

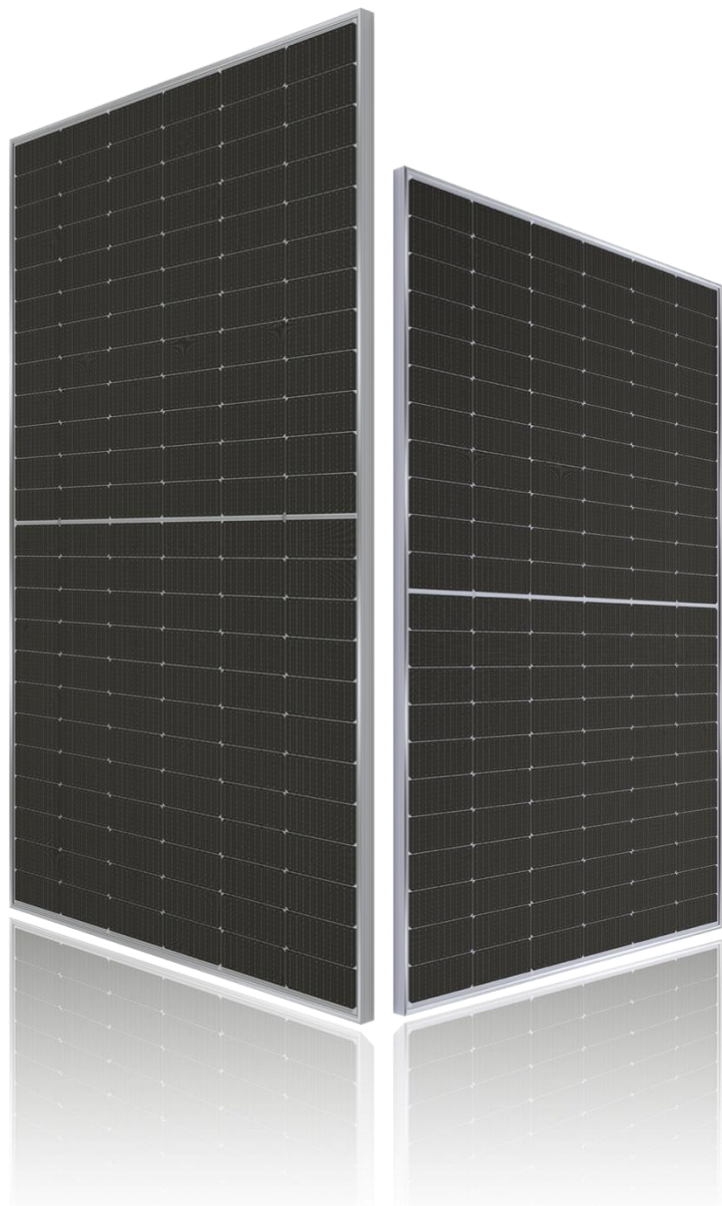
# LESSO

LESSO GROUP

STOCK CODE: 2128.HK

Solar modules

# Installation and Maintenance Guide



Version: June 2024

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## 1. Overview

- First of all, thank you for choosing Photovoltaic module (also known as solar panel, hereinafter referred to as “module”) of Guangdong LESSO Banhao New Energy Technology Group Co., Ltd. (LESSO Solar). The guide is mainly to show installation methods and safe handling of LESSO modules.
- The Guide should be read and understood before installation, operation or maintenance. It is only for reference, if any information unmentioned or unclear below, please contact professionals or LESSO's Sales Department for further explanation.
- LESSO module is designed in accordance with international standards IEC61215 and IEC61730, which is applicable to public accessible system and systems over 50 DC or 240 W. It has passed IEC61730-1 and IEC61730-2, which meets the requirements of protection against electrical shock with Class II.
- Before installing PV systems, the installer should be familiar with mechanical and electrical requirements locally.
- Fail to follow the instructions in the guide will lead to the invalidity of product’s limited warranty. Please keep the Guide for further reference.

## 2. Disclaimer

- No responsibility is assumed by LESSO for any infringement of patents or other rights of the third parties, which happened during the use of LESSO modules.
- Because the installation, operation, usage and maintenance of modules are beyond LESSO ’s control, LESSO does not assume any responsibility for power loss, module damage, casualty and other extra costs which caused by improper installation, operation, usage or maintenance.
- The Guide is edited based on LESSO technicians' experience, but such information including product specification and suggestions does not constitute a warranty. LESSO reserves the right to update the installation guide, solar products, specification and product information without prior notice.

## 3. General Safety

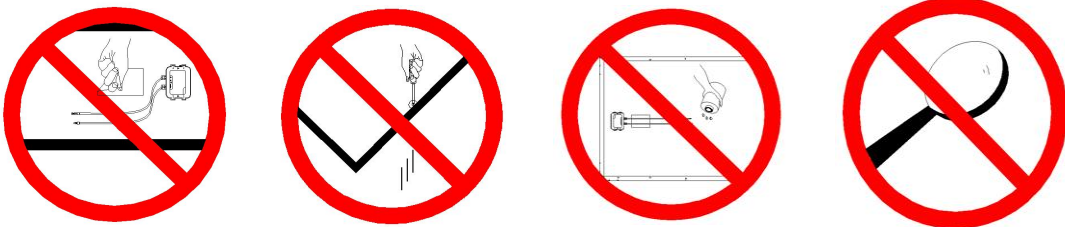
- Mechanical Installation and electrical Installation of the PV modules should refer to the related regulations, including electrical regulations, architecture law and power connection request. As for the specific terms, please contact the local authorities and obtain the corresponding license. The installer should conform to all applicable safety

precautions and local regulations listed in this guide when installing the PV modules.

- Under normal operating conditions, the output power, current, voltage and other data of modules may differ from those under standard test conditions listed in the label. A photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Factors to consider include module temperature and front side irradiance and, for bifacial modules, ground or roof albedo, row spacing, and installation height). Accordingly, the values of  $V_{OC}$  and  $I_{SC}$  (or for bifacial modules,  $I_{SC-aBSI}$ ) marked on this PV module should be multiplied by a factor of 1.25 when determining voltage and current ratings for components connected to the PV output. When the Modules are connected in series, the voltage of each string shall not be higher than the maximum voltage of the system. Reference equation of the maximum number of modules in serial connection is 
$$\text{Maximum number of modules} = V_{max} / [V_{OC} + (CV_{OC} \times V_{OC})]$$
, where  $CV_{OC} = [1 - \alpha \times (25 - T_{min})]\%$ .  $T_{min}$  is the lowest expected ambient temperature at the system location.  $\alpha$  ( $\%/^{\circ}\text{C}$ ) is the temperature coefficient of the selected module's  $V_{OC}$  (Refer to corresponding datasheet). When connected in parallel, the current output is equal to the sum of each string's current. Fuse is necessary for each module string. Take reference to the local regulation. The safety factor of 1.25 given for the minimum voltage rating of the components in the example statement above may be modified during the design of a system according to the minimum temperature of the location of the installation and the temperature coefficient for  $V_{OC}$ . The safety factor of 1.25 given for conductor current ratings values for  $I_{SC}$  (or for bifacial modules,  $I_{SC-aBSI}$ ) may be adjusted based on the maximum values of irradiance incident on the front side of the module (and the rear side for bifacial modules). To this purpose, a full simulation for the specific location and module orientation (and for bifacial modules, ground albedo, row spacing and installation height) is required. Further guidance for the choice of a safety factor other than 1.25 is given in IEC 62548.
- Only the same type of modules could be used in one system, while inverters, connectors, cables, mounting system or other related equipment should be dedicated to PV systems. It is recommended to use the inverter with integrated PID effect restore function at night in order to avoid PID effect in power station. Observe the instructions and safety precautions for all other components used in the PV system, including wiring and cables, connectors, DC-breakers, mounting hardware, inverters, batteries, etc.
- Modules could generate direct current when exposed to the sunlight. It has a risk of electric shock when touching the electriferous parts. Touching the terminal blocks of junction boxes are prohibited. Be cautious when carrying modules or connecting

cables between modules.

- Do not use mirror or other magnifiers to artificially concentrate sunlight on the module. Completely cover all modules with an opaque material during installation to prevent electricity from being generated.
- Prohibit demounting modules under loads. Disassemble the module or remove any attached labels or components are forbidden. Modules should not be marked by using sharp objects. Meanwhile, painting or pasting on the surface is prohibited.
- Make sure not to use sharp-pointed objectives to wipe the surface of the modules. Prohibit scratching or hitting PV modules, for the avoidance of damage. Do not use or install broken modules to prevent the hazard of fire, electric shock and injury.
- Keep children well away from the PV system while transporting and installing mechanical and electrical components.
- The accessible PV module surface shall be smooth and free from sharp edges, burrs, etc.
- Do not expose PV module to sunlight concentrated with mirrors, lenses or similar means.



#### **4. Transportation, Storage and Handling**

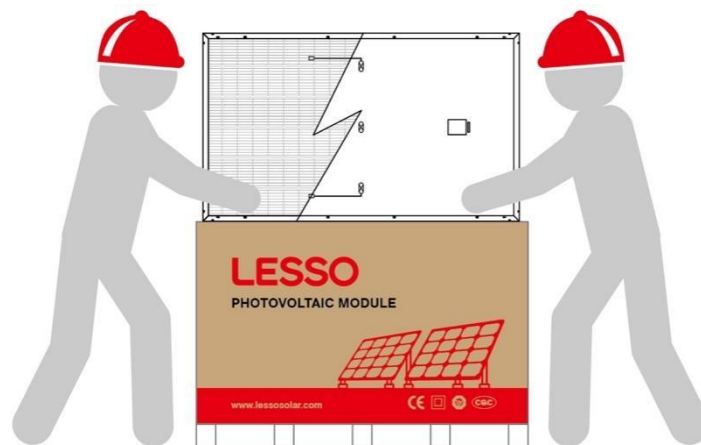
- LESSO Solar PV modules should transport in the supplied package only and kept in the package until they are ready to be installed.
- Please protect the package to prevent damage.
- To ensure pallets from falling over.
- Do not exceed the maximum height as what indicated on the pallet package.
- Please place pallets in shaded, dry and flat location. Do not open the package until you need to use the PV modules.
- For temporary storage, modules should be placed in dry and ventilated room, stacked

well to avoid sliding . When using metal pallets, a maximum of 31 pieces' modules with a frame thickness of 35 mm can be placed on one pallet, and a maximum of 36 pieces' modules with a frame thickness of 30 mm can be placed on one pallet.



**Figure1** - Pallet of PV modules

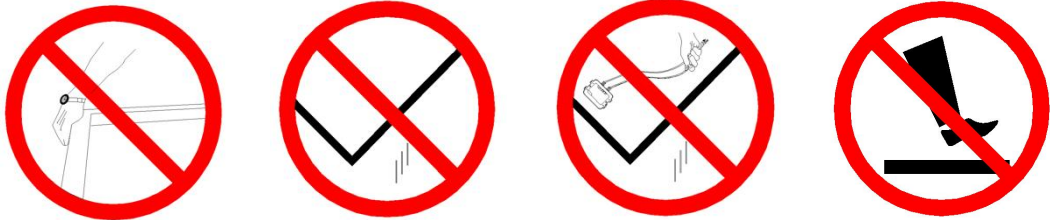
- LESSO Solar PV modules are heavy, and should be handled with care.
- For unpacking PV modules from LESSO supplied package, first remove the pallet lid and packing belts. Taking out the modules in turn and removing the first module in order of modules, and taking out the remaining modules in order from the carton. Please pay attention to the rest of modules in the package in case that they fall over to one side.



**Figure 2** - Removing PV modules from a pallet

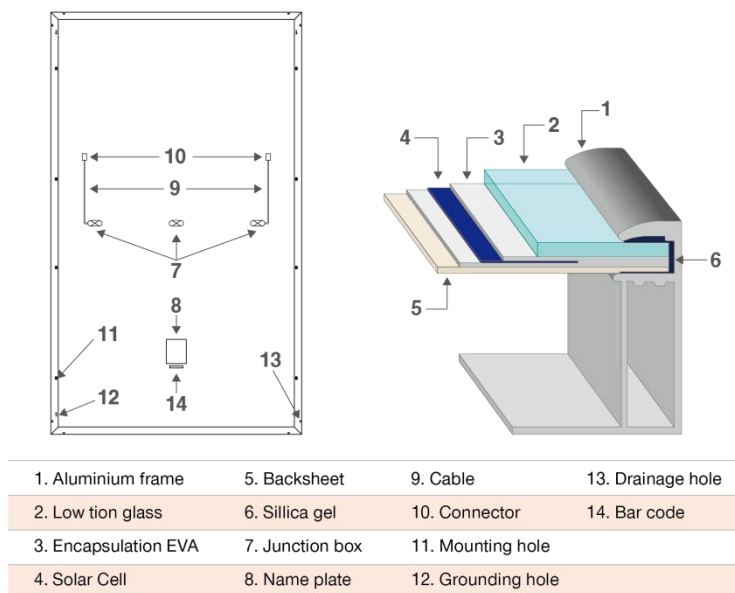
- Watches and rings must not be worn to prevent from scratching PV modules when carrying them.
- Prevent bumping and collision during carrying and installation. Lay down the module lightly. Do not hold the junction box or cables to lift the module.

- Don't stand or step on the module. Prevent one PV module falling on the other PV module.
- Do not place any heavy objects on PV modules. Broken glass can result in personal injury. PV modules with broken glass cannot be used and should be special handling.
- Broken or damaged PV modules must be handled carefully and disposed properly.

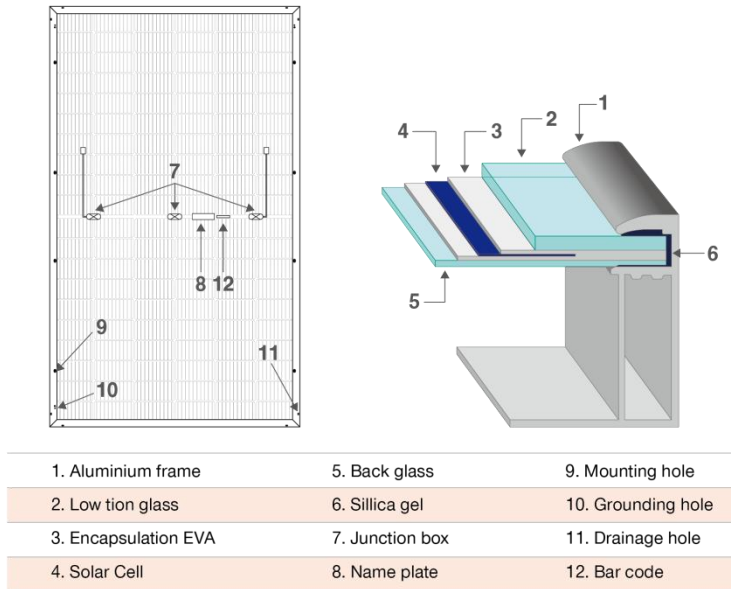


- Check PV modules for damage due to transportation before they are installed.
- PV module surfaces are susceptible to damage that could affect the performance or safety of the PV module. Contact the sales service department of LESSO in order to obtain information on making claims for defective PV modules.
- For your safety, do not disassemble or modify LESSO PV modules in any way. Doing so may degrade performance or cause irreparable damage and will invalidate any applicable warranty.
- Do not lift the module by holding the junction box or wires in any cases.

## 5. Product Identifications



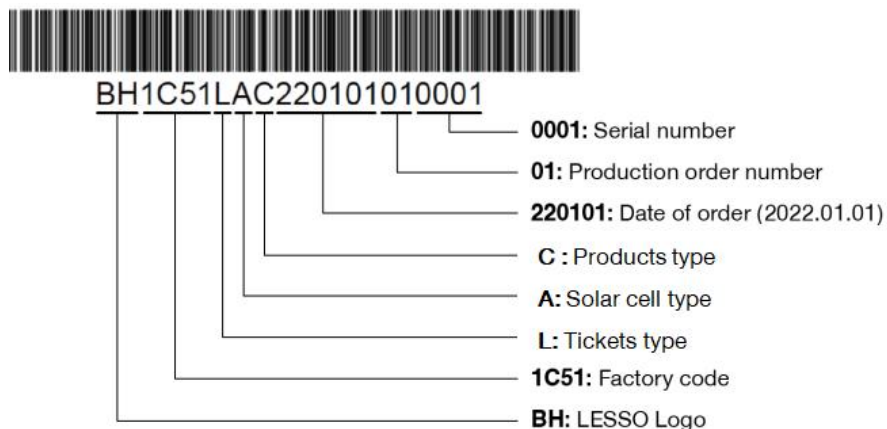
(a) Typical mechanical drawing of mono-facial modules



(b) Typical modules mechanical drawing of bifacial modules (with frame)

**Figure 3 - LESSO Solar PV module structure**

- Each module has a label on its rear side providing the following information: the product type, rated power, rated current, rated voltage, open circuit voltage, short circuit current, test conditions (STC and BNPI & BSI or aBSI for bifacial PV modules), and weight, dimension, the maximum system voltage, maximum fuse rating and so on.
- Each module has several serial numbers for traceability. One is permanently sealed up in the interior of the module, which is visible when viewing from the front of the module. The rest are pasted in frame and back sheet. The serial number coding is as follow:





- **Module external dimension as below:**

Dimension	Product Type
2278mm(L) × 1134mm(W) × 35mm/30mm(H)	A series
1722mm(L) × 1134mm(W) × 35mm/30mm(H)	D series

## 6. Installation Environment

- LESSO PV modules are suitable for ground installation in areas below 2000 meters above sea level, which cannot be used in outer space.
- LESSO suggests modules are installed in a working ambient temperature of -40 °C to 40 °C and humidity less than 85% RH environment. The working ambient temperature is the monthly average maximum temperature and minimum temperature of installation site. If modules are long-term exposed beyond the working ambient temperature limit of -40 °C - 85 °C, damage and power loss may occur earlier..
- The designed mechanical load for the product is 3600 Pa on the front and 1600 Pa on the back with safety factor is 1.5.
- Modules should be installed in areas with plenty irradiation, rather than shaded or partial shaded area.
- Modules should be protected against thunder and lightning while installation and operation, especially in frequent thunder and lightning area. Otherwise, modules are possible to be struck by lightning.
- Do not install modules near facilities or in places where inflammable gases can be generated or converged.
- Do not install modules in water immersed place, and place with water heating or water spray devices.

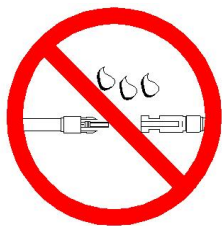
## 7. Mechanical Installation

### 7.1 General Rules

- Solar system installation requires professional knowledge and skills, and it should be operated by qualified personnel with specialized and licensed tools. Module installation personnel take all risks which may cause injuries, such as electric shock.
- Module installation has to refer to local and state applicable laws and regulations. If necessary, installation permission for architecture electric system should be obtained.
- Solar modules convert solar energy into DC current, which is designed for outdoor

installation on ground, mounting system or rooftop. System designer and installer are responsible for designing a proper mounting system.

- The whole process of system installation should be under dry conditions with dry tools. Do not carry or transport wet modules unless wearing appropriate protective equipment. Please stop installing in the rain, snow, or windy weather.
- Do not wear metallic jewelry while installation and maintenance.
- Do not touch modules with bare hands, as glass surface and frame may be hot, there is a risk of burns and electric shock.



- Because of heat-expansion and cold-contraction effect of module frames, there should be at least 10 mm distance between two adjacent modules.
- Please use the mounting holes that have been set on the aluminum frames for mounting with bolts. The most commonly used mounting method is to use the central 4 mounting holes on frames. In places with frequent snow and wind days, it is suggested to use 8 mounting holes.

## 7.2 Installation Direction and Tilt Angle Selection

- For maximum system efficiency, when installed in the northern hemisphere, modules should face south direction, while in the south hemisphere, modules should face north direction.
- Modules can be installed by long side frames or short frames. Before installation, make sure the cable length is enough. If extra cables needed, make sure to choose cables with the same type of connector.
- To get the correct installation tilt angle, please refer to standard PV module installation guide or consult with professional installer or expert. LESSO recommends that the installation angle should be not less than 10°, so modules can be self-cleaned during the rain.
- Modules in the same series should be installed at the same tilt angle. Different installation tilt angles shall cause unmatched current because absorption of different irradiation, which leads to reduced efficiency of solar system.

- Installation inclination refers to the angle between the solar photovoltaic module and the ground plane, as shown in Figure 4.

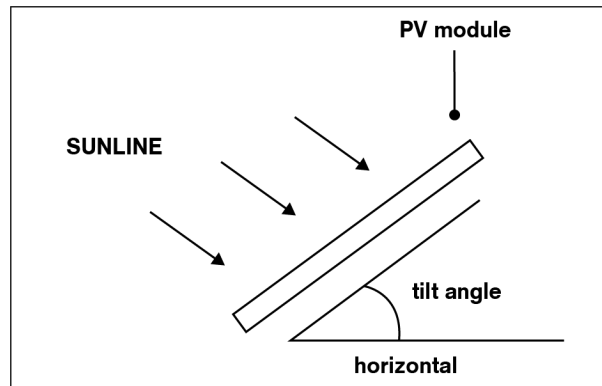


Figure 4 – Tilt angle

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°

Recommended tilt angle for fixed systems

### 7.3 Mounting System Selection

- Always observe the instructions and safety precautions of mounting systems to be used with modules. Choosing proper mounting system to meet load requirement, which is calculated by system designer or installer.
- Mounting systems must be made of anti-abrasion, anti-corrosion and UV-resistant materials.
- Do not drill holes in the aluminum frame of modules, otherwise, the warranty will be invalidated.

### 7.4 Ground Installation

- Ensure proper installation height, tilt angle and distance of mounting system to prevent the bottom of modules are not flooded by rain or buried by snow. Meanwhile, ensure the lowest part of the module is high enough to avoid being shaded by plants, buildings and obstructions and to avoid being damaged by sand and stone driven by wind.

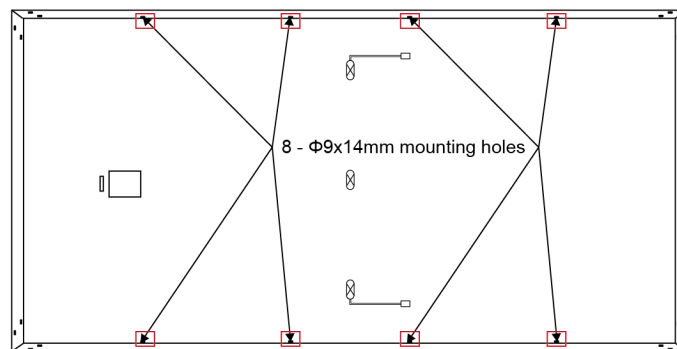
## 7.5 Rooftop Installation

- Before installing the modules on the rooftop, the construction unit and experts must evaluate the weight of the photovoltaic system to meet the relevant requirements of the roof structure, and can be installed only after meeting the local national building requirements;
- It is recommended to install modules on a roof or building under the weather of no winds or breeze, or it may cause accident in the weather of strong wind.
- When the module is installed on the roof or the building, it is necessary to ensure that the roof structure is fixed firmly and will not be damaged by heavy wind or heavy snow.
- Ensure the roof construction is suitable to install modules.
- System designer need to set up corresponding mounting system according to the special structure of the rooftop. In addition, any roof penetration required to fix the module must be properly sealed to prevent leakage.
- Adequate ventilation space should be provided under the module for cooling (10 cm minimum interval between modules and rooftop).

## 7.6 Installation Methods

### 7.6.1 Mounting with bolt

- LESSO offers one type of installation, bolts installation (install through the mounting holes).
- Each module has eight mounting holes at the aluminum frames used to fix the modules by M8 bolt on the mounting system.



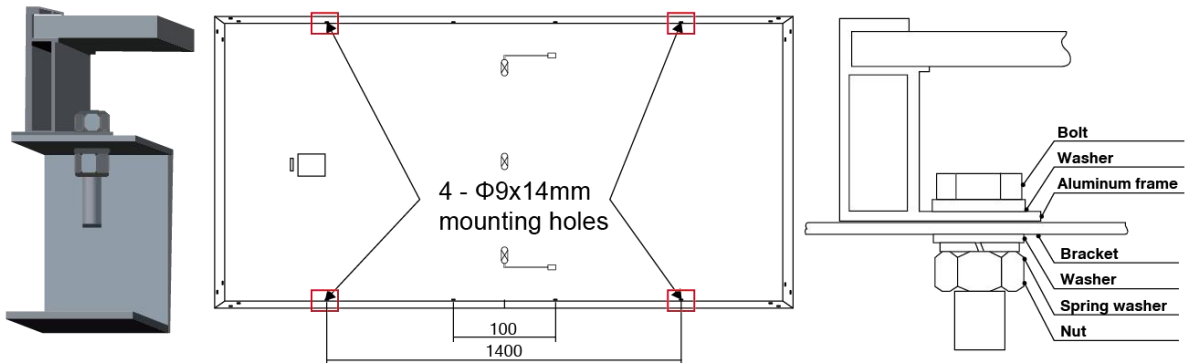
**Figure 5** - Eight mounting holes at the aluminum frames and GFRP composite frame

- The designed mechanical load for the product is 3600 Pa on the front and 1600 Pa on the back with safety factor is 1.5.

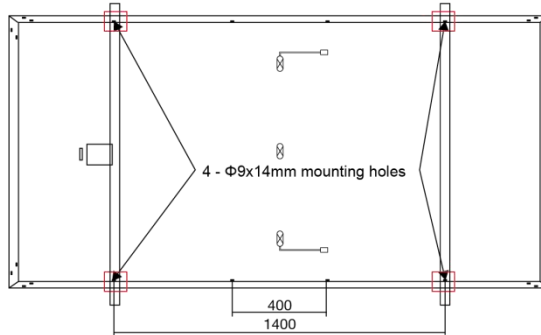
The designed mechanical load for LESSO module is as follow:

Module Name / Type	On the front	On the back	Safety factor
xxxC(HPM)xx(182)	3600 Pa	1600 Pa	1.5
xxxC(HBB)xx(182)	3600 Pa	1600 Pa	1.5
xxxC(HBD)xx(182)	3600 Pa	1600 Pa	1.5

- Mounting methods and positions**



**Figure 6 - Mounting methods and positions**



**Figure 7 - Installation with bolts into 4 outer holes, beam perpendicular to long sides**

Recommended accessories are as below:

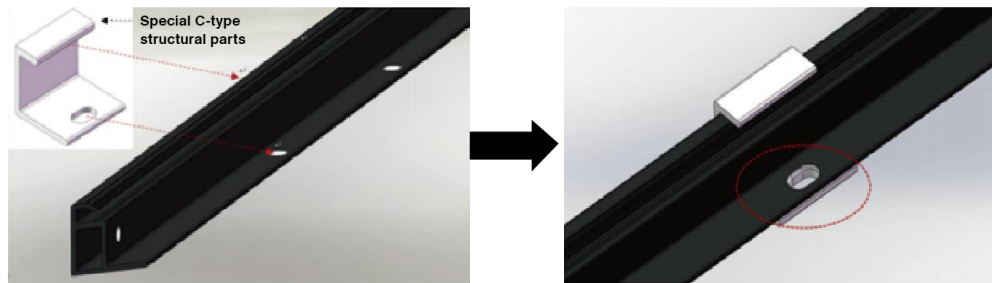
Accessories	Model	Material	Note
Bolt	M8 (full thread recommended)	Q235B/SUS304	Accessories material selection should be based on application environment.
Washer	2pcs, thickness $\geq 1.5$ mm and outside diameters = 16 mm	Q235B/SUS304	
Spring washer	8	Q235B/SUS304	
Nut	M8	Q235B/SUS304	

Suggestion: M8 bolt tightening torque range: 12-16 N • m.

- **Mounting details**
- **GFRP Composite Frame**

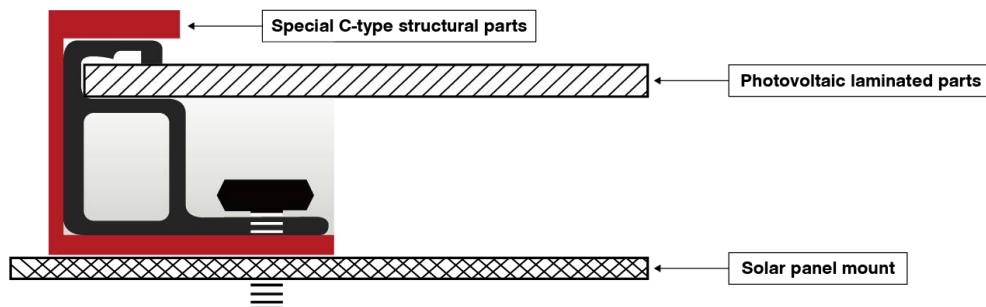
Due to the difference between the transverse and longitudinal mechanical strength of the composite material frame, and the lower elastic modulus than the aluminum frame, special C-type structural parts are required to assist the installation, the specific installation steps are as follows:

**Step 1:** Insert the C-type structural parts into the long side of the composite frame and align their mounting holes with those of the frame, as shown in Figure 8:



**Figure 8** - C-type structure and frame combination diagram

**Step 2:** Install the combined C-type structural parts and photovoltaic modules on the bracket, and the installation method after combination is consistent with the installation of conventional bolts, as shown in Figure 9 and 10:



**Figure 9** - Installation diagram

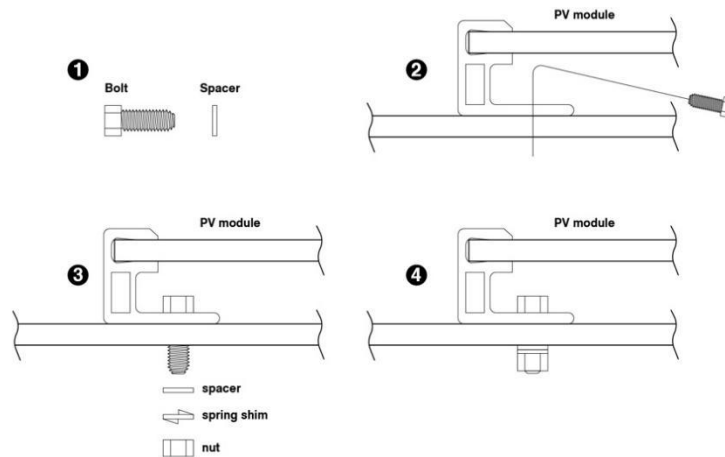
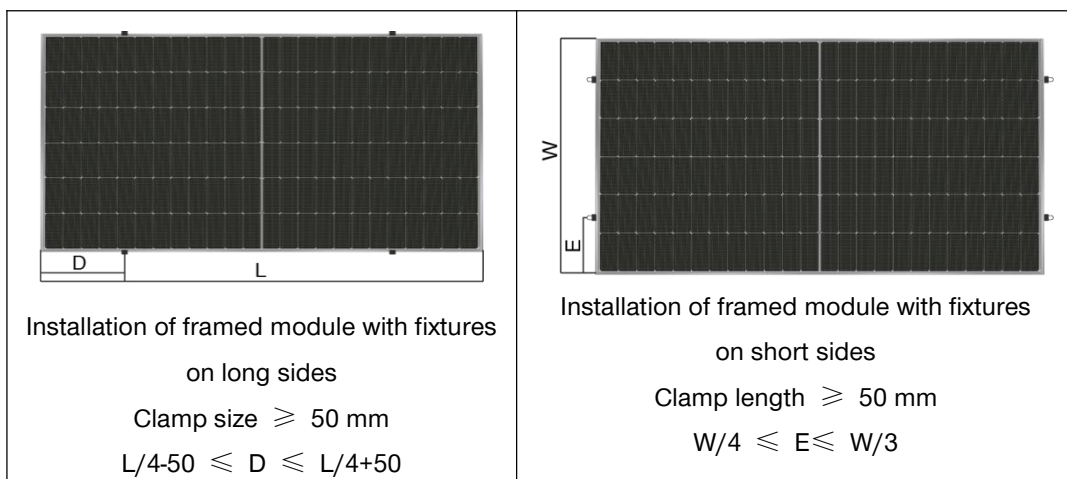


Figure 10 - Screwing mounting

### 7.6.2 Mounting with clamp

- Under no circumstances should the clamp touch the glass or deform the frame.
- The interface of the clamp to the front of the frame must be smooth and flat to prevent frame or other components from being damaged.
- Make sure no shadowing effect of the clamp.
- The drain hole cannot be blocked by the clamp.
- For framed PV module, the clamp must maintain an overlap of 8 - 11 mm with the frame of the module (you can change the cross section of the clamp if the module is securely installed).
- **Mounting methods and positions**



- **Mounting details**

The module can be mounted by a dedicated clamp, as shown in Figure 11:

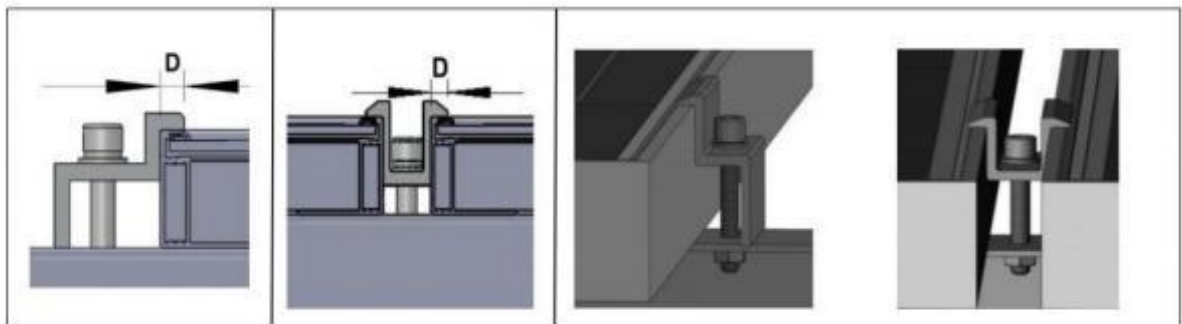
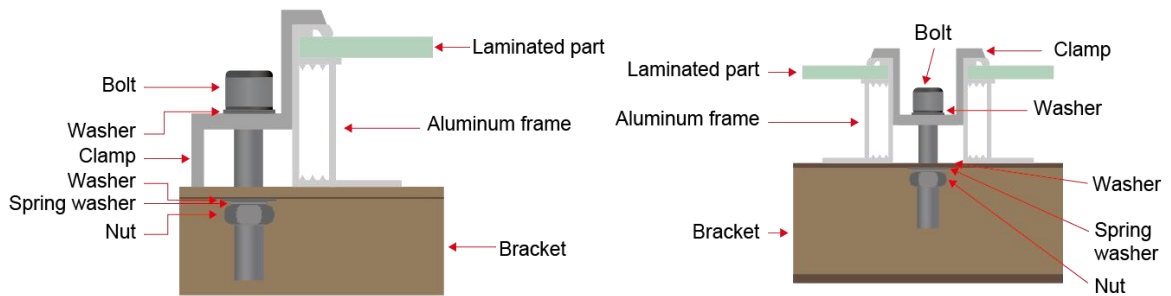


Figure 11 - Mounting with clamp

- **GFRP Composite Frame**

The composite frame exhibits a yield strength of approximately 1000 MPa. Upon release of stress below the yield strength, the frame undergoes 100% rebound.

The key point of the specially designed mounting block is the corner on side A, but the installation of the special mounting block is no different from that of the conventional mounting block, see Figure 12.

The composite frame can be made of conventional blocks when the load requirements are not high.

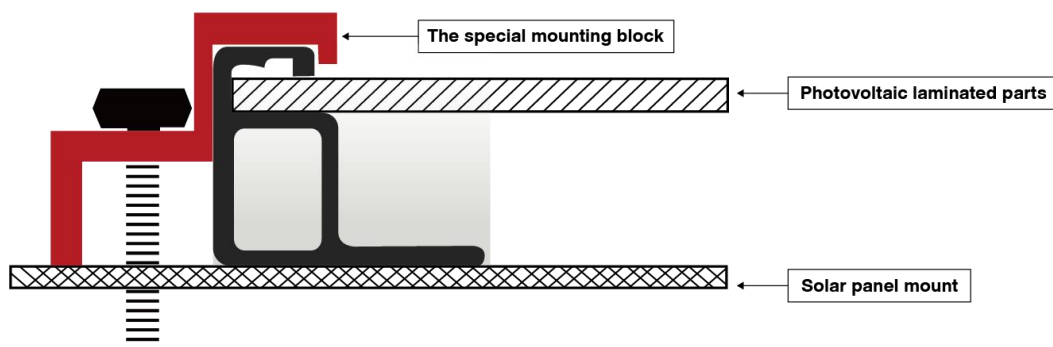


Figure 12 - Installation diagram

- NOTE:**
- a. Each PV module needs to be fixed with at least four clamp, and the applied torque is 16 N·m - 20 N·m;
  - b. Ensure that the clamp overlaps with the A side of the module frame by  $8 \text{ mm} \leq D \leq 11 \text{ mm}$ ;



c. Recommended M8 bolt, Nut, Flat washer, Spring washer, clamp are made of anti-corrosion firmware.

## 8. Electrical Installation

### 8.1 General Installation

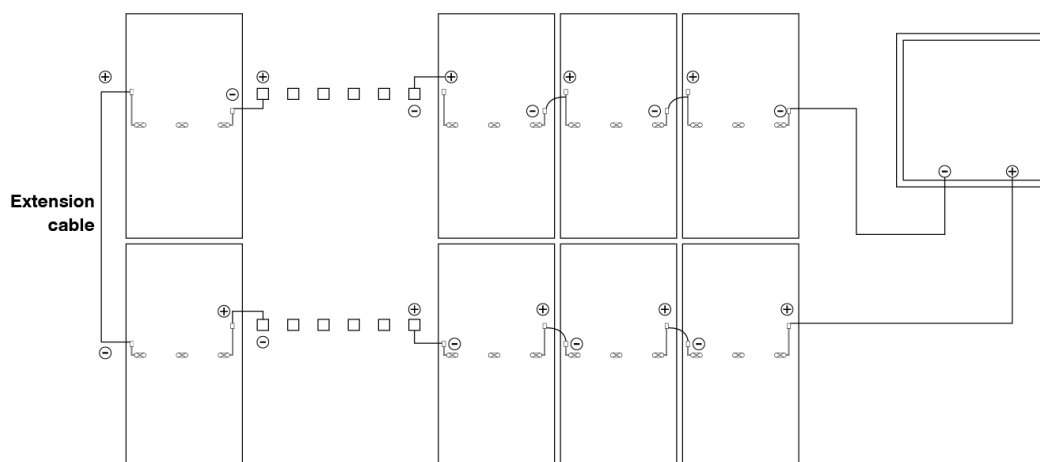
- Under normal conditions, modules may generate more power than standard test conditions.
- When selecting solar system equipment's parameters, such as rated voltage, rated current, fuse model, power output related parameters, actual installation environment and conditions should be considered.
- Please make sure connector, inverter and other electrical components are in disconnected state during the installation.
- Please refer to the regional and national regulations to determine the wires size, type and temperature. To prevent the cables and the connectors from overheating, the cross-sectional area of cable and the capacity of connector must be selected to suit the system short circuit current and temperature when they are exposed to sunlight, otherwise the cable and connector will be overheated under large current.
- The cable delivered with modules is  $1 \times 4.0 \text{ mm}^2$  which was certified according to IEC 62930 and/or EN 50618. The connector delivered with 1500 V system voltage modules is which was certified according to IEC 62852.
- In places with frequent thunder and lightning, arrester device must be installed for solar system to reduce the risk of lightning damage, loop area should be kept as small as possible when laying cables.
- It is necessary to avoid mechanical damage of cables and modules when fixing cables on support frames.
- When fixing the cable in a proper way, it should be fixed with light resistant binding wire and avoid direct sunlight and water immersion.

### 8.2 Grid-connected Electrical System

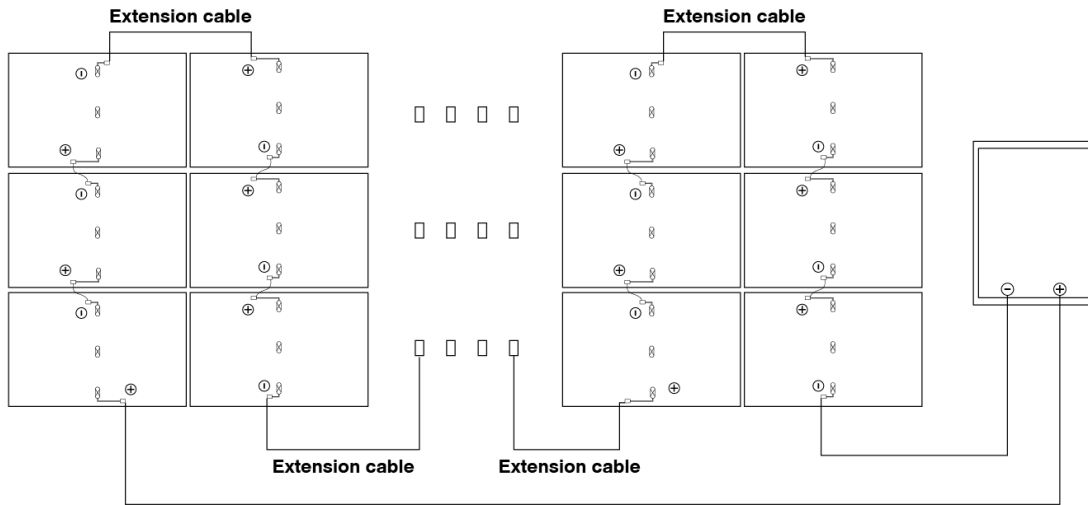
- DC generated by solar system can be converted into AC and connected to a public grid system.
- Because the policy of connecting PV systems to the public grid varies in different regions, please consult with a qualified system engineer to design a system. Typically, the installation of this system requires confirmation, acceptance and formal approval from the public sector.

### 8.3 Electrical Connect Methods

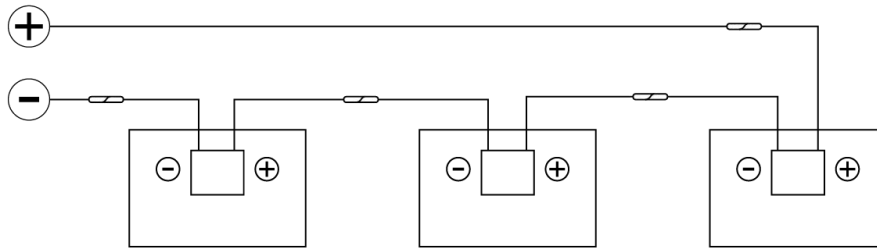
- Several PV modules are connected in series and then connected in parallel to form a PV array, which is especially for application with a high operation voltage.
- If modules are connected in series, the total voltage is equal to the sum of individual voltages.
- For applications requirement of high current, several modules can be connected in parallel, and the total current of the array is equal to the sum of the currents of each module.
- The maximum quantity of modules in series and in parallel must be calculated based on the related regulations.
- The open-circuit voltage ( $V_{OC}$ ) under the expected lowest local temperature and the highest irradiation should not exceed DC 1500 V, the regulated maximum system voltage.
- Reference formula for quantity of modules in series:  $1500 V / [V_{OC} + (CV_{OC} \times V_{OC})]$ ;
- Reference formula for protection devices per string:  $1.25 \times I_{SC}$ .
- LESSO modules are provided with standard cables with a cross sectional area of  $4 \text{ mm}^2$  and the temperature in the range from  $-40 \text{ }^\circ\text{C}$  to  $85 \text{ }^\circ\text{C}$ .
- The plug connector is divided into positive and negative polarity, which need to be of the same type.
- Make sure that connection is clean, dry, safe and tight.
- Wrong connection or loose connection may cause electric arc or electric shock.
- Plug connector should not receive external stress.
- Unqualified personnel should not open locked nut.
- Connectors should only be used to connect circuit, but never be used to turn circuit on or off.



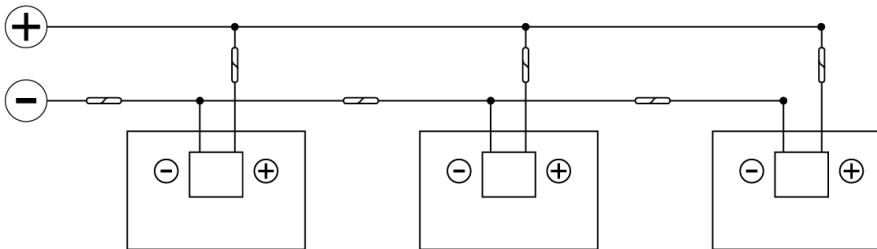
(a) Series Connection (Vertical installation of short cable modules)



(b) Typical modules mechanical drawing of bifacial modules (with frame)

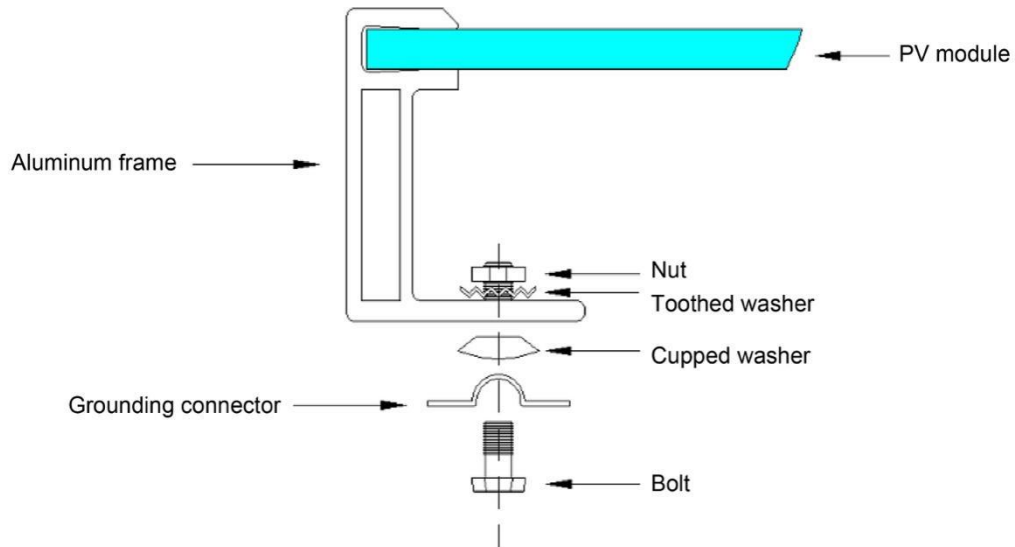


(c) Series connection



(d) Parallel connection





**Figure 14** - Grounding methods and positions

- PV modules can be grounded by connecting to support frames integrated with grounding device or to separate grounding device.
- Make sure grounding measure is safe and effective, and do not cause electrochemical corrosion of different metals and aluminum frames.
- To get the most output power and avoid PID effect, the DC negative electrode of the array is supposed to be grounded when installation. If not, the output power may decrease.

### **8.5 Fusing and Temperature Coefficient**

- Module over current protection is rated for DC use.
- Please refer to the application requirements of local standard to determine the fuse.
- If reverse current which exceed the Max. Series fuse current pass-through modules, over current protective device of the same specifications should be used to protect the modules.
- If modules in parallel exceed 2 strings, each string must be installed with an over current protective device.
- Fuse should be installed rated for the maximum direct current voltage and connected to each ungrounded pole of the array. In other words, if the system is not grounded, the fuse should be connected to the positive and negative poles.
- The maximum rating of a fuse in series with an array string for different modules and the temperature coefficient for different modules are as follows:

<b>Module Name / Type</b>	<b>The maximum rating of a fuse (A)</b>	<b>Current temperature coefficient <math>\alpha</math> (%/°C)</b>	<b>Voltage temperature coefficient <math>\beta</math> (%/°C)</b>	<b>Power temperature coefficient <math>\delta</math> (%/°C)</b>
xxxC(HPM)xx(182)	25	0.043	-0.25	-0.30
xxxC(HBB)xx(182)	30	0.043	-0.25	-0.30
xxxC(HBD)xx(182)	30	0.043	-0.25	-0.30

## 9. Adjustment and Maintenance

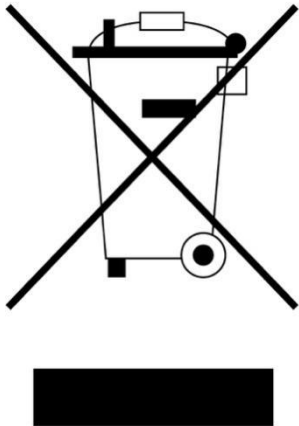
LESSO Solar recommends the following adjustment and maintenance items to ensure optimum performance of the module:

- Electrical and mechanical connections should be checked at least once half a year by qualified personnel to verify they are clean, secure and undamaged. Pay attention to observe the maintenance instructions for all components used in the system, such as mounting systems, inverters, PV combiner box, batteries, etc.
- As time goes on, dirt and dust may accumulate on the surface of modules, which will lead to the decrease of output power. It is recommended to clean modules at least once a year to ensure the maximum output power, especially in low rainfall areas.
- It is suggested to clean modules when sunshine is not strong.
- Do not touch glass surface with bare hand to avoid leaving fingerprint and other dirt on the glass.
- Please use dry duster or dishcloth to remove dirt from the surface of modules, and then use soft sponge or dishcloth to clean modules with water. Mild, non-abrasive cleansers (ethyl alcohol, methyl alcohol etc.) can be used to remove stubborn dirt.
- Do not use water with high mineral content and excessive water pressure to clean modules. Normal water supply is applicable.
- If modules installed in dusty places, blow dust first when cleaning modules. To clean snow on modules, do not try to scrape the frozen snow and ice with too much force.
- Do not clean modules with broken glass or bare cables, there is electric shock hazard.
- If any problems arise, please arrange qualified personnel for inspection.

## 10. Others

Meaning of crossed – out wheeled dustbin:

- Do not dispose of electrical appliances as unsorted municipal waste, use separate collection facilities. Contact your local government for information regarding the collection systems available. If electrical appliances are disposed of in landfills or dumps, hazardous substances can leak into the groundwater and get into the food chain, damaging your health and well-being.
- When replacing old appliances with new ones, the retailer is legally obligated to take back your old appliance for disposals at least free of charge.



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## 11. The appendix

### Product Information

- All electrical data should be measured under below test conditions:

STC: AM= 1.5, E= 1000 W/m<sup>2</sup> , Tc=25 °C;

The additional test conditions for Bifacial PV modules:

BNPI: E= 1000 W/m<sup>2</sup> +  $\varphi$  • 135 W/m<sup>2</sup>

BSI: E= 1000 W/m<sup>2</sup> +  $\varphi$  • 300 W/m<sup>2</sup>

P<sub>max</sub> of any individual module will be within ±3% tolerance of these specified values.

V<sub>OC</sub> of any individual module will be within ±3% tolerance of these specified values.

I<sub>SC</sub> of any individual module will be within ±4% tolerance of these specified values.

Specifications and electric characteristics in Table 1 and 2 is subject to technical and product innovations.

Information in this document is subject to change without notice.

**Table 1: The specifications for LESSO Single-Glass PV Module**

- xxxC(HPM)72(182) /xxxC(HPM)54(182) /xxxC(HBB)72(182) /xxxC(HBB)54(182) Series**

Type Name or Model No.	xxxC(HPM)72(182) (xxx=580-600)	xxxC(HPM)54(182) (xxx=430-440)	xxxC(HBB)72(182) (xxx=580-585)	xxxC(HBB)54(182) (xxx=430-435)
Maximum System Voltage [V <sub>DC</sub> ]	1500	1500	1500	1500
Rated Maximum Power [W]	600, 595, 590, 585, 580	440,435,430	585, 580	435, 430
Tolerance of Rated Maximum Power [%]	±3%	±3%	±3%	±3%
Rated Short Circuit Current [A]	14.75, 14.67, 14.59, 14.51, 14.43	14.37, 14.29, 14.21	14.48, 14.42	14.88, 14.82
Tolerance of Rated Short Circuit Current [%]	±3%	±3%	±3%	±3%
Rated Open Circuit Voltage [V]	53.23, 53.03, 52.83, 52.63, 52.43	38.92, 38.73, 38.54	53.71, 53.51	40.28, 40.13
Tolerance of Rated Open Circuit Voltage [%]	±4%	±4%	±4%	±4%

<b>Rated Maximum Power Current [A]</b>	13.92, 13.85, 13.78, 13.71, 13.64	13.60, 13.52, 13.44	13.72, 13.65	13.63, 13.57
<b>Rated Maximum Power Voltage [V]</b>	43.12, 42.97, 42.82, 42.67, 42.53	32.35, 32.18, 32.00	42.65, 42.50	31.92, 31.69
<b>Rated Maximum Power at BNPI [W]</b>	-	-	635, 630	472, 467
<b>Rated Open Circuit Voltage at BNPI [V]</b>	-	-	53.80, 53.60	40.35, 40.20
<b>Rated Short Circuit Current at BNPI [A]</b>	-	-	15.99, 15.92	16.43, 16.36
<b>Rated Short Circuit Current at BSI [A]</b>	-	-	16.08	16.08
<b>Tolerance of Short Circuit Current at BSI [%]</b>	-	-	±4%	±4%
<b>Over-current Protection Rating [A]</b>	25	25	30	30
<b>Protection Classification (IEC 61730)</b>	Class II	Class II	Class II	Class II
<b>Dimensions (LxWxH) [mm]</b>	2278×1134×35/30	1722×1134×35/30	2278×1134×30	1722×1134×30
<b>Module Area [m<sup>2</sup>]</b>	2.59	1.96	2.59	1.96
<b>Min-creepage Distance [mm]</b>	13.5	13.5	13.5	13.5
<b>Number of Solar Cells</b>	144	108	144	108
<b>Cells per Bypass Diode</b>	48	36	48	36
<b>Serial / Parallel Connection of Cells (S, SP, SPS)</b>	SP	SP	SP	SP
<b>Number of Diodes</b>	3	3	3	3

**Table 2: The specifications for LESSO Double-Glass PV Module**

- **xxxC(HBD)72(182) /xxxC(HBD)54(182) Series**

Type Name or Model No.	xxxC(HBD)72(182) (xxx=580-600)	xxxC(HBD)54(182) ) (xxx=430-440)
Maximum System Voltage [V <sub>DC</sub> ]	1500	1500
Rated Maximum Power [W]	600,595,590,585, 580	440,435,430
Tolerance of Rated Maximum Power [%]	±3%	±3%
Rated Short Circuit Current [A]	14.57, 14.51, 14.45, 14.39, 14.33	14.85, 14.79, 14.73
Tolerance of Rated Short Circuit Current [%]	±3%	±3%
Rated Open Circuit Voltage [V]	52.23, 52.03, 51.83, 51.63, 51.43	37.77, 37.57, 37.37
Tolerance of Rated Open Circuit Voltage [%]	±4%	±4%
Rated Maximum Power Current [A]	13.85, 13.78, 13.71, 13.64, 13.57	13.61, 13.55, 13.49
Rated Maximum Power Voltage [V]	43.33, 43.18, 43.04, 42.89, 42.75	32.34, 32.11, 31.88
Rated Maximum Power at BNPI [W]	660, 655, 650, 645, 639	485, 479, 474
Rated Open Circuit Voltage at BNPI [V]	52.22, 52.02, 51.82, 51.62, 51.42	37.76, 37.56, 37.36
Rated Short Circuit Current at BNPI [A]	16.09, 16.02, 15.95, 15.89, 15.82	16.39, 16.33, 16.26
Rated Short Circuit Current at BSI [A]	30	30

<b>Tolerance of Short Circuit Current at BSI [%]</b>	Class II	Class II
<b>Over-current Protection Rating [A]</b>	2278×1134×35/30	1722×1134×35/30
<b>Protection Classification (IEC 61730)</b>	2.59	1.96
<b>Dimensions (LxWxH) [mm]</b>	13.5	13.5
<b>Module Area [m<sup>2</sup>]</b>	144	108
<b>Min-creepage Distance [mm]</b>	48	36
<b>Number of Solar Cells</b>	SP	SP
<b>Cells per Bypass Diode</b>	3	3