taille de commandes connectées à la sortie PV.
- La valeur nominale maximale d'un fusible connecté en série avec une chaîne de matrice généralement 25/30 A le module réel note spécifique peut être trouvé sur l'étiquette du produit et dans la fiche technique du produit. Préférez l'article 690, Solaire Systèmes électriques du code électrique national (module sous portée UL) pour l'installation.

## 1.2 La sécurité incendie

- Les modules sont qualifiés pour la classe d'application A : tension dangereuse (IEC61730 : supérieure à 50 V CC ; EN 61730 : supérieur à 120 V), applications électriques dangereuses (supérieures à 240 W) où le contact général l'accès est prévu. Modules qualifiés pour la classe de sécurité incendie C et la sécurité selon EN IEC 61730 -1 et Les normes IEC 61730 - 2 de cette classe d'application sont considérées comme conformes aux exigences de la classe de sécurité II.
- Consultez vos autorités locales pour obtenir des conseils et des exigences pour l'installation ou la sécurité incendie du bâtiment.
- La structure supérieure et l'installation peuvent affecter la sécurité incendie du bâtiment ; une installation incorrecte peut entraîner risques d'incendie.
- Comme l'exigent les autorités locales, utilisez des dispositifs tels que des disjoncteurs de fuite à la terre et des fusibles.
- Veuillez ne pas utiliser le panneau dans un environnement vulnérable aux gaz combustibles ou à proximité de équipement.
- Interdiction d'utiliser des extincteurs à eau sur module PV chargé ou feu d'origine électrique.