

# SKALA

AVANCIS SKALA PHOTOVOLTAIC MODULES

## SAFETY, INSTALLATION AND OPERATION MANUAL

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**WARNING! ELECTRICAL EQUIPMENT**



AVANCIS photovoltaic (PV) modules are designed for outdoor use to produce direct current (DC) electrical energy from sunlight. This manual provides very important safety, installation and operating information. Please make sure you are familiar with this information before handling, installing and operating the modules. Avoid all hazards when handling, installing and operating PV modules.

The entire PV system must be designed, installed and commissioned by a licensed and qualified electrotechnical professional unless local codes determine otherwise.

Please make sure you follow precisely the instructions being given by the suppliers of these components.

Follow all applicable PV system design guidelines, because these guidelines are not covered by this document. AVANCIS recommends use of electrical and mechanical components and tools suitable and qualified for use in PV systems. Installation and operation of these components are also not covered by this document.

PV modules with a suspected problem should be removed from the PV system by a qualified person and be returned to AVANCIS for inspection and subsequent actions as described in the AVANCIS WARRANTY FOR PHOTOVOLTAIC MODULE(S).

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**General Information**

- Before starting to handle, install and operate the photovoltaic (PV) modules, all safety, installation and operation instructions should be understood. Follow all applicable local, regional, national and international regulations, code requirements and standards.
- Further technical information given in the technical data sheet of the appropriate module type must be considered.
- Keep unauthorised people away from the PV system and the PV components when unpacking and installing.
- PV modules produce voltage when exposed to light, even when operated in open circuit mode.
- PV modules produce approximately full voltage as specified on the module label, even under lowlight conditions. With light intensity, both current and power will increase.
- Under operating conditions, a PV module is likely to produce more current and/or voltage than reported at Standard Test Conditions (1,000 W/m<sup>2</sup> irradiance in the plane of module, module temperature 25 °C and a spectral distribution of irradiance according to air mass [AM] 1.5). Accordingly, the values of short circuit current (I<sub>sc</sub>) and open circuit voltage (V<sub>oc</sub>) given on the module label should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current rating, fuse sizes and the size of controls connected to the PV output.
- Make sure that the operating temperature of the PV modules remains exclusively in a range between -40 °C and +85 °C.
- Artificially concentrated light must not be directed on the modules.
- The modules must not be used on any kind of moving vehicles.
- Installations where the modules come into contact with salt, salt water or salt water spray are not permitted.
- The PV modules must not become partially or wholly submerged in water or be exposed to water spray (e.g. fountains, sea surf).
- The PV modules should not be located near aggressive substances, such as salt (see above) or any other types of corrosive agent, which could harm the module.
- If PV modules are installed in or on buildings, the applicable regulations and local building standards must be observed.
- Do not disassemble, modify or adapt the modules and their serial numbers or remove labels.
- AVANCIS recommends keeping a record of the PV module serial and variant numbers associated with the exact location in the PV system. Serial and variant number are printed on the label on the module's rear side.
- Customer and installer should save this document.
- Apply pressure only to those parts of the module explicitly described in this manual.

**Handling Safety**

- Please follow the instructions on the AVANCIS module box. The module boxes are not weather-resistant.
- Removing the PV modules from the box is easier if you start at the box side with the module positioned higher.
- The EPS parts used for packaging are marked with the EPS-Recycling symbol. For recycling of EPS parts in your region, please visit [www.epsrecycling.org](http://www.epsrecycling.org).
- Do not stand or step on the module boxes or on the modules and prevent objects from falling on the modules.
- Do not drop the modules, and avoid setting the module down hard on any surface, particularly when placing it on a module corner.
- While handling the modules, follow the locally applicable job safety rules for handling glass products.
- Do not damage or scratch the surfaces of the PV modules.
- Do not use the junction boxes, electrical cables or connectors as a grip to handle the PV modules.
- Never lean a module unsecured or without support, and prevent modules from sliding down any surfaces.
- Do not apply paint, glue or adhesive to the surface of the module.
- A PV module with broken glass or a damaged back rail or other parts cannot be repaired and must not be used. This module could have sharp edges and cause injury. Broken or damaged PV modules must be handled carefully and disposed of properly.

**Installation Safety**

- Do not install when there are adverse conditions, like strong or gusty winds or frosted roof surfaces. Also do not work under wet conditions, and use dry tools only.
- Use only insulated tools that are approved for working on electrical installations.
- AVANCIS recommends to use protective clothing, such as appropriate gloves for protection against electrical shock and sharp parts.
- Follow appropriate safety requirements when installing PV modules at heights to avoid possible falling or any other safety hazards.
- Observe the restrictions regarding the minimal bending radius of the electrical cables.
- Securely fasten the electrical cables after connection, but avoid any excessive mechanical stress on them.
- Electrical cables should be mounted in such a way that they do not cause people to trip or stumble.
- PV modules can only be switched off by removing them from light or by fully covering their front surface with an opaque material. When working with PV modules in light, follow all applicable regulations regarding working with live electrical equipment.
- Do not touch electrical terminals or broken electrical cables or ends of wire while the PV module is exposed to light or while installing the module. Contact with electrically active parts or any surface of broken modules can result in burns, sparks and lethal shock.
- Ensure that connectors are clean and dry before connecting them and that they are not submerged in water, snow or ice during operation.
- Never disconnect electrical connections or unplug connectors under load, in order to prevent direct current to arc across gaps or any other dangers.
- Do not wear metallic jewellery while performing installation.
- Cable conduits should be used in locations where wiring is accessible to children or cable-damaging animals, such as martens, etc.
- Make sure that the installation of the PV system does not cause corrosion of the system itself or parts near the system.

### Fire Safety

- Follow the local guidelines, codes and requirements for fire safety.
- The installation of a PV system on a building may affect fire safety of the building.
- For roof application, the PV system must be mounted over a fire-resistant roof covering rated for this application (outside USA and Canada).
- Do not install or use the PV modules near hazardous locations where flammable gases or vapors can be generated or collected.
- PV modules mounted on buildings will continue to produce hazardous DC voltage in case of a fire, even in the following cases:
  - low-light intensity
  - disconnected line between PV modules and inverter
  - partly or entirely damaged modules
  - damaged DC cabling
- Stay away from the PV system during and after a fire.
- Inform the fire fighters about the particular hazards from the PV system.
- After the fire, have your installer bring the PV system in a safe mode (if possible).
- The fire rating of this module (as stated in the technical data sheet) is valid only when mounted in the manner specified in the mechanical mounting instructions.

### Mechanical Installation

- Depending on the installation, appropriate measures should be taken to prevent any water, dirt or other substances from accumulating on the module.
- Landscape and portrait mounting of the modules in different directions is allowed. All modules should be mounted in one direction to achieve a unique appealing surface. This means that the module labels on the backsides are pointing to the same side. Keep the tilt angle of the modules between 0° and 40° against the horizontal when mounting the modules in landscape orientation (does not apply to free-field installations).
- To prevent staining of the modules during long-term operation, it is recommended to fully remove the adhesive that holds the cables to the rear glass before commissioning.
- The PV modules must be securely fastened to a mounting structure which follows the local building law regulations and which is suitable for PV applications and the local maximum wind and snow loads. Follow the instructions of the respective supplier.

- The back rails of the modules shall only be installed onto a sufficiently stable mounting structure, that can permanently guarantee a fastening torque of 20 Nm for the SMART clamps. Wooden mounting structures typically do not fulfill this condition.
- Ensure that modules are not subjected to wind or snow loads in excess of the maximum permissible loads as specified in the applicable product information literature.
- Ensure that the modules are not subjected to excessive forces due to thermal expansion of the support structure.
- During installation and operation, the support structure must not cause excessive bending or twisting of the module. All four mounting points must be within the same plane. To minimize mechanical stress on the modules, the maximum deviation of each of the four mounting points from the plane shall be less than 1 mm.
- Provide adequate rear ventilation behind a PV module for cooling and dissipation of condensation or moisture.
- When mounted, clearance of a minimum of 5 mm between the modules is required to allow for thermal expansion of the modules.
- With the exception of the back rails, all other parts of the modules must always be kept free from any structural elements that can come into contact with the module and cause damage.
- Do not drill any additional holes in the back rails. Doing so could compromise the mechanical integrity of the module and/or cause electrical hazards or corrosion.
- AVANCIS requires that the PV modules are mounted using the four mounting areas located on the back rails (marked in grey in figures 2 and 4).
- The modules' glass edges are sensitive to impact. Avoid contact with other modules, tools, etc.

### Electrical Installation

- PV modules of different configurations and different nominal power ratings must not be used in the same PV array, unless the inverters and/or system components are specified for this.
- The modules are factory-equipped with electrical cables and connectors for easy interconnection in series.
- Use the same type of connectors for connecting the PV modules. In case connectors of different manufacturers are to be paired, the connection should be approved in writing by both manufacturers.
- User-supplied electrical cable extensions might be required for connecting the modules.

- Use applicable system wiring with suitable cross-sectional areas and connectors that are approved for the maximum reverse current ( $I_R$ ) of the PV module.
- Match the polarities of electrical cables and terminals when making the connections; failure to do so may result in damage to the module.
- Make sure that the PV system has appropriate lightning and over-voltage protection and follow all applicable regulations (including those from insurance companies).
- Ensure that all electrical connections are secure and tight.
- A bypass diode is integrated in one of the two module junction boxes. This diode is not user-replaceable. The junction box must not be opened.
- The maximum number of PV modules being connected in series must be calculated in line with the applicable regulations in such a way that the specified maximum system voltage ( $V_{sys}$ ) of the module and all other electrical DC components will not be exceeded in open-circuit operation, even at low temperatures. If there are n modules, the following must apply:  $n \cdot V_{oc} < V_{sys}$ .
- Not more than two PV modules or module strings should be connected in parallel without using appropriate string current protection (otherwise the maximum  $I_R$  specification may be exceeded and the module will be damaged).

Underwriters Laboratory Information for USA and Canada:

- Refer to section 690-8 of the National Electric Code (NEC) for an additional multiplying factor of 125 % which may be applicable.
- Under normal conditions, PV modules are likely to experience conditions that produce more current and/or voltage than reported at Standard Test Conditions. Accordingly, the values of  $I_{sc}$  and  $V_{oc}$  marked on this module should be multiplied by a factor of 1.25 resp. 1.10 when determining component voltage ratings, conductor capacities, fuse sizes and size of controls connected to the PV output.

### Grounding of Back Rails

Even when applicable regulations, code requirements and standards do not require safety-related grounding, AVANCIS strongly recommends grounding of the PV module back rails in order to ensure voltage between back rails and ground is zero volts under all circumstances. This will increase the safety of the PV system in case of malfunctions and protect the system from induced overvoltage. For safety-related grounding of the module back rails, the back rails are provided with grounding holes (marked with grounding signs). These holes should be used for grounding purposes only and in accordance with the local regulations, code requirements and standards. If permitted, AVANCIS recommends for grounding to use the grounding holes in combination with a screw, nut and two lock washers (see figure 1). Please note: only materials should be used which do not cause corrosion. Make sure that the grounding screws do not touch any cable. Other means and methods for grounding are permissible as long as they meet the applicable regulations, code requirements and standards.

### Mounting

- Permanent or recurring complete or almost complete shading of a small number of cell stripes (parallel to the long side of the module), e.g., by ledges, sheathings or poles, must be avoided. The operation of an AVANCIS module under such conditions leads to yield losses and can permanently damage the partially shaded module.
- The PV modules must be mounted with 4 SMART clamps that can be obtained from AVANCIS. The clamps are to be mounted on the mounting lips of the rear side of the back rails, with one clamp holding 2 modules (except the modules at the end of each row). All other parts (such as screws, bolts, ...) are supplied by the customer. The screws must be approved for the long-lasting use in PV systems. The SMART clamps shall only be mounted as shown in figure 3 and need to be fastened with a torque of 20 Nm.
- In order to install a second module, make sure that the clamps are placed over the mounting lip of the first module and slide the second module towards the first module. The mounting lip of the second module will automatically lift the clamp and the clamp will go down after the mounting lip of this module is also under the clamp. Finally, fasten the clamp once the second module has been positioned correctly.
- The glass edges of the two modules must not touch during installation as this can result in the glass breaking.

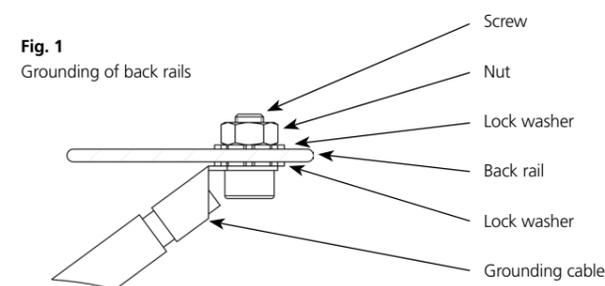


Fig. 1  
Grounding of back rails

Fig. 2  
Module rear side

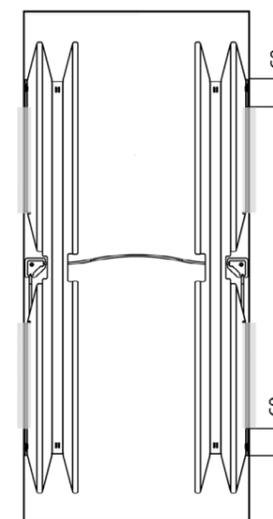
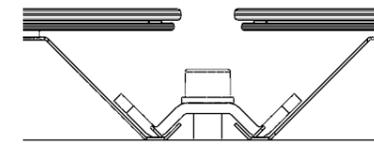


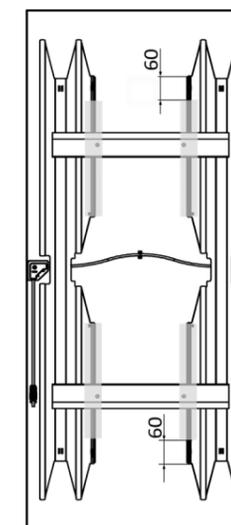
Fig. 3  
Mounting of the SMART clamp



### „Hook-in“ Variant

- The „hook-in“ version of the SKALA PV module is mounted as shown in figure 4, in which the regions indicated in grey mark the permitted regions for mounting the SMART clamp.
- The description for mounting the „hook-in“ version above only applies to the mounting of the joining element (mounting-kit) on the SKALA module. For the mounting of this combined element to the facade, the specifications of the facade system need to be observed.

Fig. 4  
Module rear side, „Hook-in“ variant



- The mounting structure must be parallel to the short side of the module and therefore perpendicular to the back rails. Other orientations of the mounting structure are not permitted.
- The full length of the SMART clamps must be in contact with the permitted mounting zone of the back rails (marked in grey in figures 2 and 4). The permitted mounting zone comprises the full length of the mounting lip of a back rail with the exclusion of the first 6 cm, measured from the outer end. The optimal position of the SMART clamps is located in the middle of the clamping regions.
- Depending on the local regulations and building codes, the following installations are allowed when installing the modules in a building facade or on a roof: in portrait orientation within a facade with an angle of maximal 10° from vertical; in landscape orientation on a roof only with an angle between 0° and 40° from horizontal.
- A usage of the PV modules as overhead glazing requires an assessment of the local regulations and building codes.

Detailed information, including the electrical data, is available in the respective SKALA data sheet as well as on the label on the rear side of the SKALA PV module.

#### Operation

- Before connecting a PV system to the grid, make sure the entire system was checked, tested and approved in accordance with the applicable regulations for such electrical systems.
- Depending on local regulations and utility policies, the physical connection to the grid and start-up of the PV system may only be performed by an authorised installer.
- The PV modules do not require any routine maintenance.
- AVANCIS recommends that PV systems are checked periodically for any loose mechanical and electrical connections.
- Based on regional conditions, PV modules might be affected by dust, dirt or other deposits on the top surface. This could have negative effects on the electrical performance. To clean the surface of the modules from time to time, AVANCIS recommends using decalcified water and a soft cloth or sponge to clean the front glass (avoid cleaning agents and abrasives). Only use water with a temperature that will not cause too much thermal stress to the module.
- During operation of the PV module, a complete or almost complete shading of cell stripes of the module (parallel to the long side), e.g., by cleaning tools, is to be avoided. Cleaning and maintenance work should generally not be done during times of strong irradiance and only after the PV system has been switched into open circuit condition. Ideally, this kind of work is performed during nighttime.
- Maximum operating altitude: 2000 m above sea level.

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#### Disclaimer of Liability

Since compliance with this Safety, Installation and Operation Manual and the conditions and methods of handling, installation, operation, use and maintenance of the PV modules are beyond AVANCIS' control, AVANCIS does not assume responsibility and disclaims liability for loss, damage, injury or expense arising out of or in any way connected with such handling, installation, operation, use or maintenance of the AVANCIS modules. AVANCIS assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the modules. No licence is granted implicitly or otherwise under any patent or patent rights. The information provided in this Safety, Installation and Operation Manual, including product specifications (without

limitations) and suggestions, do not constitute a warranty, expressed or implied. AVANCIS reserves the right to make changes to the product, specifications or this manual without prior notice.

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