

Shell Solar

Installation Guide for Shell Solar Photovoltaic Modules

www.shell.com/solar/

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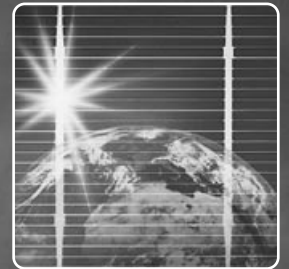
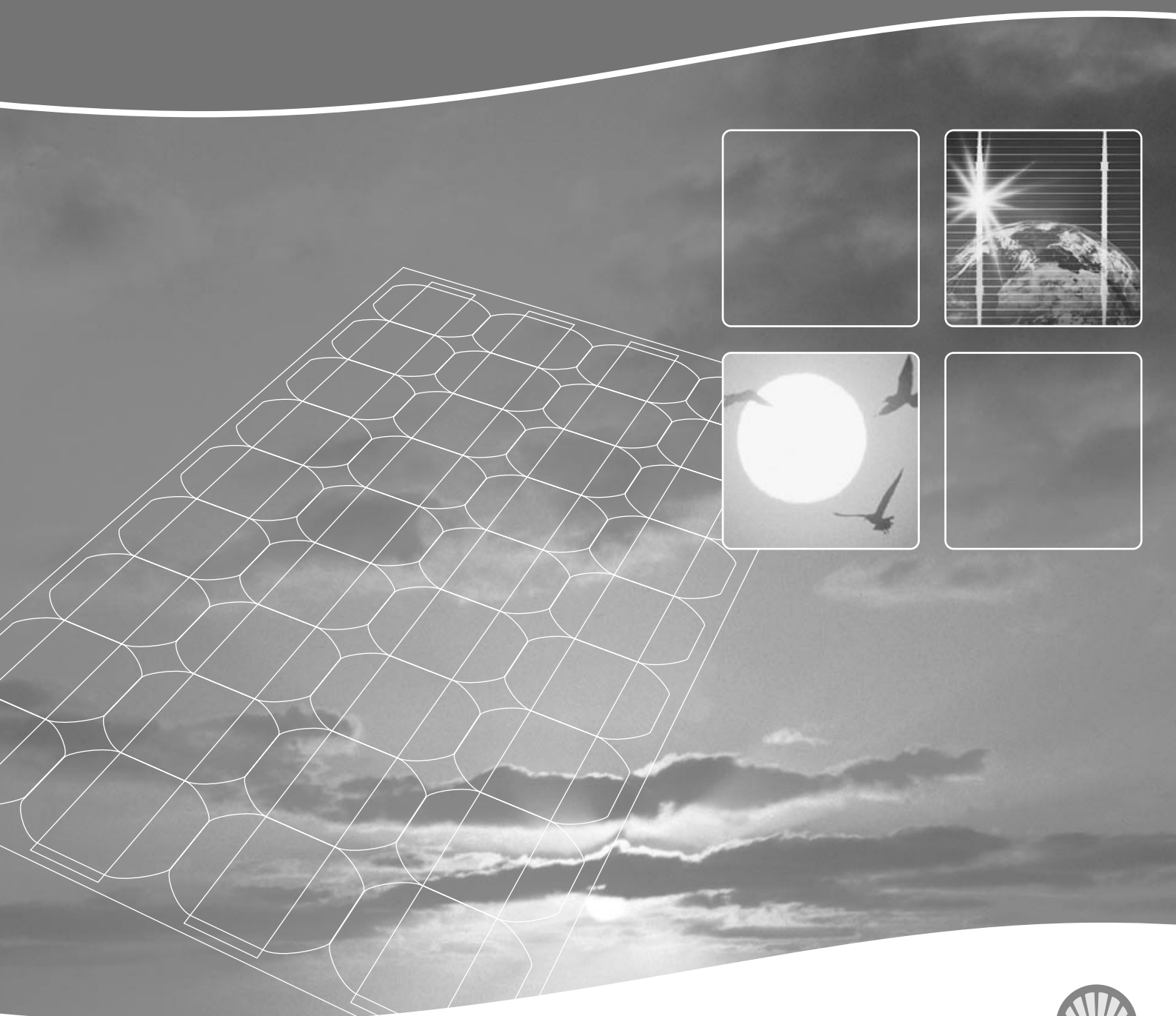




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Purpose of this guide

This guide contains information regarding the installation and safe handling of Shell Solar photovoltaic modules (hereafter referred to as "modules").

Please follow these instructions carefully and observe all of the safety precautions.

Although this guide describes several typical systems using photovoltaic solar power modules, it *does not* describe how to install or operate such systems. Please consult your solar power dealer for additional information on the following subjects:

- ▶ dimensioning and constructing solar photovoltaic systems
- ▶ wiring materials
- ▶ connectors
- ▶ stands and supports

Before installing a solar photovoltaic system, you should familiarize yourself with the mechanical and electrical requirements for such systems. For this reason, we recommend that you read this guide completely before starting the installation.

In the guide, the term 'module' should generally be understood to refer to individual modules and/or groups of modules according to the context.



Caution

If these products are used in the USA, please observe the instructions marked '[USA]'.

General information

Installing solar photovoltaic systems may require specialised skills and knowledge. It should only be performed by qualified electricians.



Caution

If the total DC voltage available from several modules connected in series (the sum of the open-circuit voltages of the individual modules) can exceed 120 V, installation and commissioning of the system must be performed by a licensed electrician or specialized company.

The installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock. Shell Solar electric modules do not require the use of special cable assemblies. All modules come with a permanently attached junction box that will accept a variety of wiring applications or with a special cable assembly

for ease of installation. It is recommended to utilize a qualified installer or reseller for service.



WARNING

All instructions should be read and understood before attempting to install, wire, operate, and maintain the module. Contact with electrically active parts of the module such as terminals can result in burns, sparks, and lethal shock whether the module is connected or disconnected.

Proper use

Photovoltaic solar modules produce direct-current electrical energy from light. They are designed for outdoor use, and depending on their construction can be mounted on support frames, stands, flat surfaces, vehicles or boats.

- ▶ Do not disassemble the module, and do not remove any attached nameplates or components.



- ▶ Do not apply paint or adhesive to the rear surface.



- ▶ Do not use mirrors or lenses to artificially concentrate sunlight on the module.



When installing the system, observe all local, regional and national statutory regulations, such as obtaining a building permit. Also observe local and national regulations with regard to use on vehicles or boats.

Safety precautions for installing a solar photovoltaic system



Caution

Solar modules produce electrical energy when light shines on their front surfaces, regardless of whether they are connected. A system with several modules can generate potentially lethal voltages and currents. If modules are connected in series, the total voltage is equal to the sum of the individual voltages. If they are connected in parallel, the total current is equal to the sum of the individual currents. Contact with a DC voltage of 30 V or more is potentially hazardous.



Personal safety precautions:

- ▶ Respect the directives and regulations of local authorities and/or industrial accident prevention organisations with regard to:
 - working safely on roofs and buildings
 - electrical installations
- ▶ Keep children well away from the system while installing mechanical and electrical components.



- ▶ Completely cover the module with an opaque material during mechanical and electrical installation to stop electricity being generated.



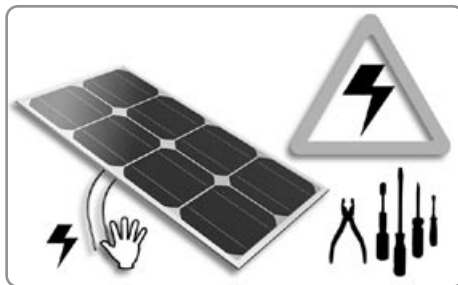
- ▶ Do not touch electrical terminals or ends of wires while the module is exposed to light or while installing the module.



- ▶ Do not wear metallic jewellery while performing mechanical or electrical installation.



- ▶ Use only insulated tools that are approved for working on electrical installations.



- ▶ Work only under dry conditions, and use only dry tools.



- ▶ Observe the safety regulations for all other components used in the system, including wiring and cables, connectors, charging regulators, inverters, storage batteries and rechargeable batteries, etc.



Operational safety and reliability precautions:

- ▶ Use only equipment, connectors, wiring and support frames suitable for use in a solar electric system.
- ▶ Always use the same type of module within a particular system.
- ▶ Keep this guide in a safe place for future reference (care and maintenance) and in case of sale or disposal of the module.



Instructions to ensure conformity with the Underwriters Laboratory Listings [USA]:

- ▶ For module wiring that is directly exposed to weather, use only 'UF' type wiring with solid or stranded copper conductors and insulation resistant to sunlight (UV) and weather.
- ▶ Observe the requirements listed in the Technical Specifications for the type of module used.
- ▶ The module frame must be earthed. If an earth wire with a cross-section greater than No. 10 AWG is used, a connector that can be fastened to the module frame using the supplied fastening screw must be fitted to the module.
- ▶ Under normal conditions, a photovoltaic module may experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of short-circuit current (I_{sc}) and open-circuit voltage (V_{oc}) marked on UL listed modules should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor capacities, fuse sizes, and size of controls connected to the module output. Refer to Section 690-8 of the National Electric Code for an additional multiplying factor of 1.25 which may be applicable.

Product Identification

Each module has a label on its rear side providing the following information:

- ▶ The Module Type name - consisting of an "S" and a second letter which determines the cell technology, followed by a number that is equivalent to the rated power of the module.
- ▶ The Serial Number - used to identify the specific product. Each individual module has a unique serial number.
- ▶ Rated Power, Rated Current and Rated Voltage. All are characteristic values important for the design of your PV-system.
- ▶ The Open Circuit Voltage exceeds the rated Voltage. Take care that the Open Circuit Voltage multiplied by the number of modules in series is not higher than the Maximum System Voltage.
- ▶ Maximum System Voltage. This voltage is certified per UL1703 and/or TÜV Safety Class II.
- ▶ Warning Notes.

Do not remove the label. If the label is removed the product warranty will no longer be honoured by Shell Solar.

Solar Modul Shell SP150-L

CE

All technical data at standard test conditions: AM 1.5; G = 1000 W/m²; T cell = 25°C
 Alle technischen Daten unter Standard-Testbedingungen

Rated Power Output Nennleistung	Power Output Leistung	Short Circuit Current Kurzschluss-Strom	Rated Current Nennstrom
P _{MPP} 150W	P _{MPP} ± 5%	I _{sc} 4,8 A	I _{MPP} 4,4 A

Class II Equipment Schutzklasse II	Open Circuit Voltage Leerlaufspannung	Rated Voltage Nennspannung
V _{max} 715 V	V _{oc} 43,4 V	V _{MPP} 34,0 V

Serial No.
Serien Nr.

301134 A 2080200001

Warning! Electrical Hazard!
 Before attempting to install, use and maintain this product, read, understand and follow all safety precautions detailed in the instruction manual. This module produces electricity when exposed to sunlight. If the module is not connected to a properly installed wiring system, it can be a shock hazard. They will or greater is considered a shock hazard.
 Do not connect terminals when module is exposed to sunlight. Do not produce sparks near flammable vapors. Follow safety precautions of the battery manufacturer if batteries are used with modules. Do not immerse in liquid. Module is not sea-water-resistant. Do not wear jewelry. Do not shadow with. Do not expose module to concentrated sunlight with mirrors, lenses or similar optics. Install module and ground frames in accordance with local codes or the National Electrical Code. Consult local authorities for permit, installation and inspection requirements. Consult manufacturer for proper installation on special vehicles such as boats and campers. Product should be installed and maintained by qualified personnel. Keep module away from children.

Warnung! Elektrische Gefahr!
 Vor Installation, Einsatz oder Wartung dieses Produktes müssen alle in der Montage- und Gebrauchsanweisung aufgeführten Hinweise zu Sicherheitsvorkehrungen gelesen und befolgt werden. Dieses Modul erzeugt bei Einwirkung von Sonnenlicht elektrische Energie. Jede Fehlfunktion oder Fehlanleitung von Modulen erhöht die Spannung bzw. Stromstärke. Spannung kann direkt auf Sie und darüber stellen bei Berührung eine Gefahr darstellen. Berühren Sie keine Anschlüsse/Leitungen, wenn das Modul Sonnenlicht ausgesetzt ist. Achten Sie darauf, dass in der Nähe von elektrischen Geräten keine Funken entstehen. Wenn zusammen mit den Modulen Batterien verwendet werden, sind den Sicherheitsanweisungen des Batterieherstellers Folge zu leisten. Module nicht in Flüssigkeiten eintauchen! Das Modul ist nicht wasserdicht. Vermeiden Sie Beschädigungen des Moduls durch Spiegel, Linsen, Objektive etc. Stellen nicht abstrahlende Sonnenstrahlung nicht mit Spiegel, Linsen oder ähnlichen Hilfsmitteln auf das Modul konzentrieren! Modulare Tragetaschen müssen gemäß den lokalen Vorschriften oder den nationalen elektrischen Bestimmungen installiert werden. Halten Sie sich an alle Genehmigungs-, Installations- und Inspektionsanforderungen. Für die sichere Installation auf Spezialfahrzeugen wie Booten und Campingwagen ist der entsprechende Hersteller zu Rate zu ziehen. Installation und Wartung des Produktes ist durch qualifiziertes Personal vorzunehmen.

Shell Solar B.V.
 P.O. Box 38000
 1000 BN Amsterdam
 The Netherlands

Made in Germany

Mechanical Installation

Selecting the location

Select a suitable location for installing the module. It should be positioned such that it is not shaded by other objects between 9 am and 3 pm on the shortest day of the year. The modules must be facing south in the northern latitudes and north in the southern latitudes. For detailed information on the best tilt angle for your installation, please consult your local solar power dealer.



Caution

- ▶ The module should not be shaded at any time of day.



- ▶ Do not use modules near equipment or locations where flammable gases can be generated or can collect.



Selecting the proper support frame

Always observe the instructions and safety precautions included with the support frame. If necessary, you can obtain more information from your dealer or sales partner.



Caution

- ▶ Do not drill holes in the frame or glass of the module. Doing so will void the warranty.



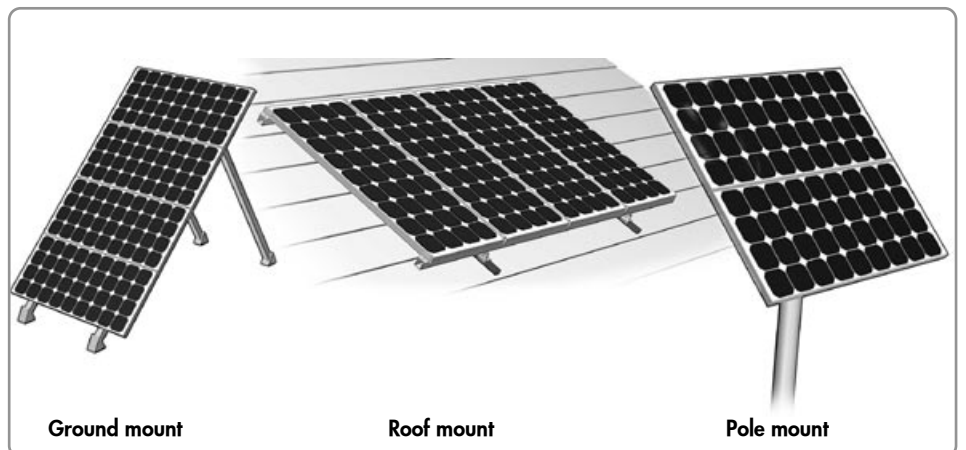
Modules must be securely attached to a surface using support frames or installation kits. The entire solar system must be able to withstand the mechanical loads that are typical for the region where it is installed.

Make sure the support structure is strong enough to withstand the anticipated wind and snow loads according to local standards and regulations.

Ensure that the modules are not subjected to excessive forces due to thermal expansion of the support structure.

The support structure should be made of durable, corrosion-resistant and UV-resistant material.

Support structures and installation kits for many different uses are available from Shell Solar and specialist companies. Ask your dealer or sales partner for advice.



Ground mount:

Select the height of the mounting system to prevent the edge of the lowest module being covered by snow for a long period of time. Also make sure the lowest module is placed high enough so that it is not shaded by plants or trees.

Roof mount:

When installing a module on a roof or building, ensure that it is securely fastened and cannot fall as a result of wind and snow loads.

Observe prevailing safety regulations when installing modules on roofs and buildings, and use prescribed safety equipment (safety nets, lifelines etc.).

Provide adequate ventilation on the rear side of the modules. For proper operation and to avoid damage from condensation, the module requires an adequate flow of air across the rear surface.

When installing the module, ensure that there is sufficient distance between the rear of the module and the mounting surface. The minimum distance between the roof and the modules should be 5 cm (2 Inches).

Pole mount:

When installing a module on top of a pole, make sure the pole is strong enough to withstand anticipated wind speeds and gusts without substantial bending. The pole must be installed with adequate foundations. Use a mounting frame to fasten the module to the top of the pole.

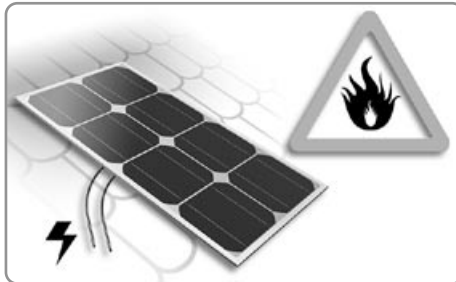
Roof Mounting

When installing modules on a roof, ensure that the roof construction is suitable. In some cases, a special support frame may be necessary.

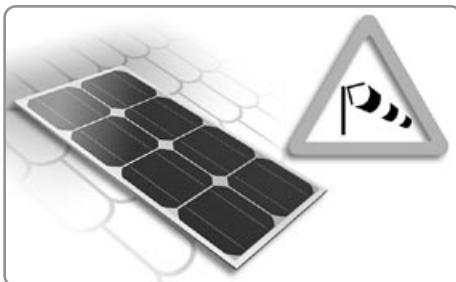


Caution

- ▶ The roof construction and installation may affect fire safety. Consequently, it may be necessary to use components such as earth ground fault circuit breakers, fuses and circuit breakers. An improper installation can create an additional hazard. Please consult knowledgeable experts regarding the installation.



- ▶ When installing a module on a roof or building, ensure that it is securely fastened and cannot fall as the result of wind or snow loads.



- ▶ Observe prevailing safety regulations when installing modules on roofs and buildings, and use prescribed safety equipment (safety nets, lifelines etc.).

Mounting hole locations

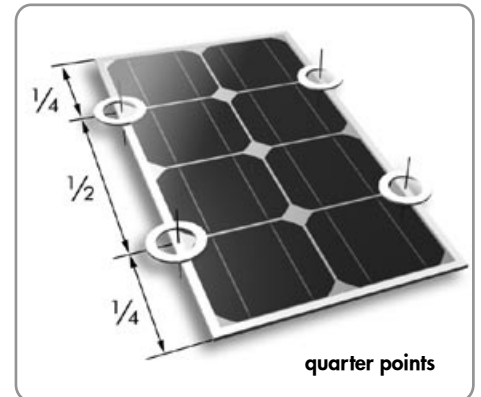
For secure installation use only the recommended mounting locations on the modules.

Wherever possible mount the module using the predrilled holes in the frame. The most secure mounting is achieved by mounting the module using the four "quarter" points as shown.

For modules with a slot in the frame on the rear side, use the quarter points for the most secure mounting.

Seek advice from your dealer if you intend to mount the modules without using the pre-defined mounting locations in the frame.

Shell Solar will not honour the product warranty if additional holes are drilled in the frame.



Mounting hole locations

Installing frameless modules

Shell Solar supplies two types of frameless modules - one type provided with factory assembled (pre-mounted) clamps for mounting and pre-certified to IEC61215, the other type provided without factory assembled clamps and certified as a UL recognised component [USA].

Shell Solar will only warrant products if they are installed in mounting systems which are IEC or UL certified. IEC requires mounting systems to be certified together with the frameless modules being used. UL must approve of the mounting method being used with a frameless module before full UL approval can be obtained.

For any other mounting method contact your Shell solar representative for more information.

General Requirements:

- ▶ Frameless modules are not suitable for applications on vehicles, boats etc. for mobile use.
- ▶ Frameless modules shall only be used in regions with moderate snow loads and wind speeds up to 130 km/h. - Frameless modules are vulnerable to breakage during transportation and installation. Handle them with care.
- ▶ No structures or objects that could touch the module at its maximum permitted flexure of 5 mm should be located in front of or behind the module.
- ▶ The deviation of the four mounting surfaces from a plane surface must not exceed 1.2 degrees.
- ▶ The support surface at each mounting position should have an area of at least 25 mm x 25 mm.

Frameless modules with pre-mounted clamps
A Shell Solar frameless module provided with pre-mounted clamps is an IEC tested and certified system and comes with the standard Shell Solar product warranty.

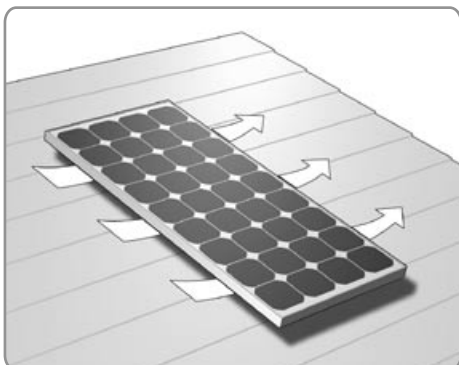
- ▶ Attach clamps to a solid, clean and flat surface
- ▶ Avoid putting the module under stress when tightening the clamps. Do not create any forces that could affect the module or cause the clamps to pull away from the module or slide towards the module.
- ▶ Use high quality M8 screws with strength class 8.8 (in accordance with DIN EN 24014) and washers compliant with EN ISO 7093-8-200HV (minimum diameter 24 mm, thickness 2 mm).
- ▶ We recommend using full-metal, self-locking nuts with spring-washers.
- ▶ Use a torque wrench and tighten the nuts with a torque of 30 Nm.
- ▶ Two days after installing the modules test all screws for proper tightness using a torque wrench.
- ▶ Always arrange frameless modules in landscape position with the mounting clamps along the bottom and top edges. If positioned in portrait position, the narrow bottom edge must be secured against slipping.

[USA] Frameless modules without pre-mounted clamps

This product is a UL recognized component and can only be used with a UL certified mounting system. Follow strictly the instructions in the installation guide of the mounting system.

Provide adequate rear ventilation

For proper operation and to avoid damage from condensation, the module requires an adequate flow of air across the rear surface. When installing the module, ensure that there is sufficient distance between the rear of the module and the mounting surface. For roof-mounted modules, the minimum distance between the roof and the modules should be 5 cm (2 in).

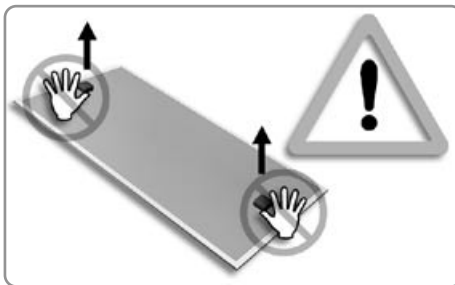


Unpacking and handling the module

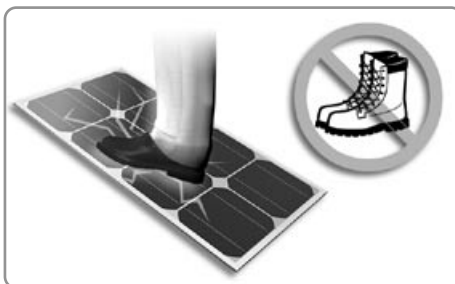
- ▶ Leave the module in its package until you are ready to install it.



- ▶ When installing or working with module or wiring, cover module face completely with opaque material (e.g. cardboard packaging) to halt production of electricity. These precautions are not necessary if the module is fitted with a connecting cable and a shock proof plug connector.
- ▶ Do not use the attached junction box to hold or transport the module.



- ▶ Do not stand or step on module.



- ▶ Do not drop module or allow objects to fall on module.



- ▶ To avoid glass breakage and damage to the module, do not place any heavy objects on the module or on its rear surface. Avoid setting the module down hard on any surface, particularly when placing it on a corner. Do not lay the module on an uneven surface. If the glass of the module is broken, it cannot be used.



- ▶ Do not carry out installation work for modules on roofs or buildings when there are strong winds. There is also a risk of damage or injury from wind forces when lifting or moving support frames with several attached modules.



Electrical Installation

There are many different applications for photovoltaic solar energy systems. This guide describes some of the most important typical uses as representative examples.

Off-grid electrical system with battery storage using a charge regulator

Solar power systems are frequently used to supply electrical power to technical equipment, remote cottages and hunting cabins, camping vehicles and boats. In such systems, the photovoltaic system charges a storage battery via a charging regulator. The charging regulator controls the charging process in order to protect the battery against overcharging and ensure long battery life. If necessary, an inverter can be used to provide electrical power from the storage battery to equipment operating at the normal mains voltage.

Off-grid electrical system with battery storage using a self-regulating module

When a self-regulating module is used, it is not necessary to use a charging regulator. The charging current provided by the self-regulating module depends on the charge state of the battery and decreases as the battery voltage increases. This means that during daylight hours, the charging current automatically adjusts to suit the charge state of the battery and the power consumption of the connected loads.



▶ When using a self-regulating module, make sure there is sufficient battery capacity.

In the dark a small current could flow from the battery and through the module. This can reduce the state of charge of the battery during the night. To eliminate this reverse

current, connect a “blocking diode” in series between the solar module and the battery. Use a diode that is specified for a current that is at least 1.5 times more than the maximum current generated by the module. Mount the diode in such a way that allows for proper cooling of this device. Please check with your dealer for an appropriate diode type.

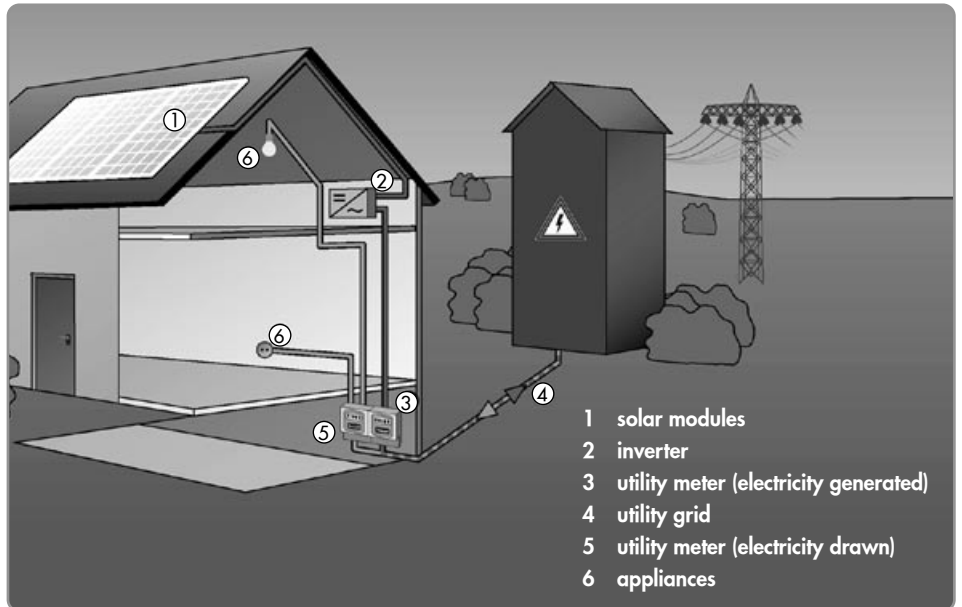
Grid-connected electrical system

For this purpose, the electrical energy generated by the solar power system is supplied to the public electricity grid.

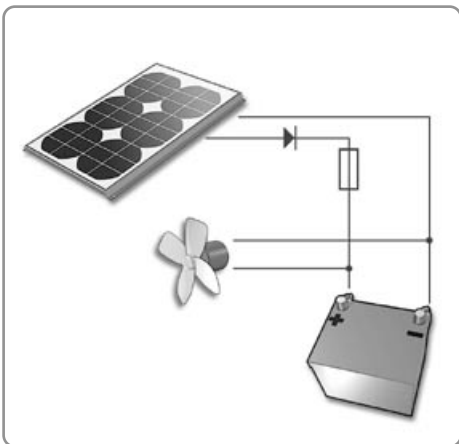
The structure and dimensioning of the system vary from system to system. Usually, several

modules are connected in series to form a block, and several blocks are connected in parallel to a network inverter that links the photovoltaic solar power system to the public electricity grid. The amount of power fed into the public electricity grid can be measured using a supplementary meter. See “Comparison of series and parallel wiring”, page 8.

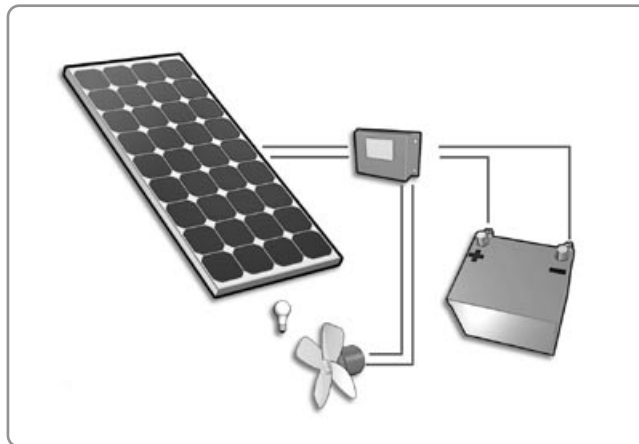
The amount of compensation paid for the power fed into the public electricity grid depends on contractual agreements with electricity companies and statutory provisions. A permit is always required for any system coupled to the public electricity grid, and such a system must be formally approved and accepted by an authorised expert.



Typical Photovoltaic system coupled to the public electricity grid



Typical off-grid electrical system with battery storage using a self-regulating module



Off-grid electrical system with battery storage using a charge regulator

Comparison of series and parallel wiring

For applications with a *high operating voltage*, several photovoltaic modules can be connected in series:

$$V_{\text{total}} = V_1 + V_2 + V_n$$
$$I_{\text{total}} = I_1 = I_2 = I_n$$

A photovoltaic system with a high open-circuit voltage is suitable for use with a battery storage system having an operating voltage of 48 V or more.



▶ The maximum open-circuit voltage of the system must not be greater than the specified maximum system voltage for the module.

- ▶ There is an increased risk of short circuits and arcing with high DC voltages. Use adequately insulated wiring and connectors that are approved for use at the maximum open-circuit voltage.

For applications with a *high current consumption*, several photovoltaic modules can be connected in parallel:

$$I_{\text{total}} = I_1 + I_2 + I_n$$
$$V_{\text{total}} = V_1 = V_2 = V_n$$

A parallel wiring is suitable for use in systems containing low-voltage loads with high power consumption, or for optimising the charging process with high-capacity battery storage systems.

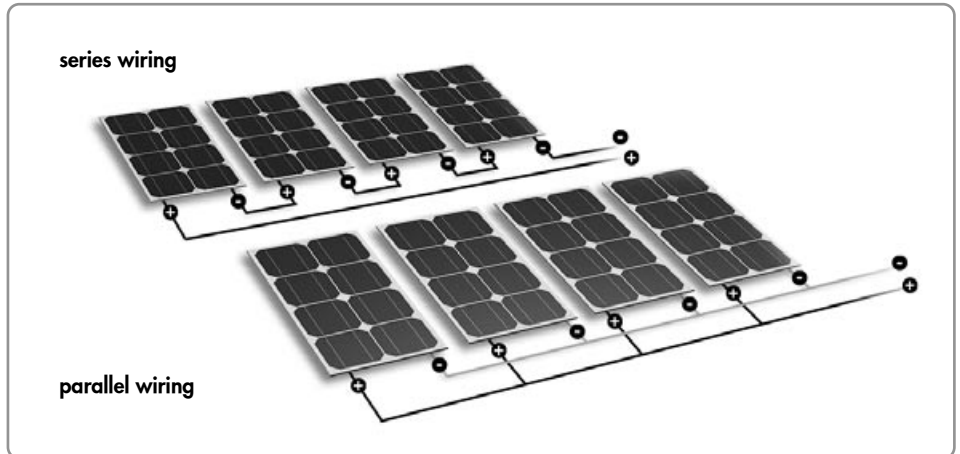


▶ The wiring and connectors can become overheated at high currents. Use wiring with suitable cross-sectional areas and connectors that are approved for use at the maximum short-circuit current. Observe the manufacturer's instructions and local electrical code.

- ▶ It is recommended to use additional junction boxes when connecting several modules in parallel. Modules with conduit ready (CR) ProCharger™ junction boxes can be directly connected in parallel.

Use suitable solar-power wiring

Modules supplied with pre-assembled cables can easily be connected to other modules or matching electrical components, such as charge regulators or inverters, using plug connectors.



If you select or assemble your own wiring for a photovoltaic solar power system, please observe the following points:

- ▶ Use only wiring material that is specifically intended to be used in photovoltaic solar power systems.
- ▶ At extreme low temperatures the cable should be handled with more than usual care.
- ▶ Select wiring material with insulation that is UV-resistant and weatherproof. It should have a rated voltage of at least 600 V.
- ▶ The cross-sectional area of the (stranded) conductor depends on the maximum short-circuit current and the overall length of the wiring.
- ▶ If you use multi-conductor cable, the insulation of the individual conductors must be resistant to damage resulting from movement

Typically, conductors with a cross-sectional area of at least 2.5 mm² are used, although 4 mm² is recommended. Shell Solar recommends using wiring specially designed for solar power systems. Ask your dealer to recommend manufacturers that can provide cables with connectors made to meet your requirements.

Use suitable connectors

If you select or assemble connectors for a photovoltaic solar power system, please observe the following points:

- ▶ Use only connectors that are specifically intended to be used in photovoltaic solar power systems.
- ▶ Use the tools recommended or prescribed by the connector manufacturer for assembling connectors.
- ▶ Do not unplug a connector while the circuit is under load. It is OK to unplug a connector while the circuit is 'live'.

- ▶ Use protective caps to guard loose connectors against the effects of weather.

Special connectors for solar power system are commercially available - ask your dealer.

Installing solar-power wiring

Correctly installed wiring assures reliable long-term operation of the photovoltaic solar power system. Please observe the following:

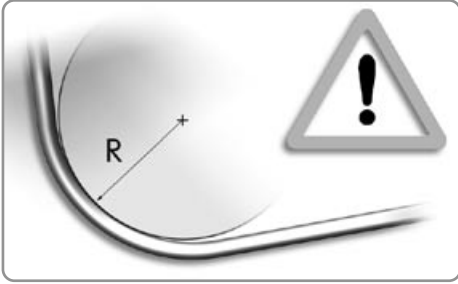
- ▶ Keep cable length as short as possible to reduce efficiency / voltage drop.
- ▶ If you connect several modules together, secure the wiring to the support frame.
- ▶ Where possible, use suitable fasteners to restrict the range of motion of loose sections of wiring.



- ▶ Avoid running wiring over sharp edges.



- ▶ Observe the allowable minimum bending radius for the type of wire used.



- ▶ Never open electrical connections or unplug connectors while the circuit is under load.



- ▶ Cable conduits should be used in locations where the wiring is accessible to children or small animals.



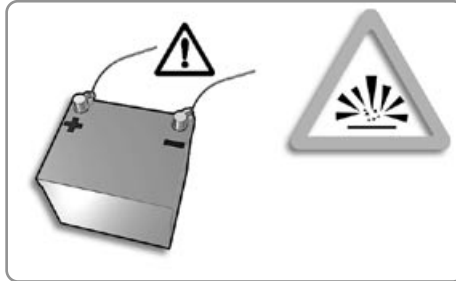
Electrical connections to the module



- ▶ Fully cover the module with an opaque material during mechanical and electrical installation.

- ▶ Protect the wiring against damage.
- ▶ Grounding must be performed in compliance with all national standards and regulations (see "Selecting the proper support frame", page 4).

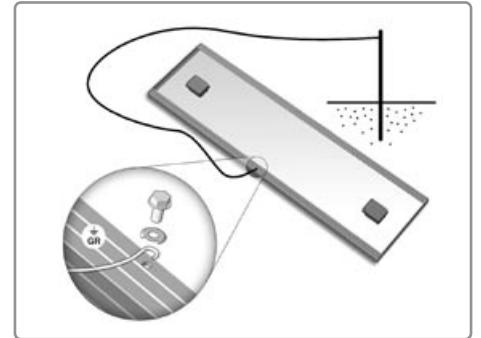
- ▶ Connecting a module to a battery with the leads reversed (reversed polarity) can cause:
 - damage to the bypass diode in the module,
 - a risk of explosion due to excessive gas generation in the battery.



Grounding

Ground the modules and the support frame. Modules with frames have a predrilled hole in the lateral frame member for fitting a No. 10 self-threading clamping screw and washer. [USA]

- ▶ If the ground wire is not fitted with a ring lug, first insert the clamping screw with the dished washer into the drilled hole.
- ▶ Strip 16 mm of insulation from the end of the conductor, and pass the bare wire between the head of the screw and the washer.
- ▶ Finally, tighten the screw.



Correct connection of the grounding wire [USA]

Junction box arrangements



ProCharger™ CR junction box, see page 10.
Note, some CR boxes do not have the "handle" configuration as shown here.



Spelsberg S junction box, see page 11.
Note, some S junction boxes have 2 cable glands.



ProCharger™ S junction box, see page 11.



ProCharger™ terminal cover, see page 12.

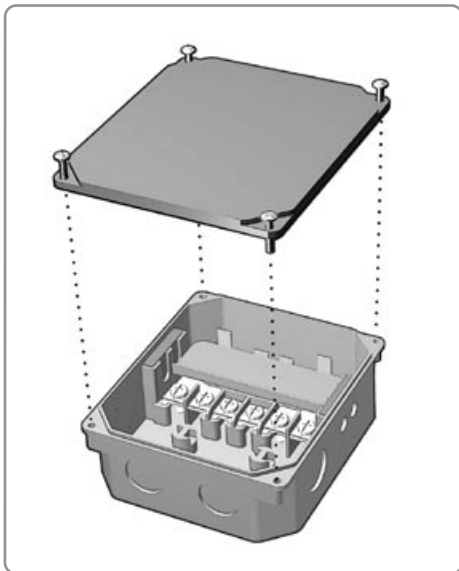
Installing a ProCharger™ CR junction box



Match the polarities of the cables and terminals when making the connections.

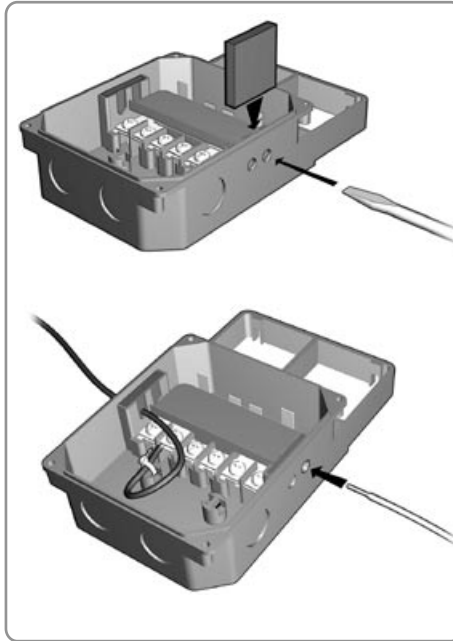
Opening the junction box

- ▶ The ProCharger™ - CR junction box has four captive screws that secure the lid to the base. To remove the lid, loosen the screws with a small flat or Phillips screwdriver.
- ▶ Once wiring is complete, install the junction box lid and tighten screws to 0.5 - 0.7 Nm (4 - 6 in-lb.). Caution, **DO NOT OVERTIGHTEN** the lid screws.
- ▶ Do not use sealant to bond lid to its base.



Wiring

- ▶ Remove the knockout plug from the entry by carefully punching it out with a screwdriver.
- ▶ Slide the foam seal into the cavity behind the cable entry and press it down using a screwdriver.
- ▶ Strip 16 mm of insulation from the end of the wire. Wire size must range from 8 AWG - 14 AWG (1.5-10 mm²)
- ▶ Pass *only one* wire through the wire entry by pressing it through the foam seal.
- ▶ Route the wire around the strain relief, and then pass the bare end between the clamping plate and the washer of the screw. Tighten the screw to a maximum torque of 2.3 Nm.



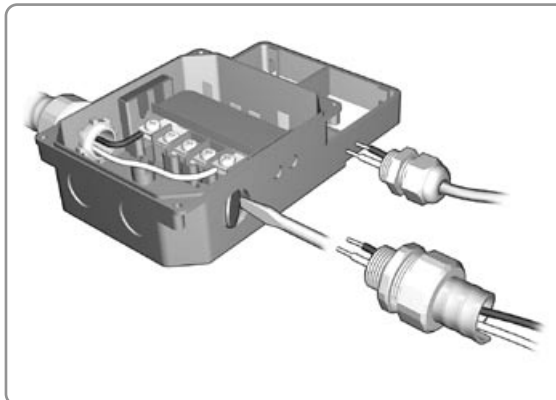
Wiring ProCharger™ CR cable junction box

Waterproof ½" cable fitting or conduit fitting

You will need a UL-approved ½" cable fitting. Refer to the manufacturer's instructions.

- ▶ Remove the knockout plug by placing the tip of a screwdriver at the edge of the plug and striking the screwdriver with a hammer.
- ▶ Attach the fitting to the junction box and leave it loose.
- ▶ Pass the wire through the fitting and route it to a terminal. Be careful to select the proper polarity.
- ▶ Insert the wires between the clamping plates and the washer of the screw. Tighten the screw to a maximum torque of 2.3 Nm.
- ▶ Tighten the fitting.

The same procedure should be used for a conduit fitting.



Waterproof ½" cable fitting or conduit fitting

Interconnecting several modules with ProCharger™ cable junction boxes



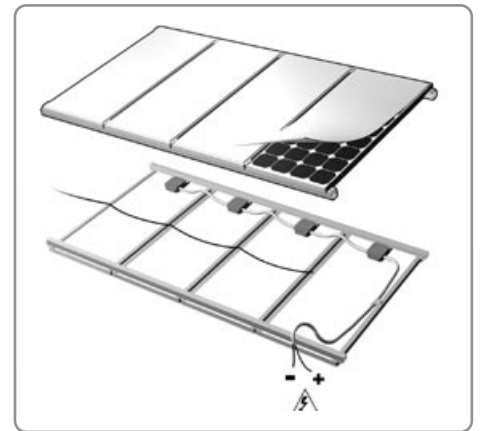
Use conduit fittings in all places where the wiring is accessible to children or small animals.

Series circuit:

- ▶ Connect the negative terminal of each module to the positive terminal of its adjacent module.
- ▶ Fasten loose lengths of wiring using UV- and weather-resistant cable clamps.
- ▶ At the first and last modules in the series, replace the regular cable fitting for the wire leading away from the module with a conduit fitting. To remove the fitting, loosen its lock nut.
- ▶ If a regular cable fitting is present at the first and last modules of the series, replace it with a conduit fitting.

Parallel circuit see "Comparison of series and parallel wiring", page 8.

Use a conduit fitting that can be used to route the cable leading from each module group connected in parallel.



Cover the module with an opaque material during installation

After making the electrical connections ...

- ▶ Replace the covers on the junction boxes and carefully tighten the four retaining screws (0.5-0.7 Nm). Do not apply any supplementary sealant to the junction boxes.

Connecting modules with ProCharger™-S junction boxes



Always check the polarity of the cables and the junction box terminals.

Opening the junction box

- ▶ To open the junction box, use a Philips screwdriver to loosen the retaining screws.

Versions

Junction box with a single terminal (single pole).

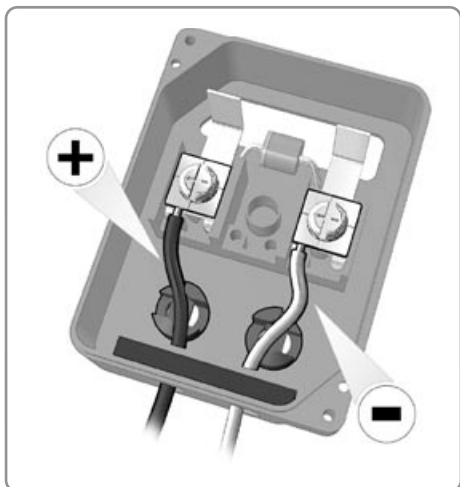


Do not remove the plastic cover from the unused terminal.



ProCharger™-S-junction box with a single terminal

Junction box with two terminals (dual pole).



ProCharger™-S-junction box with two terminals

Wiring

- ▶ Strip 16 mm of insulation from the end of the wire. Wire size must range from 12 AWG - 16 AWG (1.5-4 mm²)
- ▶ Pass *only one* wire through the wire entry by pressing it through the foam seal.
- ▶ Pass the bare end between the clamping plate and the washer of the screw. Tighten the screw with a maximum torque of 2.3 Nm
- ▶ If strain relief is necessary, route the wire along the bracket, pass a short cable tie through the slot and secure the cable tie.

After making the electrical connections.....

- ▶ Replace the covers on the junction boxes and carefully tighten the four retaining screws (0.5-0.7 Nm). Do not apply any supplementary sealant to the junction boxes.



Wiring ProCharger™-S-junction box

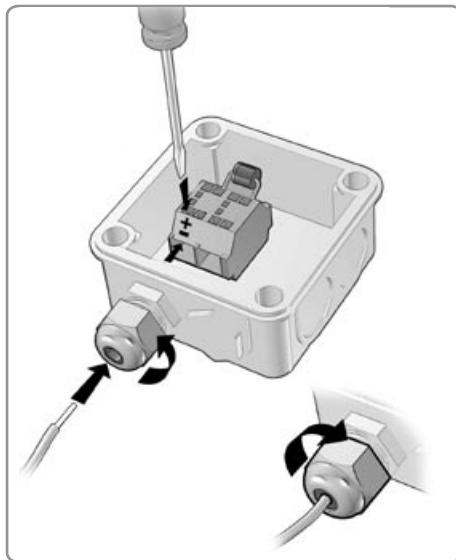
Connecting modules with Spelsberg junction boxes

Opening the junction box

- ▶ To open the junction box, use a flat-blade screwdriver to loosen the retaining screws.

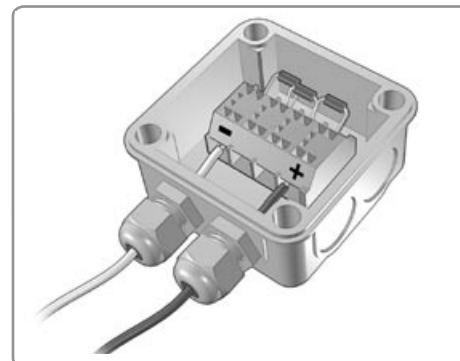
Versions

Junction box with a single terminal (single pole).



Spelsberg-junction box with a single terminal

Junction box with two terminals (both poles).



Spelsberg-junction box with two terminals

Wiring

- ▶ Strip 16 mm of insulation from the end of the wire.
- ▶ Loosen the nut of the cable fitting.
- ▶ Pass the wire through the fitting and route it to the terminal. Pay attention to the polarity.
- ▶ Using a small flat-blade screwdriver, press down on the terminal clamp. Feed the end of the wire into the opening in the terminal.
- ▶ Tighten the nut of the cable fitting.

After making the electrical connections...

- ▶ Replace the covers on the junction boxes and carefully tighten the four retaining screws (0.5-0.7 Nm). Do not apply any supplementary sealant to the junction boxes.

Commissioning and Maintenance

Connecting modules with permanently attached cables but no plug connectors (ProCharger™ junction box cover)

Crimp-type connectors are recommended. If spliced joins are used, they should be soldered, and they must be protected against corrosion and short circuits with insulating tape.

For more detailed information, refer to:
▶ 'Installing solar power wiring' (page 8)



Modules with permanently attached cables may only be connected in parallel. Never connect such modules in series.

Blocking diodes

Blocking diodes prevent current from flowing from the battery to the module when no electricity is being generated. It is recommended to use blocking diodes when a charging regulator is not used. Your specialist dealer can advise you with regard to suitable types, such as Schottky diodes.

If it is necessary to connect modules in parallel within a series circuit, the integrated diodes will not be able to equally distribute the current. In this case, a supplementary blocking diode must be used as follows:

- ▶ Connect the modules in parallel, and connect a large external diode across the parallel group
- ▶ Fit a heat sink to the diode.

Bypass Diodes

In systems with more than two modules in series high currents can flow through cells in the reverse direction in the case of partial shading (where part of a module is shaded and the rest is exposed to the sun). These currents can cause the affected cells to get very hot and could even damage the module. To protect modules from such high reverse currents, bypass diodes are used. All Shell modules rated greater than 40 Watt have bypass diodes already integrated in the junction box.

In the unlikely event of diode failure, a replacement can easily be fitted.

Protect yourself against electrical shocks while commissioning and maintaining the solar power system. Refer to the precautions at the beginning of the 'Electrical Installation' section.

Testing, commissioning and troubleshooting

Test all electrical and electronic components of your system *before commissioning it*. Follow the instructions in the guides supplied with the components and equipment. Systems having a DC voltage greater than 120 V and systems coupled to the mains grid must be tested and formally approved by authorised technical specialists.

Testing modules connected in series before they are connected to the system

- ▶ Check the open-circuit voltage of every series circuit. The measured value should correspond to the sum of the open-circuit voltages of the individual modules. You will find the rated voltage in the technical specifications of the type of module used. If the measured value is significantly lower than the expected value, please proceed as described under 'Troubleshooting an excessively low voltage'.
- ▶ Check the short-circuit current of every series circuit with direct solar illumination. You will find the rated current in the technical specifications of the type of module used. The measured value can vary significantly, depending on weather conditions, the time of day and shading of the module.

Troubleshooting an excessively low voltage

Typical causes of this problem are improper connections at the terminals and defective bypass diodes.

- ▶ First, check all wiring connections.
- ▶ Check the open-circuit voltage of each module:
 - ▶ Fully cover the modules with an opaque material.
 - ▶ Disconnect the wiring at both terminals of the modules.
- ▶ Remove the opaque material from the module to be checked and measure the open-circuit voltage at its terminals. If the measured voltage is only half the rated value, this indicates a defective bypass diode. Refer to 'Testing and replacing bypass diodes'.

Modules with permanently attached cables can only be checked at the open end of the cable after it has been disconnected.

In the case of modules with CR cable junction boxes, do not disconnect the wires from the terminals. If the voltage across the terminals differs from the rated value by more than 5 percent, this indicates a bad electrical connection.

Maintenance

Shell Solar recommends the following maintenance in order to ensure optimum performance of the module:

- ▶ Clean the glass surfaces of the module as necessary. Always use water and a soft sponge or cloth for cleaning. A mild, non-abrasive cleaning agent can be used to remove stubborn dirt.
- ▶ Check the electrical and mechanical connections every six months to verify that they are clean, secure and undamaged.
- ▶ If any problems arise, have them be investigated by an authorised specialist.



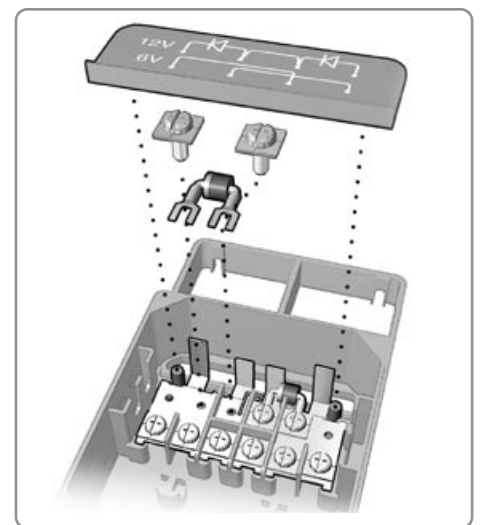
Observe the maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries etc.

Testing and replacing bypass diodes

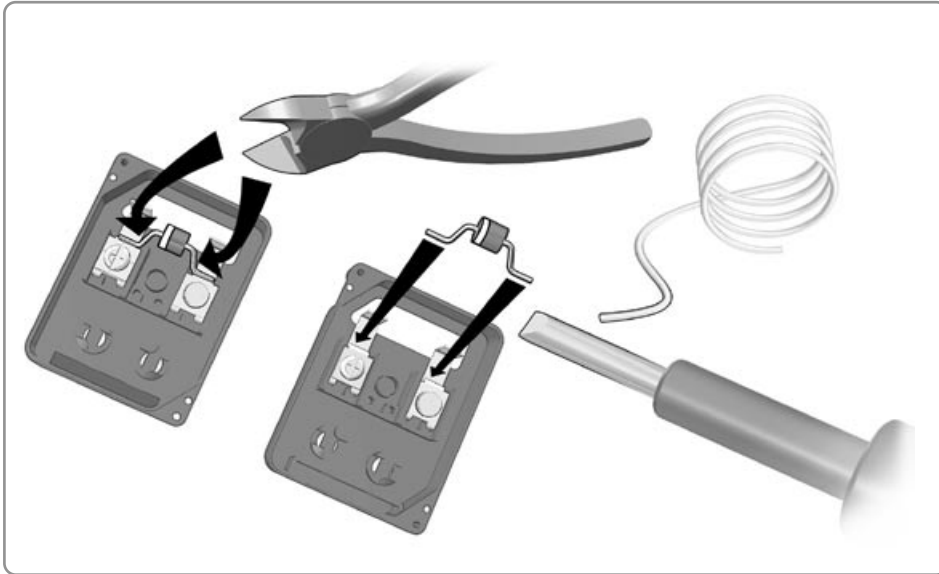
ProCharger™-CR junction box

The bypass diodes are located underneath a protective cover. The connections for 6-V and 12-V operation are shown on this cover.

- ▶ Lift off the cover by gently pulling up a corner of the cover with your finger.
- ▶ Remove the diodes by loosening the fastening screws. Note the orientations of the polarity markings on the diodes.



Replacing a bypass-diode in a ProCharger™-CR-junction box



Replacing a soldered bypass-diode in a ProCharger™-CR-junction box

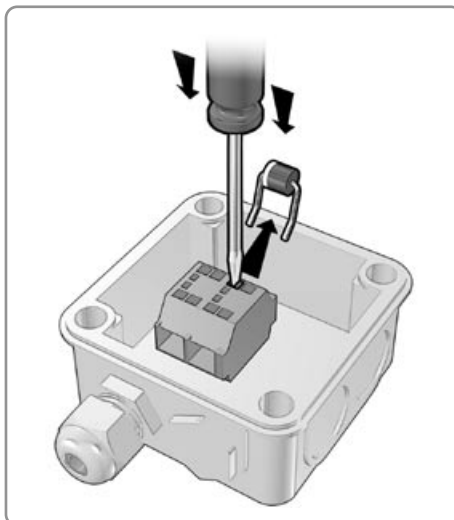
- ▶ Check the conductivity of the diodes. They should conduct electricity when the test leads are connected in one direction and show a high resistance in the other direction. If a diode conducts in both directions, it is defective.
- ▶ Replace a defective diode with a diode of the same type, and ensure that its polarity marking is oriented the same way as the original diode.
- ▶ Finally, check the open-circuit voltage of the module and replace both covers.

ProCharger™-S junction box

- ▶ Open the cover and remove the diodes by cutting their leads with a wire cutter. Note the orientations of the polarity markings on the diodes.
- ▶ Check the conductivity of the diodes. They should conduct electricity when the test leads are connected in one direction and show a high resistance in the other direction. If a diode conducts in both directions, it is defective.
- ▶ Replace a defective diode with a diode of the same type, and ensure that its polarity marking is oriented the same way as the original diode. Solder the leads of the diode to the contacts.
- ▶ Finally, check the open-circuit voltage of the module and close the cover.

Spelsberg junction box

- ▶ Open the cover, and remove the diodes by pressing on each terminal with a small flat-blade screwdriver and extracting the diode lead. Note the orientations of the polarity markings on the diodes.
- ▶ Check the conductivity of the diodes. They should conduct electricity when the test leads are connected in one direction and show a high resistance in the other direction. If a diode conducts in both directions, it is defective.
- ▶ Replace a defective diode with a diode of the same type, and ensure that its polarity marking is oriented the same way as the original diode.
- ▶ Finally, check the open-circuit voltage of the module and close the cover.



Replacing a bypass-diode in a Spelsberg-junction box

Disclaimer of Liability

Since the use of this manual and the conditions or methods of installation, operation, use and maintenance of the photovoltaic (PV) product are beyond Shell Solar's control, Shell Solar does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance.

No responsibility is assumed by Shell Solar for any infringement of patents or other rights of third parties, which may result from use of the PV product. No license is granted by implication or otherwise under any patent or patent rights.

The information in this manual is based on Shell Solar's knowledge and experience and is believed to be reliable; but such information including product specifications (without limitations) and suggestions do not constitute a warranty, expressed or implied. Shell Solar reserves the right to make changes to this manual, the PV product, the specifications, or product information sheets without prior notice.

SHELL SOLAR LIMITED WARRANTY FOR PV-MODULES

("Limited Warranty") – (Excluding U.S.)

General Version excluding U.S. valid as from 1 August 2003

1. Limited Product Warranty - Two Year Repair, Replacement or Refund Remedy

Shell Solar B.V. having its registered office at Amsterdam, the Netherlands ("Shell Solar") warrants its Photovoltaic modules ("PV-modules"), including field replaceable DC connector cable assemblies, to be free from defects in materials and workmanship under normal, application, installation, use and service conditions. If the PV-modules fail to conform to this warranty, then for a period ending twenty-four (24) months from date of sale to the original end-customer ("the Customer"), Shell Solar will, at its option, either repair or replace the product, or refund the purchase price as paid by the Customer ("Purchase Price"). The repair, replacement or refund remedy shall be the sole and exclusive remedy provided under the Limited Product Warranty and shall not extend beyond the twenty-four (24) month period set forth herein. This Limited Product Warranty does not warrant a specific power output, which shall be exclusively covered under clause 2 hereinafter (Limited Peak Power Warranty).

2. 'Limited Peak Power Warranty' - Limited Remedy A: 10 years

For the PV-modules (excluding the inverter/ converter) ST5, ST10, ST20, ST36, ST40, S10, S25, and S36 Shell Solar additionally warrants: If, within ten (10) years from date of sale to the Customer any PV-module(s) exhibits a power output less than 90% of the minimum Peak Power at STC as specified at the date of delivery in Shell Solar's Product Information Sheet, provided that such loss in power is determined by Shell Solar (at its sole and absolute discretion) to be due to defects in material or workmanship, Shell Solar will replace such loss in power by either providing to the Customer additional PV-modules to make up such loss in power, or by repairing or replacing the defective PV-module(s), or by refunding the Purchase Price taking into account a yearly depreciation of ten (10)% of the Purchase Price, at the option of Shell Solar.

B: 20 years

For the PV-modules (excluding the inverter/ converter) S60, S65, S70-C, S75-C, S105-C and S115-C Shell Solar additionally warrants: If, within (a) the first ten (10) years from date of sale to the Customer, any PV-module(s) exhibits a power output less than 90% of the minimum Peak Power at STC¹ as specified at the date of delivery in Shell Solar's Product Information Sheet, or (b), within a period of twenty (20) years from date of sale to the Customer any PV-module(s) exhibits a power output less than 80% of the minimum Peak Power at STC¹, provided that such loss in power is determined by Shell Solar (at its sole and absolute discretion) to be due to defects in material or workmanship, Shell Solar will replace such loss in power by either providing to the Customer additional PV-modules to make up such loss in power, or by repairing or replacing the defective PV-module(s), or by refunding the Purchase Price taking into account a yearly depreciation of five (5)% of the Purchase Price, at the option of Shell Solar.

C: 25 years

For the PV-modules (excluding the inverter/ converter) SM46, SM50, SM50-H, SM55, SM100-12, SM110-12, SM100-24, SM100-24C, SM110-24, SM110-24C, SP65, SP70, SP75, SP130, SP130-C, SP140, SP140-C, SP150, SP150-C, SQ70, SQ75, SQ80, SQ140-C, SQ150-C and SQ160-C Shell Solar additionally warrants: If, within (a) the first ten (10) years from date of sale to the Customer, any PV-module(s) exhibits a power output less than 90% of the minimum Peak Power at STC¹ as specified at the date of delivery in Shell Solar's Product Information Sheet, or (b), within a period of twenty-five (25) years from date of sale to

the Customer any PV-module(s) exhibits a power output less than 80% of the minimum Peak Power at STC¹, provided that such loss in power is determined by Shell Solar (at its sole and absolute discretion) to be due to defects in material or workmanship, Shell Solar will replace such loss in power by either providing to the Customer additional PV-modules to make up such loss in power, or by repairing or replacing the defective PV-module(s), or by refunding the Purchase Price taking into account a yearly depreciation of four (4)% of the Purchase Price, at the option of Shell Solar. The remedies set forth in this clause 2 shall be the sole and exclusive remedies provided under the Limited Peak Power Warranty.

3. Exclusions and limitations

- A. Warranty claims must in any event be filed within the applicable Warranty period.
- B. The Limited Warranties do not apply to any PV-modules which in Shell Solar's absolute judgement have been subjected to:
 - misuse, abuse, neglect or accident;
 - alteration, improper installation or application;
 - non-observance of Shell Solar's installation, users- and maintenance instructions;
 - repair or modifications by someone other than an approved service technician of Shell Solar;
 - power failure surges, lightning, flood, fire, accidental breakage or other events outside Shell Solar's control.
- C. The Limited Warranties do not cover any transportation costs for return of the PV-modules, or for reshipment of any repaired or replaced PV-modules, or cost associated with installation, removal or reinstallation of the PV-modules.
- D. When used in non-land based applications the Limited Peak Power Warranty, applying to any of the PV-modules shall be limited to ten (10) years as per the provisions of clause 2A hereof.
- E. Warranty claims will not be honoured if the type or serial number of the PV-modules have been altered, removed or made illegible.

4. Limitation of Warranty Scope

THE LIMITED WARRANTIES SET FORTH HEREIN ARE EXPRESSLY IN LIEU OF AND EXCLUDE ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR PARTICULAR PURPOSE, USE, OR APPLICATION, AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF SHELL SOLAR, UNLESS SUCH OTHER WARRANTIES, OBLIGATIONS OR LIABILITIES ARE EXPRESSLY AGREED TO IN WRITING SIGNED AND APPROVED BY SHELL SOLAR. SHELL SOLAR SHALL HAVE NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR DAMAGE OR INJURY TO PERSONS OR PROPERTY, OR FOR OTHER LOSS OR INJURY RESULTING FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR RELATED TO THE PRODUCT, INCLUDING, WITHOUT LIMITATION, ANY DEFECTS IN THE MODULE, OR FROM USE OR INSTALLATION. UNDER NO CIRCUMSTANCES SHALL SHELL SOLAR BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, HOWSOEVER CAUSED. LOSS OF USE, LOSS OF PROFITS, LOSS OF PRODUCTION, LOSS OF REVENUES ARE THEREFORE SPECIFICALLY BUT WITHOUT LIMITATION EXCLUDED.

SHELL SOLAR'S AGGREGATE LIABILITY, IF ANY, IN DAMAGES OR OTHERWISE, SHALL NOT EXCEED THE INVOICE VALUE AS PAID BY THE CUSTOMER, FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS THE SUBJECT OF CLAIM OR DISPUTE.

5. Obtaining Warranty Performance

If the Customer feels he/she has a justified claim covered by this Limited Warranty, he/she must immediately notify the (a) dealer, who sold the PV-modules, or (b) any authorised Shell Solar distributor, of the claim in writing, or (c) send such notification to Shell Solar (P.O. Box 38000, 1030 BN Amsterdam, the Netherlands) directly. Together with the notification Customer should enclose evidence of the date of sale on which the Solar Products have been purchased. If applicable, Customer's dealer or distributor will give advice on handling the claim. If further assistance is required, Customer is invited to write Shell Solar for instructions. The return of any PV-modules will not be accepted unless prior written authorisation has been given by Shell Solar.

6. Severability

If a part, provision or clause of this Limited Warranty, or the application thereof to any person or circumstance, is held invalid, void or unenforceable, such holding shall not affect and shall leave all other parts, provisions, clauses or applications of the Limited Warranty, and to this end such other parts, provisions, clauses or applications of this Limited Warranty shall be treated as severable.

7. Disputes

No action, regardless of form, arising out of or in any way connected with this Limited Warranty, may be brought by the Customer more than one (1) year after the cause of action has accrued.

8. Various

The repair or replacement of the PV-modules or the supply of additional PV-modules, does not cause the beginning of new warranty terms, nor shall the original terms of this Limited Warranty be extended. Any replaced PV-modules shall become the property of Shell Solar. Shell Solar has the right to deliver another type of PV-module (different in size, colour, shape and/or power) in case Shell Solar discontinued producing the PV-module in question at the time of the claim.

In the event that any of the PV-modules purchased by the Customer are not listed in this Limited Warranty, the Customer should contact Shell Solar for further information regarding the applicable warranties, if any.

9. Force Majeure

Shell Solar shall not be in any way be responsible or liable to the Customer or any third-party arising out of any non-performance or delay in performance of any terms and conditions of sale, including this Limited Warranty, due to acts of God, war, riots, strikes, unavailability of suitable and sufficient labour, material, die, or capacity or technical or yield failures and any unforeseen event beyond its control, including, without limitations, any technological or physical event or condition which is not reasonably known or understood at the time of the sale of the PV-modules or the claim.

¹ "Peak Power" is the power in watt peak that a PV-module generates in its maximum power point. "STC" are as follows (a) light spectrum of AM 1.5, (b) an irradiation of 1,000 W per m² and (c) a cell temperature of 25 degrees Centigrade. The measurements are carried out in accordance with IEC60904 as tested at the junction box terminals per the calibration and testing standards of Shell Solar valid at the date of manufacture of the PV-modules. Shell Solar's calibration standards shall be in compliance with the standards applied by international institutions accredited for this purpose.

SHELL SOLAR LIMITED WARRANTY FOR PV-MODULES

("Limited Warranty") – (U.S.)

General U.S. Version valid as of 1 August 2003

1. Limited Product Warranty – Two Year Repair, Replacement or Refund Remedy

Shell Solar Industries LP with offices at 4650 Adohr Lane, Camarillo, CA 93012 ("Shell Solar") warrants its Photovoltaic modules ("PV-modules"), including field replaceable DC connector cable assemblies, to be free from defects in materials and workmanship under normal, application, installation, use and service conditions. If the PV-modules fail to conform to this warranty, then for a period ending twenty-four (24) months from date of sale to the original end-customer ("the Customer"), Shell Solar will, at its option, either repair or replace the product, or refund the purchase price as paid by the Customer ("Purchase Price"). The repair, replacement or refund remedy shall be the sole and exclusive remedy provided under the Limited Product Warranty and shall not extend beyond the twenty-four (24) month period set forth herein. This Limited Product Warranty does not warrant a specific power output, which shall be exclusively covered under clause 2 hereinafter (Limited Peak Power Warranty).

2. 'Limited Peak Power Warranty' – Limited Remedy A: 10 years

For the PV-modules (excluding the inverter/converter) ST5, ST10, ST20, ST36, and ST40 Shell Solar additionally warrants:

If, within ten (10) years from date of sale to the Customer any PV-module(s) exhibits a power output less than 90% of the minimum Peak Power at STC¹ as specified at the date of delivery in Shell Solar's Product Information Sheet, provided that such loss in power is determined by Shell Solar (at its sole and absolute discretion) to be due to defects in material or workmanship, Shell Solar will replace such loss in power by either providing to the Customer additional PV-modules to make up such loss in power, or by repairing or replacing the defective PV-module(s), or by refunding the Purchase Price taking into account a yearly depreciation of ten (10)% of the Purchase Price, at the option of Shell Solar

B: 25 years

For the PV-modules (excluding the inverter/ converter), SM50H, SM55, SM110-12P, SM110-24P, SP70, SQ75, SP75, SQ80, SP140-P/PC, SP150-P/PC, SQ150-P/PC and SQ160-P/PC Shell Solar additionally warrants:

If, within (a) the first ten (10) years from date of sale to the Customer, any PV-module(s) exhibits a power output less than 90% of the minimum Peak Power at STC¹ as specified at the date of delivery in Shell Solar's Product Information Sheet, or (b), within a period of twenty-five (25) years from date of sale to the Customer any PV-module(s) exhibits a power output less than 80% of the minimum Peak Power at STC¹, provided that such loss in power is determined by Shell Solar (at its sole and absolute discretion) to be due to defects in material or workmanship, Shell Solar will replace such loss in power by either providing to the Customer additional PV-modules to make up such loss in power, or by repairing or replacing the defective PV-module(s), or by refunding the Purchase Price taking into account a yearly depreciation of four (4)% of the Purchase Price, at the option of Shell Solar.

The remedies set forth in this clause 2 shall be the sole and exclusive remedies provided under the Limited Peak Power Warranty.

3. Exclusions and limitations

- A. Warranty claims must in any event be filed within the applicable Warranty period.
- B. The Limited Warranties do not apply to any PV-modules which in Shell Solar's absolute judgement have been subjected to:
 - misuse, abuse, neglect or accident;
 - alteration, improper installation or application;
 - non-observance of Shell Solar's installation, users- and maintenance instructions;
 - repair or modifications by someone other than an approved service technician of Shell Solar;
 - power failure surges, lighting, flood, fire, accidental breakage or other events outside Shell Solar's control.
- C. The Limited Warranties do not cover any transportation costs for return of the PV-modules, or for reshipment of any repaired or replaced PV-modules, or cost associated with installation, removal or reinstallation of the PV-modules.
- D. When used in non-land based applications the Limited Peak Power Warranty, applying to any of the PV-modules shall be limited to ten (10) years as per the provisions of clause 2A hereof.
- E. Warranty claims will not be honored if the type or serial number of the PV-modules have been altered, removed or made illegible.

4. Limitation of Warranty Scope

THE LIMITED WARRANTIES SET FORTH HEREIN ARE EXPRESSLY IN LIEU OF AND EXCLUDE ALL OTHER EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND OF FITNESS FOR PARTICULAR PURPOSE, USE, OR APPLICATION, AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF SHELL SOLAR, UNLESS SUCH OTHER WARRANTIES, OBLIGATIONS OR LIABILITIES ARE EXPRESSLY AGREED TO IN WRITING SIGNED AND APPROVED BY SHELL SOLAR. SHELL SOLAR SHALL HAVE NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR DAMAGE OR INJURY TO PERSONS OR PROPERTY, OR FOR OTHER LOSS OR INJURY RESULTING FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR RELATED TO THE PRODUCT, INCLUDING, WITHOUT LIMITATION, ANY DEFECTS IN THE MODULE, OR FROM USE OR INSTALLATION. UNDER NO CIRCUMSTANCES SHALL SHELL SOLAR BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES, HOWSOEVER CAUSED. LOSS OF USE, LOSS OF PROFITS, LOSS OF PRODUCTION, LOSS OF REVENUES ARE THEREFORE SPECIFICALLY BUT WITHOUT LIMITATION EXCLUDED.

SHELL SOLAR'S AGGREGATE LIABILITY, IF ANY, IN DAMAGES OR OTHERWISE, SHALL NOT EXCEED THE INVOICE VALUE AS PAID BY THE CUSTOMER, FOR THE UNIT OF PRODUCT OR SERVICE FURNISHED OR TO BE FURNISHED, AS THE CASE MAY BE, WHICH IS THE SUBJECT OF CLAIM OR DISPUTE.

SOME STATES DO NOT ALLOW LIMITATIONS ON IMPLIED WARRANTIES OR THE EXCLUSION OF DAMAGES SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

5. Obtaining Warranty Performance

If the Customer feels he/she has a justified claim covered by this Limited Warranty, he/she must immediately notify the (a) dealer, who sold the PV-modules, or (b) any authorized Shell Solar distributor, of the claim in writing, or (c) send such notification to Shell Solar Industries LP (P.O. Box 6032, Camarillo, CA 93011) directly. Together with the notification Customer should enclose evidence of the date of sale on which the Solar Products have been purchased. If applicable, Customer's dealer or distributor will give advice on handling the claim. If further assistance is required, Customer is invited to write Shell Solar for instructions. The return of any PV-modules will not be accepted unless prior written authorization has been given by Shell Solar.

6. Severability

If a part, provision or clause of this Limited Warranty, or the application thereof to any person or circumstance, is held invalid, void or unenforceable, such holding shall not affect and shall leave all other parts, provisions, clauses or applications of this Limited Warranty, and to this end such other parts, provisions, clauses or applications of this Limited Warranty shall be treated as severable.

7. Disputes

No action, regardless of form, arising out of or in any way connected with this Limited Warranty, may be brought by the Customer more than one (1) year after the cause of action has accrued.

THIS LIMITED WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS; YOU MAY ALSO HAVE OTHER RIGHTS THAT VARY FROM STATE TO STATE.

8. Various

The repair or replacement of the PV-modules or the supply of additional PV-modules, does not cause the beginning of new warranty terms, nor shall the original terms of this Limited Warranty be extended. Any replaced PV-modules shall become the property of Shell Solar. Shell Solar has the right to deliver another type of PV-module (different in size, color, shape and/or power) in case Shell Solar discontinued producing the PV-module in question at the time of the claim.

9. Force Majeure

Shell Solar shall not be in any way be responsible or liable to the Customer or any third-party arising out of any non-performance or delay in performance of any terms and conditions of sale, including this Limited Warranty, due to acts of God, war, riots, strikes, unavailability of suitable and sufficient labor, material, die, or capacity or technical or yield failures and any unforeseen event beyond its control, including, without limitations, any technological or physical event or condition which is not reasonably known or understood at the time of the sale of the PV-modules or the claim.

¹ "Peak Power" is the power in watt peak that a PV-module generates in its maximum power point. "STC" are as follows (a) light spectrum of AM 1.5, (b) an irradiation of 1,000 W per m² and (c) a cell temperature of 25 degrees Centigrade. The measurements are carried out in accordance with IEC60904 as tested at the junction box terminals per the calibration and testing standards of Shell Solar valid at the date of manufacture of the PV-modules. Shell Solar's calibration standards shall be in compliance with the standards applied by international institutions accredited for this purpose.

Shell modules are recyclable.

Internet: www.shell.com/solar

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