



Solar Integrated Solar Roof Panel System Installation Manual



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Table of Contents

IMPORTANT - READ ALL SAFETY WARNINGS FIRST

	Page
Disclaimer.....	1
Safety and Site Security.....	2
Pre-Construction Meeting.....	2
General Safety Instructions.....	3
Cautions.....	4
System Description.....	5
Solar Roof Panel Electrical and Physical Specifications.....	7
System Siting and Roof Preparation.....	8
Rooftop Safety.....	8
Delivery, Storage and Handling.....	8
Safe Lifting Materials to Roof.....	9
Roof Preparation.....	9
Roof Layout and Installation.....	10
Balance of System Installation and Grid Intertie.....	14
System Testing and Start-up.....	15
Troubleshooting and Repair.....	16

Disclaimer

The information contained in this manual is based on Solar Integrated's (SI) knowledge and experience, but such information does not constitute a warranty expressed or implied. The installation, use and maintenance of SI Solar Roof Panels and Systems are beyond the control of SI. SI assumes no responsibility and expressly disclaims liability for any loss, damage or expense associated with the use, installation or operation of SI Solar Roof Panels and Systems. Any liability of SI is strictly limited to the Limited Warranty. SI reserves the right to make changes to product specifications and to this manual without notice.

Safety and Site Security

Safety and Security Supervisor

Solar Integrated (SI) solar roof panel and system installations shall have a **safety and security supervisor** whose job is to schedule safety and security meetings and ensure strict compliance with all safety and security procedures.

Before the installation, the safety and security supervisor shall have a general safety and security meeting attended by project superintendent, project foreman, all subcontractors, the property owner or his representative and other personnel associated with the work. The purpose of the meeting is to discuss all safety and security procedures including site conditions, potential hazards and the safeguards necessary to accomplish the work in a safe and secure manner. If a subcontractor or other participants are unable to attend the general safety meeting, it is the responsibility of the safety and security supervisor to meet with those persons and provide them with safety and security information discussed at the general meeting.

The safety and security supervisor and the foreman or job crew chief shall give daily tailgate safety and security meetings at the start of each work day and conduct daily job site inspections before and at the end of each work day.

Site security includes site access control and equipment and materials control. Unauthorized personnel are forbidden from the work site and the flow of materials, tools, equipment and vehicles shall be closely monitored and controlled.

Pre-Construction Meeting

The contracting installer, the owner or his representative, subcontractors and SI shall meet to discuss all aspects of the project including but not limited to safety, set-up, construction schedule, contract conditions and coordination of the work.

General Safety Instructions

The installation, maintenance and repair of the SI solar roof panel and system involves possible contact with potentially lethal voltages and currents. No attempt to install or service the system should be made by anyone who is not a qualified, trained technician familiar with electrical installations and power electronic equipment.

GROUNDING The SI solar roof panel has a red DC positive wire and a black DC negative wire. Verify that the DC-to-AC inverter(s) used in the PV system have ground fault protection and that the DC circuits of the PV system are not earth grounded.

Refer to the National Electrical Code (NEC) Sections 250 and 690 for proper compliance in wiring and grounding of the system.

WARNING Read these installation instructions completely before installing, using and maintaining the SI Solar Roof Panel. Contact with electrically active parts of the solar roof panel such as wires and connectors can result in burns, sparks, and lethal shock whether the solar roof panel is connected or disconnected. The word “panel” refers to the solar roof panel. An array refers to an assembly of panels.

WARNING The installation of solar electric panels should only be performed by trained and qualified personnel. Unauthorized persons and children should not be allowed near the solar electric installation. Follow all permit, installation and inspection requirements and all local, regional and national electrical codes. Follow the safety precautions of all other system components.

WARNING Solar roof panels produce electricity when sunlight or other sources illuminate the front face. The voltage from a single panel is a shock hazard. When panels are connected in series, voltages are additive. When panels are connected in parallel, current is additive. A solar roof power system can produce high voltages and current which could cause serious injury or death.

CAUTIONS

- The SI Solar Roof Panel and System contain live electrical components enclosed and protected within. Do not cut or drive screws into any part of the SI Solar Roof Panel and System where solar modules or wiring are present which includes, but is not limited to the Uni-Solar module, the SI inter-panel wiring assembly and the rooftop solar array wiring.
- Maintain good housekeeping conditions and perform all tasks in a safe, workman-like manner.
- Avoid electrical hazards when installing, wiring, operating and maintaining the solar roof panel and all other electrical equipment.
- A panel generates DC electricity when exposed to sunlight or other light sources.
- Do not touch the exposed copper wire leads while the panel is exposed to light or during installation. Use properly insulated tools only.
- Work only under dry conditions with dry panels and tools.
- The SI Solar Roof Panel is slippery when wet. Use extreme caution and proper roof safety practices when working on or near the panels.
- Do not stand or step on the panel.
- Do not drop the panel or allow objects to fall on the panel.
- Do not place equipment on the SI Solar Roof Panel.
- Use insulated tools when wiring solar panels. Cover solar panels with an opaque material before making wiring connections to reduce the risk of electric shock or sparks.
- Never leave a panel unsecured. Keep the panel front and back surface free from foreign objects.
- Do not install panels where flammable gases or vapors are present since sparks may be produced.
- Do not drill or cut holes in the panel solar modules or wiring. Avoid sharp edges.
- Artificially concentrated sunlight shall not be directed on the panel.
- Use the panel for its intended use only. Do not disassemble the panel or remove any part or label installed by the manufacturer.

System Description

The SI Solar Roof Panel is a Building Integrated Photovoltaic (BIPV) flexible solar electric roofing panel designed to serve the bi-functional needs of roofing and power generation. The SI Solar Roof Panel is a combination of flexible photovoltaic (PV) modules fused to an industrial membrane. The wiring interconnecting all of the PV modules is embedded within the panel. The membrane is long-lasting, heat-weldable poly vinyl chloride (PVC) with integral reinforcement for high strength and contains ultraviolet (UV) stabilizers, flame retardant and mold resistant biocide. The PV modules have a stainless steel substrate and bypass diodes for each cell for shade tolerance. The non-glass cover is a durable UV stabilized polymer that repels dust and environmental pollutants.



Four SI744G1 (SR2004A) Solar Roof Panels

The standard method of installation for the SI solar roof panel is hot air welded in strict accordance with the membrane manufacturer's specifications and practices. This installation manual covers only the heat welded attachment method. Contact SI for information about other installation attachment methods which include Adhered, Mechanically-Attached, and Ballasted systems.

The SI panel is heat welded directly to the roofing membrane with a hot-air welder. The advantage of the fastening system is speed of installation and simplicity of design. The high-strength reinforced membrane and seam-attached system exceeds Factory Mutual (FM) requirements for wind uplift testing.

The SI panel shall be applied only by a Roofing Contractor authorized by Solar Integrated and shall be in strict compliance with the membrane manufacturer's specifications.

The SI Solar Roof Panel weighs 12 ounces per square foot (12 oz/ft²). The weight of a solar roof assembly consisting of SI panels, fasteners, gypsum board underlay, rigid foam board insulation, electrical wiring and conduit is approximately 2.6 pounds per square foot (2.6 lbs/ft²). Roof loading must be within the structural capacity of the building roof and may require calculations from a licensed structural engineer. The maximum allowable roof slope is 2 inches in 12 inches (2-in-12).

The electrical characteristics of the SI Solar Roof Panel are within ± 10 percent of the indicated values of I_{sc}, V_{oc}, and P_{max} under standard test conditions (irradiance of 100 mW/cm², AM 1.5 spectrum, and a cell temperature of 25° C (77° F)).

During the first 8-10 weeks of operation, electrical output exceeds specified ratings. Power output may be higher by 15%, operating voltage may be higher by 11% and operating current may be higher by 4%.

Under normal conditions, a photovoltaic panel is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} for this panel should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, fuse sizes, and size of controls connected to the PV output.

The V_{oc} multiplying factor for the SI panel at conditions of an irradiance of 125 mW/cm², AM 1.5 spectrum, and a cell temperature of minus 10° C (plus 14° F) is -0.38%/degree C.

The I_{sc} multiplying factor for the SI panel at conditions of an irradiance of 125 mW/cm², AM 1.5 Spectrum, and a cell temperature of plus 75° C (167° F) is +0.10%/degree C.

Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent derating) which may be applicable.

Solar Integrated solar panels consist of amorphous (non-crystalline) silicon solar cells. The maximum system dc photovoltaic source circuit or output circuit is 600 volts. Solar Integrated solar panels shall be connected to a dc-to-ac inverter with an integrated nighttime disconnect switch or an inverter through a separate nighttime disconnect switch that opens (interrupts) the circuit at night and in low-light conditions (below 70 W/m² irradiance). The nighttime disconnect switch shall open (interrupt) the circuit when not energized and remain open whenever the voltage is not between 180 and 600 volts dc or within the inverter dc input voltage range. The nighttime disconnect switch shall close (complete) the circuit when sunlight is present and the inverter is energized. The installer shall test the nighttime switch to ensure proper performance before energizing the system. Refer to Section 690-7 of the National Electrical Code.

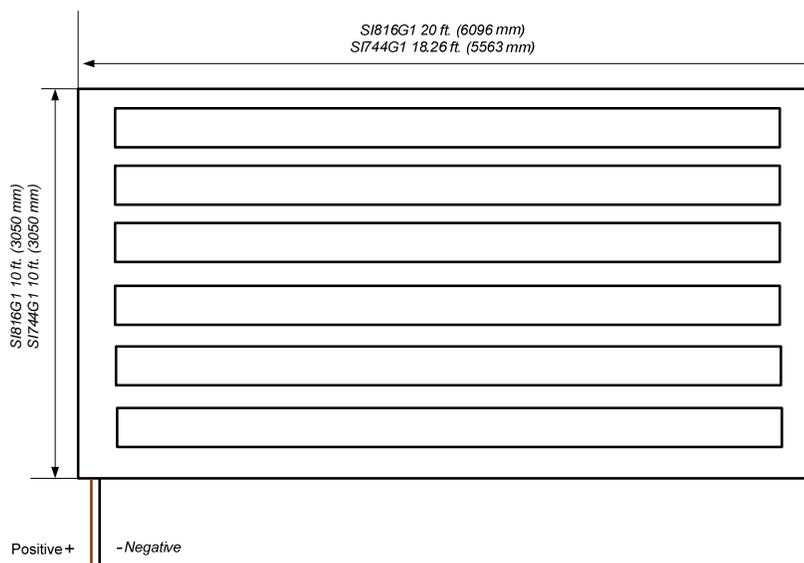
Solar Panel Electrical Specifications

Model	SI816G1 (SR2001A)	SI744G1 (SR2004A)
Maximum Power watts DC STC	816	744
Maximum Power watts DC PTC	772.4	704.2
Operating Voltage (Vmax)	198	180
Open Circuit Voltage (Voc)	277.2	252
Operating Current (Imax)	4.13	4.13
Short Circuit Current (Isc)	5.1	5.1
Maximum System Volts	600	600
Series Fuse Rating Amperes	8	8
Minimum Blocking Diode Amperes	8	8

Solar Panel Physical Specifications

	SI816G1 (SR2001A)	SI744G1 (SR2004A)
Length ft / mm	20 / 6096	18.26 / 5563
Width ft / mm	10 / 3050	10 / 3050
Thickness in / mm	0.12 / 3.05	0.12 / 3.05
Area ft ² / m ²	200 / 18.58	182.6 / 16.93
Weight per Panel lb / kg	147.73 / 67	134.5 / 61
Weight/Area lb/ft ² / kg/m ²	0.74 / 0.34	0.74 / 0.34
Class A Fire Rating	Yes	Yes

Specifications are subject to change without notice.



System Siting and Roof Preparation

IMPORTANT SI Solar Roof Panels shall be applied only by a licensed roofing contractor authorized by Solar Integrated. The Balance of System (BOS) shall be installed only by a licensed contractor qualified to perform electrical work.

Rooftop Safety

Inspect the roof deck to ensure that it has adequate strength and is secure and free of deterioration before loading the roof with workers, material and equipment. Cover roof openings, install guardrails and use other hazard warning and fall protection systems as required before beginning work. The safety and security supervisor shall ensure that all workers comply with site specific safety instructions.



Delivery of SI Solar Roof Panels to Job Site

Delivery, Storage and Handling

Product delivery, storage and handling shall comply with the manufacturers' instructions. SI panels shall be stored in an ambient temperature of 15° C to 30° C (50° F to 85° F). SI panels delivered to the site shall be in the original unopened containers or wrappings. Handle all materials to prevent damage. Place all materials on pallets and fully protect from moisture. SI panels must be handled so that the solar modules are not creased or bent and panels must not be coiled any tighter than 20 inches in diameter.



Lifting SI Solar Roof Panels rolled on shipping tubes

Safe Lifting Materials to Roof

Survey the site and use the best location for the crane or forklift to lift materials to the roof. The designated lifting area shall have adequate strength and space for staging materials and shall be secured and roped off. One worker shall be designated to direct pedestrian and vehicle traffic and make sure that all people are aware of materials being lifted overhead. Hardhats must be worn by all workers at all times during crane or forklift operation.

Roof Preparation

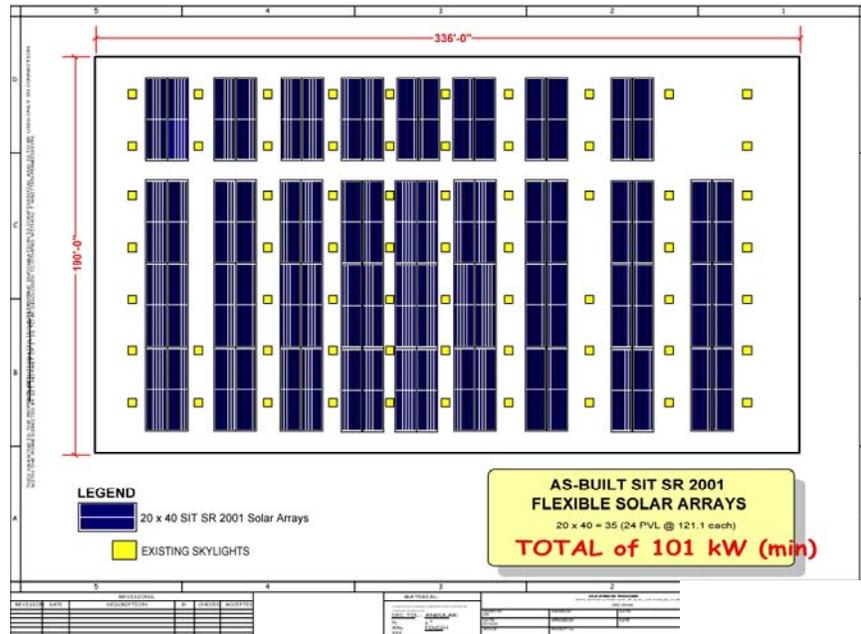
Clean the roof of any debris and dirt by broom, power vacuum, blowing air or similar methods. All loose gravel shall be removed. Installation of the SI panel over coal tar pitch or a resaturated roof requires special consideration to protect the pvc membrane from volatile fumes and materials. Consult SI for precautions. Verify that all roof drains are functioning properly.

Roof Layout and Installation

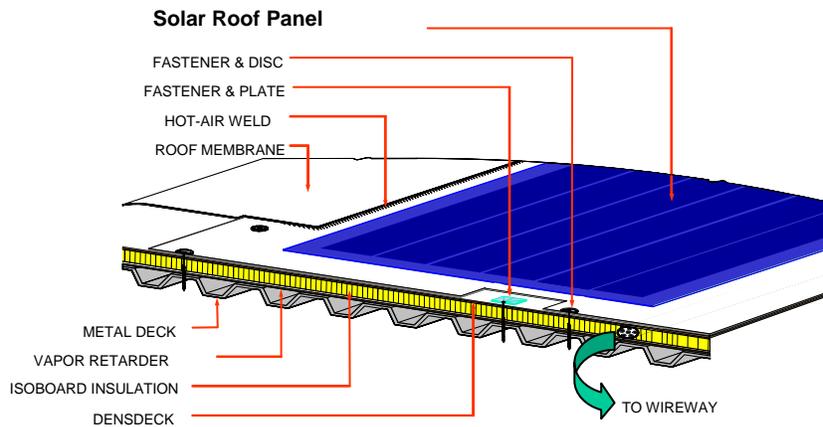
Survey the roof to ensure that all measurements and the location of all roof penetrations are consistent with the drawings.

For field connections, use No. 12 AWG wires insulated for a minimum of 90 degrees C. Use larger gauge wire with 90 degrees C insulation if required based on site specific wire resistance losses. Use copper wire only.

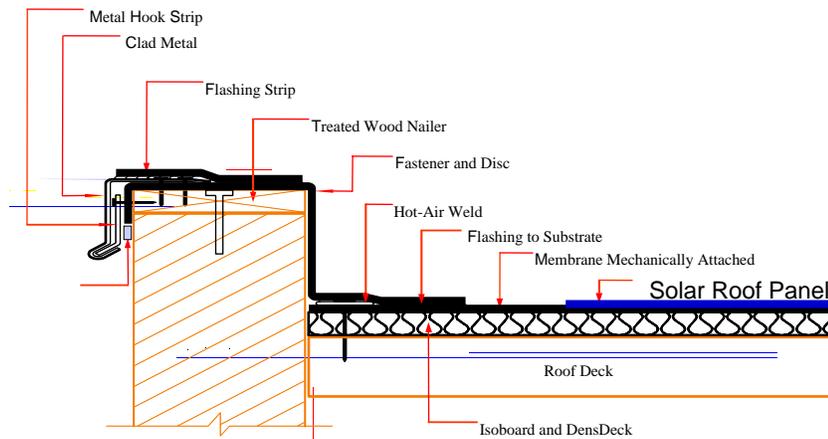
Locate each SI panel in accordance with the Roof Layout Drawing and mark the location for each junction box. Lay out and install the roof conduit.



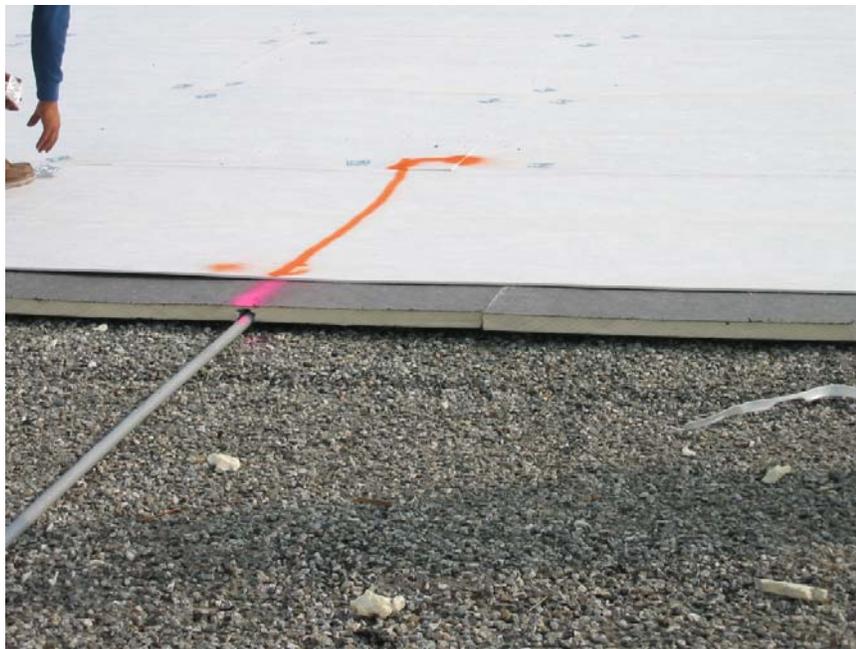
Typical Roof Layout Drawing



Typical Attached System to Metal Deck



Typical System Attached to Wood Deck



Roof deck with conduit, insulation board and gypsum board

For a solar roof system with in-roof conduit, insulation board and gypsum board, route out the insulation board where the conduit will fit into the board. Lay the board down over the conduit. Lay out the gypsum board over the insulation board and attach to the roof deck with mechanical fasteners. Insulation board and gypsum board shall be installed according to the manufacturers' instructions. Mark conduit locations on insulation board and gypsum board with spray paint.



Gypsum board marked to show conduit runs

SI panels shall be installed according to the membrane manufacturer's instructions for mechanical attachment and as specified by SI. Check each SI panel for proper voltage. Prior to fastening and heat welding the panel, feed the panel wire leads through the conduit to the electrical junction box.



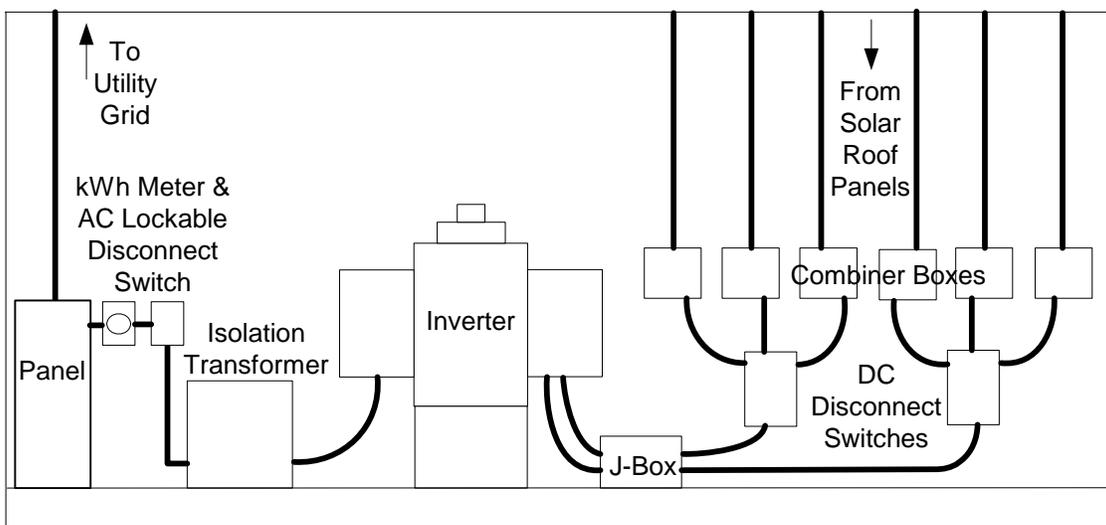
Installing SI Solar Roof Panels on existing pvc roofing



CAUTION HAZARDOUS VOLTAGES Check each SI panel for proper voltage before feeding panel leads through roof conduit to a Junction Box mounted in the building directly below the roof deck. Remove Combiner Box fuses and check the panel polarity before connecting panel lead wires within the combiner box. **DO NOT** replace the fuses at this time.

Balance of System (BOS) Installation and Grid Intertie

Locate and mount the Combiner Boxes, DC Disconnect, Inverter, AC Disconnect and Isolation Transformer near the building's electrical service panel. **WITH THE AC AND DC DISCONNECT SWITCHES OPEN**, complete the interconnection at the building electrical panel in accordance with inverter manufacturer's instructions and all Codes and Utility Company requirements.



Typical Equipment Layout for 100 kW Solar Roof Panel System

Note: Combiner Boxes may be installed on roof

System Testing and Start-up

1. Remove fuses from Combiner Boxes.
2. Open (off) the DC and AC Disconnect Switches.
3. Visually inspect the entire system before startup for properly installed panels, wiring, conduit, fasteners, connections and equipment mounts and hardware.
4. Refer to the Inverter Instruction Manual and verify proper installation of the DC and AC disconnects and all DC and AC wiring.
5. Verify system grounding with an ohm-meter.
6. Identify polarity and measure open circuit voltage (Voc) for each panel string which should be $\pm 3\%$ of predicted design values. Record results for each string circuit.
7. Megger test each panel string circuit to verify electrical isolation and replace Combiner Box fuses at this time.
8. Megger test the isolation transformer.
9. Megger test circuit breakers and fused disconnects.
10. Verify all protection functions of under/over voltage/frequency, and ground fault detection of utility intertie protective relays.
11. Verify inverter grounding.
12. Verify voltage and polarities at main DC disconnect switch while open and main AC disconnect switch while open.
13. Close AC disconnect and verify inverter functions.
14. Close DC disconnect and initiate start of system.
15. Perform inverter operational tests including local operation and control and wake-up and sleep separation.
16. Measure each panel string circuit current with a clamp-on DC ammeter and record the readings.

Troubleshooting and Repair

FIRST Check for open circuit breakers, blown fuses and loose wires.

Panel string voltage not as predicted

With AC power off, disconnect the solar panel at the roof junction box and measure panel open circuit voltage (Voc). If panel Voc is incorrect, contact SI for instructions. If panel Voc is correct, test the homerun wire to the Combiner Box for opens, shorts or incorrect resistance reading. If wiring is bad, ensure that all conduit and conduit fittings are in good condition and replace the bad wire with new wire.

Inverter and Disconnects not functioning properly

Refer to manufacturers' instructions for testing and troubleshooting.