

Installation Requirement of Solar Module

(Simplified Version)

Note: Electrical and mechanical installation information will be introduced in this installation manual, so please read and understand the information before installing Ulica's modules. The Buyer shall not change the installation method by their own, any simplified installation method or different from this installation manual shall be checked with and confirmed by the Seller, otherwise the Seller will not be responsible for any quality issues caused by the unauthorized installation method.

It is recommended to visit our website www.ulicasolar.com for the latest full version of this installation manual.

1.Installation Conditions

1.1 Installation Site and Working Environment

- (1) The modules cannot be used in space.
- (2) Do not manually focus sunlight with mirrors or magnifying glass onto modules.
- (3) Ulica modules shall be installed on proper buildings or other appropriate places (such as ground, garage, building outer wall, roof, PV tracking system) but shall not be installed on any vehicles.
- (4) Do not install modules at places that are possible to be flooded.
- (5) Ulica suggests that modules be installed in the working environment with the temperature of -20°C to 50°C of which is the monthly average highest and lowest temperature of the installation sites. The extreme working environment temperature for modules is -40°C to 85°C.
- (6) Make sure that installed modules do not suffer wind or snow pressure that exceeds the permissible maximum load limit.
- (7) Modules shall be installed in places free from shadows throughout the year. Make sure there are no light-blocking obstacles in the installation sites.
- (8) Carry out lightning protection for modules installed in places with frequent lightning and thunder.
- (9) Do not install modules in places with possible inflammable gases.
- (10) Modules cannot be used in environments with too much hails, snows, flue gas, air pollution and soot or in places with strong corrosive substances such as salt, salt mist, saline, active chemical steam, acid rain, or other substances corroding modules, affecting modules' safety or performance.
- (11) Please take protective measures to ensure reliable and safe installation of modules in severe environments such as heavy snow, cold and strong wind or islands close to water and salt mist or deserts.
- (12) Ulica modules passed the IEC61701 salt spray corrosion test, but the corrosion may still occur on where the modules frame is connected to the bracket or where the grounding is connected. In case Ulica modules are installed 50m –500m away from the ocean side, stainless steel or aluminum materials are need to be used to contact the PV modules, and the connection point should be protected with anti-corrosion measures. If it needs to be installed within 50m of the sea or on the sea or beach, please contact the sales representative of Ulica.

1.2 Selection of Tilt Angles

Tilt angle of modules: Included angle between module surface and horizontal surface; the module will obtain the maximum power output in direct facing of sunlight.

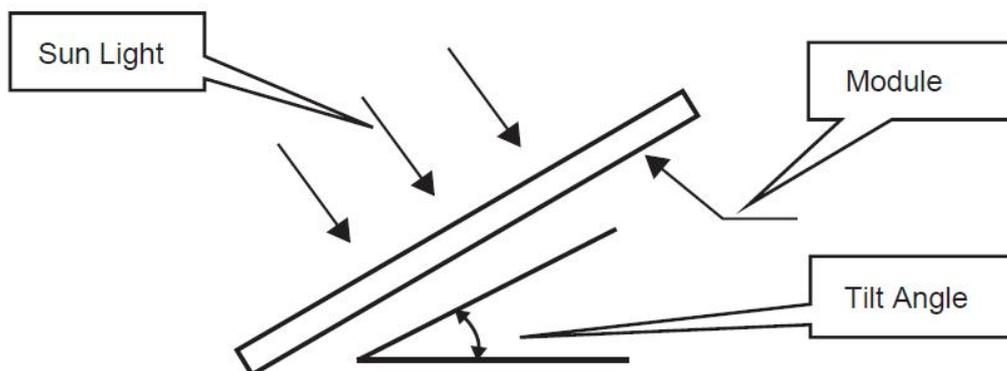


Figure 5 Schematic diagram of component inclination

Modules are preferred to be south-facing in the north hemisphere and north-facing in the south hemisphere.

Please refer to standard modules installation guideline or suggestions from experienced PV module installer, for the specific installation angle.

Ulica suggests that tilt angle of module installation be no less than 10° , so module surface dust can be washed away easily by rainfall and frequency of cleaning can be reduced. In that case, the PV's generation will difficult to guarantee. If the tilt angle of module installation less than 5° , some cells will cause hot spots caused by dust and pollutants and reduce power generation, even with regular maintenance, the power generation may not meet the expectations. The tilt angle of module installation less than 1° is strictly prohibited, if not the warranty will be invalid.

And it is easy for ponding to flow away and avoid water mark on the glass due to long time of water ponding which may further affect module appearance and performance.

Ulica modules connected in string should be installed with the same orientation and tilt angle. Different orientations and tilt angles may result in different received solar irradiation and output power loss. In order to achieve the maximum annual generating capacity, the optimal orientation and inclination of PV modules in the installed area should be selected to ensure that sunlight can still reach to modules even on the shortest day of the year.

If Ulica modules are used in off-grid System, the tilt angle should be calculated based on seasons and irradiation to maximize the output power.

If the modules output power meets the acquired load under the period of the worst irradiation in the year, the modules should be able to meet the load of the whole year. If the Ulica modules are used in grid-connected system, the tilt angle should be calculated based on the principle to maximize the yearly output power.

2. Mechanical Installation

2.1 Regular Requirements

(1) Make sure that module installation mode and bracket system can meet the expected load, which is requisite assurance that the bracket installer must provide. Installation bracket system shall be tested and inspected by the third party testing institution with static mechanical analysis capacity in accordance with local national standards or international standards.

(2) Module bracket shall be made from durable, corrosion resistant, UV-proof materials.

(3) Modules shall be fixed on the bracket solidly.

(4) Use higher brackets in places with heavy snow accumulation so the lowest point of modules will not be shadowed by snow for a long time. In addition, make the lowest point of modules high enough so as to avoid shading of vegetation and woods or reduce damage of sands and stones.

(5) If modules are installed on brackets parallel to the roof or wall, the minimum gap between the module frame and the roof/wall shall be 10cm for air ventilation in case of module wire damage.

(6) Make sure the building is suitable for installation before installing modules on roof. Moreover, seal properly to prevent leakage.

(7) The module frames can appear thermal expansion and cold contraction so the frame interval between two adjoining modules shall be no less than 10mm.

(8) Make sure that backsheets of modules will not be in contact with bracket or building structures that can pierce into the inside of the modules, especially when the module surface is imposed by pressure.

(9) Maximum static load of the PV module is down force 5400pa and uplift force 2400pa, which can vary from different mounting methods of the modules (please refer to the following installation guidance), the described load in this manual is for the test load.

(10) Note: on the basis of IEC61215 - 2016 installation requirements, when computing the corresponding maximum design load, need to consider the safety factor of 1.5 times.

(11) Modules can be installed horizontally or vertically. When installing the modules, be cautious not to block the drain hole of the frame.

2.2 Monofacial assembly mechanical installation

Module and bracket system connection can be realized by mounting holes, clamps or embedded systems. Installation shall follow the demonstration and suggestions below. If installation mode is different, please consult Ulica and obtain approval. Otherwise, modules may be damaged and limited warranty will be invalid.

2.2.1 Bolts Mounting

Apply bolts to fix modules on the bracket through mounting holes on the back frame. See details in Figure6.

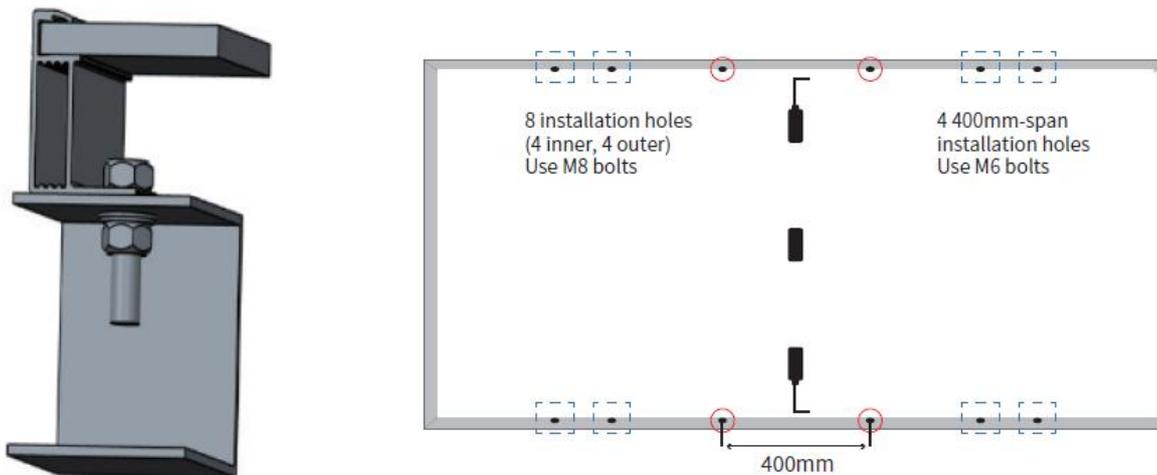
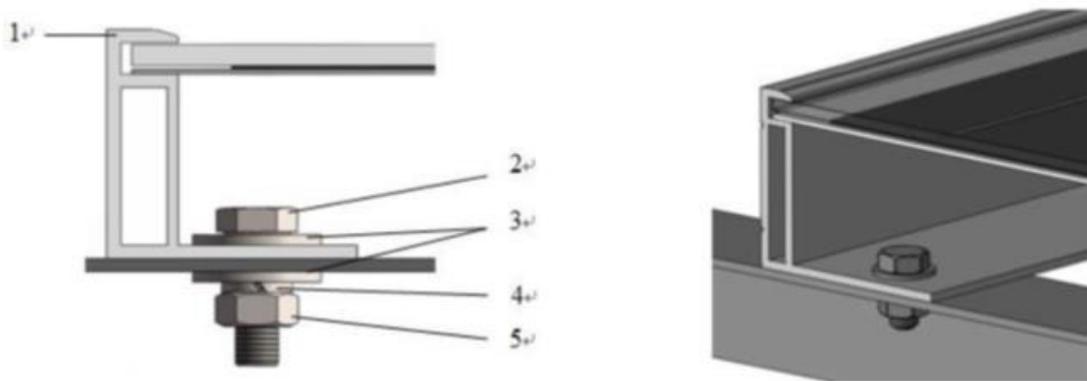


Figure 6 Schematic diagram1 of monofacial bodule with bolt Installation



1. Aluminum alloy frame 2. M8 stainless bolt 3. Flat stainless washer 4. Spring stainless wash 5. HEX stainless nut

Figure7 Schematic diagram2 of monofacial module with bolt Installation

Recommended accessories are as below :

Accessories	Model		Material	Note
Bolt	M8 (full thread recommended)	M6 (full thread recommended)	Q235B/SUS304	Accessories material selection should be based on application environment.
Washer	2*8	2*6 (6.4*18-1.6 ISO 7093)	Q235B/SUS304	
Spring Washer	8	6	Q235B/SUS304	
Nut	M8	M6	Q235B/SUS304	

Table 2 Recommended materials of module with bolt Installation

Suggestion :

- (1) M8 bolt tightening torque range: 14N•m-18N•m; M6 bolt tightening torque range: 8N•m-12N•m;
- (2) When using Ulica 30mm (30H) height frame module, it is recommended to select $L \leq 20\text{mm}$ length fasteners. (If there is a special model, consult Ulica customer service).

5.2.2 Clamp Mounting

The module can be mounted by a dedicated clamp, as shown in Figure 8.

Under no circumstances should the clamp touch the glass or deform the frame. The interface of the clamp to the front of the frame must be smooth and flat to prevent frame or other components from being damaged.

Make sure no shadowing effect of the fixture. The drain hole cannot be blocked by the fixture.

For framed PV module, the clamp must maintain an overlap of 8-11 mm with the frame of the module (you can change the cross section of the clamp if the module is securely installed). For frameless PV module, the clamp must maintain an overlap of 15 mm at maximum with the module.

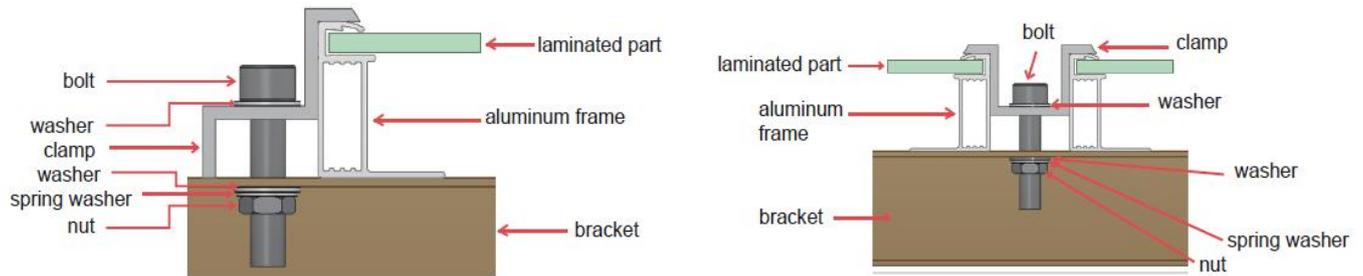
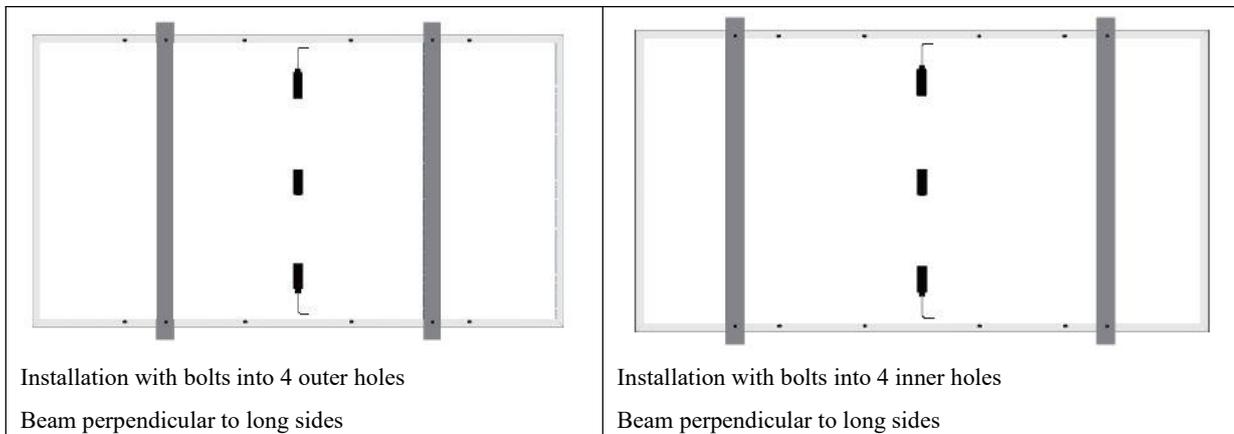


Figure 8 Clamp Installation of Monofacial Module

5.2.3 Installation and Mechanical Load of Monofacial Module



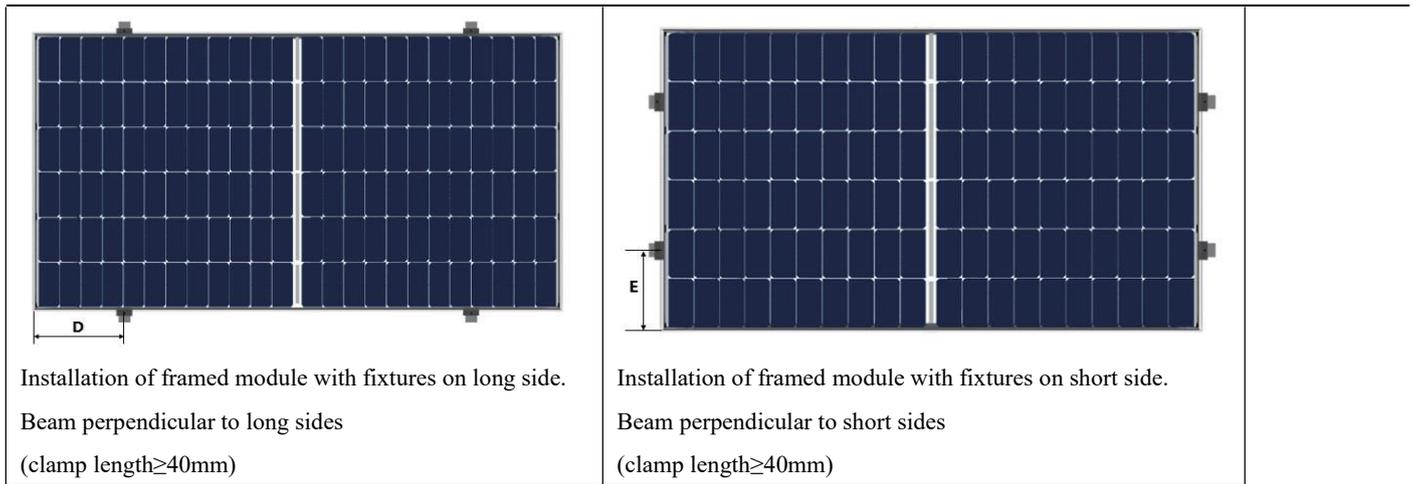


Figure 9 Monofacial Module Installation Annex

Monofacial Modules model:

Module type	Cell type	Cell quantity	Dimensions (mm)	Length of cable (mm) positive/ negative	Flame Dimensions(mm)
UL-xxx P-120 (156)	156*156	6*10*2	1685*992*35	400/300	35*35
UL-xxx M-120 (158)	158*158	6*10*2	1705*1004*35	400/300	35*35
UL-xxx M-120 (166)	166*166	6*10*2	1755*1038*30	400/300	30*30
UL-xxx M-108 (182)	182*182	6*9*2	1722*1134*30	400/300	30*30
UL-xxx M-132 (182)	182*182	6*11*2	2094*1134*35	400/300	35*35
UL-xxx M-144 (166)	166*166	6*12*2	2094*1038*35	400/300	35*35
UL-xxx M-144 (182)	182*182	6*12*2	2279*1134*35	400/300	35*35

Table 3 Ulica's Monofacial Modules

These installation mode are Ulica's recommended installation method. Load Capacities of Framed Monofacial modules:

Installation Method Module Type	Installation with bolts		Installation with fixtures		
	4 outer holes (beam perpendicular to long sides)	4 inner holes (beam perpendicular to long sides)	$1/4L-50 \leq D \leq 1/4L+50$ (beam perpendicular to long sides)	$350 \leq D \leq 450$ (beam perpendicular to long sides)	$150 \leq E \leq 250$ (beam perpendicular to short sides)
UL-xxx P-120 (156)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$
UL-xxx M-120 (158)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$
UL-xxx M-120 (166)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$
UL-xxx M-108 (182)	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 5400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 3600\text{Pa}$, Uplift load $\leq 2400\text{Pa}$	Down force load $\leq 2400\text{Pa}$, Uplift load $\leq 2400\text{Pa}$

UL-xxx M-132 (182)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤3600Pa, Uplift load ≤2400Pa	Down force load ≤2400Pa, Uplift load ≤2400Pa
UL-xxx M-144 (166)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤3600Pa, Uplift load ≤2400Pa	Down force load ≤2400Pa, Uplift load ≤2400Pa
UL-xxx M-144 (182)	Down force load ≤2400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤5400Pa, Uplift load ≤2400Pa	Down force load ≤3600Pa, Uplift load ≤2400Pa	Down force load ≤2400Pa, Uplift load ≤2400Pa

Table 4 Down force load and Uplift load with different Installation mode

The following installation methods and mechanical loads have been verified by the Ulica Solar's Laboratory for PV Science and Technology.

The following installation methods is Simple installation mode, these installation mode are not Ulica's recommended installation method.



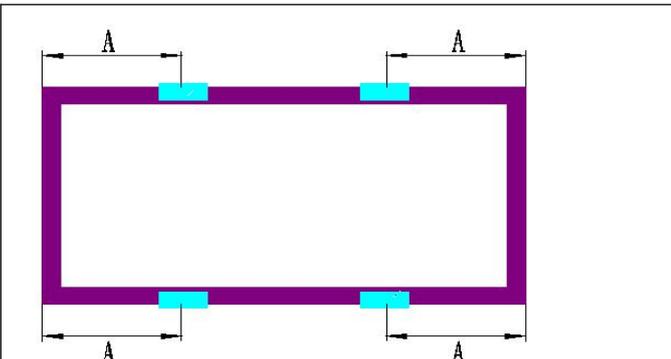
Use 4 clamps on the short side.
Mounting rails run perpendicular to the long side frame. (fixture length ≥ 40mm , A=20~200mm)

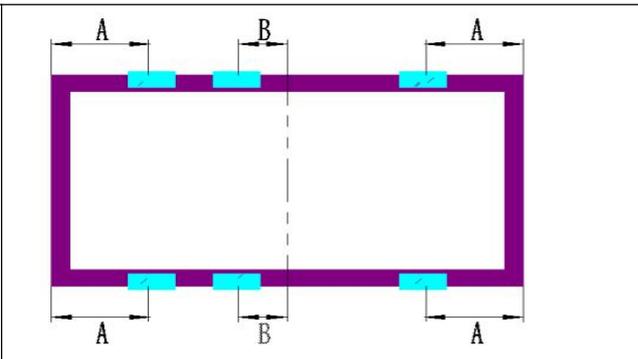


Use 4 clamps on the short side. No mounting rails (fixture length ≥ 40mm , A=20~200mm)

Load capacities of framed Monofacial modules:

Installation Method	Use 4 clamps on the short side. Mounting rails run perpendicular to the long side frame. (fixture length ≥ 40mm , A=20~200mm)	Use 4 clamps on the short side. No mounting rails (fixture length ≥ 40mm , A=20~200mm)
	Module Type	
UL-xxx P-120 (156)	Down force load ≤1800Pa, Uplift load ≤1800Pa	Down force load ≤1800Pa, Uplift load ≤1800Pa
UL-xxx M-120 (158)	Down force load ≤1800Pa, Uplift load ≤1800Pa	Down force load ≤1800Pa, Uplift load ≤1800Pa
UL-xxx M-120 (166)	Down force load ≤1200Pa, Uplift load ≤1200Pa	Down force load ≤1200Pa, Uplift load ≤1200Pa
UL-xxx M-108 (182)	Down force load ≤1200Pa, Uplift load ≤1200Pa	Down force load ≤1200Pa, Uplift load ≤1200Pa
UL-xxx M-132 (182)	Down force load ≤1200Pa, Uplift load ≤1200Pa	Down force load ≤1200Pa, Uplift load ≤1200Pa
UL-xxx M-144 (166)	Down force load ≤1200Pa, Uplift load ≤1200Pa	Down force load ≤1200Pa, Uplift load ≤1200Pa
UL-xxx M-144 (182)	Down force load ≤1200Pa, Uplift load ≤1200Pa	Down force load ≤1200Pa, Uplift load ≤1200Pa



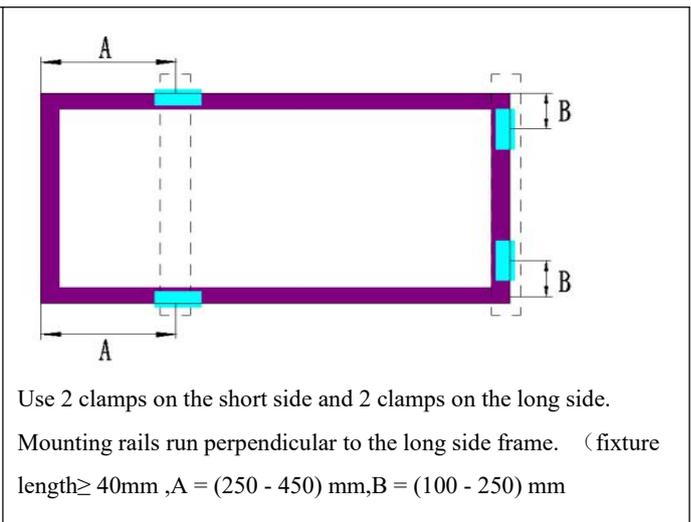
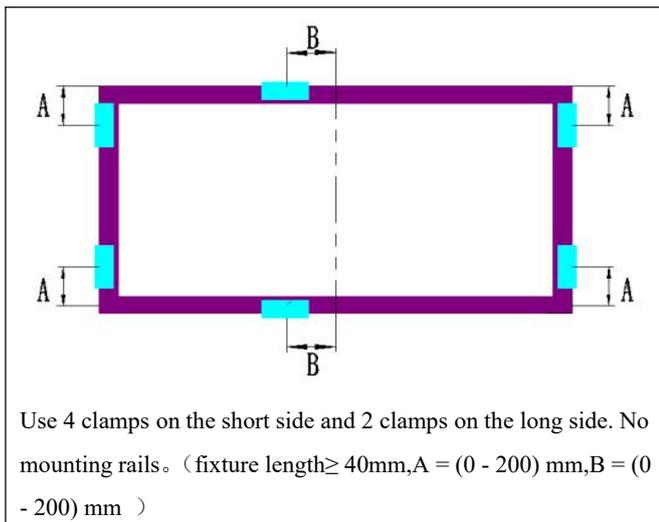


Use 4 clamps on the long side. No mounting rails (fixture length ≥ 40mm , A=20~200mm)

Use 4 clamps on the long side. No mounting rails (fixture length \geq 40mm ,A=200~400mm,or A=400~600mm)	length \geq 40mm ,A = (0 - 200) mm ,B = (0 - 200) mm)
---	--

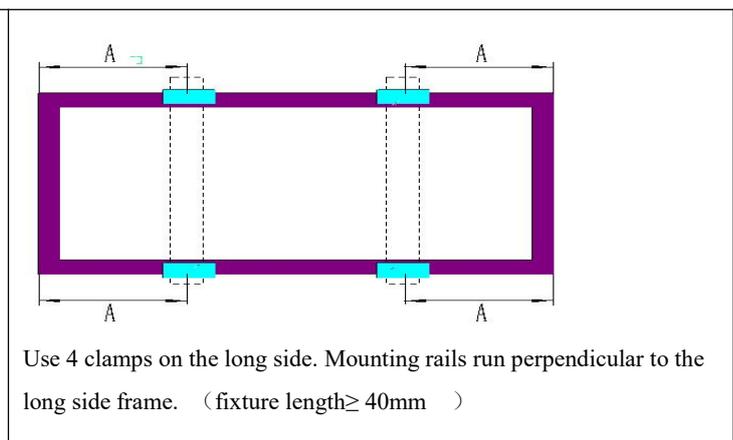
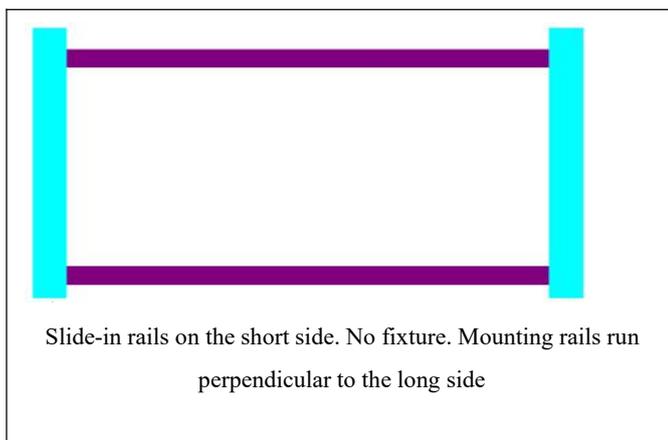
Load capacities of framed Monofacial modules:

Installation Method Module Type	Use 4 clamps on the long side. No mounting rails (fixture length \geq 40mm ,A=200~400mm,	Use 4 clamps on the long side. No mounting rails (fixture length \geq 40mm ,A = (0 - 200) mm ,B = (0 - 200) mm)
UL-xxx P-120 (156)	Down force load \leq 3600Pa, Uplift load \leq 2400Pa	Down force load \leq 3600Pa, Uplift load \leq 2400Pa
UL-xxx M-120 (158)	Down force load \leq 3600Pa, Uplift load \leq 2400Pa	Down force load \leq 3600Pa, Uplift load \leq 2400Pa
Installation Method Module Type	Use 4 clamps on the long side. No mounting rails (fixture length \geq 40mm ,A=400~600mm,	Use 4 clamps on the long side. No mounting rails (fixture length \geq 40mm ,A = (0 - 200) mm ,B = (0 - 200) mm)
UL-xxx M-120 (166)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 2400Pa
UL-xxx M-108 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 2400Pa
UL-xxx M-132 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 2400Pa
UL-xxx M-144 (166)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 2400Pa
UL-xxx M-144 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 2400Pa



Installation Method Module Type	Use 4 clamps on the short side and 2 clamps on the long side. No mounting rails. (fixture length \geq 40mm,A = (0 - 200) mm,B = (0 - 200) mm)	Use 2 clamps on the short side and 2 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length \geq 40mm ,A = (250 - 450) mm,B = (100 - 250) mm
UL-xxx P-120 (156)	Down force load \leq 3000Pa, Uplift load \leq 2400Pa	Down force load \leq 2400Pa, Uplift load \leq 1800Pa
UL-xxx M-120 (158)	Down force load \leq 3000Pa, Uplift load \leq 2400Pa	Down force load \leq 2400Pa, Uplift load \leq 1800Pa

Installation Method	Use 4 clamps on the short side and 2 clamps on the long side. No mounting rails. (fixture length \geq 40mm, A = (0 - 200) mm, B = (0 - 200) mm)	Use 2 clamps on the short side and 2 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length \geq 40mm ,A = (250 - 450) mm, B = (100 - 250) mm
Module Type		
UL-xxx M-120 (166)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1200Pa, Uplift load \leq 1200Pa
UL-xxx M-108 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 1800Pa
UL-xxx M-132 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 1800Pa
UL-xxx M-144 (166)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 1800Pa
UL-xxx M-144 (182)	Down force load \leq 1800Pa, Uplift load \leq 1800Pa	Down force load \leq 1800Pa, Uplift load \leq 1800Pa



Installation Method	Slide-in rails on the short side. No fixture. Mounting rails run perpendicular to the long side	Use 4 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length \geq 40mm)
Module Type		
UL-xxx P-120 (156)	Down force load \leq 2400Pa, Uplift load \leq 2000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
UL-xxx M-120 (158)	Down force load \leq 2400Pa, Uplift load \leq 2000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
Installation Method	Slide-in rails on the short side. No fixture. Mounting rails run perpendicular to the long side	Use 4 clamps on the long side. Mounting rails run perpendicular to the long side frame. (fixture length \geq 40mm)
Module Type		
UL-xxx M-120 (166)	Down force load \leq 1000Pa, Uplift load \leq 1000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
UL-xxx M-108 (182)	Down force load \leq 1000Pa, Uplift load \leq 1000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
UL-xxx M-132 (182)	Down force load \leq 1000Pa, Uplift load \leq 1000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
UL-xxx M-144 (166)	Down force load \leq 1000Pa, Uplift load \leq 1000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa
UL-xxx M-144 (182)	Down force load \leq 1000Pa, Uplift load \leq 1000Pa	Down force load \leq 5400Pa, Uplift load \leq 2400Pa