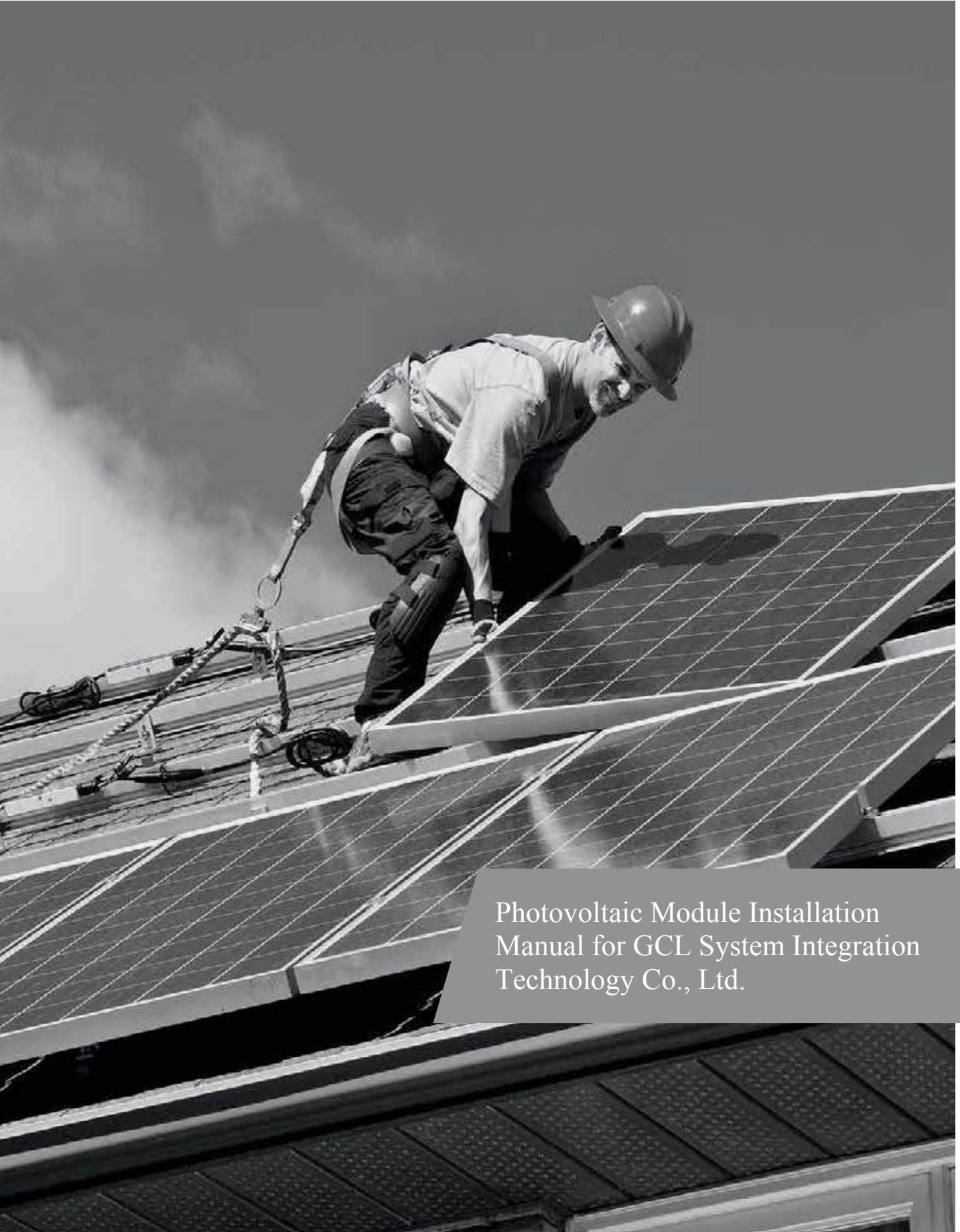




Version: GCLSI_2018.12.19_V3



Photovoltaic Module Installation
Manual for GCL System Integration
Technology Co., Ltd.

CONTENTS

PURPOSE OF THIS MANUAL	2
DISCLAIMER.....	2
SAFETY & TRANSPORT.....	3
MECHANICAL INSTALLATION	5
ELECTRICAL INSTALLATION.....	11
GROUNDING.....	17
BYPASS DIODES AND BLOCK DIODES	18
MAINTENANCE.....	19

PURPOSE OF THIS MANUAL

- This manual applies exclusively to the solar photovoltaic module (hereinafter referred to as Module) of GCL System Integration Technology Co., Ltd. (hereinafter referred to as GCLSI). The contents of this manual involve the installation methods, operation safety and maintenance information of GCLSI's Modules.
- 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.
- 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.

DISCLAIMER

- GCLSI 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.
- 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 GCLSI. The information in this manual is based on GCLSI'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.
- GCLSI reserves the rights to change the manual, the Modules, the specifications or any other information of the Modules without prior notice.

SAFETY & TRANSPORT

General Detailed Rules

- Keep all the Modules and electrical connectors clean and dry before installation.
- Use dry and ventilated room when storing uninstalled Modules.
- Use both hands to carry Modules. Do not overlap Modules.
- Be cautious when carrying Modules. Slip-proof gloves are necessary.
- Use supportive disassembling tools when unpacking.



Do not stamp on Modules or put weight on Modules.



Do not disassemble or drop Modules. Do not remove any nameplate or component of the module.



Do not use mirrors or magnifiers to concentrate sunlight onto Modules.



Do not lift the module by grasping the junction box or cable wire.



Do not use any sharp object with Modules.



Do not directly apply pressure on the glass surface or backsheet of Modules. Must use both hands to carry Modules.

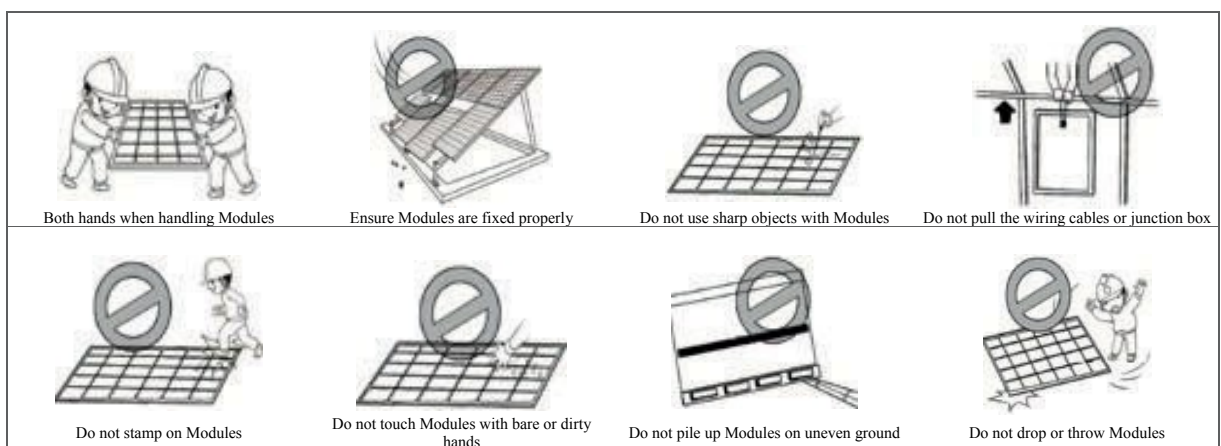


Do not touch the surface of the coated glass with bare hands.



Ensure all contacts and the operating environment are clean and dry.



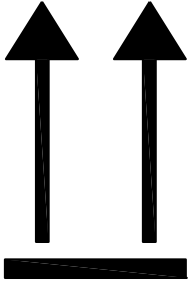
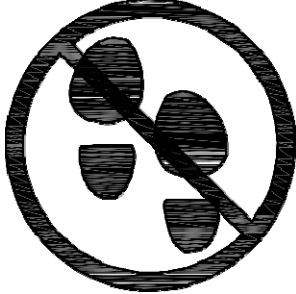
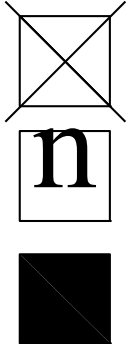
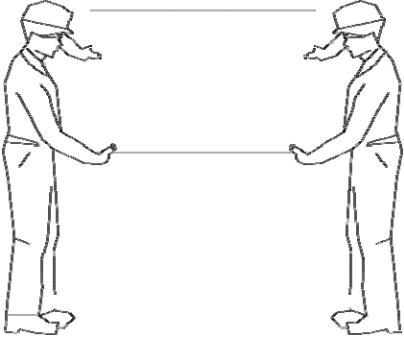
Module Carry and Installation Instruction



SAFETY & TRANSPORT

Description of Package Signs

Before the operation, it is necessary to read carefully the unpacking instruction and outer packing box instruction, and carry out the operation as instructed.

<p>1. DO NOT expose the module to rain or moisture.</p> 	<p>2. The Modules in the carton box are fragile. Handle with care.</p> 
<p>3. The package shall never be upside down during the transportation.</p> 	<p>4. It is prohibited to tramp on the packing box and module.</p> 
<p>5. During the stacking of the Modules, the outer packing box can be stacked not exceed the maximum layer allowed (n=2 means it is allowed to stack for at most two layers.)</p> 	<p>6. One module shall be handled by two people together.</p> 

SAFETY & TRANSPORT

Unloading, Transportation and Storage

- When the Modules are delivered to the project site, the freight car shall be ready in the flat, even and open area for parking and unloading.
- Choose the appropriate carrying forklift according to the commodity weight, unload the Modules from the freight car, and place them on flat ground.
- It is prohibited to stack the Modules in the project site.
- During the transportation in the project site, the Modules shall not be stacked, but only allowing for one layer in transportation.
- Storage in the project site:
Storage environment requirements: humidity<85%, temperature -20°C~+50°C;
Modules statically stacked for ≤ 2 layers.
- Temporary storage in the project site:
The Modules shall be stored in a dry ,well-ventilated place . They shall not be stacked but shall be covered with waterproof cloth to prevent dampness in the Modules.

MECHANICAL INSTALLATION

Location Selection

- Select suitable places to install Modules. The module in the north latitude region shall face south, and shall face north in the south latitude region.
- Install Modules at the places with sufficient sunlight and without shade at any time. If a module is shaded or even partially shaded, it will result in lower power output. A permanent or regular shade will cause damage, which will result in the invalidity of product's limited warranty.
- Do not store, install or use Modules at the places where combustible gas is easily generated or gathering.
- The straight-line distance between the installation site and coastline shall not be shorter than 1 km unless there is a writ ten approval from GCLSI or an engagement specified in the contract.
- GCLSI recommends that the module should be installed at a working ambient temperature of $-20\text{ }^{\circ}\text{C}$ ~ $46\text{ }^{\circ}\text{C}$. The module's limit working ambient temperature range is from $-40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$.
- The maximum altitude of the PV module should be less than 2000m.

Tilt Angle

- 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.
- Please refer to Table 1 for the recommended mounting tilt angles of the Modules.

Local latitude	Mounting Tilt Angles
$0^{\circ}\sim 15^{\circ}$	15°
$15^{\circ}\sim 25^{\circ}$	Local latitude
$25^{\circ}\sim 30^{\circ}$	Local latitude + 5°
$30^{\circ}\sim 35^{\circ}$	Local latitude + 10°
$35^{\circ}\sim 40^{\circ}$	Local latitude + 15°
$>40^{\circ}$	Local latitude + 20°

Table 1 Mounting Tilt Angle of Modules

MECHANICAL INSTALLATION

Module Installation

➤ General Installation

- 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.
- The module shall be firmly mounted on the support.
- Choose proper installation height of the photovoltaic support system, and ensure the lowest part of the module is high enough, to avoid being shaded by plant or being damaged by the flying sand. or being covered by snow for a long time in winter .
- 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 observe 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.
- The application level of GCLSI module is Class A according to IEC61730, which can be used in systems operating at greater than 50 V DC or 240 W, where general contact access is anticipated.
- This module is rated as “Fire safety class C” according to IEC61730.

MECHANICAL INSTALLATION

➤ Installation Method

The Modules may be installed and fixed with the following methods:

Clamping system: use proper clamp, and fix the module with the installation support, as shown in Fig. 1.

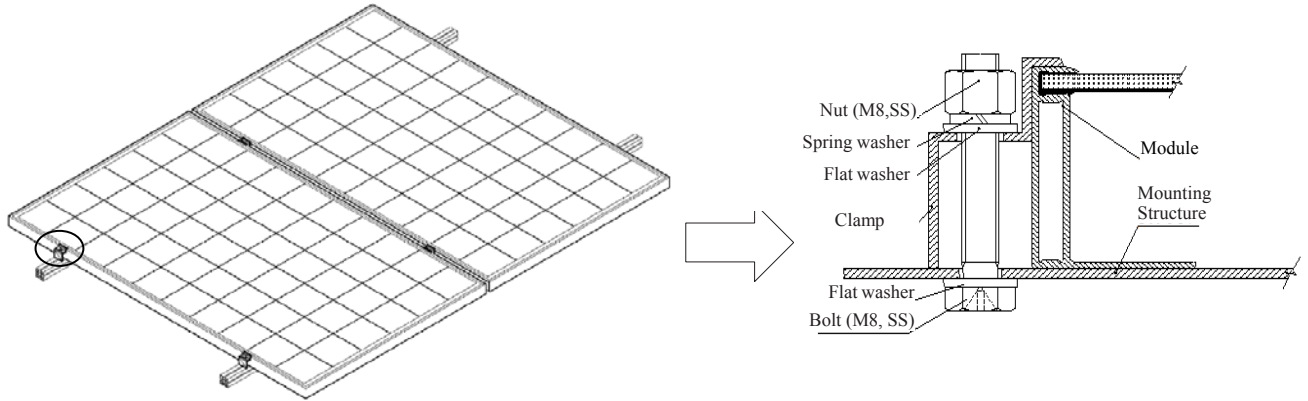


Figure 1 Mounting clamps

The mounting accessories recommended are listed below:

Bolt	Flat washer	Spring washer	Nut
Material: stainless	Steel material: stainless steel	Material: stainless steel	Material: stainless steel
Size: M8	Size: M8	Size: M8	Size: M8

The range of torque for screw tightening is 14N.m to 20N.m.

Use at least 4 clamps on each module.

MECHANICAL INSTALLATION

- Choose the proper installation method according to the loading requirement, the detailed information is shown in Fig. 2.

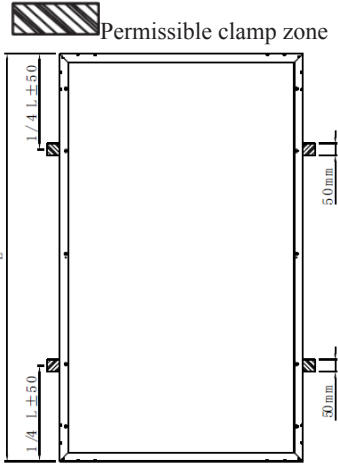
static mechanical load	design load :3600Pa (downward)/1600Pa(upward), $\gamma_m=1.5$
Installation with the mounting clamp	 <p>Permissible clamp zone</p> <p>Use 4 mounting clamps</p>

Figure 2. Installation method

MECHANICAL INSTALLATION

➤ Module Specification (as shown in Figure 3 and Table 2)

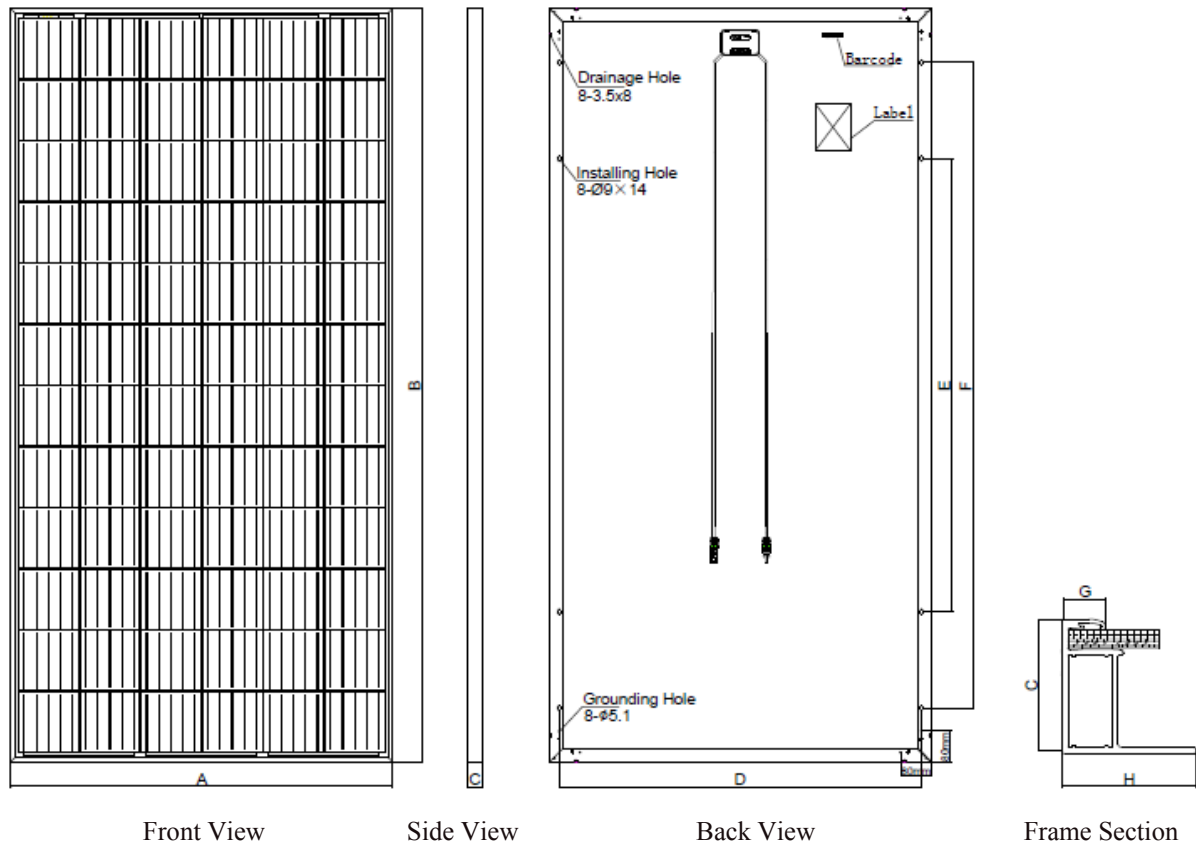


Figure 3 Schematics for the Module Specification

Table 2 Detailed Module Mounting Dimension Contrast Table

Unit:mm

No	Module Type	A	B	C	D	E	F	G	H
1	GCL - P6/60XXX GCL - M6/60XXX GCL - P6/60HXXX GCL - M6/60HXXX	992	1640	40/35	941	990	1350	11/11.5	35
2	GCL - P6/72XXX GCL - M6/72XXX GCL - P6/72HXXX GCL - M6/72HXXX	992	1956	40/35	941	1176	1676	11/11.5	35

Note: "XXX" refers to Module Power Index.

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.

General Installation

- Installation structure should be compatible with aluminum frame of 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 may 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 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 4). 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. Reference equation of the maximum number of the Modules in serial connection:

$$\text{Max System voltage} \geq N * \text{VOC} * [1 - \alpha \text{Voc} * (25 - \text{Tmin})]$$

N: Number of modules in series

VOC: Open circuit voltage of each module

α Voc: Temperature coefficient of open-circuit voltage

Tmin: The lowest expected ambient temperature

- When connected in parallel, the current output is equal to the sum of each string's current (as shown in Figure 5). Fuse is necessary for each module string. Please take reference to the local regulation. Recommended maximum parallel Modules configurations: Fuse rating/(1.25* short-circuit current).

ELECTRICAL INSTALLATION

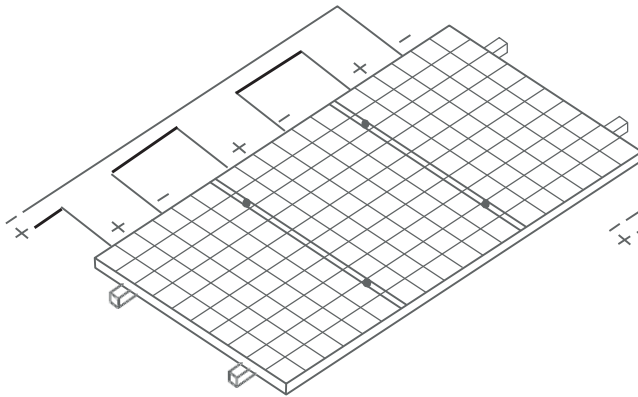


Figure 4 Connection in Series

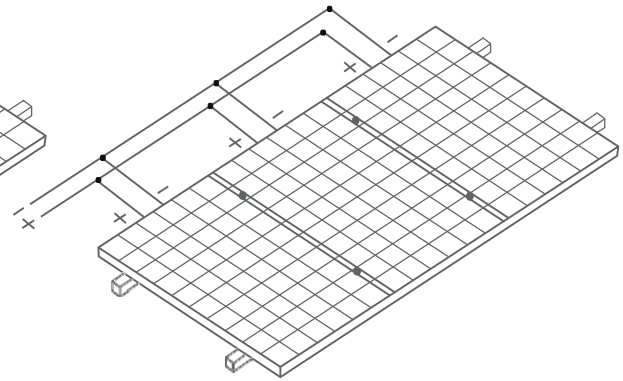


Figure 5 Connection in Parallel

- Please 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 mm², and the recommended rated current for the connector is greater than 15A), 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.

Connectors suitable for 1000V module

Object	Manufacturer/trademark	Type
Connector	QC Solar(Suzhou) Corporation	QC4.10-cd
	Suzhou Bright Photovoltaic Electronic Technology Co., Ltd	B01
	Suzhou Xtong Phtovoltaic Technology Co.,Ltd.	PV-XT101.1
	Jiangsu Hatitian Microelectronics Corp. Minor Enterprise	PV-HT03
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy-UR; PV-KBT4-EVO 2/xy-UR
	Multi-Contract Essen GmbH	PV-KST4/6II- UR; PV-KBT4/6II-UR(MC4)

ELECTRICAL INSTALLATION

Connectors suitable for 1500V module

Object	Manufacturer/trademark	Type
Connector	QC Solar(Suzhou) Corporation	QC4.10-cd
	Suzhou Bright Photovoltaic Electronic Technology Co., Ltd	B01
	Suzhou Xtong Phtovoltaic Technology Co.,Ltd.	PV-XT101.1
	Jiangsu Hatitian Microelectronics Corp. Minor Enterprise	PV-HT03
	Staubli Electrical Connectors AG	PV-KST4-EVO 2/xy-UR; PV-KBT4-EVO 2/xy-UR

ELECTRICAL INSTALLATION

Electrical Output

The module is tested at Standard Test Conditions STC (Air Mass AM1.5, Irradiance 1000W/m², Cell Temperature 25°C). Tolerance of Rating Pmax is ±3%, Voc is ±3%, and Isc is ±4%.

Electrical characteristics (at STC)

Module Type	Pmax	Isc	Voc	Maximum System Voltage	Over-current protection
GCL-P6/60260	260	9.09	37.90	1000	15
GCL-P6/60265	265	9.20	38.10	1000	15
GCL-P6/60270	270	9.29	38.30	1000	15
GCL-P6/60275	275	9.38	38.50	1000	15
GCL-P6/60280	280	9.46	38.70	1000	15
GCL-P6/60285	285	9.54	38.90	1000	15
GCL-M6/60270	270	9.29	38.30	1000	15
GCL-M6/60275	275	9.38	38.50	1000	15
GCL-M6/60280	280	9.46	38.70	1000	15
GCL-M6/60285	285	9.54	38.90	1000	15
GCL-M6/60290	290	9.63	39.10	1000	15
GCL-M6/60295	295	9.69	39.30	1000	15
GCL-M6/60300	300	9.78	39.50	1000	15
GCL-P6/72310	310	8.99	45.40	1000	15
GCL-P6/72315	315	9.08	45.60	1000	15
GCL-P6/72320	320	9.17	45.80	1000	15
GCL-P6/72325	325	9.24	46.00	1000	15
GCL-P6/72330	330	9.33	46.20	1000	15
GCL-P6/72335	335	9.41	46.40	1000	15
GCL-P6/72340	340	9.49	46.60	1000	15
GCL-P6/72345	345	9.61	47.30	1000	15

ELECTRICAL INSTALLATION

GCL-M6/72325	325	9.24	46.00	1000	15
GCL-M6/72330	330	9.33	46.20	1000	15
GCL-M6/72335	335	9.41	46.40	1000	15
GCL-M6/72340	340	9.49	46.60	1000	15
GCL-M6/72345	345	9.57	46.80	1000	15
GCL-M6/72350	350	9.65	47.00	1000	15
GCL-M6/72355	355	9.73	47.20	1000	15
GCL-M6/72360	360	9.81	47.40	1000	15
GCL-P6/60H270	270	9.29	38.30	1500	15
GCL-P6/60H275	275	9.38	38.50	1500	15
GCL-P6/60H280	280	9.46	38.70	1500	15
GCL-P6/60H285	285	9.54	38.90	1500	15
GCL-M6/60H285	285	9.54	38.90	1500	15
GCL-M6/60H290	290	9.63	39.10	1500	15
GCL-M6/60H295	295	9.69	39.30	1500	15
GCL-M6/60H300	300	9.78	39.50	1500	15
GCL-P6/72H320	320	9.17	45.80	1500	15
GCL-P6/72H325	325	9.24	46.00	1500	15
GCL-P6/72H330	330	9.33	46.20	1500	15
GCL-P6/72H335	335	9.41	46.40	1500	15
GCL-P6/72H340	340	9.49	46.60	1500	15
GCL-P6/72H345	345	9.61	47.30	1500	15
GCL-M6/72H335	335	9.41	46.40	1500	15
GCL-M6/72H340	340	9.49	46.60	1500	15
GCL-M6/72H345	345	9.57	46.80	1500	15
GCL-M6/72H350	350	9.65	47.00	1500	15
GCL-M6/72H355	355	9.73	47.20	1500	15

ELECTRICAL INSTALLATION

GCL-M6/72H360	360	9.81	47.40	1500	15
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Temperature Ratings of poly modules

- Temperature Coefficient of Pmax: $-0.39\%/^{\circ}\text{C}$.
- Temperature Coefficient of Voc: $-0.30\%/^{\circ}\text{C}$.
- Temperature Coefficient of Isc: $+0.050\%/^{\circ}\text{C}$.

Temperature Ratings of mono modules

- Temperature Coefficient of Pmax: $-0.39\%/^{\circ}\text{C}$.
- Temperature Coefficient of Voc: $-0.30\%/^{\circ}\text{C}$.
- Temperature Coefficient of Isc: $+0.060\%/^{\circ}\text{C}$.

GROUNDING

➤ Grounding by cable

- The grounding bolts must be made of stainless steel and be used in the specified grounding holes. First, make the M3.5 stainless steel bolt pass through the spring washer, flat washer, cup washer (copper conductor with a diameter of 2.1 mm) and star washer, and then insert through the grounding hole, flat washer and spring washer on the frame. Finally, tighten with a M3.5 nut. Caution: The upper limited temperature of the conductor is 85°C. As for the installation, refer to Figure 6.

➤ Grounding by lugs

- All the module frames and mounting structures shall be grounded according to regional and national electricity regulations. Use recommended hardware to connect grounding cables and fasten to the Module frames.
- While using the metal structure, make sure the surface of the system have been electroplated to keep a good conducting circuit.
- Use suitable grounding conductors to connect the Module frame to the mounting structure. This can achieve proper grounding effects.
- The grounding conductor must be connected to ground via an appropriate grounding electrode. It is recommended to use lugs to connect the grounding cables. If it is only mechanically connected to a grounded module without bolts and nuts, the mounting system should be grounded as well.
- First, peel the grounding cable to a proper length without damage to the metal core. Then insert the peeled cable into the lug, tighten the screw. As shown in Figure 7, connect the lug to the aluminum frame with stainless steel bolts and connection components. The recommended tightening torque for M3 bolts is 2.3N•m.

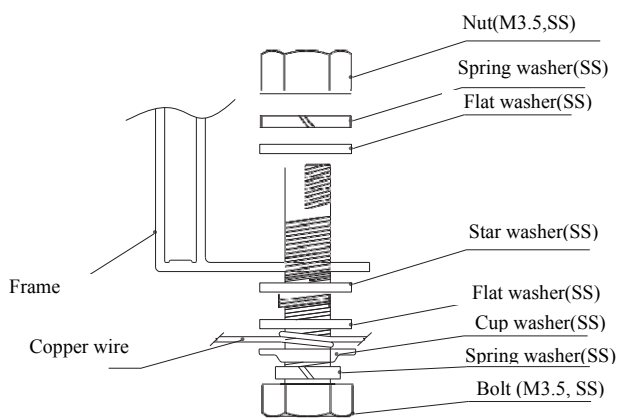


Figure 6

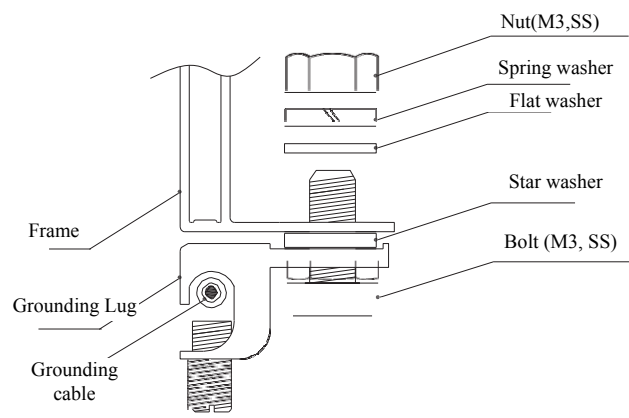


Figure 7

BYPASS DIODES AND BLOCK 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. There are bypass diodes in junction boxes, which can reduce the effects of partial shadows. Do not privately disassemble the junction box to replace the diodes, even when the diodes are broken. This should be processed by the professionals.

Object	Manufacturer/trademark	Type	Technical data/ratings
Bypass diode	Yangzhou yangjie Electronic Technology Co., Ltd.	GF2045MG	Tj max=200° C Rated current=16A

In a system with batteries, if the controller doesn't have the function of backswing protection, block diodes installed between the battery and the Module can prevent the reverse current from damaging the Module.

MAINTENANCE

Normally, the Modules do not need repair. Follow the maintenance methods below to ensure the best performance of the Modules:

- 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.
- Do not try to clean a Module with broken glass or perforated backsheet. It will cause serious electrical shock. Take a regular inspection on grounding, mechanical and electrical connections every 6 months. Make sure all the Module connectors are connected, clean and without damage or corrosion.
- When disassembling the connectors, must make sure all the components are working well; otherwise the connectors shall be replaced. Damage on the connector will cause electronic leakage. The tightening torque of the nut should be $1.5 \text{ N} \cdot \text{m} - 3 \text{ N} \cdot \text{m}$.
- Use opaque material to completely cover the Modules during repair to avoid electric shock. When exposed to the sunshine, the Modules will produce high voltage. The repair work must be carried out by professionals.



Warning: Shut down the system before any electric repair.
Improper maintenance may cause electric shock or fire.



Bring Green Power to Life

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