

# swiss solar

## **Installation Manual** for SWISS SOLAR PV module





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# 1. Information Regarding this Manual

## 1.1 Object

This manual provides detailed instructions for the installation and safe handling of TM Swiss Solar photovoltaic modules, developed and manufactured by SSWISS GROUP AG (Switzerland).

Hereinafter, these products are referred to as “modules”, and SSWISS GROUP AG as “Swiss Solar”.

## 1.2 Target group

- The installation of photovoltaic systems requires specific technical skills and professional expertise.
- This document is intended for qualified specialists trained in the installation and maintenance of solar energy systems.
- Before beginning the installation, the content of this manual must be carefully read and fully understood.
- In case of any questions, please contact the Swiss Solar Sales or Technical Support Department at [info@swissenergy-solar.ch](mailto:info@swissenergy-solar.ch).
- Installers must comply with all safety precautions described in this manual, as well as with all applicable national and local regulations.
- Before installation, the installer must familiarize themselves with the mechanical and electrical characteristics of the modules.
- Keep this manual in a safe place for future reference — for maintenance, service, resale, or disposal of the modules.

## 1.3 Validity

SSWISS GROUP AG reserves the right to make changes to the design of TM Swiss Solar modules or to the content of this manual at any time without prior notice.

The specifications and conditions stated in the order confirmation shall apply.

## 1.4 Scope of Application (On-Grid / Off-Grid Systems)

Swiss Solar photovoltaic modules are designed and certified for use in both on-grid (grid-connected) and off-grid (stand-alone) solar power systems, in accordance with in-

ternational standards IEC 61215, IEC 61730, and IEC 62548.

The following section defines the scope, operational limits, and compatibility requirements for various system types.

### 1.4.1 On-Grid (Grid-Connected) Systems.

Swiss Solar modules are fully compatible with grid-connected photovoltaic systems intended for residential, commercial, or industrial applications.

In such configurations, the modules are connected to a grid-tied inverter that converts DC output into AC power synchronized with the public utility network.

#### Key requirements:

- System must comply with IEC 61727, EN 50549, or local grid-connection regulations.
- Maximum system voltage: 1500 V DC.
- All components (inverter, DC cables, connectors, fuses, surge protection devices) must be certified for use in PV systems.
- DC circuits must include over-current and surge protection in accordance with IEC 60364-7-712.
- Grounding and earthing of metallic components must follow IEC 60364-5-54 or equivalent national standards.
- Connection to the AC grid must be performed by authorized and qualified personnel.

#### Typical applications:

- Residential rooftop systems (3–20 kW)
- Commercial rooftop or façade systems (20–500 kW)
- Utility-scale ground-mounted plants ( $\geq 1$  MW)

**💡 Engineering Note:** When used in grid-connected systems, the energy yield and safety depend significantly on inverter MPPT voltage range, string length, and cable sizing. Always verify system design against the inverter manufacturer's specifications.

### 1.4.3 Environmental and Installation Conditions (Applicable to All Systems)

- Ambient operating temperature range: **-40 °C ... +85 °C**
- Relative humidity: **up to 100 %, non-condensing**
- Maximum altitude: **2000 m above sea level**
- Installation environments: open outdoor areas, rooftops, carports, floating or ground-mounted structures
- Do not install modules in areas with explosive gases, continuous vibration, or severe chemical corrosion (unless certified per **IEC 61701 / IEC 62716**)

## 1.5 Liability and disclaimer

As the use of these instructions, as well as the methods of installation, operation, and maintenance of photovoltaic modules, are beyond the reasonable control of the manufacturer, **SSWISS GROUP AG** (hereinafter referred to as Swiss Solar) assumes no responsibility for any loss, damage, or expenses arising from or in connection with the installation, operation, use, or maintenance of the modules.

**Swiss Solar** shall not be held liable for any infringement of patents or other third-party rights resulting from the use of the products. No license under any patent or patent rights is granted – either explicitly, implicitly, or in any other form.

The information contained in this document is based on the knowledge and experience of Swiss Solar and is provided in good faith. Such information, including technical specifications and recommendations, does not constitute any explicit or implied guarantee.

**Swiss Solar** reserves the right to modify the instructions, the products, technical specifications, or related documentation without prior notice.

### 1.5.1 GUARANTEE AND PROPER USE

The current warranty policy of TM Swiss Solar photovoltaic modules, manufactured by SSWISS GROUP AG (Switzerland), shall apply.

## 1.6 Regulatory provisions

All design, installation, and operation work of photovoltaic (PV) systems must strictly comply with the applicable national and international technical standards.

Failure to observe these regulations may result in equipment malfunction, voided warranty, or violation of electrical safety requirements.

The following list provides a non-exhaustive overview of

key standards and regulations that must be followed during the installation and operation of **TM Swiss Solar** modules manufactured by **SSWISS GROUP AG**:

### International Standards (IEC / ISO):

- **IEC 61215** – Design qualification and type approval of crystalline silicon photovoltaic (PV) modules
- **IEC 61730 (Parts 1 & 2)** – Photovoltaic module safety qualification (construction and testing requirements)
- **IEC 62716** – Ammonia corrosion testing of PV modules
- **IEC 61701** – Salt mist corrosion testing of PV modules
- **ISO 9001** – Quality management system
- **ISO 14001** – Environmental management system
- **ISO 45001** – Occupational health and safety management system

### European and National Standards:

- **DIN VDE 0100** – Installation of electrical power systems with nominal voltages up to 1,500 V
- **VDI 6012, Part 2** – Local energy systems in buildings
- **DIN 1055** – Load assumptions for structures
- **VDE 0185** – Lightning protection
- **BGR 203 (BGV A2/A3)** – Safety regulations of the trade association for roof work and electrical installations
- Regulations of local grid operators
- Regional building and safety codes

### General Requirements:

- Installation and connection must be carried out only by qualified personnel authorized to perform electrical work.
- Prior to grid connection, the installer must obtain approval from the local grid operator.
- All system components must comply with the specified maximum DC voltage of **up to 1,500 V** and the environmental conditions stated in the product data-sheet.

## 1.7 Transport & Storage

Proper transport, handling, and storage of **Swiss Solar photovoltaic modules** are essential to maintain their mechanical integrity, electrical performance, and long-term reliability.

Failure to follow the instructions below may result in damage, microcracks, or loss of warranty coverage.

### 1.7.1 Transport Conditions

- Only use **certified logistics providers** experienced in handling fragile electrical equipment.
- Transport packages in **upright (vertical)** position; horizontal stacking is strictly prohibited.
- Do not exceed the **maximum number of pallets per stack** indicated on the outer packaging label.
- Secure all pallets properly to prevent movement, tilting, or vibration during transport.
- Avoid exposure to excessive shocks, compression, or bending.
- Do not step on pallets, sit, or place heavy objects on the boxes.
- Modules must be transported in **closed and dry vehicles**, protected from direct sunlight, rain, and high humidity.
- During transport, maintain ambient temperature between  $-20^{\circ}\text{C}$  and  $+60^{\circ}\text{C}$ .

**⚠ Caution:** Dropping a pallet or striking a module corner can cause invisible microcracks that lead to power loss over time.

### 1.7.2 Unloading and Handling

- Unloading should be performed by **trained personnel** using forklifts, pallet jacks, or cranes with soft lifting straps.
- Always lift the pallet **from both sides** using the correct forks or lifting points.
- Never drag, tilt, or roll pallets.
- Do not remove protective film or packaging until modules are ready for installation.
- Handle modules carefully using **both hands**, holding only by the frame.
- Avoid contact with the glass surface or junction box.
- Do not stack unpacked modules directly on top of each other.
- Avoid placing modules on uneven or abrasive surfaces.

### 1.7.3 Storage Conditions

- Store modules in their **original packaging** in a **clean, dry, and ventilated** warehouse.
- Avoid exposure to direct sunlight, rain, or corrosive atmospheres (ammonia, salt, or chemical vapors).
- Recommended storage temperature:  $-20^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$ , relative humidity below **85%**.
- Do not store modules outdoors or in contact with the ground.
- When stacking pallets, ensure the maximum stack height does not exceed:
  - **2 pallets** (in factory packaging)
  - **1 pallet** (after partial unpacking)
- Keep a minimum clearance of 0.5 m from walls and 1 m from heat sources.

**💡 Engineering Note:** Prolonged exposure to moisture or high temperature may degrade encapsulant materials or connectors, leading to corrosion or delamination.

### 1.7.4 Inspection Upon Delivery

- Upon receipt, inspect all pallets and packaging for visible signs of damage (tears, punctures, water stains, compression marks).
- Record any damage on the delivery note before signing and **take photographs** for claim documentation.
- If modules are visibly damaged (broken glass, bent frame, displaced junction box), **do not install or connect them**.
- Report any transport or handling damage to **Swiss Solar Technical Support within 7 days of delivery** via email: [info@swissenergy-solar.ch](mailto:info@swissenergy-solar.ch)

### 1.7.5 Temporary On-Site Storage

- If modules must be stored on site before installation:
  - Keep them on flat, stable ground in the vertical position (leaned at  $\sim 10^{\circ}$  angle for stability).
  - Protect modules with **waterproof covers**, ensuring ventilation to avoid condensation.
  - Avoid stacking more than 10 modules together without separators.
  - Do not expose packaging to standing water or direct sunlight for extended periods.

**💡 Reminder:** ▶

💡 **Reminder:** Improper handling during transport and storage is one of the most common causes of hidden microcracks and performance degradation.

Always follow Swiss Solar transport and storage guidelines to preserve module warranty validity and ensure long-term efficiency.

## 2. Safety Instructions

The safety of personnel and equipment during the installation and operation of **Swiss Solar photovoltaic modules** is of highest importance.

Failure to follow the instructions below may result in electrical shock, fire, mechanical damage, or loss of warranty rights.

### 2.1 General and Electrical Safety

- All installation, connection, and maintenance work must be carried out only by qualified personnel authorized to perform electrical work (minimum Level II), trained according to **IEC 60364** and **IEC 62446**.
- Photovoltaic modules generate DC voltage whenever exposed to light – even diffuse sunlight. Treat all conductors as live.
- Never connect or disconnect connectors under load.
- Before working, isolate both **AC and DC circuits**, inverters, and charge controllers.
- Use insulated tools rated for at least **1000 V DC (CAT III or CAT IV)** and wear appropriate personal protective equipment.
- Perform insulation and continuity tests with a megohmmeter  $\leq 1000$  V DC.
- All metallic parts and frames must be properly grounded in accordance with **IEC 60364-5-54**.
- Install **Class II surge protection devices (SPD)** on the DC side.
- Integrate the PV system into the building's **lightning-protection system per VDE 0185**.

### 2.2 Mechanical and Installation Safety

- Mount modules only on **load-bearing structures** designed for combined wind and snow loads per **DIN 1055** or local regulations.
- Do not walk, sit, or place any objects on modules.
- Maintain at least **50 mm rear clearance** for ventilation and cooling.
- Do not install during rain, strong wind, or high humidity.

- When working on roofs, use certified **fall-arrest safety systems**.
- Keep children and unauthorized persons away from the installation area.

### 2.3 Fire and Environmental Safety

- Swiss Solar modules are rated **Fire Class C** and may be installed on roofs with Fire Class A structures.
- Keep a **minimum 0.5 m** distance from chimneys, exhaust vents, or flammable materials.
- Use **fire-resistant cables, junction boxes, and mounting hardware**.
- In case of fire, disconnect the PV system using AC / DC isolators before firefighting.
- Install modules only in environments within the certified limits:
  - Ambient temperature:  $-40$  °C to  $+85$  °C
  - Relative humidity: up to 100 %, non-condensing
  - Maximum altitude: 2000 m a.s.l.
  - Max. wind / snow load: 2400 / 5400 Pa
- Avoid environments containing ammonia, salt, or chemical vapors unless the modules are certified per **IEC 61701 / IEC 62716**.
- Use **A2 / A4 stainless-steel fasteners** in coastal or industrial areas.

### 2.4 Handling and Material Protection

- Handle modules with **both hands**; do not lift by the junction box or cables.
- Avoid impacts, drops, or placing modules on sharp or uneven surfaces.
- Never short-circuit module terminals.
- Do not drill or punch additional holes in the frame or glass.
- Do not remove, cover, or alter factory labels, serial numbers, or certification markings – this voids the warranty.
- Do not paint, coat, or glue any part of the frame or glass.

- Prevent direct sunlight on the rear encapsulation film to avoid delamination or discoloration.
- Store and transport modules vertically, protected from moisture and vibration.
- Keep a **maintenance logbook** documenting all inspections, cleaning, and repairs.
- Replace damaged parts only with **certified original components**

## 2.5 Installation Conditions

- Ambient temperature:  $-40\text{ °C} \dots +85\text{ °C}$
- Maximum altitude: 2000 m
- Maximum system voltage: 1500 V DC
- Relative humidity:  $\leq 100\%$ , non-condensing
- Avoid locations with explosive gases, open flames, or constant vibration.
- Ensure proper **drainage, ventilation, and maintenance access** at the installation site.

## 2.6 System Compliance and Electrical Performance

- Use only components compliant with **IEC 60364, IEC 62548, and EN 50618 (H1Z2Z2-K)**.
- Connect modules using **MC4-compatible or manufacturer-approved connectors**.
- Verify polarity before connection ( + to + , - to - ).
- Prevent reverse-current flow using fuses or blocking diodes when required.
- Ensure the total string voltage never exceeds **1500 V DC** under open-circuit or cold conditions.
- Grounding conductors must meet **IEC 60364-5-54**.
- All electrical contacts must be dry, tight, and corrosion-free.

## 2.7 Inspection and Maintenance

- Inspect the PV system **at least once per year** and after severe weather (storm, hail, heavy snow).
- Check for loose fasteners, corrosion, cracks, or delamination.
- Clean glass surfaces with **de-ionized water and a soft cloth** only.
- Do not use detergents, abrasives, or high-pressure water.
- Never step on modules during cleaning.

# 3. Mechanical Installation

## 3.1 Selection of the Installation Site

Proper selection of the installation site for Swiss Solar photovoltaic modules is essential to ensure maximum performance, durability, and operational safety.

### General Recommendations

Modules may be installed:

- on the ground (concrete or pile-driven structures),
- on building rooftops,
- on carports, parking shelters, or canopies,
- on vehicles or floating platforms.

In the Northern Hemisphere, modules should face **south**, and in the Southern Hemisphere – **north**, to maximize annual energy yield.

The optimal tilt angle generally equals the **geographical latitude ±10°**.

For fixed installations, a tilt between **25° and 40°** is recommended to balance summer and winter production.

## 3.2 Shading and Row Spacing

Any shading of modules – even partial – must be strictly avoided. Even small shadows from chimneys, antennas, or trees can cause hot spots and significant power loss.

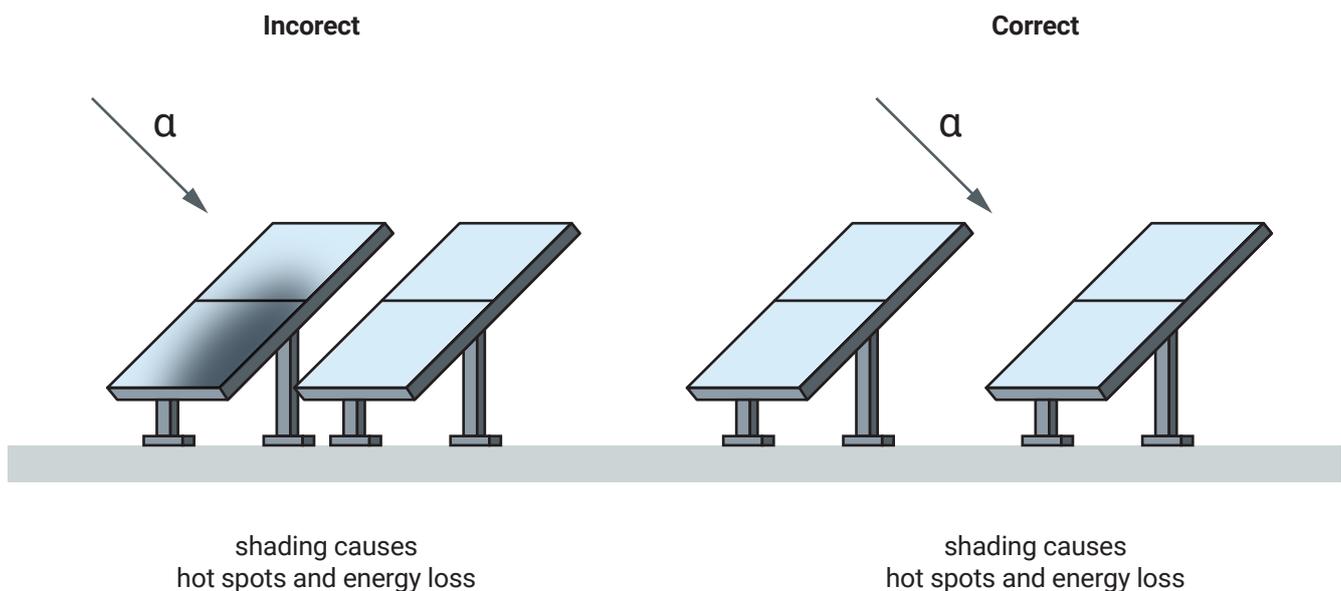
When designing the array, consider the seasonal sun path and potential inter-row shading.

The minimum spacing between rows should be calculated using the formula:

$$D \geq H \times \tan(\alpha)$$

where:

- **D** = distance between rows,
- **H** = height of the row,
- **α** = minimum solar elevation angle (winter solstice).



### 3.3 Mounting Requirements

Proper mechanical installation of Swiss Solar photovoltaic modules is essential to ensure system safety, mechanical stability, and long-term performance.

All installation work must be carried out strictly in accordance with these requirements and international standards IEC 61215, IEC 61730 and IEC 62548.

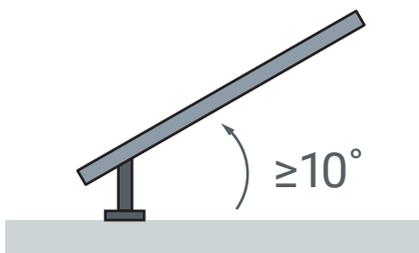
#### 3.3.1 Structural Requirements

Mounting structures must be designed to withstand combined static, wind, and snow loads in accordance with DIN 1055 or equivalent national standards.

- The supporting structure must be verified by a qualified structural engineer to handle at least the following design loads:
  - Front (snow/wind pressure): 5400 Pa
  - Rear (wind suction): 2400 Pa
  - Dynamic load tests are recommended for sites exposed to gusts or seismic vibration.
- Roofs must have a minimum load-bearing capacity of 1.5 kN/m<sup>2</sup>.
- All contact points between the module frame and mounting system must evenly distribute loads to prevent frame deformation or glass stress.

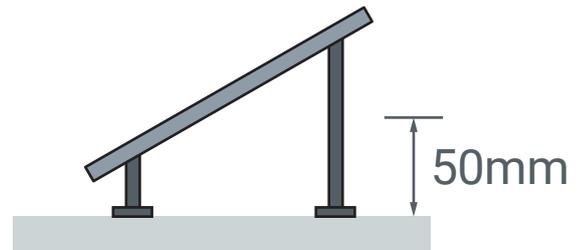
#### 3.3.3 Ventilation and Clearance

- To ensure proper cooling and prevent power loss from heat accumulation, maintain a minimum clearance between the rear surface of the module and the mounting surface:
  - $\geq 50$  mm under standard conditions;
  - $\geq 100$  mm recommended for installations in high-temperature or low-airflow environments (e.g., flat roofs).
- Avoid full-contact mounting; partial contact points should allow continuous airflow under the module.



#### 3.3.4 Tilt Angle and Drainage

- The minimum tilt angle for fixed installations is 10°, ensuring natural water drainage and self-cleaning by rainfall.
- The optimal tilt angle generally equals the geographical latitude  $\pm 10^\circ$  for balanced annual energy yield.
- For horizontal or low-tilt installations ( $< 10^\circ$ ), additional cleaning and drainage maintenance must be scheduled.



### 3.3.5 Fasteners and Materials

Component	Material Specification	Standard	Notes
Bolts / Nuts	Stainless Steel A2 / A4	ISO 3506	Use locking washers or thread sealant
Clamps	Anodized Aluminum 6063-T6	EN 755-2	Width 40–50 mm
Mounting Rails	Anodized Aluminum or Galvanized Steel	EN AW 6063-T6 / DIN EN 10346	Must be corrosion-resistant
Grounding Hardware	Stainless Steel A2 / A4	UL 467 / IEC 60364-5-54	Ensure metal-to-metal contact

### 3.3.6 Recommended Torque Values

Fastener Type	Size	Torque (N·m)	Application
Bolt + Nut	M6	6 – 8	Frame clamps, rails
Bolt + Nut	M8	8 – 10	Structural brackets
Bolt + Nut	M10	20 – 25	Ground anchors / supports
Clamp Bolt	–	8 – 10	Module frame clamps

**Note:** Always use calibrated torque tools. Under-tightening may cause loosening during wind loads, while over-tightening can lead to glass or frame damage.

### 3.3.7 Handling and Safety

- Walking, sitting, or placing objects on modules is strictly prohibited.
- Install only during dry, calm weather (avoid rain, strong wind, or high humidity).
- Use fall-arrest systems when working on rooftops.
- Ensure children and unauthorized personnel are kept away from the installation site.
- Do not use sharp tools or impact hammers near the module surface.



### 3.3.8 Compliance Reference

- All mechanical installation work must comply with:
- IEC 61215 – Mechanical Load Testing
  - IEC 61730 – PV Module Safety Qualification
  - IEC 62548 – Design and Installation of PV Systems
  - DIN 1055 – Load Assumptions for Structures
  - VDE 0185 – Lightning Protection

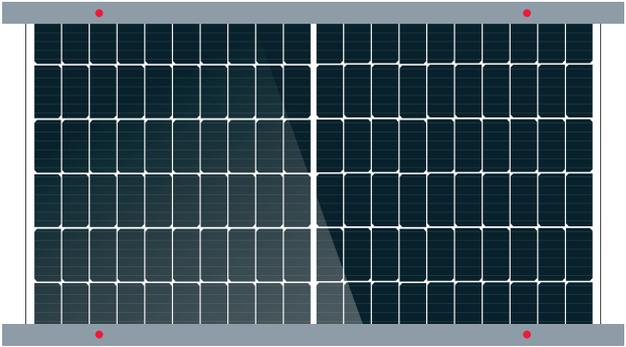
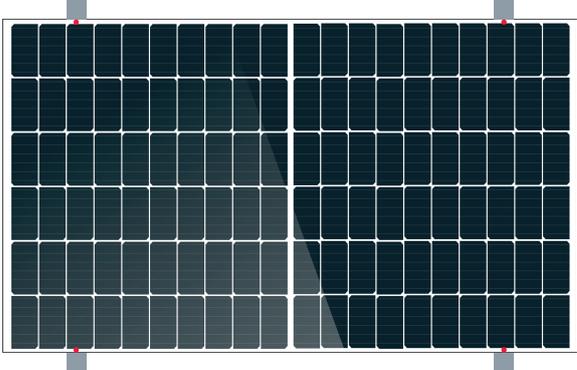
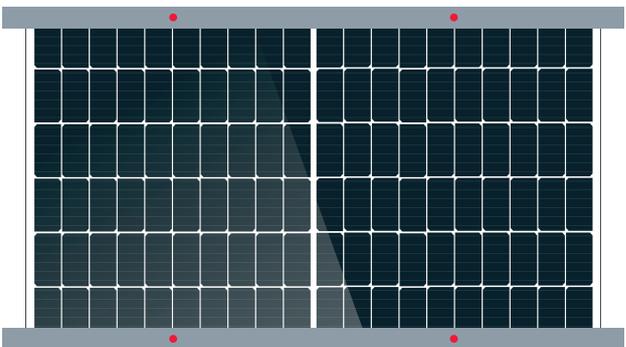
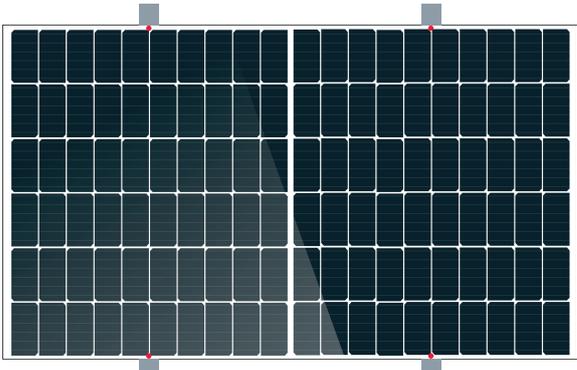
**Engineering Note:** Improper torque, insufficient clearance, or incorrect clamping can reduce energy yield by up to 20% and may cause long-term structural damage. Always verify fastener tightness, ventilation gaps, and tilt alignment before commissioning.

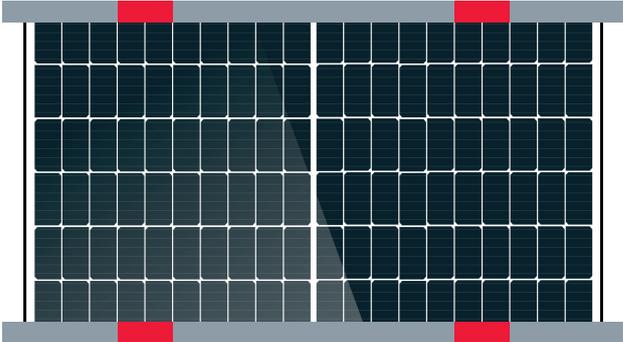
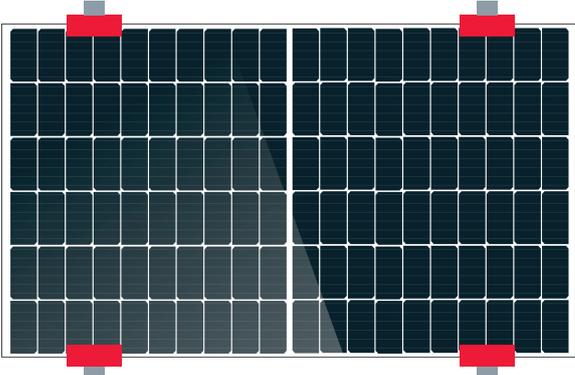
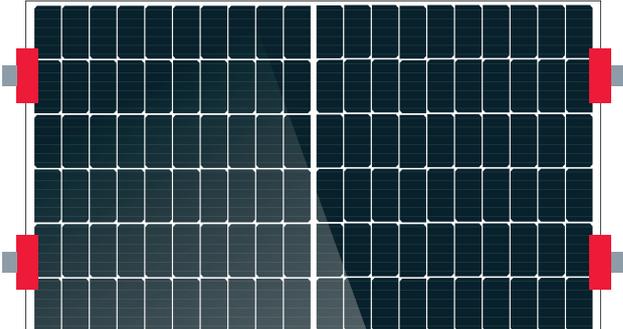
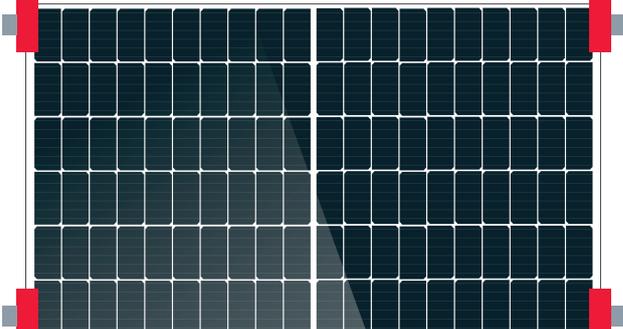
### 3.4 Mounting Methods

Swiss Solar Bifacial modules can be mounted by bolts or clamps. The mounting method and maximum test load are shown as follow. (The unit of distance and length in the table below is millimeter (mm), and the unit of pressure is Pascal (Pa)).

Do not drill additional holes in the module frame or glass.

Ensure the load is evenly distributed across the entire structure to prevent frame deformation.

<p><i>Outer Four-hole bolts Mounting <b>Method 1</b> Mounting rails parallel the long frame</i></p>	
<p><i>Outer Four-hole bolts Mounting <b>Method 2</b> Mounting rails cross the long frame.</i></p>	
<p><i>Inner Four-hole bolts Mounting <b>Method 3</b> Mounting rails parallel the long frame.</i></p>	
<p><i>Inner Four-hole bolts Mounting <b>Method 4</b> Mounting rails cross the long frame.</i></p>	

<p>Clamps Mounting <b>Method 5</b> Mounting rails parallel the long frame.</p>	
<p>Clamps Mounting <b>Method 6</b> Mounting rails cross the long frame.</p>	
<p>Clamps Mounting <b>Method 7</b> Mounting rails cross the short frame.</p>	
<p>Clamps are mounted at the corners of short frame. <b>Method 8</b> (clamp length <math>\geq 60\text{mm}</math>, the overlap of clamp and frame <math>\geq 10\text{mm}</math>)</p>	

## Mounting Methods and Mechanical Load Ratings for Swiss Solar Bifacial Glass Glass Modules (48 / 54 / 66 / 72 / 78 cells)

Mounting Method	Description	Mounting Rail Orientation	Applicable Module Types	Mechanical Load (Pa)	Application
① Outer Four-hole Mounting – Long Side	Bolts fixed through outer holes on the long sides of the frame. Provides standard resistance to wind and snow loads.	Rails parallel to the long side	48, 54, 66, 72, 78	Front: 2400 / Back: 2400	Recommended method for most systems; suitable for bifacial Glass-Glass modules.
② Outer Four-hole Mounting – Short Side	Bolts fixed through outer holes on the short sides of the frame for improved snow load resistance.	Rails crossing the long side	48, 54, 66, 72, 78	Front: 2400 / Back: 2400	Optimal for northern regions or sites with heavy snow loads.
③ Inner Four-hole Mounting – Long Side	Bolts fixed through inner holes on the long sides of the frame. Enhances overall rigidity and reduces stress on glass edges.	Parallel to the long side	48, 54, 66, 72, 78	Front: 2400 / Back: 2400	Provides superior structural stability for heavy-load conditions.
④ Inner Four-hole Mounting – Short Side	Bolts fixed through inner holes on the short sides of the frame.	Perpendicular to the long side	48, 54, 66, 72, 78	Front: 2400 / Back: 2400	Used for compact installations or limited-space applications.
⑤ Clamp Mounting – Long Side	Clamps placed along the long sides of the frame.	Rails parallel to the long side	66, 72, 78	Front: 3600 / Back: 2400	Clamp position from module edge: 200–400 mm. Recommended rear ventilation gap $\geq$ 100 mm.
⑥ Clamp Mounting – Long Side (Cross Orientation)	Clamps along the long sides with rails crossing the module.	Perpendicular to the long side	66, 72, 78	Front: 3600 / Back: 2400	Suitable for vertical or compact installations. Not recommended for high-wind regions.
⑦ Clamp Mounting – Short Side	Clamps placed along the short sides of the frame.	Parallel to the short side	66, 72, 78	Front: 2400 / Back: 1800	Suitable for vertical or compact installations. Not recommended for high-wind regions.
⑧ Corner Clamp Mounting	Clamps located at the corners of the short frame sides.	Diagonal / corner-mounted	48, 54, 66	Front: 2400 / Back: 1800	Minimum clamp length $\geq$ 60 mm, frame overlap $\geq$ 10 mm. Use only in low-wind installations.

### Additional Notes and Recommendations

- **Front side load** – pressure from snow or wind acting on the front surface.
- **Back side load** – suction effect from wind acting on the rear side.
- **Clamp position range** – 200–400 mm from module edge to clamp center (see Figures 3.5.1–3.5.2).
- **Clamp and bolt materials** – stainless steel A2 / A4 or equivalent (ISO 3506 compliant).
- **Mounting rail material** – anodized aluminum EN AW 6063-T6 or equivalent.
- **Standards compliance:** IEC 61215 (mechanical load), IEC 61730 (safety), IEC 62548 (PV system installation).

**💡 Engineering Note:** Bolted methods (①–④) ensure maximum structural strength and reliability, especially in areas with high snow or wind loads.

Clamp-based methods (⑤–⑧) are ideal for commercial and residential rooftops where installation speed and appearance are key priorities.

### 3.5 Clamp Installation

Mounting clamps must be used **only in designated clamping zones** along the module frame edges. Improper clamp placement may cause glass breakage or frame damage and will void the warranty.

#### Clamping Guidelines

- Use **four clamps per module** (two on each long side).
- Clamp width: **40–50 mm**.
- Tightening torque: **8–10 N·m**.
- Do not install clamps near the junction box or label area.
- All clamps must be aligned and tightened uniformly.

#### Illustration 3.5.1 – Correct clamp positions For Bifacial Glass Glass solar modules.

Minimum edge distance: 200 mm; Maximum edge distance: 400 mm.

Use four clamps per module (two on each long side) within the permissible clamping range shown above.

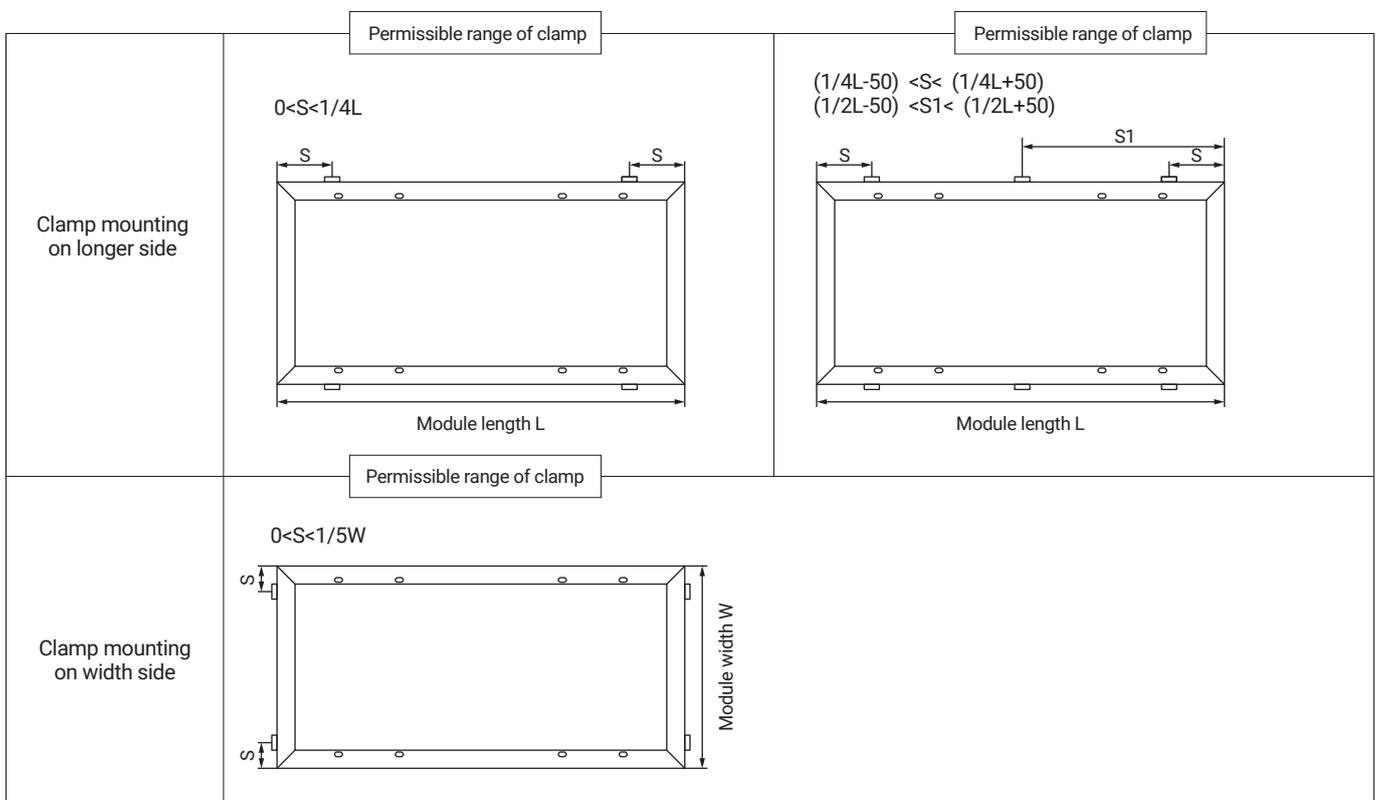


Figure 4 Position requirements of connecting points

### 3.6 Mounting and Connection Points

Modules must be mounted only using the factory pre-drilled holes located along the long sides of the frame. Drilling new holes or altering the frame is strictly prohibited.

Typical hole dimensions:

- Diameter: **Ø 9 mm** for **M8 bolts**,
- Center spacing: **400–600 mm**.

All mounting rails must be parallel and electrically bonded if made of metal.

Grounding conductors must be connected through dedicated **M4/M5 grounding holes** with serrated washers.

### 3.7 Cables and Connectors

Each Swiss Solar module is equipped with factory-installed solar cables and MC4-compatible connectors.

#### Technical Specifications:

- **Cable type:** Tinned copper solar cable, double-insulated, UV- and ozone-resistant, compliant with **IEC 62930**
- **Conductor cross-section:** 4.0 mm<sup>2</sup>
- **Cable length:**
  - Positive (+): **250 mm**
  - Negative (-): **350 mm**
- **Minimum bending radius:** 6 × cable diameter
- **Connector protection rating:** **IP68** (dust-tight and protected against continuous immersion in water)

#### Connection Guidelines:

- Ensure connectors lock securely with an audible click.
- Do not connect or disconnect under electrical load.
- Keep all connectors dry, clean, and free of dust.
- Replace any damaged or contaminated connectors immediately.
- Always maintain correct polarity (+ / -).

### 3.7 Cables and Connectors

Each **Swiss Solar** module is equipped with **bypass diodes** integrated into the junction box to protect the cells from overheating and reverse current.

#### Bypass Diode Function

- Protects cells under partial shading conditions.
- Allows current to bypass shaded cell groups (typically three diodes per module).

#### System Design Recommendations

- When connecting strings in parallel, use **blocking diodes** or **string fuses** as required by the inverter manufacturer.
- The total string voltage must not exceed **1500 V DC** at the lowest expected ambient temperature.
- All parameters must comply with the product datasheet and **IEC 62548**.

### 3.9 Bifacial Module Considerations

The performance of bifacial modules depends on the **ground surface reflectivity (albedo)** and the **installation height**.

- Best performance is achieved over **light or reflective surfaces** (gravel, concrete, white membrane).
- Recommended installation height above ground: **0.6–1.2 m**.
- The surface beneath the modules should be **flat, non-conductive, and non-reflective** to avoid optical or electrical interference.

### 3.10 Documentation and Compliance

All installation work must comply with **IEC 61215**, **IEC 61730**, **IEC 62548**, as well as applicable national building and electrical codes.

Before installation, confirm that there are no underground utilities or hidden structures in the construction area.

If required by local authorities, obtain **all building permits and grid connection approvals** prior to beginning installation.

 **Engineering Note:** Improper clamping, wiring, or grounding can cause module damage, insulation failure, or power losses exceeding 20%.

Always verify torque, polarity, grounding, and alignment before system commissioning.

## 4. Module Identification

Each **Swiss Solar** photovoltaic module is equipped with **three factory-applied identification labels**, containing essential product and certification information.

These labels are permanently affixed during the production process and must remain intact for warranty validation and traceability.

### 4.1 Nameplate Label

This label provides key **electrical and certification data** for the module, including:

- Product type and model designation
- Nominal power output (Pmax)
- Rated current (Imp) and rated voltage (Vmp)
- Open-circuit voltage (Voc) and short-circuit current (Isc) under Standard Test Conditions (STC)
- Maximum system voltage and application class
- Safety and certification marks (IEC, TÜV, CE, MCS, etc.)

 The nameplate serves as the **primary technical reference** for installation, operation, and performance verification.

### 4.2 Current Sorting Label

Modules are classified according to their optimal operating current at the time of production to ensure consistent electrical performance within an installation string.

The current classification is indicated by one of the following markings:

- H – High current level
- M – Medium current level
- L – Low current level

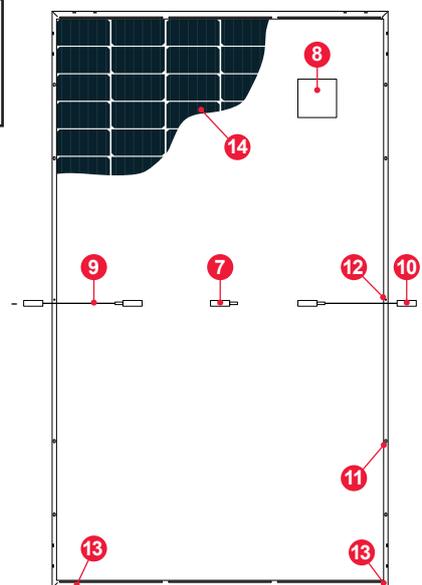
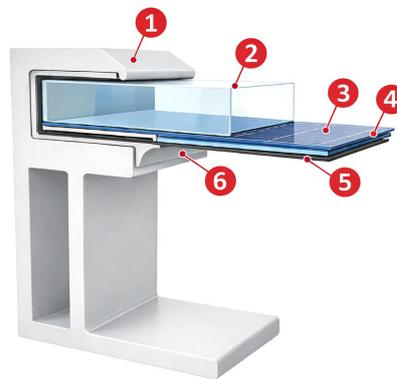
 For optimal system efficiency and uniform string performance, it is strongly recommended to install modules with **the same current class** (e.g., all “H” modules) within the same string.

### 4.3 Serial Number Label

Each module carries a **unique serial number (S/N)** permanently embedded within the laminate for traceability and quality control.

- The serial number is visible **from the front upper area** of the module.
- It is applied **before the lamination process**, ensuring durability throughout the product’s lifetime.
- This serial code is also stored in the **Swiss Solar quality database**, linking each module to its production batch, test results, and material traceability records.

The serial number must always remain legible. Removal or alteration of any label may void the product warranty and certification validity.



1. Aluminum alloy frame
2. PV tempered glass
3. POA
4. Cells
5. Back plate or glass
6. Silica gel
7. Connecting box
8. Nameplate
9. Cables
10. Connector
11. Mounting hole
12. Grounding hole
13. Leakage hole
14. Cell

# 5. Grounding

Grounding is an essential safety measure to protect Swiss Solar photovoltaic modules from lightning strikes, electrostatic discharge, and electrical faults.

All module frames and metallic mounting structures **must be properly grounded** in accordance with international and local electrical standards.

## 5.1 General Requirements

This label provides key electrical and certification data for the module, including:

- Swiss Solar modules are built with **anodized corrosion-resistant aluminum alloy frames** to ensure rigidity and long-term protection.
- For safety and compliance, the aluminum frame must be electrically bonded to the system grounding circuit.
- The grounding device must be in **full contact with the bare aluminum surface** to penetrate the anodized oxide layer and ensure proper conductivity.
- **Do not drill additional grounding holes** or modify the frame structure in any way. Grounding holes are **factory pre-drilled** and marked with the grounding symbol  $\perp$  in accordance with **IEC 61730-1**.
- Grounding work must be performed by **qualified electricians** using components that comply with **IEC 60364-5-54** and **UL 467** (where applicable).

## 5.2 Grounding Components

- **Recommended conductor:** copper or tinned copper wire, minimum **4 mm<sup>2</sup>** cross-section (equivalent to **12 AWG**).
- **Grounding hardware:** stainless steel bolts, serrated washers, and grounding lugs with anti-corrosion coating.
- The grounding conductor must be securely connected to a **suitable grounding electrode system** in compliance with national electrical codes (NEC, VDE, or equivalent).

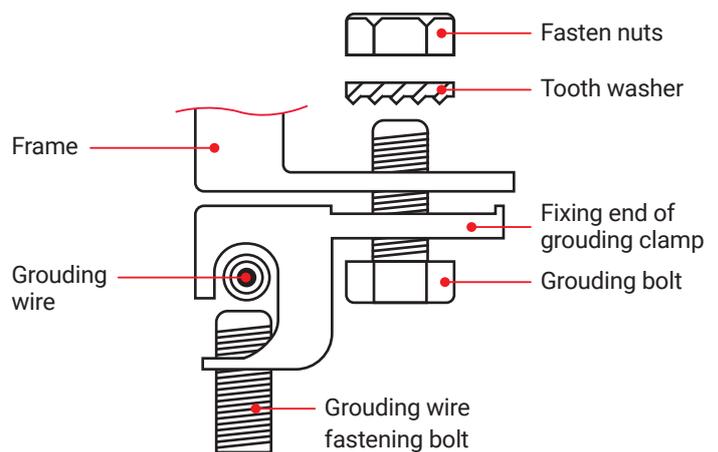
## 5.3 Grounding Method

One of the recommended grounding methods for Swiss Solar modules is illustrated below.

### Steps:

- a) Align the grounding clamp with the module's grounding hole ( $\varnothing 4.2$  mm).
- b) Insert the grounding bolt through the clamp and the frame grounding hole.
- c) Place a **tooth washer** and **nut** on the opposite side, ensuring a firm and conductive connection.
- d) Insert the grounding wire into the clamp and fasten securely with a grounding bolt.
- e) Tighten all bolts and verify continuity between module frames using a multimeter (resistance  $\leq 0.1 \Omega$ ).

### Illustrations - Bolt Grounding Method of PV Module



## 5.4 Grounding Verification and Compliance

- All grounding connections must meet the **continuity requirements** of **IEC 61730** and **IEC 62548**.
- Grounding between adjacent modules must be electrically continuous. Use bonding jumpers where necessary.
- Grounding devices must be installed according to **Swiss Solar** and **local electrical authority** guidelines.
- Verify the integrity of grounding connections periodically, especially after installation, maintenance, or extreme weather events.

# 6. Operation and Maintenance

## 6.1 General Requirements

Regular inspection and maintenance of **Swiss Solar** photovoltaic modules are essential to ensure long-term reliability, maximum performance, and the preservation of warranty coverage.

It is the **system owner's responsibility** to perform periodic inspections and preventive maintenance throughout the product's service life, especially during the warranty period.

If any damage, malfunction, or abnormal condition (such as broken glass, frame deformation, delamination, discoloration, or cable damage) is detected, the **supplier or an authorized Swiss Solar service partner must be informed within 14 days** of discovery.

Maintenance work must only be performed by **qualified and trained personnel** in accordance with **IEC 62446, IEC 62548**, and local electrical safety regulations.

## 6.2 Inspection Schedule

To maintain optimal performance and safety, the PV system should be visually inspected **at least once per year** and additionally:

- after severe weather events (hail, heavy snow, storms, strong winds, etc.),
- after maintenance or construction work near the installation,
- after lightning or grid surge incidents.

## 6.3 Visual Inspection Checklist

During inspection, the following components must be checked carefully:

### Modules:

- No cracks, chips, or breakage on glass surfaces.
- No delamination or yellowing of encapsulant.
- No signs of burn marks, corrosion, or moisture ingress inside the laminate.
- Frames are not deformed, bent, or corroded.

### Electrical Components:

- Junction boxes are securely closed and undamaged.
- Cables and connectors show no insulation damage or discoloration.
- Connectors are properly mated (locked with audible click) and clean.
- Grounding conductors and bonding connections are intact and corrosion-free.

### Mounting System:

- No loose bolts or clamps; all components are securely tightened.
- No signs of corrosion or metal fatigue on mounting structures.
- Ensure modules remain in correct position and alignment.

## 6.4 Cleaning Recommendations

- Clean the module surface **as needed**, depending on dust, pollen, or bird droppings accumulation.
- Use **soft cloths or sponges** with clean water or mild, non-abrasive detergent.
- Do not use high-pressure washers, strong alkaline/acidic cleaners, or sharp tools.
- Perform cleaning **in the early morning or late afternoon** when modules are cool to prevent thermal stress and glass cracking.
- Avoid spraying water directly on hot modules under sunlight.

💡 For coastal or industrial areas, more frequent cleaning (2–4 times per year) is recommended.

## 6.5 Electrical Performance Verification

- Measure string voltages and currents under standard irradiance to detect possible deviations between strings.
- Insulation resistance should be  $\geq 40 \text{ M}\Omega$  at 1000 V DC.
- Check for ground faults and reverse polarity connections.
- Record all measurements in the **maintenance logbook** for traceability and warranty purposes.

## 6.6 Post-Storm Inspection

After extreme weather conditions:

- Check for cracks, broken glass, or displaced modules.
- Inspect mounting rails, clamps, and bolts for loosening or deformation.
- Verify the integrity of all electrical connections and grounding.
- Do not touch damaged modules — isolate the system and contact qualified service personnel.

Swiss Solar recommends maintaining a Maintenance Logbook as part of the PV system documentation package.

## 6.7 Maintenance Recordkeeping

All inspection and maintenance activities must be documented, including:

- Date of inspection,
- Technician's name,
- Findings (visual/electrical),
- Corrective actions taken.

Swiss Solar recommends maintaining a **Maintenance Logbook** as part of the PV system documentation package.

# 7. Decommissioning & Recycling

## Scope

This section defines the safe procedures for dismantling, de-energizing, transport, and environmentally responsible recycling of Swiss Solar photovoltaic modules at the end of their service life or in case of system relocation or replacement.

All work must be performed in compliance with international standards (IEC 62548, IEC 62446, IEC 62941, and WEEE Directive 2012/19/EU).

## 7.1 General Requirements

Decommissioning and dismantling of photovoltaic systems must be carried out **only by qualified and trained personnel** authorized to perform electrical and structural work.

Personnel must wear certified **Personal Protective Equipment (PPE)** including insulated gloves (EN 60903), safety goggles, protective clothing, and antistatic footwear.

Work should be performed only under safe weather conditions – **no rain, high humidity, or strong wind.**

Before beginning any work:

- Completely **disconnect the PV system** from the AC grid and ensure all DC circuits are de-energized.
- Verify with a voltmeter that the voltage at each string's terminals is **0 V** before handling.
- Use **insulated tools** rated for 1000 V DC and ensure connectors are clean and dry.
- Handle all modules with the same care as during installation to avoid injury or damage.

### **Warning:**

Photovoltaic modules can still generate voltage when exposed to light. Always cover modules with an opaque material during dismantling to prevent electric shock.

## 7.2 Decommissioning Procedure

### System Shutdown

1. Switch off the **main AC isolator** (grid side) and **DC isolator** (PV side).
2. Disconnect the **inverter** following the manufacturer's instructions.
3. Verify **absence of residual voltage** using an appropriate measuring device.

### Disconnection of Modules

- Unplug MC4 or equivalent connectors **only after confirming zero current flow.**
- Disconnect all **grounding and bonding conductors.**
- Clearly **label each string** for traceability and system documentation.
- Cover disconnected connectors with **protective caps** to prevent moisture or dust ingress.
- Ensure allv exposed cables are **insulated or capped** to prevent accidental short circuits.

### Dismantling from the Structure

- Remove modules **starting from the top rows** to prevent imbalance.
- Use proper lifting techniques and avoid applying pressure to the glass or junction box.
- Remove clamps or bolts **evenly and symmetrically** to avoid frame distortion.
- Store dismantled modules **vertically** in a shaded, dry, and vibration-free environment.

### Inspection and Sorting

After dismantling, visually inspect all modules for damage and separate them into two categories:

 **Reusable / Resale:** fully functional modules with no visible damage or performance degradation.

 **Recycling / Disposal:** cracked, delaminated, or electrically defective modules.

## 7.3 Recycling and Environmental Compliance

Swiss Solar fully supports sustainable recycling practices and circular economy principles.

All Swiss Solar photovoltaic modules are **RoHS-compliant** and contain no hazardous substances such as lead, cadmium, or mercury above permitted thresholds.

### Recommended recycling process:

- **Glass (≈70% of module mass):** recoverable for industrial glass manufacturing.
- **Aluminum frame:** 100% recyclable using standard metal recovery processes.
- **Silicon cells and EVA encapsulant:** recyclable through pyrolysis or chemical delamination methods.
- **Cables and connectors:** copper and polymers separated for secondary material use.

 Swiss Solar modules comply with **EU WEEE Directive 2012/19/EU** and **ISO 14021** for end-of-life management.

Modules in the European Union must be delivered to an **authorized WEEE collection or recycling facility**.

Recycling and waste management should follow **IEC 62941 (Quality Management for PV manufacturing)** to ensure environmentally responsible processing.

## 7.4 Reuse and Second-Life Applications

Modules that remain mechanically and electrically intact after decommissioning can be repurposed for:

- Educational or research installations
- Low-power off-grid systems
- Humanitarian or community electrification projects

Before reuse, all modules must undergo testing according to **IEC 61215** and **IEC 62446**:

- **Visual inspection:** no cracks, delamination, or corrosion
- **Insulation resistance test:**  $\geq 40 \text{ M}\Omega$  at 1000 V DC
- **Output power test:**  $\geq 80\%$  of rated  $P_{\text{max}}$  under Standard Test Conditions (STC: 1000 W/m<sup>2</sup>, 25°C, AM 1.5G)

All reused modules must retain their **original serial numbers and labeling** for traceability.

## 7.5 Documentation and Disposal Records

System owners must maintain detailed documentation of all decommissioning and recycling activities, including:

- Date and location of dismantling
- Quantity and serial numbers of removed modules
- Final destination (reuse, recycling, disposal)

Documentation should be retained for at least **10 years**, or as required by local environmental regulations.

Records may be requested by **Swiss Solar** or relevant authorities for verification of proper end-of-life management.

## 7.6 Contact for Recycling Support

For technical guidance, WEEE documentation, or certified recycling partner information, please contact:

 **Swiss Solar Environmental & Compliance Department**  
E-mail: [info@swissenergy-solar.ch](mailto:info@swissenergy-solar.ch)  
Website: [www.swissenergy-solar.ch](http://www.swissenergy-solar.ch)

 **Engineering Note:** Improper disposal or uncontrolled landfilling of photovoltaic modules is strictly prohibited under EU and international environmental laws.

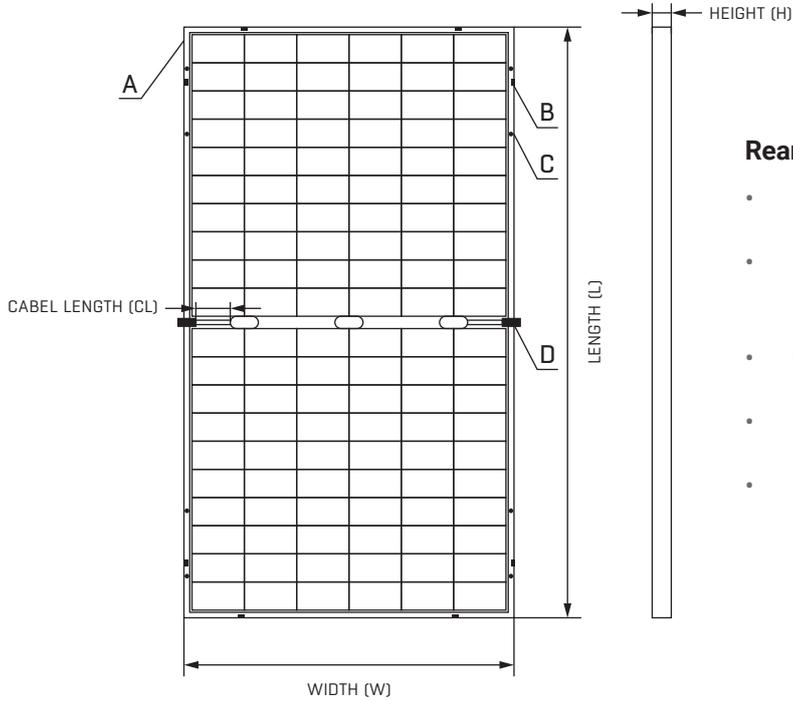
Proper recycling not only minimizes ecological impact but also recovers valuable materials such as aluminum, glass, and silicon — contributing to a more sustainable solar industry.

## 8. Applicable Module Type

	Module Type	Certification Status	Module Structure
<b>Bifacial Module</b>	IBEX-60M TOPCON xxx	TUV SUD, CE, IEC	double glass
	IBEX66M TOPCON xxx	TUV SUD, CE, IEC	double glass
	Phantom 48-TCA xxx	TUV SUD, CE, IEC	double glass
	Phantom 54-TCA xxx	TUV SUD, CE, IEC	double glass
	Phantom 66-TCA xxx	TUV SUD, CE, IEC	double glass
	Phantom 144-TCA xxx	TUV SUD, CE, IEC	double glass
	Phantom 156-TCA xxx	TUV SUD, CE, IEC	double glass
	IBEX108BF MHC TOPCON xxx	TUV SUD, CE, IEC	double glass
	IBEX120BF MHC TOPCON xxx	TUV SUD, CE, IEC	double glass
	IBEX132BF MHC TOPCON xxx	TUV SUD, CE, IEC	double glass
	IBEX144BF MHC TOPCON xxx	TUV SUD, CE, IEC	double glass
	IBEX156BF MHC TOPCON xxx	TUV SUD, CE, IEC	double glass
<b>Mono-facial Module</b>	Phantom 132-TCA xxx	TUV SUD, CE, IEC	single glass
	IBEX132MHC TOPCON xxx	TUV SUD, CE, IEC	single glass
	IBEX120MHC-TOPCON-xxx	TUV SUD, CE, IEC	single glass

# 9. APPENDICES

## 9.1 Dimensional Drawings



### Rear/Front/Side view

- Tolerance L/W = +/- 3 mm
- L/W/H = Dimensions of panel can vary, dimensions given in the order confirmation are decisive
- CL = Length of cable can vary from standard
- A, B, C, D = Position of mounting holes upon request.
- B: 8 x VENTILATION

Module Type	Length (mm)	Width (mm)	Thickness (mm)
IBEX-60M TOPCON xxx	2278	1134	30/33/35
IBEX66M TOPCON xxx	2384	1303	35/40
Phantom 48-TCA xxx	1762	1134	30/33/35
Phantom 54-TCA xxx	1962	1134	30/33/35
Phantom 66-TCA xxx	2384	1301	35/40
Phantom 144-TCA xxx	2278	1134	30/33/35
Phantom 156-TCA xxx	2382	1134	30/33/35
IBEX108BF MHC TOPCON xxx	1722	1134	30/33/35
IBEX120BF MHC TOPCON xxx	1903	1134	30/33/35
IBEX132BF MHC TOPCON xxx	2094/2102	1134	30/33/35
IBEX144BF MHC TOPCON xxx	2278	1134	30/33/35
IBEX156BF MHC TOPCON xxx	2465	1134	35/40
Phantom 132-TCA xxx	2094	1134	30/33/35
IBEX132MHC TOPCON xxx	2094	1134	30/33/35
IBEX120MHC-TOPCON-xxx	1903	1134	30/33/35

## 9.2 Electrical Connection Diagrams

Below are standard connection examples for PV modules:

### Series and parallel connection circuit diagram

**Serial connection** – modules connected end-to-end, voltage increases, current remains constant.

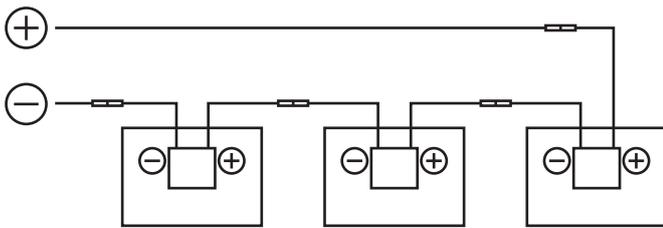
**Parallel connection** – modules connected by combining positive-to-positive and negative-to-negative, voltage remains constant, current increases.

**Parallel connection after series connection** – several strings connected in parallel after series connection.

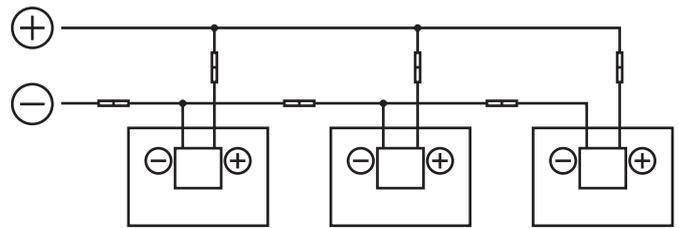
Circuit includes:

- Bypass Diode
- Overcurrent protector
- Connector

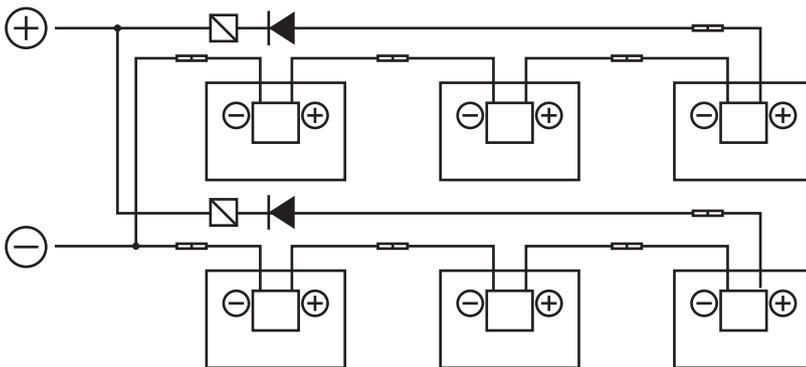
#### 1. Serial connection



#### 2. Parallel connection



#### 3. Parallel connection after series connection



Blocking Diode



Over Current Protection Device



Connector



# swiss solar



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