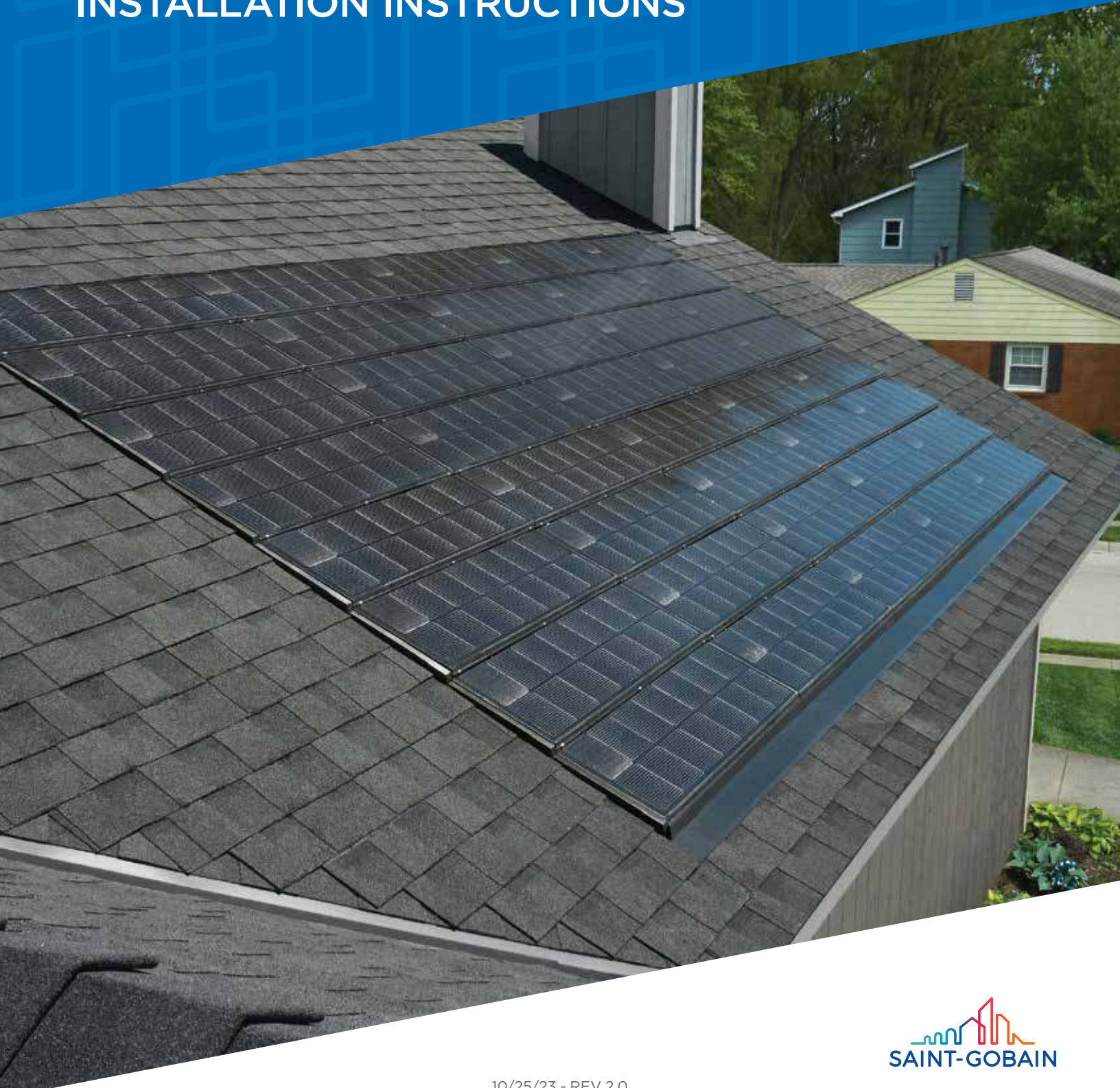




# Solstice™ Shingle

## INSTALLATION INSTRUCTIONS





- Safety Precautions .....4**
- Installation Limitations .....4**
- Installation Requirements .....5**
- Recommended Tools and Materials .....5**
- System Overview .....6**
- Additional Parts (not shown in System Overview) .....6**
- Prior to Installing Solstice Shingle™ System .....8**
- Solstice Shingle™ Fire Rating .....9**
- Installing the Solstice Shingle™ System .....9**
- STEP 1 - Plan..... 9
- STEP 2 - Install Bottom Flashing ..... 10
- STEP 3 - Apply Waterproofing Underlayment..... 10
- STEP 4 - Install the Starter Strip..... 10
- STEP 5 - Apply FR Underlayment (for Class A systems only)..... 11
- STEP 6 - Attach the Solstice Shingle™ ..... 12
- STEP 7 - Complete the First Row..... 12
- STEP 8 - Wiring the PV Shingles ..... 12
  - Proper Connections..... 13
  - Wire Management..... 13
- STEP 9 - Installing the Next Row of PV Shingles..... 14
- STEP 10 - Wiring the Second Row ..... 14
- STEP 11 - Continue Installing PV Shingles ..... 14
- STEP 12 - Install Side Flashing..... 15
- STEP 13 - Roof Deck Penetration..... 16
- STEP 14 - Install the Right Corner and First Top Flashing ..... 17
- STEP 15 - Install the Left Corner Flashing ..... 18
- STEP 16 - Inside Corner Installation Instructions ..... 18
  - Wiring Inside Corners..... 19
  - Right Inside Corner Flashing Installation..... 19
  - Left Inside Corner Flashing Installation..... 20
- STEP 17 - Install Surrounding Asphalt Shingles..... 20
- STEP 18 - Balance of System Installation ..... 22
- Appendix A - Sample Wiring Diagram .....23**
- Appendix B - How to Test a Course/String During Installation ..... 24**
- Appendix C - Electrical Parameters Table .....25**
- Appendix D - Technical Data Sheet: Solstice Shingle 70W-01 .....26**
- Appendix E - Rating Label: Solstice Shingle 70W-01 .....28**
- Photovoltaic Hazard Control System (PVHCS) Manual .....29**
- Document Revision History. .... 31**

## Safety Precautions

- A Solstice Shingle™ System must be installed by a credentialed installer [UL3741]. Potentially dangerous electrical voltage is present in Solstice Shingle™ PV Shingles and system components. The installer must be familiar with appropriate safety procedures for handling electricity and must wear appropriate Personal Protective Equipment (PPE).
- Solstice Shingle™ PV Shingles do not have an "On/Off" switch and generate electricity when exposed to any light source. The shock hazard from the PV Shingles increases when the panels are connected in series. Do not touch live terminals with bare hands or any conductive material. The only way to make PV Shingles inactive is to remove them from any light source [UL3741].
- Prior to conducting maintenance or cleaning Solstice Shingle™ PV Shingles check the panel display of the inverter. If it indicates a "Ground Fault Error", do not clean or conduct maintenance. Immediately contact a qualified electrician or qualified installer [UL3741].
- The maximum number of series connected modules (with 25% safety factor) is 50 [UL3741] before consideration of inverters or other electronics.
- NOTE: Maximum PV string voltage shall be no greater than 600VDC
- The diode used is Zhejiang Renhe PST5040D with 20A current rating.
- The max fuse rating for the Solstice Shingle is 15A.
- DO NOT connect or disconnect Solstice Shingle™ PV Shingle connectors when the inverter is under load or operating.
- DO NOT redirect or concentrate sunlight or artificial light onto Solstice Shingle™ PV Shingles.
- Appropriate Personal Protective Equipment (PPE) must be worn at all times. Refer to CertainTeed's Shingle Applicator's Manual for additional roofing-specific safety guidelines.
- DO NOT walk on Solstice Shingle.
- Under normal conditions, the Solstice Shingle™ is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current capabilities, fuse sizes, and size of controls connected the photovoltaic output. Refer to Section 690-8 of the National Electrical Code for an additional multiplying factor of 125 percent (80 percent de-rating), which may be applicable. See Solstice Shingle™ PV Shingles' labels for specific electrical ratings. These electrical characteristics are within +/- 10 percent of the indicated values of Isc and Voc, and within +/-5 percent for Pmax, under standard test conditions (irradiance of 1000 W/m<sup>2</sup>, AM 1.5 spectrum, and a cell temperature of 25°C (77°F)).
- Solstice Shingle™ may allow snow to slide off a roof easily, and therefore the use of snow guards below the array is highly recommended in all applications where snow is a concern. The risk of snow sliding off a roof increases in areas with above-average snowfall, and the use of snow guards is particularly important in such areas. The installer should refer to local building codes and requirements for the use of snow guards and should follow the snow guard manufacturer's instructions for correct spacing and application.
- Solstice Shingle PV Shingles have been tested to and passed temperature ranges from -40C to +85C, and the average environmental temperature range is calculated as -40C to +40C.
- Solstice Shingle™ PV Shingles have a design load of +2400/-1600 Pa.

## Installation Limitations

- Solstice Shingle™ is designed to be installed on pitched roofs with slopes of 2:12 or greater. DO NOT install on slopes lower than 2:12.
- The roof deck must be a minimum of 15/32" veneer plywood, 7/16" non-veneer APA rated sheathing panel (oriented strand board panels, structural particleboard panels, composite panels or wafer-board panels) or 3/4" thick wood sheathing boards.
- For High Velocity Hurricane Zone (HVHZ) areas the roof deck must be a minimum of 19/32" CD exposure 1 plywood or equivalent. Local building code entity would be the authority on whether or not the structure is within a HVHZ.
- Solstice Shingle™ may only be installed in new construction or on a retrofit roof. DO NOT install Solstice Shingle™ over an existing roof system.

- Solstice Shingle™ PV Shingles must not be installed over any roof projections, plumbing or attic vents. Vent pipes/stacks may be moved to an alternate location in order to accommodate a continuous solar array. DO NOT attempt to cut or modify the PV Shingle.
- Solstice Shingle™ PV Shingles must not be installed within 12 inches of the perimeter of the roof to allow enough space to install appropriate underlayment and flashing for the system. Consult your local Authority Having Jurisdiction (AHJ) to determine if larger setbacks are required.
- The installer should check for pre-existing conditions that could affect the installation of a finished system. Examples include, but are not limited to, formation of ice dams in the winter, attic ventilation issues, etc. These items should be resolved prior to installing the Solstice Shingle™ System.
- Solstice Shingle PV Shingles are designed to be used in altitudes of 2000m or less from sea level.
- PV arrays shall have no exposed wiring methods or conductive parts and be installed more than 2.5 m (8 ft) from exposed grounded conductive parts or ground.
- Do not install over metal roofs.

## Installation Requirements

- Only installers trained on the installation of the Solstice Shingle™ system are permitted to install the Solstice Shingle™ system.
- Only qualified electrical contractors are permitted to install electrical components.
- Read the Solstice Shingle™ Installation Instructions and Inverter Installation and Operations Manual in their entirety before attempting to install a Solstice Shingle™ system.
- Attic ventilation is required and must meet or exceed current HUD standards.
- Follow all related shingle manufacturer's instructions and standard trade practices.
- Ensure that required roofing and electrical permit(s) and inspections have been obtained from local authorities. Supplying installation specifics will assist the code official in understanding the application.

- Ensure approval for grid interconnection from the local power company.
- Installation of the Solstice Shingle™ PV Shingles must be performed in compliance with all applicable building and safety codes, both local and national which include, but are not limited to, the National Electric Code, local codes and requirements and utility interconnection requirements. Non-compliance with applicable building and electrical codes, ordinances, and regulations may void the warranty.

## Recommended Tools and Materials

The following tools are needed to properly install the Solstice Shingle System:

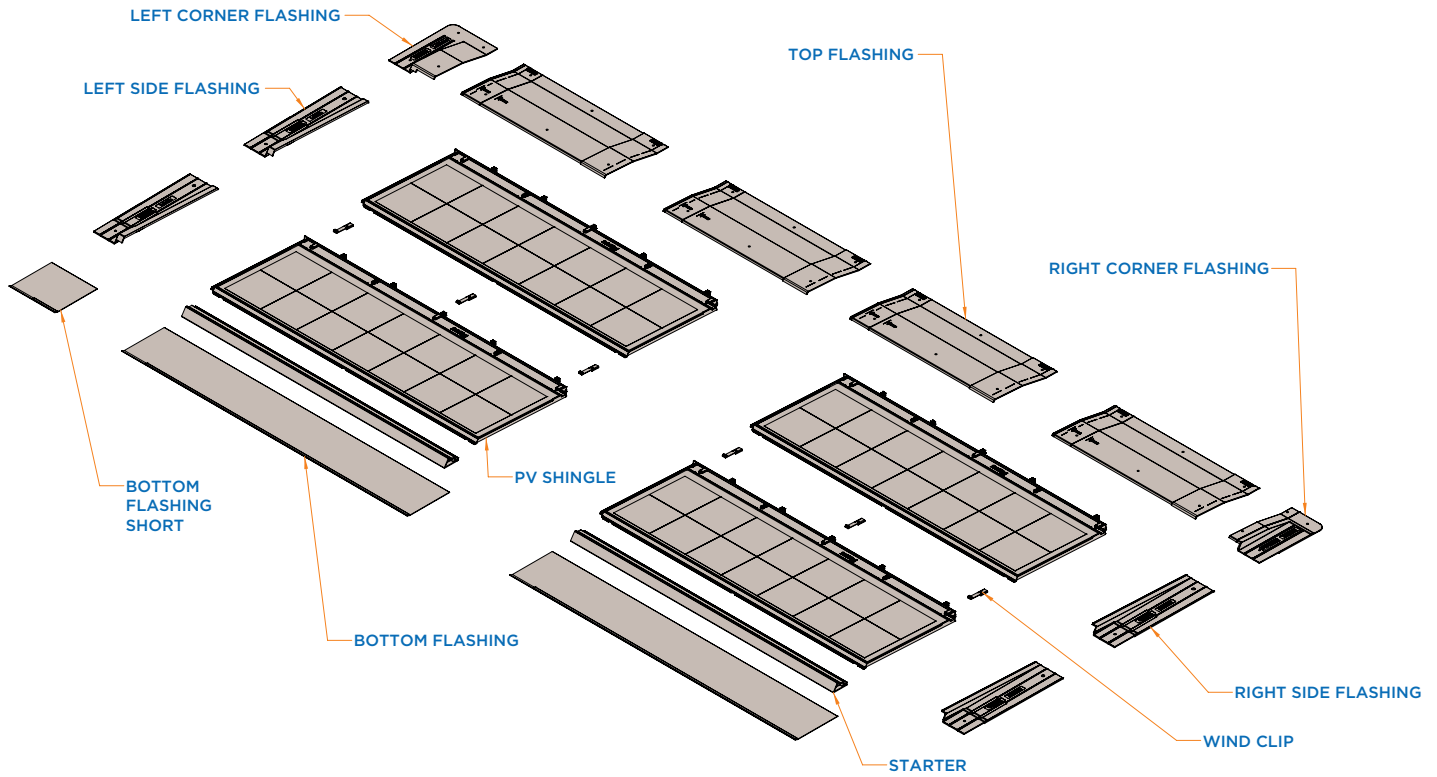
- Tape measure
- Chalk line
- Utility knife
- Digital multi-mete rated for 600 Volts DC or higher
- Cordless drill
- 1-5/8" Hole saw/ spade bit (roof deck penetration)
- Circular Saw

A standard selection of roofing hand tools is necessary to complete the installation of asphalt shingles surrounding the Solstice Shingle System.

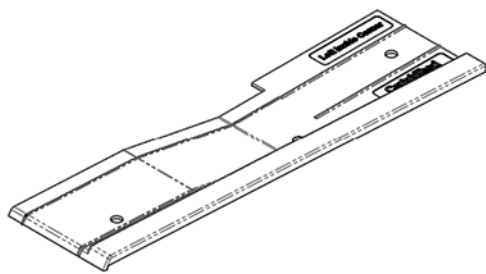
The following materials must be provided by the installer. This list is representative only, and additional materials may be required depending on the installation.

- High quality elastomeric, urethane, or roofing mastic which meets ASTM D4586 Type II
- Snow guards, where required
- Wiring, conduit, conduit fittings, enclosures, disconnects and/or overcurrent protection devices from roof to electrical service panel.
- Electrical Safety labels as specified by permit package or local AHJ.

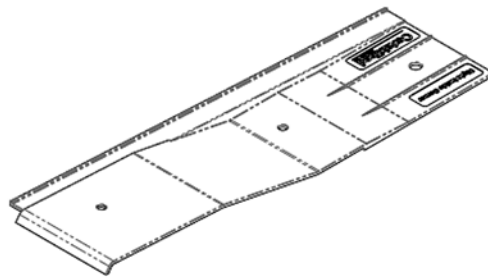
## System Overview



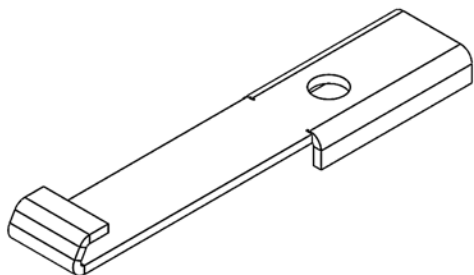
## Additional Parts (not shown in System Overview)



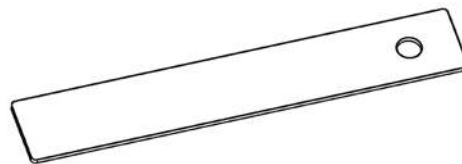
Left Inside Corner Flashing



Right Inside Corner Flashing



Wind Clip

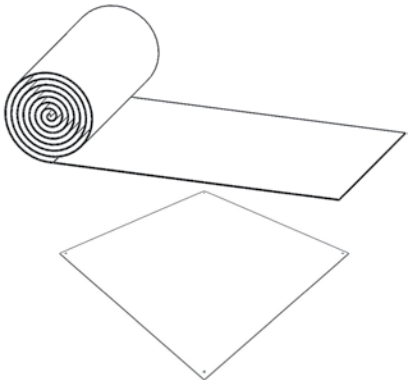


Gap Spacer

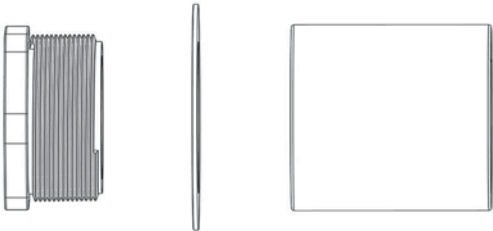
# Additional Parts (not shown in System Overview)



Unlocking Tool



Underlayment(s)  
Waterproofing Underlayment - Grace Ice and Water Shield HT (Fire Class C)  
MgO Board (Fire Class A)



Penetration Bushing  
-Box adaptor  
-Reducing Washer  
-Coupling



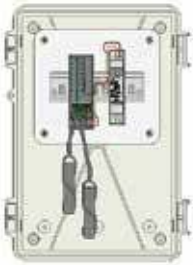
Extension (46" length)  
Homerun Wire (75ft.)



#10 2" Wafer or Pan Head Screws  
- Stainless Steel or TAS 114 App E compliant for FLHVHZ



Rapid Shutdown Device



Sun Spec Transmitter Kit  
- For use with Sol-Ark inverters

## Prior to Installing Solstice Shingle™ System

### WARNING

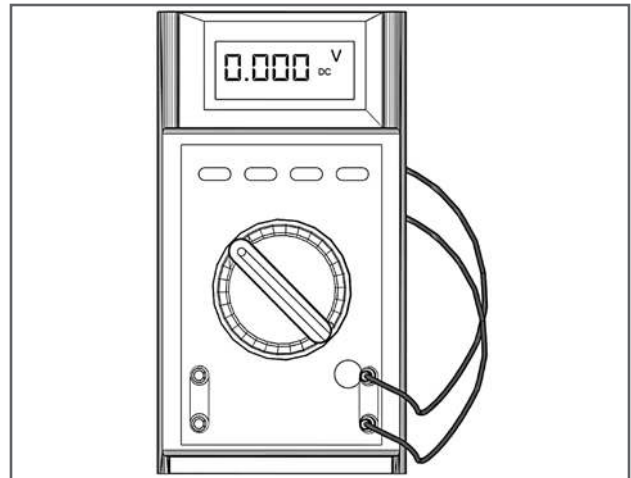
To reduce the risk of injury, read the Solstice Shingle™ Installation Manual and other components installation and operating manuals in their entirety.

1. Ensure that all materials are on site.
2. Review the system design and layout. The System Layout, based on measurements of the available roof space, shows the approximate physical location of the PV Shingles on the roof. The installer is responsible for laying out the array such that it fits the actual roof on site. If obstructions are present, these should be moved and all penetrations and openings properly sealed before installing the array.
3. Have your qualified electrical contractor prepare a Stringing Diagram based on your System Layout. A Stringing Diagram shows how the PV Shingles in an array will be connected in series strings. Each string is a separate circuit with two Homerun Wires - one positive and one negative. An example is shown in Appendix A.

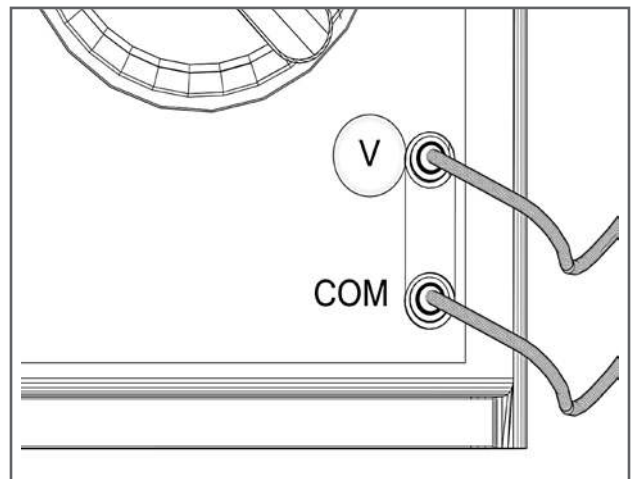
### WARNING

Deviating from your electrician's Stringing Diagram will void the warranty and may result in property damage or bodily injury.

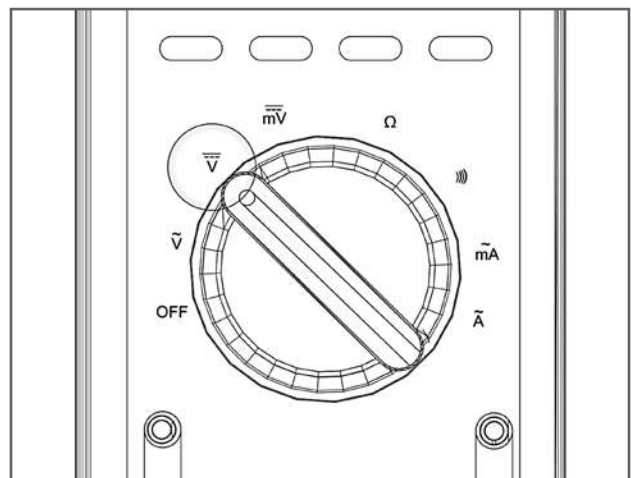
4. Based on the System Layout, determine where the system will be located. Snap chalk lines as necessary to mark the appropriate areas.
5. Verify that each Solstice Shingle™ PV Shingle voltage (V) approximates the Open Circuit Voltage (Voc) specified in the Technical Data Sheet & Electrical Parameters Table. Because voltage decreases with decreased availability of light, it is best to perform this test in full sunlight. Other conditions in the field may cause the voltage to vary. Generally, if the measured voltage is within 10% of the specified voltage, the PV Shingle is acceptable.



Set up Multi-Meter

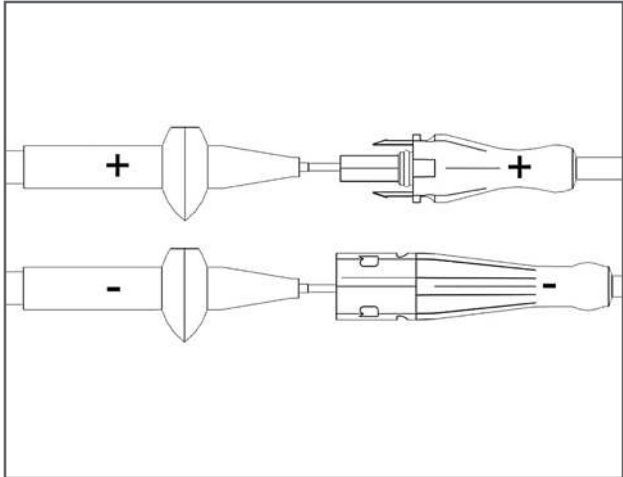


1. Insert leads into correct ports

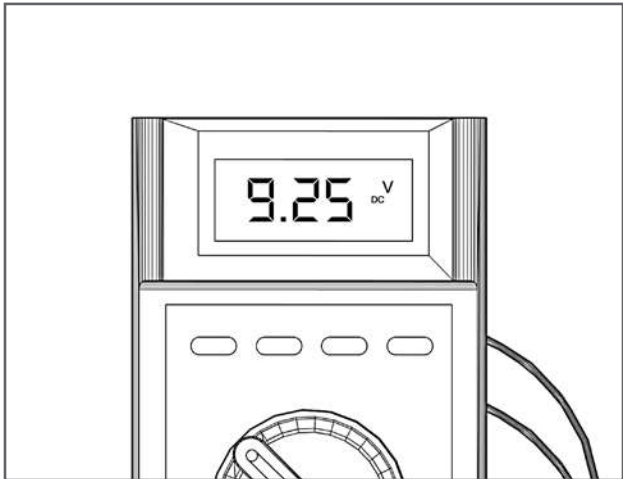


2. Set dial to DC Volts





Insert probes into Solstice Shingle™ connectors



Read voltage & verify against Open Circuit Voltage (Voc) in Solstice Shingle Technical Data Sheet & Electrical Parameters Table



Location of Solstice Shingle™ Array Area

## Solstice Shingle™ Fire Rating

Solstice Shingle™ PV Shingles have a Class C Fire Rating when installed over one layer of Waterproofing Underlayment.

Solstice Shingle™ PV Shingles have a Class A Fire Rating when installed over one layer of Waterproofing Underlayment and one layer of MgO Boards.

### IMPORTANT

Failure to properly install the underlayment(s) may result in the loss of the system’s Fire Class Rating. Any substitution of underlayments will void the warranty and may result in the loss of the system’s Fire Class Rating.

## Installing the Solstice Shingle™ System

For a new construction application, proceed directly to STEP 1.

For a retrofit application, remove all existing roofing materials, including underlayment, shingle nails, and any other materials within the Underlayment Area until a clean, smooth, dry roof deck is reached. Replace deck materials if necessary to ensure the roof deck is flat.

### STEP 1 - Plan

Determine the location of the Solstice Shingle™ array [Array Area] and plan where the Grace Ice and Water Shield HT Underlayment Area will be located per the diagram below, left. Use chalk lines to plan and indicate the position of the Array Area and Flashing Area.

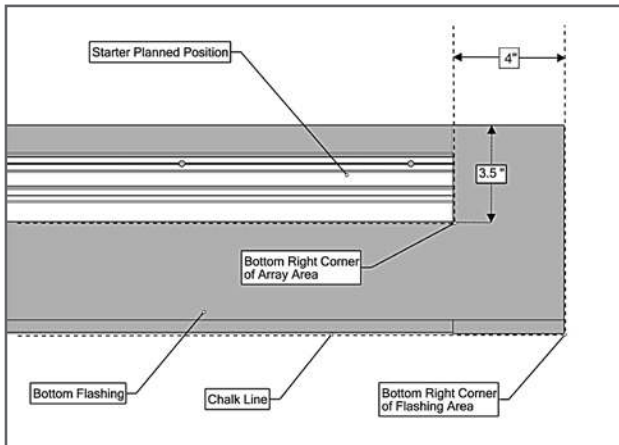
General Design Rules:

- 12" from rakes, valleys and obstructions along the side of solar array
- At least 2 courses of asphalt shingles installed per asphalt shingle installation manual to start arrays at eaves or above obstruction
- Alternative underlayments to Grace Ice and Water Shield HT may be used per local building and fire code in areas outside the defined Underlayment Area per the Array Area diagram. However, do not install Grace Ice and Water Shield HT on top of other underlayments. Use proper lapping procedures per underlayment installation instructions.
- 18" between the top of any solar shingles to ridge or obstructions
- Fire solar easements per AHJ’s specifications

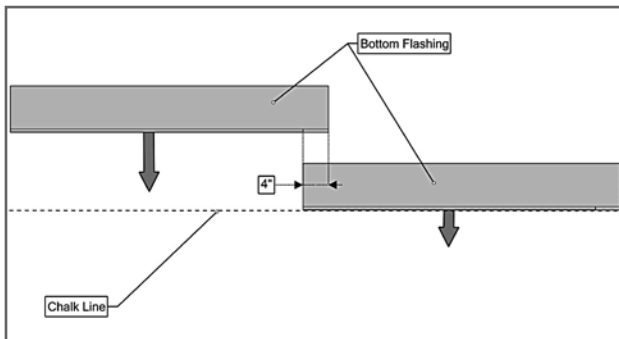
## STEP 2 - Install Bottom Flashing

Starting at the bottom right corner of the Flashing Area, position the Bottom Flashing as shown.

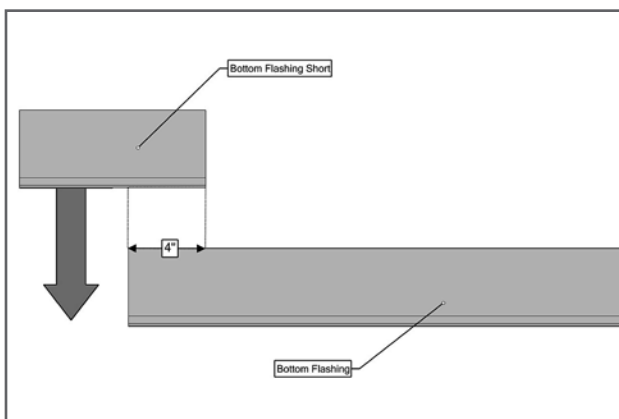
To hold the bottom flashing in place for subsequent installation steps, fasten 1 fastener in the top 1" of each of the 2 top corners.



Moving from right to left, install Bottom Flashing pieces so that each new piece overlaps the previous one by 4".



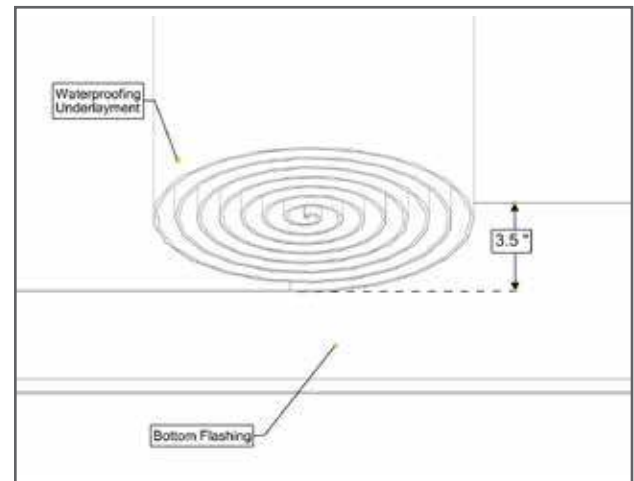
Install the Bottom Flashing Short piece so that it overlaps the final Bottom Flashing piece by 4".



## STEP 3 - Apply Grace Ice and Water Shield HT Waterproofing Underlayment

### IMPORTANT

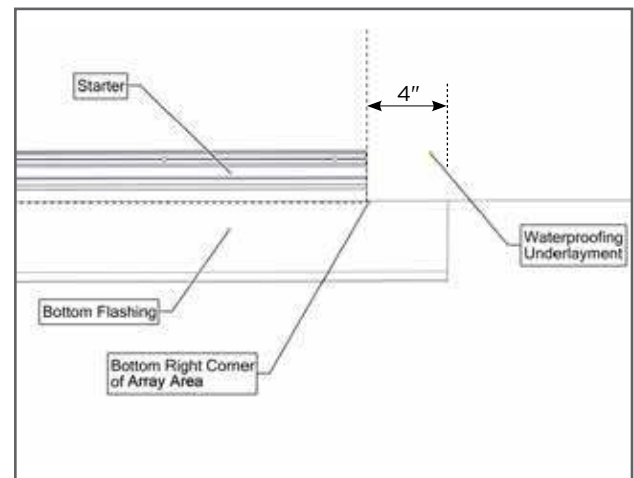
Ensure that the roof deck in the Underlayment Area is clean, smooth, dry and free of any debris.



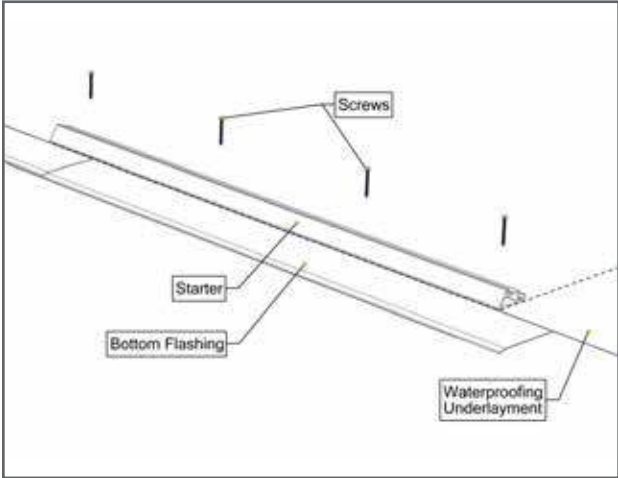
Install Grace Ice and Water Shield HT Waterproofing Underlayment so that it covers the top 3.5" of the Bottom Flashing. Continue installing the Waterproofing Underlayment using a 6" overlap at the vertical seams and a 3" overlap at the horizontal seams. Cover the entire Underlayment Area.

## STEP 4 - Install the Starter Strip

Starting at the bottom right corner of the Array Area, position the first Starter flush with the bottom edge of the Waterproofing Underlayment.



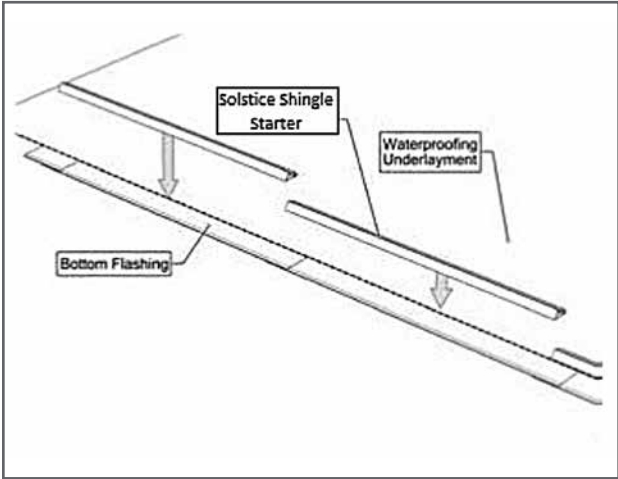
Install the first Starter using four (4) 2" fully threaded screws in the holes provided.



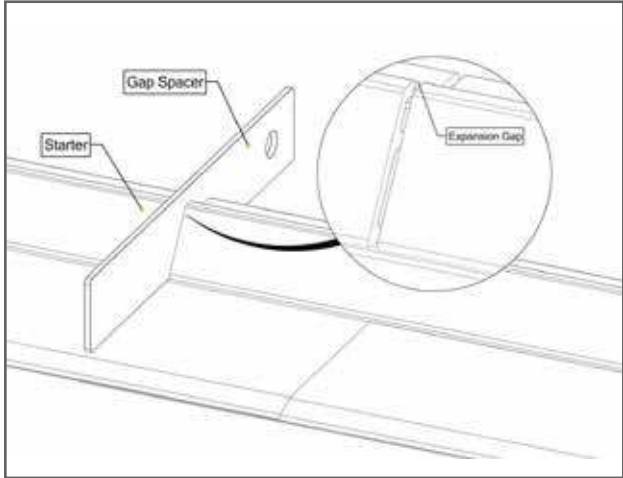
**IMPORTANT**

Starters must be straight across the roof to properly install PV Shingles as well as to ensure proper appearance. After installing them, check the appearance against eaves to ensure that the array will be properly positioned.

Install the remaining Starters across the roof following the bottom edge of the Waterproofing Underlayment.



Leave a gap between Starters using the provided Gap Spacer.

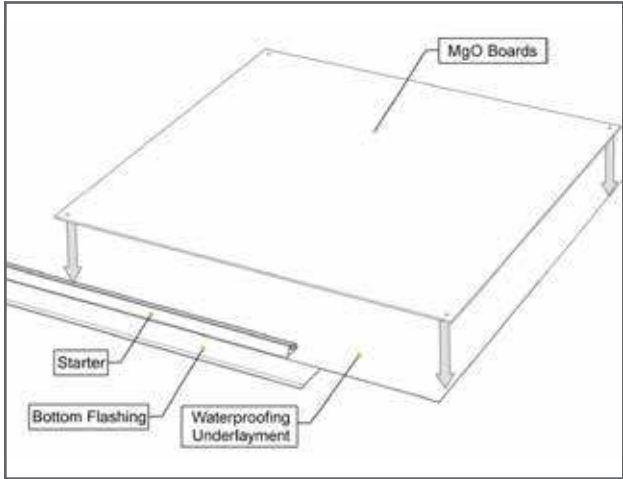


**IMPORTANT**

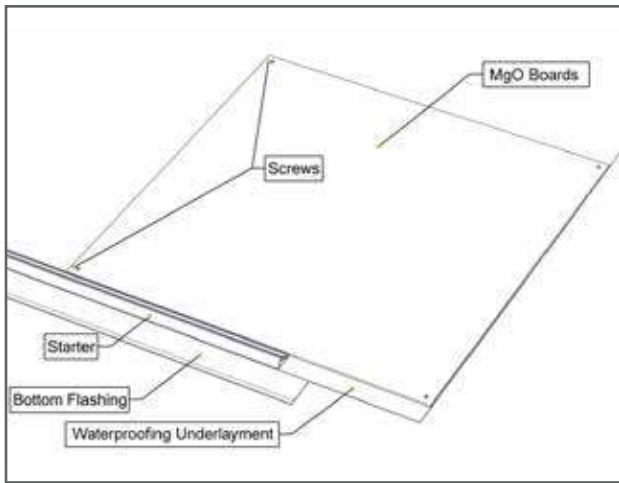
This gap is necessary to allow for Starter expansion. Ensure that the Gap Spacer is not bent or deformed.

**STEP 5 - Apply MgO Boards (for Class A systems only)**

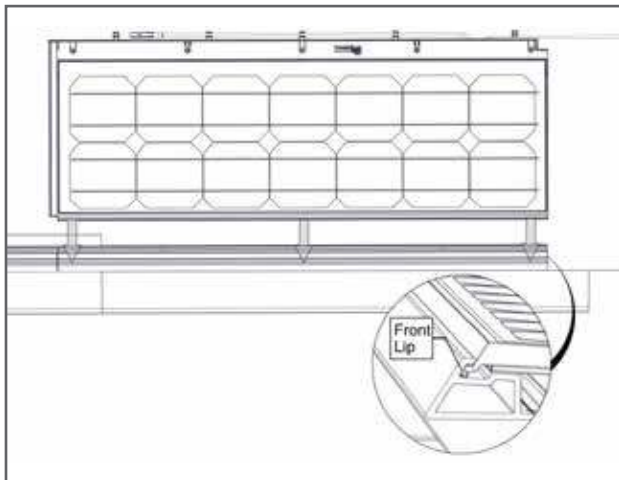
Install the MgO Boards along the top edge of the Bottom Flashing and flush with the right side of the Underlayment Area.



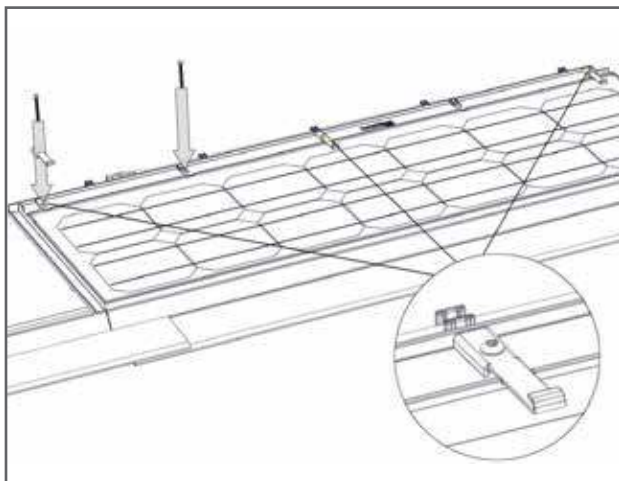
Fasten the FR Underlayment to the roof deck using four (4) screws, one in each corner, covering the remaining Underlayment Area.



**STEP 6 - Attach the Solstice Shingle™**



Slide the PV Shingle down until the front lip locks onto the Starter and is flush with either side.



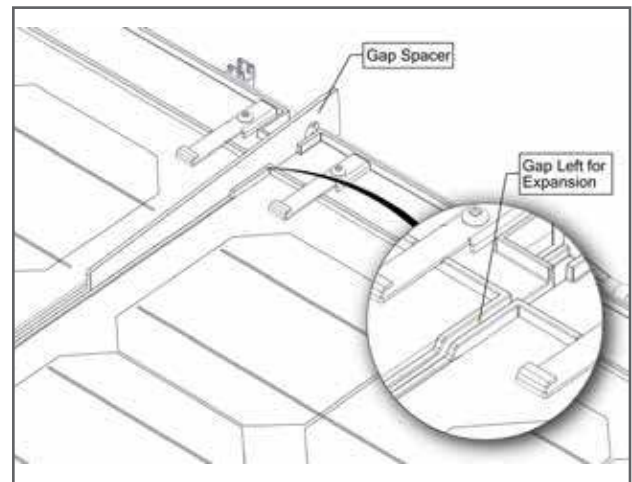
Place three (3) Wind Clips on the top of the PV Shingle in the locations indicated. Fasten the PV Shingle using five (5) screws.

**IMPORTANT**

Do not over-tighten screws as this could damage the frame or strip the wood decking.

**STEP 7 - Complete the First Row**

Using the same method outlined in STEP 6 above, install the remaining PV Shingles in the first row using the Gap Spacer to properly space the PV Shingles.



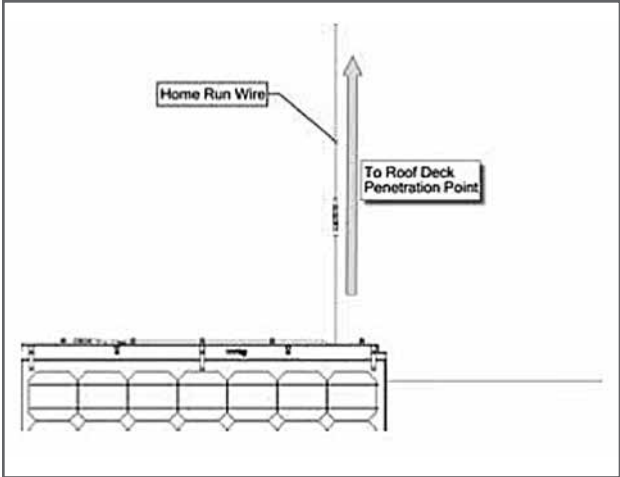
**IMPORTANT**

This gap is necessary to allow for module frame expansion. Ensure that the Gap Spacer is not bent or deformed.

**STEP 8 - Wiring the PV Shingles**

**WARNING**

Solstice Shingle™ PV Shingles generate DC electricity when exposed to any light source, whether or not they are connected in a circuit. Always treat the output wires as a potential shock hazard. The shock hazard increases when PV Shingles are connected in series. DO NOT connect panel wiring under wet conditions. Review the Safety Precautions, Proper Connections and Proper Wire Management sections before making any electrical connections. A qualified person must be present when wiring is being done during the installation of the array. Check with your local AHJ for local requirements.



Connect a Homerun Wire to the first PV Shingle in the series string. This Homerun Wire will run to the roof deck penetration point at the top of the array where the wiring enters the building.

**NOTE**

Homerun Wires are supplied with a positive connector on one end and a negative connector on the other end. Homerun Wire lengths should be determined and the Homerun Wire cut to make two lengths; one with a positive connector and one with a negative connector.

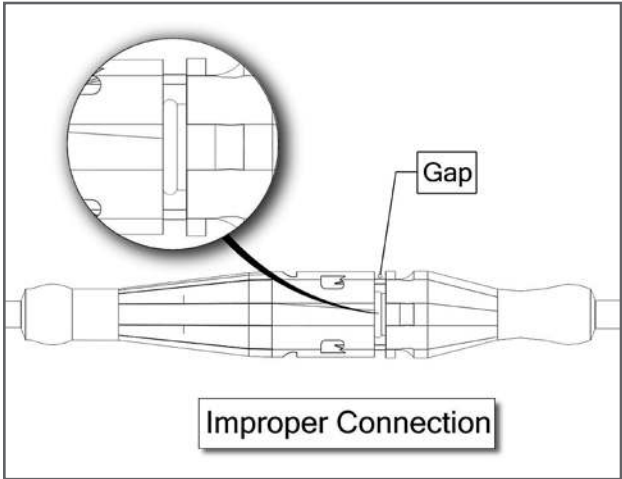
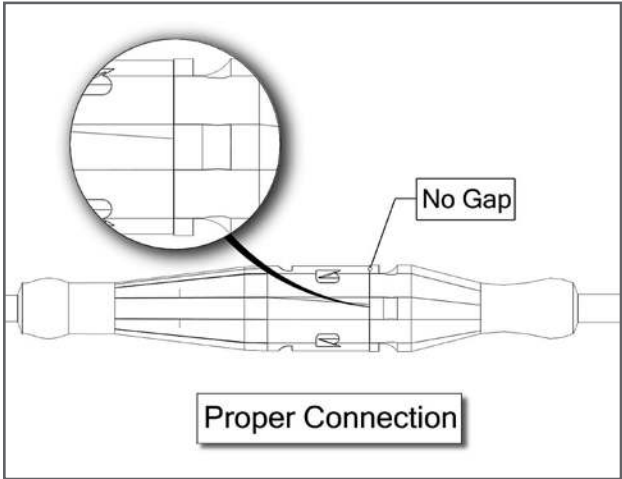
**IMPORTANT**

Be sure you have reviewed and fully understand the Stringing Diagram before attempting any wiring. An example is located in Appendix A.

**Proper Connections**

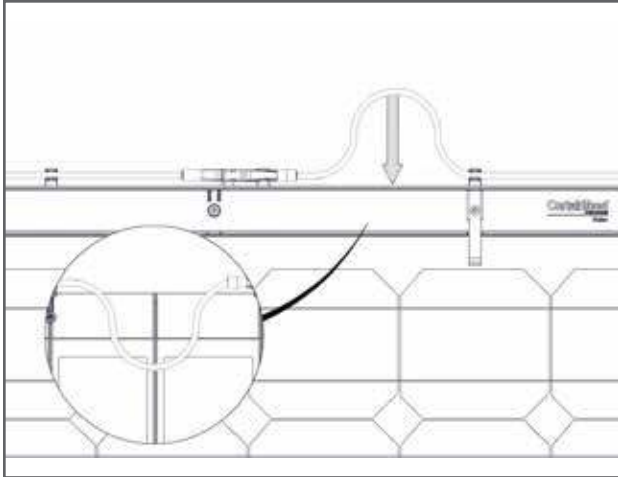
Wiring Solstice Shingle™ PV Shingles together into strings is simple using the provided male-female, positive and negative connectors. Simply plug the connectors together until they lock which will ensure that they are fully mated as shown below. Once connected, gently attempt to pull the connectors apart to verify that they are fully mated and locked.

**Wire Management**



**CAUTION**

As you connect the PV Shingles together in the row, it is critical any additional wire length and the connectors be managed. Excess wire length can be stored underneath the PV Shingle.



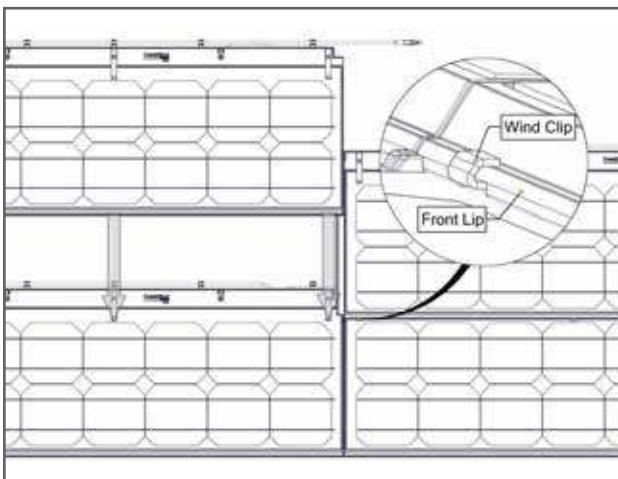
**IMPORTANT**

The accumulated string voltage should be checked after the installation of each row to ensure that all connections have been made properly and all PV Shingles are functioning. See Appendix B for instructions on checking voltage.

**STEP 9 - Installing the Next Row of PV Shingles**

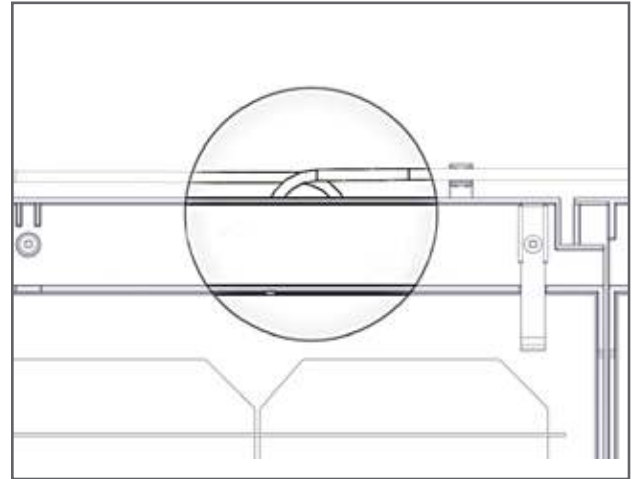
**WARNING**

It is critical to make sure that no wires are pinched between the PV Shingle frame and the deck. Ensure that all wiring from previously installed PV Shingles is properly secured in wire management clips and excess stored under the PV Shingles before attempting to install the next row. PV Shingles should lay as flat as the existing deck allows. If they do not, it may be an indication that there is a pinched wire.



Starting from the right side, fasten into place with screws the next row of PV Shingles. Slide the PV Shingle down until the front lip locks into the Wind Clips installed on the PV Shingle in the prior row.

**STEP 10 - Wiring the Second Row**



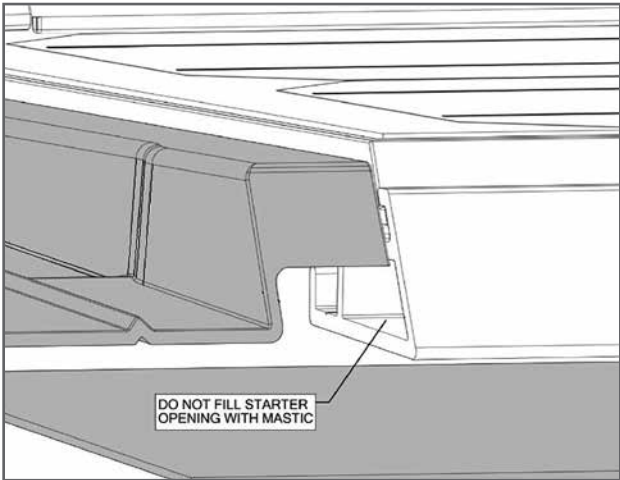
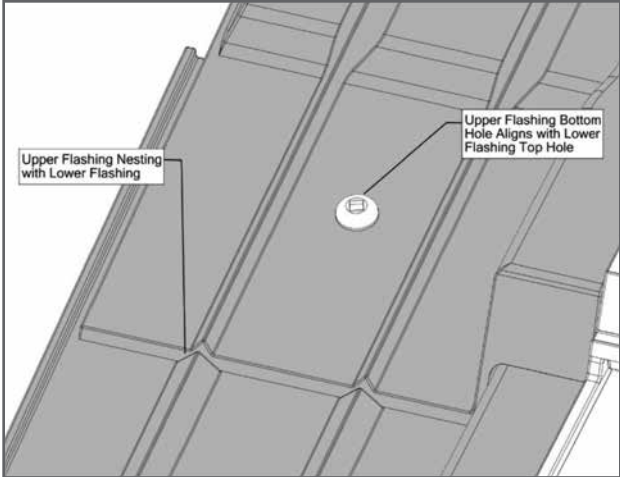
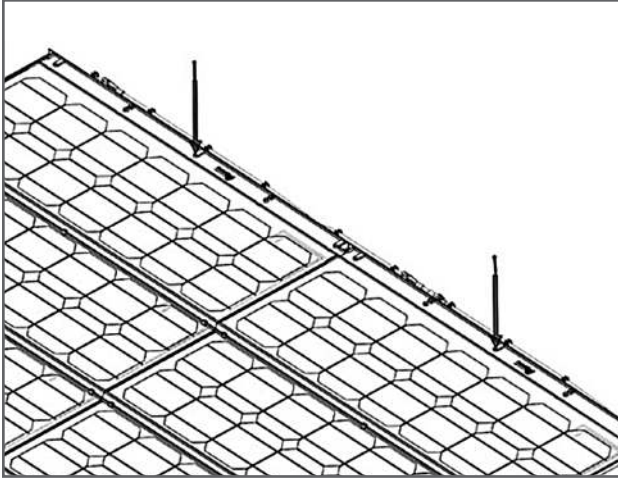
When wiring the next row, the polarity of the connectors will need to be switched. To do this, simply cross the wires as they exit from the upper portion of the PV Shingle.

**IMPORTANT**

PV Shingles are designed to be installed in rows moving from right to left. Stringing (electrically connecting the PV Shingles) should be done in an “S” pattern. Every other row will require crossed wires. If the array contains multiple strings, ensure that you are aware of where one string ends and the other begins. See sample Stringing Diagram in Appendix A.

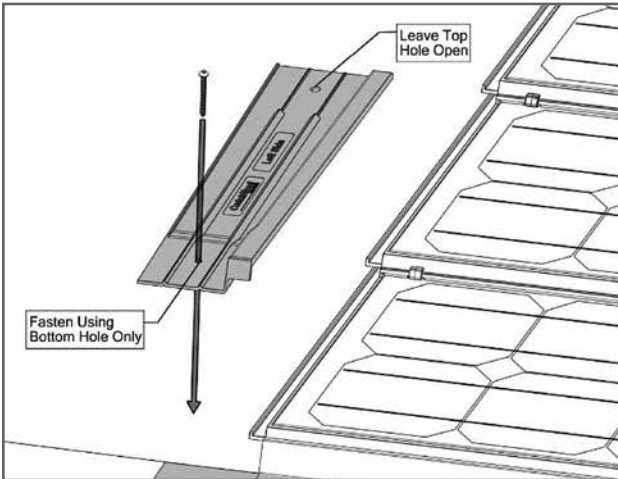
### STEP 11 - Continue Installing PV Shingles

Set the final course of PV Shingles in place and temporarily fasten with one screw in each as shown.



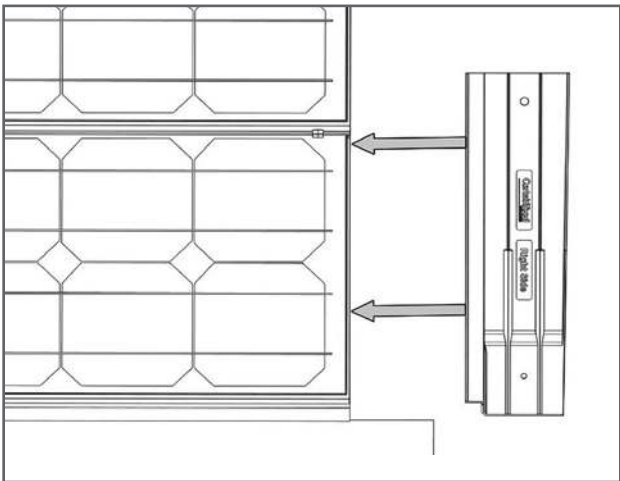
### STEP 12 - Install Side Flashing

Install the Left Side Flashing so that it covers the edge of the PV Shingle to the right and slides under the edge of the PV Shingle above. Fasten through the bottom hole using a 2" fully threaded screw.

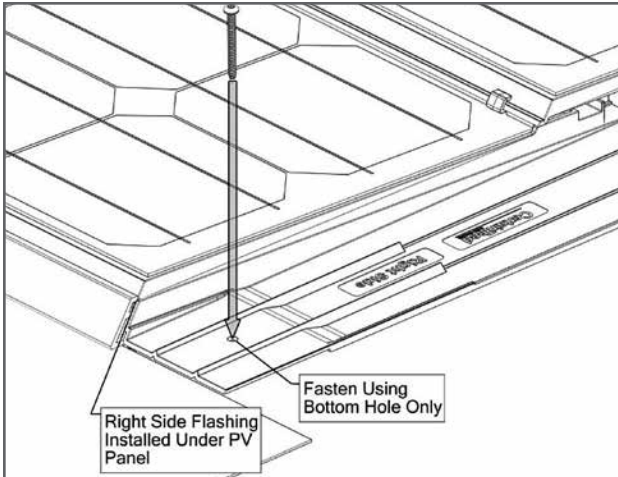


As additional Left Side Flashings are installed, be sure that the upper flashing nests onto the water diverters of the lower flashing. Align the attachment holes of the flashings and fasten using 2" fully threaded screws.

Install one Left Side Flashing for each row of PV Shingles.



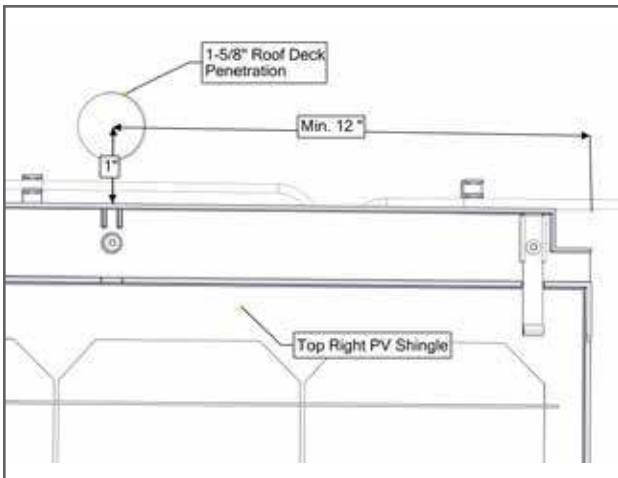
Slide the Right Side Flashing under the edge of the PV Shingle.



Fasten the Right Side Flashing through the bottom hole using a 2" fully threaded screw. When installing additional Right Side Flashings be sure that the triangular water diverters in the lower flashing nest into the water diverters of the upper flashing. Align the hole at the top of the lower flashing and the hole in the bottom of the upper flashing. Fasten using 2" fully threaded screws.

**IMPORTANT**

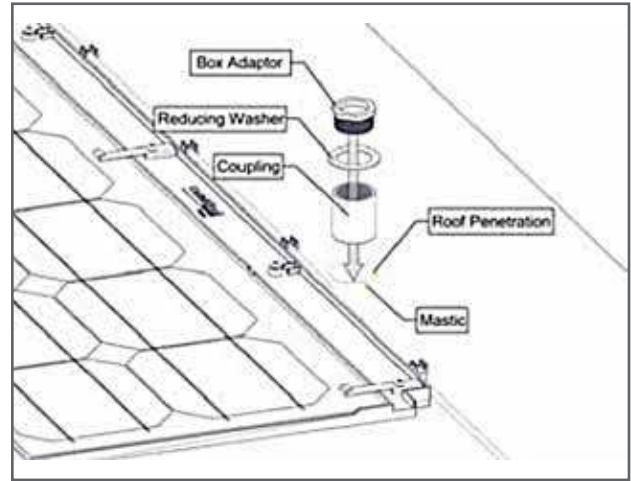
Side Flashing is not designed to be interwoven with asphalt shingles. DO NOT nail the flashing. Use only the recommended screws to fasten the flashing.



**STEP 13 - Roof Deck Penetration**

Ensure that the roof deck penetration point is clear of any rafters. Using a hole saw or spade bit, drill a 1-5/8" hole through the roof deck centered 1" from the top edge of the PV Shingle. Do not locate the hole closer than 12" from the left or right corners.

Assemble the Box Adaptor, Reducing Washer and Coupling into the Penetration Bushing. Apply mastic around the Penetration Bushing and press into the hole.

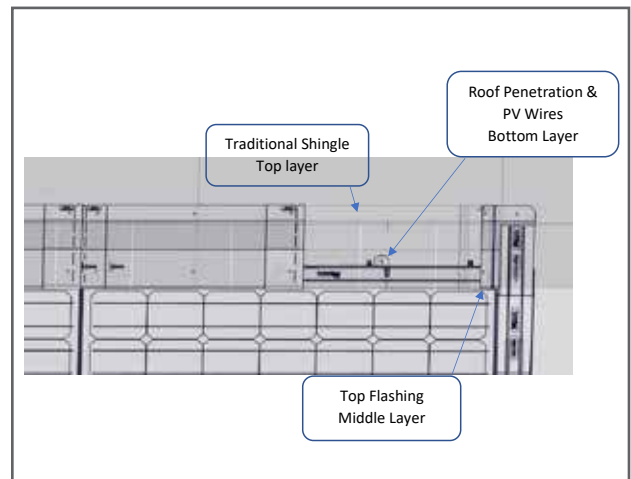


**WARNING**

The cut ends of the Homerun Wires are LIVE. DO NOT allow them to come into contact with each other. Each one must be capped with a wire nut and electrical tape before placing them through the roof deck penetration. Label all wire ends with string number and polarity ( + or - ) before pushing them through the penetration into the attic.

Cover the penetration with Grace Ice and Water Shield HT Underlayment.

All PV Leads and Homerun wires are to be covered by asphalt shingles once they are routed through the roof penetration; this is required for all styles and configurations of PV arrays. Proceed to follow installation manual instructions for details.

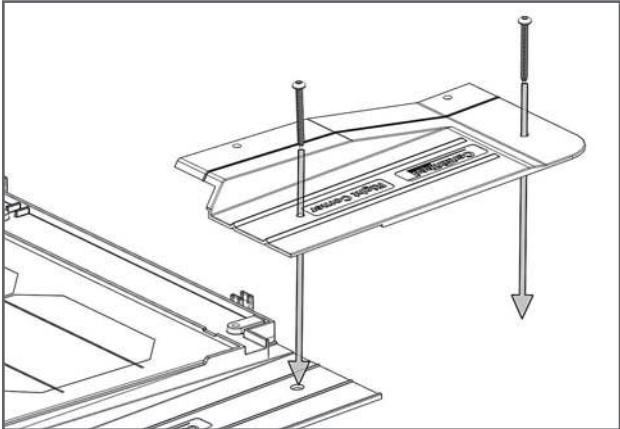




### STEP 14 - Install the Right Corner and Top Flashing

**WARNING**

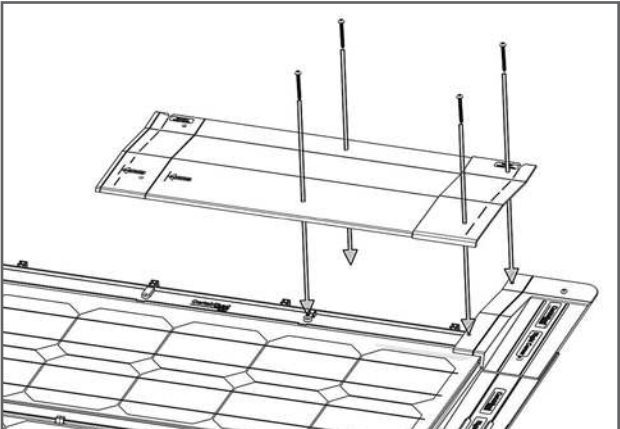
When Installing the Top Flashings, take great care to avoid penetrating the PV Array wiring. Any damage to the Homerun Wires or PV Shingle wiring can result in a shock hazard and must be repaired.



Once all Side Flashings are installed, begin by installing the Right Corner Flashing with two 2" fully threaded screws as shown. Be sure that the triangular water diverters on the Right Corner Flashing are nested on top of the water diverters on the Right Side Flashing.

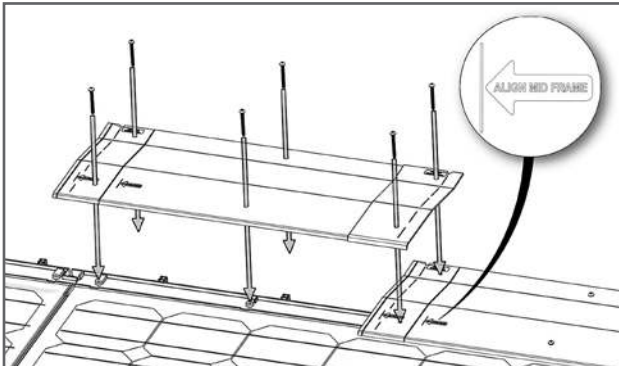
**IMPORTANT**

Top Flashings are designed so that they can be installed utilizing the fastening holes in the PV Shingles to secure the front edge. In order to ensure proper installation be aware of the alignment arrows imprinted on the left edge of each Top Flashing. These arrows indicate where to align the right edge of the Top Flashing when installing at the center of a PV Shingle or at the seam between two PV Shingles.

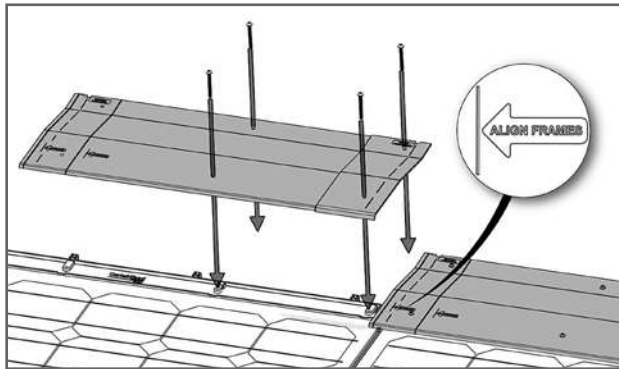


Top Flashings are to be installed from right to left starting at the upper right corner of the array. Install the first Top Flashing by lining up the holes on the right side with the holes on the Right Corner Flashing. Fasten with four 2" fully threaded screws as shown.

Continue installing the Top Flashings across the array as shown making sure to align the fastening holes of the Top Flashings with those of the PV Shingles. When installing a Top Flashing at the center of a PV Shingle align the right edge with the "Align Mid Frame" arrow.

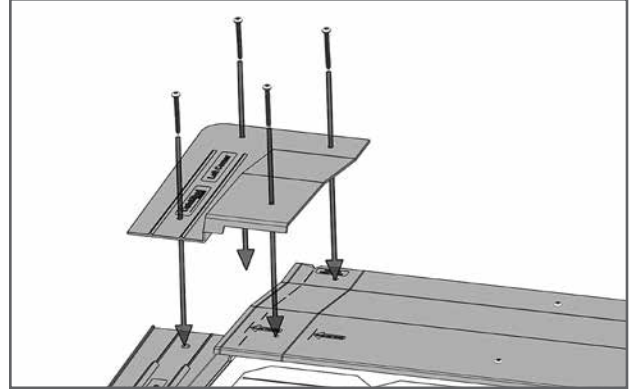


When installing a Top Flashing at the seam between two PV Shingles align the right side with the "Align Frames" arrow.



### Step 15 - Installing the Left Corner Flashing

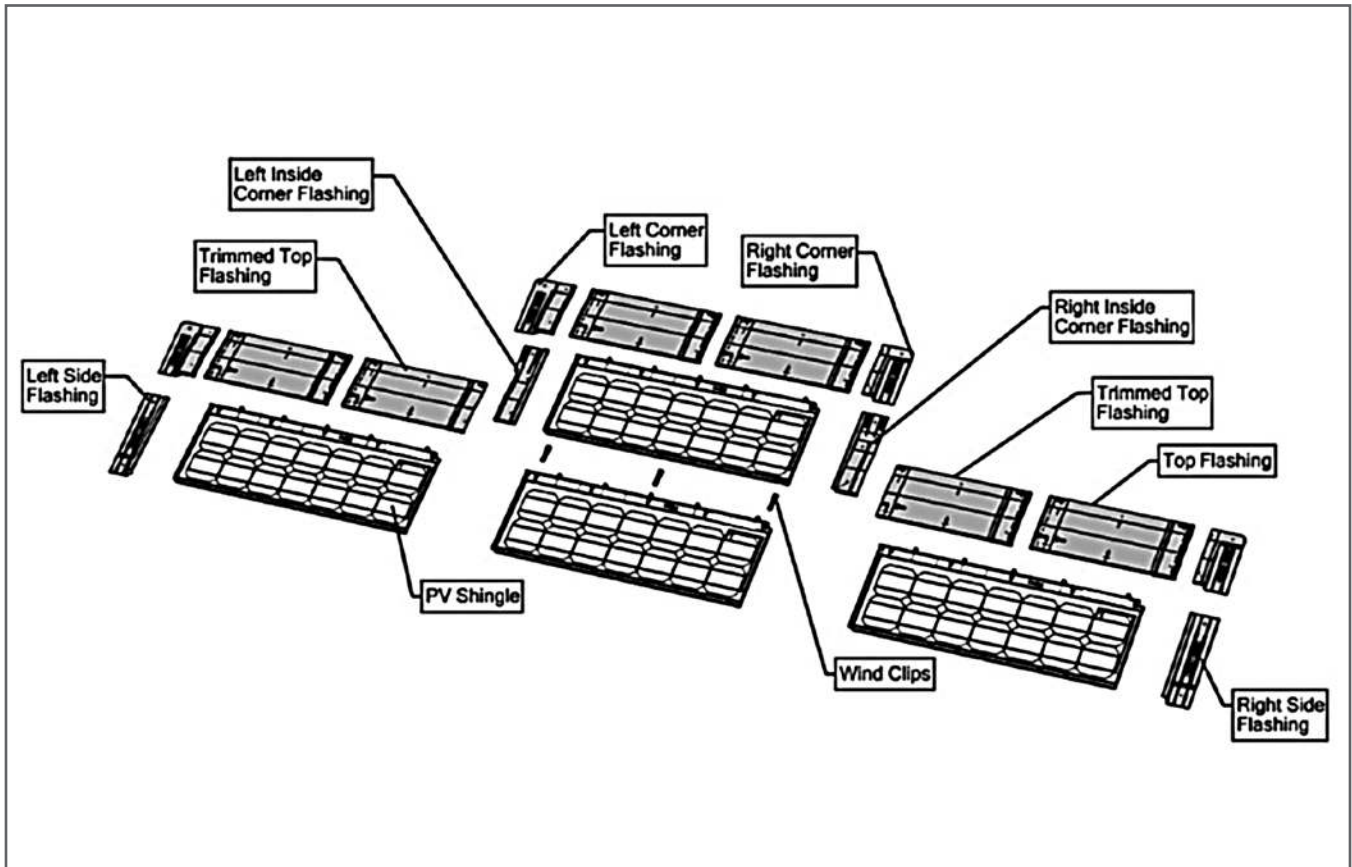
Install the Left Corner over the last Top Flashing and Left Side Flashing as shown. Make sure that the holes in the Left Flashing line up with the holes in the Top Flashing and that the triangular water diverters on the Left Corner Flashing are nested on top of the water diverters on the Left Side Flashing.



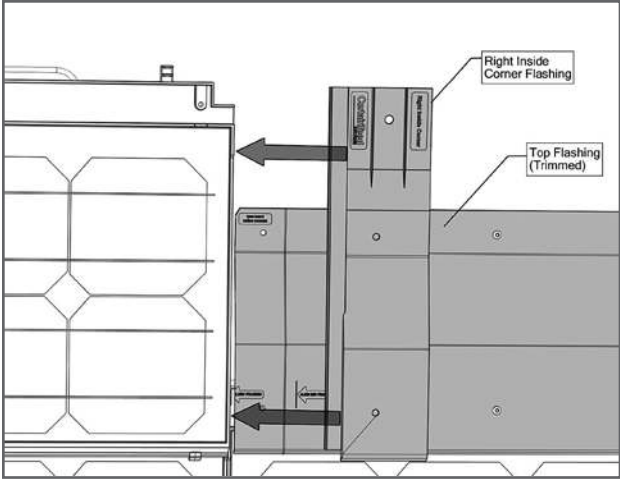
### Step 16 - Inside Corner Installation Instructions

Installing Non-rectangular Arrays

A Left or Right Inside Corner flashing piece is used to flash the inside corners.



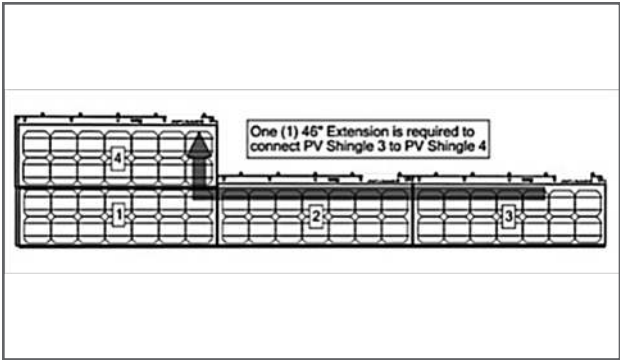
### Wiring Inside Corners



For each inset greater than one panel, an Extension is necessary to complete the wiring. For example, a two panel inset (shown below) requires one Extension, a three panel inset would require two Extensions, and so on.

**NOTE**

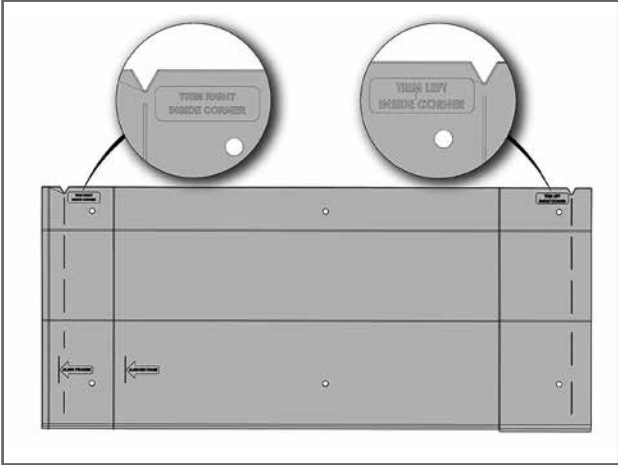
Follow wire management practices outlined in STEP 8 - Wiring the PV Shingles.



### Right Inside Corner Flashing Installation

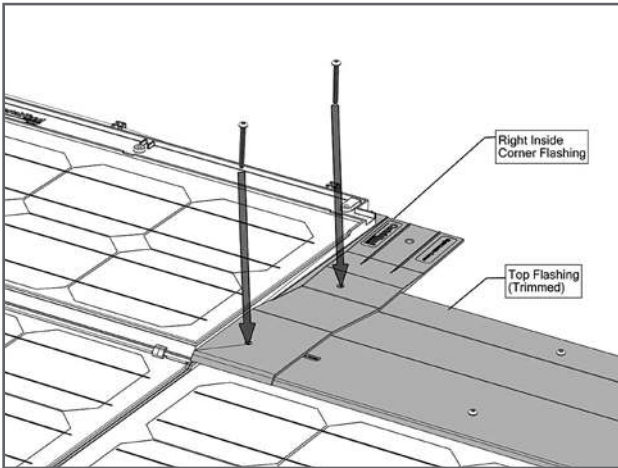
**NOTE**

Before installing the flashing at a Right or Left Inside Corner, be sure to note the trim lines on the right and left edges of the Top Flashing. A dotted line is placed 1" from the left edge to use as a guide for cutting. These lines indicate where to cut the Top Flashing so that it will fit in each configuration. The flashing can be cut with a circular saw and the cut should be straight and clean.



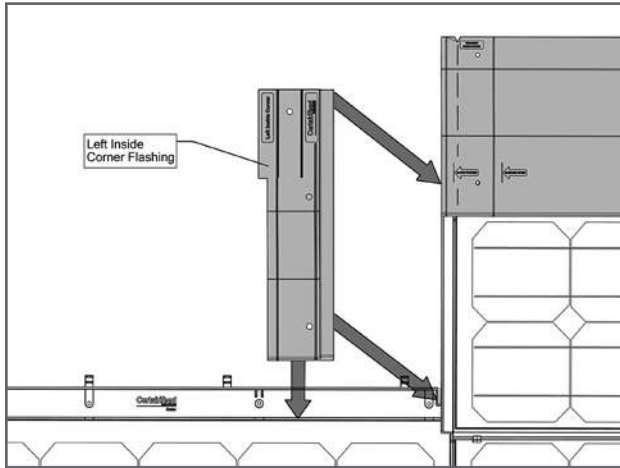
When flashing the PV Shingles in a right inside corner configuration, Top Flashings should be installed as described in Step 14 of this manual. When it is time to install the last Top Flashing, trim it along the left edge as described above. Do not install the 2" screws on the left edge of the Top Flashing.

Install the Right Inside Corner Flashing as shown by sliding it over the top flashing and under the right side of the PV Shingle.



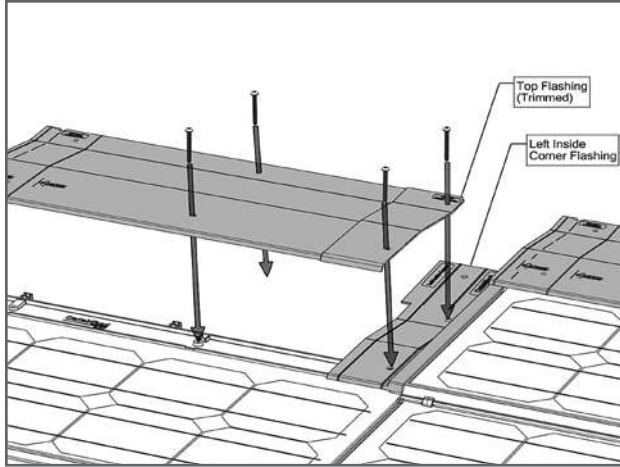
Fasten the Right Inside Corner Flashing with two fasteners.

## Left Inside Corner Installation

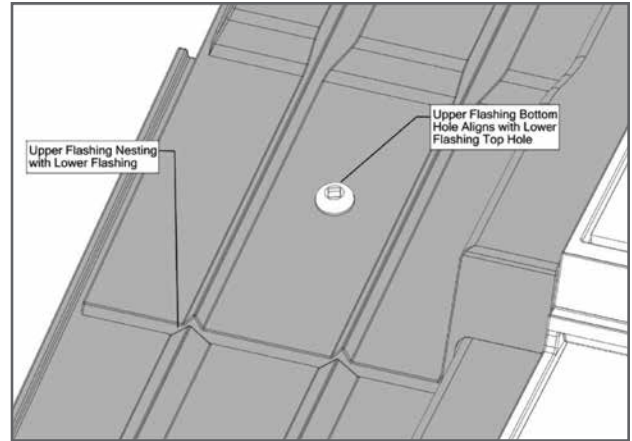


Install the Left Inside Corner as shown but do not fasten it.

When flashing the PV Shingles in a left inside corner configuration, Top Flashings should be installed as described in Step 14 of this manual. When it is time to install the last Top Flashing, trim it along the right edge as previously described.



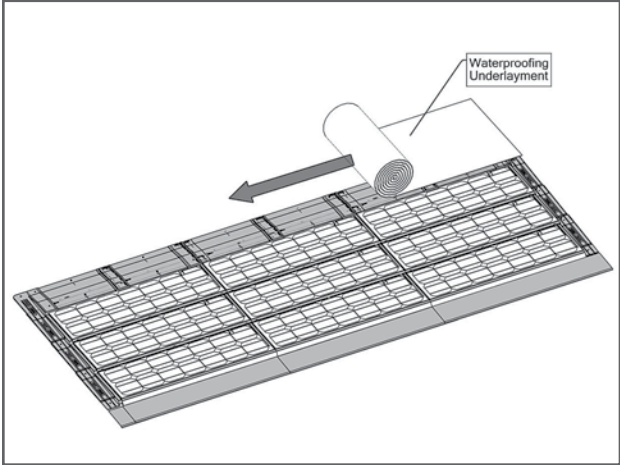
The middle fastening location on the Left Inside Corner is a depression. This is to ensure the watershedding properties of the flashing when a screw is installed here.



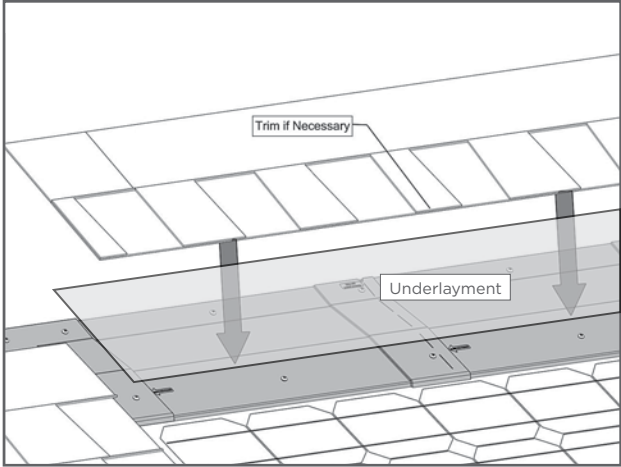
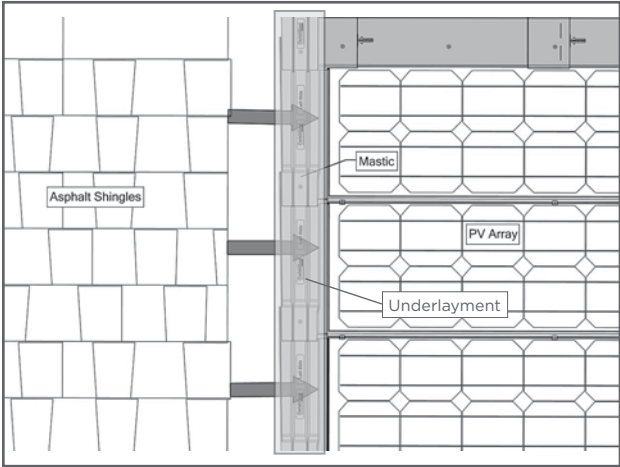
Fasten Top Flashing and Left Inside Corner as shown.

### Step 17 - Install Surrounding Asphalt Shingles

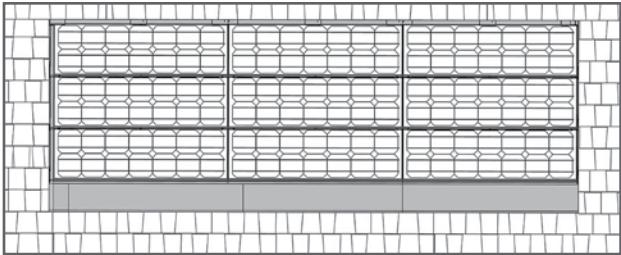
Install a layer of Grace Ice and Water Shield HT over the top edge of the top flashing, being sure to cover the fasteners.



Trim a thin strip of Grace Ice and Water Shield HT and apply over the fasteners on each side and corner flashing piece before installing surrounding asphalt shingles.



Continue installing asphalt shingles above the Top Flashing following the shingle manufacturer's application instructions.



**WARNING**

If nailing through the top flashing is required, only nail through the portion of the top flashing that lays directly on the deck. Hand-seal all shingles where the exposed area rests on the Top Flashing.

## Step 18 – Balance of System Installation

Balance of system (BOS) components supplied with the Solstice Shingle™ system include an inverter, a rapid shutdown device, and Homerun Wires. SMA inverter will be provided with the Solstice Shingle system. Alternative inverter from the approved vendor list can be purchased from a distributor. Refer to the inverter manufacturer’s installation instructions for proper inverter installation. All other BOS components will need to be supplied by the installer. These include, but are not limited to, wiring, conduit, conduit fittings, disconnects, overcurrent protection devices and specialty labels.

Once the Solstice Shingle™ system is installed, apply Safety Labels, per the NEC and any applicable local codes. Ensure that Safety Labels are applied to a clean, dry surface.

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### IMPORTANT

For field wiring, use minimum 12AWG wire rated for minimum 90°C.

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### IMPORTANT

Selection and installation of these components must conform to the National Electrical Code (NEC) if in the US, Canadian Electrical Code Part I (CSA C22.1) if in Canada, and any applicable local codes.

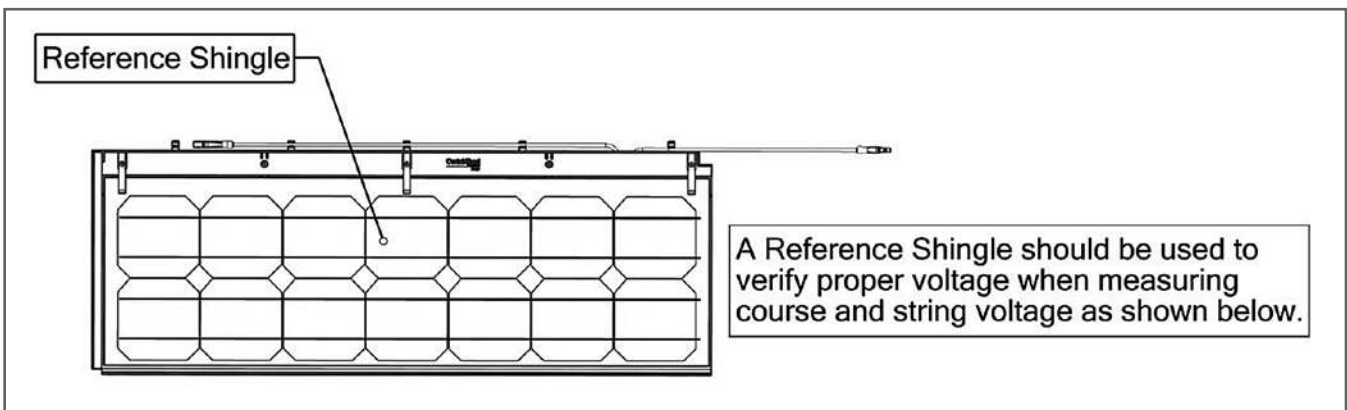
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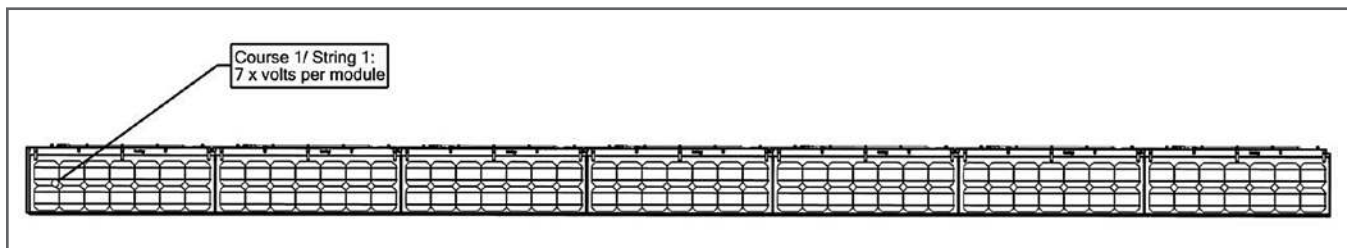
## Appendix B

### How to Test a Course/String During Installation

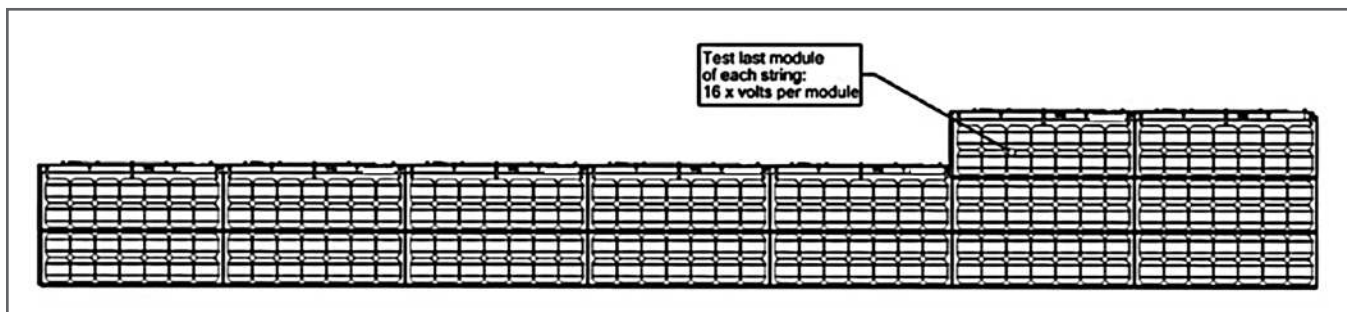
1. Testing Voltage. In order to ensure proper course and string voltage it is important to check these values as installation progresses. Test each course as well as each string of PV Shingles as it is installed to verify that all connections are tight and every PV Shingle is operating properly.
  - a. Reference Shingle. Use a PV Shingle to be sure that the voltage readings taken at course and string endpoints are consistent with normal PV Shingle Output. The Reference Shingle should be placed on the same roof plane as the array being installed to ensure that the temperature tilt and orientation are constant. Before taking course and string readings, first test the reference panel to get a real time voltage reading. This is important because the voltage produced by each PV Shingle can vary as the day progresses due to changes in the orientation of the sun and light conditions. Refer to the label on the back side of a PV Shingle to obtain the expected output voltage.



- b. Course Test. Upon completion of each course of PV Shingles, use a multi-meter to test voltage at the Homerun Wire connected to the first PV Shingle in the string and the unused connector on the last PV Shingle in the course. As courses increase within a string, be sure to add the voltage measured from previous courses. Voltage readings should be within  $\pm 1\%$  of the calculated total.



- c. String Test. Once a string is completed, use a multi-meter to test voltage at the Homerun Wire connected to the first PV Shingle in the string and the unused connector on the last PV Shingle in the string. Voltage readings should be within  $\pm 1\%$  of the calculated total.





# Appendix C

## Electrical Parameters Table

<b>Electrical parameters</b> (STC Conditions: 1,000W/m <sup>2</sup> , AM 1.5, 25 ± 2 °C)	<b>Solstice Shingle 68W-01</b> (RCP-B014B068L)	<b>Solstice Shingle 70W-01</b> (RCP-B014B070L)	<b>Solstice Shingle 72W-01</b> (RCP-B014B072L)
<b>Voc: open-circuit voltage, [V]:</b>	9.37 ± 10%	9.51 ± 10%	9.65 ± 10%
<b>Isc: short-circuit current, [A]:</b>	9.30 ± 10%	9.44 ± 10%	9.57 ± 10%
<b>Vmp: voltage at max. power, [V]:</b>	7.70 ± 10%	7.82 ± 10%	7.93 ± 10%
<b>Imp: current at max. power, [A]:</b>	8.83 ± 10%	8.96 ± 10%	9.08 ± 10%
<b>Pmp: nominal max. power, [W]:</b>	68 ± 5%	70 ± 5%	72 ± 5%

## Appendix D Technical Data Sheet: Solstice Shingle 70W-01

# Solstice<sup>®</sup> Shingle

## 70 Watts



A high-efficiency solar shingle designed for integration with all asphalt shingle roofs.

### FEATURES AND BENEFITS

#### Beautiful

- Sleek and uniform appearance that integrates seamlessly with asphalt shingles.

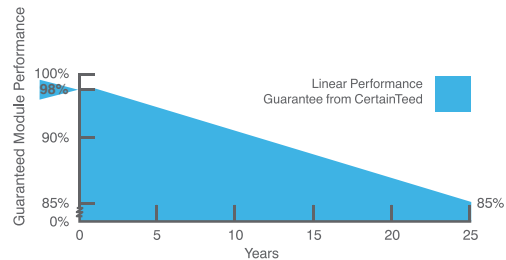
#### Simplified

- Easy design and permitting using industry leading software.
- Designed for fast installation by shingle roofing crews. Installed directly on roof sheathing using standard deck screws.

#### Dependable

- Industry-leading reliability thanks to use of patented state-of-the-art technology that makes the Solstice Shingles one of the most electrically and mechanically robust solar shingles on the market.
- Market-leading impact and wind resistance for solar shingles.
- Watertight: Water channels and raised fastener locations provide added protection against water intrusion. With over a century of roofing experience, we know how to keep rain out of your home.
- Superior performance even under diffused light and shade boosting overall energy production.

### POWER OUTPUT WARRANTY

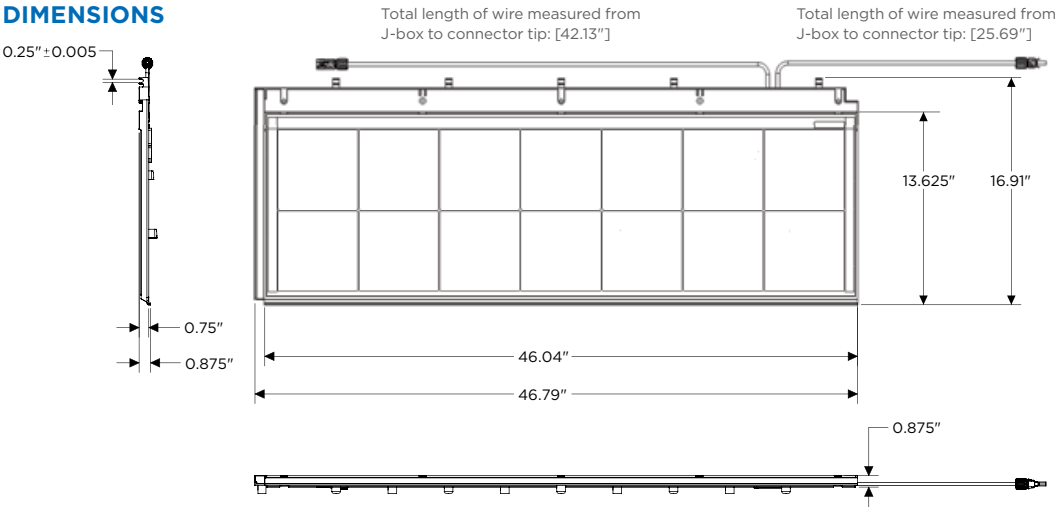


### WARRANTY AND CERTIFICATIONS

<b>Warranty*</b>	25 year limited power warranty 25 year limited workmanship warranty
<b>Certifications</b>	UL 61730 BIPV UL 7103 (pending) Fire Certification UL 790 Class A & C Wind Classification ASTM D3161 Class F Impact Resistance FM4473 Class 3 NEC 690.12 Compliant UL 3741 (pending) California CEC Listed (pending) FBC HVHZ Approved FL #42164 (V ultimate of 194 mph)

\*See CertainTeed's limited warranty for details

**DIMENSIONS**



**ELECTRICAL CHARACTERISTICS**

Standard Test Conditions (STC): 25° C, 1000 W/m², AM1.5

Maximum Power (Pmax)	70 W
Voltage at Maximum Power (Vmp)	7.8 V
Current at Maximum Power (Imp)	9.0 A
Open Circuit Voltage (Voc)	9.5 V
Short Circuit Current (Isc)	9.4 A
Maximum System Voltage	600 V
Series Fuse Rating	15 A
Temperature Coefficient of Pmax	-0.34 %/°C
Temperature Coefficient of Voc	-0.26 %/°C
Temperature Coefficient of Isc	+0.04%/°C
Nominal Operating Cell Temperature (NOCT)	53.6° C
Active Cell Efficiency	19.85%
PVUSA Test Condition (PTC) Power	62.6 W

Power Performance Tolerance +/- 5%  
 All other electrical characteristics within +/- 10%

**MECHANICAL CHARACTERISTICS**

Tested and Passed Temperature Range	-40 to +85° C
Exposed Area	46" x 13-5/8"
Weight	12.7 lb (2.3 lb per sq ft)
Cell	Monocrystalline PERC
Number of Cells and Connections	14 in series
Bypass Diode	2 per shingle
Design Load	+2400/-1600 Pa
Wiring	12 AWG PV wire
Connectors	Renhe RHC2
Minimum Roof Pitch	2/12"



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## Appendix E

### Rating Label: Solstice Shingle 70W-01



PART NUMBER: SOLSTICE SHINGLE 70W-01 (RCP-B014070L)

Peak power (Pmax):	70 W
Peak power voltage (Vmp):	7.82 V
Peak power current (Imp):	8.96 A
Short-circuit current (Isc):	9.44 A
Open-circuit voltage (Voc):	9.51 V

*Power tolerance: ±5%, Electrical rating tolerance: ±10%*

*Nominal ratings at STC (1,000W/m<sup>2</sup>, AM 1.5, 25°C)*

Maximum system voltage:	600 V
Maximum series overcurrent protection, where required:	15 A
Copper only field wiring minimum:	12 AWG
Insulated for minimum:	85° C
Design load rating (front):	2,400 Pa
Design load rating (rear):	1,600 Pa
System fire class rating (UL 790)	Class A or C
Impact resistance rating (FM 4473)	Class 3
Application Class	Class II

*See installation instructions for requirements to achieve the specified fire class rating. See module literature for appropriate mating connectors. DO NOT DISCONNECT UNDER LOAD.*

*Advertisement risque de choc électrique. Ce module produit des tensions élevées dans la Lumière du soleil. Risque électrique peut choquer, brûler ou de provoquer la mort. NE PAS TOUCHER LA BORNE*

Conforms to UL SUB 7103

Conforms to UL STDs  
61730-1 & 61730-2

Tested to ASTM D 3161  
Class F

Conforms to ANSI/UL  
STD 3741 when installed in  
accordance with installation  
manual Rev 2.X



**Intertek**  
**5026145**



Designed in California  
Made in India

20 Moores Road  
Malvern, PA, 19355  
Tel: 800-233-8990

# SOLSTICE SHINGLE™ Photovoltaic Hazard Control System (PVHCS) Manual

**Purpose:**

This manual describes the requirements of the Saint-Gobain/CertainTeed Solstice Shingle Photovoltaic Hazard Control System (PVHCS). The Solstice Shingle is designed to utilize String Level Rapid Shut Down to comply with the National Electric Code section 690.12 Rapid Shutdown of PV Systems on Buildings. The String Level RSD approach limits the number of electronics installed within the system when compared to the module-based approach.

**Designations and Terminology:**

PVHCS – Photovoltaic Hazard Control System

PVHCE – Photovoltaic Hazard Control Equipment

UL 3741 Safety Analysis Requirement – Designated as [UL3741]

**Installation and Operations  
Instructions:**

[UL3741] For any roof top mounted PVHCE minimum 4X rating is required

Solis/Ginlong Inverters:  
For installation of Solis/Ginlong inverters, reference applicable installation and operating instructions for direction. The latest versions can be found on the vendor’s website. (CertainTeed UL3741 Approved)

Growatt Inverters:  
For installation of Growatt inverters, reference applicable installation and operating instructions for direction. The latest versions can be found on the vendor’s website. (CertainTeed UL3741 Approved)

Rapid Shut Down:  
For installation of Rapid Shut Down Device, reference applicable installation and operating instructions for direction. The latest versions can be obtained through the CertainTeed Sales department.

**[UL 3741] PVHCE:**

The following equipment is included within this manual revision. The equipment listed here are those that were submitted to Intertek for UL3741 Safety Analysis review and were approved.

<b>BIPV Module</b>	Merlin Solar Technologies, Inc. (5020442)	Solstice Shingle 68W-01	
		Solstice Shingle 70W-01	
		Solstice Shingle 72W-01	
<b>Inverter</b>	Ginlong Technologies Co.,	Solis 1P3.6K-4G-US Solis 1P5K-4G-US Solis 1P6K-4G-US	Solis 1P7.6K-4G-US Solis 1P9K-4G-US Solis 1P10K-4G-US
	Shenzhen Growatt New Energy Co., Ltd	MIN 3000TL-XH-US MIN 3800TL-XH-US MIN 5000TL-XH-US MIN 6000TL-XH-US MIN 7600TL-XH-US	MIN 8200TL-XH-US MIN 9000TL-XH-US MIN 10000TL-XH-US MIN 11400TL-XH-US
<b>Rapid Shutdown Control Box</b>	MidNite Solar, INC.	MNSST-Dual	
		MNPV6-WS	

[UL3741] For installation of PVHCS components, reference applicable installation and operating instructions for direction.

[UL3741] The PVHC system shall be provided with complete instructions for installation, operation and maintenance of the system. The installation instructions include a detailed description of the installation in accordance with the National Electrical Code (NEC), NFPA 70 and the Canadian Electrical Code (CE Code), C22.1.

[UL3741] Adhere to all cautionary markings and ratings unique to the equipment being installed per the applicable installation and operating manuals.

[UL3741] WARNING: To Reduce the Risk of Injury, read all instructions in the applicable installation and operating manuals

[UL3741] All technical requirements, restrictions, design constraints, documented within the latest approved National Electric Code within the installing jurisdiction, and applicable installation and operating manuals shall be adhered to.

[UL3741] PV Module String Restriction: The maximum capable designed string voltage shall be no greater than 600VDC.

[UL3741] The maximum number of modules per string shall be no greater than 50.

[UL3741] Rapid Shut Down Receiver: The rapid shut down receiver shall be located within 1' of the PV array in which it is protecting.

[UL3741] Mechanical and electrical characteristics documented within the applicable installation and operating manuals shall be adhered to.

[UL3741] Follow all testing and maintenance instructions documented within the applicable installation and operating manuals for the equipment being installed

[UL3741] When replacing components within the PVHCS, follow applicable replacement instructions within the installation and operating instruction manuals.

[UL3741] Install conductors, materials, and components in accordance with the latest approved National Electric code within the installing jurisdiction, and applicable installation and operating manuals for the product being installed.

[UL3741] The operating instructions shall contain warnings addressing the replacement of PV system equipment, including required specifications, if the replacement of such equipment impacts the operational integrity of the hazard control function.

### Non UL 3741 Compliant Installations:

For jurisdictions that do not require UL 3741 compliance, the following inverters can also be utilized:

#### SMA Solar Technology AG (E210376)

SB7.7-1SP-US-41

For installation of SMA inverters, reference applicable installation and operating instructions for direction. The latest versions can be found on the vendor's website.

#### Sol-Ark (SGSNA/22/GZ/00171)

Limitless 15k-LV (15k-2P-N)

Sol-Ark-12K-P (12k-2P-N)

Sol-Ark-8k-48-ST (8k-2P-N)

5k-120V/8k-230V-1P (5k-1P-N)

For installation of Sol-Ark inverters, reference applicable installation and operating instructions for direction. The latest versions can be found on the vendor's website.

# Document Revision History

Revision Level	Date	Comments
1.0	5/5/23	Initial Release
2.0	10/25/23	Added Growatt Inverters to PVHCS Updated Label



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