Installation Manual(Double glass PV module)

1. The Purpose

This installation manual provides installation instructions for the double glass solar modules (hereinafter referred to as double glass PV modules) of Ningbo Raytech New Energy Materials Co., Ltd. (hereinafter referred to as "Raytech"), and describes the installation and maintenance related to the modules. The installation of the modules shall be strictly carried out by professional technicians. Please read this manual carefully before installation.

2. Disclaimer

The installation, operation, use and maintenance of Raytech double glass PV modules are not in the control of the Company. Raytech is not responsible for any loss, damage or expense caused by installation, operation, use or maintenance.
Raytech shall not be liable for infringement of third party patents or other rights arising from the use of the module. No license is granted by implication or by any patent or patent right.
Raytech reserves the right to modify the manual, modules specifications or module information without prior notice.

3. Safty Considerations

1) When design a PV system, be sure to take the voltage changes at different temperature into consideration (Please check the temperature coefficient of each module in the product specifications. The variable output voltage of the module shall increase when the temperature drops).
2) We require that each string of PV modules be fused before connected to other modules strings. For the maximum fuse rating, please refer to the parameters in the product specifications.
3) The PV modules generate electricity under exposure to the light source. Array of solar modules can cause fatal electric shock or burns. Personnel who are not authorized or trained should not touch PV modules.
4) Use a properly insulated tool and appropriate protective equipment to reduce the risk of electric shock.
5) Do not tread or stand on the modules.
6) Do not damage or scratch the front or back of the modules.
7) It is strictly forbidden to use a module with damaged glass or top substrate. Do not try to repair the damaged modules, otherwise touch the surface of the modules may cause electric shock.
8) Do not disassemble the modules or remove any component of the modules.
9) Keep the plug connectors clean and do not use stained or damaged plugs.
10) Do not install or operate the modules when wet or in windy days.
11) Do not connect the positive end of a single PV module to the positive end of the cable.
12) Make sure there is no gap between the individual insulation washers of the connectors. Otherwise it may cause fire or electric shock.
13) Make sure that the polarity of each module or module string is not opposite of the other modules or module strings.
14) Do not artificially gather sunlight on these solar modules.
15) The maximum system voltage shall not exceed 1500V DC. According to the National Electrical Code, when used on the roof, the maximum system voltage shall not exceed 1000V.

16) Under normal circumstances, the current or voltage produced by the PV Modules may be higher than those in standard tests under certain conditions. Please follow the relevant requirements of the United States National Electrical Code (NEC) Article 690 to handle the situations where the output value is higher than the standard report value. If the installation conditions do not meet NEC's requirements, multiply the ISC and VOC values marked by this module by a coefficient of 1.25, to determine the module's voltage rating, the conductor current carrying capacity, the overcurrent protector's rating, and the size of the control device connected to the PV module's output terminal.
17) The PV modules we provide are Class A with restricted applications to the components of this application level. They can be applied to systems with operating voltage or power higher than 50V DC or 320W (expected to use universal contractors for access).
18) The installation should be carried out in accordance with the Canadian Electrical Code Part I: Electrical Installation Safety Standards CSA C22.1.
19) The exposed components of the conductive parts should be grounded in accordance with the instructions below and the United States National Electrical Code, or as a violation of UL 1703.
20) According to the UL1703 updated on May 20, 2014, this series of PV modules have reached the fireproofing rating of 13. However, this fireproofing rating can only be effective when the installation is carried out in the way described in the mechanical installation instructions.
21) PV system fireproofing rating should be graded based on the conditions of roof materials and mounting frames.

4. Unpacking and Storage Considerations

1) The storage place should be flat and indoor warehouse, not exposed to rain.
2) The boxes can be stacked for 2 layers. But do not place unpacked boxes in the lower layer.
3) When stored, modules can't be bent and should be kept in the same flatness. And do not stack multiple modules horizontally.
4) Modules shall keep indoors. When modules have to be placed outdoors in particular cases, please cover modules with waterproof to avoid soaking or damage.
5) When unpacking, please use both hands to move modules.
6) Be careful when double glass PV modules are moved. Slip-proof gloves are required for moving and installation.

5. Environment Conditions and Site Selection

5.1 Climate Environment

Raytech double glass PV modules should be installed in the following conditions:

- Ambient temperature: - 40 ℃ to +40 ℃
- Tmperature: - 40 ℃ to +85℃
- Storage temperature: - 20 ℃ to +40 ℃
- Humidity: < 85%
- Mechanical load pressure: the positive shall not exceed 3600 Pa and the negative shall not exceed 1600 Pa with the safty factor 1.5.

- Maximum altitude: less than or equal to 2000m

* The mechanical load capacity of modules (including wind load and snow load) depends on the installation methods of Raytech modules. And it should be calculated by professional system installers according to system design.

5.2 Site Selection

1) In most of use conditions, Raytech modules should be installed at the location with a full irradiation of sunshine and will not be blocked at any time.
2) Please do not install under corrosive environment.
3) Do not install modules in the position where may be soaked or constantly exposed to sprinklers or the fountain.
4) Do not install modules near open flame or flammable objects.
5) Do not install modules directly on the roof or the wall. The fixed bracket must be used and the edges of modules or the gap between the surface and the roof or the wall shall not less than 100mm.

5.3 Installation Angle

1) The same string of modules must be installed at the same angle. Different installation angles will lead to different radiation quantity received by modules so as to cause the mismatching of electricity current, resulting in an decrease in operating efficiency of system.
2) Refer to table 1 for the module installation angle.

Table 1

Local latitude	Modules installation angle
0°~15°	= 15°
15°~25°	= latitude
25°~30°	= latitude+5 °
30°~35°	= latitude+10 °
35°~40°	= latitude+15 °
＞40°	= latitude+20 °

6. Installation Description

6.1 General Rules of Installation

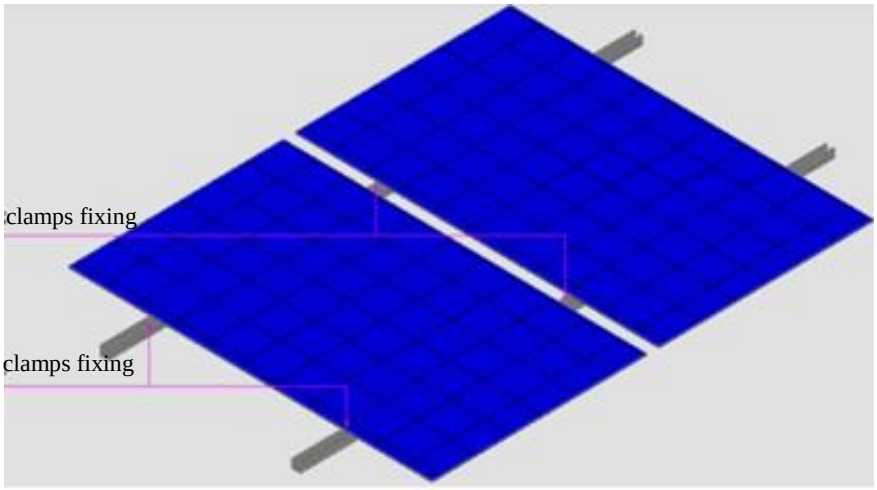
1) The bracket structure must be made of durable, rust-proof and UV-resistance materials.
2) Modules must be firmly installed on the brackets.
3) Choose an appropriate installation height of the PV system to avoid the underpart of modules being covered by snow for a long time in winter. In addition, make sure that the lowest part of the modules is high enough so as not to be blocked by plants or be damaged by sand and stones blown about by wind.
4) Considering that the brackets used for fixing modules will be influenced by the thermal expansion, the installation distance between two modules is suggested to be 10mm at minimum.

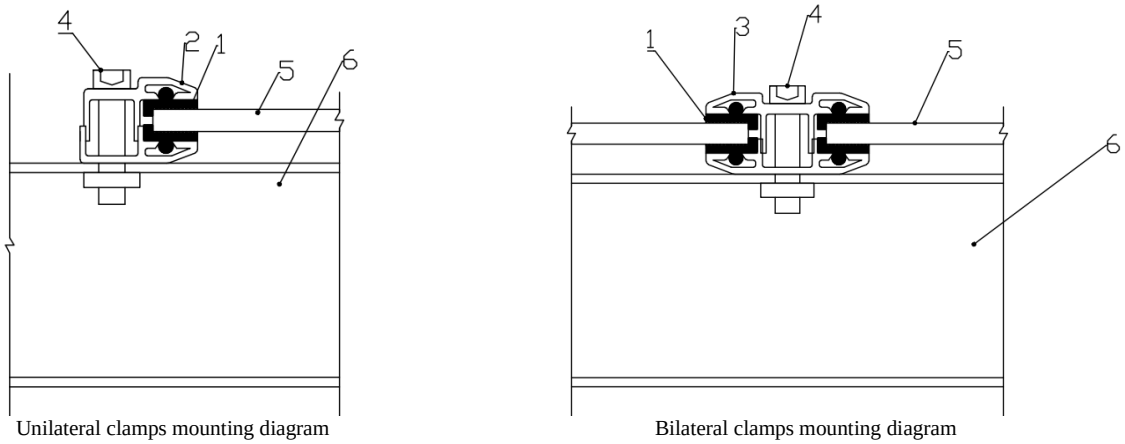
5) Comply with instruction guidance and safety instructions attached to the bracket.
6) Do not drill holes on the glass surface of modules, or the after-service would be invalidated.
7) Choose the brackets and the module installation structures which are capable of resisting the local wind when modules are installed on the brackets.

6.2 Installation method

Clamp mounting installation

Fix the module edge by clamps in order to fix the modules and brackets, as showed in Figures 1:





Unilateral clamps mounting diagram　　Bilateral clamps mounting diagram

Figures 1: installation diagram

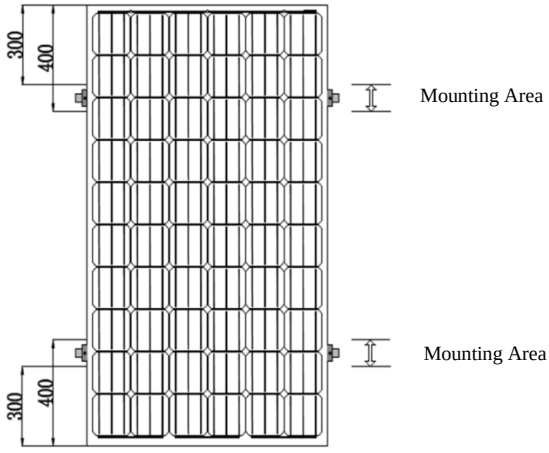
NO.	Name	Purpose	Note
1	EPDM	Rigid contact between buffer module and clamp	Ethylene-Propylene-Diene Monomer, size 150*14*2.5mm
2	Unilateral clamps mounting	Fix and connect modules	Aluminum alloy 6063-T5, effective clamping width is suggested to exceed 10mm
3	Bilateral clamps mounting	Fix and connect adjacent modules	Aluminum alloy 6063-T5, effective clamping width is suggested to exceed 10mm
4	Bolt	Fix clamps	SS304 stainless steel bolts is recommended to use with M8 bolts, with a torque among 16-20 N * m
5	Double glass PV module	——	——
6	C-type galvanized steel	Support and fix modules	Specifications and types should be determined according to local wind, snow, earthquake and constant load calculation.

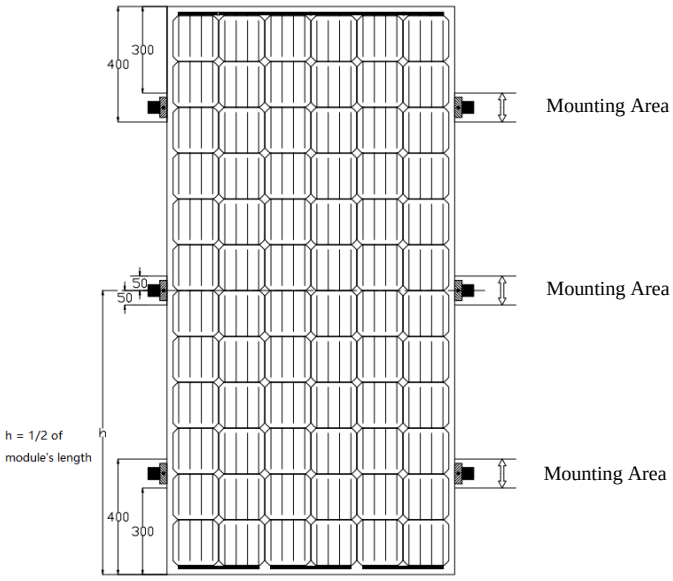
Note:

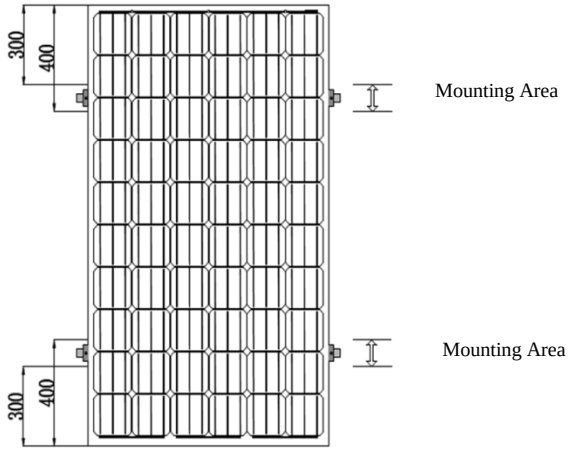
1) The modules should be fixed to the bracket with aluminum alloy clamp. It is recommended to use a clamp approved by the modules suppliers.
2) Avoid pressing the clamp directly on the glass or deforming the modules. The clamp shall not affect the normal function of the modules.

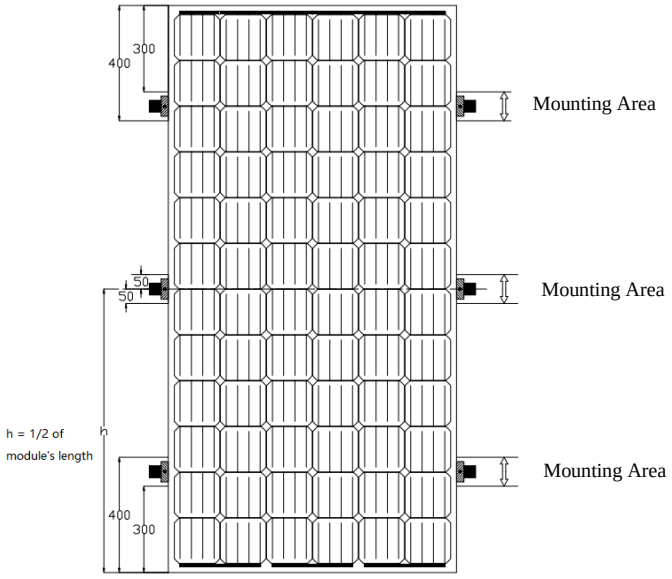
Installation Position Description:

The clamp should be connected to the modules longwise edge in a position of 300 to 400 mm from the short edge. This distance is from the modules short edge to the clamp center. For the 72 or 144 type double glass solar modules, 3 keels should be set to support and 6 clamps should be used to install each module.

DM28,DM36, DM60 series double glass PV modules of 6 mm and 7.4 mm			
Mechanical load pressure	**Clamp length**	**Safety factor**	**Installation direction**
+3600Pa /-1600Pa	150mm	1.5	 **Note: The mentioned size 300 and 400 refer that the distance from the center of upper and lower clamps to the module edge should be within a range of 300mm to 400mm.**

DM72 series double glass PV modules of 6 mm and 7.4 mm			
Mechanical load pressure	**Clamp length**	**Safety factor**	**Installation direction**
+3600Pa /-1600Pa	150mm	1.5	 **Note: The mentioned size 300 and 400 refer that the distance from the center of upper and lower clamps to the module edge should be within a range of 300mm to 400mm. The mentioned size 50 refers that the distance from the middle clamps center to the module center line should be with in a range of 50mm.**

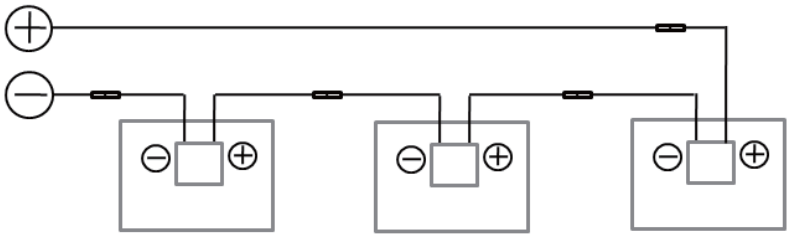
BPDM60 series double glass PV modules of 6 mm			
Mechanical load pressure	**Clamp length**	**Safety factor**	**Installation direction**
+3600Pa /-1600Pa	150mm	1.5	 **Note: The mentioned size 300 and 400 refer that the distance from the center of upper and lower clamps to the module edge should be within a range of 300mm to 400mm.**

BPDM72 series double glass PV modules of 6 mm			
Mechanical load pressure	**Clamp length**	**Safety factor**	**Installation direction**
+3600Pa /-1600Pa	150mm	1.5	 **Note: The mentioned size 300 and 400 refer that the distance from the center of upper and lower clamps to the module edge should be within a range of 300mm to 400mm. The mentioned size 50 refers that the distance from the middle clamps center to the module center line should be with in a range of 50mm.**

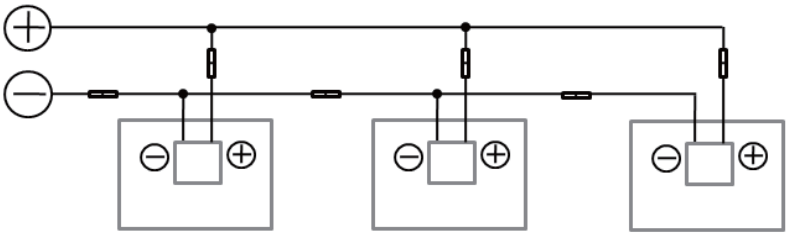
7. Module wiring

1) Each module has two standard 90 ℃ light resistant output cables of diameter 4 mm², which are all connected to connectors & movable joint. These cables can be used in direct sunlight. It is recommended for all wiring and electrical connections to comply with the relevant national electrical code.
2) For field connections, use a copper wire with a diameter of no less than 4 mm² and a light resistance of no less than 90℃.
3) Cable outer diameter should between 5mm and 7mm. For the maximum electrical rating of the serial fuse, refer to the Specifications section.
4) Do not use different configuration in the same PV system components.
5) In order to ensure the normal running of the system, the modules connected to the battery or other modules, please observe the polarity of the cable. If the connection is not correct, the bypass diode may be damaged.
6) Modules can be connected in series(Figures 2 & 4) to increase the operating voltage by plugging the positive plug of one module into the negative socket of the next. Before connecting modules always ensure that the contacts are corrosion free, clean and dry.
7) Modules can be connected in parallel(Figures 3 & 4) to increase the current by connecting the positive plug of one module to the positive plug of the next.
8) Under normal conditions, a photovoltaic 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 this module should be

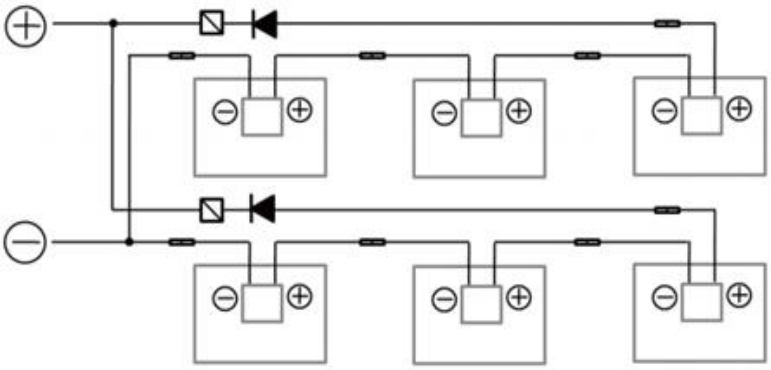
multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.



Figures 2: Connected in series



Figurs 3: Parallel connection



Figurs 4: parallel connection after series

9) Each string of components can be connected in series, largest amount must be calculated according to relevant regulations and requirements. The open circuit voltage at a local minimum temperatures expected value under the condition of no more than maximum system voltage value of the component the value of the dc electrical components and other requirements. If there may be higher than the component's largest fuse current reverse current through the component, must use the same specifications of the over current protection device to protect the components. If parallel or equal number greater than two series, on each string components must have an over current protection device.

10) GROUNDING: Double glass PV module without frame do not need grounding because there will be no leakage current between cell and encapsulation material due to non-frame structure.

8. Maintenance

1) Partially blocking a single module may cause a reverse voltage inside. At this point the current will be affected by other modules and flows through the sunlight blocked area. If the bypass diodes are routed parallel to the series modules, the current that is affected will flow through the diodes and bypass the sunlight blocked PV modules to minimize the modules heating and array current damage.
2) The diodes used to occlude diodes must meet the following conditions:

   - Rated average forward current [IF (AV)] at the highest module operating temperature is higher than the maximum system current .

   - Rated repetitive peak reverse voltage [VRRM] at the lowest module operating temperature is higher than the maximum system voltage .
3) Do not disassemble the junction box or replace the internal parts, all wiring methods must maintain the default factory setting. Do not leave the junction box connectors in a short circuit condition. Under the sunlight, use a suitable safety device (insulated tool, insulated glove) when connecting or disconnecting the connectors, and cover the surface of the module's glass with a shading material to prevent electrical shock when maintaining the modules. Modules exposed to the sun will produce high voltage, therefore please be careful in maintenance and pay attention to the risk of electric shock.

4) Must conduct regular annual inspection of the modules, and be wary of joints fall-off, poor grounding, installation brackets loosening and so on. For the modules whose installation angles are larger than 10 degrees, in most cases, the normal rainfall can keep the module glass surface clean. If it's too dirty or stained, arrange workers to clean it if necessary. To clean it, you need to wet the glass surface, and use a soft cloth. When cleaning, be careful not to scratch the glass surface, or else it will affect the optimum power output of the module. If cannot clean manually, you can use a high-pressure cleaner but must comply with the following conditions:

   ① Cleaning fluid: use water at the normal ambient temperature instead of cleaning agents or other with chemicals

   ② Water pressure setting: ≤13.1 MPa

   ③ Flow rate setting: ≤7 L / min

   ④ Distance between outlet and module: ≥30 cm

   ⑤ Horizontal spraying angle: ≥ 15 °

   ⑥ Cleaning should be carried out at night or in the morning

Installation Manual(Single glass PV module)

1. The Purpose

This installation manual provides installation instructions for the single glass solar modules (hereinafter referred to as single glass PV modules) of Ningbo Raytech New Energy Materials Co., Ltd. (hereinafter referred to as "Raytech"), and describes the installation and maintenance related to the modules. The installation of the modules shall be strictly carried out by professional technicians. Please read this manual carefully before installation.

2. Disclaimer

The installation, operation, use and maintenance of Raytech single glass PV modules are not in the control of the Company. Raytech is not responsible for any loss, damage or expense caused by installation, operation, use or maintenance.
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3. Safty Considerations

1） When design a PV system, be sure to take the voltage changes at different temperature into consideration (Please check the temperature coefficient of each module in the product specifications. The variable output voltage of the module shall increase when the temperature drops).

2） We require that each string of PV modules be fused before connected to other modules strings. For the maximum fuse rating, please refer to the parameters in the product specifications.

3） The PV modules generate electricity under exposure to the light source. Array of solar modules can cause fatal electric shock or burns. Personnel who are not authorized or trained should not touch PV modules.

4） Use a properly insulated tool and appropriate protective equipment to reduce the risk of electric shock.

5） Do not tread or stand on the modules.

6） Do not damage or scratch the front or back of the modules.

7） It is strictly forbidden to use a module with damaged glass or top substrate. Do not try to repair the damaged modules, otherwise touch the surface of the modules may cause electric shock.

8） Do not disassemble the modules or remove any component of the modules.

9） Keep the plug connectors clean and do not use stained or damaged plugs.

10） Do not install or operate the modules when wet or in windy days.

11） Do not connect the positive end of a single PV module to the positive end of the cable.

12） Make sure there is no gap between the individual insulation washers of the connectors. Otherwise it may cause fire or electric shock.

13） Make sure that the polarity of each module or module string is not opposite of the other modules or module strings.

14） Do not artificially gather sunlight on these solar modules.

15） The maximum system voltage shall not exceed 1500V DC. According to the National Electrical Code, when used on the roof, the maximum system voltage shall not exceed 1000V.

16） Under normal circumstances, the current or voltage produced by the PV Modules may be higher than those in standard tests under certain conditions. Please follow the relevant requirements of the United States National Electrical Code (NEC) Article 690 to handle the situations where the output value is higher than the standard report value. If the installation conditions do not meet NEC's requirements, multiply the ISC and VOC values marked by this module by a coefficient of 1.25, to determine the module's voltage rating, the conductor current carrying capacity, the overcurrent protector's rating, and the size of the control device connected to the PV module's output terminal.

17） The PV modules we provide are Class A with restricted applications to the components of this application level. They can be applied to systems with operating voltage or power higher than 50V DC or 320W (expected to use universal contractors for access).

18） The installation should be carried out in accordance with the Canadian Electrical Code Part I: Electrical Installation Safety Standards CSA C22.1.

19） The exposed components of the conductive parts should be grounded in accordance with the instructions below and the United States National Electrical Code, or as a violation of UL 1703.

20） According to the UL1703 updated on May 20, 2014, this series of PV modules have reached the fireproofing rating of 13. However, this fireproofing rating can only be effective when the installation is carried out in the way described in the mechanical installation instructions.

21） PV system fireproofing rating should be graded based on the conditions of roof materials and mounting frames.

4. Unpacking and Storage Considerations

1） The storage place should be flat and indoor warehouse, not exposed to rain.

2） The boxes can be stacked for 2 layers. But do not place unpacked boxes in the lower layer.

3） When stored, modules can't be bent and should be kept in the same flatness. And do not stack multiple modules horizontally.

4） Modules shall keep indoors. When modules have to be placed outdoors in particular cases, please cover modules with waterproof to avoid soaking or damage.

5） When unpacking, please use both hands to move modules.

6） Be careful when double glass PV modules are moved. Slip-proof gloves are required for moving and installation.

5. Environment Conditions and Site Selection

5.1 Climate Environment

Raytech double glass PV modules should be installed in the following conditions:

- Ambient temperature: - 40 ℃ to +40 ℃
- Tmperature: - 40 ℃ to +85℃
- Storage temperature: - 20 ℃ to +40 ℃
- Humidity: < 85%

- Mechanical load pressure: the front (snow load) shall not exceed 5400 Pa and the back (wind load) shall not exceed 2400 Pa.
- Maximum altitude: less than or equal to 2000m

*The mechanical load capacity of modules (including wind load and snow load) depends on the installation methods of Raytech modules. And it should be calculated by professional system installers according to system design.

5.2 Site Selection

1） In most of use conditions, Raytech modules should be installed at the location with a full irradiation of sunshine and will not be blocked at any time.

2） Please do not install under corrosive environment.

3） Do not install modules in the position where may be soaked or constantly exposed to sprinklers or the fountain.

4） Do not install modules near open flame or flammable objects.

5） Do not install modules directly on the roof or the wall. The fixed bracket must be used and the edges of modules or the gap between the surface and the roof or the wall shall not less than 100mm.

5.3 Installation Angle

1） The same string of modules must be installed at the same angle. Different installation angles will lead to different radiation quantity received by modules so as to cause the mismatching of electricity current, resulting in an decrease in operating efficiency of system.

2） Refer to table 1 for the module installation angle.

Table 1

Local latitude	Modules installation angle
0°~15°	= 15°
15°~25°	= latitude
25°~30°	= latitude+5 °
30°~35°	= latitude+10 °
35°~40°	= latitude+15 °
＞40°	= latitude+20 °

6. Installation Description

6.1 General Rules of Installation

1） The bracket structure must be made of durable, rust-proof and UV-resistance materials.

2） Modules must be firmly installed on the brackets.

3） Choose an appropriate installation height of the PV system to avoid the underpart of modules being covered by snow for a long time in winter. In addition, make sure that the lowest part of the modules is high enough so as not to be blocked by plants or be damaged by sand and stones blown about by wind.

4） Considering that the brackets used for fixing modules will be influenced by the thermal expansion, the installation distance between two modules is suggested to be 10mm at minimum.

5） Comply with instruction guidance and safety instructions attached to the bracket.

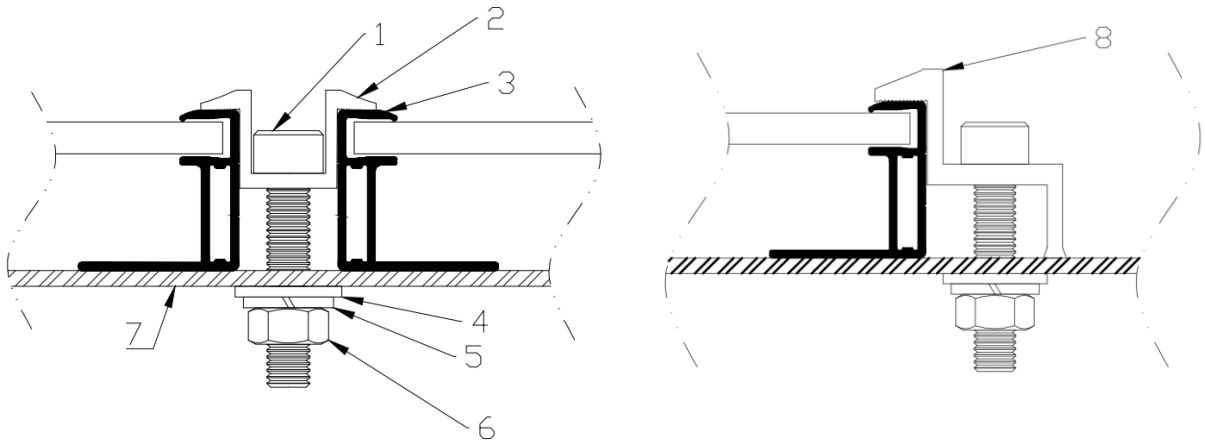
6） Do not drill holes on the glass surface of modules, or the after-service would be invalidated.

7） Choose the brackets and the module installation structures which are capable of resisting the local wind when modules are installed on the brackets.

6.2 Installation method

Clamp mounting installation

Fix the module edge by clamps in order to fix the modules and brackets, as showed in Figures 1:



Unilateral clamps mounting diagram　　Bilateral clamps mounting diagram

Figures 1: installation diagram

No.	Name	Purpose	Note
1	Bolt	Fix clamp to bracket	SS304 stainless steel M8 bolts is recommended to use with a torque among 16-20 N * m
2	Bilateral clamps mounting	Fix and connect modules	Aluminum alloy 6063-T5, effective clamping width is suggested to exceed 8mm
3	Single glass PV module	——	——
4	Flat washer	Reduce pressure and prevent loosening	——
5	Spring washer	Prevent loosening	——
6	Screw nut	Locking bolt	SS304 stainless steel nut is recommended to use and matching the bolt
7	Bracket	Support and fix modules	Specifications and types should be determined according to local wind, snow, earthquake and constant load calculation.
8	Unilateral clamps mounting	Fix and connect modules	Aluminum alloy 6063-T5, effective clamping width is suggested to exceed 8mm

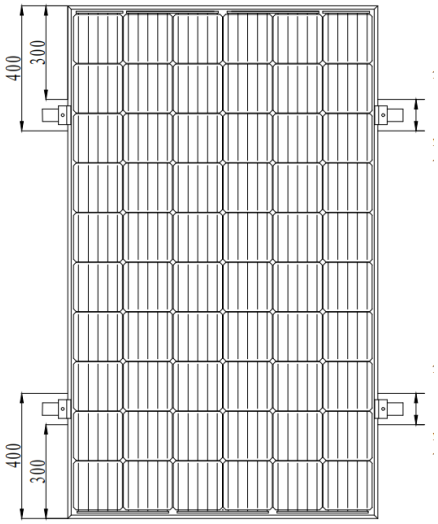
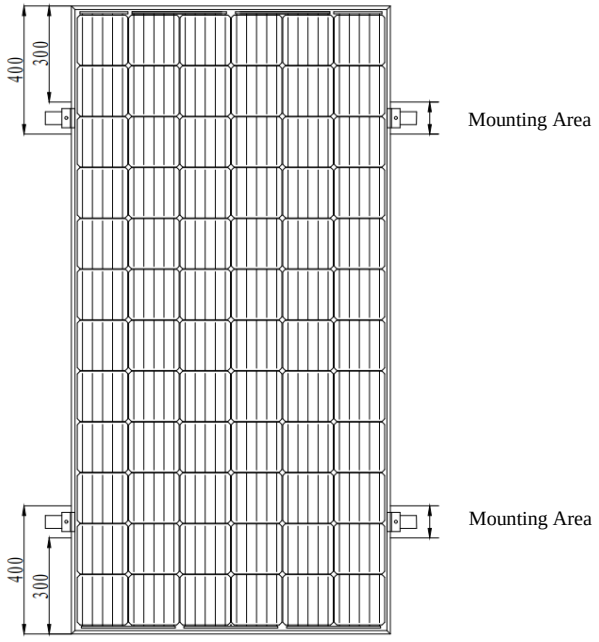
Note:

1） The modules should be fixed to the bracket with aluminum alloy clamp. It is recommended to use a clamp approved by the modules suppliers.

2） Avoid pressing the clamp directly on the glass or deforming the modules. The clamp shall not affect the normal function of the modules.

Installation Position Description:

The clamp should be connected to the modules longwise edge in a position of 300 to 400 mm from the short edge. This distance is from the modules short edge to the clamp center.

Module type	Mechanical loading	Safety factor	Installation direction
SM60 series single glass PV module	+3600Pa /-1600Pa	1.5	
SM72 series single glass PV module	+3600Pa /-1600Pa	1.5	

7. Module wiring

1） Each module has two standard 90 ℃ light resistant output cables of diameter 4 mm², which are all connected to connectors & movable joint. These cables can be used in direct sunlight. It is recommended for all wiring and electrical connections to comply with the relevant national electrical code.

2） For field connections, use a copper wire with a diameter of no less than 4 mm² and a light resistance of no less than 90℃.

3） Cable outer diameter should between 5mm and 7mm. For the maximum electrical rating of the serial fuse, refer to the Specifications section.

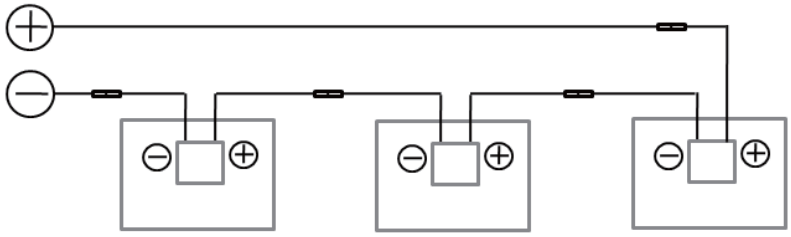
4） Do not use different configuration in the same PV system components.

5） In order to ensure the normal running of the system, the modules connected to the battery or other modules, please observe the polarity of the cable. If the connection is not correct, the bypass diode may be damaged.

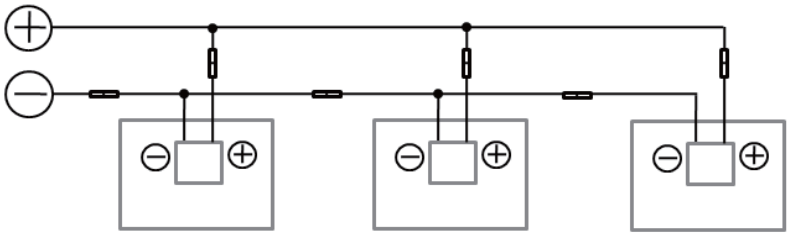
6） Modules can be connected in series(Figures 2 & 4) to increase the operating voltage by plugging the positive plug of one module into the negative socket of the next. Before connecting modules always ensure that the contacts are corrosion free, clean and dry.

7） Modules can be connected in parallel(Figures 3 & 4) to increase the current by connecting the positive plug of one module to the positive plug of the next.

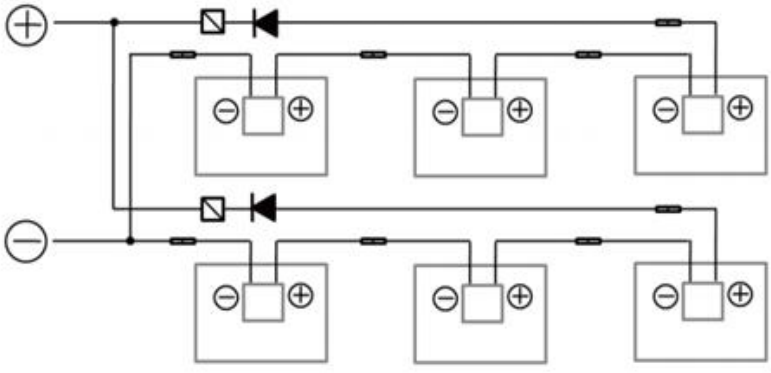
8） Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.



Figures 2: Connected in series



Figurs 3: Parallel connection



Figurs 4: parallel connection after series

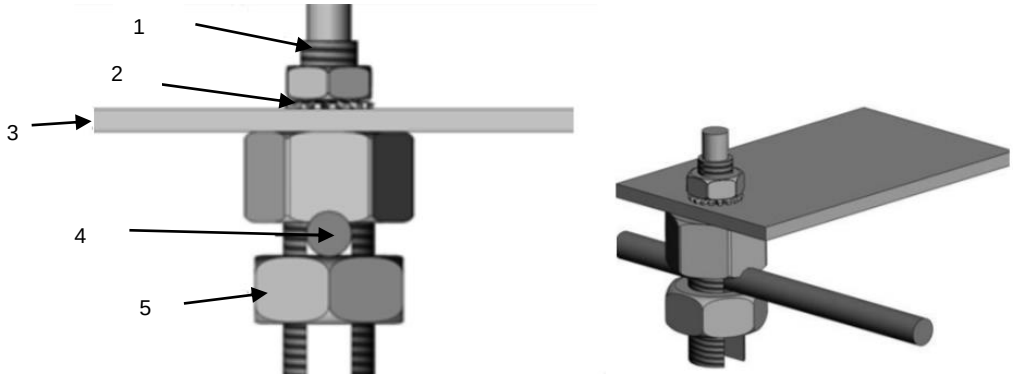
9） Each string of components can be connected in series, largest amount must be calculated according to relevant regulations and requirements. The open circuit voltage at a local minimum temperatures expected value under the condition of no more than maximum system voltage value of the component the value of the dc electrical components and other requirements. If there may be higher than the component's largest fuse current reverse current through the component, must use the same specifications of the over current protection device to protect the components. If parallel or equal number greater than two series, on each string components must have an over current protection device.

10） GROUNDING:

a. Proper grounding is achieved by bonding the module frame(s) and all metallic structural members together continuously using a suitable grounding conductor. The grounding conductor or strap may be copper, copper alloy, or any other material acceptable for use as an electrical conductor per respective National Electrical Codes. The grounding conductor must then make a connection to earth using a suitable earth ground electrode.

b. The grounding hole with a diameter of 4mm is on the frames of solar modules. The aluminum frame of the solar module is connected with a separate grounding wire and related accessories, and the other end of grounding wire is connected to the ground. The grounding bolt is M4 bolt and matched with M4 nut, star-shaped washer, etc., which can ensure that the module is safely and firmly grounded.

c. Tyco grounding bolt can be an optional choice for grounding



Figurs 5: Tyco grounding bolt

1 Wire bolt 2 Mounting wash hex nut 3 Aluminum frame 4 cable 5 Hex Nut

- Electrical contact is made by penetrating the anodized coating of the aluminum frame, and tightening the mounting hex nut (come with the star washer) to the proper torque of 25lbf.in.
- Grounding wire size (6 to 12 AWG solid bare copper) should be selected and installed underneath the wire binding bolt.
- The wire binding bolt should be tightened to the proper torque of 45lbf.in.

8. Maintenance

1） Partially blocking a single module may cause a reverse voltage inside. At this point the current will be affected by other modules and flows through the sunlight blocked area. If the bypass diodes are routed parallel to the series modules, the current that is affected will flow through the diodes and bypass the sunlight blocked PV modules to minimize the modules heating and array current damage.

2） The diodes used to occlude diodes must meet the following conditions:

- Rated average forward current [IF (AV)] at the highest module operating temperature is higher than the maximum system current .

- Rated repetitive peak reverse voltage [VRRM] at the lowest module operating temperature is higher than the maximum system voltage .

3） Do not disassemble the junction box or replace the internal parts, all wiring methods must maintain the default factory setting. Do not leave the junction box connectors in a short circuit condition. Under the sunlight, use a suitable safety device (insulated tool, insulated glove) when connecting or disconnecting the connectors, and cover the surface of the module's glass with a shading material to prevent electrical shock when maintaining the modules. Modules exposed to the sun will produce high voltage, therefore please be careful in maintenance and pay attention to the risk of electric shock.

4） Must conduct regular annual inspection of the modules, and be wary of joints fall-off, poor grounding, installation brackets loosening and so on. For the modules whose installation angles are larger than 10 degrees, in most cases, the normal rainfall can keep the module glass surface clean. If it's too dirty or stained, arrange workers to clean it if necessary. To clean it, you need to wet the glass surface, and use a soft cloth. When cleaning, be careful not to scratch the glass surface, or else it will affect the optimum power output of the module. If cannot clean manually, you can use a high-pressure cleaner but must comply with the following conditions:

① Cleaning fluid: use water at the normal ambient temperature instead of cleaning agents or other with chemicals
② Water pressure setting: ≤13.1 MPa
③ Flow rate setting: ≤7 L / min
④ Distance between outlet and module: ≥30 cm
⑤ Horizontal spraying angle: ≥ 15 °
⑥ Cleaning should be carried out at night or in the morning