



**Polish manufacturer
of photovoltaic panel
fasteners**

Installation manual

and safe operation instructions
of photovoltaic modules
ENCOR

[Does not apply to BIFACIAL modules]

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General information

This manual contains information regarding the installation and safe operation instructions of ENCOR photovoltaic modules (hereinafter referred to as "Module").

All instructions should be read and understood before attempting to install. If there are any questions, please contact the manufacturer for further explanation. The installer should conform to all the safety precautions in the manual when installing the module. Local regulations should also be followed in such installation.

Before installing a solar photovoltaic system, the installer should become familiar with the mechanical and electrical requirement for such a system. Keep this guide in a safe place for further reference (care and maintenance) and in case of sale or disposal of the module.

Safety precautions

The modules are designed to meet the requirements of IEC 61215 and IEC 61730, and its end use level is A. Class A modules are suitable for systems with direct current voltage greater than 50V or 240W that may be contacted by the public. These modules' security is classified in IEC 61730-1 and IEC 61730-2 and they meet the requirement of security class II according to IEC 61140.

General safety

- Installing photovoltaic modules requires specialized skills and knowledge determined in regulations applicable in a given country.
- Installation must only be performed by authorized and trained personnel. Installers must assume all risks of injury that might occur during installation, including, but not limited to, the risk of electric shock.
- A single module generates a direct current voltage over 30 V that can cause personal injury in the presence of direct sunlight. Contact with direct current has high potential risk, please avoid contact with direct current under any circumstances.
- PV modules are recommended to be installed at altitudes of less than 2000 m.
- Modules can be ground mounted or mounted on rooftops. The proper design of support structures lies within the responsibility of the system designers and installers.
- When installing the system, abide to all local, regional and national statutory regulations. Obtain a building permit if necessary.

■ The electrical characteristics are within ± 3 percent of the indicated values of I_{sc} , V_{oc} and P_{max} under standard test conditions: irradiance of 1000 W/m^2 , AM 1.5 spectrum, and a cell temperature of 25°C (77°F).

■ Only use equipment, connectors, wiring and support frames suitable for solar electric systems.

■ Always use fall protection equipment when working from heights. Follow Occupational Safety and Health Act (OSHA) or local safety regulations regarding fall protection.

■ Do not sit, stand, step on, or walk on modules, including the frames. Except for natural rainfall or periodic module cleaning, do not soak any part of the module in water or continuously impact the module with water.

Operation safety

- Store pallets in a ventilated, rain-proof and dry location until the modules are ready to be unpacked.
- During the transportation, do not to apply direct pressure on the backsheet or glass.
- Do not open the package of modules during transportation and storing until they are ready to be installed.
- Inappropriate transport may cause damage to the module and void the warranty.
- Do not lift the module by holding the module's junction box or electrical leads. Do not place any heavy or sharp objects on the module.
- Do not attempt to disassemble the modules, and do not remove any attached nameplates or components from the modules.
- Do not use mirrors, other magnifiers or artificially concentrated sunlight onto the modules.
- Do not apply paint or adhesive to the module top surface or backsheet.
- To avoid damage to the backsheet and cells, do not scratch, dent or hit the backsheet.
- Do not drill holes in the frame. This may compromise the frame strength, cause corrosion of the frame and void the warranty.
- A module with broken glass or torn backsheet cannot be repaired and must not be used since contact with any module surface or the frame can cause an electric shock.

- Work only under dry conditions, and use only dry tools. Do not handle modules under wet conditions unless wearing appropriate protective equipment.
- When storing uninstalled modules outdoors for any period of time, always cover the modules and ensure that the glass faces down on a soft flat surface to prevent water from collecting inside the module and causing damage to exposed connectors.

Installation safety

- Never disconnect electrical connections or unplug connectors while the circuit is under load.
- Contact with electrically active parts of the modules, such as terminals, can result in burns, sparks and lethal shock whether or not the module is connected.
- Do not touch the PV module unnecessarily during installation. The glass surface and the frame may be hot; there is a risk of burns and electric shock.
- Completely cover the module with an opaque material during installation to prevent electricity from being generated.
- Do not work in the rain, snow or in windy conditions.
- Avoid exposing cables and connectors to direct sunlight and scratches or cuts in order to prevent insulation degradation.
- Keep children well away from the system while transporting and installing mechanical and electrical components.
- Use only insulated tools that are approved for working on electrical installations.
- Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or troubleshooting photovoltaic systems.
- Follow the safety regulations (e.g., safety rules for working on electrical power plant stations) of your regions and for all other system components, including wires and cables, connectors, charging regulators, inverters, storage batteries, rechargeable batteries, etc.
- 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 I_{sc} and V_{oc} marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, minimum factor of fuse sizes, and size of controls connected to the PV output. Rated values of systems are selected based on temperature factors and local weather conditions.

- Only use same connectors to connect modules to form a string, or connect to another device. Removing the connectors will void the warranty.

Fire safety

- Consult your local authority for guidelines and requirements for building or structural fire safety.
- According to IEC 61730-2 standard, the modules have been rated Fire Class C. W
- When installing on the roof, the roof must be covered with a layer of fireproof material adequate for this application, and sufficient ventilation between the back of the module frame and the installation surface must be ensured.
- Roof construction and installation may affect the fire safety of the building. Improper installation may create hazards in the event of a fire.
- Use appropriate components such as fuses, circuit breakers and grounding connectors as requires by local authority.
- Do not use modules near equipment or in locations where flammable gases may be generated or collected.

Product identification

Each module has two labels providing the following information.

1. **Nameplate:** describes the product type; rated power, rated current, rated voltage, open circuit voltage, short circuit current, all as measured under standard test conditions; weight, dimensions, the maximum system voltage, etc.;
2. **Barcode:** each single module has a unique serial number. The serial number contains the model number, manufacturing time, and corresponding serial number of the module (except for customer designation). Each module has only one barcode, which is permanently fixed to the internal part of the module (excluding black modules) and visible from the top in the front part of the module. The barcode is placed on the module before the process of lamination.

INSTALLATION

Location selection

- Select a suitable location for the module installation, where they receive maximum sunlight throughout the year.
- In the northern hemisphere, the module is recommended to face south, while in the southern hemisphere, the module is recommended to face north.
- The module should not be shaded at any time of the day.
- The recommended ambient temperature should be within -20°C to 40°C, the temperature limits are defined as the monthly average high and low of the installation site, the limit operating temperature should be -40°C to 85°C.
- Modules have passed the IEC61701 requirements concerning salt-mist, however galvanic corrosion can occur between the aluminium frame of the modules and mounting or grounding hardware if such hardware is comprised of other metals. When the module is installed near the sea, the module should be installed at a distance of at least 500 m from the coastline. The offshore installation needs to be confirmed with the manufacturer and installed after approval.
- Modules must not be installed or operated in areas where salt, hail, snow, sand, dust, air pollution, chemically active, acid rain, soot, etc., are excessive. Modules must be sited in locations where aggressive substances such as salt or salt-water, or any other type of corrosive agent, cannot affect the safety and/or performance of the modules.
- Modules are not allowed to be placed where flammable gases are easily generated or concentrated.

Tilt angle selection

The tilt angle of the PV module is measured between the surface of the PV module and a horizontal ground surface. The PV module generates maximum output power when it faces the sun directly.

Dust accumulation on the module surface may degrade its performance. It is recommended to instal modules with the inclination angle according to the following table so the accumulated dust can easily be washed by the rain.

Module	Tilt angle
EC 370M-6-120FB 370Wp	5°
EC 375M-6-120B 375Wp	
EC 395M-10-108FB 395Wp	
EC 405M-10-108B 405Wp	10°

Conventional requirements

- The module mounting structure must be made of durable, corrosion-resistant and UV-resistant material. Always use tested and certified mounting structures approved for a given system design. It is recommended to use structures or parts manufactured by Corab S.A.
- Ensure that the module installation method and bracket system are strong enough to allow the module to withstand the predetermined load conditions. Always comply with safety instructions and precautions supplied with the module support frames.
- In regions with heavy snowfall in winter, select the height of the mounting system so that the lowest edge of the module is not covered by snow for any length of time. In addition, ensure that the lowest portion of the module is placed high enough so that it is not shaded by plants, trees or damaged by ground soil moved by or through the air.
- For ground mounting systems, the minimum distance recommend from the ground to the bottom of the module is at least 60 cm.
- Provide adequate ventilation under the modules in conformity to your local regulations.
- Modules must be securely attached to the mounting structure. For clamping system installation methods, the recommended maximum compression for each clamp is 2900 PSI (20 MPa) in order to avoid potential damages to module frames. Follow the instruction of the clamping system supplier. Use of clamps manufactured by Corab S.A. is recommended.

■ The following recommendations must be observed during installation:

Module	Distance between module frame and roof surface	Tightening torque of Corab S.A. clamps	Clamp overlap depth on module frame
EC 370M-6-120FB 370W p EC 375M-6-120B 375W p	min. 70 mm	10-12 Nm	min. 7mm - max. 11mm
EC 395M-10-108FB 395W p EC 405M-10-108B 405W p	min. 100 mm	18-24 Nm	min. 7mm - max. 12mm

■ Avoid the frame receiving the lateral tension and pressure, causing deformations or cracking of the glass.

■ Before installing modules on a roof, always ensure the roof construction is suitable. In addition, any roof penetration required to mount the module must be properly sealed to prevent leaks.

■ Observe and take into account the linear thermal expansion of the module frames (the recommended minimum distance between two modules is 1 cm).

■ When installing the module on the column, choose the column and module installation structure that can withstand the expected local wind and snow load.

■ Ensure that the modules are not subjected to wind pressure or snow load in excess of the maximum permissible values and are not subjected to excessive forces as a result of thermal expansion of the structures. Under no circumstances should modules overlap or protrude beyond the outline of the roof. For more detailed information, see the description of installation methods below.

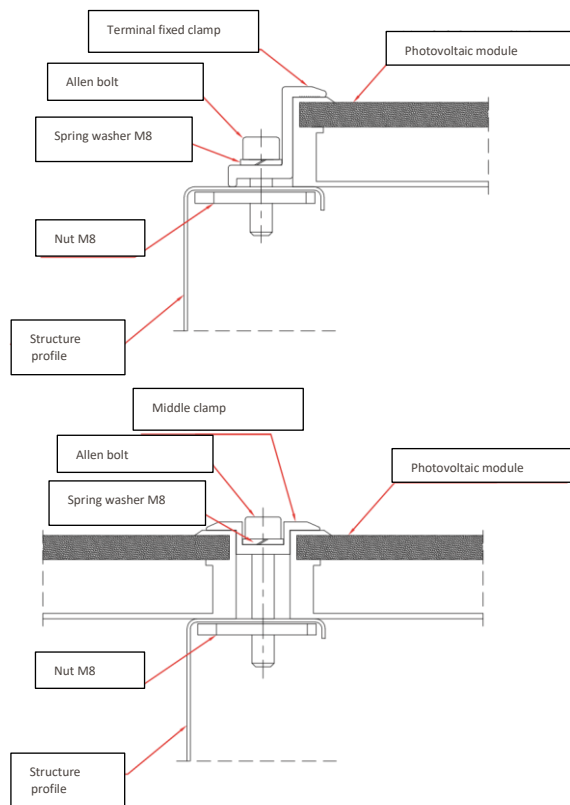
Installation methods

Mounting with clamps

When choosing this type of clamp-mounting method, use at least four clamps on each module, two clamps should be attached on each long sides of the module (for portrait orientation) or each short sides of the module (for landscape orientation). The minimum recommended length for each fixture shall be 50 mm. Depending on local wind and snow loads, additional clamps may be required to ensure that modules can bear the load.

Modules clamps should not come into contact with the front glass and must not deform the frame. Be sure to

avoid shadowing effects from the module clamps. The mounting details are shown in the following figures.

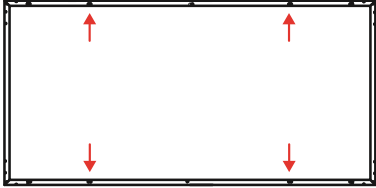
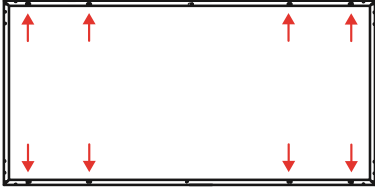
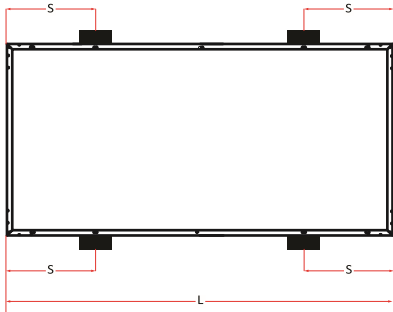
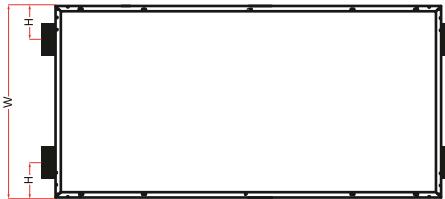
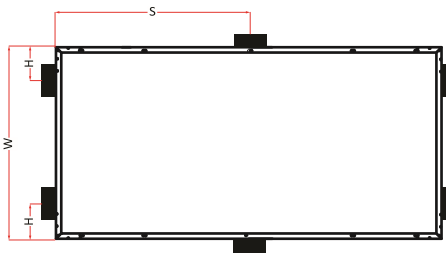


Fastening guidelines

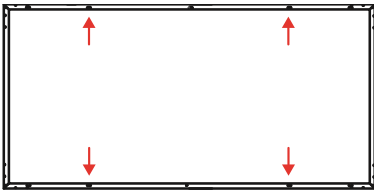
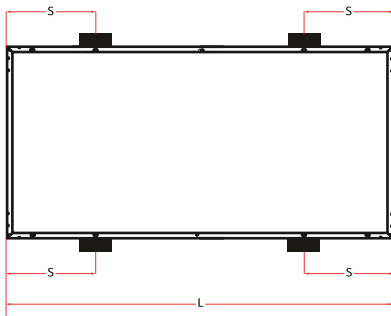
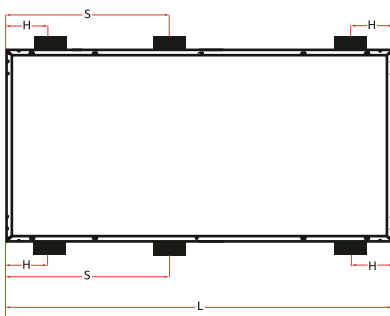
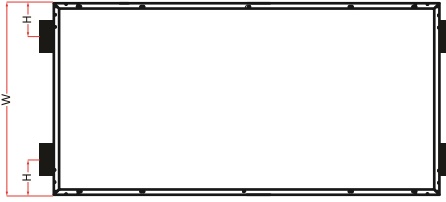
The standard/lower loading capacity applies to normal environment: the modules are tested under a maximum positive pressure of 2400 Pa, and negative pressure of 1600 Pa or 2400 Pa, the modules are designed to meet a maximum positive pressure of 1600 Pa, and negative pressure of 1067 Pa, this design load was then tested with a safety factor of 1.5 times.

The high loading capacity applies to severe environment, like storm, big snow, etc. The modules are tested under a maximum positive pressure of 5400 Pa, and negative pressure of 2400 Pa, the modules are designed to meet a maximum positive pressure of 3600 Pa, and negative pressure of 1600 Pa, this design load was then tested with a safety factor of 1.5 times.

Mounting of modules EC 370M-6-120FB 370Wp and EC 375M-6-120B 375Wp

Clamp position / Installation method	Test load: positive pressure 2400 Pa/negative pressure 2400 Pa Design load: positive pressure 1600 Pa/negative pressure 1600 Pa	Test load: positive pressure 5400 Pa/ negative pressure 2400 Pa Design load: positive pressure 3600 Pa/ negative pressure 1600 Pa
Fasten to the long side / Mounting method with screws.		
Fasten to the long side / Mounting method with terminal and middle clamps.	 $(1/4L-50)<S<(1/4L+50)$	
	Test load: positive pressure 1600 Pa/ negative pressure 1600 Pa Design load: positive pressure 1067 Pa/ negative pressure 1067 Pa	Test load: positive pressure 5400 Pa/ negative pressure 2400 Pa Design load: positive pressure 3600 Pa/ negative pressure 1600 Pa
Fasten to the short side / Mounting method with terminal and middle clamps.	 $0<H<1/4W$	 $(1/2L-50)<S<(1/2L+50)$ $0<H<1/4W$

Mounting of modules EC 395M-10-108FB 395Wp and EC 405M-10-108B 405Wp

Clamp position / Installation method	Test load: positive pressure 5400 Pa/ negative pressure 2400 Pa Design load: positive pressure 3600 Pa/ negative pressure 1600 Pa	
Fasten to the long side / Mounting method with screws.		
	Test load: positive pressure 5400 Pa/ negative pressure 2400 Pa Design load: positive pressure 3600 Pa/ negative pressure 1600 Pa	Test load: positive pressure 5400 Pa/ negative pressure 3600 Pa Design load: positive pressure 3600 Pa/ negative pressure 2400 Pa
Fasten to the long side / Mounting method with terminal and middle clamps.	 $(1/5L-50) < S < (1/5L+50)$	 $(1/2L-80) < S < (1/2L-30)$ $(1/6L-50) < H < (1/6L+50)$
	Test load: positive pressure 2400 Pa/ negative pressure 1600 Pa Design load: positive pressure 1600 Pa/ negative pressure 1067 Pa	
Fasten to the short side / Mounting method with terminal and middle clamps.	 $0 < H < 1/4W$	

Electrical installation

■ To avoid galvanic corrosion, all components used must be compatible with the module material. Damages caused by galvanic corrosion are not covered under the warranty.

■ It is not recommended to use modules with different configurations (grounding, wiring) in the same system.

■ Excessive cables must be organized or fixed in an adequate way, e.g. attached to the mounting structure by using non-metallic cable ties or other suitable ties. Solar cables, connectors and junction boxes should not be exposed to water and snow, and rain or water submersion for a long period of time (IP65/67/68).

■ For applications requiring high operating voltage several modules can be connected in series to form a string of modules; the system voltage is then equal to the sum of the voltage of each module.

■ For applications requiring high operating currents several strings of modules can be connected in parallel; the system current is then equal to the sum of the current of each string of modules.

■ The maximum system voltage is 600 volts, 1000 volts or 1500 volts depending on the product family direct current value according to standards.

■ The maximum number of series of connected modules depends on the system design, type of inverter used and environmental conditions.

■ Based on the maximum series fuse rating of module and local electrical installation code, always make sure that PV modules are assembled with the appropriate string fuse for circuit protection. There is no specific limitation on the number of modules that can be connected in parallel, the number of modules is determined by system design parameters such as current or power output.

■ To prevent the cables and the connectors from overheating, the cross section of the cables and the capacity of the connectors must be selected to suit the maximum system short circuit current. The recommended cable is PV wire with a cross section of at least 4 mm².

■ Caution: do not secure the cables too tight. Any cable damage caused by cable management system is not covered under module warranty.

■ Always observe the bending radius specified by the cable manufacturer, which includes the radius after the connectors.

■ When designing large modules arrays connected to a single inverter, always take into account the resulting isolation resistance (Riso), which decreases with an

increase in the number of modules in the array. A too low Riso can result in inverter faults. Please read local regulations to determine the wire size, type and temperature.

■ The modules are supplied with connectors used for system electrical connections. It is strongly recommended to use the original connectors specified in the module data sheet. Selecting a connector type other than those specified may invalidate the warranty.

■ To ensure reliable electric connection and to prevent possible intrusion of humidity, two connectors must be mated and locked together until a click can be heard.

■ Long-term exposure to wet environments may cause connectors' poor connectivity, resulting in current leakage and poor conductivity which voids the warranty. Proper management of connector/cable/wire is recommended to prevent moisture intrusion. Depending on the amount of humidity, it is recommended to conduct periodic inspections of the installation system to maintain optimal module performance.

■ The DC current generated by photovoltaic systems can be converted into AC current and fed into a public grid. As local public utility policies on connecting renewable energy systems to the grids vary from region to region, always seek the advice from a qualified system designer. Building permits, inspections and approvals by the local utility facilities are generally required.

■ For larger installations, it is recommended to install lightning protection following the local requirements and regulations.

Grounding

For grounding and connecting requirements, please refer to regional and national safety and electricity standards. If grounding is required, use a recommended connector type for the grounding wire.

PV Modules use an anodic oxidized aluminium frame to resist corrosion, so the module frame should be connected to the system grounding wire to prevent thunder and electrical shock.

The frame rails have pre-drilled holes marked with a grounding sign, these holes should be used for grounding purposes and should not be used for mounting the modules.

Photovoltaic modules can be grounded using accessories manufactured by another company, provided that they are certified for grounding the modules and installed in accordance with the instructions provided by the manufacturer. It is recommended to use grounding solutions from Corab S.A.

Maintenance and care

It is required to perform regular inspections and maintenance of the modules, especially during the warranty period. To ensure optimum module performance, the following maintenance measures are recommended:

Visual inspection

Inspect the modules to find if there are any visual defects. If so, the following items should be evaluated for:

- Any slight cell colour differences at different angles. This is a normal phenomenon of modules with anti-reflection coating technology.
- Any broken glass panes.
- Any sharp objects in contact with the PV module surfaces.
- Any shading of the PV modules by undesirable obstacles and/or foreign material.
- Any corrosion along the cells' bus-bar. This kind of corrosion is caused by humidity penetrating the back surface of the module frame. Inspect the back of the frame for damage.
- Any burns at the back sheet.
- Check if screws and mounting brackets are tight, adjust and tighten as necessary.

Cleaning

- Clean the module glass surface as necessary. Always use distilled water and a soft sponge or cloth for cleaning.
- A mild, nonabrasive cleaning agent can be used to remove stubborn dirt.
- In order to reduce the potential for electrical and thermal shock, it is recommended to clean PV modules during early morning or late afternoon hours when solar radiation is low and the modules are cooler, especially in regions with hotter temperatures.
- Never attempt to clean a PV module with broken glass or other signs of exposed wiring, as this presents a shock hazard.

- Never use chemicals when cleaning modules as this may affect the module warranty and energy output.

- Do not allow the connector to come into contact with substances such as oils, greases, acetone, alcohol, release agent, adhesives, cleaning agents that may generate oxime gas.

Inspection of connector and cable

It is recommended to implement the following maintenance every 6 months, however at least once a year:

- Check the photovoltaic modules for any wear signs.
- Check all wiring for possible damage from rodents, weather conditions and whether all connectors are tight and free from corrosion. Check for current leakage to the grounding.
If any problem arises, consult a professional solar service provider for suggestions. Caution: observe solar product manufacturers' maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries etc.

Disclaimer of liability

Since the use of this manual and the conditions or methods of installation, operation, use and maintenance of the photovoltaic (PV) product are beyond the control of the module manufacturer, the manufacturer assumes no responsibility and expressly disclaims liability for loss, damage or costs arising out of or in any way connected with such installation, operation, use or maintenance. The module manufacturer accepts no responsibility for any infringement of patents or other third party rights that may arise from the use of the photovoltaic product. No license is granted by implication or otherwise under any patent or patent rights. The information contained in this manual is based on the knowledge and experience of the module manufacturer and is believed to be reliable; but such information, including product specifications (without limitation) and recommendations, does not constitute a warranty, expressed or implied. The module manufacturer reserves the right to modify the manual, photovoltaic product, specifications or product data sheet without prior notice.