



## INTRODUCTION

This Guide contains application and safety information with which you should be familiar before using your Mission Solar Energy, LLC ("Mission Solar") PV module. Your authorized Mission Solar distributor or dealer can provide additional sizing and system design information if necessary.

#### DISCLAIMER OF LIABILITY

Since the use of this guide and the conditions or methods of installation, operation, use, and maintenance of the module are beyond Mission Solar control, Mission 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. Mission Solar assumes no responsibility for any infringement of patents or other rights of third parties that may result from use of the module.

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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. Mission Solar 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.

#### WARNING!

#### IT IS RECOMMENDED TO UTILIZE A QUALIFIED INSTALLER OR RESELLER FOR SERVICE.

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 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.

If modules are connected in parallel, then each module (or series string of modules so connected) shall be provided with the maximum series fuse as specified.

For roof mounting, the assembly is to be mounted over a fire resistant roof covering rated for the application.

#### **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 for motor vehicle applications for which additional requirements may apply.

#### Electrical ground module(s) for all systems of any voltage

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 Laboratories Listing Information**

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

- 1. Conductor recommendations: single conductor cable, type USE-2 (non-conduit), 8-14AWG (2.5-10mm2).
- 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.

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# 1.0 WARNING AND NOTICES

• 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 30 VDC 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 drill holes into module frame, as it will void warranty.



- 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.



- Do not artificially concentrate sunlight on the module.
- Keep back surface free from foreign objects.



Mission Solar modules are comprised of a glass front surface and Tedlar backsheet and possess a Class C fire rating.



- Since sparks may be produced, do not install module where flammable gasses or vapors are present.
- 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 manufacturers' 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.
- The modules have been evaluated by UL for a maximum positive or negative design loading of 30 lbs/ft2.
- The installation of Mission Solar modules should conform to electrical regulation of various countries.

# 2.0 INSTALLATION AND OPERATION

- Systems should be installed by qualified personnel only. The system involves electricity and can be dangerous if the personnel are not familiar with the appropriate safety procedures.
- Do not step on the module.
- Although Mission Solar modules are quite rugged, the glass can be broken (and the module will no longer work properly) if it is dropped or hit by tools or other objects.
- Sunlight shall not be concentrated on the module.
- The module frame is made of anodized aluminum and therefore corrosion can occur if the module is subject to a salt-water environment with contact to a rack of another type of metal. (Electrolysis Corrosion) If required, PVC or stainless steel washers can be placed between the solar module frame and support structure to prevent this type of corrosion.
- Module support structures that are to be used to support Mission Solar module(s) should be wind rated and approved for use by the appropriate local and civil codes prior to installation.

# 3.0 MECHANICAL INSTALLATION

## 3.1 HOW TO INSTALL MISSION SOLAR MODULES

The aluminum frame of each module has 7mm diameter mounting holes for 72-cell module. These holes are used to fix the modules to the supporting structure. An example of a ground-mounted structure is shown as below.



## 3.2 MOUNTING METHOD USED BY UL

The 72 cell modules have been evaluated by UL for mounting using the 2 provided 7 mm diameter mounting holes in the long sides of the frame. M7 (7 mm x L30 mm) stainless screw with M7 spring washer, and M7 nylon clock nut were placed into each 7mm diameter mounting hole. The torque force is 6.5 foot-pound for securement.

## 3.3 ROOF MOUNT

Often the most convenient and appropriate place to put the PV array is on the roof of the building. The PV array may be mounted above and parallel to the roof surface with a standoff of 3 inches for cooling purposes. Sometimes, such as with flat roofs, a separate structure with a more optimal tilt angle is mounted on the roof. Proper roof mounting can be labor intensive. Particular attention must be paid to the roof structure and the weather sealing of roof penetrations. It is typical to have one support bracket for every 100 Watts of PV modules. For new construction, support brackets are usually mounted after the roof decking is applied

and before the roofing materials is installed. The crew in charge of laying out the array mounting system normally installs the brackets.

The roofing contractor can then flash around the brackets as they install the roof. A simple installation detail and a sample of the support bracket is often all that is needed for a roofing contractor to estimate the flashing cost.

Masonry roofs are often structurally designed near the limit of their weight-bearing capacity. In this case, the roof structure must either be enhanced to handle the additional weight of the PV system or the masonry roof transitioned to composition shingles in the area where the PV array is to be mounted. By transitioning to a lighter roofing product, there is no need to reinforce the roof structure since the combined weight of composite shingles and PV array is usually less than the displaced masonry product.



Figure 1: Roof Mounted PV System

#### FIRE RATING

Mission Solar standard modules are comprised of a glass front surface and Tedlar back sheet. The standard modules are PV Type Designation 2.

#### 3.4 GROUNDING

Before installing your solar system, contact local authorities to determine the necessary grounding. Attach all module frames to an earth ground in accordance with the National Electrical Code (NEC). The grounding method of the frame of arrays shall comply with the NEC, Article 250. For CNL marked modules, the installation shall be in accordance with CSA C22.1, Safety Standard for Electrical Installations, Canadian Electrical Code [Part 1]. CNL model instruction manuals shall be provided in French as well as in English. Proper grounding is achieved by connecting the module frame(s) and structural members contiguously one to another using a suitable "grounding conductor". Please use corrosion resistant hardware while grounding. Any hardware such as copper hardware which may cause corrosion or degradation of aluminum frame should be avoided. The grounding conductor, or strap, may be copper, copper alloy, or another material acceptable for use as an electrical conductor per NEC. The grounding conductor must then make a connection to earth using a suitable earth ground electrode. Ensure positive electrical contact through the anodizing on the module's frame by utilizing the following grounding method.

#### A. GROUNDING\_METHOD

Please use existing 4.5mm diameter grounding holes in the PV module back flange to ground PV module. Refer to diagram below.

Please use the SolKlip ground clips. Part number 1954381-1. (UL approval number E69905) of Tyco Electronics corporation as the grounding component. In addition, use solid uninsulated copper wire sizes 10 or 12 AWG as grounding conductor. The wire must not be nicked, cut, or scraped.



### **B. MOUNTING GROUNDING SOLKIP GROUND CLIP TO FRAME**

The SolKlip grounding clip must be placed onto the frame so that the stainless steel #10-32 cutting screw straddles the pre-drilled grounding hole. It is recommended that the stainless steel #10-32 cutting screw, stainless steel star washer and stainless steel M5 nut be tightened to a torque of 1.5 foot-pounds (7 Nm). The head of the screw must be flush with the base and the base must be flush with the frame. Care must be used to avoid interference between adjacent grounding clips and other components for removal of the grounding clips. Refer to Figure 2.



Figure 2

#### **B.1 GROUNDING WIRE PLACEMENT**

The solid uninsulated copper wire sizes 10 or 12 AWG. Grounding wire must be bottomed in the wire slot of "SolKlip ground clips". Refer to Figure 3.



#### B.2 TERMINATING THE WIRE

Push the slider of SolKlip ground clips to be engaged (slider covers the base). Refer to Figure 4.



### B.3 <u>REMOVAL</u>

The grounding wire can be removed from the grounding clip when the slider is disengaged (slider and screw is exposed). The cutting screw must be loosened before the grounding clip can be removed from the frame.

### B.4 TOOLING

A No.2 cross-recessed screwdriver must be used to secure (and remove) the screw of the grounding clip to the frame. The slider can be engaged manually or channel lock pliers can be used to engage the slider. A flat-heed screwdriver must be used to disengage the slider.

#### **B.5** VISUAL INSPECTION

The illustration below shows the appropriate grounding installation of SolKlip ground clips assembly. This illustration should be used by assembly personnel to ensure a correctly grounding installation. Applications, which DO NOT appear correct, should be inspected using the information in the preceding pages of this grounding method. Refer to Figure 5.



### **B.6** 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.

The module has been evaluated for use with a standoff height of 200mm or 7.87 inches.



### 4.0 ELECTRICAL INSTALLATION

- 4.1 Avoid all electrical hazards when installing, wiring, operating and maintaining a module.
- 4.2 Do not use modules of different electrical or physical configurations in the same system.
- 4.3 The maximum open circuit voltage of the system must not be greater than the specified maximum system voltage for the module.
- 4.4 Module frames should be connected to an earth ground for safety and protection from lightning.
- 4.5 All Mission Solar modules are equipped with factory-installed wires and quick connectors. Modules are designed to be easily interconnected in series.
- 4.6 Use system wiring with suitable cross-sectional areas and connectors that are approved for use at the maximum short-circuit current of the module.
- 4.7 Match the polarities of cables and terminals when making the connections; failure to do so may result in damage to the module.
- 4.8 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.
- 4.9 The rating of the over-current device shall not exceed the value of the maximum protective fuse marked on the back of the module.
- 4.10 The module contains factory installed bypass diodes located inside the junction box.
- 4.11 The junction box is not designed or certified to be field accessible or maintainable and should under no circumstances be opened. Opening the junction box may void the warranty.
- 4.12 Modules with a suspected electrical problem should be returned to Mission Solar for inspection and possible repair or replacement as per the warranty conditions provided by Mission Solar.
- 4.13 Warning: 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.

# 5.0 MODULES AND TERMINATION

## 5.1 SUNTER PV-ZH202 PLUG CONNECTOR

Attention: Do not disconnect under load! Current path should only be disconnected using approved disconnect devices. To protect against shock, ensure that conductors and their associated connectors are separated from opposite polarity components.

Connectors labeled with a + or – are keyed and can only be mated to similarly marked and keyed connectors.



### A. DISCONNECTING



CAUTION: Do not disconnect the connector under load!

Disconnect circuit from load before unplugging connectors.

### **B. UNMATING OF THE CONNECTOR**



B.1 De-pressing the latches as shown above opens the locking mechanism.

B.2 Pull out the connectors. While depressing the latches, disconnect the connector by pulling the connector halves apart

# 6.0 MAINTENACNE, TESTING AND TROUBLESHOOTING

### 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.

## 6.1 SYSTEM TEST & 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.

A. 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. 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.



**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.

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

B. 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 ½ 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 Mission Solar customer service for warranty information.

# 7.0 INSTALLATION FOR MODULES WITH STANDARD ALUMINUM FRAME

- Install using mounting holes. For 72 cell module, Insert one M7 (7mm \* L30mm) stainless screw with M7 spring
  washer placed into each 7mm diameter mounting hole (8 mounting holes in one module). Then use M7 nylon
  lock nuts to secure module on support structure. For 60 cell module, Insert one M8 (8mm \* L30mm) stainless
  screw with M8 spring washer placed into each 9mm diameter mounting hole (4 mounting holes in one
  module), then use M8 nylon lock nuts to secure module on support structure.
- During securing, the torque force should be 6.5 foot-pounds or more.
- Refer to product spec sheet for hole location.
- If using one pair of mounting rails, use inner most holes.
- Alternatively, clamps may be used. Follow the guidance below on location of clamps:



**60 cell module** Short side: not allowed Long side: 205-410mm (from edge)

**72 cell module** Short side: not allowed Long side: 245-489mm (from edge)

# 8.0 SPECIFICATION

# 8.1 SPECIFICATIONS

Model	Cell	Pmax	L	W	Н
MSE60A (290-315)	60	290-315W	1646mm	992mm	40mm

## 8.2 SCHEMATIC



## 8.3 ELECTRICAL SPECIFICATION

Model #	Voc	Vmp	Maximum	Imp	lsc	Max	Maximum
			System			Power	Series
			Voltage				Fuse, (A)
MSE60A290	39.77	32.00	1000	9.06	9.62	290	20
MSE60A295	40.11	32.24	1000	9.15	9.77	295	20
MSE60A300	40.45	32.48	1000	9.24	9.91	300	20
MSE60A305	40.79	32.73	1000	9.32	10.06	305	20
MSE60A310	41.14	32.97	1000	9.40	10.21	310	20
MSE60A315	41.49	33.22	1000	9.48	10.37	315	20

### Note:

- 1) Rated electrical characteristics are within 10% of measure 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 US National Electrical Code for an additional multiplying factor of 1.25, which may be applicable.

# 8.4 JUNCTION BOX SPECIFICATION

Junction	Boxes
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Dimensions:	Depending on junction box type		
Temperature Range:	-40 °C to +105 °C		
Wire Size Range:	up to AWG 12		
Protection Degree:	IP 67 closed		
Connector			
Dimensions:	Diameter 18 mm, (diameter 0.71 inch)		
Temperature Range:	– 40 °C to +105 °C		
Wire Size Range:	AWG 14, AWG 12, AWG 10 stranded wire		
Protection Degree:	IP 67, mated		
Contact Finish:	silver plated,		
Mating Cycles:	50, silver plated		
Unmating Force:	30-40 Newton		
Additional Features:	Coded housing ensures mating safety Contact voltage-proof Connector with crimp technology		
Standards	IEC 61215 Edition 2, 61646, IEC 61730, Protection Class II, UL 1703		

# 8.5 BYPAS DIODE SPECIFICATION

## SUNTER JUNCTION BOX

Diada Manufacturar	Diada Turpa	Diode Ratings		
	Diode Type	(A)	(PIV)	
Ningbo ZhongHuan Sunter PV Technology Co., Ltd	20SQ045	20	45	

# 9.0 LIMITED WARRANTY

Mission Solar PV modules come with limited workmanship and performance warranties. Please refer to the Mission Solar PV Module Warranty document for details.

# 10.0 PV MODULE INSTALLATION INSTRUCTION EMPLOYING EXTRUDED ALUMINUM FRAME

## 10.1 INSTALLING MODULES

The aluminum frame of each module uses a specially designed, highly rigid module frame that enables the modules to be attached directly to the roof at the perimeter of the frame without the use of underlying racking or rails. Modules are connected together in the east-west direction with E-W Splices, and share roof mounts between rows using N-S Brackets. As shown in the figure below, an array of 6 modules composed of two rows of three modules would have 9 roof mounts (assuming rafter spacing of 16" and roof attachment spacing of 48").



Note that 20 modules is a more typical array size; however, for clarity a very small array is shown.



## 10.2 ATTACHING MODULES TO ROOF SURFACE

Modules are attached to the roof mount using an L Foot. Depending on the type of roof surface, this roof mount may be a flashing, standoff, hook or bracket. Follow the instructions for the roof mount for the type of roof surface being used. Instructions for the roof mount will describe the way in which the roof mount is attached to the roof surface, and the way in which the L Foot will be attached to the roof mount. L Feet have 1-1/2" of vertical adjustability to account for uneven roof surfaces. Typical distance from the bottom of the module frame to a composition roof surface is 3".

The specific number of roof mounts will be determined by the rafter spacing, rafter type, roof slope, module orientation, risk category, exposure category,

snow load, wind speed, roof type and other characteristics as defined by the system designer. The distance between mounting points is typically 48", but may be more or less depending on system characteristics. The maximum unsupported length of a module at the end of a row (cantilever) is 16".

To attach the L Foot to the module, insert a 3/8-16 x 1" T bolt in the bottom slot of the module. Slide the T bolt into the open vertical slot in the L Foot, and secure the T bolt with a 3/8-16 flange nut. Ridges in the side of the module should engage with ridges in the side of the L Foot. Torque the flange nut to 25 foot-pounds.



## **10.3 ATTACHING MODULES TOGETHER**

Adjacent modules are connected side-by-side with E-W Splices. Hex bolts on the top of the E-W Splices should be loose so that the bottom clamp can be depressed by pushing down on top of hex bolt. Insert two E-W Splices in the first module already installed (should already be secured with two or four L Feet to the roof). One splice is installed at the top of the module, and one at the bottom of the module. E-W Splices slide into the upper groove of the module and snap into place when the two modules are close together and properly aligned. Tighten the 1/4-20 hex bolts at the top of each E-W Splice to torque of 5 foot-pounds. The teeth on the bottom clamp of the E-W splice go towards the outside edge of the module frame and establish a bond path between adjacent modules.



### 10.4 ATTACHING ROWS TOGETHER

Adjacent rows of modules are connected together with N-S Brackets. Attach an N-S bracket to each L-Foot that is securing the top of the first row of modules. A 3/8-16 x 1" T bolt is used to attach the N-S Bracket to the upper side of the L Foot, and the T bolt is secured with a 3/8-16 flange nut (use the same T bolt and nut that is used to attach the L Foot to the module).

Torque the flange nut to 25 foot-pounds. Ridges on N-S bracket must engage with ridges of L-Foot. Hex bolts on top of N-S Brackets should be loose so that clamp can be depressed by pushing down on top of hex bolt. Slide the next module in the row above into the N-S Bracket, with the bottom clamp supporting the bottom of the module. Once the module is secured by one

or more N-S Brackets towards the downslope of the roof and the module is secured by one or more L Feet at the top of the roof, tighten the 1/4-20 hex bolts at the top of each N-S Bracket to a torque of 5 foot-pounds. The teeth on the bottom clamp of the N-S Bracket establish a bond path between adjacent rows of modules.



### 10.5 GROUNDING

Install a grounding lug in one of the identified grounding holes on one module in each contiguous array. Use the grounding assembly by sliding the star washer on the steel bolt, inserting the bolt through the front of the grounding lug, sliding the spacer onto the bolt, inserting the bolt through the grounding hole on the module, and securing the bolt with the star washer/nut from the back side of the module. Torque the bolt to 60inch pounds. A solid gauge copper wire, AWG 4-10, is attached to this grounding lug. The copper wire is then connected to Ilsco, type GBL-4DB and torque to 20 in-lb. for 10 to 12 AWG size wire, or 35 in-lb. for 4 to 6 AWG size.

# www.missionsolar.com

# **Mission Solar Energy**

8303 S. New Braunfels Ave. San Antonio, Texas 78235 info@missionsolar.com 210-531-8600