

# **PV module installation manual**

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## 1. Purpose of this manual

1.1 This manual applies exclusively to the solar photovoltaic module (hereinafter referred to as Module) of AE SOLAR. The contents of this manual involve the installation methods, operation safety and maintenance information.

1.2 Modules must be installed by professionals. Please read this manual carefully before installation. The installers must follow all the rules in this manual strictly as well as local requirements and regulations by law or authorized organizations.

1.3 Before installing, the installer must be familiar with their mechanical and electrical requirements. Please keep this manual in a safe place for future reference (care and maintenance) and in case of sale or disposal of the Modules.

## 2. Disclaimer

2.1 AE SOLAR shall not be responsible for any loss arising from the installation, operation, use or maintenance of the Modules which is not complying with the guidance of this manual, including breakdown or damage of the Modules or any other expenses incurred.

2.2 Any customer shall not get any patent or authorization of the patent when using the Modules, expressed or implied. Any infringement of patents or other rights of the third party, which may result from the use of the Module, is not within the responsibility scope of AE SOLAR. The information in this manual is based on AE SOLAR's knowledge and experience and is believed to be reliable, but such information including product specification (without limitation) and relevant suggestions do not constitute a warranty, expressed or implied. Jiangsu AE SOLAR reserves the rights to change the manual, the Modules, the specifications or any other information of the modules without prior notice.

## 3. General Detailed Rules

### 3.1 Warning

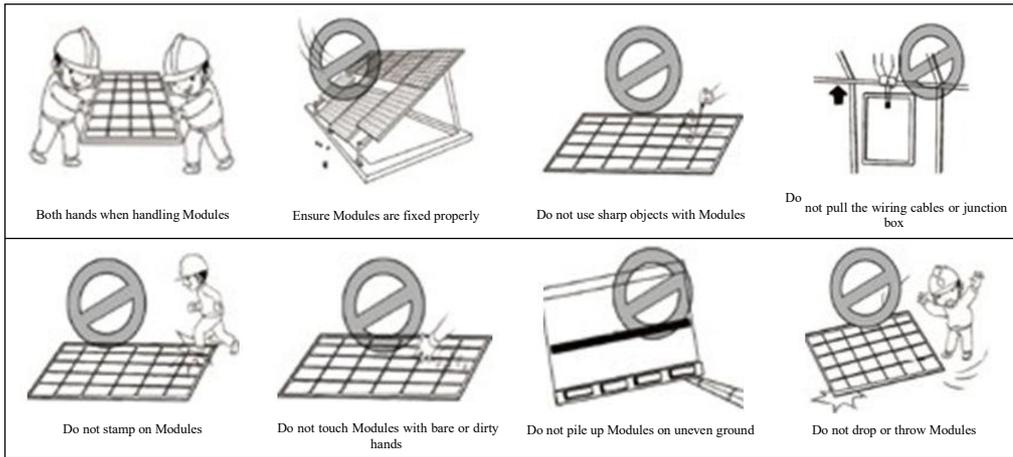


Before installing, wiring, operating, or maintaining modules, you should read and understand all safety precautions. Direct current (DC) is generated when the battery surface of the module is exposed to direct sunlight or other light sources, and direct contact with the live parts of the module, such as terminals, may result in death of personnel whether connected to the module or not .

### 3.2 General safety

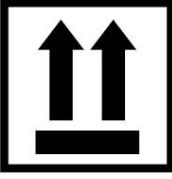
- All installation work must comply with the local codes and the relevant international electrical standards.
- AE SOLAR recommends that PV module installation is conducted by personnel with experience in PV system installation. Operation by personnel who are not familiar with the relevant safety procedures will be very dangerous.
- Do NOT allow unauthorized persons to access the installation area or module storage area
- Do NOT install modules with damaged glass or damaged backsheet.
- Do NOT disassemble or move any part of the module
- Do NOT artificially focus the light on the module
- Do NOT connect or disconnect the module when it is energized or connected with the external power supply.
- Only special insulation tools for electrical installation can be used
- If the circuit breaker and over-current protection circuit breaker cannot be opened or the inverter cannot be closed during module installation or wiring, an opaque material should be used to cover the array of module to stop the power output
- Do not attempt to insert any conductive parts into the plug and junction box. Do not touch the plug or expose the terminal.

### 3.3 Module Carry and Installation Instruction



### 3.4 Storage and unpacking

- Modules should be stored in a dry and ventilated environment to avoid direct sunlight and moisture. If the module is stored in an uncontrolled environment, the storage time shall not be more than 3 months and additional measures shall be taken to protect the connector from moisture or the module from sun exposure such as using the connector cover.
- Please protect the packing from damage. Follow the recommended unpacking steps to open the module wrapper. Opening package, transportation and storage procedures should be handled with care.
- The unpacking process must be operated by two people at the same time, and modules need to be carried by both hands.
- Package label description

 <p>The Modules in the carton box are fragile. Handle with care.</p>	 <p>DO NOT expose the module to rain or moisture</p>
 <p>During the stacking of the Modules, the outer packing box can be stacked not exceed 2</p>	 <p>The package shall never be upside down during the transportation</p>
 <p>It is prohibited to tramp on the packing box and module.</p>	 <p>Cartons can be recycled</p>

## 4. Mechanical installation

### 4.1 Installation site

- Modules can be installed in land area in addition to the salt water, acid and alkali corrosion.
- For the modules installed near the coastline, the location of the modules should be greater than 1000m away from the coastline at high tide.
- Do not store, install, or use modules in places where flammable gases are likely to be generated or collected.
- Modules should be installed away from trees, buildings and other obstacles, so that the modules could get the maximum light area to reduce the shadow. Even partial occlusion of a module can result in a significant reduction in output power. The shading on the module increases the temperature of the shaded area, resulting in a decrease in output power and a decrease in lifetime
- Customers need to be informed in advance if modules need to be installed at unconventional areas

### 4.2 Installation tilt

- Modules in the same string should be installed at the same angle. Modules installed in different angles will receive different irradiation, which will cause current different. As a result, it will decrease the operation efficiency of the system
- The mounting tilt angle range should be between  $0 \sim 90^\circ$ . An appropriate installation angle can realize the maximum light area on the modules
- The optimum inclination Angle of the module depends on the corresponding latitude. It is recommended
- to use professional photovoltaic system software to obtain this data.

### 4.3 Installation requirements

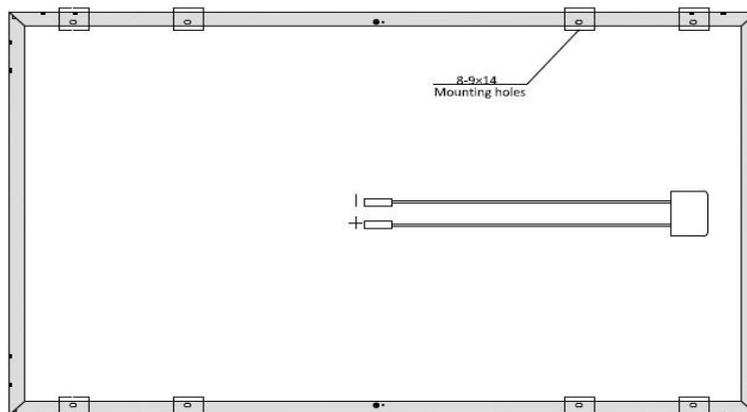
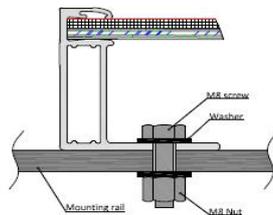
- Ensure the module installation means and support system sufficiently robust, so that the Modules can undertake the preset loading conditions, the support installer or supplier shall provide necessary guarantee and other related certifications. The installation support system shall pass the inspection and test by the third-party test institution with the static mechanic analysis capability, and use the local national or international standards, such as DIN1055 or equivalent.
- The support structure shall be made of the durable, corrosion resistant and ultraviolet resistant materials.
- Always wear dry insulation protection equipment: insulated tools, head gear, insulated gloves, safety belt and safety shoes (with rubber soles).
- Ensure the correct connection between male and female connector, check the connection status, all of the cable shall not be separated from modules in case of the connectors scratch or squeeze the back sheet.
- 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, and the back of the module shall be well-ventilated to facilitate the cooling of the module (the minimum gap between the module and installation surface is 10cm).
- Considering the influence of linear thermal expansion of the module frame, the minimum distance between two Modules should not be less than 20mm.
- Ensure that the module backside will not contact the support or architectural structure even if there is the module surface is under the external pressure.
- It is required to follow the instruction guide and safety rules attached on the support.

- It is not allowed to drill the hole in the glass surface or frame of the module. Otherwise ,the guarantee will be invalidated.
- When to install the Modules on the roof, it is necessary to guarantee the roof structure is suitable for the module installation. And the installed modules should not be beyond the roof zone. Additionally, The roof area where it is penetrated by module installation shall be properly sealed to prevent the roof from water leakage.
- When the module is installed on the supporting column, it is necessary to ensure the supporting column and module installation structure is capable of withstanding the expected local wind.
- Modules can be mounted in landscape or portrait orientation.

#### 4.4 Mounting with bolts

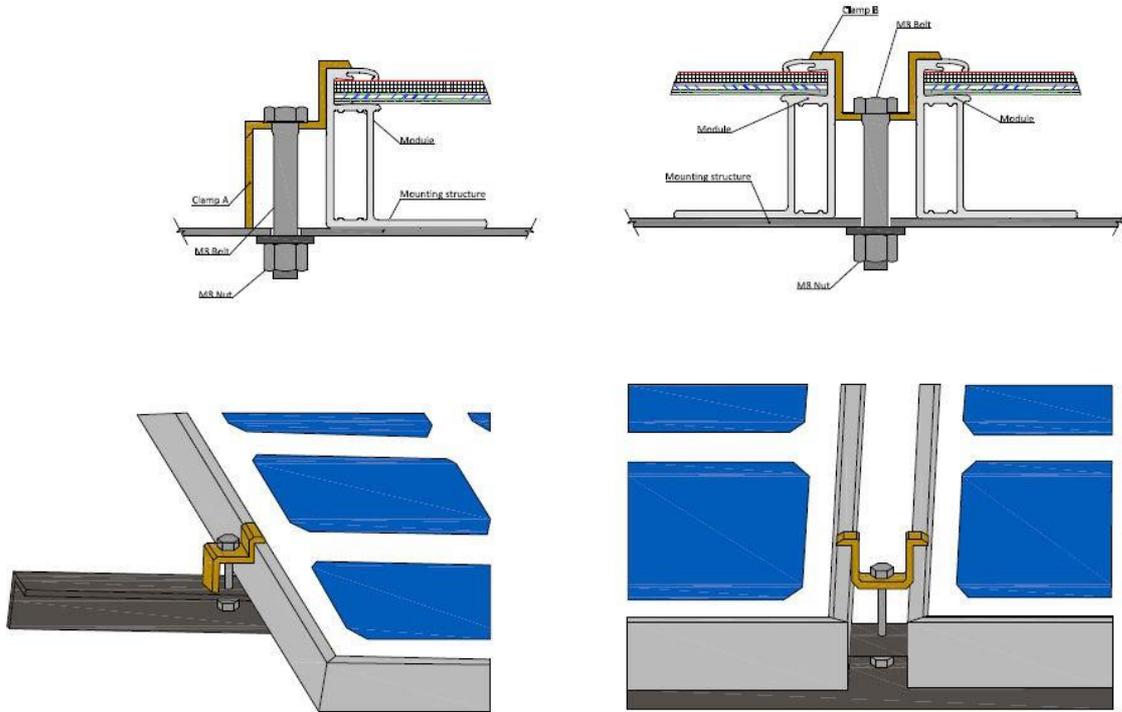
- Use the corrosion-resistant M8 bolt, a flat washer and a spring washer for fixing with the installation support through the installation hole in the frame of the module, and tighten to a torque of 14~20 N.m
- The frame of each module has 8-φ9\*12mm mounting holes. The number of mounting holes shall be used according to the load demand.

Module Series	Hardware	Material	Size	NO. provide(Per hole)	Mounting hole Size	Design load
All	Screw Bolt	Stainless Steel	M8	1	9*14mm	1600Pa Front & Back for Inner4holesused, 3600Pa front & 1600Pa back for 8 holes used
	Spring washer			2		
	Flat washer			1		
	Screw Nut			1		

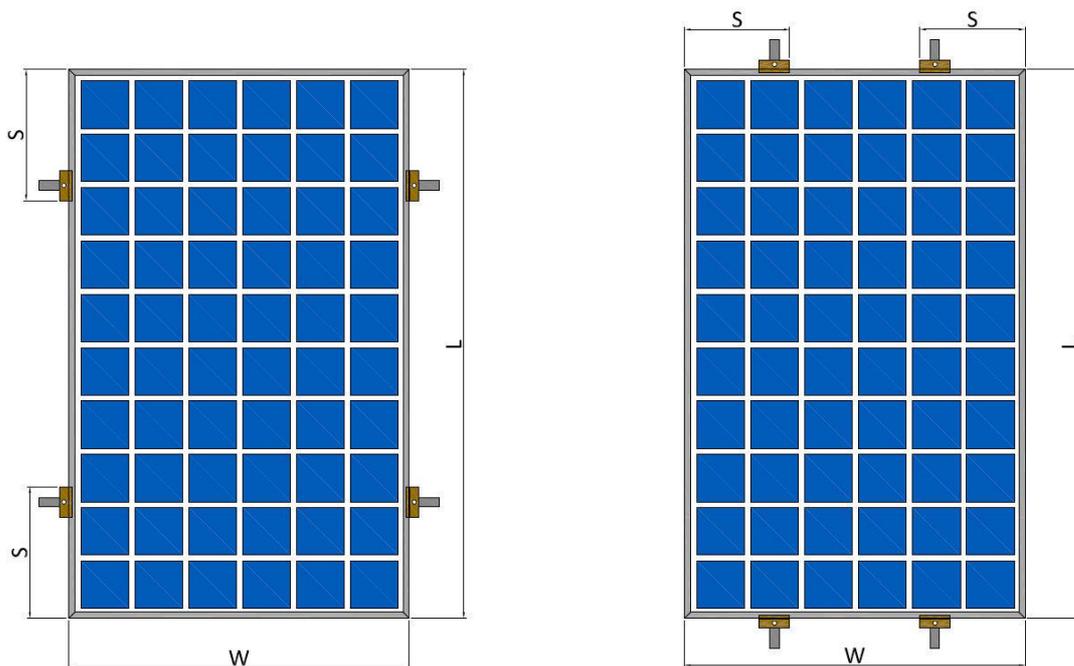


#### 4.5 Mounting with clamps

When choosing this type of mounting method, please be sure use at least 4 clamps on each module and no module clamps shall contact or make any shading on the modules glass. An integrated M8 hex head cap screw tightens down to the frame with a torque between 12.5-18 NM



Method	Installed Frame(L)	Clamp Position(S)	Design load
Mounting with clamps	Long Frame	$0 < S \leq 1/4L$	3600Pa (Front)& 1600Pa(Back)
		$(1/4L - 50\text{mm}) < S \leq (1/4L + 50\text{mm})$	1600Pa (Front)& 1600Pa(Back)
	Short Frame	$0 < S \leq 1/4W$	1600Pa (Front)& 1600Pa(Back)

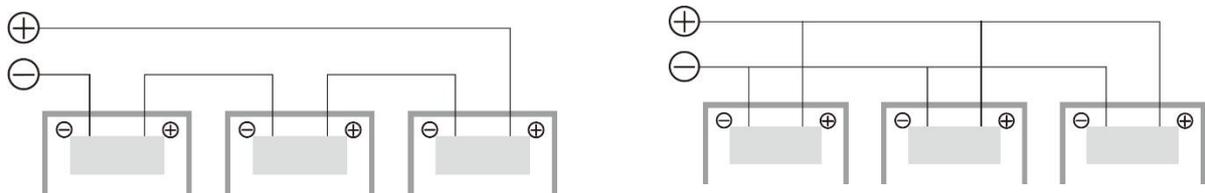


## 5. Electrical installation

DC power generated by the photovoltaic system can be converted into AC power and fed into the grid. Policies on connecting renewable energy system to the grid vary from region to region. Consult senior system designer before designing the system. Generally, the system installation shall be formally approved by the local public sector.

### 5.1 General Installation

- Installation structure should be compatible with module, in order to avoid galvanic corrosion. Any defects caused by such corrosion will void the warranty.
- The DC-side system potential of the photovoltaic array includes the practice of floating ground, positive- pole grounding and negative-pole grounding according to the system requirements; and different cell technologies have different adaptability. In a power-station project, particularly the module of the crystalline silicon photovoltaic cells, too large an absolute value of the negative to the ground might cause potential induced degradation (PID). Consequently, it is appropriate to use the negative grounding system so that the potential of the circuit is positive. Consult the inverter manufacturer for details.
- It is forbidden for non-professionals to open the lock nuts of the connector. Make sure that the connectors are clean, dry and fully connected.(A click sound should be heard when fully connected), otherwise it may lead to electric arc sparks which will damage the connector or cause a fire.
- Under normal conditions, a module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions, Accordingly, the values of ISC and VOC marked on the Module should be multiplied by a factor of 1.25 when to determining component voltage ratings, current ratings, fuse sizes, and size of controls connected to the PV output.
- Completely cover the Modules with an opaque material to prevent electricity from being generated during disassembling the conductors.
- It is not allowed to use the Modules in different models in the same solar photovoltaic system. When the Modules are connected in series, the voltage of every string shall not be higher than the maximum voltage of the system (as shown in Figure 8). Reference equation of the maximum number of the Modules in serial connection:  $\text{maximum system voltage of the module} / (1.25 * \text{open-circuit voltage})$ .
- When connected in parallel, the current output is equal to the sum of each string's current (as shown in Figure 9). Fuse is necessary for each module string. Take reference to the local regulation. Recommended maximum parallel Modules configurations:  $\text{Fuse rating} / (1.25 * \text{short-circuit current})$ .

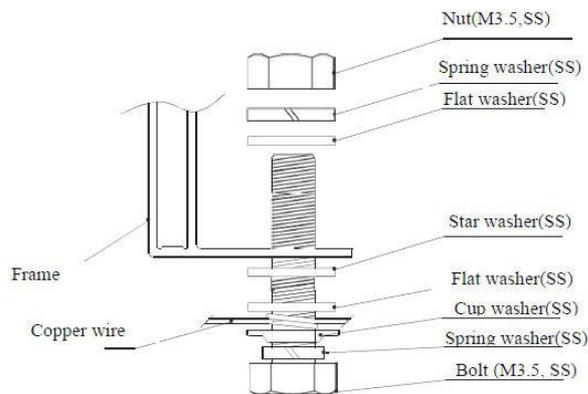


- Refer to the local regulations to determine the system wire size, types and temperatures.
- The cross section of the cables and the capacity of the connectors must be selected to suit the maximum system short circuit current (The recommended section area for a single piece of Module is 4 mm<sup>2</sup>, and the recommended rated current for the connector is greater than 10A), otherwise the cables and connectors shall be overheated under large current. Caution:
- The maximal temperature of the cable is 85°C while the upper limited temperature of the connector is 105°C.

- Make sure the electric components such as the connectors and inverters are off-state during the installation.
- To reduce lightning damage, the loop area should be kept as small as possible when laying cables. It is recommended to use fuses in each string.

### 5.2 Grounding

- The modules are designed with anodized corrosion-resistant aluminum alloy frames as rigid supports. In order to use safely and avoid modules from lightning or static damage, the module frame must be grounded. When grounding, the grounding device must be fully in contact with the aluminum alloy to penetrate the oxide film on the surface of the frame.
- It is forbidden to drill any additional grounding hole on the module frame, otherwise the warranty will be invalid
- The grounding of the module shall be performed by qualified electricians. The module frame shall be connected to each other with appropriate grounding wires. 4-14mm<sup>2</sup> copper wire is recommended as the grounding wire.  Is recommended to be used as the grounding mark. All conductive connections must be securely connected.
- Stainless steel shall be used for bolts, nuts, plain washers, plain washers and other relevant parts unless otherwise specified. TRUNSUN does not provide grounding parts.
- The grounding method is shown in the figure below.



Module Series	Hardware	Material	Size	No. provided
All	Screw Bolt	Stainless Steel	M3.5	1
	Spring washer			2
	Flat washer			2
	Star washer			1
	Cup washer			1
	Screw Nut			1

## 6. Bypass diodes and current protection

### 6.1 Bypass diodes

In a system with two or more Modules connected in series, if part of a Module is shaded while the other part is exposed to the sun, a very high reverse current will go through the cells which have been partly or entirely covered and it will cause overheat on the cells, which may damage the Module. Using bypass diodes can protect modules from this kind of risk.

Only professionals are allowed to install the bypass diodes. Open the junction box cover and install the same type diodes in the appropriate holes in the module.

### 6.2 Current protection

- Always install a fuse or circuit breaker for the module that matches its maximum fuse current and system voltage in accordance with local regulations. To ensure the protection of the fuse, refer to the fuse range recommended on the module nameplate, and refer to the local power installation safety manual
- When the modules are installed in parallel, each piece of module or a string of cells must have a fuse
- that meets the maximum fuse current specified in the power specification.
- The nominal rating of all electrical components shall not be less than the nominal rating of the system and shall not exceed the maximum system voltage indicated on the module nameplate.

## 7. Maintenance

### 7.1 Visual and electrical inspection

- The modules in a PV array should be regularly checked for damage. Factors such as glass breakage, cable breakage, and junction box damage may lead to function and safety problems
- It is recommended to perform a preventive inspection every six months without changing the components of the module. If electrical or mechanical properties are required for inspection or maintenance, qualified professionals should be advised to avoid any electric shock or loss of life
- Inspect for loose or corroded electrical interfaces, loose connections between supports and components, connections between cables, connectors, and grounding.
- Replacement modules must be of same type. Do NOT touch live parts of cables and connectors.
- Use appropriate safety equipment (insulated tools, insulating gloves, etc.) when handling modules.
- Trim any vegetation which may shade the solar array, thus impacting performance.

### 7.2 Cleaning

- The amount of electricity generated by a solar module is proportional to the amount of light falling on it. A module with shaded cells will produce less energy and therefore it is important to keep modules clean. Appropriate maintenance measures shall be taken to keep the assembly free of snow, guano, seeds, pollen, leaves, branches, dust and stains, etc.
- In most conditions, the normal rainwater can keep the module glass clean. Clean the glass surfaces with wet soft sponge or cloth if necessary. Use mild non-abrasive cleaning agent to remove stubborn dirt. If the module installation Angle with the ground is  $0^\circ$ , it required relatively frequent cleaning frequency. In general, if installation Angle is  $15^\circ$ , the module's self cleaning ability is better than  $0^\circ$ .
- When cleaning PV modules, do NOT step on the modules; do NOT spray water on the backside of the
- module or the cables; do NOT clean the backside of the modules; keep the connectors clean and dry; prevent fire and electrical shock from occurring; do NOT use as steam cleaner.
- Modules can work effectively without cleaning, but removing dust from the glass surface can increase output power. Use a wet sponge or cloth to clean the surface of the glass. Wear rubber

gloves for maintenance.

- 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 projects that might damage the penetrating the substrate material.

## **8. Note**

The output power value described in the manual is the value of the module tested under standard conditions. Daily operation environment and standard test conditions are often different

		AE375M6-72	AE380M6-72	AE385M6-72						
NominalMax.Power	Pmax (Wp)	375	380	385						
Maximum Power Voltage	Vmp (V)	40.20	40.5	40.80						
Maximum Power Current	Imp (A)	9.33	9.39	9.44						
Open-Circuit Voltage	Voc (V)	47.9	48.1	48.3						
Short-Circuit Current	Isc (A)	10.13	10.17	10.21						
		AE315M6-60	AE320M6-60							
NominalMax.Power	Pmax (Wp)	315	320							
Maximum Power Voltage	Vmp (V)	33.20	33.40							
Maximum Power Current	Imp (A)	9.49	9.59							
Open-Circuit Voltage	Voc (V)	40.7	40.9							
Short-Circuit Current	Isc (A)	10.04	10.15							
		AE380HM6L-72	AE385HM6L-72	AE390HM6L-72	AE395HM6L-72	AE400HM6L-72	AE405HM6L-72	AE410HM6L-72	AE415HM6L-72	
NominalMax.Power	Pmax (Wp)	380	385	390	395	400	405	410	415	
Maximum Power Voltage	Vmp (V)	40.25	40.53	40.79	41.06	41.32	41.59	41.85	42.09	
Maximum Power Current	Imp (A)	9.44	9.50	9.56	9.62	9.68	9.74	9.80	9.86	
Open-Circuit Voltage	Voc (V)	48.1	48.3	48.5	48.7	48.9	49.1	49.3	49.5	
Short-Circuit Current	Isc (A)	10.17	10.21	10.25	10.29	10.33	10.37	10.41	10.45	
		AE315HM6L-60	AE320HM6L-60	AE325HM6L-60	AE330HM6L-60	AE335HM6L-60	AE340HM6L-60	AE345HM6L-60		
NominalMax.Power	Pmax (Wp)	315	320	325	330	335	340	345		
Maximum Power Voltage	Vmp (V)	33.26	33.61	33.89	34.17	34.44	34.69	34.95		
Maximum Power Current	Imp (A)	9.47	9.52	9.59	9.66	9.73	9.80	9.87		
Open-Circuit Voltage	Voc (V)	40.7	40.9	41.1	41.3	41.5	41.7	41.9		
Short-Circuit Current	Isc (A)	10.04	10.15	10.2	10.31	10.36	10.55	10.64		
		AE425HM6L-72	AE430HM6L-72	AE435HM6L-72	AE440HM6L-72	AE445HM6L-72	AE450HM6L-72	AE455HM6L-72	AE460HM6L-72	AE465HM6L-72
NominalMax.Power	Pmax (Wp)	425	430	435	440	445	450	455	460	465
Maximum Power Voltage	Vmp (V)	40.20	40.4	40.6	40.8	41.0	41.2	41.4	41.6	41.8
Maximum Power Current	Imp (A)	10.45	10.52	10.60	10.67	10.74	10.92	10.99	11.06	11.12
Open-Circuit Voltage	Voc (V)	48.2	48.4	48.7	48.9	49.2	49.5	49.7	49.9	50.1
Short-Circuit Current	Isc (A)	11.12	11.18	11.24	11.3	11.36	11.42	11.48	11.53	11.58
		AE355HM6L-60	AE360HM6L-60	AE365HM6L-60	AE370HM6L-60	AE375HM6L-60	AE380HM6L-60	AE385HM6L-60		
NominalMax.Power	Pmax (Wp)	355	360	365	370	375	380	385		
Maximum Power Voltage	Vmp (V)	34.46	34.65	34.84	35.03	35.22	35.41	35.6		
Maximum Power Current	Imp (A)	10.30	10.39	10.48	10.56	10.65	10.73	10.81		
Open-Circuit Voltage	Voc (V)	40.7	40.9	41.1	41.3	41.5	41.7	41.9		
Short-Circuit Current	Isc (A)	11.3	11.4	11.5	11.6	11.7	11.8	11.9		