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Solar Module Installation Manual (UL)

www.canadiansolar.com

CONTENTS

1.0 GENERAL INFORMATION

This general manual provides important safety information relating to the installation, maintenance and handling of CS-series solar modules. System users and professional installers should read this manual carefully and strictly follow the instructions. Failure to follow these instructions may result in death, injury or property damage. The installation of solar modules requires specialized skills and should only be performed by licensed professionals.

The word "module" or "PV module" used in this manual refers to one or more CS-Series Solar Modules.

Please retain this manual for future reference. It is recommended to regularly check on www.canadiansolar.com for the most updated version.

1.1 DISCLAIMER OF INSTALLATION MANUAL

The information contained in this manual is subject to change by Canadian Solar Inc. without prior notice. Canadian Solar Inc. makes no warranty of any kind whatsoever, either explicitly or implicitly, with respect to the information contained herein.

1.2 LIMITATION OF LIABILITY

Canadian Solar Inc. shall not be held responsible for damages of any kind, including without limitation bodily harm, injury and property damage, relating to module handling, system installation, or compliance or non-compliance with the instructions set forth in this manual.

2.0 SAFETY PRECAUTIONS

Warning: All instructions should be read and understood before attempting to install, wire, operate and/or maintain the module. Module interconnects pass direct current (DC) when exposed to sunlight or other light sources. Contact with electrically active parts of the module, such as terminals, can result in injury or death, whether the module is connected or disconnected.

Avertissement: Toutes les instructions devront être lues et comprises avant de procéder à l'installation, le câblage, l'exploitation et/ou l'entretien des panneaux. Les interconnexions des panneaux conduisent du courant continu (CC) lorsque le panneau est exposé à la lumière du soleil ou à d'autres sources lumineuses. Tout contact avec des éléments sous tension du panneau tels que ses bornes de sortie peut entraîner des blessures ou la mort, que le panneau soit connecté ou non.

General Safety

- All Modules must be installed by licensed electricians in accordance to the applicable electrical codes such as, the latest National Electrical Code (USA) or Canadian Electric Code (Canada) or other national or international electrical codes.
- Wear suitable protection (non-slip gloves, clothes, etc.) to prevent direct contact with 30VDC or greater, and to protect your hands from sharp edges during the installation.
- Use electrical insulated tools to reduce the risk of electric shock.
- Remove all metallic jewelry prior to installation to reduce the chance of accidental exposure to live circuits.
- During normal operation, if the disconnects and OCPD's cannot be opened or the inverter cannot be powered down, cover the front of the modules in the PV array with an opaque material to halt production of electricity when installing or working with a module or wiring.
- When installing or handling the modules during light rains, morning dews or high wind periods,

appropriate safety measures should be taken to avoid damage to module or injuries to people.

- Do not use or install broken modules.
- If the front glass is broken, or the back sheet is torn, contact with any module surface or the frame can cause electric shock.
- Keep the junction box cover closed at all times.
- Do not attempt to repair any part of the module. There're no serviceable parts within the PV module.
- Do not disassemble a module or remove any module part.
- Do not artificially concentrate sunlight on a module.
- Do not connect or disconnect modules when current from the modules or an external source is present.
- Do not allow children and unauthorized persons near the installation site or storage area of modules.

Hazardous Locations Safety

- For modules which are suitable for use in Class I, Division 2, Groups A, B, C and D hazardous locations, the following WARNINGS should be strictly conformed to avoid any personal injury or property loss.

Warning: Explosion hazard – Do not disconnect equipment unless power has been switched off or the area is known to be non-hazardous.

Avertissement: Risque d'explosion – Avant de déconnecter l'equipement, couper le courant ou s'assurer que l'emplacement est désigné non dangereux.

3.0 MECHANICAL / ELECTRICAL SPECIFICATIONS

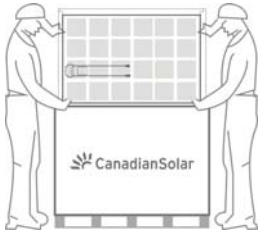
The module electrical ratings are measured under Standard Test Conditions (STC) of 1 kW/m^2 irradiance with an AM1.5 spectrum, and cell temperature of 25°C. The detailed electrical and mechanical characteristics of Canadian Solar Inc. crystalline silicon PV modules can be found in Annex C. Main electrical characteristics at STC also appear on each module label. The maximum system voltage for all modules series is either 600V or 1000V. Please refer to the datasheet or the product nameplate for the maximum system voltage.

Under certain conditions, a module may produce more current or voltage than its Standard Test Conditions (STC) rated power. Accordingly, a module's open-circuit voltage and short-circuit current at STC should be multiplied by 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output. An additional 1.25 multiplier for a short-circuit current (for a total of 1.56), for sizing conductors and fuses may be applicable, as described in section 690-8 of U.S. NEC.

4.0 UNPACKING AND STORAGE

Precautions

- If panels are stored in an uncontrolled environment for less than 3 months, extra precautions should be exercised to prevent moisture exposure to connectors or sunlight exposure to panels.Unpacking module pallet with care and follow the unpacking steps marked on the pallet. Be careful when unpacking, transporting and storing the modules.
- Two people are required to unpack modules from the packing box. When handling modules always use both hands.
- Do not carry a module by its wires or junction box; Carry it by its frame.
- When stacking modules on top of each other, maximum 12 modules can be stacked and frame should be aligned.
- Do not place excessive loads on the module or twist the module frame.
- Do not bow modules under their own weight.



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- Do not stand, step, walk and/or jump on the module.
- Do not carry the module on worker's head.

- Do not drop or place objects on the modules (such as tools.)
- Do not mark the modules with sharp instrument. Particular attention should be taken to avoid module backsheet to come in contact with sharp objects, as scratches may directly affect product safety.
- Do not leave a module unsupported or unsecured.
- Do not change the wiring of bypass diodes.
- Keep all electrical contacts clean and dry.

Product identification

- Each module is fitted with two identical barcodes (one on the laminate under the front glass, the second on the module rear cover) for its unique identification. Each module has a unique serial number with 13 (before 2013/03) or 14 digits (after 2013/03) digits.
- A nameplate is also affixed on the rear side of each module. This nameplate defines the model type, as well as the main electrical and safety characteristics of the module.

5.0 MODULE INSTALLATION

Precautions and General Safety

- Before installing modules, contact the appropriate authorities for site, installation and inspection permission and requirement.
- Check applicable building codes to ensure that the construction or structure (roof, facade, support, etc.) can withstand the module system load.
- When installing the modules, please ensure the assembly is mounted over a fire resistant roof covering rated for the application. Canadian Solar modules have been listed as Class C according to UL790 standard.
- The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.

- **Notice**: In any case DO NOT STAND OR STEP on the modules, as localized high loads may induce severe micro-cracks at the cell level, which in turn may compromise module reliability. Failure to comply with above caution will void Canadian Solar Inc warranty.

Environmental conditions

- The module is intended for use in general open climates, as defined in IEC 60721-2-1: Classification of environmental conditions Part 2-1: Environmental conditions appearing in nature - temperature and humidity.
- Do not install modules near naked flames or flammable materials.

- Do not immerse modules in water or constantly expose modules to water (either fresh or salt) (i.e. from fountains, sea spray).
- Exposing modules to salt (i.e. marine environments) and sulfur (i.e. sulfur sources, volcanoes) risks module corrosion.

Requirements of installation

- Ensure that the module meets the technical requirements of the system as a whole.
- Ensure that other systems components do not exert damaging mechanical or electrical influences on the modules.
- Modules can be wired in a series to increase voltage or in parallel to increase current. To connect in series, connect cables from the positive terminal of one module to the negative terminal of the next module. To connect in parallel, connect cables from the positive terminal of one module to the positive terminal on the next module.
- Quantity of bypass diodes provided can vary depending on model series.
- Connect the quantity of modules that match the voltage specifications of the inverters used in the system. Modules must NOT be connected together to create a voltage higher than the permitted maximum system voltage, even under the worst local temperature conditions.
- Similar electrical performance modules should be connected in the same series to avoid or minimize mismatch effects in arrays.
- To minimize risk in the event of an indirect lightning strike, avoid forming loops when designing the system.
- The recommended maximum series fuse rating is tabulated in annex.
- Modules should be firmly fixed in place in a manner suitable to withstand all expected loads, including wind and snow loads. A minimum clearance of 6.5 mm (1⁄4 of an inch) or more between modules is required to allow for thermal expansion of the frames.
- Small openings for water draining on the underside of the module should not be blocked after mounting.

Optimum orientation and tilt

- Find out the optimum orientation and tilt of the PV modules for your region to achieve the maximum annual yield. Generation of maximum power occurs when sunlight shines perpendicularly onto the PV modules.

Avoid shading

- Even the slightest partial shading (e.g., from dirt deposits) will cause a reduction in yield. A module is considered "shadow-free" if it is unobstructed across its entire surface for the whole year. Even on the shortest day of the year, unobstructed sunlight can reach the module.

Reliable ventilation

- Sufficient clearance (at least 10 cm) between the module frame and the mounting surface is required to allow for cooling air to circulate around the back of the module. This also allows for condensation or moisture to dissipate.

5.1 MODULE WIRING

Correct wiring scheme

- Make sure that wiring is correct before starting up the system. If the measured open circuit voltage (Voc) and short-circuit current (Isc) differ from the specifications, then there is a wiring fault.

Correct connection of plug connectors

- Make sure that the connection is safe and tight. The plug connector should not receive outer stress. The connector should only be used to connect the circuit. It should never be used to turn the circuit on and off.

Use of suitable materials

- Use special solar cable and suitable plugs only (wiring should be placed in conduit that is sunlight-resistant or, if exposed, should be sunlight-resistant) in accordance with local fire, building and electrical code. Ensure that they are in perfect electrical and mechanical condition.
- The permitted type of solar cable is single conductor cable listed and labeled as USE-2 or PV Wire, 90°C wet rated, with proper insulation to withstand the maximum possible system open-circuit voltage. The conductor material should use copper only. Select a suitable conductor gauge to minimize voltage drop and ensure conductor ampacity complies with local regulations (such as NEC 690.8(D)).

Cable protection

- Secure the cables to the mounting system using UV-resistant cable ties. Protect exposed cables from damage with appropriate precautions (e.g. locate them within plastic conduit). Avoid exposure to the direct sunlight.
- Minimum bending radius of 60mm is required when securing the junction box cables to the racking system.

5.2 EQUIPMENT GROUNDING

- A module with exposed conductive parts is considered to be in compliance with U1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National Electrical Code.
- The modules are required to be grounded, and the module installation complies with all local electrical codes and regulations.
- The earth grounding connection should be made by a qualified electrician.
- Connect module frames to each other using suitable grounding conductor. Holes provided for this purpose are identified with a grounding symbol. ⏚
- Use 6-12 AWG (4-14 mm^2) copper wire only. The bolts, nuts, flat washers, lock washers or other relevant hardware should be made of stainless steel, unless otherwise specified.
- All the junctions on the conductive connection must be fixed. Metal containing iron in the conductive connection should be made with stainless steel or be treated against corrosion by anodizing, spray-painting, or galvanization to prevent rusting and corrosion.
- Grounding hardware is not provided by Canadian Solar Inc.
- One grounding method approved by North-American certification bodies is recommended for Canadian Solar modules, as described below. For alternative grounding methods, please refer to the Annex B (Alternative Grounding Methods) on the website (www.canadiansolar.com). For specific module ranges, standard grounding methods cannot be applied, please refer to the Annex B for more details.

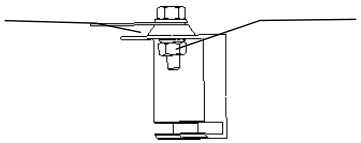
Grounding Method: Bolt + Nut with teeth + Cup washer

When diameter of the grounding holes is 5mm (CSA certified).

- A grounding kit with M5 size SS cap bolt, M5 size SS flat washer, M5 size SS cup washer, and M5 size SS nut (with teeth) is used to attach a copper grounding wire to grounding hole pre-drilled on the frame (see picture below).
- Attach the wire between the flat washer and the cup washer. Ensure the cup washer is between the frame

and wire with concave side up to prevent corrosion due to dissimilar metal. Tighten the bolt securely using the SS nut with teeth. A wrench may be used in this application. The tightening torque is 1 Nm.

Attach wire between the flat washer and cup washer. Place cup washer (concave side up) between frame and wire.



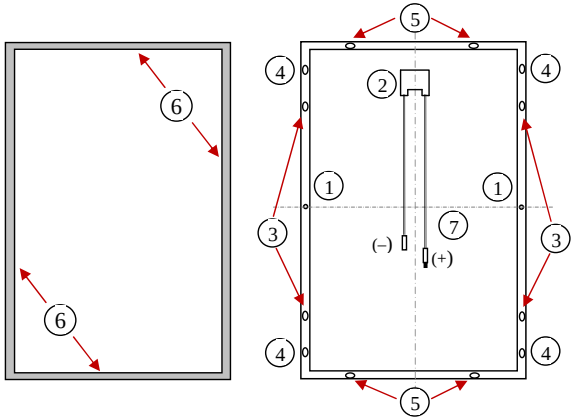
Tighten the bolt using the nut with teeth.

6.0 MOUNTING INSTRUCTIONS

Standard modules

- For a clear understanding of module, please refer to the illustration of a standard module shown below:

Reference	Designation
1	Grounding holes
2	Junction box
3	Standard mounting holes (long side)
4	Additional mounting holes (high wind or snow loads)
5	Standard mounting holes (short side)
6	Module frame
7	Cables and connectors



- The mounting design must be certified by a registered professional engineer. The mounting design and procedures shall comply with local electrical and building codes.
- The module is considered to be in compliance with UL 1703 only when the module is mounted in the manner specified by the mounting instructions below.
- All installation methods listed in CSI installation manual (including in Annex) have been qualified by major North-American certification bodies (CSA, or Intertek).
- Mounting hardware is not provided by Canadian Solar Inc.
- Canadian Solar Inc. modules can be mounted to a support structure by several approved methods, one mounting method is described as below. Other mounting methods and mounting methods for special module range are recommended for Canadian Solar Inc., please refer to the Annex A (Alternative Mounting Methods) on the website (www.canadiansolar.com) for more details. For other installation hardware, please contact your local representative for further information. Failure to use a recognized installation method will void Canadian Solar Inc. warranty.
- Use appropriate corrosion-proof fastening materials. All mounting hardware (bolt/spring washer/flat washer/nut) should be made with stainless steel.
- Use a torque wrench for installation.
- Do not drill additional holes or modify the module frame. Doing so will void the warranty.

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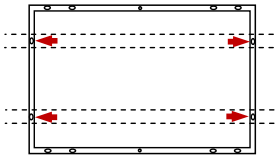
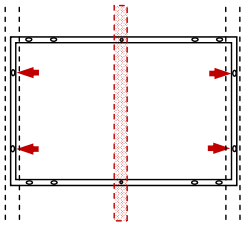
- Any module without a frame (laminate) shall not be considered to comply with the requirements of UL 1703 unless the module is mounted with hardware that has been tested and evaluated with the module under this standard or by a field Inspection certifying that the installed module complies with the requirements of UL 1703.
- Canadian Solar Inc. modules can be installed in either landscape or portrait position, refer to the detailed instructions for further guidance. Note that further countermeasures such as the use of additional support bars should be considered in heavy snow areas (> 2400 Pa), to avoid damage by the snow accumulating in the lowest row of modules.
- When the addition of a support bar is recommended to enhance mechanical stability and module long term performance reliability, material of suitable resistance should be selected. Canadian Solar Inc. recommends a minimum thickness of 50mm for the bar. The support bar centerline should be positioned within 100 mm of the side frame centerline (slight shift may be necessary to access module grounding hole).

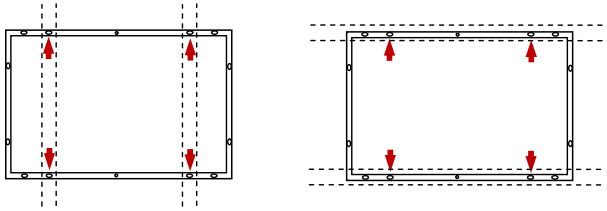
6.1 MOUNTING METHOD: BOLTING

- Modules should be bolted to support structures through mounting holes located in the frame's back flanges only.
- Each module must be securely fastened at a minimum of 4 points on two opposite sides, using the most inner mounting holes. M6 size bolt and nut are used for bolting method. Tightening torques should be within 4~6 Nm for M6x1 coarse thread bolts, depending on bolt class. If additional wind loads are anticipated for this installation, additional mounting points should be used. System designer and installer are responsible for load calculations and for proper support structure design.
- **Mounting Method : Bolting(INTEETEK and CSA qualified)**

- Modules should be bolted at the following hole locations depending on the configuration and load:

Table 6-1: Authorized attachments for bolting method

	Uplift load ≤ 2400 Pa **Downforce load ≤ 2400 Pa**	**Uplift load ≤ 2400 Pa** **2400 Pa ≤ Downforce load ≤ 5400 Pa**
Bolting on short side frame **(except for 6X series)**	Use 4 standard mounting holes (short side)  Mounting rails may run parallel or perpendicularly to the short side frame	Use 4 standard mounting holes (short side). An additional support bar should be placed below the module.  Mounting rails should run parallel to the short side frame

Bolting on long side frame	Use 4 standard mounting holes (long side)  Mounting rails may run perpendicularly or parallel to the long side frame

7.0 MAINTENANCE

- Regular maintenance is required to keep modules clear of snow, bird droppings, seeds, pollen, leaves, branches, dirt spots and dust.
- If a module has a sufficient tilt (at least 15^0), it generally is not necessary to clean the modules (rainfall will have a self-cleaning effect). When there is a noticeable buildup of soiling deposits on the module surface, wash the PV array with water and a gentle cleaning implement (a sponge) during the cool part of the day. Dirt must never be scraped or rubbed away when dry, as this will cause micro-scratches.
- If snow is present, a brush with soft bristles can be used to clean the surface of the module.
- Periodically inspect the system to make sure all wiring and supports stay intact.
- If you need electrical or mechanical inspection or maintenance, it is recommended to have a licensed, authorized professional carry out the job to avoid hazards of electric shock or injury.
- Do not change the PV components (diode, junction box, plug connectors).
- Please refer to Annex D for more information about module cleaning guidelines

AMENDMENT EDITIONS AND DATES

- The first edition Rev 1.1 is released in Jan, 2009.
- Rev 2.1 is amended and released in Jan, 2011.
- Rev 2.2 is amended and released in Apr, 2012.
- Rev 2.3 is amended and released in Sep, 2012.
- Rev 2.4 is amended and released in May, 2013.
- Rev 2.5 is amended and released in Nov, 2013.