

TESLA

SOLAR ROOF V3

INSTALLATION MANUAL

for integrated diode tile



Disclaimer of Liability

Tesla Incorporated (“Tesla”) and its subsidiaries are not liable for any damages caused by failure to follow the instructions and guidelines found in this manual, or from inappropriate use or maintenance of PV Modules. This includes, without limitation, any damages, losses, and expenses caused by non-observance of the instructions of this manual, as well as damages, losses, and expenses caused by, or in connection with, products of other manufacturers.

Notices

The information in this manual is believed to be reliable, but does not constitute an express or implied warranty. Tesla reserves the right to make changes to its PV Modules and other products, their specifications, or this manual without prior notice.

This manual applies to Solar Roof PV Modules, Roofing Tiles, Partial Tiles, the Prepared Roofing System elements which serve as their mounting system, and electrical wiring elements manufactured by Tesla. It is explicitly written for qualified professionals (“Installer” or “Installers”), including without limitation licensed electricians and NABCEP-Certified PV Installers.

Contact Information

EnergyTechPubs@tesla.com

Tesla, Inc
3500 Deer Creek Road
Palo Alto, CA 94304 U.S.A.

TESR-IM-0293-21
ISSUE DATE: Jan 25, 2022

Important Safety Instructions

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

All instructions must be read and understood before attempting to install, wire, operate, or maintain a PV system. Failure to read and comply with any of the limitations noted herein can result in property damage, serious bodily injury, or death.

Abide by local, regional, and national statutory regulations when installing the system, and obtain a building permit if necessary. Consult your local authority for guidelines and requirements for building or structural fire safety.

NOTE TO TRAINED PROFESSIONALS

Tesla Solar Roof requires specialized skills and knowledge. Use qualified personnel for installation. The installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock.



DANGER:

Tesla Solar Roof is slippery and is a fall hazard. Only access a Solar Roof with appropriate safety equipment and while wearing personal fall protection equipment. Use fall protection when working from heights of 6 feet (183 cm) or above. Follow Occupational Safety and Health Act (OSHA) or local governing safety regulations regarding Fall Protection.

An approved and safe walking platform should be used when accessing the roof to prevent falls, and damage to the roof. In addition, skylights, roof openings and light transfer panels must be covered with approved covering to prevent falls.

Tesla Solar Roof is engineered to safely withstand applicable live loads required by building code for steep slope applications. However, to ensure safety and maintain maximum roof life, walking on a Solar Roof should be avoided except by trained Tesla Solar Roof installation professionals and first responders. This is a common recommendation for other high-end roof types, including slate, clay, concrete, and composite tile products.

In the event of a fire at the premises, rapid shutdown equipment in the array will reduce voltages and control the hazard for firefighter operations. Nevertheless the array wiring should be treated as potentially dangerous, especially if it is damaged by heat or flames. Inform the fire crew about the particular hazards from the PV system, and stay away from all elements of the PV system during and after a fire until the necessary steps have been taken to make the PV system safe.

ELECTRICAL SAFETY PRECAUTIONS



DANGER:

- **Use equipment, connectors, and wiring suitable for solar electric systems.** Use insulated tools that are approved for working on electrical installations. Do not open electrical connections or unplug connectors while the circuit is under load.
- Do not use PV Modules near equipment or in places where flammable liquid, gases, or other hazardous materials are located.
- **Work under dry conditions and use dry tools.** Do not handle PV Modules under wet conditions unless wearing appropriate protective equipment or attempt to make an electrical connection with wet, soiled, or otherwise faulty connectors.
- **Prevent damage to PV Modules.** Wear non-slip gloves when carrying PV Modules and exercise caution when transporting and installing PV Modules. Do not lift any module by the module's junction box or electrical leads. Do not drop PV Modules or allow objects to fall on modules. Do not leave a module unsupported or unsecured. A damaged PV Module cannot be repaired and must not be used. Do not use a PV Module with broken glass.
- **Do not disassemble or modify PV Modules in any way.** Do not apply paint or adhesive to any module top surface or backsheet. Doing so may degrade performance or cause irreparable damage and will void any applicable warranties.

OPERATING CONDITIONS

- The operating temperature must be within -40°C (-40 °F) to 85°C (185 °F).
- Do not install modules above 13,120 ft (4,000 m) altitude above sea level.



DANGER:

A PV Module may experience conditions that produce more current and/or voltage than reported at standard test conditions. Follow the requirements of the National Electrical Code (NEC) in Article 690 to address these increased outputs. In installations not under the requirements of the NEC, multiply the values of I_{sc} and V_{oc} marked on the Solar Roof PV Modules by a factor of 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output.

Table of Contents

Solar Roof System Overview _____	6	Appendix 1: Decking Requirements _____	32
PVHCS Certification _____	7	Appendix 2: Roof Overlay Requirements _____	33
Components		Appendix 3: Underlayment Specifications _____	34
PV Module Specifications		Appendix 4: Wildlife Urban Interface Compliance _____	36
Mid-Circuit Interrupter Specifications		Appendix 5: High Wind Tiles _____	39
Pass Through Box Specifications		Appendix 6: Flashing Components _____	40
Ground Fault Path			
Module Mounting Hardware and Fastener Specifications _____	13		
Module Installation Procedure _____	14		
Mid-Circuit Interrupter Installation Standards _____	15		
On Roof Wire Management _____	21		
Minimum Bend Radius			
Built in Wire Management Features			
Flexible Non-Metallic Conduit			
Parallel String Connections			
String Testing Procedure _____	23		
Style 1 Mounting Plane, Tempered Roofing Tiles _____	24		
Fastening			
Interlocking Elements			
Style 2 Mounting Plane, Metal Tile _____	27		
Fastening			
Interlocking Elements			

Solar Roof System Overview

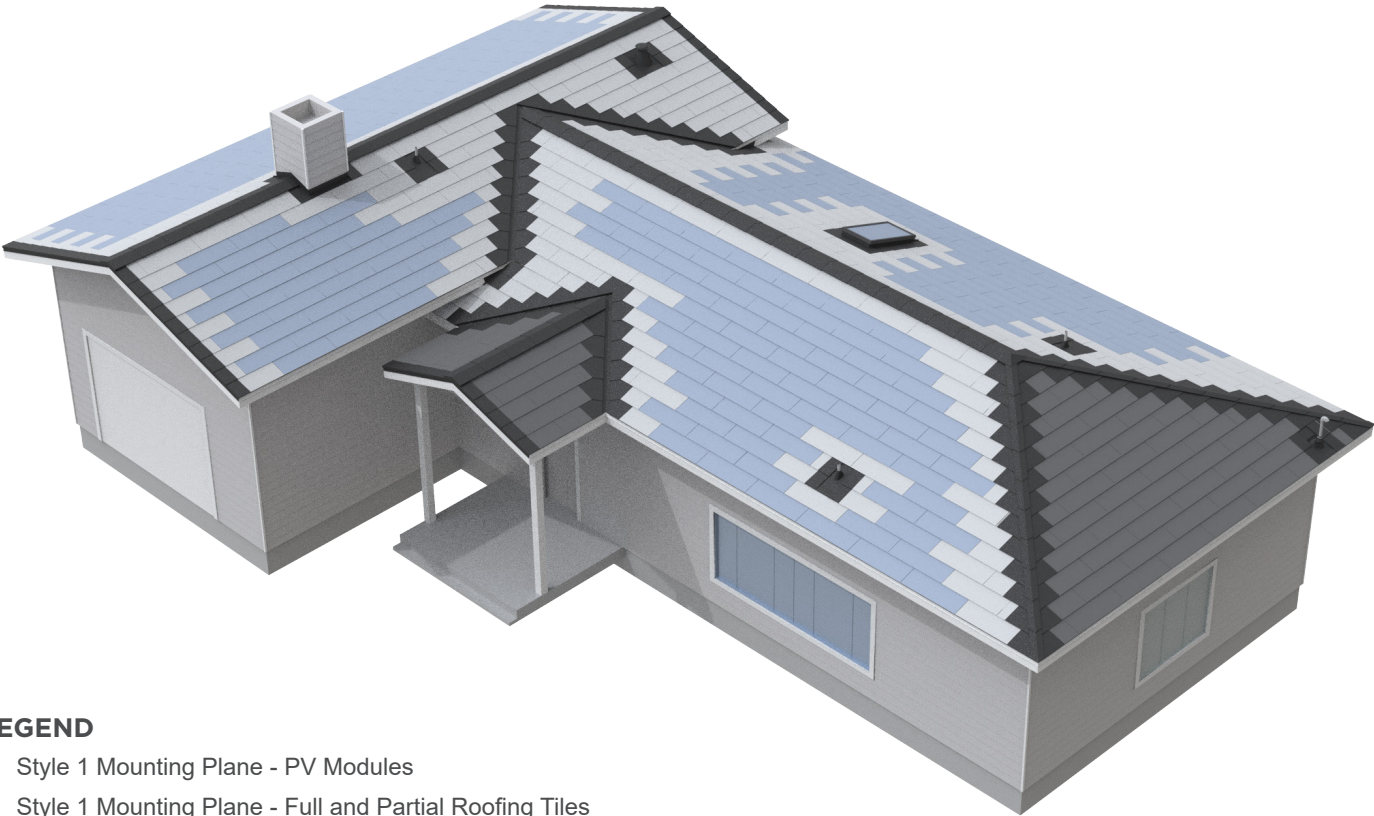
A Solar Roof functions in fundamentally the same way as traditional roof-mounted PV systems. Sunlight is converted to DC electricity at each individual module. Individual modules are connected in series using diode harnesses to form a complete PV “string.” One or more strings connect in parallel at a typical string inverter to convert power to AC.

Traditional PV

- DC modules
- Tempered glass
- Silicon cells
- Backsheet & encapsulant
- Module J-boxes, PV wire and Listed connectors
- Series strings below 600 V
- DC - AC inverters
- Rapid shutdown

Tesla Solar Roof Array

- DC modules
- Tempered glass
- Silicon cells
- Backsheet & encapsulant
- Module J-boxes, pv wire and Listed connectors
- Series strings below 600 V
- DC - AC inverters
- Rapid shutdown



LEGEND

- Style 1 Mounting Plane - PV Modules
- Style 1 Mounting Plane - Full and Partial Roofing Tiles
- Style 2 Mounting Plane - Metal Tiles
- Flashings

PV Hazard Control System (PVHCS) Certification

UL 3741 Report Date 8-12-21

PV Rapid Shutdown Array, UL 1741 Category QIJR, Report Date: 2021-06-11 (Rev 8-10-21)

WARNING: To reduce the risk of injury, read all instructions.

PV Hazard Control Equipment and Components

Function	Manufacturer	Model No.	Firmware Versions and Checksums	Certification Standard
PVRSE Mid Circuit Interrupter (MCI)	Tesla	MCI-1 1550379 ¹	N/A	UL 1741 PVRSE
Inverter or Powerwall+	Tesla	7.6 kW: 1538000 ¹ 3.8 kW: 1534000 ¹ 7.6 kW: 1850000 ¹	V4, CEA4F802 V4, FF7BE4E1 V4, CEA4F802	UL 1741, 1998 PVRSS/PVRSE
PV Module	Tesla	SR60T1, SR72T1 SR72T2	N/A	UL 61730
Diode Harness (Not applicable to SR72T2)	Tesla	SRDTH	N/A	UL 9703
PV Wire Jumper(s)	Tesla	SR-BJ2X, SR-BJ3X, SR-BJ4X, SR-BJMini	N/A	UL 9703
Pass-Through Box	Tesla	SRPTB-4	N/A	UL 1741
PVHCS Initiator : (PV Inverter)	Dedicated PV system AC circuit breaker or AC disconnect switch, labeled per NEC 690.12 requirements.			N/A
PVHCS Initiator : (Powerwall+)	Emergency stop device (NISD)- Listed "Emergency Stop Button" or "Emergency Stop Device" or "Emergency Stop Unit"			UL 508 or UL 60947 Parts 1, 5-1 and 5-5

¹ Applies to variations of this part number with suffix of two numbers and one letter.

Note: PVHCS installation requirements may reduce the effective equipment and component ratings below the individual equipment and component PVRSE ratings in order to achieve PVHCS shock hazard reduction requirements.

PVHCS Installation Requirements

Max System Voltage	600 Vdc
PVHCS Maximum Circuit Voltage (Array Internal Voltage After Actuation)	165 Vdc (cold weather open circuit)
Max Series-Connected Panels between MCIs	10

Other Installation Instructions

1. An MCI must be connected to one end of each series string or mounting plane sub-array string.
2. Verification that MCIs are installed with 10 or fewer modules between MCIs shall be documented for inspection, by voltage measurement logs and/or as-built string layout diagrams.
3. For PV Inverter: The PVHCS initiator (AC breaker or switch) shall be sized and installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings.
4. For Powerwall+: The PVHCS emergency stop initiator shall have the following minimum ratings: Outdoor (Type 3R or higher), 12V, 1A, and shall be installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings. Refer to the Powerwall+ installation manual for further details.

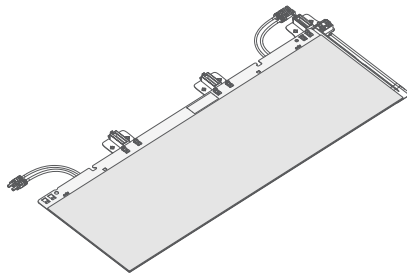


Certification Mark of UL on the installation instructions is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The Certification Mark for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY," the geographic identifier(s), and a file number.

PV Hazard Control System (PVHCS) Components

PV Module

Model #SR60T1, #SR72T1
UL 61730, UL 3741
UL 790 Class A
ASTM D3161 Class F
TAS100



Model #SR72T2
UL 61730, UL 3741
UL 790 Class A
ASTM D3161 Class F
TAS100

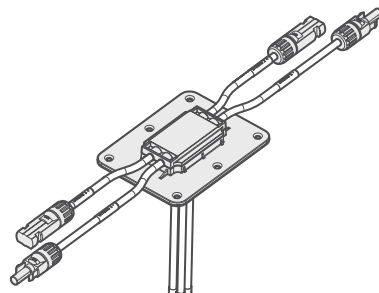
Mid-Circuit Interrupter

Model #MCI-1, #1550379, 650 V, 12 A
UL 1741 PVRSE



Pass Through Box

Model #SRPTB-4
UL 1741, File #E318357



Jumper

Model #SR-BJ2X, #SR-BJ3X, #SR-BJ4X, and #SR-BJMini
UL 9703

Jumper Length	Part Number	When to Use
1x	1705337-01-A	Up to 1.5 Module Lengths
3x	1705337-03-A	2 to 3.5 Module Lengths
5x	1705337-05-A	4 to 5.5 Module Lengths
7x	1705337-07-A	6 to 7.5 Module Lengths
9x	1705337-09-A	8 to 9.5 Module Lengths
12x	1705337-12-A	10 to 12.5 Module Lengths

Branch socket, Staubli

Model #PV-AZB4
UL 6703



Branch plug, Staubli

Model #PV-AZS4
UL 6703

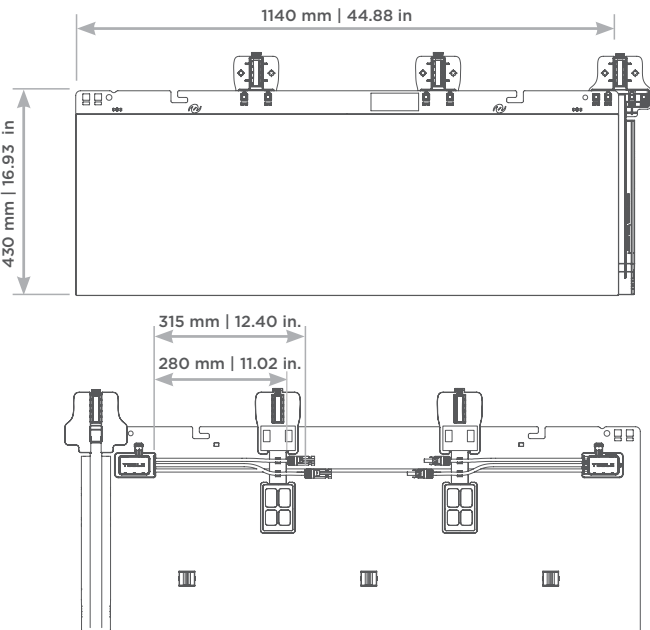


Inverter

7.6 kW: #1538000
3.8 kW: #1534000
UL 1741 PVRSS/PVRSE, 1998

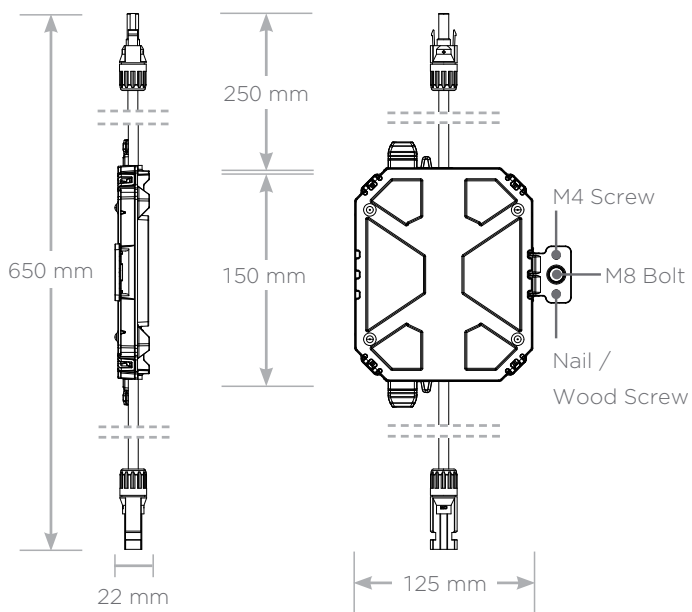


Module Specifications

Electrical Characteristics		System Certifications	
Power Class	SR72T2	UL 61730 (UL Listed)	
Test Method	STC	UL 9703 (UL Listed)	
Max Power, P _{MAX} (W)	72	UL 1741 (UL Listed)	
Open Circuit Voltage, V _{OC} (V) per diode	14.20	UL 3741 (UL Listed)	
Short Circuit Current, I _{SC} (A)	6.80	UL 790 Class A (ETL Listed)	
Max Power Voltage, V _{MP} (V)	11.30	ASTM D3161 Class F (ETL Listed)	
Max Power Current, I _{MP} (A)	6.30	TAS100 (ETL Listed)	
STC	1000 W/m², 25°C, AM 1.5 spectrum		
Mechanical Loading		Temperature Rating (STC)	
Wind Rating	Up to 87 m/s 194 mph	Temperature Coefficient of I _{sc}	0.038 % / °C
Roof Snow Load	Up to 1280 kg/m² 263 lbs/ft² surface-normal Up to 270 kg/m² 55 lbs/ft² shear	Temperature Coefficient of V _{OC}	-0.267 % / °C
Hailstone Rating	FM 4473 Class 3 (Intertek)	Temperature Coefficient of P _{MAX} (W)	-0.372 % / °C
Mechanical Parameters			
Cells	14		
Junction Box	IP68, 1 diodes		
Cable	12 AWG PV Wire, 90 °C wet or dry, Long lead 315 mm 12.40 in. length Short lead 280 mm 11.02 in. length		
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)		
Principal Materials	Glass, Polymers, Fiberglass and Silicon		
Height From Deck	35.3 mm 1.39 in		
Installed System Weight	15 kg/m² 3.1 lb/ ft²		
Dimension	430 mm x 1140 mm x 5 mm 16.93 in x 44.88 in x .20 in		
Operation Parameters			
Operational Temperature	-40 °C up to 85 °C		
Power Output Tolerance	-0 /+5%		
Max System Voltage	DC 1000 V (IEC/UL) for installations above 2000m but below 3000m the system voltage is 877 V		
Max Series Fuse Rating	10 A		
Safety Class	Class II		
Fire Rating	UL 61730 Class A		
Limited Warranties			
Module Warranty	25 years		
The power output capacity of your Solar Roof will be at least 95% of maximum rated output power of the Solar Roof system at 5 years after install. The power output capacity will decline by no more than 0.5% per year for the following 20 years. This warranty covers the power your Solar Roof will produce under standard test conditions.			

Mid-Circuit Interrupter Specifications

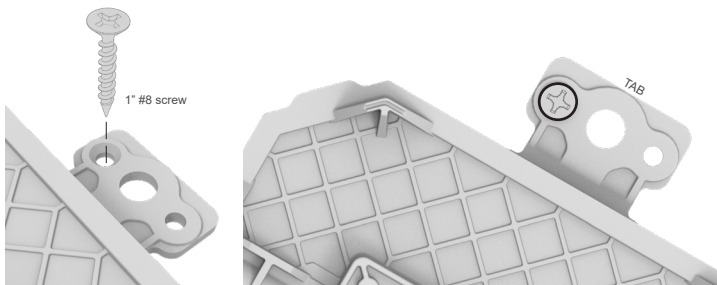
Electrical Characteristics		Certifications
Model Number	MCI-1	UL 1741 PVRSE, UL 3741
Enclosure Rating	NEMA 4 / IP65	
Max Input Short Circuit Current, I_{sc} (A)	15 A	
Nominal Input Current, I_{MP} (A)	12 A	
Mechanical Parameters		
Cable	Length 250 mm (9.84 in)	
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)	
Housing	Plastic	
Weight	350 g (0.77 lb)	
Dimension	125 mm x 150 mm x 22 mm (5 in x 6 in x 1 in)	
Environmental Specifications		
Ambient Temperature	-40 °F up to 122 °F (-40°C to 50°C)	
Storage Temperature	-22°F to 158°F (-30°C to 70°C)	
Max System Voltage	DC 600 V	



Fastening Specifications

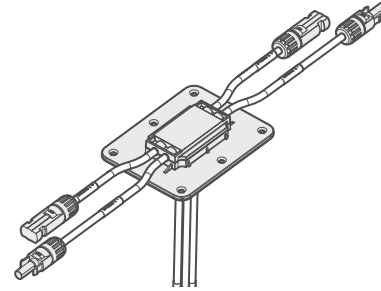
Use a 1" - #8 deck screw to secure the MCI to the roof surface using the three hole tab.

Install the screw through the beveled hole so that the screw's head sits flush.



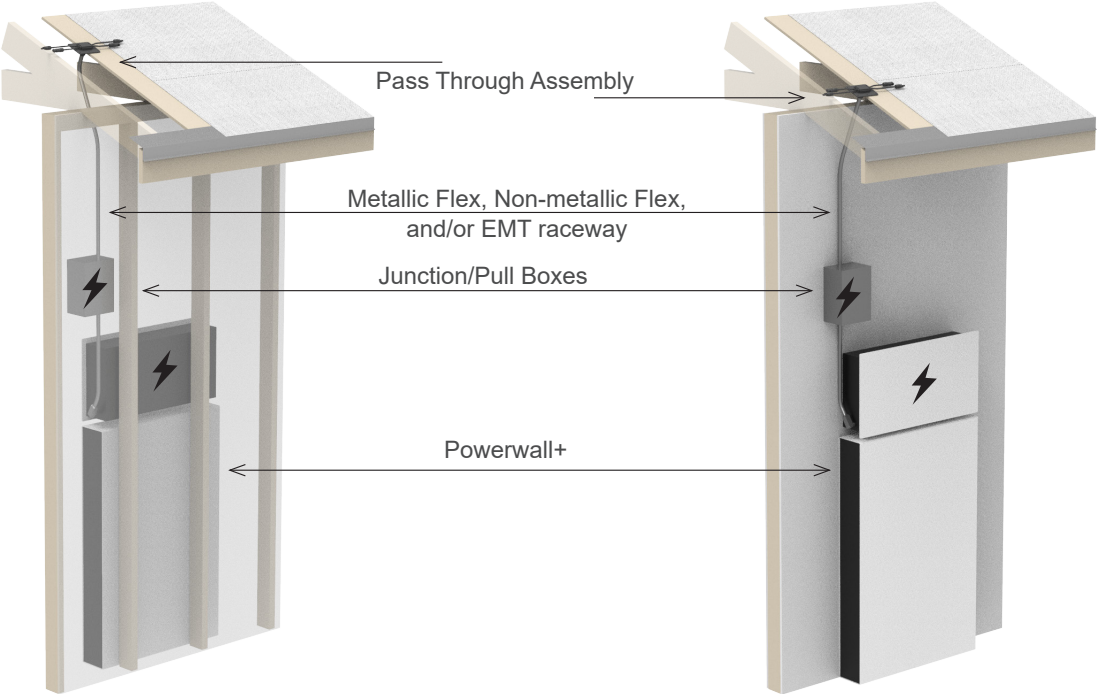
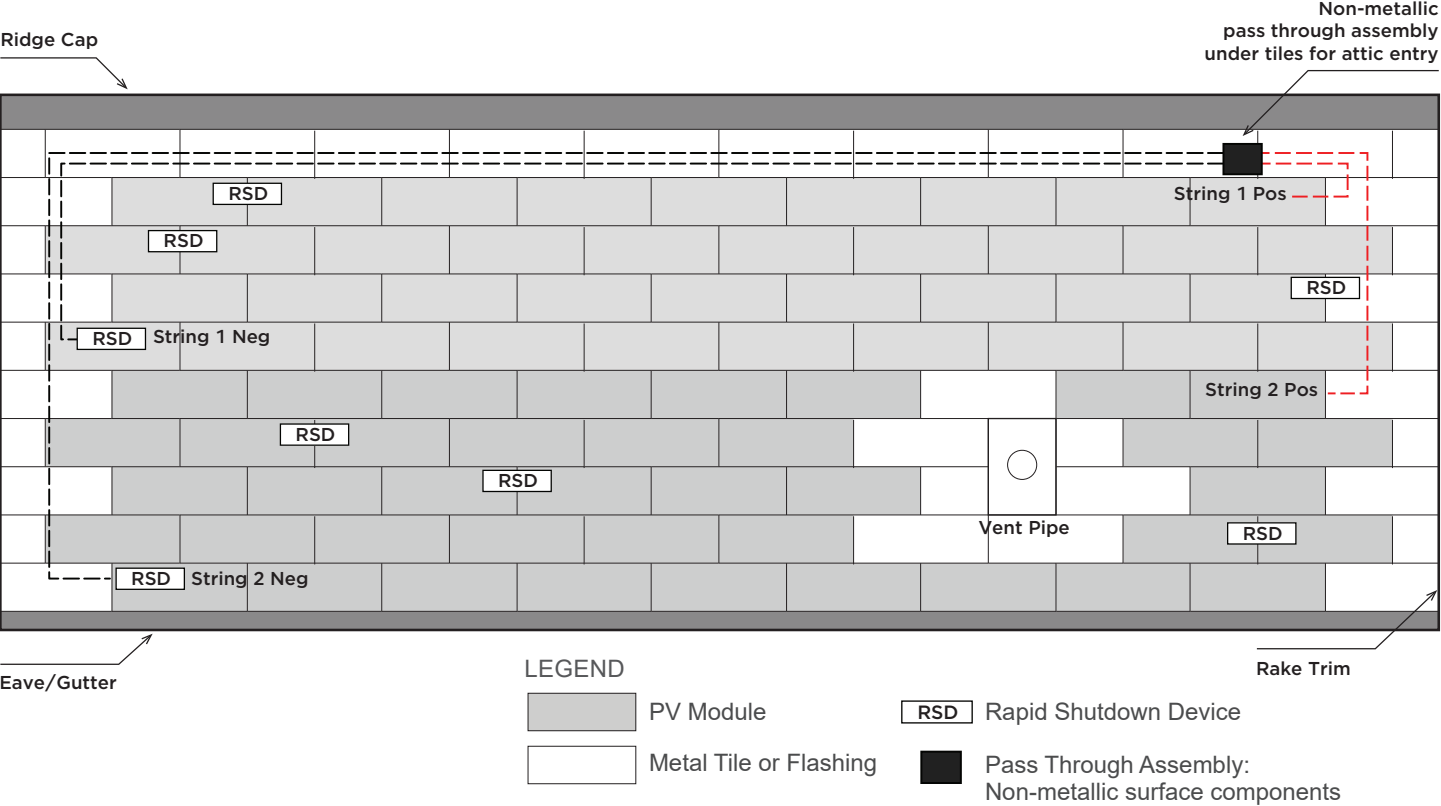
Pass Through Box Specifications

Electrical Characteristics		Certifications
Model Number	SRPTB-4	UL 1741, File #E318357
Mechanical Parameters		Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
Cable Type	10 AWG PV Wire (ZKLA), 90 °C wet or dry,	
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)	
Housing	Plastic	
Environmental Specifications		
Max System Voltage	DC 600 V	
Fastening Specifications		
Verify transition location on plan set. Install Pass Through Box using wiring methods and materials that comply with Article 690 and Chapter 3 of the NEC and local regulations. Fasten the Pass Through Box to the deck using six Buglehead Screws. Use Tesla approved fasteners only. Use of unapproved fasteners may invalidate warranty. Confirm whether the job is a full tear-off or overlay installation. Full Tear-Off: Screw, Phillip Buglehead; DK, #8 x 1" Coated; PN 1470351-00-A Overlay: Screw, Phillip Buglehead; #8 x 1.5"; PN 1716850-00-A or 1717851-00-A		



Ground Fault Path

Ground fault paths for Solar Roof systems exist only for the DC circuit conductors as they exit the roof surface into the attic or under an eave or soffit via pass-through assemblies, as shown in the figure below. The PV tiles have no conductive external parts. Rooftop circuits that run adjacent to or under conductive parts such as metal tiles or flashings are contained in non-metallic raceways. Circuits exit the pass-through assemblies into conventional junction boxes or conduit couplings, where equipment ground conductors and conduit ground bushings are employed to ensure a continuous EGC path to the inverter or Powerwall+ ground bus.

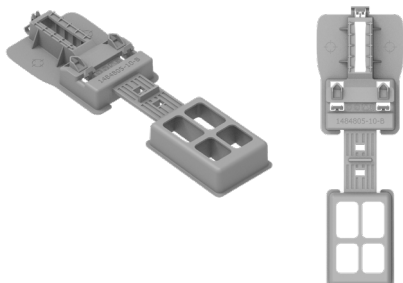


Module Mounting Hardware and Fastener Specifications

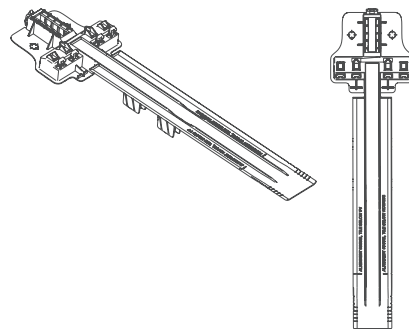
Mounting Hardware

The PV Module comes pre-assembled with mounting hardware, the Foot with Support and Footlap.

Foot with Support
Model #SR-FOOTSUP
(PN 1484805-10-B)
UL 790 Class A
ASTM D3161 Class F
TAS100



Footlap
Model #SR-FOOTLAP
UL 790 Class A
ASTM D3161 Class F
TAS100



Fastener Specifications

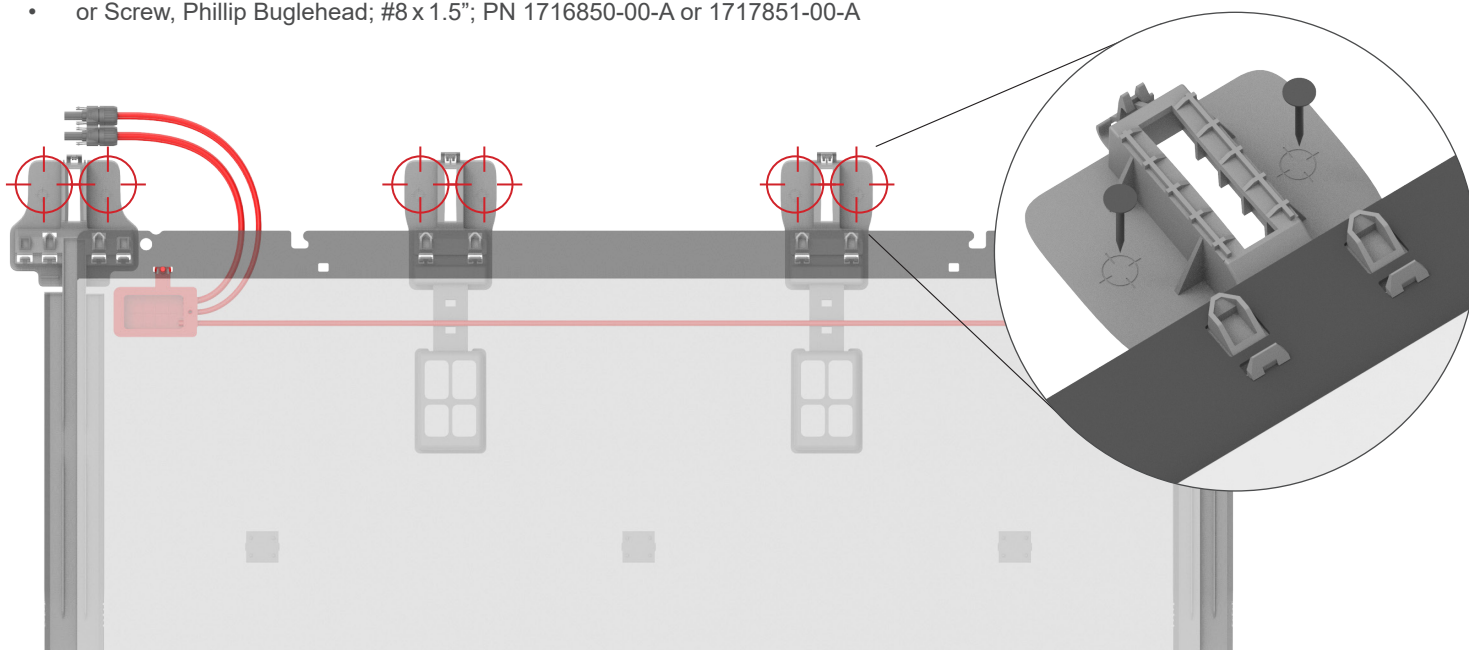
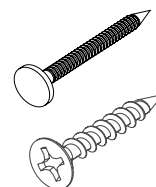
The fastening location for the PV Module is through the target in each Foot for a total of 6 fasteners per PV Module. Use Tesla approved fasteners only. Use of unapproved fasteners may invalidate warranty. Confirm whether the job is a full tear-off or overlay installation. Overlay installations will have a longer nails marked with a painted orange head.

Full Tear-Off

- Nail, Ring Shank Roofing; 11-GA 1.25", Collated, CR; PN 1549330-01-A, 1549330-04-A, or 1549330-05-A
- or Screw, Phillip Buglehead; DK, #8 x 1" Coated; PN 1470351-00-A

Overlay

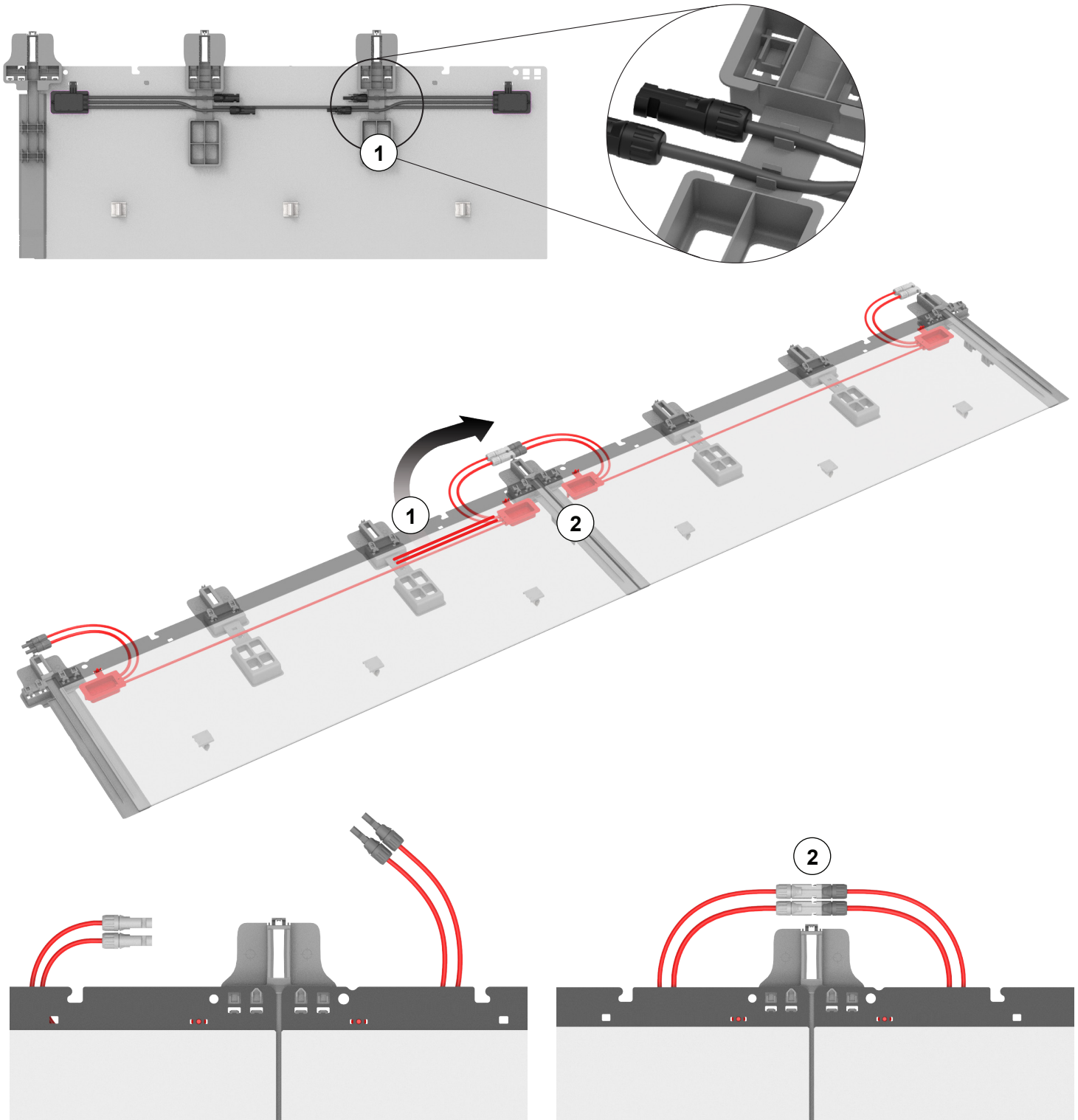
- Nail, Ring Shank Roofing (orange); 11- GA 1.75", Collated, CR; PN 1704763-00-A
- or Screw, Phillip Buglehead; #8 x 1.5"; PN 1716850-00-A or 1717851-00-A



Module Installation Procedure

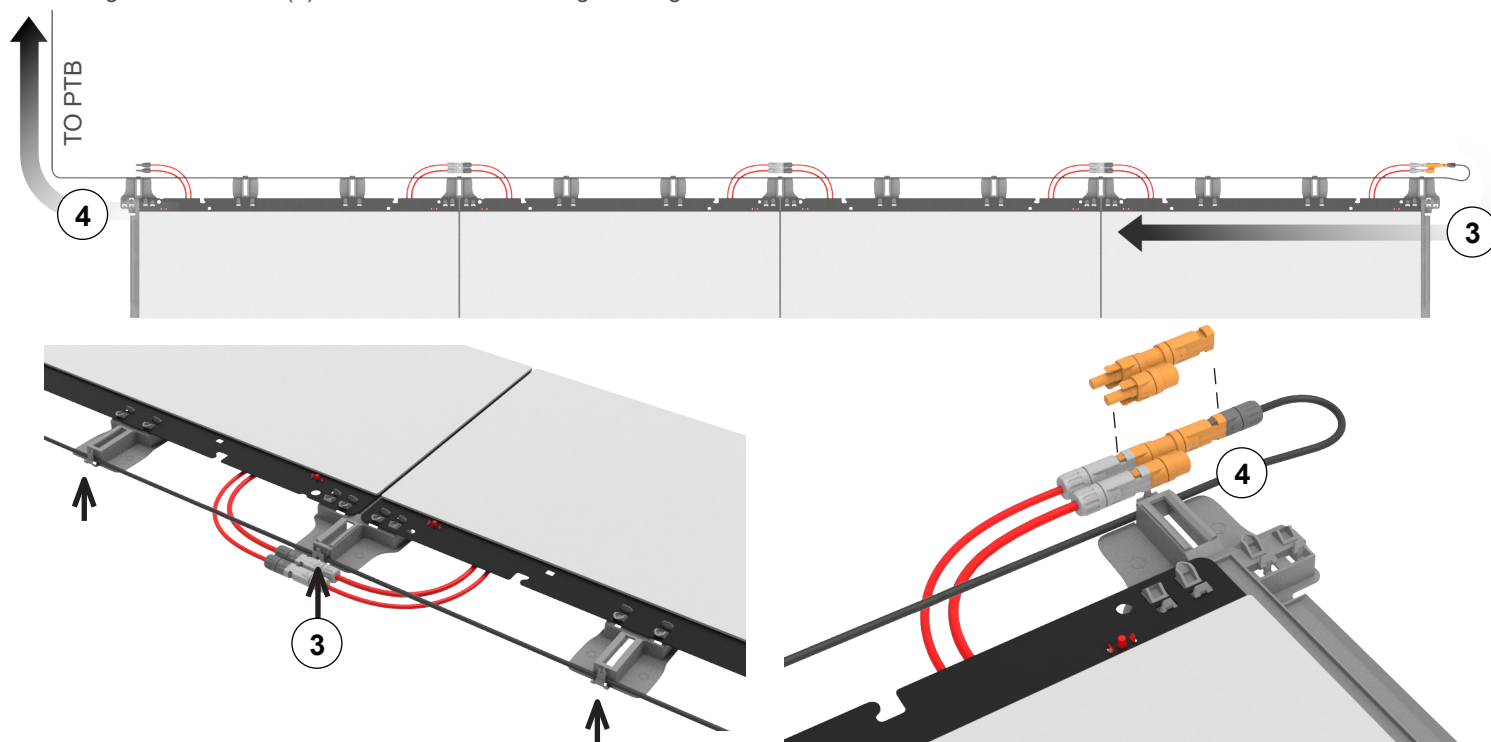
1. Module to module connection

Release the cables from each individual tile where they are held (1) by the Foot with Support, and connect adjacent modules above the Footlap (2). Ensure that the cabling is not under mechanical stress (Comply with bending radius of ≥ 2.36 in (60 mm)). Ensure that the cables do not run in areas where they are in danger of being pinched.



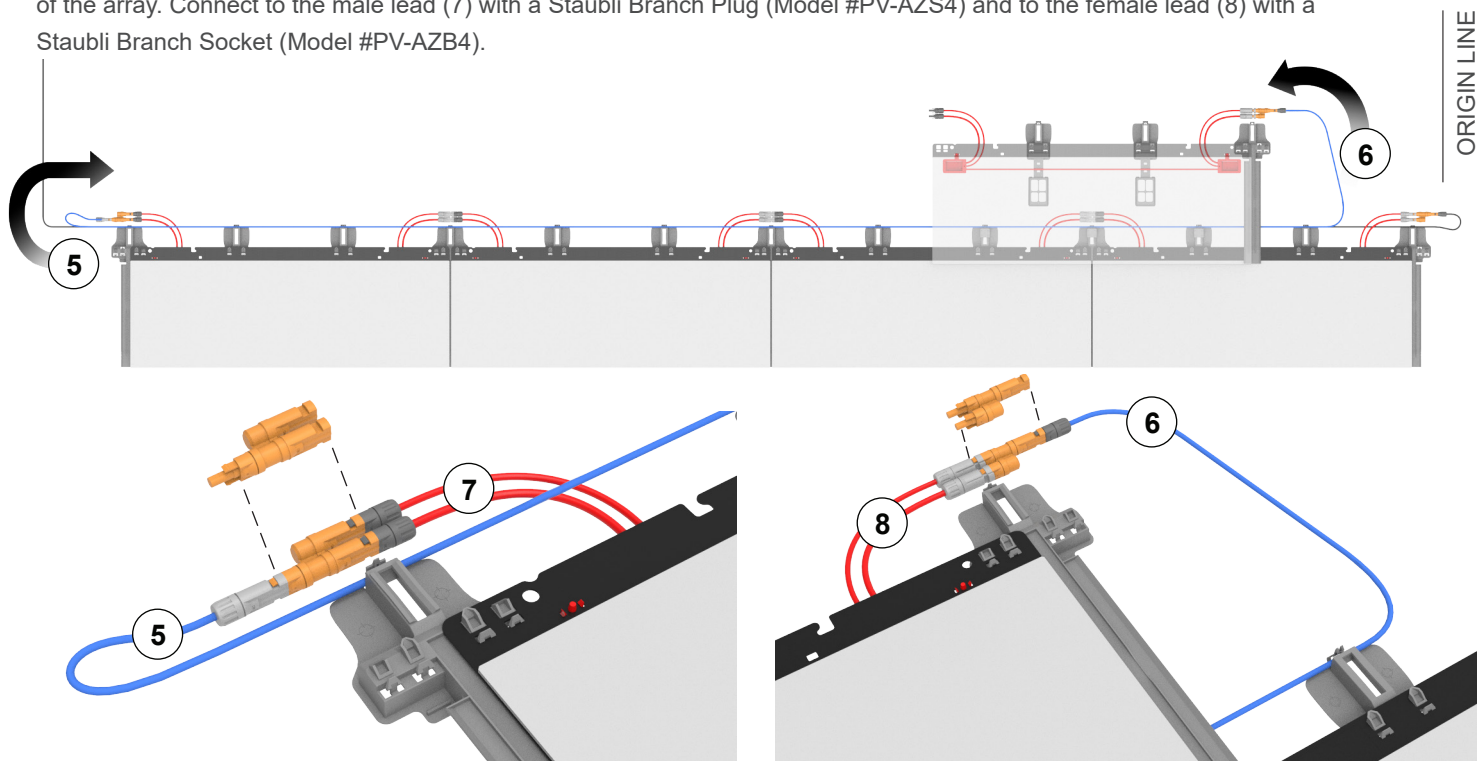
2. Install the home run cable

Run the home run cable from the first module (3) to the Pass Through Box location (4) marked on the planset. Use the wire management features (3) to secure the cable along the length of the run.



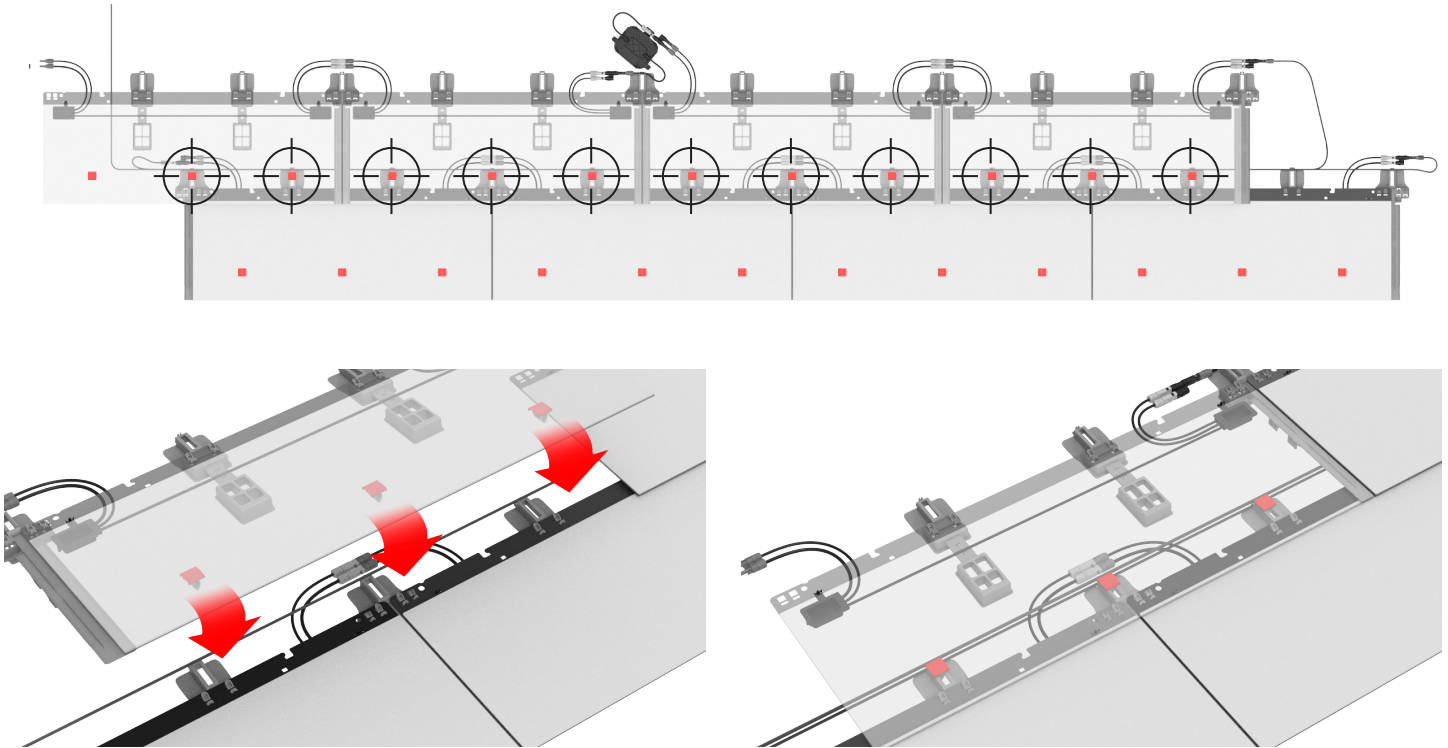
3. Install the first row jumper cable

Connect the first and second rows of modules by running a jumper cable (5) back to the origin line (6) on the left or the right side of the array. Connect to the male lead (7) with a Staubli Branch Plug (Model #PV-AZS4) and to the female lead (8) with a Staubli Branch Socket (Model #PV-AZB4).



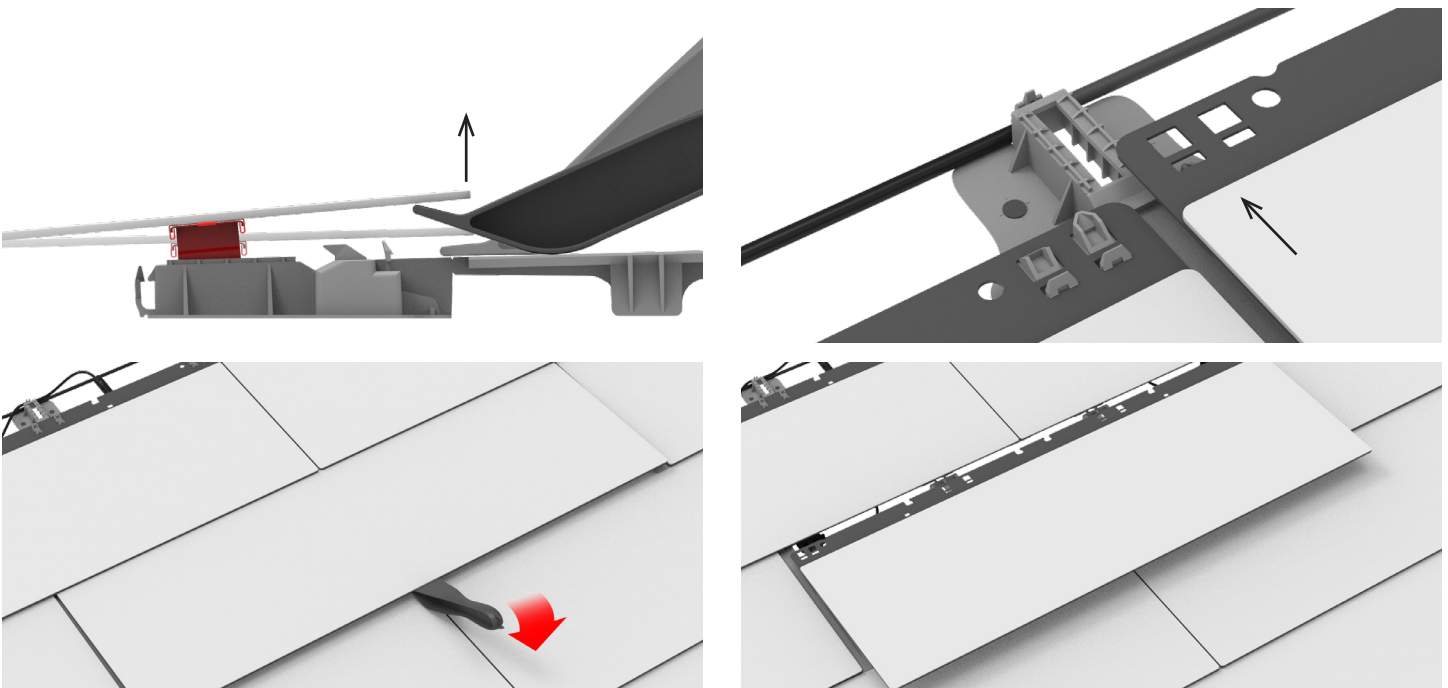
4. Lock the uproof modules into the downroof modules

Adjacent tiles will share a Footlap. Lock subsequent rows together using the Uplift Clip feature on the bottom of the tile. The Uplift Clip will mate into the slot in the Footlap and Foot.



5. Removal and maintenance (if needed)

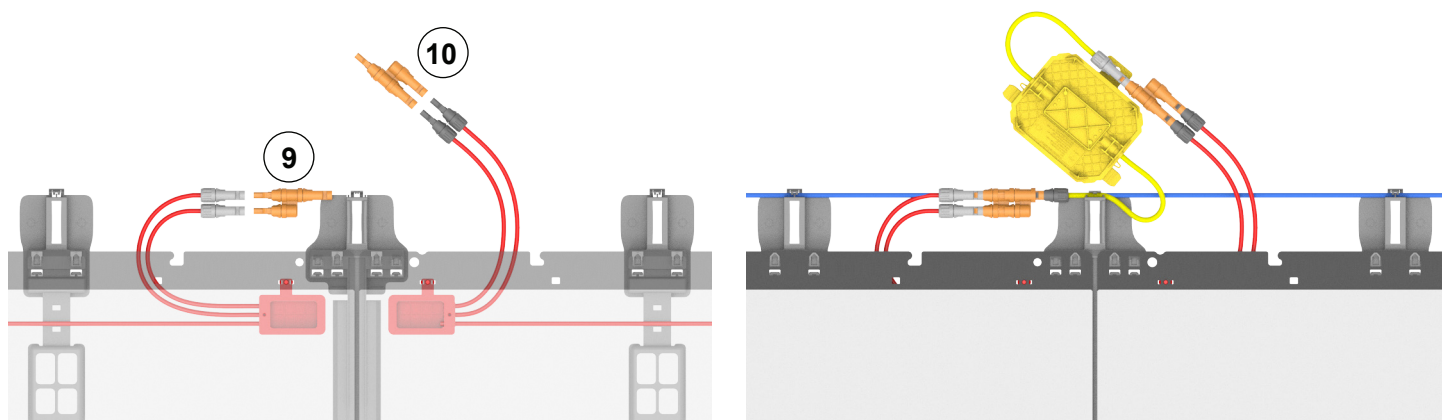
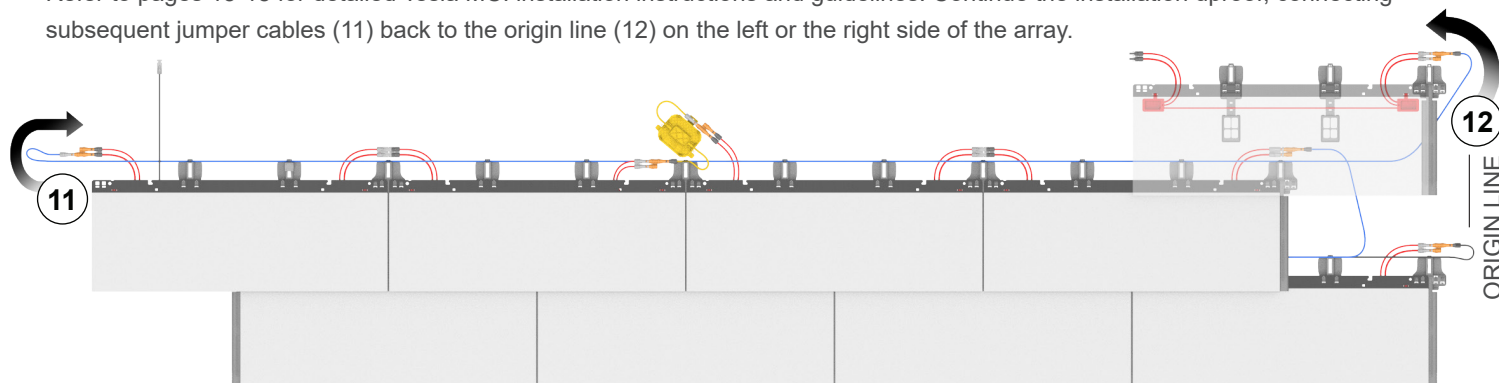
Disengage Uplift Clips in the tile by gently prying the tile up using a plastic door lifter or Tesla Module Removal Tool. Push the tile uproof to disengage the uproof hooks from the feet, then slide the tile downroof and out of the array.



6. Continue installation row by row

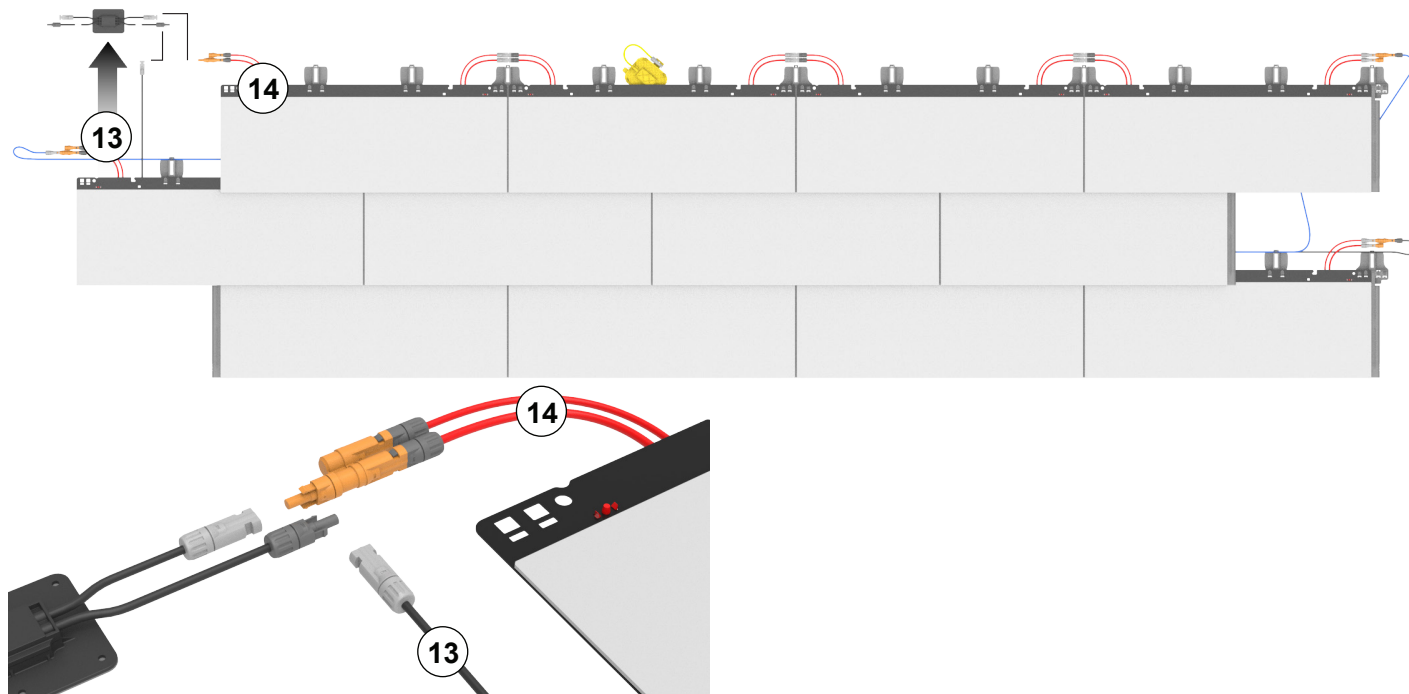
Connect the Mid-Circuit Interrupter between modules using a Staubli Branch Plug (9) and Staubli Branch Socket (10).

Refer to pages 15-18 for detailed Tesla MCI installation instructions and guidelines. Continue the installation uproof, connecting subsequent jumper cables (11) back to the origin line (12) on the left or the right side of the array.



7. Connect to the Pass Through Box

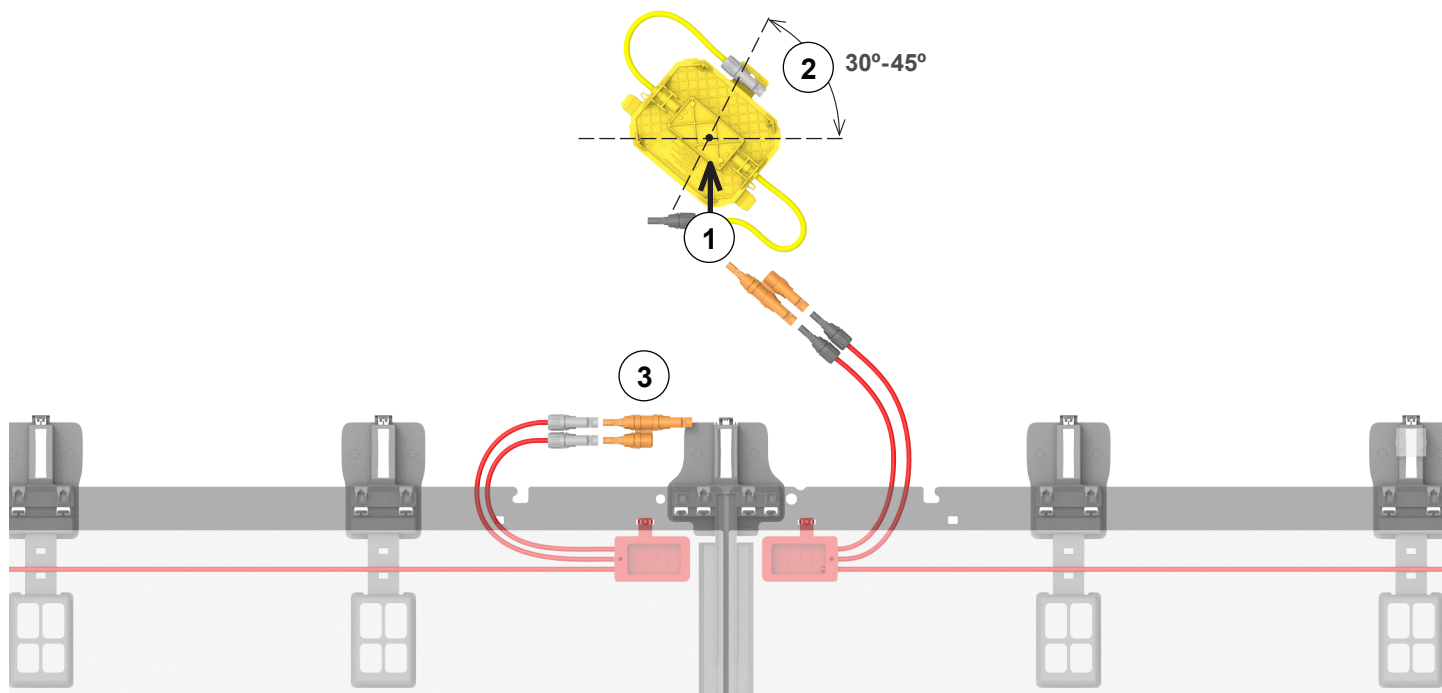
Complete the string by connecting the home run cable (13) and the final module (14) to the Pass Through Box. Each Pass Through Box accommodates up to two strings. Cap any unused open leads where a Pass Through Box services a single string.



Mid-Circuit Installation Standards

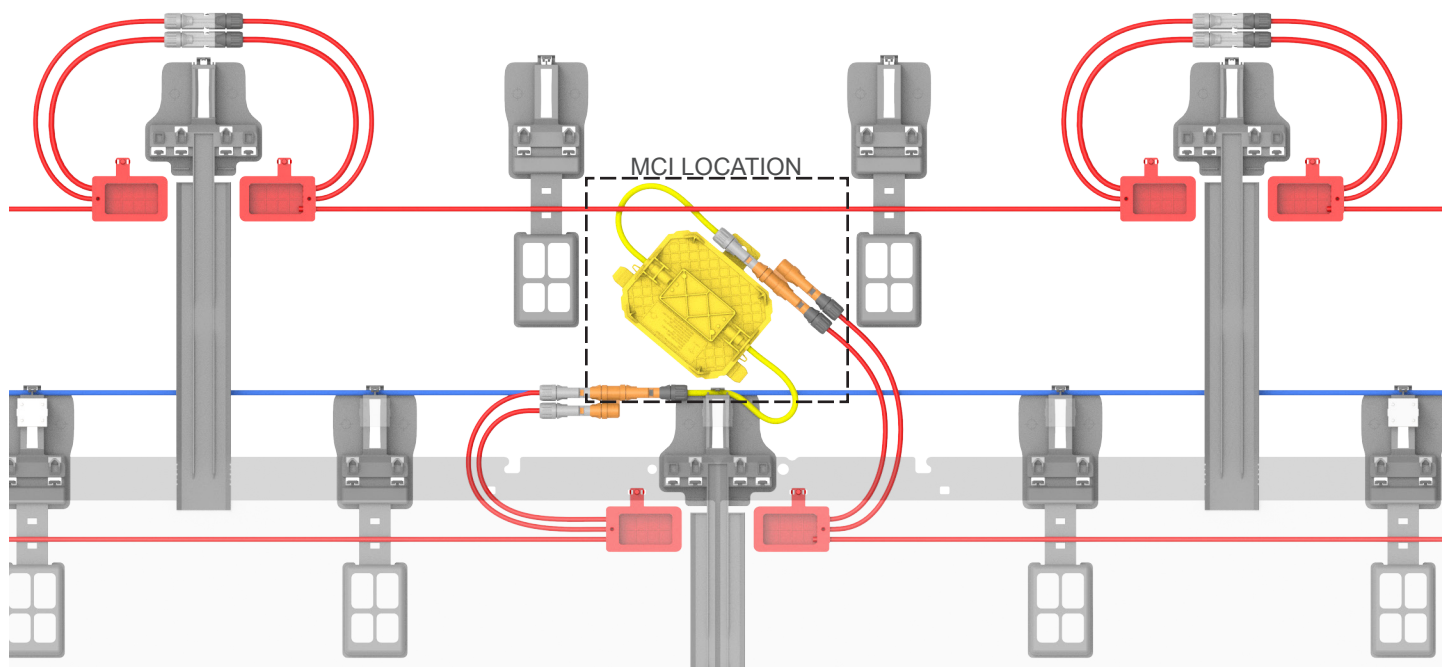
1. Placement: Install between feet

Position the MCI directly above Tile Footlaps. This location will ease wire connections and wire management while avoiding the hardware of subsequent tile rows. The MCI cannot interfere with module supports. Do not install the MCI in a manner which would cause it to raise the PV Module above it. For example, directly underneath a Footlap. Provide enough clearance so the MCI does not directly contact the downroof module. The MCI cannot come in contact with the glass or backside of a module.



2. Orientation: Angle the MCI

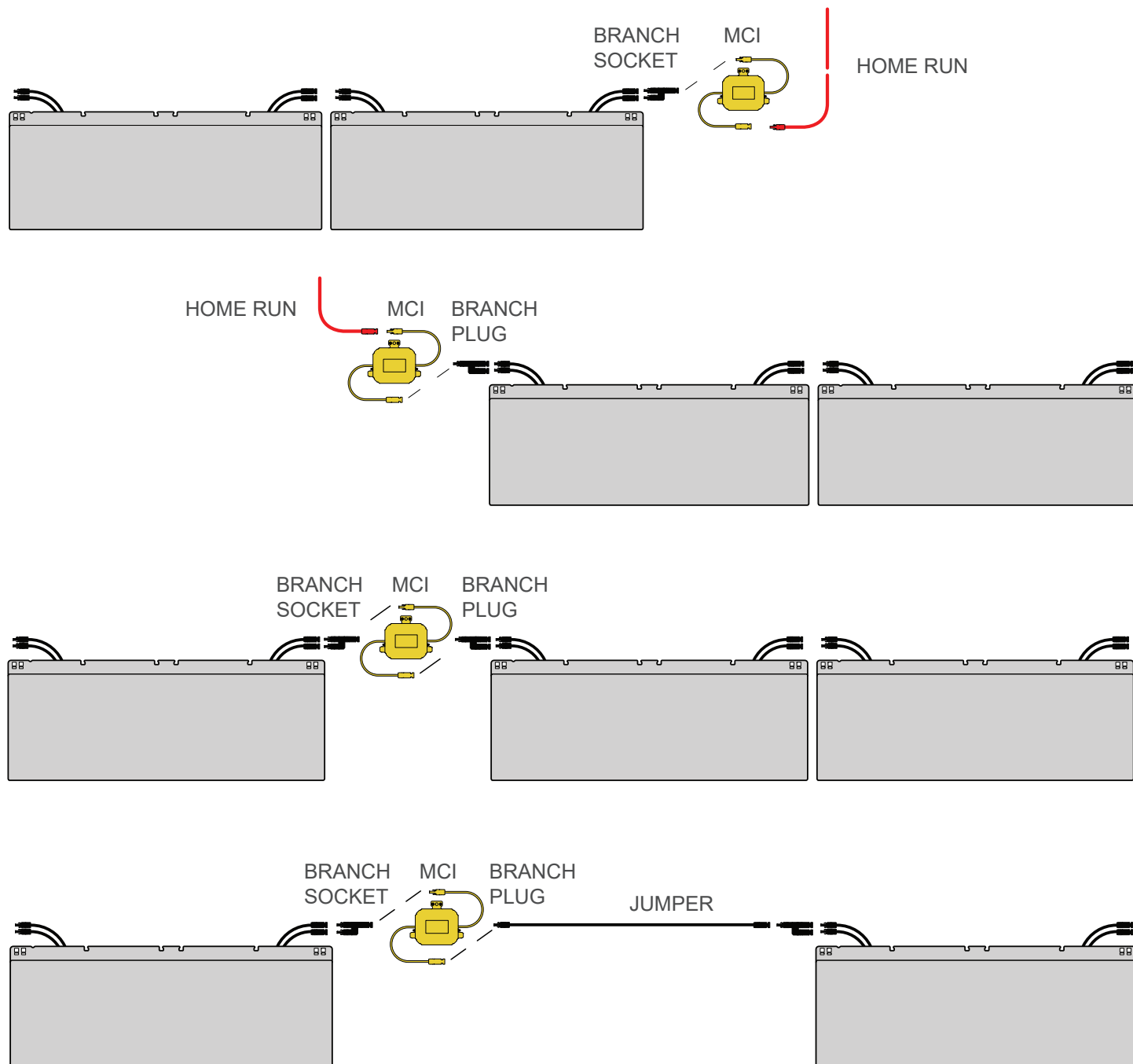
The MCI should be secured to the roof at a slight angle to encourage water shedding. The MCI can be installed with the tab facing down or up roof, whichever eases in-line wire connections to the MCI's positive and negative cables.



3. Potential MCI locations

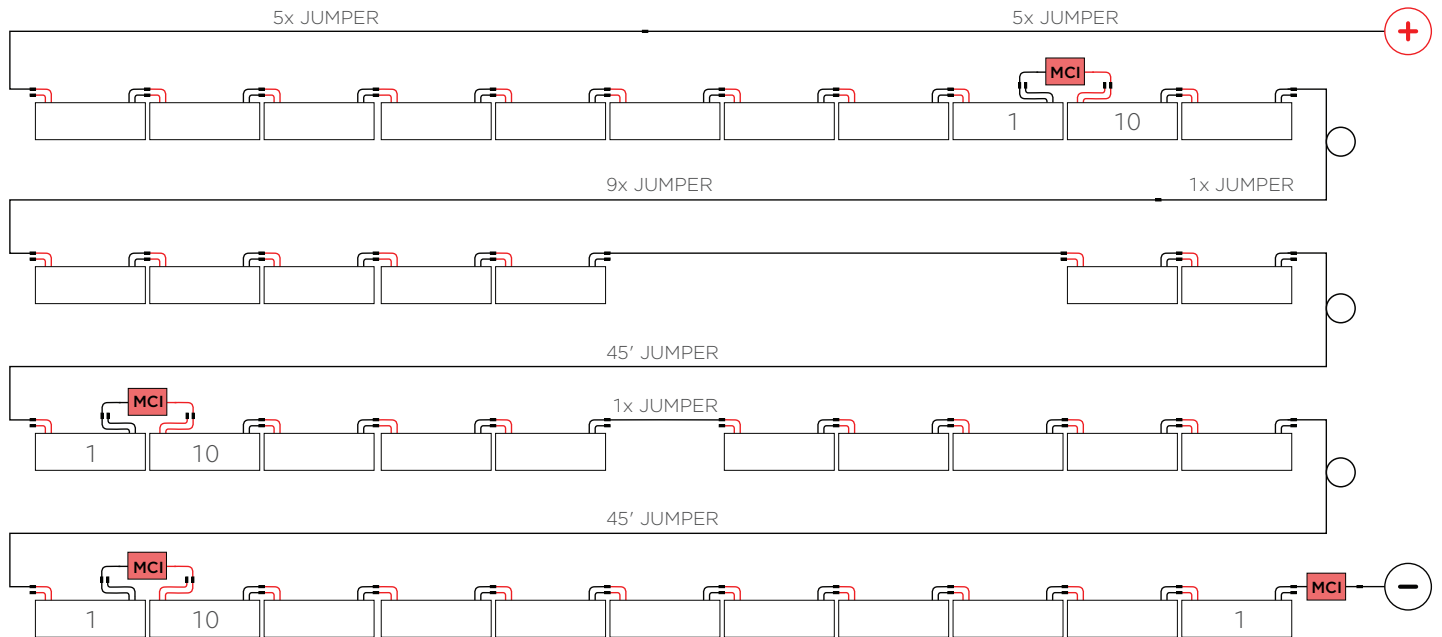
The Mid-Circuit Interrupter is installed along the row or sub-string of modules that connects to its input and output.

1. An MCI must be connected to one end of each series string or mounting plane sub-array string.
2. Verification that MCIs are installed with 10 or fewer modules between MCIs shall be documented for inspection, by voltage measurement logs and/or as-built string layout diagrams.
3. The dedicated PV system AC circuit breaker or PV system AC disconnect switch shall serve as the PVRSA initiator and shall be sized and installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings.



Example string layout with MCIs

An MCI is required at the positive or negative end of every string. Wire the string with up to 10 solar roof modules between MCIs. Use the appropriate jumper lengths between rows.



Jumper Length	Part Number	When to Use
1x	1705337-01-A	Up to 1.5 Module Lengths
3x	1705337-03-A	2 to 3.5 Module Lengths
5x	1705337-05-A	4 to 5.5 Module Lengths
7x	1705337-07-A	6 to 7.5 Module Lengths
9x	1705337-09-A	8 to 9.5 Module Lengths
12x	1705337-12-A	10 to 12.5 Module Lengths

On Roof Wire Management

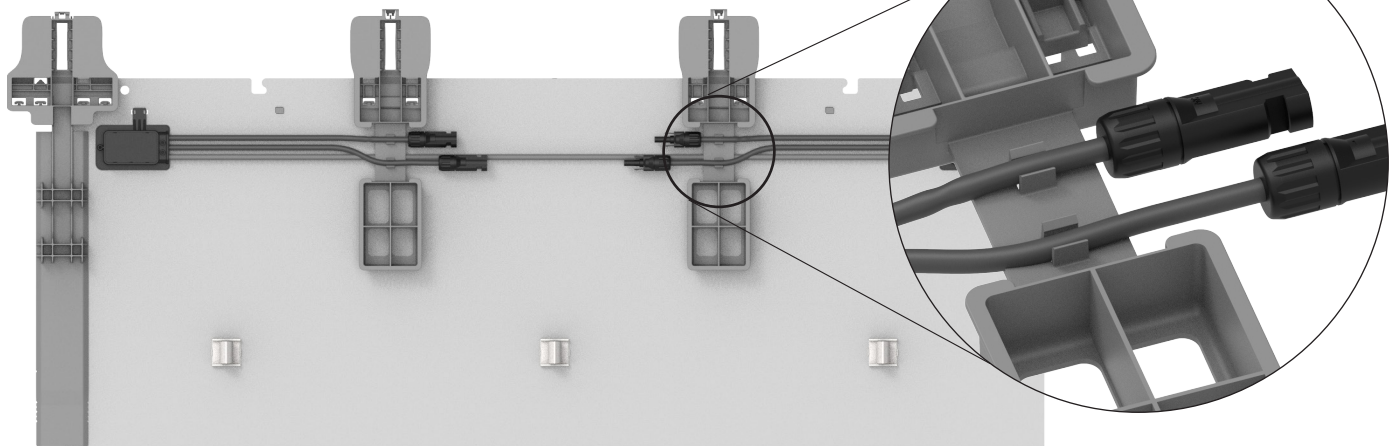
Minimum bend radius

Ensure that the cabling is not under mechanical stress (Comply with a bending radius of ≥ 2.36 in (60 mm)).

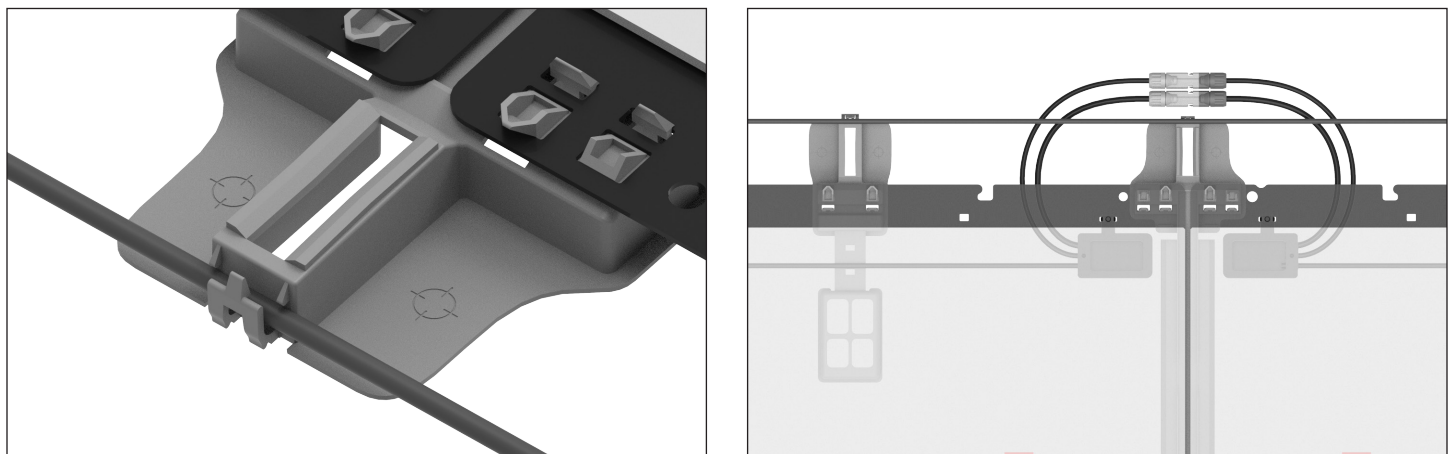
Built in wire management features

PV Module mounting components include integrated wire management features. Use these features to tuck the Diode Harness wires and prevent excessive slack in wiring.

BACK OF MODULE, BEFORE INSTALLATION



WIRE MANAGEMENT PERFORMED DURING INSTALLATION



Flexible non-metallic conduit

Non-metallic conduit may be used to manage wires around metal flashings at transitions across hips and ridges. All FNMC (non-metallic conduit) that is installed underneath the tile needs to be rated to 95 °C (203 °F). Blue carlon conduit (smurf tubing) or liquid-tight conduit are not rated for Solar Roof applications and can lead to early system failures.

Conduit, Non-Metallic

PN: 1479971

PUSG-17B, 171 feet

Parallel string connections

Branch Sockets and Branch Plugs are used to make parallel connections between PV strings before entering a Pass Through Box. These connectors are installed on the roofing surface under the modules.

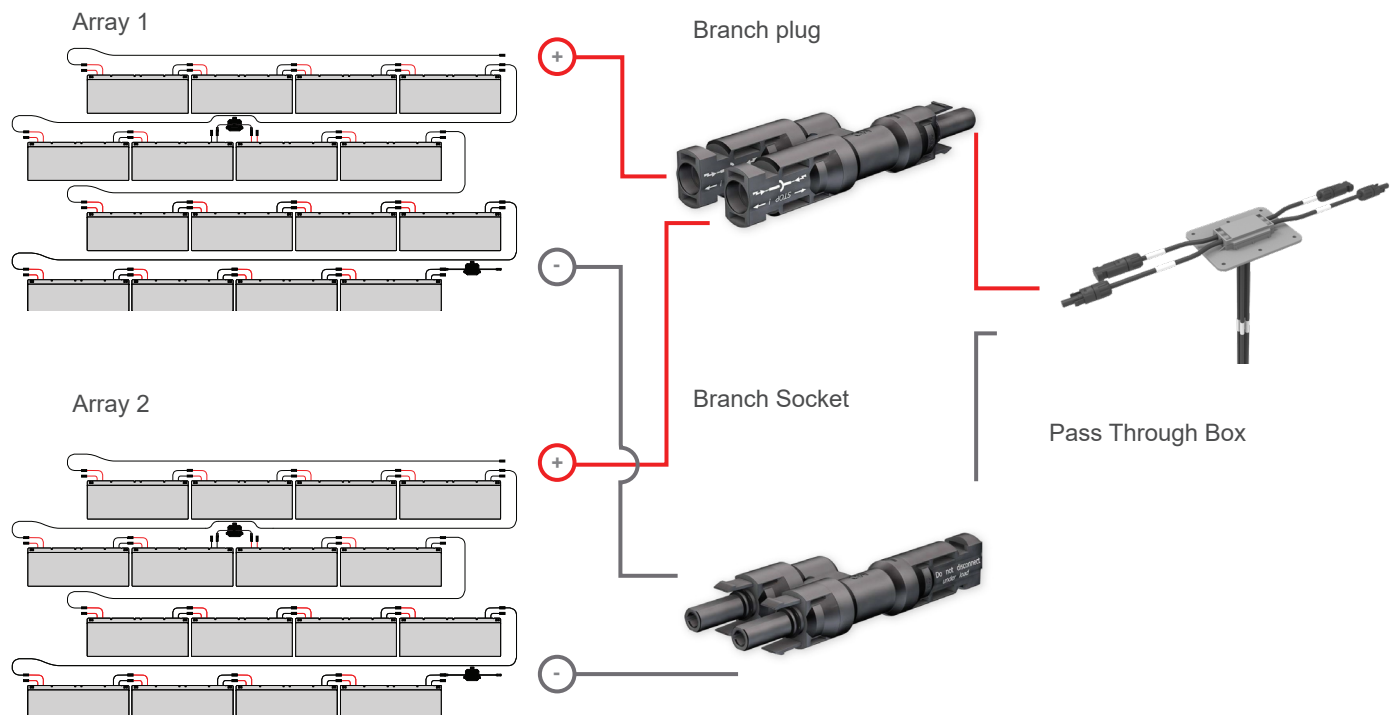
Branch socket, Staubli
Model #PV-AZB4
UL 6703



Branch plug, Staubli
Model #PV-AZS4
UL 6703



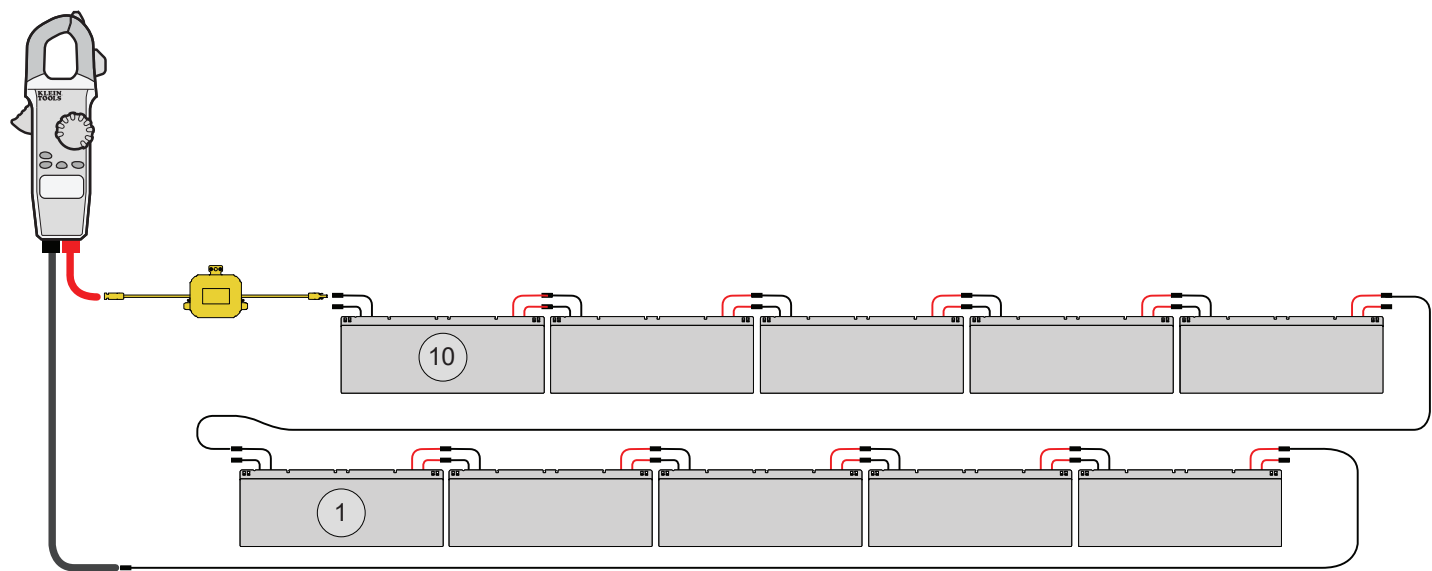
Example layout



String Testing Procedure

1. Required tools

A Digital Multi-Meter with a 10 MOhm input impedance is required to measure Voc before and after each Mid-Circuit Interrupter. It is recommended to use a Klein brand clamp meter since all Klein products provide a 10 MOhm input impedance. Fluke meters, which provide only a 1 MOhm input impedance are not compatible with the Tesla Inverter and Tesla MCI components.



2. Required documentation

Determine the assumed voltage of a single tile, in this case 13.34 Volts. Voltage may vary depending on temperature and shading conditions. Measure each sub-string as it is installed (a sub-string is defined as modules between MCIs). Log the Voc values on the string layout diagram. Note conditions (temperature, partly cloudy, cloudy, sunny) in the form.

MCI	Tile Count	Voc before MCI
1		
2		
3		
4		
5		

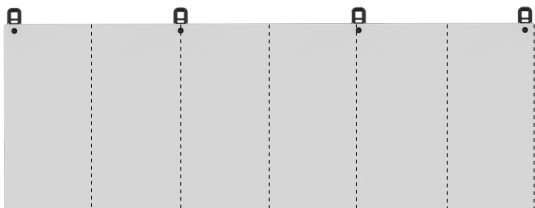
Style 1 MP | Tempered Roofing Module

MODEL #: SRNFT1/6, #SRNFT1/3, #SRNFT1/2, #SRNFT2/3, #SRNFT5/6 and #SRNFT1

Roofing Tiles are non-electrical tempered glass tiles buffering the solar array at all edge conditions. Roofing Tiles come in six different sizes to accommodate all areas of the mounting plane and are cross-compatible with the PV Module mounting hardware.

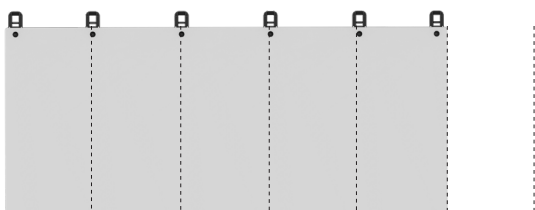
Full tile

Model #SRNFT1



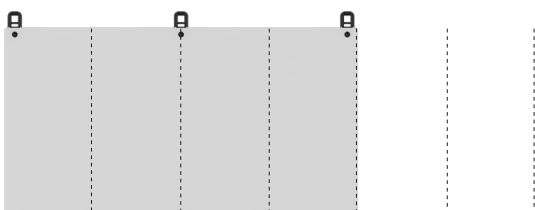
5/6 Partial tile

Model #SRNFT5/6



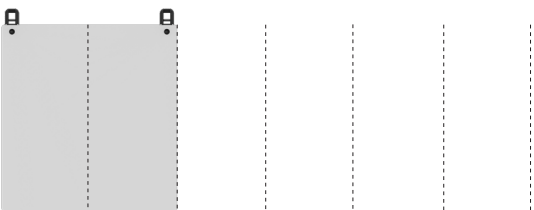
2/3 Partial tile

Model #SRNFT2/3



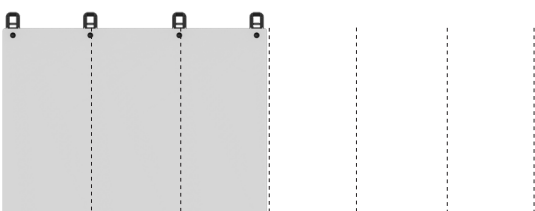
1/3 Partial tile

Model #SRNFT1/3



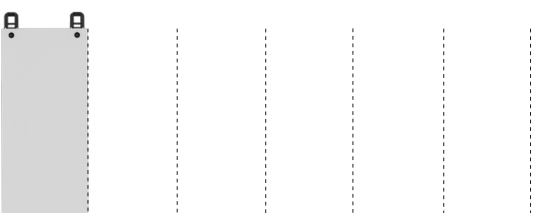
1/2 Partial tile

Model #SRNFT1/2



1/6 Partial tile

Model #SRNFT1/6



Certifications

UL 61730

UL 790 Class A

ASTM D3161 Class F

TAS100

Style 1 MP | Tempered Roofing Module

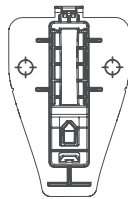
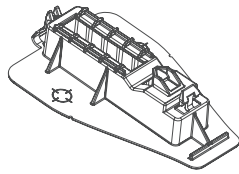
MODEL #: SRNFT1/6, #SRNFT1/3, #SRNFT1/2, #SRNFT2/3, #SRNFT5/6 and #SRNFT1

Mounting Hardware

The Roofing Module comes pre-assembled with mounting hardware, the Roofing Foot and Footlap. The Reduced Footlap is used as an alternate where clearance is required.

Roofing Foot

Model #SR-FOOT



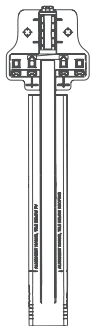
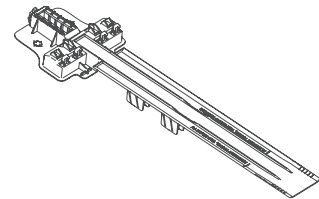
Footlap

Model #SR-FOOTLAP

UL 790 Class A

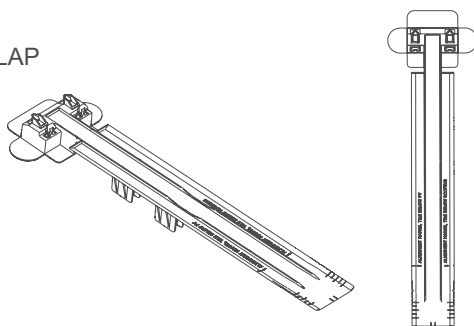
ASTM D3161 Class F

TAS100



Reduced Footlap

Model # SR-RFOOTLAP



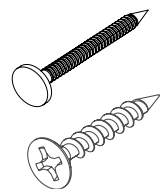
Fastener Specifications

The fastening location for the Roofing Module is through the target in each Foot for a total of 6 fasteners per module.

Use Tesla approved fasteners only. Use of unapproved fasteners may invalidate warranty. Confirm whether the job is a full tear-off or overlay installation. Overlay installations will have a longer nails marked with a painted orange head.

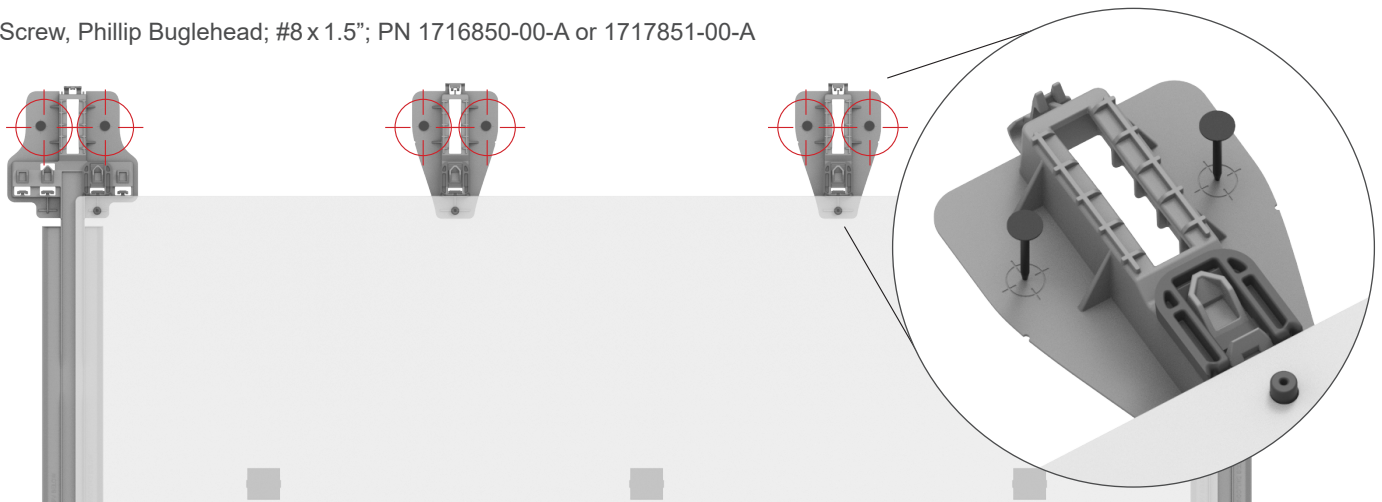
Full Tear-Off

- Nail, Ring Shank Roofing; 11-GA 1.25", Collated, CR; PN 1549330-01-A, 1549330-04-A, or 1549330-05-A
- or Screw, Phillip Buglehead; DK, #8 x 1" Coated; PN 1470351-00-A



Overlay

- Nail, Ring Shank Roofing (orange); 11- GA 1.75", Collated, CR; PN 1704763-00-A
- or Screw, Phillip Buglehead; #8 x 1.5"; PN 1716850-00-A or 1717851-00-A

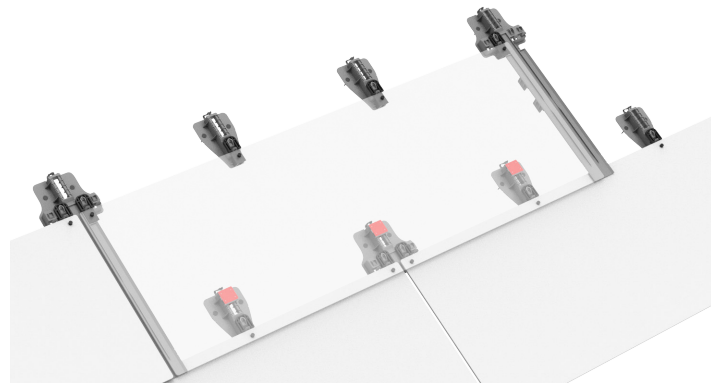
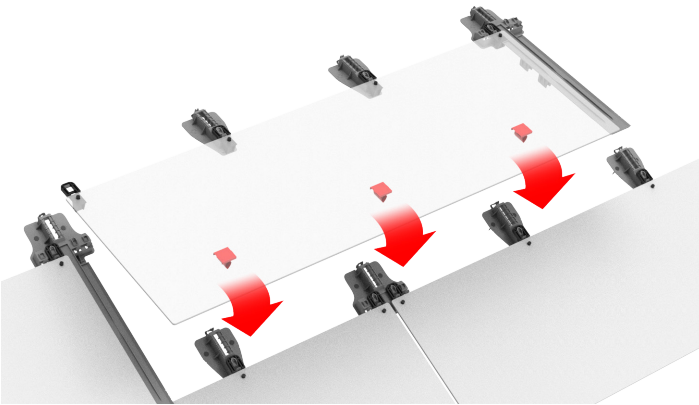
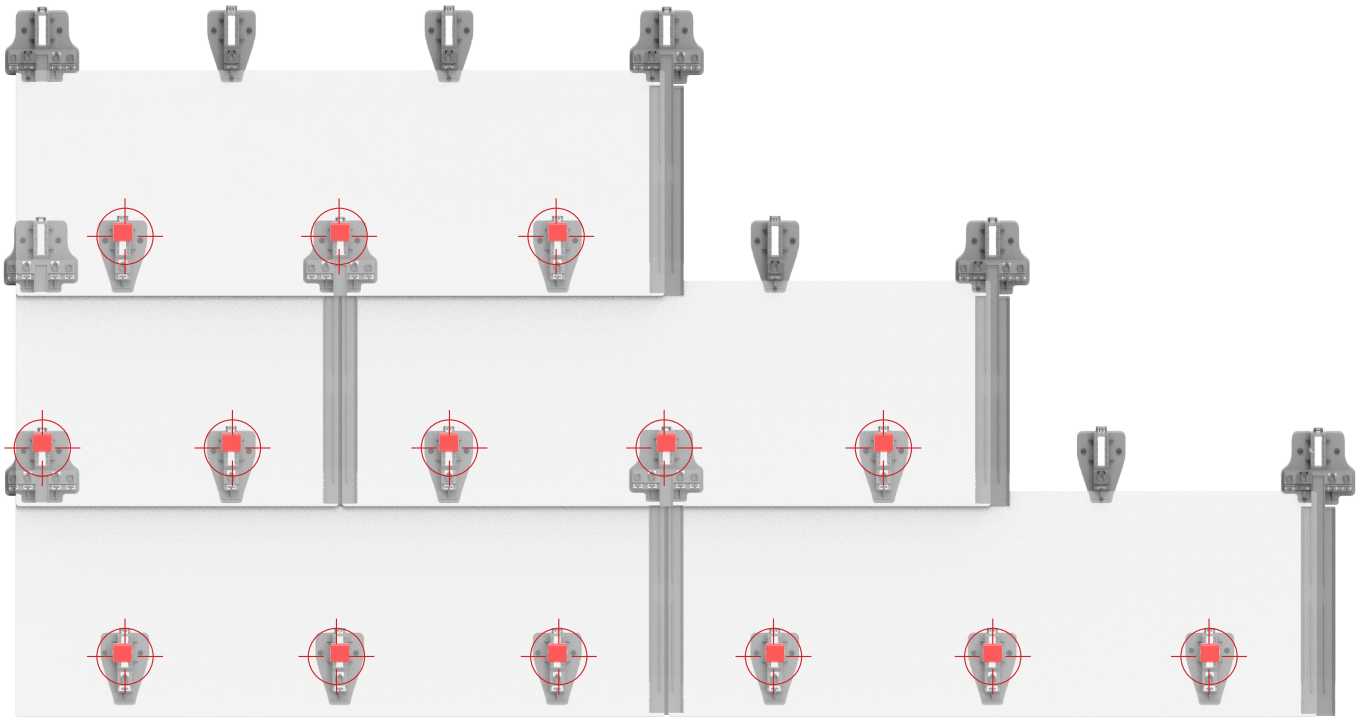


Style 1 MP | Tempered Roofing Module

MODEL #: SRNFT1/6, #SRNFT1/3, #SRNFT1/2, #SRNFT2/3, #SRNFT5/6 and #SRNFT1

Interlocking Elements

Install adjacent tiles row by row. Adjacent tiles will share a Footlap. Lock subsequent rows together using the Uplift Clip feature on the bottom of the tile. The Uplift Clip will mate into the slot in the Footlap and Foot. At the periphery of the mounting plane, use Partial Tiles of the appropriate size.



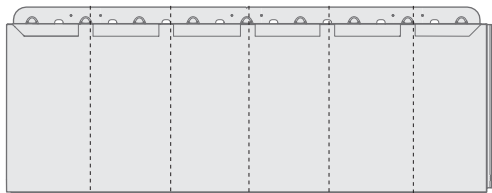
Style 2 MP | Metal Tile

MODEL #: SRMTT1, SRMTT5/6, SRMTT2/3, SRMTT1/2, SRMTT1/3 and SRMTT1/6

Where applicable a non-energized mounting plane may be installed using Metal Tiles only. Confirm this tile type on the project planset. 'Rest of Roof' or Metal Tiles consists of sheet metal adhered to a foam insert. Similar to Roofing Tiles, Metal Tiles come in six different sizes to accommodate all areas of the mounting plane. Metal Tiles are never installed on a mounting plane containing PV Modules.

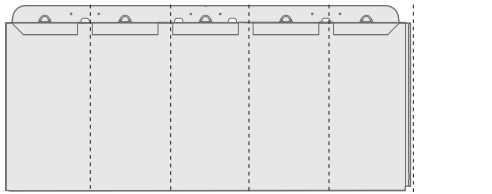
Full tile

Model #SRMTT1



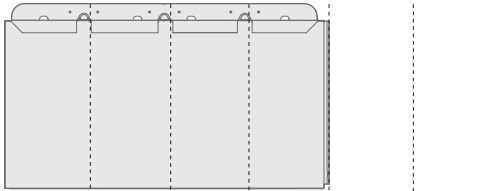
5/6 Partial tile

Model #SRMTT5/6



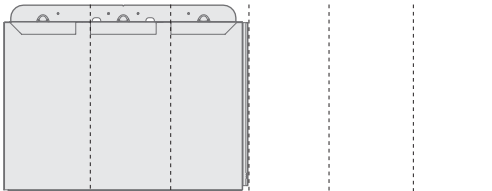
2/3 Partial tile

Model #SRMTT2/3



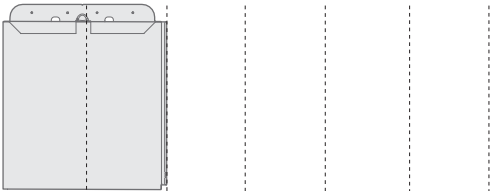
1/2 Partial tile

Model #SRMTT1/2



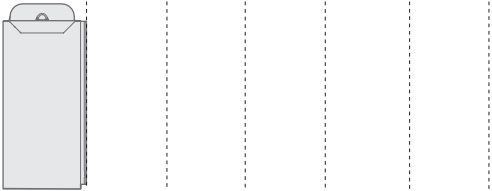
1/3 Partial tile

Model #SRMTT1/3



1/6 Partial tile

Model #SRMTT1/6



Certifications

- UL 1897
- UL 790 Class A
- ASTM D3161 Class F
- TAS100

Style 2 MP | Metal Tile

MODEL #: SRMTT1, SRMTT5/6, SRMTT2/3, SRMTT1/2, SRMTT1/3 and SRMTT1/6

Fasteners

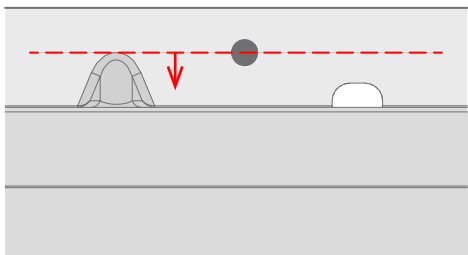
Metal tiles are fastened with nails or screws at the top of the tile. No additional mounting hardware is required. The minimum number of nails per module will be higher for High Wind systems and at mounting plane peripheries. Fasten nails no closer than 15 mm or appx. 1/2" from the top edge. Use Tesla approved fasteners only. Use of unapproved fasteners may invalidate warranty.

Full Tear-Off

- Nail, Ring Shank Roofing; 11-GA 1.25", Collated, CR; PN 1549330-01-A, 1549330-04-A or 1549330-05-A
- or Screw, Phillip Buglehead; DK, #8 x 1" Coated; PN 1470351-00-A

Overlay

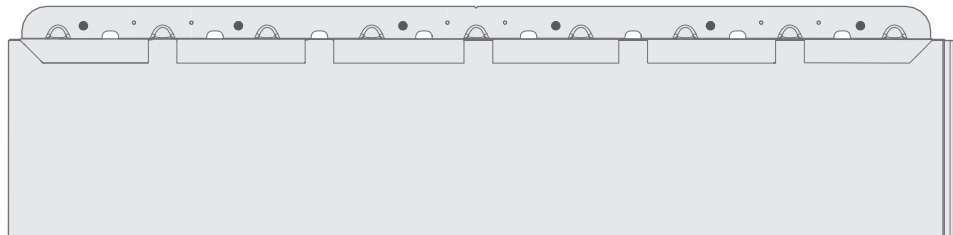
- Nail, Ring Shank Roofing (orange); 11- GA 1.75", Collated, CR; PN 1704763-00-A
- or Screw, Phillip Buglehead; #8 x 1.5"; PN 1716850-00-A or 1717851-00-A



Minimum # of nails per module		
System Type	Perimeter Tiles	Center Tiles
139 mph and below	9 ct. (5" spacing)	6 ct. (7.5" spacing)
194 mph and below	12 ct. (3.75" spacing)	9 ct. (5" spacing)

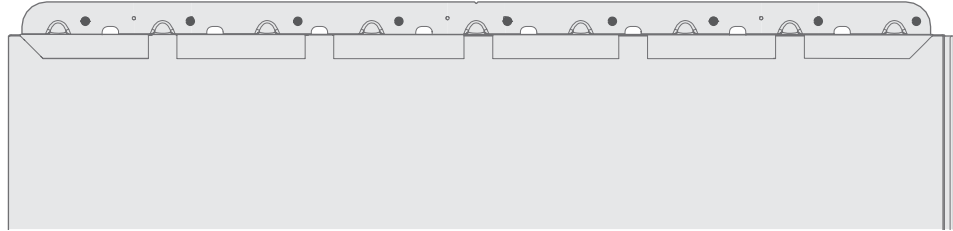
6 Nail Pattern

Fasten the nail at every third gap, no closer than 15 mm or appx. 1/2" from the top edge.



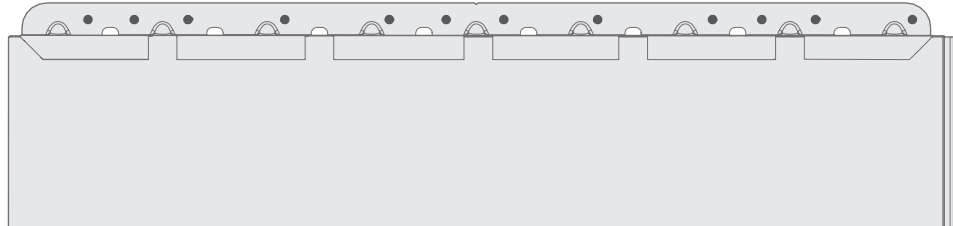
9 Nail Pattern

Fasten the nail at every other gap, no closer than 15 mm or appx. 1/2" from the top edge.



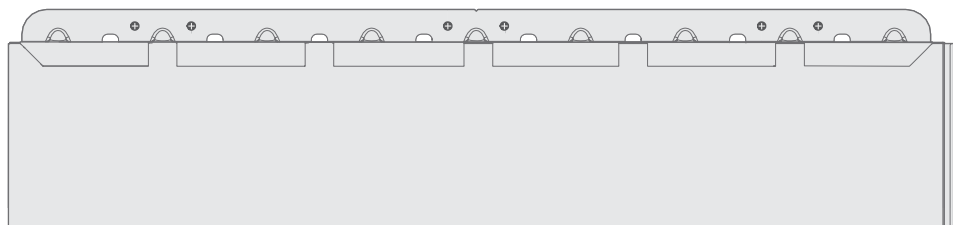
12 Nail Pattern

Fasten evenly every 3.75" or as a 3-1 pattern, no closer than 15 mm or appx. 1/2" from the top edge.



6 Screw Pattern

Fasten through the provided holes.



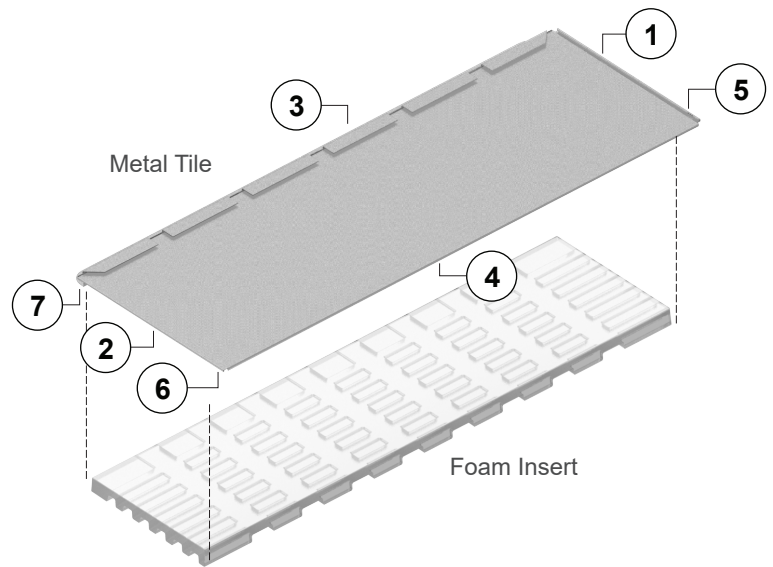
Style 2 MP | Metal Tile

MODEL #: SRMTT1, SRMTT5/6, SRMTT2/3, SRMTT1/2, SRMTT1/3 and SRMTT1/6

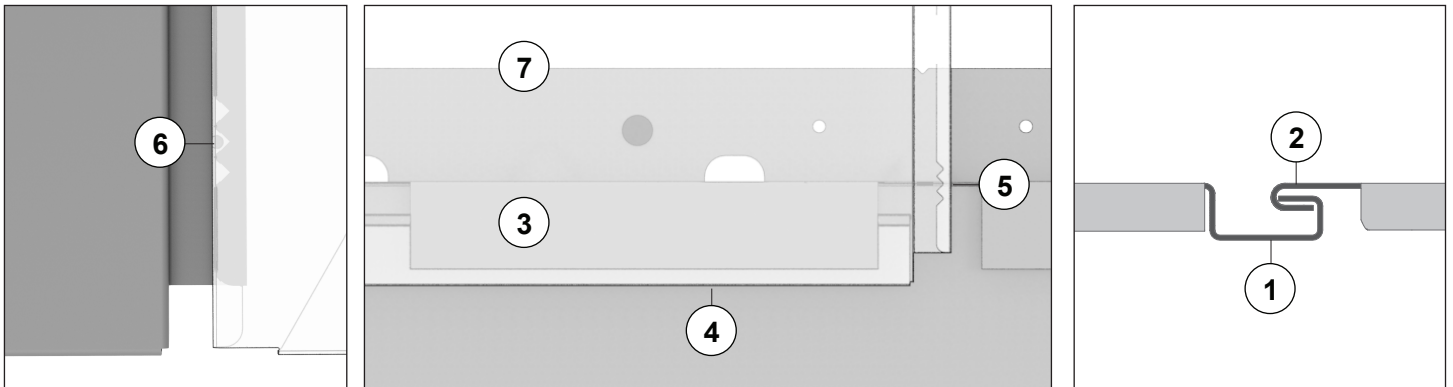
Interlocking elements

The perimeter of a Metal Tile is hemmed to interlock both vertically and horizontally.

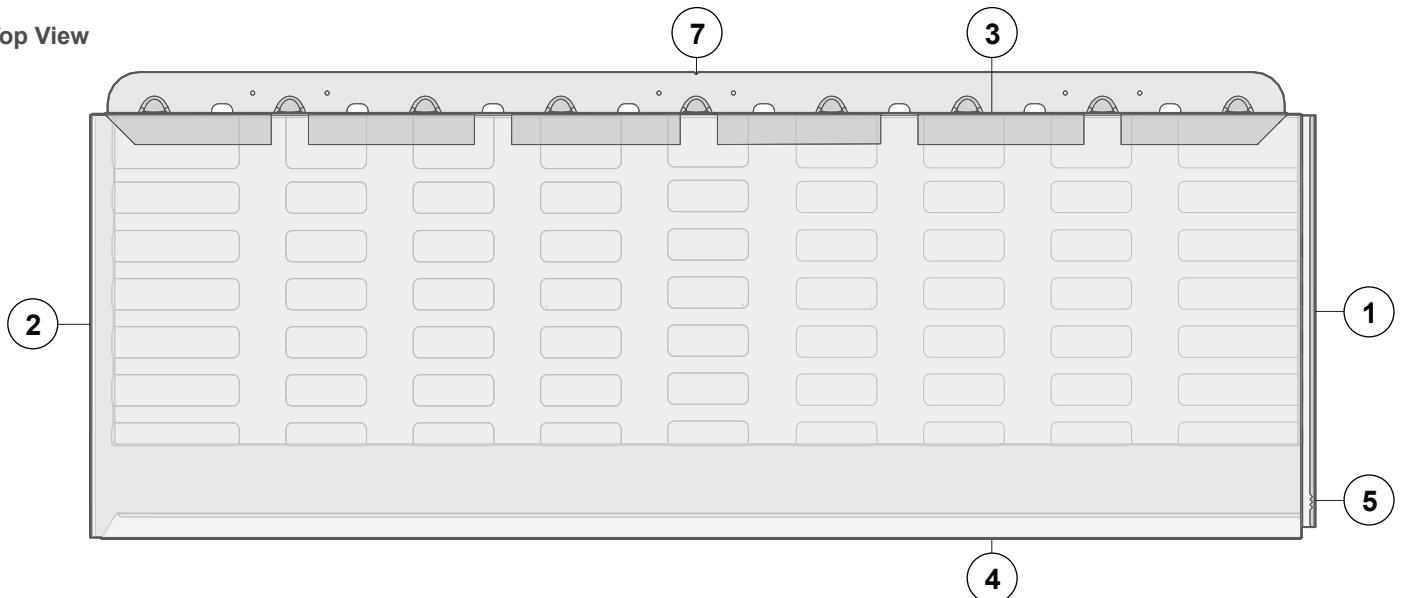
1. Vertical hem - Upward
2. Vertical hem - Downward
3. Horizontal hem - Upward
4. Horizontal hem - Downward
5. Row alignment notch (min/max)
6. Alignment notch
7. Fastening lip



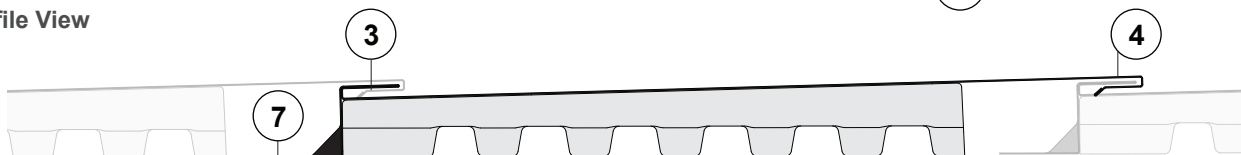
Vertical and Horizontal Hems



Top View



Profile View



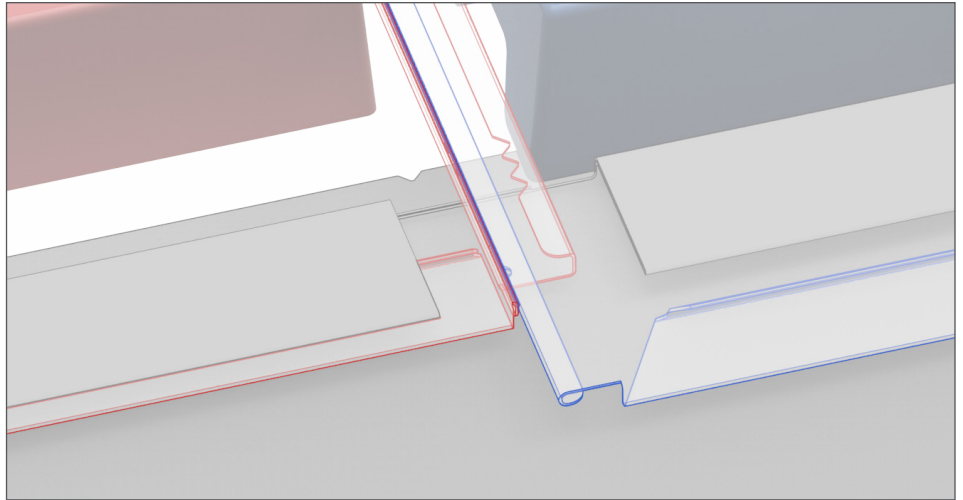
Style 2 MP | Metal Tile

MODEL #: SRMTT1, SRMTT5/6, SRMTT2/3, SRMTT1/2, SRMTT1/3 and SRMTT1/6

Interlocking elements

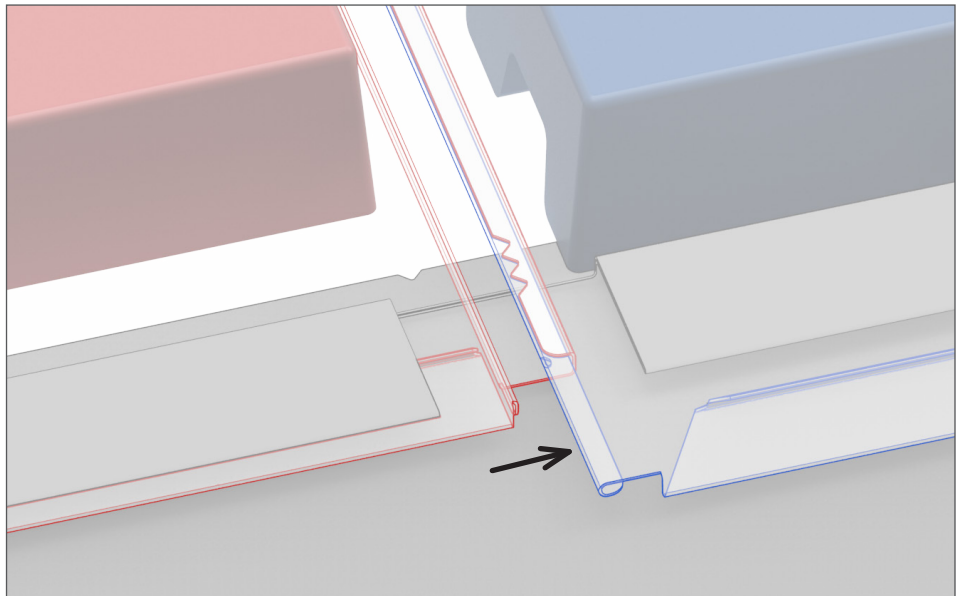
Step 1

Drop in the Metal Tile slightly below the adjacent tile leaving both the vertical and horizontal hems free. The foam backer will be resting on the deck.



Step 2

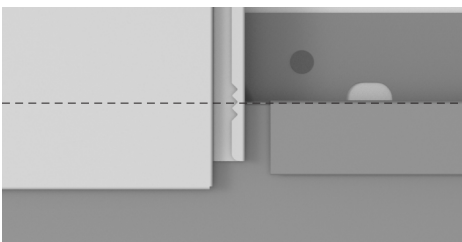
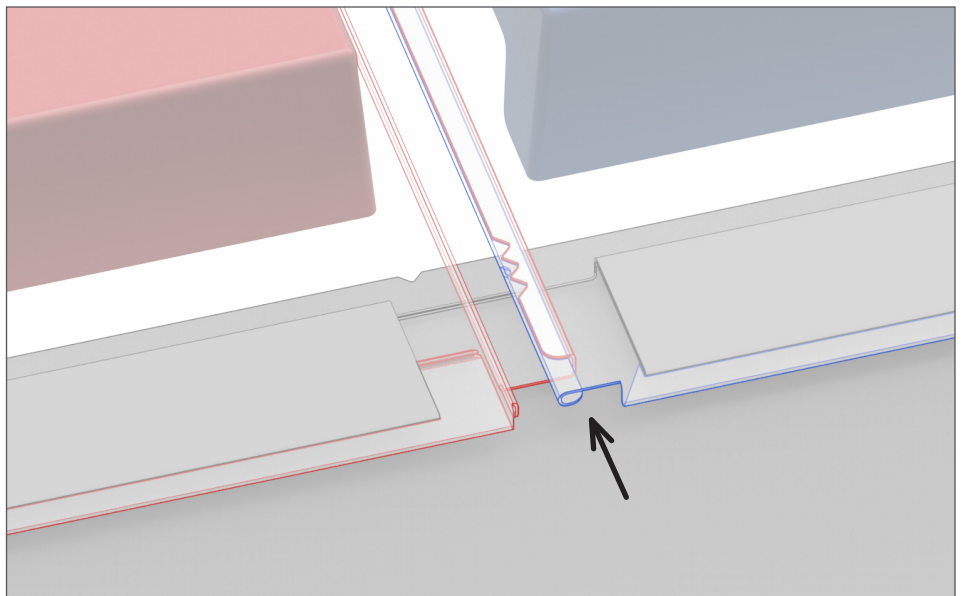
Mate adjacent tiles by engaging the Vertical Hem.



Step 3

Mate rows by engaging the Horizontal Hem and pushing the tile up.

Set the mix/max alignment notch at the middle notch. The tile reveal range is 365 mm +/- 5 mm.

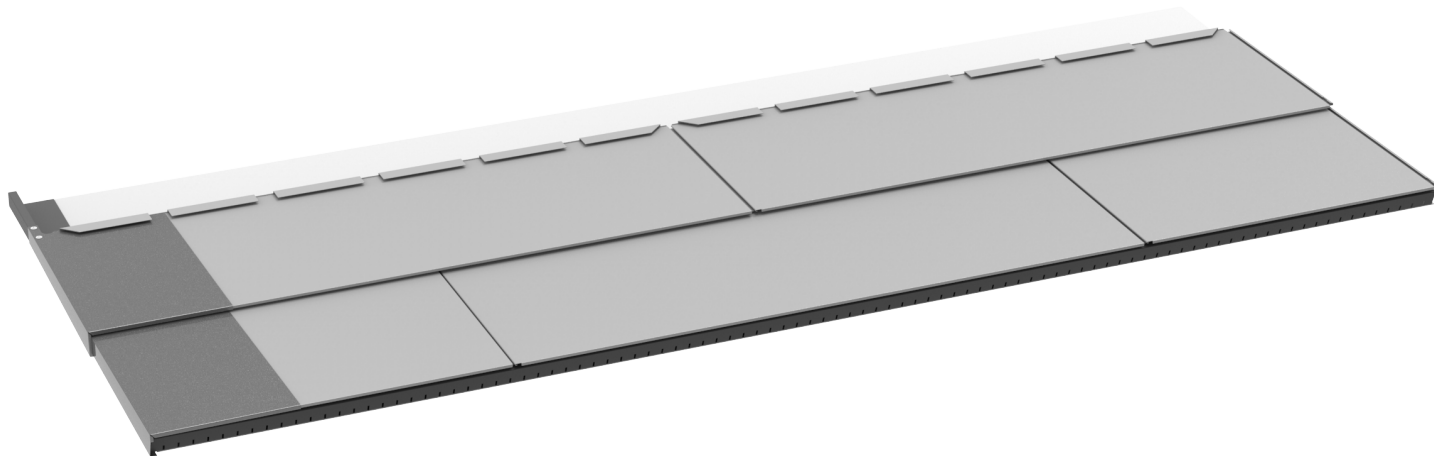


Style 2 MP | Metal Tile

MODEL #: SRMTT1, SRMTT5/6, SRMTT2/3, SRMTT1/2, SRMTT1/3 and SRMTT1/6

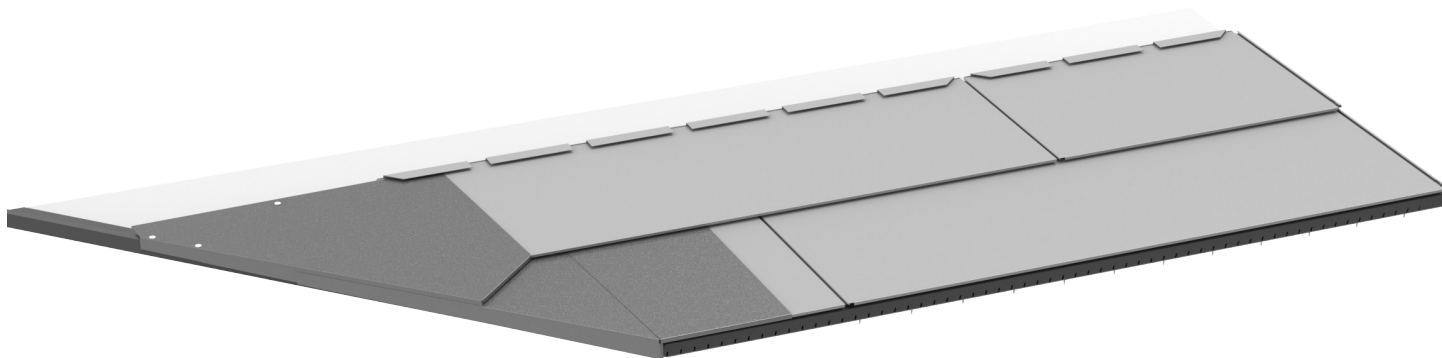
Example layout: square periphery

Follow standard installation procedure lapping the Rake Trim over the Metal Tile and installing Partial Tiles as needed.



Example layout: angled periphery

Follow standard installation procedure lapping the Valley Trim over the Metal Tile and installing Partial Tiles as needed.



Substrate requirements

Decking for Solar Roof shall be a code-compliant wood structural panel conforming to DOC PS-1 or DOC PS-2, rated Exposure 1 or Exterior Grade; or code-compliant closely-fitted solid sheathing boards. Refer to Figure 1 to determine the governing thickness based on fire classification and required wind resistance. Sheathing and supporting framing shall be free of damage, defects, or decay which could impact strength, serviceability, or fastener performance.

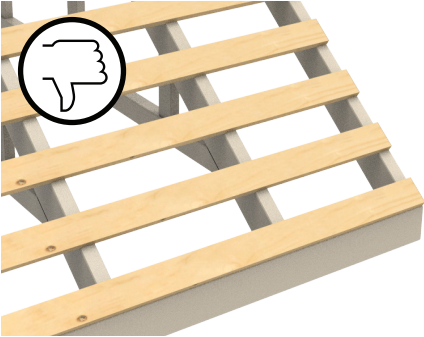
FIGURE 1 THICKNESS REQUIREMENTS

	Minimum Deck Thickness for Fire Classification				Minimum Deck Thickness for Wind Uplift Resistance	
	Class A	Class B	Class C	Unclassified	≥ 115 MPH	≤ 115 MPH
Plywood	15/32"	15/32"	15/32"	3/8"	15/32"	3/8"
OSB	7/16"	7/16"	7/16"	3/8"	7/16"	3/8"
Boards	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"

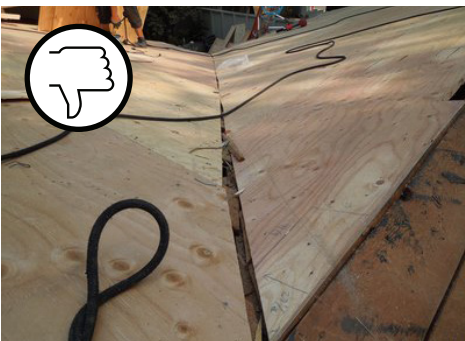
The roof deck surface needs to be free from loose or protruding nails or staples, dust, dirt, debris or any other protrusions. Lifted fasteners may compromise the new underlayment. Hammer down or remove nails and staples so they are flush to the deck. Ensure that the work surface is clean, smooth, and dry for your teams safety and convenience. Do not install over the following conditions:

- Widely spaced sheathing boards (sometimes referred to as “skip sheathing”) or sheathing that is less than the required minimum thickness
- Areas where the sheathing is not installed correctly, for example leaving gaps greater than 1/4"
- Areas with water damage, dry rot and/or mold
- Pest damage such as termites

Skip sheathing



Large gaps



Dry rot or other damage



Overlay requirements

Where the existing sheathing does not meet Tesla requirements overlay or replace the existing roof sheathing. Decking that does not meet requirements must be overlaid with additional new plywood to support the weight of Solar Roof components. The minimum combined thickness must conform to Figure 1 requirements, with the exception of skip sheathing. Skip sheathing with a single layer decking overlay must meet Figure 1 requirements.

1. Under no circumstances shall overlay layers be thinner than 11/32".
2. Fasten overlay material in accordance with code requirements for roof decking.

APPENDIX 2 | Roof Overlay Requirements

Existing roof requirements

Tesla Underlayment can be installed over existing roof covering if the following conditions are met:



Example of Single Layer Comp Shingle

1. Only one layer of strip (e.g. 3-Tab) or laminated shingles.
2. Less than 3/8" thick profile.
3. Free from surface cracks, blisters, curling or excessive granule loss.
4. Less than 1" over an 8 ft span (L/96) of roof sag.
5. Meet all sheathing and structural requirements for thickness and condition.
6. Flashings are in good condition.
7. Free from excessive organic growth.

Do not install Tesla Underlayment on a roof that does not meet the above requirements.



Example of Visual Sagging on Roof



Example of Multiple layers Comp Shingle



Example of Hip Cracking from Age



Example of Rot at Decking



Example of Shingles Curling from Age



Example of Missing Shingles

APPENDIX 3 | Underlayment Specifications

Model #SR-SAUL-1, PN: 16113738-00-A

Certified to ASTM D1970/ICC AC48; ICC AC188; and ASTM E108 Class A

SR-SAUL-1 is a self-adhering peel and stick roofing underlayment designed for sloped roof applications to help protect against water infiltration from ice dams and wind-driven rain. It is installed with Solar Roof V3 as a single layer application.

installation guidelines

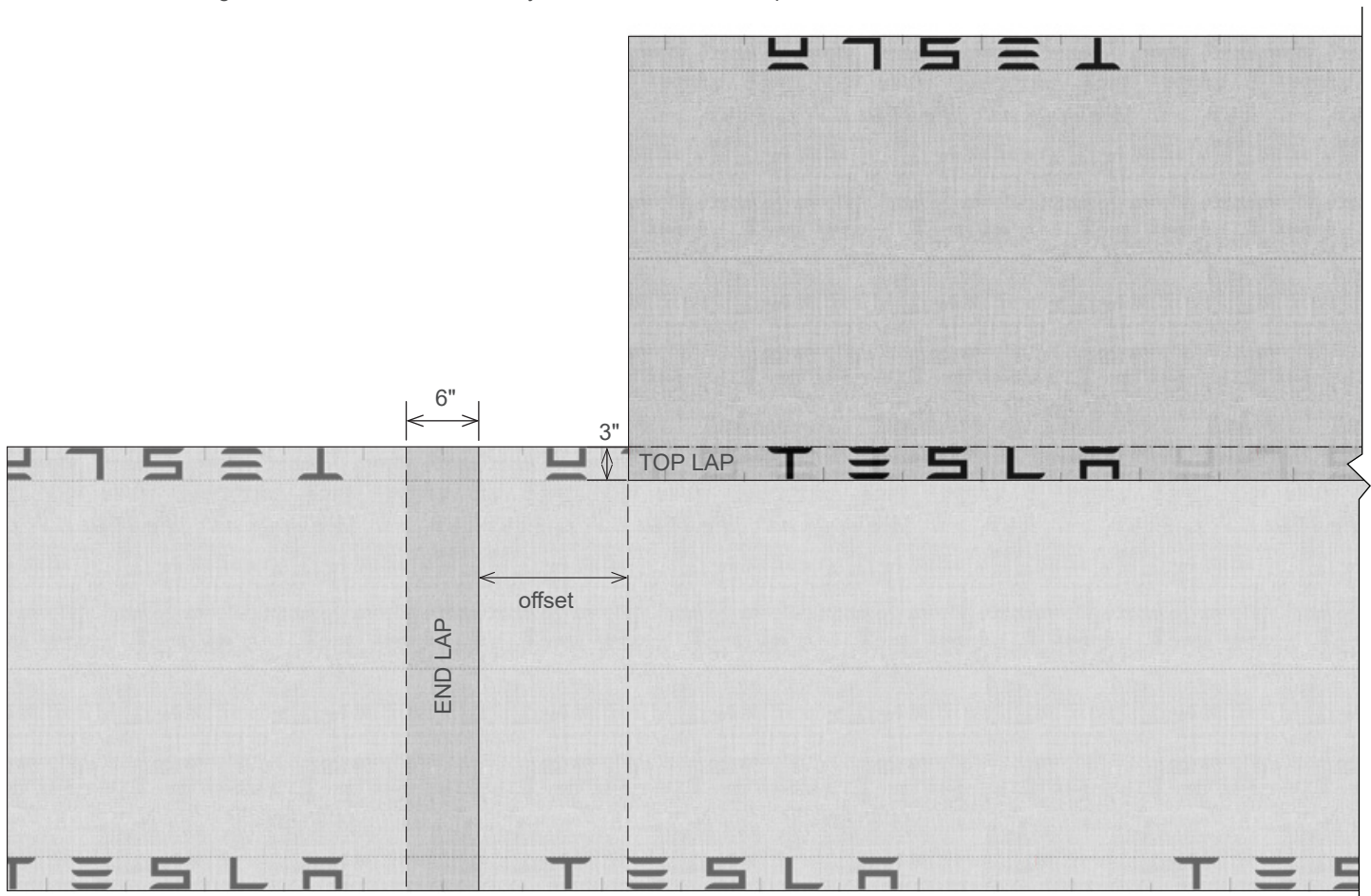
SR-SAUL-1 is installed onto the bare decking surface or onto existing roofing material if a project plan specifies an overlay system. It is acceptable to install SR-SAUL-1 directly on an existing ice/water shield if all debris is cleared. During installation, offset the edge of the underlayment 1/2" from the drip edge of the roof for aesthetics. Refer to Underlayment Work Instructions for detailed guidance.

SR-SAUL-1 can be laid out in a variety of orientations, including horizontal, vertical or diagonal. The orientation is chosen by the crew depending on convenience of installation:

- Horizontal: along the length of the eave drip edge.
- Vertical: along the length of the rake drip edge.
- Diagonal: along angled features such as a hip or valley.

Install the underlayment with the printed side up. Follow these lapping guidelines for all seams:

- Top lap: Lap each succeeding course 3" over the preceding course fully concealing the upside-down Tesla logo.
- End lap: Lap a minimum of 6". Offset end laps a minimum of 6' on adjacent courses.
- Use a roller along the entire face of the underlayment to ensure an adequate seal.



APPENDIX 3 | Underlayment specifications

Model #SR-SAUL-1, PN: 16113738-00-A

High Velocity Hurricane Zone

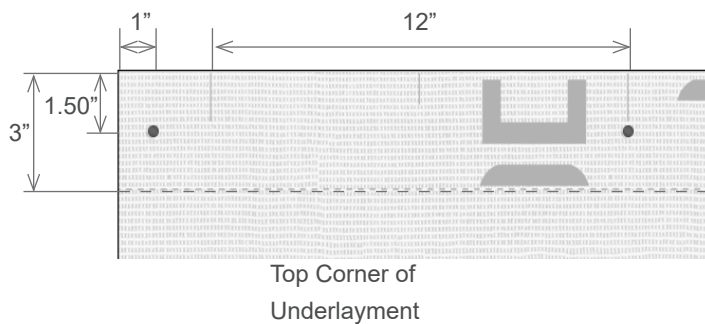
Where required by code in High Velocity Hurricane Zones, install a code compliant mechanically attached anchor layer to the deck before applying the self-adhering underlayment.

Cold Weather Application

At temperatures -4°F (-20°C) or below, blind nail the upper most overlap edge using $3/8"$ head roofing nails 1" or longer. Space nails at 12" intervals along upper side lap area 1" in from the edge using the guide marks. For best results, warm Cobalt FR to room temperature prior to application.

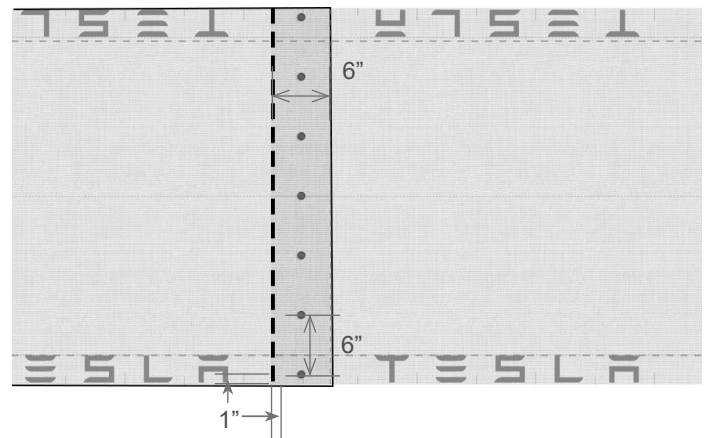
Horizontal laps

Lap 3" min. Fasten every 12" with nails.



End laps

Lap 6" min. Fasten every 6" with nails.

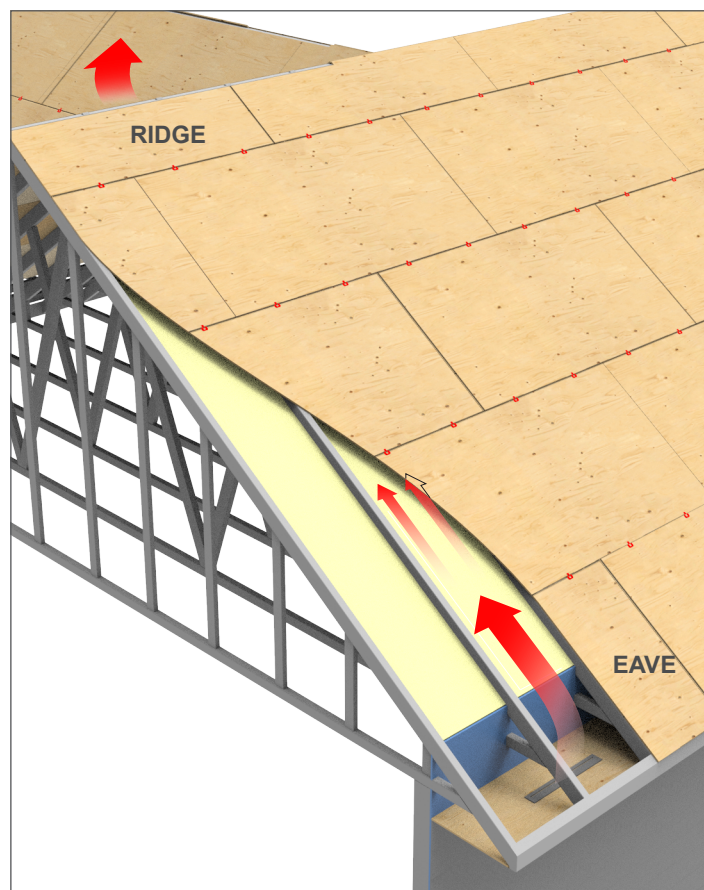
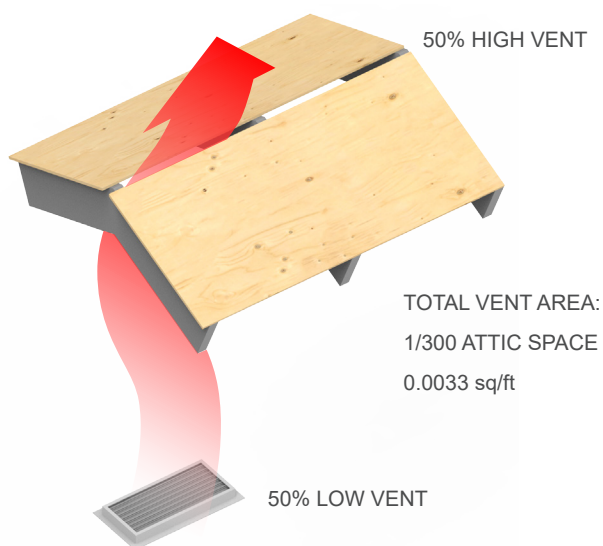


Steep Slope and High Temperatures Application

Steep slopes (5:12 or greater), high wind areas, or when installing at temperatures greater than 100°F (38°C), it is recommended to blind nail the under lap area as per above under cold weather application.

Types of Vents

The type of vents used on Solar Roof are continuous vents at the soffit and ridge which have ratings based upon square inches per linear foot. For proper airflow the vents need to be sized correctly. Discrete vents such as eyebrow vents do not comply with Solar Roof design. Do not cut vents into lofted ceilings.



706A.2 Requirements

Ventilation openings for enclosed attics, enclosed eave soffit spaces, enclosed rafter spaces formed where ceilings are applied directly to the underside of roof rafters, and underfloor ventilation openings shall be fully covered with wire mesh, vents, other materials or other devices that meeting one of the following requirements :

2. Vents complying with all of the following:

2.1 The dimensions of the openings therein shall be a minimum of 1/16-inch (1.6 mm) and shall not exceed 1/8-inch (3.2 mm).

2.2 The materials used shall be noncombustible.

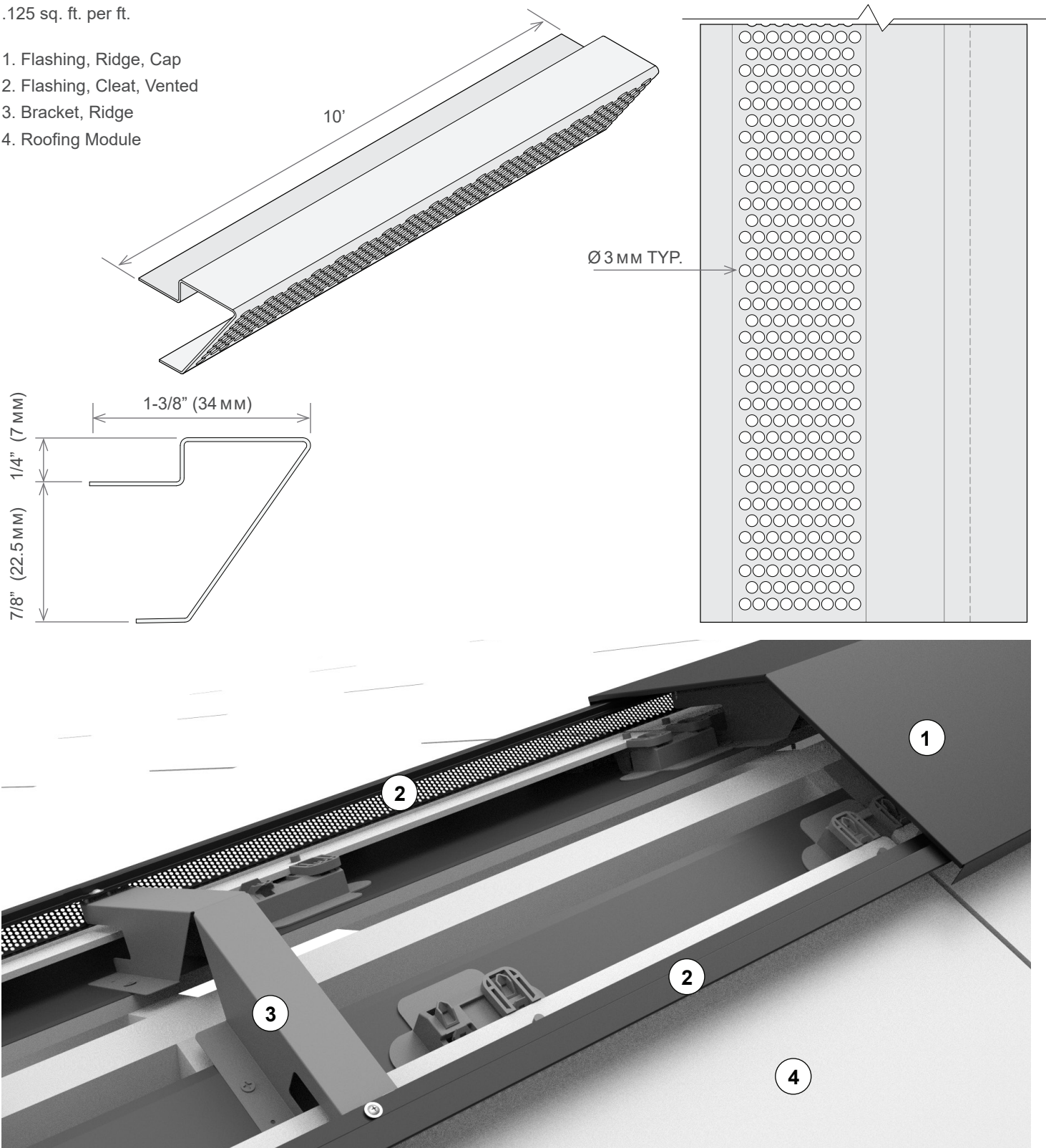
2.3 The materials used shall be corrosion resistant.

Ridge and eave flashing systems are designed to ensure that embers cannot enter into the building in the event of a wildland fire.

Ridge Flashing Assembly

Ridge vents are enclosed with a flashing assembly consisting of a Ridge Cap, Vented Cleat Flashing, and Ridge Bracket. The Vented Cleat has 3 millimeter round holes and is installed along the entire length of the ridge. The Net Free Area of Solar Roof ridge vent is .125 sq. ft. per ft.

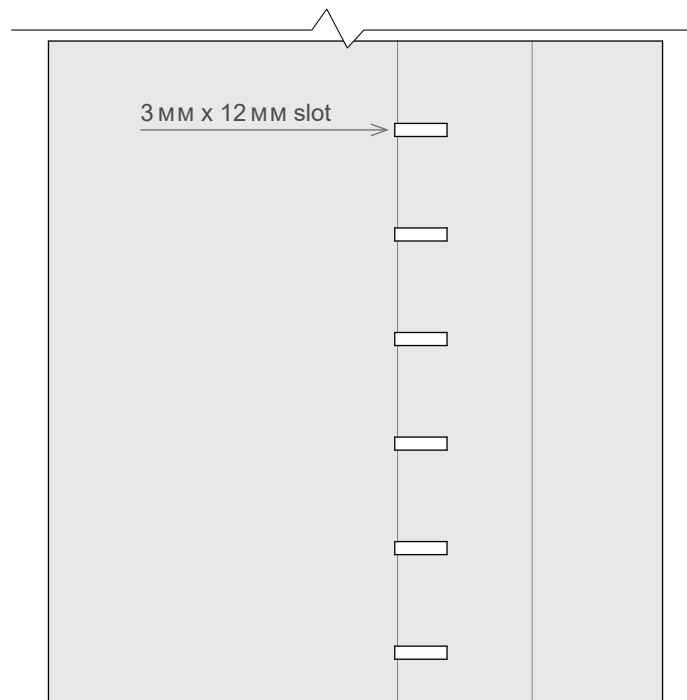
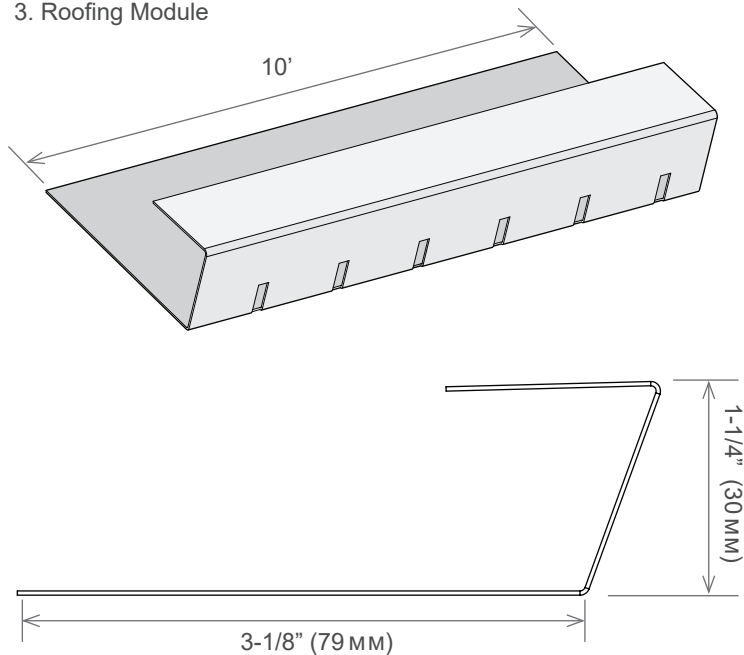
- 1. Flashing, Ridge, Cap
- 2. Flashing, Cleat, Vented
- 3. Bracket, Ridge
- 4. Roofing Module



Eave Flashing Assembly

At the eave Solar Roof is vented with soffit vents. The Starter Trim is a component of the tile level assembly that includes drainage slots compliant with WUI requirements (3 millimeter x 12 millimeter square slots).

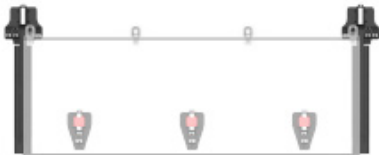
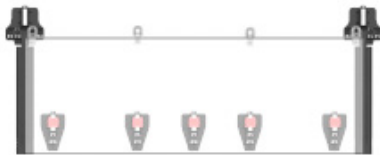
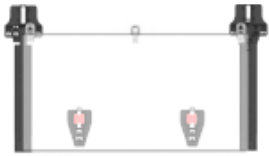
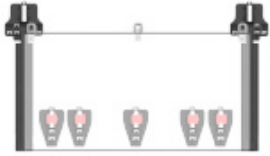
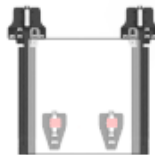
1. Flashing, Eave
2. Trim, Starter
3. Roofing Module



APPENDIX 5 | High Wind, 140 to 194 mph Winds

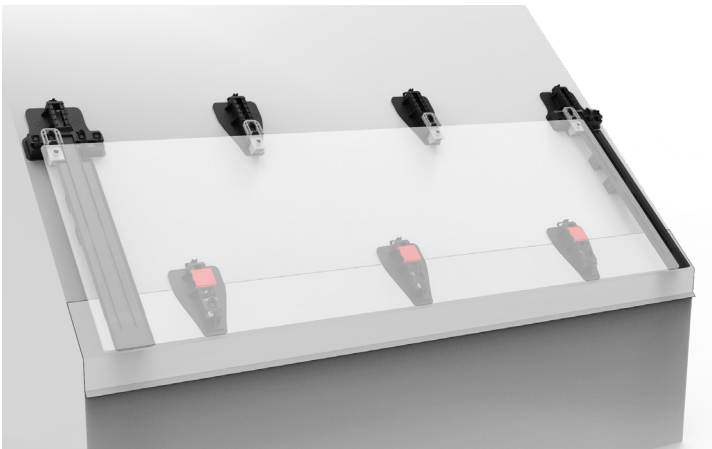
PN: 1558848-00-A, 1558939-00-A, 1558938-00-A

In high wind regions, additional feet are installed at the first row starter course to prevent tile uplift at the eave. The Full Tile, 2/3 Tile, and 1/3 Tile are speciality High Wind Tiles. The 5/6 tile, 1/2 Tile and 1/6 Tile use existing tiles with additional feet installed.

	Standard tiles	140-194 Mph Wind
Full Tile	PN: 1523807-00-D	PN: 1558848-00-A
		
	3 feet	5 feet
2/3 Tile	PN: 1525182-00-B	PN: 1558939-00-A
		
	2 feet	5 feet
1/3 Tile	PN: 1525184-00-B	PN: 1558938-00-A
		
	1 foot	2 feet

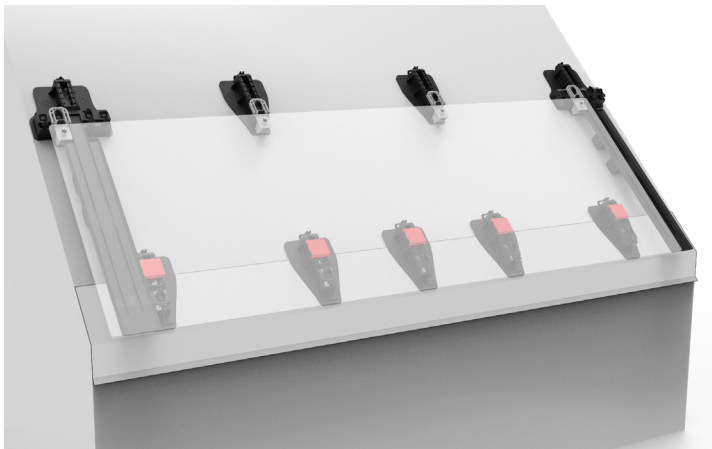
Standard Installation

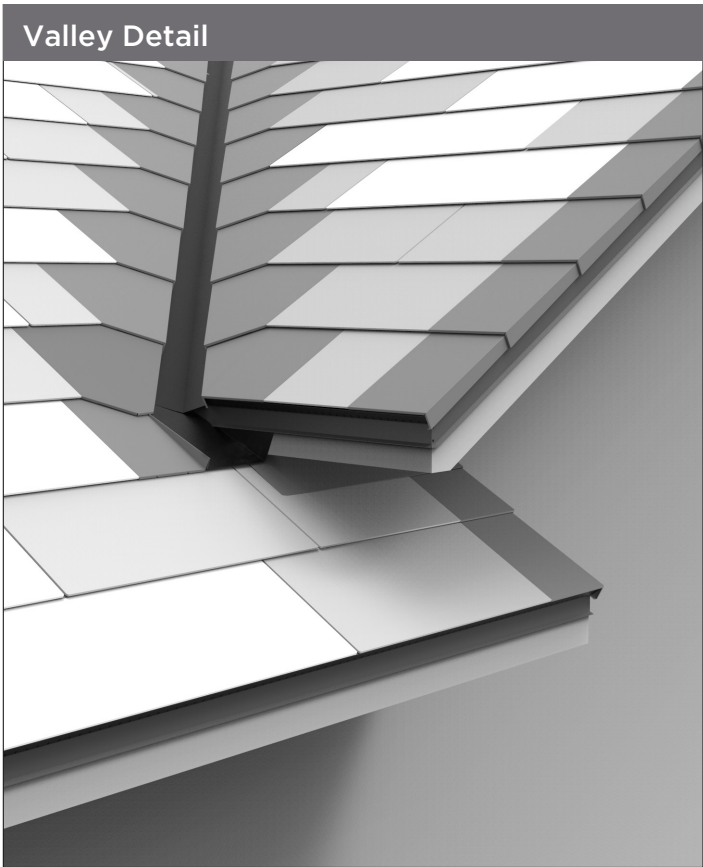
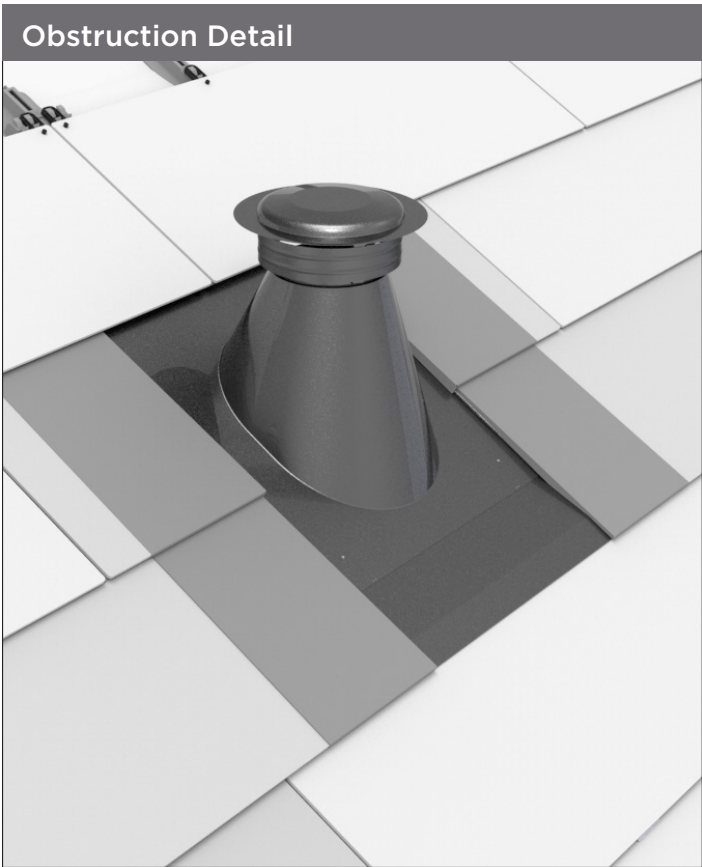
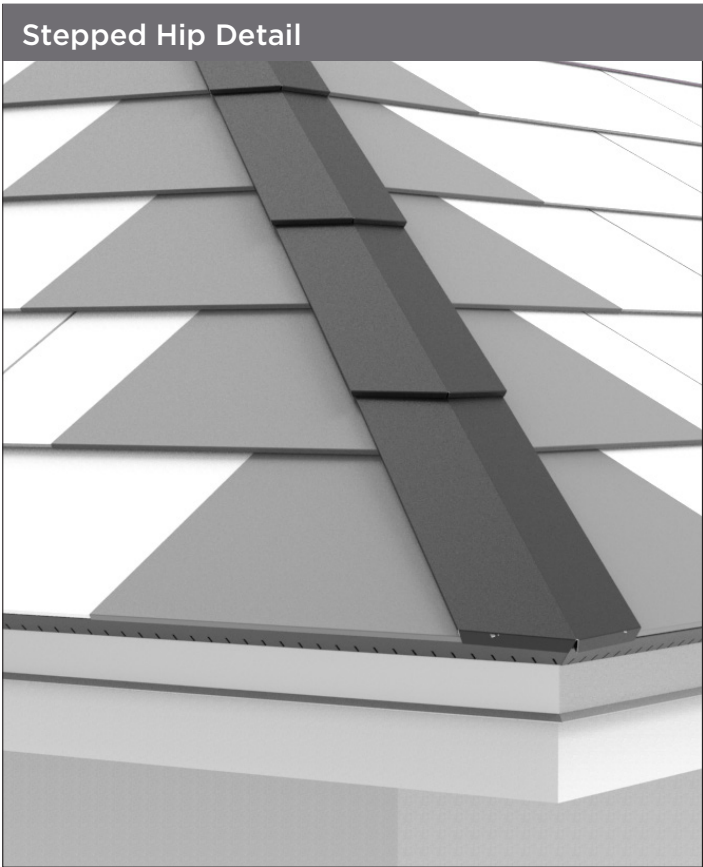
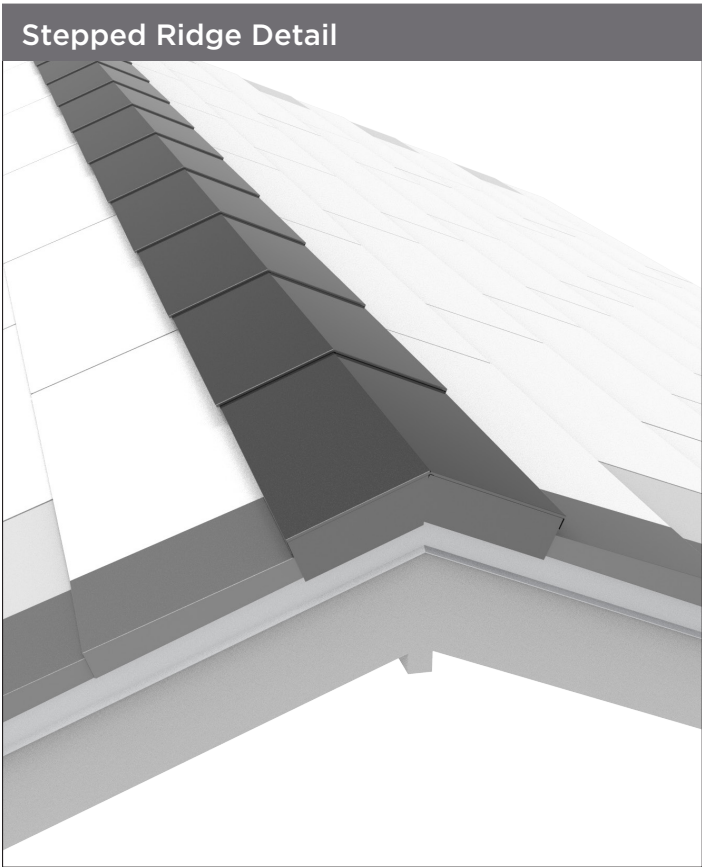
A standard full tile starter course installation has three downroof feet.



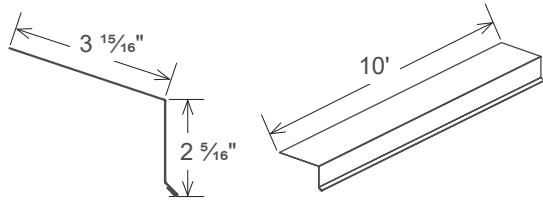
High Wind Installation

A high wind full tile starter course installation has five downroof feet.

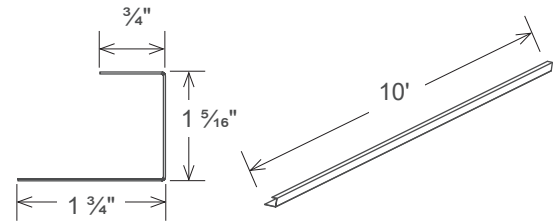




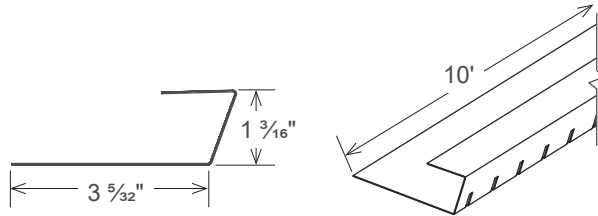
FLASHING, DRIP EDGE



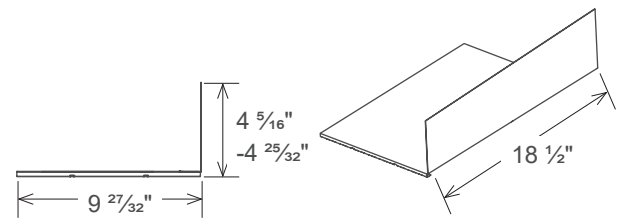
DECK, C CHANNEL



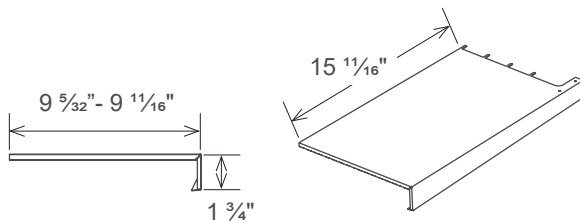
TRIM, STARTER



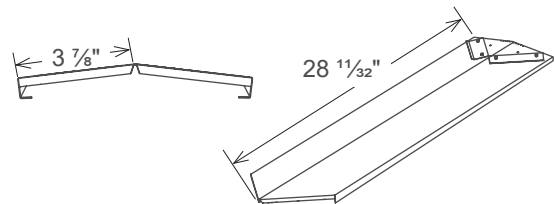
FLASHING, SIDEWALL STEP



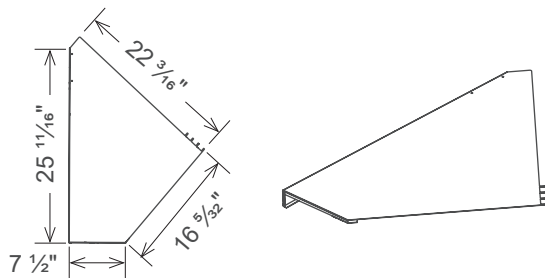
TRIM, RAKE



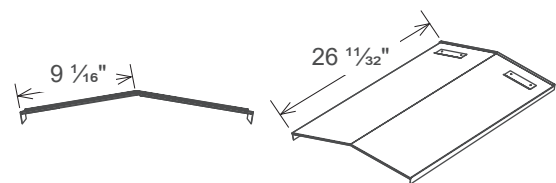
FLASHING, HIP CAP



TRIM, VALLEY



FLASHING, CAP, RIDGE



FLASHING, VALLEY

