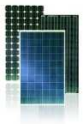
Upsolar Delivering safe solar

Photovoltaic Module Safety & Installation Manual

Version: revised version 1.14 - English

***NOTICE!* Please carefully read and understand the provided installation manual before installing, wiring, or operating our product in your PV system. Failure to follow all proceeding terms and conditions will void Upsolar's Limited Warranty contract.**



1.0 INTRODUCTION

Thank you for choosing the Upsolar Photovoltaic module. Our goal is to provide you with a top quality long lasting product.
This installation guide, provided by Upsolar Co., Ltd. and supplied with Upsolar modules, contains information regarding proper handling, installation, and maintenance.

All instruction in this guide should be read and understood by all parties before attempting to install Upsolar photovoltaic modules. PV designers and installers should always comply with all safety precautions listed within this guide as well as any local or jurisdictional codes that pertain to PV installations.

Upsolar reserves the right to make changes to both products and installation manual without prior notice to the customer.
Please contact support@upsolar.com for any additional questions or explanations.

1.1 Liability Condition

The installation techniques, handling and use of Upsolar product are beyond Upsolar's company control. Therefore, Upsolar does not assume responsibility for loss, damage or expense resulting from improper installation, handling or use.

1.2 Limited Warranty

All Upsolar PV module warranties are listed in the Upsolar warranty conditions which can be downloaded from our website. www.upsolar.com

2.0 SAFETY PRECAUTIONS

Before installing or operating modules, please read and understand all general safety instructions in this manual!

Module Installation should only be carried out by qualified individuals.

- **Always** follow and observe all appropriate regional and jurisdictional electric codes.
- **Always** use properly insulated and/or rated electrical and mechanical tools during installation of PV modules
- **Always** mount PV modules over a fire resistant roof, in case of roof mounting (according to IEC 61730-1 clause 12.4)
- **Always** ground all PV modules according to the local electrical codes.
- **Always** use only the same type of PV modules within 1 PV circuit**.**
- **Do not** step on or put heavy/sharp objects on PV module.
- **Do not** disconnect module under load.
- **Do not** use artificial methods for cooling the PV module (water).
- **Do not** touch PV module terminals (avoid wearing metallic jewelry or devices attached to the body during installation).
- **Do not** install PV modules in wet or windy conditions.
- **Do not** drill extra holes in module frame or glass surface
- **Do not** store or install PV modules near flammable gasses or materials
- **Do not** disassemble any part of the PV module
- **Do not** expose the artificially concentrated sunlight to a module or panel (according to IEC 61730-1 clause 12.5)

3.0 ELECTRICAL CHARACTERISTICS OF A PV MODULE

It is very important to understand that a photovoltaic module can have electrical characteristics different than the (Standard Test Conditions) STC rating on the module nameplate. Atmospheric conditions often increase the module's current and/or voltage higher than that reported at STC.

STC = 1000 W/m^2 AM 1.5 25℃

Always refer to your local jurisdictional codes when sizing conductors, fuses, inverters, and other Balance of System (BOS) components.

Danger

WARNING!

All installation and mounting instructions must be read and properly understood before attempting to install, wire, and/or operate PV modules. PV modules generate DC electricity when exposed to light. This can pose danger to the installer, user, and/or property. Any contact with electrically active module-terminals can result in arcing; leading to shocks, burns, fires, and/or death.

PV modules are electrically live when mounted and installed.

Danger: Electrical potential (SHOCK DANGER) increases with parallel (higher currents) and series (higher voltage) connection of PV modules.

The PV installer must assume all inherent risk of property damage and/or personal injury related to the mishandling of PV modules during installation and maintenance.

"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of ISC and VOC marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output." (Extract from IEC 61730-1 clause 12.7 and UL1703 clause 48.9)

"Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable." (according to UL1703, clause 48.6)

4.0 ELECTRICAL CONFIGURATIONS

4.1 General Wiring / Configuration

Please follow all module specification and jurisdictional laws regarding interconnection of PV modules. Photovoltaic modules can be connected in both series and/or parallel to attain the desired electrical output.
Combined source circuits should contain only 1 type of PV module.

Conductors must meet or exceed the following requirements (IEC 61730-1 clause 12.3):

- Size: minimum 4.0 mm^2 (12 AWG) for modules connected in series
- Temperature rating (-40℃ to +90℃)
- Type PV-wire, USE-2 or equivalent

4.2 Maximum Voltage (i.e. series connections)

The maximum PV system voltage for a circuit should be calculated as the sum of the rated open circuit voltage of the series connected PV modules (corrected for the lowest expected ambient temperature). Open Circuit Voltage should be used to determine the voltage rating of all other BOS (Balance of System) components in the system

The open voltage of each string must never exceed the maximum system voltage value defined by the local regulation (IEC 61730-1 clause 12.3)

Refer to the datasheets for PV modules Temperature Coefficients.

4.3 PV Module and Equipment Grounding

Please refer to the applicable regional and local codes in regards to grounding PV modules, and other PV system components.

If PV modules individual grounding is requested by the local legislation, Upsolar PV modules should be grounded to the module frame using one of the provided grounding holes (Figure 1). Please refer to NEC Article 250, 690.41-690.49, and UL Standard 1703 for proper grounding procedures.

Example (according to IEC61730-1 clause 12.3): Remove any anodization or oxidation from the module frame at the grounding lug point of contact. Apply a thin coat of anti-oxidant film, then use a stainless steel M10 screw, nut, and lock washer to attach an outdoor rated tin-plated copper lug. Attach an equipment grounding conductor (4mm^2-12AWG) to the installed grounding lug (always check your local grounding code before any installation).

4.4 Lightning protection

PV systems do not generally increase the risk of buildings being struck by lightning. If a lightning protection system currently exists on the installation building, the PV system should be connected to any lightning protection system.

Surge arrestors on the DC side of the PV system are recommended. If no lightning protection exists, all PV modules should be earth-grounded.

4.5 Overcurrent Protection (OCPD))

When the series current of a PV string exceeds the rated Upsolar PV module series fuse rating (15A for monocrystalline modules with 5" cells and 20A for polycrystalline modules and monocrystalline modules with 6" cells) an overcurrent protection device (OCPD) must be used (IEC 61730-1 clause 12.3). 1 or 2 strings of PV modules in parallel do not require OCPD's, but 3 or more PV strings in parallel will usually require an OCPD. In this case, it is recommended to use one fuse per string rated at 1.56 x Isc or higher (Isc is the PV module short circuit current at STC). Example of fuse types: DCM 600Vdc for UL or PV Fuse – 1000Vdc for IEC

Each Upsolar module is equipped with 3 by-pass diodes (Schottky type) to limit the cells heating in case of shading (hot-spot effect).

5.0 MODULE CHARACTERISTICS

5.1 Operating Temperature

Always try to provide adequate ventilation around installed PV modules, especially in hot environments. Cells performance will be affected by temperature.

Predetermined Nominal Temperatures for Upsolar Modules:

Maximum Operating Temperature	+90°C	+194°F
Minimum Operating Temperature	-40°C	-40°F

Table 1: UPSOLAR MODULE OPERATING TEMPERATURES

- It is recommended that at least 5 cm or 2 inches is maintained between the mounting surface and the PV module.
- ≥ (3/16) inch or 5 mm gap is recommended between adjoining modules to allow for thermal expansion.

5.2 PV Module Design Strength

Upsolar PV modules have been tested according to IEC design qualification type EN 61215: 2005 and IEC safety standard EN 61730-1&2:2007 (Application class A, refer to clause 12.1).

Modules rated for use in the application class A may be used in systems operating at greater than 50 V DC or 240 W, where general contact access is anticipated. Modules qualified for safety through this part of IEC 61730 and IEC 61730-2 and within this application class are considered to meet the requirements for safety class II.

Upsolar PV modules have passed the mechanical load test to 5400 Pa. This corresponds to a wind speed of approximately 250 mph.

Upsolar PV modules comply with the test requirements for UL 790 Class C Spread of Flame Test and Burning Brand Test.

5.3 Mounting Hardware

All hardware that comes into contact with the PV module frame should be corrosion and UV resistant. Damage to the module frame or structure could occur if improper materials are used.

Stainless Steel = M6 (1/4") Nuts, Bolts, Washers

To minimize galvanic corrosion similar metals to aluminum should be used when in contact with the PV module frame.

Upsolar Module Frame material: Aluminum

Always apply proper torque settings to all mounting hardware according to manufactures specifications.

5.4 Operating Environments

Do not mount or operate Upsolar PV modules in the following environments:

- Extreme wind
- Extreme temperature *(see Table 1)*
- Corrosive, salty, acidic, or sulfurous environments
- Near flammable gasses or materials
- In highly shaded areas

6.0 MOUNTING CONFIGURATIONS

Always try and select a suitable orientation to maximize the sunlight exposure to the PV module surface. Shading can significantly affect the module and string performance in a PV array.

Sufficient space between the module frames and mounting structure is required to prevent module damage and to reduce high operating temperatures due to poor air circulation.

6.1 Module Mounting Techniques

Upsolar PV modules can be mounted either vertical or landscape as long as one of the following mounting procedures is followed (according to IEC 61730-1 clause 12.4)

1. **Frame Holes:** Attach the PV module to the mounting system using the provided factory mounting holes. At least 4 points of connection are required between each module and the mounting surface. *It is recommended* that 4 M6 (1/4") SS bolts with nuts and washers are used on each module. The torque recommended to fix the bolts is 15 N.m (11.1 lb.ft).

2. **Top Mount Clamps/Clips:** Attach the PV module to the mounting system using Clamps or Clips from a certified manufacture according to their instructions. Clamp and/or clips should be spaced at ¼ the length or width from the frame ends (± 5 cm). Top mount clamps/clips should always be mounted symmetrically. See figure 1. Upsolar recommend the following minimum dimensions for each clamp: catch length: 30.0mm, catch width: 5.0mm, thickness: 3.0mm. The torque recommended to fix the clamps is 15 N.m (11.1 lb.ft).

3. **End Mount:** End mounting is the capture mounting of the length of the module's end frame to a supporting rail. The end frames are on the shorter sides of the module. The end-mounting rail and clips or clamps must be of sufficient strength to allow for maximum design pressure of the module. Verify this capacity with the mounting system vendor before installation.

Slope: PV module has class C fire rating and must be installed over a roof with appropriate fire resistance. A minimum slope of 5"/ft for installation is required to maintain fire class rating. Further consult local, regional and national building fire statutory regulation.

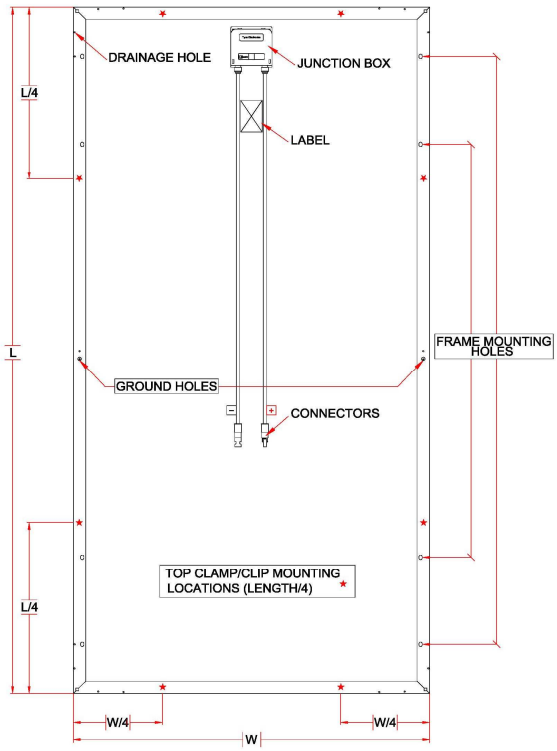


Figure 1: Module Mounting Locations

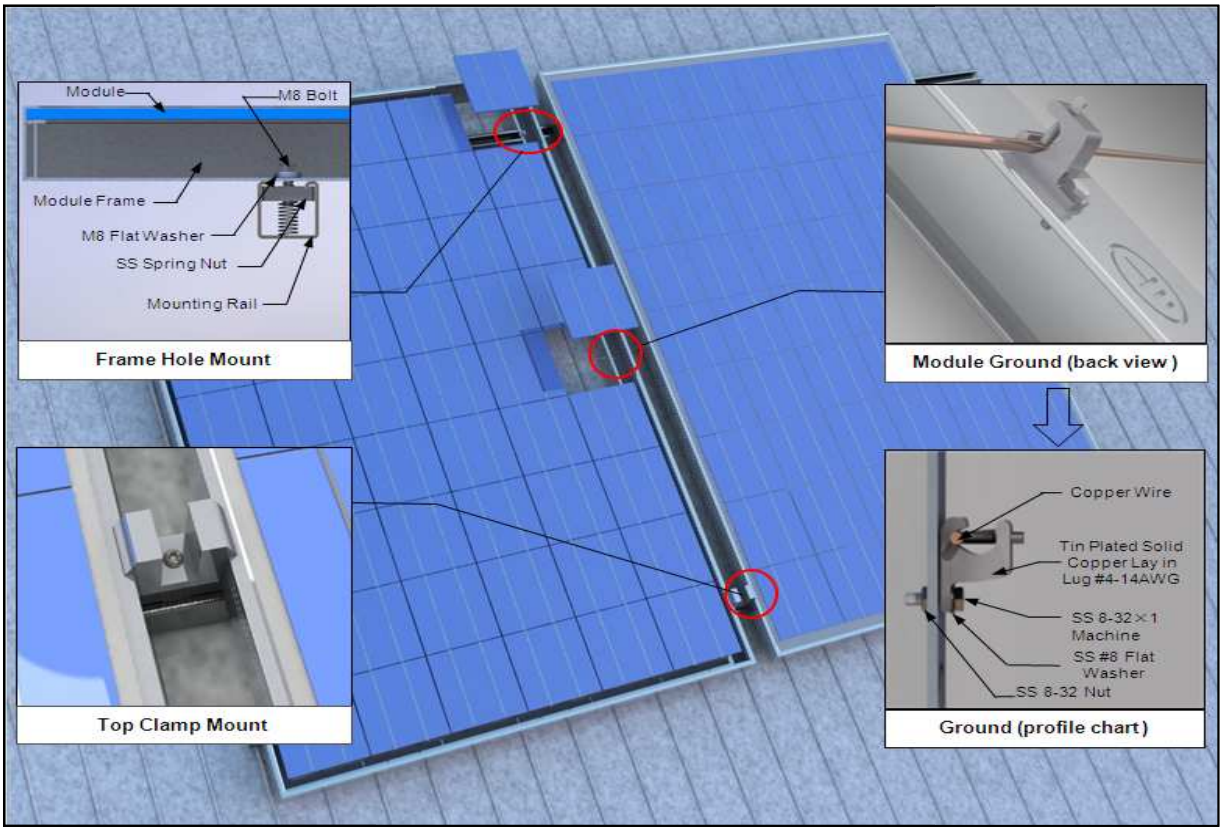


Figure 2: Module installation diagram (recommended)

7.0 MAINTENANCE

Annual inspection of the PV modules, array, and BOS is highly recommended. The following items (regarding the PV modules) should be checked periodically to keep the PV system functioning correctly for many years.

1. Ensure there is no corrosion on any mechanical connection between the PV module and the mounting structure. Tighten all loose components to specified torque settings.

2. Check all electrical connection for corrosion and separation on PV modules (connectors, cables, and grounds). **Never disconnect PV modules under load!**

3. Make sure PV modules are **clean and free of dirt and dust**. Use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used if necessary.

    - Critical Cleaning Liquid Detergent is recommended. Do not use dishwasher detergent!
    - Use water pressure of 45 PSI (3 bar) or less.
    - De-ionized water is recommended if available.
    - Do not use cold water on hot modules

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