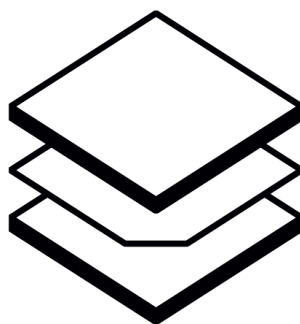




# Biosphere Solar Installation, Operation and Maintenance Manual

Contents of this manual are subject to change without notice.



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# Introduction

Welcome to the installation manual for the Biosphere Solar V1.3 solar module. This manual provides comprehensive instructions to ensure the safe and efficient installation of our circular solar modules. Proper installation is crucial for the optimal performance and longevity of the system. Please read and understand this manual thoroughly before starting the installation process.

## Codes and Regulations

### Compliance

Before installation, ensure compliance with all relevant local, state, and national electrical codes and building regulations. Adhering to these codes is crucial for the safety and legality of your solar module installation.

- **Electrical Codes:** Follow the National Electrical Code (NEC) or equivalent local standards.
- **Building Regulations:** Ensure that the installation complies with local building codes, including those related to wind loads, snow loads, and roof integrity.
- **Permits:** Obtain all necessary permits from local authorities before commencing installation.

### Standards

The module will be complying with the following standards:

- **CE- Marking:** Self-audited compliance with EU Low Voltage Directive (LVD) 2014/35/EU
- **Scope-12:** During installation, it is expected that Scope-12 screening will be done to verify module compliance.

## General

Professional installers must read these guidelines carefully and strictly follow these instructions. Failure to follow these instructions may result in death, injury or property damage. The installation and handling of PV modules requires professional skills and should only be performed by qualified professionals. The installers must inform end-users (consumers) the aforesaid information accordingly. The word "module" or "PV module" used in this manual refers to one or more Biosphere Solar modules.



## Handling

Biosphere Solar modules are heavier than traditional glass-backsheet modules due to their glass-glass design. The V1.3 modules do not have a post breakage solution and consist of **2 mm semi-tempered glass sheets**, therefore extreme care must be taken when moving the modules around since no post breakage design is present in this version. Never use the cables or junction box as a grip. Never step on the modules and drop/place heavy items on them.

## Safety Precautions

- **PPE:** Wear appropriate personal protective equipment (PPE), including gloves, safety glasses, and helmets.
- **High Voltage:** Be aware that PV modules generate high voltage when exposed to light. Handle with care. De-energize PV modules by removing them entirely from light or by covering their front surface with an opaque material.
- **Electric Arc:** When disconnecting wires connected to a photovoltaic module that is exposed to light, an electric arc may occur. Arcs can cause burns, start fires, or otherwise create safety (up to lethal electric shock) problems.
- **Weather:** When installation takes place during light rain, morning dew, take appropriate measures to prevent water ingress into the connector and do not install modules in strong wind (in accordance to the mechanical load standards).
- **Qualified Personnel:** Installation should be performed by qualified and certified professionals.
- **Fire Safety:** Keep a fire extinguisher nearby during installation.

## Documentation

- **Manual Access:** Keep this manual accessible during the installation process.
- **System Documentation:** Maintain detailed records of the installation, including wiring diagrams, module layout, and electrical parameters.

## Installation Conditions

The module is intended for use in general open-air climates, as defined in IEC 60721-2-1: Classification of environmental conditions Part-2-1: Environmental conditions appearing in nature - Temperature and humidity. The mounting components should be made out of durable, anti-corrosion and anti-UV materials such as anodized aluminum or stainless steel.

## Environmental Conditions



- **Temperature Range:** Install in environments with temperatures between -40°C and 85°C.
- **Humidity:** Ensure the installation environment is not excessively humid or wet.
- **Sunlight:** Avoid shading from nearby objects like trees, buildings, or other obstructions.
- **Corrosion:** Exposing modules to salt (i.e. marine environments) or sulfur (i.e. sulfur sources, volcanoes) incurs the risk of module corrosion.

## Structural Conditions

- **Roof Load:** Verify that the roof or structure can support the additional weight of the solar modules and mounting systems.
- **Tilt Angle:** Optimal performance is typically achieved at a tilt angle equal to the local latitude. Minimum of 10° tilt angle is required for self cleaning and load accumulation. Adjust according to specific site conditions.
- **Wind Load:** Ensure that the mounting structure can withstand local wind speeds and pressure.
- **Clamps:** A minimum of 4 clamps per module should be used in the installation. **Railless clamping** is not recommended. The panels are not able to withstand a 2400 Pa static load specified by the IEC 61215 standard in this mounting configuration.
- **Rails:** It is strongly recommended to add **at least two rails** under the solar modules to achieve a higher load resistance for the solar modules.
- **Height:** For bifacial modules it is recommended to increase the distance between the module and the surface to increase bifacial gain.

## Mechanical Installation

### Tools and Materials Required

- Mounting brackets and rails
- Wrenches and screwdrivers
- Measuring tape
- Level
- Drill
- Bolts, nuts, and washers
- Sealant

### Mounting Procedure

#### 1. Layout Planning



- Determine the layout of the solar modules on the mounting surface.
  - Ensure there is adequate space for maintenance and ventilation.
  - Plan for minimal shading throughout the day and year.
- 2. Install Mounting Brackets**
- Secure the mounting brackets to the roof or ground structure.
  - Use appropriate sealant to prevent water ingress in roof installation and ensure brackets are evenly spaced and aligned.
  - Sufficient clearance (at least 10 cm) between the module frame and the mounting surface is required to allow cooling air to circulate around the back of the module. This also enables condensation or moisture to dissipate.
- 3. Attach Rails**
- Fasten the rails to the mounting brackets using bolts, nuts, and washers.
  - Check that the rails are level and properly aligned.
  - Tighten all connections securely.
- 4. Module Placement**
- Place the solar modules onto the rails, aligning the mounting holes with the rail slots.
  - Maintain consistent spacing between modules for optimal performance and aesthetics.
  - A minimum clearance of 6.5 mm between modules is required to allow for thermal expansion of the frames.
  - The small drainage holes on the underside of the module must not be blocked
  - Shading needs to be avoided at all cost for optimal performance, sunlight should be able to reach the module even on the shortest day of the year.
- 5. Secure Modules**
- Use appropriate clamps and hardware to secure the modules to the rails.
  - Ensure clamps are tightened to the specified torque (15-20 Nm) to prevent module movement or damage. The clamps should not make contact with the glass and should not deformed the frame when tightened.
  - Double-check all mechanical connections for security.
  - Modules should be safely fixed to bear all expected loads, including wind and snow loads.

## Electrical Installation

### Cable and Wiring

All wiring must be double insulated, cross-linked cables with a minimum rating of 1.8 kV (over 1500 V voltage) and a minimum rated temperature of 90 °C (190 °F). Wire size not less than 4



mm<sup>2</sup> (12 AWG). The insulation type should be appropriate for the type of installation method used and must meet IEC 61730 and Safety Class II requirements.

## Overcurrent Protection Device

An overcurrent protection device is required for each series string if two series strings are connected in parallel. A PV fuse will protect modules and conductors from overcurrent faults. PV fuse used should have a minimum amp rating of  $1.25 \times I_{sc}$ .

## Tools and Materials Required

- MC4 connectors
- Junction boxes
- DC cables
- AC cables
- Inverter
- Multimeter

## Wiring Procedure

### 1. Connector Preparation

- Ensure connectors are correctly crimped and secure.
- Connectors are not waterproof when unmated. When installing modules, connectors should be connected to each other as soon as possible to avoid moisture and dust penetrating into the connector.

### 2. String Wiring

- Connect modules in series to form a string.
- Maintain correct polarity throughout the string to prevent damage.
- Use appropriate DC cables rated for the system voltage.
- Cable management scheme should be reviewed and approved by the EPC contractor.

### 3. Combiner Box

- Route strings to a combiner box if applicable.
- Secure all connections and ensure proper labeling of each string.

### 4. Inverter Connection

- To maintain optimal power output, Biosphere Solar recommends clients to install modules with anti-PID inverters.
- Connect the output from the combiner box or directly from the strings to the inverter.
- Follow the inverter manufacturer's guidelines for wiring and configuration.
- Check all connections with a multimeter before powering on.



## 5. Check Connections

- Verify all electrical connections are secure and properly insulated.
- Perform continuity tests to ensure there are no open circuits.

# Grounding

## Grounding Hardware

- Biosphere Solar does not provide grounding hardware.
- Use appropriate grounding lugs and wires.
- Grounding hardware must be rated for outdoor use and compatible with the module frame.
- All bolts, nuts, flat washers, lock washers and other relevant hardware should be made of stainless steel, unless otherwise specified.
- Connect module frames together using adequate grounding cables: we recommend using 4-14 mm<sup>2</sup> (AWG 6-12) copper wire. Holes provided for this purpose are identified with a grounding symbol (IEC 61730-1). All conductive connection junctions must be firmly fixed.

## Grounding Points

- Ensure each module and mounting structure is properly grounded.
- Use dedicated grounding points provided on the module frame.

## Connection to Earth

- Connect the grounding system to the building's main grounding electrode.
- Ensure the grounding conductor is sized according to local electrical codes.

# Operation and Maintenance

## Initial Checks

- **System Inspection:** Before switching on, inspect the entire system for any loose connections or physical damage.
- **Performance Verification:** Verify the system is producing the expected power output using a solar installation meter or the inverter's display.

## Regular Maintenance

### 1. Cleaning



- Regular maintenance is required to keep modules clear of snow, bird droppings, seeds, pollen, leaves, branches, dirt spots, and dust.
  - Clean the solar modules regularly with water and a soft cloth to remove dirt and debris.
  - Avoid using abrasive materials or strong chemicals.
2. **Visual Inspection**
- Periodically inspect the modules and mounting structures for any signs of wear or damage.
  - Check for any signs of corrosion on electrical connections and grounding points.
3. **Electrical Checks**
- Conduct regular checks on electrical connections and ensure there are no signs of corrosion or loose connections.
  - Check the system's performance periodically to ensure optimal output.

## Troubleshooting

- **Low Power Output**
  - Check for shading, dirt on modules, and loose electrical connections.
  - Take electroluminescence (EL) images to identify failure spots in individual modules.
  - Verify that all inverters and other system components are functioning correctly.
- **Module Damage**
  - Contact Biosphere Solar for options to repair, recycle or refurbishment for the damaged modules
  - Ensure replacements are of the same type and rating.
  - Do NOT throw the damaged modules away, contact your local producer responsibility organisations for proper treatment.
- **Inverter Issues**
  - Consult the inverter's manual for specific troubleshooting steps.
  - Check error codes and perform resets as recommended.

## Warranty Information

- **Warranty Period:** The Biosphere Solar V1.3 modules come with a 10 year warranty for defects in materials and workmanship.
- **Performance Warranty:** The modules are guaranteed to maintain at least 80% of their rated power output for 35 years.
- **Claim Process:** Contact Biosphere Solar with proof of purchase, a description of the issue, and supporting photographs to initiate a warranty claim.





## Technical Specifications

### Electrical Specifications

Version Designation	V1.3-120	V1.3-144
Efficiency	23.54%	23.54%
Cell amount	120	144
Cell type	JA half cut TOPCON bifacial	JA half cut TOPCON bifacial
PID	PID free	PID free
Bypass diodes amount	3	3
Bypass diode type	gf4045	gf4045
Cable length	1m	1m
Connector type	Stäubli MC4 (PV-KBT4/6II-UR)	Stäubli MC4 (PV-KBT4/6II-UR)
Maximum system voltage	1500V	1500V

Electrical Characteristics (STC)	V1.3-120	V1.3-144	Variance		
Nominal Max. Power (PMax)	466	560	+/-	11.55	%
Open Circuit Voltage (Voc)	41.5	49.8	+/-	1.3	%
Short Circuit Current (Isc)	13.6	13.6	+/-	2.85	%
Maximum Power Voltage (Vmpp)	36.4	43.6	+/-	1	%
Maximum Power Current (Impp)	12.8	12.8	+/-	8.15	%



## Physical Characteristics

See this [page](#) for technical drawings of Biosphere Solar modules.

	V1.3R	V1.3U
Weight (kg)	27.38	30.66
Dimensions Frameless (mm)	1134 x 1976 x 10	1134 x 2358 x 10
Dimensions with Frame (mm)	1140 x 1982 x 30	1140 x 2388 x 30
Operating temperature (°C)	-40°C / +85	-40°C / +85

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