

Solar PV Modules Installation Manual

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1. GENERAL INFORMATION

1.1 Overview

Thanks for choosing our Solar PV modules. In order to ensure the PV modules are installed correctly, please read the following installation instructions carefully before modules are installed and used.

Please remember that these products generate electricity and certain safety measures need to be taken to avoid danger.

Make sure the module array is designed not to exceed the maximum system voltage of any system component such as connectors or inverters.

The assembly is to be mounted over a fire resistant roof covering rated for the application. Before mounting the module, please consult your local building department to determine approved roofing materials.

The modules are qualified for application class A: Hazardous voltage (CSA 61730: higher than 50V DC; UL 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated. Modules are qualified for safety through UL 61730-1 and -2 within this application class are considered to meet the requirements for Safety Class II.

1.2 Warnings

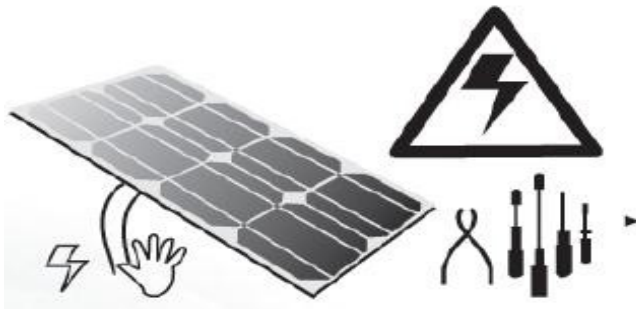


- PV modules generate DC electrical energy when exposed to sunlight or other light sources. Active parts of module such as terminals can result in burns, sparks, and lethal shock.
- Artificially concentrated sunlight should not be directed to the module or panel.



- Protective front glass is utilized on the module. Broken solar module glass is an electrical safety hazard (may cause electric shock or fire). These modules cannot be repaired and should be replaced immediately.
- To reduce the risk of electrical shocks or burns, modules may be covered with an opaque material during installation to avoid injury.
- The installation work of the PV array can only be done under the protection of sun-sheltering covers or sunshades and only qualified person can install or perform maintenance work on this module.
- Follow the battery manufacture's recommendations if batteries are used with modules.

- Do not use this module to replace or partly replace for roofs and walls of buildings.
- Do not install modules where flammable gas may be present.
- Do not touch active terminals with bare hands. Use insulated tools for electrical connections.



- Do not remove any installed parts from the solar panel or remove the module.
- All instructions should be read and understood before attempting to install, wire, operate and maintain the module.
- Don't lift up PV modules using the attached cables or the junction box.
- All Dual glass PV systems except the non-metallic frame must be earthed. If there is no special regulation, please follow the National Electrical Code or other national code.
- Under Normal conditions, a photovoltaic module is likely to experience conditions that generate more current and / or voltage than reported under standard test conditions. Accordingly, the value of I_{sc} and V_{oc} marked on the module should be multiplied by 1.25 when determining PV system component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.
- Once the PV module has been shipped to the installation site, all of the parts should be unpacked properly with care.



- Do not step on or stand on the PV module as shown in the picture. This is prohibited and there is a risk that it will damage the module and cause injury to you.
- Only PV modules with the same P_{max} and I_m should be connected in series.
- During transporting modules, please attempt to minimize shock or vibration to the module, as this may damage the module or lead to cell micro cracks.

- In all cases of transport, never drop the module from a vehicle, home or hand. This will damage the module.
- Do not clean the glass with chemicals. Only use tap water. Make sure the module surface temperature is cool to the touch. When the module surface temperature is high, cleaning the modules with cold water may cause the glass to break.
- Do not disconnect any of the modules when under load.
- When looking at PV modules with anti-reflection (AR) coating technology, it would be normal to see some cells with a slight color difference from different angles.
- Corner protection of PV module is used to protect the module during transportation, and the customer can remove it or leave it on modules.
- Connector of junction box can not be contacted with oily substances, for example, lubricant, rust inhibitor etc.

2. INSTALLATION

2.1 Installation Safety

- Always wear protective headgear, insulating gloves and safety shoes (with rubber soles).
- Keep the PV module packed in the carton until installation.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frame may be hot. There is a risk of burns and electric shock.
- Do not work in rain, snow or windy conditions.
- Due to the risk of electrical shock, do not perform any work if the terminals of the PV module are wet.
- Use insulated tools and do not use wet tools.
- When installing PV modules, do not drop any objects (e.g., PV modules or tools).
- Make sure flammable gasses are not generated or present near the installation site.
- Insert module connectors fully and correctly. An audible "click" sound should be heard. This sounds confirms the connectors are fully seated. Check all connections.
- The module leads should be securely fastened to the module frame, wire management should be done in a way to avoid the connector from scratching or impacting the rear cover of the module.
- Do not touch the junction box and the end of the interconnect cables (connectors) with bare hands during installation or under sunlight, regardless if the PV module is connected to or disconnected from the system.
- Do not expose the PV module to excessive loads on the surface of the PV module or twist the frame.
- Do not hit or put excessive load on the glass or rear cover, this may break the cells or cause micro cracks.

- During the installation or operation, don't use sharp tools to wipe the rear cover and glass. Scratches can appear on the module.
- Do not drill holes in the frame. It may cause corrosion of the frame.
- When installing modules on roof mounted structures, please try to follow the "from top to bottom" and/or "from left to right" principle, and don't step on the module. This will damage the module and would be dangerous for personal safety.

2.2 Installation Condition

2.2.1 Climate Condition

Please install the modules in the following conditions:

- 1)The environment temperature: with in -40°C (-40°F) to 85°C (185°F).
- 2)Do not install modules in a place where there may be water immersion.

Note: The mechanical load bearing (include wind and snow loads) of the module is based on the approved mounting methods. The professional system installer must be responsible for mechanical load calculation according to the system design.

2.2.2 Site selection

In most applications, our solar PV modules should be installed in a location where they will receive maximum sunlight throughout the year. In the Northern Hemisphere, the module should typically look at south, and in the Southern Hemisphere, the modules should typically look at north.

Modules facing 30 degrees away from true South (or North) will lose approximately 10 or 15 percent of their power output. If the module faces 60 degrees away from true South (or North), the power loss will be 20 to 30 percent. When choosing a location, avoid trees, buildings or obstacles that can create shadows in solar photovoltaic modules, especially during winter when the arc of the sun is lowest on the horizon. Shading causes output loss, although factory-installed bypass diodes in the PV module will minimize such losses. Do not install the PV module near open flame or flammable materials.

When solar modules are used to charge batteries, the battery must be installed in such a way as to protect the performance of the system and the safety of its users. Follow the battery manufacturer's guidelines concerning installation, operation and maintenance recommendations.

In general, the battery (or battery bank) should be away from the main flow of people and animal traffic. Select a battery site that is protected from sunlight, rain, snow, debris, and is well ventilated. Most batteries generate hydrogen gas while charging, which can be explosive. Do not burn matches or create sparks near the battery bank. When a battery is installed outdoors, it must be placed in an insulated and ventilated battery box specially designed for this purpose. Do not install the PV module where it will be immersed in water or where it will be constantly exposed to water from the sprinkler.

2.2.3 Tilt angle selection

The tilt angle of the PV module is measured between the surface of the PV module and a horizontal ground surface (Figure 1). The PV module generates maximum output power when it faces the sun directly.

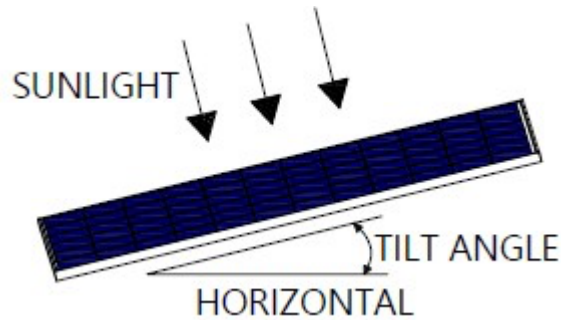


Figure1: Tilt angle of PV module

For standalone systems with batteries where the PV modules are attached to a permanent structure, the tilt angle of the PV modules should be selected to optimize the performance based on seasonal load and sunlight. In general, if the PV output is sufficient when irradiance is low (e.g., winter), then the angle chosen should be sufficient during the rest of the year. For grid-connected installations where the PV modules are attached to a permanent structure, PV modules should be tilted so that the energy production from the PV modules will be maximized on an annual basis.

2.2.4 Mechanical Installation introduction (Fixation with clamps)

Solar PV modules usually can be mounted by using the following methods: bolts and clamps.

*** Note:**

- 1) All installation methods herein are only for reference, and us solar will not provide related mounting components, the system installer or trained professional personnel must be responsible for the PV system's design, installation, and mechanical load calculation and security of the system.
- 2) Before installation, the following items should be addressed:
 - a) Visually check the module for any damage. Clean the module if any dirt or residue remains from shipping .
 - b) Check if module serial number stickers match.
- 3) us modules are designed to meet a maximum positive (only downward) pressure of 5400Pa and negative (downward or upward)pressure of 2400Pa. When mounting modules in snow-prone or high-wind environments, special care should be taken to mount the modules in a manner that provides sufficient design strength while meeting local code requirements

***Fixation with clamps**

The module clamps should not contact with the front glass and must not deform the frame. Be sure to avoid shadowing effects from the module clamps. The module frame is not to be modified under any circumstances. When choosing this type of clamp-mounting method, please be sure to use at least four or eight clamps on each module (as shown below) , two clamps should be attached on each long sides of the module.Dependng on the local wind and snow loads, if excessive pressure load is expected, additional clamps or support would be required to ensure the module can bear the load. The applied torque value should be big enough to fix the modules steadily (Please consult with the support 's supplier for the specific torque value,Typical values is 16~22N*m). Please find detailed mounting information in the below illustration.

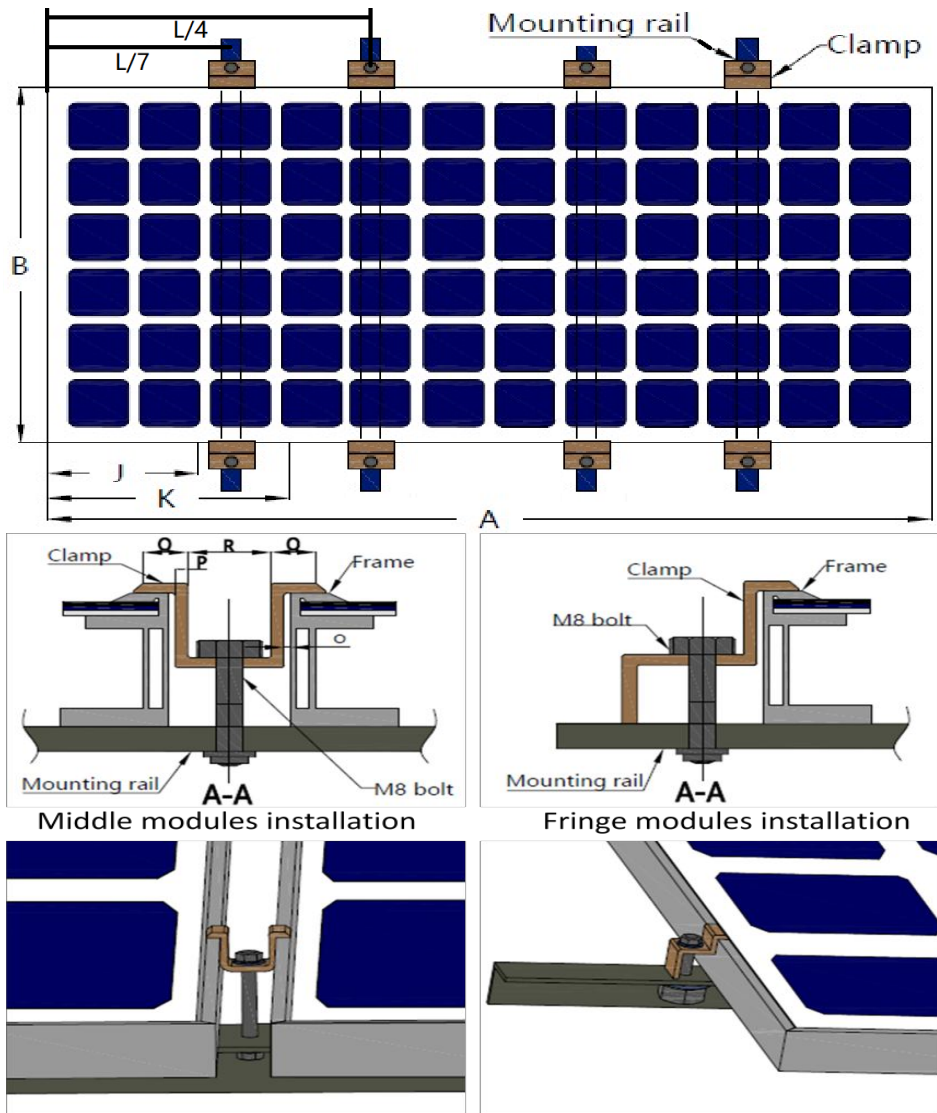


Figure 3 : The mounting method of clamps for modules with frame

Module type	Dimensions(mm)			Mechanical Load Pressure	Safety factor	minimum number of Clamps
	A*B	J	K			
AL-KVNC-xxxM-72H-GBF	2278 x 1133 x35mm	L/4 ± 50mm (L is the length of the long side of the module)		+3600Pa/-1600Pa	1.5	4
	2278 x 1133 x40mm					4
AL-KVNC-xxxM-66H-GBF	2090 x 1133 x35mm 2073 x 1133 x35mm	L/4 ± 50mm (L is the length of the long side of the module)		+3600Pa/-1600Pa	1.5	4
	2090x 1133 x40mm 2073 x 1133 x40mm					4

AL-KVNC-xxxM-60H-GBF	1909 x 1133 x35mm 1909 x 1133 x40mm	280	480	+3600Pa/-1600Pa	1.5	4
AL-KVNC-xxxM-54H-GBF	1722 x 1133 x35mm 1710 x 1133 x35mm 1722 x 1133 x40mm 1710 x 1133 x40mm 1722 x 1134 x35mm 1722 x 1134 x40mm	280	420	+3600Pa/-1600Pa	1.5	4

Table 2 : Mechanical dimensions when modules installed with fitting method of clamps

*** Note:**

- 1) All installation methods herein are only for reference, and our solar will not provide related mounting components, the system installer or trained professional personnel must be responsible for the PV system's design, installation, and mechanical load calculation and security of the system.
- 2) Before installation, the following items should be addressed:
 - a) Visually check the module for any damage. Clean the module if any dirt or residue remains from shipping.
 - b) Check that the module serial number labels match.
- 3) When mounting modules in snow-prone or high windy environments, special attention should be paid to mounting the modules in such a way that they provide adequate design power while meeting native code requirements.
- 4) When installing the dual glass modules at a certain angle, please installed the modules in front of the sun. However, the junction box mounted on the rear surface of the module is not allowed to be exposed to the sun.
- 5) For double-glass modules, it is recommended that the height from the bottom of the module to the installation plane is not less than 1 meter in order to achieve better power generation from the rear side of the module.

3. WIRING AND CONNECTION

- a) Before this procedure, please read the operation instructions of the PV system carefully. Make wiring by multi-connecting cables between the PV modules in series or parallel connection, which is determined by user's configuration requirement for system power, current and voltage.
- b) PV module connected in series should have similar current. Modules should not be connected together to create a voltage higher than the permitted system voltage(1500VDC). The maximum number of modules in the series depends on system design, type of inverter used and environmental conditions.
- c) The maximum fuse rating value in an array string can be found on the product label or in the product datasheet. The fuse rating value is also corresponding to the maximum reverse current that a module can withstand. Therefore, depending on the maximum serial fuse rating of the module and local wiring criteria, make sure that the parallel module strings for connection must be installed with the appropriate string fuse for circuit protection.
- d) Open the combiner box of the control system and connect the conductor from the PV arrays to the combiner box in accordance with the the design and local codes and standards. The cross-

sectional area and cable connector capacity must satisfy the maximum short-circuit of the PV system (for a single component, we recommended that the cross-sectional area of cables be 4mm^2 and the rated current of connectors be more than 15A), otherwise cables and connectors will become overheating for large current. Please note that the temperature limit of cables is 85°C .

- e) Module with frame must be properly grounded in accordance with local and national electrical codes. Mounting racks must be properly grounded in accordance with local and national electrical codes too. Module without frame do not need grounding because there will be no leakage current between cell and encapsulation material due to non-frame structure. Attach the equipment grounding conductor to the module frame using the provided hole and hardware. Note that a stainless-steel star washer is used between the ground wire and module frame (see Figure 4 below). This washer is used to avoid corrosion due to dissimilar metals. Tighten the screw securely.

In order to obtain the best power output (to prevent PID effect), we suggest that the DC negative pole of the module array should be grounded when installing the module. If the operation is not in accordance with the requirements of this article, the output power of the system may be reduced.

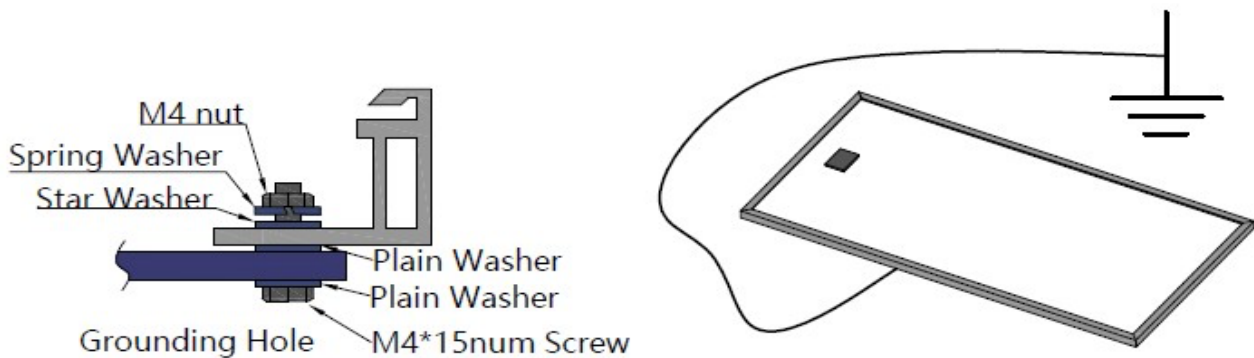


Figure 4 : The graph of Grounding

- f) Follow the requirements of applicable local and national electrical codes.
g) These modules contain factory-installed bypass diodes. If these modules are incorrectly connected to each other, the bypass diodes, cable or junction box maybe damaged.

4. MAINTENANCE AND CARE

It is especially necessary to carry out regular inspection and maintenance of the modules during the warranty period. To ensure optimum module performance, we recommend the following maintenance measures:

4.1 Visual Inspection

Examine the modules visually to find if there are any visual defects, if any, the following items should be evaluated:

- a) If the modules are observed to have slight cell color differences at different angles, this is a normal case for modules with anti-reflection coating technology.
- b) Whether the glass is broken
- c) No sharp objects are in contact with the PV module surfaces
- d) PV modules are not shaded by unwanted obstacles and/or foreign material
- e) Corrosion along the cells" bus-bar. Corrosion is caused by moisture ingress from the module back cover. Check the back cover for damage.
- f) Check whether the rear cover is burn out.
- g) Check if screws and mounting brackets are tight, adjust and tighten as necessary.

4.2 Cleaning

- a) Accumulation of dust or dirt on the front of the module (s) causes the energy output to drop. Clean the panel(s) once a year (depending on field conditions) if necessary, using a dry or damp soft cloth, if possible. Water with high mineral content may leave deposits on the glass surface and is not recommended.
- b) Never use abrasive material under any circumstances.
- c) In order to reduce the potential for electrical and thermal shock, we recommend cleaning PV modules during early morning or late afternoon hours when solar radiation is low and the modules are cooler, especially in regions with hotter temperatures.
- d) Never attempt to clean a PV module with broken glass or other signs of exposed wiring, as this presents a shock hazard.
- e) Never use chemicals when cleaning modules, as this may affect module warranty and energy output.

4.3 Inspection of connector and cable

It's recommended to implement the following preventive maintenance every 6 months:

- a) Check the sealing gels of the junction box for any damage.
- b) Examine the PV module(s) for signs of deterioration. Check for possible rodent damage, decomposition and if all connections are tight and corrosion-free. Check electrical leakage to ground. The dual glass modules of the non-metallic frame should not be earthed.

5. ELECTRICAL SPECIFICATION

The module electrical ratings are measured under Standard Test Conditions, which are 1000W/m², irradiance with AM 1.5 spectrum and 25 deg (77°F) ambient temperature. The module might produce more or less voltage or current than rating value in uncertainty condition.

1. Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} marked on this PV module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g. inverter) connected to the PV output."

2. The safety factor of 1,25 for the minimum voltage rating of the components can 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}. I_{sc} can be adjusted based on maximal temperature, irradiance and orientation of the module. To this end a full simulation for the specific location is required using long term weather data.

3. The module is considered to be in compliance with this standard only when the module is either mounted in the manner specified by the mounting instructions, or when the mounting means has been evaluated with this PV module to UL 2703. A module with exposed conductive parts is considered to be in compliance with this standard only when it is either electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017), or when the bonding means has been evaluated with this PV module to UL 2703.

4: (182 cell)

Modle	Voc (V)	Vmpp (V)	Isc (A)	Impp (A)	Pmpp (W)	Tolerance of Isc	Tolerance of Voc	Tolerance of Pmpp
AL-KVNC-520M-72H-GBF	48.9	40.9	13.6	12.71	520	±5%	±5%	±3%
AL-KVNC-525M-72H-GBF	49.05	41.05	13.66	12.79	525	±5%	±5%	±3%
AL-KVNC-530M-72H-GBF	49.2	41.2	13.72	12.86	530	±5%	±5%	±3%
AL-KVNC-535M-72H-GBF	49.35	41.35	13.78	12.94	535	±5%	±5%	±3%
AL-KVNC-540M-72H-GBF	49.5	41.5	13.85	13.01	540	±5%	±5%	±3%
AL-KVNC-545M-72H-GBF	49.65	41.8	13.92	13.04	545	±5%	±5%	±3%
AL-KVNC-550M-72H-GBF	49.8	41.95	13.98	13.11	550	±5%	±5%	±3%
AL-KVNC-555M-72H-GBF	49.95	42.05	14.05	13.2	555	±5%	±5%	±3%
AL-KVNC-560M-72H-GBF	50.1	42.3	14.12	13.24	560	±5%	±5%	±3%
AL-KVNC-475M-66H-GBF	44.8	37.5	13.51	12.67	475	±5%	±5%	±3%
AL-KVNC-480M-66H-GBF	44.95	37.62	13.59	12.76	480	±5%	±5%	±3%
AL-KVNC-485M-66H-GBF	45.1	37.98	13.67	12.77	485	±5%	±5%	±3%
AL-KVNC-490M-66H-GBF	45.25	38.16	13.74	12.84	490	±5%	±5%	±3%
AL-KVNC-495M-66H-GBF	45.4	38.31	13.82	12.92	495	±5%	±5%	±3%
AL-KVNC-500M-66H-GBF	45.55	38.43	13.9	13.01	500	±5%	±5%	±3%
AL-KVNC-505M-66H-GBF	45.7	38.52	13.97	13.11	505	±5%	±5%	±3%
AL-KVNC-510M-66H-GBF	45.85	38.61	14.04	13.21	510	±5%	±5%	±3%
AL-KVNC-435M-60H-GBF	40.88	33.6	13.66	12.95	435	±5%	±5%	±3%
AL-KVNC-440M-60H-GBF	41	33.8	13.72	13.02	440	±5%	±5%	±3%
AL-KVNC-445M-60H-GBF	41.13	34.1	13.78	13.05	445	±5%	±5%	±3%
AL-KVNC-450M-60H-GBF	41.25	34.3	13.85	13.12	450	±5%	±5%	±3%
AL-KVNC-455M-60H-GBF	41.38	34.5	13.92	13.19	455	±5%	±5%	±3%
AL-KVNC-460M-60H-GBF	41.51	34.7	13.99	13.26	460	±5%	±5%	±3%
AL-KVNC-465M-60H-GBF	41.64	34.9	14.06	13.32	465	±5%	±5%	±3%
AL-KVNC-390M-54H-GBF	36.66	30.5	13.65	12.79	390	±5%	±5%	±3%
AL-KVNC-395M-54H-GBF	36.75	30.6	13.71	12.91	395	±5%	±5%	±3%
AL-KVNC-400M-54H-GBF	36.84	30.9	13.77	12.94	400	±5%	±5%	±3%
AL-KVNC-405M-54H-GBF	36.93	31.2	13.84	12.98	405	±5%	±5%	±3%
AL-KVNC-410M-54H-GBF	37.02	31.5	13.91	13.02	410	±5%	±5%	±3%
AL-KVNC-415M-54H-GBF	37.14	31.7	13.98	13.09	415	±5%	±5%	±3%
AL-KVNC-420M-54H-GBF	37.26	31.9	14.05	13.17	420	±5%	±5%	±3%

Modle	Maximum System Voltage(V dc)	recommended maximum series/parallel PV module configurations	temperature coefficient for voltage at open-circuit	temperature coefficient for short-circuit current	temperature coefficient for maximum power
AL-KVNC-520M-72H-GBF	1500V	72 pieces in series and 2 parallel strings, 144 pieces in total	-0.0036	0.0007	-0.0038
AL-KVNC-525M-72H-GBF	1500V	72 pieces in series and 2 parallel strings, 144 pieces in total	-0.0036	0.0007	-0.0038
AL-KVNC-530M-72H-GBF	1500V	72 pieces in series and 2 parallel strings, 144 pieces in total	-0.0036	0.0007	-0.0038
AL-KVNC-535M-72H-GBF	1500V	72 pieces in series and 2 parallel strings, 144 pieces in total	-0.0036	0.0007	-0.0038
AL-KVNC-540M-72H-GBF	1500V	72 pieces in series and 2 parallel strings, 144 pieces in total	-0.0036	0.0007	-0.0038

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