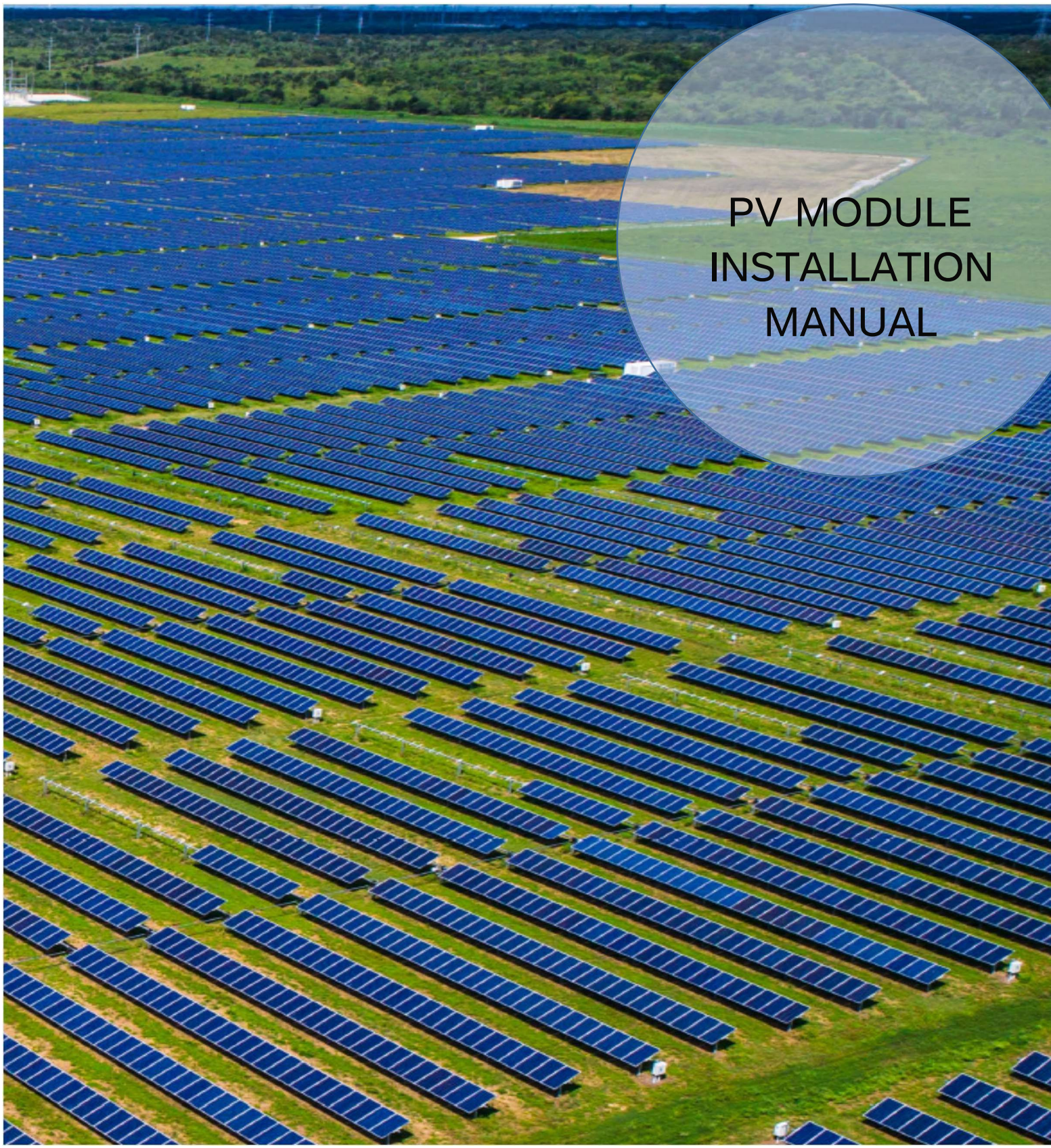


PV MODULE INSTALLATION MANUAL

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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 / Adani New Industries Limited (ANIL). MSPVL/ ANIL / MSEL is referred as Adani / Adani Solar in the Installation Manual. MSPVL / MSEL / ANIL 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 fails to install modules as per requirements that are stipulated in this manual, the limited warranty provided for customer will be invalid. Adani has rights to amend this manual and PV module specifications and it can be changed by Adani without giving any prior information.

2. SAFETY MEASURES

2.1 General Safety Instruction

- On direct exposure to Sunlight, PV module produces electricity, which can result in electric shock so while working with module exposed under direct Sunlight, it is advised to use installation tools and for precaution wear hand gloves to get protected 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 cells. PV Modules warranty claims will not be acceptable, if it is discovered that anyone has 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 human contact with the broken glass surface of a PV modules may lead to electrical shocks. Once a broken glass of solar module is identified in any live string, on the immediate effect the string must be electrically isolated. After ensuring the string is electrically isolated, the broken module should be covered with a dry cloth, cardboard, or any opaque material and then should be removed from its mounting structure. Further, the broken module can be considered for it's disposal as per local jurisdiction.
- It is advisable to keep the difference in the water temperature and module temperature not more that 15ºC, which is to be used for cleaning of modules. It is to avoid any thermal shock & damage to the module.
- Do not damage or scratch the front or back sheet/Glass surfaces of the module.
- Do not punch or drill holes in the frame, it may cause corrosion to the frame.
- Do not drill holes on the frame of module, as it may reduce frame loading capacity, impact frame coating and lead corrosion. This action will invalidate the limited product and performance warranty provided to customers.
- The maximum altitude the PV module is designed for ≤ 2000m above Sea Level.
- Any loose connection in connectors of PV module can cause electrical arcing and can further lead to fire hazard and can damage peripheral equipment's connected with the modules. It is recommended to use same make of connectors with cable what have been used with PV modules Junction Box connectors. It is to ensure proper connectivity of PV modules with module string cables. Do not insert other metal objects into the connector or make electrical connections in any other way.
- Also to ensure that all the connections should be corrosion free and protected against corrosion and soiling. It is strictly prohibited to remove or cut any of the connectors of PV Module for any reason and if done so, the module will be deemed out of warranty.
- The connector needs to be protected or added with the dust plug when installing the module in the Coastal area. Other anti-rust measures are also necessary to prevent the relevant components from rusting (Buyer must contact the technical team of Adani Solar to confirm the specific protective measures requirements according to installation or storage site).
- The modules must be connected immediately after removing the dust plug. And also the sealing cap must be used for disconnected connector to avoid ingress of insects or lipid foreign body, dust & water. Please ensure the cavity of connectors are cleaned before connecting.
- While working with PV modules on rainy days, take suitable protective measures to prevent moisture from entering the connectors.
- Do not install or handle any PV modules in unfavorable environmental conditions like high flow winds, rain, storm, and wet snowy roof surfaces for personal safety. Ensure that the module and its mounting structure are always dry while installing.

- Please ensure the polarity of the modules or strings are not reversed with respect 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 II 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 at STC. Snow and water cause 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 is typically 30A to 35A. The actual maximum rating of the fuse specific to the PV modules model, can be found on the product label and in the product data sheet. Prefer Article 690, Solar Electric Systems of National Electric Code (module under UL scope) for installation.

- Do not dispose PV modules and its peripheral components as unsorted municipal waste and dispose as per local regulation and guideline. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being. When replacing old or end of life PV modules with new ones, the retailer is legally obligated to take back your old PV modules for disposals. To maintain the electrical safety performance of PV modules, it is essential to avoid exposing them to substances such as grease, organic ester compounds (e.g., DOP and plasticizers), aromatics, phenols, ketones, halogenated compounds, mineral oil, alkanes (e.g., gasoline and cleaning lubricants), alcohol, adhesive sheets that can generate oxime gas, potting glue (only for connectors), TBP (plasticizer), and detergents.

- Under no circumstances, the attempt to disassemble or relocate any component of the PV module should be made. If the connector of the PV module becomes wet, refrain from taking any action to prevent the risk of electric shock.

- When deploying photovoltaic modules in desert, windy, sandy areas, or for long-term transportation and storage, it is advisable to use connector dust caps before installation. Alternatively, take other precautions to prevent sand and dust from entering the connectors. Failure to do so may lead to insertion issues or compromise electrical safety.

2.2 Fire Safety

- Modules are classified as protection against electric shock with Class II and Fire safety

Class C.

- 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.
- In order to prevent the risk of fire, don't install PV modules near inflammable liquids/gases, or locations with hazardous materials.
- In case of fire, it is strictly prohibited to use water as a fire extinguisher on PV modules or any peripheral electrically charged equipment. In case of electrical fire, it is recommended to use Class C extinguishing agents – CO_2 or dry chemicals, /or as directed by NFPA (for USA), NSCI (India) or equivalent competent organization as per location of installation.

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 modules serial number and other details are present on the box of the PV modules.
- Do not stack packing boxes (pallets) more than1 boxes high (i.e. double stacking). If pallets are temporarily stored outside, all weatherproof protective cover should be placed over the pallets or pallets stacks.
- Storage and preservation area must be free from rain, dust, rodent, or any other factor that may damage or deteriorate the quality of packaging materials and its longevity. Unloading, movement & stacking of pallets must be as per unloading instruction provided.
- During unpacking there should be two people to unpack from vertical side as shown in figure below.

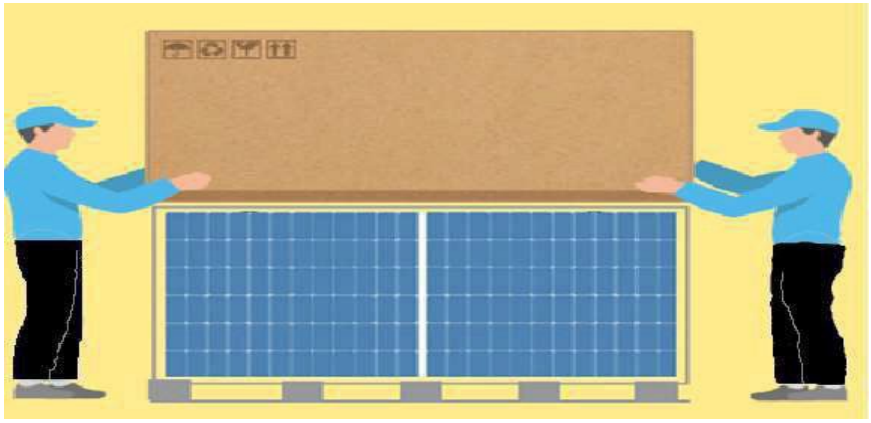


Fig1: Method of module unpacking

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.*

Important Instructions

- For unloading modules from vehicle (ref: MSEL/MSPVL/ANIL unloading procedure document)
- During transportation, please aim to minimize the shock and vibration to the modules. The shock and vibration may lead to micro cracks in solar cells of the modules.
- Recommendation for proper stuffing should be made like use of air bags to fill the empty space inside vehicle to restrict movement of pallets or pallets needs to be lashed properly with vehicle in addition to use of airbags.
- For side support which are needed for supporting the modules on one-side, before cutting the straps details can be found in the document. (Ref: MSEL/ANIL/MSPVL unpacking work instruction document).
- Improper handling of PV module may cause scratches and damage to the module. It is not

recommended to apply adhesives or paints on the surfaces 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 inside 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 models are tested as per IEC 61215, IEC 61730-I & II, IEC 61701, IEC 62716, IEC 62804, IEC 60068 standards. The modules are qualified for protection against electric shock with Class II, and safety qualification 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 testing of salt mist corrosion resistance as per 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

Maximum rated operating temperature Module [T98]max[ºC]	+70°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 times Mechanical load: 5400Pa front and 2400Pa back (As per section 6 of this installation manual)

Table 1. Environmental conditions

5. SITE SELECTION

- PV modules are intended for use in general open-air climates, as defined in IEC 60721-2-1: Classification of environmental conditions Part 2-1: Environmental conditions appearing in nature-Temperature and humidity.
- 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 needed 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 fireproof 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 for 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.
- At any condition PV module should not be installed by immersing the module or its connectors under water. Also don't place the connector directly on the surface of the roof. Instead secure the connector with under module with cable ties.
- 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

Table 2. Albedo

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/ANIL/MSPVL technical support department for more information on the use of modules in special climates, such as an altitude greater than 2000 m from above sea level. 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 advice the customer to choose the modules carefully considering the environmental conditions.
- Adani Modules design, safety factor is certified as IEC standards.
- Module installation in projects is recommended to 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 the 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 the Sun produces more power. When solar modules are installed on seasonal tilt structure, it is recommended to tilt the PV modules for optimum performance during different season throughout the year. Measurement of tilt angle done between the solar module and the ground.
- For fixed tilt standalone systems, the tilt angle of the modules should be selected to optimize the performance based on the season and sunlight. In general, if the module output is adequate when the irradiance is low (i.e., winter), the angle chosen should be adequate during the rest of the year.

  For fixed tilt grid-connected systems, modules should be tilted at the angle that the energy production from the modules will be maximized on an annual basis. The Fire Class Rating of a module for roof mounted system shall meet local code requirements in order to achieve the specified System Fire Class Rating for a standard PV-module.

- Adani recommends a minimum clearance between the modules and 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. For rooftop, gap between the roof shed and module should be at least 100mm for better ventilation and so more generation.

- PV modules should not be installed under shade or shadow under any condition 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.

- The maximum loads that different types of modules can withstand on the front side and back side are dependent on installation methods. If there is heavy snow and strong wind on the module installation site, take special protection to meet the actual requirements.

Note: Maximum Test Load = 1.5 (Safety factor) x Design load

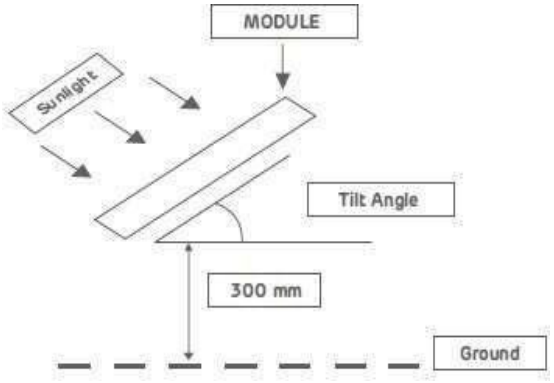


Fig2: Tilt angle of Module

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 should also be considered according to the local regulation's requirements.

b) Minimum distance between each PV module should be 10 mm.

c) Use durable, rust-proof and ultraviolet resistant materials to fabricate the modules support structure and use such support structures that are already tested, certified and

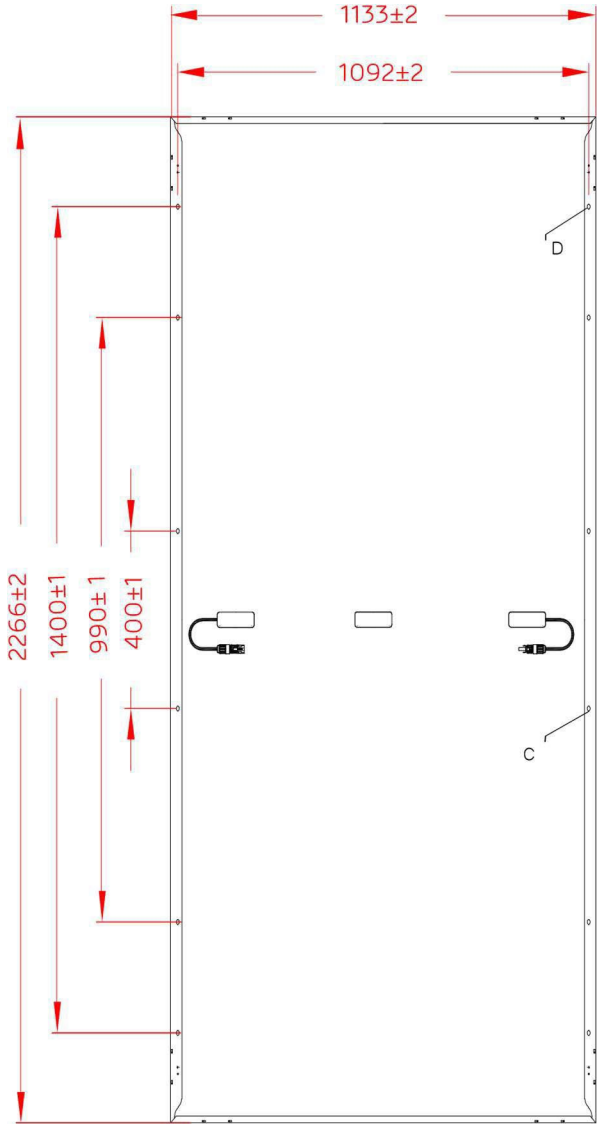
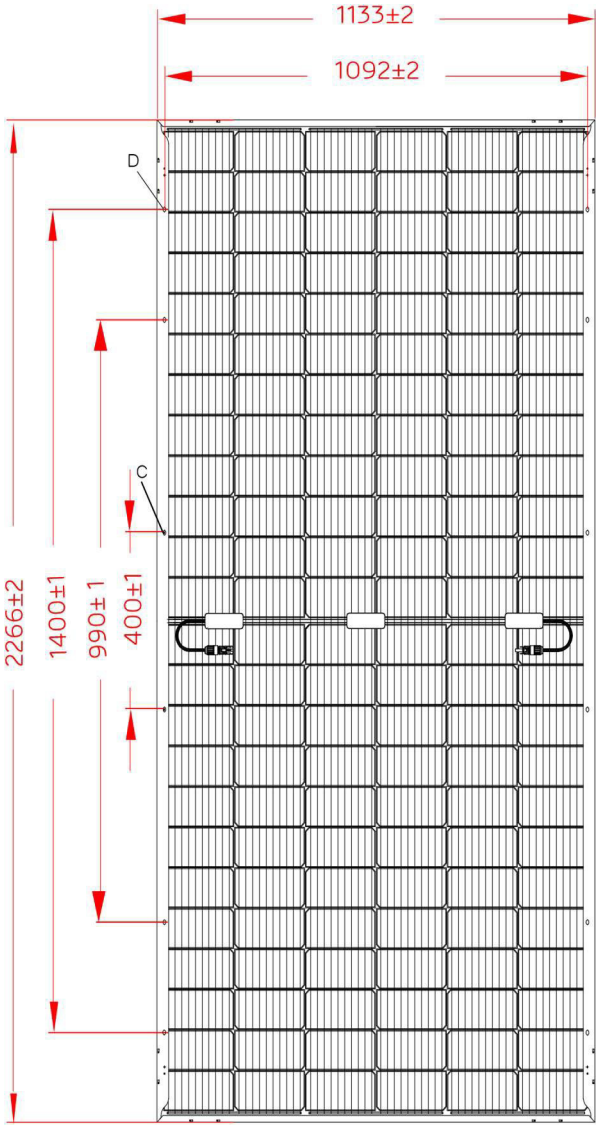
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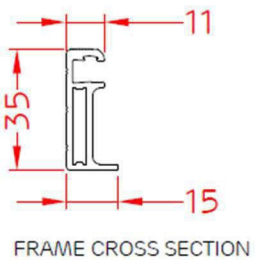
PV modules are not to be subjected to wind or snow load exceeding the maximums permissible loads and should not be subjected to excessive forces due to the thermal expansion of support structures, careful consideration has to be shown during system design and installation such that thermal expansion of support structures do not cause any breakage of PV modules which will not be part of Adani Solar warranty claim. 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.

Module Technology	Model type	Size	Generation
Adani Solar Bifacial Framed Module (Glass to Glass & Glass to Transparent back-sheet)	ASB-M10-144-XXX	2266mm X 1133mm X 35mm	Gen 1
	ASB-M10-144-XXX	2278mm X 1133mm X 30mm	Gen 2
	AB-G12R-132-XXX	2382mm X 1133mm X 30mm	Gen 3

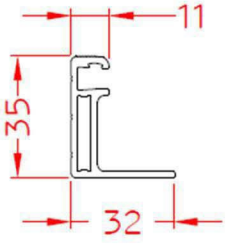
**Please refer the specific datasheet for Model details as well as electrical values.*

Table.3 Products description

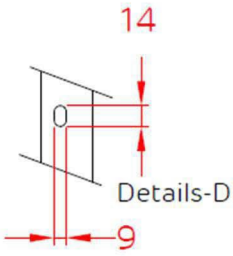
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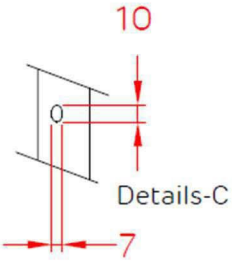


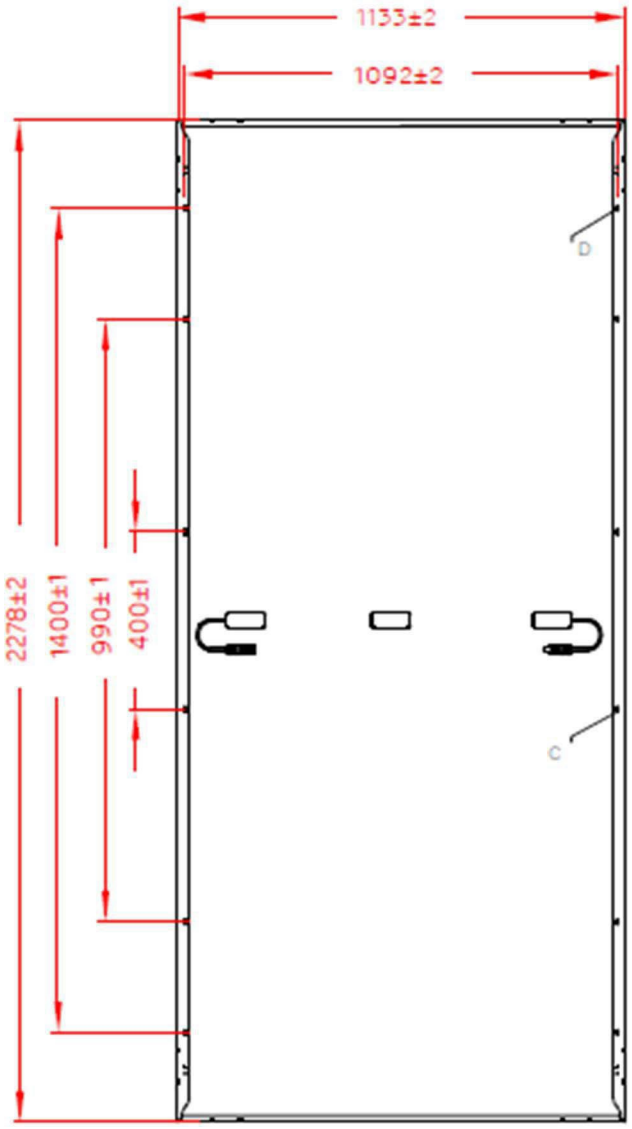
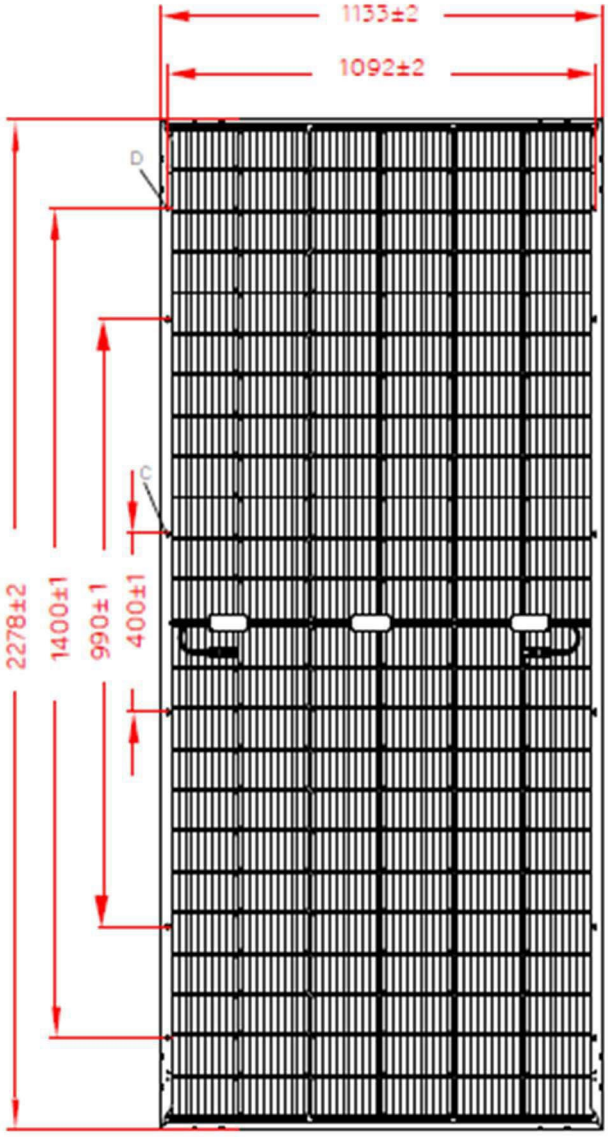
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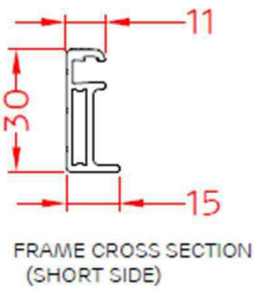


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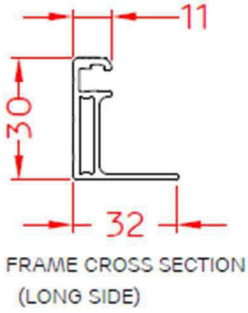




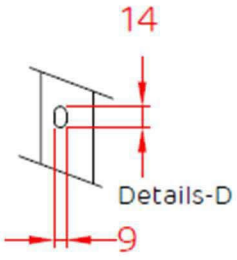
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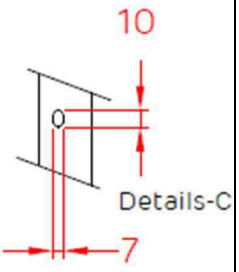


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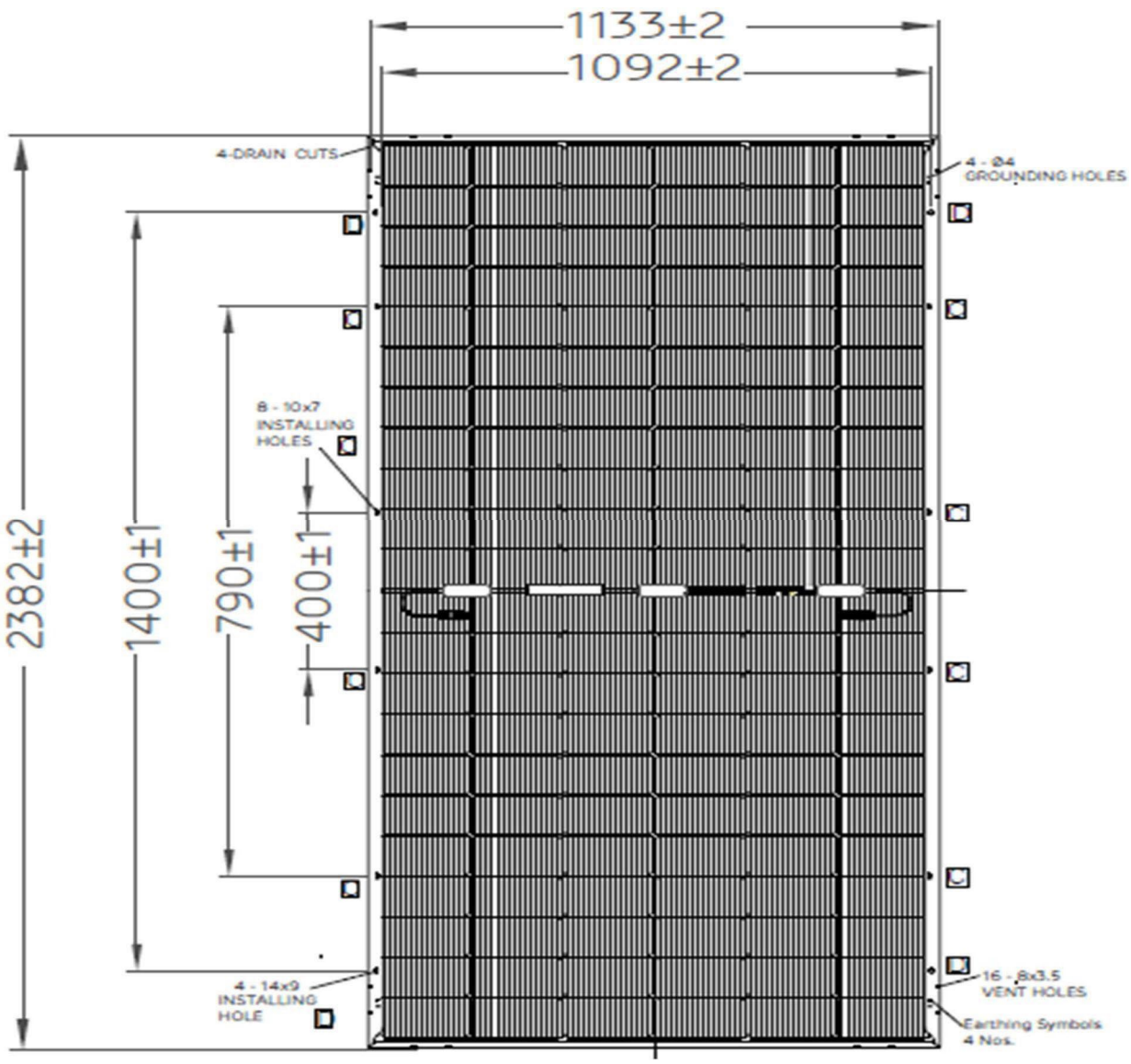


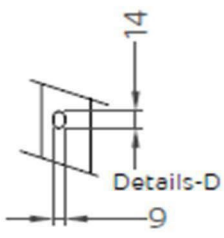
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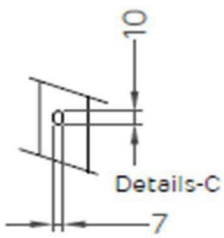


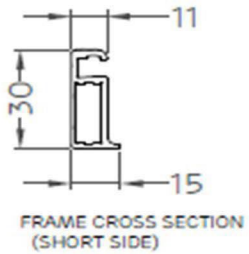


Mechanical Drawings of PV Module
AB-G12R-132- XXX

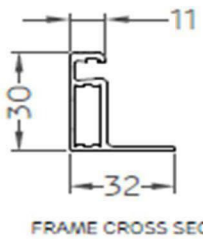






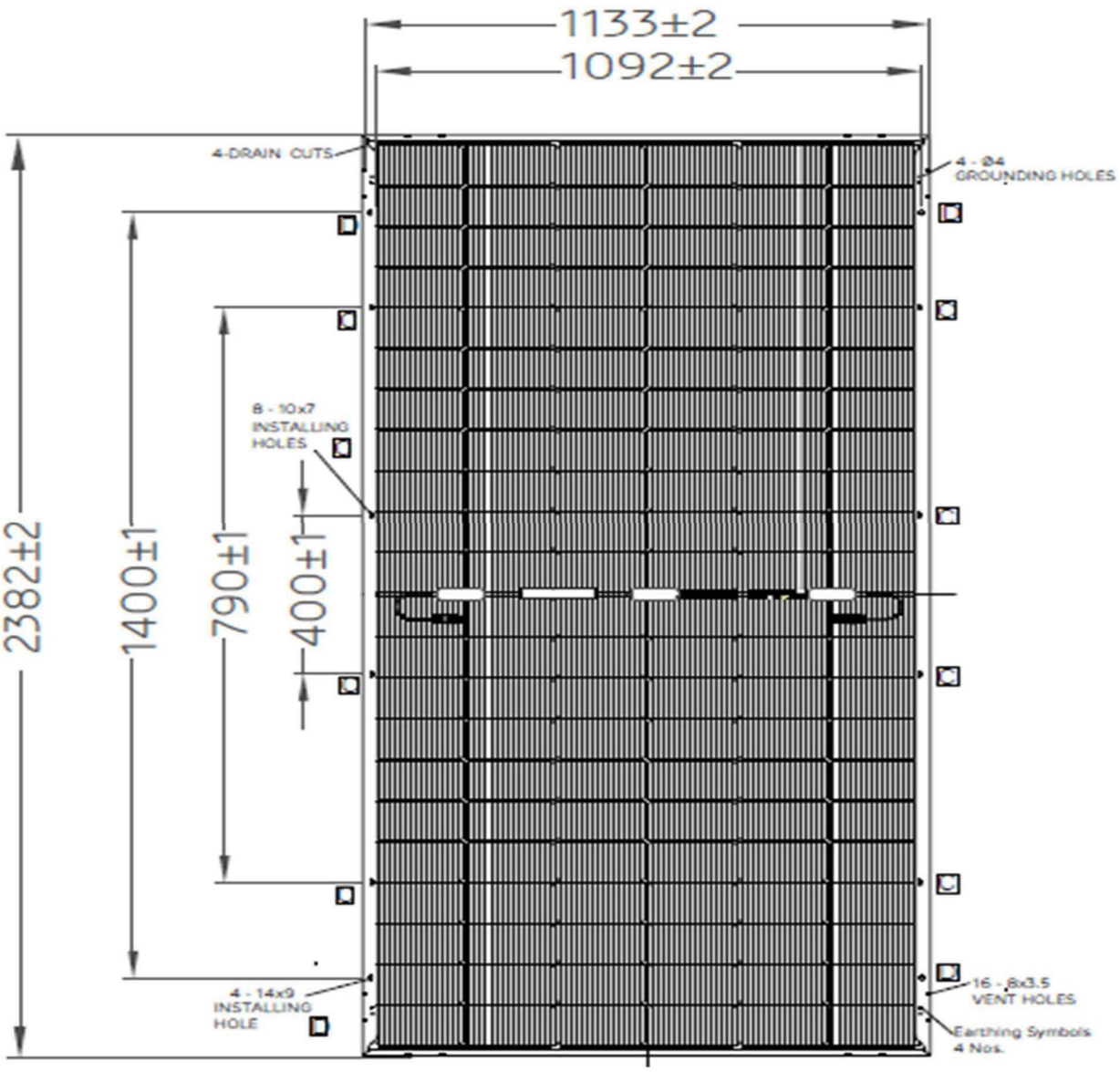


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Mechanical Drawings of PV Module (Low weight Frame)AB-G12R-132- XXX



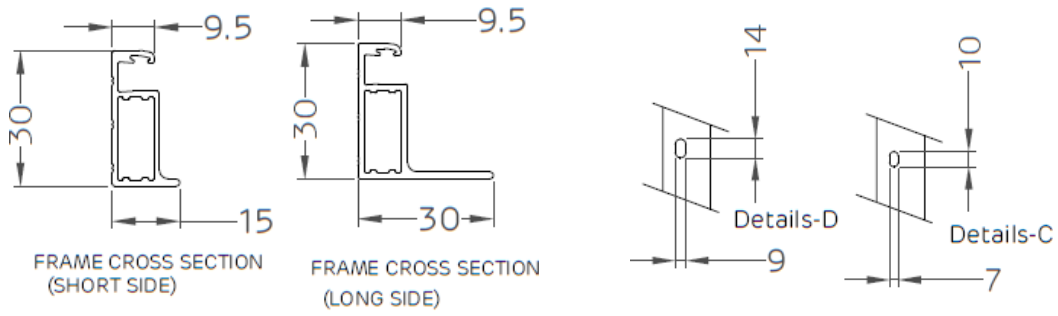


FIG 3. Solar PV Modules Mechanical Drawings

6.3.1 Monofacial & Bifacial Assembly Mechanical Installation

6.3.1.1 Bolts Mounting Monofacial & Bifacial Modules

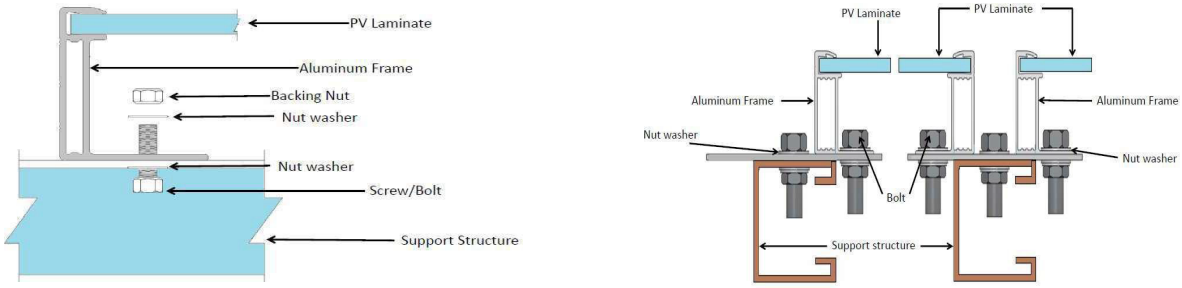


Fig 4. PV Modules installed with screw/bolt fitting method.

6.3.1.1.(A) Different methods of Bolt installation

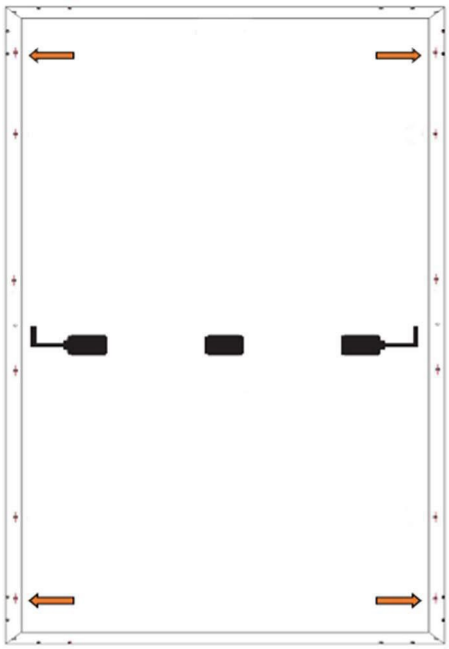
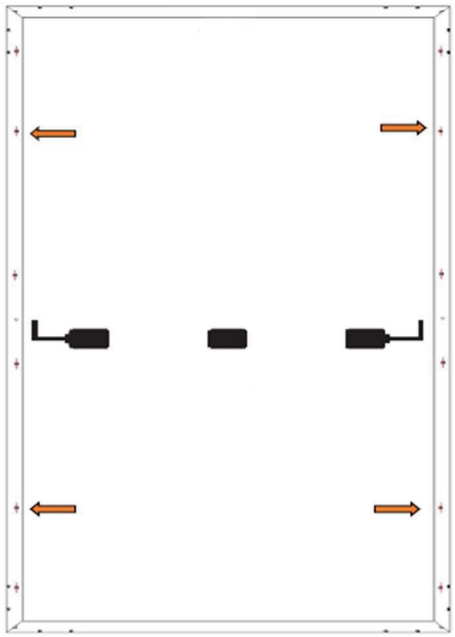
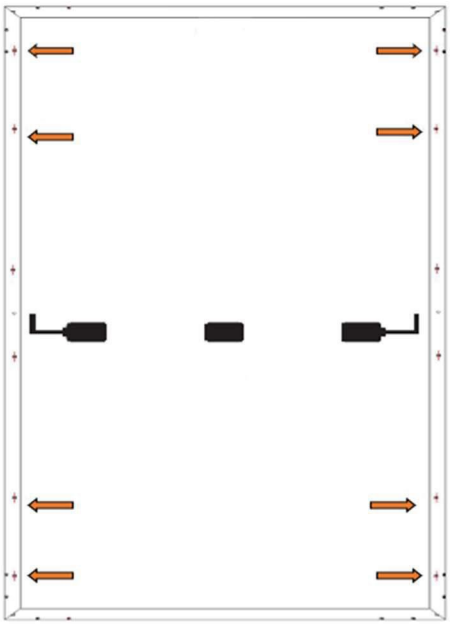
		
Installation with bolts into 4 outer holes (1400mm Pitch), Beam perpendicular to long sides	Installation with bolts into 4 Inner holes (990mm pitch). Beam perpendicular to long sides	Installation with bolts into 4 outer & 4 inner holes (1400mm & 990mm), Beam perpendicular to long sides

Fig 5: Different method Installed with screw/Bolt fitting method

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

Accessories	Mode	Material	Note
Bolt	M6	Q235B/SUS304	Accessories material selection should be based on application environment.
Washer	2*6		
Spring washer	6		
Nut	M6		

Table 4: Recommended accessories

Suggestion:

(1) M8 bolt tightening torque range: 16Nm to 20Nm.

(2) When using MSEL/ANIL/MSPVL 30mm or 35mm height frame module, it is recommended to select

≤ 20mm length fasteners.

(3) M6 bolt tightening torque range: 8 Nm to 12 Nm.

(4) When using MSEL/MSPVL/ANIL 30 mm or 35 mm frame height modules, it is recommended to select fasteners with a length ≤ 18 mm.

Note: The final torque value should be verified against the bolt grade, material (Q235B/SUS304), washer configuration, and mounting structure design requirements.

6.3.1.1.(B) Mechanical loads for different bolt installation

	Module Type	**Installation with 4 outer holes**	**Installation with 4 inner holes**	**Installation with 4 outer & 4 inner holes**
		Test Load Pascal		
ASB-M10-144-XXX	Gen – 1 Gen – 2	+ 2400 / -2400	+ 2400 / -2400	+ 5400 / - 2400
AB-G12R-132-XXX	Gen – 3	+ 2400 / -2400	+ 2400 / -2400	+ 5400 / - 2400

Table 5: Load values for different bolt installation

6.3.1.2 Clamp Type Fixing Monofacial & Bifacial 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 10 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 etc.) should be hot dip galvanized or made of stainless steel. Prevent the fixtures shading the modules front or rear side.

• The modules can be installed horizontally or 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 to 20 Nm be used to tighten the bolts.

• When fixtures are used for installation, use at least four fixtures 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.

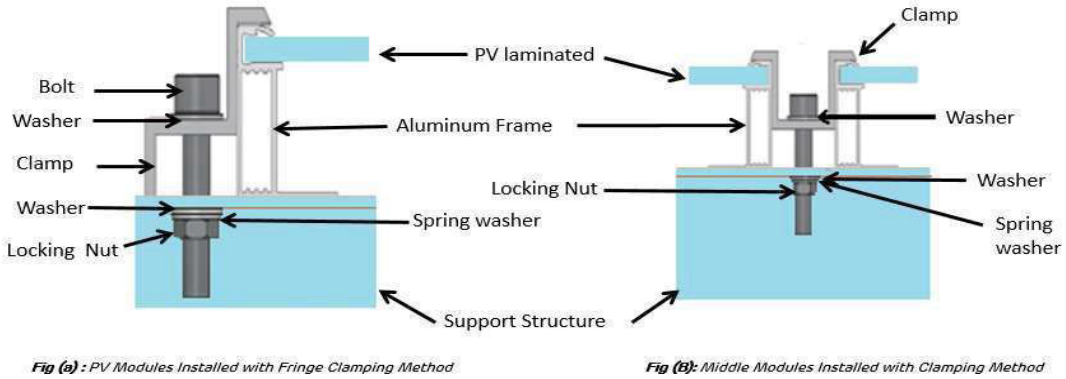
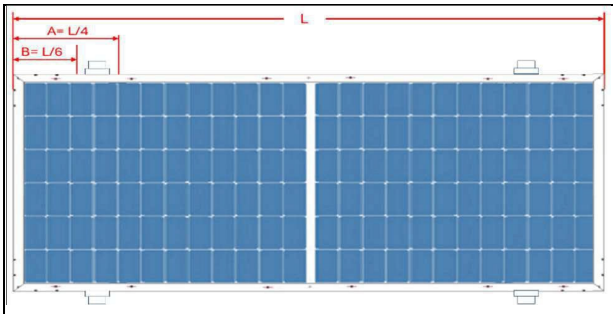


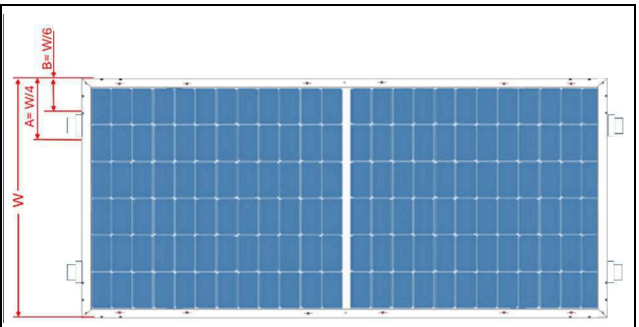
Fig (a) : PV Modules Installed with Fringe Clamping Method *Fig (b): Middle Modules Installed with Clamping Method*

Fig 6: PV Modules installed with clamp method

6.3.1.2.(A) Different methods of clamp installation



Installation with Clamps into 4 outer holes (1400mm pitch), Beams perpendicular to long sides



Installation with Clamps into 4 inner holes (990mm pitch), Beams perpendicular to short sides

**Note: For mounting hole/structure, please refer the desired PV module datasheet. The Proposed Clamping Mechanism for Bifacial and Monofacialmodules 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.*

Fig 7 Different methods of clamp installation

6.3.1.2.(B) Mechanical loads for different Clamp installation

Model Name	Installation with Clamps into 4 outer holes, Beams perpendicular to long sides	Installation with Clamps into 4 inner holes, Beams perpendicular to short sides
	Test Load Pascal	
ASB-M10-144- XXX	+ 2400 / -2400	+ 2400 / -2400
AB-G12R-132-XXX	+ 2400 / -2400	+ 2400 / -2400

Table 6: Load values for different clamp installation

6.4 Tracker Installations

Adani Solar modules also have high compatibility with various mainstream tracker systems in the industry. The maximum load that Adani modules can achieve, is as listed in Table 7. For detailed installation drawings, as well as other tracker systems that are not listed in the table, please contact Adani Solar customer service team. The compatibility with given test loads as mentioned in Table 7, can only be assured if the site conditions and installation is within maximum permissible limits as tested for the different Tracker models and installation done exactly the same way as done during the load approval testing. Consult Tracker manufacturers or Adani Solar for these details & approvals.

Module Type	Tracker System	Installation	Test Load (Pa)
ASB-M10-144-XXX AB-G12R-132-XXX	NEXTracker 1P	400mm rail mounting assembly	+2220/-2100
ASB-M10-144-XXX AB-G12R-132-XXX	Gamechanger	1400mm purlin rail assembly	+3300/-3800
ASB-M10-144-XXX AB-G12R-132-XXX	Array Technologies	400mm thru-bolt clamps 1400mm thru-bolt clamps	+1710/-1640 +3260/-3135
ASB-M10-144-XXX AB-G12R-132-XXX	Jash Energy	400mm thru-bolt	+1600/-1600

Table 7: Test load under different trackers installations

6.5 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, 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 modules have to be connected in series, and for connecting modules in series, positive connector of one module is connected to the negative connector of another module. During the series connections, ensure the sound of click. Click sound shows the proper connectivity between the two connectors.

- If any module/array/string is connected in reverse polarity, in that case product may get damaged beyond repair 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.
- 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.
- String cables should always be fastened either on module frames, mounting rails or by any other method, in order to avoid shading on module rear side.
- Adani Solar modules contain copper cables with $4mm^2$ cross-sectional area with voltage rating 1500V (IEC) and 1500 V (UL) for maximum system voltage, 90º C and are also UV resistant. Do not expose cable in waterlogged places.
- Maximum system voltage should be less than the rated system voltage or the maximum input voltage of the inverter, whichever is minimum. Voc (1/T) so the open circuit voltage is required to be calculated at the lowest ambient temperature for the power generation unit location.
  For this, below formula can be used: -
  Max. System voltage = X * Voc * [1 + TCvoc x (Tmin - 25)]
  Where;
  X - No: modules which are connected in series.
  Voc - Open circuit voltage of each module (Refer to the Data Sheet)
  TCvoc - Thermal coefficient of open circuit voltage for the module in percentage
  Tmin - Minimum ambient temperature of the location of the plant.
- In field application it is recommended to use $4mm^2$ cables insulated for minimum of 90ºC and designated as PV wire.
- In field application it is recommended to use $4mm^2$ cables insulated for minimum of 90ºC and designated as PV wire.
- It is recommended to use Connectors from same manufacturers for mating with each other. Please contact Adani solar if such a replacement is needed and for specific connector specifications. Also, please refer to the connector manufacturer's installation manual*.
  **Please refer the connector specifications.*
- Cables should be fixed to the mounting structure in such a way that mechanical damage of the cable and/or the modules is avoided. Do not apply stress to the cables. The minimum cables bending radius should not be less than 8 times of the cable diameter. Any cable damage caused by bending too much or cable management system is not covered under warranty. For fixing the connector, use appropriate means, such as sunlight resistant cable ties and/or wire management clips specifically designed to attach to the module frame. While the cables are sunlight resistant and waterproof, however if it is possible, then avoid direct sunlight exposure and water immersion of the cables. Cable arrangement must comply with local laws and regulations.

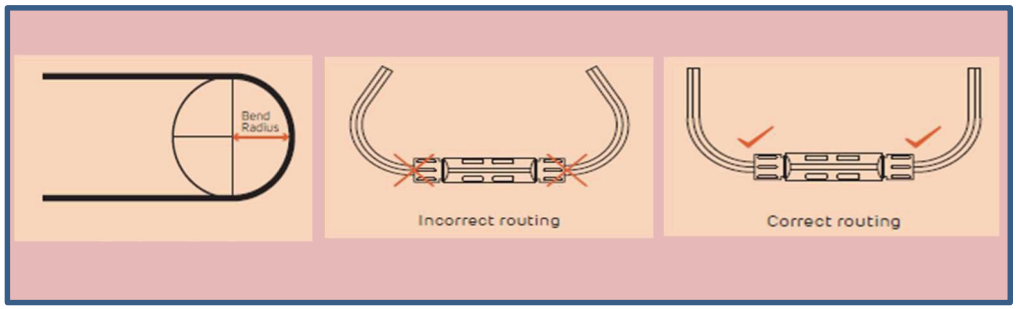


Fig 8 Cable arrangement

- Make sure that all connections are safe and properly mated. The PV connector needs to be free from any external stress. Connectors must only be used to connect the circuit only and should never be used to turn the circuit on and off.
- Do not pinch the positive connector wings.

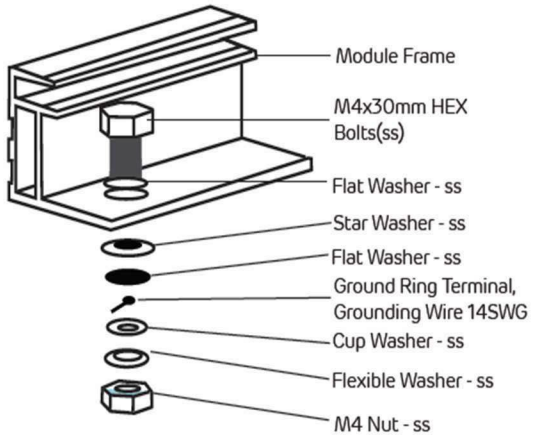


- Connectors are not waterproof when unmated, while installing the modules, connectors should be connected to each other as soon as possible or appropriate measures (like using connector endcaps) should be taken to avoid moisture and dust penetrating into the connector.
- The connectors in normal working conditions have passed tests for water drainage, dust prevention, and ultraviolet radiation. Moreover, it is recommended to avoid direct sunlight or rain exposure and stay away from areas prone to water accumulation.

6.6 PV Module Grounding



- 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 at 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 prospective 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.
- 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.



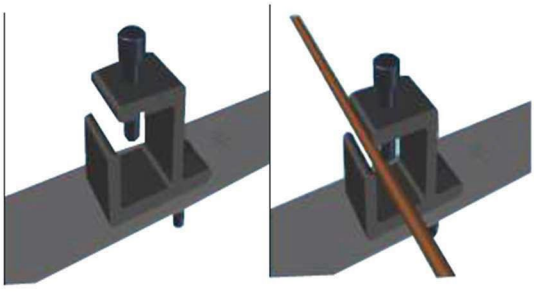
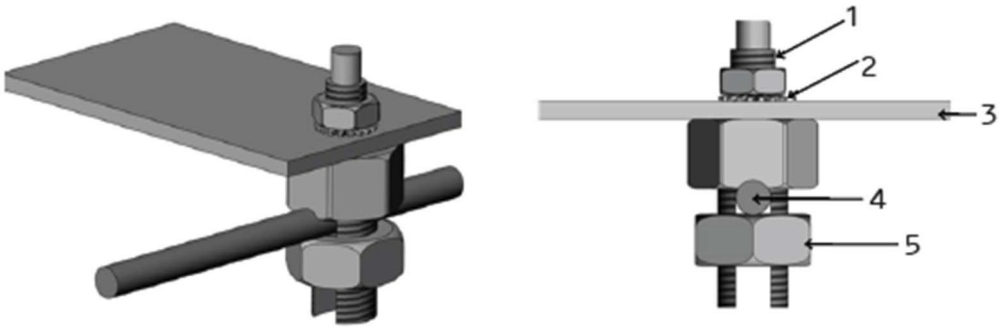


Fig. Grounding assembly of PV module

- 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.

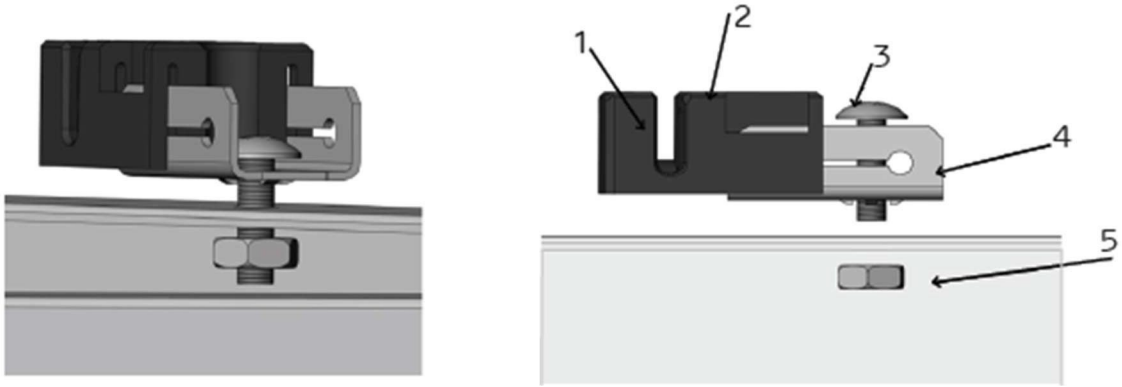
Procedure 1:- Grounding by bolts: 2058729-1



1) Wire bolt and slot 2) Mounting wash hex nut 3) Aluminum 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



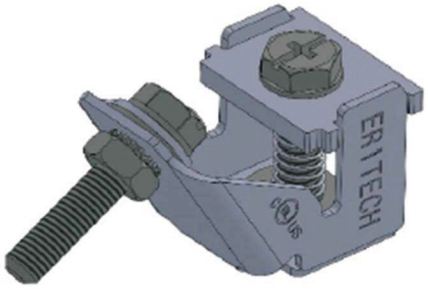
1) Wire slot (available for 4-6 mm² cable) 2) Slider 3) Bolt 4) Base 5) Nut

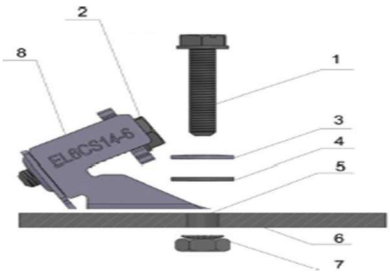
- Tyco made grounding hardware comes with grounding bolt, mounting and grounding hex

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







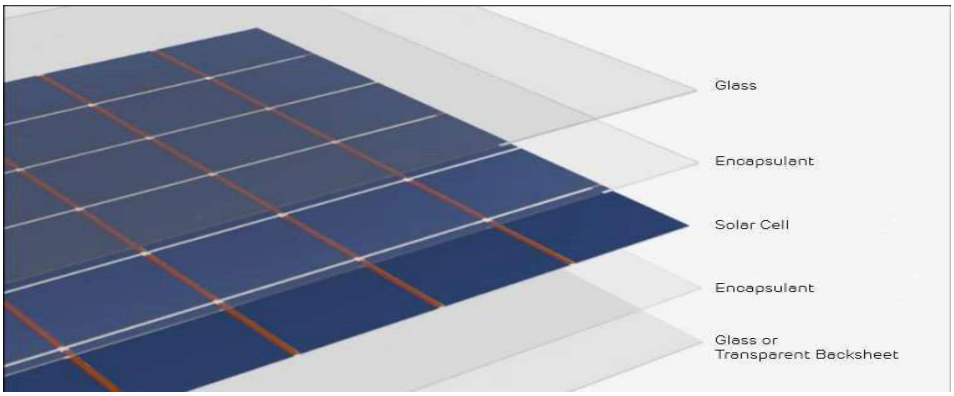
1) Machine bolt 2) Machine bolt B 3) Belleville washer 4) Flat washer 5) Clearance hole for 10 [M5] machine bolt
6) Aluminium frame 7) Machine bolt hex nut with lock washer 8) Grounding bolt

- 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, spilt-ring lock washers, flat washers) 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 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 ASB & AB 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 is measured under Standard Test Conditions, which are 1000W/m2, irradiance with AM 1.5 spectrum and 25- C ambient temperature. The module might produce more or less voltage or current than rated value in uncertainty condition. Please refer technical datasheet of different models of Adani Solar modules for finding the



electrical values.

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. ASB-M10-144-XXX & AB-G12R-132-XXX 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 recommended 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 modules, String Combiner Box etc. Adani solar is not responsible for any type of accident occurring in Power plant using Adani modules.

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 analyze 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, appropriately sized 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 considerable increase in 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 can be 30A to 35A. Actual fuse rating is mentioned in PV module specification sheet and on the PV Module back label. Fuse rating value also indicate the maximum 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 string in parallel are protected with the appropriate in-line string fusing.

7.2 Selection of Inverter and Compatibility

Only connect the appropriate 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, Adani Modules 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 to 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 Plant maintenance by trained professionals as per site requirement. Complete everyday tracking of PV modules 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 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 obstructions. All the 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 glue/sealant found nearby the junction box.

• Check whether there are traces of burning mark on the module back sheet.

• Check all the strings fuses of each nonearthed 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 cleaning, 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 modules 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. Do not apply water that is more than 20°C warmer or colder than module surface temperature. Please do not make contact with any conductive part or clean any damaged modules; otherwise, electrical shocks may happen.

Note: Forcleaning module better and safely ref: MSEL/ANIL/MSPVL cleaning SOP 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 modules.

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
2. Email customer feedback at cs@adani.com

Appendix 1 : Connector Specifications

Manufacturer	Type/Model	Specification
QC Solar (Suzhou) Corporation	QC4.10-cds	Max. Voltage: 1500VDC Max. Current: 41/46A Max Temp: 100°C
Zhejiang Jiaming Tianheyuan Photovoltaics Technology Co., Ltd.,	PV-JM608 PV-JM601A	Max. Voltage: 1500VDC Max. Current: 30 A/ 41 A Max Temp: 100°C
DhaSh PV Technologies Pvt., Ltd.	DS01	Max. Voltage: 1500VDC Max. Current: 35 A Max Temp: 100°C
Staubli Electricals Connectors AG	PV-KST4-EVO 2/xy_UR (male) PV-KBT4-EVO 2/xy_UR (female) PV-KST4-EVO2A/xy; PV-KBT4-EVO2A/xy; PV-KST4/xy-UR; PV-KBT4/xy-UR	Max. Voltage: 1500VDC Max. Current: 39 A/ 45 A Max Temp: 100°C
Amphenol Technology (Shenzhen) Co., Ltd.	UTXCFabcde; UTXCMabcde (a=A, b=4, c=A, d=A to Z, e=Blank or A or Z) H4Cabcdef(c=4)(b=B, M or N)	System voltage [VDC]: 1500 Rated current [A]: 35 Max Temp: 100°C
Tyco Electronics Austria GmbH	PV4-S1yx	System voltage [VDC]: 1500 Rated current [A]: 40 Max Temp: 100°C
Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M2/xy (Plug+Socket)	System voltage [VDC]: 1500 Rated current [A]: 45 Max Temp: 100°C
DAS SOLAR CO., LTD.	PV-DA01M2-XY	System voltage [VDC]: 1500 Rated current [A]: 45 Max Temp: 100°C
Taizhou Chuangda Electronic Co., Ltd.	CD2	System voltage [VDC]: 1500 Rated current [A]: 48 Max Temp: 100°C

Appendix 2 : 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 développé 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 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 chaîn déconnecté 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 ≤ 2000 m.
- L'irradiance maximale est de 1300W/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 installation.
- Veuillez vous assurer que la polarité des modules ou des chaînes n'est pas inversée par rapport aux autres module la ficelle

- 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

- Modules qualifiés pour la classe de sécurité incendie C et la sécurité selon EN IEC 61730 -1 et Les normes IEC 61730 - 2 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.