

# Shell Solar

## General Installation Guide for Shell Solar Electric Modules - U.S. Version

**PLEASE READ THIS GUIDE COMPLETELY BEFORE INSTALLING OR USING THE SOLAR ELECTRIC MODULES**

### INTRODUCTION

This Guide contains application and safety information with which you should be familiar before using your Shell Solar electric module. Your authorized Shell Solar distributor or dealer can provide additional sizing and system design information if necessary.

If this product is being installed outside the U.S., please contact your nearest Shell Solar customer service center for a local version of the installation manual. The Shell Solar customer service center list is located at the end of this guide.

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### GENERAL INFORMATION

THE INSTALLATION OF MODULES REQUIRES A GREAT DEGREE OF SKILL AND SHOULD (IF DC VOLTAGE EXCEEDS 100V: *MUST*) ONLY BE PERFORMED BY A QUALIFIED LICENSED PROFESSIONAL, INCLUDING, WITHOUT LIMITATION, LICENSED

CONTRACTORS AND LICENSED ELECTRICIANS. 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.*

*Modules produce electricity when sunlight or other sources illuminate the front face. The voltage from a single module is not considered a shock hazard. When modules are connected in series, voltages are additive. When modules are connected in parallel, current is additive. Consequently, a multi-module system can produce high voltages and current which constitute an increased hazard and could cause serious injury or death.*

### GENERAL SAFETY Follow All Permit, Installation, and Inspection Requirements

- Before installing a module, contact appropriate authorities to determine permit, installation, and inspection requirements that should be followed. This should be done not only for installations in conjunction with buildings, but also for marine and motor vehicle applications for which additional requirements may apply.

- Electrically ground module(s) for all systems of any voltage (US only).

- If not otherwise specified, it is recommended that the latest National and International Electrical

Code requirements be followed.

- For roof mounted modules, special construction may be required to help provide proper installation. When installing modules on any structure above ground, avoid any possible falling safety hazards by following appropriate safety practice(s) and using required safety equipment. Both roof construction and module installation design have an effect on the fire resistance of the building. Improper installation may contribute to hazards in the event of fire. Additional devices such as ground fault, fuses, and disconnects may be required.

- Do not use modules of different configurations in the same system.

- Follow all safety precautions of other used components.

### Underwriters Laboratory Listing Information (US Only):

To satisfy the conditions of the UL Listing when installing the modules, be sure to:

1. Use only stranded or solid copper single-conductor type UF cable, rated sunlight resistant, for modules and module wiring that is exposed to weather.
2. Observe the requirements described by note under Electrical Characteristics in the Specifications section of this Guide.
3. Grounding of the module frame is required. When ground wires greater than No. 10 AWG are required, the installer will need to provide suitable terminal connectors to interface with the No.10 binding screw provided with each module.

### Table of Contents:

- 1 Cautions
- 2 Installation
- 4 Modules and Termination
- 5 ProCharger™ - CR/- CR Cable Junction Box (U.S.)
- 7 ProCharger™ - S Junction Box (U.S./Europe)
- 8 Spelsberg Junction Box (Europe)
- 9 Cable Termination (U.S./Europe)
- 10 Typical Battery Charging Systems
- 11 Maintenance, Testing, and Troubleshooting
- 12 Bypass Diode Test and Replacement
- 13 Specifications
- 15 Limited Warranty

## Cautions

- The word "module" as used in this Guide refers to one or more solar electric modules.

- Avoid electrical hazards when installing, wiring, operating and maintaining the module.

- A module generates DC electricity when exposed to sunlight or other light sources.

- It is recommended that the module remains packed in the box until time of installation.

- Do not touch terminals while module is exposed to light or during installation. Provide suitable guards to prevent contact with 30VDC or greater. As an added precaution, use properly insulated tools only.



- When installing or working with module or wiring, cover module face completely with opaque material to halt production of electricity.



- Work only under dry conditions, with a dry module and tools.



- Do not stand or step on module.



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



- Never leave a module unsupported or unsecured. If a module should fall, the glass can break. A module with broken glass cannot be repaired and must not be used.



- Keep back surface free from foreign objects.



- Since sparks may be produced, do not install module where flammable gases or vapors are present.



- Do not drill holes into module frame as it will void warranty.



- Avoid sharp edges.



- Do not artificially concentrate sunlight on the module.



- It must be assured that other system components do not generate any hazard of any mechanical or electrical nature to the module.

- **Module installation and operation should be performed by qualified personnel only. Children should not be allowed near the solar electric installation.**

- If not otherwise specified, it is recommended that requirements of the latest local, national or regional electrical codes be followed.

- Use module for its intended function only. Follow all module manufacturer's instructions. Do not disassemble the module, or remove any part or label installed by the manufacturer. Do not treat the back of the module with paint or adhesives.

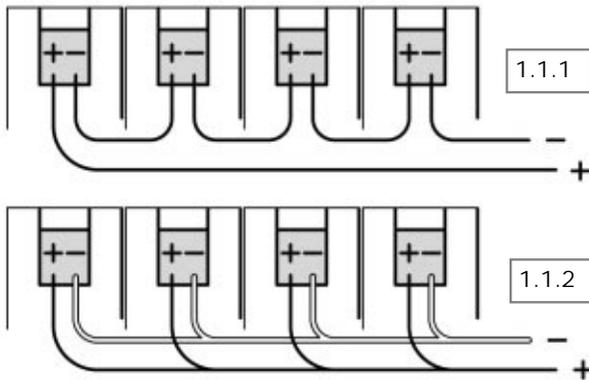
- Retain this instruction booklet for future reference.

**1.1 Series and Parallel Wiring**

Modules can be wired in series to increase voltage. Connect wires from the positive terminal of one module to the negative terminal of the next module. Illustration 1.1.1 shows four modules connected in series. **Caution: Do not connect Shell ST modules with wire terminations in series to increase voltage (see page 9).**

Connect modules in parallel to increase current. Connect wires from the positive terminal of one module to the positive terminal on the next module. Illustration 1.1.2 shows four modules connected in parallel.

**SERIES for more voltage**



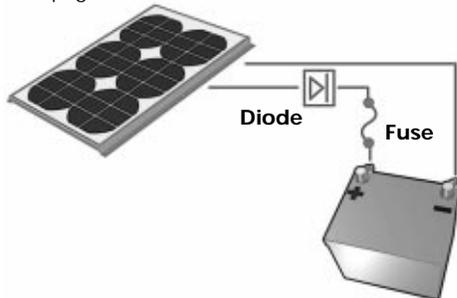
**PARALLEL for more current**

Note, it is recommended that paralleling modules be performed using an external junction box. However, a small number of modules may be paralleled using the junction box on the back of the modules. Contact your local reseller for more information.

**1.2 Direct Connection (for self-regulating and trickle charging modules only)**

Self-regulating and trickle charging modules used for battery maintenance can be wired directly to the battery. It is important to fuse the connection to the battery for safety. Refer to the module rating label (on module) for recommended fuse size. A blocking diode can be used to prevent the discharge of the battery through the solar module during dark periods, at night, or under covered storage.

See page 10 for further information.

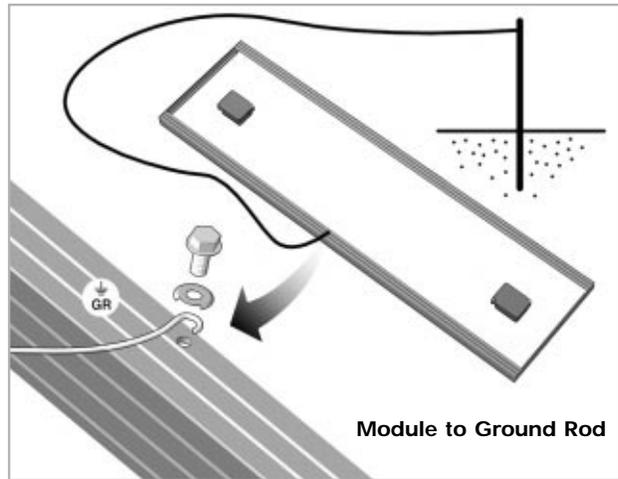


**1.3 Grounding**

Module frames should be connected to an earth ground for safety and protection from lightning. Modules greater than 20W are provided with a #10 binding screw, washer, and grounding location. The ground wire should be at least the same size as the electrical conductors.

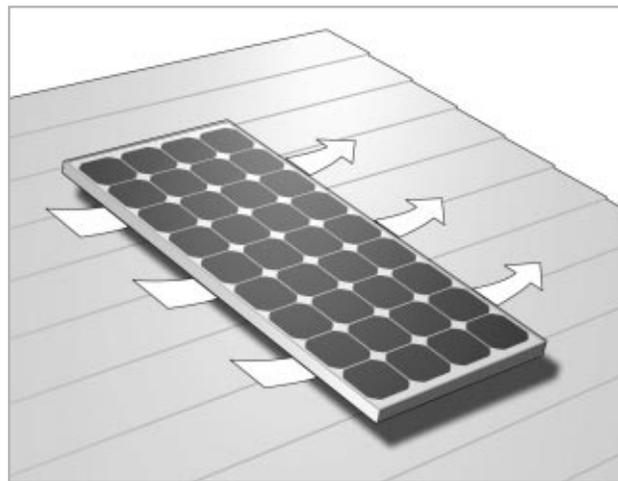
**US only: This assembly must be performed for a safe and proper installation. Other accessories provided are for optional use.**

The ground wire should also be attached to the support structure. Modules installed on RV's and boats do not require grounding.



**1.4 Air Circulation Under Module**

Sufficient clearance between the module frame and the mounting surface is required to allow cooling air to circulate around the back of the module. This also allows any condensation or moisture to dissipate.



### 1.5 Mounting and Determining Proper Module Tilt Angle

There are many types of mounting systems used to install Shell modules.

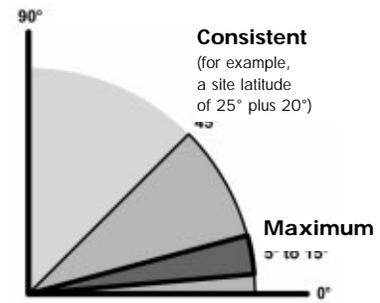
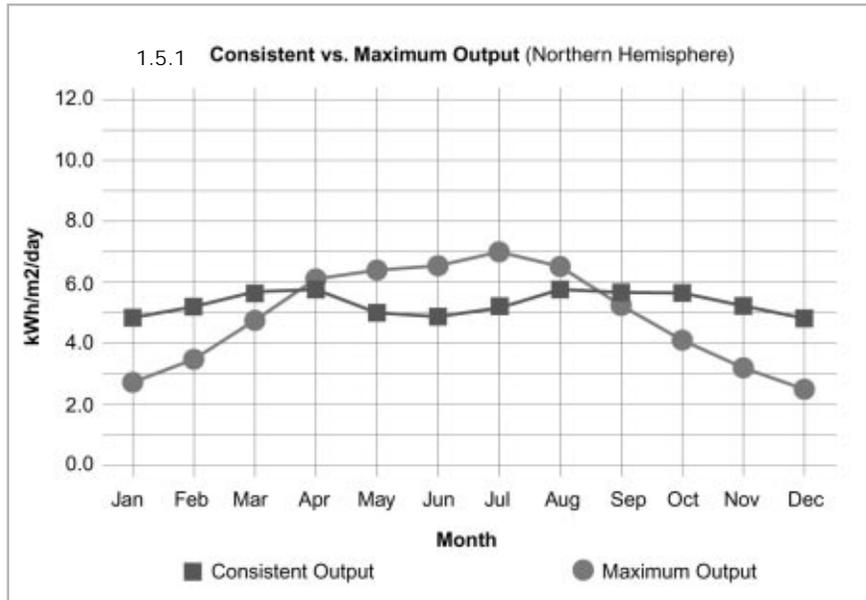
Modules should be firmly fixed in place in a manner suitable

to withstand all expected loads, including wind and snow loads. Modules should be mounted with the orientation and tilt angle required for

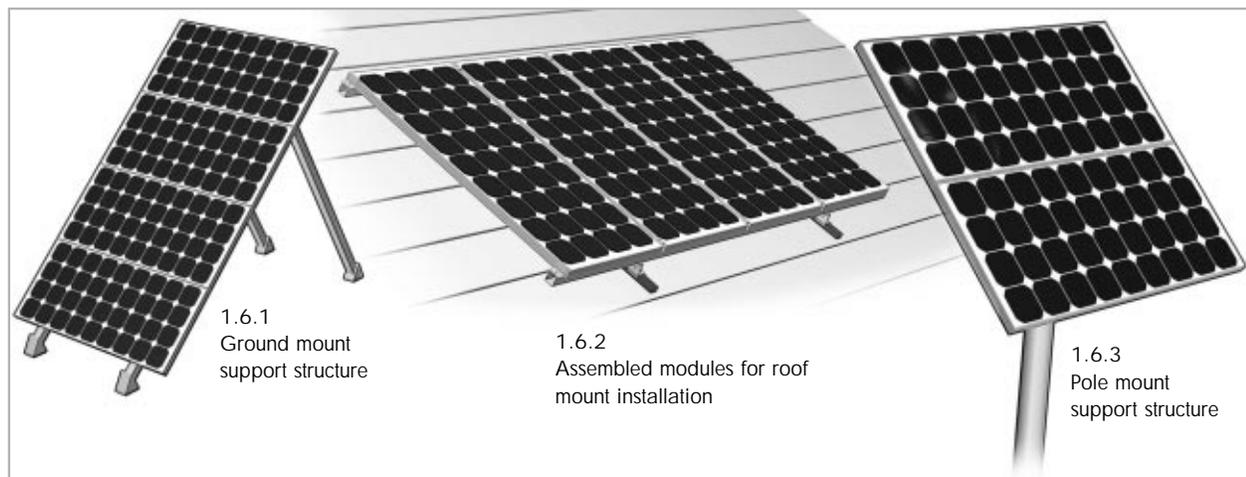
**consistent** performance (seasonally, yearly). The location should be selected to have direct access to sunlight from 9:00 a.m. to 3:00 p.m. on the shortest day of the year.

Calculate the tilt angle by using the site latitude plus 20 degrees, with modules facing south in the northern latitudes and north in the southern latitudes. This will result in **consistent** energy output throughout the year.

A tilt angle of 5 to 15 degrees will result in **maximum** energy output in the summer but less in the winter.



1.5.2



### 1.6 Typical Mounting Methods and Support Structures

The mounting structure must withstand all snow and wind forces. Module mounting holes are provided for easy installation and proper mechanical loading.

Do not drill additional mounting holes in the module frame as it will void the warranty. The use of proper mounting hardware is recommended to minimize the

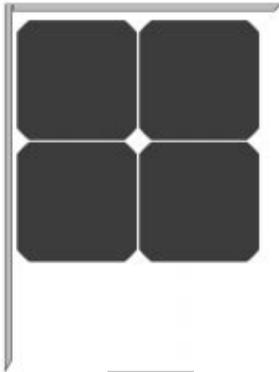
possibility of corrosion of the module frame, mounting structure, and hardware.

Contact your local dealer for information regarding

mounting structures and special mounting profiles for modules and laminates.

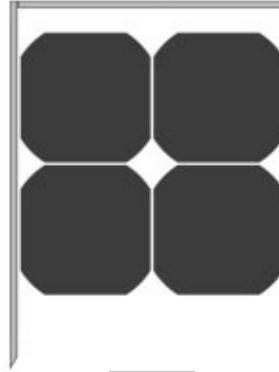
See page 13 for mounting hole information.

Module Types



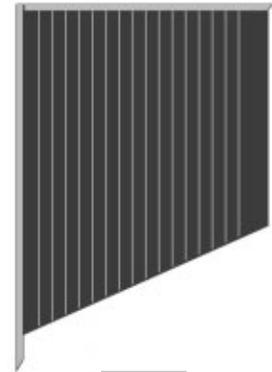
2.1

**Shell SM modules**  
use square cells.



2.2

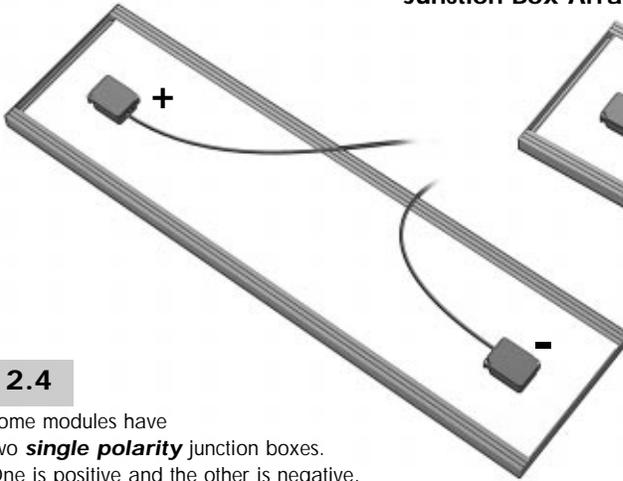
**Shell SP modules**  
use round cells with flat sides.



2.3

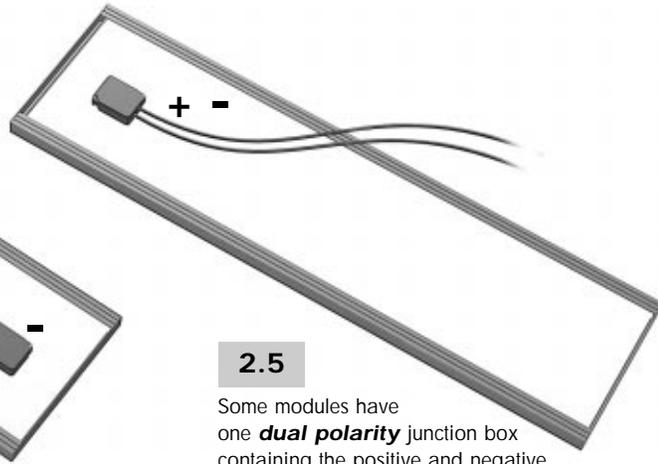
**Shell ST thin film modules**  
are dark and solid in appearance.

Junction Box Arrangements



2.4

Some modules have two **single polarity** junction boxes. One is positive and the other is negative.



2.5

Some modules have one **dual polarity** junction box containing the positive and negative connections.

Termination Types



2.6a

**ProCharger™  
CR Cable Junction  
(U.S.)**  
Type: CR Cable



2.6b

**ProCharger™  
CR Junction Box (U.S.)**  
Type: CR  
See Page 5  
Note, some CR boxes do not have the "handle" configuration as shown here.



2.7

**ProCharger™  
S Junction Box  
(U.S./Europe)**  
Type: S  
See Page 7



2.8

**Spelsberg  
Junction Box  
(Europe)**  
Type: SP  
See Page 8

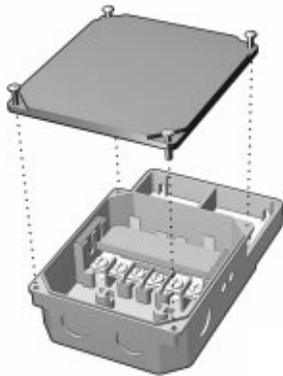


2.9

**ProCharger™  
Terminal Cover  
(U.S./Europe)**  
Type: Cable  
(for wire or cable terminations)  
See Page 9

### 3.1 Lid

3.1.1 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.



3.1.2 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.



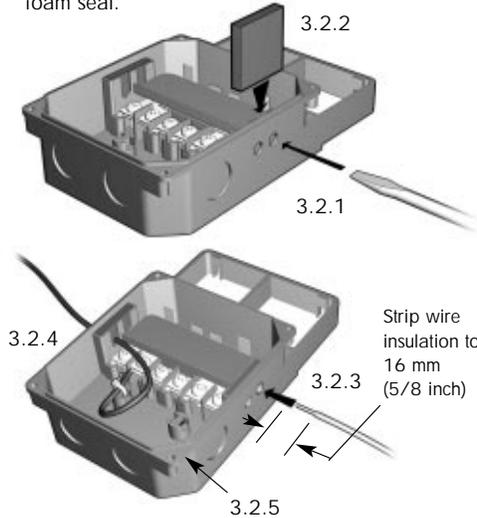
3.1.3 Do not use sealant to bond lid to its base.

### 3.2 For Connection of Individual Wires

3.2.1 Punch out a small knockout with a screwdriver. Remove any rough edges from the inside surface.

3.2.2 Slide foam seal into slot.

3.2.3 Push wire through hole and foam seal. An awl or other sharp tool can be used to pierce through the foam seal.



3.2.4 Connect wire to terminal screw. Tighten screw to 2.3 Nm (20 in-lb.).

3.2.5 Two strain relief posts are provided to secure the wires to the junction box. Slide a cable tie through the slot in the strain relief post and wrap around the wire.

### 3.3 Connection of 1/2 inch Conduit or Cable Fittings

• 3.3.1 Punch out the large knockout with a screwdriver. Remove any rough edges from the inside surface.

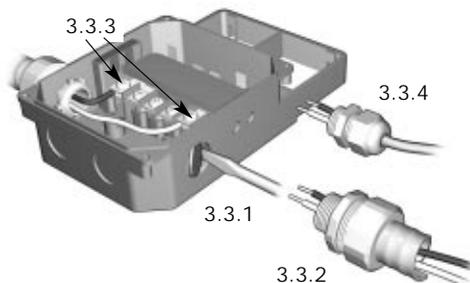
• 3.3.2 Insert conduit fitting and secure with locknut.

Follow the applicable codes for outdoor installation of wires in conduits.

• 3.3.3 Connect the positive wire to a positive terminal screw and the negative wire to a negative terminal screw. Tighten terminal screws to 2.3 Nm (20 in-lb.).

• 3.3.4 Use the same process when using cable fittings.

Note: Use of a UL recognized liquid tight 1/2 inch fitting is required to seal and strain relieve the wire/cable installed.



Check local codes regarding appropriate wire type required.

### 3.35 Connection of modules which use the ProCharger™ CR Cable Junction Box

• 3.35.1 Series connections between modules is made by plugging together the positive and negative DC connectors as shown in figure 3.35.1. Negative connector needs to be fully inserted into positive connector. Any loose cables should be securely fastened to either the module or mounting hardware to avoid cable damage, UV resistant or stainless steel cable ties can be used.

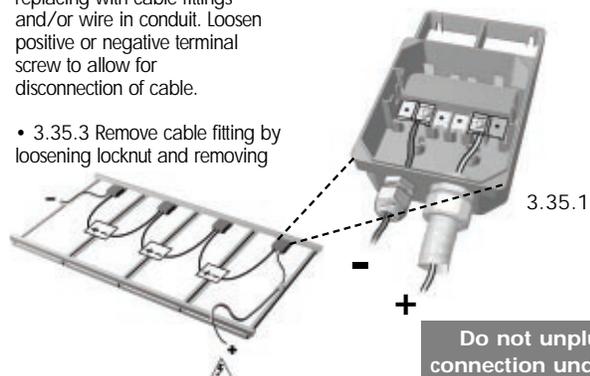
• 3.35.2 Final module run connection should be made by removing factory installed cable/DC connector and replacing with cable fittings and/or wire in conduit. Loosen positive or negative terminal screw to allow for disconnection of cable.

• 3.35.3 Remove cable fitting by loosening locknut and removing

• 3.35.4 Replace wiring connection with either 1/2" conduit or cable fitting by following section 3.3 for connection of 1/2" conduit or cable fitting. Completed final module run connections shown in figure 3.35.1.

• 3.35.5 When wiring modules or module strings in parallel, final run connections should be connected in parallel in a separate code compliant junction box.

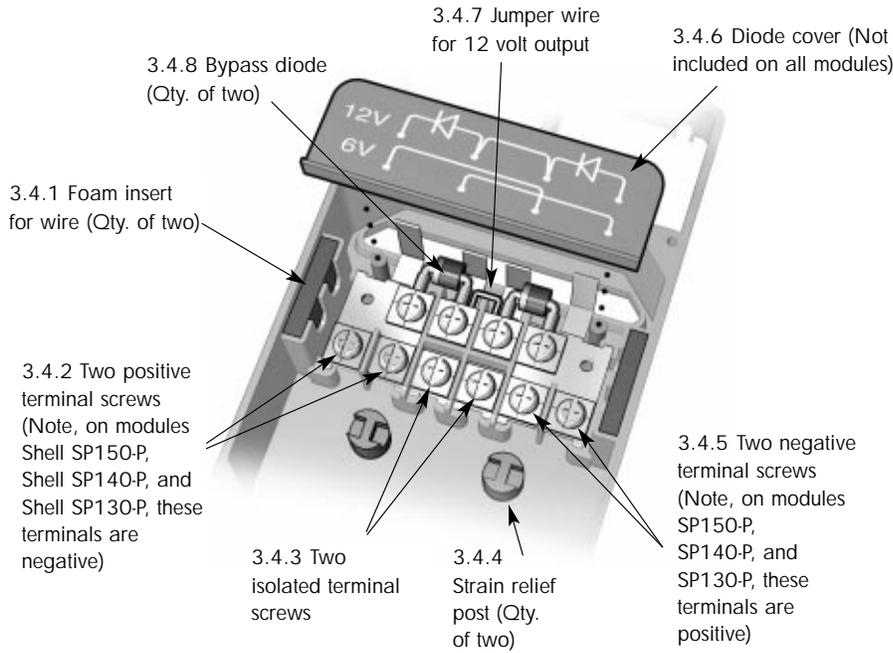
• 3.35.6 Shell Solar recommends use of conduit whenever wiring is accessible by unsupervised children or pets.



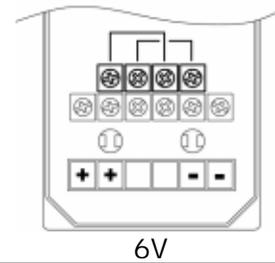
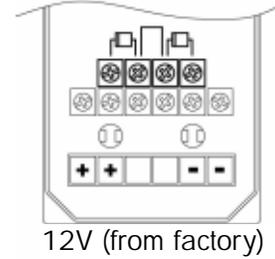
Do not unplug DC connection under load!

**3.4 Component Description**

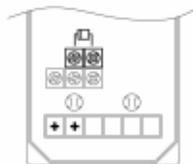
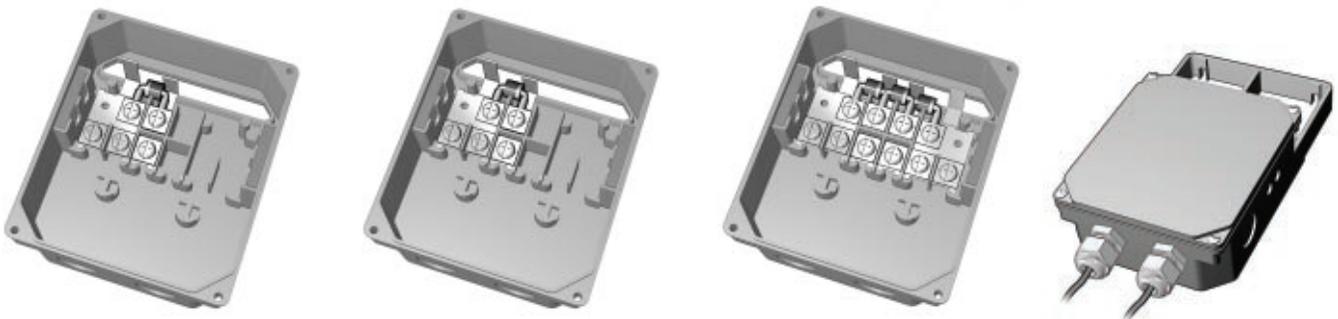
(The configuration shown here is used in the Shell SP65, Shell SP70, Shell SP75)



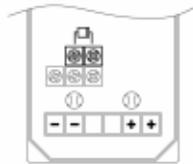
**3.5** Modules with this junction box (Shell SP65/70/75 only) are configured for 12 volts from the factory. Remove the diodes and install the large jumpers for 6 volt configuration. Jumpers must not touch each other. See Page 12 for removal of diode cover and diodes.



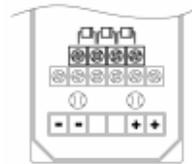
**3.6 Other Arrangements**



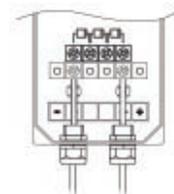
3.6.1 Single Polarity - Positive



3.6.2 Single Polarity - Negative



3.6.3 Dual Polarity - 24V Modules



3.6.4 Dual Polarity - 24V CR Cable

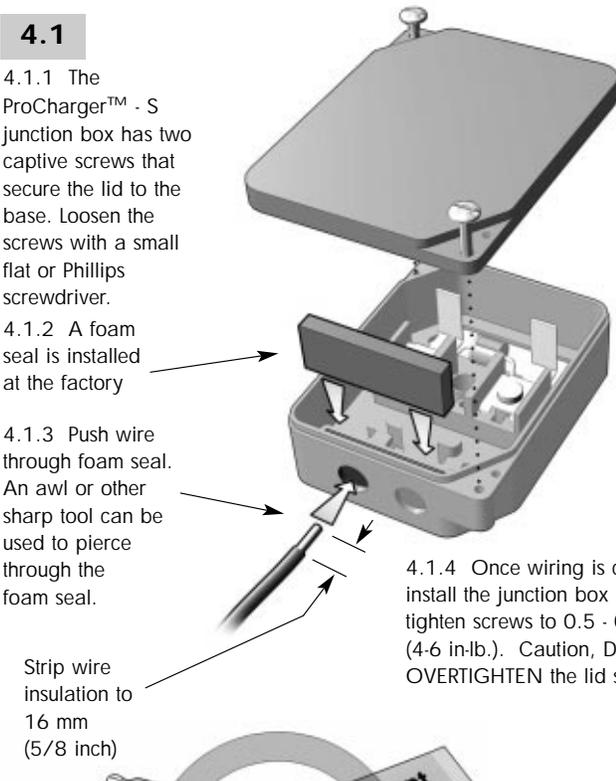
**4.1**

4.1.1 The ProCharger™ - S junction box has two captive screws that secure the lid to the base. Loosen the screws with a small flat or Phillips screwdriver.

4.1.2 A foam seal is installed at the factory

4.1.3 Push wire through foam seal. An awl or other sharp tool can be used to pierce through the foam seal.

Strip wire insulation to 16 mm (5/8 inch)



4.1.4 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.

4.1.5 Do not use sealant to bond lid to its base.

**4.2 Single Polarity Versions**

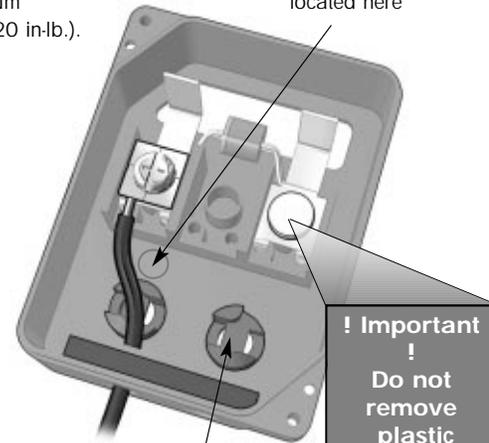
4.2.1 Push the positive wire through the left hole, through the foam seal, and connect to the left terminal screw labeled (+).

OR

Push the negative wire through the left hole, through the foam seal, and connect to the left terminal screw labeled (-).

Tighten terminal screws to 2.3 Nm (20 in-lb.).

4.2.2 Polarity symbol located here



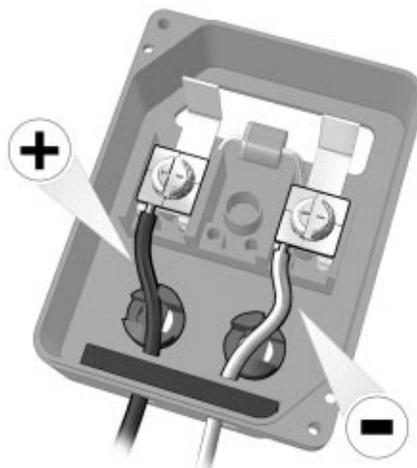
4.2.3 Strain relief post (Qty. of two)

**! Important !**  
Do not remove plastic plug. Removal of plug will void warranty.

**4.3 Dual Polarity Versions**

Dual polarity versions have 2 screw terminals labeled (+) and (-). Push the positive wire through the left hole, through the foam seal, and connect to the left terminal screw labeled (+). Push the negative wire through the right hole, through the foam seal, and connect to the right terminal screw labeled (-).

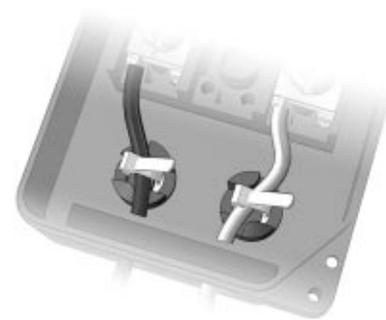
Tighten terminal screws to 2.3 Nm (20 in-lb.).



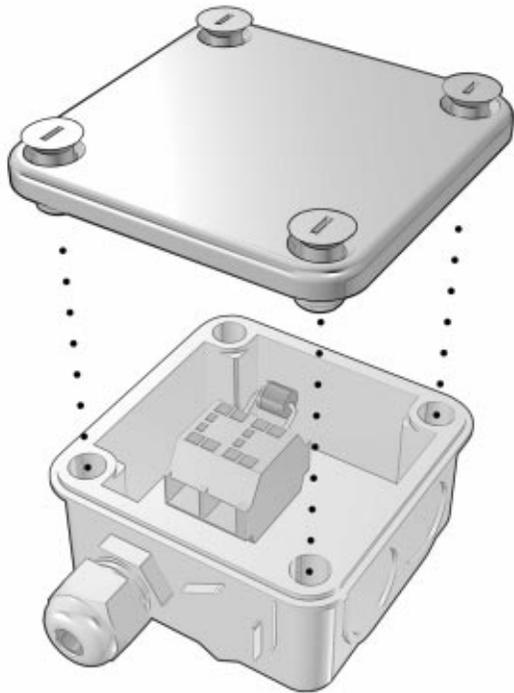
Check local codes regarding appropriate wire type required.

**4.4 Strain Relief**

Two strain relief posts are provided to secure the wire to the junction box. Route wires through the strain relief posts and then slide a cable tie through the slot in the post and wrap around the wire.



- 5.1** The Spelsberg junction box has four captive screws that secure the lid to the base. Loosen the screws with a flat blade screwdriver to remove the lid.

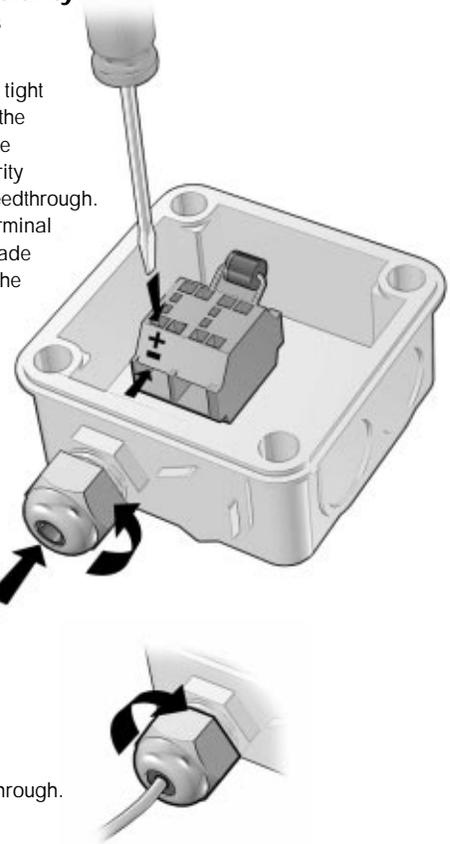


## 5.2 Single Polarity Versions

- 5.2.1 Loosen the water tight feedthrough and insert the positive or negative wire (depending of the polarity required) through the feedthrough. Depress the left front terminal connector with a flat blade screwdriver and insert the wire in the opening. Release the connector to secure the wire.

Strip wire insulation to 16 mm (5/8 inch)

- 5.2.2 Tighten the feedthrough.



## 5.3 Dual Polarity Versions

Repeat steps in 5.2 for dual polarity junction boxes. Note, the negative wire is inserted through the left feedthrough to the left terminal connector and the positive wire is inserted through the right feedthrough to the right terminal connector.



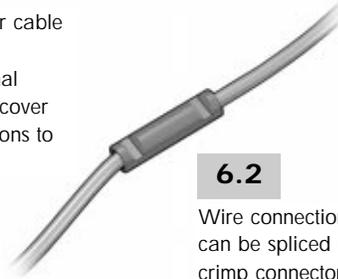
Check local codes regarding appropriate wire type required.

Check local codes regarding appropriate wire type required



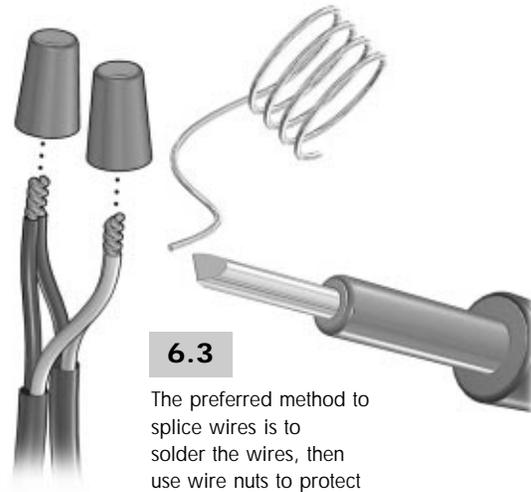
### 6.1 ProCharger™ terminal cover

Modules with wire or cable terminations use the ProCharger™ terminal cover. The terminal cover protects the connections to the solar module.



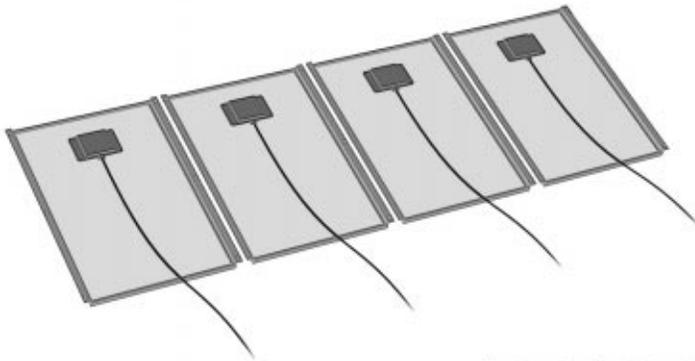
### 6.2

Wire connections can be spliced using crimp connectors.



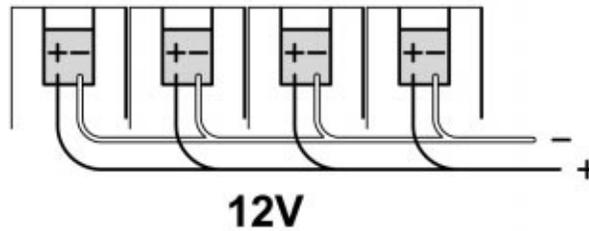
### 6.3

The preferred method to splice wires is to solder the wires, then use wire nuts to protect the connection.

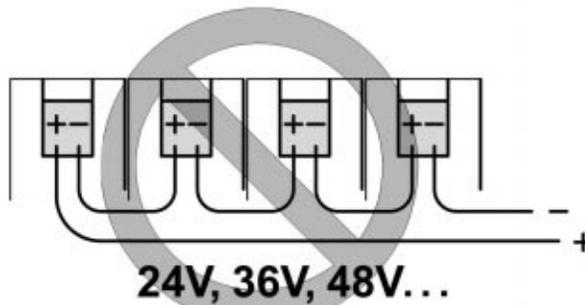


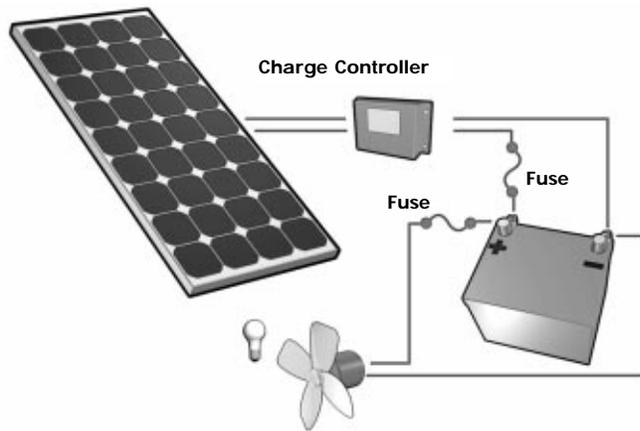
### 6.4 Parallel connections only

6.4.1 Modules with wire terminations can be connected in parallel to increase the current.



6.4.2 **Warning: Do not connect modules with wire terminations in series to increase voltage.**

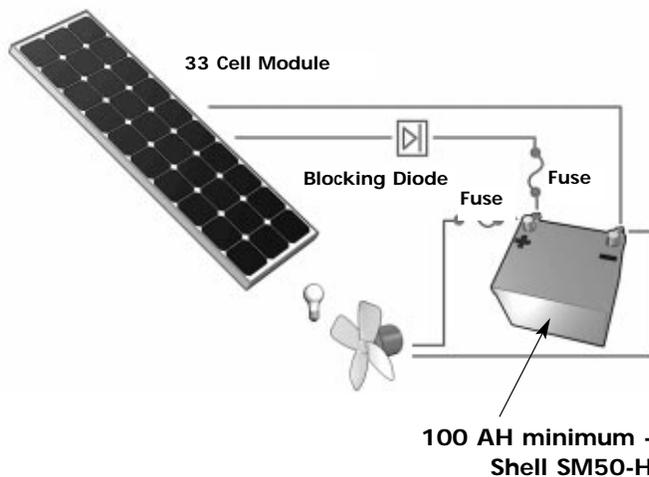




There are three common types of solar module and battery systems: battery charging using a charge controller, battery charging using a self-regulating solar module, and battery trickle charging.

### 7.1 Using a Charge Controller

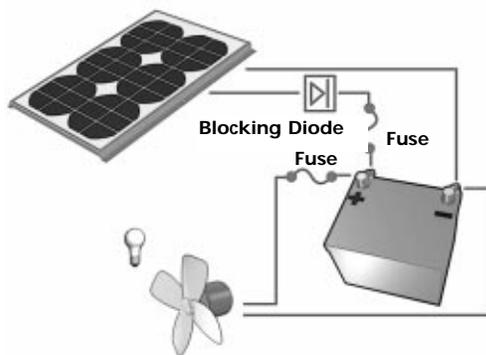
The charge controller protects the battery from overcharging by the solar module. The controller is connected in the circuit between the solar module and battery. Connect wires from the (-) and (+) terminals of the solar module to the corresponding terminals of the controller. Connect wires from the (-) and (+) terminals of the battery to the corresponding terminals of the controller. Always fuse the connections at the battery for safety. Refer to the module rating label (on module) for recommended fuse size. Also, refer to the charge controller owner's manual.



### 7.2 Using a Self-regulating Solar Module (Shell SM50-H)

In operation, the charging current provided to the battery by a self-regulating solar module decreases as the battery voltage increases; thus, a battery at a low state of charge will accept more charging current than one which is at or near a full state of charge. If the system is used during the day, the charging current will continually adjust to replace the energy used.

Model Shell SM50-H has 33 solar cells wired in series and 18 self-regulating when connected to a battery that is a minimum of 100 AH. **To avoid overcharging the battery it is important to have the same electrical consumption each day.** The module is connected in parallel with the battery. Connect a wire from the (-) terminal of the solar module to the (-) terminal of the battery. Next, connect a wire from the (+) terminal of the solar module to the (+) terminal of the battery. A blocking diode can be used to prevent the discharge of the battery through the solar module during cloudy periods, at night, or under covered storage. Select a diode at least twice the open circuit voltage and short circuit current of the system. A Schottky® barrier diode is preferred. Always fuse the connections at the battery for safety. Refer to the module rating label (on module) for



### 7.3 Trickle Charging

A small module (5 to 10 watts) is often used to maintain a charge in a 50 to 100 AH battery. The module is connected in parallel with the battery. Connect a wire from the (-) terminal of the solar module to the (-) terminal of the battery. Next, connect a wire from the (+) terminal of the solar module to the (+) terminal of the battery. A blocking diode can be used to prevent the discharge of the battery through the solar module during cloudy periods, at night, or under covered storage. Select a diode that is at least twice the open circuit voltage and short circuit current of the system. A Schottky barrier diode is preferred. Always fuse the connections at the battery for safety. Refer to the module rating label (on module) for recommended fuse size.

### Maintenance

Minimal maintenance is required to maintain optimal performance of your solar electric system.

### Solar Electric Modules

If the front of the module becomes dirty, a reduction in energy output may result. We recommend the use of water and a soft cloth or sponge to clean the glass module surface. A mild non-abrasive detergent may be used if necessary.

**Refer to the installation and operation manual of the other equipment including batteries and electronics for additional information.**

## 8.1 System Test and Troubleshooting

Systems have four key components, the solar modules, electronic devices (including the inverter and controller), batteries, and the system wiring. The most effective way to insure good system performance is to test the components in the system before it is turned on.

The system can include a single module or an array of modules in a series string and a parallel configuration.

To check the output of the solar modules(5):

### Testing a Series String of Modules or Individual Module

**Warning: When testing DC voltage over 30VDC be sure to take all precautions to protect yourself against possible electric shock.**

8.1.1 First, check the open circuit voltage of each series string of modules. The open

circuit voltage per module is located in the Specifications section of this Guide on pages 13 and 14. Test each series string by measuring this voltage at each pair of series string wires or terminals.

Next, test the series string short circuit current at the same pair of series string wires or terminals. When testing short circuit current, each module must be exposed to bright sunlight. Refer to the Specifications section in this Guide to determine the current for the module under test. The current output will vary based on the time of day of the test, shading from obstructions, and the angle that the solar array is to the sun.

After these tests are complete, the array is ready to operate and can be connected to the rest of the system.

Should the voltage reading be low, proceed to the next section, Low Voltage. Should

the current be low, call Shell Solar customer service for warranty information.

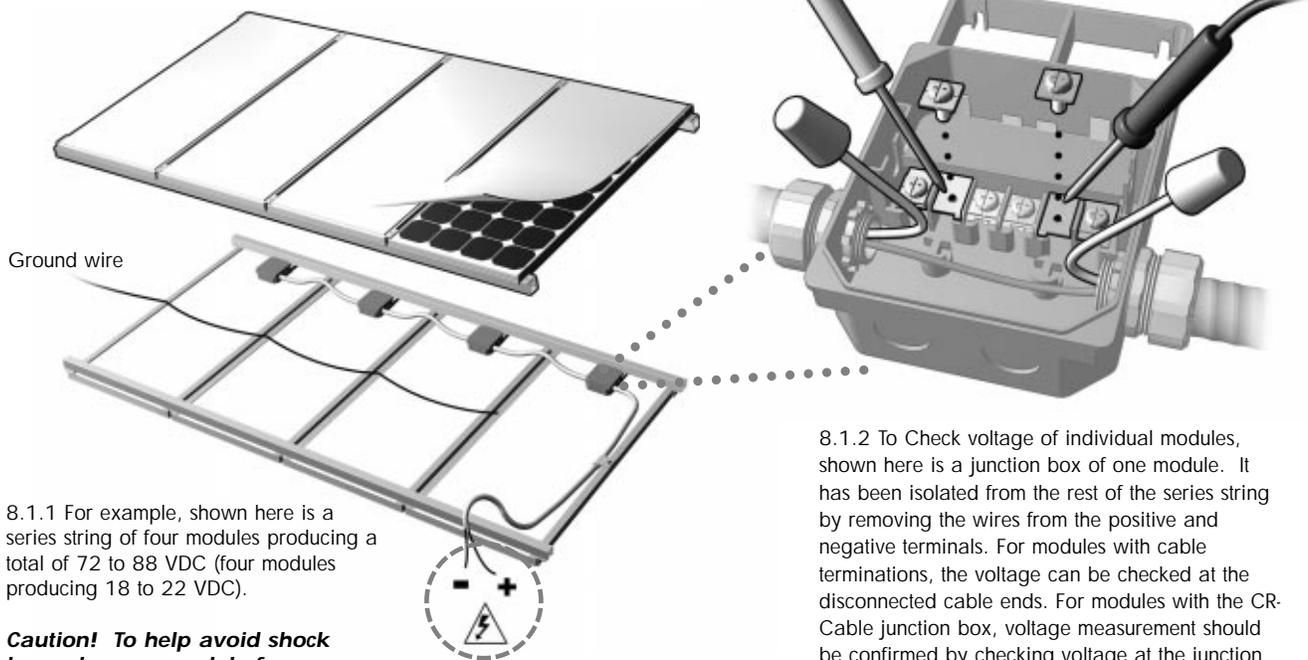
### Low Voltage

The two most common causes for low voltage are loose wiring connections and a short circuited bypass diode.

To isolate the cause of low voltage, first check all wiring connections to insure good conductivity.

8.1.2 If all connections are secure, check the voltage of each module by removing a wire from the plus and minus terminals (to isolate the module from the rest of the series string) and test the module for voltage. A reading of  $\frac{1}{2}$  of the specified voltage indicates a short circuit of a bypass diode. Refer to the next section to test and replace a bypass diode.

If the cause of low voltage is still undetermined, call Shell Solar customer service for warranty information.



8.1.1 For example, shown here is a series string of four modules producing a total of 72 to 88 VDC (four modules producing 18 to 22 VDC).

**Caution! To help avoid shock hazard, cover module face completely (when not requiring sunlight for testing purposes) with opaque material to halt production of electricity.**

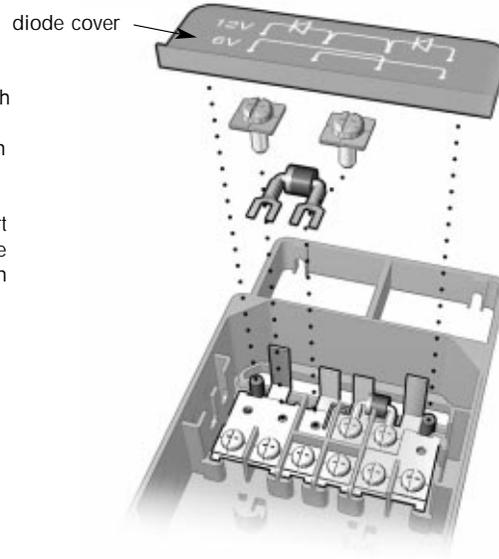
8.1.2 To Check voltage of individual modules, shown here is a junction box of one module. It has been isolated from the rest of the series string by removing the wires from the positive and negative terminals. For modules with cable terminations, the voltage can be checked at the disconnected cable ends. For modules with the CR-Cable junction box, voltage measurement should be confirmed by checking voltage at the junction box terminals. If there is a difference greater than 5%, this may indicate a cable or cable connection problem. **For safety, cap the loose wires with wire nuts.**

## 9.1 ProCharger™- CR Junction Box (U.S.)

Two bypass diodes are located under the protective cover in the junction box. This cover has an illustration of the diodes embossed on its surface. To access the diodes, remove the cover by placing a finger under the edge of the cover and prying up. The cover will pop off of its connecting pins. Loosen the terminal screws that hold one diode. Observe the direction of the diode markings and remove the diode. Note: if a jumper between the diodes is present, be sure to replace it as required for the desired voltage configuration.

Test the diode for continuity with a digital meter. The diode will have resistance in one direction and an open circuit in the reverse direction. Continuity in both directions indicates a short circuit of the diode. Replace the diode with a new component in the same orientation. Tighten terminal screws to 2.3 Nm (20 in-lb.). Retest the module for voltage.

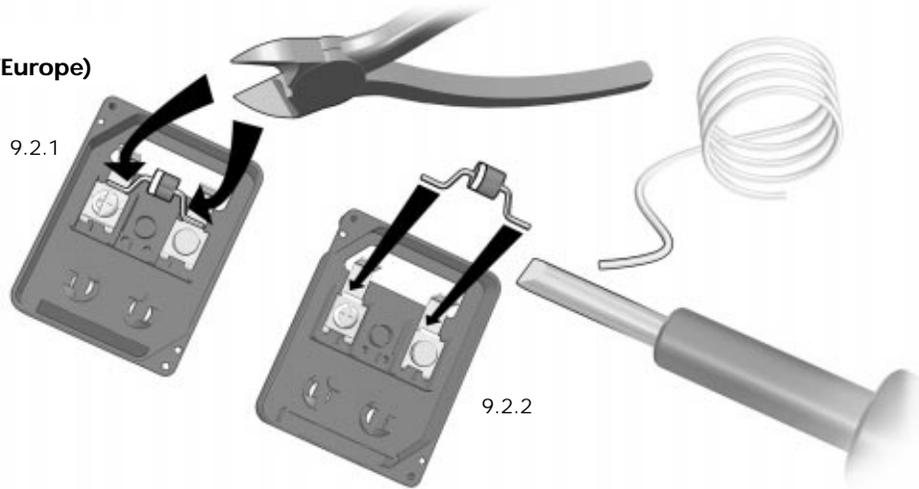
Test the second diode as described above. Replace the diode cover.



## 9.2 ProCharger™- S Junction Box (U.S./Europe)

9.2.1 Observe the direction of the diode markings and remove the diode with a wire cutter. Test the diode for continuity with a digital meter. The diode will have resistance in one direction and an open circuit in the reverse direction. Continuity in both directions indicates a short circuit of the diode.

9.2.2 Solder a new diode into the terminals in the same orientation and retest the module for voltage.

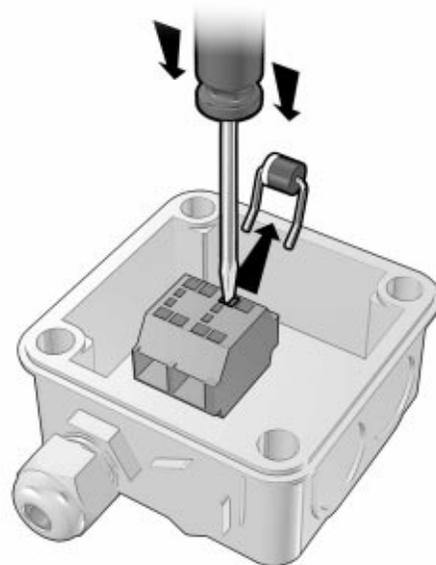


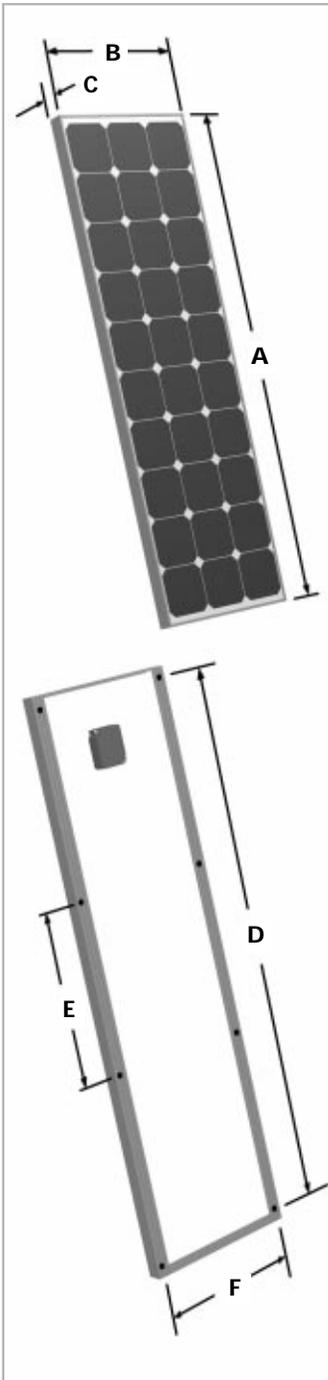
## 9.3 Spelsberg Junction Box (Europe)

Insert a flat blade screwdriver in each terminal connector to release each lead of the diode. (Use the same method to install the new diode). Observe the direction of the diode markings and remove the diode.

Test the diode for continuity with a digital meter. The diode will have resistance in one direction and an open circuit in the reverse direction.

Continuity in both directions indicates a short circuit of the diode. Replace the diode with a new component in the same orientation and retest the module for voltage.





**Physical Characteristics**

Model Number	Shell ST40 Shell ST36	Shell ST20	Shell ST10	Shell ST5	Shell SP130-PC, Shell SP140-PC, Shell SP150-PC <sup>3</sup>
<b>(A)</b> Length, inches (mm)	50.9 (1293)	29.5 (748)	15.3 (387)	12.9 (328)	63.9 (1622)
<b>(B)</b> Width, inches (mm)	12.9 (328)	12.9 (328)	12.9 (328)	8.1 (206)	32.1 (814)
<b>(C)</b> Depth (frame), inches (mm)	1.3 (35)	1.3 (35)	1.3 (35)	1.3 (3.5)	2.2 (56)
Depth (including j-box), inches (mm)	1.3 (35)	1.3 (35)	1.3 (35)	1.3 (3.5)	1.6 (40)
Weight, pounds (kg)	15.4 (7)	9 (4.1)	5.2 (2.4)	3.1 (1.4)	38 (17.2)

**Mounting Holes**

<b>(D)</b> Length of Module, outside, inches (mm)	49.8 (1264)	28.3 (719)	14.1 (359)	11.2 (285)	62.5 (1689)
<b>(E)</b> Length of Module, quarter, inches (mm)	25.3 (643)	NA	NA	NA	25.3 (643)
<b>(F)</b> Width of Module, inches (mm)	11.3 (286)	11.2 (285)	11.2 (285)	7 (178)	30.3 (769)
Diameter, mounting holes, inches (mm)	.26 (6.6)	.26 (6.6)	.26 (6.6)	.26 (6.6)	.26 (6.6)
Cable Length inches (m)		59 (1.5)	59 (1.5)	59 (1.5)	+ 39 (1.0) - 51 (1.3)

**Electrical Characteristics**

Model Number	Shell ST40	Shell ST36	Shell ST20	Shell ST10	Shell ST5	Shell SP150-PC	Shell SP140-PC	Shell SP130-PC	Shell SP75
<b>Junction Box Type</b>	S	S	Cable	Cable	Cable	CR-Cable	CR-Cable	CR-Cable	CR
<b>Configuration / Changeable</b>	12V	12V	12V	12V	12V	24V	24V	24V	12V
<b>Number in Series</b>	42	42	42	42	42	72	72	72	36
<b>Rated Power, Watts (Pmax)</b>	40	36	20	10	5	150	140	130	75
<b>Min Power, Watts (Pmin)</b>	36	32.4	18	9	4.5	142.5	133	123.5	70
<b>Open Circuit Voltage (Voc)</b>	23.3	22.9	22.9	22.9	22.9	43.4	42.8	42.8	21.7
<b>Short Circuit Current (Isc)</b>	2.68	2.68	1.54	0.77	0.39	4.8	4.7	4.5	4.8
<b>Voltage at Load (Vmpp)</b>	16.6	15.8	15.6	15.6	15.6	34.0	33.0	33.0	17.0
<b>Current at Load (Impp)</b>	2.41	2.28	1.29	0.64	0.32	4.4	4.25	3.95	4.4
<b>Cell Type (Impp)</b>	CIS	CIS	CIS	CIS	CIS	Mono	Mono	Mono	Mono
<b>Maximum System Voc</b>	600	600	25	25	25	600	600	600	600
<b>Factory Installed Bypass Diode</b>	Yes	Yes	No	No	No	Yes	Yes	Yes	No

**Notes:**

1. Rated electrical characteristics are within 10% of measured values at Standard Test Conditions (STC) of: 1000 W/m<sup>2</sup>, 25°C cell temperature and solar spectral irradiance per ASTM E 892.

2. Under normal conditions, a photovoltaic module may experience conditions that produce more current and voltage than reported at standard component test conditions. Accordingly, the values of Isc and Voc marked on UL Listed modules should be multiplied by a factor of 1.25 when determining voltage ratings, conductor capacities, fuse sizes, and size of controls connected to the module output. Refer to Section 690-8 of the

**Physical Characteristics**

Shell SP75, Shell SP70, Shell SP65	Shell SM110-12P, Shell SM110-24P Shell SM100-12P, Shell SM 100-24P	Shell SM55 Shell SM50	Shell SM50-H	Shell SM46
47.2 (1200)	51.8 (1316)	50.9 (1293)	48 (1220)	42.6 (1083)
20.8 (527)	26 (660)	13 (329)	13 (329)	13 (329)
2.2 (56)	2.2 (56)	1.3 (35)	1.3 (35)	1.3 (35)
1.3 (34)	1.6 (40)	1.3 (35)	1.3 (35)	1.3 (35)
16.7 (7.6)	25.1 (11.5)	12 (5.5)	11.5 (5.2)	10.2 (4.6)

46.1 (1172)	50.5 (1283)	49.8 (1264)	46.9 (1191)	41.5 (1054)
25.3 (643)	25.3 (643)	25.3 (643)	25.3 (643)	25.3 (643)
19.0 (483)	24.2 (615)	11.3 (286)	11.3 (286)	11.3 (286)
.26 (6.6)	.26 (6.6)	.26 (6.6)	.26 (6.6)	.26 (6.6)

**Electrical Characteristics**

Shell SP70		Shell SP65		Shell SM110-12P		Shell SM100-12P		Shell SM110-24P		Shell SM100-24P		Shell SM55	Shell SM50	Shell SM50-H	Shell SM46
CR	CR	CR	CR	CR	CR	CR	CR	CR	CR	S	S	S	S	S	S
12V	6V	12V	6V	12V	12V	24V	24V	12V	12V	12V	12V	12V	12V	12V	12V
36	18	36	18	36	36	72	72	36	36	33	30				
70	70	65	65	110	100	110	100	55	50	50	46				
65	65	60	60	104.5	95	104.5	95	50	45	45	41				
21.4	10.7	21.4	10.7	21.7	21.0	43.5	42.0	21.7	21.4	19.8	18.0				
4.7	9.4	4.5	9.0	6.9	6.5	3.45	3.25	3.4	3.3	3.4	3.35				
16.5	8.25	16.5	8.25	17.5	17.0	35.0	34.0	17.4	16.6	15.9	14.6				
4.25	8.5	3.95	7.9	6.3	5.9	3.15	2.95	3.15	3.05	3.15	3.15				
<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>	<b>Mono</b>
600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

U. S. National Electrical Code for an additional multiplying factor of 1.25 which may be applicable.

3. The Shell SP130-P, SP140-P, and SP150-P are non-cable versions of the Shell SP-130-PC, SP140-PC, and SP150-PC and use the CR Junction Box.

**'SHELL SOLAR LIMITED WARRANTY FOR PV-MODULES' ("Limited Warranty")**

**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 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. 25 years**

For the PV-modules (excluding the inverter/ converter), SM46, SM50, SM50-H, SM55, SM100-12P, SM100-24P, SM110-12P, SM110-24P, SP65, SP70, SP75, SP130-P/PC, SP140-P/PC

and SP150-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 STC<sup>1</sup> 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 STC<sup>1</sup>, 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.

<sup>1</sup>"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 m<sup>2</sup> 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.

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