

Installation Manual of Solar Module

Version Number: UL202401

Note: Electrical and mechanical installation information will be introduced in this installation manual, so please read and understand the information before installing Ulica's modules. The Buyer shall not change the installation method by their own, any simplified installation method or different from this installation manual shall be checked with and confirmed by the Seller, otherwise the Seller will not be responsible for any quality issues caused by the unauthorized installation method.

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Introduction

Electrical and mechanical installation information will be introduced in this installation manual, so please read and understand the information before installing Ulica's modules. In addition, this manual also contains some safety information that you shall be familiar with. All contents in this manual are intellectual properties of Ulica which originates from long term of technical exploration and experience accumulation of Ulica.

This installation manual does not entail any explicit or implicit quality warranty and does not stipulate on compensation schemes for losses, module damages or other costs caused by or related to module installation, operation, utilization and maintenance process. Ulica will not take any responsibility if patent rights or the third party rights are infringed by use of modules. Ulica reserves the rights for modifying product manual or installation manual without noticing in advance. It is recommended to visit our website regularly at www.Ulica-solar.com for the latest version of this installation manual. If customers fail to install modules as per requirements set forth in this manual, the limited warranty provided for customers will be invalid. In addition, suggestions in this manual are to improve safety of module installation, which are tested and proved by practices. Please provide this manual to PV system users for reference and advise on PPE(Personal Protective Equipment), operation and maintenance requirements and other suggestions..

2. Laws and Regulation

The mechanical and electrical installation of photovoltaic modules shall be in accordance with applicable regulations, including electrical law, construction law and electrical connection requirements. These regulations vary from sites to sites, for example, building roof installation, vehicle applications, etc. Requirements may also vary depending on the installed system voltage, DC or AC. Please contact local authorities for specific terms.

3. General Information

3.1 Modules Identification

labels on the modules contain information below:

3.1.1. Nameplate: product type, rated power, rated current, rated voltage, open circuit voltage, short circuit current under testing conditions, certification indicator, maximum system voltage, etc.

3.1.2. Current classification label: Rated working current. (H indicates High, M indicates Medium, L indicates Low),this is optional.

3.1.3. Serial Number label: A unique serial number is laminated inside the module which can be found in the front of the module. The serial number is also beside the module nameplate and at the side of the aluminum frame.

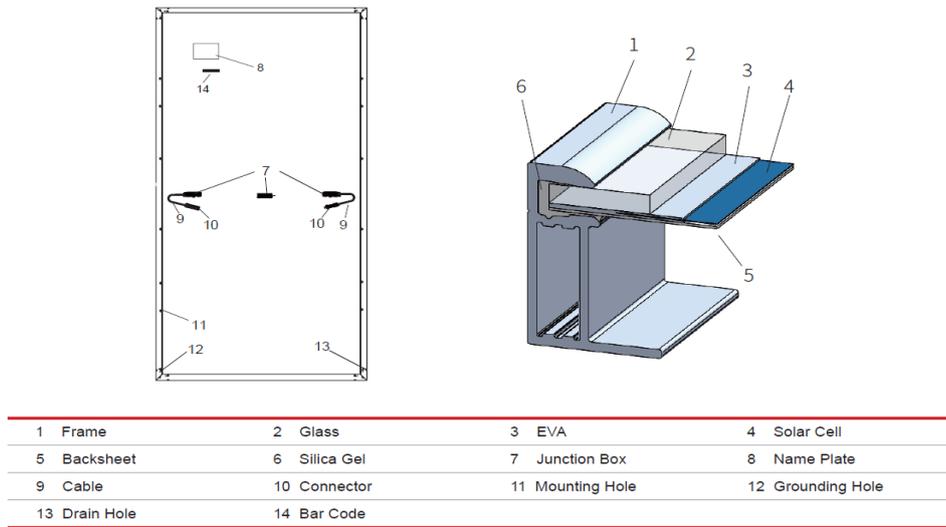
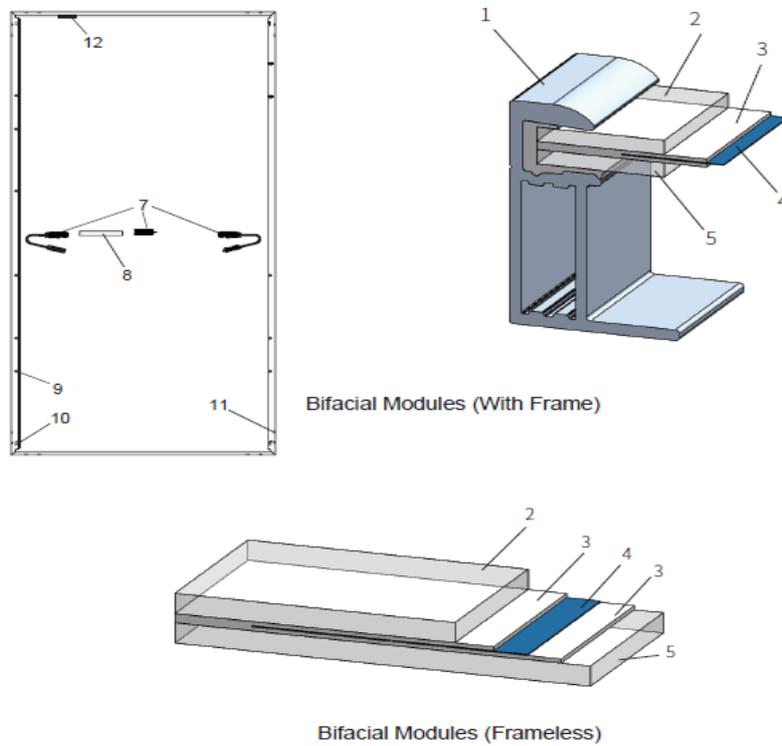


Figure 1 Regular modules Mechanical drawing



1 Frame	2 Front Glass	3 EVA/POE	4 Solar Cell
5 Back Glass	6 Sealent	7 Junction Box	8 Name Plate
9 Mounting Holes	10 Grounding Holes	11 Drain Holes	12 Bar Code

Figure 2 Regular Modules Mechanical Drawing

3.2 Junction Box Style and Wiring Method

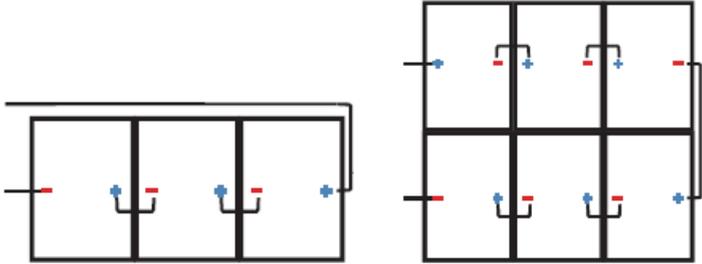
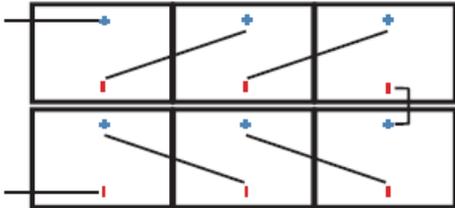
Junction Box Location Icon	Recommended Wiring Method
	<p data-bbox="651 327 1396 405">Vertical Installation: Standard Cable length: (Note: An extension cord is required at the rotor head of the double row assembly and at the end of the single row.)</p>  <p data-bbox="651 730 1396 808">Horizontal Installation: 60 type PV module cable length $\geq 1.2\text{m}$, 72 type PV module cable length $\geq 1.4\text{m}$, 78 type PV module cable length $\geq 1.5\text{m}$</p> 

Figure 3 Junction Box Style and Wiring Method

3.3 Regular Safety

3.3.1 The application level of Ulica Solar module is ClassII, which can be used in systems operating at $> 50 \text{ V DC}$ or $>240 \text{ W}$, where general contact access is anticipated;

3.3.2 When the modules are for rooftop application, it is necessary to take the overall fire rating of the finished structure as well as operation and maintenance into account. The roofing PV system shall be installed after being evaluated by construction experts or engineers and with official analysis results for the entire structure. It shall be proved capable of supporting extra system bracket pressure, including PV module weight.

3.3.3 For your safety, please do not work on the roof without PPE(Personal Protective Equipment) which include but not limited to fall protection, ladders or stairs and personal protective measures.

3.3.4 For your safety, please do not install or handle modules in unsafe conditions including but not limited to strong wind or gust, damp or sandy roofs.

3.3.5 Installing solar photovoltaic systems requires specialised skills and knowledge.

3.3.6 Installation should only be performed by qualified personnel.

3.3.7 Installers should assume all risks of injury that might occur during installation, including, but not limited to, the risk of electric shock.

3.3.8 One single module may generate more than 30V DC when exposed to direct sunlight. Contact with a DC voltage of 30V or more is potentially hazardous.

3.3.9 Do not disconnect whilst the unit is under load.

3.3.10 Photovoltaic solar modules convert light energy to direct current electrical energy.

3.3.11 They are designed for outdoor use. Modules can be mounted on the ground, on vehicles or boats. The proper design of support structures lies within the responsibility of the system designers and installers.

3.3.12 When installing the system, abide to all local, regional and national statutory regulations. Obtain a building permit if necessary.

3.3.13 The electrical characteristics are within ± 10 percent of the indicated values of I_{sc} , V_{oc} and P_{max} under standard test conditions (irradiance of 100 mW/cm², AM 1.5 spectrum, and a cell temperature of 25 °C (77 °F)).

3.3.14 Only use equipment, connectors, wiring and support frames suitable for solar electric systems.

3.4 Electrical Performance Safety

PV modules can produce DC current under illumination, any contact of the exposed metal of the modules connection wires may result in electrical shock or burn. Any contact of 30V or larger DC Voltage can be fatal.

If there is no connected load or external circuits, the modules can still produce voltage. Please use insulation tools and wear rubber gloves when operating modules in direct sunlight.

There is no off switch on the PV modules. Operating of PV modules can only be stopped when they are kept from sunlight or covered by hard board or UV-proof materials.

To avoid electric arc or electric shock hazards, please do not perform any electrical work in loaded conditions. Incorrect connections will also lead to electric arc or shock. Keep connectors dry and clean and make sure that they are in good operating condition. Do not insert other metals into the connectors or carry out electric connection by any other means.

Snow, water and other reflective mediums in surrounding environments that intensify light re-reflection will increase output current and power. This leads to the modules voltage and power increasing under low temperature conditions.

If the module glass or other sealing materials are damaged, please wear PPE(personal protective equipment) and then isolate the modules from the circuit.

Do not operate when modules are wet unless you wear PPE(personal protective equipment). Please follow the cleaning requirements in this manual when cleaning modules.

Do not allow the connectors contact with the following chemicals: Gasoline, White Flower oil, Woodlock oil, Mold, Temperature oil, Engine oil (such as KV46), Grease (such as Molykote EM-50L), Lubricating oil, Rust-proof oil, Stamping oil, Diesel, Cooking oil, Acetone, Alcohol, Essential balm, Bone-setting liquid, Banana oil, Release agent (such as Pelicoat S-6, Adhesive and potting materials capable of generating oxime gas (such as KE200、CX-200、chemlok), TBP, cleaning agent etc.

3.5 Operation Safety



Figure 4 operation safety diagram of module

- (1) Only open the package when you are ready for installation.
- (2) Do not damage the package and do not drop packaged modules on the ground.

- (3) Do not exceed the indicated maximum layer limit on the packaging carton when piling modules up.
- (4) Only unpack the modules in water-proof and dry places.
- (5) Follow unpacking instructions when Opening packaging carton.
- (6) Carrying modules whilst the junction box or wires are connected is strictly forbidden.
- (7) Do not stand or walk on the modules.
- (8) Do not place or rest any heavy object on the module as the glass will break.
- (9) Take extra care when placing the modules at corners in particular.
- (10) Do not try to dismantle the module or remove nameplate or parts of modules.
- (11) Do not paint or apply any other adhesives on the modules.
- (12) Do not damage or scratch the backsheet of the modules.
- (13) Do not drill holes on the frame of the module, this may reduce the frame loading capacity and lead to frame corrosion and invalidation of the limited warranty.
- (14) Do not scratch the anodic coating of aluminum alloy frame except for grounding the connection. Scratches may lead to frame corrosion and reduce frame loading capacity and long-term reliability.
- (15) Do not repair problematic modules on your own.

3.6 Fire Safety

Please refer to local laws and regulations before installing modules and abide by any requirements on building fire protection. According to the corresponding certification standards, the fire rating of Ulica modules is Class C. The roof you install onto should be coated by a layer of fireproof materials with suitable fire protection rating. Ensure that the back sheet and the mounting surface are fully ventilated. Different roof structures and installation modes will affect performance of the buildings fireproofing. Improper installation may lead to the risk of fire.

To guarantee the roofs fire rating, the distance between module frame and roof surface must be $\geq 10\text{cm}$.

(4in) Connect the proper module accessories such as a fuse, circuit breaker and grounding connector according to local regulations.

Please do not fit the modules where they may be exposed flammable gases.

3.7 Unload/Transportation

Precautions and general safety rules:

3.7.1 The modules should be stored in the original packaging before installation. Protect the package from damage. Unpack the modules as per the recommended unpacking procedures. The whole process of unpacking, transport and storing should be handled with care.

3.7.2 Do not stand, climb, walk or jump on unpacked pallets of modules.

3.7.3 Before installation, ensure that all modules and electrical contacts are clean and dry.

If the modules are required to be stored temporarily, they should be stored in dry and ventilated conditions.

3.7.4 Unpacking must be carried out by two or more persons with non-slip gloves; Do NOT handle the modules over-head or stack the modules. It is forbidden to use the wires or junction boxes of the modules to carry the modules

3.7.5 Do not put the modules in a place that is not supported or stable.

3.7.6 Do not allow the modules to come in contact with sharp-pointed objectives to prevent them from scratches, avoiding a direct impact on the safety of modules.

3.7.7 Do not remove the original packaging if the modules require long-distance transport or long-term storage.

3.7.8 The finished package can be transported by land, sea or air. During transport, make sure that the

package is fixed with packing straps, securely to the shipping platform without movement.

3.7.9 Transport: Do not stack more than two layers on truck.

3.7.10 One layer stacking is only allowed for small truck. Make sure that the package is fixed with packing straps securely to the shipping platform without movement.

3.7.11 One layer stacking is only allowed for transport at the project site.

4. Unload/ Transportation/ Storage

Please make sure to have sufficient safe distance during forklift operation to prevent people from standing or passing on both sides.

When unloading using a forklift, particular care should be taken to control the travel speed and prevent tilting during cornering.

In any circumstances, for vertical landscape packages, it shall not be stacked more than two layers; for vertical portrait (only 210cell series modules) packages, stacking is not allowed, if there are special needs, please contact the retailer.

The working ground needs to be level so that the packaging box can be placed horizontally and steadily to avoid tipping.

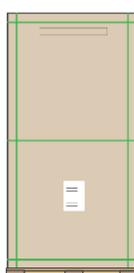
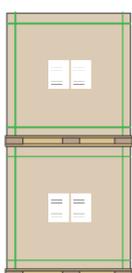
- Examples of vertical landscape packages (short-side vertically placed) and vertical portrait packages (long-side vertically placed) are below:



Vertical landscape package
(short-side vertically placed)



Vertical portrait package (long-side vertically placed)



4.1 Unloading

Upon arrival of the modules, please check the packaging is in good condition, and if the module type and quantity on the outer packaging are consistent with the your order, if anything is wrong, please contact the retailer.

4.1.1. Unloading with a crane

When a crane is used to unload the modules, please use specialised tooling according to the weight and size of the module. Please adjust the position of the sling to keep the modules steady. To ensure the safety of the module, wooden sticks, boards or other fixtures of the same width as the outer packing should be used on the upper part of the box to prevent the sling from squeezing the pallet and damaging the modules. When placing the modules, do not lower the packing box too quickly and put it on a flat ground.

For vertical landscape packages, do not lift up more than FOUR pallets of modules at once; for vertical portrait packages, do not lift up more than TWO pallets of modules at once.

Do not unload modules in extreme weather conditions for example, strong winds, heavy rain or heavy snow.

4.1.2. Unloading with a forklift

The loading dock should be at the same height as the underside of the carrier.

The forklift should be driven at a controlled speed of ≤ 5 km/h in straight, and ≤ 3 km/h for turning, so as to avoid sudden stop and rapid start.

Since the packing box will block the sight of the forklift driver, it is recommended to drive backwards during the forklifting, and arrange for special supervision and command to prevent bumping into people or items causing personal injury or damage to the modules.

Please choose a flat and solid ground to place the module package after transportation to the installation site.

4.1.3. Forklift operation in warehouse

When using a forklift to unload the modules, please choose a forklift with suitable tonnage according to module weight. The forks should go into the pallet at least 3/4 of the pallet depth during unloading (the forks length $L \geq 3/4$ of pallet length).

In order to ensure better stability during forklift transport, the forks distance (W) should be adjusted to the maximum position without any interference.

Please drive slowly and do not allow forks to hit the cartons or pallets. Please place buffer protection material (in yellow, preferably silicone, rubber, EPE) in advance to prevent the inside modules being damaged due to the external force.

It is recommended to extend the height or width of the forklift backrest to prevent direct contact with the module glass.

Please also pay attention to the following precautions when unloading (taking vertical portrait packages as an example).

- (1) Prevent collision on the top when unloading from the container.
- (2) It is recommended to secure the module package to the forklift with a safety rope, and transport horizontally with no one standing on either side.
- (3) Control the speed to prevent tipping.
- (4) Ensure there is no collision on the module glass.
- (5) Ensure you store the packages straight and not tilted to prevent damage.

4.1.4. Forklift operation at project site

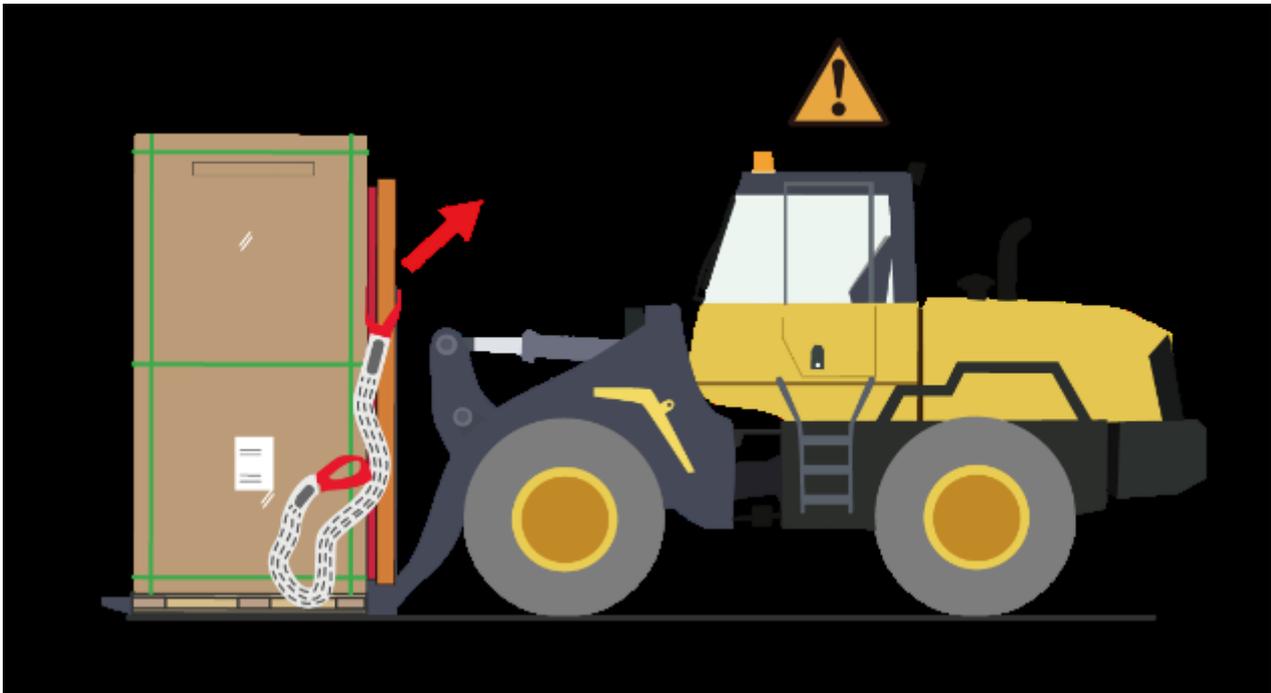
The forklift operation at the project site refers to the transportation of modules between the storage site and the installation site after they arrived at the project storage site.



Vertical portrait package (long-side vertically placed), the forklift must be operated from the long side of the pallet (forks enter slowly into the pallet from the long side). Do not collide with the module. Both sides of the beam shall contact with the package at the same time.



Vertical portrait package (long-side vertically placed), the forklift must be operated from the long side of the pallet.



Place the module package smoothly on the ground, untie the safety rope after the confirming there is no risk of tilting.



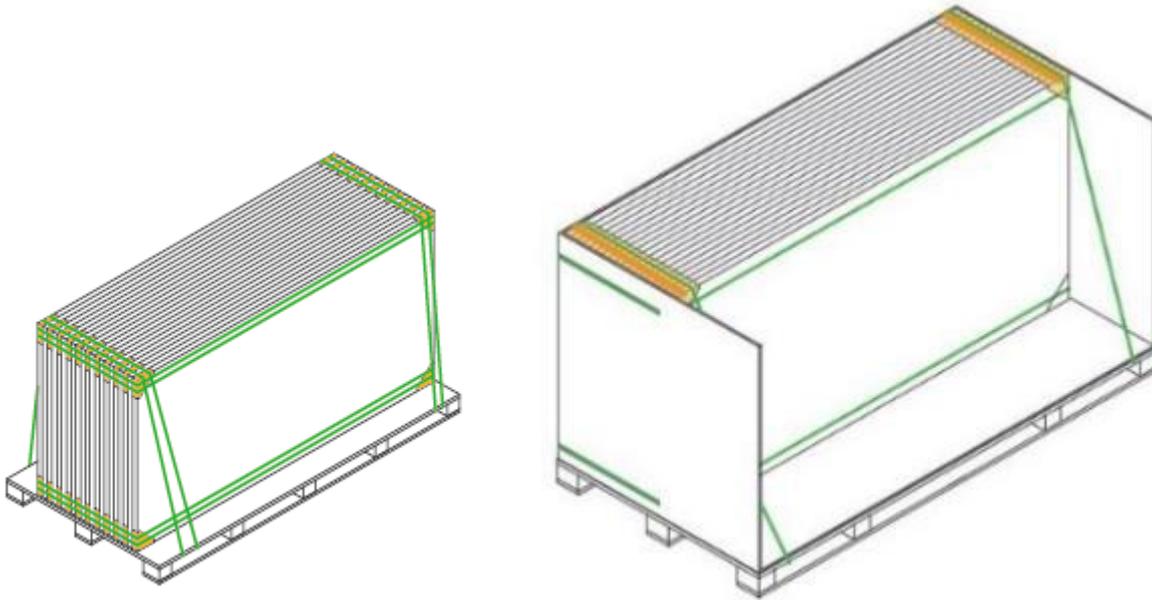
Exit the forklift slowly.

4.2 Secondary Transportation

The packaged modules can be transported by land, sea or air. During transportation, make sure that the package is securely fixed with packing belts onto the shipping platform. There should be no movement. If the unpacked modules need to be transported to other places, it is recommended to pack a single module together in a package to the maximum number allowed, and secure them with inner packing belts (2100N force recommended). Finally, cover it with the packaging carton box and fix it with the same number of packing belts as before.

If the number of modules need to be packed is less than the maximum number allowed in a package, the

modules need to be fixed and secured to the center of the pallet for utility packaging (the following figure to the left) or on the side for distribution packaging (the following figure to the right), and fixed with inner packing belts (2100N force recommended). Finally, cover it with the packaging carton box and fix it with the same number of packing belts as before. Do not put the unfulfilled package on the lower layer when transported.



Please use appropriate means of transport to transport the modules. Do not use pedicab to transport or handle the modules.

Secondary transport is not allowed for the monofacial modules that are packaged horizontally.

There is no stacking of pallets allowed (for both vertical landscape and vertical portrait packages), when transporting with small trucks. Please fix the package to the vehicle using safety ropes and control the driving speed according to the road conditions. Please put a paper corner support or other buffer material between safety rope and carbon box to protect modules from damage.

When using a box trucker and a flatbed trucker transport the modules, the module packages should be placed close to each other without any gap. The empty space needs to be filled to prevent the package moving backwards to the rear of the truck. Additionally, every package needs to be fixed using ropes to the vehicle when transporting with the flatbed trucker.

Do not allow pallets to exceed the loading area of the transport vehicle.

4.3 Storage

Modules should be stored in a dry and ventilated environment on a flat ground (for vertically portrait package, the inclination of ground need to be less than 8 °), to avoid damage or dumping of the modules due to ground deformation or collapse.

Storage requirements: relative humidity < 85% and temperature range of -40 °C to 50 °C.

Do not remove the original package and keep the wrapping film and carton box in a good condition, in case the modules require long-distance transportation or long-term storage.

For long-term storage, it is recommended to store the modules in a standard warehouse with regular inspection, and confirm your personal safety before reinforcing the package in a timely manner if any anomalies are found.

The warehouse shelves should have sufficient carrying capacity and storage space, regular inspection is required to ensure the safe storage.

If you need to store the modules in the project site, do not choose soft ground or ground that is liable to

collapse. You should choose a hard ground or a higher ground with flat surface to ensure the module packages will not collapse or tilt.

In rainy weather, please fully cover the modules and pallets with a rain protection cover and take moisture-proof measures on pallets and cartons to prevent collapse and moisture ingress. In sunny or windy conditions, remove the rain cover to check for any water ingress. If there has been water ingress allow the package to dry as soon as possible to prevent the packaging collapsing.

Do not allow the pallets to soak in water. Ground drainage measures need to be taken and ensured prior to storing the modules in any place.

Do not allow unauthorised persons to access the module storage area.

The modules should be centrally stored.



5 .Unpacking Introduction

5.1 Unpacking Safety

Before unpacking, please check the product type, power bins, serial number and relevant suggestions on the A4 paper of the packaging box, and read the unpacking instructions carefully. Do not unpack the modules in any other way.

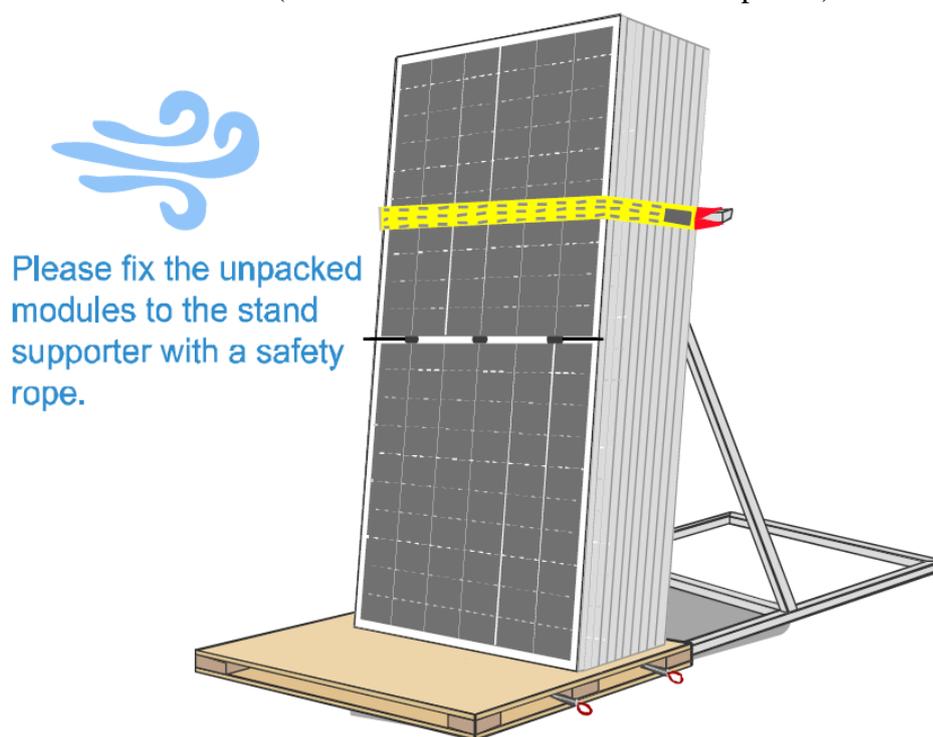
Before unpacking, please make sure that the packaging box is in good condition, it is recommended to use a knife to remove the packing belt and wrapping film. Take extra care during this, if you push too hard you will damage the module and this will not be covered under your warranty.

Please check that the number of modules in the box and the barcode information on the module frame are consistent with the information on the A4 paper on the packaging box.

Please follow the recommended unpacking steps to unpack the modules. Unpacking, must be done by two or more people at the same time. Always wear insulating gloves when handling the modules.

If all the modules are not taken out after unpacking, the remaining modules shall be placed horizontally and repackaged to prevent them from tipping. When packaging, please note that the glass on the bottom module should face up, the glass on the middle modules should face down, and the glass on the top module should face up. Stacks of modules should contain no more than 16 modules, and the frames should be aligned.

If the unpacked modules are not installed immediately, they should be fixed to the stand supporter with a safety rope out of the effects of weather. (the modules should be less than 12 pieces).



In windy weather, it is recommended not to carry the modules, and the unpacked modules should be properly secured.

Do not unpack the modules outside in rainy or snowy conditions.

One person should not carry the module to prevent the module from slipping and hitting other modules, causing scratches, cracks, or deformation or personal injury.

Do not lift the modules by their cables or the junction box.

Before removing the inner packing belts, please take measures to protect the modules from falling over.

If you are unpacking the vertical landscape packages on non-horizontal ground, anti-tilting measures should be taken.

The vertical portrait packages have a high center of gravity and it is prohibited to unpack these on a non-horizontal or soft ground to avoid personal injury or death.

When unpacking a vertical portrait package, do not stand on the back of the stand supporter, please operate in strict accordance with the requirements of the unpacking instructions.

When removing the packing belts for a vertical portrait package, take care not to hurt yourself (face, eyes, etc.).

Do not stand on the pallet during unpacking, please carry the modules using the sides of the pallet.

Do not move the stand supporter during unpacking to prevent the modules being tilted.

Do not lean the module on any instable objects, such as poles or mounting columns.

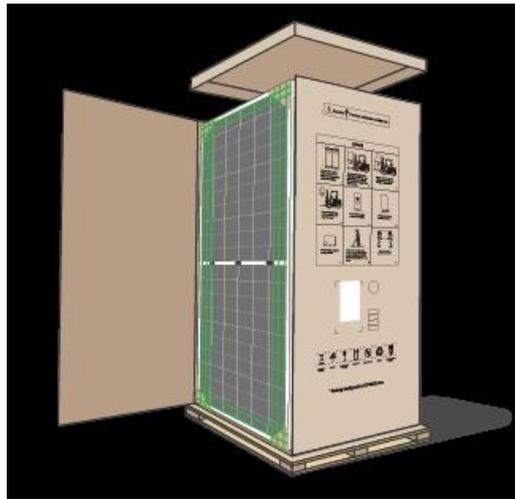
Do not support the back of the modules directly with materials such as wooden strips or hard materials.

5.2 Unpacking steps

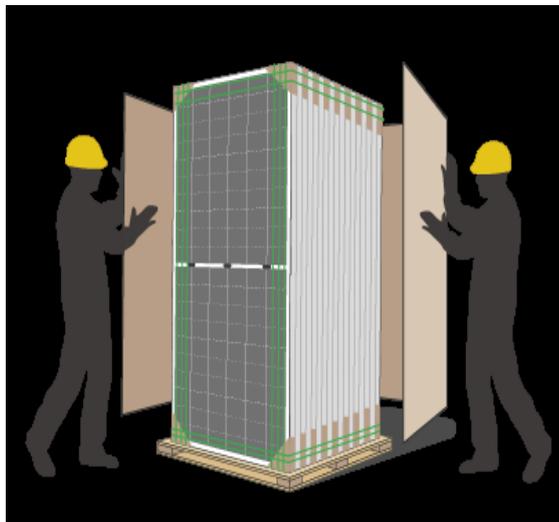
Method A (Vertical portrait package, long-side vertically placed): Unpacking for UL-660M-132HV etc. series modules with vertical portrait package.



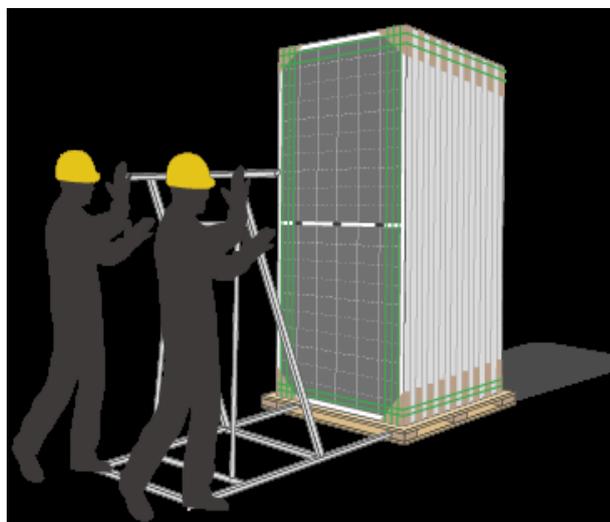
Step1



Step2



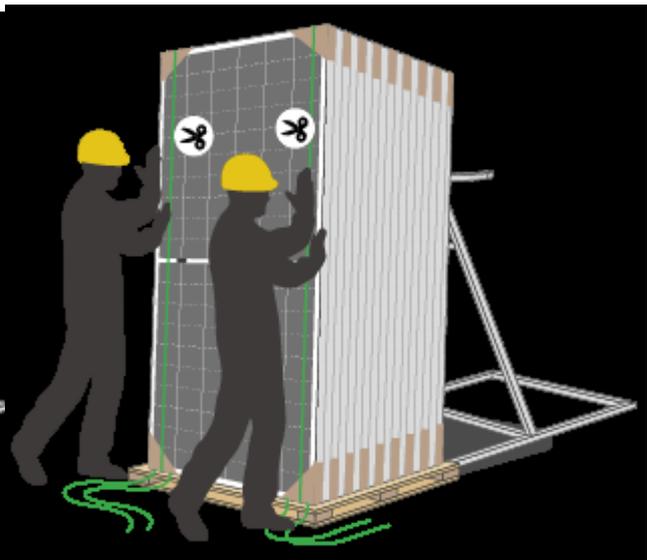
Step3



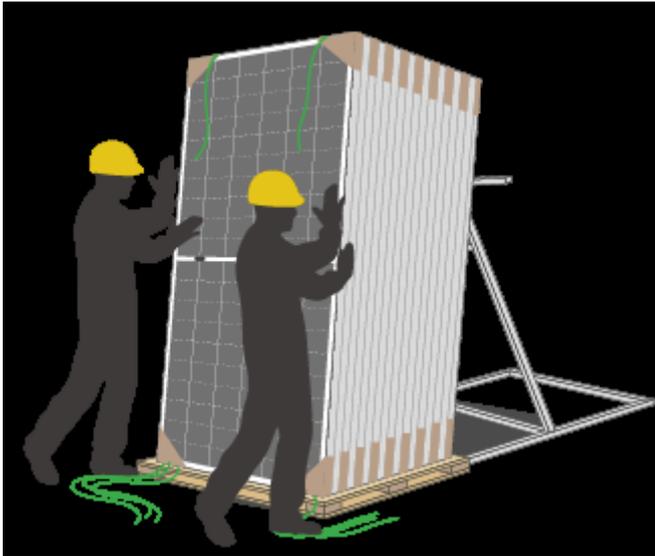
Step4



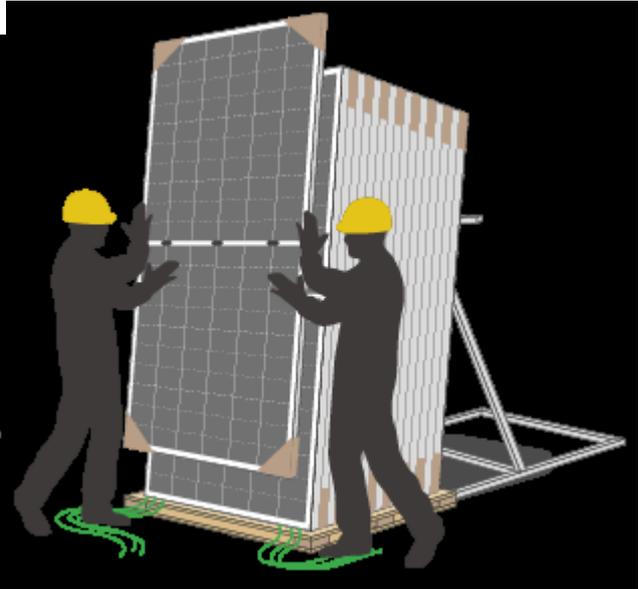
Step5



Step6



Step7



Step8

Unpacking steps as below:

Step 1 - Remove the wrapping film and packing belts.

Step 2 - Remove the top cover and sealing tape.

Step 3 - Remove the carton box.

Step 4 - Place the stand supporter in place supporting the glass or back sheet side.

Step 5 - Cut off the horizontal packing bets.

Step 6 -When there are 1-2 vertical packing belts remaining, push the module gently to tilt toward the stand supporter.

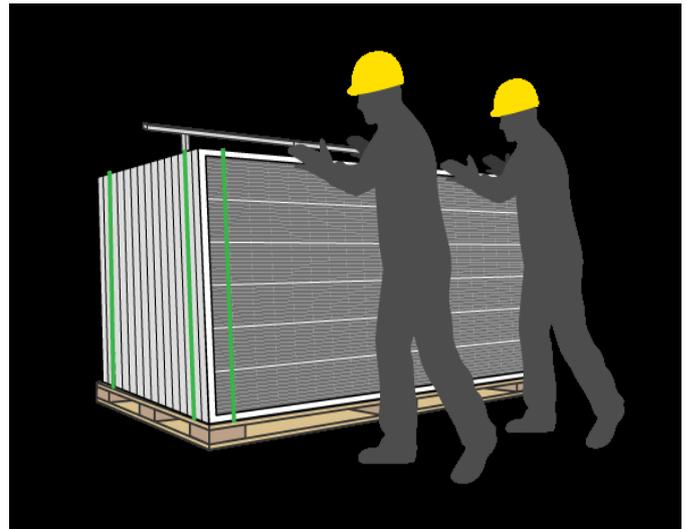
Step 7 Cut off the remaining packing belts so that the modules rest on the stand supporter.

Step 8 Take out the modules in order.

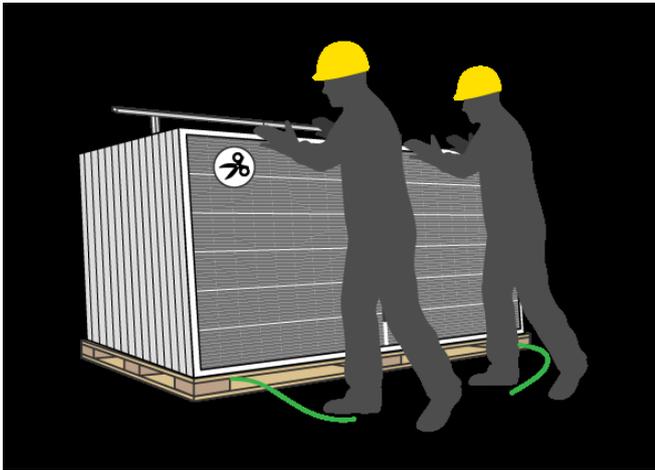
Method B(Unpacking for vertical landscape package, short-side vertically placed), Unpacking for modules that power less than 560W.



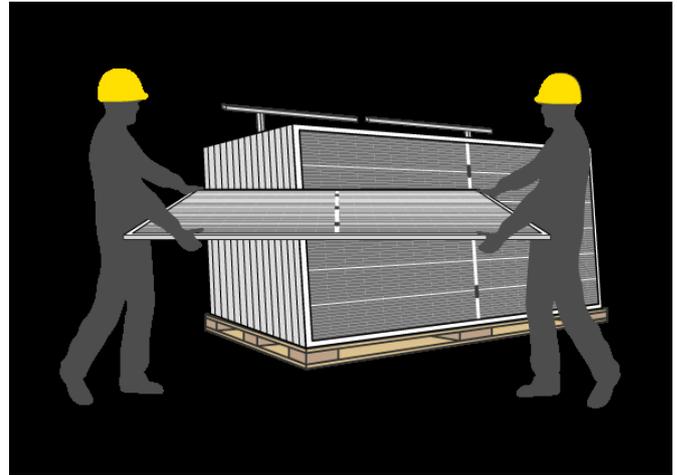
Step1



Step2



Step3



Step4

Step 1 Remove the wrapping film and packing belts.

Step 2 Remove the top cover and sealing tape.

Step 3 Place the stand supporter so that it is higher or wider than the module in order to avoid hitting and damaging the glass.

Step 4 Cut off all the horizontal packing belts; when there are 1 or 2 vertical packing belts remaining, push the module gently to tilt toward the stand supporter.

Step 5 Cut off the remaining packing belts.

Step 6 Take out the modules in order.

6. Installation Conditions

6.1 Installation Site and Working Environment

- (1) The modules cannot be used in space.
- (2) Do not manually focus sunlight with mirrors or magnifying glass onto modules.
- (3) Ulica modules shall be installed on proper buildings or other appropriate places (such as ground, garage, building outer wall, roof, PV tracking system) but shall not be installed on any vehicles.
- (4) Do not install modules at places that are possible to be flooded.
- (5) Ulica suggests that modules be installed in a working environment with the average temperature of -20°C to 50°C . The extreme working environment temperature for modules is -40°C to 85°C .
- (6) Make sure that installed modules do not suffer wind or snow pressure that exceeds the permissible maximum load limit.
- (7) Modules shall be installed in places free from shadowed areas throughout the year. Make sure there are no light-blocking obstacles in the installation sites.
- (8) Carry out lightning protection for modules installed in places with frequent lightning and thunder.
- (9) Do not install modules in places with possible flammable gases.
- (10) Modules cannot be used in environments with excessive hails, snows, flue gas, air pollution and soot or in places with strong corrosive substances such as salt, salt mist, saline, active chemical steam, acid rain, or other substances corroding modules, affecting modules' safety or performance.
- (11) Please take protective measures to ensure reliable and safe installation of the modules in severe environments such as heavy snow, cold and strong wind or islands close to water and salt mist or deserts.

(12) Ulica modules passed the IEC61701 salt spray corrosion test, but the corrosion may still occur on the modules where the frame is connected to the bracket or where the grounding is connected. In case Ulica modules are installed 50m –500m away from the ocean side, stainless steel or aluminum materials need to be used to connect the PV modules, and the connection point should be protected with anti-corrosion measures. If it needs to be installed within 50m of the sea or on the sea or beach, please contact the retailer.

6.2 Selection of Tilt Angles

Tilt angle of modules: The angle between module surface and horizontal surface; the module will obtain the maximum power output when facing direct sunlight.

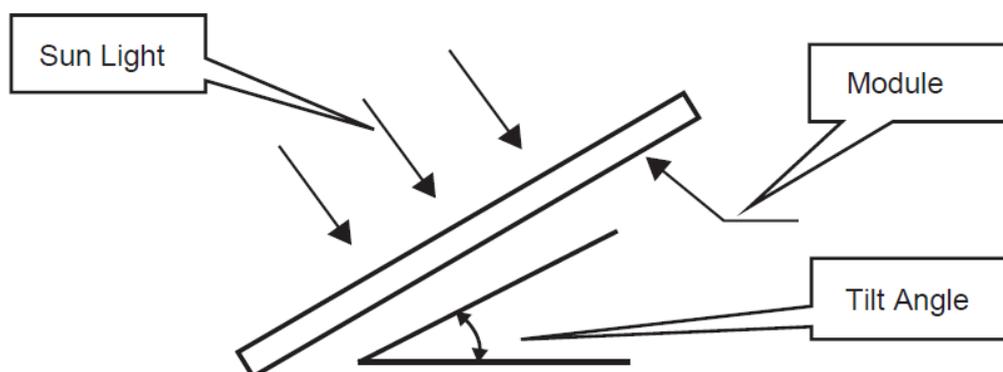


Figure 5 Schematic diagram of component inclination

Modules are preferred to be south-facing in the northern hemisphere and north-facing in the south hemisphere. Please refer to standard modules installation guideline or suggestions from experienced PV module installer, for the specific installation angle.

Ulica suggests that tilt angle of module installation be no less than 10°, so any surface dust can be washed away easily by rainfall and reducing the frequency of manual cleaning. In that case, the PV's generation will difficult to guarantee. If the tilt angle of module installation less than 5°, dust can cause some cells to create hot spots and pollutants and reduce power generation, even with regular maintenance, the power generation may not meet the expectations. Installing the module at a tilt angle of 1° or less is strictly prohibited, and will invalidate your warranty.

Ensure there is adequate drainage to avoid water marks on the glass due to the prolonged pooling of water which may affect module appearance and performance.

Ulica modules connected in a line should be installed with the same orientation and tilt angle. Different orientations and tilt angles may result in different received solar irradiation and output power loss. In order to achieve the maximum annual generating capacity, the optimal orientation and inclination of PV modules in the installed area should be selected to ensure that sunlight can still reach to modules even on the shortest day of the year.

If Ulica modules are used in an off-grid System, the tilt angle should be calculated based on the seasons and irradiation to maximise the output power. If the modules output power meets the acquired load under the period of the worst irradiation in the year, the modules should be able to meet the load of the whole year. If the Ulica modules are used in a grid-connected system, the tilt angle should be calculated based on the principle to maximise the yearly output power.

7. Mechanical Installation

7.1 Regular Requirements

- (1) Your installer should provide the bracket system and ensure the system meets the load requirements. The installation bracket system shall be approved to be used in the local area you are installing the modules, in line with all regulations.
- (2) The module bracket shall be made from durable, corrosion resistant, UV-proof materials.
- (3) Modules shall be fixed on the bracket solidly.
- (4) Use higher fitting brackets in areas with heavy snow accumulation so the lowest point of the modules will not be covered or shaded by snow for a long time. In addition, make the lowest point of modules high enough so as to avoid shading of vegetation and woods which reduces damage from sands and stones.
- (5) If modules are installed on brackets parallel to a roof or wall, the minimum gap between the module frame and the roof/ wall shall be 10cm for air ventilation. Failure to do so can cause module wire damage.
- (6) Make sure the building is suitable for installation before installing modules on a roof. It is crucial to ensure everything is sealed properly to prevent a leakage.
- (7) The module frames can be affected by thermal expansion and cold contraction so the frame interval between two adjoining modules shall be no less than 10mm.
- (8) Make sure that back sheet of the modules will not be in contact with the bracket or building structures as they can pierce the modules, especially when the module surface is under by pressure.
- (9) The maximum static load of the PV module is a down force of 5400pa and a uplift force of 2400pa. This can vary depending on the mounting method of the modules (please refer to the following installation guidance), the described load in this manual is for the test load.
- (10) Note: on the basis of IEC61215 - 2016 installation requirements, when calculating the maximum load of each mechanical fixing, you will need to consider a safety factor of 1.5 times.
- (11) Modules can be installed horizontally or vertically. When installing the modules, be cautious not to block the drain hole on the frame.

7.2 Monofacial Assembly Mechanical Installation

The module and bracket system installation can be secured by utilising the mounting holes, clamps or embedded systems. Installation shall follow the demonstration and suggestions below. Failure to follow these instructions can lead to modules being damaged and invalidation of your warranty.

7.2.1 Bolts Mounting

Fix the modules onto the brackets using the bolts through the mounting holes on the back frame of the module. See details in Figure 6.

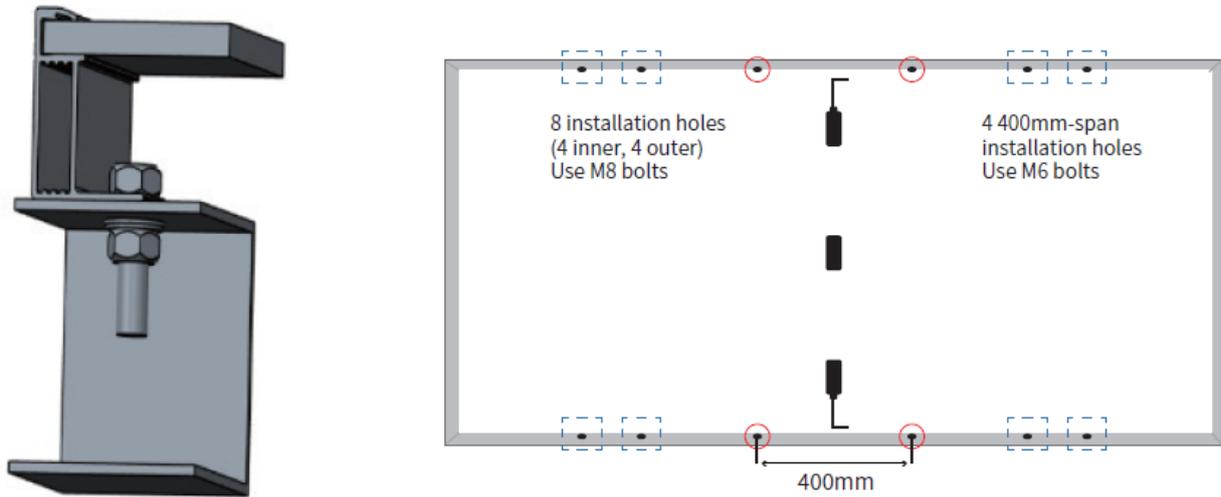
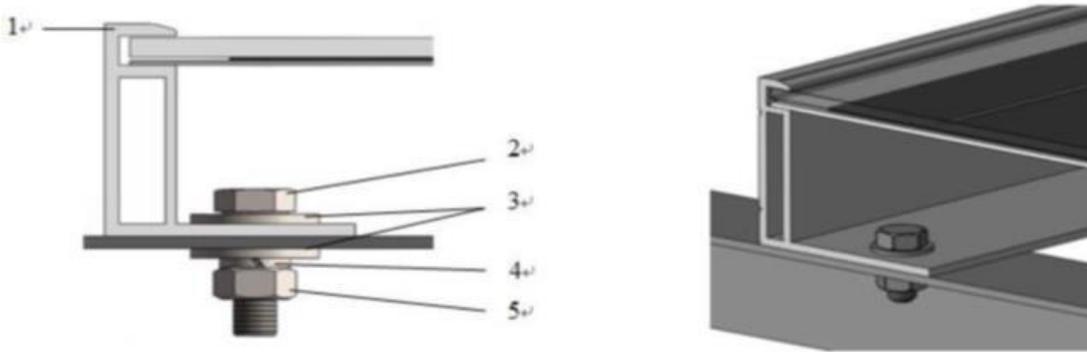


Figure 6 Schematic diagram 1 of monofacial module with bolt Installation



1. Aluminum alloy frame 2. M8 stainless bolt 3. Flat stainless washer 4. Spring stainless washer
5 HEX stainless nut

Figure 7 Schematic diagram 2 of monofacial module with bolt

Installation Recommended accessories are as below :

Accessories	Model	Material	Note
Bolt	M8 (full thread recommended)	M6 (full thread recommended)	Accessories material selection should be based on application environment.
Washer	2*8	2*6 (6.4*18-1.6 ISO 7093)	
Spring Washer	8	6	
Nut	M8	M6	

Table 2 Recommended materials of module with bolt Installation

Suggestion :

- (1) M8 bolt tightening torque range: 14N•m-18N•m; M6 bolt tightening torque range: 8N•m-12N•m;
- (2) When using Ulica 30mm (30H) height frame module, it is recommended to select $L \leq 20$ mm length fasteners.

7.2.2 Clamp Mounting

The module can be mounted by a dedicated clamp, as shown in Figure 8.

Under no circumstances should the clamp touch the glass or deform the frame. The placement of the clamp on the front of the frame must be level to prevent damage to the frame or other components.

Ensure the clamp position is not creating a shadow on the modules.

Do not obstruct the drain hole.

For the framed PV module, the clamp must overlap by 8-11 mm with the frame of the module (you can change the cross section of the clamp if the module is securely installed). For the frameless PV module, the clamp must overlap by a maximum of 15 mm with the module.

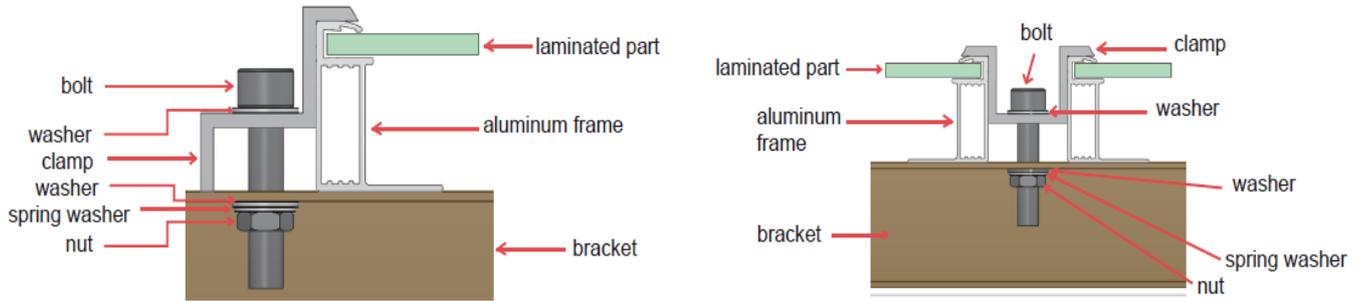


Figure 8 Clamp Installation of Monofacial Module

7.2.3 Installation and Mechanical Load of Monofacial Module

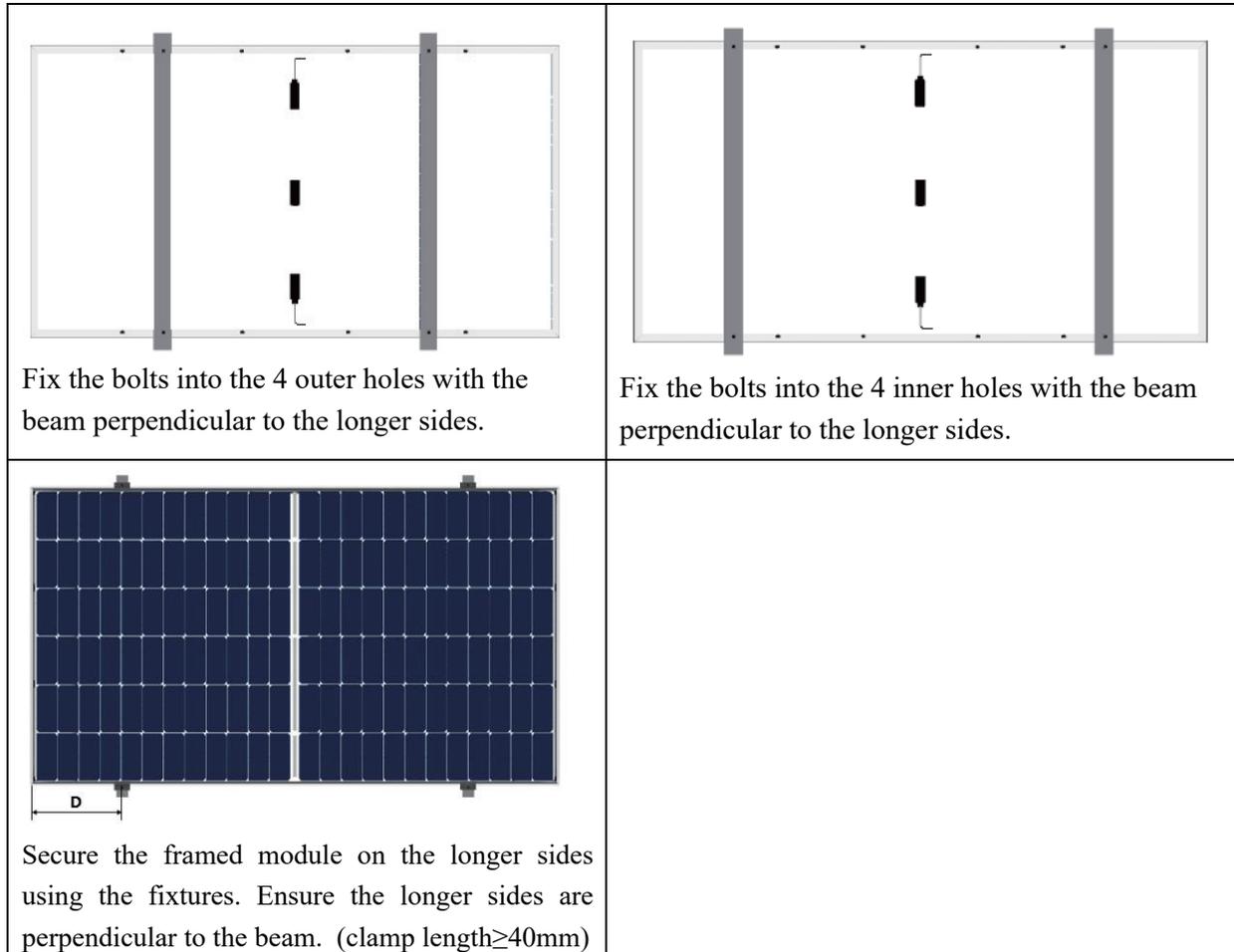


Figure 9 Monofacial Module Installation Annex

Monofacial Modules model: Your model is in bold.

Module type	Cell type	Cell quantity	Dimensions (mm)	Length of cable (mm) positive/ negative	Flame Dimensions (mm)
UL-xxx M-120 (166)	166*166	6*10*2	1755*1038*30	400/200	30*30
UL-xxx M-108 (182)	182*182	6*9*2	1722*1134*30	400/200	30*30

UL-xxx M-108 (188)	182*188	6*9*2	1762*1134*30	400/200	30*30
UL-xxx M-108 (191.6)	182*191.6	6*9*2	1800*1134*30	400/200	30*30
UL-xxx M-120 (188)	182*188	6*10*2	1952*1134*30	400/200	30*30
UL-xxx M-144 (166)	166*166	6*12*2	2094*1038*35	400/200	35*35
<u>UL-xxx M-144 (182)</u>	<u>182*182</u>	<u>6*12*2</u>	<u>2279*1134*35</u>	<u>400/200</u>	<u>35*35</u>
UL-xxx M-144 (191.6)	182*191.6	6*12*2	2382*1134*30	400/200	30*30
UL-xxx M-132 (210)	210*210	6*11*2	2384*1303*35	400/200	35*35

Table 3 Ulica's Monofacial Modules

These installation mode are Ulica's recommended installation method.

Load Capacities of Framed Monofacial modules:

Installation Method Module Type	Installation with bolts		Installation with fixtures
	4 outer holes (beam perpendicular to long sides)	4 inner holes (beam perpendicular to long sides)	1/4L-50≤D≤1/4L+50 (L= long frame length , beam perpendicular to long sides)
UL-xxx M-120 (166)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-108 (182)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-108 (188)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-108 (191.6)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-144 (166)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
<u>UL-xxx M-144 (182)</u>	<u>Down force load ≤2400Pa, Uplift load ≤2400Pa</u>	<u>Down force load ≤5400Pa, Uplift load ≤2400Pa</u>	<u>Down force load ≤5400Pa, Uplift load ≤2400Pa</u>
UL-xxx M-144 (191.6)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-120 (210)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa
UL-xxx M-132 (210)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa

Table 4 Down force load and Uplift load with different Installation mode

The following installation methods and mechanical loads have been verified by the Ulica Solar's Laboratory for PV Science and Technology. The following installation methods are the easiest and simplest ways to install the modules, however they are not the most secure or the best. We recommend a professional decides how to install in your area for optimum results and to ensure a long lifespan. The common advantages of simple installation methods are that they are convenient and less costly. The disadvantage is that after installation, the anti snow load capacity of the components may be weak, which can easily lead to component fragmentation. Do not use this method in areas with snow cover greater than 0.5 meters.

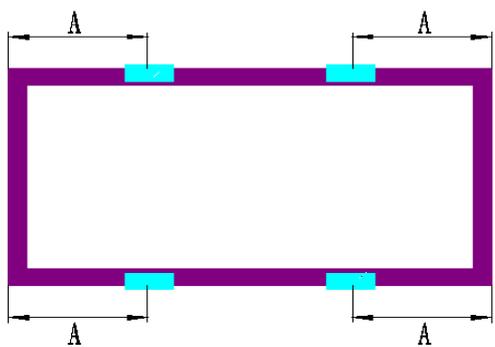
The installation of clamps only on the short sides can cause a slight bending and deformation of the aluminum frame due to the large span of the modules. Customers who are concerned about this occurring should not use this method under any circumstances. A guide rail can be added into the middle of the long sides of the module so that the middle of the module does not sag or bend significantly.

L= long frame length
W= short frame length

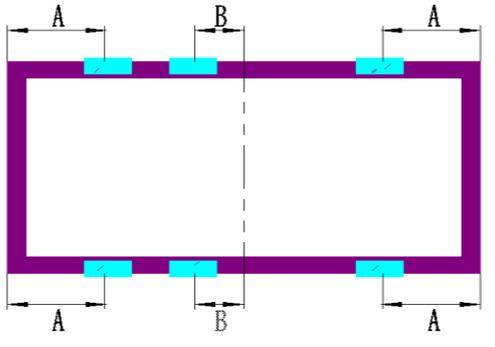
 <p>Use 4 clamps on the short sides. Mounting rails are to run perpendicular to the long sides of the frame. (Fixture length $\geq 40\text{mm}$, $1/4W-50 \leq A \leq 1/4W+50$, W= short frame length)</p>	 <p>Use 4 clamps on the short sides. No mounting rails are required. (Fixture length $\geq 40\text{mm}$, $1/4W-50 \leq A \leq 1/4W+50$, W= short frame length)</p>
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Load capacities of framed Monofacial modules:

Installation Method / Module Type	Use 4 clamps on the short side. Mounting rails run perpendicular to the long side frame. (fixture length $\geq 40\text{mm}$, $1/4W-50 \leq A \leq 1/4W+50$)	Use 4 clamps on the short side. No mounting rails (fixture length $\geq 40\text{mm}$, $1/4W-50 \leq A \leq 1/4W+50$)
UL-xxx M-120 (166)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$
UL-xxx M-108 (182)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$
UL-xxx M-108 (188)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$
UL-xxx M-108 (191.6)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$
UL-xxx M-144 (166)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$
<u>UL-xxx M-144 (182)</u>	<u>Down force load $\leq 1200\text{Pa}$, Uplift load $\leq 1200\text{Pa}$</u>	<u>Down force load $\leq 1200\text{Pa}$, Uplift load $\leq 1200\text{Pa}$</u>
UL-xxx M-144 (191.6)	N/A	N/A
UL-xxx M-120 (210)	N/A	N/A
UL-xxx M-132 (210)	N/A	N/A



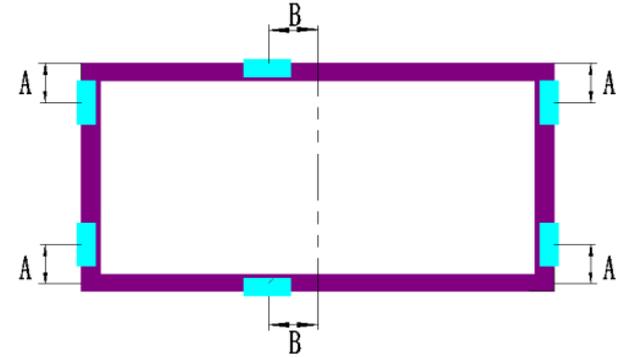
Use 4 clamps on the long sides. No mounting rails are required.
(Fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$)



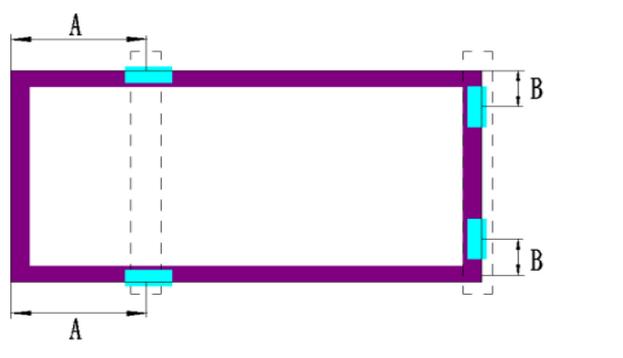
Use 6 clamps on the long sides. No mounting rails are required. (Fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$, $B = (0 - 50)$ mm)

Load capacities of framed Monofacial modules:

Installation Method / Module Type	Use 4 clamps on the long side. No mounting rails (fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$)	Use 6 clamps on the long side. No mounting rails (fixture length $\geq 40\text{mm}$, $A = 1/4L \pm 50\text{mm}$, $B = (0 - 50)$ mm)
UL-xxx M-120 (166)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 7200\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (182)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 7200\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (188)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 7200\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (191.6)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 7200\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-144 (166)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 7200\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-144 (182)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 6000\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-144 (191.6)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 6000\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-120 (210)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 6000\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-132 (210)	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 6000\text{Pa}$, Uplift load $\leq 3800\text{Pa}$



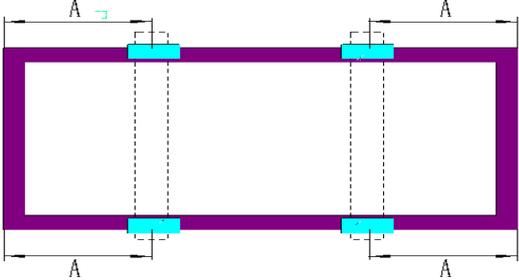
Use 4 clamps on the short sides and 2 clamps on the long sides. No mounting rails are required. (Fixture length $\geq 40\text{mm}$, $A = 1/4W \pm 50\text{mm}$, $B = (0 - 50)$ mm)



Use 2 clamps on the short sides and 2 clamps on the long sides. Mounting rails are to run perpendicular to the long side frame. (Fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$, $B = 1/4W + 50/-100\text{mm}$)

Installation Method / Module Type	Use 4 clamps on the short side and 2 clamps on the long side. No mounting rails. (fixture length $\geq 40\text{mm}$, $A = 1/4W \pm 50\text{mm}$, $B = (0 - 50)$ mm)	Use 2 clamps on the short side and 2 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length $\geq 40\text{mm}$, $A = 1/4L \pm 50\text{mm}$ mm, $B = 1/4W + 50/-100\text{mm}$)
UL-xxx M-120 (166)	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-108 (182)	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-108 (188)	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$

UL-xxx M-108 (191.6)	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-144 (166)	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
<u>UL-xxx M-144 (182)</u>	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-144 (191.6)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 1800\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-120 (210)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 1800\text{Pa}$, Uplift load $\leq 1800\text{Pa}$
UL-xxx M-132 (210)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 1800\text{Pa}$, Uplift load $\leq 1800\text{Pa}$

 <p>Slide-in rails on the short sides. No fixtures are required. Mounting rails are to run perpendicular to the long sides.</p>	 <p>Use 4 clamps on the long sides. Mounting rails are to run perpendicular to the long side frame. (Fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$)</p>
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Installation Method Module Type	Slide-in rails on the short side. No fixture. Mounting rails run perpendicular to the long side	Use 4 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length $\geq 40\text{mm}$, $A=1/4L \pm 50\text{mm}$)
UL-xxx M-120 (166)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (182)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (188)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-108 (191.6)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-144 (166)	Down force load $\leq 1600\text{Pa}$, Uplift load $\leq 1600\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
<u>UL-xxx M-144 (182)</u>	Down force load $\leq 1200\text{Pa}$, Uplift load $\leq 1200\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-144 (191.6)	N/A	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-120 (210)	N/A	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$
UL-xxx M-132 (210)	N/A	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 3800\text{Pa}$

8. Electrical Installation

Ensure there is no power to any component whilst you are installing.

8.1 Electrical Performance

The reported performance measurements are subject to +/-3% uncertainty at STC (1000 W/m² Irradiance, a cell temperature of 25°C and an AM1.5 spectrum) for voltage, current and power.

When modules are connected in a series this is referred to as a string connection, the strings voltage is the sum of all individual modules in the series added together. When modules are installed in a parallel connection, the current is the sum of all individual modules, as shown in below figure 13. Modules with different electric performance can not be connected in one string.

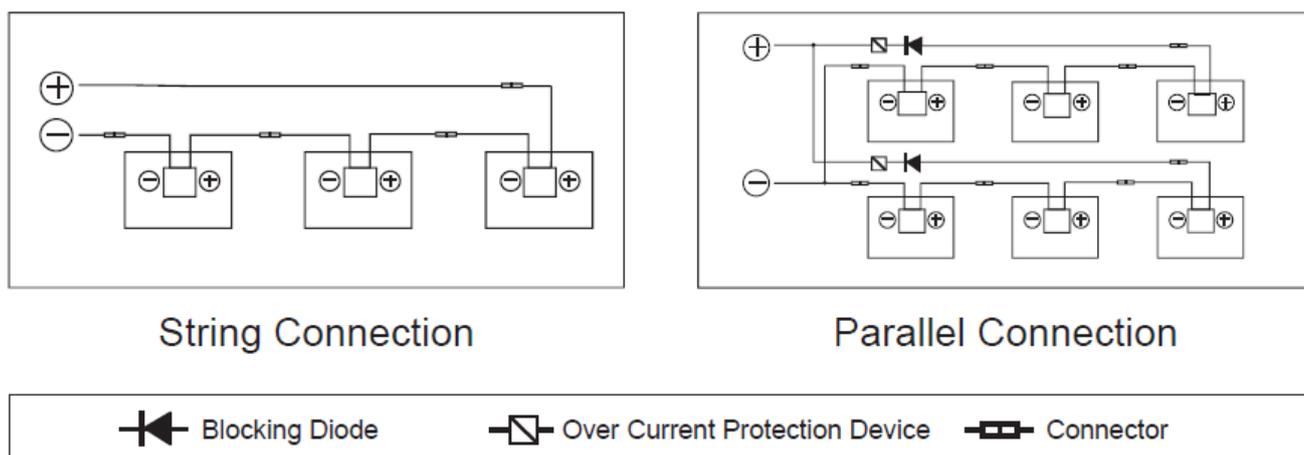


Figure 13 Series Connection and Parallel Connection Circuit Diagram

The maximum allowed quantity of modules in string connection shall be calculated according to applicable regulations. The open circuit voltage value at the expected lowest temperature shall not exceed the maximum system voltage value allowed by the modules and the other values required by DC electric parts. (Ulica modules maximum system voltage is DC1000V/DC1500V---the actual system voltage is designed based on the selected module and inverter model.)

The VOC factor can be calculated by the following formula. $C_{Voc} = 1 - \beta V_{oc} \times (25 - T)$ T: The expected lowest temperature of the installation site. β : VOC temperature coefficient (% /°C) (Refer to the modules data sheet for further details). If there is reverse current exceeding the maximum fuse current flowing through the module, use an over current protection device with the same specifications to protect the module; if your parallel connection has more than 2 modules, there must be an over current protection device on each string of modules.

8.2 Cables and Wiring

Only install junction boxes with a protection level of IP67 for on-site connections. This will provide environmental protection for the wires, the connections and for contact protection for non-insulating electric parts. Each module has two individual wires connecting the junction box, one is a negative pole and the other is a positive pole. To connect two modules in a series connection you need to insert the positive pole wire of one module into the negative pole of the adjoining module.

In accordance with local fire protection, building and electrical regulations, you will need to apply the proper cables and connectors; ensure the electrical and mechanical properties of the cables are suitable and compatible. (The cables should be put in a sleeve with anti-UV aging properties, and if exposed to air, the cable itself should have anti-UV aging capability). Only use single-wire cables, 2.5-16mm² (5-14 AWG), 90 °C , with the insulation capability to withstand the maximum open circuit voltage (such as EN50618 approval). Ensure you consider the specifications of the wires to reduce the voltage drop. Ulica requires that all wiring and electrical connections comply with the appropriate local regulations.

When you are fixing the cables to the brackets, ensure you avoid damaging any of the cables or modules. Do not use force to press the cables in place. Only use UV resistant cable ties and clamps to fix the cables onto the brackets. Although cables are UV resistant and water proof, it is still necessary to keep them from direct sun light and being immersed in water. The minimum bending radius of the cables should be 43mm. (1.69in)

8.3 Connector

Please keep the connectors clean and dry. Make sure the connector caps are fastened before connection. Do not connect the connectors if they are not in pristine condition. Avoid allowing the connectors to be in direct sun light, immersed in water or fall onto the ground or roof.

Incorrect connection may lead to an electric arc and electric shock. Please make sure that all electric connections are reliable and all connectors are fully locked.

Only compatible connectors can be connected, for example, the same model and from the same retailer.

8.4 Bypass diode

Ulica solar's module junction box contains a bypass diode which is in parallel connection with the cell string. If a hot spot occurs, the diode will activate to stop the main current from flowing through the hot spot cells, in order to prevent the module over-heating and loss of performance.

Please note: the bypass diode is not an over current protection device. If the diode is faulty or is suspected to be, please contact the retailer.

Please do not try to open the module junction box on your own.

8.5 PID

Protection and Inverter Compatibility.

PV modules may appear Potential Induced Degradation (PID) under high humidity, high temperature and high voltage condition. Modules may appear Potential Induced Degradation (PID) under the conditions below:

- (1) PV modules installed in hot and humid weather conditions.
- (2) The PV modules installation site is subject to long term humid conditions such as a floating PV system.
- (3) To reduce the risk of PID, on the modules DC connection site, it is recommended to connect the negative to ground.

The PID protection measures on system level are recommended as follow:

- (1) For an isolated PV inverter, the negative of the module's DC connection side can be directly grounded.
- (2) For a non-isolated PV inverter, an isolated transformer is to be installed before applying virtual grounding (follow the inverter's manufacturers guidance for the grounding method).

9. Grounding

The modules have an anodized corrosion resistant aluminum alloy frame for structural support. To protect modules from lightning and static-electricity damage, the module frame must be grounded.

The grounding device must be in full contact with inner side of the aluminum alloy and penetrate the surface's oxide film on the frame.

Do not drill additional grounding holes on module frame.

The grounding conductor or wire may be copper, copper alloy, or any other material acceptable for application as an electrical conductor as per local regulations. The grounding conductor must then make a connection to ground with a suitable ground electrode.

Holes marked with a grounding mark on the frame can only be used for grounding, never use these to mount the modules. The frameless double glass modules have no exposed conductor, meaning these do not require grounding.

Grounding methods below are permissible:

- (1) Grounding by grounding clamp.

There is a grounding hole with the diameter of $\varnothing 4.2$ mm at the edge of the module's back frame. The central line of the grounding sign located on the edge of the module's back frame overlaps with that of the grounding hole.

Grounding between modules shall be confirmed by a qualified electrician and grounding devices shall be approved to be sold and used in your local area. The torque of copper core wire used for the grounding clamp is recommended to be $2.3\text{N}\cdot\text{m}$. 12 AWG. Do not press the copper wires during installation as they may get damaged.

- (2) Grounding by unoccupied mounting holes .

Mounting holes on modules that are not occupied can be used for installing grounding components.

- ◆ Align the grounding clamp to the frame mounting hole. Use grounding bolt to go through the grounding clamp and the frame.
- ◆ Put the tooth side of the washer on the other side and fasten the nuts.
- ◆ Put grounding wires through the grounding clamp and grounding wire material, ensuring the dimensions meet requirements in local laws and regulations.
- ◆ Fasten the bolts of the grounding wires and then installation is complete.

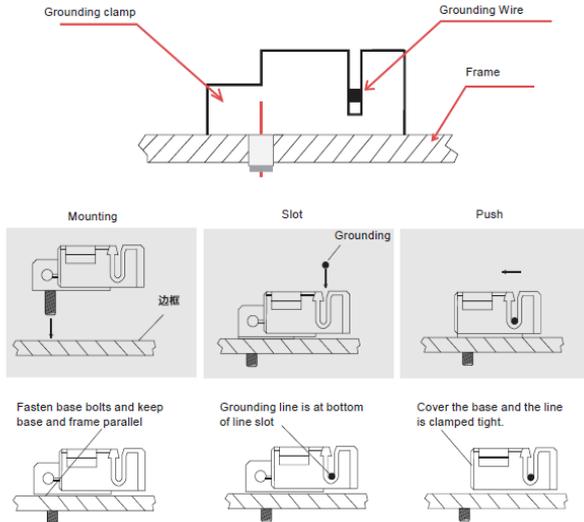


Figure 14 Clamp Grounding Method

Note: TYCO. 1954381-1 (Recommended) is used in figures above.

Third party grounding devices

A third party grounding device can be used for the grounding of Ulica modules but such grounding shall need be tested and proved to be reliable. Grounding device shall be operated in line with stipulations of the manufacturer.

10. Operation and maintenance

It is the users' responsibility to carry out regular user inspection and maintenance on the modules, especially during the period of limited warranty; inform the supplier within two weeks if modules are found to be broken. Do not attempt any maintenance that needs to be performed by a professional.

10.1 Cleaning

Accumulated contaminants, such as dust and dirt, on the module surface glass will reduce the power output and lead to local hot spots. The severity of the effect of accumulated contaminants will depend on their transparency. Small amounts of dust will affect the intensity and evenness of the received solar irradiation but it is not dangerous and the power will not be reduced significantly.

During operation of the modules, ensure there are no environmental factors to shade modules fully or partially. These factors include: other modules, the module mounting system, birds dwelling, dust, soil or plants. These will significantly reduce output power. Ulica suggests that the module surface should not be shadowed in any circumstance.

The frequency of cleaning depends on the speed of dirt accumulation. In normal situations, rainwater will clean the module surface and reduce the cleaning frequency. It is suggested to use sponge dipped with clean water or soft cloth to wipe the glass surface. Do not use acid and alkaline detergents to clean modules. Do not use any tool with rough surface to clean.

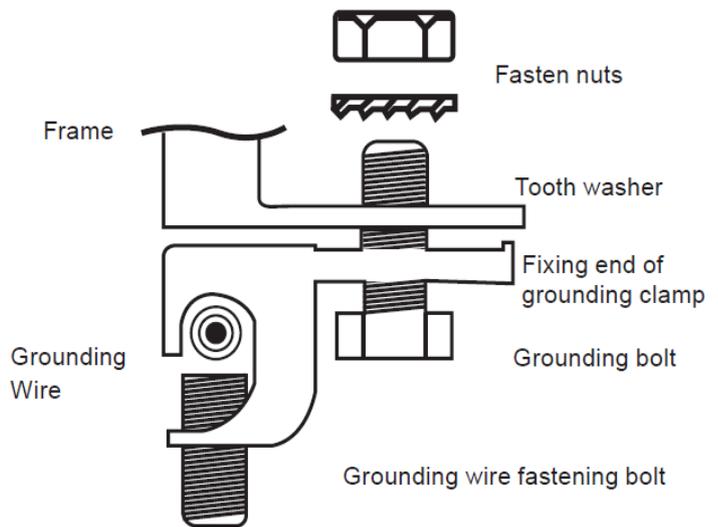


Figure 15 Bolt Grounding Method

In order to avoid potential risk of electrical shock or burns, Ulica suggests cleaning the modules during early morning and evening when there is low irradiance and a low module temperature especially in areas with high average temperature.

In order to avoid potential risk of electrical shock, do not try to clean any module with damaged glass or expose wires.

10.2 Module Appearance Inspection

Check module for cosmetic defects, especially for:

- (1) Module glass cracks.
- (2) Corrosion at the welding parts of the cell main grid, caused by moisture into the module due to damage of the sealing materials during installation or transportation.
- (3) Check whether there are traces of burning marks on the module back sheet.
- (4) Check PV modules if there are any signs of aging including rodent damage, climate aging, connectors tightness, corrosion and grounding condition.
- (5) Check if any sharp objects are in contact with PV modules' surface.
- (6) Check if any obstacles are shading the PV modules.
- (7) Check if there are any loose or damaged screws between the modules and mounting system. If so, adjust and fix in time.

10.3 Inspection of Connectors and Cables

It is suggested to carry out the following preventive inspection twice a year:

Check if any crack or gap of silicone nearby the junction box.

11 Release and Execution

This manual document is implemented and managed by product management department. Product management department reserves the right to modify and revise in any time.

12 UK Support

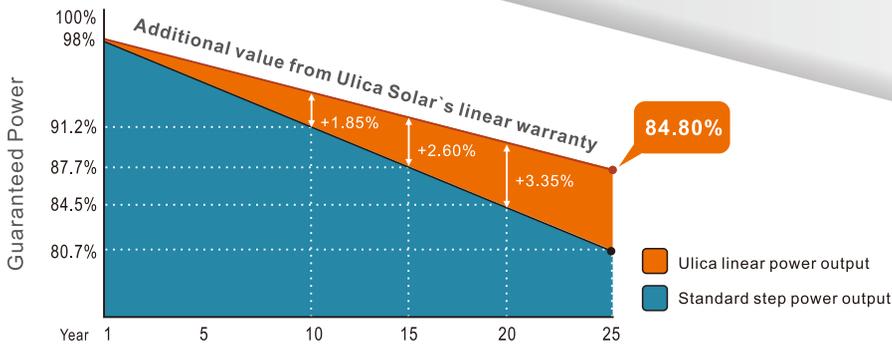
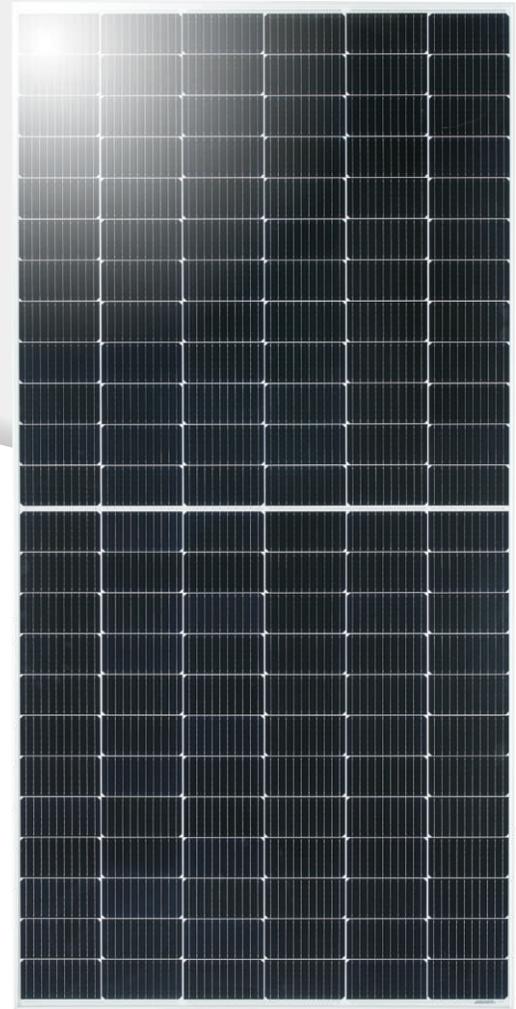
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MONO HALF-CUT MODULE

UL-545 | 550 | 555M-144HV

545W~555W 1500V MBB 182mm cell



Global Tier 1 brand as announced by Bloomberg NEF



Lower LCOE
Lower shading and resistive loss
Lower temperature coefficient



Outstanding mechanical load resistance
3800 Pa wind load, 5400 Pa snow load



Anti-PID (potential induced degradation)
Passed anti-PID test under 85% damp heat, 85% relative humidity for 96 hours



Great Durability against extreme conditions
Passed salt mist corrosion test, ammonia corrosion test, dust & sand test, fire test, all certified by TUV



About Ulica Solar: As member of Shanshan Group (stock code: 600884) which is TOP500 Enterprise in China, Ulica Solar is the leading manufacturer of solar cells and solar panels in China since 2005, and has been continuously listed as the Tier 1 PV Module Manufacturer from Q1 2020 by Bloomberg NEF, with the annual capacity of 3GW, and own investment projects of 300MW.

ELECTRICAL PERFORMANCE

Electrical Parameters Standard Test Conditions

Module Type	UL-545M-144HV		UL-550M-144HV	UL-555M-144HV	
Power Output	P _{max}	W	545	550	555
Power Tolerance	ΔP _{max}	W	0/+5W		
Module Efficiency	η _m	%	21.09	21.28	21.48
Voltage at P _{max}	V _m	V	41.8	41.9	42.0
Current at P _{max}	I _m	A	13.04	13.13	13.21
Open-Circuit Voltage	V _{oc}	V	49.9	50.0	50.1
Short-Circuit Current	I _{sc}	A	13.65	13.75	13.83

STC:1000W/m² irradiance,25C module temperature,AM1.5

THERMAL CHARACTERISTICS

Nominal Operating Cell Temperature	NOCT	°C	43±2
Temperature Coefficient of P _{max}	γ	%/°C	-0.340
Temperature Coefficient of V _{oc}	β _{voc}	%/°C	-0.265
Temperature Coefficient of I _{sc}	α _{isc}	%/°C	+0.049

OPERATING CONDITIONS

Max.System Voltage	DC1500V
Max.Series Fuse Rating	25A
Operating Temperature Range	-40°C~85°C
Max static snow load	5400Pa
Max static wind load	3800Pa
Application Class	A

CONSTRUCTION MATERIALS

Front Cover(material/type/thickness)	low-iron tempered glass/3.2mm
Cell(quantity/material/type/dimension)	144/monocrystalline/182X91mm
Encapsulant(material)	ethylene vinyl acetate(EVA)
Frame(material/anodization color)	anodized aluminum alloy/silver or black
Junction Box(protection degree)	IP68
Cable(length/cross-sectionalarea)	Landscape: (+) 1400mm/(-)1400 mm Portrait: (+)400 mm/(-) 200mm
Plug Connector	MC4 compatible

GENERAL CHARACTERISTICS

Dimension(L/W/H)	2279/1134/35mm
Weight	27.5kg

PACKING CONFIGURATION

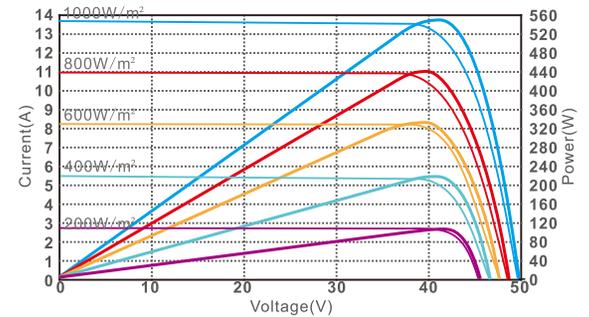
Pallet Size(L/W/H)	2320/1130/2540mm
Pallet Weight	1790kg
Pieces per Pallet	62pcs
Pieces per Container	620pcs

INTERNATIONAL CERTIFICATES

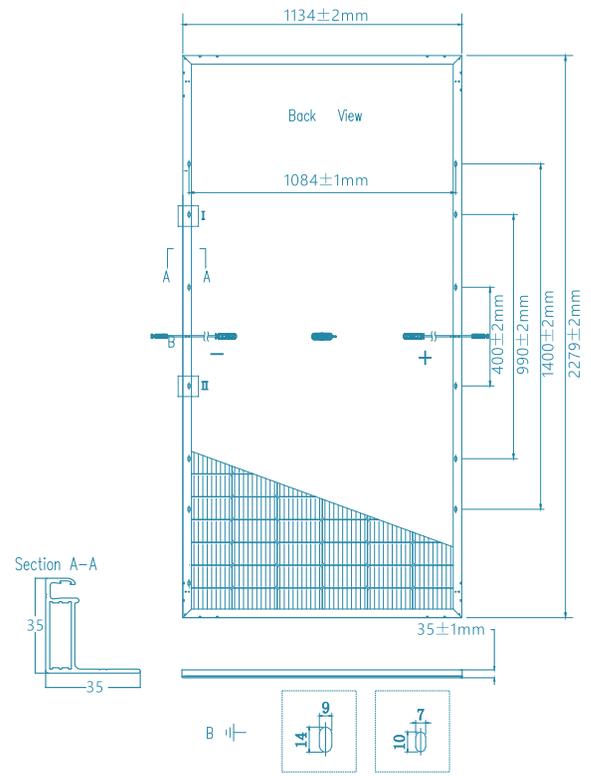
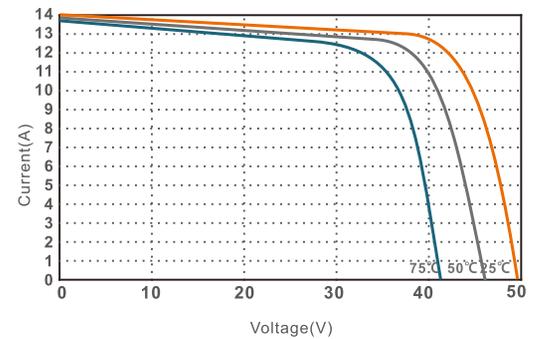
- IEC 61215, IEC 61730
- ISO 9001: 2015(Quality management systems)
- ISO 14001: 2015 (Environmental management systems)
- ISO 45001: 2018 (Occupational health and safety)
- UNI 9177 Ia CLASSE DI REAZIONE AL FUOCO:1

I-V CURVE

I-V characteristics at different irradiances



I-V characteristics at different temperature



Please read the instruction entirely before handling, installing and operating Ulica Solar modules.
Due to continuous research and development, the specification is subject to change without prior notice.