SILFAB ONTARIO INC.

SAFETY and INSTALLATION MANUAL

Photovoltaic Modules:

SLAXXXM3A/SLAXXXM, SLAXXXP3A/SLAXXXP,

SLGXXXM3G/SLGXXXM, SLGXXXP3G/SLGXXXP

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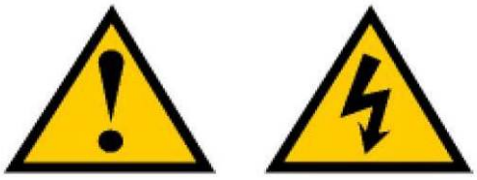
SAFETY NOTICE

This Safety and Installation Manual provides important safety information relating to the installation, maintenance and handling of Silfab SLA and SLG 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.



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.

1. General Information

The photovoltaic (PV) modules SILFAB SLAXXXM3A/SLAXXXM, SLAXXXP3A/SLAXXXP ('SLA') and SLGXXXM3G/SLGXXXM, SLGXXXP3G/SLGXXXP ('SLG') are devices that produce electrical energy by converting the sunlight's radiation reaching their surface, when appropriately exposed, into continuous/direct current (DC).

The SLA/SLG modules are intended to be used only and exclusively in photovoltaic module systems connected to the electrical grid; therefore, it is not recommended to use them in battery powered photovoltaic module systems (stand alone).

The rated currents at Standard Test Conditions (STC) of the SLA/SLG modules are variable depending on the model and the relative power rating, as indicated in the respective **technical data sheets.** Most of the electrical parameters of the modules, specified in the datasheets, are determinable only by using special instrumentation in the laboratory; therefore, only some of them are measurable outside of a lab, using common instrumentation *(voltmeter, ammeter, solarimeter/pyranometer).*

It is possible, following very precise procedures, to carry out electrical measurements of voltage and current as snapshots, which enable you to monitor the operation of the modules and determine possible, although rare, anomalies.

The electrical output parameters for SLA/SLG modules, of technical importance during the operation, installation and maintenance, are the following:

- Voltage at open circuit (V_{oc})
- Current at short circuit (I_{sc})
- Voltage at point of maximum power (Vp_{max})
- Current at point of maximum power (Ip_{max})
- Solar radiation in W/m^2 at the time
- Temperature of the cells

The general performance of the modules is heavily dependent on the intensity of the incident solar radiation, as illustrated in Fig.1. Acheiving maximum performance requires proper installation, with the modules oriented towards the South and their surface exposed as perpendicularly possible to the incident rays of the sun.

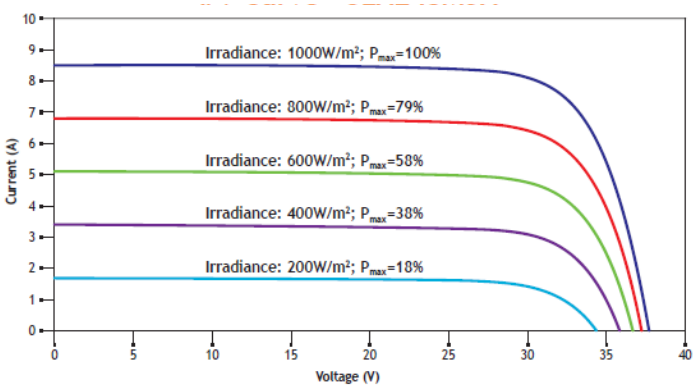


Fig. 1: *IV curve at different irradiance*

Avoid any shading caused by obstacles in and around the area of installation as shading can cause loss of output.

A high ambient temperature and therefore, an increased operational temperature of the modules, also contribute to a proportional reduction in electrical performance.

In order to optimize the production of electical energy of the modules, and therefore of the system connected to an electrical grid, it is the responsibility of the installer to make sure the modules are positioned as much as possible facing south, with the tilt angle (β) (inclination of the surface of the modules in respect to the ground, as shown in Fig.2) optimal for the type of desired application.

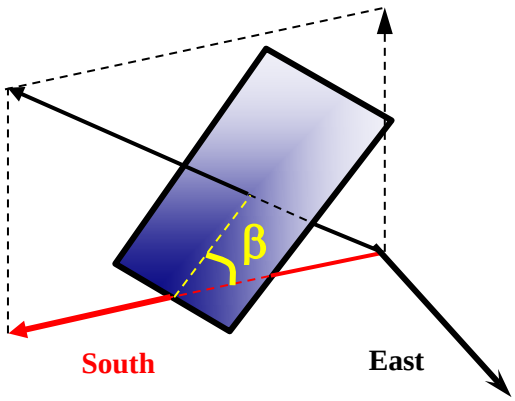


Fig. 2: *Orientation Vs. Azimuth*

The tilt angle of ideal average throughout Ontario, Canada is **ß = 30°**; however, even the inclination typical the roof of a dwelling (ß = 15-20°), being already an inclined plane, could make the angle acceptable, if not ideal, for the installation of coplanar modules on it (using a special standard structure for support).

Depending on the variation of the tilt angle of the modules with respect to the ground, or of their orientation in relation to facing south (Azimuth), there will be changes in the annual average amount of energy produced by the modules themselves, and therefore, of the plant connected to the network to which they are linked.

2. Disclaimer of Liability

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

3. Underwriters Laboratories (UL) Listing Information

This product meets or exceeds the requirements set forth by UL 1703 for PV Modules. This UL Standard covers flat-plate PV modules and panels intended for installation on buildings or those intended to be freestanding. To satisfy the listing for this product the modules must be mounted with a rack or standoff structure. The UL listing does not include integration into a building surface because additional requirements may apply. *This product is not intended for use where artificially concentrated sunlight is applied to the module.*

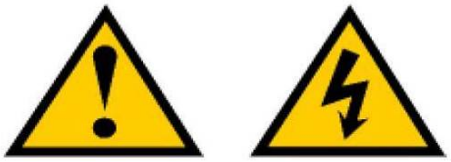
4. Limited Warranty

Please refer to SILFAB General Terms and Conditions of Sale for details of the modules' limited warranty. Failure to comply with this Safety and Installation Manual will invalidate SILFAB Warranty for the PV modules as stated in the General Terms and Conditions of Sale.

5. Module Specification

Please refer to the technical datasheet for the module SILFAB SLA or SLG respectively for electrical performance data. These electrical data are measured under Standard Test Conditions (STC) of 1000 W/m^2 irradiance, with Air Mass (AM) of 1.5 spectrum, and a cell temperature of 25°C.

6. Safety Precautions



⚠ ***Installation should be performed only by authorized personnel!***

⚠ Module installation must be performed in compliance with the latest U.S. National Electrical Code (NEC) in the USA or with the latest Canadian Electrical Code and any applicable local codes.

⚠ Within the modules there are no user serviceable parts. Do not attempt to repair any part of the modules. Contact your module supplier if maintenance is necessary.

⚠ 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 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 at the connectors or junction box!

⚠ Do not install or handle the modules when they are wet or during periods of high winds.

⚠ Do not use oil based lubricants on any part of the junction box as this can cause long term damage to the plastics.

⚠ Ensure that wire cable connections are routed in accordance with the junction box manufacturer's recommendations. Incorrect routing of the wire cable can lead to stress damage to the junction box.

⚠ Do not leave cable connectors exposed in adverse climatic conditions. Water and dust deposits inside the cable connectors can cause long term damage.

⚠ Broken module glass, a torn backsheet, a broken junction box or broken connectors are electrical safety hazards; consequently, contact with a damaged module can cause electric shock.

⚠ 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 400 W/m^2!!** Follow the Isc measurement instructions in section 8b to determine the value of the solar irradiance (E).

- Methods to ensure a low 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 to light

intensity greater than 400 W/m^2. Opaque material can be supplied by Silfab upon request.

- Making the connections during hours of low intensity of solar irradiance (such as early morning or late afternoon).

- Making the connections with the modules tilted perpendicular to the sun, to increase shading between the strings thus decreasing solar irradiance.

7. Installation

7a) Module Mounting

⚠ The module is class C fire rated.

⚠ When installing Silfab modules, local building code requirements and regulations must be adhered to at all times. In particular, in case of roof mounting, fire protection must be compatible with the class C fire rating (ie. fire resistant roofing materials). Class C rating is to be maintained when mounting the modules at any inclination angle.

⚠ Sufficient ventilation of the module backside is required for maintain the Class C fires rating, and therefore the mounting configuration (e.g. sufficient clearance) should be adapted accordingly**.** The recommended clearance distance is a minimum 10 cm.

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

⚠ ***Pre-assembled mounting systems will need written approval by Silfab in advance.***

- The modules can be mounted in every angle from horizontal to vertical, avoiding configurations with the junction box up-side down at all times (e.g. trackers with "sleep mode").

- In order to maximize module exposure to direct sunlight, the modules should be oriented to the south in the northern hemisphere and to the north in the southern hemisphere.

Mounting Methods:

Mounting using mounting holes:

- Each module must be securely fastened at a minimum of 4 points.
- Use the 4 mounting holes (slots, see Fig. 3a/3b) 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.***

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.

- When using clamps, it is possible to mount the modules in horizontal (the shorter side of one module facing the shorter side of the neighboring module) or in vertical (the longer sides facing each other) configuration. Refer to Fig. 4b,c,d for an example of attaching the modules to a support structure using mounting clamps. (It is recommended to always use stainless steel screws and bolts.)

- The 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 (vertical or horizontal) of the module (Fig. 5a/5b).

- In vertical configuration, it is strongly recommended to place the supporting elements nearby the mounting holes, or in any case, allow a spacing of 800-941 mm between them. This is necessary in order to maintain a correct load distribution (Fig.

5a/5b), and achieve the 5.4 kPa load rating.

- In horizontal configuration, fixing the modules by blocking them at the 4 mounting holes will guarantee the characteristics regarding the static loads as certified.
- When clamping the modules in horizontal configuration on a support structure, the following rules have to be applied in order to maintain the resistance against static loads as certified:
    - If the bars or rails are in vertical direction, they have to be placed nearby the corner holes or in any case a spacing of 800-941 mm between the bars has to be maintained in order to achieve the 5.4 kPa load rating (Fig. 5a/5b).
    - If the bars or rails are in horizontal direction, they have to be placed with a spacing of 500-750 mm in order to achieve the UL specified 2.4 kPa load rating (Fig. 5a/5b).
- The modules can also be fixed by placing them with their frame on a structure that is supporting the two sides of the frame over their whole length. In this case, the position of the mounting clamps must be in accordance with the above mentioned spacings (800-941 mm and 500-750 mm respectively) – refer also to Fig. 5a/5b.

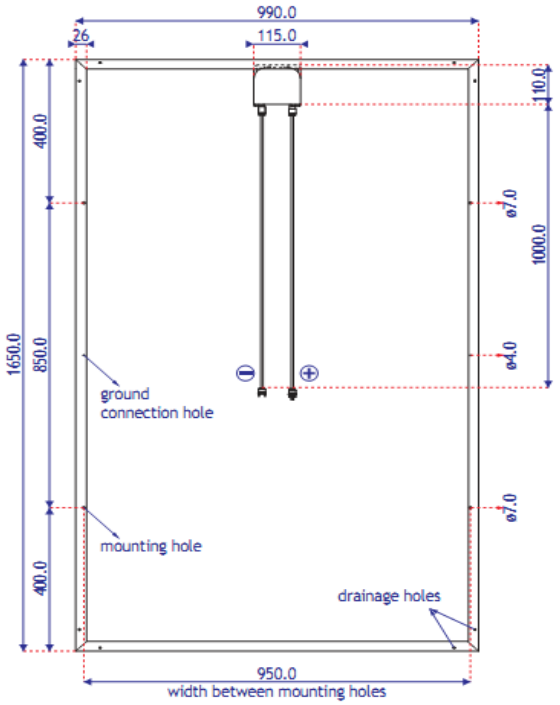


Fig. 3a: *Mechanical drawing of an SLA module showing the mounting holes, the drainage holes, and the ground connection holes*

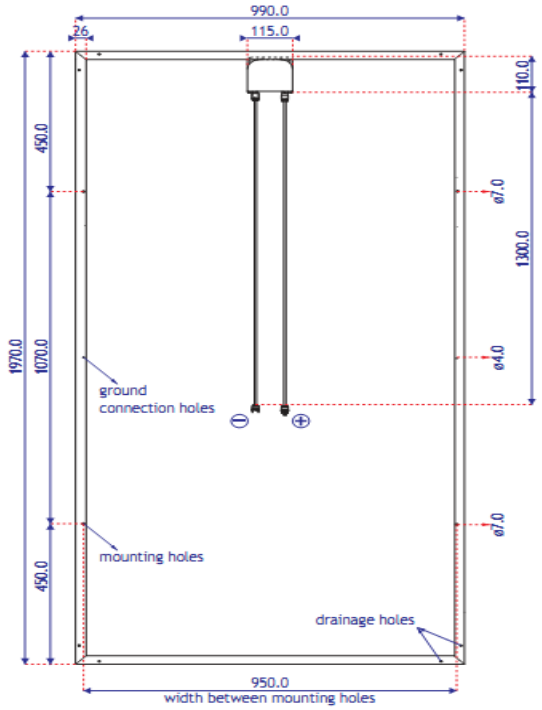


Fig. 3b: *Mechanical drawing of an SLG module showing the mounting holes, the drainage holes, and the ground connection holes*

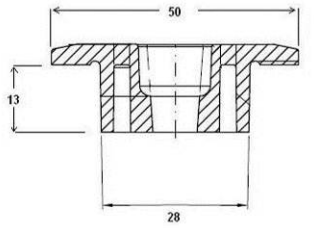


Fig. 4a: *cross section of a mounting clamp to be used for attaching the modules to support structure.*

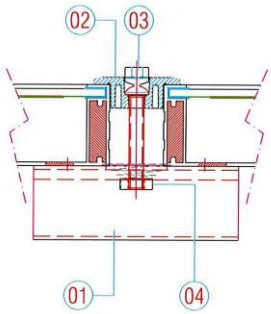


Fig. 4b: *modules attached to supporting structure (rail, item 01) using a clamp (item 02) fixed with a bolt (item 03) and nut (item 04) – view between two modules.*

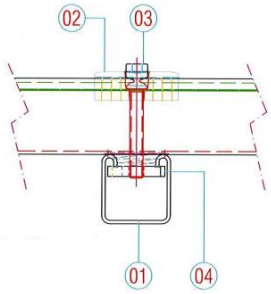


Fig. 4c: *modules attached to supporting structure – side view.*

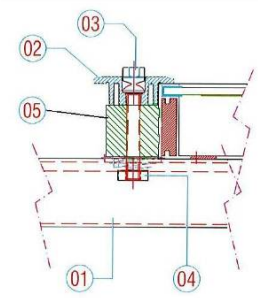


Fig. 4d: *end of module row with additional spacer (item 05: 50mm x 30mm x 24mm)*

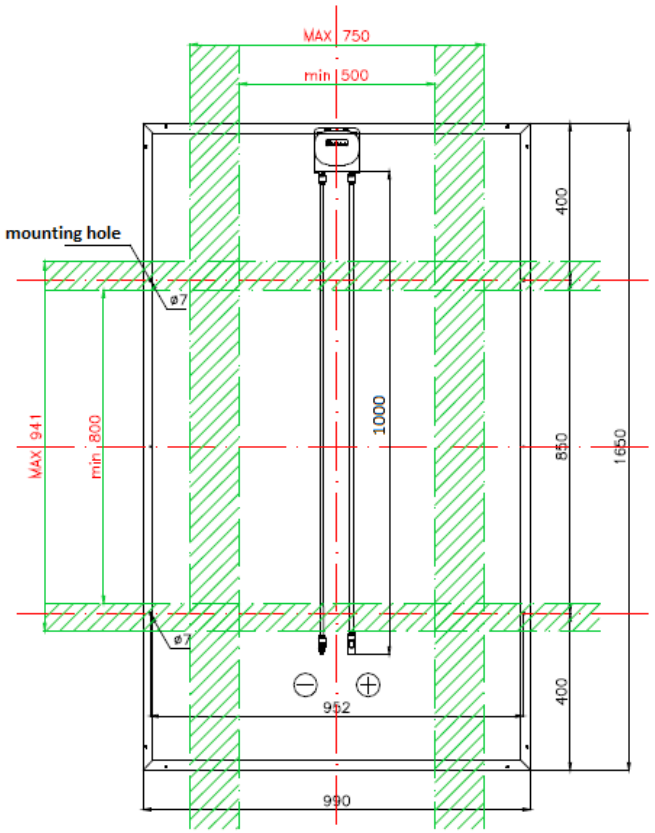


Fig. 5a: *allowed positions for fixing SLA modules using mounting clamps.*

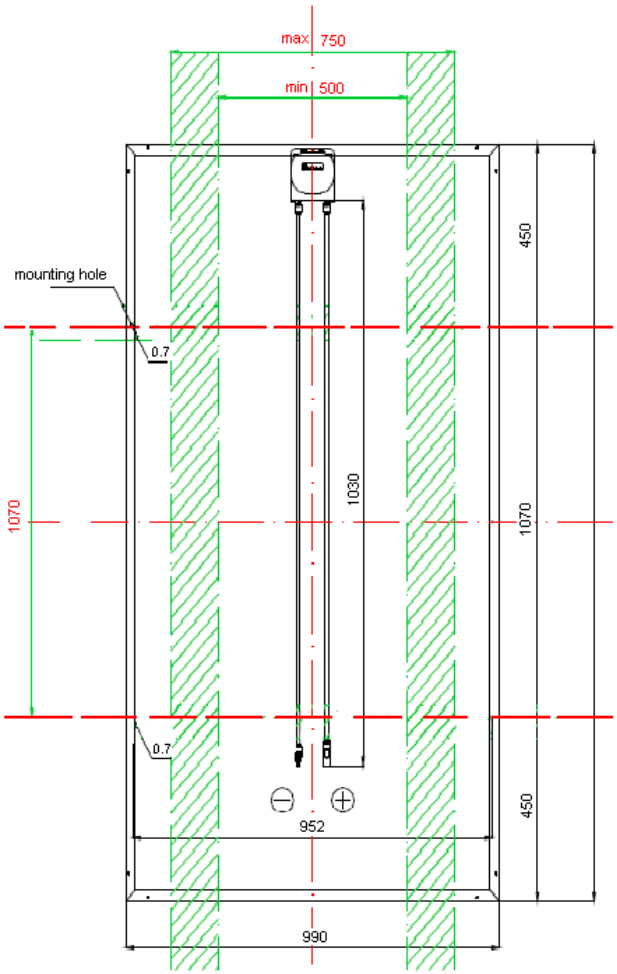
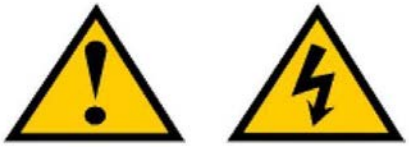


Fig. 5b: *allowed positions for fixing SLG modules using mounting clamps.*

⚠ **ATTENTION:** in the case of installation with modules in the vertical position, it is preferable to maintain the Junction Box located in the upper part of the module. This practice will help reduce, as much as possible, contact between any standing water and the Junction Box, and avoid possible water infiltration.

7b) Handling of Modules



⚠ The Silfab modules are robust, but in particular the glass front cover and cells may be subject to damage if the modules is improperly handled or installed.

⚠ Wear protective gloves when handling and installing the modules in order to be protected against cutting by sharp edges and against skin burns.

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

⚠ Do not carry the module by its connector wires in order to avoid the risk of electric shock and prevent damage to the module.

⚠ During the wiring and installation of the modules use caution!

⚠ Do not trample on or scratch the modules.

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

⚠ Do not subject the modules to any impact, in particular in the vicinity of the edges of the frames and do not flex them mechanically. The modules are made of a single laminate, therefore once damaged, they are not repairable.

⚠ In the event of any damage to either the front or the back of the module, the part exposed might be electrically active and therefore dangerous, especially if the module is connected in series to a string.

⚠ The junction box does not require any extra field wiring at the terminals. (Changing wires or modifying any piece of the junction box, including the bypass diodes will void the module warranty.)

7c) Electrical Connection

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

⚠ Even if the modules are protected against accidental contact, under unfavorable conditions 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.

⚠ Before connection of the system to the grid, the PV system must be approved for correct installation, by an electrician responsible to the operator and the local electricity company.

⚠ The design of the PV system should be done by a qualified person familiar with PV system design. The system design is the responsibility of the PV system designer. Therefore, SILFAB does not assume any liability for how the modules are installed.

⚠ The junction boxes used with SLA/SLG modules contain bypass diodes wired in parallel with the PV cell strings. In the case of partial shading, the diodes bypass the current generated by the non-shaded cells, thereby limiting the module's heating and performance losses. Bypass diodes are not over-current protection devices.

⚠ In the event of a known or suspected diode failure, installers or maintenance providers should contact Silfab. ***Never attempt to open the junction box by yourself!***

Under normal conditions, a PV module is likely to experience conditions that produce more current and/or voltage than reported at STC. Accordingly, ***the values of I_{sc} and V_{oc} marked on the module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, fuse sizes, and size of controls connected to the PV output.*** *Refer to NEC 690.8 (B) for an additional 1.25 multiplier that may be required for sizing fuses and conductors.*

- V_{oc} should be increased by a factor according to the lowest ambient air temperatures expected for the installation site. Refer to NEC 690.7 for the correct V_{oc} 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 V_{oc}.

- In order to obtain the required electrical current and/or voltage, the modules can be connected in series, in parallel, or in a combination of both.

  - In the case of series connection, do not exceed the maximum system voltage of 600V even at low temperatures. Always use the same type and rating of module in one installation!

  - In the case of parallel connection of modules or series strings of modules, fusing may be required. Information about the fuse rating can be found on the module's nameplate and in the datasheet – see also NEC 690 for additional fusing requirements.

  - The voltage of the strings of modules, in series, when measured at their poles, is the sum of all the individual voltages of

each module. This total voltage should be compatible with the range of input voltages admissible for the inverter to which the modules are connected.

7d) Grounding

- The module frame or array must be grounded before wiring. For grounding, use material that is certified according to UL 1703 – in particular the grounding should be performed by a qualified electrician using grounding methods in accordance with article 250 of NEC and relevant local codes and regulations.

- SLA/SLG modules can be grounded using third party grounding devices as long as they are certified for grounding modules and the devices are installed according to the manufacturer's specified instructions.

- Examples of acceptable grounding methods include the following (must be verified with local codes and regulations):
  - Attach a separate approved ground wire to one of the holes marked with a ground label on the module frame with a UL approved ring terminal or UL listed grounding lug.
  - Schletter Rapid Clamps are acceptable when using the proper size to match Silfab's 38 mm frame.
  - WEEB clips compatible with the chosen racking mounting clip are also acceptable when properly installed (ensuring an electrical bond between the module frame and the grounded racking).

- Ensure that the grounding area for the connection is clean and free from oxides or any debris that could impede the electrical grounding.

⚠ **Always follow safety procedures when installing any grounding/mounting system.**

7e) Environmental Considerations

- SLA/SLG modules should be installed in a location where there is no shading throughout the year.
  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.
  Ensure there are no obstacles to block light near the installation site.

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

- Although Silfab modules are designed to be able to withstand high snow pressure, in regions with heavy snowfall in winter, select the height of the mounting system so that the lowest edge of the modules is not covered by snow for any length of time.

8. USE AND MAINTENANCE

8a) Intended Use

SLA/SLG modules are designed for use in grid-connected systems. They are therefore linked in series/parallel combinations to feed a dedicated inverter with a DC input and an AC output of 110V AC - 60Hz to provide energy to the local electricity grid.

8b) Operational Measurements

The only two electrical parameters of output from a PV module, measurable with conventional instrumentation, are the V_{oc} and I_{sc}.

When the PV modules are instead connected in series/parallel configuration to an inverter, from its display it is possible to read:

- Operational voltage at maximum power output (Vp_{max}) of the string
- Operational current at maximum power output (Ip_{max}) of the string

From these above values it is possible to estimate the voltage at maximum power (Vp_{max}) of a module in the string under review and any non-uniformity in the voltages (Vp_{max}) of multiple strings connected to the same inverter.

From the Ip_{max} for the string it is also possible to verify whether there are obvious differences between one string and another. When a uniform condition is detected, it can be assumed that all the modules are working properly.
The following measures serve to collect preliminary information on the operational status of the PV modules in a PV system.
If there is a need to perform direct measurements on individual modules using conventional instrumentation, the following action should be taken:

To measure the open circuit voltage (V_{oc}):

- Note: even in the presence of an insolation average of 500 W/m^2, a module exposed to the rays of the sun presents at its poles (+ and –) a V_{oc} very close to the nominal value at STC (as shown in Fig.3).

- When taking the temperature at which the module is working at that moment into account, the open circuit voltage module (V_{ocmod}) will be approximately equal to:

  $$V_{ocmod} = V_{ocSTC} - [(T_{mod} - 25°C) \times 0.125V]$$

  Where:
  - V_{ocSTC} is the open circuit voltage measured at STC;
  - -0,125V/ °C is the average variation of V_{oc} of a module for a variation in temperature of 1°C;
  - 25°C is the reference temperature of STC;
  - In the case of good solar radiation and at the ambient temperature (T_{amb}), one can estimate the temperature of the module as follows:

    $$T_{mod} = T_{amb} + 30°C$$

- Using the calculations above, it is possible when measuring with a multi-meter, to verify V_{oc} meets the standard shown in the module datasheet.

- In a case that the V_{oc} to the connectors is decidedly lower than the standard values (75% or less) this could represent a condition of anomaly which should be investigated more thoroughly.

To measure the short-circuit current (I_{sc}):

- A PV module exposed to the south, inclined perpendicularly to the rays of the sun, in the middle of the day (about 12:00 to 1:00 PM) and in conditions of good weather, presents a value of I_{sc} similar to the rated values at STC, as measurable with an amp-meter in continuous current.

- By measuring the solar radiation (E) effective at the moment with a solarmeter/pyranometer in W/m^2 the short circuit current of the

module at the moment I_{scmod} should be very close to the following value:

$I_{scmod} = I_{scSTC} \times E/1000$

Where:

- I_{scSTC} is the short circuit current measured at STC;
- 1000 W/m2 is the radiation at STC.

- The measurement of the Isc is executable with precision only when using a solarmeter/pyranometer which gives exact information on the conditions of solar radiation at the moment, otherwise it is not reliable.

- In the case of the unavailability of a solarmeter/pyranometer, it will only be possible to have an estimate of the functionality of the module by comparing the value of I_{scmod} measured in relation to those of the other modules of the PV system, measured under the same conditions of irradiation.
  The acknowledgment of any obvious discrepancies of I_{sc} in the modules thus serves to identify anomalies.

⚠ ***ATTENTION!!!!!:***

To avoid the phenomena of electric arcing, both the connection and disconnection of the connectors of the modules being tested and the measurements of V_{oc} and I_{sc} should be performed with the string of modules in conditions of open circuit.

In addition, the Isc should be measured for each individual module in conditions of open circuit and not to the extreme poles of the string, which could be affected by voltages up to 600V.

- NOTE: an excess of intensity due to meteorological phenomena (for example, lightning) or mistakes in the connection (for example, connecting the modules under full irradiance) can cause damage, or short-circuit of the bypass diodes contained in the junction box. As a result, the Voc of the module may decline in proportion to the damaged diodes to ⅔Voc, ⅓Voc, or 0V. **In this case, the bypass diodes must be substituted only by Silfab personnel, onsite or offsite at Silfab's sole discretion.**

8c) Maintenance

Although PV modules do not require any routine maintenance, periodic (annual) inspection for damage to glass and inspection of the electrical connections and for corrosion as well as the mechanical connection is recommended.

Under normal conditions (sufficient rainfall), cleaning of the module is not required. In extreme climatic conditions, the electrical performance of the module may be affected by accumulation of dirt, dust or debris on the glass front cover.
In this case, the front cover can be washed using water or commercial glass cleaners, alcohol/ ethanol/methanol and a soft cloth.

Do not use 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 some Silfab modules.

Most municipal water used as cleaning water; however, it is not recommended to use water with high mineral content as it may deposit on the glass surface when the water is dry. The pressure of the cleaning water should be less than 690Kpa.

⚠ Exercise extreme caution when applying water on any electrical device!!

The module cleaning should be done in the early morning, in the evening, at night or on rainy days. When cleaning in the morning or evening, select the period when sunshine is not strong.

If you need to clear snow to improve output power, use a soft brush to gently remove the snow. But do not try to remove frozen snow or ice on the modules as it could lead to property damage.

9. PACKAGING, HANDLING AND STORAGE OF MODULES

9a) Silfab's Packaging

SILFAB Ontario provides the SLA/SLG modules in the most appropriate packaging, designed to guarantee that the transportation and storage will be in conditions of maximum safety and protection until the time of installation. Each package contains up to 35 modules, arranged in a horizontal position with the glass facing downwards (as shown in Fig. 6).

Transport the module in its original packaging until installation. If transporting outside of the original packaging is necessary, contact Silfab for written approval in advance.
Protect all parts of the module during transport and installation from mechanical stresses.

Fig. 6: *Module Packaging*

The packaging consists of:

- A maximum number of 35 SLA modules or 30 SLG modules
- 1 wooden pallet (Fig. 7)
- 4 plastic protective corner angles per module (Max 140, Fig. 8)
- Containment straps
- 1 waterproof cover
- Transparent film for containment

Fig. 7: *Wooden pallet*

Fig. 8: *Protective corner*

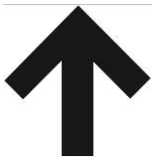
9b) How to Manage the Packaging

Each package has been designed to allow the shipment and storage of modules in order to maintain their integrity unchanged over time, provided that the information and indications supplied by SILFAB Ontario are closely observed and followed. These indications are summarised by a series of standard symbols posted in a visible manner on each pallet. The list below illustrates the meaning of each symbol:

DO NOT STACK: each pallet of modules is packaged according to the maximum number of modules stackable vertically, in order to avoid or reduce mechanical stress or damage as a result of the pressure exerted by the stacked modules. Therefore, it is absolutely forbidden to stack a pallet on top of another, both in the process of shipment and storage of modules.

DO NOT EXPOSE TO ATMOSPHERIC AGENTS: each pallet of modules is suitably dressed in a cap of transparent plastic in order to avoid temporary contact with generic water spray or atmospheric agents. The plastic casing does not ensure the protection of the modules in the case of prolonged exposure to atmospheric agents. Similarly, in the case of flooding, the pallet does not ensure the maintenance of the mechanical properties of the weight of the modules. For this reason it is recommended to store the pallet in a place that is sheltered and dry. In addition, as the the junction

box has an IP65 degree of protection, in the event of a flood the stagnant water inside of the frame could oxidise the metal contacts of the connectors degrading the characteristics and altering the electrical properties of the contacts of the module causing damage.



DO NOT OVERTURN THE PACKAGING: the packaging is only designed to be handled and stored with the modules maintaining the position of the arrow printed on the packaging, with the arrow always facing upwards. Not following these indicated directions may create forms of mechanical stress on the modules that could cause damage or breakage.

RECYCLABLE: most of the photovoltaic modules are recyclable. They should not be thrown into landfill without a proper method for recycling. Although they are not yet regulated by current rules of refutes RAEE, many institutions and public structures are organising to collect the modules that are damaged or are no longer usable for materials.

FRAGILE: the photovoltaic modules are manufactured using a glass front which makes up approximately 70% of the total materials used to construct them. Although the modules are stiffened by an aluminium frame, 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.

HANDLE WITH CARE: during the operation of shipping and storage of the modules use maximum care to ensure the full integrity of the modules.

9c) How to Handle the Pallet

During the handling of the pallet make sure to pay the utmost attention. The packaging must be raised/moved exclusively with fork-lift trucks or hand pallet trucks fitted with forks of length appropriate to its size and weight. The pallet which supports the packaging is a "4 ways" type, (able to be lifted from any of the short or long sides) with dimensions of 1750 x 1080 mm. For the safe handling of the pallet the forks length should be:

- A minimum of 1800 mm for lifting from the shorter side
- Able to support the total weight of the packaging of approximately **700 kg**

Fig. 9: *How to handle the packaging*

Pay attention during the stages of handling and unpacking. Verify that the package is positioned on a surface that is either flat or not excessively deformed to a point that would impart an

inclination to the pallets which could damage the PV modules.

SILFAB DOES NOT ASSUME RESPONSIBILITY IN THE EVENT OF DAMAGE TO THE MODULES ARISING FROM MANAGEMENT OF THE PACKAGING THAT IS IMPROPER OR DIFFERENT FROM WHAT WAS STATED IN THIS DOCUMENT.

9d) Unpackaging

Observe the following procedures for the unpacking of modules:

- Place the packaging on a stable and flat surface
- Using a cutter, cut the plastic wrap surrounding the package
- Remove the plastic wrap
- Remove the upper cover
- Recover the flash list (for record keeping)
- Using a cutter, cut the straps
- Remove the PV modules and their protective corners without damaging
- Collect and store the protective corners and the wooden pallets awaiting recovery by the supplier, as described in section 9f.

Note: avoid storing partial packaging!
Once you have removed the strapping the packaging must no longer be moved!!

9e) 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.10 below.

Fig. 10: *Pallet sheet*

9f) 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.7) and protective corners (Fig.8) are to be preserved and returned intact to the supplier.

SILFAB is a part of the recovery and organizes the return of these materials. Pallets and protective corners that are recovered will be reused by SILFAB on new packages, minimizing the amount of material ending up in landfills.

The customer must collect the protective corners in nylon bags or something of similar texture (see Fig.11), and stack the pallets (max 15 units, see Fig.12) in order to facilitate the loading operations. SILFAB will periodically, when the amount justifies the cost of the transportation, recover these materials, returning them for reuse at the manufacturing plant.

Fig. 11 & 12: *How to package the pallets and plastic corners, respectively, after unloading, ready to deliver back to Silfab for reuse.*

10. APPENDIX 1 – Electrical Specifications

	SLA250M	SLA255M	SLA260M	SLA265M	SLA270M	SLA275M	SLA280M	SLA285M
Pmax	250	255	260	265	270	275	280	285
Vmp	30.4	30.6	30.8	31	31.2	31.4	31.7	32
Imp	8.27	8.38	8.49	8.6	8.71	8.8	8.86	8.91
Voc	37.4	37.6	37.8	38	38.2	38.4	38.7	39.1
Isc	8.8	8.92	9.04	9.16	9.28	9.36	9.43	9.47
Eff	15.3%	15.6%	15.9%	16.2%	16.5%	16.8%	17.1%	17.4%

	SLA240P	SLA245P	SLA250P	SLA255P	SLA260P
Pmax	240	245	250	255	260
Vmp	30.1	30.3	30.5	30.7	30.9
Imp	8.01	8.13	8.24	8.35	8.46
Voc	37.1	37.3	37.5	37.7	37.9
Isc	8.53	8.64	8.76	8.87	8.99
Eff	14.7%	15.0%	15.3%	15.6%	15.9%

	SLG300M	SLG305M	SLG310M	SLG315M	SLG320M	SLG325M	SLG330M	SLG335M
Pmax	300	305	310	315	320	325	340	345
Vmp	36.5	36.7	36.9	37.1	37.3	37.5	37.8	38.1
Imp	8.26	8.35	8.44	8.53	8.62	8.7	8.75	8.8
Voc	44.9	45.1	45.3	45.5	45.6	45.8	46.1	46.4
Isc	8.79	8.88	8.99	9.09	9.19	9.29	9.34	9.38
Eff	15.4%	15.6%	15.9%	16.2%	16.4%	16.7%	17.4%	17.7%

	SLG290P	SLG295P	SLG300P	SLG305P	SLG310P
Pmax	290	295	300	305	310
Vmp	36.3	36.5	36.7	36.9	37.1
Imp	8.03	8.12	8.21	8.3	8.39
Voc	44.9	45.1	45.3	45.5	45.7
Isc	8.52	8.62	8.72	8.82	8.9
Eff	14.9%	15.1%	15.4%	15.6%	15.9%

Standard Test Conditions (Measurement conditions: STC 1000 W/m² - AM 1.5 - Temperature 25 °C)
Measurement uncertainty ≤ 3% - Sun simulator calibration with modules calibrated by Fraunhofer Institute
Power Tolerance: Positive Sorting (-0/+5W)
Maximum System Voltage: 600V or 1000V (on request)
Series fuse rating: 15A
Electrical characteristics may vary by ±5% and power by -0/+5W

Please conserve a copy of this manual

at the location of the PV System,

and inform the system owner of all relevant aspects of

safety, operation, and maintenance!!

To download a copy of this installation manual scan the QR-Code on the back of a Silfab module, or go to: www.silfab.ca/media-center/download-area.html

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