Photovoltaic Module User Manual

1. General Information

This manual provides information on the installation and safe use of components of Econess Energy Co., Ltd. Before installation, the installer must read and understand this manual. Before installing components, the installer must read and understand this manual. If you have any questions, please contact the sales or customer service personnel of Econess Energy Co., Ltd. for further understanding. When installing components, the installer shall abide by all safety precautions in this manual and relevant laws and regulations of installation; The installation personnel shall be familiar with the mechanical load and electrical requirements of the installation system. In case of product damage caused by defects in construction or power generation system design, Econess Energy Co., Ltd. has the right to refuse compensation.

1.1 Applicable Products

This document is applicable to the series of solar module as listed below:

PV Modules with 6" Poly-crystalline Silicon Solar Cells:

72 cells: EN156P-72-xxx (xxx = 300 - 350, in increments of5)

60 cells: EN156P-60-xxx (xxx = 250 - 290, in increments of5)

54 cells: EN156P-54-xxx (xxx = 225 - 260, in increments of5)

48 cells: EN156P-48-xxx (xxx = 200 - 230, in increments of5)

36 cells: EN156P-36-xxx (xxx = 150 - 175, in increments of5)

PV Modules with 6" Mono-crystalline Silicon Solar Cells:

72 cells: EN156M-72-xxx (xxx = 330 - 370, in increments of5)

60 cells: EN156M-60-xxx (xxx = 275 - 305, in increments of5)

54 cells: EN156M-54-xxx (xxx = 245 - 275, in increments of5)

48 cells: EN156M-48-xxx (xxx = 220 - 245, in increments of5)

36 cells: EN156M-36-xxx (xxx = 165 - 185, in increments of5)

PV Modules with 6" Half-cut Poly-crystalline Silicon Solar Cells:

144 cells: EN156P-144-xxx (xxx = 300 - 355, in increments of5)

120 cells: EN156P-120-xxx (xxx = 250 - 295, in increments of5)

144 cells: EN158P-144-xxx (xxx = 300 - 355, in increments of5)

120 cells: EN158P-120-xxx (xxx = 250 - 295, in increments of5)

PV Modules with 6" Half-cut Mono-crystalline Silicon Solar Cells:

144 cells: EN156M-144-xxx (xxx = 345 - 395, in increments of5)

120 cells: EN156M-120-xxx (xxx = 290 - 330, in increments of5)

144 cells: EN158M-144-xxx (xxx = 370 - 415, in increments of5)

120 cells: EN158M-120-xxx (xxx = 310 - 345, in increments of5)

144 cells: EN166M-144-xxx (xxx = 405 - 460, in increments of5)

120 cells: EN166M-120-xxx (xxx = 335 - 380, in increments of5)

144 cells: EN166M-144D-xxx (xxx = 405 - 460, in increments of5)

120 cells: EN166M-120D-xxx (xxx = 335 - 380, in increments of5）

PV Modules with 7" Half-cut Mono-crystalline Silicon Solar Cells:

156 cells: EN182M-156-xxx (xxx = 570 - 605, in increments of5)

144 cells: EN182M-144-xxx (xxx = 520 - 555, in increments of5)

120 cells: EN182M-120-xxx (xxx = 440 - 460, in increments of5)

108 cells: EN182M-108-xxx (xxx = 390 - 420, in increments of5)

156 cells: EN182M-156D-xxx (xxx = 565 - 600, in increments of5)

144 cells: EN182M-144D-xxx (xxx = 525 - 555, in increments of5)

120 cells: EN182M-120D-xxx (xxx = 440 - 460, in increments of5)

108 cells: EN182M-108D-xxx (xxx = 395 - 415, in increments of5)

PV Modules with 7" Half-cut N-type Mono-crystalline Silicon Solar Cells:

156 cells: EN182N-156-xxx (xxx = 600 - 630, in increments of5)

144 cells: EN182N-144-xxx (xxx = 555 - 575, in increments of5)

120 cells: EN182N-120-xxx (xxx = 460 - 480, in increments of5)

108 cells: EN182N-108-xxx (xxx = 415 - 435, in increments of5)

156 cells: EN182N-156D-xxx (xxx = 605 - 625, in increments of5)

144 cells: EN182N-144D-xxx (xxx = 555 - 575, in increments of5)

120 cells: EN182N-120D-xxx (xxx = 455 - 480, in increments of5)

108 cells: EN182N-108D-xxx (xxx = 415 - 435, in increments of5)

PV Modules with 8" Half-cut Mono-crystalline Silicon Solar Cells:

132 cells: EN210M-132-xxx (xxx = 650 - 670, in increments of5)

120 cells: EN210M-120-xxx (xxx = 585 - 605, in increments of5)

110 cells: EN210M-110-xxx (xxx = 530 - 550, in increments of5)

132 cells: EN210M-132D-xxx (xxx = 635 - 670, in increments of5)

120 cells: EN210M-120D-xxx (xxx = 580 - 610, in increments of5)

110 cells: EN210M-110D-xxx (xxx = 530 - 555, in increments of5)

1.2 Disclaimers

Since the use of this manual and the conditions or methods for the installation, operation, use and maintenance of photovoltaic (PV) products are beyond the control of Econess Energy Co., Ltd., Econess Energy Co., Ltd. shall not be responsible for the loss, damage or expenses caused by any operation related to these installation, operation, use or maintenance. The infringement of third-party patents or other rights caused by the use of photovoltaic (PV) products does not belong to the scope of responsibility of Econess Energy Co., Ltd. The customer is not authorized to use any patent or patent right for using the solar products of Econess Energy Co., Ltd., whether express or implied.

Econess Energy Co., Ltd. provides paid replacement or repair services for product damage caused by product installation, operation, use and maintenance not in accordance with this manual. The information in this manual is based on the knowledge and reliable experience of Econess Energy Co., Ltd. However, these information and suggestions including product specifications do not constitute any warranty, express or implied. Econess Energy Co., Ltd. reserves the right to modify the manual, photovoltaic (PV) products, specifications or product information without prior notice.

1.3 Product identification

The following information will be provided on the label behind each component:

Nameplate: describe the product model, including nominal power, rated current, rated voltage, open circuit voltage, working current and other values measured under standard test conditions (STC); Weight, size and maximum system voltage.

Barcode: Each component has a unique serial number. There is only one barcode on the component. The bar code is put into the component when stacking, and after lamination, it is permanently fixed inside the component, which can be seen from the front of the component.

1.4 Authentication information

Econess photovoltaic modules meet all the following requirements based on the official quality and safety standards:

IEC 61215: performance test standard

IEC 61730-1 and 2: safety conditions for photovoltaic modules

ISO 9001: quality management system for manufacturing and selling solar photovoltaic modules

1.5 Guarantee period

Econess Energy Co., Ltd. stipulates the guarantee conditions for components in the Econess Energy Co., Ltd. quality assurance document. If negligence is caused by ignoring the instructions and precautions specified herein, Econess Energy Co., Ltd. will cancel the guarantee. Please contact our sales or customer service personnel to ask about any guarantee.

1.6 Safety Cautions

In the installation and maintenance, all the Safety Cautions mentioned in this manuals should be followed, in the meantime, all the requirements defined by local law, authority agency or government should be followed.

Failed to follow this manual or the above rules/law will cause the fail of our Limited Warranty to the modules.

- Please get contact with local authority agency to confirm if the installation is legally allowed and meets the installation inspection requirements before installing the PV system.
- When designing the PV system, please be sure to consider about the voltage change under different temperatures (please check the temperature coefficients of all PV modules, when the temperature drops, the variable output voltage of the module will rise).
- The shading on the module surface will affect the power generation much, the module should be installed in the place where the module cannot be shadowed totally (such as the shadow from building, chimney and tree etc.), and even the partially shading (such as the dirt, snow and aerial wire etc.) should be avoided.
- The modules should be kept inside the original packaging before installation. In the transportation and storage period, please do not damage the packaging. The packaging cannot be opened unless at the installation site. It is recommended to open the packaging according to the opening procedure and handle this procedure carefully. It is forbidden to let the packaged module dropped directly.
- Please ensure the correct and proper method of transportation and installation, otherwise it could cause the module damage.
- The maximum limit of the stack layer is defined in the outer packaging carton box, please do not stack the modules more than this limit. Before opening the packaging, Please keep it in a ventilated, rainproof and dry place.
- It is prohibited to stand, climb, walk and jump on the unpacked packaging.
- To avoid damaging the module and to avoid affecting the module safety, please never put any heavy or sharp objects on the front and rear surface of the module at any time.
- When open the packing box, please use the professional and proper tools which can

avoid the inclining and dropping of the module. It is forbidden to put the module in a place without any supports or fixtures.

- Never handle and move the module via the cable or the J-Box at any time. At least 2 personnel with non-slip gloves are required to handle one module at the same time. Do not carry the module via overhead and do not handle the stacked modules for moving.
- Please store the modules in a ventilated, rainproof and dry place when the temporary storage is needed.
- Please ensure all the modules and electrical contact parts are clean and dry in the installation.
- Do not install any module when it is raining, snowing and strong windy.
- Artificially concentrated sunlight shall not be directed on the module.
- Use durable, rust-resistant and UV-resistant materials to fabricate the module bracket structures which have been tested, certified and approved.
- When the modules were installed on the brackets, the brackets structure should have the ability to bear the wind load and snow load at site. And please ensure these load will not exceed the maximum load design of the module.
- The modules with the glass broken or the back-sheet damage cannot be repaired and cannot be used, there will be the electrical shock risk in case to touch the surface or frame of these kind of modules.
- Do not try to disassemble the module, and do not remove or damage the module nameplate and any other parts of the module.
- It is forbidden to stand on the modules in the installation progress, and do not damage or scratch the glass surface of the module.
- Do not apply any paint or glue to the module glass surface.
- The Solar PV modules will generate the electrical power when exposed to the sunlight, and this power is sufficient to cause fatal electrical shock and burning risk. Only the authorized personnel who is professional trained can close to the solar PV module.
- To avoid the electrical shock and burning risk, the opaque material can be used to cover the modules in the installation.
- To avoid the electrical shock risk by damaged module, please do not wear metal objects such as ring, watch, ear ring and nose ring in the term of the installation and maintenance.
- Do not disconnect any electrical connections or unplug any connectors under circuit load.

- In order to prevent the degradation of the module insulation ability, please avoid scratching and cutting any cables or connectors.
- Use well insulated tools in accordance with relevant electrical installation standards. Keep children away from the installation site during transportation and assembly.
- Installation shall comply with local safety regulations (e.g., safety regulations, plant operation regulations), including wires and cables, connectors, charging controllers, inverters, batteries, rechargeable batteries, etc.
- Under the requirements of the NEC (National Electrical Code), the maximum system voltage shall not be higher than 1000V or 1500V. And the actual system voltage is specified on the nameplate of the module you are using.
- Under normal conditions, a mono-facial dual glass PV module is likely to experience conditions that produce more current and/ or voltage than reported at standard test conditions. The requirements of the National Electrical Code (NEC) in Article 690 shall be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining module voltage ratings, conductor ampacities, over current device ratings, and size of controls connected to the PV output; for bifacial dual glass module, additional factor of 1.1 should be multiplied at the same time.
- Econess Energy PV modules is designed according to the IEC61215 and IEC61730, The application level is Class A, which can be used in systems operating at greater than 50 V DC or 240 W, where general contact access is anticipated, and Risen module also passed the IEC61730-1 and IEC61730-2, it meets the requirements of safety class Ⅱ.
- Comply with electrical specification - part 1- electrical equipment safety standard CSA C22.1-12-2012.
- Modules with exposed conductive parts should be grounded according to the instructions in the installation manual and the electrical specifications required by local regulations，For use in regions or countries where UL1703 is required, it must comply with the requirements of the U.S. National Electrical Code or it will be considered a violation of UL1703.Please consult with local authorities for the requirements on installation methods and fire safety of buildings.
- Assess the fire rating of the system according to the condition of the roof and mounting brackets, subject to local electrical safety regulations. A suitable layer of fireproof material for this class shall be covered and the ventilation should be maintained.
- The difference of the roof structure and installation method will affect the fire safety performance, and unappropriated installation will take the risk to cause the fire. In order

to ensure the fire rating of the roof, the minimum distance between the module frame and the roof surface is 100mm, the requirements to meet UL1703 region or country to use, modules on the surface of the frame and roof minimum distance is 115 mm ， and appropriate modules such as fuses, circuit breakers and ground connectors should be used according to local electrical safety regulations.

- Observe the safety precautions of the module installation manual. If the modules are installed on the roof, ensure that the roof structure is reasonable. In addition, the installation of any roof modules must be sealed to prevent leakage and to ensure the fire rating levels. The accumulation of dust on the modules surface will impair the performance of the modules. During the installation, the module tilt angle should be maintained at more than 10° to allow the rain to wash away the dust, while the module with too small tilt angle requires more frequent cleaning.
- Please do not operate any devices at the place where is closed to the flammable gas.

2. Installation

2.1 Design concept

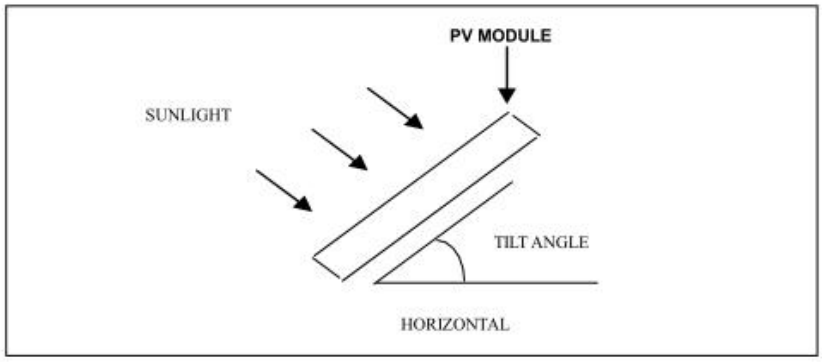
- In most cases, the Econess Energy PV modules are recommended to be installed at the location with the largest amount of sunlight throughout the year. The northern hemisphere generally faces south, while the southern hemisphere faces north. Components installed 30 ° away from due south (or due north) will reduce their power output by nearly 10-30%.
- The Econess Energy PV modules in series must be installed in the same direction and angle. Different directions and angles will lead to power loss caused by different directions of sunlight. In order to ensure the smooth progress of maintenance and inspection, the layout of photovoltaic system components is improved.

2.2 Installation conditions

Econess solar modules must be installed and used under the following conditions:

- Operating temperature: - 40 ℃ to + 85 ℃
- Storage temperature: - 40 ℃ to + 60 ℃ humidity: lower than 85RH%
- Wind pressure: less than 50.12lb / ft2 (2400pa)
- Snow pressure: Less than 11278lb / ft2 (5400pa)
- Corrosion resistance: corrosive areas containing salt and sulfur.

2.3Tilt angle of Installation



- The installation of solar PV module string should be in the same orientation and the same installation angle. Different installation directions and installation angles will lead to the mismatches in current and voltage which is caused by different light absorption of different solar modules, this mismatch will cause the PV system power output loss.
- The largest power will be generated When direct sunlight on solar PV module. For modules which are installed on the fixed brackets, the best installation angle should be selected to ensure the maximum power output can be generated at winter time, if the angle can guarantee enough power output during the winter, it will make the whole solar PV system in the rest of the year can have enough power output also.
- Installation inclination refers to the Angle between the solar photovoltaic module and the ground plane, as shown below.

latitude	Fixed angle of inclination
0°~15°	15°
15°~25°	The same latitude
25°~30°	Same latitude +5°
30°~35°	Same latitude +10°
35°~40°	Same latitude +15°
40°+	Same latitude +20°

Note: Disassembly, drilling or modification of PV modules are not allowed. If doing so will invalidate the warranty. If you are not clear about the installation procedure of the component, please contact technical service.

2.4 Installation Guidelines

- Ensure that the support system is strong enough and the modules must be fixed to the support system as required；

- The limit load of the support system must be calculated according to the project site conditions, installation methods, etc. and the local specifications. The support system supplier must be responsible for the design, verification, installation and maintenance of the photovoltaic system；
- In order to reduce the adaptation loss, please ensure that the modules with the same color cells to be installed together.
- The module frame has the effect of thermal expansion and cold contraction ,the minimum clearance between two adjacent modules must not be less than 20mm.
- The module frame drain holes cannot be blocked in any situation during installation or use.
- PV modules are not suitable for long-term exposure to the environment containing sulfur, strong acid, strong alkali, acid rain, chemical pollution and other corrosion risk to the product, there is a risk of corrosion;
- Packaging angle bead and assembly safe edge play a protective role in packaging and transportation, which can be removed automatically when assembly is installed
- All the load values below are the test load of laboratory static mechanical load experiment, and the actual design load of the project site needs to consider 1.5 times of safety factor.

2.5 Installation method

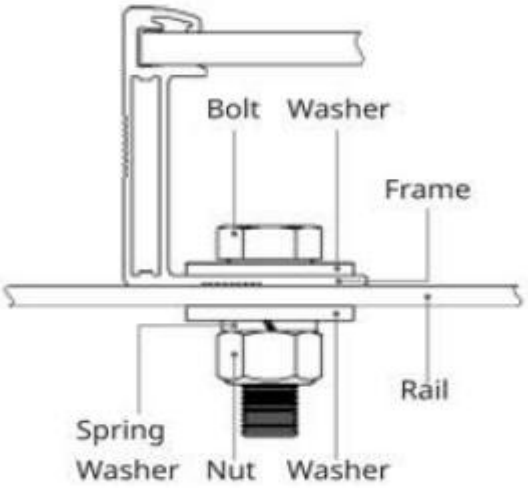
Econess Energy PV modules can be connected to the support system by means of bolts or pressing blocks; Supports are generally divided into fixed support system and tracking support system; The bolted connection between PV modules and supports is applicable to all types of supports and application scenarios; The pressing block connection between photovoltaic module and support is only applicable to fixed support system, and shall be applied to tiled roof;

2.5.1 Bolts installation：

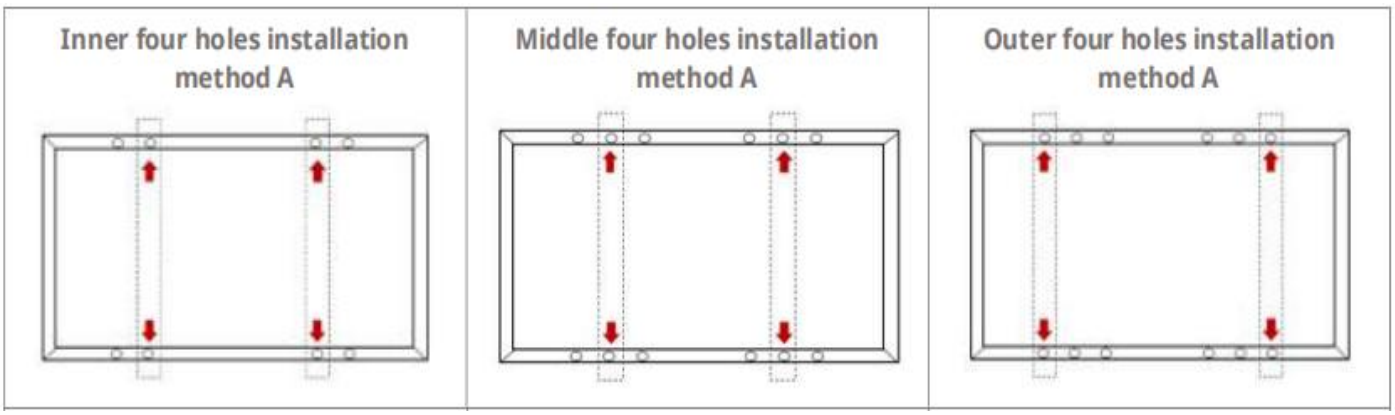
- Due to the anodized aluminum frame on the component, corrosion (electrochemical corrosion) will occur in humid environment or in contact with other kinds of metals. To prevent this corrosion, PVC or stainless steel isolation can be placed on the PV module support and support structure during installation. In addition, before installation, it must be ensured that the photovoltaic module is supported into a support structure with a certain inclination angle, which must be able to withstand the wind and snow load performance required by local regulations and civil regulations.
- Installation of PV modules using continuously improved and certified materials and structures.
- Considering the influence of linear thermal expansion of module frame, it is recommended that the distance between two solar modules should be 5mm. However, in order to ensure

good ventilation and reduce load, the installation distance between two modules is recommended to be 20mm. The installation of photovoltaic modules must ensure that their drainage holes are not blocked.

- There are mounting holes for connecting with the bracket system on the rear frame of the photovoltaic module, including φ9x14 mounting hole and φ7x10 mounting hole. When using φ9x14 mounting holes, use M8 bolts; when using φ7x10 mounting holes, use M6 bolts.
- Each assembly shall be secured by at least two 4 points on the side; For heavy snow or high wind load areas, eight symmetrical mounting holes should be used simultaneously to strengthen the fixation. According to the diagram below, flat gasket and elastic gasket must be used. The size and thickness of the gasket must be no less than the standard size of the national standard.

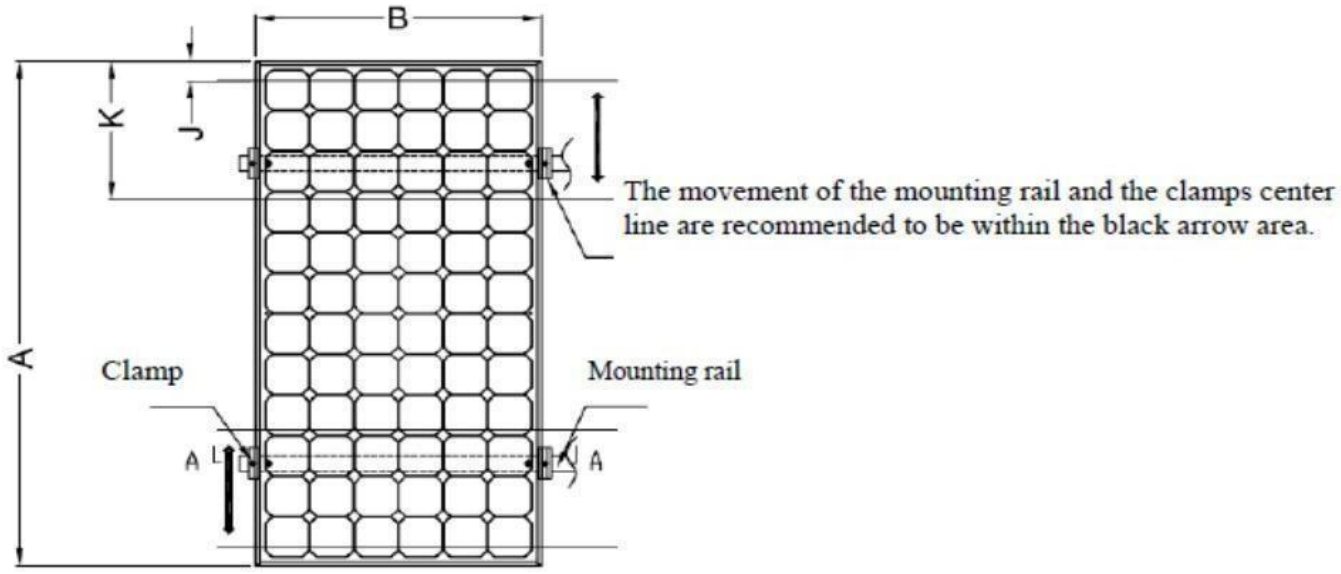


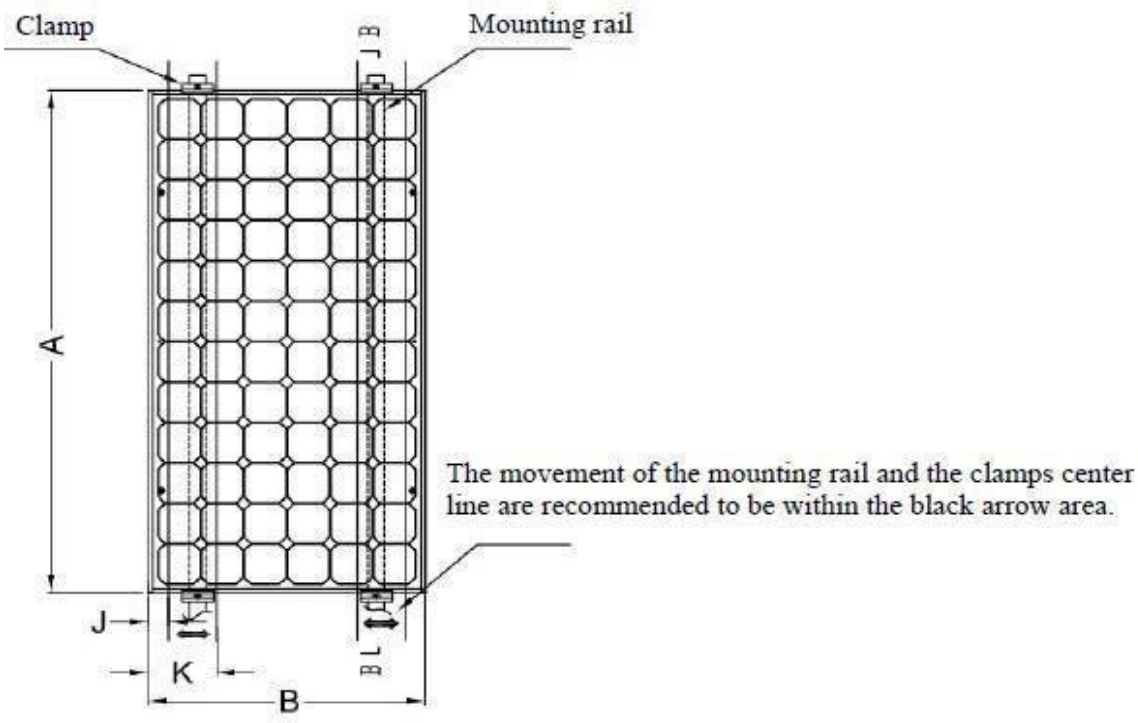
- The assembly shall be bolted to the position of the mounting hole below according to the structure and load requirements.



2.5.2 Fixture installation：

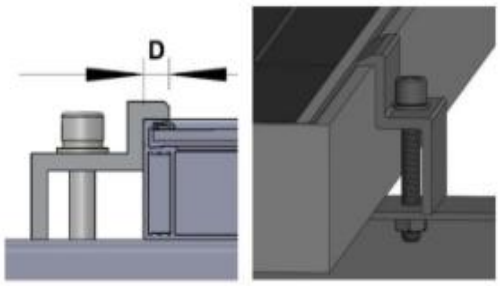
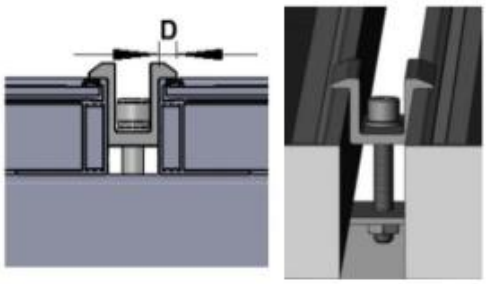
- The method of pressing block connection is only applicable to fixed support system and shall be applied to tiled roof.
- The pressing block must only be fixed on the frame of the component. The pressing block shall not contact the glass. The pressing block shall not be installed beyond the specified range or at one end of the short side of the component, which will affect the mechanical load of the component.
- The pressing block shall not contact the front glass or deform the frame. In order to avoid the hidden effect of clamp block, Z-type fixture is adopted for installation to ensure that each single module mounting frame can independently bear mechanical load test, including wind load of 2400pa and snow load of 5400pa.
- The length of the support must be longer than the component size, otherwise it shall be confirmed by Econess in advance.
- The following figure is the schematic diagram for the installation of long frame and short frame of pressure block, in which the black arrow represents the main installation position of pressure block (range dimensions are j and K).





- Each aluminum pressure block is equipped with an M8 bolt, a flat washer, a spring washer and an M8 nut. The fixing steps are as follows:

  1. Place the assembly on two supports (not provided). The support must be made of stainless steel or have undergone anti-corrosion treatment (such as hot-dip galvanization). Each photovoltaic module needs at least 4 pressing blocks to be fixed. During installation, do not let the pressing blocks directly contact the glass and deform the frame, otherwise the module will be damaged.
  2. Be sure to avoid blocking the components due to the shadow formed by the pressure block. The water leakage hole shall not be blocked by the fixture. The pressing block must maintain an overlap of at least 8mm - 11mm with the component frame, as shown in the table below.

Type	clamp	
	Side clamp	Middle clamp
Apply to aluminum frame assembly clamp		
Attention	Ensure that the clamp is in contact with the A side of the moduel frame by 8mm≤ D ≤11mm;	
Specifications	clamp size：length≥50mm， thickness≥3mm；(For aluminum frame modules)	
parts	M8 bolt 、Nut、 Flat washer、 Spring washer、clamp（ To maximize support life, use of anti-corrosion firmware is recommended）	

- The installation scope of long side pressing block and short side pressing block of Econess photovoltaic module is shown in the table below.

The series of Econess solar modules	PV module size (mm)	Installation mode (mm)	
		Installation of long side pressing block (j-k)	Installation of short side pressing block (j-k)
EN156P-60-XXX	1640*992	280-420mm	50-240mm
	1650*992		
EN156M-60-XXX	1640*992	280-420mm	50-240mm
	1650*992		
EN156P-72-XXX	1956*992	280-480mm	50-240mm
	1960*992		
EN156M-72-XXX	1956*992	280-480mm	50-240mm
	1960*992		
EN156P-120-XXX	1675*992	280-420mm	50-240mm
EN156M-120-XXX	1675*992		
EN158P-120-XXX	1684*1002	280-420mm	50-240mm
EN158M-120-XXX	1684*1002		

EN166M-120-XXX	1755*1048 1765*1048	280-420mm	50-240mm
EN156P-144-XXX	2000*992	280-480mm	50-240mm
EN156M-144-XXX	2000*992		
EN158P-144-XXX	2008*1002	280-480mm	50-240mm
EN158M-144-XXX	2008*1002		
EN166M-120-XXX	1755*1048 1765*1048	280-420mm	50-240mm
EN166M-144-XXX	2094*1038 2108*1048	280-480mm	50-240mm
EN182M/N-156-XXX	2465*1134	480-530mm	--
EN182M/N-144-XXX	2279*1134	400-450mm	--
	2256*1133	400-450mm	--
EN182M/N-120-XXX	1903*1134	475±50mm	100-240mm
EN182M/M-108-XXX	1724*1134 1722*1134 1708*1133	400±50mm	200±50mm
EN182M/N-156D-XXX	2465*1134	480-530mm	--
EN182M/N-144D-XXX	2278*1134	400-450mm	--
EN182M/N-120D-XXX	1903*1134	475±50mm	--
EN182M/M-108D-XXX	1722*1134	400±50mm	--
EN182M/M-108D-XXX	1708*1133	400±50mm	--
EN210M-132-XXX	2384*1303	400-500mm	--
EN210M-120-XXX	2172*1303	375-425mm	--
EN210M-110-XXX	2384*1096	400-500mm	--
EN210M-132D-XXX	2384*1303	400-500mm	--
EN210M-120D-XXX	2172*1303	375-425mm	--
EN210M-110D-XXX	2384*1096	400-500mm	--

3. Electrical Connection

- The Direct Current (DC) generated by the PV system can be converted to Alternating Current (AC) and connected to the public power grid. Different regions may have different policies, laws and regulations to stipulate the installation and grid-connection requirements of PV systems. Therefore, during the Extension Cable design, installation and grid-connection of PV system, please comply with the local policies, laws and regulations.
- PV modules can obtain different current and voltage outputs through series connection and parallel connection. Read this installation manual carefully before electrical connection and installation. Please design and connect according to the current and voltage required by customers. Before connection, please ensure that the connection part is free from corrosion, and keep it clean and dry.
- Different types of modules cannot be connected in series. Modules connected in series should ensure the consistency of their current. The voltage of the module string should not

exceed the allowable system voltage value, which can be found on the nameplate or datasheet of the module.

- Product can be irreparably damaged if an array string is connected in reverse polarity to another. Always verify the voltage and polarity of each individual string before making a parallel connection. If you measure a reversed polarity or a difference of more than 10V between strings then check the string configuration before making the connection.
- Before wiring the module, ensure that the contact points are corrosion resistant, clean and dry; If a string of modules is reversed, irreparable damage can be caused
- For relatively large installations, Econess recommends that you use lightning protection in accordance with local requirements and regulations.

3.1 General rules for electrical installation

- Several modules are connected in series and then connected in parallel to form a photovoltaic array, which is especially suitable for the case of high voltage. If the components are connected in series, the total voltage is equal to the sum of the voltages of each component. Try to use components with the same configuration on the same power generation system.
- The assembly can provide prefabricated connectors for the electrical connection of the system. These cables, conductors and connectors shall not be removed or cut off. For the selection of parameters such as cable size, type and temperature, please refer to relevant regulations.

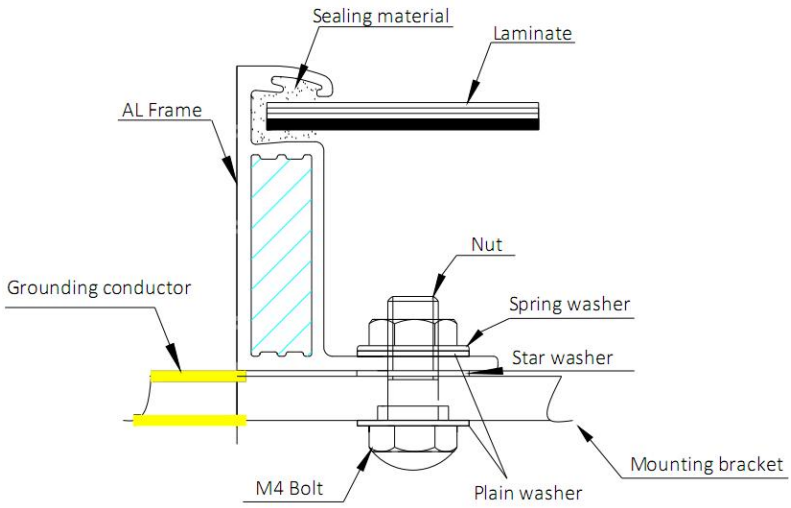
3.2 Bypass diode and blocking diode

- The local shadow of an independent component can cause reverse voltage to the shadow photovoltaic module, and the current will flow from other components to the shadow module. When a bypass diode is connected in parallel with it, these currents will flow to the diode and bypass the shadow photovoltaic module to reduce module heating and overall current loss. Econess photovoltaic module is inside the junction box. Bypass diodes are installed to reduce the impact of local shadows.
- In the system using battery, the blocking diode must have an average forward current greater than the maximum system current. At the lowest operating temperature of the component, the blocking diode must have a peak reverse voltage greater than the maximum system voltage.

4. Grounding

- All component frames and mounting brackets must be properly grounded. Use the recommended connection terminal and connect the grounding cable well and fix it to the component frame. The support frame after electroplating treatment is used to ensure good circuit continuity.

- An appropriate grounding conductor is used to connect the component frame and the supporting member to achieve an appropriate grounding effect.
- The grounding conductor must be connected to the ground through a suitable ground electrode. It is recommended to use grounding wire fittings (lugs) to connect grounding cables. If it is not mechanically connected to the grounded PV module through bolts and nuts, the support must also be grounded.
- In addition to using the grounding hole for grounding, you can also use the following methods for grounding.
  - ◆ Grounding by unused mounting holes
  - ◆ Other special grounding devices
- The electrical contact points of all the above grounding methods should penetrate the anodized film of the aluminum frame. Econess modules can be grounded by other grounding devices, which must be reliable and certified. The manufacturer's requirements should be followed.
- The following figure shows the grounding diagram:



5. Commissioning and maintenance

In order to ensure the long-term using of the installed PV system and maximize the Power output performance of the modules, the installed PV modules need to be inspected and maintained regularly. The inspection and maintenance of modules in the PV array shall be carried out by personnel who have received professional PV system maintenance training and obtained relevant qualifications and authorization.

- Test all electrical and electronic components of the system before use, and follow the instructions provided by components and equipment. Commissioning and maintenance must be completed by professionals.
- Use a digital multimeter to check the open circuit voltage of series components. The measured

value should be equal to the sum of the open circuit voltage of individual components. You will find the rated voltage in the technical specification of the type of component used. If the measured value is much lower than the expected value, please refer to the instructions in "low voltage troubleshooting".

- Check the short-circuit current in a series circuit, which can be measured directly by connecting a digital multimeter to both ends of the series module or rough measurement with PV lamp load. Note: the rated scale of the ammeter or the rated current of the load should be greater than 1.25 times of the rated short-circuit current of the series component. You can find the rated current in the technical manual of the component of the model used. The measured values will vary significantly with climatic conditions, time and shading of components.

5.1 Low voltage troubleshooting

Identify the normal low voltage and fault voltage. The normal low voltage mentioned here refers to the reduction of the open circuit voltage of the module, which is caused by the high temperature or low irradiance of the solar cell.

Fault low voltage is usually caused by incorrect terminal connection or damage of bypass diode. If the problem cannot be solved, please contact technical service personnel.

5.2 Component inspection and maintenance

Econess Energy Co., Ltd. recommends the following maintenance measures to ensure the best performance of the module:

- The PV modules installed in the PV array should be inspected periodically for damage. If functional and safety faults are found due to the following factors, the modules of the same type should be replaced immediately.
  - ✓ PV modules have broken glass, scratched back sheet.
  - ✓ Bubbles or delamination form a continuous path between electric circuit and the edge of the module.
  - ✓ Junction box is deformed, cracked or burned, and the terminals cannot be connected well.
- Replace failed PV modules with same type. Do not touch live wires and connectors directly. When you need to touch them, use suitable safety devices (insulation tools/gloves, etc.).
- The warning signs on the PV modules must not be lost.
- Check the electrical, grounding and mechanical connections every 6 months to ensure they are clean and safe, free from damage or rust. Check that the mounting parts are tight. Check all cables and make sure that the connectors are securely. PV modules frames and bracket should be well mechanically connected.
- Check whether there is any foreign body on the surface of the PV modules and whether there is

any shielding.

- When repairing PV modules, cover the surface of PV modules with opaque material to prevent electric shock. Exposure of PV modules to sunlight will generate high voltages, this is dangerous. Please pay attention to safety when maintenance and it must be done by professionals.
- When the irradiance is no less than 200W/m², if the terminal voltage is more than 5% different than the rated value, it illustrates the connection of the modules is not good.
- Comply with maintenance instructions for all modules used in the PV system, such as brackets, charging rectifiers, inverters, batteries, lightning protection systems, etc.
- Warning: Any electrical maintenance must shut down the PV system firstly. Improper system maintenance may cause fatal dangers such as electric shock and burning.

5.3 Cleaning

- Dust accumulation on the glass surface of the module will reduce its power output and may cause hot spots. So the surface of photovoltaic modules should be kept clean. Maintenance work should be performed at least once a year or frequently.
- Warning: It should be carried out by trained personnel. Workers should wear PPE, such as goggles, electric insulation gloves and safety shoes. The gloves should withstand DC voltages of no less than 2000V
- Use dry or wet soft cloths, sponges, etc. to clean the modules during the cleaning process, but do not put any modules directly into the water, do not use corrosive solvents and do not wipe the PV modules with hard objects. When the pressure water is used, the water pressure on the glass surface of the module must not exceed 700 KPa. The module must not be subjected to additional external force. If necessary, use isopropyl alcohol (IPA) according to the safety instructions to clean and ensure that no IPA flows into the gap between the edge of the module and the module frame.
- Clean PV modules when the irradiance is below 200W/m². Liquid with a large temperature difference compared to modules shall not be used for cleaning. For example, do not use cold water to clean the module when the temperature of it is high during the day, otherwise there will be the risk of module damage.
- It is forbidden to clean photovoltaic modules under weather conditions with heavy rain, heavy snow or winds greater than class 4.
- The back surface of the module normally does not need to be cleaned, but in the event this is deemed necessary, avoid the use of any sharp objects that might damage or penetrating the substrate material.

- Water requirements when cleaning:
  - ✓ PH: 5～7；
  - ✓ Chloride or salt content: 0 - 3,000 mg/L
  - ✓ Turbidity: 0-30 NTU
  - ✓ Conductivity: 1500～3000 μs / cm
  - ✓ Total dissolved solids: ≤1000 mg/L
  - ✓ Water hardness: 0-40 mg/L
  - ✓ Non-alkaline water must be used, and softened water can be used when conditions permitted.
- Module inspection after cleaning:
  - ✓ Visual inspection to check if the module is clean, bright and free of stains;
  - ✓ Spot check to verify whether there is soot deposit on the module surface;
  - ✓ Check to whether there are visible scratches on the surface of the module or not;
  - ✓ Check whether there is no man-made cracks on the module surface or not;
  - ✓ Check whether the module support structure is leaning or bent or not;
  - ✓ Check whether the connectors of the module are detached or not，After cleaning, fill out the PV module cleaning record.

5.4 Component use and recycling

In 2010, Econess Energy Co., Ltd. was a member of PV cycle, a European Association for voluntary recycling and recycling of PV modules whose service life has ended. Econess Energy Co., Ltd. guarantees that all components will be recycled and reused through special organizations after the service life of modules has ended, To ensure the environmental protection of all photovoltaic modules during use, all service terms comply with the provisions of the European Commission, and provide services for end users free of charge (except for accidents during installation).

6.Contact us

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