

580W

Monocrystalline Solar Panels

GK-1-72HTBD-580M

Features

- Conversion efficiency up to 23.2%
- Strong anti-degradation: only 1% power loss in the first year, just 0.4% per year after
- High energy output in real conditions: better temp coefficient, low-light performance, and bifacial efficiency



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01 Introduction

This installation guide contains important electrical and mechanical installation information as well as essential safety information that you must be familiar with. It provides critical safety instructions for the installation, use, and maintenance of solar modules. Users, installers, and O&M personnel must carefully read it and strictly comply with its contents. Failure to follow these safety guidelines may result in personal injury or property damage.

Installation and operation of solar modules requires professional skills and may only be carried out by qualified personnel with relevant certifications. Please read the safety and installation instructions before using, installing, or maintaining these modules. Keep this manual in a safe place for future reference during maintenance and servicing. Installers must also ensure that the above matters are clearly communicated to end-users (or consumers).

This manual does not constitute any warranty, whether express or implied. Felicitysolar assumes no responsibility for any product defects or damage, personal injury, or property loss caused by any operation while handling the modules (including but not limited to unpacking, loading/unloading, transportation, storage, installation, connection, disassembly, and O&M). Failure by the customer to follow this manual during installation may result in the invalidation of the product's limited warranty. Felicitysolar assumes no responsibility for any infringement of patent rights or third-party rights caused by the use of these modules. The recommendations in this manual have been tested and verified in practice. They are intended to improve safety and stability during module installation and operation.

02 Regulations and Standards

Mechanical and electrical installation of PV modules must comply with applicable regulations, including electrical codes, building codes, and power connection requirements. These regulations may vary depending on the installation location, as well as the system voltage and current type (DC or AC). For specific provisions, please consult the local authorities.

03 Safety Guidelines

3.1 General Safety



Before installing, wiring, operating, or maintaining the modules, read and understand all the safety rules. When the module is exposed to sunlight or other light sources, it generates direct current (DC). Whether the module is connected or not, direct contact with live parts such as terminals may result in serious injury or death.

Felicitysolar modules comply with the IEC 61215 and IEC 61730 standards, meet the requirements of Safety Class II, and are rated as Application Class A: may be used in systems accessible to the public with voltages greater than 50 V or power greater than 240 W.

For your safety, do not perform installation or maintenance work without proper protective measures, including but not limited to fall protection, ladders or stairs, and personal protective equipment.

For your safety, do not install or handle the modules in severe or hazardous environmental conditions, including but not limited to strong winds, rain, snow, or sandstorms.

Ensure the integrity of the modules during installation or handling. Do not use or install damaged modules, including but not limited to broken (front or back) glass, cracked backsheet, non-sealed junction box cover,

damaged cables or connectors, or exposed metal.

All installation work must fully comply with local regulations as well as applicable national or international electrical standards.

3.2 Electrical Safety



Solar modules generate direct current and voltage when exposed to light. To avoid direct contact with 30 V DC or higher, whether or not the module is connected to the system, appropriate protective measures must be taken when touching it or entering the power plant, such as insulated tools, safety helmets, insulated gloves, safety belts, and insulated shoes. Direct current at 30 V or above may be fatal.

Modules have no switch. They only stop producing electricity when the light source is removed (for example, by covering them with cloth, cardboard, or completely opaque material).

In some cases, the open-circuit voltage or short-circuit current it generates may exceed the values measured under standard test conditions (STC: irradiance 1000 W/m², module temperature 25°C, air mass 1.5). Therefore, the electrical design and system calculations must be determined by a qualified electrical engineer. A reasonable safety factor should be applied when calculating the module's rated voltage, rated current, fuse rating, and specifications of devices connected to the PV output.

Use dry tools to install or maintain modules under dry conditions. Do not touch them when they are wet unless wearing appropriate anti-shock protective equipment. Follow the cleaning requirements provided in this manual.

To avoid arcing and electric shocks, do not disconnect the module from any electrical device while in operation. Incorrect connections may also cause arcing and shocks. Connectors must be kept dry and clean, and in good working condition. Do not insert other metal objects into the connectors, or use any other method to make electrical connections.

When a system ground fault alarm occurs, wear protective equipment and disconnect the system and the faulty module under safe conditions. To avoid potential electric shock risks, do not touch other parts of the module.

Only use compatible connectors to connect modules to each other or to other equipment. Removing the connectors will void the product warranty.

3.3 Operational Safety



In order to ensure the safety of the modules during transportation and storage, do not open the packaging until arrival at the installation site.

When stacking module pallets, strictly follow the maximum stacking limit indicated on the carton. Generally, cartons placed upright on the short side cannot be stacked more than two layers, while cartons placed upright on the long side may be stacked.

During storage, keep the packaging intact and store the modules in a dry and ventilated environment to avoid direct sunlight and humidity. Storage in an uncontrolled environment must not exceed three months, and additional measures should be taken to prevent exposure to moisture or sunlight.

If the modules will not be installed shortly after unpacking, place the remaining modules horizontally on a pallet with the frames aligned, and do not stack more than 12 pieces. This temporary storage method does not allow secondary transportation. For secondary transportation, re-stack loose modules of the same type according

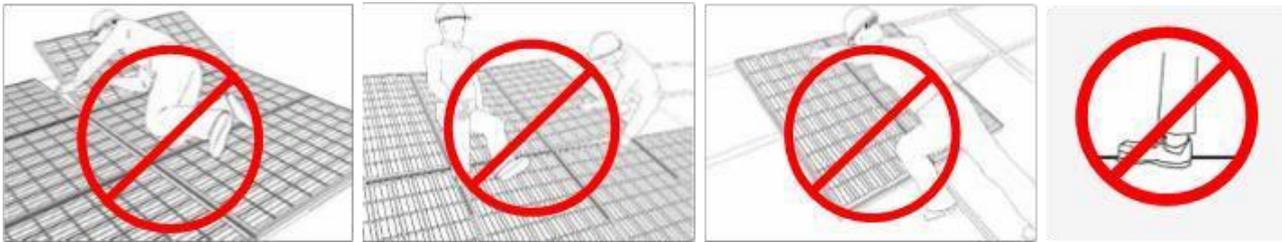
to the original packaging quantity and arrangement, secure them with packing straps (recommended tension 2100 N), and finally apply moisture-proofing and dust-proofing measures before transportation.

Follow Felicitysolar 's official unpacking instructions when opening the module packaging.

Do not wear metal rings, watches, earrings, nose rings, lip rings, or other metal objects when installing or repairing the PV system.

 Under no circumstances should the modules be carried by pulling on the cables or junction boxes. Modules must be carried by holding the frame. During handling and installation, do not subject the modules to deformation or bending caused by external forces other than their own weight.

Do not stand, sit, lie, step, walk, or jump on the modules.



Do not apply excessive loads or torsion to the modules.

Do not disassemble or remove any part of the module, including but not limited to the nameplate, labels, junction box, connectors, or frame.

Do not paint or apply any other adhesives on the surface of the module.

Do not drill holes in the frame, as this will reduce the load resistance of the module and void the limited warranty.

Damages or scratching on the front or back of the module affect its safety. Do not use if the front or back is found to be damaged.

Do not drop or place heavy objects, tools, or sharp items on the module.

Do not pull, scratch, or excessively bend the cables, as this may damage the insulation and cause electrical leakage or shock. (The minimum allowable bending radius is 43 mm.)

Do not insert any conductive material into the module connectors.

Do not use mirrors or other magnifying devices to artificially concentrate sunlight on the module.

Do not carry or secure the module by supporting its front or back, for example, by holding it overhead or against your back.

Do not attempt to repair the module yourself.

Do not use damaged modules.

Do not allow the module or junction box connectors to come into contact with unauthorized chemicals, including but not limited to gasoline, white oil, medicated oils, mold thermal oil, machine oils (such as KV46), lubricating grease (such as Molykote EM series), lubricating oil, rust prevention oil, stamping oil, butter, diesel, edible oil, acetone, alcohol, essential balms, liniment, thinner, release agents (such as Pelicoat S-6), oxime-generating adhesives and potting compounds (such as KE200, CX-200, Chemlok), TBP (plasticizer), cleaning agents, herbicides, paint removers, adhesives, rust inhibitors, descalers, emulsifiers, cutting oils, or cosmetics. For more information, contact Felicitysolar technical support.

3.4 Fire Safety



Before installing the modules, consult local laws and regulations and comply with the guidance and requirements regarding fire safety for installation and construction. The modules have passed the IEC 61730 standard fire rating test.

When installed on rooftops, a layer of fireproof material with the required rating must cover the roof, and sufficient ventilation must be ensured between the back of the module and the mounting surface. The minimum distance between the module and the roof surface is 10 cm.

The fire safety performance of a building is affected by its roof structures and their installation. Improper installation may result in fire hazards.

The fire rating of the modules is valid only when they are installed according to the instructions. Consult the relevant local authorities and mounting system suppliers for fire safety requirements and guidance regarding buildings, structures, and mounting systems.

Use appropriate module accessories such as fuses, circuit breakers, and grounding connectors in accordance with local regulatory requirements.

Do not install or use the modules near open flames or flammable or explosive materials.

Do not use water to extinguish fires when the power supply has not been disconnected.

3.5 Chemical Safety

In some installation scenarios near salt water, components of anti-corrosion products may have certain properties that pose safety risks to installation personnel. Felicitysolar strongly urges anyone involved with or exposed to anti-corrosion solutions to obtain the Material Safety Data Sheet (MSDS) for the selected anti-corrosion application.

Whether fluorocarbon solutions or butyl tape products are chosen, carefully read and strictly follow this user manual. Special protective equipment may be required before or during operation. Refer to the product's Material Safety Data Sheet.

04 Installation Conditions

4.1 Installation Location and Working Environment

These modules are not suitable for space environments.

Never use mirrors or magnifying lenses to artificially concentrate sunlight on the modules.

These modules must be installed on suitable buildings or other appropriate sites (such as the ground, carports, building facades, rooftops, or PV tracking systems). They may not be installed on any type of mobile vehicle.

Do not install these modules in locations where they may be submerged in water.

Felicitysolar recommends installing these modules in environments where the monthly average operating ambient temperature is between -40°C and $+40^{\circ}\text{C}$. The extreme operating temperature range of the modules is -40°C to 85°C .

Ensure that wind or snow pressure applied to the modules after installation do not exceed the maximum permissible load.

Modules must be installed in locations free of shadows throughout the year. Ensure that there

are no obstacles at the installation site that may block sunlight. If the modules are installed in areas with frequent lightning activity, lightning protection must be applied.

Do not install or use the modules near flames or combustible materials.

Never install or use the modules in environments with excessive hail, snow, sand, smoke, dust, air pollution, or coal soot. Never install or use the modules in environments with strong corrosive substances (such as salt, salt mist, saltwater, aggressive chemical vapors, acid rain, or other substances that may corrode the modules or affect their safety or performance).

In harsh environments such as heavy snow, extreme cold, strong winds, near water, areas exposed to sea salt mist (islands), or deserts, appropriate protective measures must be adopted to ensure reliable and safe installation.

Corrosion may occur at the connection points between the module frame and the mounting structure, or at the grounding connection points. Felicitysolar solar modules can be installed at locations at least 50 m away from the nearest saltwater, but the relevant components must receive proper anti-corrosion treatment.

4.2 Tilt Angle and Orientation

The tilt angle of a module refers to the angle between its surface and the ground. The power output is maximized when the module faces the sun directly.



Module

In the Northern Hemisphere, the optimal installation direction is facing south. In the Southern Hemisphere, the optimal direction is facing north.

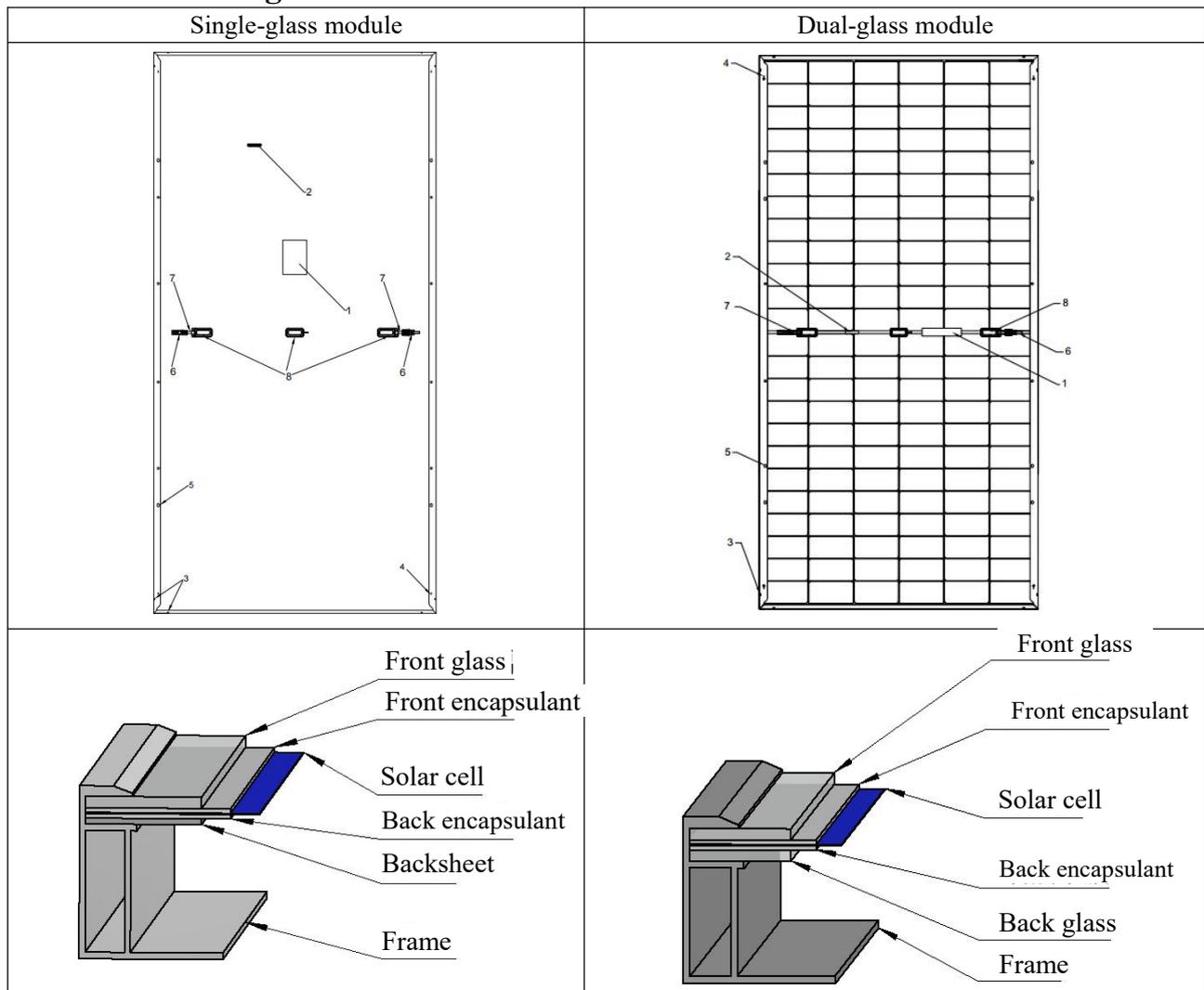
For detailed installation angles, follow the standard PV module installation guidelines or the recommendations provided by experienced installers.

Felicitysolar recommends installing modules at higher tilt angles so that dust on the surface can be more easily washed away by the rain, thereby reducing the need for frequent cleaning. For modules installed at smaller angles, cleaning should be done more frequently according to the actual conditions to avoid long-term dust accumulation, which could affect both the appearance and performance.

PV modules connected in series must be installed at the same orientation and tilt angle. If the orientations or tilt angles differ, the amount of solar radiation received by each module will vary, leading to output power losses. To achieve the maximum year-round energy yield, the optimal orientation and tilt angle for the installation site should be selected to ensure that the modules still receive sunlight even on the shortest day of the year.

For stand-alone PV systems, the installation angle should be adjusted according to seasonal sunlight conditions to maximize power output. Generally, if the chosen angle allows sufficient output even under the lowest irradiance conditions, it will satisfy the energy demand throughout the year. For grid-connected systems, the installation angle should be chosen to maximize year-round energy output.

05 Module Diagram for Product Identification



1 – Module nameplate	2 – Module barcode
3 – Drainage hole	4 – Grounding hole
5 – Mounting hole	6 – Connector
7 – Cable	8 – Junction box

Each module has three labels providing the following information.

1. Nameplate: product type, rated power, rated current, rated voltage, open-circuit voltage, short-circuit current under standard test conditions, certification marks, maximum system voltage, and other information.

2. Current grading label: modules are classified according to rated current, which is marked on the module for differentiation.

3. SN: Each module has a unique serial number. This serial number is printed on the barcode and placed inside the module before lamination, and cannot be removed or altered after lamination. In addition, an identical number can be found on or next to the module nameplate.

Note: Do not remove any labels. Removing any label will void the Felicitysolar warranty.

06 Mechanical Installation

Installation safety instructions: During installation, it is recommended that two people handle the PV modules.

The modules can be installed using the following methods: mounting structure – bolt installation, or mounting structure – clamp installation.

Note:

The load values listed in this manual are all test loads. Installation methods are for reference only, and the results of third-party tests and internal Felicitysolar tests shall prevail.

1. Felicitysolar does not provide installation accessories. The PV system design, installation, mechanical load calculation, and system safety are the responsibility of system installers or trained professionals.
2. Before installation, pay attention to the following:
 - a) Any external damage. If there is any dirt or residue, clean the module.
 - b) Whether the serial number of the module is correct.
3. The maximum load that the fronts and backs of different module types can withstand depends on the installation method. Refer to Tables 2, 3, and 5. If the installation site is in an environment with heavy snow or strong wind, special protective measures must be taken during installation accordingly.

Note: Design load = Test load ÷ 1.5 (safety factor)

4. Modules must be installed on the mounting structure according to the following methods. If any other installation method is required, consult Felicitysolar for approval. Otherwise, the warranty will be void.
5. Under the fixed mounting structure installation methods specified in this manual, modules may show varying degrees of sag due to gravity. This is normal and does not affect their normal use. Any additional external forces will cause extra sag. Therefore, all operations on the modules must comply with this manual.
6. Minimum installation distance: the installed spacing between each module must not be less than 1 cm.

6.1 Mounting Structure – Bolt Installation

Use anti-corrosion bolts, spring washers, and flat washers to secure the modules to the mounting rails. Sufficient torque must be applied to ensure that the modules are securely fixed.

The reference torque for M8 bolts is 16–20 N·m, and for M6 bolts is 9–12 N·m. If a special mounting system or installation method is required, confirm the torque values again with the mounting system supplier. Figure 1 illustrates the installation.

Figure 2 shows the product models and installation positions for modules using bolt installation (inner 4 holes) . Figure 3 shows the product models and installation positions for modules using the bolt installation method (outer 4 holes). Table 1 lists the recommended bolt sizes corresponding to different installation hole sizes.

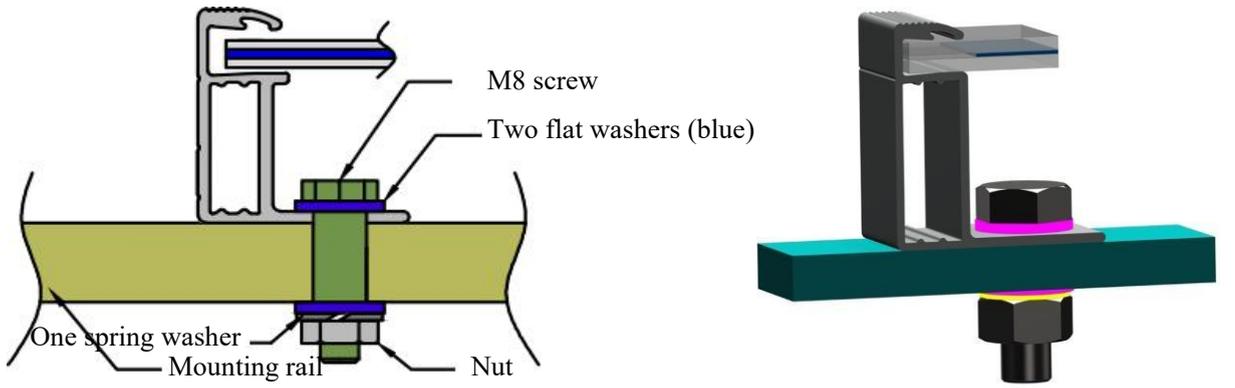


Figure 1 Bolt installation diagram

Mounting hole (mm)	Recommended bolt size
14 x 9	M8
10 x 7	M6

Table 1 Bolt sizes corresponding to different installation holes

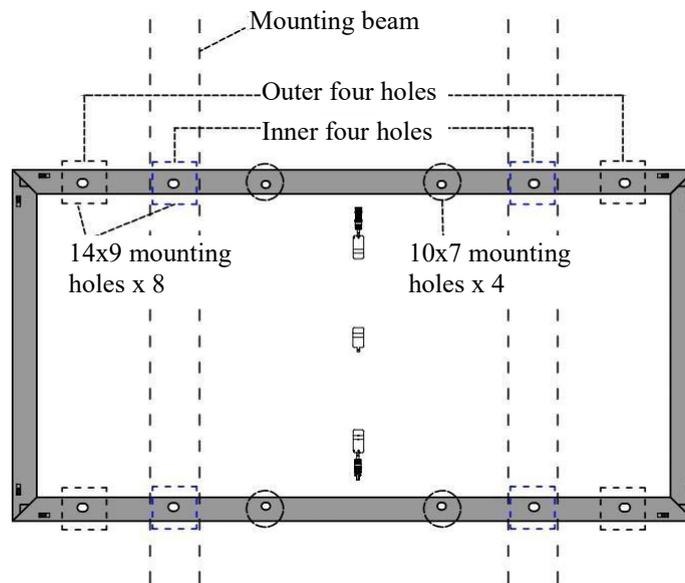


Figure 2 Bolt installation method (inner 4 holes)

Module Model	Bolt Inner 4-Hole Installation (Test Load Pa)
GK-1-72HTBD	+5400/-2400

Table 2 Test loads for different module models with inner 4-hole installation

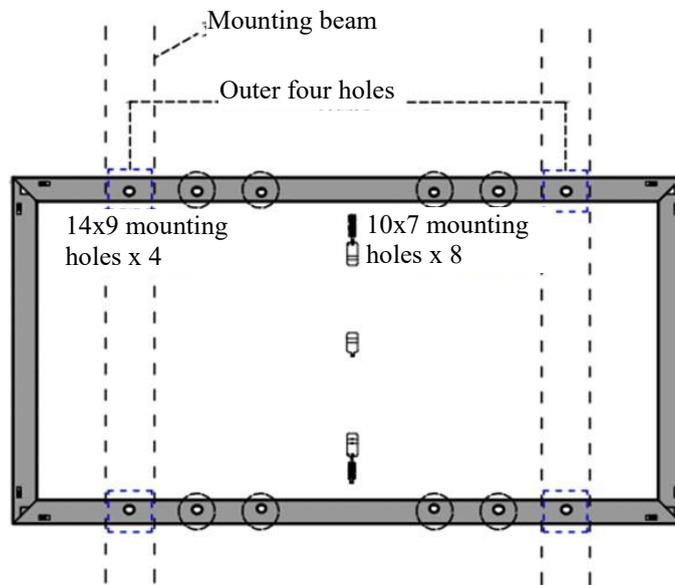


Figure 3 Bolt installation method (outer 4 holes)

Module Model	Outer 4-Hole Bolt Installation (test load Pa)
GK-1-72HTBD	+5400/-2400

Table 3 Test loads for different module models with outer 4-hole installation

6.2 Mounting Structure – Clamp Installation

The clamps must not come into contact with the front glass of the module, or deform the module frame. Ensure that the clamps do not cause shading on the module. Under no circumstances should the frame be modified. When selecting the clamp installation method, ensure that at least four clamps are used on each module. The maximum load capacity of the module depends on the clamp installation position. Figures 5–9 show different installation methods and clamp positions under different installation conditions. If excessive combined loads are possible based on local wind and snow loads, additional clamps are required to ensure that the modules have sufficient load-bearing capacity. The torque applied when installing clamps must be sufficient to secure the modules firmly (for specific values, consult the installer or mounting system supplier). The clamp length and width are represented in Figure 5 by a and b . The minimum length of a is 50 mm, the minimum contact width d between the clamp and the frame is 10 mm, and the minimum wall thickness of the clamp is 3 mm. The distance between the clamp installation position on the long side and the edge is represented by L in Figures 5 and 9. The distance between the clamp installation position on the short side and the edge is represented by S in Figures 6–9.

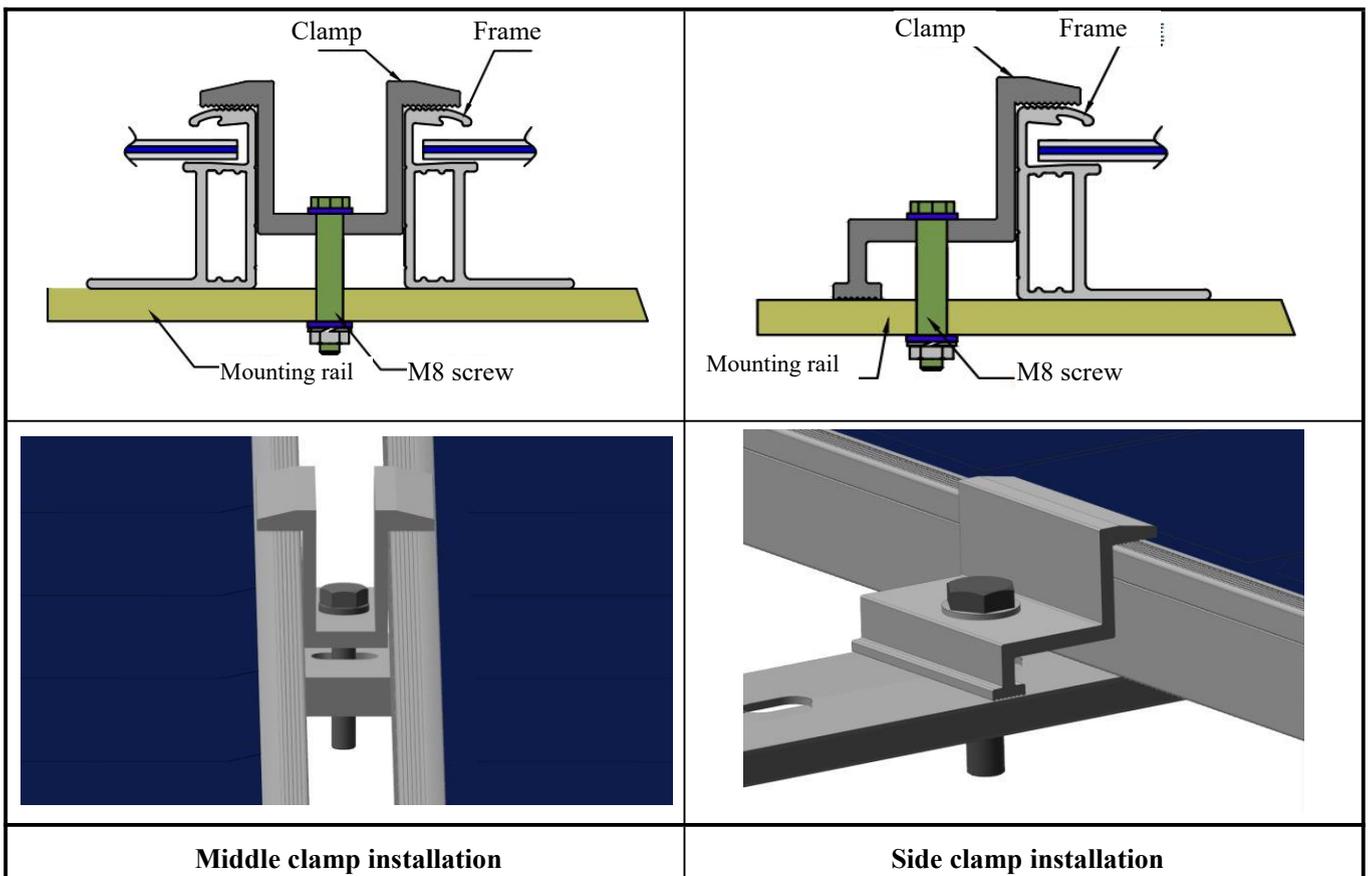
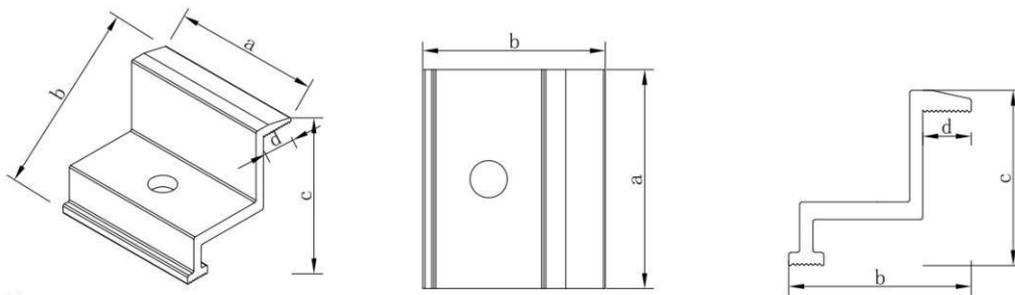


Figure 4 Clamp installation diagram

Different clamp installation methods

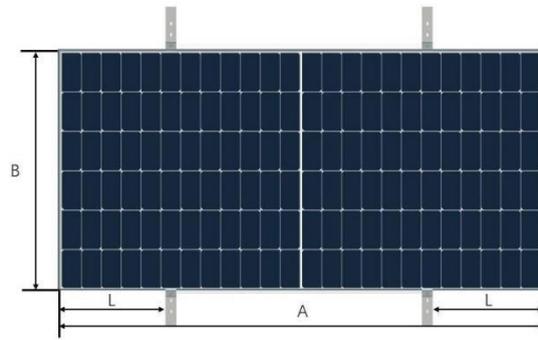


Figure 5

Long-side clamp installation

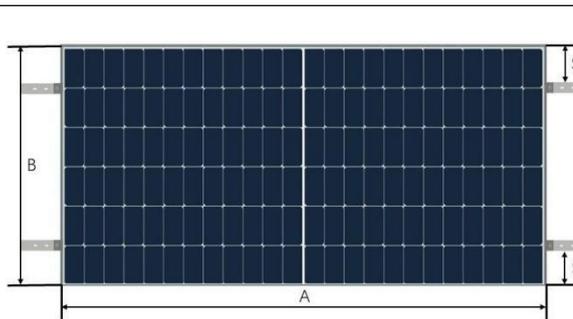


Figure 6

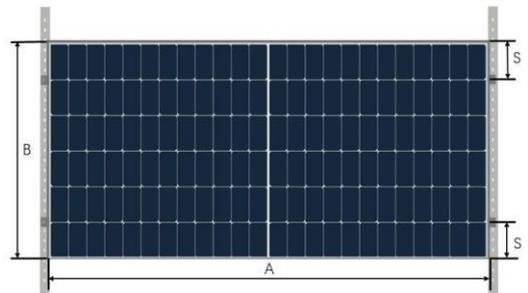


Figure 7

Short-side clamp installation

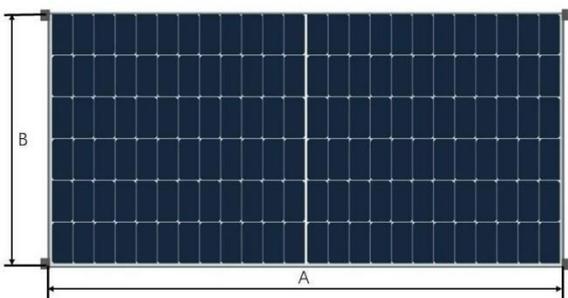


Figure 8

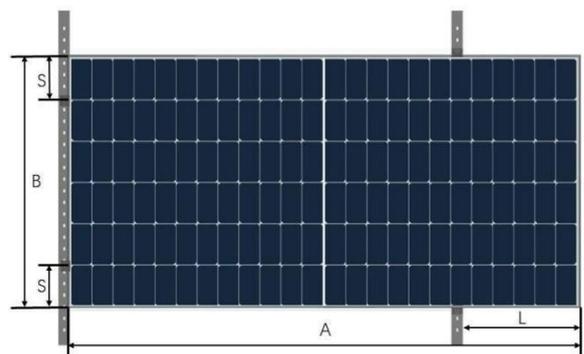


Figure 9

Four-corner clamp installation ($S = 0$)

Short- and long-side clamp installation

Table 4 Clamp installation methods

Load capacity of different installation methods

Installation Method	Long-Side Clamp Installation (+5400 Pa, -2400 Pa) L in Figure 5	
Frame Height	30	33
GK-1-72HTBD	A/4±50mm	/
Notes	A is the module length; B is the width. Refer to the module datasheet for specific dimensions.	

Table 5 Installation dimensions for different module models with clamp fixing

(Note: For installation methods and load capacities not listed in Table 5, contact Felicitysolar for further details.)

07 Grounding

For safety and to prevent damage from lightning strikes and static electricity, the module frame must be grounded.

Felicitysolar recommends referring to local and national codes and requirements regarding PV module grounding. If permitted by local authorities, Felicitysolar strongly recommends negative grounding.

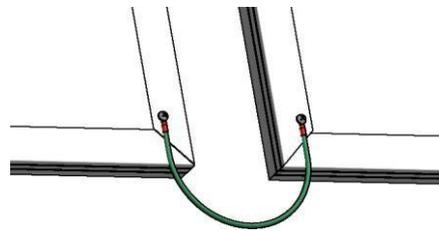
To ensure proper electrical connection, mounting hardware and wiring must be connected to the appropriate grounding symbol positions indicated on the mounting structure.

Φ4.0 mm grounding holes are located at each end of the back frame. The grounding hole on the frame is marked with the typical grounding symbol (\perp) according to IEC 61730-1 and is intended only for grounding, not for module installation.

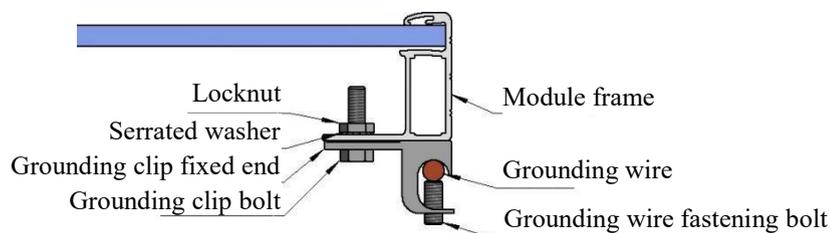
Grounding must be connected by qualified electricians, and grounding devices must be manufactured by certified electrical equipment manufacturers. To ensure reliable grounding, all conductive points connecting to the module frame must penetrate the insulation layer.

Never add any additional grounding holes to the module frame. Felicitysolar recommends grounding resistance $< 1 \Omega$.

Grounding between modules can be achieved using 4 mm² copper wire. Place a serrated washer, flat washer, and grounding wire in sequence, insert the screw through the grounding hole, and tighten it to connect the adjacent grounding holes on the module frames. (Unused mounting holes on the frame may also be used for grounding.)



Felicitysolar recommends the following grounding method:



Nuts and washers must be made of stainless steel. The material and size of the grounding wire should comply with the relevant local country, region, or international requirements, laws, and standards. 4–14 mm² (AWG 6–12) bare copper wire is recommended.

Felicitysolar PV modules may use third-party grounding devices, but the grounding must be proven reliable.

08 Electrical Installation

8.1 Safety Instructions

All wiring work must be carried out by qualified installers in accordance with local electrical construction codes, regulations, manuals, and procedures.

Modules can be connected in series to increase operating voltage by inserting the positive connector of one module into the negative connector of the next. Always ensure that the contacts are free from corrosion, clean,

and dry before connecting them.

Connecting one series of modules with reverse polarity to another will cause irreversible damage. Before making parallel connections, always confirm the voltage and polarity of each series. If measurements show reversed polarity between series or a voltage difference greater than 10 V, check the configuration before making the connection.

Felicitysolar solar modules are equipped with PV cables with cross-sectional area $\geq 4 \text{ mm}^2$ and UV-resistant insulation. All other cables used to connect DC systems should have similar or higher specifications. Felicitysolar recommends routing all cables in suitable conduits or cable trays and keeping them away from areas prone to water accumulation.

The series voltage must not exceed the maximum voltage the system can withstand, nor the maximum input voltage of the inverter or other electrical equipment in the installation. To ensure this, the array's open-circuit voltage must be calculated at the lowest expected ambient temperature at the installation site. The following formula is recommended:

$$\text{Maximum system voltage} \geq N \times V_{oc} \times [1 + TC_{Voc} \times (T_{min} - 25)]$$

Where,

N Number of modules in the series

V_{oc} Open-circuit voltage of each module (refer to the product label or datasheet)

TC_{Voc} Temperature coefficient of open-circuit voltage (refer to datasheet)

T_{min} Lowest ambient temperature

The exact number of modules that can be connected must be determined according to the PV system design specifications and electrical design standards of the installation site, by qualified design institutions or personnel. The formula recommended by Felicitysolar is for reference only.

Each module has two standard PV output cables, each fitted with a plug-and-play connector at the terminal. All wiring and electrical connections must comply with the electrical design and construction codes, standards, and regulations applicable to the installation site. The cable outer diameter must be 5–7 mm.

On-site wiring must use PV connection wires with temperature resistance of at least 90°C, UV resistance, and a cross-sectional area of no less than 4 mm².

The minimum bending radius of the cable is 43 mm.

8.2 Wiring

To ensure normal system operation, always ensure the cable polarity is correct when connecting modules or connecting to loads (such as inverters or batteries, etc.). If the modules are connected incorrectly, the bypass diodes may be damaged. PV modules can be wired in series to increase voltage, or in parallel to increase current.

Before making connections, ensure that only connectors approved by Felicitysolar are used. Otherwise, Felicitysolar assumes no responsibility.

Felicitysolar recommends the following wiring methods, depending on the module installation method: cable or short cable. For standard cable lengths, refer to the product datasheet.



Vertical installation:

Select standard short cables.



Vertical installation:

Select standard short cables.

The short-cable direct connection method remains consistent.



Horizontal installation:

Select standard long cables or custom cables.

8.3 Fuses

Correction factors must be determined by licensed professional electrical engineers according to relevant design codes and system simulation results. Felicitysolar is not responsible for determining the minimum fuse rating.

The fuse rated current of the module should be selected according to different standards, as shown below:

$1.5 K_f \cdot I_{SC} \leq I_n \leq \text{Maximum rated fuse current (IEC regions)}$

$1.56 K_f \cdot I_{SC} \leq I_n \leq \text{Maximum rated fuse current (NEC regions)}$

where

I_n : Rated fuse current

I_{SC} : Module short-circuit current

K_f : Temperature correction factor

The rated current should be corrected using the temperature correction factor (Kf) according to the operating ambient temperature. Confirm the final fuse model selection with qualified design institutions and fuse manufacturers at the installation site. The maximum fuse rating provided on Felicitysolar product datasheets is for reference only.

09 Operation and Maintenance

It is the user's responsibility to inspect and maintain the modules regularly, especially during the warranty period. If the modules are found to be damaged or show other significant abnormalities, please notify Felicitysolar customer service within two weeks.

9.1 Visual Inspection

Carefully check the modules for appearance defects, focusing on the following points:

1. The module glass is cracked.
2. Corrosion at the main busbar welds of the cells (caused by damage to the surface encapsulation material during installation or transportation, allowing moisture to enter the module).
3. Burn marks on the backsheet.
4. Signs of module aging. This includes possible damage by rodents, climate-related aging, and whether all connectors are tightly connected and free from corrosion. Check that the module is properly grounded.
5. Any sharp objects in contact with the module surface.
6. The module is blocked by obstacles or foreign objects.
7. In the case of loose or damaged fixing screws between the module and the mounting structure, make timely adjustments or repairs.

9.2 Cleaning

The power generation of PV modules is related to the solar irradiance they receive. Dirt on the glass surface of the modules will reduce their power output and may even cause localized hot spots, therefore it is essential to keep the module surface clean. Bird droppings, leaves, and dust should be removed. Felicitysolar recommends cleaning the modules at least once a year. In dusty environments or for modules installed at low tilt angles, increase the frequency as necessary to maintain surface cleanliness. Uncontrolled contamination and failure to clean modules in a timely manner will invalidate the warranty.

This section contains the cleaning requirements for Felicitysolar PV modules. System users and professional installers should read it carefully and strictly comply. Failure to follow these instructions may result in personal injury or property damage. Felicitysolar assumes no responsibility for damages caused by improper cleaning, and the product's limited warranty will be void.



Warnings

Cleaning may damage the modules and associated components, and it also increases the risk of electric shock.

Cracked or damaged modules may pose an electric shock hazard due to current leakage, and the risk increases when the modules are wet. Before cleaning, carefully check whether the modules are cracked, damaged, or have loose connectors.

During the day, the voltage and current in the array are sufficient to cause fatal electric shocks. Therefore, cleaning should be carried out under low irradiance conditions.

Before cleaning, ensure the circuit is disconnected.

While cleaning, wear appropriate protections (clothing, insulated gloves, and insulated shoes, etc.).

Do not immerse the modules, either partially or completely, in water or any type of cleaning liquid.

The back of the module generally does not need cleaning. If necessary to clean the back of bifacial modules, take extreme care to avoid damage. Gently clean stains by hand or with a sponge.

Use only the cleaning solvents specified by Felicitysolar in the Cleaning Methods section.

Cleaning Methods

1. High-pressure water

Water quality requirement: pH 6–8

Water hardness: calcium carbonate concentration ≤ 600 mg/L (soft water is recommended).

Water pressure: ≤ 4 MPa (40 bar)

2. Compressed air

Compressed air cleaning is recommended for soft dirt (such as dust).

3. Manual

If there is heavy dirt on the surface of the module, carefully use an insulated brush, sponge, or other soft cleaning tool.

Ensure that the tool is made of insulating material to minimize the risk of electric shock, and that it does not scratch the glass or aluminum frame.

If oil stains are present, carefully clean them with environmentally-friendly cleaning agents.

4. Robotic

If robotic cleaning is used, the brushes must be made of soft plastic, and the cleaning process and results must not scratch the module glass surface or aluminum frame. The robot must not be excessively heavy. Any module damage or power degradation caused by improper robotic cleaning is not covered under the Felicitysolar warranty.

To ensure optimal performance, Felicitysolar recommends the following maintenance measures:

Check the electrical, grounding, and mechanical connection points every six months to ensure they are clean, safe, undamaged, and free of rust. Otherwise, the warranty will be invalid.

In the event of a ground fault, do not clean or spray water on the modules until the fault is corrected by authorized solar inverter service personnel and the inverter is fully operational. Otherwise, electric shock or serious safety issues may occur.

If any issues arise, consult and seek advice from professional solar service providers.

Note: Follow the manufacturer maintenance instructions of all system components, such as mounting structures, charge controllers, inverters, and batteries, etc.

Appendix 1: Electrical Performance Parameters

Module Type/S	GK-1-72HTBD-580M
Voc-STC ($\pm 3\%$) [V]	51.47
Isc-STC ($\pm 3\%$) [A]	14.37
VPmax-STC [V]	42.59
IPmax-STC [A]	13.62
Pmax ($\pm 3\%$)-STC [W]	580
Voc-BNPI ($\pm 3\%$) [V]	51.57
Isc-BNPI ($\pm 3\%$) [A]	15.82
VPmax-BNPI [V]	42.70
IPmax-BNPI [A]	14.99
Pmax ($\pm 3\%$)-BNPI [W]	640
Isc-BSI ($\pm 3\%$) [A]	17.63
Pmax ($\pm 3\%$)-BSI [W]	715
Vsys [V]	1500
Maximum series fuse [A]	30
Class of Protection	Class II
Bifaciality coefficient	$\phi P_{\max}=80\pm 5\%, \phi I_{\text{sc}}=80\pm 5\%, V_{\text{oc}}=100\pm 5\%$

Appendix 2: Junction Box Connectors

J-box		Connector	
Manufacture	Type	Manufacture	Type
Ningbo Minghe New Energy Technology Co.,Ltd	MH2z	Ningbo Minghe New Energy Technology Co.,Ltd	PV-MH5
		Stäubli Electrical connectors AG	PV-KST4-EVO2/xy_UR&PV-KBT4-EVO2/xy_UR, 1500VDC
QC Solar(Suzhou)Corporation	Type: 3Qxy	QC Solar(Suzhou)Corporation	QC4.10-cds
		QC Solar(Suzhou)Corporation	QC4.10-ab
		QC Solar(Suzhou)Corporation	QC4
		Changshu Tlian Co.,Ltd.	T4-PPE-1; T4-PC-1
		Tyco Electronics Austria GmbH.	PV4-Syx&PV4-Slyx
		Stäubli Electrical connectors AG	PV-KST4-EVO2/xy&PV-KBT4-EVO2/xy
		Stäubli Electrical connectors AG	PV-KST4-EVO2A/xy&PV-KBT4-EVO2A/xy
Jiangxi Jinko PV Material Co., Ltd.	PV-JK09Exy	Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M/xy
		Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M1/xyz
		Jiangxi Jinko PV Material Co., Ltd.	PV-JK03M2/xy
		Stäubli Electrical connectors AG	PV-KST4-EVO2/xy_UR&PV-KBT4-EVO2/xy_UR
		Stäubli Electrical connectors AG	PV-KST4-EVO2A/xy&PV-KBT4-EVO2A/xy
Suzhou Xtong Photovoltaic Technologies Co.,Ltd	PV-XT1609Nxyz	Suzhou Xtong Photovoltaic Technologies Co.,Ltd	PV-XT101.1;PV-XT101.2;XT2
		Stäubli Electrical connectors AG	PV-KST4-EVO 2/xy_UR&PV-KBT4-EVO2/xy_UR PV-KST4-EVO2A/xy&PV-KBT4-EVO2A/xy
Gokin Solar Co., Ltd.	GKxy	Gokin Solar Co., Ltd.	PV-GK01
		Stäubli Electrical connectors AG	PV-KST4-EVO2/xy_UR&PV-KBT4-EVO2/xy_UR, 1500VDC,
		Stäubli Electrical connectors AG	PV-KST4-EVO2A/xy &PV-KBT4-EVO2/xy, 1500VDC