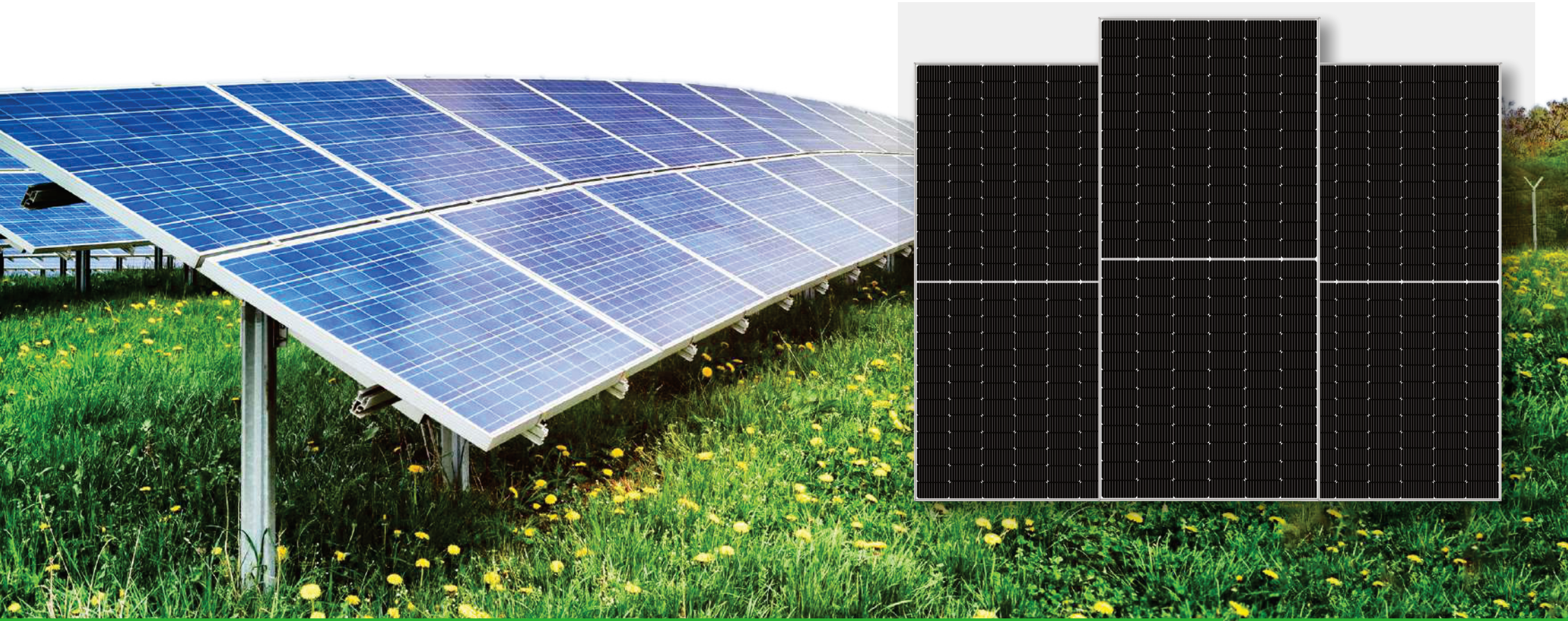
INSTALLATION MANUAL

FRAMED SOLAR PV MODULES

ORIENT SOLAR

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INSTALLATION AND OPERATION MANUAL

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TABLE OF CONTENTS

Sr No.	Particulars	Page No.
1	Introduction	01
2	Disclaimer Of Liability	01
3	General Information	02
4	Safety Precaution	02
4.1	Fire Safety	06
5	Storage Unpacking & Handling of PV Module	07
5.1	Module Identification	10
5.2	Maximizing Power Output through Bifaciality	05
6	Environmental Consideration and Site Selection	06
6.1	Site Selection	13
6.2	Module Specification	13
7	Mounting Instructions	14
7.1	Mounting Methods	15
7.2	Grounding	17
7.3	Module Wiring	20
8	Electrical Configuration	22
8.1	Fuses	22
8.2	Inverter Selection And Compatibility	23
8.3	Diodes	23
9	Maintenance & Cleaning Of PV Module	24

1. INTRODUCTION

This manual contains information regarding safe handeling, installation, operation and maintenance of ORIENT Photo Voltaic (PV) Modules. Before installation or using the PV Modules, it is important to read this manual and understand the instructions carefully.

2. DISCLAIMER OF LIABILITY

Since Installation and Maintenance of the Module are beyond (ORIENT) company's control; ORIENT does not assume responsibility and expressly disclaims liability for loss, damage, injury or expense arising out of or in any way connected with such installation, operation, use or maintenance of the Modules.

ORIENT assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the Module. No license is granted by implication or otherwise under any patent or patent rights.

The information in this Manual is based on our knowledge and experience and is believed to be reliable; but such information including product specifications (without limitations) and suggestions do no constitute a warranty, expressed or implied. ORIENT reserves the right to make changes to the product, specifications or this manual without prior notice.





3. GENERAL INFORMATION

The installation of solar PV Modules requires great degree of skills, it should only be performed by a qualified and licensed professional, including, without limitation, licensed contractors and licensed electricians. The installer assumes the risk of all injury that might occur during installation, including without limitation, the risk of electric shock.

Warning

For your safety and the safety of others, please read the entire Installation, operation and maintenance manual carefully prior to installing, wiring, operating and performing maintenance of PV modules. Also, carefully read the Module Data Sheet provided with this product. Determine local permits, installation and inspection requirements before installing module(s). If not otherwise specified, it is recommended that the requirements of the regional & National Electric Code (NEC) be followed.

The photovoltaic Module produces electricity when exposed to the sunlight, even at low light levels or when other sources illuminate the front face. The voltage of a single Module is less than 50 V DC and around or over 50V DC for bifacial module. However, the voltage increases as Modules are connected in series and the available current increases as the Modules are connected in parallel. Thus, for a Module connected within a system, contact with electrically active parts of the Module such as terminals can result in lethal shock, sparks and burns. The only way to eliminate this hazard is to prevent exposure of the Module(s) to light.

Caution

To avoid the hazard of electric shock and injury when installing, wiring, operating and maintaining the PV modules, below guidelines shall be strictly followed

4. SAFETY PRECAUTION

- Potentially lethal DC voltages can be generated whenever PV Modules are exposed to a light source, therefore, avoid contact with electrically active parts and be sure to isolate live circuits before attempting to make or break any connections.
- Only authorized and trained personnel should have access or perform work on the modules or solar system, always wearing safety gloves and safety shoes.
- When working on electrical connections, remove all metallic jewelry, use properly insulated tools and wear appropriate personal protective equipment to reduce the risk of electric shock.
- Cover the entire front surface of the PV Module & both front and back surface in case of bifacial module with a dense, opaque material such as cardboard box, during installation and handling of the Modules. Important: ORIENT'S Bifacial Modules produce Voltage when exposed to light also on backside.
- Since sparks may occur, do not install the Module where flammable gases or vapors are present.
- For modules under IEC investigation, under normal conditions, a solar photovoltaic module is likely to Experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes and size of controls connected to the PV output
- For modules under UL investigation, most of the time, the solar module is likely to produce more power, or current, than that rated at standard test conditions. Accordingly, the value of ISC marked on back label of module should be multiplied by a factor of 1.25 when determining the conductor current ratings, fuse sizes and size of controls connected to the PV output. Refer to Section 690.8 of the National Electric Code to check when an additional multiplying factor of 1.25 may be applicable.





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- Where common grounding hardware (nuts, bolts, star washers, spilt-ring lock washers, flat washers and the like) is used to attach a listed grounding/bonding device, the attachment must be made in conformance with the grounding device manufacturer's instructions.
- Rated electrical characteristics are within the production tolerance of measured values at Standard Test Conditions of 1000 W/m², 25°C±2 cell temperature and AM 1.5 solar spectral irradiance, according to IEC 60904-3.
- The module is considered to be in compliance with UL1703/UL 61730 only when the module is mounted in the manner specified by the mounting instructions.
- Broken modules cannot be repaired and contact with any module surface or frame can lead to electrical shock. Do NOT use a module with broken glass or torn substrate.
- Do NOT disassemble the modules or remove any part of the module.
- Protect the electrical plug contacts against corrosion and soiling. Make sure that all connectors are corrosion free and clean before making the connection.
- Do NOT install or handle modules when they are wet or during periods of high wind.
- Make sure that the polarity of each module or a string is not reversed considering the rest of the modules or strings. The similar witness of polarity shall be checked at the combiner box/ array junction box/ inverter and/or at appropriate level.
- Use Module for its intended function only.
- Be sure that all other system components are compatible, and they do not subject the Module to mechanical or electrical hazards.

- Do not touch terminals while Module is exposed to light or during installation. As a precaution use properly insulated tools only.
- Do not damage or scratch the back sheet of the Module. Do not expose Back sheet directly to sunlight.
- Do not drop Module or allow objects to fall on the Module. Do not stand or step on the Module.
- Do not disassemble, modify or adapt the Module or remove any part or labeling installed/ pasted by the manufacturer.
- When carrying a Module, two or more people should carry it by its frame wearing non-slip gloves (to avoid injury by a slipped Module, or by the edge of frame, and so on).
- Only PV Modules with the same cell type, same power output and size should be connected.
- Avoid uneven shade on the PV Module surface. Shaded cells may become hot (hot spot phenomenon) which may result in permanent damage to the Module.
- Do not drill holes in the frame or glass of the Module, it may compromise the frame strength and cause corrosion of the frame and also voids the warranty.
- Do not treat back sheet and front surface of the Module with paint and adhesives, Such cases will void Warranty.
- Artificially concentrated sunlight shall not be directed onto the front or back face of the PV module.
- Be sure to completely ground all Modules.
- Do not use the junction box to hold or transport the Module
- The maximum open circuit voltage of an array must not be greater than the specified maximum system voltage. Voltage is directly proportional to the number of PV Modules in series and is affected by weather conditions.

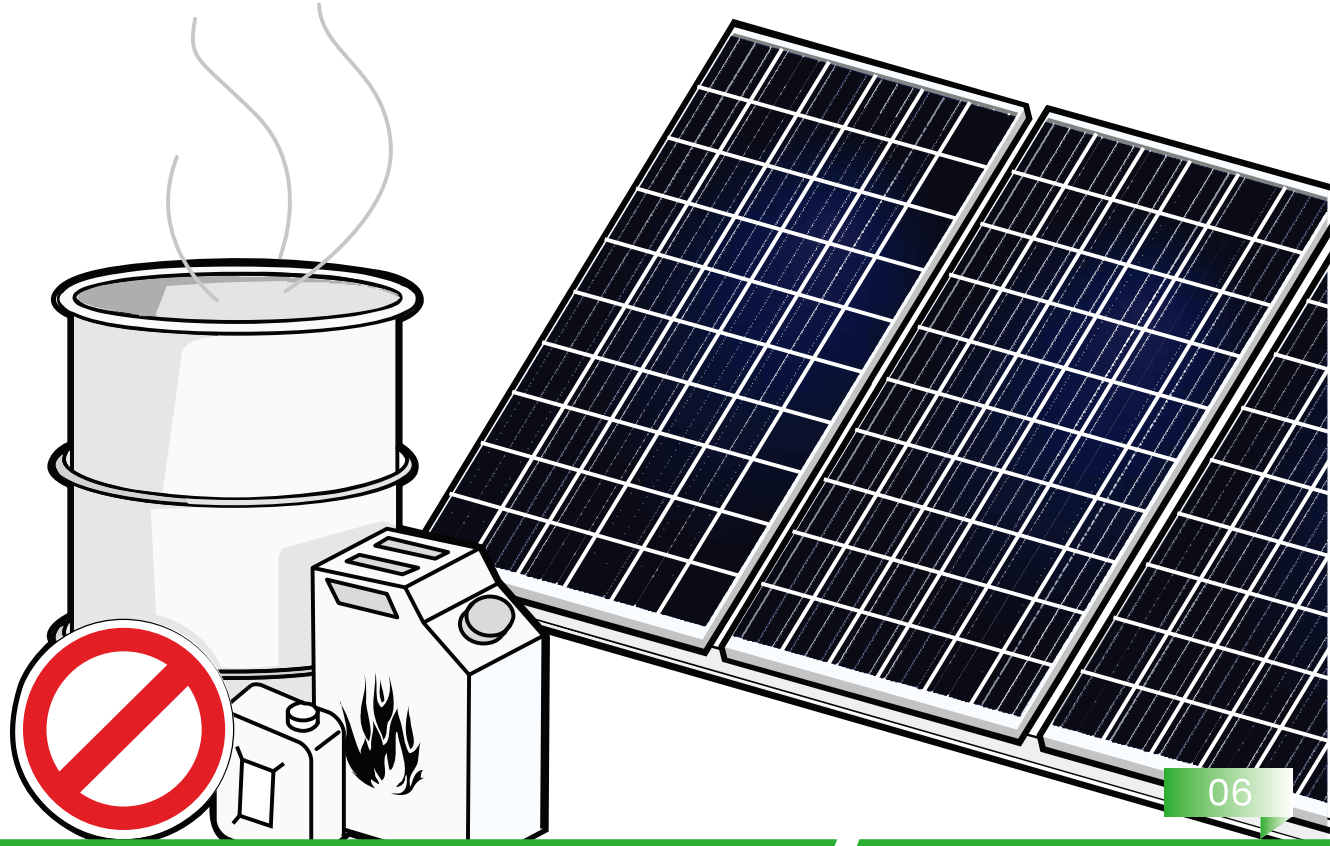


4.1 FIRE SAFETY

- In the case of a fire, SPV modules may produce dangerous voltage/surge current, even if they have been disconnected from the inverter, or have been partly or entirely destroyed, or the naked wiring destroyed. In the event of fire, inform the fire/safety team about the particular hazards from the PV system, and stay away from all elements of the PV system during and after a fire until the necessary steps have been taken to mitigate the risk.
- Before mounting the module, please consult your local building department to determine approved roofing materials.
- Any module or panel mounting system has limitations on specific inclination required to maintain a specific System Fire Class C Rating.
- The fire rating of the module is valid only when mounted in the manner specified in the mechanical mounting instructions.
- A minimum slope of 5 in/ft. for installation over a roof is required to maintain the fire class C rating. Refer to your local authority for guidelines and requirements for building or structural fire safety. For roof application, the Modules should be mounted over a fire resistant covering rated for the application.
- Ensure that all connections are securely made with no gap between the contacts. Any gap can result in electrical arcing that can cause a fire hazard and/or an electric shock.
- Do NOT use water to extinguish fires of an electrical origin

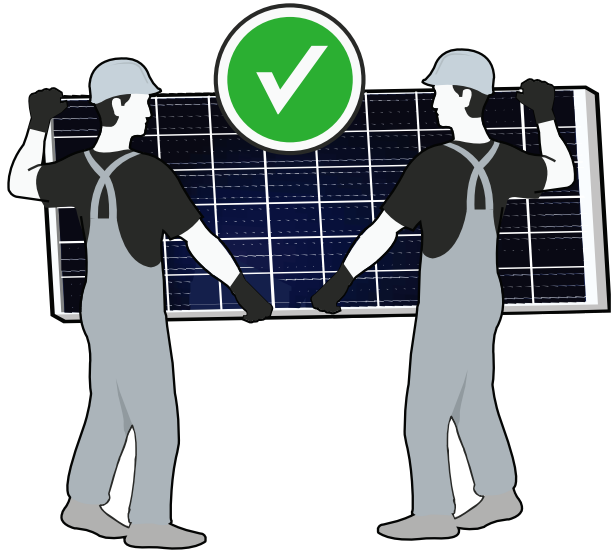


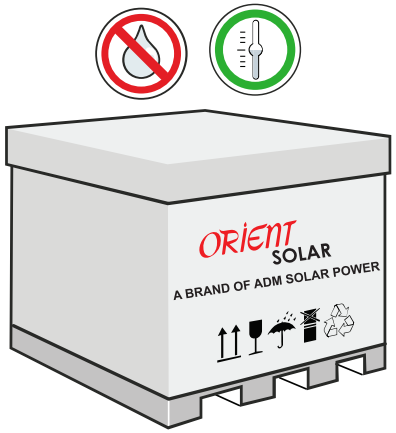


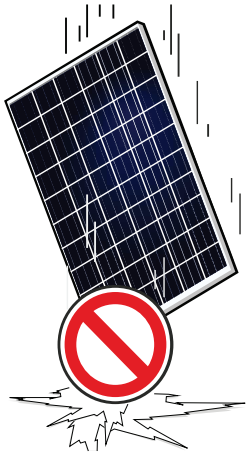


5. STORAGE, UNPACKING & HANDLING OF PV MODULE

- The pallet packaging is not water or weatherproof. Prior to installation, and to avoid any damage or degradation to the packaging or panel components, pallets and panels must be stored in a protected environment, ideally in internal storage conditions, where it is shielded from the elements, e.g., rain, dust, and direct sunlight. If overnight external storage in an uncontrolled environment is unavoidable, the panels and the pallet packaging must be protected from direct exposure to the elements and from contact with the ground, including earth, mud etc.
- If pallets are stored temporarily outside then place a protective covering over the pallet to protect it from direct weathering and Do NOT stack more than the maximum amount of allowable pallets on top of each other.
- The handling of Modules requires great diligence. Therefore, caution is required while unpacking, transporting and temporarily storing these Modules.
- Do NOT use a knife to cut the zip-ties, always use wire cutting pliers.
- Do NOT place modules directly on top of each other without corner protect. Do not carry the Module on Head.
- When carrying a bigger Module, two or more people should carry it by its frame and wear non-slip gloves (to avoid injury by a slipping Module, cuts by the edge of a frame etc.). Do not leave the Module unsupported or unsecured prior to installation.
- Store Modules in a dry and ventilated room.
- Do not place Modules on an uneven surface, for example, wind can cause a Module which is leaning against a fence to fall and break.



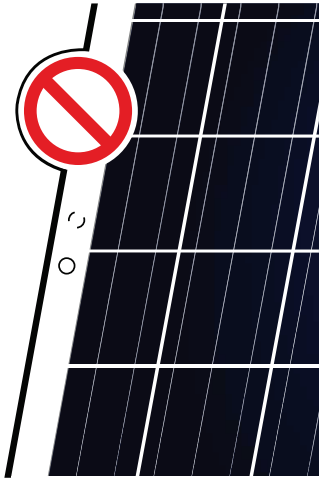






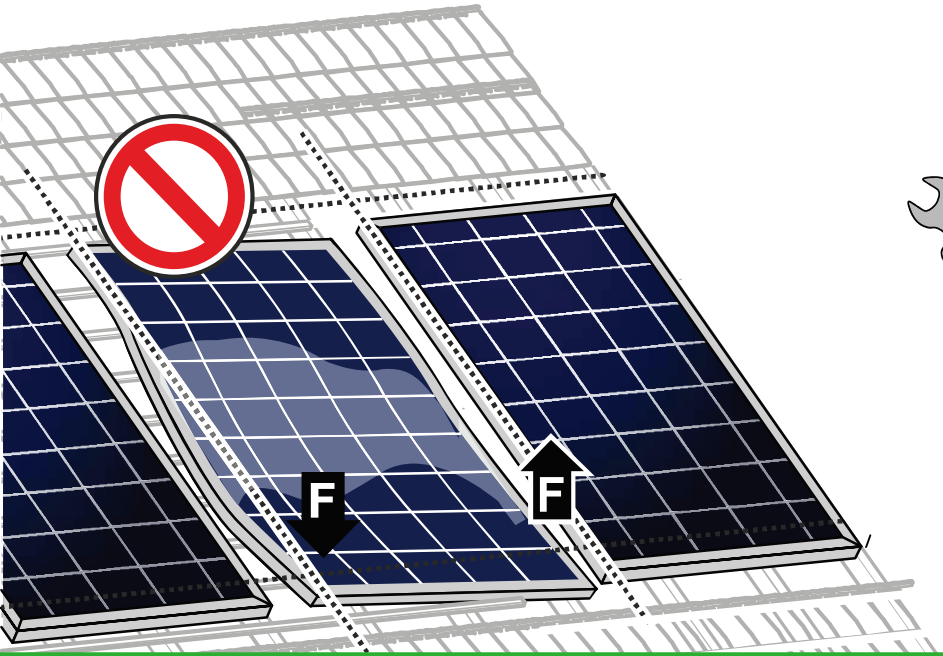
- Avoid applications of excessive bending or twisting of the Module, it may cause severe micro-cracks at the cell level, which in turn may compromise Module reliability.
- A Module with broken glass or torn backsheet cannot be repaired and must not be used since contact with any Module surface or the frame can produce electrical shock.
- At the installation site, take care to keep Modules and particularly their electrical contacts clean
- Broken or damaged Modules must be handled carefully and disposed off properly. Broken glass can be sharp and may cause injury if not handled with appropriate protective equipment.
- Do not stand, step, walk and/or jump on the Module. Do not drop or place objects on the Modules (such as tools.)
- Do not mark the Modules with sharp instrument. Particularly attention should be taken to avoid Module backsheet to come in contact with sharp objects, as scratches may directly affect product safety and reliability.





Caution

In any case DO NOT STAND OR STEP on the modules, Do not drop or place objects on the module(s) (such as tools), do not thump / give extra pressure on the surface of the module(s) as localized high loads can induce severe micro -cracks at the cell level, which in turn may compromise module reliability. Failure to comply with above caution will void ORIENT's warranty



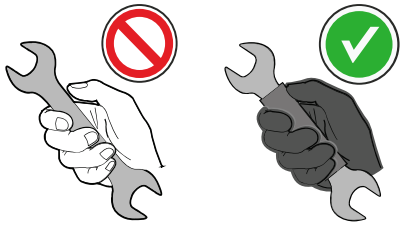




Figure 1: Wrong methods of installing, operation and maintenance of solar PV module





5.1 MODULE IDENTIFICATION

Each module has a unique serial number, which is laminated behind the glass. Please do not tamper with the serial number of the module and always record the serial numbers during an installation for your future records. A nameplate containing model name, electrical and safety characteristics of the module are also affixed to the back side.

Warning

Bifacial modules increase energy and power production respect to STC nominal data through Albedo on rear surface. Refer to the specific area on data sheet for real parameters expected after installation to calculate correctly inverter, cables and connection size.

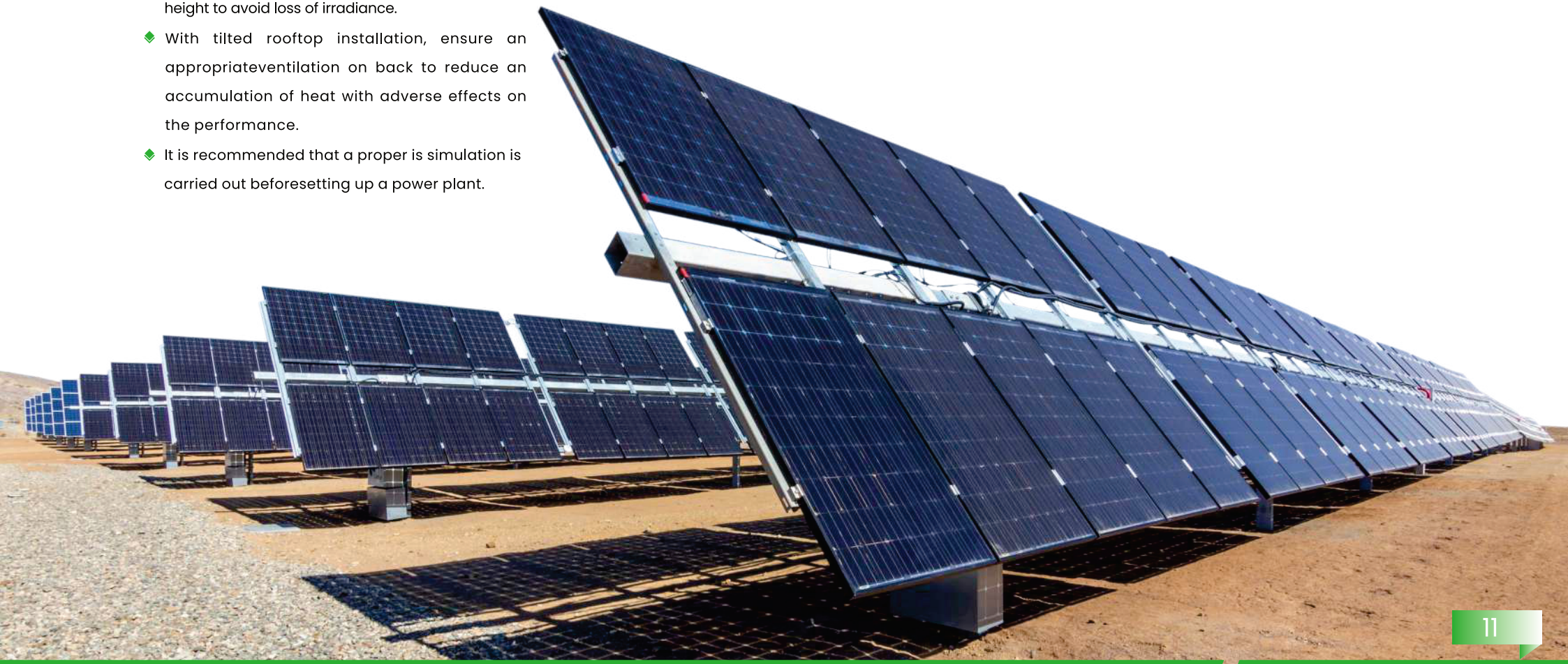


5.2 MAXIMIZING POWER OUTPUT THROUGH BIFACIALITY

The power output of a bifacial module increases proportionally to the light received by rear side of module. The available light that hits the back of the module is directly related to the height and tilt angle of the module installed over the surface.

- Choose the highest possible Surface Reflectivity/Albedo, such as a white roof or white ground surface covering.
- Avoid shading the back side of the module by the support rack.
- Elevate the modules above the mounting surface at anappropriate height to avoid loss of irradiance.
- With tilted rooftop installation, ensure an appropriateventilation on back to reduce an accumulation of heat with adverse effects on the performance.
- It is recommended that a proper is simulation is carried out beforesetting up a power plant.





6. ENVIRONMENTAL CONSIDERATION AND SITE SELECTION

Solar modules are certified for IEC 61215, IEC 61730-I &II, IEC 62804. In addition to the required IEC certification to meet European standards, WAAREE Solar products have also been tested and certified for resistance to ammonia fumes (IEC 62716) that may be present in barns sheltering cattle, pigs, as well as sustainability for Installation in Humid (coastal) areas of high sand storms. Although ORIENT PV modules have passed Salt mist (IEC 61701)corrosion test with a salt concentration of 5 % by weight, galvanic corrosion can occur between the aluminium frame and mounting or ground materials if such materials are made of dissimilar metals

Environmental Conditions:

- Ambient temperature: -40 °C to +50 °C
- Operating temperature: -40 °C to +85 °C
- The relative humidity shall be below 85 %.
- Statement: the maximum altitude is up to 2000

* NOTE :

- The mechanical load bearing capacity depends upon the Installer's mounting methods and failure to follow the instructions of this manual may result in different capabilities to withstand snow and wind loads. The system installer should ensure that installation methods used meet these requirements and any local codes and regulations.
- Rated electrical characteristics are within the production tolerance of measured values at Standard Test Conditions of 1000 W/m², 25°C±2 cell temperature and AM 1.5 solar spectral irradiance, according to IEC 60904-3.



6.1 SITE SELECTION

- PV modules should be installed in a place where there is no shading across the location throughout the year. Shading can be minimized by having the distance between the obstruction and solar array is more than thrice the height of obstruction
- Solar module is recommended to be installed at an optimized tilt angle to maximize the energy output. It is roughly equal to the latitude of the project site as a rule of thumb, facing to equator. But always design the plant based on local situations to find out the optimum conditions.
- PV modules should typically face south in the northern hemisphere and north in southern hemisphere. ORIENT modules can be mounted either in landscape or portrait orientation however the impact of dirt shading the solar cells can be minimized by orienting the product in portrait
- Modules shall be mounted with the orientation and tilt angle required for consistent performance (seasonally, yearly). The location selected shall have direct access to sunlight from 9:00A.M. to 3.00P.M. on the shortest day of the year.
- A minimum slope of 5 in/ft. for installation over a roof is required to maintain the fire class C rating. Refer to your local authority for guidelines and requirements for building or structural fire safety. For roof application, the Modules should be mounted over a fire resistant covering rated for the application.

6.2 MODULE SPECIFICATION

- Please refer to the latest Module datasheet for more details.



7. MOUNTING INSTRUCTIONS

- Modules should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads. Module mounting holes are provided for easy installation and proper mechanical loading.
- The Modules shall be mounted so that the junction box remains in the uppermost position to minimize the ingress of moisture/water.
- Appropriate material should be used for mounting hardware to prevent the Module frame, mounting structure etc. from corrosion.
- When installing solar modules on a roof always leave a safe working area between the edge of the roof and the external edge of the solar array.
- Do not install PV modules in a location where they will be immersed in water or continually exposed to water from a sprinkler or fountain, etc
- Avoid using a mounting method that will block the drainage holes in the module frame. The drain holes cannot be blocked in any situation during installation or use.
- We recommend leaving a space of at least 10mm~10.5 mm between two Modules considering linear thermal expansion of the Module frames.
- Clearance between the Module frame and the mounting surface is required to allow cooling air to circulate around the back of the Module. This also allows any condensation or moisture to dissipate. The Module should never be sealed to the mounting surface with sealant that prevents air from circulating under the Module. For roof mounted systems, provide adequate rear ventilation (100mm: 4inch gap minimum) for cooling of Modules.
- Site-specific loads such as wind and snow need to be taken into consideration to ensure that the pressure of such a load does not exceed the specified maximum load.
- Always abide by the instructions and safety precautions included with the Module. The mounting structure and all hardware like bolts, nuts and washers should be of stainless steel so as to eliminate the possibility of rust.
- When installing a free standing ground mounted system, be sure to select the appropriate height of the support Module mounting structure. It is also important to select the appropriate height of the mounting system to prevent the lowest edge of the Module from being covered by snow for a long time in areas that experience heavy snowfall. If snow settles on the PV modules regular cleaning of snow and other foreign particles are highly recommended for long term reliability of the PV modules, failure to comply may result in damage of the module resulting in deformation and not covered under warranty.

7.1 MECHANICAL MOUNTING METHODS

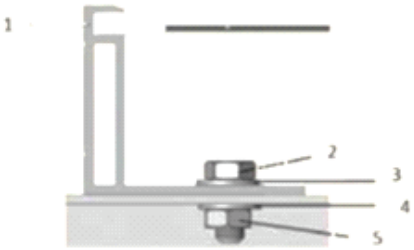
A. MOUNTING WITH BOLTS

Modules must be mounted on mounting holes located at rear side with the M6 stainless steel nut, bolt and washer. It is recommended to use stainless steel fixing only. Module mounting must use the pre-drilled mounting holes in the frame. Always select the length of mounting screw after considering a clearance of 5-10 mm between the Module back face & screw face to avoid any breakage of Module while tightening.

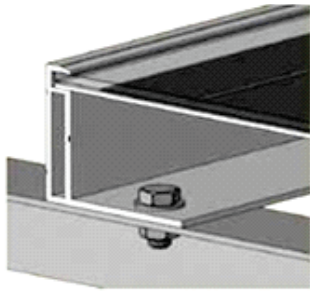
Applied torque should refer to mechanical design standard according to the bolt customer is using. For Mounting hole size of 8 x12mm – M6 bolt shall be use. Bolts shall be tightened to a torque of 16 -25 N

Note: -

Do not drill additional mounting holes on the frame & glass surface of the Module. Doing so will void the warranty.

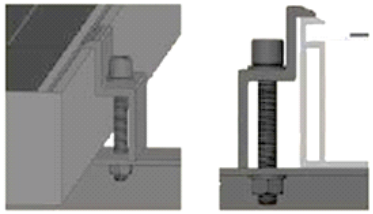
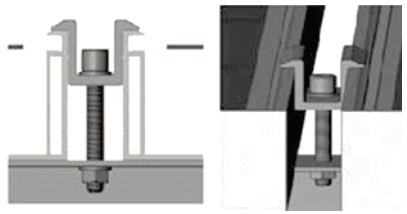


1. Aluminium Frame
2. M6 Stainless Steel bolts
3. Flat Stainless Steel washer
4. Spring Stainless Steel washer
5. HEX Stainless Nut

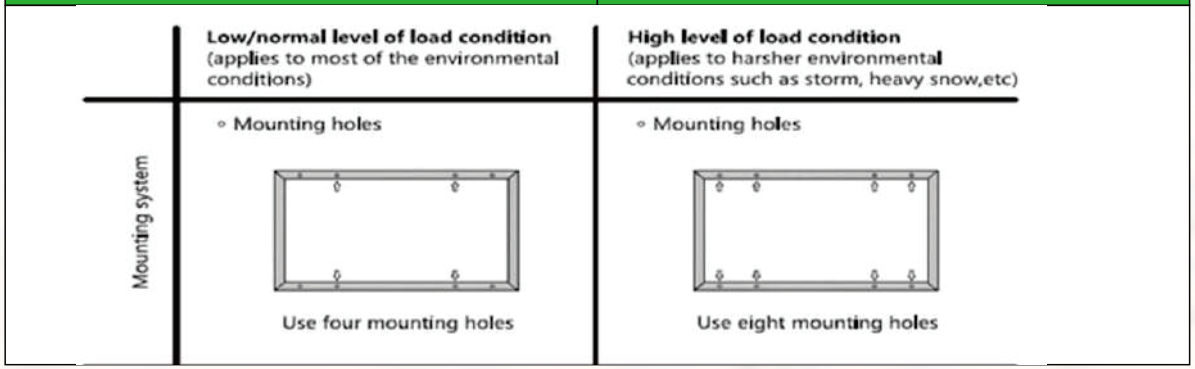


B. MOUNTING WITH CLAMPS

Each Module must be securely fixed to the mounting structure at a minimum of four points. The Module clamps shall not come into contact with the front glass and must not deform the frame. Be sure to avoid shadowing effects from the Module clamps. The clamp must overlap the module frame by at least 7mm (0.28in) but no more than 10mm (0.39in). The Module frame is not to be modified under any circumstances. When choosing this type of clamp-mounting method, use at least four clamps on each module, two clamps should be attached on each long sides of the module (for portrait orientation) or each short sides of the module (for landscape orientation). Depending on local wind and snow loads, additional clamps may be required to ensure that modules can bear the load. The applied torque shall be big enough to fix it steadily. For safety, it is better to follow the clamp manufacturer's recommendations.

End Clamp installation	Middle Clamp installation
	

INSTALLATION DIAGRAM

2400Pa (1600Pa with design safety factors ym=1.5 load condition)	5400Pa (3600Pa with design safety factors ym=1.5 load condition)
	

Different mounting configurations can be tried as per Installer's calculations; however failure to comply with the above suggestions may result in a lowering of load handling capabilities and may lead to failure of any overload situation which may not be covered under ORIENT's warranty.

Before design mounting structure needs to be considered design safety factors ym=1.5, positive 3600 Pa and negative 1600 Pa avoid site failure.



7.2 GROUNDING

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

Module frames should be connected to an earth ground for safety and protection from lightning. good connection between the grounding hardware is essential for an effective ground. The anodization on a Module frame provides a coating to minimize the corrosion due to weather and it acts as a barrier that reduces the effectiveness of the grounding connection. For an adequate ground, the grounding hardware should pierce the anodization layer.

Proper grounding is achieved by bonding the Module frame(s) and all metallic structural members together continuously using a suitable grounding conductor. The grounding conductor or strap may be copper, copper alloy, or any other material acceptable for use as an electrical conductor. The devices have to be installed in accordance with the grounding device manufacturer's specified instructions. The grounding must be cross verified for its proper continuity.

Note: -

"Please avoid negative bias of the cells with respect to the grounded frames".

Solar modules can be installed with the use of third party listed grounding devices for grounding the metallic frames of PV modules. The devices have to be installed in accordance with the grounding device manufacturer's specified instructions

We also recommend using the following methods to ground installation properly under UL investigation.

Method 1: Tyco grounding bolt # 2058729-1:



Fig: Grounding bolt # 2058729-1

01) Wire bolt and slot
02) Mounting wash hex nut
03) Aluminium frame
04) 4 to 16 mm² cable
05) HEX nut

- Tyco grounding hardware comes in a package that includes the grounding bolt, mounting and grounding hex nut. Electrical contact is made by penetrating the anodized coating of the aluminium frame, and tightening the mounting hex nut (come with the star washer) to the proper torque of 25lbf.in. Grounding wire size (6 to 12 AWG solid bare copper) should be selected and installed underneath the wire binding bolt.
- The wire binding bolt should be tightened to the proper torque of 45lbf.in

Method 2: Grounding bolt #1954381-2:

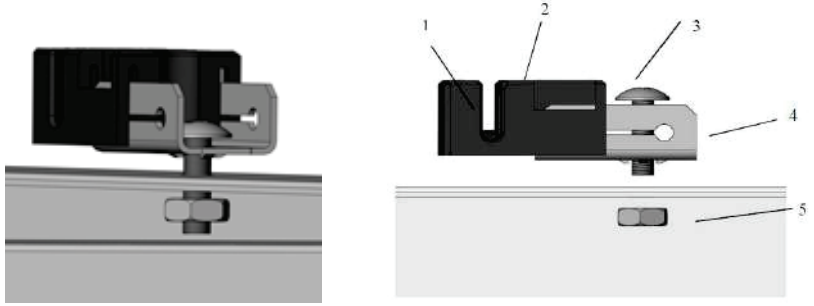


Fig: Grounding bolt # 1954381-2

01) Wire slot (available for 4-6 mm² cable)
02) Slider
03) Bolt
04) Base
05) Nut

Tyco grounding hardware comes in a package that includes the grounding bolt, mounting and grounding hex nut Electrical contact is made by penetrating the anodized coating of the aluminium frame, and tightening the mounting hex nut (come with the star washer) to the proper torque of 25 in lb Grounding wire size (6 to 12 AWG solid bare copper) should be selected and installed underneath the wire binding bolt. The wire binding bolt should be tightened to the proper torque of 45 in lb The Tyco grounding bolt is only listed for use with 6 to 12 AWG bare solid copper wire.

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Method 3: ERICO grounding bolt # EL6CS

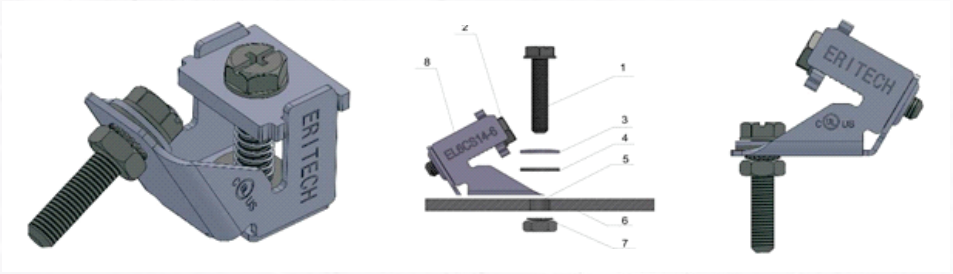


Fig: ERICO grounding bolt # EL6CS

01) Machine bolt A
02) Machine bolt B
03) Belleville washer
04) Flat washer
05) Clearance hole for #10[M5] machine bolt
06) Aluminium frame
07) Machine bolt hex nut with lock washer
08) Grounding bolt

- The lug should be installed on a surface that is larger than the bottom surface of the lug
- The lug should be installed in the grounding holes provided on the PV module
- Machine bolt A should be torqued to 35 in lb, to secure the grounding bolt to module frame
- The grounding bolt is only listed for use with 6-12 AWG bare solid copper wire
- For proper wire binding, machine bolt B should be torqued to 35 in lb

7.3 MODULE WIRING

- All wiring should be performed, by qualified installers, All wiring should be done in accordance with applicable electrical codes and regulations Modules can be connected in series to increase the operating voltage by plugging the positive plug of one module into the negative socket of the next. Before connecting modules always ensure that the contacts are corrosion free, clean and dry
- PV modules can be connected in Series to have an increase in the Operating Voltage. The positive connector plug of module is connected to the negative connector plug of another module until there is a click sound. Only if there is a click sound assumes the modules are connected.
- Product can be irreparably damaged if an array string is connected in reverse polarity to another i.e. If the positive end is connected to negative input of the string combiner box and vice versa. So proper connection in the right polarity is recommended and if any reverse polarity is seen or any difference of more than 10 V is observed, the string configuration connection needs to be checked and connected appropriately
- ORIENT Solar modules are provided with standard Cables with a 4 mm^2 cross-sectional area and are rated upto 1500 V (IEC and UL) for maximum system voltage,90°C and are UV resistant. Ensure the cables are not exposed to water logged area's.
- The maximum voltage of the system should be lesser than the certified system voltage (typically 1500 V) or the maximum input voltage of the inverter.

Actual Maximum system voltage & minimum string fuse rating of Installed system can be calculated as per below formula to identify the recommended maximum series/parallel module configurations,

Max System voltage = $X * V_{oc} * [1 - ((T_{\alpha} - V_{oc} (\%) \times (25 - T_{min}))]$

Minimum string fuse rating = $I_{sc} \times 1.25 \times Max (1.175, I_{m\alpha} \div I_m)$

X - No: modules which are connected in series

V_{oc} - Open circuit voltage of each module (Refer to the Data Sheet)

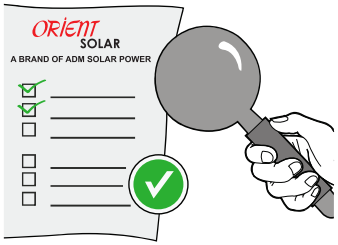
$T_{\alpha}-V_{oc}$ - Thermal coefficient of open circuit voltage for the module in Percentage

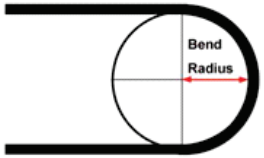
T_{min} - Minimum ambient temperature of the location of the plant

I_{sc} - Short circuit current of each module at 0% bifacial gain (in case of bifacial module) (Refer to the Data Sheet)

$I_{m\alpha}$- The highest 3-hour current average resulting from the simulated local simultaneous irradiances on the front and rear sides of the PV array accounting for elevation and orientation

I_m – The MPP operating current at 0% bifacial gain (in case of bifacial module) (Refer to the Data Sheet)





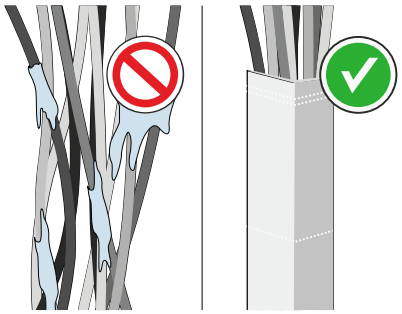


Incorrect routing of cable

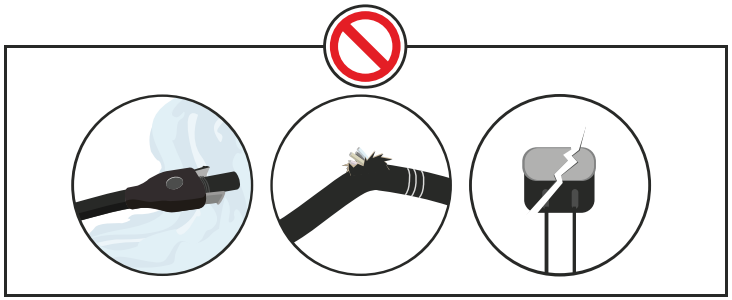


Correct routing of cable

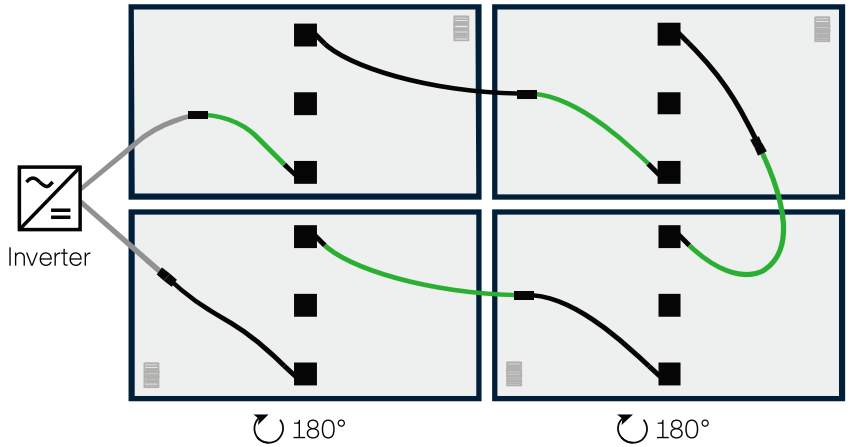
The minimum bending radius cables should be 43mm(1.69in).

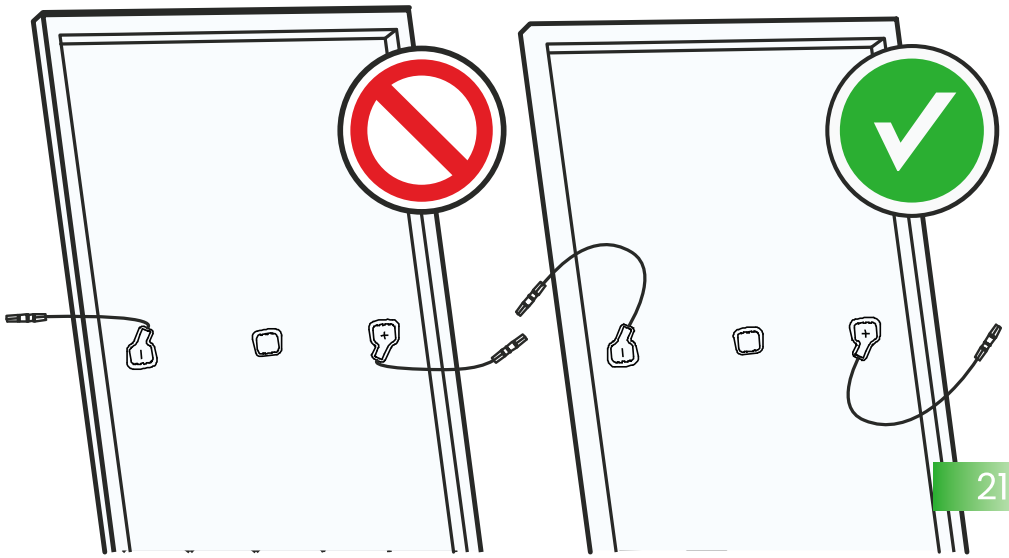


- ORIENT Modules contain factory installed bypass diodes. If the Modules are incorrectly connected to each other, the bypass diodes, cables, or junction box may be damaged.
- When reverse currents can exceed the value of the maximum protective fuse, a properly rated and certified over current device (fuse or circuit breaker) must be connected in series with each Module or string of Modules.
- Match the polarities of cables and terminals when making the connections; failure to do so may result in damage to the Module.
- Connecting Modules in reverse polarity to a high current source, such as a battery, will destroy the bypass diodes and render the Module inoperative. Bypass diodes are not user replaceable.
- The junction box, cable and connectors shall not be altered in any case. Modules with a suspected electrical problem should be returned to ORIENT for inspection and possible repair or replacement as per the warranty policy shall be provided by ORIENT.









8. ELECTRICAL CONFIGURATION

Photovoltaic (electric) systems operate automatically and require very little day-to-day supervision. The solar array generates DC electricity whenever light falls on it similarly the inverter automatically turns ON as soon as there is sufficient energy from the solar array to efficiently convert this into grid.

Caution

Solar module is rated to operate at potentially lethal DC voltages which have the potential can cause severe electrical shock, arcing and fire hazards. Whilst some solar modules, manufactured by ORIENT , are certified to operate up to 1500 V DC always check the module Back label to confirm the actual rating of your product before making connections.

It is recommended to use a suitably rated isolator (DC switch) to interrupt the current flow before Disconnecting the connectors. Even after disconnecting, the DC power may be active for some time, hence only expert operators are recommended to operate upon the panels, string combiner box, etc. ORIENT will not be responsible for any electrical accidents occurring in power plants using ORIENT Solar modules.

8.1 FUSE

When fuses are fitted they should be rated for the maximum DC voltage and connected in each, Non-grounded pole of the array (i.e. if the system is not grounded then fuses should be connected in both the positive and negative poles). The maximum rating of a fuse connected in series with an array string can be found on the product label and in the product datasheet.

This fuse rating value also corresponds to the maximum reverse current that a module can withstand (when one string is shaded then the other parallel strings of modules will be loaded by the shaded string and current will flow) and therefore impacts the number of strings in parallel.



8.2 INVERTER SELECTION 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 IEC norms and regulations, ORIENT modules normally do not need to be electronically connected to earth and can operate with either galvanically isolated (with transformer) and transformer less inverters. If the system is located in hot and very humid locations then galvanically isolated Inverters with Transformers must be used and the negative pole of the array must be connected to earth. It is recommend to adopt inverter negatively earthed installation to avoid the PID effect. If a Transformer less Inverter is used in hot humid climatic locations, The Installer should ensure the right active negative earthing kit is to be installed by consulting and having assurance from the inverter supplier.

8.3 BYPASS DIODES

- ORIENT Solar PV modules are equipped with bypass diodes in the junction box. This minimizes module heating and current losses. Do not try to open the junction box to change the diodes even if they malfunction.
- In a system using a battery, blocking diodes are typically placed between the battery and the PV module output to prevent battery discharge at night.



9. MAINTENANCE & CLEANING OF PV MODULE

- It is common for dust and dirt particles to accumulate on the surface(s) (front and back in case of bifacial module) of the Module. This can reduce the optimal output performance of the solar Modules. Normally, the accumulated dust can be washed with water, but in some instances some maintenance is recommended to clean the surface of the glass with water and a soft cloth or sponge to remove layer of dirt. A mild non-abrasive detergent may be applied to remove persistent dirt.
- PV Module Cleaning should be done only by properly trained personnel who understand the risks of applying water to electrical components.
- It is advisable to perform periodic inspection of the Modules for damage to glass, backsheet, frame, junction box or external electrical / loose connections and corrosion by the authorized professional.
- No aggressive and abrasive cleansers or chemicals should ever be used on the coated front glass. No alkali- based chemicals should be used, including ammonia based solutions
- Always wear rubber gloves for electrical insulation while maintaining, washing or cleaning Modules. Appropriate electrically insulating Personal Protective Equipment (PPE) must be worn during any cleaning or inspection operations.
- Acceptable Module cleaning methods are to spray the Modules with low-pressure water closely matched in temperature to the Module or to use a dry cleaning technique. Do not apply water that is more than 20°C warmer or colder than Module surface temperature.
- Always make sure that Cleaning should not be done during Generation time, the recommended time to clean Modules is from dusk to dawn when production is not affected and risk of electrical shock hazard is minimized. During the generation time the temperature of Module is higher and washing may also cause thermal stress in Module.
- Maintenance should be carried out at least once a year by trained personnel, alwayswearing safety gloves and safety shoes
- Trim any vegetation which may shade the solar array thus impacting performance.
- Check that mounting hardware is properly tightened.
- Inspect all cables to verify that connections are tight; the cables are protected from direct sunlight and sited away from areas of water collection.

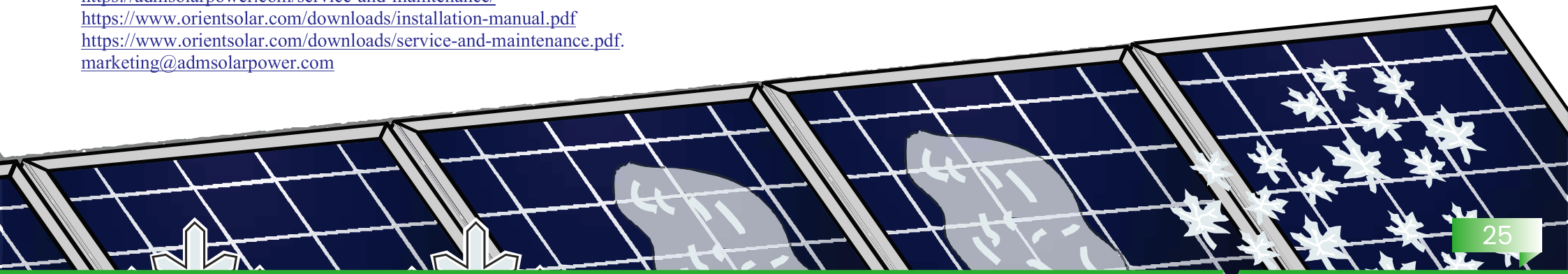


- Check that all string fuses in each non/earthed pole are operating.
- It is recommended to check the torque of terminal bolts and the general condition of wiring at least twice in a year. Also, check that mounting hardware is properly torqued. Loose connections will result in damage to the array.
- Replacement modules must be of same type. Do not touch live parts of cables and connectors. Use appropriate safety equipment (insulated tools, insulating gloves, etc.) when handling modules.
- The amount of electricity generated by a solar module is proportional to the amount of light falling on it. A module with shaded cells will produce less energy and therefore it is important to keep modules clean.
- High pollution or close to large bird populations will require more regular cleaning.
- The back surface of the monofacial module normally does not need to be cleaned but if needed, avoid the use of any sharp projects that might penetrate the substrate material.
- For cleaning of Modules Fresh water (TDS < 1500 mg/l) may be used. If needed, a mild, non-abrasive, non- caustic detergent with a final fresh water and detergent solution mix between 6.5 < pH < 8.5 at 25°C may be used.

General Term & Condition

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- When using water, RO water provides the best results. In absence of RO water, tap water with low mineral content (total hardness <75 mg/l) or deionized water may be used. Calcium should not exceed: 75 mg/ml. Do not use solutions containing hydrochloric acid, D-Limonene, ammonia or sodium hydroxide.
- In case if soft water (with low mineral content) is not available, Module can be dry cleaned with the help of a soft cloth or with soft sponge to remove dirt, dust. One can also use wet cloth, sponge to clean dirt which is not easily removed by dry cleaning.
- Do not clean or spray water at the Junction Box.
- Frequency of Cleaning will vary depending upon any special conditions in the area where the Modules are installed. Modules installed in high windy or dusty areas should be inspected more frequently.
- If excessive soiling is present, a non-conductive soft brush, sponge, or other mild agitating method may be used before using water. Ensure brushes or agitating tools are not abrasive to glass.
- Module damage that arises as a result of improper cleaning will not be warranted by ORIENT.
- To avoid dirt accumulation or white efflorescence due to water accumulation, do not install PV Modules horizontally.
- For More Details, Refer to our cleaning guidelines.



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