



Solar Module Installation Manual

Mono S5 / Mono S4 / Mono S3 / Mono S2 / M Series / P Series

Creating a Powerful Future

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1. Scope

- + Mono S5 88 triple-cut cells
- + Mono S5 60 half-cells

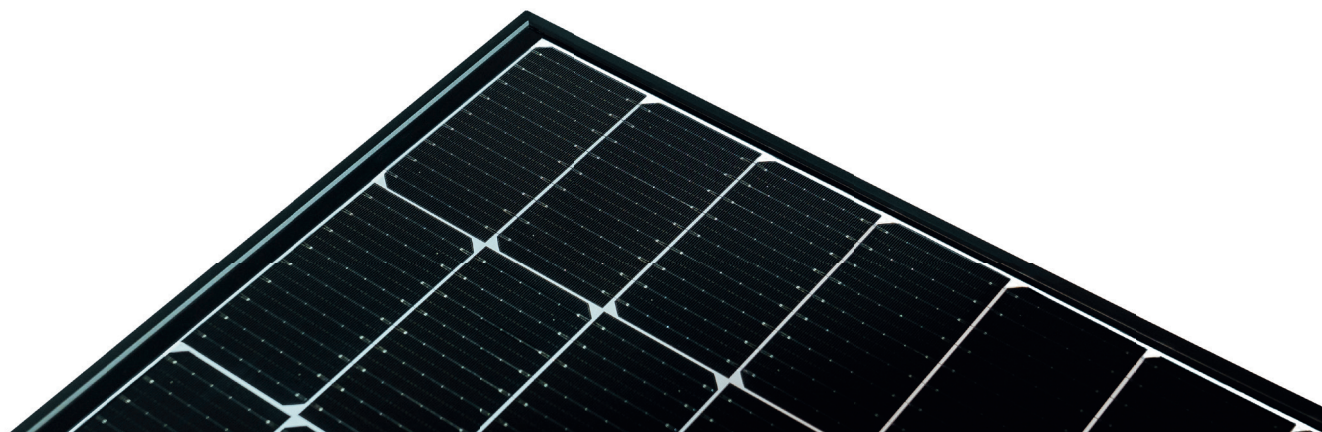
- + Mono S4 108 half-cells
- + Mono S4 120 half-cells
- + Mono S4 144 half-cells

- + Mono S3 120 half-cells
- + Mono S3 120 bifacial half-cells
- + Mono S3 144 half-cells

- + Mono S2 60 full cells
- + Mono S2 120 half-cells
- + Mono S2 72 full cells
- + Mono S2 144 half-cells

- + M-Serie 60 full cells
- + M-Serie 120 half-cells
- + M-Serie 72 full cells

- + P-Serie 60 full cells
- + P-Serie 72 full cells



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2. Safety Instructions

General safety instructions

Repair and operation of a PV system require sound specialist knowledge. All work on the system must therefore be carried out only by appropriately qualified and authorised specialists. Read this installation manual carefully and attentively before installing, commissioning or maintaining the PV system, and keep it readily accessible. Failure to observe the safety instructions may result in personal injury and property damage. Keep children away!

We are continuously committed to innovation, research and further improvement of our products.

We therefore reserve the right to change the information contained in this installation manual without prior notice.

Applicable safety regulations

The system modules may only be used for applications for which they are suitable. The modules must not be technically modified. During installation, ensure compliance with locally applicable building regulations, standards and accident prevention regulations. Ensure that the necessary safety instructions for installing and operating other system components are also followed.

Use of the modules

In particular, observe the following points when using our solar modules:

- + Installation and operation of the solar modules are approved up to a maximum altitude of 2000 m above sea level.
- + The operation of the modules has been tested at ambient temperatures from -40° to +85°C. This range should be observed.

- + The module must not be exposed to exceptional chemical stress (e.g. emissions from manufacturing facilities).
- + When connecting solar modules to energy storage systems, observe the relevant safety instructions of the manufacturer.

Warning: Danger to life!

Danger to life from electric shock!

Solar modules generate electricity. When exposed to light, they are live and may pose a hazard. Although the voltage of an individual module is still low at less than 50 V DC, the total voltage increases when several modules are connected in series. Currents likewise add together when several modules are connected in parallel. Although fully insulated connectors provide protection against contact, the following precautions must be observed when handling solar modules to prevent fire, sparking and, above all, fatal electric shock:

- + Do not insert electrically conductive parts into plugs or sockets!
- + Do not wear metal jewellery during mechanical or electrical installation work! Keep tools and the working environment free of moisture! Install solar modules and cables only with dry plugs and sockets!
- + Proceed with the utmost caution and care! Use only insulated tools for all work on cables and also wear insulating gloves!
- + Do not dismantle modules! Never remove parts or nameplates fitted by the manufacturer! Use only modules in faultless condition! Do not work on the rear of the module with pointed objects, paints or adhesives!
- + Do not expose solar modules to artificially concentrated sunlight.

Please note that modules may only be interconnected by qualified and authorised specialists!

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Danger to life from high voltage!

Dangerous touch voltages may still be present in the inverter even after electrical isolation. Therefore:

- + Exercise extreme caution during all work on the inverter and cables!
- + To allow high-voltage components to discharge, always observe the time intervals specified by the inverter manufacturer after switching off the inverter and before starting further work! Always follow the inverter manufacturer's installation instructions!

Danger to life from electric arcs!

Solar modules produce direct current when exposed to light. Opening a closed string, e.g. by disconnecting the DC cable from the inverter under load, can cause a fatal electric arc.

- + Never disconnect the PV array from the inverter while the inverter is connected to the grid!
- + Ensure that cable connections are in faultless condition! Connect cables without gaps and keep them free of dirt!

Electrical installation

The solar modules are designed for use in application class A PV systems and may therefore be operated in systems with hazardous DC voltages (greater than 120 V DC according to EN 61730) and power levels. PV modules of this application class may be used in systems with unrestricted access.

Solar Fabrik GmbH modules of the Mono S5, Mono S4, Mono S3, Mono S2, M and P series that are qualified within this application class to EN 61730 meet the requirements of protection class II when electrically installed in accordance with the regulations.

Transport, interim storage and safe unpacking

The modules are sensitive technical components that require the utmost care in handling. Take particular care during transport and interim storage, and leave the modules in their packaging until use. Always lift and carry modules with both hands; do not use the junction box as a carrying handle.

Do not drop modules or place them roughly on hard ground or on their corners. Do not place objects on modules. Do not stack modules on top of each other without protection.

Avoid bending the modules. Do not step on modules. Do not work on them with pointed objects, and keep all electrical contacts clean and dry.

It is advisable to record the serial numbers for system documentation. If interim storage is necessary, provide a dry, ventilated room.

Clean, non-slip gloves must be worn during all transport and installation work to prevent cuts from module edges. Fingerprints on the solar glass must also be avoided, as they may damage the special glass coating.

Always observe the warnings on the packaging and the enclosed unpacking instructions!

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3. Installing the Module

Ensure safe installation

Protect yourself and others against falls, do not perform installation work in strong winds, and prevent objects from falling as far as possible. Carefully secure the working area to avoid endangering or injuring people.

Always observe the maximum permissible mechanical load according to DIN EN 1991-1-3 / DIN EN 1991-1-4

Ensure that the maximum mechanical load is not exceeded, and always take account of site-specific loads such as wind or snow. Remember that the module may bend under high loads.

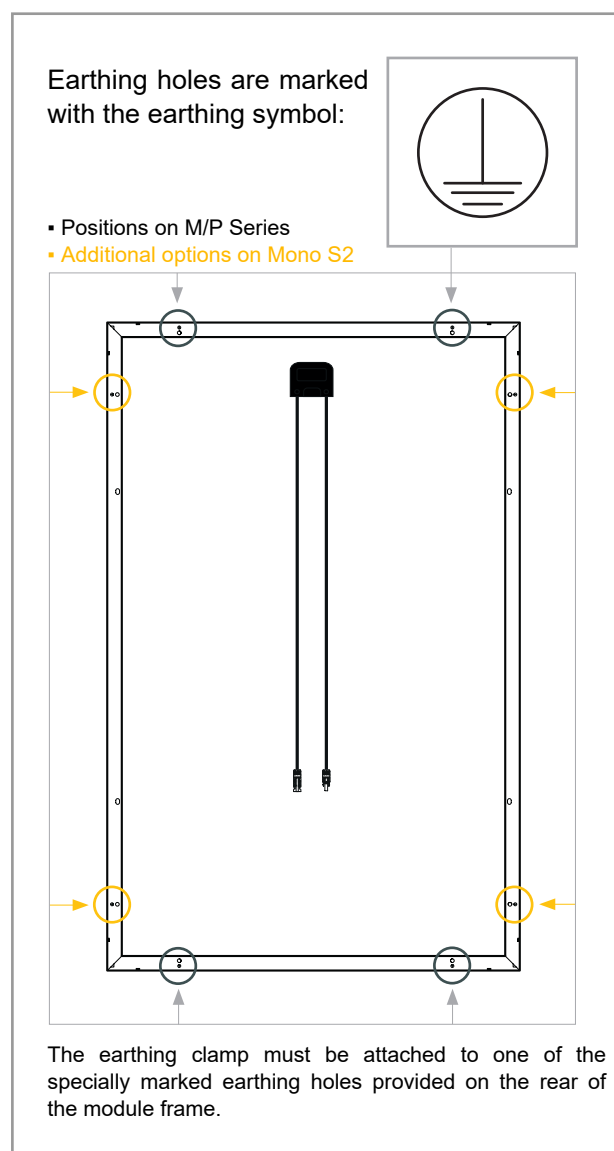
When using fasteners, cable ties or similar connecting materials between the rear of the module and the cross-members, ensure that pointed or uneven structures cannot damage the module.

Ensure proper earthing of the modules

Under the provisions of Solar Fabrik GmbH, earthing of the module frames and mounting structure is not required for trouble-free operation. To minimise the risk of electric shock (e.g. from static charges), Solar Fabrik GmbH recommends that the installer provide proper earthing. If an external lightning protection system is present, a specialist must integrate the PV system into the lightning protection concept. Country-specific standards and regulations must be observed.

The earth connections between modules must be approved by a qualified electrician. The main earth connection must also be made only by a qualified electrician.

In the USA and Canada, an earthing method approved by Underwriters Laboratories (UL) is mandatory. Optimum electrical conductivity must be ensured for proper earthing. Earthing holes are provided on the rear of the module frame for this purpose. These holes are marked with a stamped earthing symbol.



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Correct handling of AR-glass modules

The nanoporous coating on the glass surfaces of the solar module reduces reflection losses. Compared with uncoated glass, this can yield up to 2% more power through angle-dependent transmission when the angle of incidence deviates from the perpendicular. To maintain this effect and avoid visual impairment, we strongly recommend observing the following instructions:

- + Handle the modules carefully because of their coated glass.
- + Handle the modules with care during unpacking and installation. We recommend touching their surfaces only with clean gloves. The special reflection properties make slight soiling more noticeable. In particular, even small amounts of grease and oil are visible and may affect transmission.
- + We strongly advise against attaching stickers or labels to the coated surface. Depending on the material used, this may leave very fine residues that are difficult to remove.
- + In rare cases, visible white residues of the coating fluid and colour variations may occur at the edges (≤ 5 mm). These modules are fully functional, and this does not constitute a reduction in quality.
- + If heavy soiling makes cleaning necessary, we recommend the following procedure:
 - + Clean modules when they have cooled down (e.g. in the morning).
 - + For moderate to heavy residues, we recommend lukewarm demineralised water and clean, lint-free cotton, microfibre or paper cloths.
 - + For particularly heavy and stubborn soiling, we recommend cleaners containing surfactants.
 - + Avoid cleaning with strong acids, alkalis, petrol-based cleaners, steam, hot cleaners, cleaners containing silicone

oils, fluorides or waxes, polishes, alkaline or abrasive cleaners, or high-pressure cleaners.

- + This so-called anti-reflective coating is subject to coating tolerances that cause individual modules to differ in colour, particularly under diffuse light. It can be confirmed that the anti-reflective coating can increase energy yield and is not a sign of poor quality. According to current experience, these visual differences should diminish during the first years of operation due to climatic effects. The system can therefore be operated with these modules without concern.

Technical explanation of solar module cell production

- + Without exception, the cells we use are classified as "A-grade" cells. However, cell sorting takes place both manually and by machine. This alone may result in non-uniform cell colours that become visible with a black backsheet.
- + The cells used are 166 mm x 83 mm and 182 mm x 91 mm Mono PERC P-Type half-cut cells or TOPCon N-Type half-cut cells. These module cells undergo a coating/passivation process (backside passivation coating with AL203/SiNx). Tolerances in coating thickness may also cause colour differences during this process.
- + During production, the cells are also treated by plasma-enhanced chemical vapour deposition (PECVD). This deposition process improves efficiency, but also produces colour differences within the blue colour range. Module cells may therefore vary from slightly bluish to greyish.

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Irrespective of these processes, Solar Fabrik modules are tested again by an independent testing laboratory. Electroluminescence testing demonstrates the required quality characteristics. This ensures worry-free operation.

Ensure comprehensive fire protection

The installation of rooftop systems may affect the fire safety of a building. In particular, improper installation may create a hazard in the event of fire. As the module is not explosion-protected equipment, it must not be installed near highly flammable gases or vapours, e.g. near gas tanks, paint-spraying facilities or filling stations. The module must also not be installed near open flames or flammable materials. The system must always comply with local conditions, laws and regulations.

Ensure a suitable environment

The module is primarily intended for use in temperate climates. Ensure that it is neither exposed to artificially concentrated sunlight nor immersed in water or continuously exposed to splashing water at its intended location. Exceptional exposure to salts or sulphur creates a risk of corrosion.

Suitable installation conditions

It is essential that the module meet the technical requirements of the overall system. Ensure that other system components do not exert harmful mechanical or electrical effects (e.g. overvoltage) on the module.

Only modules with the same current rating may be connected in series, and only modules with the same voltage may be connected in parallel. Modules may only be operated at the permitted system voltage; operation at a higher voltage is not

intended.

The correct mounting location

The module must not be installed as overhead glazing, e.g. on a façade. Both the module and the mounting system must be able to withstand the loads expected at the installation site (snowfall, wind) without difficulty. Openings on the underside of the module frame allow rainwater to drain. Ensure that these openings remain unobstructed during installation. In portrait orientation, installation with the junction box facing either upwards or downwards is approved. Otherwise, only installation with the junction box facing upwards is approved.

Optimise yield through correct orientation and inclination

Before installation, we recommend obtaining information on the appropriate orientation and inclination of the modules so that the system can achieve optimum yield. Ideal conditions for power generation occur when sunlight strikes the array surface perpendicularly. To avoid power losses in a series connection, ensure that all modules are installed with the same orientation and inclination.

Install the module without shading

Even slight shading reduces system yield. It is therefore particularly important to install the module with as little shading as possible. It should never be completely shaded throughout the year and should receive unobstructed sunlight for several hours even on the least favourable days of the year.

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Ensure adequate rear ventilation

Adequate rear ventilation prevents heat build-up that would reduce performance.

Secure mounting

To install the modules as intended, each module must be securely fastened at no fewer than four points. Framed PV modules may be clamped along either their short or long sides.

NOTE: Observe the maximum mechanical load capacity of the modules, taking account of wind and snow load zones, terrain category and building height!

Mounting instructions

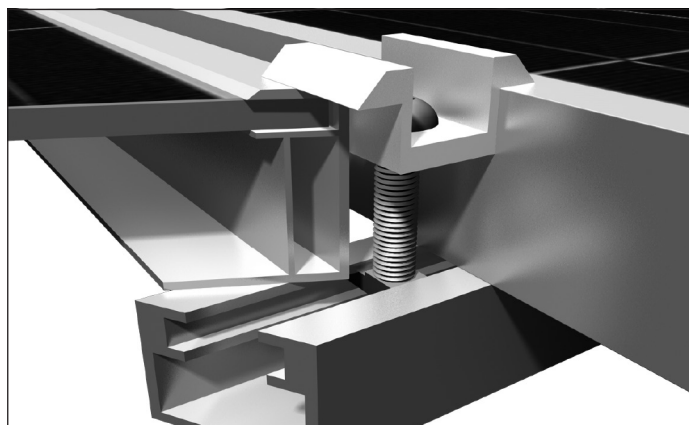
Modules can be attached to the mounting structure in various ways: either by clamping them from the front (see Example 1) or by bolting them from the rear (see Example 2) through the mounting holes provided.

Use a torque wrench for installation. In the examples shown, the required tightening torque is **16-20 Nm**. Please note that **20 Nm must not be exceeded**. Use M8 bolts made of V2A stainless steel. Use only the existing holes for installation. Drilling additional holes will void the warranty.

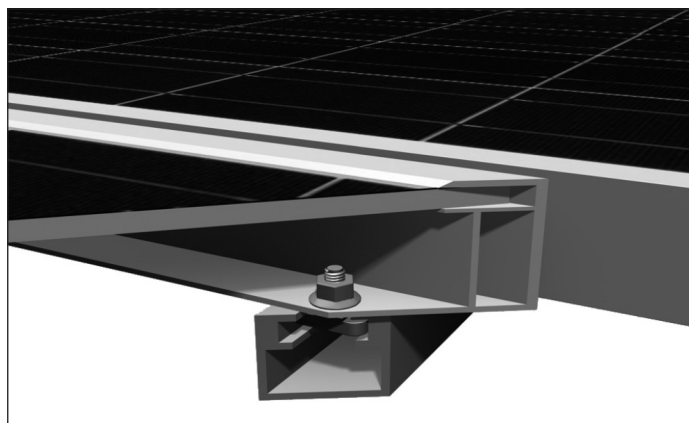
Load capacities

Depending on the mounting method, the solar modules can withstand the corresponding loads. As a general rule, avoid subjecting the modules to unnecessary loads.

When using the clamping method (see Example 1), the fixing points must be within the specified clamping zones. A diagram of the clamping zones is provided on page 10. Please note that failure to comply will void any entitlement to the corresponding warranty remedies.



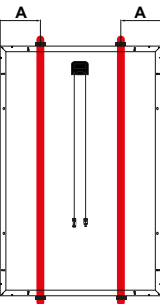
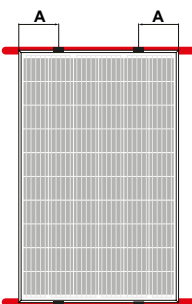
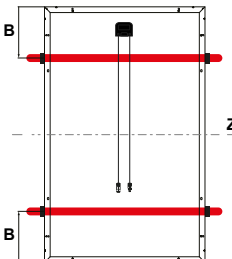
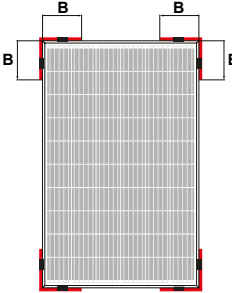
Example 1 - Clamping flange



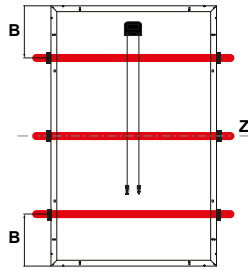
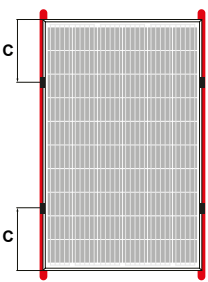
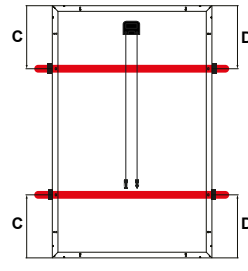
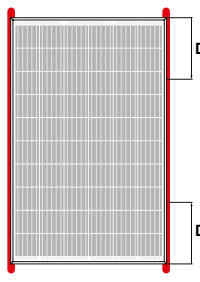
Example 2 - Direct bolting

Mounting Options | Standard Modules

Load capacity 2400 N/m²

Point-supported module frame			Surface/aerodynamically supported frame		
	Solar module	Mounting (4 clamps)		Solar module	Mounting (4 clamps)
	P-Serie	A = 200-300 mm		P-Serie	A = 200-300 mm
	M Serie	A = 200-300 mm		M Serie	A = 200-300 mm
	Mono S2	A = 200-300 mm		Mono S2	A = 200-300 mm
	M-Serie [HC]	A = 200-300 mm		M-Serie [HC]	A = 200-300 mm
	Mono S2 [HC]	A = 200-300 mm		Mono S2 [HC]	A = 200-300 mm
	Mono S3 [HC]	A = 200-300 mm		Mono S3 [HC]	A = 200-300 mm
	Mono S5 [TC]	A = 200-300 mm		Mono S5 [TC]	A = 200-300 mm
	Mono S4 [HC]	A = 250-350 mm		Mono S4 [HC]	A = 250-350 mm
	Solar module	Mounting (4 clamps)		Solar module	Mounting (4 clamps)
	P-Serie	B = 0-250 mm		P-Serie	B = 0-250 mm
	M Serie	B = 0-250 mm		M Serie	B = 0-250 mm
	Mono S2	B = 0-250 mm		Mono S2	B = 0-250 mm
	M-Serie [HC]	B = 0-250 mm		M-Serie [HC]	B = 0-250 mm
	Mono S2 [HC]	B = 0-250 mm		Mono S2 [HC]	B = 0-250 mm
	Mono S3 [HC]	B = 0-250 mm		Mono S3 [HC]	B = 0-250 mm
	Mono S5 [TC]	B = 0-250 mm		Mono S5 [TC]	B = 0-250 mm
	Mono S4 [HC]	B = 0-250 mm		Mono S4 [HC]	B = 0-250 mm

Load capacity 5400 N/m²

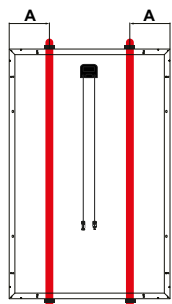
Point-supported module frame			Surface-supported module frame		
	Solar module	Mounting (6 clamps)		Solar module	Mounting (4 clamps)
	P-Serie	Z= B = 150-350 mm		P-Serie	C = 250-450 mm
	M Serie	vert. B = 150-350 mm		M Serie	C = 250-450 mm
	Mono S2	cent. B = 150-350 mm		Mono S2	C = 250-450 mm
	M-Serie [HC]	B = 150-350 mm		M-Serie [HC]	C = 250-450 mm
	Mono S2 [HC]	B = 150-350 mm		Mono S2 [HC]	C = 250-450 mm
	Mono S3 [HC]	B = 150-350 mm		Mono S3 [HC]	C = 250-450 mm
	Mono S5 [TC]	B = 150-350 mm		Mono S5 [TC]	C = 250-450 mm
	Mono S4 [HC]	B = 150-350 mm		Mono S4 [HC]	C = 250-450 mm
	Solar module	Mounting (clamped / bolted)		Solar module	Mounting (4 clamps)
	P-Serie	C = D = 325 mm		P-Serie	D = 325 mm
	M Serie	250- D = 325 mm		M Serie	D = 325 mm
	Mono S2	450 D = 332 mm		Mono S2	D = 332 mm
	M-Serie [HC]	mm D = 337 mm		M-Serie [HC]	D = 337 mm
	Mono S2 [HC]	D = 242 mm		Mono S2 [HC]	D = 242 mm
	Mono S3 [HC]	D = 383,5 mm		Mono S3 [HC]	D = 382,5 mm
	Mono S5 [TC]	D = 382,5 mm		Mono S5 [TC]	D = 382,5 mm
	Mono S4 [HC]	D = 242 mm		Mono S4 [HC]	D = 242 mm

Mounting Options | Non-standard Modules

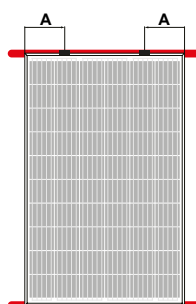
Load capacity 2400 N/m²

Point-supported module frame

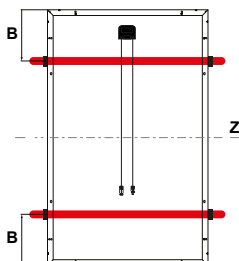
Surface/aerodynamically supported frame



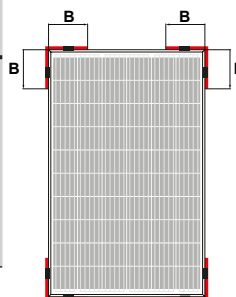
Solar module	Mounting (4 clamps)
P-Serie [72 cells]	A = 200-300 mm
M Serie [72 cells]	A = 200-300 mm
Mono S2 [72 cells]	A = 200-300 mm
Mono S2 [HC, 144 cells]	A = 200-300 mm
Mono S3 [HC, 144 cells]	A = 200-300 mm
Mono S4 [HC, 144 cells]	A = 200-300 mm



Solar module	Mounting (4 clamps)
P-Serie [72 cells]	A = 200-300 mm
M Serie [72 cells]	A = 200-300 mm
Mono S2 [72 cells]	A = 200-300 mm
Mono S2 [HC, 144 cells]	A = 200-300 mm
Mono S3 [HC, 144 cells]	A = 200-300 mm
Mono S4 [HC, 144 cells]	A = 200-300 mm



Solar module	Mounting (4 clamps)
P-Serie [72 cells]	B = 200-240 mm or B = 320-360 mm
M Serie [72 cells]	
Mono S2 [72 cells]	
Mono S2 [HC, 144 cells]	
Mono S3 [HC, 144 cells]	
Mono S4 [HC, 144 cells]	

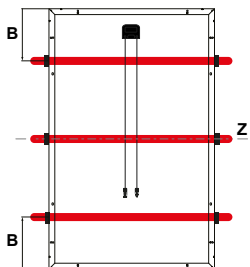


Solar module	Mounting (4 clamps)
P-Serie [72 cells]	B = 0-250 mm
M Serie [72 cells]	B = 0-250 mm
Mono S2 [72 cells]	B = 0-250 mm
Mono S2 [HC, 144 cells]	B = 0-250 mm
Mono S3 [HC, 144 cells]	B = 0-250 mm
Mono S4 [HC, 144 cells]	B = 0-250 mm

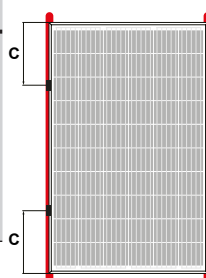
Load capacity 5400 N/m²

Point-supported module frame

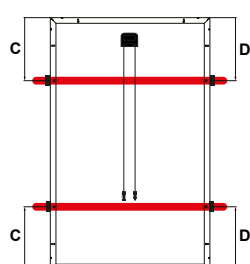
Surface-supported module frame



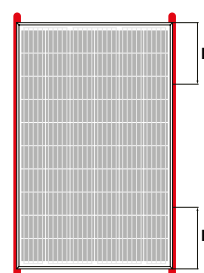
Solar module	Mounting (6 clamps)
P-Serie [72 cells]	B = 200-240 mm or B = 320-360 mm Z = vertically centred
M Serie [72 cells]	
Mono S2 [72 cells]	
Mono S2 [HC, 144 cells]	
Mono S3 [HC, 144 cells]	
Mono S4 [HC, 144 cells]	



Solar module	Mounting (4 clamps)
P-Serie [72 cells]	C = 240-320 mm
M Serie [72 cells]	C = 240-320 mm
Mono S2 [72 cells]	C = 240-320 mm
Mono S2 [HC, 144 cells]	C = 240-320 mm
Mono S3 [HC, 144 cells]	C = 240-320 mm
Mono S4 [HC, 144 cells]	C = 240-320 mm



Solar module	Mounting (clamped / bolted)
P-Serie [72 cells]	D = 264 mm
M Serie [72 cells]	D = 264 mm
Mono S2 [72 cells]	D = 270 mm
Mono S2 [HC, 144 cells]	D = 284 mm
Mono S3 [HC, 144 cells]	D = 327 mm
Mono S4 [HC, 144 cells]	D = 327 mm



Solar module	Mounting (4 clamps)
P-Serie [72 cells]	D = 264 mm
M Serie [72 cells]	D = 264 mm
Mono S2 [72 cells]	D = 270 mm
Mono S2 [HC, 144 cells]	D = 284 mm
Mono S3 [HC, 144 cells]	D = 327 mm
Mono S4 [HC, 144 cells]	D = 327 mm

Correct cabling

Never open the junction box! The modules are factory-fitted with the necessary cables and connectors.

Ensure correct interconnection

The integrated connection cables are UV-resistant and have a conductor cross-section of 4 mm². They are fitted with pre-assembled connectors protected against reverse polarity for interconnection.

Keep the total area of all conductor loops as small as possible to reduce voltages caused by indirect lightning strikes. Always perform a careful final inspection of the interconnections before commissioning the array. If the measured open-circuit voltage differs from the specified value, there is an interconnection fault. Also ensure correct polarity.

Mate the connectors correctly! Connectors may only be mated when dry. Also ensure that a gap-free connection is possible. The requirements of the inverters used must also be observed.

Appropriate overcurrent protection must be provided when modules are connected in parallel. Use DC fuses that prevent a reverse current greater than 15 A.

Also observe the connection conditions and design guidelines of the inverter manufacturers.

Before installation, check the connectors of the modules supplied; after completing each string, check that the completed string functions correctly. Do this by testing the voltage. Pay particular attention to the engagement between the plastic cable sleeve and the aluminium cable sheath. Engagement should be audible. If the string and/or connector does not function as required, contact Solar Fabrik GmbH immediately.

Use only suitable materials

The system may only be wired using dedicated solar cables complying with DIN EN 50618 Class 5 and suitable connectors.

It is essential that all materials used are in faultless electrical and mechanical condition. Use only single-core cables and select the appropriate conductor cross-section to minimise voltage drop.

For further module connections, use only suitable cables with a minimum cross-section of 4 mm². For longer distances, adjust the cable cross-section accordingly. Cable routing must also comply with the requirements of DIN VDE 0298-3.

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Protect cables from harmful environmental influences

Use only UV-resistant cable ties to secure cables to the mounting system. Protect exposed cables against possible damage, e.g. by routing them in plastic conduits. Avoid direct sunlight.

Under normal, expected conditions, a PV module may deliver higher current and/or voltage than stated under standard test conditions. Therefore, to determine component voltage ratings, conductor current ratings, fuse sizes and the ratings of controls connected to PV module outputs, multiply the I_{sc} and U_{oc} values stated on the module by a factor of 1.25.

Ensure proper installation of the connectors

To ensure that only connectors of the same type are used, the module cable may be cut just before the module connector and an alternative connector approved in writing by Solar Fabrik GmbH may be fitted.

The Forward Electronics connector sold by Solar Fabrik GmbH is approved for installation. Other connectors may be available on request. Please contact your Solar Fabrik GmbH sales representative.

Install the connector on the module in accordance with the installation instructions supplied with the connector. The entire process of fitting the new connector must take place at ground level. Also ensure that the module is not connected to the PV array during this work.

During all work steps, the photoactive front of the module should, wherever possible, be covered or face the ground to keep the voltage low. If all

installation instructions are followed and installation is carried out by a specialist, the module product warranty remains fully valid.

Maintenance and cleaning

Rainfall usually cleans the modules naturally. With sufficient inclination (greater than 15°), separate cleaning is therefore generally unnecessary. If heavily soiled, we recommend cleaning with plenty of water, without cleaning agents.

Clean, non-slip gloves must be worn during all transport and installation work to prevent cuts from module edges. Fingerprints on the solar glass must also be avoided, as they may damage the special glass coating.

For heavy soiling, we recommend cleaning with plenty of low-lime water. The pH of the water should be between 6.0 and 7.5. Do not use a nozzle attachment, and use only appropriate water pressure and temperature. Cleaning agents and abrasive cleaning equipment damage the special anti-reflective coating and void the product and performance warranties.

Never scrape or rub off dirt when dry. Damage to the highly efficient anti-reflective surface may cause visual changes to the module surface and power losses.

The use of automatic cleaning machines for solar installations is at your own risk and is not approved by Solar Fabrik GmbH.

- + Secure attachment and freedom from corrosion of all fastenings
- + Secure connection, cleanliness, integrity and freedom from corrosion of all cable connections
- + Contact resistance of equipotential bonding connections

Solar Module Installation Manual

Mono S5 / Mono S4 / Mono S3 / Mono S2 / M Series / P Series

Dismantling instructions -> Electrical isolation!

- + Disconnect the inverter(s) from the supply grid on the AC side so that the photovoltaic system is no longer under load.
- + Disconnect the photovoltaic system from the inverter at the DC isolation point.
- + Ensure that no voltage remains present in the system.
- + You can now dismantle the photovoltaic system. Observe the safety instructions.

Disposal of the modules

The disposal and recycling of solar modules are governed by the German Electrical and Electronic Equipment Act (ElektroG), which implements the WEEE Directive in German law. Also observe country-specific regulations. Registration or notification may be required in the relevant country.

Liability and status of this manual

If the instructions in this user information are not followed, Solar Fabrik GmbH provides no warranty that the modules will be suitable for use or function correctly.

Please note that failure to comply voids any entitlement to the corresponding warranty remedies. As Solar Fabrik GmbH cannot check or monitor compliance with these safety instructions or the conditions and methods of module installation, operation, use and maintenance, Solar Fabrik GmbH also accepts no liability for damage resulting from improper use or incorrect installation, operation, use or maintenance.

The text and illustrations in this installation manual reflect the technical status at the time of printing.

Subject to change.