SILFAB SOLAR®

SILFAB SOLAR INC.
SAFETY & INSTALLATION MANUAL

SILFAB ELITE : BK/BG
SILFAB PRIME : HC/HC+/QD
SILFAB COMMERCIAL : HN/HM/QM/XM/XM+

BAA/ARRA COMPLIANT | FLUORINE FREE | 25 YEAR PRODUCT WARRANTY | 30 YEAR PERFORMANCE WARRANTY | AUTOMATED MANUFACTURING | HIGH EFFICIENCY

Document Number: MAN-SSI-09 | SAFETY AND INSTALLATION MANUAL FOR PHOTOVOLTAIC MODULES

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1. SAFETY NOTICE

This Safety and Installation Manual provides important safety information relating to the installation, maintenance and handling of Silfab SIL series modules. Professional installers, operation & maintenance technicians, and system users/owners should read this manual carefully and strictly follow the instructions. Failure to follow these instructions may result in death, injury or property damage, and possible void of warranty.

Please keep this manual for future reference.

We recommend checking www.silfabsolar.com regularly for the most updated version.

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 panneau solaire. Les interconnexions des panneau solaire 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.

2. INSTALLATION MANUAL DISCLAIMER

The information contained in this manual is subject to change by Silfab Solar Inc. without prior notice. Silfab Solar Inc. gives no guarantee of any kind whatsoever, either explicitly or implicitly, with respect to the information contained herein. This Manual (or document) is written in English with Spanish (or other language) translation for reference only. In case there are inconsistencies or conflicts between the English version and the Spanish version (or other language version) of this Manual (or document), the English version shall overcome and take control in all respects.

3. GENERAL INFORMATION

Silfab Solar modules convert the energy of light directly into continuous/direct current (DC) by the photovoltaic effect.

SIL series consisted of different modules in the sense of cell number, contact technology, and module size.

3.1 Model Naming Overview:

SIL-XXX B(X) / H(X) / N(X) / Q(X) / X(M) Where:
SIL-Silfab brand and XXX-indicates the power bin in watts.
B/H/N/Q/X is used to indicate technology, e.g. B = back-contact, H = mono half-cell, N = mono M3, Q = N-type, X = Bifacial. (X) to indicate size. C = 1762 mm x 1037 mm, C+ = 1914 mm x 1036 mm, D = 1721 mm x 1133 mm, G = 1864 mm x 1029 mm, K = 1795 mm x 990 mm, M = 2098 mm x 1133 mm, M+ = 2278 mm x 1133 mm, N = 2263 mm x 1037 mm.

3.2 Electrical Specifications

The performance and all photovoltaic parameters of the modules are measured under two different conditions: (1) Standard Test Conditions (STC) and (2) Normal Operating Cell Temperature (NOCT). Detailed electrical characteristics for all PV modules are presented in our products' DATASHEET and www.silfabsolar.com.

3.3 Disclaimer of Liability

Since the methods of system design, installation techniques, handling and use of this product are beyond company control; Silfab Solar Inc. does not assume responsibility and expressly disclaims liability, for loss, damage or expense resulting from improper installation, handling or use.

4. PRODUCT CERTIFICATION

All Silfab products have UL 61215-1:2017 Ed.1, UL 61215-2:2017 Ed.1, UL 61730-1:2017 Ed.1, UL 61730-2:2017 Ed.1, CSA C22.2#61730-1:2019 Ed.2, CSA C22.2#61730-2:2019 Ed.2, IEC 61215-1:2016 Ed.1, IEC 61215-2:2016 Ed.1, IEC 61730-1:2016 Ed.2, IEC 61730-2:2016 Ed.2 certification. A list of products including SIL-XXX BK, SIL-XXX HC, SIL-XXX HN have UL 1703 and ULC ORD C1703 certifications. These UL and IEC to be freestanding. To satisfy the listing for this product the modules must be mounted with a rack or standoff structure. The UL and IEC listing does not include integration into a building surface because additional requirements may apply. The module is considered to be in compliance with UL 1703, IEC 61215/61730 and UL 61215/61730 only when the module is mounted in the manner specified by the mounting instructions contained in this document.

5. LIMITED WARRANTY

Please refer to Silfab General Terms and Conditions of Sale for details of the module's limited warranty. Failure to comply with this Safety and Installation Manual would void Silfab Warranty for the PV modules as stated in the General Terms and Conditions of Sale.

6. MODULE SPECIFICATION

Please refer to the appropriate DATASHEETS for electrical performance data and mechanical installation information.

7. SAFETY PRECAUTIONS

Installation should be performed only by authorized personnel.

All installations must comply with the applicable geographic electrical standards. I.e. International, National, Regional and local electrical standards etc.

Within the modules there are no user serviceable parts. Do not attempt to repair any part of the modules. Do not use or install broken modules.

In order to reduce the risk of electric shock, prior to installing the modules, remove metallic jewelry and use insulated tools during installation.

Modules produce voltage even when not connected to an electrical circuit or load and have no on/off switch. Modules can be rendered inoperative only by removing them from sunlight, or by fully covering their front surface with cloth, cardboard, or other completely opaque non-marking material, or by working with them face down on a smooth, flat surface.

- Do not expose the modules to artificially concentrated sunlight.
- Do not stand on, drop, scratch, or allow objects to fall on the modules.
- Do not lift the modules by the junction box or junction box cables.
- Do not install or handle the modules when they are wet or during periods of high winds. Modules in Silfab packaging should not be kept outdoors for a period exceeding 60 days.
- Ensure that junction box cables are provided with strain relief to avoid damage to the junction box, maintaining a minimum bending radius of 50 mm at all locations along the cable.
- Do not leave cable connectors exposed in adverse climatic conditions. Water and dust deposits inside the cable connectors can cause long term damage.

A module with broken glass, torn or cut backsheet, damaged junction box, connectors or cables present electrical safety hazards and must be removed from service.

The total voltage of modules connected in series corresponds to the sum of the voltages of the single modules; whereas connecting the modules in parallel results in adding up the currents. Consequently, strings of inter-connected modules can produce high voltages and high currents and constitute an increased risk of electric shock and may cause injury or death.

For installation, maintenance, or before making any electrical connection or disconnection, ensure all modules in the PV array are exposed to a light intensity that is less than 400W/m^2 as measured by an accurate solarmeter/ pyranometer.

Methods to reduce solar irradiance when making electrical connections or disconnections include:

- Covering the modules with an opaque cloth or other material in order to shield them from exposure.
- Making the connections during hours of low intensity of solar irradiance (such as early morning or late afternoon).

8. INSTALLATION

8.1 Module Mounting Overview

The fire rating of Silfab modules is valid only when mounted in the manner specified in the mechanical mounting instructions.

When installing Silfab modules, local building code requirements and regulations must be adhered to at all times. In case of roof mounting, the appropriate system fire class rating of PV module with Mounting system in combination with roof covering and slope applications should be considered. Silfab modules are fire rating Type 1 or Type 2 in accordance with UL 1703 and/ or UL61730. For more information about the specific product, please check DATASHEET or www.silfabsolar.com.

Sufficient ventilation of the module backside is required to maintain the Type 1 or 2 fire rating, and therefore the mounting configuration (e.g. sufficient clearance) should be adapted accordingly. The recommended clearance distance is a minimum 10 cm (3 15/16”).

To maximize the rate of energy conversion, modules have to be installed in the best orientation and tilt according to your region. To prevent solar module hot spots and/or reduction in power, find a location that has the lowest shading.

Avoid low tilt angles to prevent the accumulation of dirt/debris along the module edge.

Modules must be spaced a minimum 10 mm (3/8”) a part on all sides to provide space for thermal expansion and to provide ventilation.

Do not drill any additional holes into the module frames and do not cover the drainage holes.

Do not mount Silfab modules in a position where the junction boxes are “upside down” (leads facing upwards).

8.2 Module Mounting Method using mounting holes

Each module must be securely fastened at a minimum of 4 points.

Only use the 4 pre-drilled mounting holes (slots, see Figures 3 and 5) on the PV module frame to bolt the module with M6 (1/4”) stainless steel screws and nuts to the mounting framework.

The distance of the mounting holes has been designed in order to result in a uniform wind and snow load without damaging the module.

⊘ Do not drill additional holes in the module frame; doing so will void the Warranty.

8.3 Mounting using clamping method

Silfab recommends the use of clamps with a design as shown in Fig. 4a (or equivalent). The use of improper clamps will void the Warranty.

- These modules can be installed in either Portrait (vertical) or Landscape (horizontal) configuration. Refer to Fig. 4 b, c, and d for an example of attaching the modules to a support structure using mounting clamps. Use stainless steel fastening hardware.
- These modules can be mounted on continuous base structures (inclined or horizontal) such as rails or similar.
- Both base structures must be mounted at the same distance from the symmetrical axis (portrait or landscape) of the module.
- Placing the supporting elements according to the mounting instructions on the following pages in order to maintain a correct load distribution and achieve the design and test load rating based on the UL1703 and/or IEC 61215.
- When clamping the modules on a support structure, refer to the following pages that identify mounting locations and associated load ratings.

8.4 Mounting Using rear flange mounted clamping hardware (e.g. CAMO clamp / IronRidge, PanelClaw / Esdec)

Silfab recommends the use of rear flange mounted clamping hardware with a design as shown in Fig. 4 e. The following conditions have to be applied in order to receive coverage under Silfab’s Warranty:

- Rear flange mounted clamping hardware is allowable only for the following Silfab product lines: (SIL-XXX BK/BG/HC/HC+/ HN/HM/QM/XM/XM+/QD).
- Bars or rails must run parallel to the module’s short frame edge, and they must be placed outside of the mounting holes (minimum of 15mm away from the edge of the mounting hole).

8.5 Orientation and Tilt

The highest energy yields are achieved when sunlight shines perpendicularly (at 90°) to the surface of the PV modules. To maximize system output, panels should be installed at the optimum orientation and tilt angle, which depends on location and on local conditions. The optimum orientation can be calculated by a qualified system design engineer(s). It is recommended that all panels in one string have the same orientation and tilt to ensure the system does not underperform due to mismatched outputs. Dependent on location, rainfall and pollution levels - a lower angle of installation potentially increases the requirement for regular cleaning.

RECOMMENDED

A photovoltaic system composed of Silfab modules mounted on a UL2703 certified mounting system should be evaluated in combination with roof coverings in accordance with UL 1703 and/or IEC 61215 standard meet the requirements to achieve the specified System Fire Type designation for a non-BIPIV module or panel.

For instance, if a listed mounting system with Class A System rating is installed with type 1 modules, the photovoltaic system is suitable to maintain the System Class A Fire Rating.

Any mounting system limitations on inclination or accessories required to maintain a specified System Fire Class Rating should be clearly specified in the installation instruction and UL2703 certification of the mounting system supplier.

Recommended clearance distance of 115mm (4.5inch) (recommended) between module frame and the surface of the wall or roof. Other mounting techniques may affect the UL Listing or the fire class ratings.

Fig. 4a: cross section of a mounting clamp to be used for attaching the modules to support structure (minimum length is 40 mm).

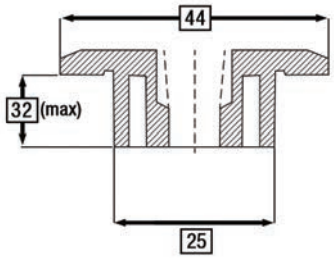


Fig. 4b: modules attached to supporting structure (rail, item 01) using a clamp (item 02) fixed with a bolt (item 03) and nut (item 04) – view between two modules.
1 Rail 2 Clamp 3 Bolt 4 Nut

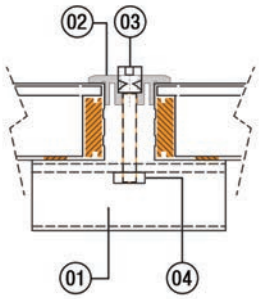


Fig. 4c: modules attached to supporting structure – side view

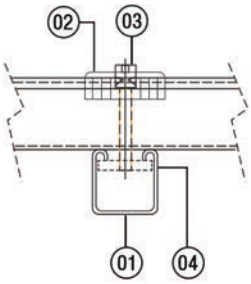


Fig. 4d: end of module row with additional spacer (item 05: 50mm x 30mm x 24mm)

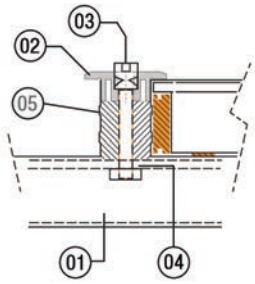
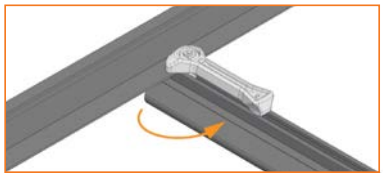
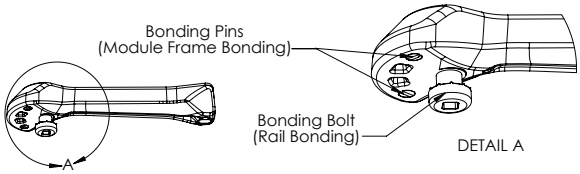


Fig. 4e: Example CAMO clamp, a type of rear flange mounted clamping hardware. Clamp slides into the rail channel and the bonding pins contact the rear module flange. CAMO hidden end clamp. Clamp slide into rail channel and the bonding pins contacts the module flange edge.





MOUNTING FOR SIL BK

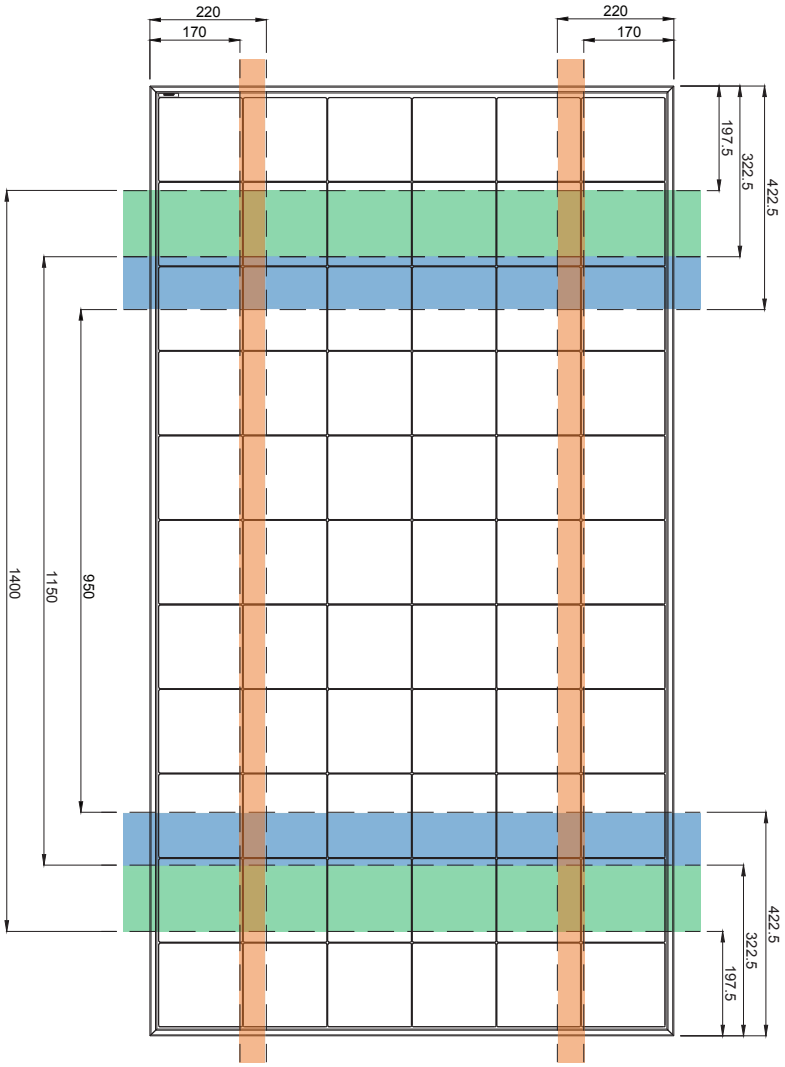
Allowed positions for fixing the **SIL BK** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= Long Edge Primary Mounting Zone

= Long Edge Secondary Mounting Zone

= Short Edge Mounting Zone



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their "upright" position. This will reduce the risk of moisture ingress into the junction box.

SIL BK

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp / Mounting Holes	Long Edge Primary	322.5mm-422.5mm	+3600Pa/ -2667Pa	+5400Pa/ -4000Pa
Clamp	Long Edge Secondary	197.5mm-322.5mm	+2667Pa /-1600Pa	+4000Pa /-2400Pa
Clamp	Short Edge	170mm-220mm	+1600Pa /-1470Pa	+2400Pa /-2200Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces

MOUNTING FOR SIL BG

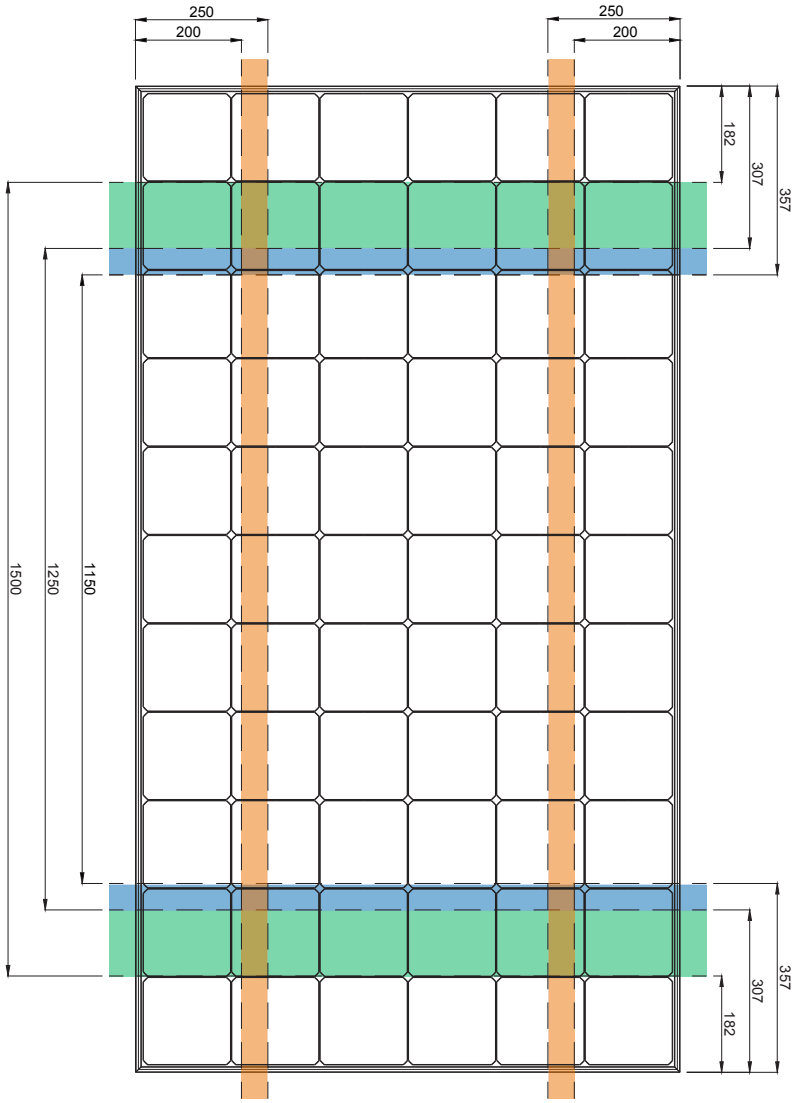
Allowed positions for fixing the **SIL BG** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= Long Edge Primary Mounting Zone

= Long Edge Secondary Mounting Zone

= Short Edge Mounting Zone



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their “upright” position. This will reduce the risk of moisture ingress into the junction box.

SIL BG

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp / Mounting Holes	Long Edge Primary	307mm-357mm	+3600Pa/ -3600Pa	+5400Pa/ -5400Pa
Clamp	Long Edge Secondary	182mm-307mm	+2667Pa /-1600Pa	+4000Pa /-2400Pa
Clamp	Short Edge	200mm-250mm	+1600Pa /-1470Pa	+2400Pa /-2200Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

MOUNTING FOR SIL HC

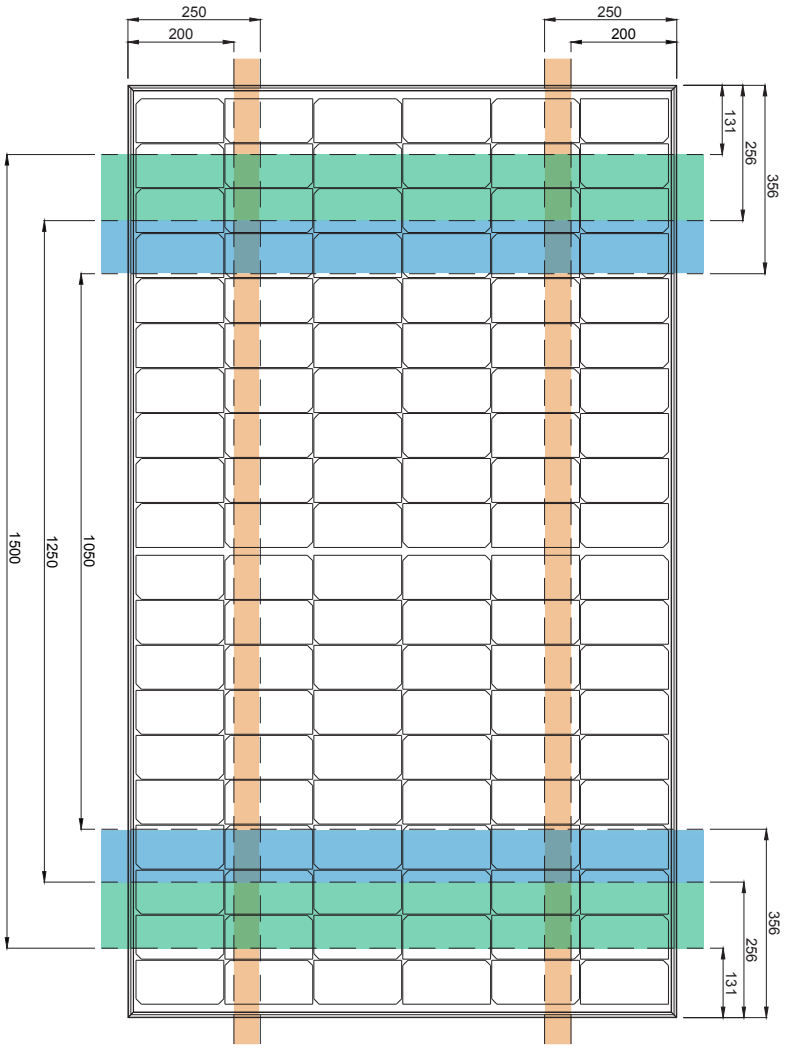
Allowed positions for fixing the **SIL HC** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= **Long Edge Primary Mounting Zone**

= **Long Edge Secondary Mounting Zone**

= **Short Edge Mounting Zone**



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their “upright” position. This will reduce the risk of moisture ingress into the junction box.

SIL HC

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp / Mounting Holes	Long Edge Primary	256mm-356mm	+3600Pa/ -3600Pa	+5400Pa/ -5400Pa
Clamp	Long Edge Secondary	131mm-256mm	+2667Pa /-1600Pa	+4000Pa /-2400Pa
Clamp	Short Edge	200mm-250mm	+1600Pa/ -1600Pa	+2400Pa/ -2400Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

MOUNTING FOR SIL HC+

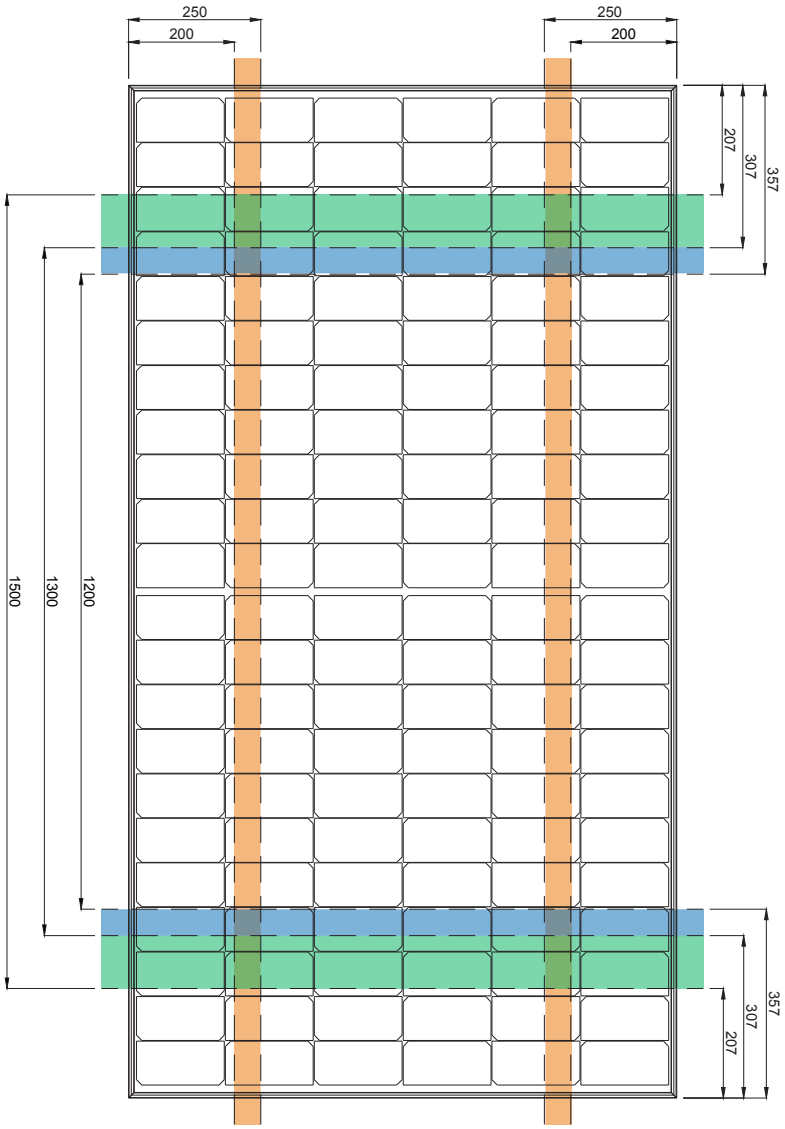
Allowed positions for fixing the **SIL HC+** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= **Long Edge Primary Mounting Zone**

= **Long Edge Secondary Mounting Zone**

= **Short Edge Mounting Zone**



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their “upright” position. This will reduce the risk of moisture ingress into the junction box.

SIL HC+

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp / Mounting Holes	Long Edge Primary	307mm-357mm	+3600Pa/ -3600Pa	+5400Pa/ -5400Pa
Clamp	Long Edge Secondary	207mm-307mm	+2667Pa /-1600Pa	+4000Pa /-2400Pa
Clamp	Short Edge	200mm-250mm	+1600Pa/ -1600Pa	+2400Pa/ -2400Pa

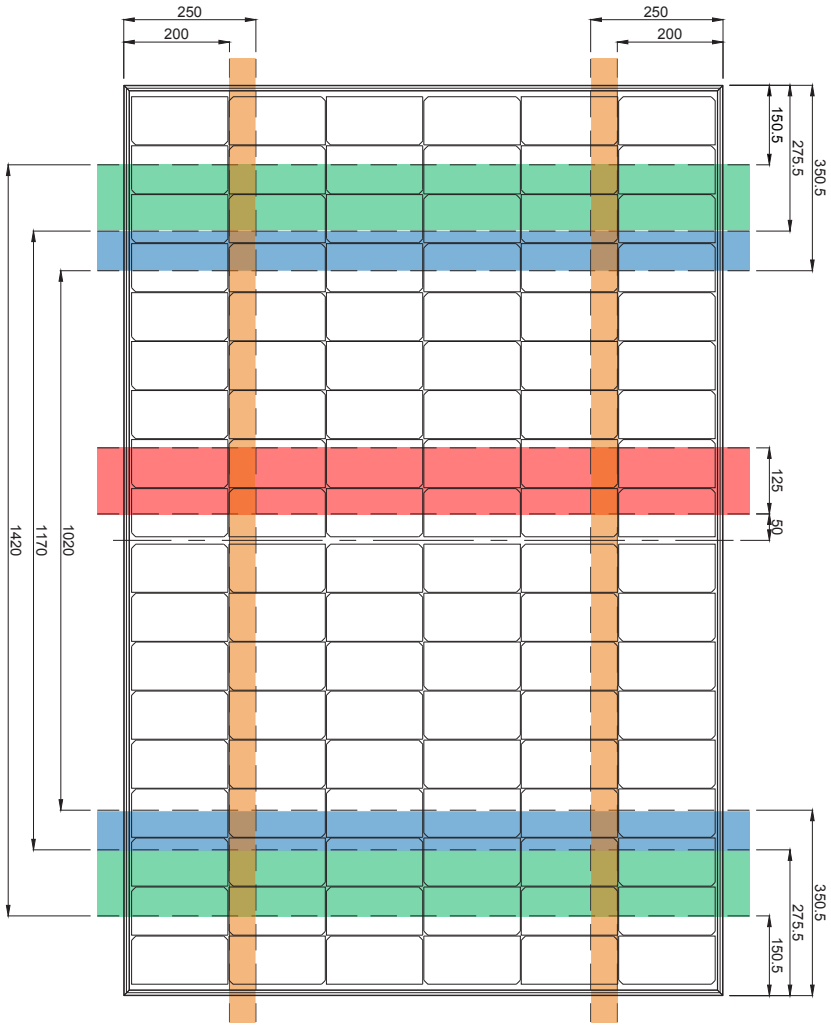
*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

MOUNTING FOR SIL QD

Allowed positions for fixing the **SIL QD** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

- = Long Edge Primary Mounting Zone
- = Long Edge Secondary Mounting Zone
- = Long Edge Third Mounting Zone
- = Short Edge Mounting Zone



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their "upright" position. This will reduce the risk of moisture ingress into the junction box.

SIL QD

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp	Long Edge Primary	275.5mm-350.5mm	+3600Pa/ -2667Pa	+5400Pa/ -4000Pa
Clamp	Long Edge Secondary	150.5mm-275.5mm	+2667Pa /-2400Pa	+4000Pa /-3600Pa
Clamp	Long Edge Three Rails	150.5mm-350.5mm and red zone	+3600Pa/ -3600Pa	+5400Pa/ -5400Pa
Clamp	Short Edge	200mm-250mm	+1600Pa/ -1600Pa	+2400Pa/ -2400Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

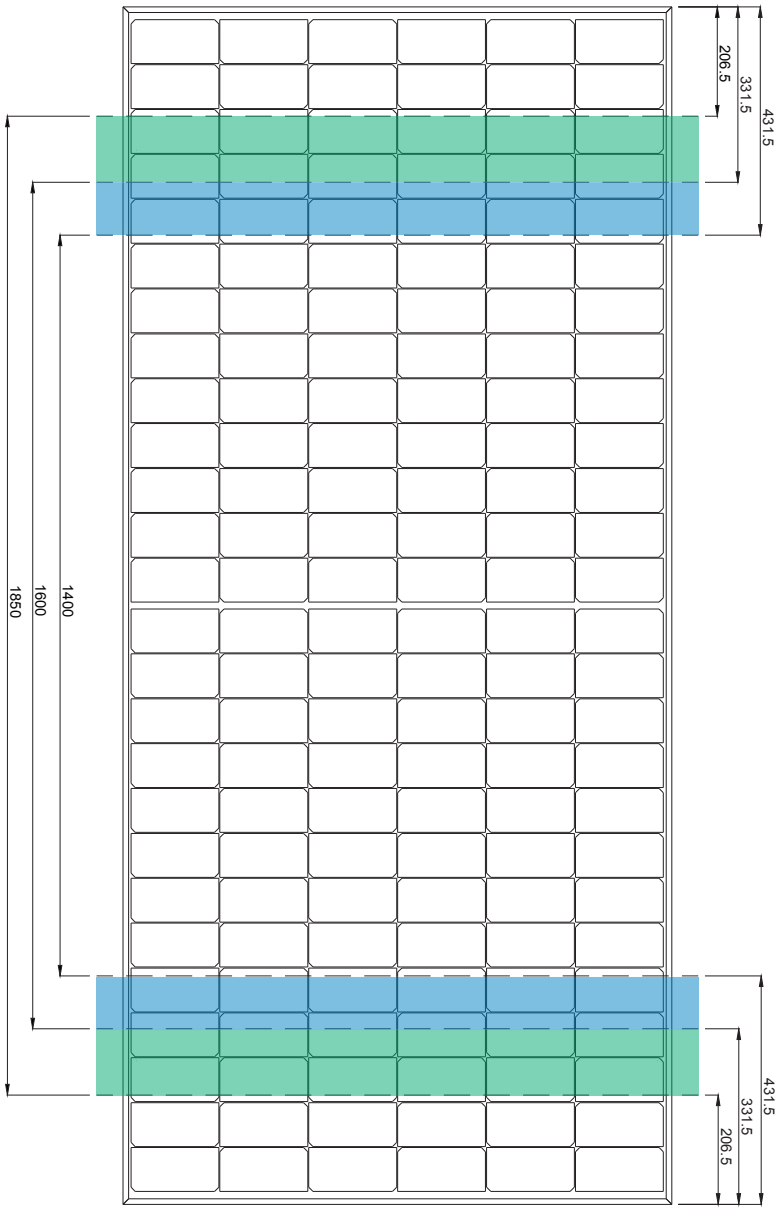
MOUNTING FOR SIL HN

Allowed positions for fixing the **SIL HN** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= Long Edge Primary Mounting Zone

= Long Edge Secondary Mounting Zone



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their "upright" position. This will reduce the risk of moisture ingress into the junction box.

SIL HN

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp / Mounting Holes	Long Edge Primary	331.5mm-431.5mm	+3600Pa/ -1600Pa	+5400Pa/ -2400Pa
Clamp	Long Edge Secondary	206.5mm-331.5mm	+1600Pa /-1600Pa	+2400Pa /-2400Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

MOUNTING FOR SIL HM, QM and XM

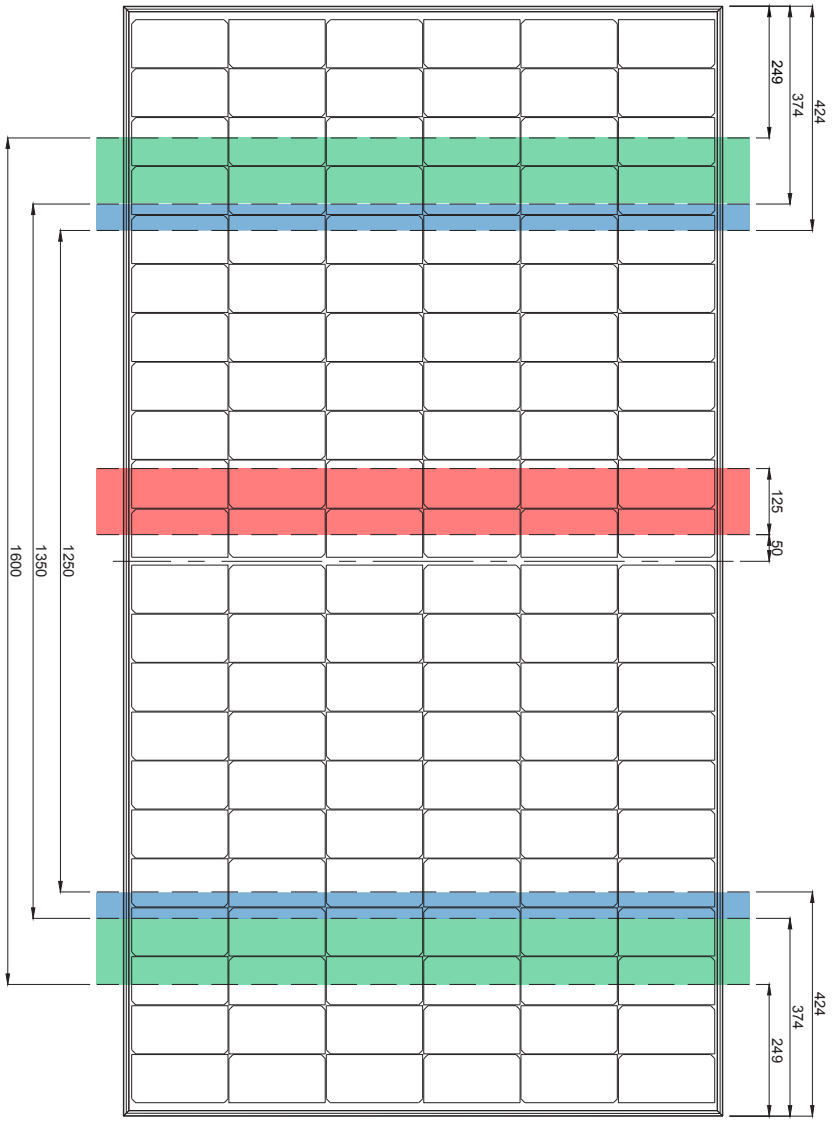
Allowed positions for fixing the **SIL HM, QM** and **XM** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= Long Edge Primary Mounting Zone

= Long Edge Secondary Mounting Zone

= Long Edge Third Mounting Zone



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their "upright" position. This will reduce the risk of moisture ingress into the junction box.

SIL HM/QM/XM

MOUNTING TYPE	MOUNTING POSITION	MOUNTING ZONE	DESIGN LOAD RATING*	TEST LOAD RATING
Clamp/Mounting Hole	Long Edge Primary	374mm-424mm	+3600Pa/ -1600Pa	+5400Pa/ -2400Pa
Clamp	Long Edge Secondary	249mm-374mm	+1600Pa /-1600Pa	+2400Pa /-2400Pa
Clamp	Long Edge Three Rails	249mm-424mm and red zone	+3600Pa/ -2667Pa	+5400Pa/ -4000Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

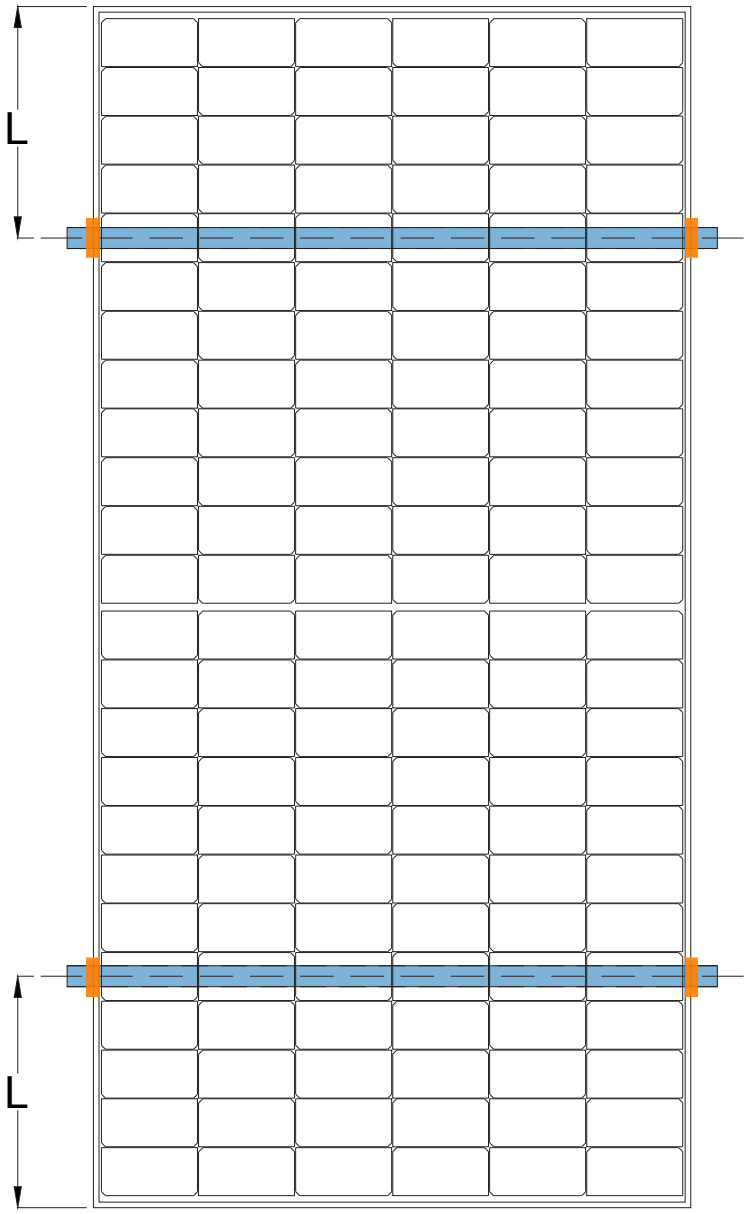
MOUNTING FOR SIL XM+

Allowed positions for fixing the **SIL XM+** module using mounting clamps.

Mounting must stay WITHIN the coloured areas.

= Mounting Rail

= Clamp



ATTENTION:

In the case of installation with modules in the portrait configuration, install the modules with the junction boxes at the top in their "upright" position. This will reduce the risk of moisture ingress into the junction box.

SIL XM+

MOUNTING TYPE	CLAMP POSITION		DESIGN LOAD RATING*	TEST LOAD RATING
4 Clamps on Long Side 2 Continuous Rails Parallel to Short Side	L	13.8 - 19.7 in (350 - 500 mm)	+2400Pa/ -1600Pa	+3600Pa/ -2400Pa

*Positive values correspond to downward forces, Negative Values correspond to uplift forces.

9. HANDLING OF MODULES

The Silfab modules are robust, but cells may be subject to damage if the modules are improperly handled or installed.

Wear protective gloves when handling and installing the modules to protect against cuts and burns.

Handle the module in a way that avoids breakage or scratching of the glass or backsheet and mechanical damage to any other part of the module.

Do not carry the module by its cables. Electric shock or damage to the module may result.

Do not drop sharp or heavy objects on either surfaces of the module.

Do not subject the modules to any impact, and do not flex them mechanically.

In the event of any damage to either the front or the back of the module, dangerous electrical hazards may exist, especially if the module is connected in series to a string. Replace the module immediately and take extreme caution when handling.

Do not step or stand on the PV Module.

9.1 Electrical Connection

Do not connect or disconnect modules under load! Danger! Risk of serious injury or death from electric shock or electric arc flash!

Only connect modules with the same rated current in series and modules with the same rated voltage in parallel.

High hazardous voltage (several hundreds of volts) may occur during installation. Consequently, installation and maintenance of the modules, as well as the connection to the main power supply, may only be performed by authorized and qualified persons.

Under normal conditions, a PV 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 the module should be multiplied by an appropriate safety factor to be determined by the design engineer based on local electrical code requirements. As a worst case, use a safety factor of 1.25 for voltage and cable ampacities and a safety factor of 1.56 for fuse sizing.

For SIL-XXX BK/BG/HC/HC+/QD, the maximum system voltage rating is 1000V for TUV/IEC and 1000V for UL. For SIL-XXX HN/HM/QM/XM/XM+, the maximum system voltage rating is 1500V.

The maximum series fuse rating is 20A.

The bypass diodes are not over-current protection devices. In the event of known or suspected diode failure, installers or maintenance providers should contact Silfab. Never attempt to open the junction box!

To obtain the desired system voltage, modules are wired in series connection. The recommended maximum series configuration must NOT exceed the certified maximum system voltage stated in the module spec sheets calculated in the worst case Voc conditions to be determined by the engineer of record (EOR).

*Refer to the appropriate local geographic electrical codes and regulations for the correct Voc correction factor according to the respective temperatures. If this information is not available, a 1.25 multiplying factor can be used as default value for correction of Voc.

For connection of the modules use only appropriate cables with a minimum conduct cross-section of 4 mm^2 that is compliant to the relevant jurisdiction code.

Verify the junction box lid is firmly closed before installing the module.

Do not repair or reconnect junction box cable. It may occur spark or electric shock.

Do not bend junction box cable. Under stress, it can damage the module. Cable bending radius should be at least more than 4 times the cable diameter.

Before connection of the system to the grid, the PV system must be approved for correct installation, by all appropriate authorities.

Lightning protection is recommended for PV systems that are to be installed in locations with high probability of lightning strikes.

The design of the PV system should be done by a qualified person familiar with PV system design. Silfab does not assume any responsibility for how the modules are installed or how the system is designed.

For all solar systems, the connectors MUST be UL rated for interminability and fully inter-matable with Silfab modules' connectors. Otherwise, Silfab will void the warranty and will not be responsible for any resulting safety issue.

Silfab solar modules are equipped with factory-assembled Junction box with 12AWG/4mm^2 cables, and insulated for 90°C maximum, with either either MC4 or EV2 connectors. Any attempt to repair/modify the junction box, cable, or connector will void the Silfab Solar warranty.

9.2 Functioning Grounding

For installations located in tropical regions (between 23.5o N and 23.5o S), functional grounding at the negative pole of the DC side of the system must be implemented.

- Ensure the difference in potential between the negative pole of the DC array and the negative end of the DC side of the inverter input terminals is 0V.
- Follow the directions of the inverter manufacturer and prevailing local regulations.
- Only use inverters which include licensed grounding kits.
- Functional grounding is required to be implemented in installation sites with increased salt content in the air. (e.g. close the sea, defined as less than 500m from a coastline).

9.3 Protective Grounding

In order to prevent electrical shock or fire, the frame of the module as well as any non-current carrying metal parts of the system must be electrically grounded. While this section provides some information about grounding Silfab's frames and modules, reference should be made to local statutes and regulations for specific requirements on grounding. As an additional resource, reference the U.S. National Electrical Code addresses equipment grounding/bonding requirements in Article 250. You may also reference Canadian Electrical Code requirements located in CSA C22.1.

Proper grounding is achieved by bonding all exposed non-current carrying conductive parts to the appropriately sized equipment grounding conductor (EGC) or racking/rail system that has been tested and verified to be used as a means of integrated grounding.

Silfab's frames are protected from corrosion via an anodized coating. This coating must be penetrated in order to ensure proper bonding for equipment grounding requirements. The different methods outlined below are suggested methods to establish an appropriate bond between the frame and the EGC or racking system. The installer must ensure that the ground path of the EGC or racking system follows proper grounding requirements.

Option A: Use of a grounding lug

A UL listed grounding lug can be bonded to the grounding hole located on the bottom flange of Silfab's module frame. The holes are marked with an electrical ground symbol. ⏚

To install the grounding lug, follow the specified instructions of the manufacturer. The grounding lug should be made of stainless steel or tin plated metals such as aluminum to avoid corrosion. The grounding lug should be attached to the frame grounding hole using stainless steel hardware (screw, toothed lock washer or KEPS nut). A lock washer or other locking mechanism is required to maintain tension between the bolt and assembly; Silfab recommends a torque value of 25inch-lbs. The conductor must be attached to the ground lug using the lug's set screw. Refer to NEC Article 690. Care should be taken to avoid the use of grounding hardware of dissimilar metals which may lead to corrosion. Ensure that the grounding area for the connection is clean and free from oxides and/or any debris that could impede the pathway for the electrical ground. Always follow safety procedures when installing any grounding/mounting system.

Option B: Integrated grounding methods

A Silfab module can be bonded with a racking/rail system using a UL2703 certified integrated grounding method. The racking/rail system will then have to be electrically grounded in such a way that the overall system is properly grounded per local requirements and regulations such as what is defined in NEC article 250 or Canadian CSA C22.1.

One example of an integrated grounding method is the use of a washer recognized as meeting UL2703 requirements between the module and the racking/rail system, and is listed on UL's product database. An example of a UL2703 recognized integrated grounding method is a WEEB washer which Silfab has found to be generally compatible with Silfab modules, however each combination of module/racking system requires a specific WEEB washer size. It is the responsibility of the installer to ensure that that the specific size requirement has been met and is used appropriately per the manufacturer's installation manual. Note, WEEB washers are intended for single-use only; they must not be reused after removal or loosening. Refer to Wiley's installation instructions for the specific use of WEEB washers.

Other grounding methods may be used in conjunction with a module mounting system tested to UL2703. For these installations, the Silfab module and frame style must be tested and part of the instructions for the listed mounting product. The Silfab module must be installed in accordance with these instructions as well as the mounting system's listed instructions.

As a final reminder, both Option A and Option B must be grounded as per NEC Article 250 or CSA C22.1, whichever may apply to your local jurisdictional and code requirements.

9.4 Silfab Bifacial Modules

Bi-facial modules are able to capture and convert light from both the front and back surface of the module, as shown FIGURE 6. As a result, Levelized Cost Of Electricity (LCOE) can be further reduced with bifacial technology through rear-side generation up to 20% annual gain. This section outlines the fundamental components for consideration to maximize power output of your bi-facial PV system.

Step #1: Highest Surface Reflectivity/Albedo

- Performances of bifacial PV modules are linearly dependent on the albedo.
- Best results: crushed white rock, bright white paint, or an ENERGY STAR™ roof.

Step #2: Select the optimum height of installation & mounting structure

- Elevate the module above as much as possible, as it will capture more ground-reflected light.
- For flat ground/rooftop installation it's recommended a minimum height of 50-70 cm (19 11/16 – 27 9/16").
- Avoid shading the back side of the module from the support rack as much as possible.

Step #3: Tilt angle of modules

- Case-by-case based on site location. For site specific energy yield analysis and power reports, please contact Silfab Solar.

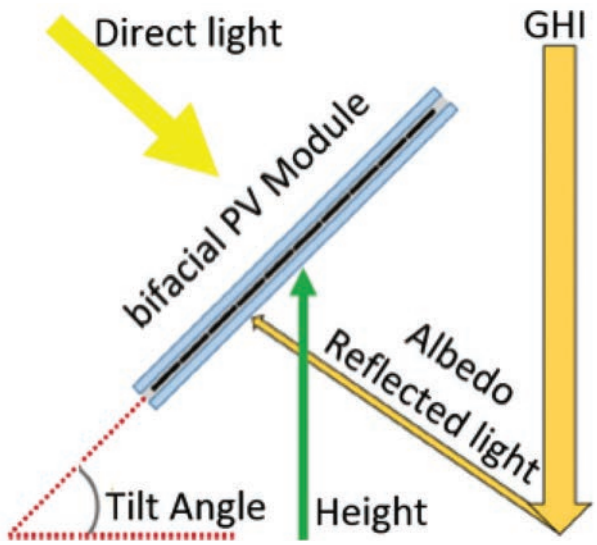


Fig. 6: Bifacial solar module

IMPORTANT NOTE: ELECTRICAL CONNECTION

With an expected gain of power (Pmp) and current (Isc) from the rear due to significant light contribution, i.e from a high albedo background, the user/designer must consider the electrical performance of both front and irradiance % on backside for the following below. It's suggested at least +20% bifaciality gain.

- Wire and string sizing
- Inverter short-circuit current input limit
- Overcurrent protection device

TIP: With multi-row structures, connect horizontal series of modules to different MPPT to reduce losses due to mismatch on reflected light on back side.

9.5 Silfab Module Installation in Marine Applications

This section provides guidance of safe handling and installation of Silfab PV modules less than 500 meters to any salt water coastal waterway regarded as "near-coastal". Improper care and negligence to properly protect PV system as recommended may potentially induce salt-mist corrosion and accelerate electrical insulation losses and galvanic corrosion. Silfab reserves the right to review any potential warranty claims in "near-coastal" environments against a customer's strict adherence to the best practices and recommendations provided in this section. Any non-conformances found will potentially disqualify the product from being covered under Silfab's Limited Product and Linear Performance Warranty. For further inquiries please contact Silfab's Customer Service.

Mechanical Installation

- Do not scratch or break the corrosion-resistant coating (e.g. anodization layer) on PV Modules and mounting system unless it is part of the electrical equipment grounding system (grounding lugs, integrated grounding hardware compliant to UL2703).
- Use corrosion-resistant material (e.g. stainless steel SUS 316) for components (e.g. nuts, bolts, gaskets, etc.) to install your PV system.
- For safe mounting installation, use insulation gaskets between mounting hardware attached to the PV module frame between PV module frame and rail, unless the mounting hardware is part of the electrical equipment grounding system using integrated mounting/grounding hardware that is compliant with UL2703.
- Recommendation for gasket insulation are mica lamination, or silicone, or fluoride made insulating material.

Grounding

- Silfab recommends to protect any exposed grounding points (such as a grounding block) of the PV system with a corrosion-resistant coating, for example (a) Butyl Plaster to completely cover an exposed grounding block or (b) spray fluorocarbon varnish of 40 um thick onto exposed ground blocks thoroughly to form an anti-corrosion protective film.

  Remember to clean the exposed grounding block and sur rounding area and make sure the surface is dry. Any exposed components must be fully covered from exposure to salt.

To ensure optimum module performance, Silfab recommends maintenance service every three months with the following measures:

- Check the module frame, mounting system, grounding block and junction areas for potential signs of corrosion.
- Clean the module frame, mounting system, grounding block and junction areas from accumulation of dust and/or salt with soft foam materials, non-woven fabrics, whisks, soft sponges, soft brushes and hair brushes may be used.
- Upon possible finding of corrosion due to salt, re-apply Butyl Plaster or fluorocarbon varnish to cover rusty area thoroughly.

IMPORTANT NOTE: DISCLAIMER OF LIABILITY

Silfab PV Modules have successfully passed IEC 61701:2011 – Level 5 Salt Mist Corrosion Test. However, full protection against salt exposure is largely dependent on multiple components of the PV system beyond Silfab's control. As such, Silfab strongly recommends to adhere to the installation procedure. If negligence is found, Silfab cannot hold responsibility and disclaim liability for any loss, damage, or expense arising out from "near-coastal" installation.

10. MAINTENANCE

Cleaning method of ARC-Glass of Silfab PV Module

Silfab uses anti-reflective coated glasses for maximum performance. It is recommended to regularly clean the modules to ensure maximum power output.

Module cleaning should be done in the early morning, in the evening, at night or on rainy days when solar irradiance is low.

Detailed description:

- Do not touch the glass with bare fingers or hands. Wear clean gloves to prevent fingerprints and other dirt from staying on the glass.
- Do not use metal tools, such as blades, knives, steel wood and other abrasive materials. Cleaning the glass with hard surface will scratch the ARC-glass.
- Do not use high pressure washers, abrasive brushes, powders, cleaners, polishers, sodium hydroxide, benzene, nitro-thinners, acid or alkali and other chemical substances. Doing so may damage the anti-reflective coating that is present on the glass of the modules and void warranty.
- All types of commercial glass cleaners, or alcohol/ ethanol/ methanol can be used.

Routine steps of cleaning:

1. Whisking: Debris such as dust and leaves on module surface should be removed with dry cloth.
2. Scraping: hard foreign matters such as dirt, bird droppings, plant branches, etc., should be scraped off with non-woven fabric or hair brush.
3. Washing: Colored substances, such as bird dropping, plant juices, etc., on module surface can be removed by cleaning by spraying water onto the dirty region and scraping with hair brush or non-woven fabric. The pressure of the cleaning water should be less than 690Kpa (100 PSI).
4. Cleaning of snow: Silfab modules can withstand heavy snow pressure up to 5400 Pascal. Do not try to remove frozen snow or ice from the module. Use a brush to gently remove the snow.

11. DIAGNOSTICS & TROUBLESHOOTING

The strict quality controls in Silfab Solar's manufacturing facility ensures all of our modules are sold free of significant defects, breakages and/or other problems. However, in its operation some problems may arise that can alter the correct operation of the modules.

In the event of accelerated deterioration of the module, Silfab Solar should be notified immediately to make the necessary replacement under the Silfab Limited warranty.

Please refer to the Silfab RMA Procedure for details on how to obtain repair or replacement service, credit or refund (as applicable) under the modules' limited warranty.

12. MODULE IDENTIFICATION

Each module is equipped with three identical serial numbers that acts as a unique identifier. They are located:

- inside the laminate under the front glass
- module frame
- on the pallet list

Moreover, each module has a specific label that is attached on the rear side. This label specifies the product information. Product label has a QR-CODE to download more information.

13. PACKAGING, HANDLING & STORAGE

13.1 Silfab's Packaging

These modules are arranged in horizontal or vertical positions as shown in Fig. 7 and 8. Transport the module in its original packaging until installation to avoid water infiltration and do not place any heavy or sharp object on the top or sides of the pallet, as it could damage the modules.

SILFAB PACKAGING DETAILS

	SILFAB ELITE	SILFAB PRIME	SILFAB COMMERCIAL
	SIL-XXX BK	SIL-XXX HC	SIL-XXX HN
Number of modules stacked	26	26	31
Modules Orientation	Horizontal	Horizontal	Vertical
Package size (L x W x H)	184 cm x 105.5 cm x 126 cm 72.4 in x 41.5 in x 49.6 in	182 cm x 109 cm x 119 cm 71.7 in x 43 in x 46.9 in	230 cm x 116 cm x 125 cm 90.5 in x 45.6 in x 49.2 in
Package weight	550 kg / 1212.5 lbs	525 kg / 1157.4 lbs	850 kg / 1874 lbs
Pallet	Wooden Pallet IPPC compliant	Wooden Pallet IPPC compliant	Wooden Pallet IPPC compliant
Packaging	Stretch Wrap Film, Containment Straps	Stretch Wrap Film, Containment Straps	Cardboard Box, Containment Straps
Module protective corners	Plastic	Plastic	Cardboard
	SIL-XXX BG	SIL-XXX HC+	SIL-XXX HM/QM/XM
Number of modules stacked	27	26	29
Modules Orientation	Horizontal	Horizontal	Vertical
Package size (L x W x H)	192 cm x 108 cm x 123 cm 75.6 in x 42.5 in x 48.4 in	197 cm x 109 cm x 119 cm 77.5 in x 43 in x 46.9 in	213cm x 106 cm x 128 cm 83.8 in x 41.7 in x 50.4 in
Package weight	620 kg / 1367 lbs	605 kg / 1334 lbs	810 kg / 1786 lbs
Pallet	Wooden Pallet IPPC compliant	Wooden Pallet IPPC compliant	Wooden Pallet IPPC compliant
Packaging	Stretch Wrap Film, Containment Straps	Stretch Wrap Film, Containment Straps	Cardboard Box, Containment Straps
Module protective corners	Plastic	Plastic	Cardboard
		SIL-XXX QD	SIL-XXX XM+
Number of modules stacked		26	29
Modules Orientation		Horizontal	Vertical
Package size (L x W x H)		177 cm x 118 cm x 119 cm 69.7 in x 46.6 in x 46.9 in	231cm x 107 cm x 128 cm 90.9 in x 42.1 in x 50.4 in
Package weight		600 kg / 1320 lbs	916 kg / 2020 lbs
Pallet		Wooden Pallet IPPC compliant	Wooden Pallet IPPC compliant
Packaging		Stretch Wrap Film, Containment Straps	Cardboard Box, Containment Straps
Module protective corners		Plastic	Cardboard

Fig. 7 Horizontal packaging of photovoltaic modules.

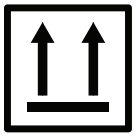
Fig. 8 Vertical packaging of photovoltaic modules.

Fig. 9 Protective Corner

13.2 Correct Handling of Module Packaging

Each package has been designed for safe shipment and storage of modules. The following symbols apply to the packing, with the following meanings:

KEEP PACKAGING UPRIGHT



The packaging is only designed to be handled and stored with the modules sitting on the pallet as per Fig. 7. Not following these indicated directions may create forms of mechanical stress on the modules that could cause damage or breakage.

STACKING

Do not stack more than two pallets high.

AVOID EXPOSING TO RAIN OR SNOW. DO NOT LEAVE EXPOSED TO FLOODING

The plastic wrap and/or cardboard is intended to prevent temporary contact with dirt, water or other materials but will not protect the modules from damage resulting from excessive rain, snow and flooding. Modules should be stored in a sheltered dry location whenever possible. Modules are not to be stored outside for a period exceeding 60 days.

HANDLE WITH CARE

During the operation of shipping and storage of the modules use maximum care to ensure the full integrity of the modules. Hidden cell damage can result if care is not taken..

RECYCLE WHERE POSSIBLE

Any direct impact to the glass or on the corners of the modules should be avoided. Avoid flexing the laminates or applying non-distributed loads and stresses. Avoid scratching the surface of the exterior glass or backsheet. Do not apply any forces to the backsheets. Do not drop the modules or pallets from any height.

FRAGILE

Any direct impact to the glass or on the corners of the modules should be avoided. Avoid flexing the laminates or applying non-distributed loads and stresses. Avoid scratching the surface of the exterior glass or backsheet. Do not apply any forces to the backsheets. Do not drop the modules or pallets from any height.

13.3 How to Handle the Pallet

The packaged pallet must be handled with the utmost care and attention. The equipment used for handling a full packaged pallet should be rated for a minimum of 1000 kg (or 2000 kg for a double stack). The "4-way" style pallet can be handled from both the short and long sides, however, lifting from the short side will provide the best support for the modules within. For that reason, lifting from the long side should only be done by suitable equipment during loading and unloading of truck and containers. The handling equipment must be fitted with forks of appropriate length for the pallet's size (see table below).

MINIMUM FORK LENGTH FOR HANDLING OF PALLETIZED MODULES (SINGLE/DOUBLE STACKS)		
	BK/BG HC/HC+/QD	HM/HN/QM/ XM/XM+
Short Side	1.5 m / 60 in	1.8 m / 72 in
Long Side (For loading/ unloading from trucks/ containers only)	1.2 m / 48 in	1.2 m / 48 in

⚠ Verify that the package is positioned on a surface that is either flat or not excessively deformed to a point that would impart and inclination to the pallets which could damage the PV modules.

⚠ Do not aggressively lift pallets as module damage may occur.

⚠ Do not attempt to move more than one pallet at a time, unless properly secured as provided by the factory. Never attempt to move a stack of three pallets under any circumstances.

13.4 Unpacking Modules

Observe the following procedures for the unpacking of modules:

- Place the packaging on a stable and flat surface
- Using a knife carefully cut the straps and plastic wrap then remove them.
- Remove the upper cover
- Recover the packing list (for record keeping)
- Remove the PV modules and their protective corners without damaging them
- Collect and store the protective and the wooden pallets

ⓘ Note: Once you have removed the strapping the pallet must no longer be moved as the load will not be secure.

If movement of the pallet is required be sure to re-strap the pallet as per the original packaging strap locations.

13.5 Pallet Sheet

Each package has a sheet ("pallet sheet") placed in a visible position and containing some pertinent information such as: serial number of each module, part number of each module and pallet number. All Numbers are readable with a standard bar code reader. See Fig.7.

13.6 Recycling Packaging Materials

Silfab undertakes efforts to treat every aspect of production to minimize the environmental impact. The packaging is made with materials that for the most part are reusable.

In particular, the wooden pallets (Fig.10) and protective corners (Fig.11) should be retained. Arrangements for recovery will be made on a case by case basis.

Fig.10

Fig.11

Fig. 10 & 11: How to package the pallets and plastic corners, respectively, after unloading, ready to deliver back to Silfab for reuse.

14. REVISION LOG

Revision Level	Section(s) affected	Brief description of changes	Date
MAN-SSI-01	NEW DOCUMENT	For Silfab Elite/BK, Silfab Prime/HC, Silfab Commercial/HN	10/20/2021
MAN-SSI-02	Page 4	Updates to PRIME/SIL BK mounting	10/27/2021
MAN-SSI-02	Cover/Back Cover	Update Silfab Logo to registered trademark	07/01/2022
MAN-SSI-03	Multiple Sections	Addition of BG, HC+, HM information, P. 3 8.5	12/15/2022
MAN-SSI-03	Pg. 5	SIL BG - Updated Design Load Rating, Test Load Rating	03/24/2023
MAN-SSI-04	Cover, TOC, Muliple Sections	Updates include the addition of QM, QD	12/05/2023
MAN-SSI-05	pp. 8, 10	Mounting data updated to include 3 rail mounting data and illustrations for QD, HM, QM	01/23/2024
MAN-SSI-06	pp. Cover, 2, 10, 11, 15, 17	Included XM in the text.	01/31/2024
MAN-SSI-07	p. 1	Included N-type reference	04/22/2024
MAN-SSI-08	pp. Cover, 1, 2, 11, 12, 16, 18	Included XM+ data	08/09/2024
MAN-SSI-09	p. 10	Update to chart	08/23/2024

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