



Installation Instructions

(Applicable to ALEX series PV modules)

Website: <http://alexussolar.com>

Tel: +1 480 866 8186

Add: 8350 S Kyrene Rd, Suite C108, Tempe AZ

Revision date: July 25, 2023

Content

1. Overview	1
2. Disclaimer Notices	1
3. Safety Precautions	2
4. Unpacking and Storage.....	4
5. Environment Conditions.....	5
6. Mechanical Installation	6
6.1 Site Selection.....	6
6.2 Mounting Bracket Options	7
6.3 Module Installation.....	7
6.4 Installation Method.....	8
7. Electrical Installation.....	10
7.1 Grounding Connection	10
7.2 Test, Debugging and Troubleshooting	11
7.3 Blocking Diode and Bypass Diode Troubleshooting	11
7.4 On-grid Electrical System	12
8. Maintenance	13
9. Attached list.....	14

1. Overview

This manual contains information on the installation, maintenance, and safe operation of PV modules produced by the Alex Renewable Energy Inc. Read and try to understand this note before installation. Professional installers are required to follow the instructions in the manual when installing the modules. If there is any problem, please contact our sales department for help.

Before installing solar PV system, the installers need to familiarize with the requirements of mechanical and electrical aspects. Please keep this manual for later use.

Artificially concentrated sunlight shall not be directed on the module.

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

2. Disclaimer Notices

- ✧ The installation, operation and use of ALEX series modules are beyond ALEX's control. Thereby, ALEX does not undertake any loss, damage, injury and consequent costs caused by improper installation, operation, use and maintenance.
- ✧ ALEX does not undertake any responsibilities for the violation of patent, third-party rights and other uses of PV products.
- ✧ Any modification towards any patent or patent right is not allowable if there is no authorization.
- ✧ This manual is made based on ALEX's technology and reliable experience, but the information and recommendations including product specifications do not constitute any warranty.
- ✧ ALEX keeps the rights of changing manuals, product information, technical specifications and product data without prior notice.

- ✧ Each individual module has a unique serial number laminated behind the glass and another permanently attached to the back-sheet of the module. Note all serial numbers in an installation for your future records.
- ✧ Nameplate: describes the Module Type, Rated Maximum Power, Tolerance, rated current, rated voltage, open circuit voltage, short circuit current. The maximum system voltage is 1000 or 1500 Vdc is shown on the nameplate. Maximum overcurrent protection rating is also shown.

3. Safety Precautions

- ✧ The installation of solar photovoltaic systems requires professional skills and knowledge, thus the installation must be carried out by professionals.
- ✧ In the process of installation, the installers assume the risk of injuries, including but not limited to the risk of electric shock.
- ✧ When exposed to direct sunlight, a single module may produce more than 30V DC voltage. The exposure with 30V or higher DC voltage has potential risks.
- ✧ The electric arcs may occur when disconnecting or linking the photovoltaic modules exposed to the sunlight. This arc may cause burns, a fire or other problems.
- ✧ Do not disconnect the linking between the modules or between the modules and inverters in case of the load.
- ✧ The photovoltaic modules could convert the power energy into DC power. The modules could be applied for the ground, roofs, vehicles or boat and other outdoor environment. It is system designer and installers' responsibility to reasonably design the support structure.
- ✧ Do not disassemble the modules or remove other attached brands or parts.
- ✧ Do not spray or glue on the upper and lower surfaces of the modules.
- ✧ Do not use the mirror or other magnifying glass equipment to concentrate the sunlight artificially to the modules.
- ✧ It needs to comply with all the local, regional and national laws and obtain a construction permit when necessary in the process of installing the system.
- ✧ It needs to keep the children away from the system when transporting and installing mechanical and electrical components.
- ✧ During installation, it is necessary to completely block the modules with opaque materials so as not to generate voltages that exceed the safety range of the human body which may cause electric shock.
- ✧ Do not wear metal rings, watch straps, ear, nose, lip rings or other metal parts when installing or inspecting the photovoltaic system.



- ✧
- ✧ The qualified insulating tools are the only choice for the electrical installation work.



- ✧
- ✧ Comply with the safety requirements of all other modules used in the system, including wiring lines and cables, connection devices, charging controllers, inverters, batteries and rechargeable batteries.
- ✧ Use the equipment suitable for solar power system, connection device, wiring lines and support frame only. In a particular photovoltaic system, use a type of module as much as possible and use the same type of the module in the same PV array only. Each input voltage of the same tracking system of each inverter must be equal and the same type of modules must be used.
- ✧ Refer to Section 690-8 of the National Electric Code for an additional multiplying factor of 1.25 which may be applicable.
- ✧ Rated electrical characteristics are within 3 percent of open-circuit voltage and maximum power, 4 percent of short-circuit current, respectively. Measured values are at Standard Test Conditions: 1000 W/m², 25°C cell temperature and solar spectral irradiance.
- ✧ Under normal outdoor conditions, the current and voltage generated by the module are different from those listed in the parameter table. The parameter table is measured under the standard test conditions (1000w/m² irradiance, AM 1.5 spectrum, 25°c temperature), so when determining other modules' rated voltage, conductor capacity, fuse capacity, controller capacity and other parameters



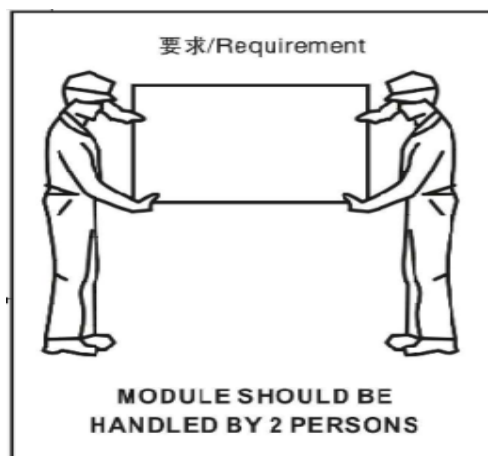
correlated to module output power, it should refer to the value of short-circuit current and open circuit voltage marked on the module and design and install the module according to the value of 125%.

- ✧ The modules should be used in the ambient temperature (-40°C~+85°C) area where the component is applicable.
- ✧ PV wiring connectors that comply with the Standard for Connectors for Use in Photovoltaic Systems, UL 6703.
- ✧ Details for wiring in accordance with the NEC, and that the grounding method of the frame of arrays shall comply with the NEC, article 250.
- ✧ Photovoltaic Systems, UL 6703, shall have the specific allowable mating connector manufacturer(s) and model number(s) listed as below:

Female type	Allowable male type to mate	Connector manufacturer	Rated Voltage
RHC2xyzC	RHC2xyzC	Zhejiang RENHE PHOTOVOLTAIC TECHNOLOGY CO LTD	1500V
PV-KBT4-EVO 2/6I-UR	PV-KST4-EVO 2/6I-UR	STAUBLI ELECTRICAL CONNECTORS AG	1500V
PV-TT02	PV-TT02	TAIZHOU CHUANGDA ELECTRONIC CO., LTD	1500V

4. Unpacking and Storage

- ✧ When receiving the goods, you should check whether the goods delivered are indeed ordered goods: the outside of each box are marked with the product name, packaging box number, module barcode.
- ✧ The packaging carton should be stored in a clean, dry area, away from direct sunlight and moisture.
- ✧ At the installation site, pay attention to keep clean and dry for the components, especially the electrical connections. If the connector cable is wet, the connections may be corroded, and the components that be corroded at any connections should not be used.
- ✧ If the tray is temporarily stored outside, please put a protective cover to prevent it from being directly affected by the weather.
- ✧ Two staff members are required to unpack the packaging carton. Be sure to use both hands when removing the modules. Do not carry the modules through the wires and junction boxes.



- ✧ If the modules needed to be temporarily stored outside, please protect the edge of the module well.
- ✧ It is forbidden to stand or walk on modules in any case.
- ✧ It is forbidden to drop or stack items on the modules.

5. Environment Conditions

The modules can be installed in the following environment for more than 25 years

Ambient temperature: -40°C to $+85^{\circ}\text{C}$

Operating Temperature: -40°C to $+85^{\circ}\text{C}$

Storage Temperature: -40°C to $+40^{\circ}\text{C}$

Humidity: $<85\%$ R.H.

Mechanical design load strength: 3600Pa positive snow pressure, 1600Pa back wind pressure.

The installation method is very important for the mechanical load. Failure to follow the installation of this manual will result in different snow pressure and wind pressure load capacity.

The system builder needs to ensure that the installation is in accordance with local laws and regulations.

6. Mechanical Installation

6.1 Site Selection

- ✧ In north latitude area it is best to face south for the module, while in south latitude area, it is best to face north. It is best that the front of the module is perpendicular to the direction of the midday sun light.
- ✧ Fix bracket installation, the module is recommended to be installed at an optimum angle of inclination for maximum capture of sunlight. According to the right hand helical law, basically the same latitude as the installation site, facing the equator. The design must be based on local conditions and choose the best inclination.
- ✧ Track bracket installation, installation methods are also two kinds of block and bolt installation, specific installation methods refer to the installation instructions, at this time the module does not have a fixed installation inclination, nor will it face the equator, but the angle of tracking the sun from east to west.
- ✧ When installing solar modules on the roof, be sure to maintain a safe working area between the edge of the roof and the solar arrays. There must be a certain safety distance between arrays of large power stations in order to facilitate the cleaning, inspection, and maintenance of the modules inside the array.
- ✧ The modules should be installed in the place where the sunlight can be fully irradiated and ensure that it can't be blocked at any time.
- ✧ The modules can't be used in the vicinity of the equipment or place where the flammable gas is generated or stored.
- ✧ The modules can't be installed in the environmental area where module defects are caused by various chemical reactions, such as acid rain, alkaline gas, salt mist, etc.
- ✧ The modules can't be installed in the environmental area that exceeds the maximum system voltage of the modules, such as high-voltage power lines. The module's position should be maintained at a safe distance from the high-voltage power while the safe distance is determined by the high voltage level.
- ✧ If the modules are to be installed on the floor of a dwelling, local regulations such as fences should be complied with (the fences should be kept at a certain distance from the array to avoid shading impact of the fence on the array).
- ✧ Do not install the PV modules in places that may be immersed in water or continuously exposed to sprinklers or fountains.

6.2 Mounting Bracket Options

- ✧ When installing the modules on the bracket, the pillar and module installation structure should be chosen those can withstand the local expected earthquake level.
- ✧ The bracket structure must be made of a durable, anti-corrosion, anti-ultraviolet materials.

6.3 Module Installation

- ✧ When carrying the modules, two hands are required to grasp the modules and keep a level of stability. It is forbidden to shake severely, carry the module by one person, drag the module, pull the connecting lines of junction box and handle two and more modules.
- ✧ Place the modules on a flat ground, place the cardboard in the bottom and the glass surface is forbidden to directly touch the ground.
- ✧ When the module is placed on the ground, it is forbidden to stack debris, step on, sit down and have other actions that may cause deformation for the module.
- ✧ Do not step on the module during installation. Do not drag the module on the bracket.
- ✧ When the modules are installed on buildings or roofs, it needs to ensure that they are securely fastened and will not be damaged by strong wind or snow.
- ✧ Ensure that the back of the modules good ventilation for cooling the modules.
- ✧ When installing the modules on the roofs, make sure the roof structure is suitable. In addition, the roofs must be properly sealed to prevent leakage.
- ✧ The gap between the module frame and the wall or roof should be at least 115mm. If there are other installation methods, it may affect the assessment of fire rating.
- ✧ The spacing between two modules should be at least 10mm.
- ✧ The installation can't block the module' drain hole.
- ✧ Modules application altitude: <2000 m.
- ✧ The recommended ambient temperature should be between -40°C (-40°F) to 40°C (104°F). Temperature limits are set as the monthly average high and low values of the installation site.



6.4 Installation Method

All installation methods described here are for reference only, and our company is not responsible for providing relevant installation parts. The design, installation, mechanical load and safety of module system must be completed by professional system installers or experienced personnel.

6.4.1 Fixture installation

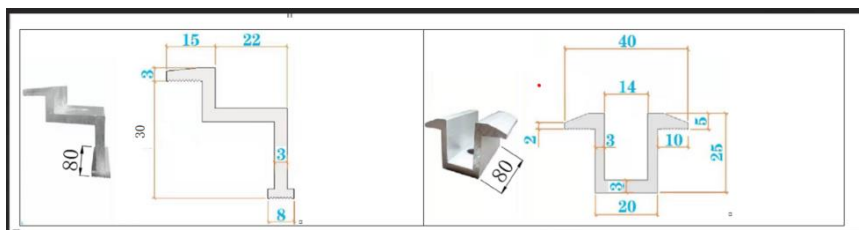
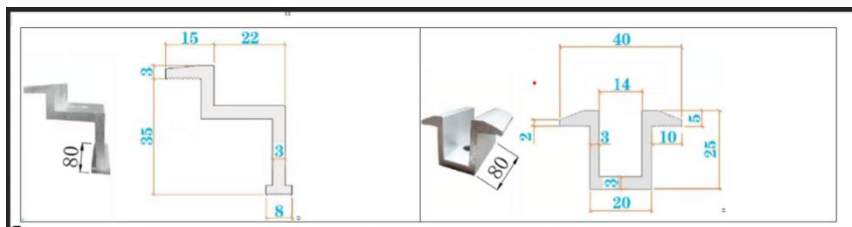
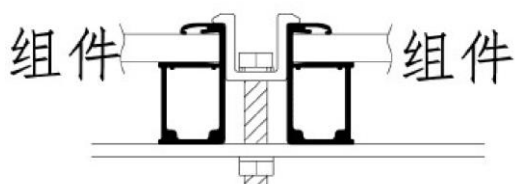


Figure A Fixture of module with frame

Figure B Fixture of module with frame



Material: Anodized aluminum AL6063-T5 or equivalent

Short clamp (Used for two mounting rails)	a: Long (mm)	b: Width (mm)	c: high (mm)	d: Thickness (mm)
End Clamp For 35mm	80	37	38	3
End Clamp For 30mm	80	37	33	3
Middle Clamp For all size	80	40	25	3

Cautions

Please select the appropriate fixture for installation according to the module with / without aluminum alloy frame

Module with frame fixtures meet the following requirements

thickness: ≥ 3 mm Length: 80 mm Material: Aluminum alloy

Bolts: M8 Tightening torque: 16-20 N.m

The fixture can't deform the module; the installation guide rail and fixture should avoid blocking the cells; the contact surface between the fixture and the frame must be smooth to prevent the frame damage from damaging the modules; the drainage hole should not be blocked by the fixture.

6.5 Installation Point Location Description

- ✧ The normal level load design is suitable for most environments: the maximum load on the back of the module is 1600 pa (equivalent to wind pressure) and the maximum load on the front is 3600 pa (equivalent to wind pressure and snow pressure).
- ✧ The higher load design is suitable for harsh environmental conditions (such as storm, heavy snow, etc.): the maximum load on the back of the module is 1600 pa (equivalent to wind pressure), and the maximum load on the front is 3600 pa (equivalent to wind pressure and snow pressure). Different load bearing can be obtained by selecting different fixture quantity, size and installation range.

6.5.1 Fixture Installation Position

Module with frame:

The load strength of module with frame is shown in the table below (L is the length of the module)

Method – clamp mounting - Four mounting clamps are fixed onto the long frames of the module (two clamps on each side) in the permitted clamping distance as Figure C, a set of M8 screw and nut was used to tighten the clamp down to the frame with a torque of 16~20 Nm:

Drawin g	Type	Number of fixtures	Fixture Length	A Clamping A distance	Positive load	Negative load	safety factor
C	ALL	4	80mm	L/4 mm	3600pa	1600pa	1.5

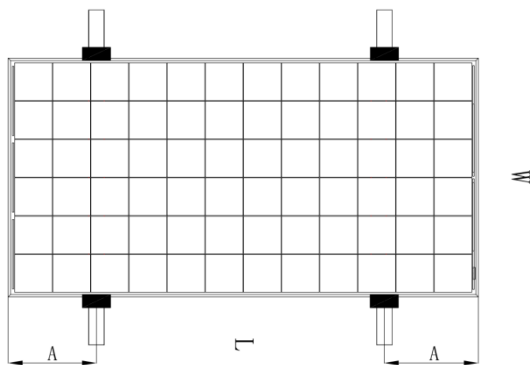
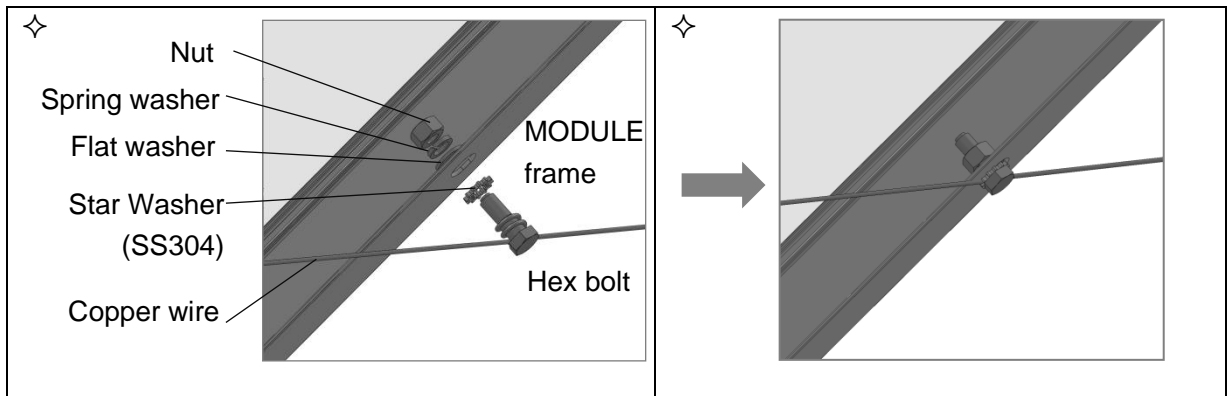


Figure C: Installation methods of clamps on long sides

7. Electrical Installation

7.1 Grounding Connection

- ✧ The modules need to be grounded, although it has been confirmed that the module meets the security level II and it meets local electrical directives and regulations.
- ✧ The grounding connection operation should be carried out by qualified electrician.
- ✧ Use the suitable grounding wire to connect the modules' frame to each other and it is recommended to use the 4 mm² copper conductor (AWG 12) as the grounding conductor. The grounding hole of the module uses grounding identification. All conductive connection points must be securely connected.
- ✧ Stainless steel material shall be used for bolts, nuts, washers, lock washers or other related parts unless otherwise specified.
- ✧ The following grounding method is recommended.



- ✧ In accordance with the above diagram, the copper conductor is connected to the grounding hole of the module frame through grounding parts (M4 stainless steel Hex bolts, M4 stainless steel nut, M4 stainless steel Spring washer, M4 stainless steel Flat washer, M4 stainless steel Star washer) Torque wrenches may be used during installation. The tightening torque of the nut is 2.3-2.8N.m.

✧

7.2 Test, Debugging and Troubleshooting

- ✧ The serial modules are connected to the test before the system. Use digital multimeter (recommended Fluke 170 series or digital multimeter which DC range can reach 1000V) to check open-circuit voltage of the series modules. The measurement value should be equal to the sum of the open-circuit voltage of a single module and you will find the rated voltage in the technical specification of the type module you are using.
- ✧ Low voltage troubleshooting. Identify the normal low voltage and fault low voltage. The normal low voltage mentioned here refers to the decrease of the open circuit voltage of the module caused by the temperature increase of the solar cell or the decrease of the irradiance. Fault Low voltage is usually caused by improper terminal connection or bypass diode damage.

7.3 Blocking Diode and Bypass Diode Troubleshooting

- ✧ Blocking diodes could prevent current from flowing from the battery to the module when the module is not generating current. If you do not use the charge controller, it is recommended to use blocking diodes. About charge controller, please consult a professional dealer.
- ✧ In the system, hot spot effect occurs when part of the module is blocked and other parts are exposed to the sunshine and thereby lead to overheat of the battery and

damage the module. Using bypass diodes in the module protects the module from being affected by this excessive reverse current. All modules those rated power are more than 55 watts have a bypass diode integrated in the junction box. Bypass Diode Model: Type FMK5040D, by Zhejiang Renhe Photovoltaic Technology Co., Ltd., Peak reverse voltage 50V, Average rectifier current 40A. And Type MK6045, TAIZHOU CHUANGDA ELECTRONIC CO., LTD., rated 45 V, 60 A.

7.4 On-grid Electrical System

- ✧ The maximum voltage of the system must be less than the maximum certified voltage (1500V typically) and the maximum input voltage of the inverter and of the other electrical devices installed in the system. To ensure that this is the case, the open circuit voltage of the array string needs to be calculated at the lowest expected ambient temperature for the location. This can be done using the following formula.
- ✧ System voltage = $N \times V_{oc} \text{ (at STC)} \times \{ 1 + TC_{voc} \times (T - 25) \}$
- ✧ Notes:
- ✧ N: Number of modules in series
- ✧ V_{oc} (at STC): Open circuit voltage of each module
- ✧ TC_{voc} : Thermal coefficient of open circuit voltage for the module (refer to data sheet)
- ✧ T: Minimum ambient temperature
- ✧ For field connections, use at least 4 mm² or 12 AWG copper wires insulated for a minimum of 90°C and sunlight resistance with insulation designated as PV Wire.
- ✧ The minimum bending radius cables should be 43 mm.



- ✧ Thirty modules in series, and then form a PV array in parallel, which is particularly suitable for high voltage situations. If the modules are connected in series, the total voltage is equal to the sum of the voltages of the individual modules.
- ✧ In the case of using high current, you can't put one PV module in parallel for modules.

- ✧ The module can provide prefabricated connectors for system's electrical connections. As for cable size, type and temperature and other parameters' choice, please refer to the relevant rules.
- ✧ The cable cross-section surface and connector's size must meet the maximum system short-circuit current, otherwise the cables and connectors will overheat because of excessive current and has the danger of burning!
- ✧ When installing, the junction box's one end to be upward to avoid being rained.
- ✧ Protect yourself from electric shock when debugging or repairing the solar system. Wear protective gloves and insulated shoes and other protective equipment. Use special electrician tools for repairs.

8. Maintenance

- ✧ To ensure the best performance of the solar panels, ALEX provide the following maintenance measures.
- ✧ The solar panel should be cleaned in the morning or evening when the power is low or no power is processing.
- ✧ Cleaning the glass surface when necessary through clean water and soft objects. The neutral detergent should be used for cleaning while the acidic or alkaline or abrasive detergent is forbidden.
- ✧ For large-scale systems, when considering whether all of the dust and deposits on the solar cell array should be cleaned or not, factors such as cleaning costs, increased energy output after cleaning, and the time it takes to get dirty again after cleaning need to be taken into consideration. If you are not sure whether the array or its sections need to be cleaned or not, you should firstly select the heavily polluted array string and then measure and record the inverter's input current from that string.
 - 1) Clean all the modules within a string.
 - 2) Measure the input current of the inverter again and calculate improvement percentage after the cleaning.
 - 3) If the improvement degree is less than 5%, it is usually not worthy to pay the cost for cleaning.
- ✧ In case of rainy weather, do not deliver the electricity if the inverter or other electrical equipment is power off. It is better to check and ensure that there is no problem in the lines before sending the electricity.

- ✧ When cleaning, the solar panel can't be washed with a high-pressure water gun for avoiding line leakage caused by excessive pressure in the connection place of the solar panel.
- ✧ Conduct a mechanical and electrical inspection for every six months and ensure that the surface is clear and the connection is reliable.
- ✧ If any other abnormal situation occurs, please consult factory or experienced engineer.
- ✧ Observe the maintenance instructions for all parts used in the system, such as bracket, charge controller, inverter, solar cell, etc.

9. Attached list

- (1) All electrical data shall be shown as relative to standard test conditions (STC) (1000 W/m², (25 ± 2) ° C, AM 1.5 according to IEC 60904-3:

Module	Open-circuit voltage (with tolerance ±3%) [V]:	Short-circuit current (with tolerance ±4%) [A]:	Voltage at max. power [V]:	Current at max. power [A]:	Maximum power (with tolerance ±3%) [W]:	Maximum system voltage [V]:	Over-current protection rating [A]:	size
ALEX-530-W-72-S; ALEX-530-B-72-S	49.16	13.72	41.31	12.58	530	1500	25	2278*1134*35
ALEX-535-W-72-S; ALEX-535-B-72-S	49.36	13.77	41.51	12.89	535	1500	25	
ALEX-540-W-72-S; ALEX-540-B-72-S	49.52	13.84	41.67	12.96	540	1500	25	
ALEX-545-W-72-S; ALEX-545-B-72-S	49.68	13.91	41.83	13.03	545	1500	25	
ALEX-550-W-72-S; ALEX-550-B-72-S	49.84	13.98	41.99	13.1	550	1500	25	
ALEX-555-W-72-S; ALEX-555-B-72-S	50	14.05	42.15	13.17	555	1500	25	
ALEX-560-W-72-S; ALEX-560-B-72-S	50.16	14.12	42.31	13.24	560	1500	25	
ALEX-445-W-60-S; ALEX-445-B-60-S	41.15	13.71	34.50	12.9	445	1500	25	1909*1134*35 /30
ALEX-450-W-60-S; ALEX-450-B-60-S	41.24	13.8	34.67	12.98	450	1500	25	
ALEX-455-W-60-S; ALEX-455-B-60-S	41.33	13.89	34.84	13.06	455	1500	25	
ALEX-460-W-60-S; ALEX-460-B-60-S	41.42	13.98	35.01	13.14	460.03 14	1500	25	



ALEX-465-W-60-S; ALEX-465-B-60-S	41.51	14.07	35.18	13.22	465.07 96	1500	25	1724*1134*35 /30
ALEX-400-W-54-S; ALEX-400-B-54-S	37.21	13.67	31.18	12.58	400	1500	25	
ALEX-405-W-54-S; ALEX-405-B-54-S	37.38	13.76	31.35	12.92	405	1500	25	
ALEX-410-W-54-S; ALEX-410-B-54-S	37.55	13.85	31.52	13.01	410	1500	25	
ALEX-415-W-54-S; ALEX-415-B-54-S	37.72	13.94	31.69	13.1	415	1500	25	2384*1303*35
ALEX-640-W-66-S; ALEX-640-B-66-S	45.25	37.25	18.19	17.19	640	1500	30	
ALEX-645-W-66-S; ALEX-645-B-66-S	45.45	37.45	18.23	17.23	645	1500	30	
ALEX-650-W-66-S; ALEX-650-B-66-S	45.65	37.65	18.27	17.27	650	1500	30	
ALEX-655-W-66-S; ALEX-655-B-66-S	45.85	37.85	18.31	17.31	655	1500	30	
ALEX-660-W-66-S; ALEX-660-B-66-S	46.05	38.05	18.35	17.35	660	1500	30	
ALEX-665-W-66-S; ALEX-665-B-66-S	46.25	38.25	18.39	17.39	665	1500	30	
ALEX-670-W-66-S; ALEX-670-B-66-S	46.45	38.45	18.43	17.43	670	1500	30	
ALEX-585-W-60-S; ALEX-585-B-60-S	40.90	33.80	18.37	17.31	585	1500	30	2172*1303*35
ALEX-590-W-60-S; ALEX-590-B-60-S	41.10	34.00	18.42	17.35	590	1500	30	
ALEX-595-W-60-S; ALEX-595-B-60-S	41.30	34.20	18.47	17.4	595	1500	30	
ALEX-600-W-60-S; ALEX-600-B-60-S	41.50	34.40	18.52	17.44	600	1500	30	
ALEX-605-W-60-S; ALEX-605-B-60-S	41.70	34.60	18.57	17.49	605	1500	30	
ALEX-610-W-60-S; ALEX-610-B-60-S	41.90	34.80	18.62	17.53	610	1500	30	

Module			
Type Name or Model No.	ALEX-xxx-W-72-S ALEX-xxx-B-72-S ALEX-xxx--W-60-S ALEX-xxx-B-60-S ALEX-xxx-W-54-S ALEX-xxx-B-54-S	ALEX-xxx-W-66-S ALEX-xxx-B-66-S ALEX-xxx-W-60-S ALEX-xxx-B-60-S	
Cell series	182 Perc	210 Perc	
Protection Class	Class II	Class II	



Fire Performance	Type 4	Type 4	
Temperature Coefficients (%/°C)	Voc: -0.25 Isc: 0.040 Pm: -0.34	Voc: -0.25 Isc: 0.040 Pm: -0.34	

(2) Module Fire Performance: Type 4

The System Fire Class Rating of the module or panel in a mounting system in combination with a roof covering complete with requirements to achieve the specified System Fire Class Rating for a non-BIPV module or panel.

Any module or panel mounting system limitations on inclination required to maintain a specific System Fire Class Rating.