



# Solar PV Module Handling, Storage, Installation, Operation & Maintenance

(Semi-rigid and Flexible  
PV Modules)



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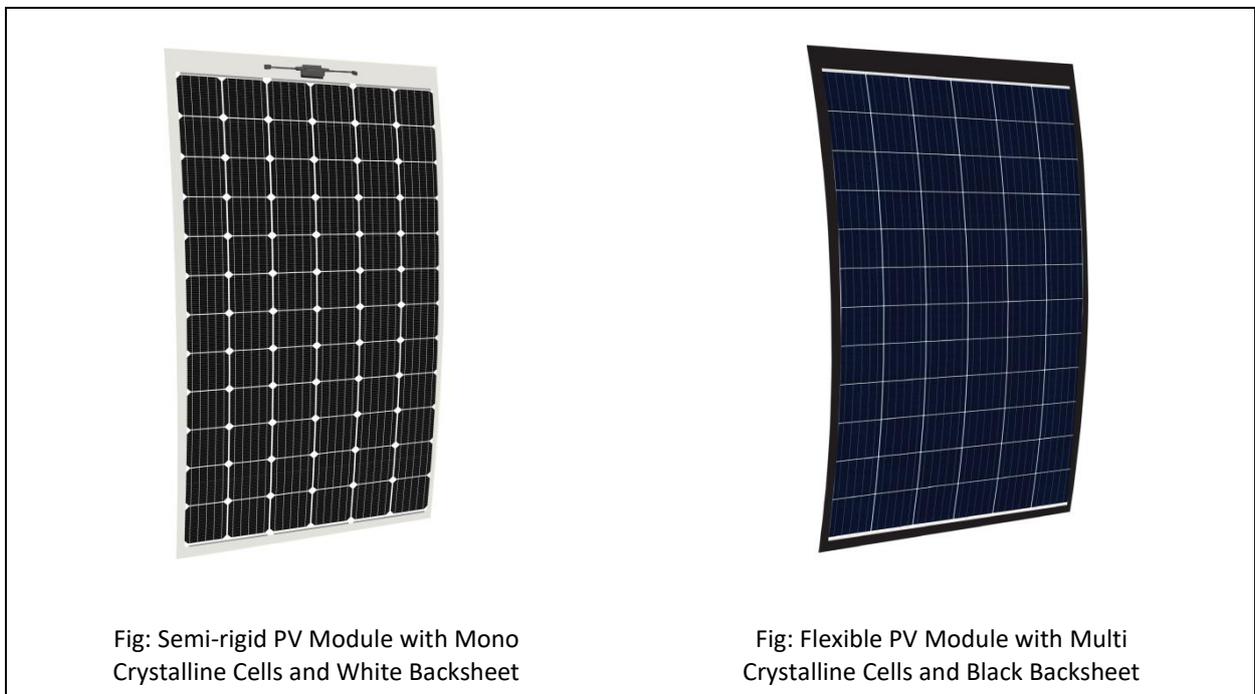


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For other module types please visit: [www.renewsysworld.com](http://www.renewsysworld.com)



## **01. INTRODUCTION:**

Thank you for choosing RenewSys Solar PV modules. This manual contains information regarding handling, storage, installation, operation, maintenance and safety handling of RenewSys's Semi-Rigid/Flexible photovoltaic modules (hereafter referred as "Modules") supplied by RENEWSYS INDIA PRIVATE LIMITED (HYDERABAD DIVISION). (Hereafter referred as "RENEWSYS").

All instructions in this guide should be read and understood before handling and installation of these Modules.

Keep this guide in a safe place for ready reference for the care and maintenance of the Modules and also for use in case of sale or disposal of the modules.

If there are any questions, please contact RENEWSYS INDIA PRIVATE LIMITED (HYDERABAD DIVISION) Sales/Service department for clarification.

## **02. DISCLAIMER OF LIABILITY:**

Since On-Site compliance to the recommendations contained in this Handling, Storage, Installation, Operation and Maintenance Manual, and the conditions of installation, operation, use and maintenance of the module are beyond RenewSys's control; RenewSys does not assume responsibility and expressly disclaims liability for loss, damage, injury or expense arising out of or in any way connected with such installation, operation, use or maintenance of the module.

RenewSys assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the module. No license is granted by implication or otherwise under any patent or patent rights.

The information in this Manual is based on RenewSys'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. RenewSys reserves the right to make changes to the product, specifications or this manual without prior notice.



### **03. GENERAL NOTES AND INSTRUCTIONS:**

- Installing solar photovoltaic systems may require specialized skills and knowledge. Installation should be performed only by qualified persons.
- Before installing the Modules in a solar power system/plant, the installer should become familiar with the mechanical and electrical requirement for such a system.
- Make sure the modules meet the technical requirements of the system as a whole.
- Ensure that other system components (BOS) do not exert damaging mechanical or electrical influences on the modules.
- The installer should conform to all the safety precautions in the guide when installing the modules.
- Note that in addition to the instructions given in this guide, the installers should follow all the Local Civil, Mechanical & Electrical Codes relevant to the installation of the Solar Photovoltaic Systems.
- Installers should assume the risk of injury that might occur during installation, including, without limitation, the risk of electric shock.
- These Solar SEMI-RIGID/FLEXIBLE modules are designed for outdoor use. Modules may be mounted on the ground, on rooftops or vehicles. Proper design of support structures is the responsibility of the system designers and installers.
- Suggestions for mounting are given in Section 6.
- Do not attempt to disassemble the modules, and do not remove any attached labels/nameplates or components from the modules.
- Do not apply paint or adhesive to module top surface.
- Do not use mirrors or other magnifiers to artificially concentrate sunlight on the modules.
- When installing the system, abide with all local, regional and national statutory regulations for safety and installation. Obtain a work/building permit wherever necessary.

#### **04. SAFETY PRECAUTIONS:**

- Keep children away from the system while transporting and installing mechanical and electrical components.
- Deploy only trained persons in handling and installation of the Modules.
- One individual module may generate voltage more than 30V DC when exposed to direct sunlight. Contact with a DC voltage of 30V or more is potentially hazardous.
- Remember that when modules are connected in series, the total voltage is equal to the sum of the individual module voltages. If modules are connected in parallel, the total current is equal to the sum of individual module currents.

**04.1. Danger of death from electric shock!** The following points must be observed when handling the solar modules to avoid the risk of fire, sparking and fatal electric shock.

- Do not insert electrically conducting parts into the plugs or sockets! Do not fit solar modules and wiring with wet plugs and sockets!
  - Exercise utmost caution when carrying out work on wiring and safety equipment (use insulated tools, insulated gloves, etc.)!
  - Do not use damaged modules!
  - Exercise utmost caution when working on wiring and the inverter. Be sure carefully to follow manufacture's installation instructions!
  - Do not connect or disconnect the Modules when they are energized.
  - Completely cover the module with an opaque material during installation to keep electricity from being generated.
  - Do not wear metallic rings, watchbands, ear, nose, lip rings or other metallic devices while installing or troubleshooting photovoltaic systems.
  - Use only insulated tools that are approved for working on electrical installations.
  - Never disconnect the solar generator from the inverter while the inverter is connected to the mains grid. Disconnect the AC side on the inverter first before disconnecting the DC side. Use safe circuit breakers for the isolation.
  - Ensure cable connections in perfect condition (no splitting, soiling or other contamination).
- 
- Abide with 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.



- Use only equipment, connectors, wiring and support frames suitable for a solar electric system.
- Always use the same type of module within a particular photovoltaic system.

**05. PRODUCT IDENTIFICATION:**

**05.1. Label Information:**

Each module has one Label pasted on its rear side. The label contains the following information.

**05.1.1. Model Number**

Format	DESERV MXX YYY Wp High Performance Multicrystalline Modules
Key Code	
DESERV	
M	Multi
XX	SR - Semi Rigid
	F - Flexible
YYY	Power Max (Pmp)

Format	DESERV SXX YYY Wp High Performance Monocrystalline Modules
Key Code	
DESERV	
M	Mono
XX	SR - Semi Rigid
	F - Flexible
YYY	Power Max (Pmp)

**05.1.2. Note on Serial Number Nomenclature**

Module Serial Number is pasted alongside the data label.

The serial number nomenclature is provided below:

**R X 0 0 0 0 W W Y Y X X X X X X**

<b>R</b>	<b>X</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>W</b>	<b>W</b>	<b>Y</b>	<b>Y</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
RenewSys India Pvt. Ltd.	Unit-1	Reserved for future use				Running week of the year		Year		Running Sl. No generated by PPC						

<b>UNIT IDENTIFICATION CODE</b>	
<b>UNIT</b>	<b>Identification no</b>
Auto line	1

**05.1.3. Electrical Characteristic of the Module**

$V_{oc}$ ,  $V_{mp}$ ,  $I_{sc}$ ,  $I_{mp}$ , and  $P_{mp}$

**05.1.4. Rated maximum system Voltage**

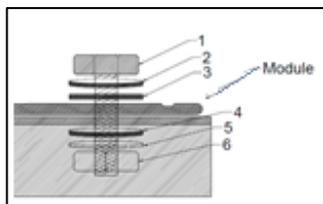
Recommended Safety Fuse Rating and the Fire Rating of the Module

**05.1.5. Safety warnings**

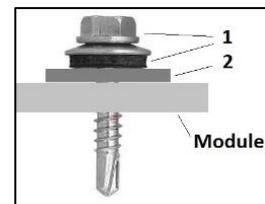
- 05.2.** A serial number label with barcode is also pasted inside on the front surface on the top left corner.
- 05.3.** RFID tag is available either inside the laminate or on the backside of module which will contain the Serial Number and Data pertaining to module.
- 05.4.** Do not peel of any label from the PV module. If the label is removed, the product warranty will no longer be valid.
- 05.5.** Refer to the data label given on the back side of the module for interface purposes.
- 05.6.** For reporting any problems related to the Module, always refer both the Model Number and the Unique Serial Number in the correspondence.

## 06. GENERAL DESCRIPTION OF THE PRODUCT:

The Semi-Rigid/Flexible Series solar modules are made of a series of either Mono or Poly crystalline solar cells of high efficiencies. The cells are laminated between a solar transparent sheet and a metalized composite Board, using EVA (ethylene vinyl acetate) as the encapsulated material. The Composite Board provides electrical insulation and resistance against environmental weathering. The electrical terminal boxes with IP-65/67/68 protection provide the housing for the connection terminals and the protection diodes (bypass diodes).



**Fig 1: Nut & Bolt**



**Fig 2: Self tap Screw**

The above figure is for hardware mounting reference:

- The following hardware recommended should be used for installation with nut bolt.
  1. Stainless steel Bolt - 304 with hexagonal head - In Metric standard: M6 x 30 mm long
  2. Stainless Steel Flat Washer - M6 Stainless steel 304
  3. Stainless Steel Rectangular Washer - 20 x 40 x 2mm M6 Stainless steel 304
  4. Stainless Steel Flat Washer - M6 Stainless steel 304
  5. Stainless Steel Spring Washer - M6 Stainless steel 304
  6. Stainless Steel Nut - M6 stainless steel 304
  7. Minimum requirement for fixing the module - M6 x 30 bolts 4nos
  
- The following hardware recommended should be used for installation of the solar modules with self-tap screw.
  1. Stainless steel self-tap screw with rubber washer: 304 with hexagonal head – In Metric standard: M6 x 30 mm long
  2. Stainless Steel Flat Washer - M6 Stainless steel 304
  3. Silicone sealant - to make each screw point leak proof



- The following hardware recommended should be used for installation of the solar modules with adhesive.
  1. Industrial grade adhesive- to be applied to rear side after peeling off the protective layer.
  2. Industrial cleaning solution (alcohol based) to clean the area of installation.

For the detailed of dimensions, refer to the Data Sheet corresponding to the Model Number of the module.

## **07. MECHANICAL INSTALLATION:**

### **07.1. GENERAL INSTRUCTIONS FOR HANDLING/STORING THE MODULES:**

- Do not lift the module by holding the module's junction box or electrical leads.
- Do not stand or step on module.
- Do not scratch /hit on the front/ back side of the Module with sharp Objects.
- Do not place any heavy objects on the module.
- Do not drop module or allow objects to fall on module.
- Do not set the module down hard on any surface.
- Do not allow the open connectors to get exposed to water/rain.
- Inappropriate transport and installation may break module.
- Store the Modules under shade in vertical position, resting on their longer sides. Provide side supports if they are in unpacked condition. The side supports must be made of soft material like wood, and must be provided on the Back side of module.

### **07.2. SELECTION OF LOCATION FOR INSTALLATION:**

- Select a suitable location for installing the modules.
- The modules should be facing south in northern latitudes and north in southern latitudes - the tilt angle depends on the latitude of the location.
- For detailed information on the best elevation tilt angle for the installation, refer to standard guidelines.
- Note that all the modules connected in a series must all be mounted at the same tilt angle - if not, the system will lose power due to differences in sunshine radiation.
- If the Modules are mounted on Solar Trackers, follow the guidelines given by the tracker designer & supplier.

- The module should not be shaded fully or partly at any time of the day. This will result in loss of power in whole string.
- Do not use module near equipment or in locations where inflammable gases can be generated or collected.
- Don't immerse the modules inside water or continually expose them near a water shower or fountain.
- The following ambient/operating temperatures are recommended for the selection of location for the installation of Modules:
- Ambient temperature: 20°C to 50°C Operating temperature: 40°C to 70°C Ambient temperature : 20°C to 50°C Operating temperature : 40°C to 70°C.

### **07.3. GENERAL MOUNTING INSTRUCTIONS:**

- For high wind and snow loads extra clamping arrangement from module to structure is recommended.
- Load calculations based on the local wind speeds and environments are left to the system designers or installers.

### **07.4. SELECTING THE PROPER SUPPORT FRAME:**

- Always observe the instructions and safety precautions included with the support frames to be used with the modules.
- Ensure that the mounting system withstands the anticipated wind and snow loads.
- The support module mounting structure must be made of durable, corrosion-resistant and UV-resistant material.
- All hardware like bolts, nuts & washers should be of stainless steel so as to eliminate the possibility of rust.

### **07.5. ROOF MOUNT:**

- When installing a module on a roof or building, ensure that it is securely fastened and will not work loose as a result of wind or snow loads.
- When installing module as a roof, ensure that the structure is suitable. In addition, any roof penetration required to mount the module must be properly sealed to prevent leaks.
- In some cases, a special support frame may be necessary.

- The roof installation of solar modules may affect the fireproofing of the house construction. Both roof construction and module installation design have an effect on the fire resistance of a building. Improper installation may contribute to fire hazards. Additional devices such as ground fault protection, fuses, and overload circuit breakers may be required.
- Do not install modules on a roof or building during strong winds to prevent accidents due to fall.

## **08. ELECTRICAL INSTALLATION:**

### **08.1. GENERAL INSTRUCTIONS:**

- Each module comes with a permanently attached Junction Box with cables  $1 \times 4.0\text{mm}^2$ , ambient temp.  $-40$  to  $+90^\circ\text{C}$ , rated voltage DC 1.8Kv of 1.2-meter length fitted with MC4 Connectors.
- Several modules are connected in series and then in parallel to form a PV array, especially for application with a high operation voltage.
- When connected in series, all modules must have the same amperage. When connected in parallel, the modules should be of the same rating and specification.
- Do not use modules of different configurations in the same array.
- If modules are connected in series, the total voltage is equal to the sum of individual voltages.
- The number of modules that can be connected in series is limited by the Maximum System Voltage Rating which is  $1000 V_{DC}$ .
- Max. Number of Modules (N) =  $1000 V/V_{oc}$  (at STC)
- Note: The electrical characteristics such as  $V_{mp}$ ,  $I_{mp}$  &  $P_{mp}$  mentioned on the Module Data Sheet are based on measurements made with  $\pm 1\%$  accuracy at standard test conditions (irradiance of  $1000 \text{ W/m}^2$ , AM 1.5 spectrums, and module temperature of  $25^\circ\text{C}$ ). Under normal outdoor conditions the module may produce current and voltages that are different than those listed in the data sheet. Accordingly, during system design, values of  $V_{oc}$  and  $I_{sc}$  should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor amperage, fuse ratings and size of controls connected to the modules or system output.
- For applications requiring high currents, several photovoltaic modules can be connected in parallel; the total current is equal to the sum of individual currents.
- Refer local (country specific) wiring regulations to determine system wire size, type, and temperature.

- The cross section area of cable and the capacity of connector must be selected to suit the maximum system short circuit current. Recommended cross section area of cable is 4 sq.mm for a single module with 9 amps rated current. Please note that the upper limit temperature of cable is  $\leq 85^{\circ}\text{C}$ , and the connector is  $\leq 105^{\circ}\text{C}$ .
- To minimize risk in the event of an indirect lightning strike, avoid forming array loops when designing the system.
- Electrical ratings at STC are below (representation only):

Short circuit current ( $I_{sc}$ ) A	9.31
Open circuit voltage ( $V_{oc}$ ) V	46.24
Maximum peak current ( $I_{mp}$ ) A	8.79
Maximum peak Voltage ( $V_{mp}$ ) V	37.67
Maximum peak Power ( $P_{mp}$ ) W	330

- Application class for PV modules is Class A.
- Any limitations on wiring methods that apply to the wiring compartment or box is nil.

## 08.2. SEMI RIGID MODULE GROUNDING:

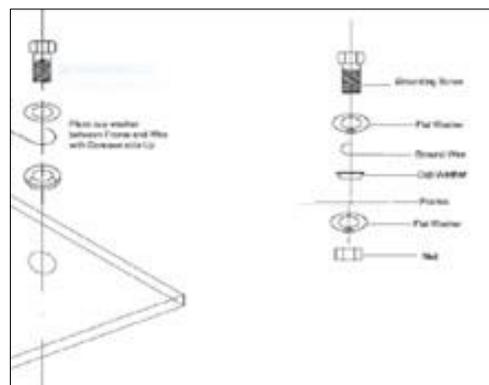
All Semi Rigid modules and mounting racks need to be grounded according to the respective regional electric codes. The module must be properly grounded. The grounding wire must be properly fastened to the module to ensure good electrical contact. The transparent sheet on a module provides a coating to minimize the corrosion due to weather and it acts as a barrier that reduces the effectiveness of the grounding connection. For an adequate ground, the grounding hardware should pierce all the layers of module.

A hole of 5 mm diameter is to be made on the semi rigid module which is not in the vicinity of cells, preferably top side of module. The following hardware recommended should be used for grounding the semi rigid modules during installation process.

- Stainless steel Bolt - 304 with hexagonal and cheese head (As per ASME standard chart) In Metric standard: M4 x 16 mm long Engage thread is 13.5 mm with the frame (2.5 mm frame thickness and 16 mm length of the screw)
- Stainless Steel Flat Washer - M4 Stainless steel 304
- Stainless Steel Cupped Washer - M4 Stainless steel 304
- Stainless Steel Flat Washer - M4 Stainless steel 304
- Stainless Steel Nut - M4 stainless steel 304

Bolt Size (mm)	Pitch (mm)	Bolt Hex (mm)	Strength Grade (NM)				
			4.6	6.8	8.8	10.9	12.9
4	0.7	7	0.95	1.91	2.54	3.57	4.29
6	1.0	10	3.92	7.85	10.5	14.7	17.7

Above details are torque chart for tightening the nut and bolt for M4 & M6 Nut & Bolt



**Fig: Grounding details**

Note: In case of a separate grounding hole is not opted for, any of the mounting holes can be used for grounding from front side, provided Stainless steel SS 304 Nut & Bolt are used for mounting.

### **08.3. GROUNDING OF MODULE FRAMES:**

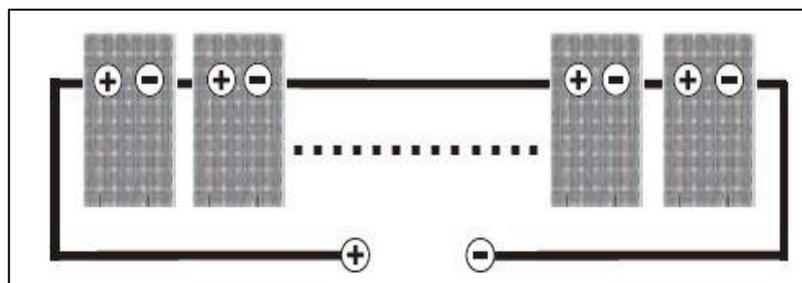
- Solar SEMI-RIGID/FLEXIBLE modules do not require the grounding of module as this module does not have Aluminium frame, however it may be necessary to ground structure to reduce or eliminate shock and fire hazards and for protection from damages due to lightening, or it may be mandatory as per local or national regulation.
- The installer of a PV system is responsible for grounding of all structures.
- The main earth ground must only be connected by a qualified electrician.

#### 08.4. GROUNDING OF DC -VE BUS OF THE ARRAY:

- It is advisable to ground the DC -ve bus in the system, so that the cells in the module would be prevented from seeing high -ve potentials.
- Note that the DC side grounding may have to be done in the Inverters and therefore, the Inverters used in the system must be designed to provide a DC -ve bus grounding, with all the safety features required as per local electrical code. Please check with your inverter supplier about this option while selecting the suitable inverter for this purpose.

#### 08.5. WIRING:

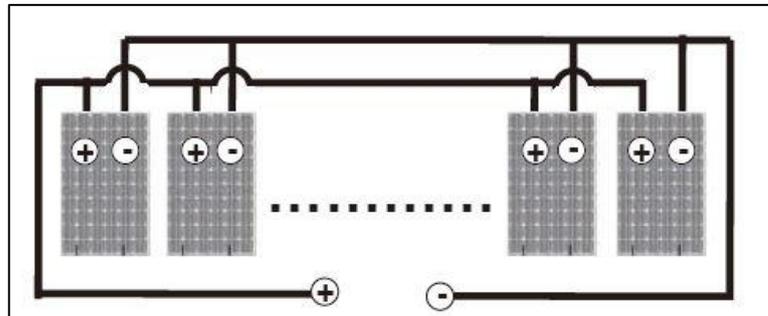
- All wiring should be done in accordance with applicable local/ National electrical codes and regulations.
- Before connecting modules always ensure that the contacts are corrosion free, clean and dry Product can be irreparably damaged if an array string is connected in reverse polarity to another.
- All wiring should be done by a qualified, licensed professional. Wiring should be protected to help ensure personal safety and to prevent its damage.
- Modules can be wired in series to increase voltage. Connect positive terminal of one module to the negative terminal of the next module.



**Fig: Series connection for more Voltage**

- Make sure the number of modules connected in series does not exceed:  $((\text{Maximum system voltage} / \text{Open circuit voltage of the module} \times 1.25) - 1)$  at standard condition, AM 1.5 G, 25 degrees temperature,  $1,000 \text{ W/m}^2$ . Open circuit voltage of the array needs to be calculated at the lowest ambient temperature for the location of power plant.
- PV modules only with the same rating should be used in series and parallel connections.
- Connect modules in parallel to increase current. Connect wires from the positive terminal of the one module to the positive terminal of the next module. Do not

connect modules in parallel without using a connection box. The number of parallel strings depends on the system integrator's requirements and the inverter ratings.



**Fig: Parallel connection for more Current**

- Always verify the voltage and polarity of each individual string before making a parallel connection. If you measure a reversed polarity or a difference of more than 10 V between strings then check the string configuration before making the connection.



- Use system wiring with suitable cross-sectional areas and connectors that are approved for use at the maximum short-circuit current of the module.
- During wiring of the solar module, bending radius of junction box cable should not be less than 42mm, see below pictures for better understanding.
- When reverse currents can exceed the value of the maximum protective fuse marked on the back of the module, a properly rated and certified over current device (fuse or circuit breaker) must be connected in series with each module or string of modules.
- The fuse used is a glass / HRC type of rating 15 Amps. The fuse rating has to be greater than or equal to 135% of the module's short circuit current.
- The rating of the over-current device shall not exceed the value of the maximum protective fuse marked on the back of the module.
- Connecting modules in reverse polarity to a high current source, such as a battery, will destroy the bypass diodes and render the module inoperative. Bypass diodes are not user replaceable.

- The junction box is under no circumstances being opened. Opening the junction box may void the warranty.
- Ensure the cables & MC4 Connectors are not exposed to water logged areas and must not lay on the Roof/Ground; allowing so can cause material damage or degradation during module life time.

Modules with a suspected electrical problem should be returned to RenewSys for inspection and possible repair or replacement as per the warranty conditions provided by RenewSys.

#### **08.6. BLOCKING DIODES AND BYPASS DIODE:**

- Blocking diodes prevent current 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. Consult a specialist dealer to select suitable type of Diode to be used.
- In systems with more than two modules in series, high reverse current can flow through cells that are shaded partially or outright when 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 module from such high reverse currents, by- pass diodes are used in module.

#### **08.7. CONNECTING A BATTERY:**

- When solar modules are used to charge batteries, the battery must be installed in a manner which will protect the performance of the system and the safety of its users. The battery should be away from the main flow of people and animal traffic.
- The battery must be protected from sunlight, rain, snow, debris, and placed in a well-ventilated place.
- Most batteries generate hydrogen gas when charging, which is explosive. Do not light matches or create sparks near the battery bank.
- When a battery is installed outdoors, it should be placed in an insulated and ventilated battery case specifically designed for the purpose.

## **08.8. GRID-CONNECTED ELECTRICAL SYSTEM:**

- The DC electrical energy generated by photovoltaic systems can be converted to AC and connected to a utility grid system. As local utilities' policies on connecting renewable energy systems to their grids vary from region to region, consult a qualified system designer or integrator to design such a system. Permits are normally required for installing such a system and the utility must formally approve and inspect such a system before it can be accepted.

## **09. COMMISSION AND MAINTENANCE:**

### **09.1. TESTING:**

- Test all electrical and electronic components of the system before using it. Follow the instructions in the guides supplied with the components and equipment.
- Check the open-circuit voltage of every series of modules by a digital multi meter (fluke 170 series are recommended). The measured values should correspond to the sum of the open-circuit voltages of the individual module.
- Check the short-circuit current of every series circuit. It can be measured directly by a digital multi meter (such as Fluke 170) connected in the two terminals of series circuit or module, or with any load such as PV illumination to make a rough measurement. Attention, the rated scale of the ammeter or the rated current of load should more than 1.25 times of the rated short-circuit current of series module. The rated current is given in the Data-Sheet corresponding to the type of module used. The measured value can vary significantly, depending on weather conditions, the time of day and shading of the module.

### **09.2. TROUBLESHOOTING LOW VOLTAGES:**

- If the drop in the Open Circuit Voltage is nominally low (< 5%), then probable causes are higher temperature of the modules or lower irradiance. If these causes are eliminated, then look out for other causes.
- Excessive voltage drop is typically caused by improper connections at the terminals or defective bypass diodes.
- First, check all wiring connections to make sure all connections are correct.
- Check the open-circuit voltage of each module in the series:
- Fully cover the modules in the series with an opaque material.

- Disconnect the wiring at both terminals of all the modules.
- Remove the opaque material from the modules to be checked and measure the open-circuit voltage at its terminals.
- If the measured voltage is only half of the rated, this indicates a defective bypass diode. Refer the issue to Customer Support.
- If the diodes are working fine, and yet the measured voltages are lower than the rated voltages, then report the issue to Customer Support.

### **09.3. MAINTENANCE:**

RENEWSYS INDIA PRIVATE LIMITED (HYDERABAD DIVISION) recommends the following maintenance in order to ensure optimum performance of the module:

- Clean the surface of the module as necessary. Always use clean soft-water shower for cleaning and a soft sponge or cloth for wiping. A mild, non-abrasive cleaning agent can be used to remove stubborn dirt.
- Dirt must never be scraped or rubbed away when dry, as this will cause micro-scratches on the module.
- Check the electrical and mechanical connections at least once every six months to verify that they are clean, secure and undamaged.
- All fastenings are tight and secure and free of corrosion.
- All cable connections are secure, tight, clean and free of corrosion.
- Cables are not damaged in any way.
- Check the earthing resistance.
- If any problems are noticed, get them investigated and resolved by a competent specialist.
- Attention: Observe the maintenance instructions for all components used in the system, such as support frames, charging regulators, inverters, batteries etc.
- If any components of the Modules such as diode, junction box, plug connectors are found to be defective, do not attempt to change or replace. Report the issue to Customer Support.



#### **09.4. MODULE CLEANING:**

Periodic cleaning of module has resulted in improved performance levels, especially in regions with low levels of annual precipitation; therefore, RenewSys recommends periodic cleaning of the modules.

To clean a module, wash its surface with potable, non-heated water. Normal water pressure is adequate. Some fingerprints, stains, or accumulations of dirt on the surface may be removed with over-the-counter cleaners (such as Windex® or equivalent), or with a 3% soap-and-water solution. Wet the module surface with the solution, let it stand for five minutes, and then wet them again and use a soft sponge or seamless cloth to wipe the surface in a circular motion. Do not use harsh industrial-strength cleaning materials such as aggressive chemicals, scouring powder, steel wool, scrapers, blades, or other sharp instruments to clean the module. Use of such materials will void the product warranty.

#### **10. CONTACT & COMMUNICATION:**

##### **Corporate Office & Factory Address:**

RenewSys India Private Limited,  
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