

Planning and Installation Instructions

µm-Si plus EU1510



BOSCH
Technik fürs Leben

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1 Safety instructions and explanation of symbols

1.1 Safety instructions

General

- ▶ Read these instructions carefully and completely until you have fully understood the required safety measures and the individual steps in the installation process.
- ▶ Do not start installation work until the required physical and organizational conditions are in place to implement the necessary safety precautions.
- ▶ Keep these instructions in a safe place.

Installation and initial operation

- ▶ Solar modules should be installed and put into operation by a specialist company only.

Maintenance and repair

- ▶ Repairs to the system should only be carried out by a specialist company.
- ▶ Only use original replacement parts.

1.2 Explanation of symbols

Signal words indicate the seriousness of a hazard which will be caused if precautionary measures are not taken.

- ▶ **Caution** means that material damage may be caused.
- ▶ **Warning** means that injuries to persons or serious material damage may be caused.
- ▶ **Danger** means that serious injuries to persons may be caused. There is risk of death in particularly serious cases.
- ▶ **Notes** contain important information regarding situations where there is no hazard to human health or equipment.

1.3 General safety instructions

For your own safety and that of your employees or third parties and for the protection of the system you are installing, please follow the safety instructions in this section as well as those in Section 5. There may be other hazards which arise in addition to the ones mentioned in the safety instructions here. You will need to take additional safety precautions in such cases. Carry out a risk assessment for this purpose if necessary.

Danger!

Do not disconnect, pull or open the coupler under load!

Danger!

Use insulated tools only. Do not insert any metal objects into plug couplers!

Danger!

Do not touch any live electrical components!

Danger!

The solar module features a junction box without a bypass diode. A permanent or regular shadowing effect must be avoided at all costs!

Warning!

Modules may become hot and their surfaces can reach up to 90 °C!

Warning!

The voltages in modules increase when modules are connected in series. A maximum of 10 modules may be connected in series!

Warning!

Connecting modules in series leads to high system voltages even under poor light conditions and may damage modules and connected system components!

2 General product properties

2.1 Specifications for the product series

Basic specifications for the μ m-Si plus EU1510 product series	
Efficiency	7.3 – 9.0 %
Output	105 – 130 Wp
Grading	-0/ +4.99 Wp
Initial Voc (before stabilization)	90 V
Stab. Voc (after stabilization)	89 V
Temperature coefficients	
Voc	-0.37 %/K
Isc	+0.08 %/K
Pmpp	-0.33 %/K
System voltage	1,000 V
Reverse-current resistance	6 A
Application class according to IEC 61730	A (buildings, commercial) A-1 (accessible ground-mounted and on-roof installations)
Protection class	II
Weight	25 Kg \pm 0.7
Surface	1.43 m ²
Weight/surface	16.78 Kg/m ²

Note:

All power ratings on the data sheet and product label refer to a stabilized solar module output.

Note:

Electrical parameters are typical mean values from historical production data. Bosch Solar Energy AG does not assume any guarantee for the accuracy of this data for future production batches. All data and figures are subject to a tolerance of 10 %, unless specified otherwise.

Warning!

Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this 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!

2.2 Specifications for the junction box system

Junction box system properties	
Cable cross-section	2.5 mm ²
Length of connecting cable with PV-KST 4 coupler socket (MINUS)	1,000 mm
Length of connecting cable with PV-KBT 4 MC4 coupler plug (PLUS)	500 mm
Contact material	Tin-plated copper
Conductive material	Copper
Rated voltage	1,000 V
Rated current	10 A
Protection rating for junction box	IP 65
UV-resistant & weatherproof	Yes
Flame class	UL 94-V0
Temperature range	-40 to +90 °C

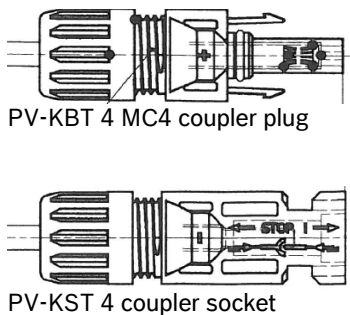


Figure 1: Multi-Contact MC4 type coupler system

2.3 Nameplate

The name plate is on the rear of the solar module. It contains all information required to comply with DIN EN 50380. It also includes information on the module's output and other electrical data. The serial number is also featured as a Code 39 (3of9) barcode.

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Bosch Solar Module μ m-Si plus EU1510

Power class: 110 Wp
Power sorting: -0 / +4,99 Wp

$$\begin{array}{ll} V_{OC} = 87 \text{ V} & V_{MPP} = 64 \text{ V} \\ I_{SC} = 1,98 \text{ A} & I_{MPP} = 1,76 \text{ A} \end{array}$$

(related to standard test conditions (STC) 1000W/m², AM 1.5, 25°C)

Maximum system voltage: 1000 V

Series Fuse Rating: 6 A

Fire Rating: Class C

Manufactured by Bosch Solar Thin Film GmbH

WARNING! Risk of electrical shock! Modules produce electricity when exposed to sunlight. Before installing, operating and servicing this unit check installation and operating manual. **DO NOT** connect or disconnect plug contacts while system is under load current. Failure to comply can result in hazardous situation. **DANGER!**



- Qualified, IEC 61646
- Safety tested, IEC 61730
- Periodic inspection



Made in Germany SN-Nr: 110927444200070



Bosch Solar Thin Film GmbH
Sonnentor 2, 99098 Erfurt

2.4 Intended use

µm-Si plus EU1510 series solar modules have been very carefully built for use in ground-mounted and rooftop photovoltaic systems. They are not intended for any other use. No liability will be accepted for any damage in cases of different use.

Improper applications or use particularly refers to:

- ▶ Applications which focus light on the surface of the module.
- ▶ Applications where the solar modules must comply with requirements for overhead glazing or toughened glass which can be walked on or offers fall protection.

Note:

Bosch Solar Energy AG's warranty and guarantee becomes null and void if the module and module components (couplers, cabling, junction box, label and other parts) are tampered with in any way!

2.5 Normal conditions of use / environmental conditions

Normal conditions of use / environmental conditions	
Module temperature	-40 - +90°C
Humidity	85 % (rh)
Hail storm	25 mm/ 23 m/s
Mechanical load-bearing capacity vertical to the module plane	2,400 Pa

Figure 2: $\mu\text{m-Si}$ plus EU1510 series nameplate

Non-standard conditions of use:

- ▶ Environmental conditions which exceed the aforementioned limit values
- ▶ Environments containing acidic, alkaline, abrasive or other chemical substances
- ▶ Partially shaded environments

2.6 EC declaration of conformity

This equipment complies with the applicable requirements specified in European Directive 2006/95/EC (Low Voltage Directive).

The equipment has been tested in compliance with IEC 61646 and IEC 61730

You can find the declaration of conformity at www.bosch-solarenergy.de.

2.7 Certification

The product is certified in accordance with the following standards and guidelines:

- ▶ **IEC 61646** (TÜV Rheinland)
- ▶ **IEC 61730** (TÜV Rheinland)
- ▶ **DIN EN61701: 1995** (pending)

You can find these product certificates at www.bosch-solarenergy.de.

3 Instructions on the system layout

3.1 General instructions

The solar modules are a key component in a photovoltaic system. Solar electricity outputs and the length of lifecycles in systems depend on a variety of factors. The following instructions on the mechanical and electrical system layout serve to ensure an optimum layout for systems containing $\mu\text{m-Si}$ plus EU1510 solar modules. You can find relevant standards and guidelines in Section 4.

- ▶ You should also familiarize yourself with applicable local standards, guidelines, directives and official regulations, such as technical conditions for connecting to the respective power supplier's grid, handling asbestos roofs, lightning protection regulations and fire safety regulations.
- ▶ $\mu\text{m-Si}$ plus EU1510 solar modules are products which contain two panes of glass. Ensure that nobody can tread on the module surfaces and fastening elements during installation and maintenance.
- ▶ Allow for access to the system for installation, inspection and maintenance purposes, ensuring that sufficient space is provided for carrying out installation and maintenance work.
- ▶ The optimum orientation for surfaces used to generate solar energy depends on the latitude and local weather conditions. In non-tracking systems in Europe, the most solar power is generated when solar modules are placed at an angle of around $30^\circ \pm 15^\circ$ with the solar module's active surface facing the Equator. You can find more detailed information on surface orientation in relevant specialist publications. If solar modules are placed in a suboptimal position, this generally leads to loss of output.

If lightning protection systems are legally required as an integral part of fire safety measures, they must not be affected by PV power generation systems.

- ▶ The solar module must be installed on a non-combustible, fire-resistant subsurface.
- ▶ The location of a PV system must be carefully selected. If a system is placed near trees and buildings, these may cause a shadowing effect on the PV system for part of the day. Permanent or regular shading must be carefully avoided.
- ▶ The direct current side must always be fitted with a DC-compatible switch with breaking capacity to ensure that the direct current side can be disconnected when under load.

3.2 Guidelines on the electrical system layout

Danger!

The solar module features a junction box without a bypass diode. A permanent or regular shadowing effect must be avoided at all costs.

Acceptable system configurations

Mounting system	System voltage	Functional grounding
Bosch Solar Rack Slide	1,000 V	Not required
Other	1000 V	Minus terminal

Warning!

The initial values of the module series are to be taken into account when designing the layout and dimensioning the system!

Danger!

Only Type MC4 couplers may be used to connect modules. Do not remove the pre-fabricated coupler assemblies!

Warning!

Type $\mu\text{m-Si plus}$ EU1510 modules must not be directly connected to previous products, such as $\mu\text{m-Si plus}$ and $\mu\text{m-Si plus EU1310}$!

Warning:

If $\mu\text{m-Si plus EU1510}$ modules are not installed using the Bosch Solar Rack Slide mounting system, a functional grounding system must be fitted to the module's line conductor (see permissible system configurations)!

- ▶ All PV strings in a PV system should be built using the same technology, should feature the same number of PV modules connected in series and should be positioned at the same angle (horizontally and vertically) to keep mismatching and malfunctions to an absolute minimum and improve output from the PV system.
- ▶ All PV modules in a PV system should also feature the same rated values for their electrical characteristic values, including those regarding short-circuit currents, open-circuit voltages, currents at maximum output, voltages at maximum output and rated outputs (under conformance testing conditions).
- ▶ Solar modules feature a reverse-current resistance of 6 A. The system should be designed in such a way that a reverse current resistance greater than 6 A is avoided.
- ▶ These solar modules have been tested for a maximum system voltage of 1,000V. This means a maximum of 10 modules can be electrically connected in series per string. The maximum voltage for the connected system components is to be taken into account while doing so.
- ▶ You should install inherently short circuit-proof and earth fault-proof wiring for the indicated system voltage.

- ▶ You should fasten the solar module connection cables without applying tensile stress on the junction box.
- ▶ $\mu\text{m-Si}$ plus EU1510 solar modules are protected by insulation (Protection Class II). As a result, they do not have a ground wire connection and do not require protective grounding.

Note:

In the case of low-resistance grounding in a line conductor, the overall generator voltage in the non-grounded line conductor comes into contact with ground potential. This is to be taken into account when selecting and dimensioning protection systems such as overvoltage protection.

- ▶ Disconnection devices must be fitted between the module and inverter.
- ▶ Cabling and disconnection elements are to be selected and dimensioned while taking into account external influences, such as resistance to UV light and heat.
- ▶ Ensure that the system does not come into direct contact with saltwater.

Note:

Bosch Solar Energy AG does not accept any responsibility for damage to equipment which has been operated with Bosch Solar $\mu\text{m-Si}$ plus EU1510 modules based on information not obtained from technical data sheets or operating instructions.

3.3 Guidelines for attaching solar modules up to 2,400 Pa

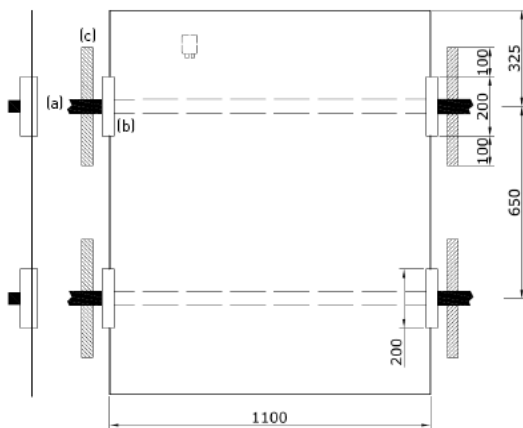
Solar modules are a key component in a photovoltaic system and are exposed to a wide range of mechanical loads when installed. Such loads consist of surface loads acting vertically to the plane, such as wind, snow and, possibly, live loads. In the case of horizontal and inclined solar modules, elements of dead load must also be absorbed and channeled through the fastening and support system.

In view of these considerations, Bosch a-Si plus solar modules are to be mounted by trained specialists in accordance with recognized technical standards while taking into account applicable industrial standards and regulations.

Standard DIN 1055- 4 "Action on Structures" contains essential rules for all construction types regarding the planning of the support framework for structures, including their foundations, and must be observed when dimensioning and designing the mounting and support system. IEC 61646 regulates, among other things, the mechanical load-bearing capacity of solar modules. The bearing capacity of solar modules for a load of 2,400 Pa according to IEC 61646 is only achieved if the following general instructions and guidelines for the permanent and secure attachment of solar modules are observed:

- ▶ Solar modules must be secured in an upright position with the junction box at the top, i.e. laser lines should run vertically or parallel to the slope of the roof.
- ▶ Solar modules must be attached to the longitudinal side along the specified clamping sections with clamps at least 200 mm long. Alternatively, the clamping length may be increased, so that solar modules are provided with two-sided linear support. However, there must be a minimum support length of 200 mm to withstand both wind suction and pressure loads. This is ensured by using sufficiently stable profile sections and suitable mechanical fasteners.
- ▶ The supporting structure or substructure must be adequately dimensioned based on a structural analysis and adapted to the environmental conditions locally to ensure that the maximum permissible deflection or deformation under a load of $L/100$ is not exceeded. You also need to ensure that the module does not distort or warp more than 30 mm across its diagonal line.

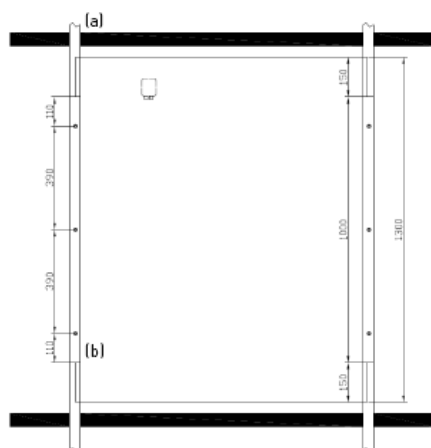
- ▶ Solar modules must be firmly mounted in permanently elastic bedding. The solar module and its glass must not come into direct contact with metal components in the substructure. You also need to ensure two glass surfaces do not come into contact with one another at any time.
- ▶ The solar module will warp more than 40 mm under a load of 2,400 Pa. A permanently elastic overlay must be installed to prevent direct contact between solar modules and the supporting structure or substructure. The length of this overlay must be sufficient to prevent contact between the glass and metal even if there is only a small gap between a solar module and the substructure. Permanently elastic beddings and overlays must be made of weatherproof, ozone-resistant, UV-stable materials.



- (a) Supporting structure or substructure
- (b) Fastening clamp 200 mm in length (vertical on the long side of the module)
- (c) Permissible clamping section for 200 mm clamps

Figure 3: Diagram showing fastening with 200 mm clamps. View from the left and from the front, not to scale

- ▶ The clamps may be placed over the glass to a maximum depth of 15 mm; this depth must be at least 8 mm to allow for installation and position tolerances.
- ▶ When solar modules are installed in an inclined position, they must be secured in a suitable way to ensure they do not slip.
- ▶ Solar modules must be fastened in such a way that they are free of any stress or distortion under all operating conditions.
- ▶ Mechanical stress which is caused by installing slightly curved solar modules on a flat plane is permitted.
- ▶ Water must not be allowed to accumulate on solar modules and must be able to reliably drain off modules. Stagnant water, caused by precipitation or condensation, leads to corrosion on the glass panes and the adhesive seal (PVB encapsulant between front and rear glass) and may cause blinding of the glass and damage the adhesive seal (delamination).
- ▶ Solar modules should be positioned at an angle of at least 7 degrees. Lower angles of inclination mean modules are more likely to get dirty. Suitable measures, such as regular cleaning, should be taken for angles of inclination less than 7 degrees in order to counteract any negative effects.
- ▶ The different thermal expansion coefficients in the materials used must be taken into account when selecting and dimensioning the base frame. The thermal expansion coefficient of glass is considerably lower than that of metals, meaning that any changes in temperature may cause stress in the structure due to such differences.



- (a) Supporting structure or substructure
 (b) Linear fastening section and / or pressure plate
 (vertical along the long side of the module)

Figure 4: Diagram showing the two-sided linear fastening. View from the front, not to scale

- ▶ You must maintain the specified gaps between fastening points for the vertical and horizontal fastening clamps (see diagram). Use the fastening torques for screws found in the mounting system supplier's instructions to ensure a permanently elastic, firm mount for solar modules.
- ▶ You must prevent sealants, such as silicone or butyl, from coming into contact with the encapsulant between the two glass panes (PVB or EVA encapsulant).

Warning!

The maximum permissible mechanical stress limits may be exceeded due to pressure from the clamping systems or if you tread on the module!

3.4 Transport and storage before installation

One packaging unit contains 20 solar modules and consists of a two-section cardboard box standing on a Euro-pallet.

Instructions on storing modules in transport packaging:

- ▶ No more than two packaging units may be stacked on top of one another, i.e. no more than two units in a stack.
- ▶ Do not store in damp conditions.
- ▶ Always store on a flat, even surface
- ▶ Secure open packaging units properly before transportation
- ▶ Do not tread on packaging units.

Dimensions and weight of loaded transport packaging:

Length	1,200 mm
Width	800 mm
Height	1,530 mm
Weight per module	25 Kg
Weight of transport packaging	535 Kg
Number of modules per packaging unit	20
Number of modules per truck	660
Number of packaging units per truck	33
Number of modules per container (40 ft.)	480
Number of packaging units per container (40 ft.)	21
Number of modules per container (20 ft.)	220
Number of packaging units per container (20 ft.)	11

4 Standards and regulations

The following standards and regulations must be taken into account during planning, installation and maintenance. This list is not exhaustive. Local official regulations may also apply.

DIN VDE 0100-712 Low-voltage installations - Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems (IEC 60364-7-712:2002, modified).

DIN 1055 Action on Structures Parts 1 to 5.

Low Voltage Directive 2006/95/EC

Directive on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

IEC 60364-1 Electrical installations of buildings – Part 1: Fundamental principles, assessment of general characteristics, definitions.

VDE 0126-23 Grid connected photovoltaic systems - Minimum requirements for system documentation, commissioning tests and inspection (IEC 62446:2009); German version EN 62446:2009.

VDE 0126-42 Installation and safety requirements for photovoltaic (PV) generators (IEC 82/592/CD: 2009; IEC 62548).

DIN IEC 60269-6 (In preparation) Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems (IEC 32B/543/CD: 2009).

Accident prevention regulations

Local standards and guidelines,
i.e. official regulations on lightning protection.

Technical conditions for connection required by the respective electric utility.

5 Installation

5.1 Safety instructions

µm-Si plus EU1510 Series solar modules are glass products and convert light into electrical energy even under very weak light conditions. In view of this, the following safety instructions must be adhered to:

Warning!

Take adequate precautions to prevent falls and electric shock. You must comply with employers' liability insurance association regulations on work safety!

Warning!

Do not install, service or clean cracked solar modules!

Warning!

Do not stand on the solar modules or fastening elements during installation, operation or maintenance!

Warning!

A solar module weighs 25 Kg. Two people are required to transport, position and fasten modules in place. Anti-slip gloves or suction handles should be used!

Caution!

Do not rest modules on a non-cushioned surface!

Caution!

Secure the modules firmly when taking a break from work to ensure that they do not slide, fall or get blown over by the wind!

Caution!

Secure work tools to ensure they do not fall onto the glass surface!

5.2 Storage and transport on the construction site

A transport packaging unit contains 20 $\mu\text{m-Si}$ plus EU1510 solar modules, in which solar modules are graded according to their performance class.

- ▶ Do not transport opened boxes without using transport securing devices.
- ▶ The boxes are made of cardboard and will no longer be rigid in extremely damp conditions.
- ▶ Secure module boxes to prevent them tipping over when you are unloading them.

Danger!

A full transport packaging unit weighs over 500 Kg. Place packaging units on a sufficiently strong substructure and level, non-inclined surfaces only!

Note:

The front of the solar modules is labeled "Front" on the outside of the packaging unit.

5.3 Checks before installation

- ▶ Check power rating and model type information on the module. Do not interconnect modules which have different electrical power ratings and are different model types.
- ▶ Check that solar module cabling and couplers are undamaged.
- ▶ Check that the solar modules are undamaged. Do not install any defective modules.

Note:

It is strongly recommended to make an immediate record of any possible transport damage, so that you can make a claim at a later stage.

5.4 Module installation

- ▶ Two people are needed to lift the modules out of their packaging and carry them to the installation location.
- ▶ Once in the installation location, depending on the type of application (roof or ground-mounted system), you either connect the coupler system on the module to the electrical system (see Electrical connection) or mount the module in its installation position.
- ▶ Fasten the solar module securely and permanently into position. You will find the fastening torques and further detailed installation instructions in the mounting system supplier's documentation.
- ▶ Fasten cabling with UV-resistant materials in a way that ensures that the connection cable is relieved of any strain.

Warning!

Do not rest modules on a non-cushioned surface or strike them against the substructure when transporting or installing them!

Warning!

Do not use chemical substances as an aid to install modules!

Warning!

Do not use the connecting cables or couplers to carry solar modules under any circumstances!

5.5 Electrical connection

µm-Si plus EU1510 solar modules are fitted with a MC4 coupler system in the factory. The following points must be observed when interconnecting modules. You can find further information on the coupler system in Section 2.

- ▶ Fasten couplers of the same type together. The coupler connection is firmly in position when you hear it click into place.
- ▶ Connection cables must feature a minimum cross-section of 2.5 mm² and must be approved for the maximum system voltage.
- ▶ Use the correct, original tool if you need to unlock the coupler connection.

Danger!

Do not disconnect, pull or open the coupler under load!

Warning!

Do not use any chemical substances as an aid to connect the coupler system!

Note

The junction box and couplers pre-fitted in the factory must not be opened or removed!

6 Environmental protection

Environmental protection is a key principle of the Bosch Group's company policy. Product quality, profitability, and environmental protection are equally important goals for us. Environmental protection laws and regulations are strictly complied with. We ensure that the environment is protected by using the best possible technology and materials while taking financial considerations into account.

6.1 Packaging

We take part in local packaging recovery schemes to ensure that packaging is recycled as effectively as possible. All packaging materials are environmentally friendly and re-usable.

6.2 Disposal

Defective or old solar modules must not be thrown away with the household waste. They should be disposed of in the correct manner.

7 Inspection, maintenance and care

You can make a considerable contribution to protecting the environment if your solar modules undergo maintenance on a regular basis. When solar modules and system components are properly maintained, this not only has a positive effect on yields, but also ensures that your system preserves its value.

Regular, expert maintenance may also be a requirement if you wish to make any warranty or guarantee claims.

We recommend that the system be inspected or serviced by a specialist company on a half-yearly basis. Only original replacement parts should be used during maintenance.

Danger!

Shut the system down before carrying out any work!

Danger!

Take all necessary fall protection measures before carrying out any work. Do not tread on modules during maintenance!

Note:

Solar modules positioned at a low angle accumulate dirt more easily. You can find instructions on maintenance-friendly installation in Section 3.

Note:

The system should not be maintained in direct sunlight or under extremely high insolation conditions as module surfaces become extremely hot and electrical voltages and currents reach a maximum level!

7.1 Inspection

The following tasks should be carried out during an inspection:

- ▶ Check solar modules for mechanical damage (cracks, shattered glass). Replace damaged modules immediately, carried out by a specialist company.
- ▶ Inspect coupler connections to ensure they are firmly in place and free of corrosion.
- ▶ Secure any cables and couplers which have become loose using UV-resistant fastening materials.
- ▶ Check the spacing between solar modules; re-position if necessary.
- ▶ Ensure that the solar module is not in direct contact with metal components in the sub-structure, such as screws and rails. If necessary, re-position solar modules or replace the permanently elastic bedding.
- ▶ Remove any dirt from solar modules; see section on cleaning.
- ▶ Check that fastening components such as rails, clamps and anti-slip devices are securely in position and, if required, re-fasten securely or replace damaged components according to the installation instructions.

7.2 Cleaning

- ▶ You should use soft cloths and plenty of water for cleaning.
- ▶ Do not use high-pressure cleaners for cleaning.
- ▶ The temperature of the water should not be widely different from the temperature of the solar module's surfaces, otherwise you risk cracking the glass surface.
- ▶ Do not use any sharp objects such as glass scrapers or metal scourers to clean modules. Any damage to glass surfaces due to scratches will weaken the glass and cause it to break.
- ▶ Do not use cleaning agents. Do not use abrasive, acid or alkaline cleaning agents under any circumstances.
- ▶ Do not step on the solar modules when cleaning. Use inspection gangways or suitable machinery, such as a cherry picker or an elevating work platform.

8 Contact addresses, contact persons

How you can contact us...

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Planning and Installation Instructions for the
 μ m-Si plus EU1510 Series

© Bosch Solar Energy AG, December 2011

Version: ENG/2011/12

We reserve the right to make any changes as a result
of technical advances and may do so without prior no-
tice.