

Installation and operation of manual photovoltaic modules**Bosch Solar Module c-Si P 48 / c-Si M 48****Bosch Solar Module c-Si P 60 / c-Si M 60**

Please read the installation and operating manual completely before transporting, installing or operating the solar modules. It contains important safety instructions. The warranty will be void if you fail to follow the instructions in this manual when using the solar modules. This documentation is current as of January 2009. We reserve the right to update the information it contains without prior notice.

1. Safety instructions

Electrical installation and initial operation may only be carried out by licensed electricians in accordance with the instructions below. Improper installation or initial operation may result in damage to property and injury to persons. Personal fall protection systems should be used when working on rooftop solar generators. All applicable occupational health and safety regulations must be followed. For your own safety and to protect your solar module, please observe the following instructions:

Notes:

- When carrying out installation and maintenance work on solar modules, comply with all applicable regulations and safety precautions relevant to the installation of electrical equipment and systems, as well as the regulations issued by your electricity supply company concerning grid-parallel operation of solar power systems.
- Make sure that the solar module is fully intact before installing it.
- Damage to the rear surface insulation film can have serious consequences (delamination, danger to life and health). Do not install or operate a module with damaged rear surface insulation film.
- When modules are connected in series (addition of module voltages), voltages may occur in excess of the safety extra-low voltage of 120 V DC.
- Module usage class: A
- Note that a full open circuit voltage is generated in the modules even at low ambient light levels.

- Disconnecting the direct current of live cables leads to arcing. Be sure to disconnect the inverter from the AC mains grid before carrying out any work, especially before disconnecting the plug connectors in the DC circuit.
- In the case of rooftop systems, modules must be installed on a fire-resistant sub-surface.
- Solar modules must therefore never be installed near easily flammable materials, gases or vapours.
- Observe all guidelines regarding fires in electrical systems.
- The maximum permitted system voltage of the solar modules must never be exceeded, even at low temperatures (see data sheet and module type plate).
- Handle solar modules as you would a glass product and do not walk or step on them.
- Never leave a solar module in a free-standing or unsecured position.
- Do not install solar modules with broken glass.
- Do not make any changes to the structure of modules.
- Comply with the safety instructions provided by the manufacturers of all other components in the solar power system.

2. Positioning instructions

To ensure the highest annual energy output possible, we recommend a module position that meets the following criteria:

- Align the front of the solar module so it faces south.
- In Germany, select a tilt angle based on local and structural conditions ($30^\circ \pm 15^\circ$). Specific instructions on optimal module positions can be found in the relevant technical literature. The tilt angle may be calculated using the following formula: tilt angle = latitude of place of installation -20° .

- All modules in a photovoltaic generator must be aligned at the same angle (both horizontally and vertically). Use a separate inverter if there are any angle deviations.
- In order to ensure adequate self-cleaning, the tilt angle should be at least 10°.
- Position the solar module in such a way that shade (even partial) is avoided. Shade can lead to performance loss and PV generator failures.
- Ensure that the rear of each module is well ventilated.
- To avoid excessive wind stress on modules, position them so that a minimum distance from building edges is maintained in accordance with DIN 1055-4.
- Ensure modules do not come into direct contact with salty air (in seaside areas).
- Focusing sunlight onto modules via a mirror or lens is prohibited.

3. Installation guidelines

- Any additional loads caused by the PV system must be taken into consideration for the structural analysis for the overall structure.
- The system builder or operator must arrange for structural checks to be carried out with regard to stability, deflection and load.
- Mount the modules on suitable substructures.
- Note the mounting areas shown in Figure 1. The modules must be securely fastened at a minimum of four points (see mounting holes in the frame drawing). The frame has been structurally approved for fastening on the long sides; it must not be fastened on the short sides.
- The mounting holes must not be used on their own for securing the modules instead they should only be used for short-term fixing of the module during installation.
- Only suitable clamping systems may be used for mounting. Make sure the solar module is flat and tension-free when mounting it on the substructure.
- Prevent all contact corrosion between the solar module and substructure when using different materials.

- Do not drill, nail or weld the module frame in place.
- Attach the solar modules so that they are able to withstand all foreseeable loads and weather conditions.
- Only use corrosion-free screws for installation.
- When mounting the solar module, it must be free of all mechanical tension and kept at a minimum distance of 5 mm from the next module to compensate for any material expansion due to temperature fluctuation.
- An adequate lightning protection system is recommended, especially in exposed areas.
- When integrating the solar module with existing lightning protection measures, be sure to observe all applicable regulations.
- Only mount the solar module vertically with the connection box pointing up or horizontal.
- When tilting the module, make sure no rainwater or condensation can flow towards the high-strength PG cable glands on the connection box.
- The solar module must not come into contact with any stagnant water or condensation. The ventilation openings in the frame must not be closed.
- Modules must be installed so that no water can flow in the direction of the cable gland, particularly along the cable.

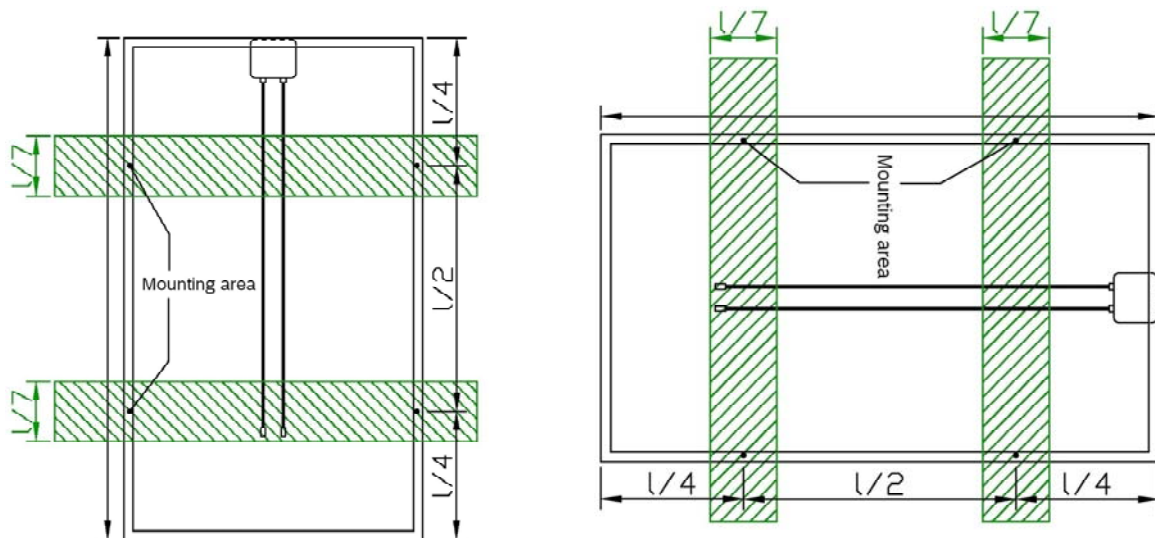


Figure 1 Mounting area of solar modules

4. Wiring instructions

You must only interconnect identical solar modules of the same type and the same power class. Make sure that the maximum system voltage is not exceeded. The maximum permitted system voltage of the solar modules may not be exceeded, even at low temperatures. The temperature coefficients for the specific module type may be used for determining voltages under different temperature extremes.

Suitable measures will be required to protect against overcurrent (e.g. line fuses) for parallel connection of modules. Care must be taken to avoid exceeding the given load with regard to the IR reverse current (16 A for the c- Si M60 and c- Si M48, 17 A for the c- Si P60 and c- Si P48).

Under normal conditions, a PV module can deliver more current and/or higher voltage than stated under standard test conditions. To determine the rated voltage of components, the rated current of conductors, size of fuses and dimensioning of controls to be connected to the outputs of PV modules the I_{sc} and U_{oc} values stated on the module should thus be multiplied by a factor of 1.25.

A line fuse must be used if more than two modules are connected in parallel.

The number of solar modules connected in series must not exceed **20** in the case of mono and polycrystalline solar modules with 60 solar cells, or 22 in the case of mono and polycrystalline solar modules with 48 solar cells.

5. Electrical connection

The solar modules are designed for use in grid-connected solar generators. If they are used for any other purpose, the different technical conditions must be taken into account. The solar modules may only be installed by qualified specialist companies. The relevant standards and regulations for PV systems, such as VDE regulations, DIN standards, VDEW guidelines, the technical connection conditions of your grid operator and all applicable industrial safety requirements, must be observed during installation.

- Check junction boxes, cables and connectors for damage before installing.
- Do not install damaged PV modules.
- Solar modules, in particular the plug-type connectors and tools, must be kept dry during installation.
- Only use suitable cables when wiring the module strings for outdoor installation (UV and ozone resistant)
- The cables must have a minimum cross-section of 4mm² and the insulation must be compatible with the system's maximum open-circuit voltage.
- Protect cables from damage.
- The connection boxes with pre-fitted cables must not be opened when installing wiring.
- Do not clean the connection boxes and cables with substances containing oil, grease or alcohol.

- During installation, make sure the module connection cable has sufficient strain relief.
- Ensure polarity is in the correct position when connecting the modules. Reverse polarity will result in permanent damage to the protective diode.
- The connecting cables are fitted with a heavy duty plug connector system for the photovoltaic panels. Either the plugs are labelled with their specific polarity, or the connection cables are coloured red for positive and blue for negative.
- Ensure polarity is in the correct position when connecting the solar modules to the inverter. Reverse polarity will result in permanent damage to key technical components such as the inverter.
- You may connect or disconnect the plugs while energized, i.e. the inverter must be disconnected from the DC mains grid.
- To avoid the risk of electric shock, all solar module frames and the support structure must be properly grounded to ensure equipotential bonding. We recommend establishing a ground connection outside of the building. When doing so, observe all applicable local statutory regulations and the recommendations of the inverter manufacturer and your insurance company.
- Prevent contact corrosion by using different metals (pay attention to electrochemical voltage series).
- Earthing holes: see figures 2 to 6.



Never connect or disconnect the plug contacts under load

6. Grounding

An adequate lightning protection system is recommended, especially in exposed areas. When integrating the solar module with existing lightning protection measures, be sure to observe all applicable country-specific standards and regulations. The respective grounding holes are marked on the reverse side of the module frame.

Please ground the system in the following way:

- Attach a suitable ring-type terminal (cable cross-section at least 2.1 mm²)
- Use a suitable fastening screw (minimum diameter 4mm), self-tapping tooth lock washer, spring lock ring and matching nut.
- Use a suitable self-tapping screw. Two complete threads must grip into the metal.

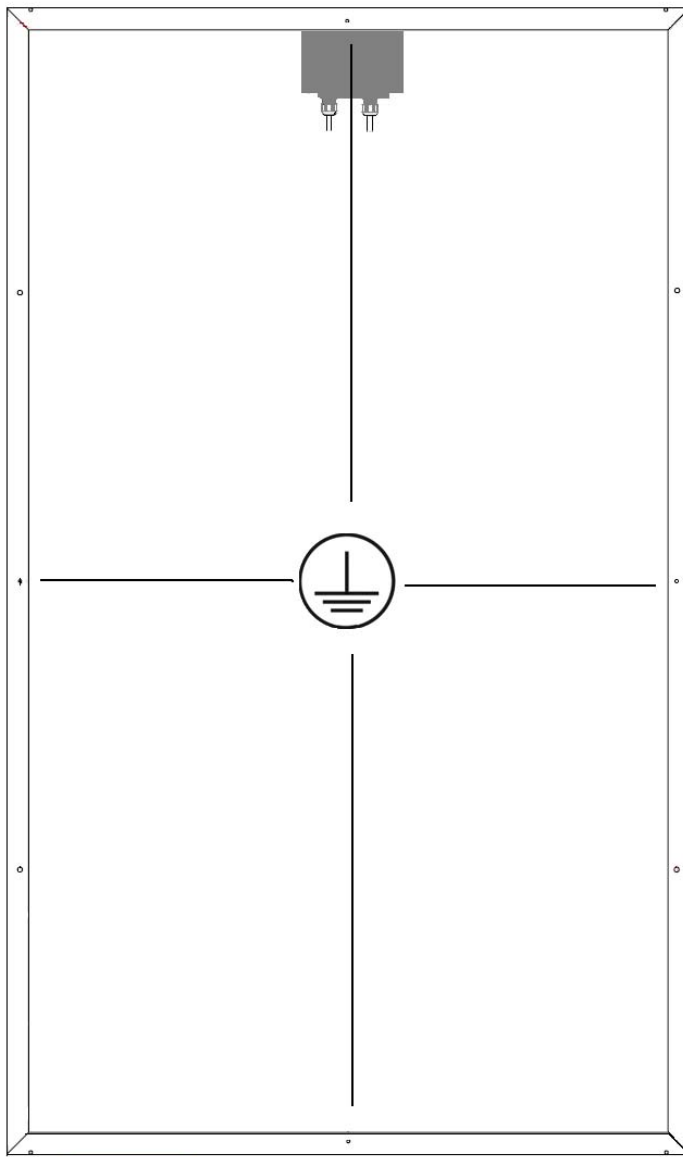


Figure 2 Manufacturer 01 c- Si M60

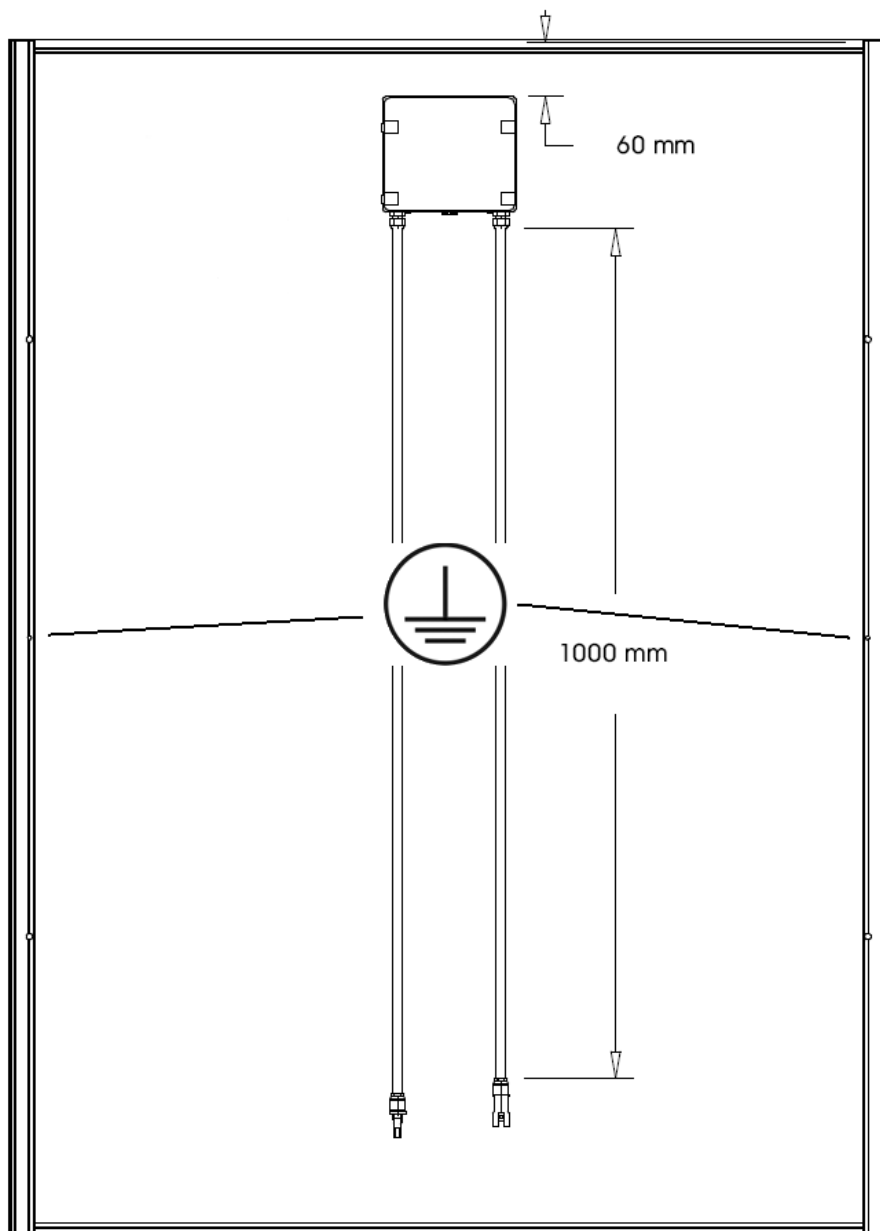


Figure 3 Manufacturer 11 c- Si M48 and c- Si P48

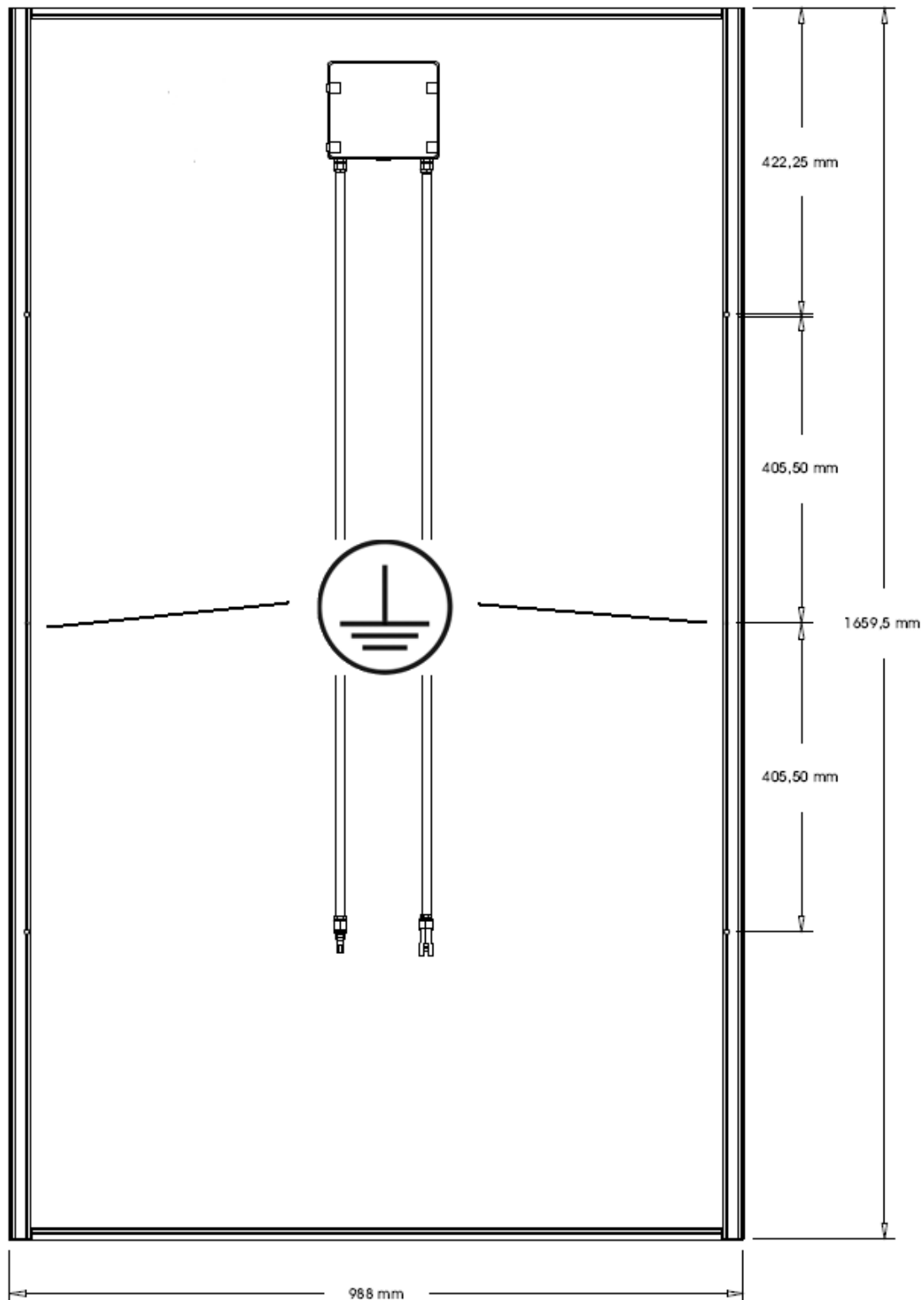


Figure 4 Manufacturer 11 c- Si M60 and c- Si P60

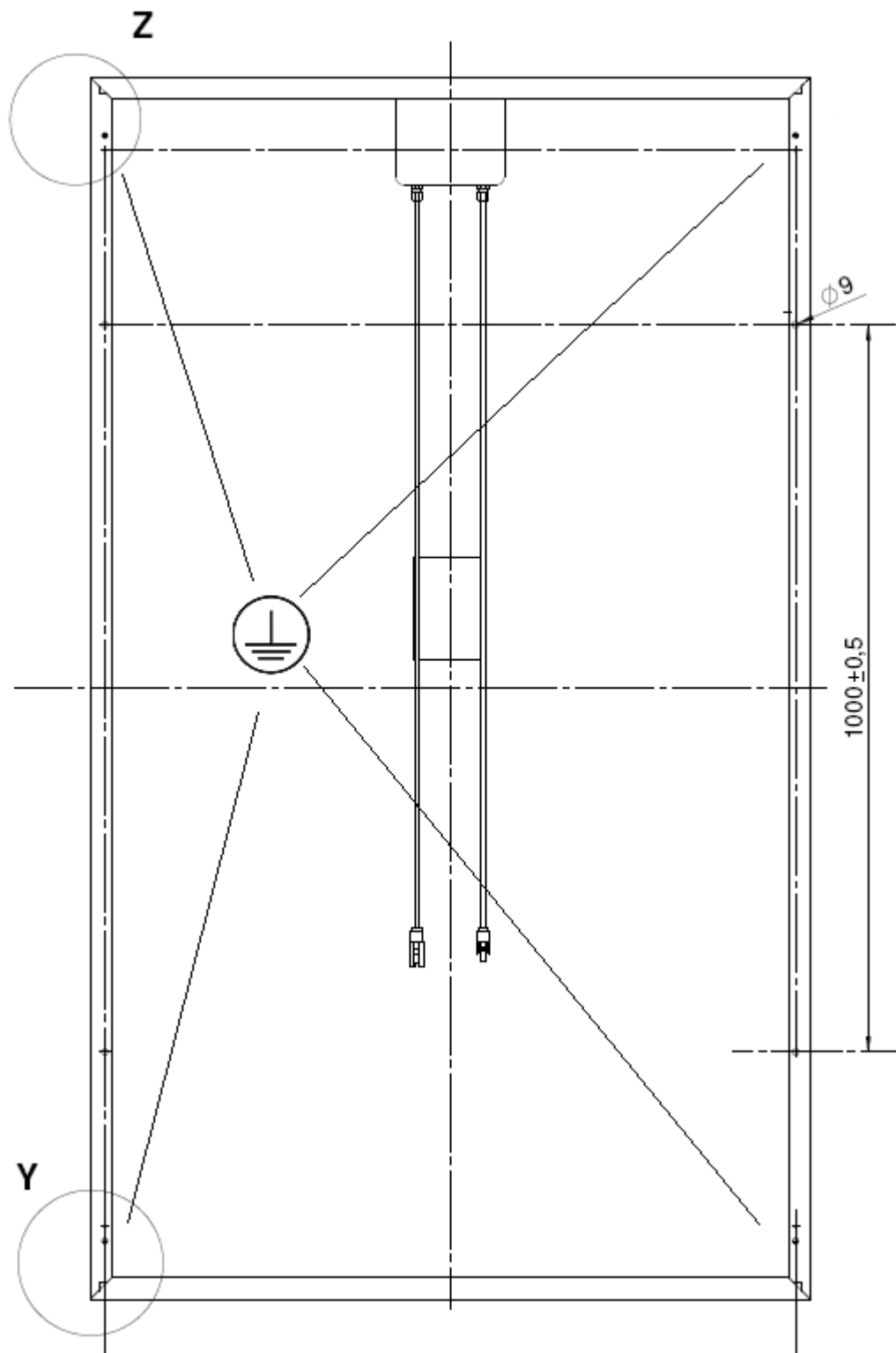


Figure 5 Manufacturer 13 c- Si M60

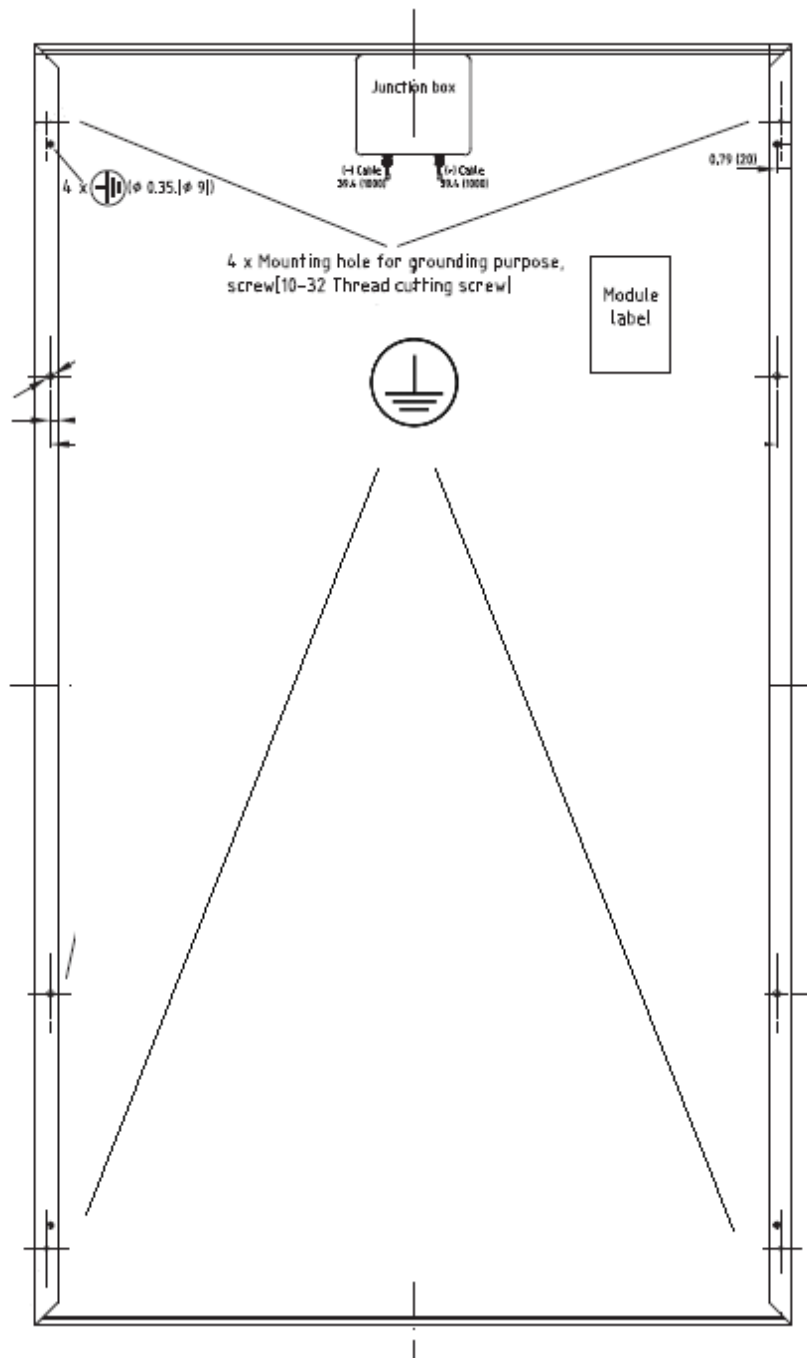


Figure 6 Manufacturer 14 c-Si M60

7. Servicing and maintenance

A minimum of service and maintenance work is necessary to ensure optimum performance in solar modules. Service and maintenance work should be carried out once every 6 months.

- Dirt build-up on the front glass surface reduces the performance of the solar module.
- If the module is very dirty, we recommend cleaning the surface with water that has the same temperature as the module and a soft brush. Do not use aggressive cleaning agents.
- Make sure all electrical and mechanical connections are clean, firmly secured and in sound condition.
- Any anomalies must be remedied immediately.
- It is recommended that the operator check output on a regular basis.

8. Disposal

Defective or old solar modules must be properly disposed of. They may not be thrown out with household waste.

9. Storage and transport

Extreme caution must be exercised when handling modules. They must be unpacked, transported and stored with due care:

- Do not set the modules carelessly down onto hard surfaces or on their corners.
- Avoid bending them.
- Do not drop the modules.
- Do not place any other objects on the modules.
- Do not handle them with sharp objects.
- When storing and transporting solar modules, ensure each module is properly supported.
- Stacking package units may damage the solar modules and must be **not** be used.
- Secure the solar modules to ensure they don't tip over.
- Insert layers of padding between the individual solar modules.

We recommend that you store all solar modules indoors and in the original packaging until final installation. Since the original packaging is

composed of non-impregnated cardboard, they must be stored in a dry location.

Avoid any damage to the modules during transport and unloading at the site of installation (e.g. roof).