INSTALLATION MANUAL

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1. INSTALLATION

Models List Applicable To Installation Manual				
Type	Module	A	B	W
Type-1	GSA-N16/144HG580W	2278	1134	30/35
Type-1	GSA-N16/144HG585W	2278	1134	30/35
Type-1	GSA-N16/144HG590W	2278	1134	30/35
Type-1	GSA-N16/144HG595W	2278	1134	30/35
Type-2	GSA-N16/132HG530W	2092	1134	30/35
Type-2	GSA-N16/132HG535W	2092	1134	30/35
Type-2	GSA-N16/132HG540W	2092	1134	30/35
Type-2	GSA-N16/132HG545W	2092	1134	30/35
Type-3	GSA-N16/108HG430W	1722	1134	30/35
Type-3	GSA-N16/108HG435W	1722	1134	30/35
Type-3	GSA-N16/108HG440W	1722	1134	30/35
Type-3	GSA-N16/108HG445W	1722	1134	30/35
Type-4	GSA-N18/132HG695W	2384	1303	30/33
Type-4	GSA-N18/132HG700W	2384	1303	30/33
Type-4	GSA-N18/132HG705W	2384	1303	30/33
Type-4	GSA-N18/132HG710W	2384	1303	30/33
Type-4	GSA-N18/132HG715W	2384	1303	30/33
Type-5	GSA-N16A/108HG450W	1800	1134	30
Type-5	GSA-N16A/108HG455W	1800	1134	30
Type-5	GSA-N16A/108HG460W	1800	1134	30

Note: A is the length of the long side of the module, B is the length of the short side, W is the width of themodule, xxx=output power. For details,please refer to Datasheet&Certificate

1.1 INSTALLATION SAFETY

GermanSolar Asia modules can be mounted horizontally or vertically. Horizontal mounting minimizes shading of the solar cells by dust. Please note that when the customer selects the horizontal mode, framed modules other than Type 5 are recommended to be mounted in the long side frame of the vertical racking and are not recommended to be mounted in the horizontal racking. Type 5 framed modules can be mounted either in the long side frame or in the short side frame. However, when the customer selects landscape mode, it is not recommended that the Type 5 Framed Module be mounted in a long side frame that is shared with the same horizontal bracket.

Always wear dry insulation protection equipment: insulated tools, headgear, insulated gloves, safety belt and safety shoes (with rubber soles).

Do NOT wear metallic jewelry which can cause electric shock during installation.

Do NOT install modules under rainy, snowy or windy conditions.

Please keep the connector dry and clean during installation to avoid the risk of electric shock. It is recommended to install it immediately after unpacking.

Due to the risk of electrical shock, do NOT perform any work if the terminals of PV module are wet. Please install immediately after you unpacking.

The application level of GermanSolar Asia module is Class A, which can be used in systems operating at greater than 50 V DC or 240 W, where general public contact access is anticipated.

Keep the PV module packed in the GermanSolar Asia carton until installation.

Please use an opaque material to completely cover the PV module surface during PV module installation and wiring.

Do NOT unplug the connector if the system circuit is connected to a load.

Do NOT stand on the module glass while installing. There is a risk of injury or electric shock if glass is broken.

Do NOT work alone (always work as a team of 2 or more people).

Do NOT damage the back sheet of PV modules when fastening the PV modules to a support with bolts.

Do NOT damage the surrounding PV modules or mounting structure when replacing a PV module.

Cables shall be located and secured so that they will not be exposed to direct sunlight after installation to prevent degradation of cables. Low drooping of cables from the terminal box must be avoided. Low hanging cables could cause various problems such as animal biting, electricity leakage in water, and fire.

Modules with different color codes are not recommended to be installed in one block or the same rooftop

1.2 INSTALLATION METHOD

1.2.1 MECHANICAL INSTALLATION AND WARN

The connection of the module to the racking system can be created through the mounting holes, with clamps, or an embedded system on the frame. The modules must be installed according to the following examples and recommendations. If a different installation method is desired, please contact GermanSolar customer service or technical support team for consultation. Improperly mounted modules maybe damaged. If alternative mounting method is used and not approved by GermanSolar, the modules will not continue to have a valid warranty.

The minimum distance between two modules is 10mm (0.4in).

Modules must not be subjected to wind or snow loads exceeding the maximum permissible loads, and must not be subjected to excessive forces due to the thermal expansion of the support structures.
The module frame drain holes cannot be blocked in any situation during installation or use.

*** Notes**

The design loading of modules have been evaluated by TUV according to IEC61215 with 1.5 times safety factor; The mechanical load bearing is dependent upon the mounting methods used and failure to follow the instructions of
this manual may result in different capabilities to withstand snow and wind loads; The system installer must ensure that the installation methods used meet these requirements and any local codes and regulations.

The modules depicted are mounted on continuous rails that extend beneath the modules. If modules are mounted without continuous rails below them, the maximum allowable loading will be reduced and is subject to review by GermanSolar.

A. Mounting with Bolts(4-ϕ9*14mm mounting holes)

Modules can be attached using the mounting holes on the back of the module frame, by fixing the module to the support rails with bolts. The mounting details are shown in the following figures.
The frame of each module has 4-ϕ9*14mm mounting holes, ideally placed to optimize the load handling capability, to secure the modules to the supporting structure. Installation holes of 4-9*14 mm are used for routine installation, as shown in Figure 1:

To maximize mounting longevity, GermanSolar strongly recommends the use of corrosion proof (stainless steel) attachment hardware.

Secure the module in each mounting location with an M8 bolt and a flat washer,spring washer and nut and tighten to a torque of 16~20 N.m(140-180lbf.in).

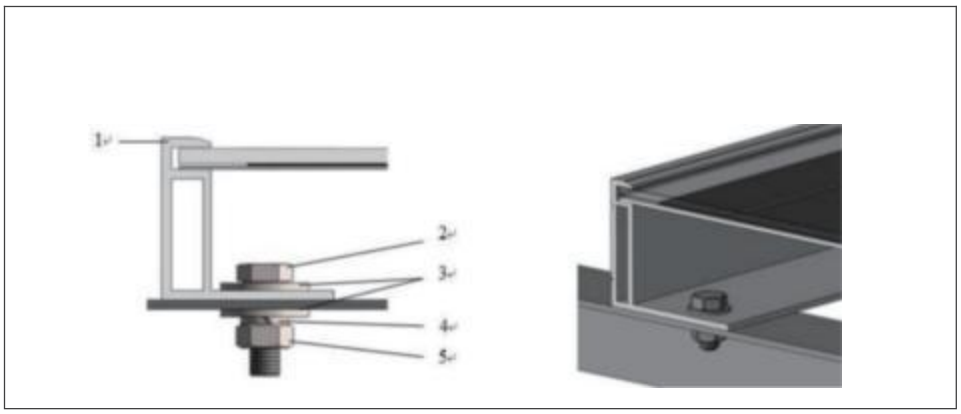
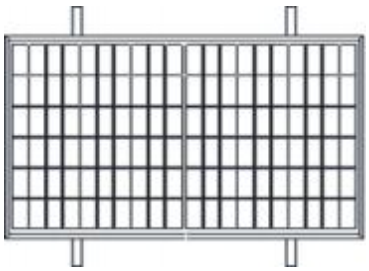


Fig.1 Backsheet-Glass/Dual-Glass module

1) Aluminum Frame
2) M8 Stainless Bolt
3) Flat Stainless Washer
4) Spring Stainless Washer
5) HEX Stainless Nut

Module	Minimum design load	Safety factor	Mounting Direction
Type3 Type5	+3600 Pa /-1600Pa	1.5	
Type1 Type2 Type4	+3600 Pa /-1600Pa	1.5	

B. Mounting with Single-axis Tracking System(4-ϕ7*10mm mounting holes).

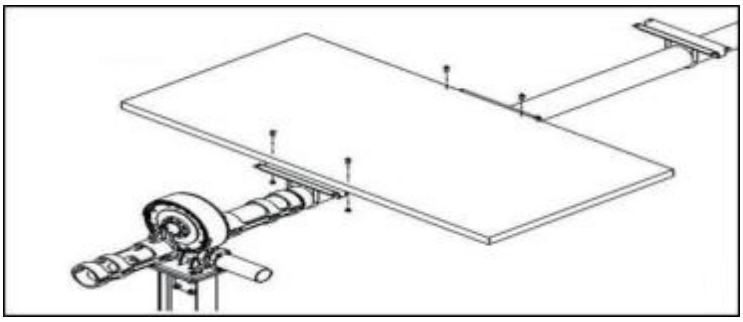
Modules can be attached using the mounting holes on the back of the module frame, by fixing the module to the support rails with bolts. The mounting details are shown in the following figures.

The frame of each module has 4-ϕ7*10mm mounting holes, ideally placed to optimize the load handling capability, to secure the modules to supporting structure. 4 installation holes of 7*10 mm are used for Single -axis tracking
system installation, as shown in Figure 2.

To maximize mounting longevity, GermanSolar Asia strongly recommends the use of corrosion proof (stainless steel) attachment hardware.

Secure the module in each mounting location with an M6 bolt and a flat washer, spring washer and nut and tighten to a torque of 16~20 N. m(140-180lbf.in.).

Flat stainless steel gaskets with a minimum thickness of 1.5mm and an external diameter of 16-20mm (0.63-0.79 inches) shall be used in all parts of the components connected to the Single-axis tracking system. Mechanical Load Pressure under this method: 30 lbs.ft2 max from the front side & 30 lbs.ft2 max from the rear according to UL1703



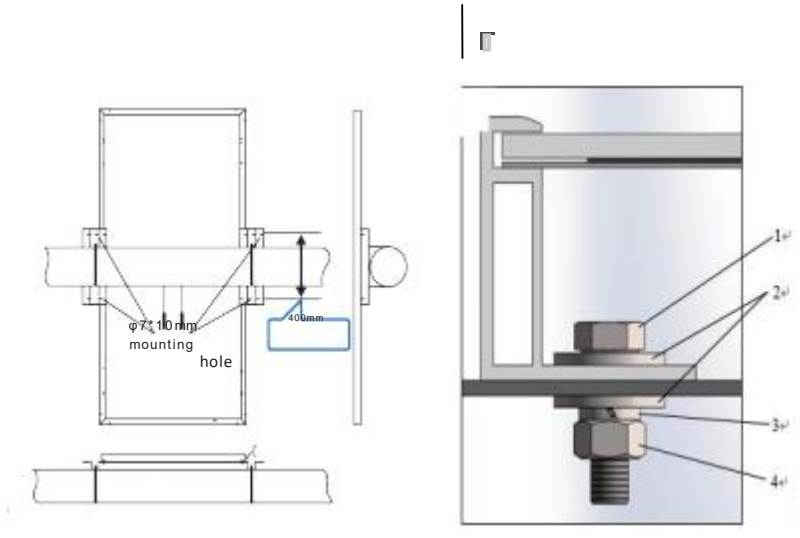


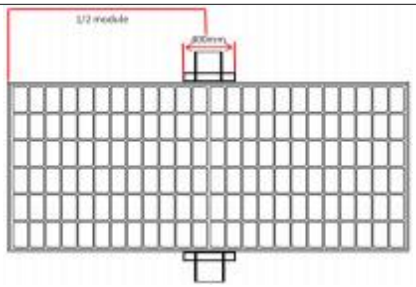
Fig 2. Backsheet-Glass/ Dual-Glass module with Single-axis Tracing System

1)M6 hex bolt M6

2)flat stainless washer

3)spring stainless washer

4)hex stainless nut

Module	Minimum design load	Safety factor	Mounting Direction
Type1 Type2 Type4	+1600 Pa /-1600 Pa	1.5	

C. Mounting with Clamps

GermanSolar Asia has tested its modules with a number of clamps from different manufacturers, mounting bolt of at least M8. The length of clamp ≥50mm (1.97in).

The clamp must overlap the module frame by at least 7mm (0.28in) but no more than 10mm (0.39in).

Use at minimum 4 clamps to attach modules to the mounting rails.

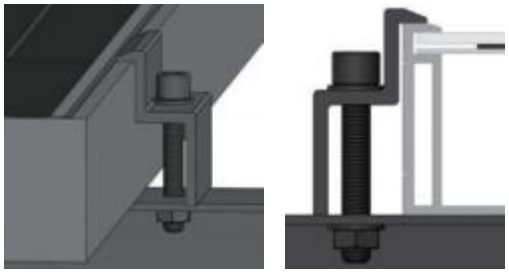
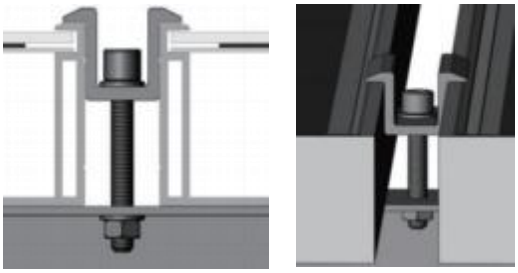
Modules clamps should not come into contact with the front glass and must not deform the frame.

Be sure to avoid shadowing effects from the module clamps.

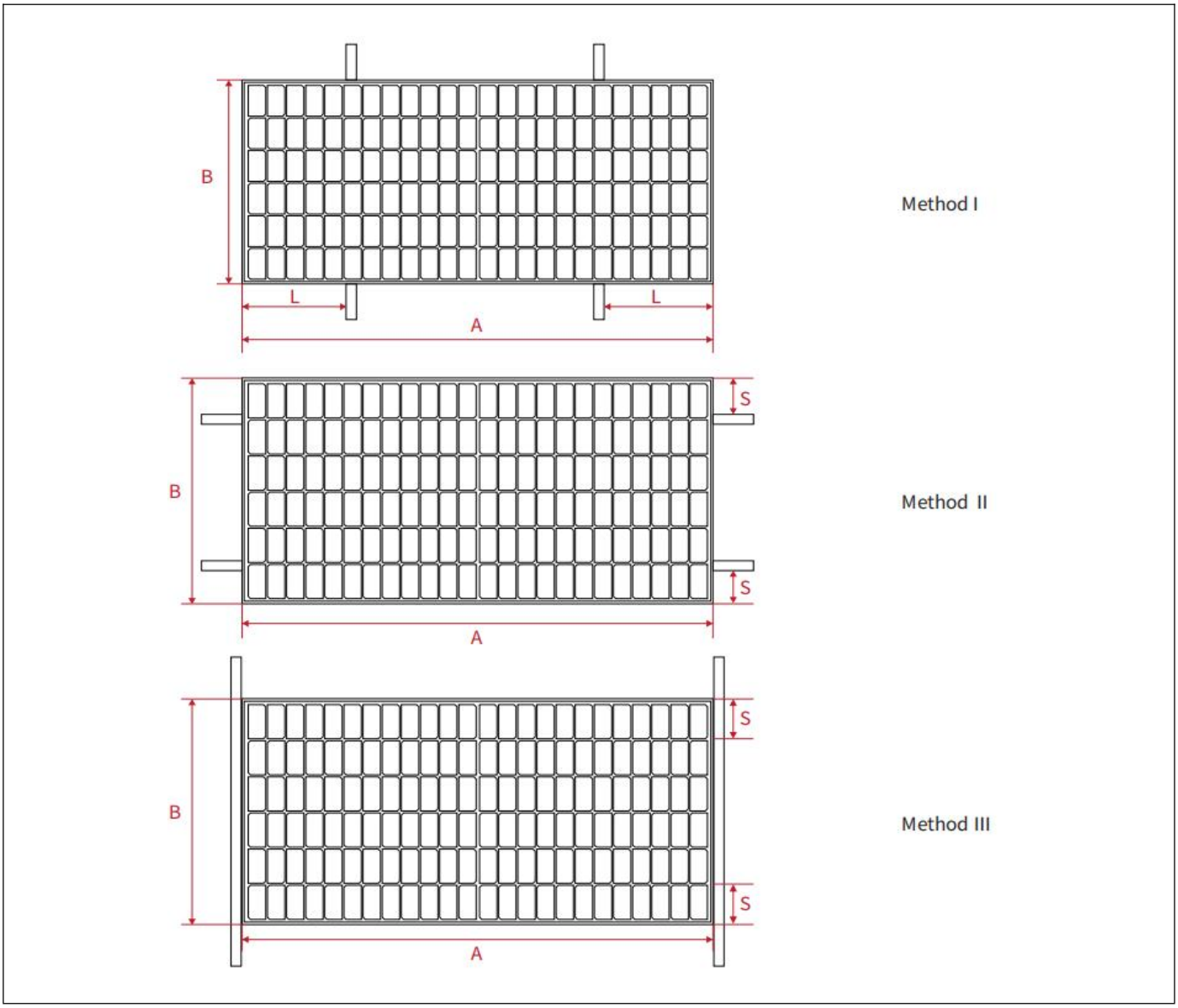
The module frame is not to be modified under any circumstances.

When choosing this type of clamp-mounting method, use at least four clamps on each module, two clamps should be attached on each long sides of the module (for portrait orientation) or each short sides of the module (for landscape
orientation). Depending on local wind and snow loads, additional clamps may be required to ensure that modules can bear the load.

Applied torque should refer to mechanical design standard according to the bolt customer is using,
ex: M8 16-20N.m(140-180lbf.in).

End Clamp installation	Middle Clamp installation
	

1.2.1.1 Different methods of clamp installation



Mechanical loads for different clamp installation			
Type	Module	Clamp installation on long side Minimum design load(+3600Pa/-1600Pa)L in Method I	Clamp installation on short side Minimum design load (±1600Pa) S in Method II, & III.
Type-1	GSA-N16/144HG580W	A/5~A/4 (A/4+50mm)	/
Type-1	GSA-N16/144HG585W	A/5~A/4 (A/4+50mm)	/
Type-1	GSA-N16/144HG590W	A/5~A/4 (A/4+50mm)	/
Type-1	GSA-N16/144HG595W	A/5~A/4 (A/4+50mm)	/
Type-2	GSA-N16/132HG530W	A/4+50mm	/
Type-2	GSA-N16/132HG535W	A/4+50mm	/
Type-2	GSA-N16/132HG540W	A/4+50mm	/
Type-2	GSA-N16/132HG545W	A/4+50mm	/
Type-3	GSA-N16/108HG430W	A/5+50mm	100~240mm
Type-3	GSA-N16/108HG435W	A/5+50mm	100~240mm
Type-3	GSA-N16/108HG440W	A/5+50mm	100~240mm
Type-3	GSA-N16/108HG445W	A/5+50mm	100~240mm
Type-4	GSA-N18/132HG695W	A/4+50mm	/
Type-4	GSA-N18/132HG700W	A/4+50mm	/
Type-4	GSA-N18/132HG705W	A/4+50mm	/
Type-4	GSA-N18/132HG710W	A/4+50mm	/
Type-4	GSA-N18/132HG715W	A/4+50mm	/
Type-5	GSA-N16A/108HG450W	A/5+50mm	100~240mm
Type-5	GSA-N16A/108HG455W	A/5+50mm	100~240mm
Type-5	GSA-N16A/108HG460W	A/5+50mm	100~240mm
Note: A is the length of the long side of the module, B is the length of the short side, xx=output power. for details,please refer to Datasheet&Certificate.			

1.2.2GROUNDING

All module frames and mounting racks must be properly grounded in accordance with appropriate respective National Electrical Code.

Proper grounding is achieved by bonding the module frame(s) and all metallic structural members together contin uously 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 ground ing conductor must then make a connection to earth using a suitable earth ground electrode.

GermanSolar modules can be installed with the use of third party listed grounding devices for grounding the metallic frames of PV modules.

The devices have to be installed in accordance with the grounding device manu facturer's specified instructions.

Please refer to the"Product Catalogue"link for detailed grounding hole locations and size at www.germansolarasia.com

GermanSolar recommends using the following methods to ground modules properly:

Method 1: Grounding bolt # 2058729-1:

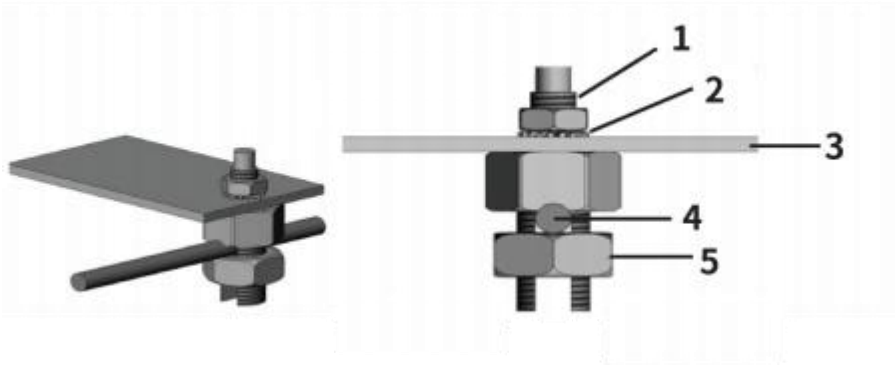


Figure 4. Grounding bolt # 2058729-1

1) Wire bolt and slot

2) Mounting wash hex nut

3) Aluminum frame

4) 4 to 16 mm² cable

5) Hex Nut

Grounding hardware comes in a package that includes the grounding bolt, mounting and grounding hex nut.

Electrical contact is made by penetrating the anodized coating of the aluminum frame, and tightening the mount ing hex nut (come with the star washer) to the proper torque of 5N.m(44 lbf.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 6N.m(53 lbf.in)

Method 2: Grounding bolt #1954381-2:

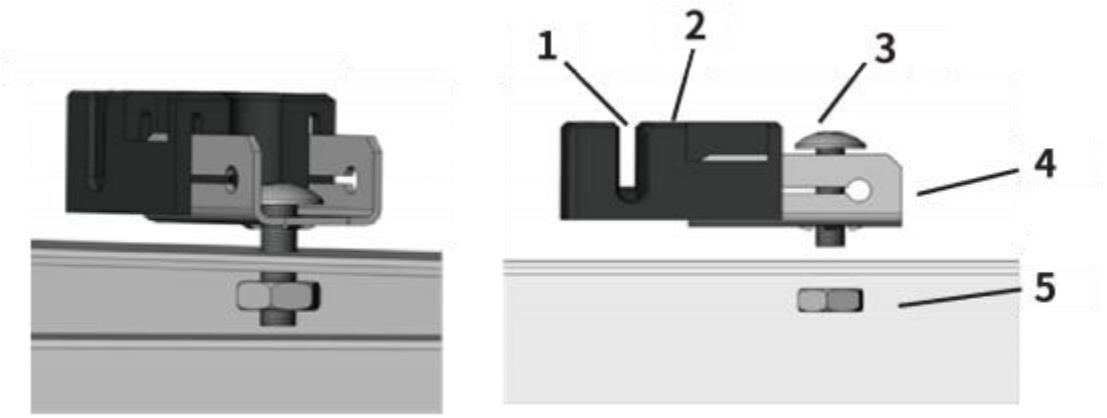


Figure 5. Grounding bolt # 1954381-2

1) Wire slot (available for 4 to 16 mm² cable)

2) Slider

3) Bolt

4) Base

5) Nut

Grounding hardware comes in a package that includes the grounding bolt, mounting and grounding 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 3N.m(27 lbf.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 6N.m(53 lbf.in).

The Tyco grounding bolt is only listed for use with 6 to 12 AWG bare solid copper wire.

Method 3: Grounding bolt # EL6CS14-6

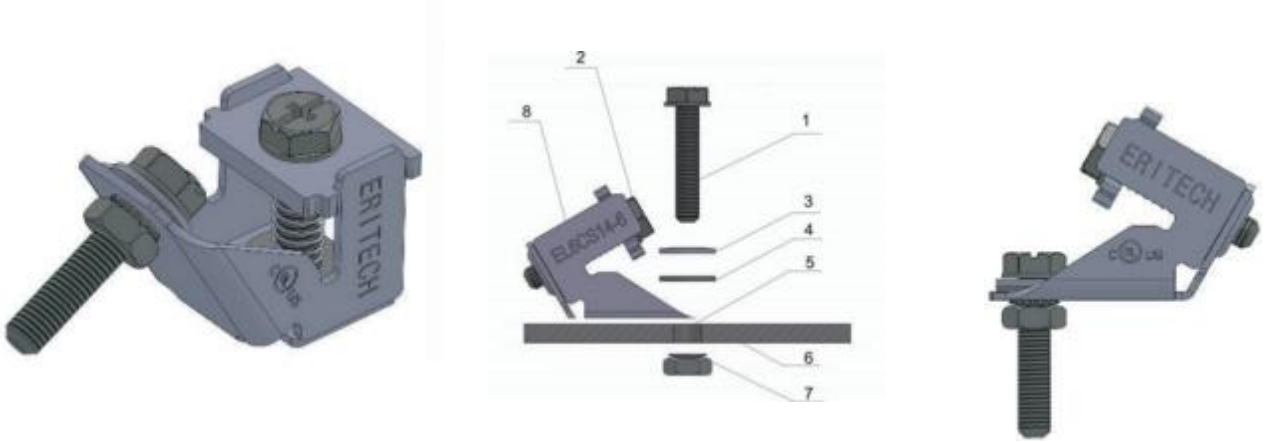


Figure 6. Grounding bolt # EL6CS14-6

1) Machine Bolt A
2) Machine Bolt B
3)Belleville washer
4) Flat Washer
5) Clearance hole for #10[M5] machine bolt
6) Aluminum frame
7) Machine box hex nut with lock washer
8) Grounding bolt

The lug should be installed on a surface that is larger than the bottom surface of the lug.
The lug should be installed in the grounding holes provided on the PV module.
Machine bolt A should be torqued to 5N.m(44 lbf.in), to secure the grounding bolt to module frame.
The grounding bolt is only listed for use with 6-12 AWG bare solid copper wire.
For proper wire binding, machine bolt B should be torqued to 5N.m(44 lbf.in).

1.2.2.1 SITE SELECTION AND ANGLE

INSTALLATION ENVIRONMENT SELECTION

The modules shall be installed in shadow-free areas throughout the year. Do not install the PV modules at a place where water damage may occur.When installing solar modules on the rooftop, a safe working area must be left between the
roof edge and the outer edge of the PV array.
When stacking module on the rooftop, the rooftop should be tested for such loading and the installation plan must be developed in accordance with the specification requirements.
When using the modules in areas with high wind load and snow load, the supporting structure design should be carried
out in strict accordance with the local design specifications, to ensure that the external load does not exceed the mechanical strength limit that the modules can withstand.

However, the modules shall not be immersed in water or in a permanently wet environment (e.g., fountains, spindrift, etc.). There is a risk of corrosion if the module is placed in a salt spray (i.e., a marine environment) or in an environment containing sulfur (e.g., volcanoes, etc.).

In the place, 50~500 m away from the sea, stainless steel or aluminum materials need to be used in where contacting PV modules, and the installation position must be processed with anti-corrosion treatment.

Corrosion Protection (Key Steps):

Salt Removal & Cleaning: Before installation, rinse all exposed surfaces—such as bolt holes and cut edges of rails—with fresh water or a 1–2 % citric-acid solution and allow to dry.

Coating System (proven on coastal sites 50–500 m from the shoreline):

1st coat: Epoxy zinc-rich primer, dry-film 40 µm

2nd coat: Fluorocarbon intermediate coat, dry-film 40 µm

3rd coat: Fluorocarbon topcoat or clear coat, dry-film 40 µm
Total dry-film thickness ≥ 120 µm. An additional stripe coat is required on edges and over bolt heads.

Galvanic Isolation:
Place 1.5–2 mm thick EPDM or silicone gaskets between stainless-steel bolts/fasteners and aluminum frames; add bimetallic Cu/Al washers if necessary to break the potential difference.

Joint Sealing:

Seal all exposed metal parts—bolt heads, grounding lugs, rail cut-outs—with ≥ 3 mm of modified fluorosilicone sealant (e.g., Dow Corning 795) to create a flexible “soft encapsulation” against salt-fog ingress.

Fit connectors with waterproof cold-shrink tubing or dust caps, and apply fire-resistant putty where cables enter cable trays.

Selection of Tilt Angle

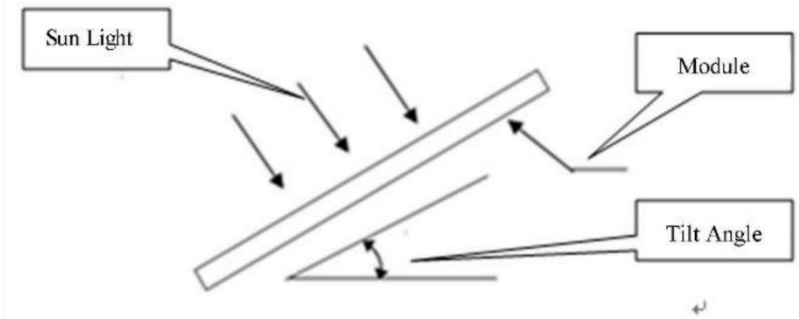


Figure 7 Schematic diagram of Module tilt angle

- Module tilt angle: the angle that the surface of the Module makes with the horizontal plane. When the Module is facing the sun, the Module will get the maximum power output. Modules installed in the northern hemisphere are recommended to be placed facing south; Modules installed in the southern hemisphere are recommended to be placed facing north.

- The same string of Module should be mounted at the same angle; Module mounted at different angles will receive different amounts of irradiation, which will result in lower operating efficiency of the system.

- GERMAN SOLAR ASIA recommends that the Module be installed at an angle not less than 10 degrees, so that when it rains, the dust on the surface of the Module is easily taken away by the rain, thus reducing the number of cleaning times of the Module; at the same time, it is conducive to the flow of water on the surface of the Module, so as to avoid the long-term large amount of water leaving marks on the glass, which will in turn affect the appearance and performance of the Module.

- For detailed installation angles, please refer to the local regulatory requirements or the advice given by experienced Module installers.

- Artificially concentrated sunlight producing current above values stated on label shall not be directed onto front and rear side of the module

1.2.2.2 INCLINATION SELECTION

Installation Environment

- GermanSolar Asia recommends that the module should be installed in a working environment with an ambient temperature of -20°C to 50°C, but not exceed the temperature limit of -40°C to 85°C.

- Generally, the Module should be installed in the location that receives the most light throughout the year, and the location where the Module is installed should have sufficient light. If the Module is blocked or partially blocked, its power output will be reduced. The Module may be damaged if it is blocked for a long time.

- The Module should be installed in a suitable place, e.g. ground, PV tracking system, roof (not used as BIPV, but only BAPV), etc.

- Module can be installed in freshwater environments for fishing and floating projects, as well as on land at a distance of 50–500 m from the coastline, but the connectors need to be protected or dust plugs need to be added when installing the Module in areas within this distance range. Connections must be made immediately after removing the dust plugs, and other anti-corrosion measures must be taken to prevent rusting of the relevant parts.

- Modules are strictly prohibited from being installed or used in environments where there are strongly corrosive substances (such as salt, salt spray, brine, active chemical vapours, acid rain, or any other substance that would corrode the Module and affect its safety or performance).

- Ensure that the wind or snow pressure to which the Module is subjected after installation does not exceed the maximum permissible load. The mechanical load that the Module can withstand is determined by the installation method, and the calculation of the mechanical load capacity during the design of the PV system requires a professional to be responsible for carrying out the design. If the installation site is likely to suffer from extreme

weather or long-term unexpected external stress, effective measures should be taken to ensure the safety of the Module.

- Altitude Consideration

  The maximum rated altitude for installation is 2000 meters above sea level. For installations above 2000 meters, please consult GermanSolar Asia for derating instructions regarding voltage and power output.

- High Temperature Environment

  If the module is to be installed in geographic areas where the 98th percentile operating temperature (T98) exceeds 70°C, adequate ventilation and installation conditions must be provided to ensure the operating temperature of the PV modules remains below 70°C. This may include but is not limited to:

  Increasing the mounting height to enhance airflow.

  Avoiding enclosed or poorly ventilated spaces.

  Using light-colored mounting structures to reduce heat absorption.

1.2.3 ELECTRICAL INSTALLATION

1.2.3.1 General Rules for Electrical Installation

- Fire Rating Limitation:

  These modules have a Fire Rating of Class C. When installed on rooftops, slopes, or other substructures, ensure that the mounting system and overall installation comply with local fire safety regulations and do not compromise the fire rating of the building.

- Grading Information:

  No separate grading labels are affixed to the PV modules. All performance grading information is provided on the product nameplate and datasheet.

- DC power generated by the PV 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 approved and duly authorized by the local public sector.

- There are certain tolerances between the nominal values of electrical performance parameters such as Pmax, Isc and Voc of modules and those under standard test conditions. Module standard test conditions (STC): an irradiance of 1000 W/m², a cell temperature of 25°C, and an air quality of AM1.5.

- Under normal conditions, modules may experience emitting more power than under standard conditions. When determining the accessories of the PV power generation system, such as the rated voltage, rated current, wire capacity, fuse specifications and other parameters related to the module power output, Isc marked on modules should be multiplied by 1.25.

- It is not allowed to use different models of modules in the same solar PV system. When 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). Please refer to the national, regional or local specifications for details.

- When connected in parallel, the output current of the whole string of modules is equal to the sum of the current of each branch module or module string (the parallel connection mode is shown in Figure 9). Each string of modules shall be equipped with a fuse. The reference formula for the maximum number of modules in parallel connection: maximum protective current / (1.25 × short-circuit current). Please refer to the national or regional or local specifications for details.

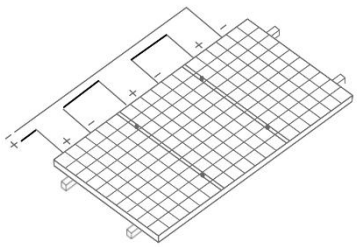


Figure 8 Connection in series

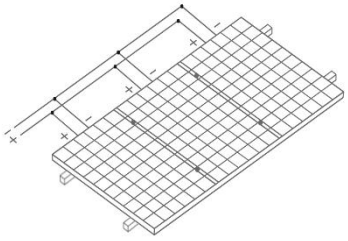


Figure 9 Connection in parallel

- The maximum number of single string modules that can be connected in series must be calculated according to relevant regulations. The open-circuit voltage under the local expected minimum temperature condition shall not exceed the maximum system voltage specified for the module and the value required by other DC electrical components. The maximum system voltage of German Solar Asia modules is DC 1500 V, and the actual system voltage is designed according to the selected module model, inverter and electrical system.
- The open-circuit voltage correction factor can be calculated according to the following formula:

  Cvoc = 1 – βvoc × (25 – T)

  T refers to the lowest ambient temperature expected at the location where the system is installed.

  βvoc refers to the temperature coefficient of the selected module Voc.
- The connectors given to customers or purchased by customers must be of the same brand, specification and model as the junction box connectors used for modules. Connectors of different brands/specifications are not allowed to plug into each other.
- Only professionals are allowed to open the locking nuts of the connector. Make sure that the connector is clean, dry and fully connected (you will hear a snap-in sound after full connection). Otherwise, arc sparks may be generated, thus damaging the connector or causing a fire.
- To prevent current from being generated during the disassembly of conductors, a kind of opaque material must be used to completely cover the module.
- Refer to local code requirements to determine the wire size, type and temperature of the system.
- Special PV conductors must be used to connect modules and equipment. The conductors shall be made of copper, and their cross-sectional area and capacity must meet the maximum short-circuit current of PV arrays. The recommended cable cross-sectional area of a single module is not less than 4 mm^2, and the rated current of the recommended connector is greater than 25 A. It is necessary to select appropriate conductor specifications according to the system to reduce voltage drop and ensure that the current-carrying capacity of conductors meets local laws, regulations and corresponding electrical standards. Otherwise, the cables and connectors will be

overheated in case of excessive current.

Note: The upper temperature limit of the cable is 85°C, and that of the connector is 105°C.

During the installation of modules, please confirm that electrical components such as connectors and inverters are turned off. In order to reduce The damage caused by lightning strikes, the loop area must be kept as small as possible when laying cables.

- In a system with two or more modules connected in series, if some modules are shaded from the sun while other modules face the sun, a very high reverse current will pass through the partially or completely covered battery, which can cause overheating of the battery and possibly damage the module. Modules are protected against such risks by bypass diodes. There are bypass diodes in the terminal box to reduce local shadowing effects. It is forbidden to disassemble the junction box and replace the diode without permission, even when the diode is damaged. Such work shall be carried out by professionals.

1.2.3.2 Module Arrangement and Wiring

The common arrangement of modules includes wiring in single vertical row, double vertical rows, single horizontal row, and double horizontal rows, as shown in Figure 10

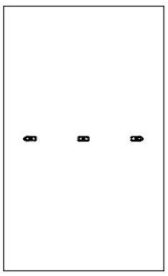
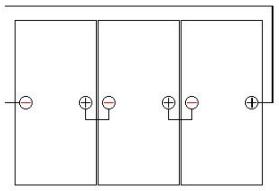
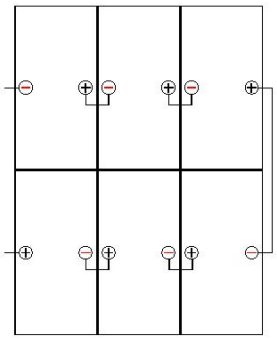
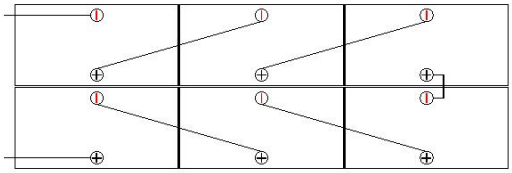
Junction box position style	Recommended wiring mode
	Vertical installation: standard cable length  
	Horizontal installation: Modules of GSA-N16/144HG series: The length of a single cable shall be ≥ 1.4 m Modules of GSA-N16/132HG series: The length of a single cable shall be ≥ 1.4 m Modules of GSA-N16/108HG series: The length of a single cable shall be ≥ 1.2 m Modules of GSA-N18/132HG series: The length of a single cable shall be ≥ 1.5 m Modules of GSA-N16A/108HG series: The length of a single cable shall be ≥ 1.2 m 

Figure 10 Common arrangement of modules

1.2.3.3 Cables and Connectors

In order to ensure the normal operation of the system, when connecting modules or connecting loads (such as inverters and batteries), observe to ensure that the polarity of cables is connected correctly. If the modules are not correctly connected, the bypass diode may be damaged.

- When the cable is fixed on the bracket, it is necessary to avoid mechanical damage to the cable or modules. Do not press the cable hard. The minimum bending radius of the module cable is 38.4 mm. Cable damage caused by excessive bending or improper cable management system will not be covered by the warranty.
- Before connection, please cut off the cable tie with diagonal pliers. Be careful not to scratch the cable and backboard. Before commissioning and operation of the power station, electrical inspection shall be carried out on modules and strings to confirm that the polarity of the string is correct and its open-circuit voltage meets the requirements of acceptance specifications.

- Please keep the connector dry and clean, and make sure that the nut of the connector is tightened before connection. Do not connect the connector when it is wet, dirty or in other conditions.
- Protect the connector from direct sunlight and rain, and keep it away from accumulated water. Avoid dropping connectors on the ground or roof.
- It is forbidden to contact the connector with organic solvents and other corrosive materials such as alcohol, gasoline, pesticides, herbicides, etc.in the connection and use environment, so as to avoid cracking of the module connector.

1.2.3.4 FUSING

When fuses are fitted they should be rated for the maximum DC voltage and connected in each, non- grounded pole of the array (i.e. if the system is not grounded then fuses should be connected in both the positive and negative poles).

The maximum rating of a fuse connected in series with an array string is typically 20A but the actual module specific rating can be found on the product label and in the product datasheet.

This fuse rating value also corresponds to the maximum reverse current that a module can withstand (when one string is shaded then the other parallel strings of modules will be loaded by the shaded string and current will flow) and therefore impacts the number of strings in parallel.

Do NOT share a fuse in a Combiner Box with two or more strings in parallel connection.

2.INVERTER SELECTION AND COMPATIBILITY

When installed in systems governed by IEC regulations, GermanSolar modules normally do not need to be electroni cally connected to earth and therefore can be operated together with either galvanically isolated (with transformer) or
transformerless inverters.

Choose inverters with isolation transformers in hot and wet areas (such as shores, wetlands), to ensure proper module function under positive voltage.

3. MAINTENANCE FOR PV MODULE

3.1 MODULE VISUAL INSPECTION AND REPLACEMENT

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. In the case of a damaged module, replace it with the same type of module.

It is recommended to perform a preventive inspection every six months without changing the components of the module. If electrical or mechanical appliances are used for inspection or maintenance, they should be operated by qualified professionals to avoid any electric shock or loss of life

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.

Cover the front surface of modules by an opaque material when repairing. Modules when exposed to sunlight gener- ate high voltage and are dangerous.

GermanSolar PV modules are equipped with bypass diodes in the junction box. This minimizes module heating and current losses.

Do NOT open the junction box to change the diodes even if they malfunction.
In a system using a cell, blocking diodes are typically placed between the cell and the PV module output to prevent cell discharge at night.

In the event that a module is damaged (broken glass or a scratch on back sheet) and needs to be replaced.

Observe the safety precautions listed earlier in this Manual.
Wear cut resistant gloves and other personal protective equipment required for the particular installation.

Isolate the impacted array string to prevent current flow before attempting to remove the module.

Disconnect the connectors of the affected module using the related disconnect tool provided by suppliers.

Replace the damaged module with a new functional module of the same type.

Check the open circuit voltage of the array string and verify that this is within 10V of the other strings to be connected in parallel.

3.2 CONNECTOR AND CABLE INSPECTION

Inspect all cables to verify that connections are tight; the cables are protected from direct sunlight and sited away from areas of water collection.

It is recommended to check the torque of terminal bolts and the general condition of wiring at least once a year. Also, check that mounting hardware is properly torqued. Loose connections will result in damage to the array.

3.3 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 all PV modules clean.

Clean PV modules when the irradiance is below 200W/m2; liquid with a large temperature difference from the modules must not be used for cleaning the modules.
It is forbidden to clean PV modules under the weather conditions of wind more than 4 grades, heavy rain or heavy snow.

When cleaning with pressurized water, the water pressure on the glass surface of the module must not exceed 700 KPa (14619.80psf); the module must Not bear the extra force.

When cleaning PV modules, do NOT step on the modules; do NOT spay water on the backside of the module or the cables; keep the connectors clean and dry; prevent fire and electrical shock from occurring; do NOT use steam cleaner.

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.

Periodically trim any vegetation which may shade the solar array thus impacting performance.

If there is greasy dirt or other substances which are difficult to clean, conventional household glass cleaning agents can be used. Pay attention not to use alkaline and strong acidic solvents, including hydrofluoric acid, alkali, acetone.

3.3.1 MODULE INSPECTION AFTER CLEANING

Ensure that the module under visual inspection is clean, bright and free of stains.

Spot check to verify whether there is soot deposit on the module surface.

Check to see there are no visible scratches on the surface of the module.

Check to see there are no man-made cracks are on the module surface.

Check to see whether the module support structure is leaning or bent after cleaning.

Check to see whether the wiring terminals of the module are detached.

After cleaning PV modules, fill out the PV module cleaning record.

3.3.2 TROUBLESHOOTING

If your installation does not work properly, please inform your installer immediately. It is recommended to perform a preventive inspection every six months without changing the components of the modules. If electrical or mechanical appliances are used for inspection or maintenance, they should be operated by qualified professionals to avoid any electric shock or loss of life.

3.4 **MODULE SAFETY**

General Rules

GERMAN SOLAR ASIA Modules are designed in accordance with the International Electrotechnical Commission (IEC) standards IEC 61215 and IEC 61730, with an application class of Class A. The Modules can be used in systems with a DC voltage greater than 50 V or a power output exceeding 240 W, which may be exposed to the public. The safety class of the Modules is Class II, and the fire rating is Class C.

No matter whether the Modules are connected to the system or not, appropriate protective measures should be used when touching the Module, such as: insulated tools, safety helmets, insulated gloves, safety belts and safety insulated shoes. When performing operations like installation, grounding, wiring, cleaning, etc., it is essential to use proper electrical safety protective tools. Avoid direct contact with the Module, which may cause electric shock or cuts.

For your safety, it is strictly prohibited to install or handle the Module in hazardous environments, including but not limited to strong winds or gusts, wet or sandy roofs.

Do not attempt to disassemble the Module or remove the Module nameplate or parts on the Module. Do not paint or apply any other adhesive to the surface of the Module. Avoid damaging the Module backsheet and do not scratch or scuff the Module backsheet.

In addition to grounding connections, drilling holes in the Module frame is prohibited, as this may reduce the frame loading capacity and lead to frame corrosion.

Do not scratch the anodic oxide layer on the surface of the aluminium alloy frame. Scratches may cause the frame to corrode, affecting the load capacity of the frame.

It is prohibited to repair Modules with damaged glass or backsheets by yourself, and scrap Modules shall be recycled and disposed of by qualified organizations.

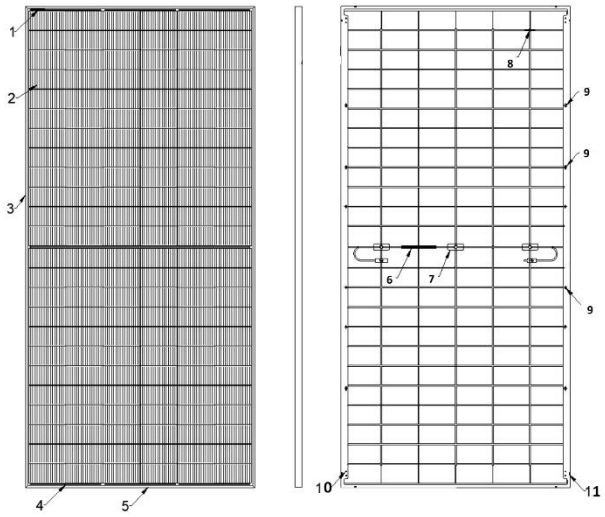
3.5 MODULE INFORMATION

There are 2 types of labels affixed to each Module, providing information as follows:

Nameplate: Module type, maximum power, open circuit voltage, short circuit current, maximum power point voltage, maximum power point current under standard test conditions, maximum system voltage, certification mark and other information.

1	**Module Barcod**	**2**	**Interconnection Bar**	**3**	**Long Frame**	**4**	**Bus bar**
5	**Short Frame**	**6**	**Nameplate**	**7**	**Junction Box**	**8**	**Module Barcod**
9	**Mounting Hole**	**10**	**Grounding hole**	**11**	**Drain Hole**		

Serial Number: Each Module has a unique serial number. This serial number is printed on the barcode, which is put into the Module before lamination and cannot be torn or smeared after lamination. In addition, an identical serial number can be found above or next to the Module nameplate.



Structure diagram and parts description of Double Glass Modul(

The left side is the front of the panel, and the right side is the back.

For Bifacial Modules Only

Front and Rear Side Identification

The front side of the bifacial module is designed for prolonged exposure to direct sunlight. The rear side is not designed for prolonged direct sunlight exposure. The nameplate is placed on the rear side of the module.

4. REPORTING TECHNICAL ISSUES or CLAIMS

Contact your installer.

Contact GermanSolar after sales service team at www.germansolarasia.com

Submit the Customer Feedback form at: www.germansolarasia.com and one of our technical service representatives will contact you within 5 business days.

For module specifications or datasheets, please download from: www.germansolarasia.com

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