



Solar Frontier K.K.

Installation and Maintenance Guide

SF-L and M series

Contents

1. **About this Guide**
2. **General Information**
3. **Technical Data**
 - 3.1 Electrical characteristics
 - 3.2 Module Performance at Low Irradiance
 - 3.3 Thermal Characteristics
 - 3.4 Characteristics for System Design
 - 3.5 Mechanical Data
 - 3.6 Bypass Diode
 - 3.7 Module Drawing
4. **Safety**
 - 4.1 General safety
5. **Mechanical Installation**
 - 5.1 Mechanical installation warning
 - 5.2 Site location
 - 5.3 Module handling instructions
 - 5.4 Module mounting instructions
6. **Electrical installation**
 - 6.1 Electrical wiring safety precautions
 - 6.2 Grounding
 - 6.3 Electrical wiring
7. **Operation**
8. **Maintenance**
9. **Disposal**

Disclaimer

This manual is the proprietary information of Solar Frontier K.K. (SF). SF's Limited Warranty Certificate for PV modules will be voided if the instructions here within are not strictly observed. SF will not assume any liability for damage arising from improper use, wrong assembly, operation or maintenance. Solar Frontier reserves the right to make amendments to the contents of this document without prior notice.

1. About this Guide

Thank you for choosing Solar Frontier's (SF) CIS photovoltaic (PV) modules. At Solar Frontier, we look forward to providing you the highest standards in solar energy performance and customer service

The following guide contains vital information on handling, installing, wiring, operating and maintaining SF PV modules and the associated risks. It is essential that you understand all the instructions and warnings thoroughly, together with any information provided by balance of system manufacturers, to ensure the correct and safe use of our modules. Please share this document with the installer/operator and keep it for future reference. **BE SURE TO CONFORM TO ALL RELEVANT LOCAL AND NATIONAL LAWS, REGULATIONS AND CODES WHEN INSTALLING, WIRING, OPERATING AND MAINTAINING SF PV MODULES.** For additional queries, please contact your local supplier or Solar Frontier.

2. General Information

Solar Frontier's CIS modules generate an electrical direct current when exposed to sunlight and are designed for terrestrial use. The nominal power of SF PV modules indicates the power generated under Standard Test Conditions (module temperature: 25°C, air mass 1.5, solar irradiance 1000 W/m²). SF PV Module power output in actual operating conditions may vary. The amount of electrical direct current generated by SF PV modules is proportional to irradiance intensity, while the voltage is subject to change according to temperature.

3. Technical Data

The technical data below represents SF PV modules distributed in all regions. Information required by UL is marked accordingly and only relevant to US installers.

3.1 Electrical Characteristics

Electrical Data at Standard Test Conditions (25°C, AM1.5, 1000W/m²)

		SF130-L SF130-M	SF135-L SF135-M	SF140-L SF140-M
Maximum Power	P _{max}	130W	135W	140W
Tolerance of P _{max}		+10/ -5%	+10/ -5%	+10/ -5%
Open circuit voltage	V _{oc}	106V	108V	109V
Short circuit current	I _{sc}	2.10A	2.10A	2.10A
Voltage at maximum power	V _{mpp}	74.0V	76.0V	77.0V
Current at maximum power	I _{mp}	1.77A	1.78A	1.82A
Open circuit voltage at -10°C and 1,250W/m ² (UL)		122V	123V	124V
Short circuit current at 75 °C and 1,250W/m ² (UL)		2.64A	2.64A	2.64A

Photovoltaic modules may produce more current and/or voltage under actual operating conditions than in Standard Test Conditions. This is due to light-soaking, a property unique to CIS PV modules, which results in higher energy output due to an increase in fill factor. The electrical characteristics are within ±10% of the indicated values of I_{sc} and V_{oc} under STC. The output stated on the label is after light-soaking. The values of I_{sc} and V_{oc} marked on UL-listed modules should be multiplied by a factor of 1.25 to determine component voltage ratings, conductor capabilities, fuse sizes and size of controls connected to the module output.

UL: Refer to Section 690.8 of the National Electrical Code for the additional multiplying factor of 125 percent (80 percent derating). Installation must be completed in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code, Part 1.

Electrical Data at Nominal Operating Cell Temperature Conditions (NOCT 47°C)

		SF130-L SF130-M	SF135-L SF135-M	SF140-L SF140-M
Maximum Power	P _{max}	94.7W	98.3W	102W
Open Circuit Voltage	V _{oc}	95.1V	96.9V	97.8V
Short Circuit Current	I _{sc}	1.66A	1.66A	1.66A
Voltage at maximum power	V _{mpp}	69.8V	71.7V	72.7V
Current at maximum power	I _{mp}	1.37A	1.38A	1.41A

3.2 Module Performance at Low Irradiance

Efficiency reduction of maximum output from an irradiance of 1,000 W/m² to 200W/m² at 25 °C is typically 3.0%. The standard deviation for the reduction efficiency is 2.6%.

3.3 Thermal Characteristics

NOCT		47°C
Temperature Coefficient of I _{sc}	α	+ 0.01 % / K
Temperature Coefficient of V _{oc}	β	- 0.30 % / K
Temperature Coefficient of P _{max}	δ	-0.31 % / K

3.4 Characteristics for System Design

Maximum System Voltage	V _{sys}	1000 V DC (UL 600V DC)
Limiting Reverse Current	I _r	7A
Maximum Series Fuse Rating	I _{sf}	4A
Maximum Number of PV Module Connection (Recommended)	Series* ¹ Parallel* ²	7 (UL 4) 4

*1 Calculated under condition of +10% tolerance of V_{oc} at STC.

The sum of V_{oc} of series modules must not exceed the maximum system voltage of the module under any condition, even at low temperature.

*2 Calculated under condition of +10% tolerance of I_{sc} at STC.

Under any condition reverse current applied to the modules should not exceed 7A

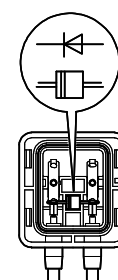
3.5 Mechanical Data

Dimensions (L x W x H)	1,257 x 977 x 35 mm (49.5 x 38.5 x 1.4 inch)
Weight	20.0 kg (44.1 lbs)
Module Operating Temperature	-40 °C to 85 °C
Application Class on IEC61730	Class A
Fire Safety Class on IEC61730	Class C
Cable	2.5mm ² / 14AWG (Halogen free)
Snow Load (to the front of the module) * ³	2,400 Pa (IEC61646) / 1,600Pa design load (UL1703)
Wind Load (to the back of the module)	2,400 Pa (IEC61646) / 1,600Pa design load (UL1703)

*3 UL: 1.5 times design load is applied to the module. Accordingly, 2,400 Pa (50 lbs /ft²) is loaded to test the 1,600 Pa (33.4 lbs /ft²) UL design load .

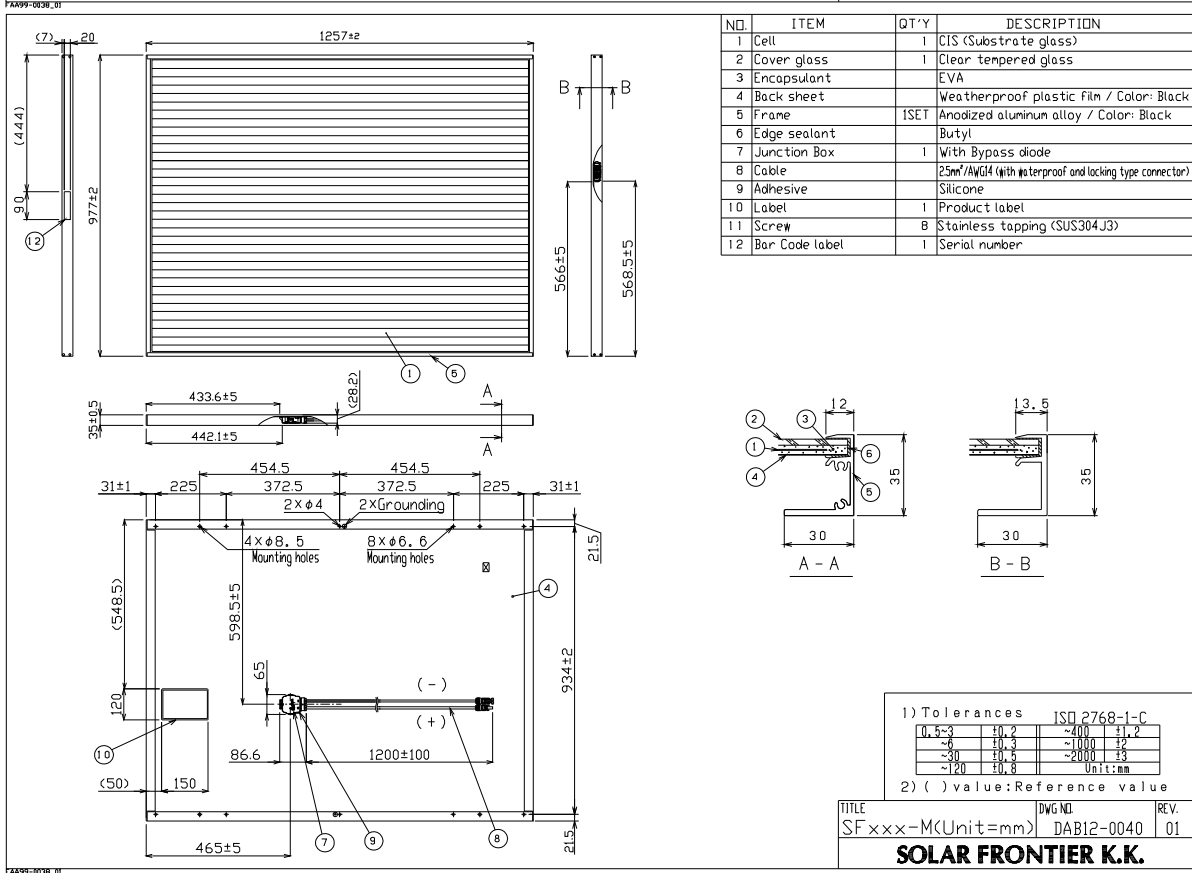
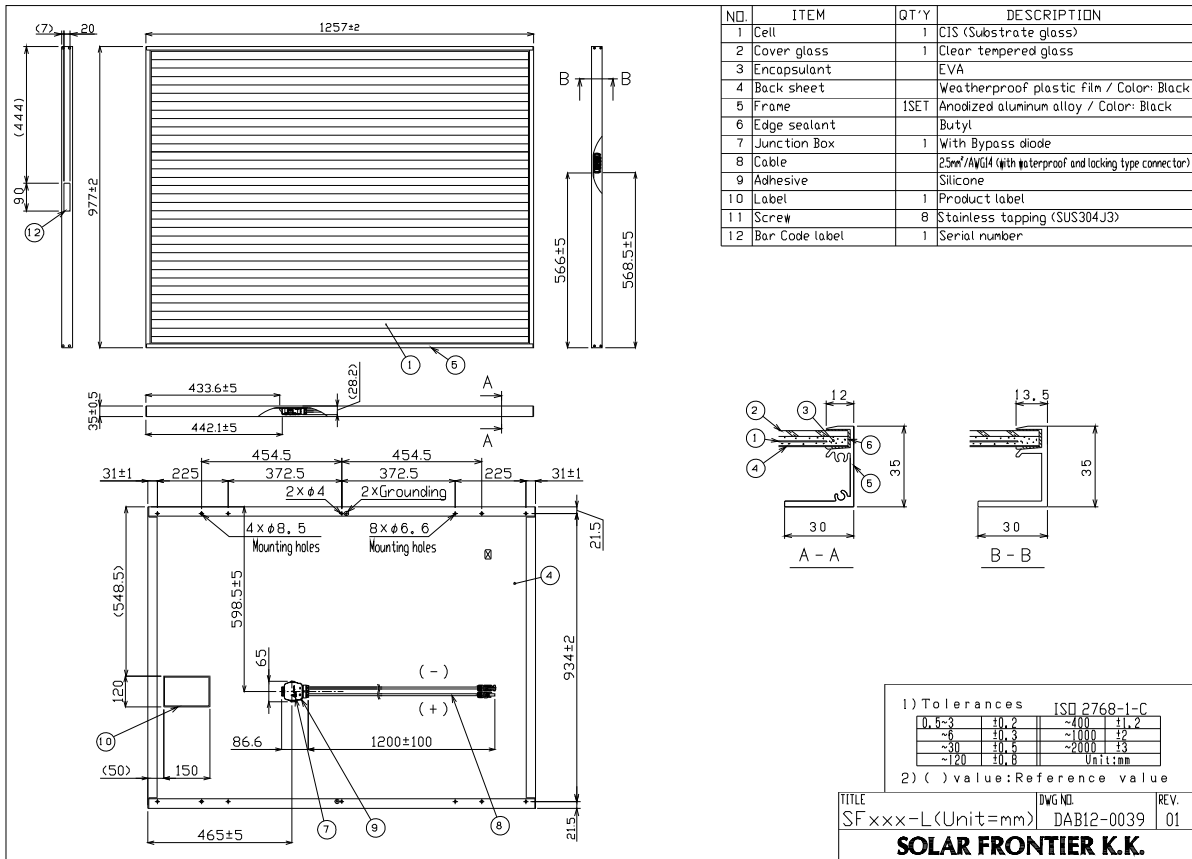
3.6 Bypass Diode

Type	Forward current	Repetitive peak reverse voltage	Surge peak reverse voltage	Max. forward voltage
P 1000 M	10A	1000V	1000V	0.9V



3.7 Module Drawing (SFxxx-M includes locking device of the connectors)

Please refer to the below module drawing for definition of the words describing module parts.



SFxxx-M includes locking devices of connectors.

Locking device



Locking device attached



4. Safety

Please ensure all necessary measures are taken to prevent accidents. Special precautions should be made when dealing with systems involving human lives, such as air and road transport safety systems. SF modules must not be used for anything other than their express purpose.

Solar Frontier advises all involved parties to strictly follow the guide below to avoid bodily injury, damage to property or death.

4.1 General Safety

- Installation, wiring, and maintenance of SF PV modules must only be carried out by licensed and trained persons.
- Ensure that all instructions and information related to SF PV modules and other balance of system components are fully understood prior to handling and installing a PV solar system.
- The front surface of SF PV modules must always be covered with an opaque material during installation.
- SF PV modules only generate direct current (DC) electricity.
- SF PV modules do not have the ability to store electricity.
- SF PV modules will experience higher voltage when connected in series and higher electrical current when connected in parallel.
- Always use the same type of module within a particular photovoltaic system.
- The PV array open-circuit voltage must never exceed the maximum system voltage (e.g. low temperature conditions).
- Leakage currents could create a shock hazard or fire.
- Do not disconnect operational modules or electrical arcing may occur. This may result in serious bodily harm or death.
- Do not use SF PV modules for purposes other than terrestrial power generation. This may result in electrical shock, fire or other accidents.
- Do not concentrate artificial sunlight on modules using lenses or mirrors.
- Do not use any light sources for power generation except natural sunlight and general illumination
- Do not use SF PV modules in water or liquid. There is a serious risk of electric shock, an electric leak or an accident.
- The level of leakage current must be limited in accordance with local regulation for safety reasons.
- Check the polarity of the wiring before the installation. Incorrect wiring may damage SF PV modules or appliances.
- Only use equipment, connectors, wiring and support frames suitable for solar electric systems.
- Wear appropriate protection and take all necessary precautions to prevent electric shock, especially when DC voltage exceeds 30 VDC

5. Storage and Transport

Please follow the instructions on the module packaging when storing and transporting SF PV modules. Ensure that each module is adequately supported and always stored in dry conditions. SF PV modules should always be kept in the original packaging until final installation

6. Mechanical Installation

6.1 Mechanical Installation Warning

- Observe all applicable health and safety regulations when installing SF modules.
- A safe distance should be cordoned off around the installation area. Fall protection equipment must be used.
- Installation must not be carried out in windy or wet conditions.
- Keep SF PV modules out of reach of children.

6.2 Site Location

- Ensure that the maximum wind and snow loads in local conditions do not exceed the SF PV module maximum load ratings.
- Do not install SF PV modules in areas where they are exposed to salt water, oil vapor or corrosive gas, grit or dust.
- Do not expose SF PV modules to corrosive saline, ammoniacal or sulphurous atmospheres. SF PV modules are not resistant to corrosive atmospheres.
- Do not install SF PV modules in locations where flammable gases accumulate or flow as there is a risk of sparks from SF PV modules under such conditions.
- Do not install SF PV modules near fire.
- Avoid installing SF PV modules in locations where they may be covered by shadows. This may adversely affect their performance.
- Do not install SF PV modules in locations where temperatures exceed the temperature range marked in the module's technical specifications.

6.3 Module Handling Instructions

- Do not disassemble or modify SF PV modules. This may result in an electric shock, fire or other accidents. Solar Frontier cannot be held responsible for any loss or damage caused by unauthorized disassembling, modification or misuse of SF PV modules.
- Do not drill additional mounting holes into the aluminum frame. Only pre-drilled holes should be used.
- Avoid placing any stress onto the SF PV modules, cables or connectors.
- Do not stand or step on SF PV modules. This may result in damage to the module and/ or bodily harm by falling.
- Do not drop SF PV modules or drop objects onto them. Both sides of the module (the glass surface and the back sheet) are fragile.
- Do not strike the terminal box or pull the cables. The terminal box can crack and break, while the output cable may unplug and cause electricity leakage or an electric shock.
- Do not scratch the backsheet or cables of the SF PV modules. Rubbing or scratching may result in an electric shock, electric leakage or an accident.
- Do not scratch the insulation coating of the frame (except for the grounding connection). This may weaken the strength of the frame or cause corrosion.
- Do not cover the water drain holes of the frame. Doing so may cause frost damage.
- Do not use glue when closing the cover of the junction box. Similarly, do not use a sealant to bond the junction box lid to its base.
- Observe the minimum bending radius of 27mm for all module cables.

6.4 Module Mounting Instructions

Mounting structures cautions

- Pay attention to the electromechanical series when selecting support structure material to avoid galvanic corrosion.
- Fasten and lock bolts completely. Inadequate mounting may result in SF PV modules falling or other accidents.

Mounting the Solar Modules

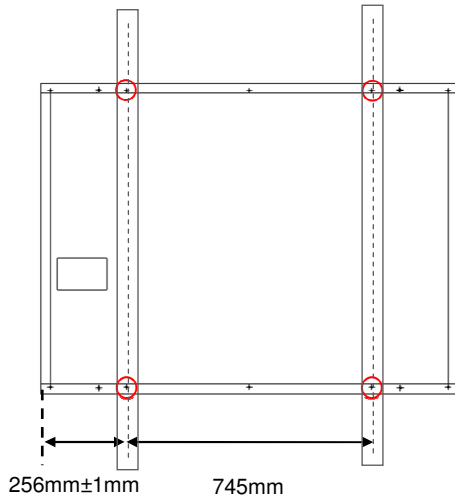
- PV modules should typically face south in the northern hemisphere and north in the southern hemisphere for optimal power production.
- SF modules should be installed between a 10° and 60° tilt.
- Modules can be installed horizontally (landscape) or vertically (portrait).
- Leave 100mm between the SF PV modules and the roof. This will allow air to circulate, cooling the module, and condensation to dissipate.

Mounting with Screws

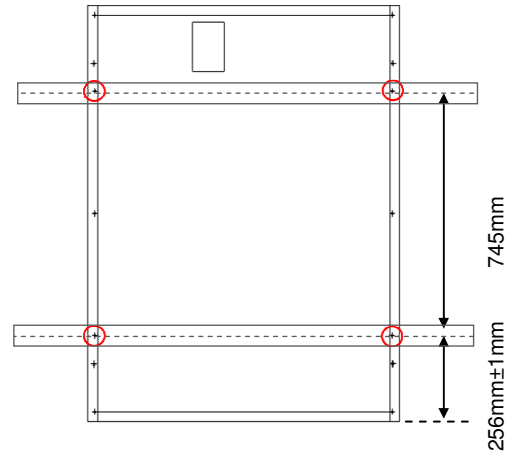
SF modules should be fastened to the support structure using the mounting holes on the frame. The support structure should be securely fastened to a non-corrosive roof.

Mounting with Inner Holes

Each module will require four M6 (or 1/4 in) bolts with washers, lock washers and nuts. The assembly must be tightened to minimum 8Nm (70.8lb-in).



Landscape (horizontally)



Portrait (vertically)

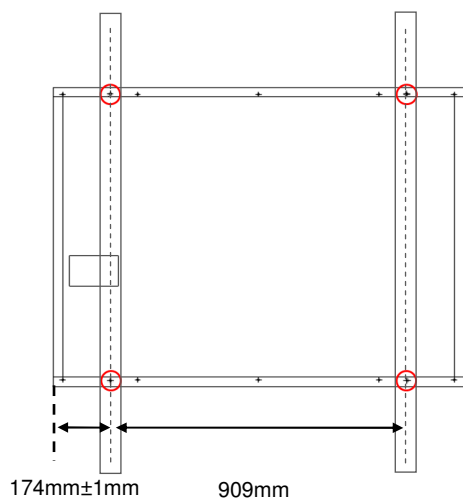
TUV: 2,400Pa (50.1 lbs/ft²) to the front and back of the module

UL: 1,600Pa (33.4 lbs/ft²) to the front and back of the module

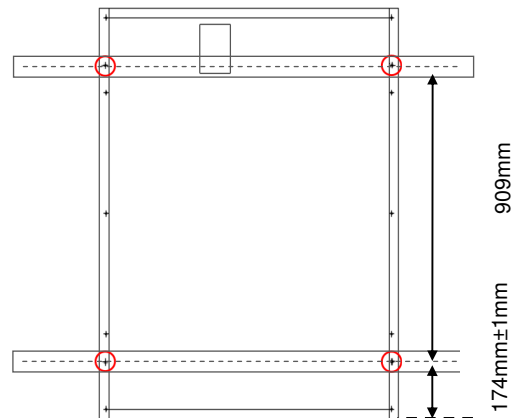
1.5 times the design load is applied to the module during UL testing. 2,400 Pa (50 lbs /ft²) is applied to test 1,600 Pa (33.4 lbs / ft²) UL design load.

Mounting with Outer Holes

Each module will require four M8 (or 5/16 in) bolts with washers, lock washers and nuts. The assembly must be tightened to minimum 15Nm (132.8lb-in).



Landscape (horizontally)



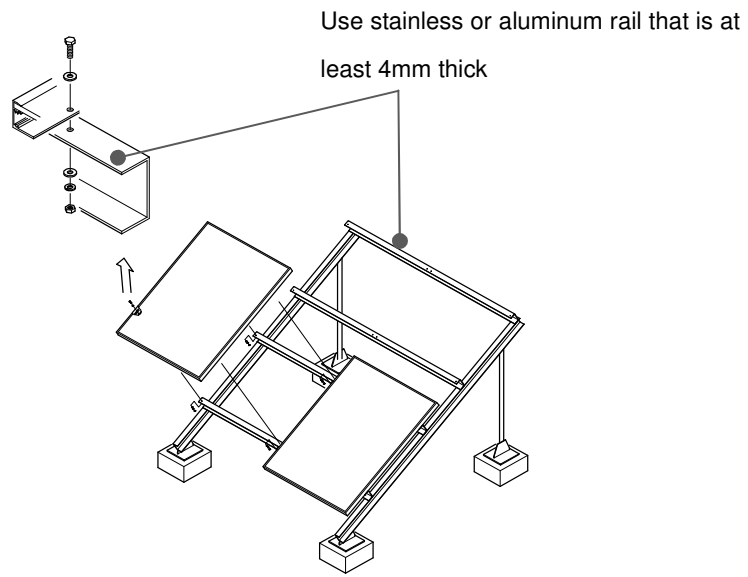
Portrait (vertically)

TUV: 2,400Pa (50.1 lbs/ft²) to the front and back of the module

UL: 1,600Pa (33.4 lbs/ft²) to the front and back of the module

1.5 times the design load is applied to the module during UL testing. 2,400 Pa (50 lbs /ft²) is applied to test 1,600 Pa (33.4 lbs / ft²) UL design load.

Rails



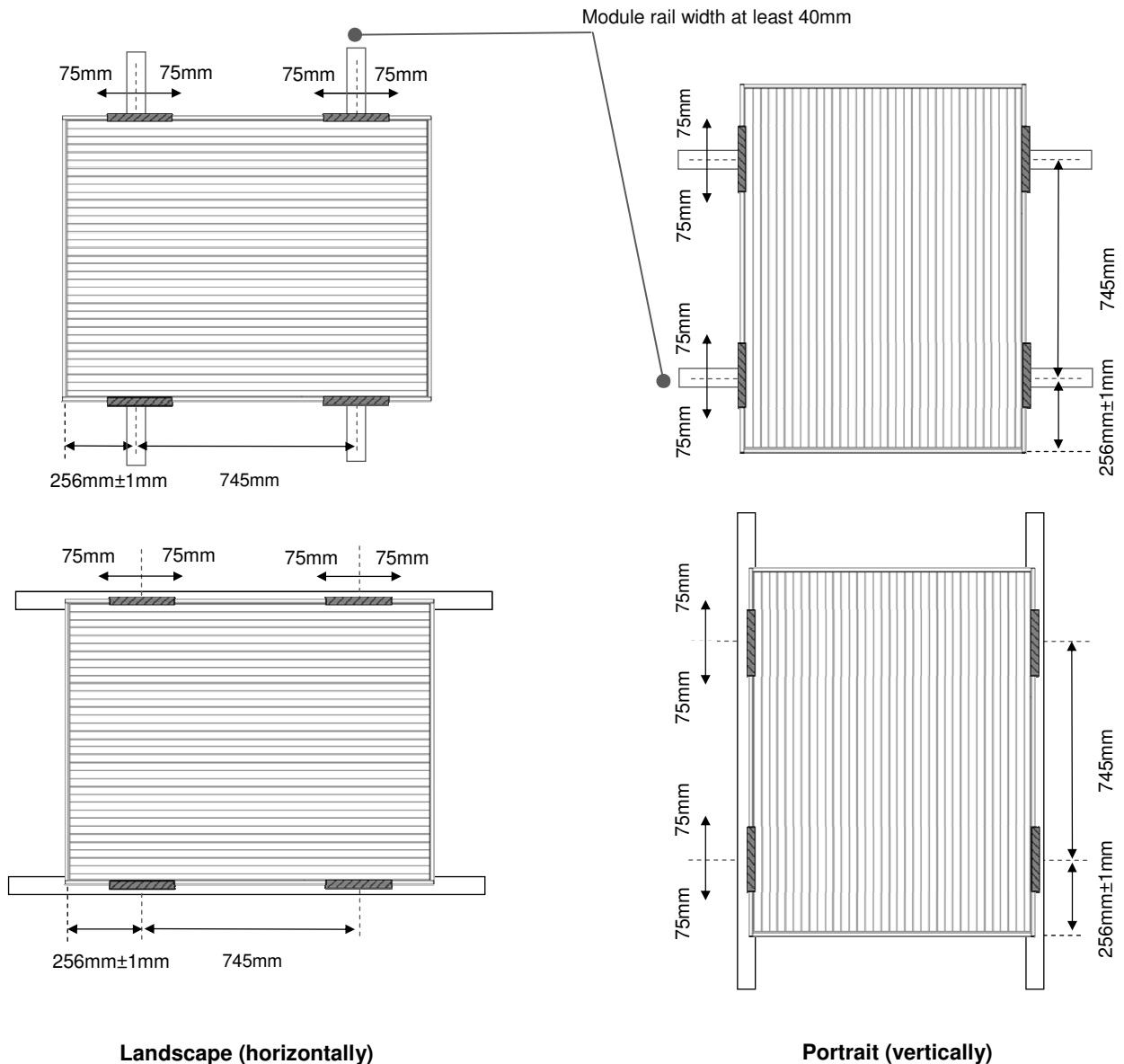
Mounting with clamps

Four or more rust-proof clamps should be used to fasten SF PV modules to the support structure. Center-line of clamps should be secured at the indicated clamping zone of the long part of the frame using stainless-steel M8 bolts with a minimum length of 20mm. These should be tightened to 15Nm or more if necessary.

All selected module clamps must be at least 50mm long, 3mm thick, and overlap the module frame by 7mm or more. The width of the rail contacting with the module should be 40mm.

Clamps must not bend the module frames in case of surface damage nor cover the front glass with shadow. Please refer to the instructions provided by the clamp manufacturer for further instructions.

Screw Points and Clamping Zone

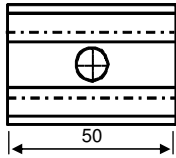
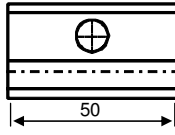
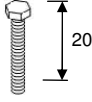
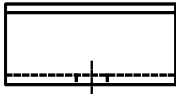
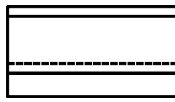
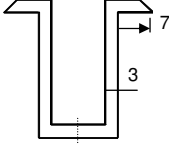
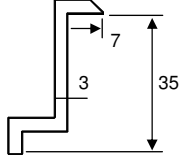


TUV: 2,400Pa (50.1 lbs/ft²) to the front and back of the module

UL: 1,600Pa (33.4 lbs/ft²) to the front and back of the module

1.5 times the design load is applied to the module during UL testing. 2,400 Pa (50 lbs /ft²) is applied to test 1,600 Pa (33.4 lbs / ft²) UL design load.

Recommended Minimum Clamp Dimension (mm)

View	Mid Clamp	End Clamp	Bolt
Top			
Side			
Section			

7. Electrical Installation

7.1 Electrical Wiring Safety Precautions

- The sum of Voc of series modules must not exceed the maximum system voltage of the module under any condition. Reverse current applied to the modules must not exceed 7A.
- Do not touch or handle the PV module, terminal box or the end of output cables with bare hands.
- Do not carry out installation when PV modules, installation tools or installation area are exposed to water.
- Ensure that the connection parts between SF PV modules and power receiving devices are isolated and waterproof. Using SF PV modules with insufficient isolation and waterproofing could result in an electric shock, an electric leak or an accident.
- Components interconnecting modules must be compatible with the connectors. They must provide system operation and fault protection.
- Inverters must meet the technical requirements of SF modules
- Do not connect the PV modules directly to loads such as motors. Variation in output power may damage the motor.
- Observe and understand the safety instructions of batteries. Their misuse can result in serious bodily harm due to a high electrical current.

7.2 Grounding


Grounding Caution

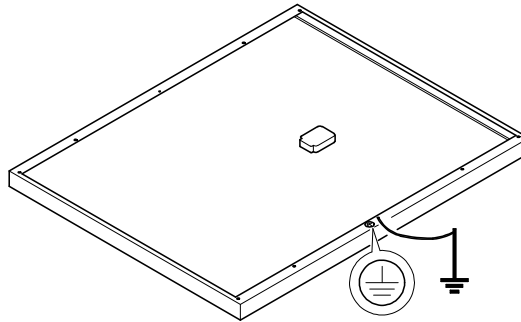
- Be aware of the necessary grounding requirements prior to installation. Your local authorities can help you further.
- Install arrestors, surge absorbers or any other appropriate lightning protection tools as needed.

Module frames, mountings, connection boxes and metal conduits should be connected to an earth ground as lightning protection, in accordance with local, regional and national standards and regulations. A hole on the aluminum frame of the SF PV modules ($\Phi 4\text{mm}$) is available as a crimping terminal. Ensure that the crimping terminal is tightly tied to the module frame with a rolling thread screw and a lock washer to ensure electrical contact. Use a grounding wire made of copper, not smaller than 2mm sq, type IV, temperature rating of the conductors -40 to 85 deg C. T

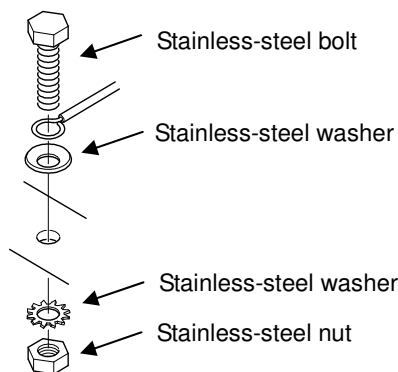
For alternative grounding methods please consult with Solar Frontier.

Grounding Image

Connect to earth ground from where the grounding sign is  indicated.



Grounding with washer



Use M4 bolt (torque value 1.5Nm) or standard gauge size #6 bolt (torque value 1.0N m)

7.3 Electrical Wiring

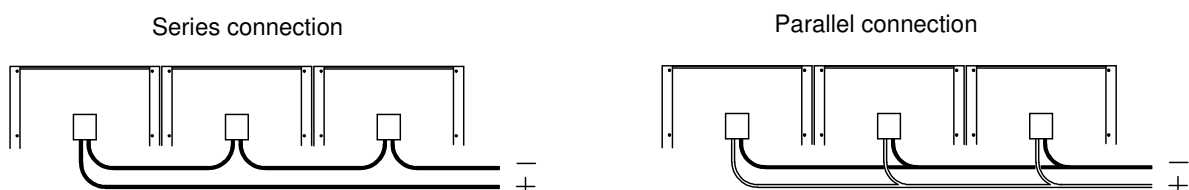
- A set of cables with a plastic connector for each polarity is supplied with SF PV modules. Use these to connect modules.
- Do not open the wiring box (junction box).
- Tie down the module cable to the frame or to the mounting system in order to avoid any stress to the connector.
- Cables drooping from the terminal box are hazardous and must be avoided.
- Cables should be secured so they are not exposed to direct sunlight (such as behind the module).

Recommended series / parallel module: 7 series (UL 4 series) / 4 parallel

Minimum field wiring diameter: 2mm sq

Calculated under condition of +10% tolerance of V_{oc} at STC. The sum of V_{oc} of series modules must not exceed the maximum system voltage under any condition, even at low temperature.

Calculated under condition of +10% tolerance of I_{sc} at STC. Under any condition reverse current applied to the modules should not exceed 7A.



Carry out installation and wiring work in compliance with all relevant health, safety and environment laws and regulations.

8. Operation

- Prior to connecting the PV system to the grid, make sure the entire system has been checked, tested and approved in accordance with the applicable regulations.
- Depending on local regulations and utility policies, connection to the grid and start up of the PV system may only be performed by authorized personnel.

9. Maintenance

A monthly visual check is highly recommended in order to maintain the efficiency of SF PV modules and the security of the mounting.

- Remove any dirt, fallen leaves or bird droppings from the surface, and check that there is no damage to the surface.
- Do not use detergent or chemicals for cleaning dirt off SF PV modules as it may damage the modules and result in degradation of insulation.
- Do not use hard brushes or any other hard materials; use only soft cloths or sponges for removing dirt from the SF PV modules surface.
- When replacement parts are required, be sure the installer/servicer uses parts specified by the manufacturer with the same characteristics as the original parts. Unauthorized substitutions may result in fire, electric shock, or other hazard.
- Stop using SF PV modules when any damage or unusual phenomena are observed. Have them immediately replaced or removed by a qualified technician.

10. Disposal

SF PV modules must be disposed of in a responsible manner. Please contact your local supplier or disposal company for further information. For health and safety reasons, SF modules should not be disposed with household garbage, and must be dealt with in accordance with local codes and regulations.

Solar Frontier is a member of PV cycle.

Solar Frontier K.K.

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