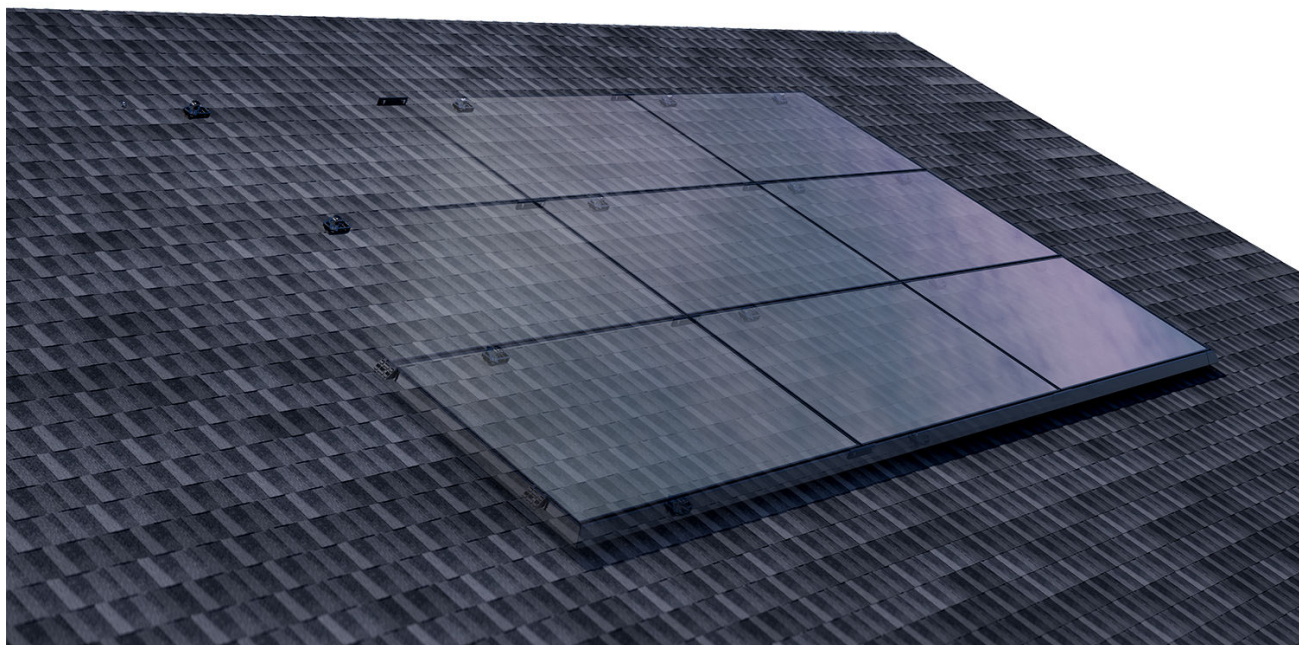




TESLA PANEL MOUNT - COMP RAFTER

INSTALLATION MANUAL



Notices..... 2

Important Safety Instructions..... 3

Introduction to Tesla Panel Mount - Comp
Rafter Mounting System..... 4

Tesla Panel Mount - Comp Rafter System
Components..... 9

Design and Layout Rules..... 17

Array Design..... 24

Installation Overview..... 30

Installation Process..... 35

 Step 1: Array Layout..... 35

 Step 2: Install the Comp Rafter Bases..... 42

 Step 3: Install the Leveling Feet..... 47

 Step 4: Install the Front Skirt..... 52

 Step 5: Install the PV Modules (SMILES)..... 57

 Step 6: Complete Wire Management and Bonding..... 71

 Step 7: Install the Side Skirts and Corner Caps..... 75

Appendix A: Grounding and Bonding..... 81

Appendix B: Thermal Expansion..... 87

Appendix C: Allowable Mounting System
Loading..... 93

Appendix D: Wire Management
Recommendations..... 95

Appendix E: Module Servicing..... 99



NOTICES

- Initial publication.

This manual contains safety, installation, configuration, and troubleshooting instructions for Tesla Solar products. Tesla recommends that you save this manual in a readily accessible location should any questions arise.

Tesla Panel Mount System is UL 2703 Listed for Bonding.

Tesla Panel Mount System has an UL 2703 Class "A" Fire Rating when installed on steep slope roofs using modules from any manufacturer certified as "Type 1" or "Type 2" to UL 61730.

Tesla Panel Mount System is to be mounted over a fire-resistant roof covering rated for the application.

This system should be periodically re-inspected by qualified service technicians. In the event any components or fasteners are found to be loose, they should be re-tightened to the manufacturer's specifications. Any components showing signs of corrosion that compromise safety or function shall be replaced immediately.

Tesla Panel Mount System may only be used to bond and mount compatible modules.

All Tesla Panel Mount compatible modules comply with IEC/UL 61730 and have been evaluated for grounding and mounting in compliance with the included instructions.

Tesla Panel Mount - Comp Rafter components are only suitable for PV modules with a series fuse rating of 20 Amps or less.

To communicate feedback about this document, please reach out to your Tesla Representative.



IMPORTANT SAFETY INSTRUCTIONS



WARNING: Read and understand all instructions before you 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. The installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock.



CAUTION: The PV modules should not be walked on or they risk being damaged.

- Always use qualified personnel for installation.
- Always follow PV module manufacturer safety precautions, installation instructions, and operating guidelines.
- Always abide by local, regional, and national statutory regulations when installing the system, and obtain a building permit if necessary.
- Always use equipment, connectors, and wiring suitable for solar electric systems.
- Always 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.
- Always use insulated tools that are approved for working on electrical installations.
- Always wear suitable personal protection equipment (PPE) to prevent the risk of personal injury, such as fall hazards or electrical hazards.
- Always exercise caution when transporting and installing PV modules.
- Always wear non-slip gloves when carrying PV modules.
- DO NOT wear metallic rings, watchbands, earrings, facial jewelry or piercings, or other metallic objects while installing or troubleshooting PV systems.
- DO NOT contact or touch electrically charged, accessible live parts of PV modules, such as terminals.
- DO NOT touch the PV module unnecessarily during installation.
- DO NOT attempt to make an electrical connection with wet, soiled, or otherwise faulty connectors.
- DO NOT use a PV module with broken glass or torn backsheet.
- DO NOT open electrical connections or unplug connectors while the circuit is under load.
- DO NOT allow children or unauthorized persons near the installation.



INTRODUCTION TO TESLA PANEL MOUNT - COMP RAFTER MOUNTING SYSTEM

The Tesla Panel Mount - Comp Rafter mounting system is designed for use with PV modules manufactured with Tesla's proprietary frame groove. The PV module frames are mechanically connected by Interlocks, creating continuous beams and eliminating the need for mounting rails. The system is installed with simple tools and requires no additional electrical bonding steps, enabling fast and easy installation.

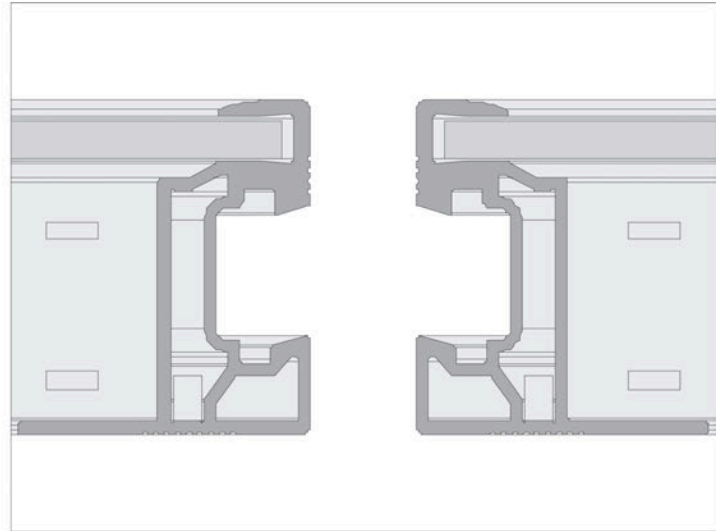
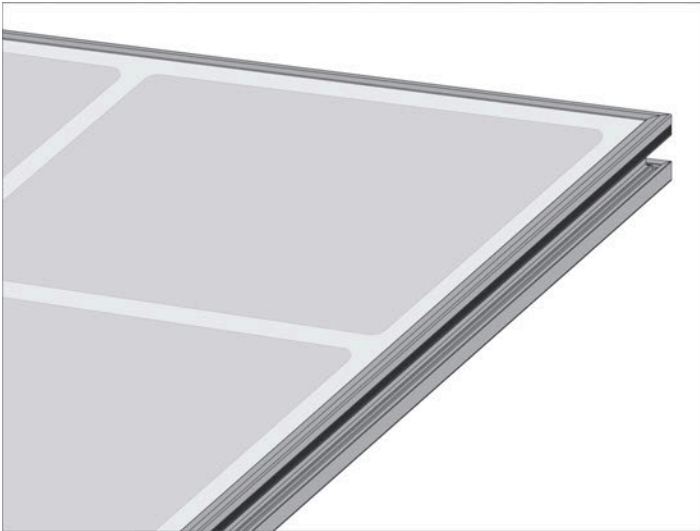


Tesla Solar Compatible

Tesla Solar mounting solutions are based on the Tesla Groove, a patented module frame profile designed to mate easily and precisely with Tesla Solar components, creating a simultaneous structural and electrical bond with a simple drop-in motion.



INTRODUCTION TO TESLA PANEL MOUNT - COMP RAFTER MOUNTING SYSTEM

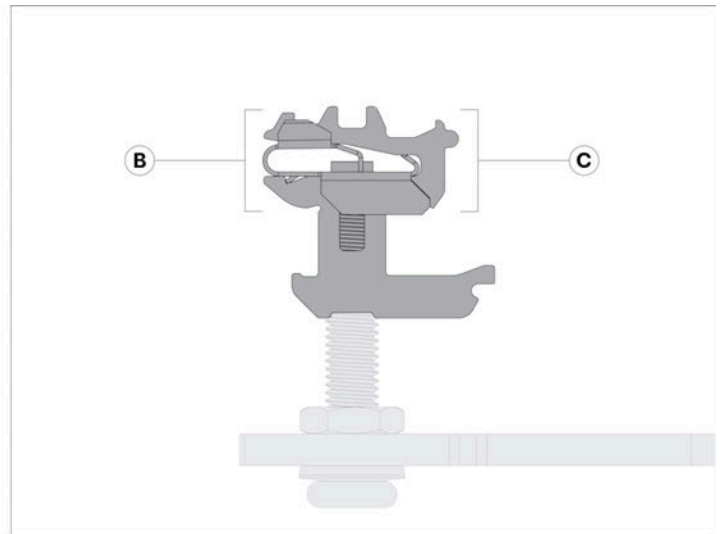
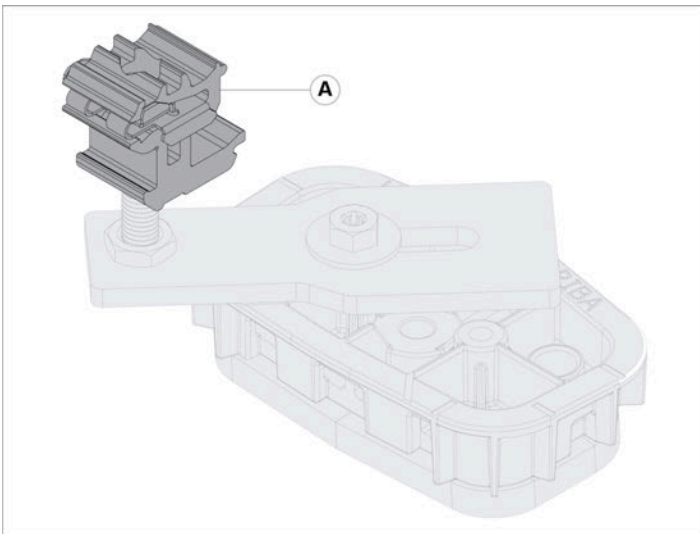


- *PV module frame with Tesla Groove*

The Key and Tongue Concept

The Key and Tongue concept informs all Tesla Solar Compatible designs. The Key side inserts into the Tesla Groove, similar to inserting a key into a lock. On the other side, the Tesla Groove allows PV modules to "drop in" easily onto the Tongue. This Key and Tongue system creates automatic structural connection and electrical bonding as the modules are dropped in to the components below.

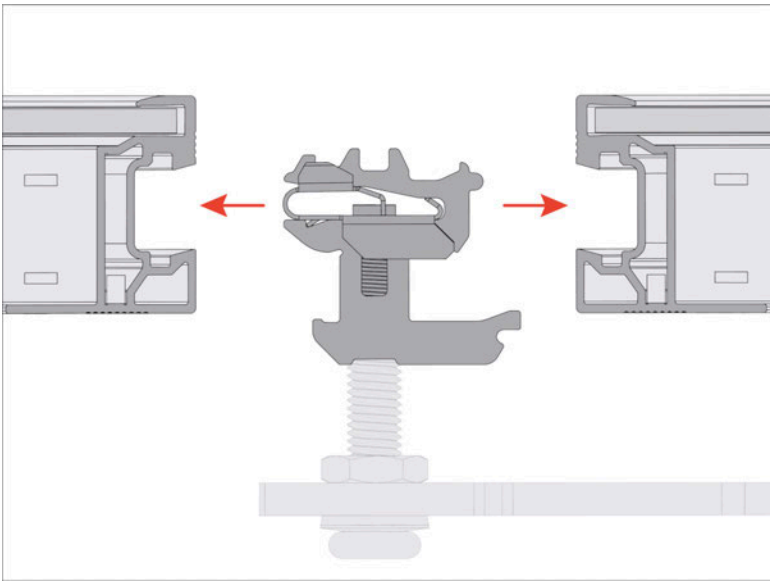
For example, the Rockit is a component in the Leveling Foot that is used to connect PV modules together and to the Base attached to the roof. The Rockit fits into the Tesla Groove on both sides: The Key side inserts, while the Tongue side receives.



- (A) - Rockit
- (B) - Key side
- (C) - Tongue side



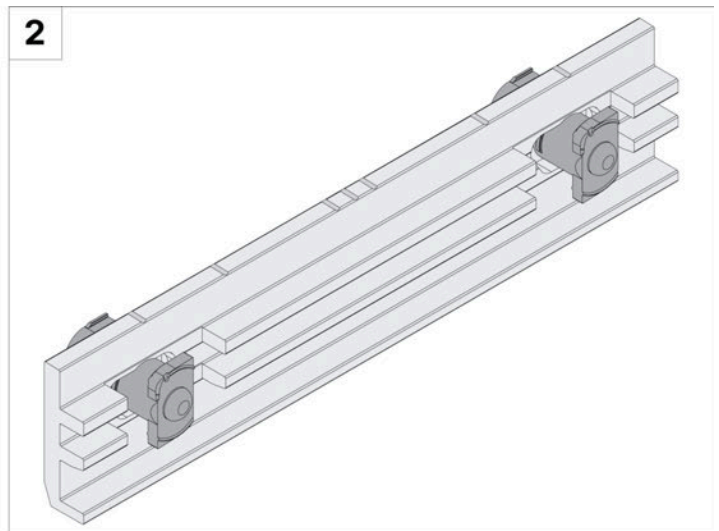
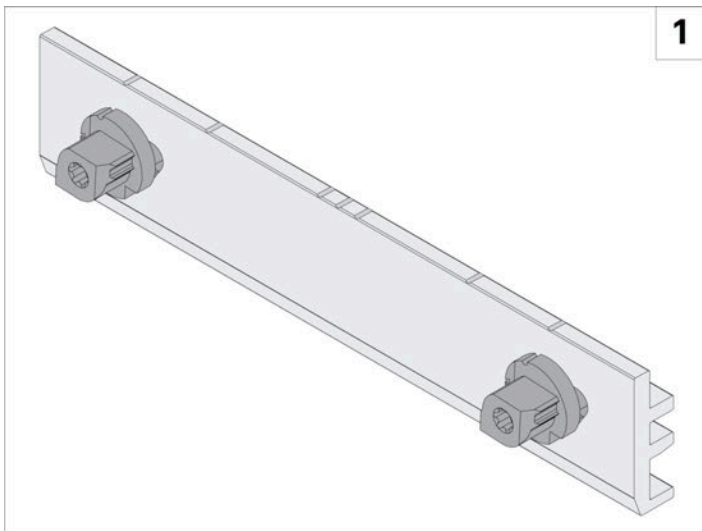
INTRODUCTION TO TESLA PANEL MOUNT - COMP RAFTER MOUNTING SYSTEM



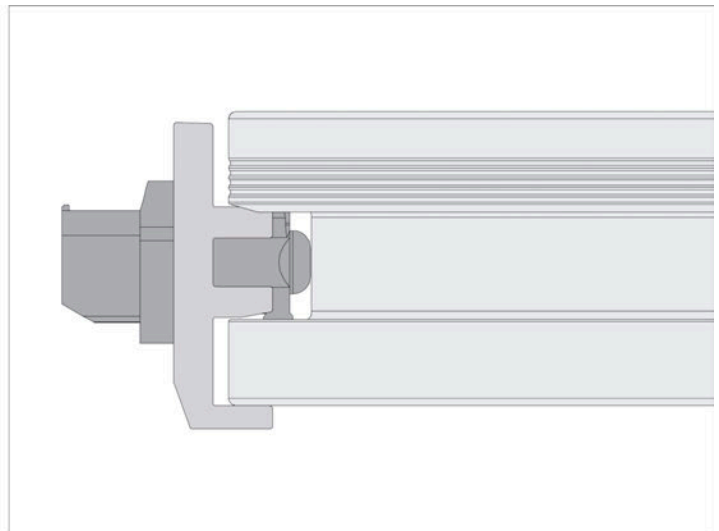
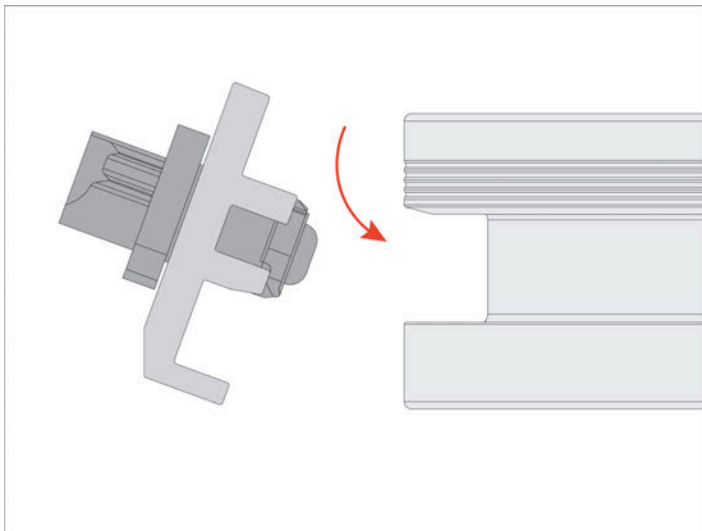
The Key and Tongue design is also used with the Interlock, a component that mechanically connects and bonds two modules together. Here, the Key and Tongue are differently shaped, but they fit into the Tesla Groove in a similar manner to the Rockit.



INTRODUCTION TO TESLA PANEL MOUNT - COMP RAFTER MOUNTING SYSTEM



- (1) - Interlock front is the Tongue side
- (2) - Interlock back is the Key side



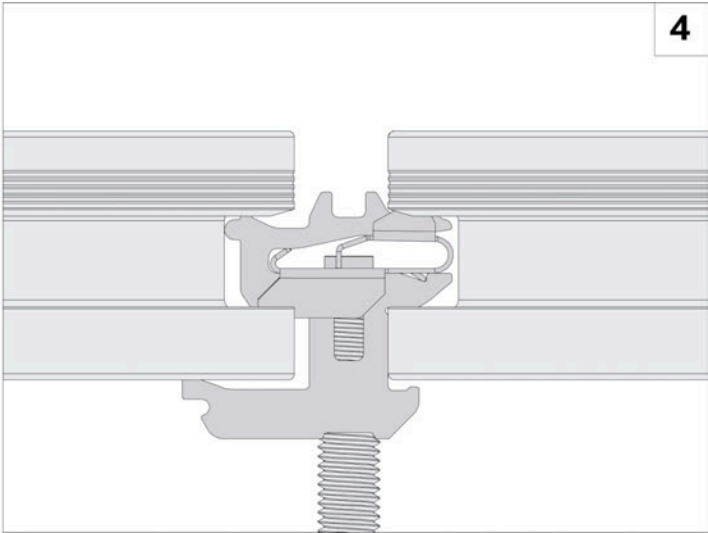
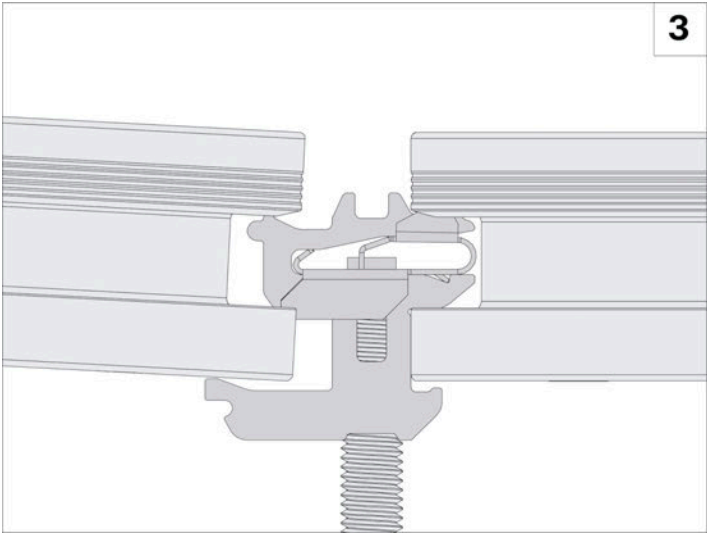
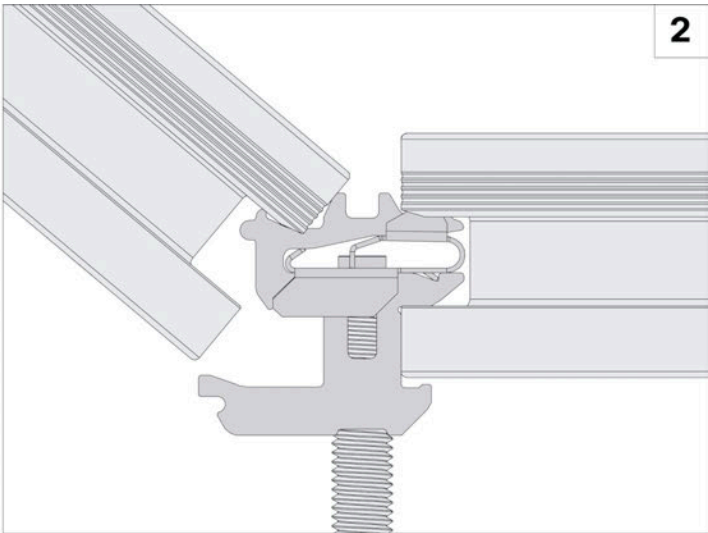
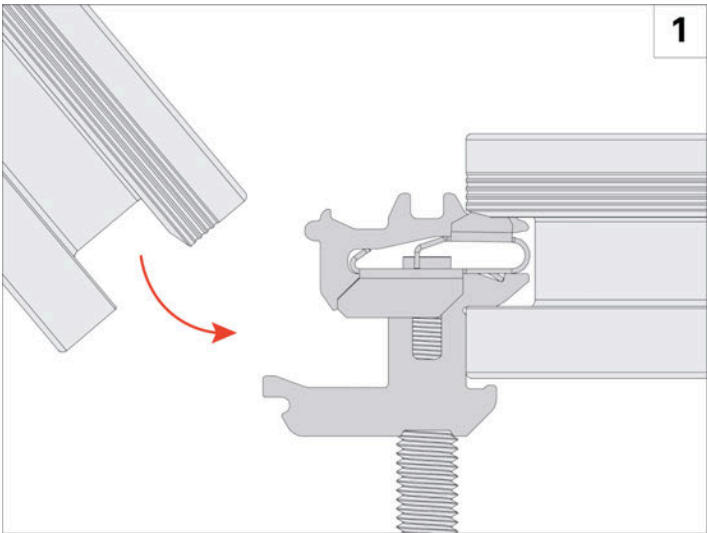
- Interlock inserting into the Tesla Groove

Module Drop-In

Tesla Solar Compatible modules are dropped in to the Rokit with a downward motion as shown (1). The module's downward motion creates forced interference with the Tesla Groove of the module frame (2), cutting through the frame coating (3) to create an electrical bond and structural connection (4).

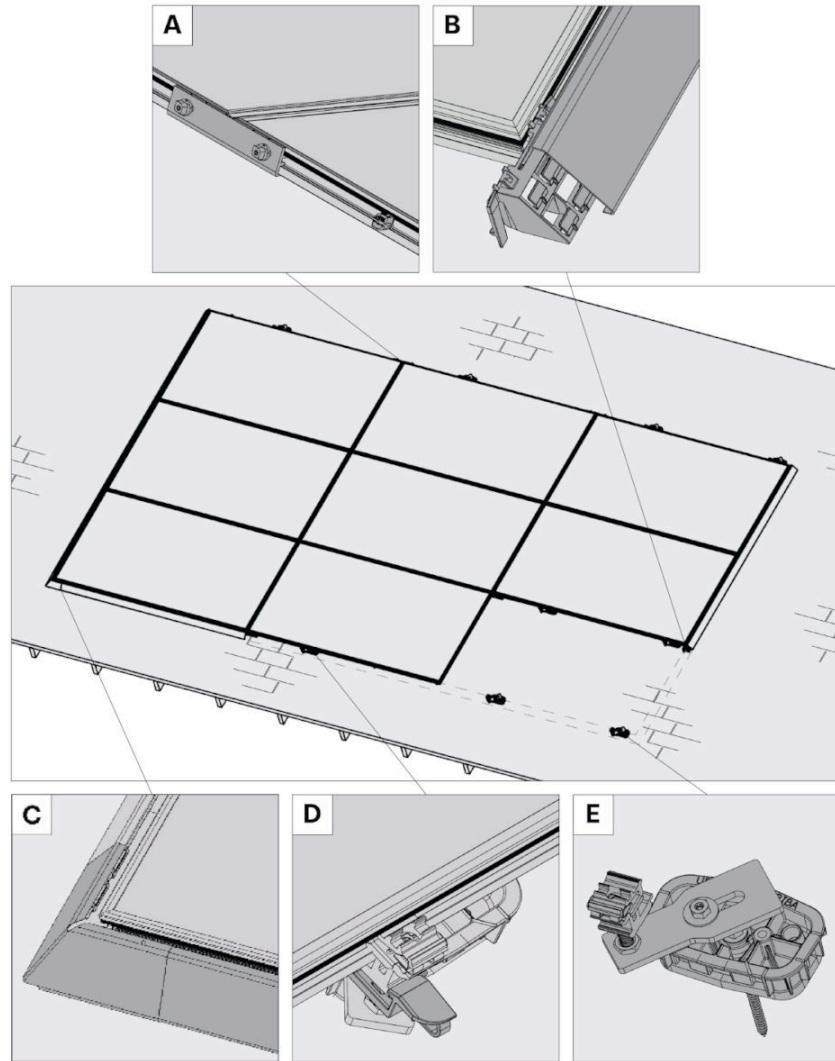


INTRODUCTION TO TESLA PANEL MOUNT - COMP RAFTER MOUNTING SYSTEM



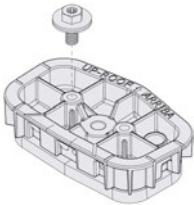
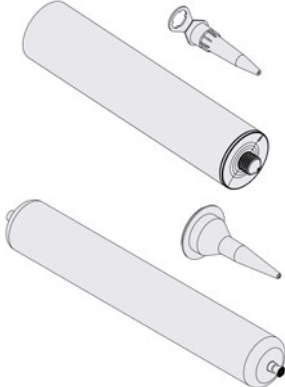


TESLA PANEL MOUNT - COMP RAFTER SYSTEM COMPONENTS



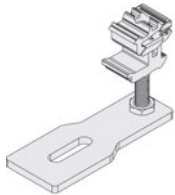
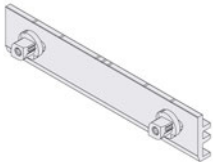
- (A) - Interlock and Ground Lockit
- (B) - Side Skirt and Side Skirt Bracket
- (C) - Corner Cap and Front Skirt
- (D) - Front Skirt Grip
- (E) - Comp Rafter Base, Lag Screw, and Leveling Foot

Mounting Components

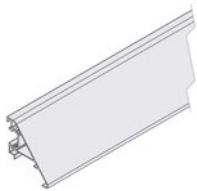
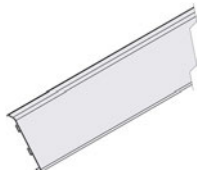
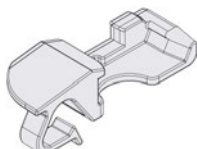
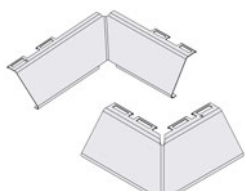
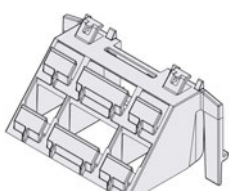
Part	Description	Part Number
Comp Rafter Base 	Provides a roof mounting attachment point for the array. Listed to UL 2703	2023000-00-X
Lag Screw 	Attaches the Comp Rafter Base to the roof rafter.	2044245-00-X (4 ¾ in.) 2044244-00-X (5 ½ in.) ¹ ¹ Verify that the correct length lag is being used to achieve 2 ½ in. threaded embedment.
Sealant Cartridge with Nozzle or Sealant Sausage Pack with Nozzle 	Tonsan MS-1937 Sealant Cartridge, 10.5 oz or Tonsan MS-1937 Sealant Sausage Pack, 600 ml Fills a cavity in the Comp Rafter Base for waterproofing.	1679265-00-X or 1576600-00-X

Fasteners shall be clean and free of damage or signs of corrosion during installation.

Structural and Bonding Components

Part	Description	Part Number
Comp Rafter Leveling Foot 	Secures PV modules to the Comp Rafter Base, bonds connected modules, and enables array leveling. Listed to UL 2703	2032169-00-X
Interlock 	Provides structural and electrical bonding between PV modules within each sub-array. Listed to UL 2703	1576999-00-X
Ground Lockit 	Provides a single point for grounding a PV array. Listed to UL 467 and UL 2703	1578119-00-X

Array Skirt Components

Part	Description	Part #
Front Skirt 	Serves as a structural and aesthetic feature for the array and helps establish a straight line to build from. Listed to UL 2703	Refer to Front Skirt Sections table below.
Side Skirt 	Covers the edges of the array to create a clean aesthetic.	Refer to Side Skirt Sections table below.
Front Skirt Grip 	Provides structural support to the Front Skirt, connecting it to the Leveling Foot. Listed to UL 2703	2088697-00-X
Corner Cap 	Conceals hardware and creates a clean aesthetic on the corners of the array.	2049667-00-X (Inside) 2049666-00-X (Outside)
Side Skirt Bracket 	Provides an attachment point for the Side Skirt, connecting it to the Tesla Groove.	2022523-00-X

Front Skirt Sections

Model	Dimensions	Part Number
Front Skirt for Tesla Solar Panel	1818 mm (71.6 in.), landscape, 1x	2047098-23-X
	2296 mm (90.4 in.), portrait, 2x	2047098-24-X
Front Skirt for QCells	1903 mm (74.9 in.), landscape, 1x	2047098-21-X
	2118 mm (83.4 in.) portrait, 2x	2047098-22-X

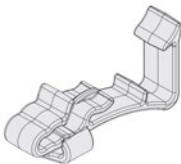
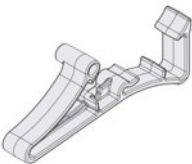
Side Skirt Sections



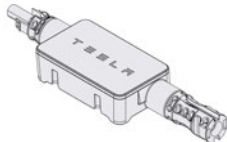
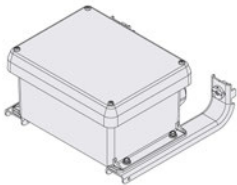
TESLA PANEL MOUNT - COMP RAFTER SYSTEM COMPONENTS

Model	Dimensions	Part Number
Side Skirt for Tesla Solar Panel	2296 mm (90.4 in.), landscape, 2x	1993354-05-X
	1148 mm (45.2 in.), landscape, 1x	1993354-06-X
	1818 mm (71.6 in.), portrait, 1x	1993354-07-X
Side Skirt for QCells	2118 mm (83.4 in.), landscape, 2x	1993354-01-X
	1059 mm (41.7 in.), landscape, 1x	1993354-02-X
	1903 mm (74.9 in.), portrait, 1x	1993354-04-X

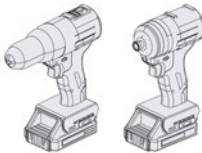
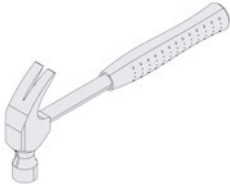
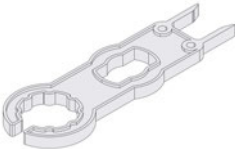
Wire Management Components

Part	Description	Part Number
DC Wire Clip 	Secures up to 3 conductors underneath a PV module by attaching to the Tesla Groove. Listed to UL 1565	1578249-00-X
Home Run Wire Clip 	Secures up to 6 conductors underneath a PV module by attaching to the Tesla Groove. Listed to UL 1565	1578389-00-X

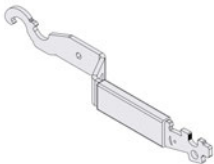
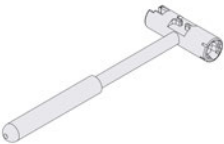
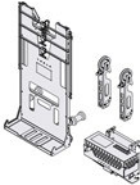
Electrical Accessories

Part	Description	Part Number
MCI-2 (Mid-Circuit Interrupter) 	Tesla's rapid shutdown solution, which is compatible with Tesla power electronics. Listed to UL 1741	1879359-00-X
Combiner Box 	Provides terminal blocks to make parallel connections and transition wire. Connects directly to the groove on Tesla Compatible PV modules. Listed to UL 1741	1571739-00-X
Conduit Support 	The Conduit Support accommodates ¾ and 1 in. trade sizes of EMT, PVC, and RMC. Adjustable, openable, and attaches with a single self-sealing fastener.	2043367-00-X

Required Tools

Part		
Drill and Impact Driver 	3/16 in. or 7/32 in. Drill Bit 	String Line 
Roof Crayon or Chalk 	Tape Measure 	Hammer 
Slotted Screwdriver 	#40 Torx Bit Socket and Ratchet Wrench 	½ in. Socket or #40 Torx Bit 
Caulk Gun or Sausage Caulk Gun 	MC4 Disconnect Tool 	

Recommended Tools

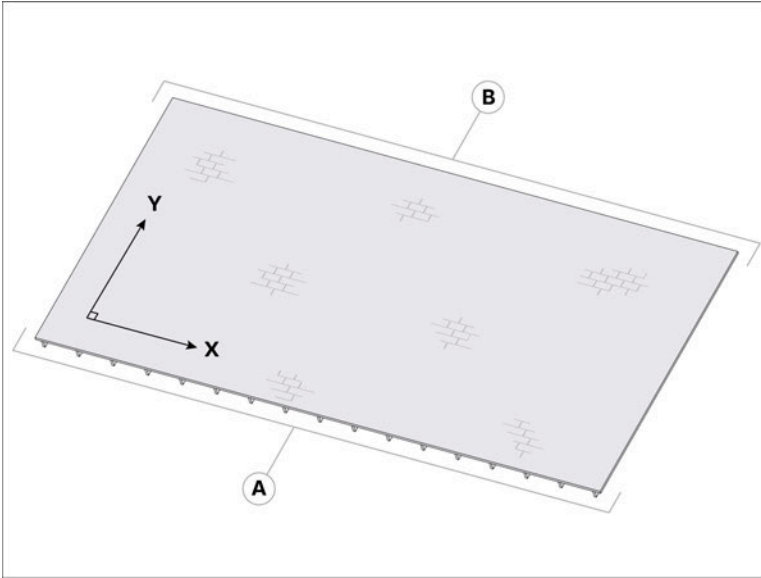
Part	Description	Part Number
Tesla Solar Wrench 	A multifunctional tool for Tesla Solar installation. Includes every feature needed for speedy installation, removal, and service of installed systems.	2066971-00-X
Tesla Installation Tool 	Provides the optimal ergonomics and speed for installing/adjusting Interlocks, Ground Lockits, and spacing modules.	1578989-00-X
Ladder Hoist 	Tesla's module lifting solution. Attaches to a standard extension ladder and is capable of lifting two modules, three skirt boxes, or multiple work bags. Can be set up and removed in less than five minutes.	2135588-00-X
Retrofit Roof Rack 	Proves a rooftop staging option for PV modules prior to installation. Connects directly to a mounting base and can hold up to 9 modules depending on pitch.	1555870-XX-A and 2094019-00-X



DESIGN AND LAYOUT RULES

The rules and guidelines described in this section, together with the individual component ratings, are important factors in array design and must be considered when adjusting or customizing array layout. Installers must be aware of these rules when making field adjustments during installation.

 **NOTE:** This document refers to directions on the roof in relation to the X and Y direction. The Y direction is up- and down-roof, typically parallel to the rafters. The X direction is horizontal, typically called left and right relative to up-roof direction. These directions hold true regardless of the presence or lack of a ridge/eave.



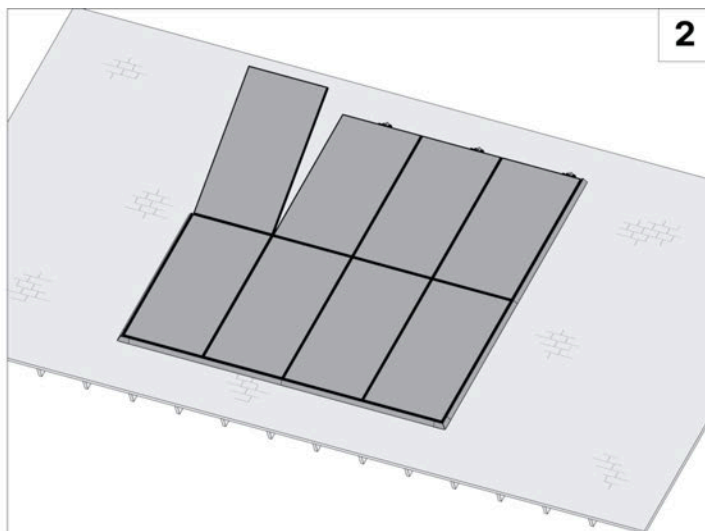
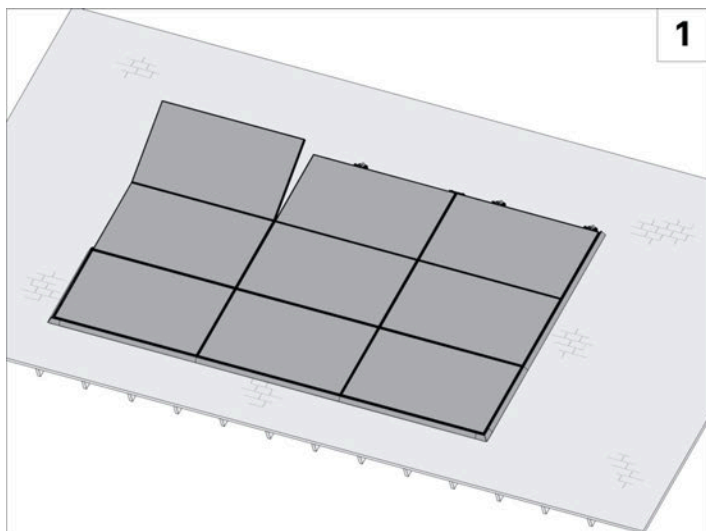
- (A) - Down-Roof
- (B) - Up-Roof

Drop-In Direction

The PV module drop-in process is specific to Tesla Panel Mount designs. Roof attachments connect to the rafters which run in the Y direction. Modules are dropped in row by row going up-roof beginning at the Front Skirt, which is nearest to the eave. The Front Skirt must always be installed along the X-axis. Modules must never be installed at an angle relative to the rafters.



DESIGN AND LAYOUT RULES



- (1) - 3 x 3 array in landscape orientation
- (2) - 2 x 4 array in portrait orientation

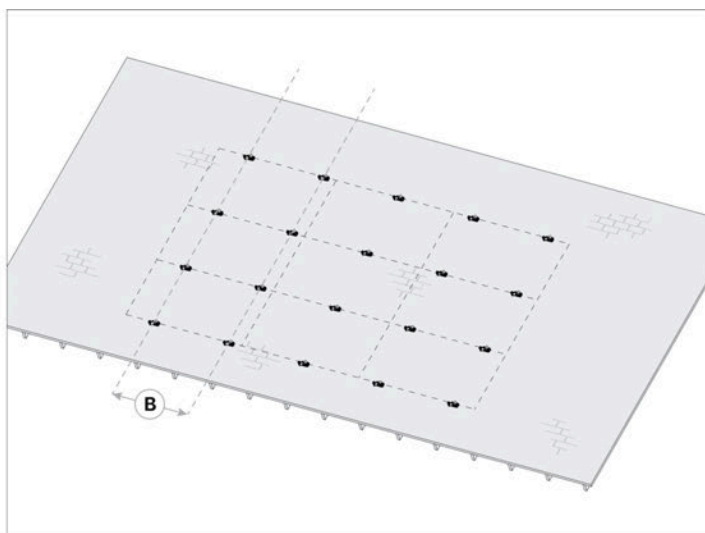
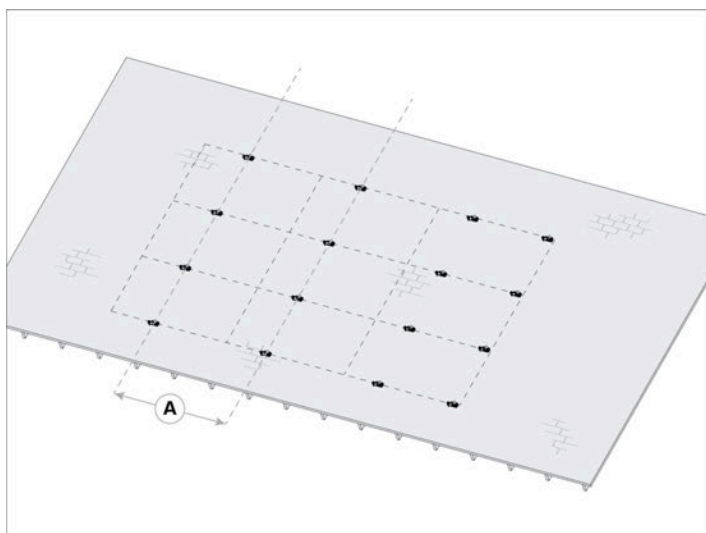
Minimum Pitch

The minimum roof pitch for installation of Tesla Panel Mount - Comp Rafter systems is 2:12, or 9.46°.

Span and Distance

Maximum Allowable Span:

The maximum allowable span between the roof attachment points is determined by various site-specific and building inputs, which are calculated using the individual component ratings.



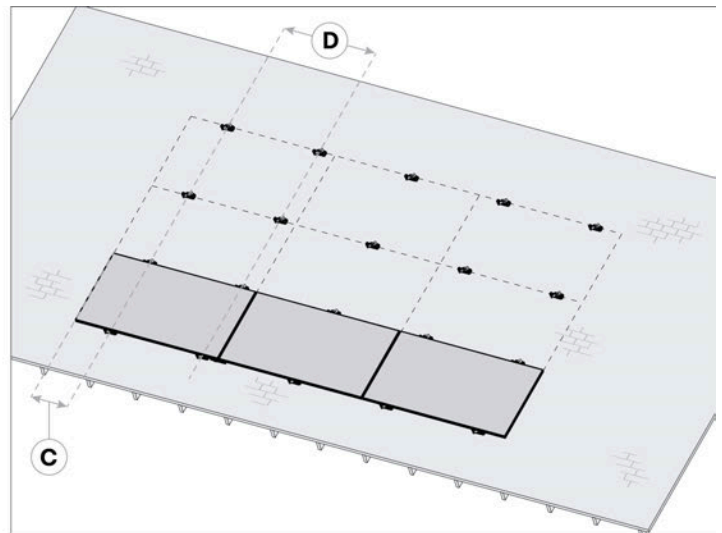
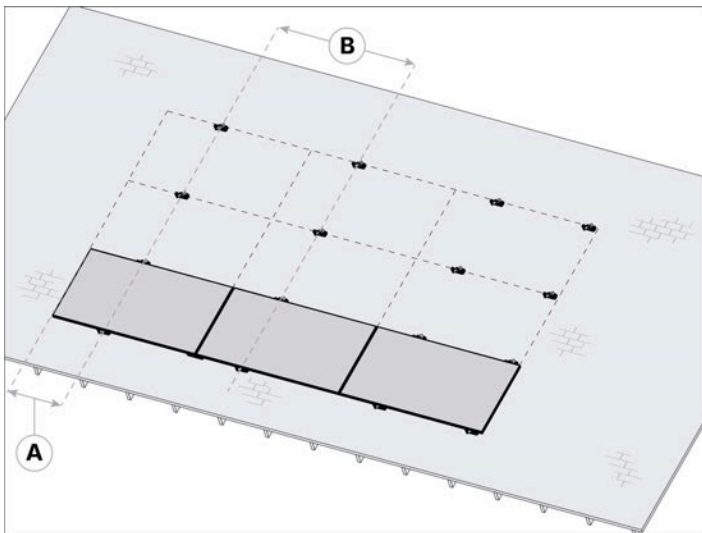
- (A) - 72 in. span
- (B) - 48 in. span

Maximum Cantilever:

The maximum module X cantilever distance varies with span and pressure, refer to [Appendix C: Allowable Mounting System Loading on page 93](#) for more information.



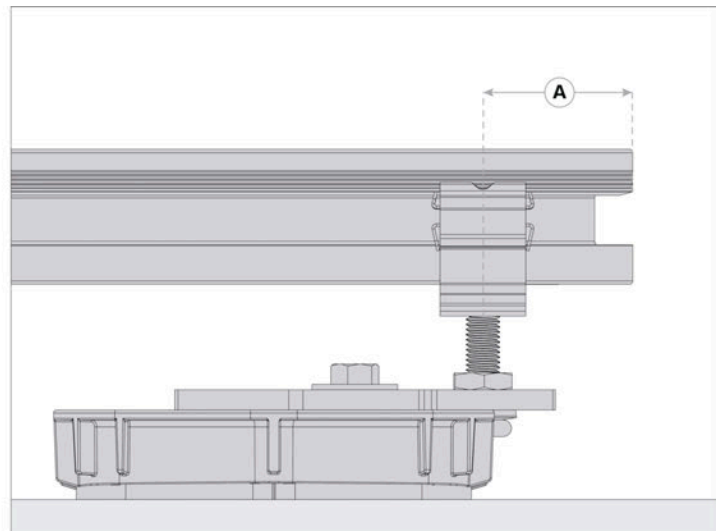
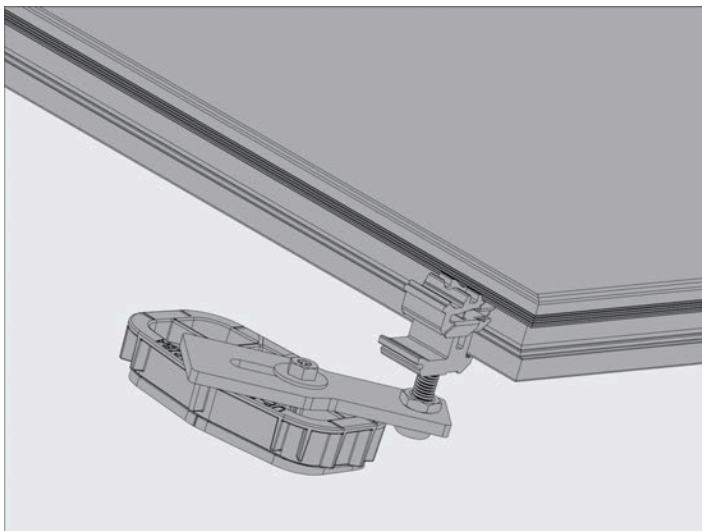
DESIGN AND LAYOUT RULES



- (A) - 24 in. max cantilever on (B) 72 in. span
- (C) - 16 in. max cantilever on (D) 48 in. span

Module Corner Minimum Distance:

Rockits and Ground Lockits must be installed a minimum distance of 2 in. (50 mm) from module corners, measured from the center of the Rockit or Ground Lockit. This minimum distance does not apply to Interlock Lockits. Other distances will be called out in the process of this document.



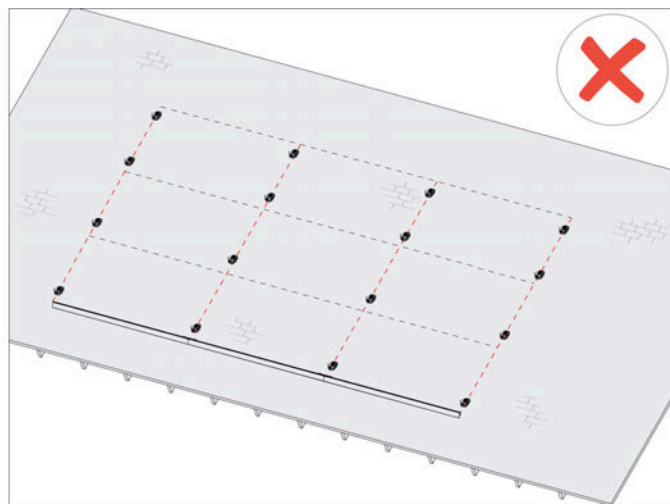
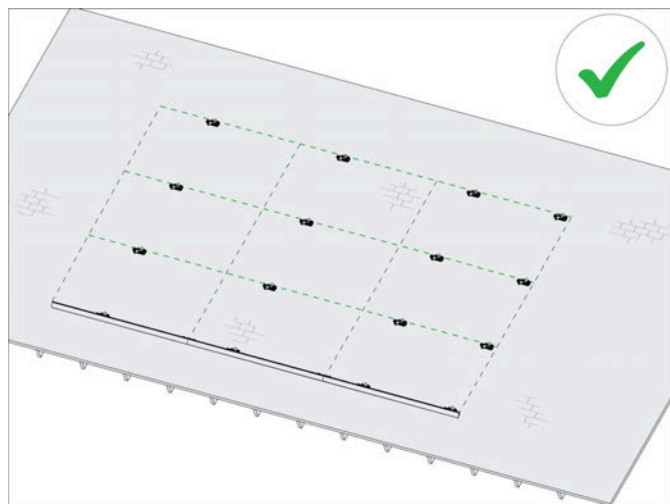
- (A) - 2 in. (50 mm) distance from module corner to center of Rockit

Component Installation Direction

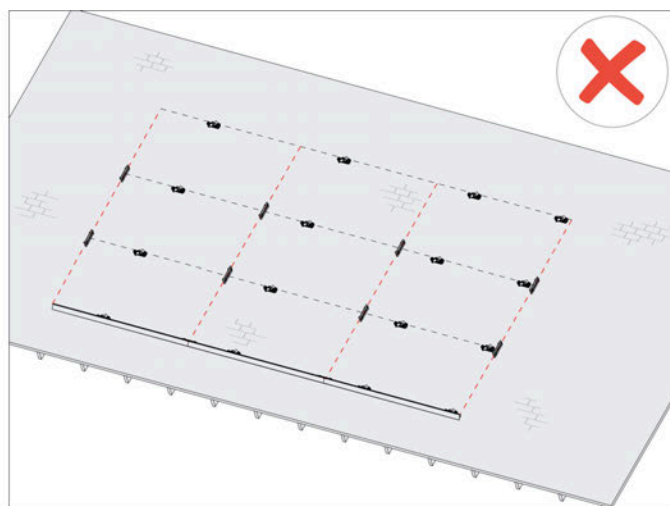
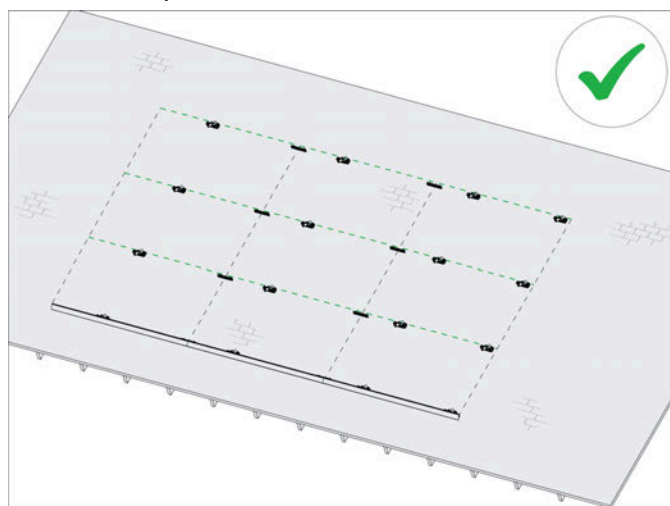
1. **Leveling Feet Attach on Opposing Sides of the Module:** Leveling Feet should always be installed on the up-roof and down-roof edges of the module, e.g. the long edges in landscape orientation, and the short edges in portrait orientation.



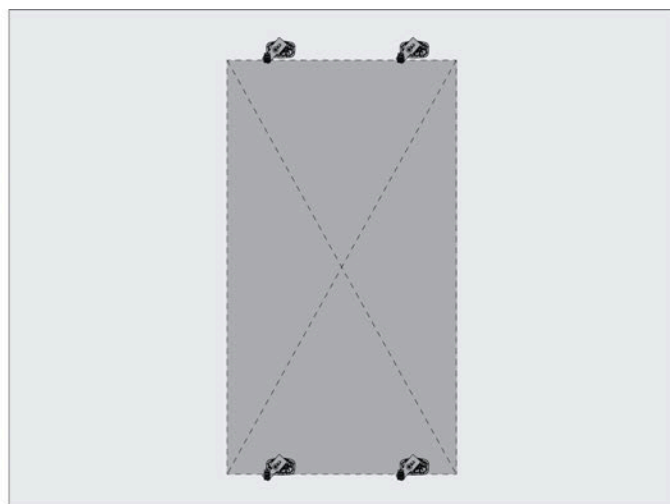
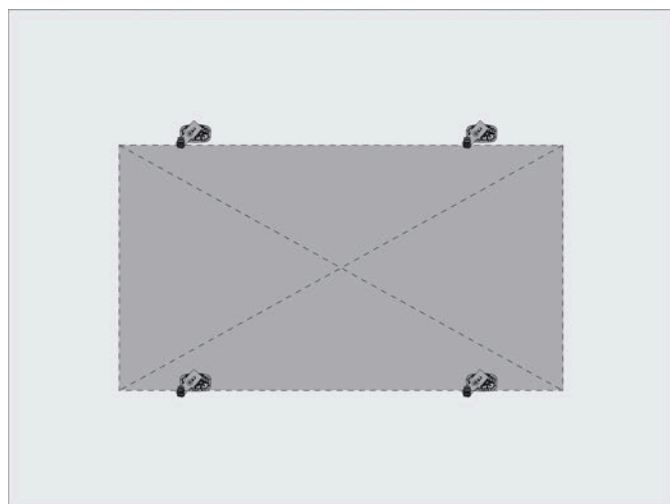
DESIGN AND LAYOUT RULES



2. **Interlocks Must be Parallel with Front Skirt:** Interlocks should be attached along the upper edge of each module row, parallel with the Front Skirt and the X-axis.



3. **Single Module Installation:** A standalone module requires two Leveling Feet on each side, for a total of four Leveling Feet. This remains true regardless of module orientation.

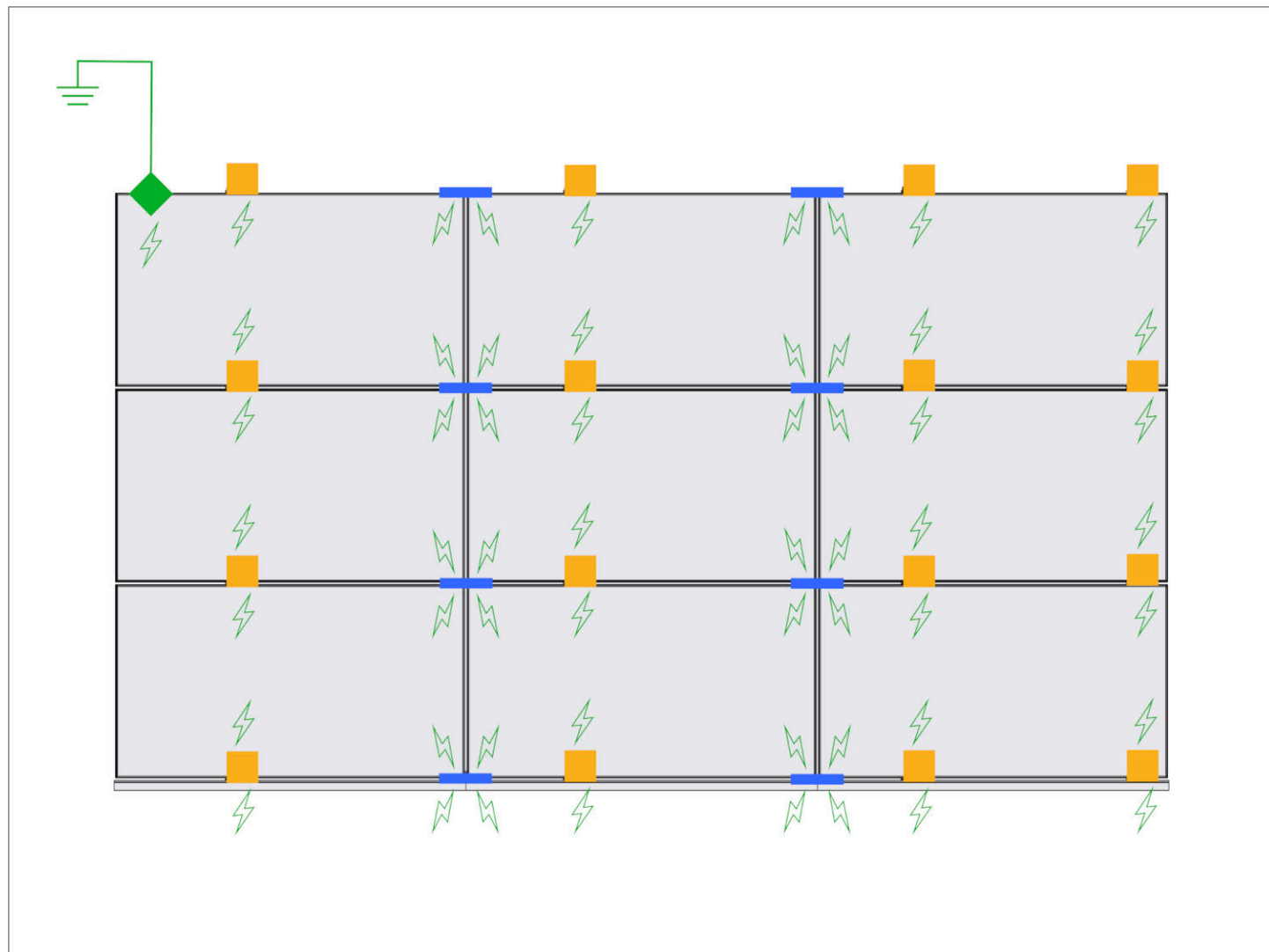




DESIGN AND LAYOUT RULES

Grounding/Earthing

The Tesla Solar Compatible design concept allows the installer to build a redundantly-bonded array with a single ground bond connection. In this system, every module is structurally and electrically bonded to the surrounding modules on all sides. This eliminates the need for jumper wires between mounting rails or modules.



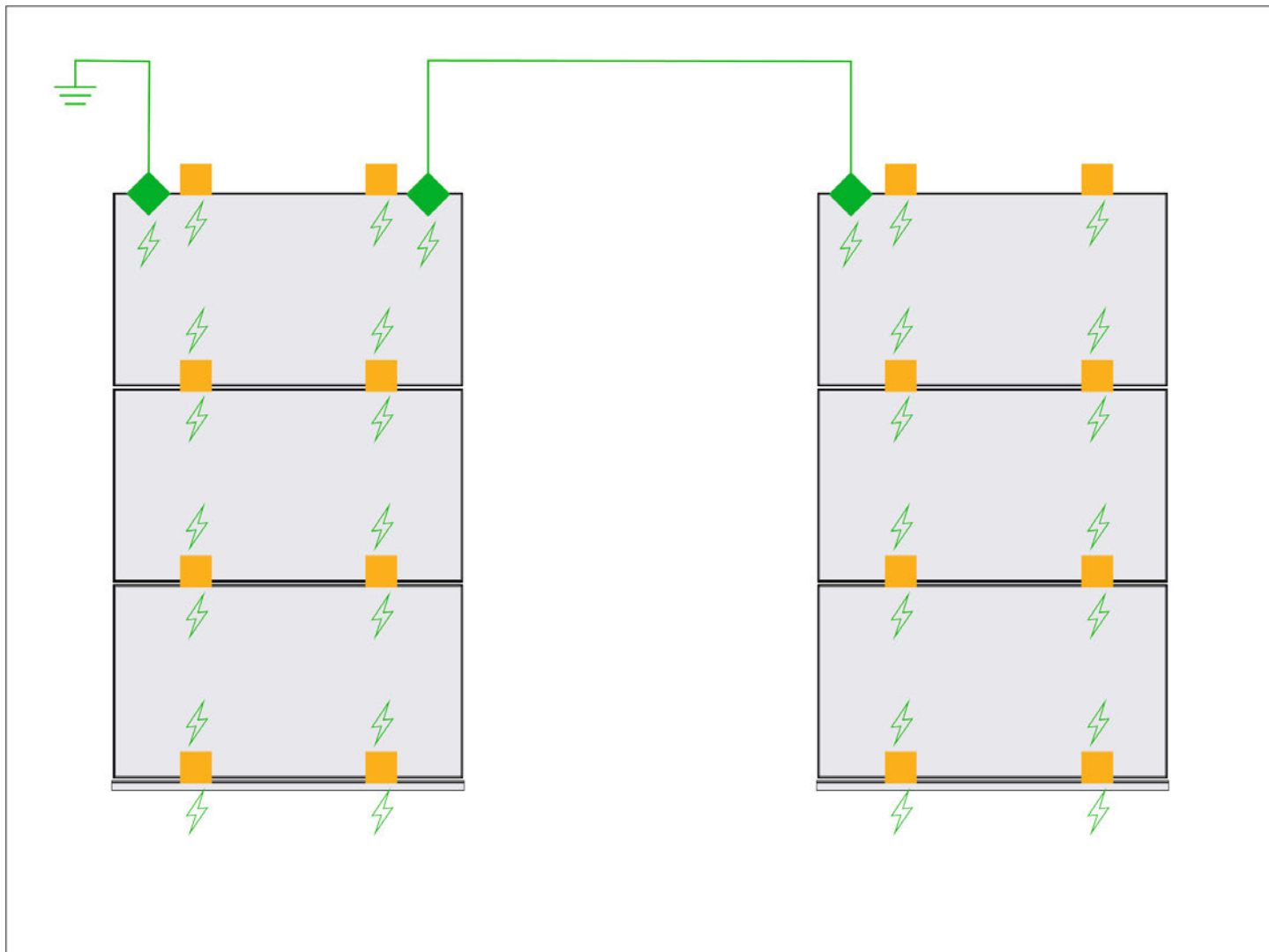
- ⚡ Bond path
- ◆ Ground Lockit
- — Equipment grounding conductor (EGC)
- — Interlock
- ≡ Earth ground
- ■ Rockit

Interlocks bond modules connected at all four corners: the two modules below, and the two modules above. Rockits bond modules directly above and below the Rockit. The Front Skirt is bonded in an identical way with both Interlocks and Rockits. For details on how this bonding occurs, refer to [Appendix A: Grounding and Bonding on page 81](#).



DESIGN AND LAYOUT RULES

Additional bond connections between modules will be required any time a physical gap exists. This includes sub-arrays on the same mounting plane and arrays on different parts of the roof. The Ground Lockit is used to bond the isolated array back to the array which is connected to the grounding electrode conductor (GEC.)



- ⚡ Bond path
- ◆ Ground Lockit
- — Equipment grounding conductor (EGC)
- — Interlock
- ≡ Earth ground
- ■ Rockit

Ground Lockit Module Limit:

A single Ground Lockit can ground up to 72 Modules.



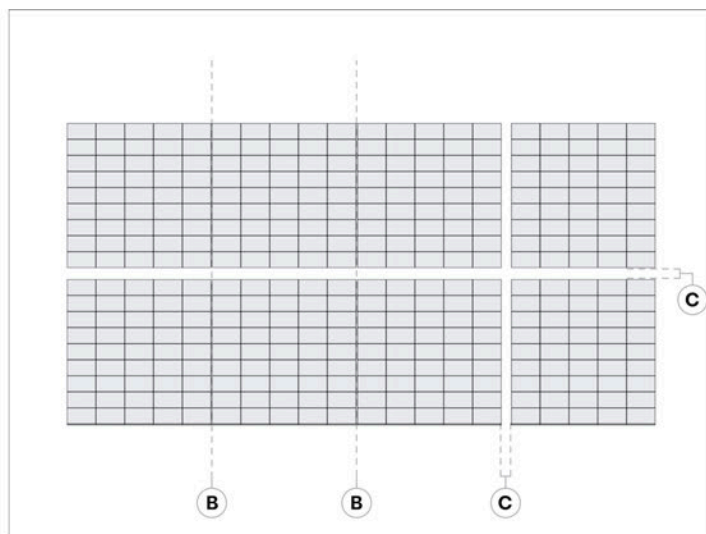
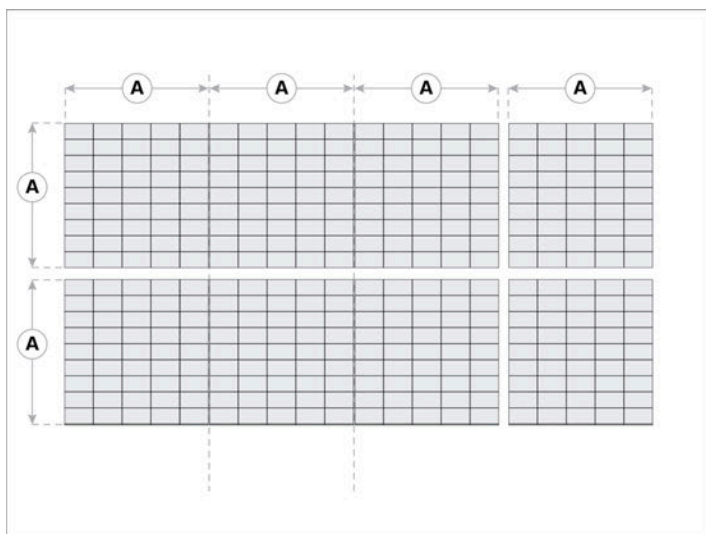
Thermal Expansion

There are two methods to address thermal expansion and contraction within very large arrays: thermal expansion joints and physical gaps between sub-arrays.

When Are Thermal Expansion Joints Needed?

Thermal expansion must be addressed when array sizes are larger than 33 ft (10 m) in either direction. For typical modules, this is every five module lengths or nine module widths.

- In the Y direction, a physical gap is required.
- In the X direction, Interlocks can be used to create a thermal expansion joint.
 - After two consecutive thermal expansion joints, a physical gap is required.



- (A) - 33 ft (10 m) in X or Y direction
- (B) - Thermal expansion joints
- (C) - Physical gaps

For more information on thermal expansion, refer to [Appendix B: Thermal Expansion on page 87](#).



ARRAY DESIGN

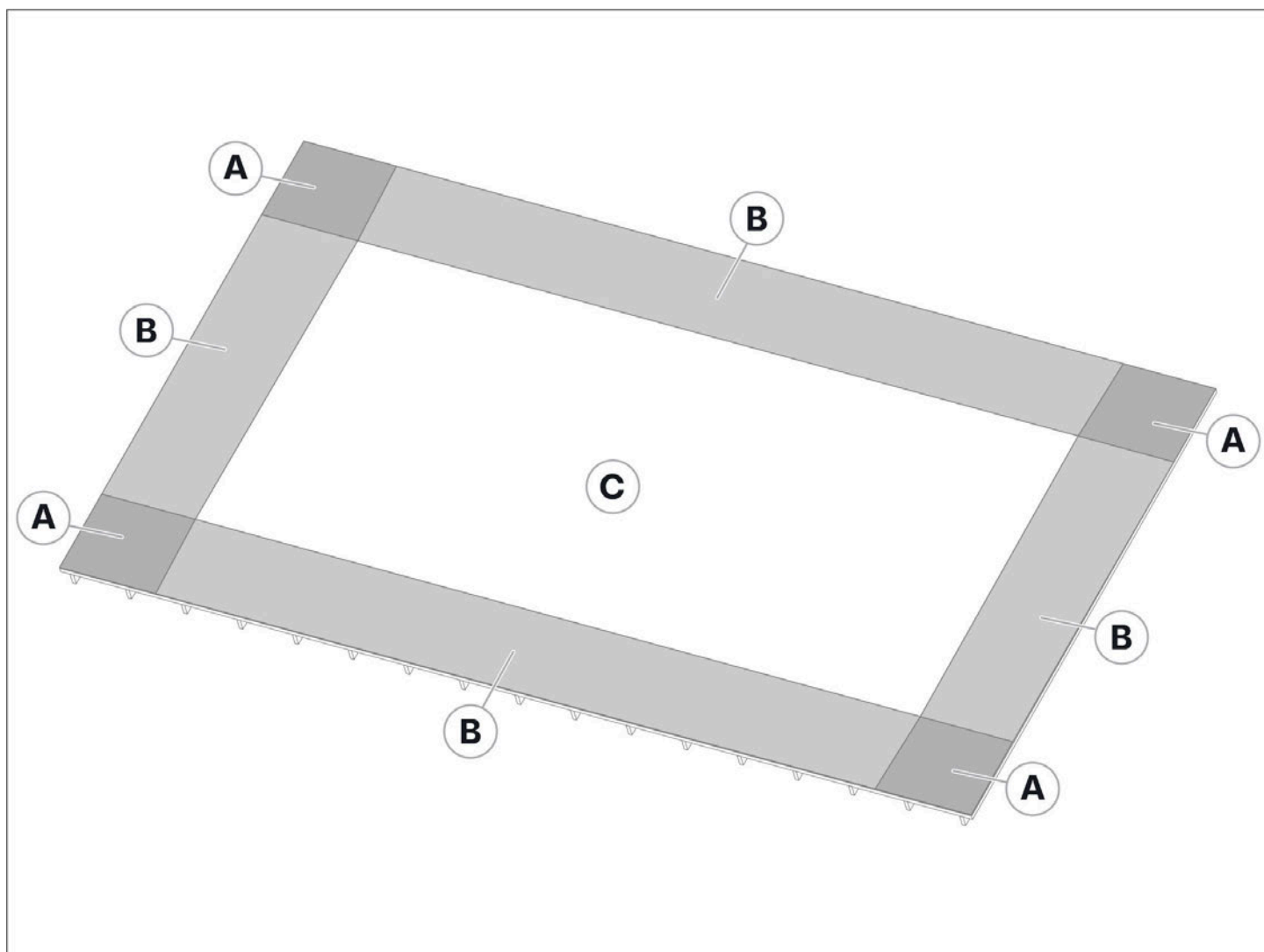
Gather Project Data

Array design begins with identifying specific information that applies to the project, including:

- Site information such as wind speed/zones, snow load, and terrain characteristics.
- Building characteristics such as rafter/truss spacing, roof pitch, sheathing type, and number of shingle layers.
- Authority Having Jurisdiction (AHJ)-specific information on fire setbacks, access/egress requirements, and obstruction clearances.
- PV array details such as PV module manufacturer, mounting area size, and desired orientation.

Roof Zones

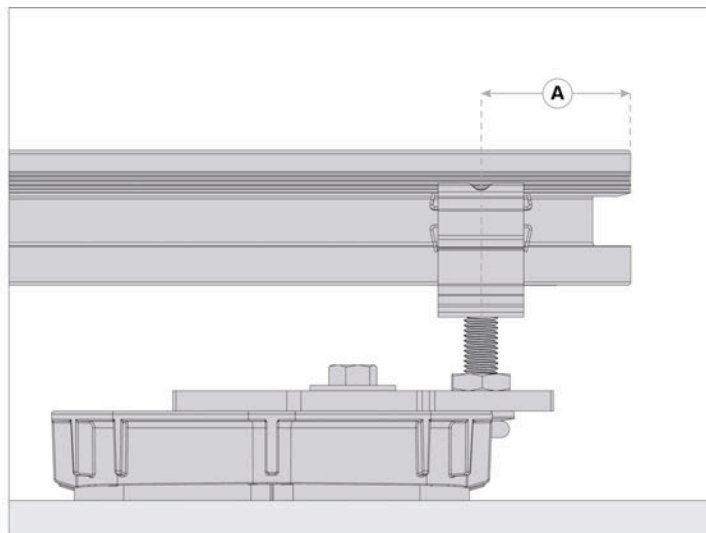
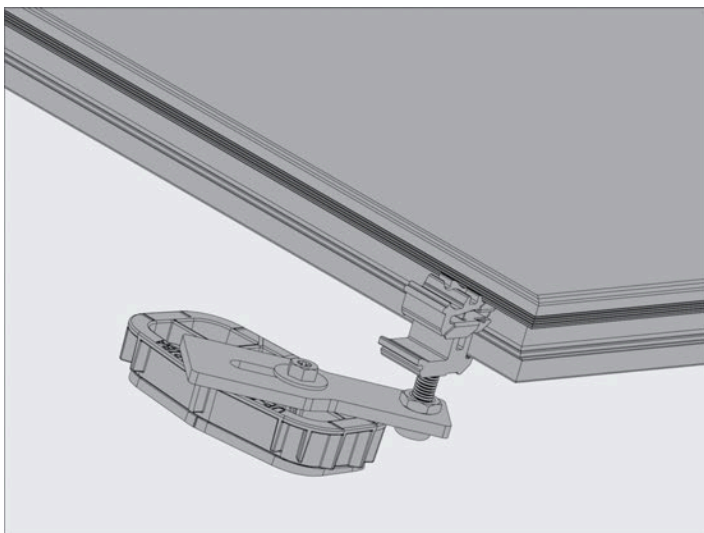
Roof zones identify the regions of a roof plane subject to low, medium, and high wind pressures. This is to account for varying wind pressure as wind passes over different areas of the roof. The maximum allowable Leveling Foot spacing and cantilever may be smaller in medium and high pressure zones. Roof zones are determined in accordance with ASCE 7 as prescribed by the AHJ. Wind zones A, B, and C below are an example; different ASCE 7 editions define and group them in different ways. Be sure to follow ASCE 7 definitions when planning the standoff placement.



- (A) - Corner zone
- (B) - Edge zone
- (C) - Interior zone



Calculate Span and Cantilever Allowances



- (A) - Cantilever distance from center of Rockit to edge of module.

Once project data has been gathered, the allowable span and cantilever allowances will need to be calculated. These calculations should account for any applicable design loads (e.g., dead, wind, and snow loading) defined within International Building Code, International Residential Code, and ASCE 7.

Individual component ratings have been tested as follows:

Table 1. Component Allowable Loads

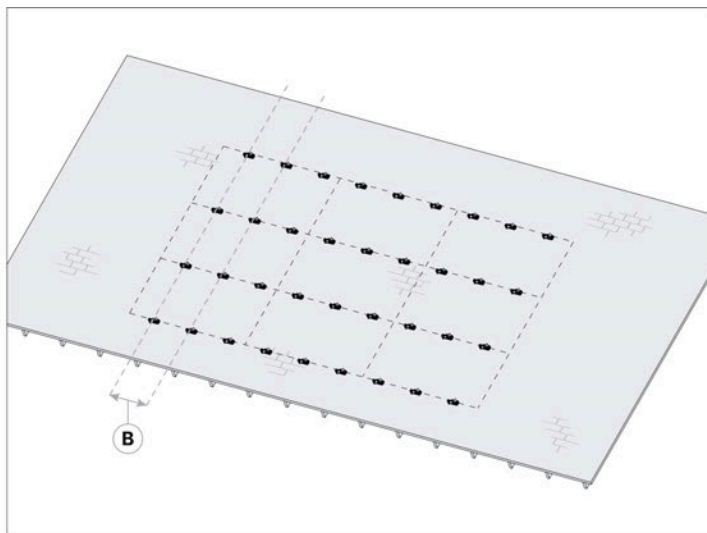
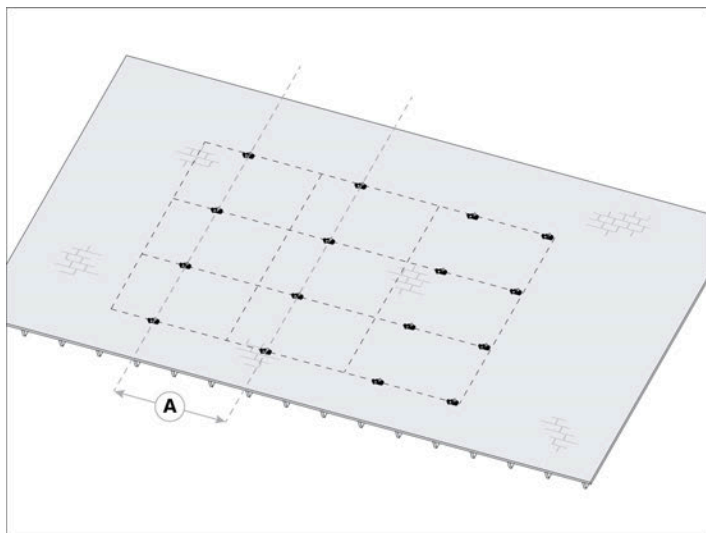
Uplift	Downforce	Shear
569 lbs (2529 N)	965 lbs (4294 N)	242 lbs (1078 N)

A safety factor of 2.0 was applied to the uplift and 1.67 to the downforce and lateral loads.

Refer to [Appendix C: Allowable Mounting System Loading on page 93](#) for span and cantilever allowances (UL 2703 testing).



Determine Hardware Attachment Placement



- (A) - 72 in.
- (B) - 24 in.

Arrange the PV modules on the roof section in the desired location. Locate the hardware attachment points on rafters at the up-roof and down-roof edges of the modules. Be sure to abide by span and cantilever rules from the previous steps.



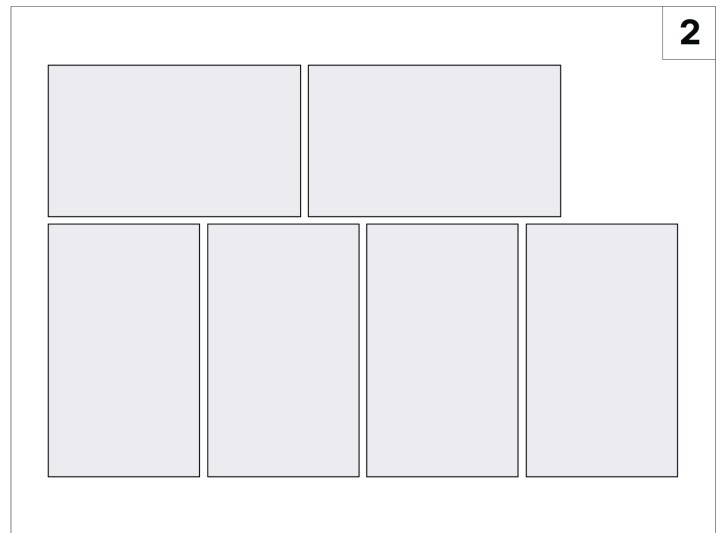
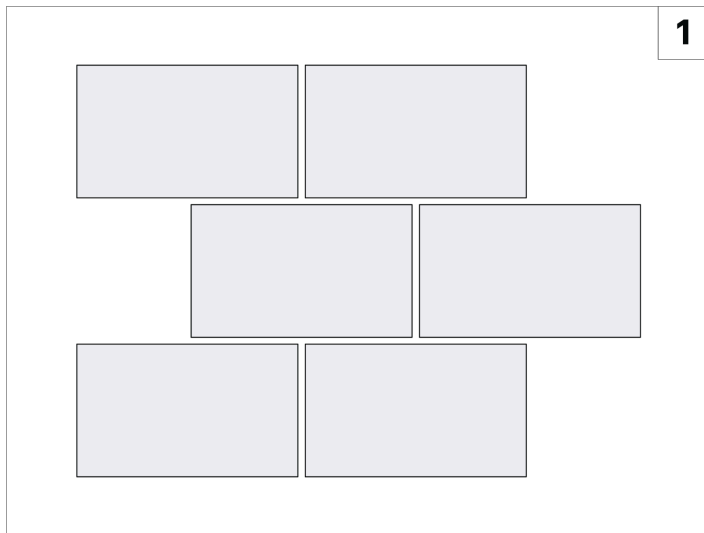
NOTE: Allow a ½ in. gap between modules in both X and Y directions; actual tolerance is ¼ - ¾ in.

Alternative Layout Possibilities

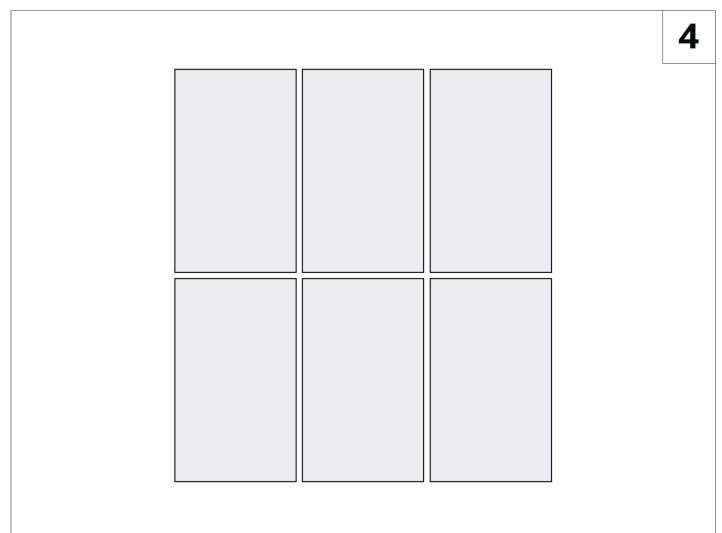
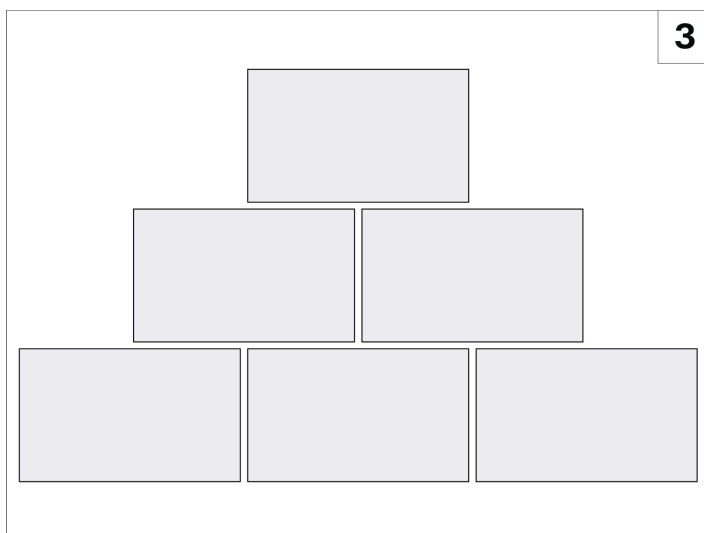
The layouts shown thus far have been simple examples for the purposes of illustration. Site-specific conditions such as roof obstacles, shading, and multiple roof planes may require an adaptive approach. The following examples show a few of the array designs that are possible with the Comp Rafter Mounting System.



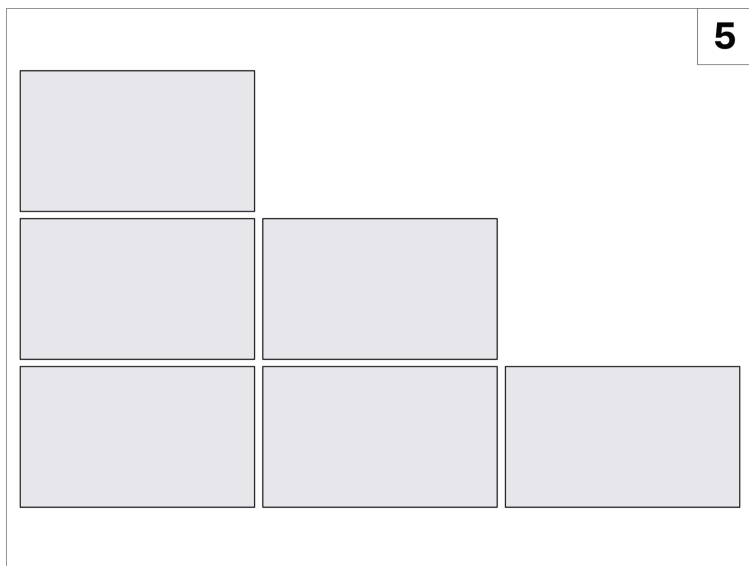
ARRAY DESIGN



- (1) - *Staggered Modules*
- (2) - *Hybrid Orientation*



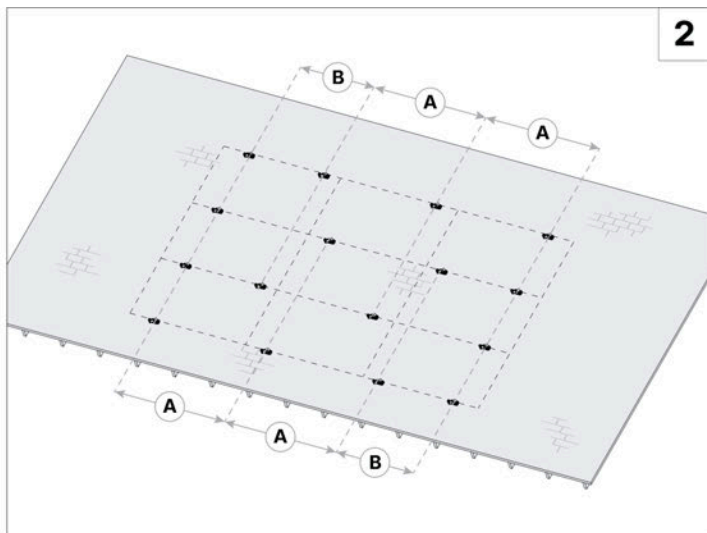
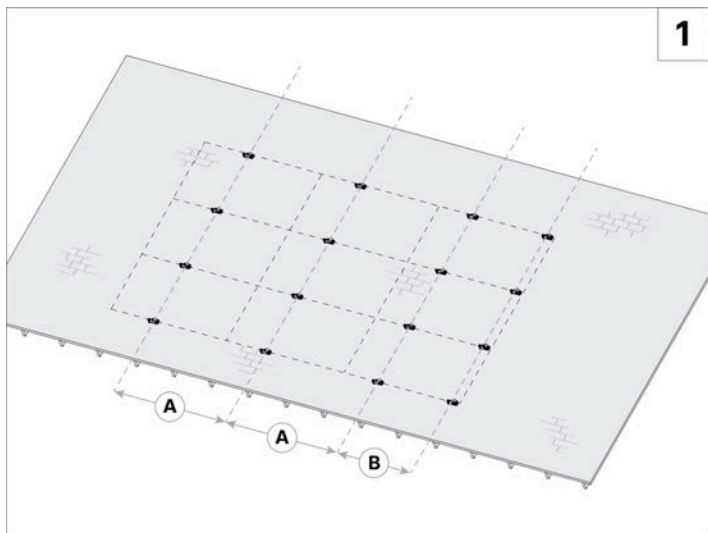
- (3) - *Pyramid Array*
- (4) - *Portrait Array*



- (5) - Stair Step Array

Staggered Comp Rafter Base Layout

The staggered Comp Rafter Base layouts may be necessary to avoid roof obstructions, fulfill required cantilevers, and distribute loading to meet system capacity requirements.



- (1) - Normal Layout
- (2) - Staggered Layout
- (A) - 72 in.
- (B) - 48 in.

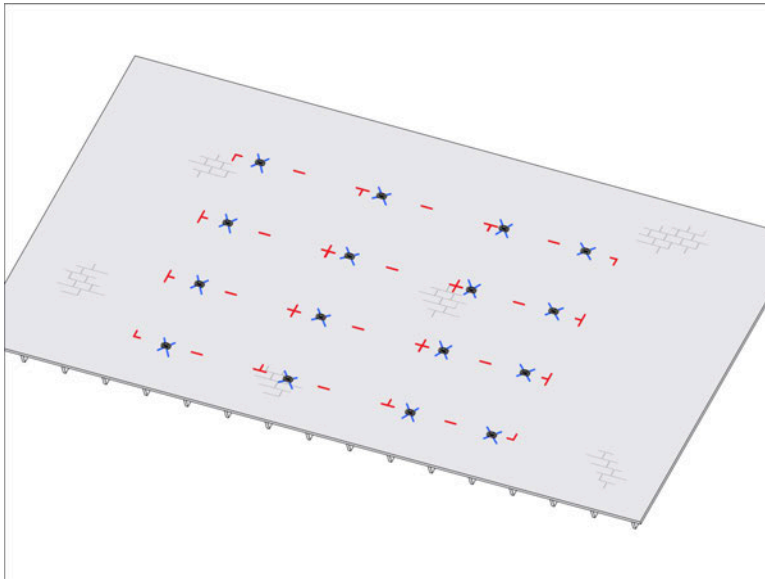


INSTALLATION OVERVIEW

1. Lay out the array and drill holes for the Comp Rafter Bases.



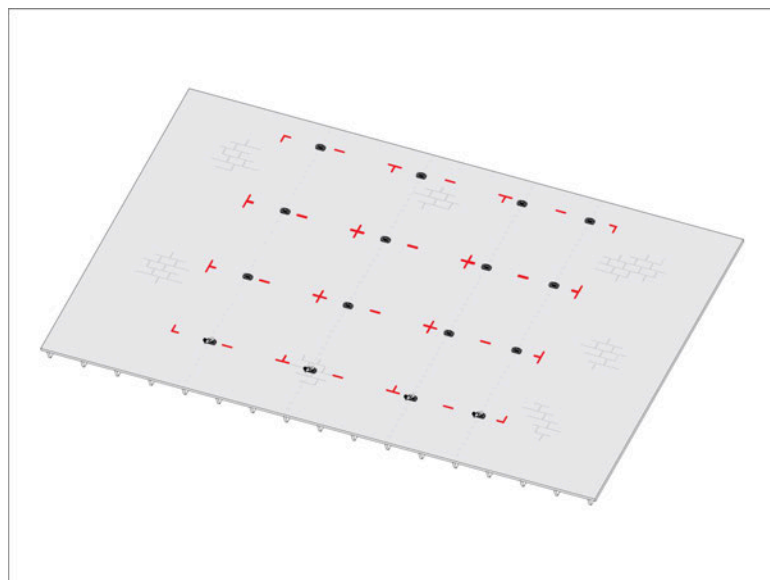
2. Install the Comp Rafter Bases.



3. Install the front row Leveling Feet.



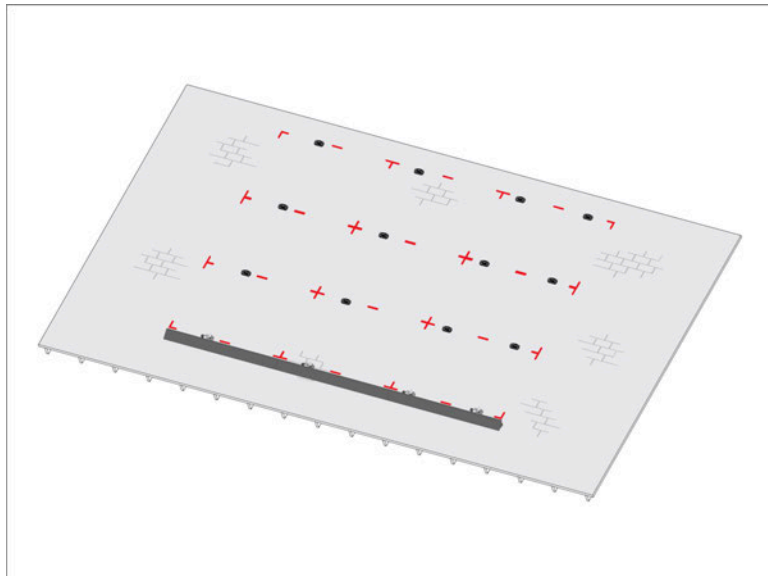
INSTALLATION OVERVIEW





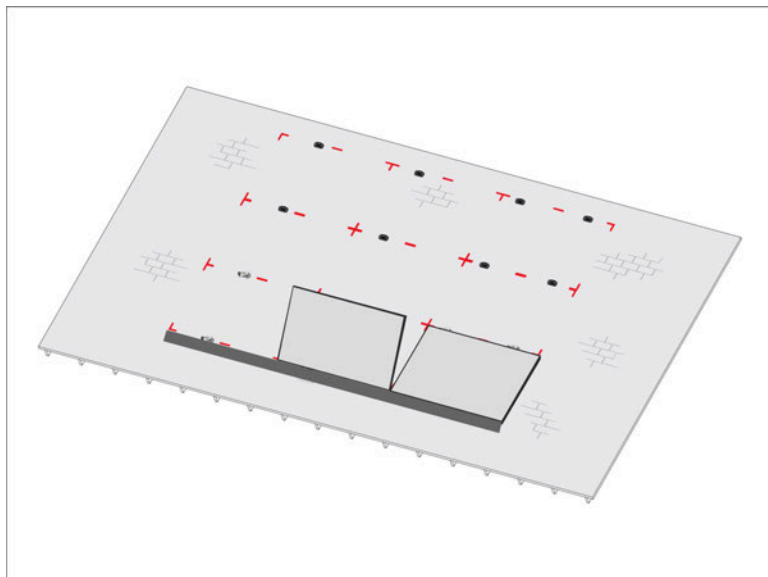
INSTALLATION OVERVIEW

4. Install the Front Skirt.



5. Install first module row - **SMILES**

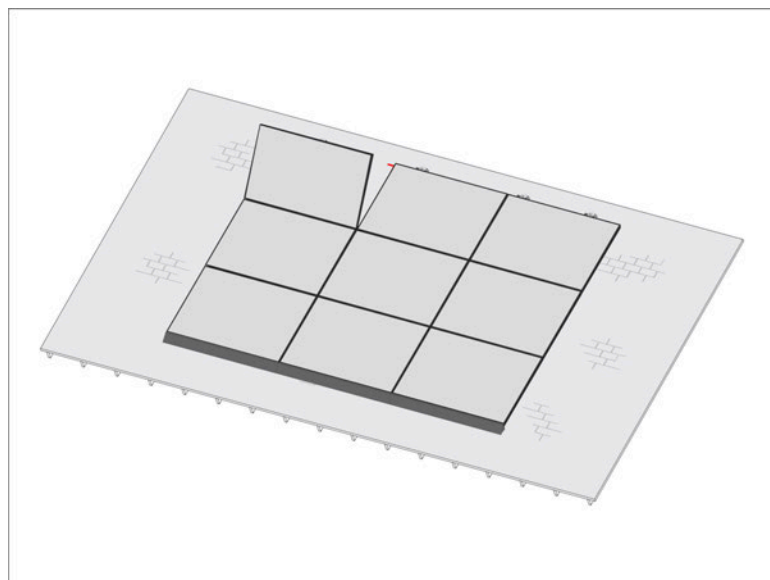
- **S**et
- **M**anage
- **I**nterlock
- **L**evel
- **E**valuate
- **S**ecure



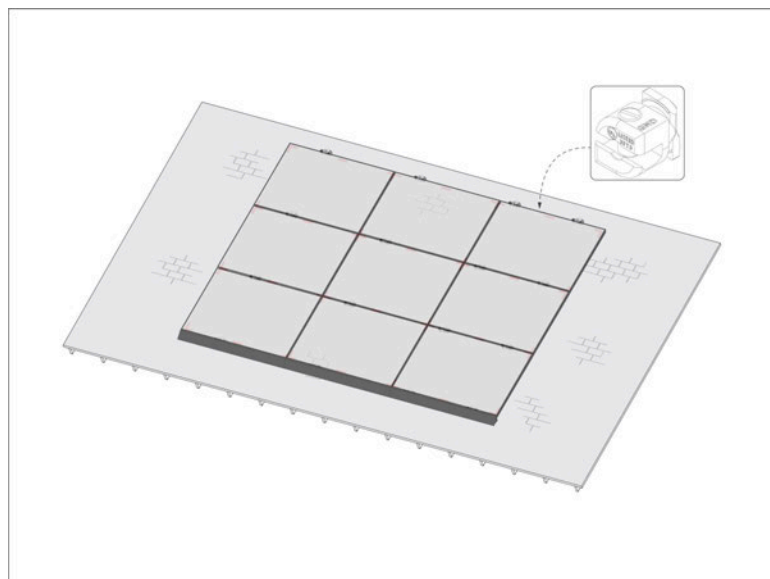
Repeat **SMILES** steps for each module row.



INSTALLATION OVERVIEW



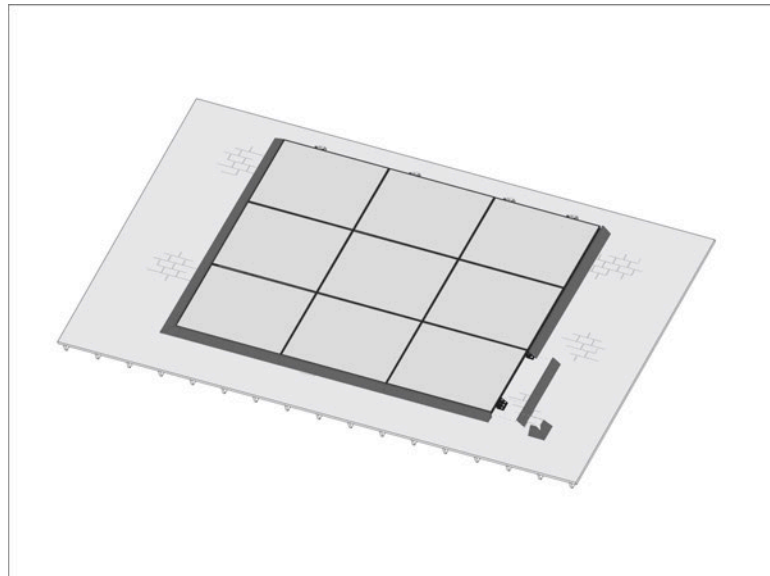
6. Complete the wire management and bonding.





INSTALLATION OVERVIEW

7. Install the Side Skirts and Corner Caps.





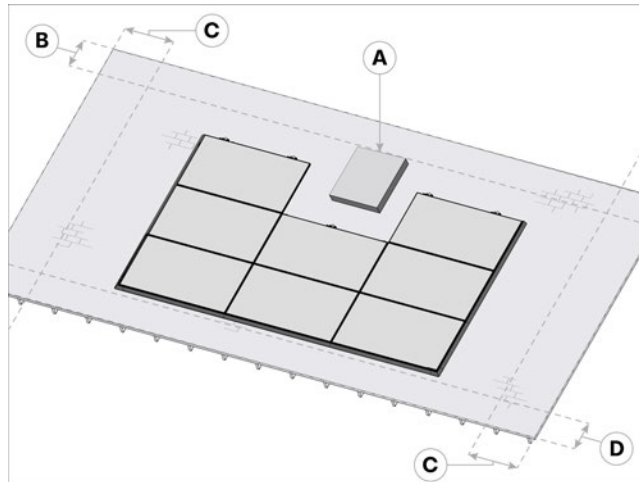
INSTALLATION PROCESS

Step 1: Array Layout

1. Lay out the array.

Note ASCE 7 wind and code-prescribed fire setbacks on the roof as defined in previous steps. Be aware of roof obstructions when marking out the array.

Obstructions may include passive vents, vent pipes, skylights, chimneys, etc. AHJs may allow or prohibit spanning over some obstructions. Care should also be taken to minimize array shading from obstructions.



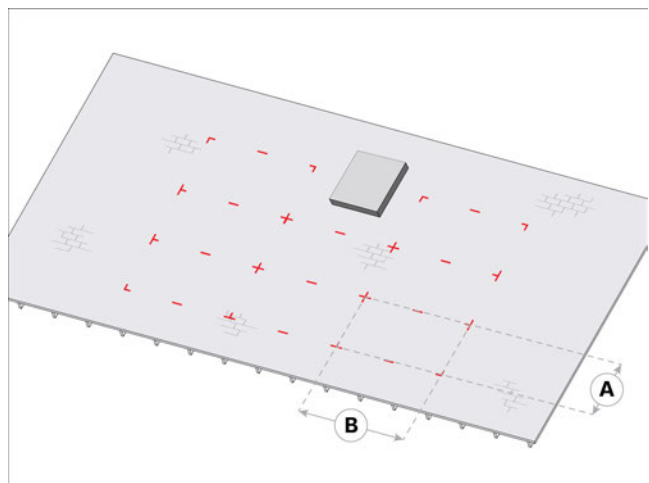
- (A) - Obstruction
- (B) - Ridge setback
- (C) - Gable setback
- (D) - Eave setback

Mark out the perimeter of the array and the module intersections as defined in the previous steps.

Adjust front row marks to a square reference, typically the eave. Ensure that the outside corners of the array on the first row are the same distance from the eave or square reference.



INSTALLATION PROCESS



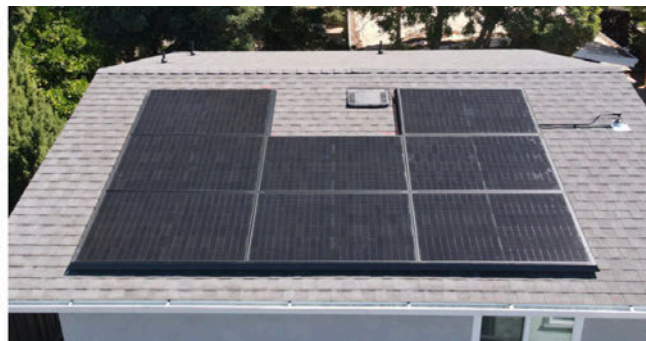
- (A) - Module Y dimension + $\frac{1}{2}$ in.
- (B) - Module X dimension + $\frac{1}{2}$ in.

Ensure that modules are not installed in the wind setback zone as defined by ASCE 7.



INSTALLATION PROCESS

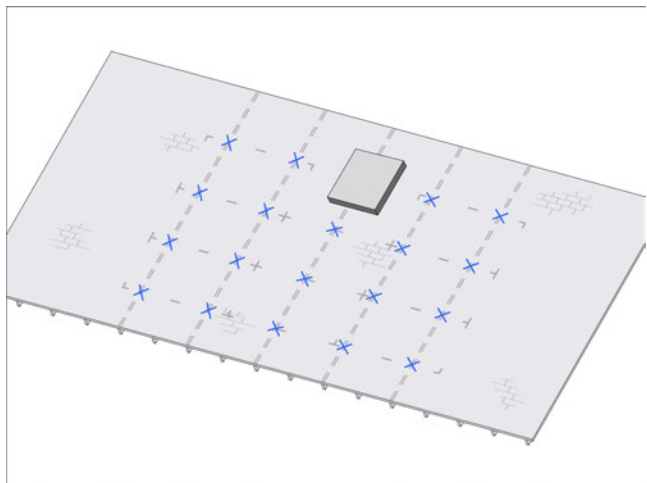
The examples below show how the PV modules have been installed around the obstructions on the roof.



2. Identify the attachment locations.

Locate the rafters that fall within the array perimeter.

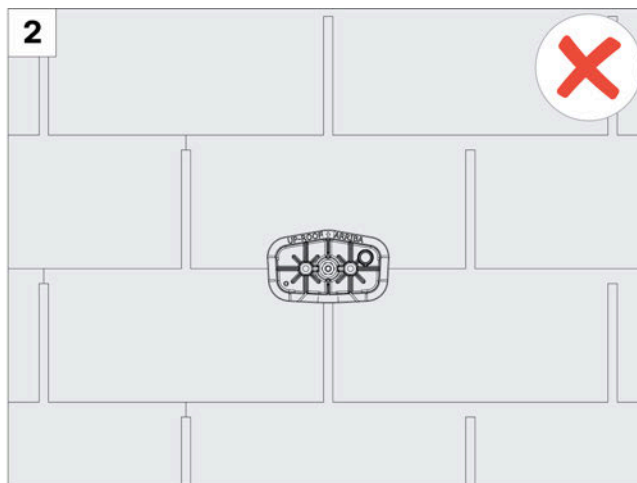
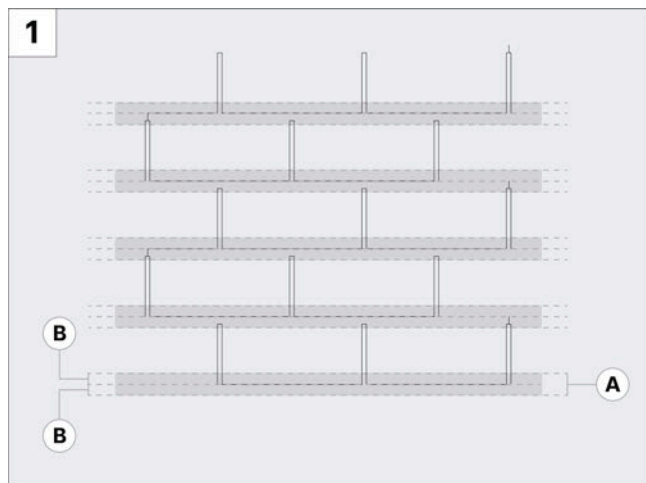
Mark the locations for attachment points based on the array layout, module size, span rules, and cantilever rules.



The No-Drill Zone is $\frac{1}{2}$ in. above and below the shingle drip edge. Attachment locations that fall in this zone will need to be adjusted up- or down-roof to exit the zone.



INSTALLATION PROCESS



- (1.A) - No-drill zone (1 in.)
- (1.B) - No-drill zone ($\frac{1}{2}$ in.)
- (2) - Incorrect base location

If two consecutive rows need to be adjusted, they should be moved in opposite directions.



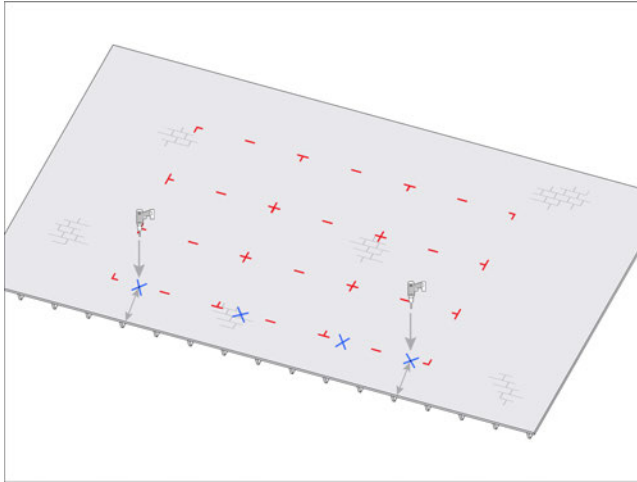
INSTALLATION PROCESS

3. Drill the pilot holes for the Comp Rafter Base.

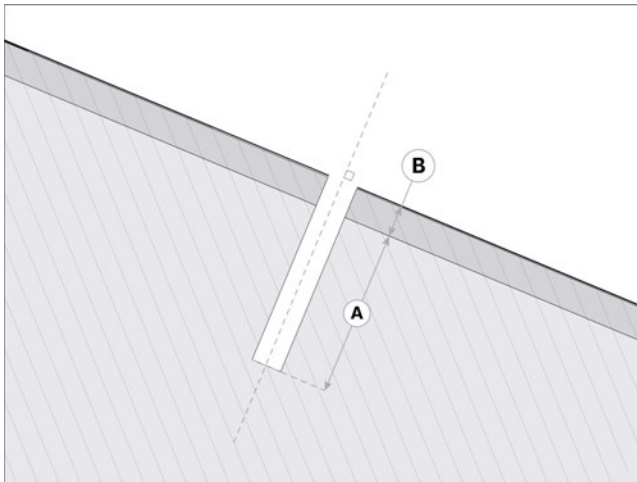
Select the correct drill bit for the lumber type:

- Soft woods will require a 3/16 in. drill bit.
- Hard woods may require a 7/32 in. drill bit.

Drill pilot holes into the rafters at the marked attachment locations. Take special care to ensure holes on the first row are the same distance from the eave or square reference. These holes will be critical in ensuring squareness of the array.



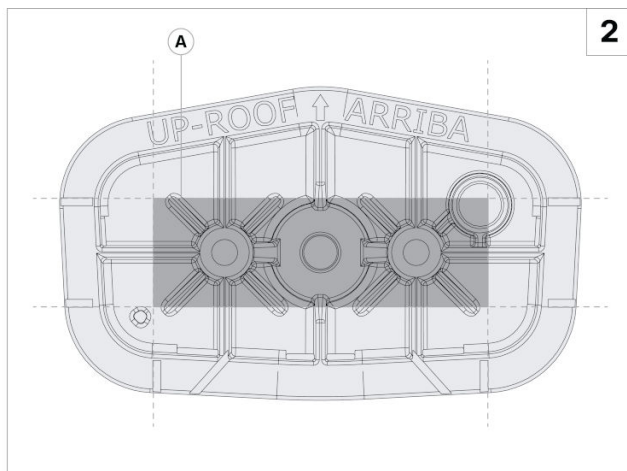
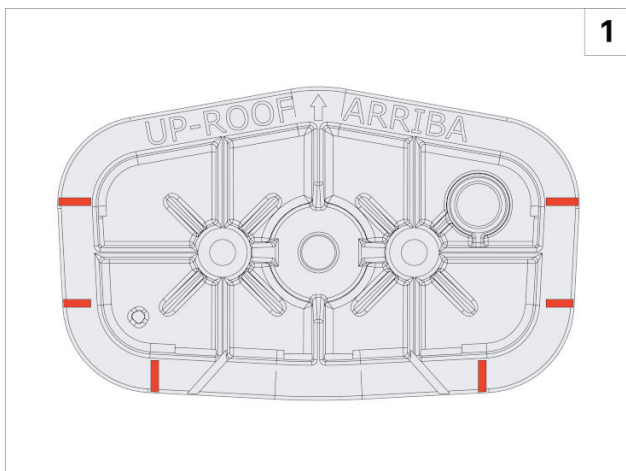
Ensure that the holes are drilled perpendicular to the roof surface and centered on the rafter width.



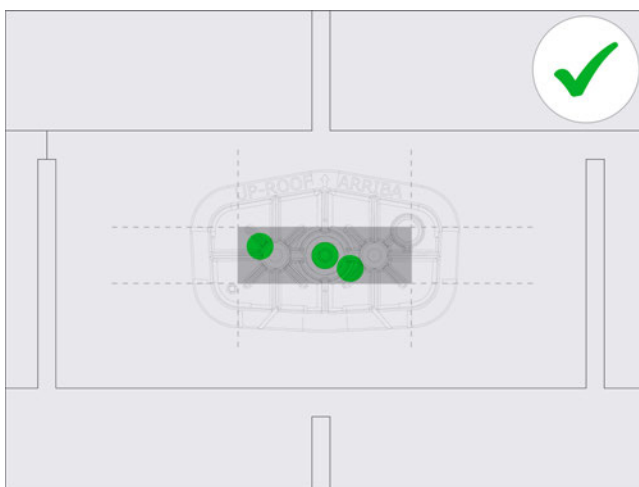
- (A) - Pre-drilled hole (must be deep enough to ensure 2 ½ in. of threaded lag embedment into the rafter)
- (B) - Layer of plywood
- The timing marks on the Comp Rafter Base indicate the allowable area of missed penetrations.



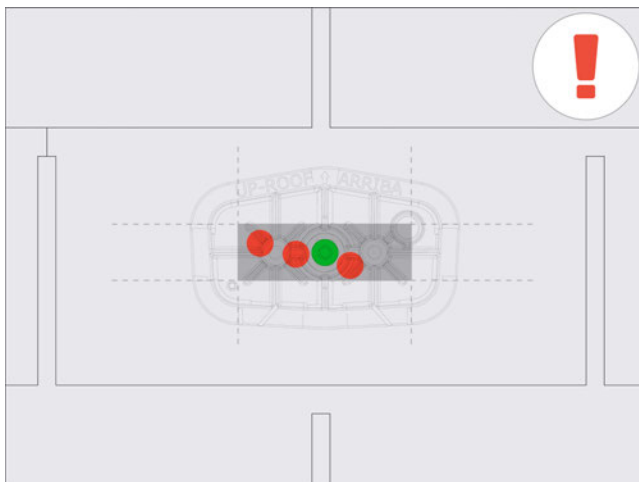
INSTALLATION PROCESS



- (1) - Timing marks on the Comp Rafter Base
- (2.A) - Allowable area of missed penetrations
- Up to two missed penetrations located *completely within* the timing marks will be sealed by the Comp Rafter Base.



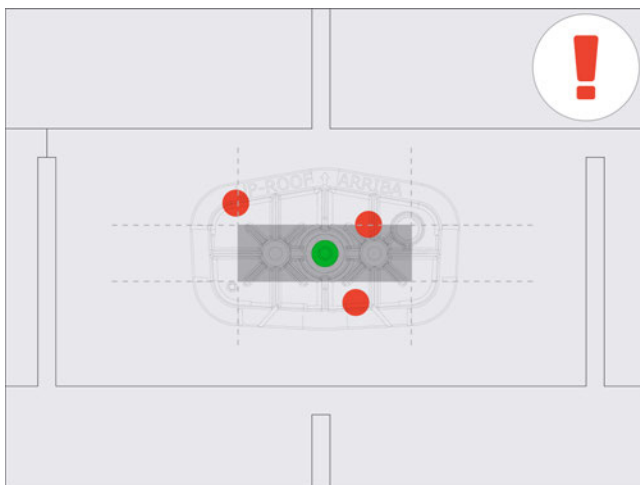
- **Three or more** missed penetrations *always require* card flashing to prevent sealant flow into attic.



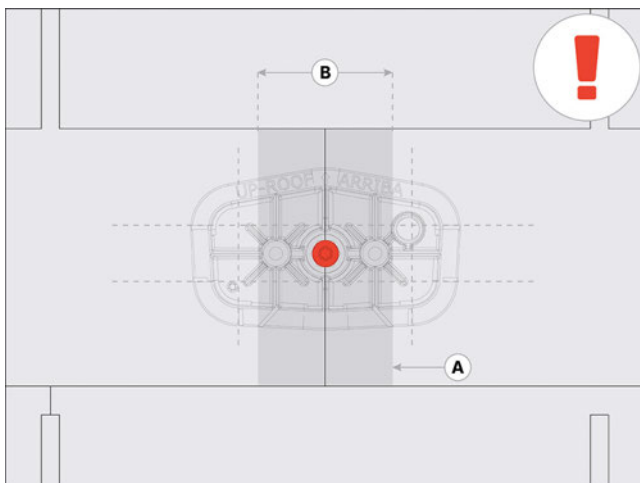
- Missed penetrations outside the area of coverage *always require* card flashing.



INSTALLATION PROCESS

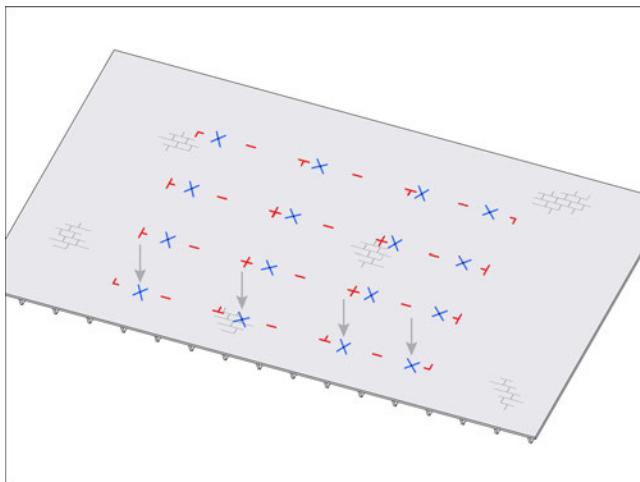


- If the lag penetration falls within 2 in. of a vertical seam between the shingles, card flashing is required under the vertical seam to ensure proper water shedding.



- (A) - Card flashing
- (B) - 4 in. area centered on vertical seam

- Drill attachment point holes before installing bases.





INSTALLATION PROCESS

Step 2: Install the Comp Rafter Bases

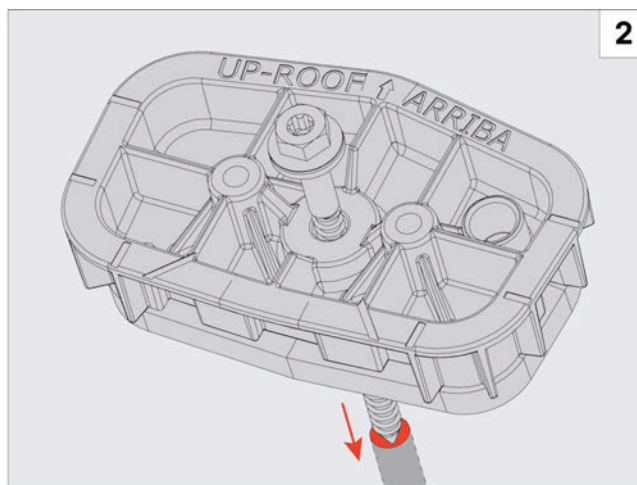
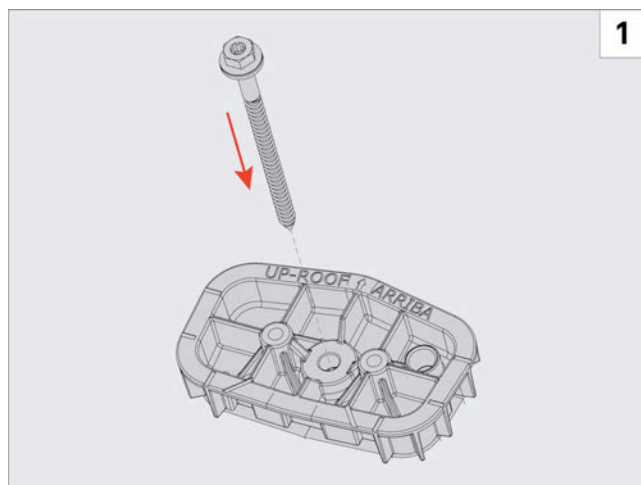
1. Fasten the Comp Rafter Base to the roof.

There are two lengths of Lag Screws used with the Comp Rafter Base: 4 ¾ in. and 5 ½ in. Ensure you are installing the correct Lag Screw based on 2 ½ in. of threaded lag embedment in the rafter.

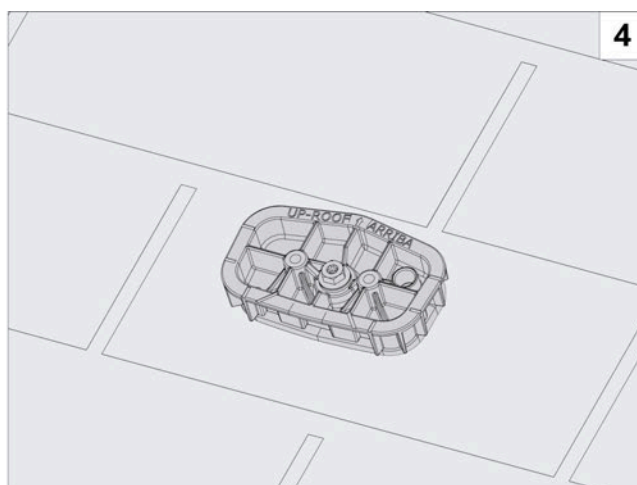
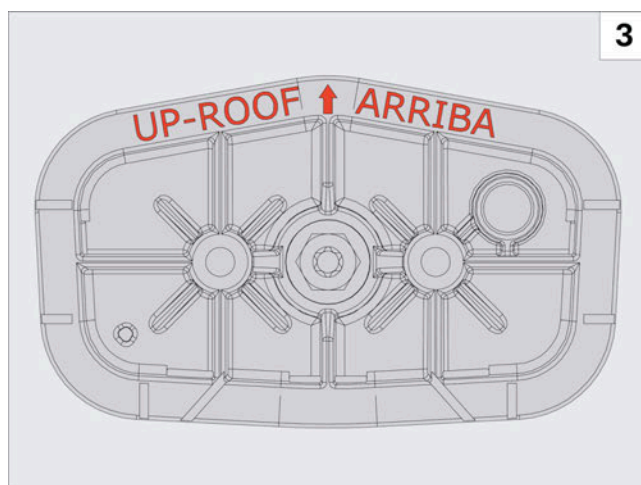


NOTE:

- 4 ¾ in. Lag Screws are typically used with plywood, OSB, or solid sheathing up to 7/8 in. nominal thickness.
- 5 ½ in. Lag Screws are typically used when skip sheathing is present between the rafters and the sheathing, or for solid sheathing greater than 7/8 in. thickness.



- (1) - Insert the Lag Screw into the central hole in the Comp Rafter Base.
- (2) - Insert the tip of the Lag Screw into the pre-drilled hole on the roof.

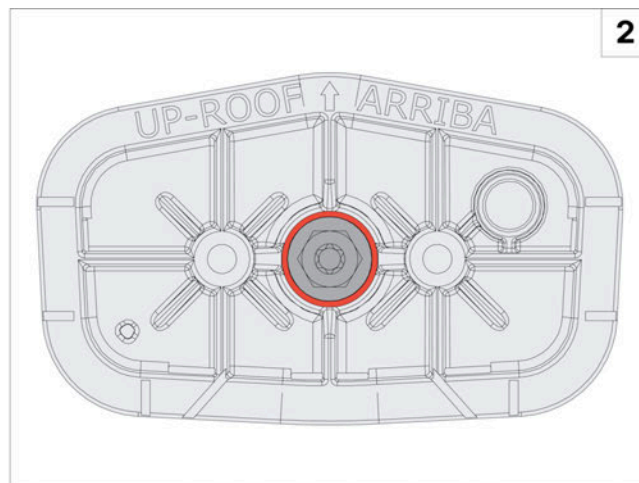
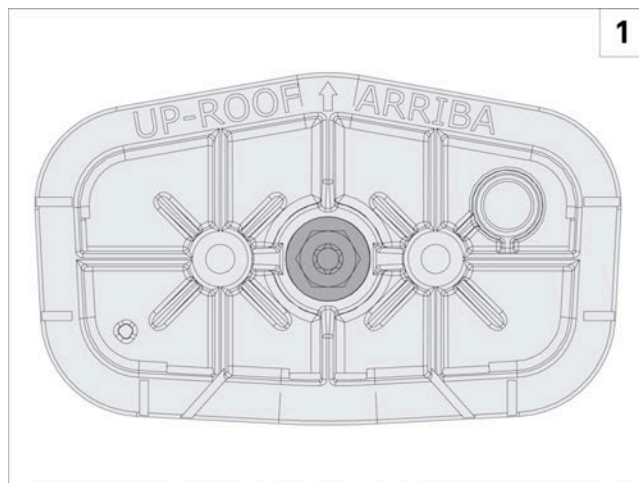


- (3) - Point the Comp Rafter Base up-roof as indicated by the inscriptions "Up-Roof & Arriba".
- (4) - Fasten the Comp Rafter Base with the Lag Screw perpendicular to the roof deck.

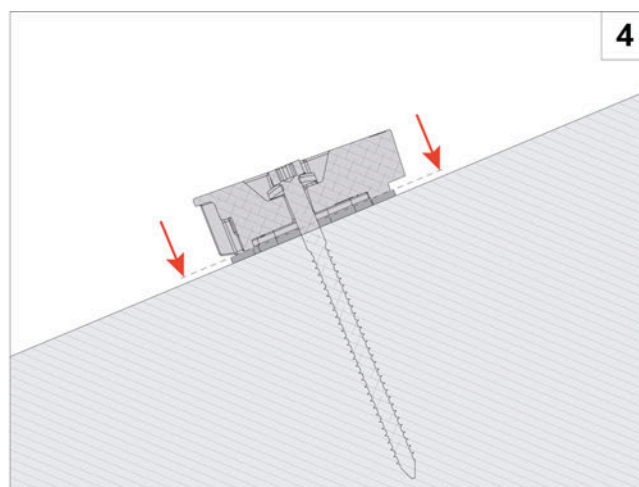
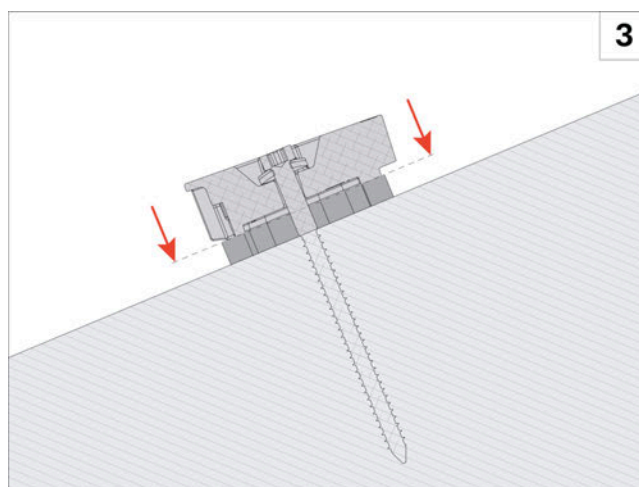
2. The gasket under the washer is visible once adequately compressed. The images below show the lag washer gasket in different states:



INSTALLATION PROCESS



- (1) - Insufficient gasket compression.
- (2) - Adequate gasket compression.



The foam gasket around the Comp Rafter Base will compress when the Lag Screw is fully seated.

- (3) - Foam gasket height before compression
- (4) - Foam gasket height after compression

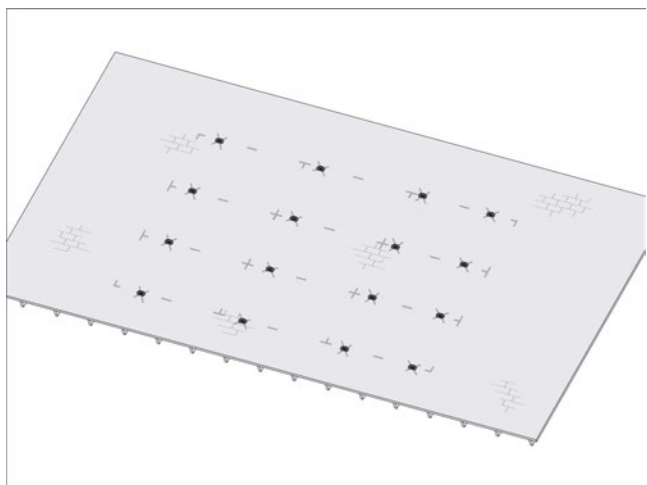


CAUTION: In the process of installation, some lags may spin or strip the hole. These "spinners" require removal and card flashing. A new pilot hole must be drilled and the Comp Rafter Base must be reinstalled.

3. Install all Comp Rafter Bases before moving on to the next step.



INSTALLATION PROCESS



- *Illustration of mounting plane with all Comp Rafter Bases installed.*

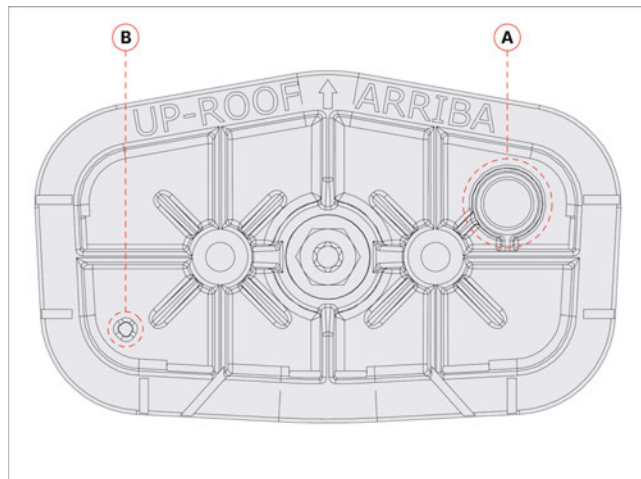


INSTALLATION PROCESS

4. Inject moisture curable sealant into the Comp Rafter Base.

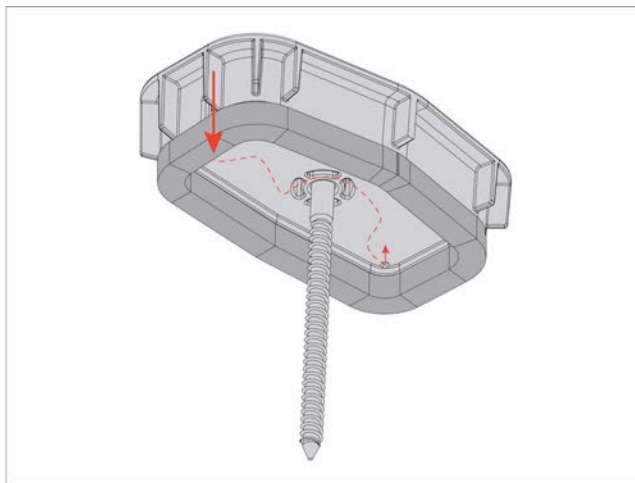
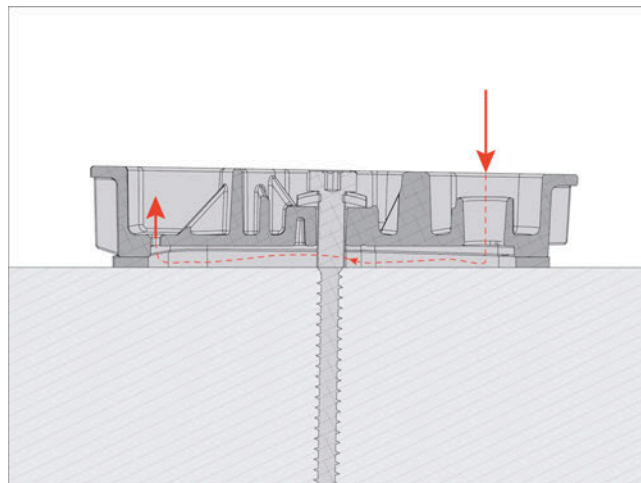
The Comp Rafter Base uses an approved sealant to ensure water proofing. This is injected into the cavity on the underside of the base where it cures and forms a waterproof seal with the shingles and around the lag.

Inject moisture curable sealant through the injection port.



- (A) - Injection Port
- (B) - Exit Port

Sealant path inside Comp Rafter Base:



- Stop injecting sealant as soon as there is any overflow visible on the exit port. At this point the cavity is completely filled and extra sealant may cause blowouts.

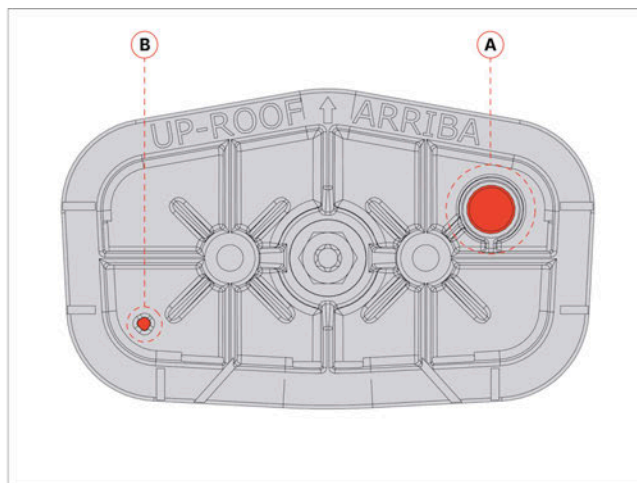
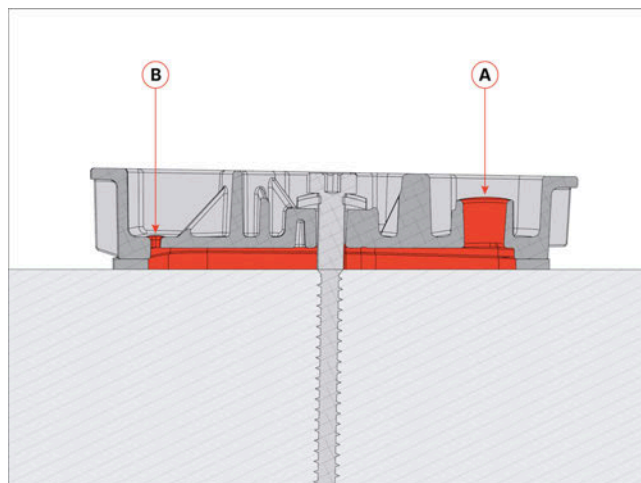


CAUTION: If after pumping several times there is no sealant coming out of the exit port, excess sealant may be flowing into the attic through missed penetrations. If this occurs, remove the Comp Rafter Base and use card flashing to seal any missed penetrations. Re-install the Comp Rafter Base and fill with sealant.

Fill the sealant to form a small dome above the edge of the injection port to prevent pooling of water.



INSTALLATION PROCESS



- Cross section of Comp Rafter Base filled with sealant.
- (A) - Injection port completely filled with sealant.
- (B) - Exit port completely filled with sealant.

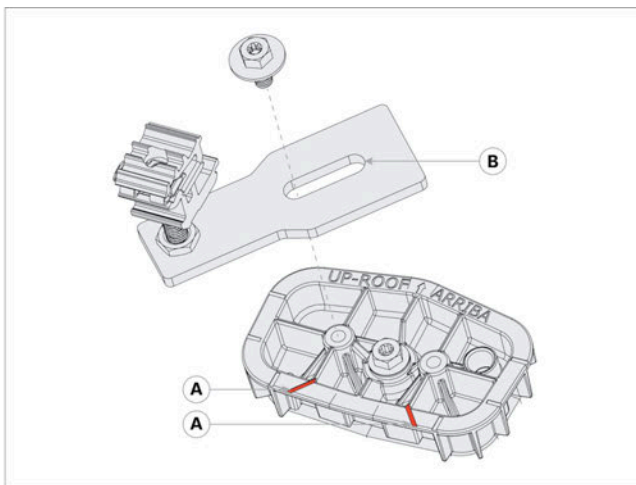
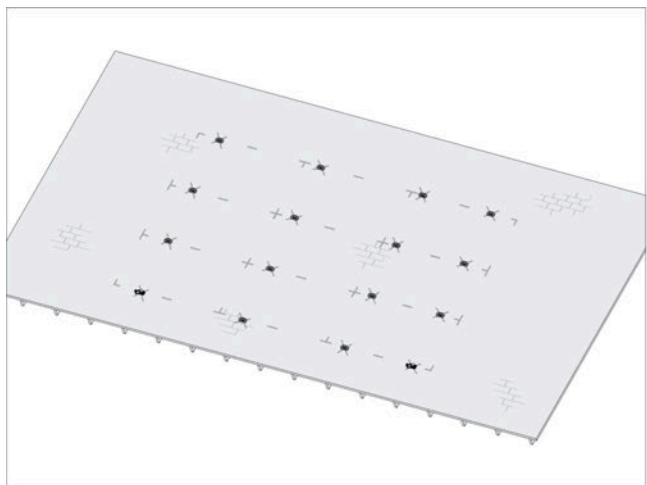
 **NOTE:** Small amounts of sealant overflow (blowouts) around the perimeter of the Comp Rafter Base foam gasket are allowed as long as there is also overflow coming out of the exit port. If blowouts are occurring and sealant is not exiting the exit port, the Comp Rafter Base will need to be removed, holes flashed, and base repositioned.



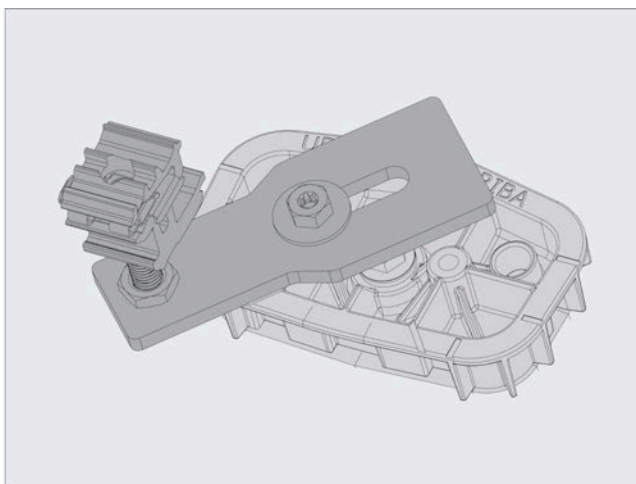
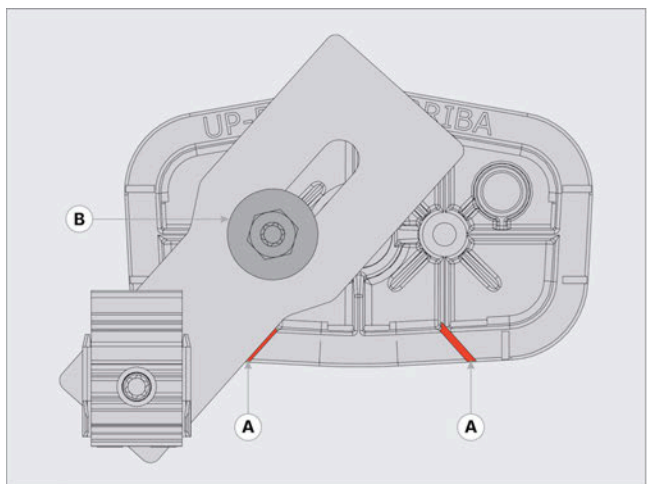
INSTALLATION PROCESS

Step 3: Install the Leveling Feet

1. Install the Leveling Feet at the corners of the first row.



Set the first Leveling Foot to the nominal position for maximum adjustability of subsequent rows:



- Use the angle marks (A) to align the Leveling Foot (B) on the side it is bolted to.
- The bolt must be at the end of the slot limit closest to the Rockit.

Secure a Leveling Foot to the Comp Rafter Base at the outside corner of the first row using the included bolt.



NOTE: Torque to a range of **13 – 20 ft-lbs.** Make sure that the washers are not deformed, and the Leveling Foot cannot be moved by hand.

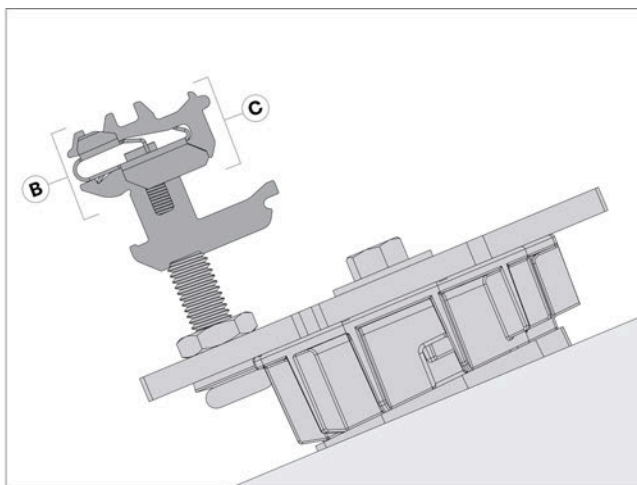
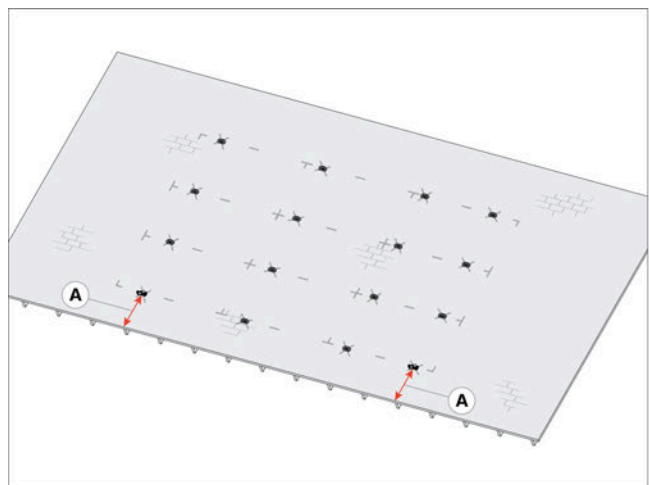
1 - Slot Limit

2 - Angle Marks

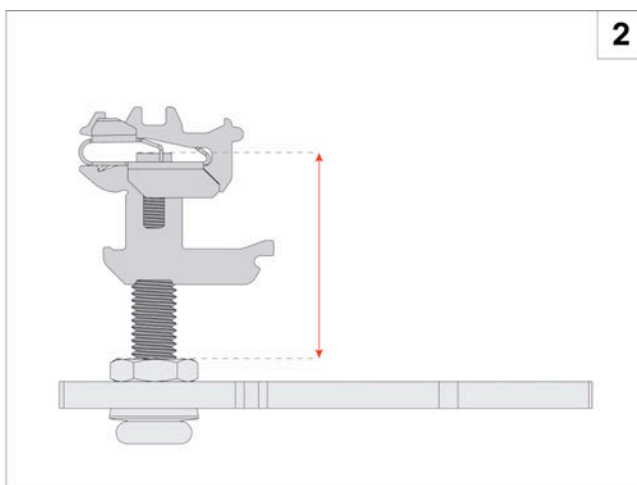
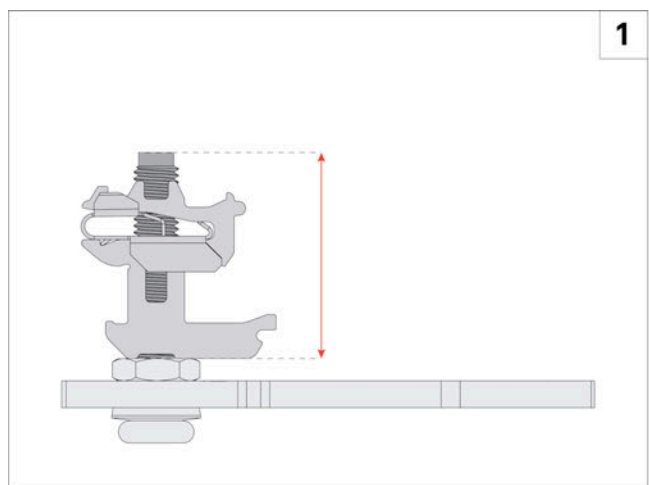
With the Key side of the Rockit facing down-roof, measure the distance from the stud of the first Leveling Foot to the eave or a square reference on the roof. Install a Leveling Foot on the opposite corner of the first row that matches the measurement from the first Leveling Foot.



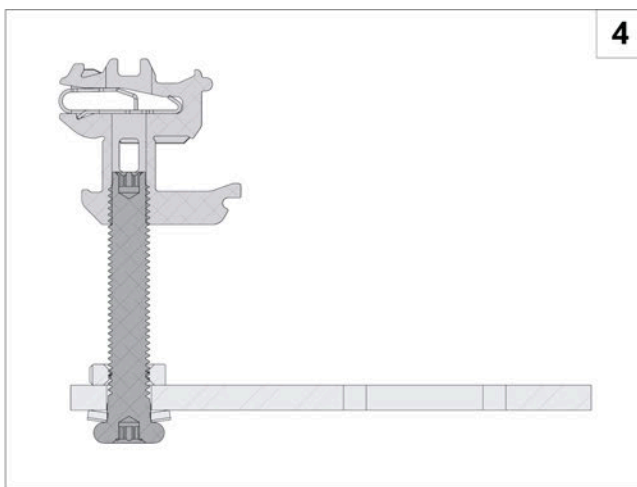
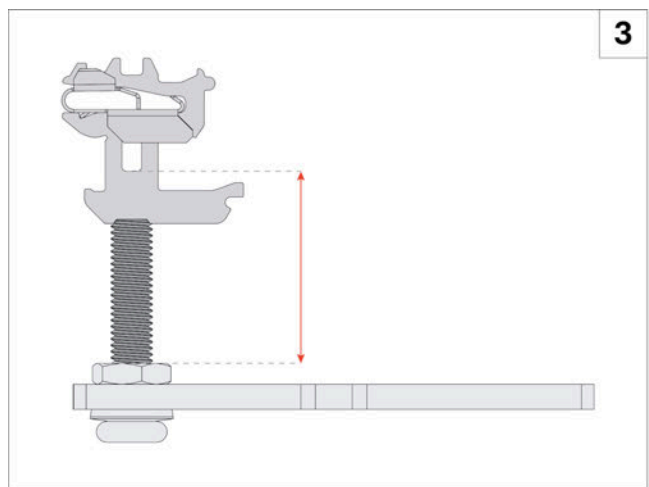
INSTALLATION PROCESS



- (A) - Measurement from stud of the first Leveling Foot to the eave
- (B) - Key side of Rockit faces down-roof
- (C) - Tongue side of Rockit faces up-roof



- (1) - Minimum height
- (2) - Nominal height

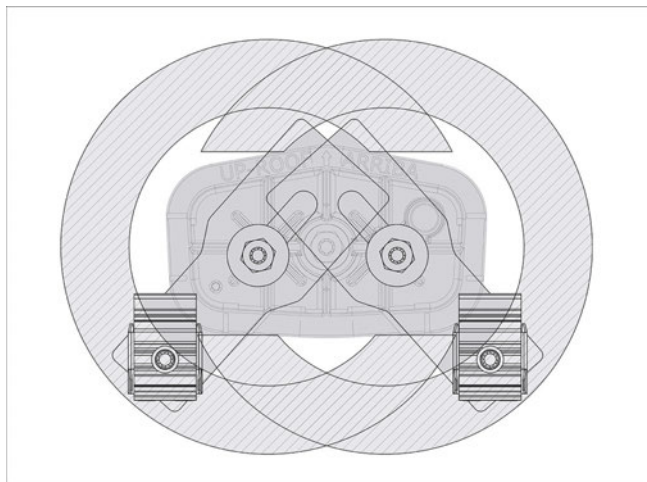


- (3) - Maximum height
- (4) - Maximum height (cross section)



INSTALLATION PROCESS

Adjustment from the nominal position may be needed. The Leveling Foot can be installed on either mounting hole of the base and can rotate in accordance with the picture below.

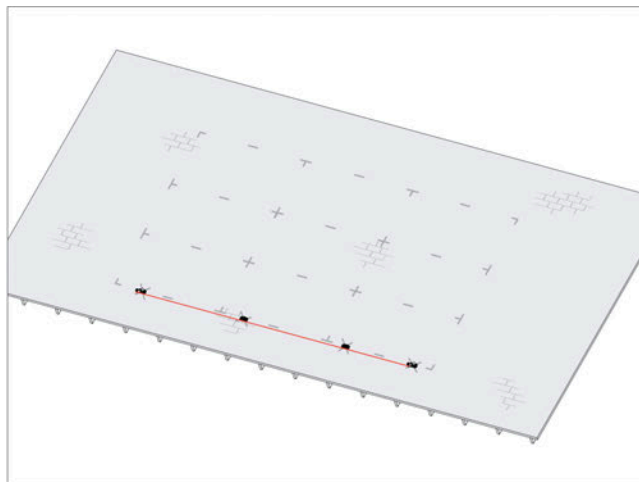
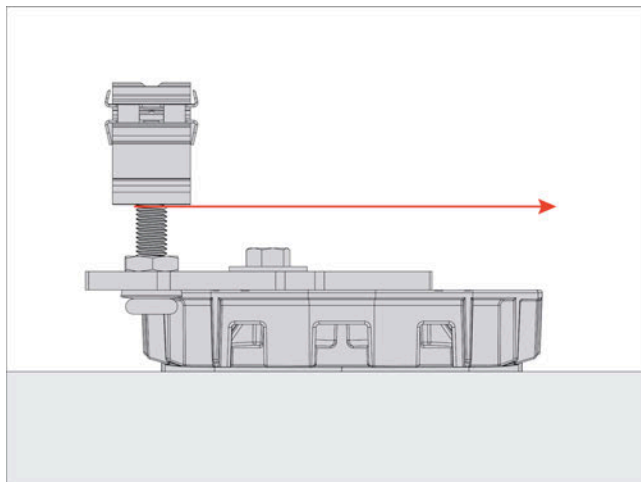


- *Rotation range for Leveling Feet*

2. Anchor a string line to the corner Leveling Feet.

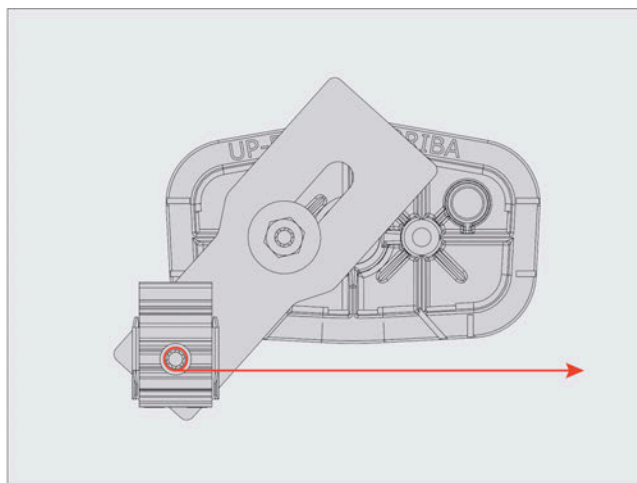
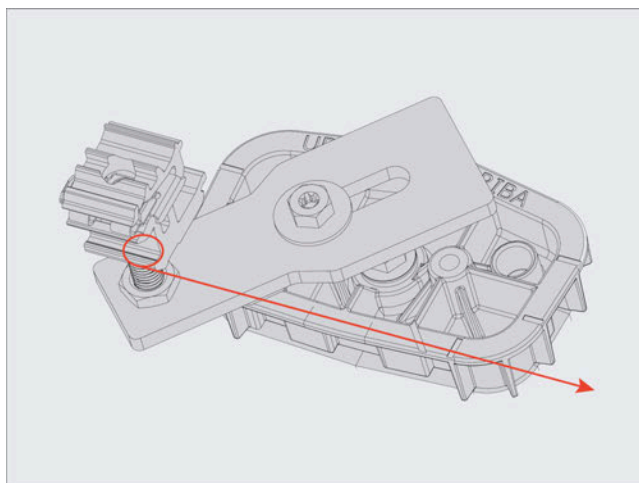
Ensure that the Rockit is at nominal height on its stud to provide maximum flexibility on consecutive rows. The Rockit is in the nominal height when the top of the stud is centered in the Rockit opening.

Run a string line between the two corner Leveling Feet. The string line should be pulled across the front of the stud and flush with the bottom of the Rockit.

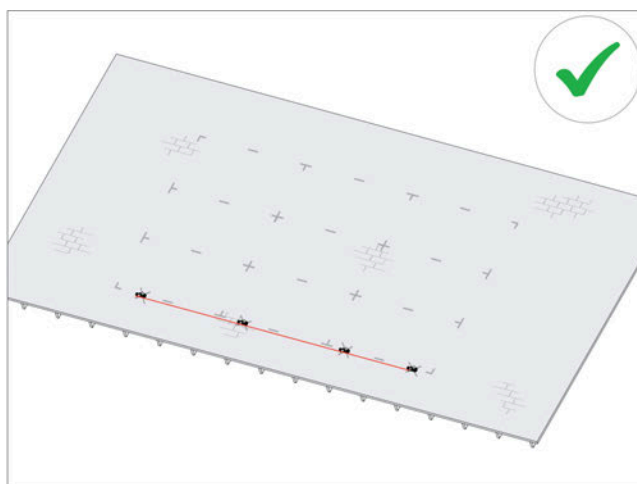
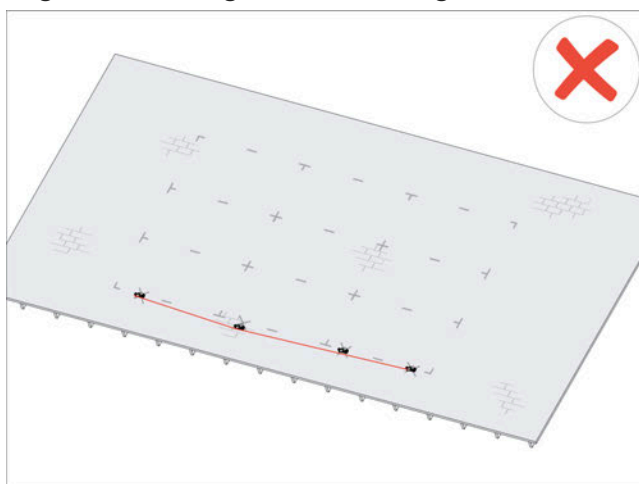




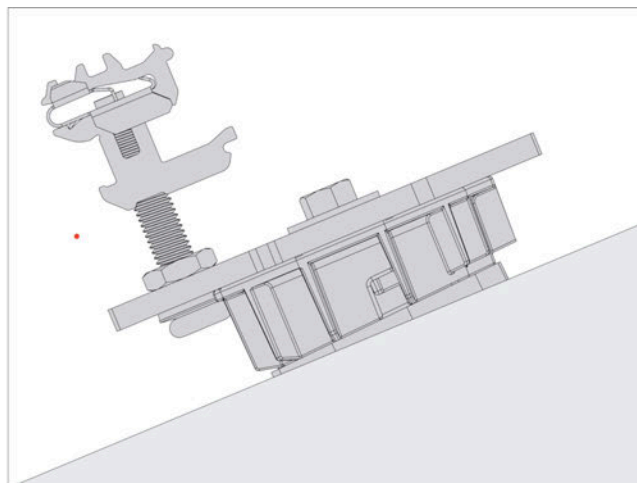
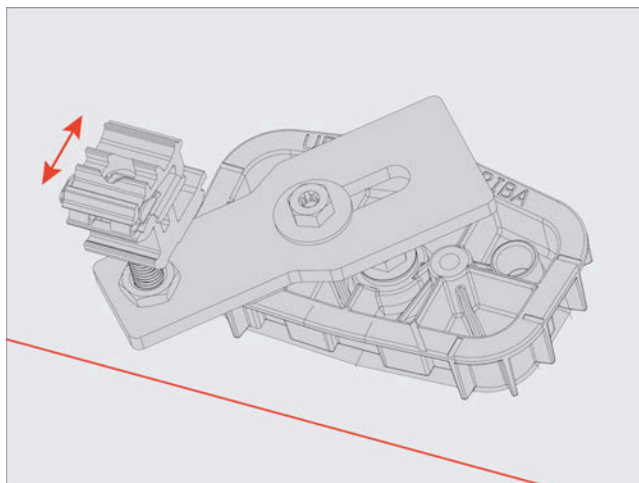
INSTALLATION PROCESS



3. Align the remaining first row Leveling Feet to the string line.

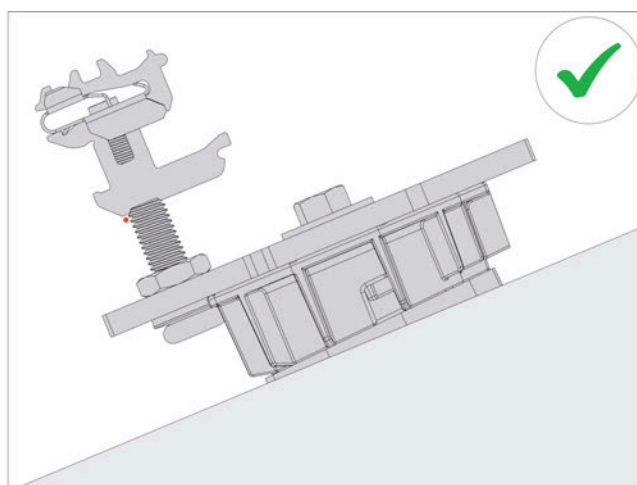
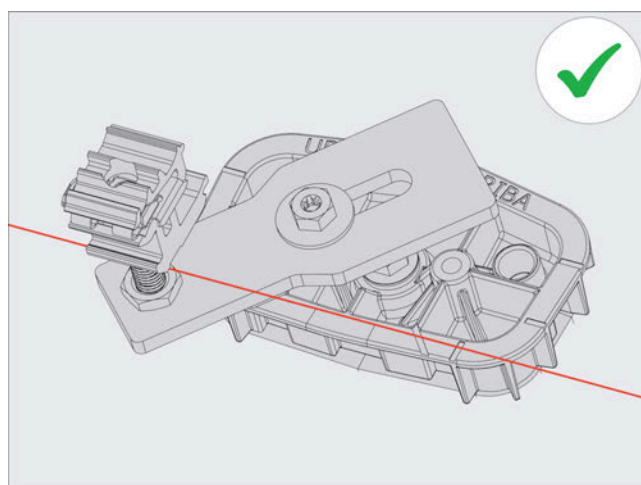
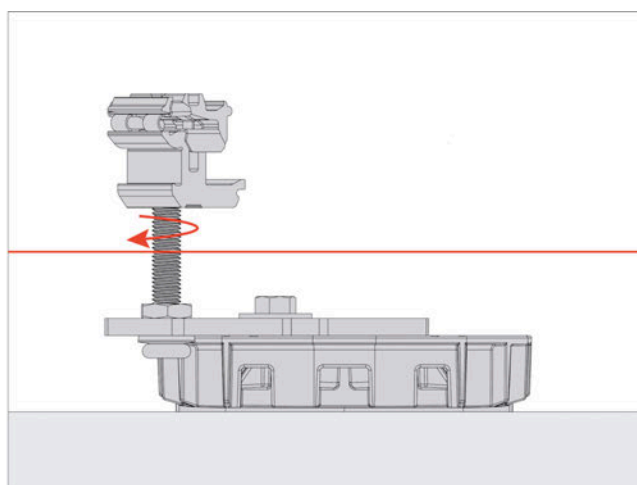
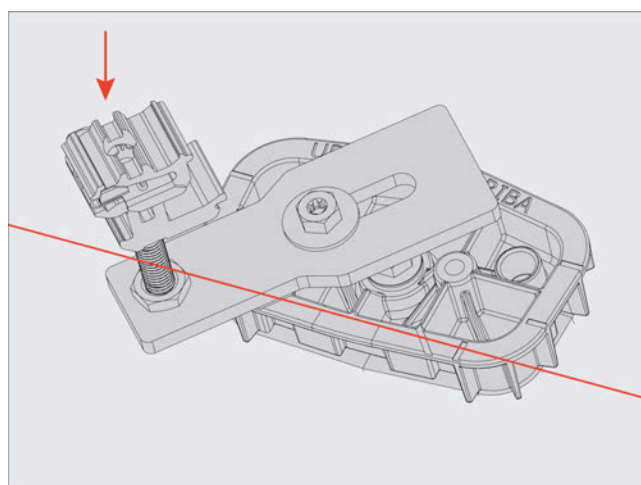
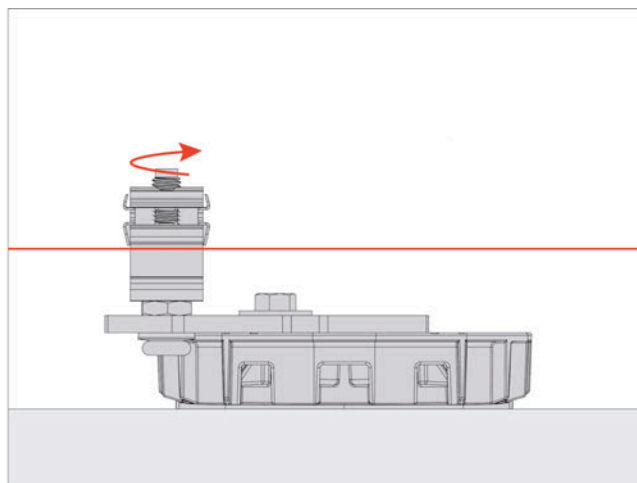
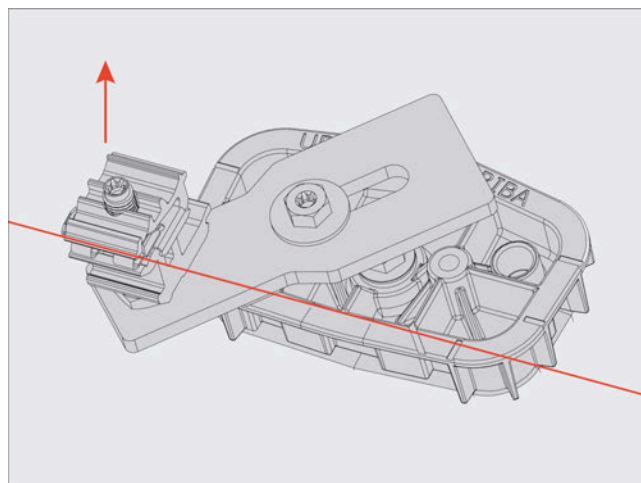


Install the remaining Leveling Feet on the first row and adjust them so that the Leveling Foot stud is as close to the string line as possible without pushing on the string line.





INSTALLATION PROCESS



To accommodate for sags or humps in the roof surface, the Rockits can be adjusted up or down by 5/8 in.

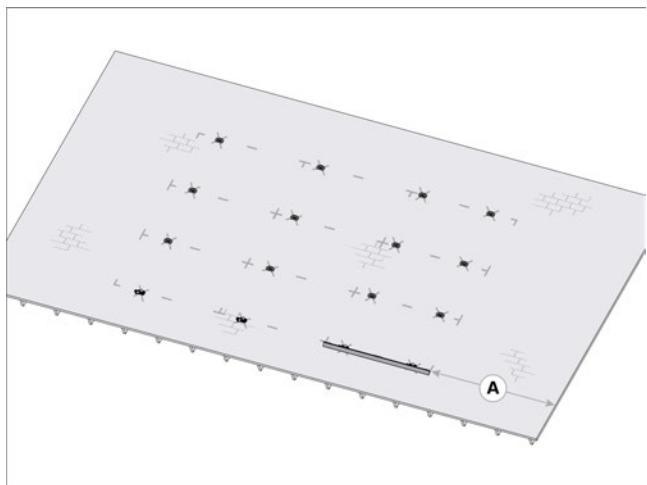
- In the lowest position, the Rockit will be touching the nut.
- In the highest position, the stud will be flush with the bottom of the window of the Rockit.

Rotate and level all first row Rockits to just above the string line. The Key side of the Rockits should be pointing down-roof and parallel to the string line.



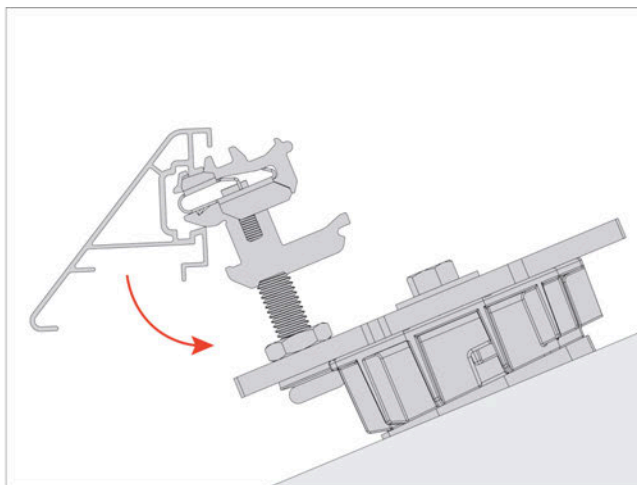
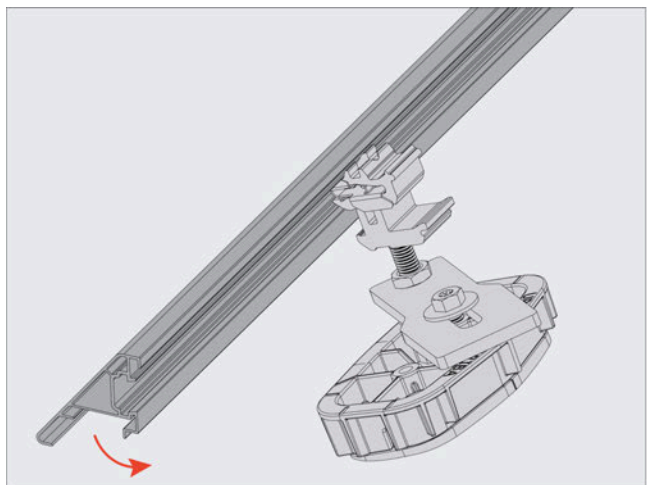
Step 4: Install the Front Skirt

1. Rock in the Front Skirt.



- (A) - Front Skirt aligned with module layout marks

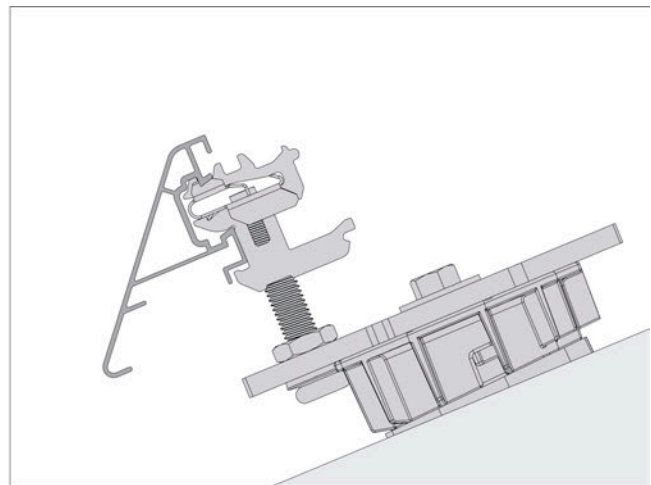
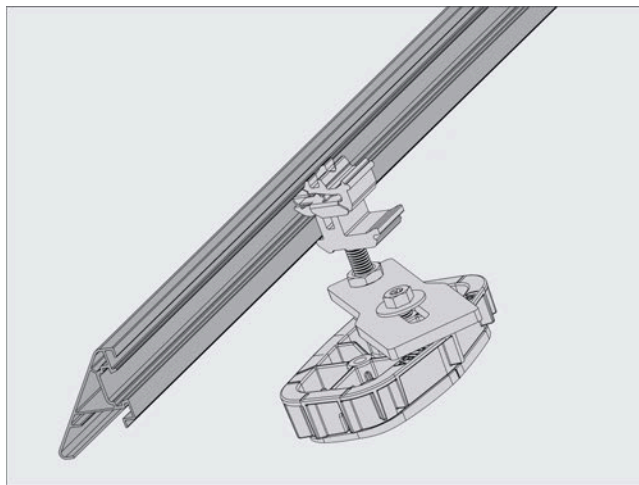
The first Front Skirt should be installed starting at the corner of the array. If either corner has two Leveling Feet spaced closer together, start with this corner. Align the edge of the skirt with the module layout marks, ensuring the skirt end stays within the allowed cantilever distance from the center of the Rockit.



Set the Front Skirt on the Rockits and rock it down, making sure to fully engage with the Key side of the Rockit. The Front Skirt should press flush against the Rockit.

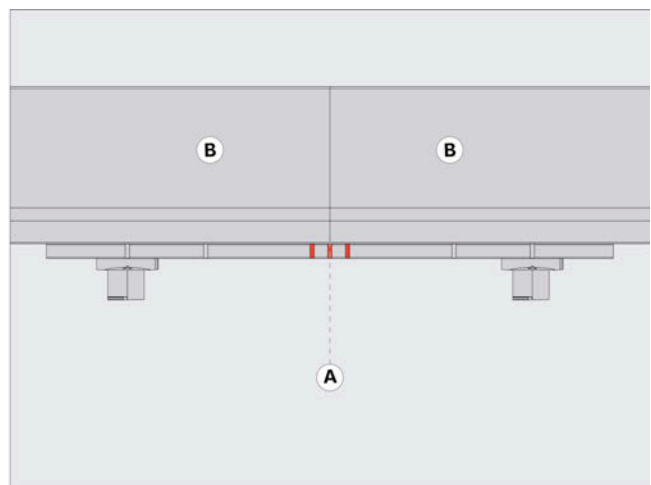
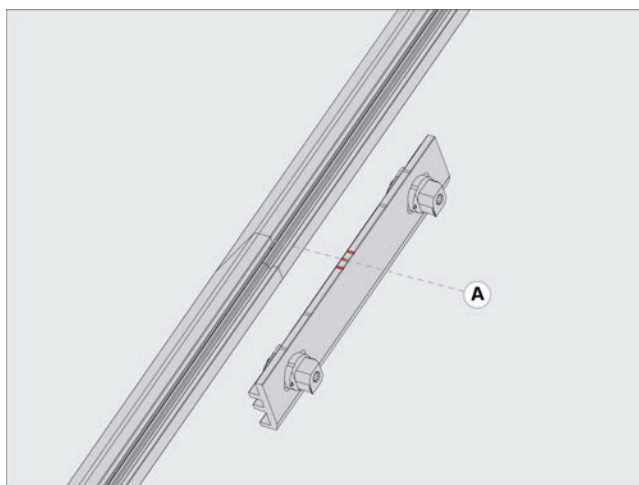


INSTALLATION PROCESS

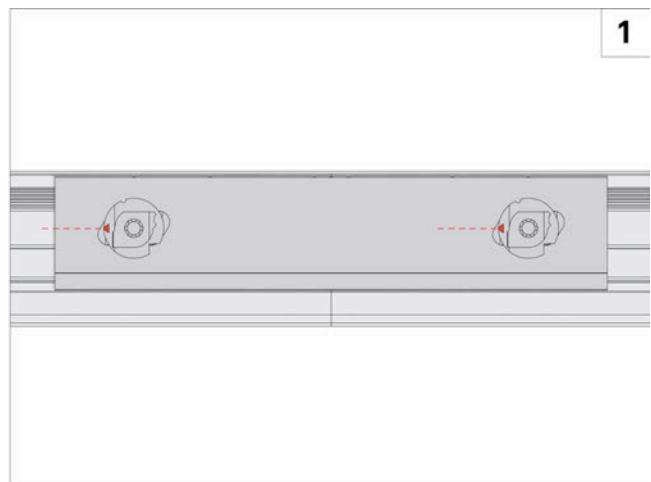


2. Install the Interlock.

Install the next Front Skirt, ensuring that the edge sits flush against the first with no gap. Place and center an Interlock over the seam of the two Front Skirts, using timing marks as shown. Rotate the Interlock Keys from Position 1 to Position 3. This bonds the two skirt sections both structurally and electrically.



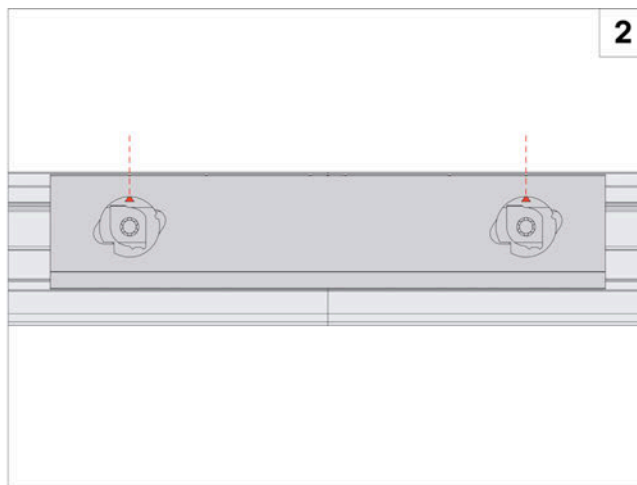
- (A) - Seam
- (B) - Front Skirt



- (1) - Interlock in open position



INSTALLATION PROCESS

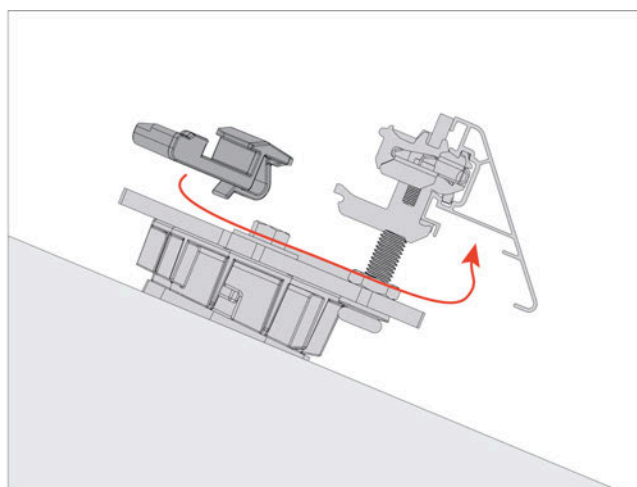
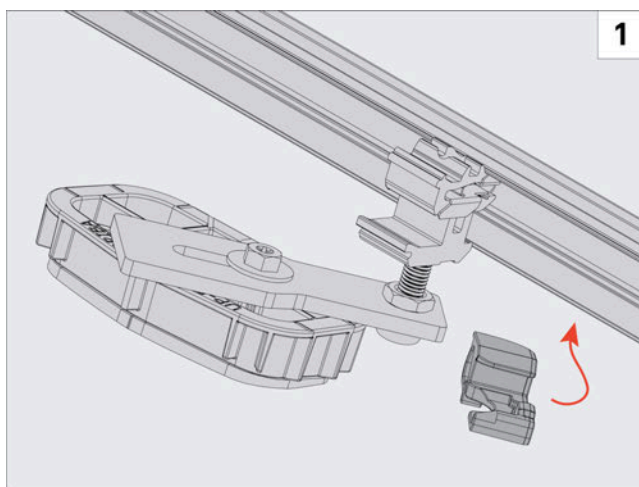


- (2) - Interlock in locked position

Complete the Front Skirt by installing additional Front Skirts with Interlocks for the length of the array.

3. Install the Skirt Grips.

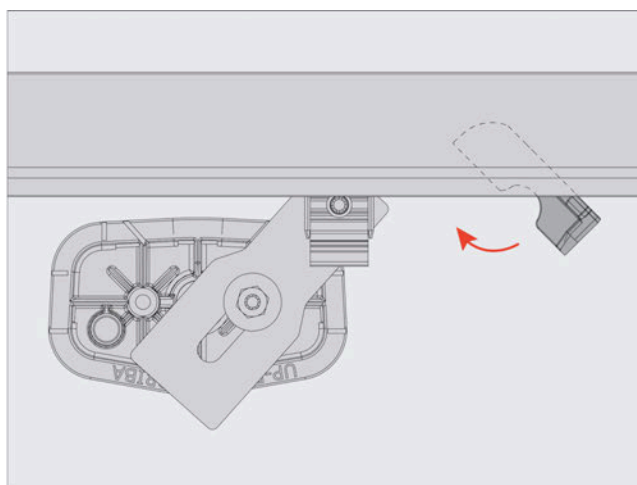
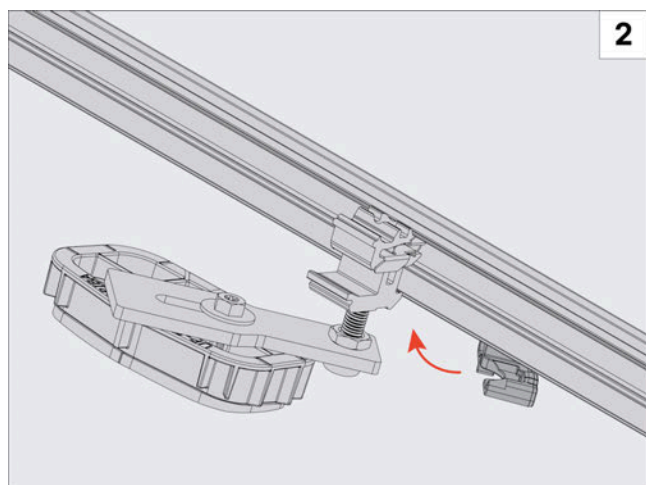
A Skirt Grip is needed to secure the Front Skirt to the Rockit. Insert the Front Skirt Grip into the slot on the underside of the Front Skirt. Front Skirt Grips are installed to the right of the Rockit (when looking down-roof as shown in the image.) Rotate the Front Skirt Grip parallel with the Rockit until it clicks into the slot. Slide the Front Skirt Grip over the Rockit until it is flush.



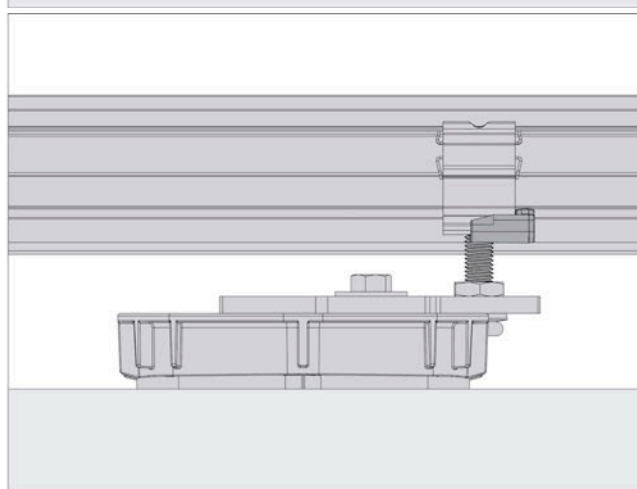
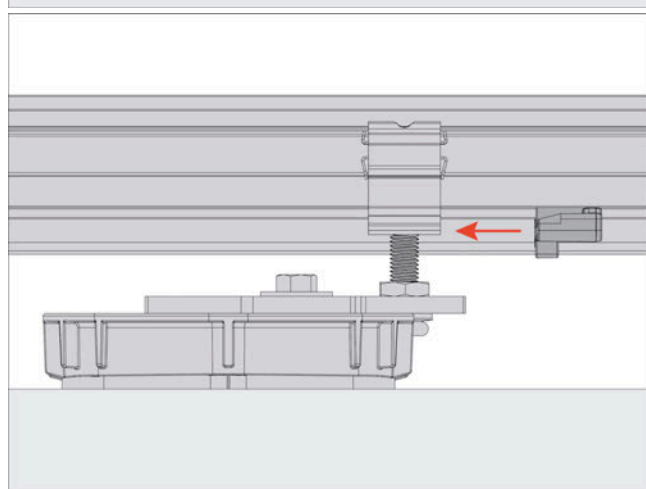
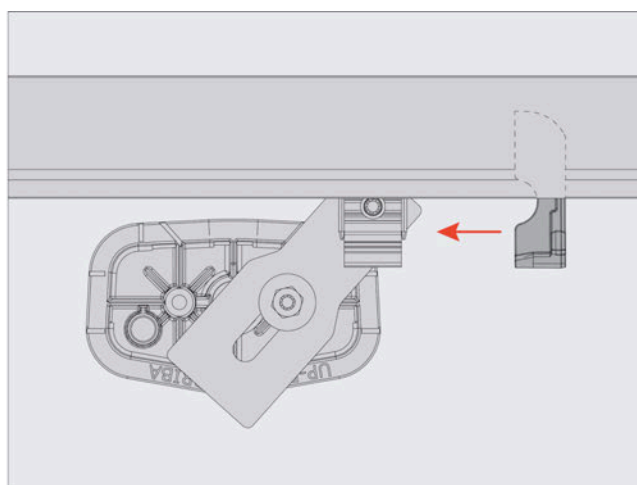
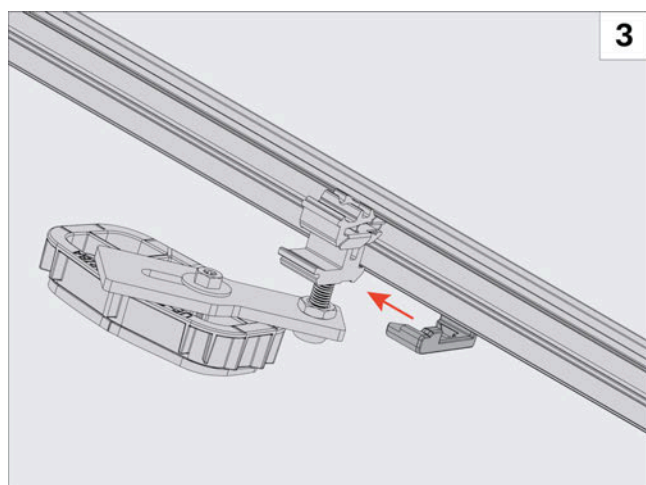
- (1) - Front Skirt Grip and slot under the Front Skirt



INSTALLATION PROCESS



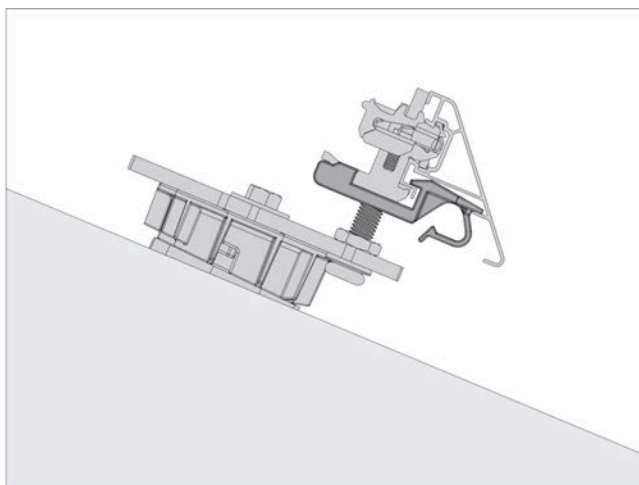
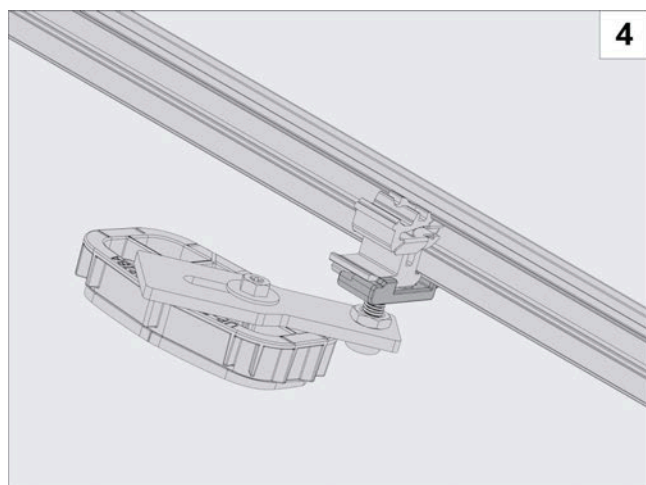
- (2) - Rotating the Front Skirt Grip into the slot



- (3) - Front Skirt Grip slides into position under the Rockit



INSTALLATION PROCESS



- (4) - Front Skirt Grip fully installed



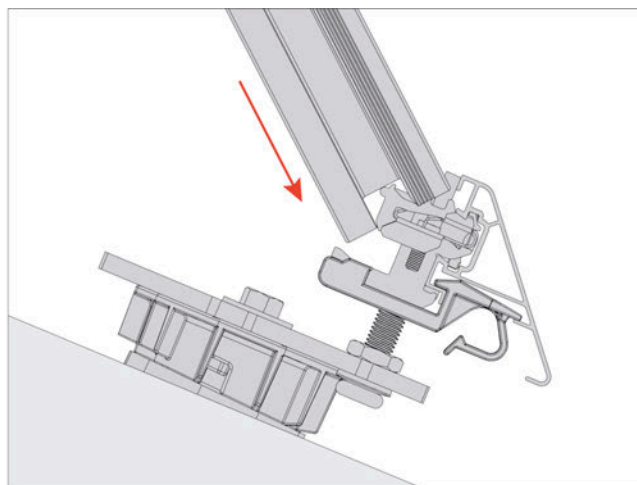
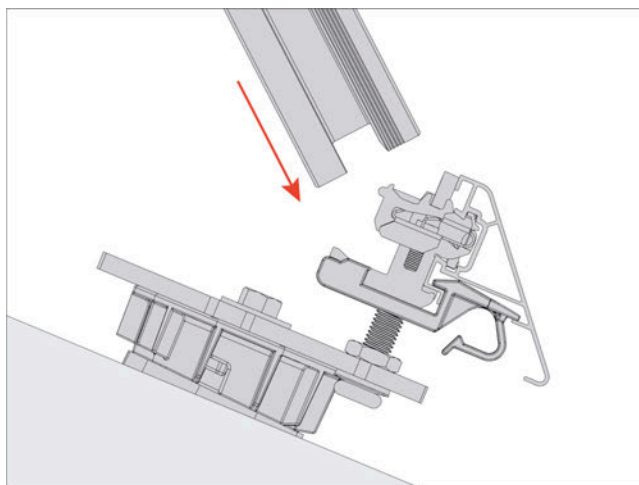
INSTALLATION PROCESS

Step 5: Install the PV Modules (SMILES)

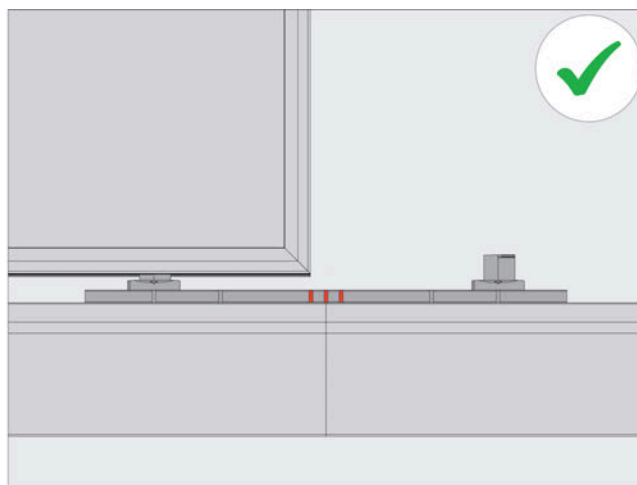
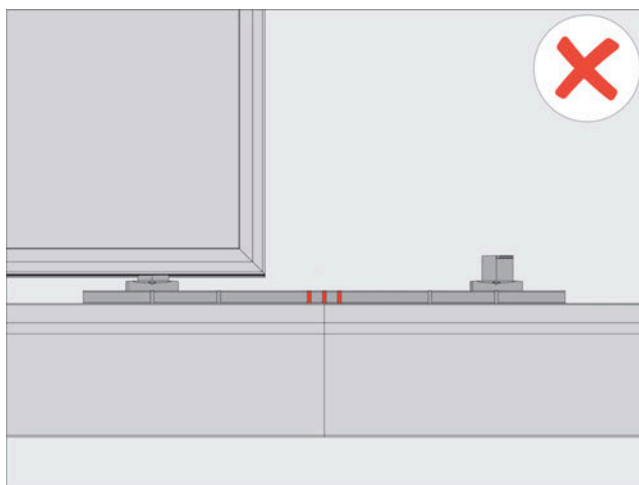
Module drop-in is the same for portrait orientation as for landscape. To remember the installation order, think **SMILES**:

- **S**et the Module
- **M**anage the Wires
- **I**nterlock
- **L**evel
- **E**valuate
- **S**ecure

1. **S**et the module (**SMILES**).



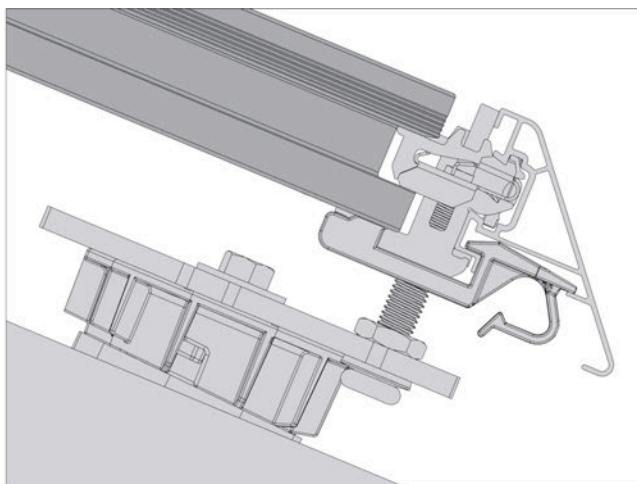
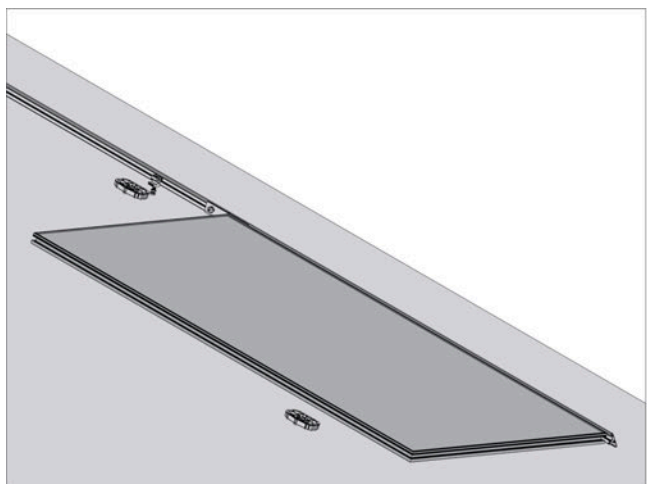
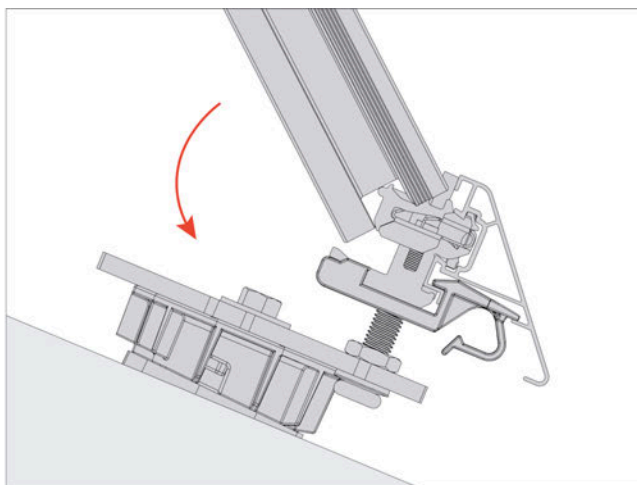
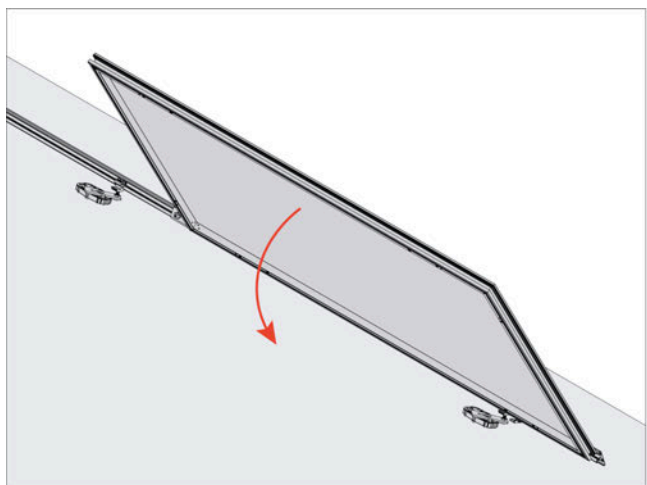
Position the first module on the Tongue side of the Rockits and Interlocks at a steep angle. Align the module edge to the Interlock timing marks.



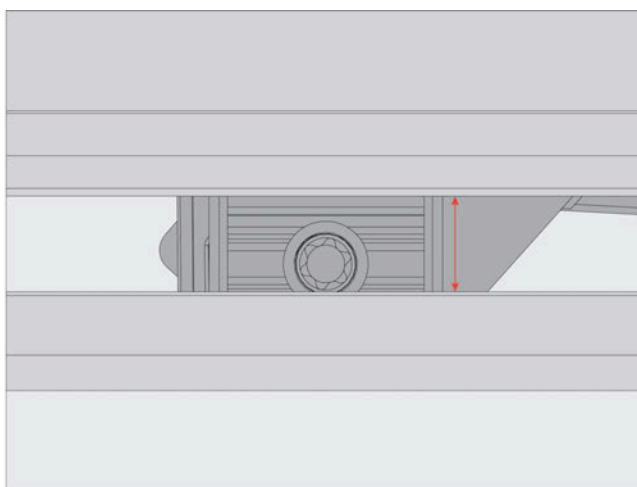
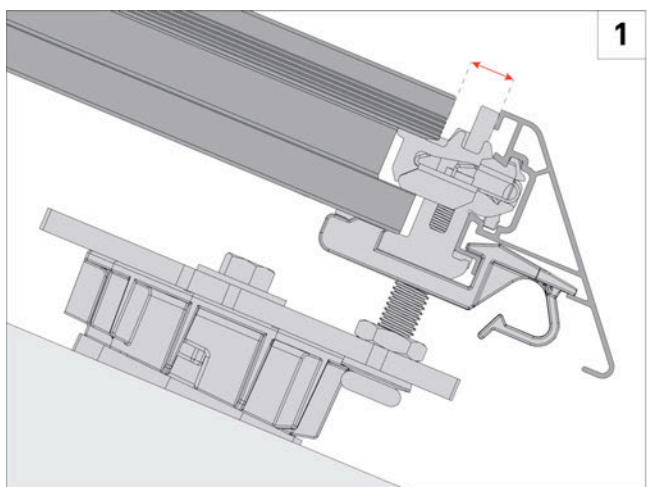
Rock the module down almost flat, while pushing the module onto the Tongues of the Rockits and Interlocks. The bonding tabs on the Rockit will engage with the module frame once the module reaches 15° and some resistance may be felt. An audible grinding sound while rocking in the module indicates that the bond is being made.



INSTALLATION PROCESS



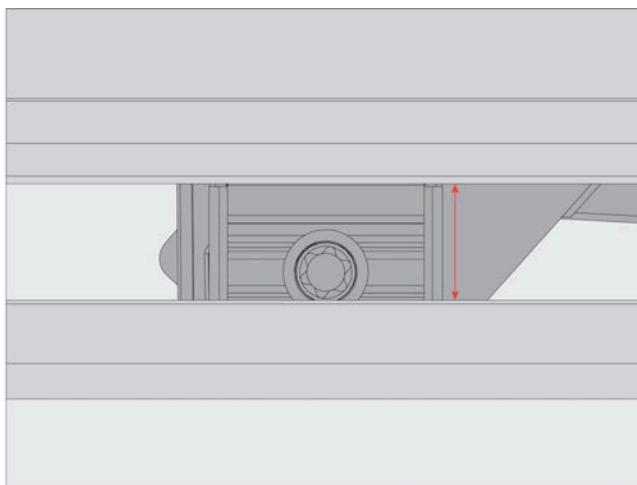
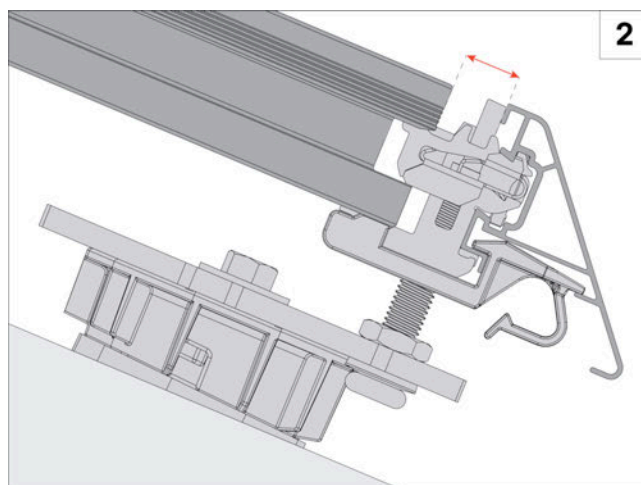
The Tongue side of the Rockit has approximately 1/8 in. of adjustment in the Y direction. If needed, the module can be adjusted within this range to ensure rows are installed straight. If adjustments are needed, lift the module just above the 15° angle before adjusting it.



- (1) - Minimum distance between PV module and Front Skirt



INSTALLATION PROCESS



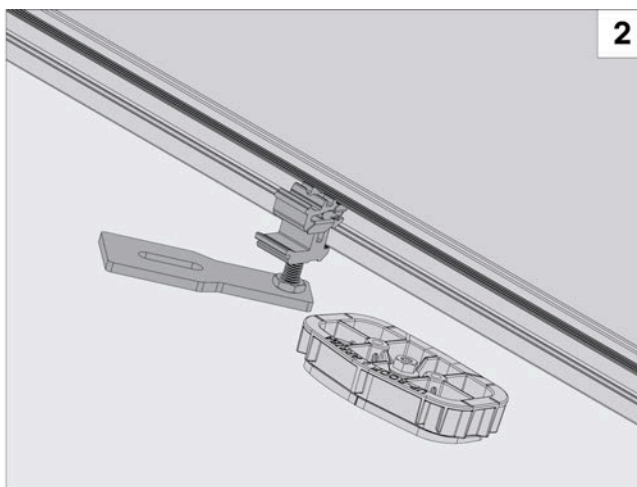
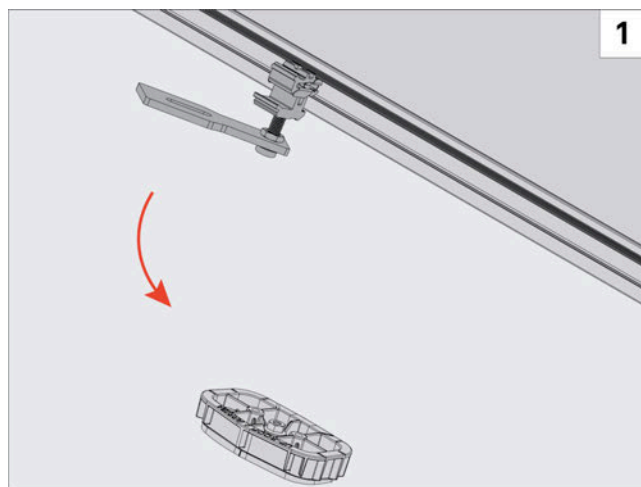
- (2) - Maximum distance between PV module and Front Skirt



NOTE: Kickstanding refers to the practice of adding a Leveling Foot to the Tesla Groove to support the module as it is lowered onto the roof deck.

- Place the Leveling Foot directly adjacent to the Comp Rafter Base.
- All Leveling Feet in a row should be offset to the same side of the Comp Rafter Base.
- This keeps the PV module from hitting the deck, which can cause damage to the shingles and stress the bonding components, degrading their bonding functionality.

At the up-roof edge of the module, install a Leveling Foot by attaching the Key side of the Rockit into the Tesla Groove of the module frame. Continue rocking the module down until it is parallel with the roof.



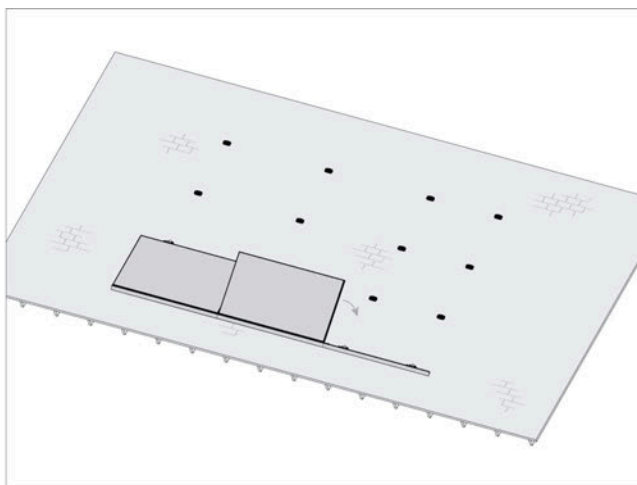
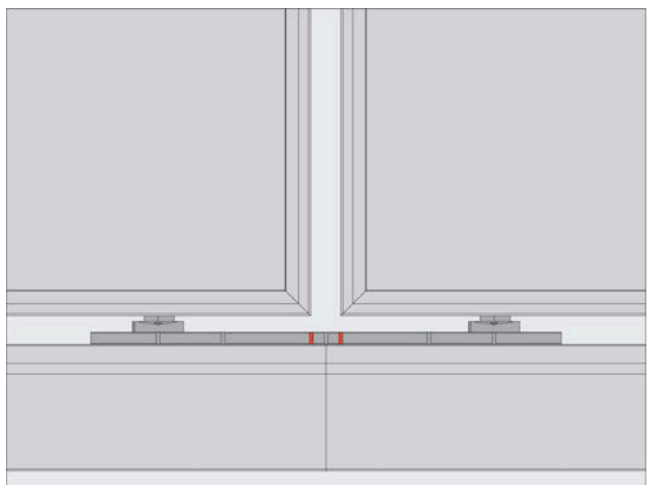
- (1) - Leveling Foot installed on up-roof edge of PV module
- (2) - Leveling Foot resting on roof

Install a full row of modules.

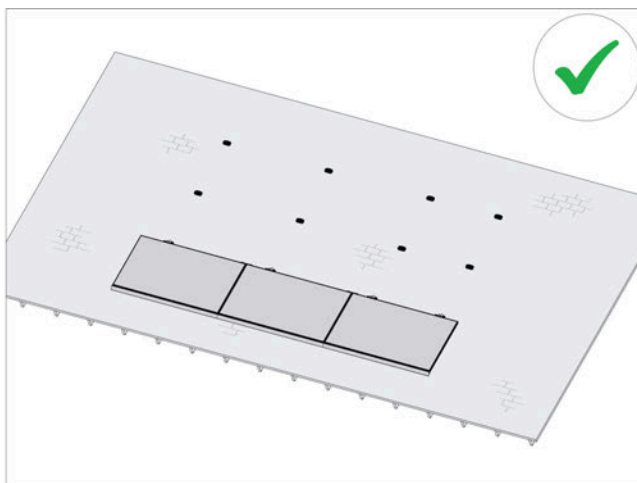
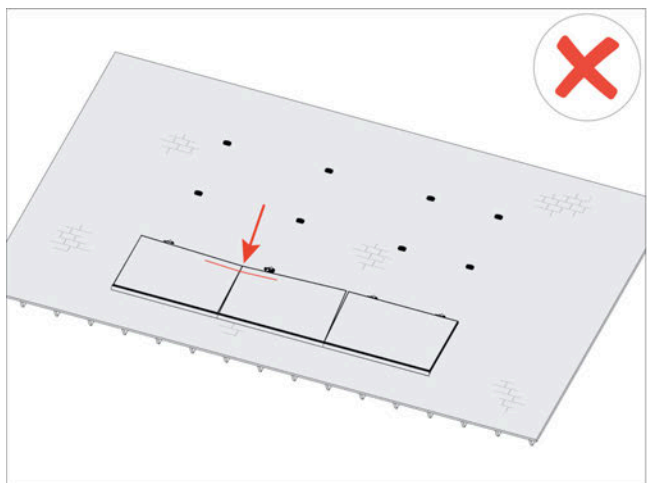
Set the next module in the row, using the center ½ in. timing marks on the Interlock to create a ½ in. gap between modules. The system allows for +/- ¼ in. of adjustability in the module gap but this should not be needed if the skirt was installed correctly.



INSTALLATION PROCESS



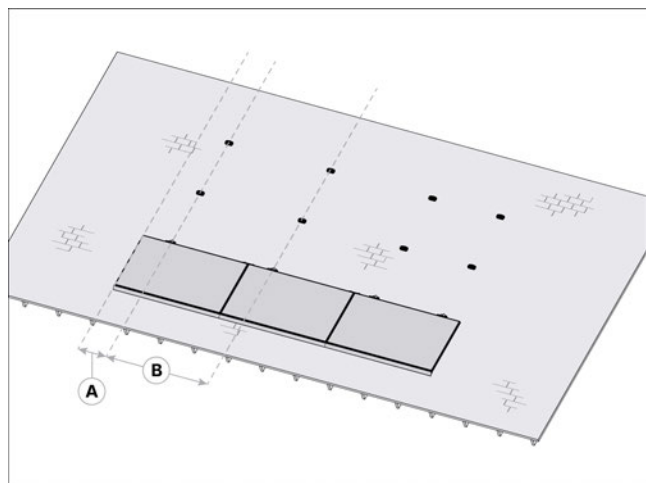
If a module does not sit parallel with the adjacent module, this indicates that the skirt was not installed straight. The Y adjustability of the Rockit should be used to re-establish a straight line along the up-roof edge of the modules. If this is insufficient to establish a straight line, adjusting the skirt may be needed.



Repeat these steps to install the full row of modules, ensuring the location of the Rockits complies with cantilever and X span.



INSTALLATION PROCESS

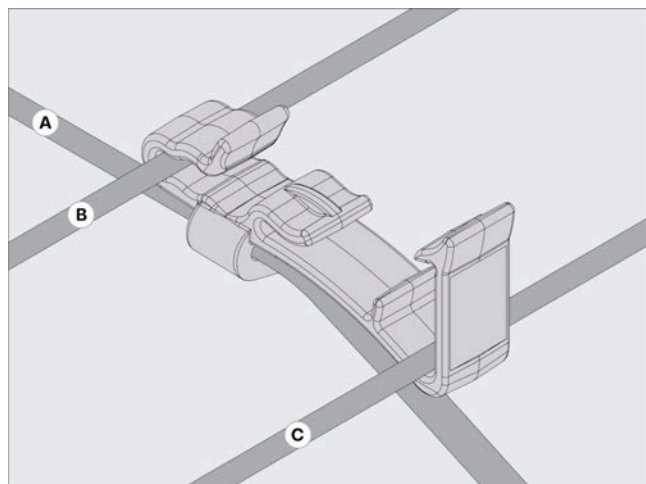


- (A) - X cantilever
- (B) - X span

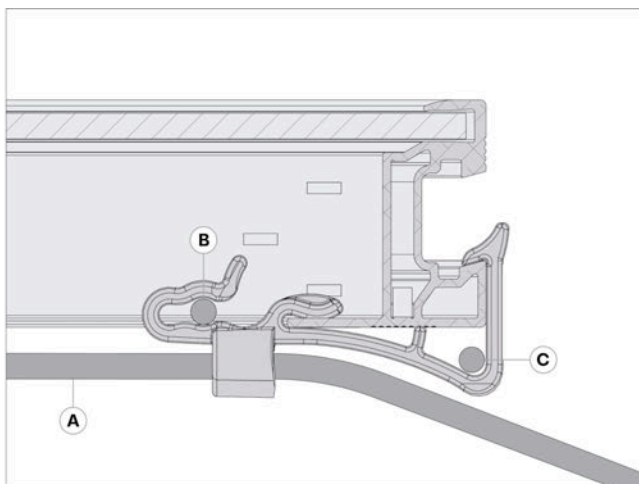
2. Manage the wires (SMILES).

Perform wire management as appropriate for the array. Refer to the example below for a standard 3x3 module array.

The DC Wire Clip (1578249-00-*) is UL listed to UL 1565 as a "wire positioning device." The DC Wire Clip accommodates up to three wires.



- (A) - Wire 1
- (B) - Wire 2
- (C) - Wire 3

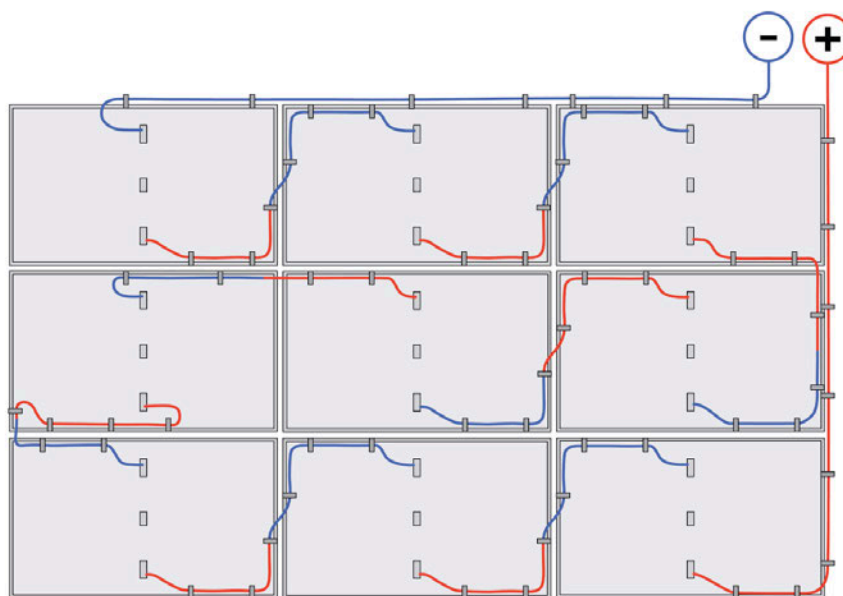


Example Array Wiring:



INSTALLATION PROCESS

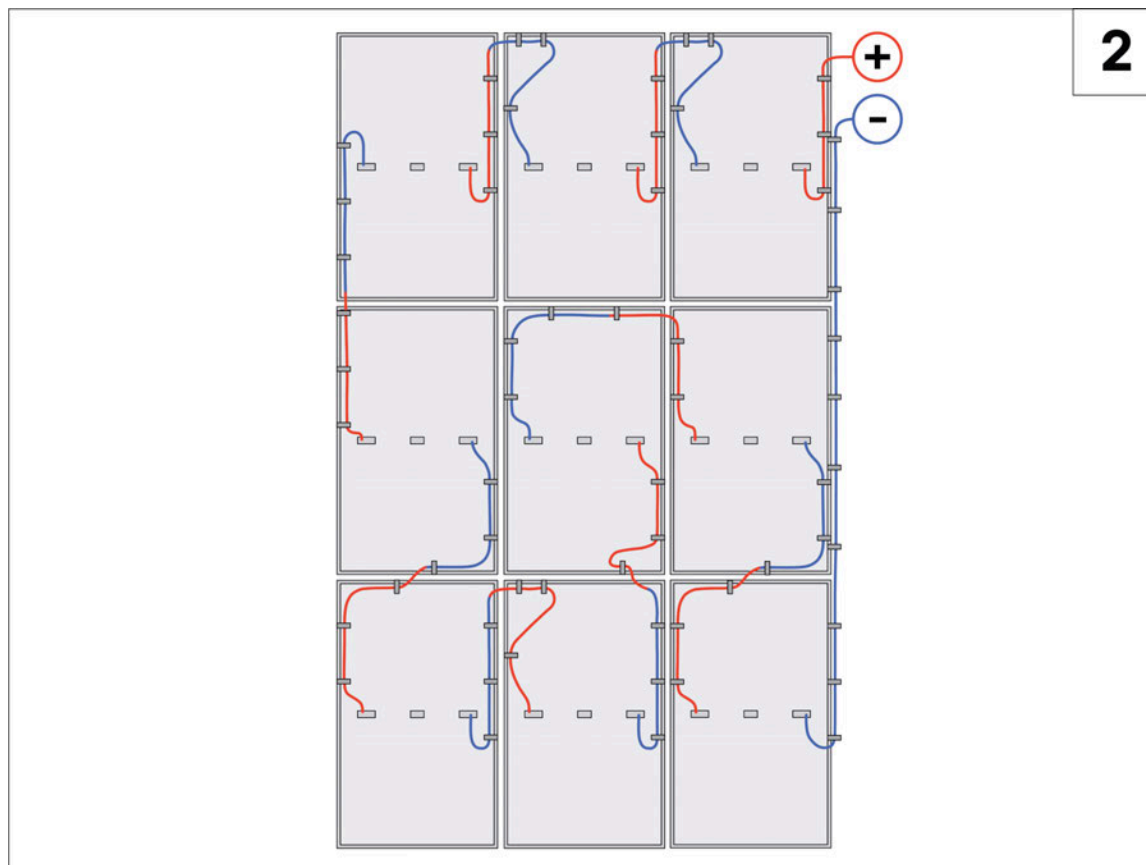
1



- (1) - Landscape orientation



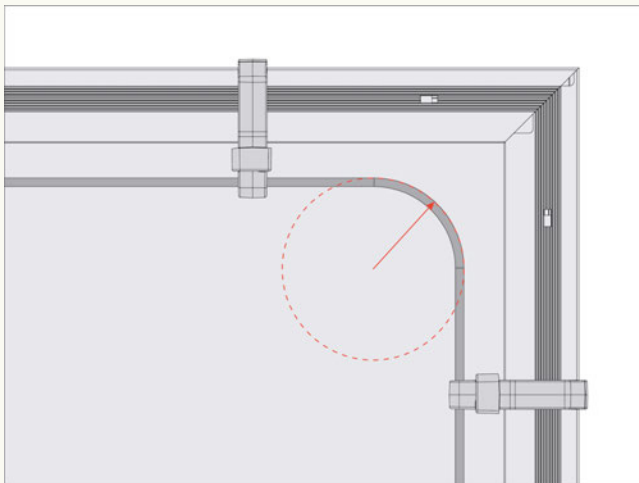
INSTALLATION PROCESS



- (2) - Portrait orientation



CAUTION: Ensure that the wires are not under mechanical stress. Recommended bending radius is 5x the wire diameter, generally $\geq 1\frac{1}{4}$ in. (30 mm.)



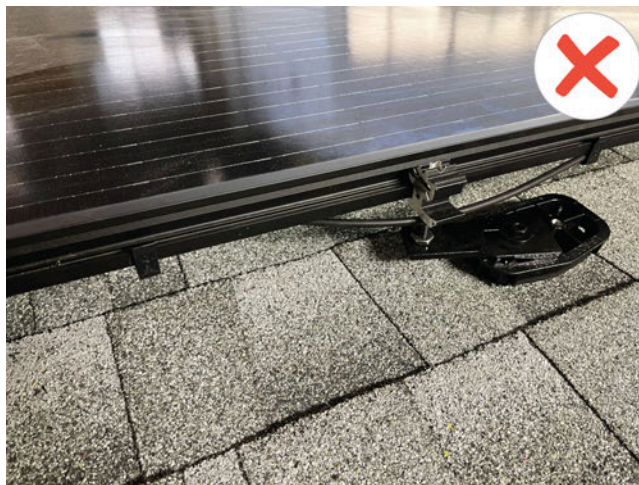
NEC 690.31(C)(1)(b) specifies that there must be a wire clip every 24 in. (600 mm.)

Wire clips should be at least 2 in. (50 mm) but not more than 6 in. (150 mm) from the connectors.

Ensure that the wires do not run around any mounting components as this can lead to abrasion or wire pinches.



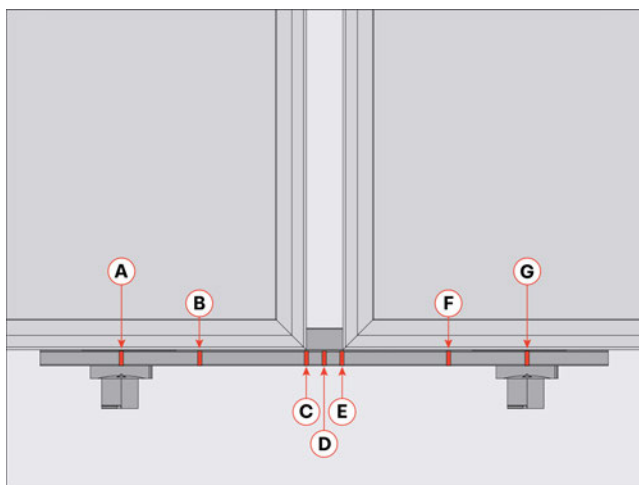
INSTALLATION PROCESS



Refer to [Appendix D: Wire Management Recommendations on page 95](#) for more information on wire management of Tesla MCI systems.

3. Interlock (SMILES).

Once a full row of modules is installed and wire managed, Interlocks will be needed to secure them together. Interlocks feature timing marks that help with module spacing.

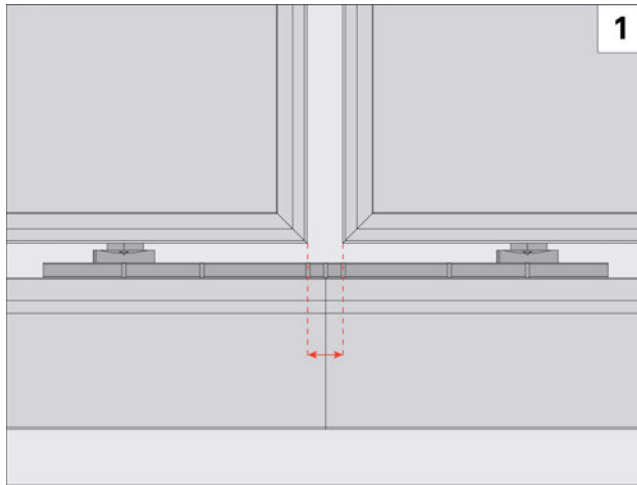


- (A) - 1st timing mark, used to verify alignment when tightening the Interlock Lockit
- (B) - 2nd timing mark, indicates maximum allowable range of module edge when sliding the Interlock
- (C) - 3rd timing mark, used to align module edges and ensure consistent spacing ($\frac{1}{4}$ in from center line)
- (D) - 4th timing mark, used to center the Interlock on the skirt or PV modules (center line of the Interlock)
- (E) - 5th timing mark, used to align module edges and ensure consistent spacing ($\frac{1}{4}$ in from center line)
- (F) - 6th timing mark, indicates maximum allowable range of module edge when sliding the Interlock
- (G) - 7th timing mark, used to verify alignment when tightening the Interlock Lockit

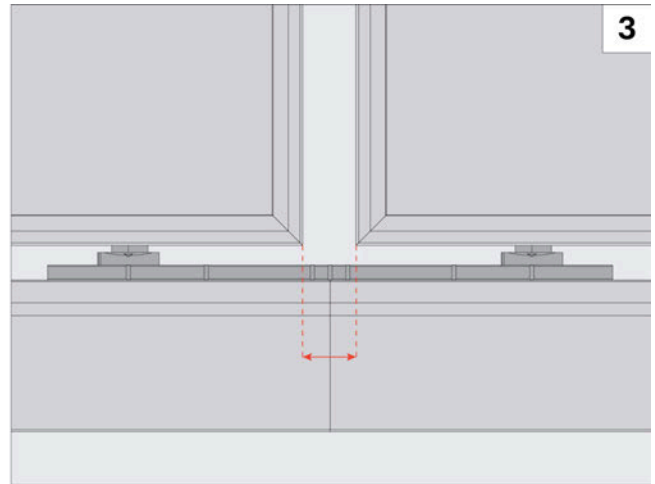
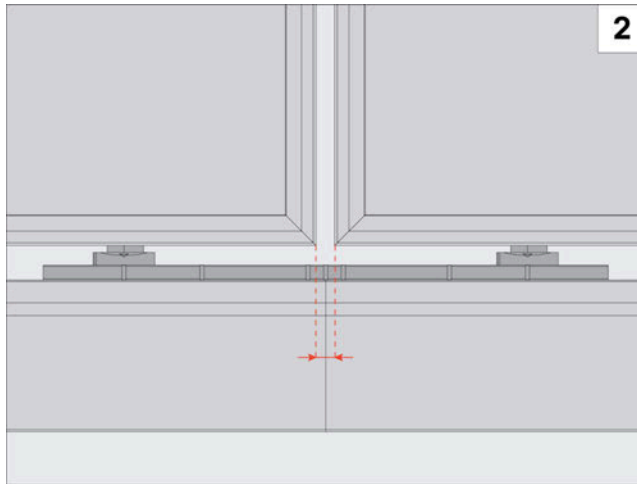
Adjust modules if necessary to ensure alignment at the up-roof edge of the module. The X gap between module corners should be $\frac{1}{2}$ in. with $\pm \frac{1}{4}$ in. of tolerance.



INSTALLATION PROCESS

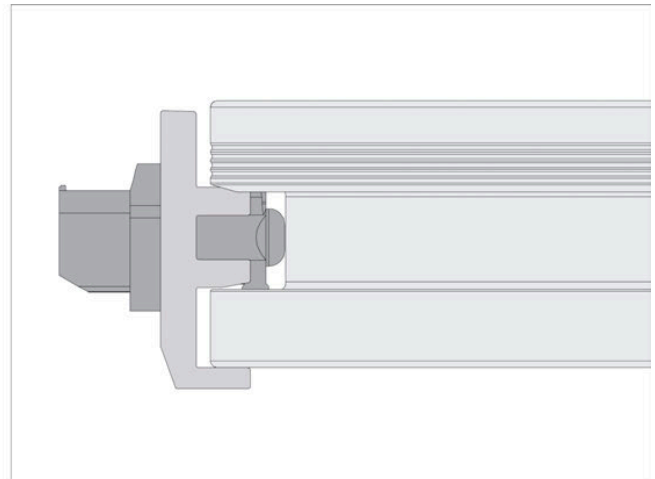
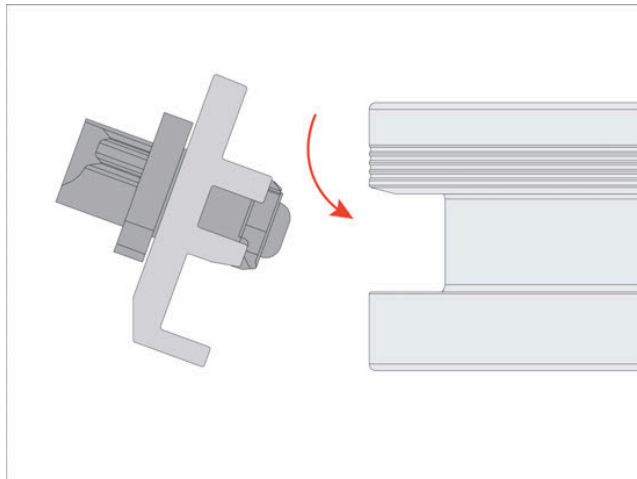


- (1) - Ideal distance between modules ($\frac{1}{2}$ in.)



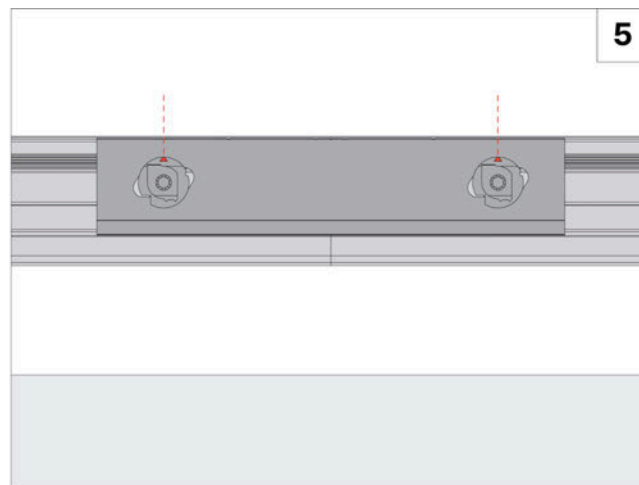
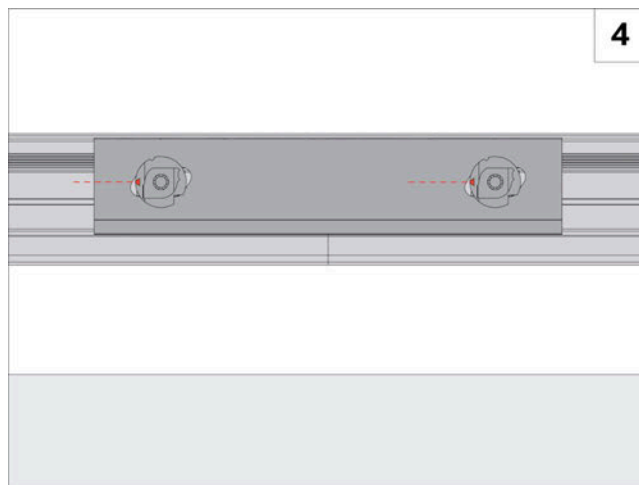
- (2) - Minimum distance between modules ($\frac{1}{4}$ in.)
- (3) - Maximum distance between modules ($\frac{3}{4}$ in.)

Insert an Interlock into the Tesla Groove between two modules. Align timing mark 4 to the center of the module gap. This will ensure the timing marks can be used as reference for the next row.





INSTALLATION PROCESS

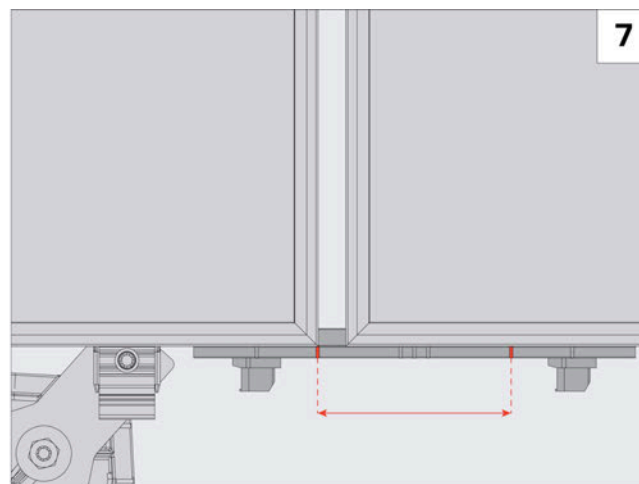
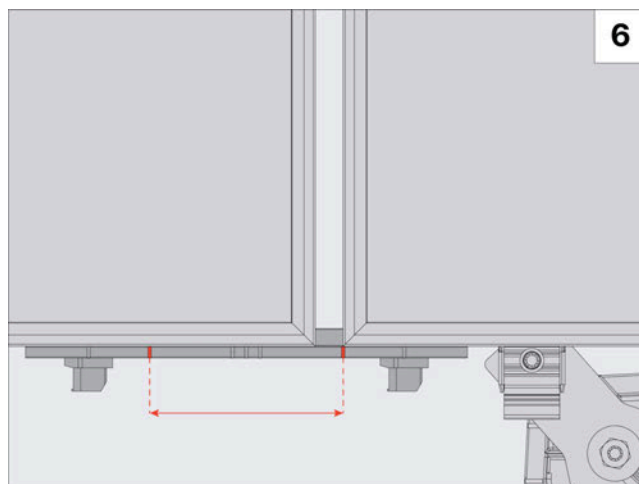


- (4) - Position 1: open Interlock
- (5) - Position 3: locked Interlock



NOTE: The Interlock may not fully seat into the Tesla Groove with hand pressure only. Rotate both Keys to Position 3 to form a structural and electrical bond with the modules. This motion will pull the Interlock into the module frame and an audible grinding sound indicates that the bond is being made.

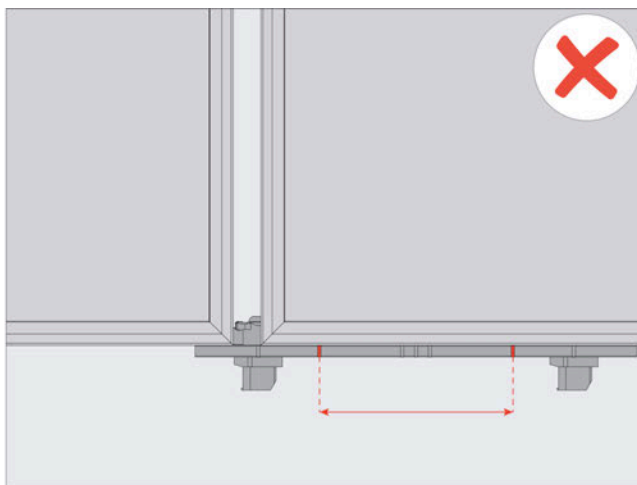
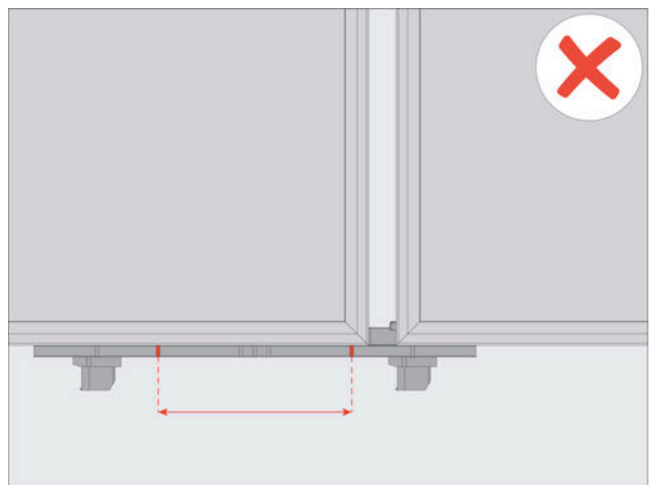
In certain cantilever and span conditions, a Rockit may land close to the corner of a module. When this Rockit lands within the space that an Interlock would normally occupy, this is called an interference. When an interference occurs, the Interlock can be adjusted in the X direction up to the point that the 2nd or 6th timing mark aligns with the module corner. In this case, the timing marks will not align with module corners for subsequent rows and care should be taken to align gaps between the rows.



- (6) - Left position within Interlock range
- (7) - Right position within Interlock range



INSTALLATION PROCESS



- *The module gap must fall within the timing marks.*

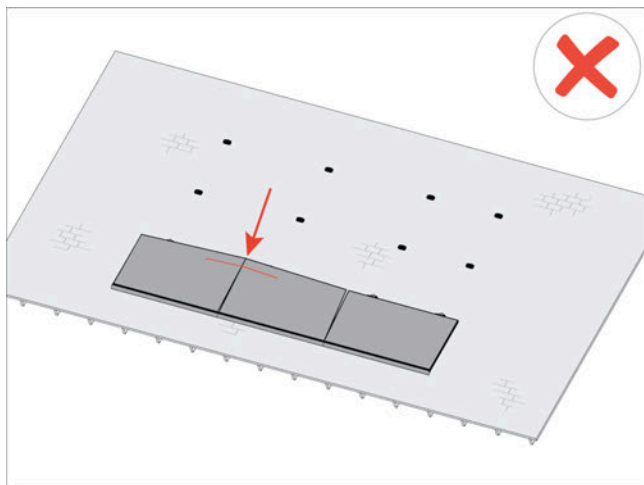


INSTALLATION PROCESS

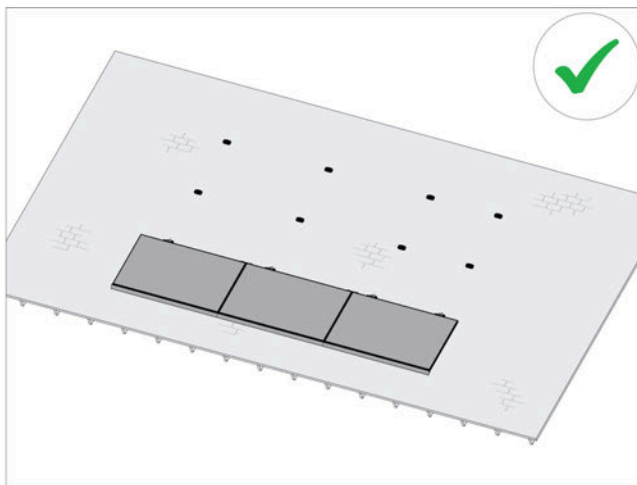
4. Level (SMILES).

From the top corner of the row, look in the X direction and Y direction to check edges for irregularities in height. Modules should be straight and parallel to the roof deck.

Uneven leveling is visually apparent and aesthetically undesirable. Level all the modules so that the array appears to be perfectly flat regardless of roof irregularities underneath.

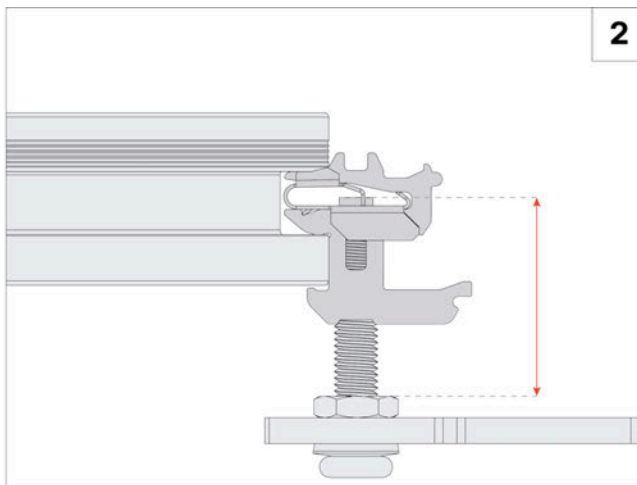
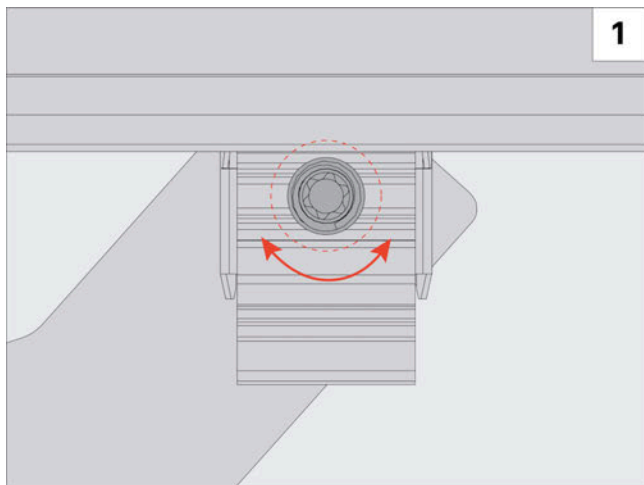


(1) - Uneven leveling



(2) - Even leveling

Rotate the threaded stud on the Leveling Foot using a #40 Torx bit to raise or lower the Rockit in relation to the foot. The stud is reverse-threaded so turning the stud clockwise will lower the module and turning it counterclockwise will raise the module.

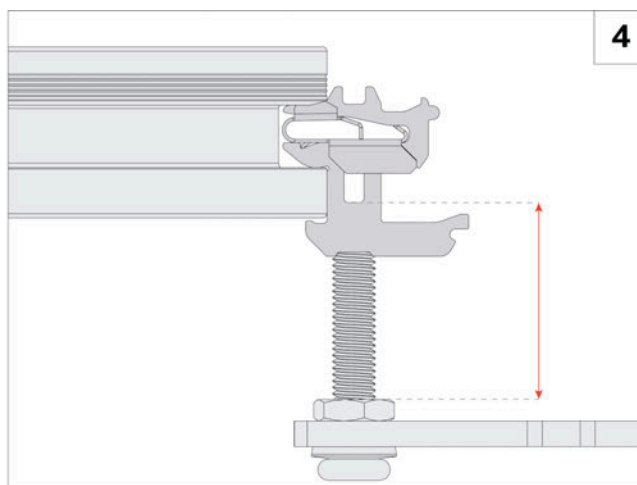
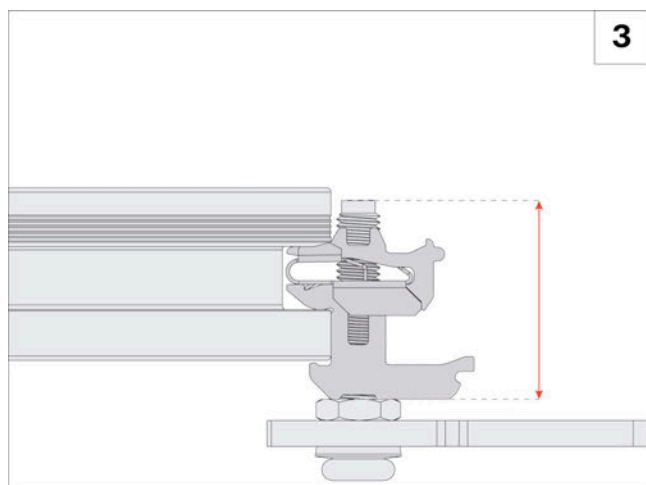


- (1) - Threaded stud on the Leveling Foot for Rockit height adjustment
- (2) - Nominal Rockit height

Do not raise the Rockit beyond 1 ¼ in. above the Leveling Foot nut. The stud will be flush with the bottom of the window of the Rockit at maximum height.



INSTALLATION PROCESS

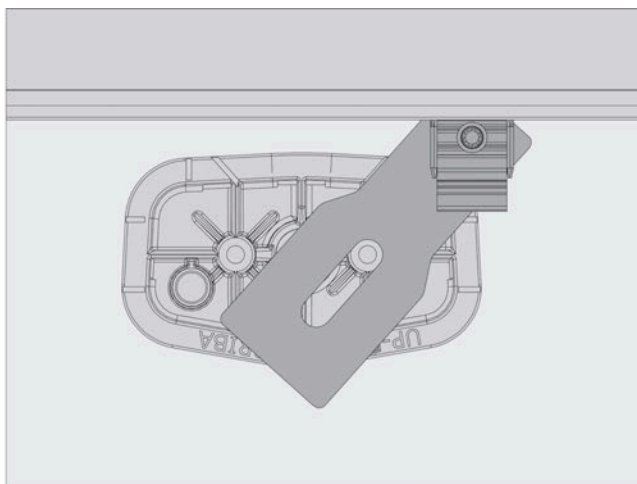
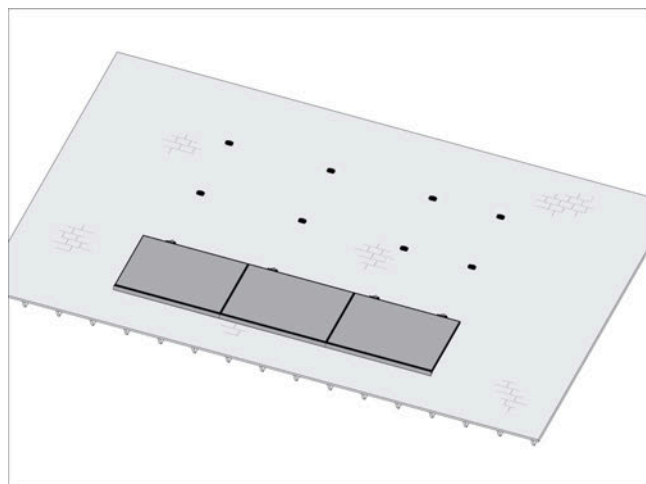


- (3) - Minimum Rockit height
- (4) - Maximum Rockit height

5. Evaluate (**SMILES**).

At this point, pause and evaluate the work done so far. Check that all wire management is proper and there are no hanging wires present, there are no missed connections or any that are touching the roof. Check that all Comp Rafter Bases are sealed.

Once all checks are done, move on to the next step to secure the Leveling Feet.



6. Secure (**SMILES**).

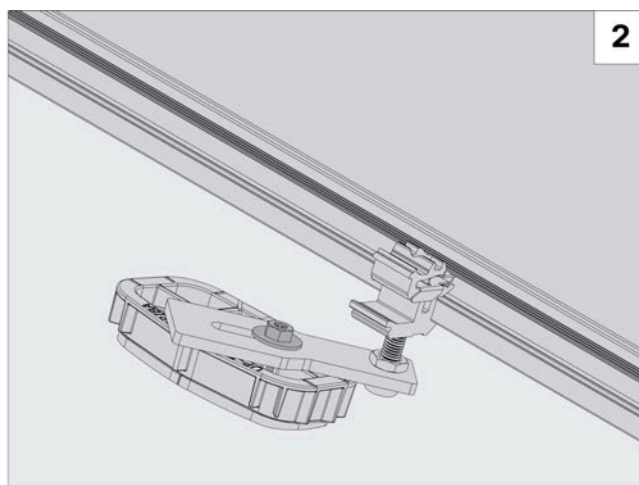
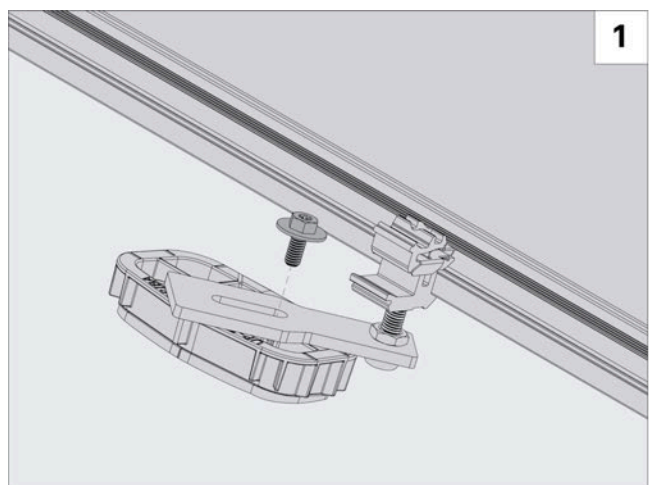
Swivel the Leveling Foot so that the slot aligns with one of the mounting holes on the base. If the slot does not align with a mounting hole, remove the Leveling Foot, readjust the Rockit position and reinstall the Leveling Foot. Secure the up-roof Leveling Feet by fastening the bolt through the Leveling Foot and into the Comp Rafter Base. Either a ½ in. socket or #40 Torx bit can be used.



NOTE: Torque to a range of **13 - 20 ft-lbs**. Make sure that the washers are not deformed, and the Leveling Foot cannot be moved by hand.



INSTALLATION PROCESS



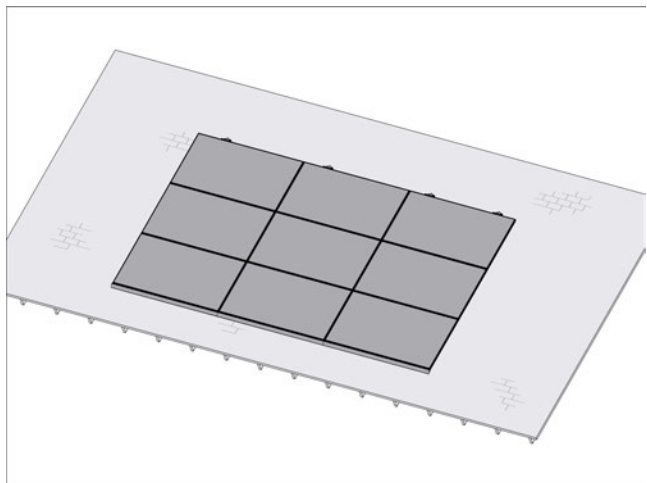
- (1) - Leveling Foot resting on base
- (2) - Leveling Foot secured to Comp Rafter Base with a fastener



INSTALLATION PROCESS

7. Repeat **SMILES**.

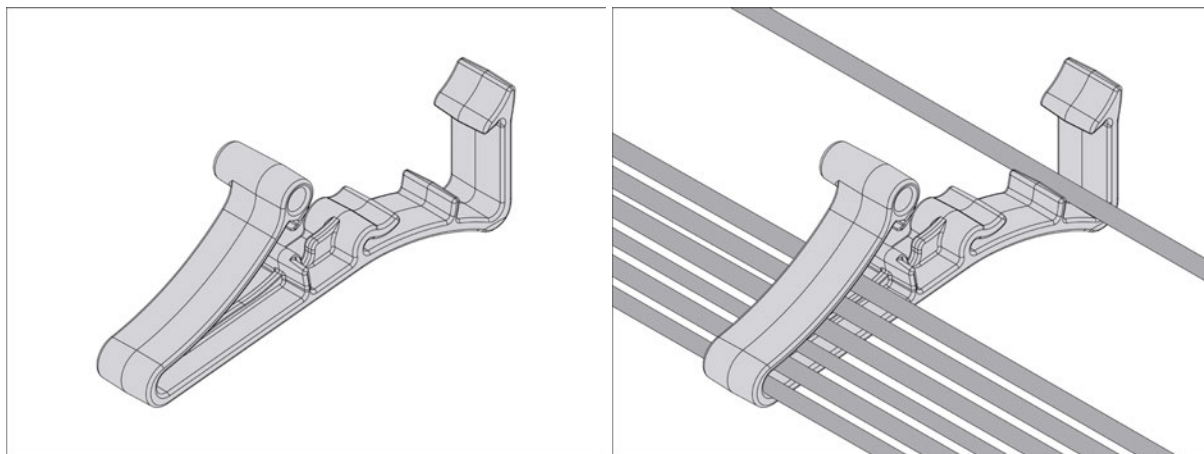
Continue to install the modules, Leveling Feet, and Interlocks until the array is complete. Complete all steps of **SMILES** for each row.



Step 6: Complete Wire Management and Bonding

1. Install Home Run Wire Clips.

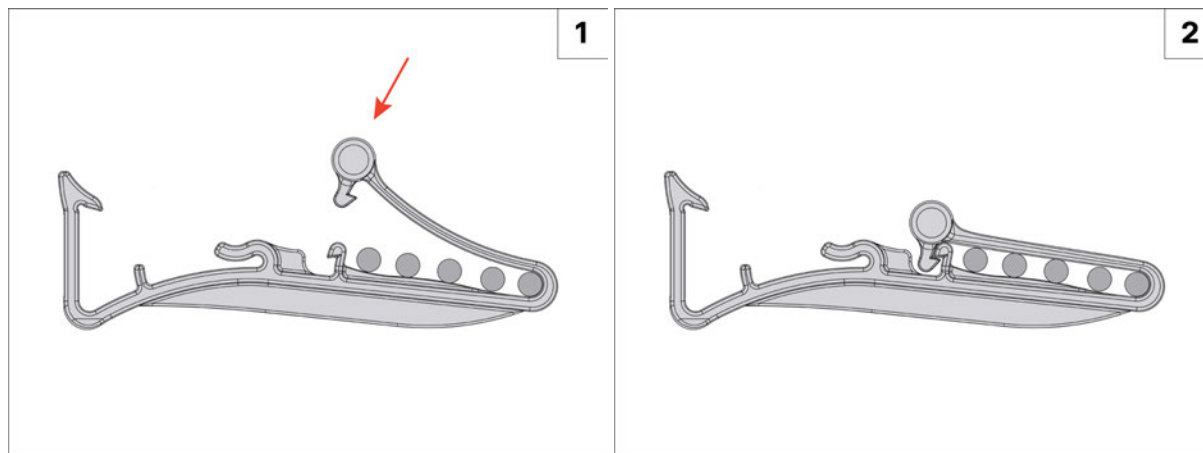
Complete wire management as necessary for the array. If more than two wires need to travel along any edge of a module the Home Run Wire Clip can be used. It holds 6x 10 AWG wires or 4x 8 AWG wires and installs in a similar fashion to the DC Wire Clip.



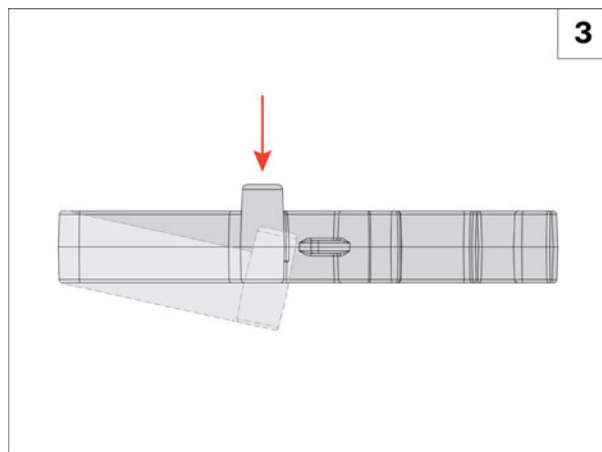
Close the Home Run Wire Clip by snapping the clip together. To open the clip, push the tab to the side.



INSTALLATION PROCESS



- (1) - Close the Home Run Wire Clip by snapping the clip together
- (2) - Closed Home Run Wire Clip



- (3) - To open the clip, push the tab to the side

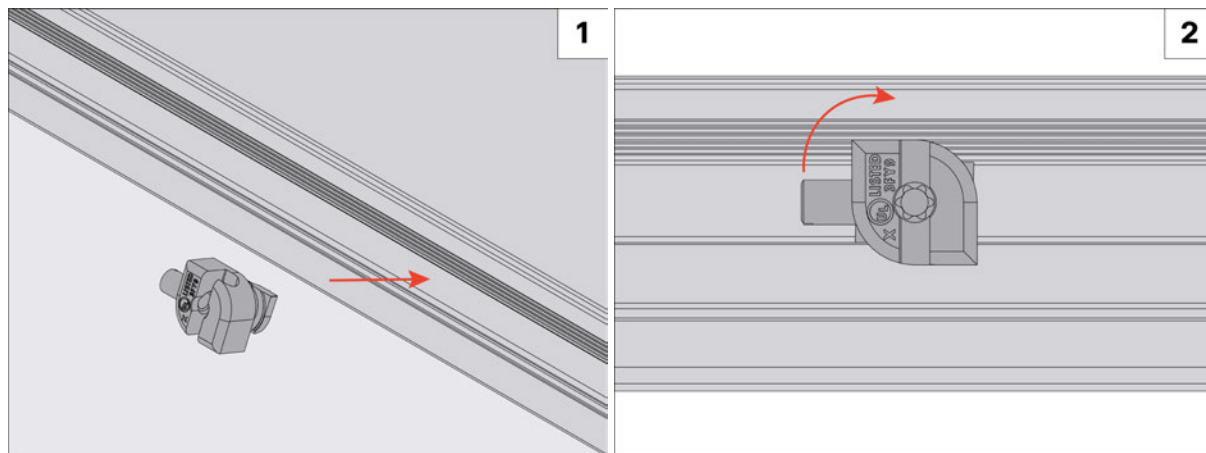
2. Install the Ground Lockit.

The Ground Lockit provides a single point of connection for the equipment grounding conductor (EGC) from the array to the grounding electrode conductor (GEC.) The Ground Lockit must be placed on the module frame where the DC wiring meets the array. This must be repeated for each sub-array.

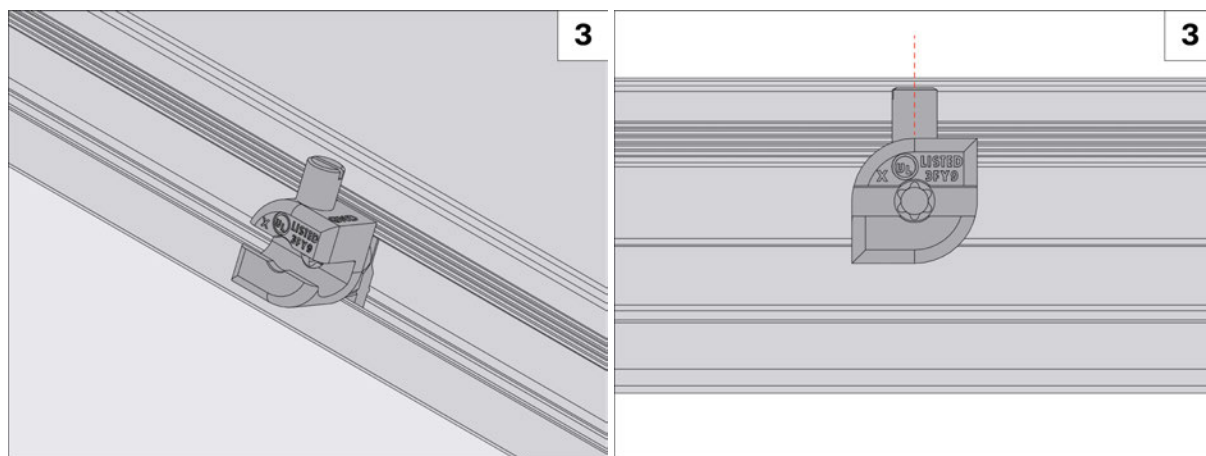
Insert a Ground Lockit into the Tesla Groove with the set screw pointing left. Rotate the Ground Lockit into place with a 90° clockwise turn.



INSTALLATION PROCESS



- (1) - Ground Lockit with the set screw pointing left
- (2) - Ground Lockit in the groove of the PV module



- (3) - Installed and rotated Ground Lockit



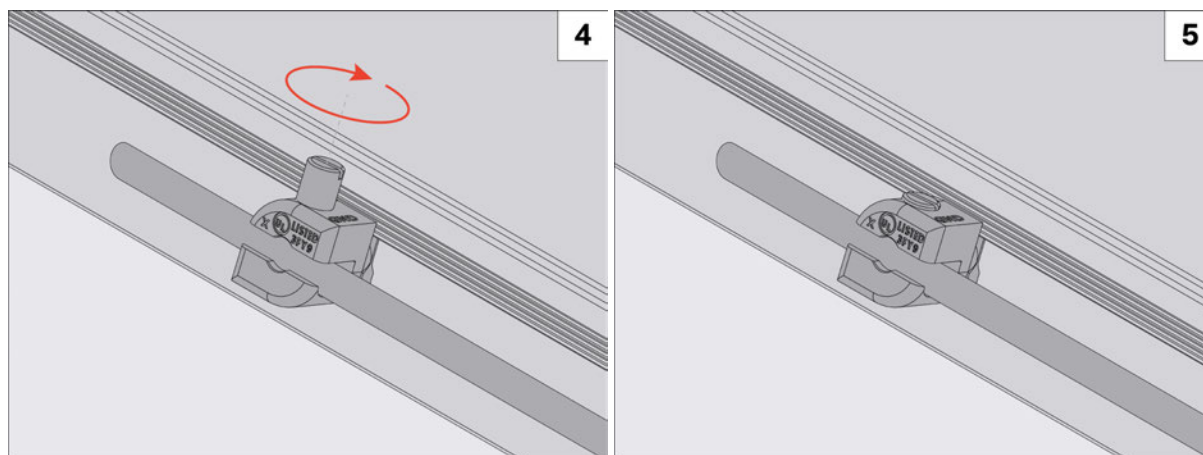
NOTE: The set screw must be pointing straight up.

3. Insert the Ground Wire.

Insert the ground wire into the ground wire retention slot. Ensure that excess ground wire is not sticking out of the Ground Lockit.



INSTALLATION PROCESS



- (4) - Ground Lockit with inserted ground wire
- (5) - Fully installed Ground Lockit

Torque the set screw based on the ground wire size:

Cat. No.	Conductor Material	Conductor Size	Tightening Torque
850-1511	Copper, solid	14 - 10 AWG	40 in-lbf
		8 AWG	45 in-lbf
		6 AWG	50 in-lbf
		4 AWG	55 in-lbf

Refer to [Appendix D: Wire Management Recommendations on page 95](#) for additional information on wire management.

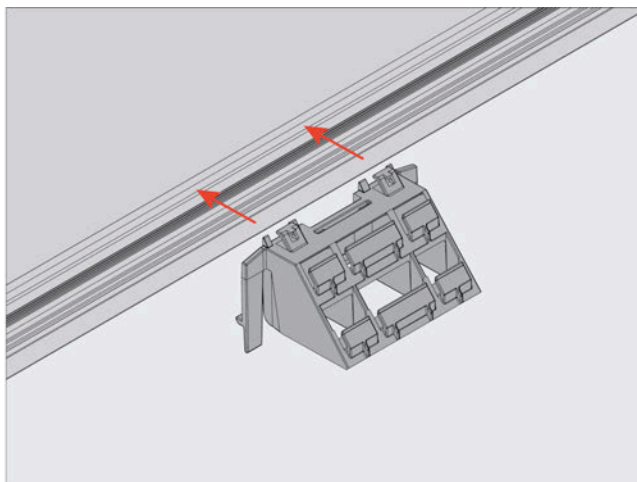
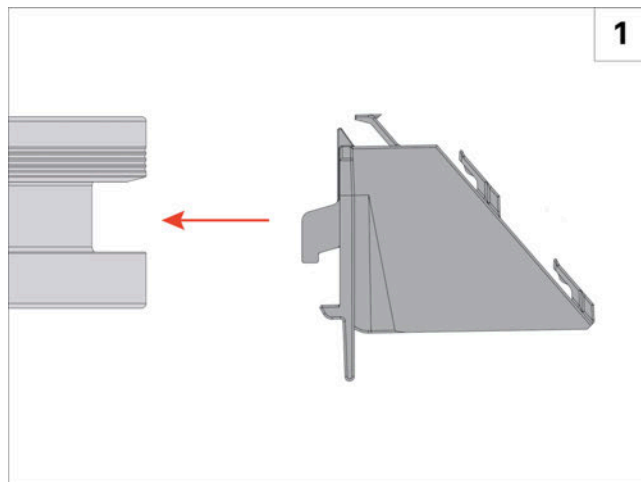


INSTALLATION PROCESS

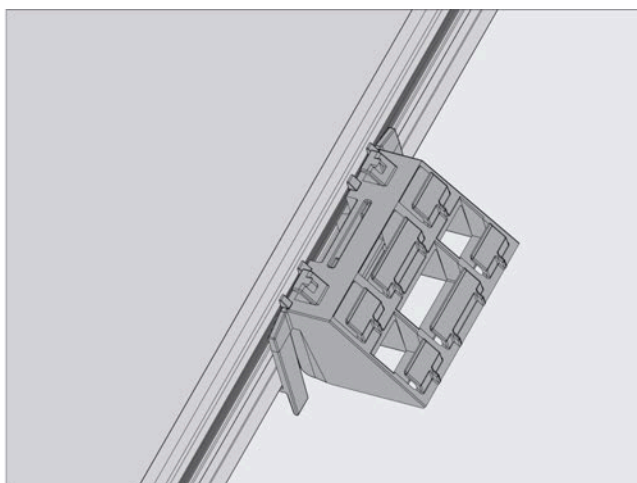
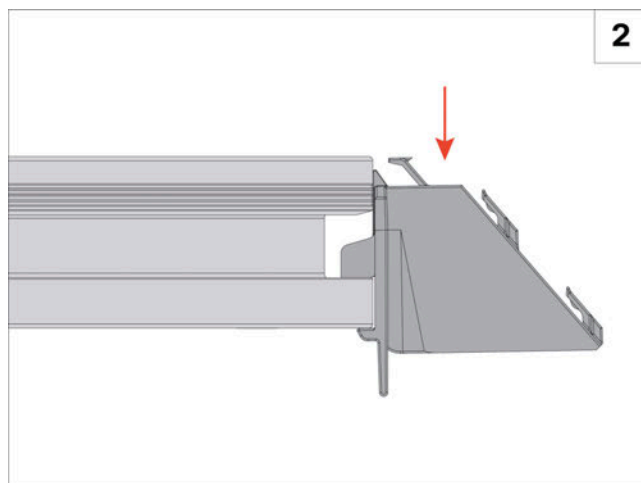
Step 7: Install the Side Skirts and Corner Caps

1. Install the Side Skirt Brackets.

Side Skirt Brackets are installed into the Tesla Groove by hand with an inward motion then by pressing downward. A click indicates that the brackets are correctly installed.



- (1) - Inserting Side Skirt Bracket into Tesla Groove

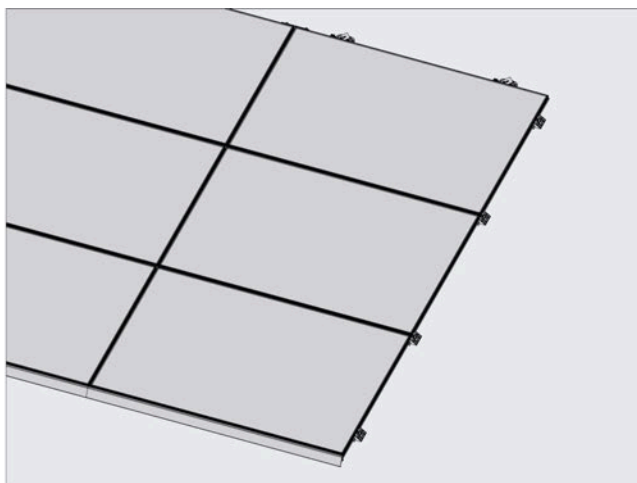
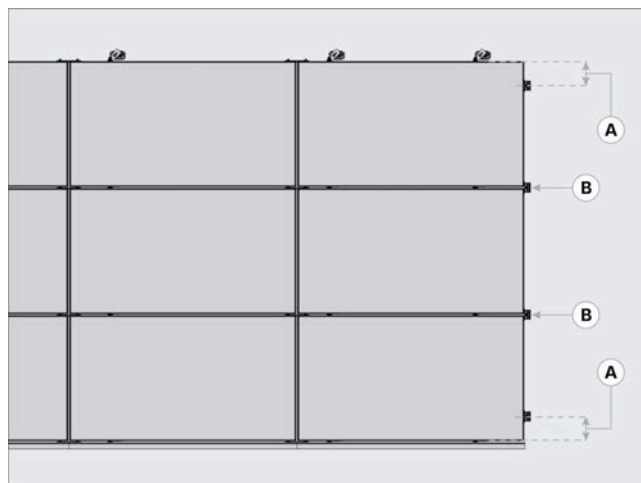


- (2) - Side Skirt Bracket clicks into place when pressed down

Install the Side Skirt Brackets 8 in. from an inside, outside, or top corner of the array and at every module junction.

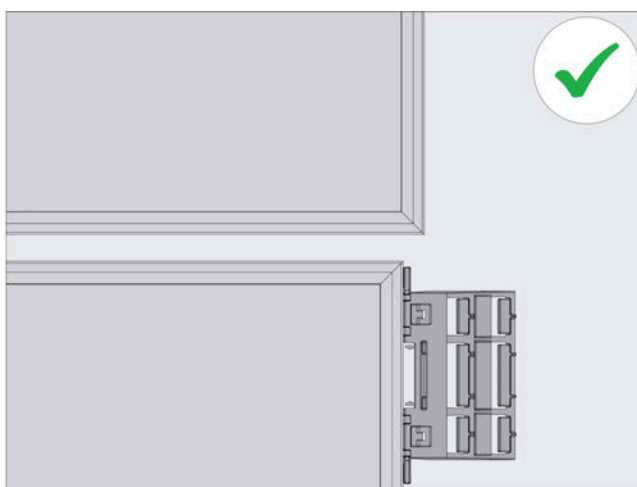
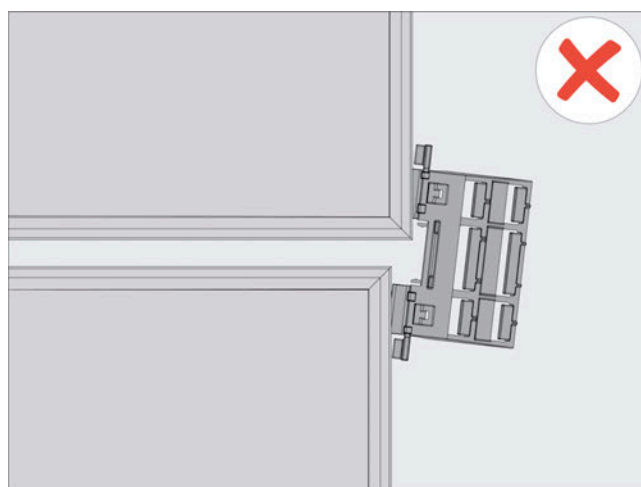


INSTALLATION PROCESS



- (A) - 8 in. spacing from corner of array
- (B) - Module junctions

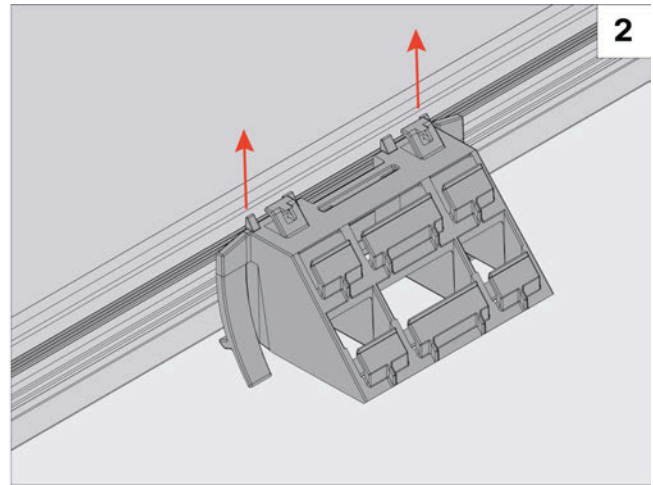
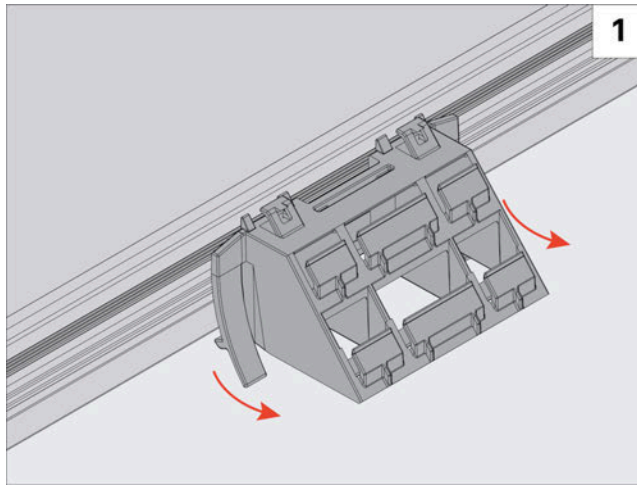
If misalignment exists, the Side Skirt Brackets may not install correctly at module junctions. Either adjust X location of the modules if possible or install the bracket fully on one module.



To reposition a Side Skirt Bracket remove it from the module frame and adjust the location. Do so by pulling back on the tabs at the bottom of the bracket then lifting straight up on the bracket.



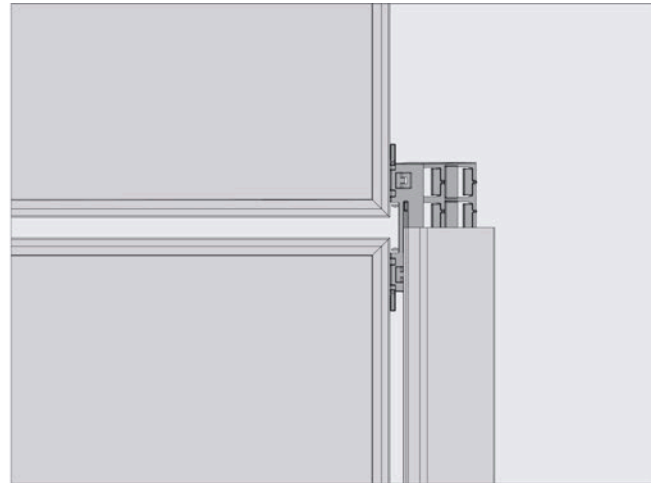
INSTALLATION PROCESS



- (1) - Pull tabs away from module.
- (2) - Lift up to remove Side Skirt Bracket.

2. Install the Side Skirt.

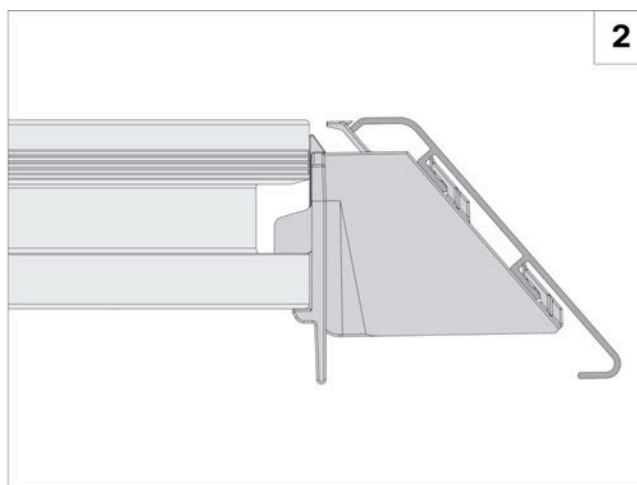
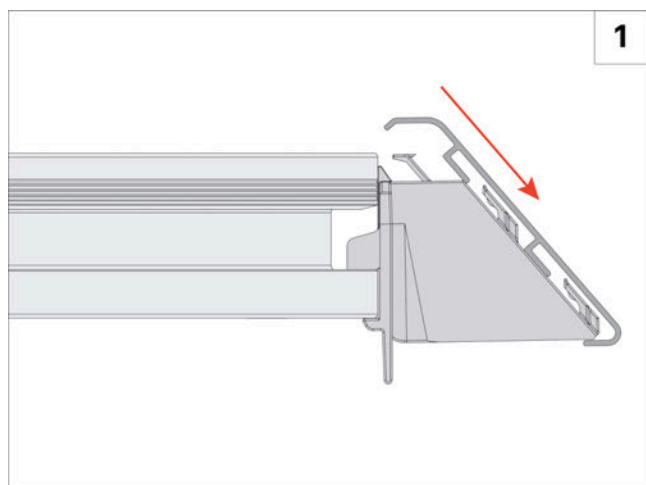
Starting at the bottom corner, align the Side Skirt with the corner of the module (A) and snap it into the Side Skirt Bracket. A clicking sound indicates it is in place. The tabs at the top of the bracket will wrap around the upper lip of the Side Skirt when fully seated.



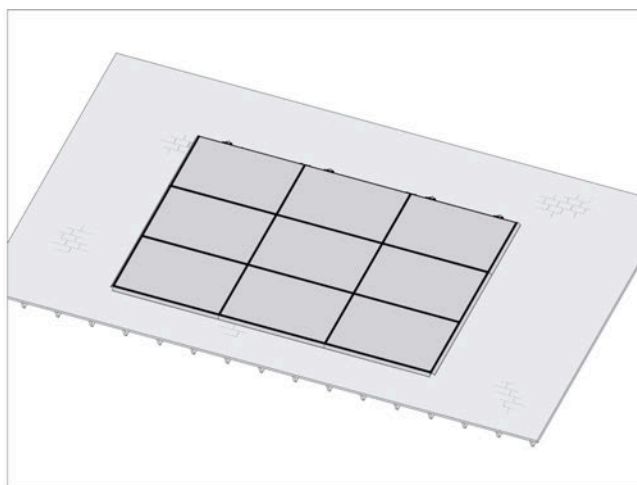
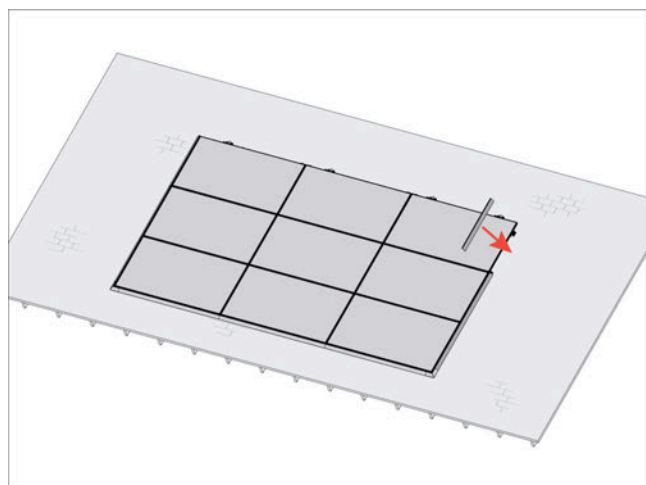
Adjacent Side Skirts will share a Side Skirt Bracket where the edges meet.



INSTALLATION PROCESS



- (1) - Installing Side Skirt onto Side Skirt Bracket
- (2) - Side Skirt clicks into place when fully seated



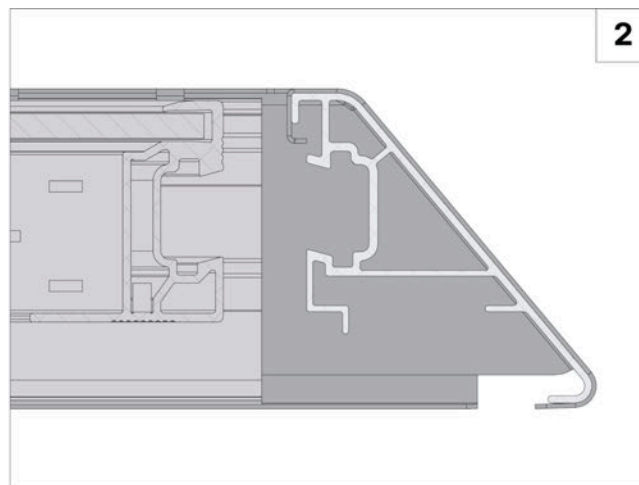
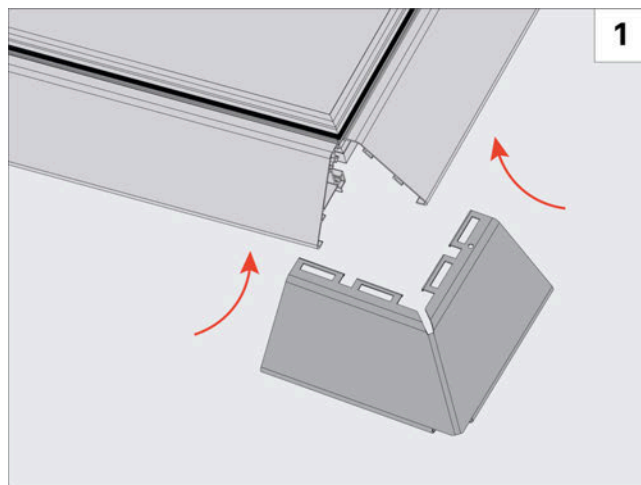
NOTE: Side Skirt Brackets can be pre-installed on the Side Skirt before attachment to the modules. Always comply with spacing requirements and avoid placing brackets on top of wire clips.

3. Install the Corner Caps.

Install the Corner Cap at the junction between the Front Skirt and Side Skirt. Ensure that the lower flange on the Corner Cap wraps around the bottom edge of the skirts.

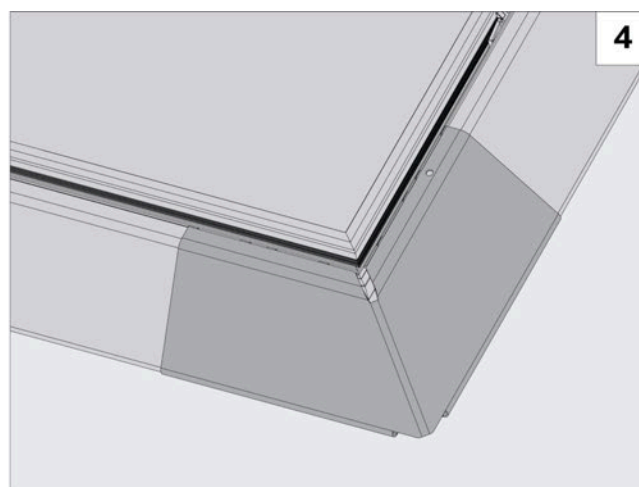
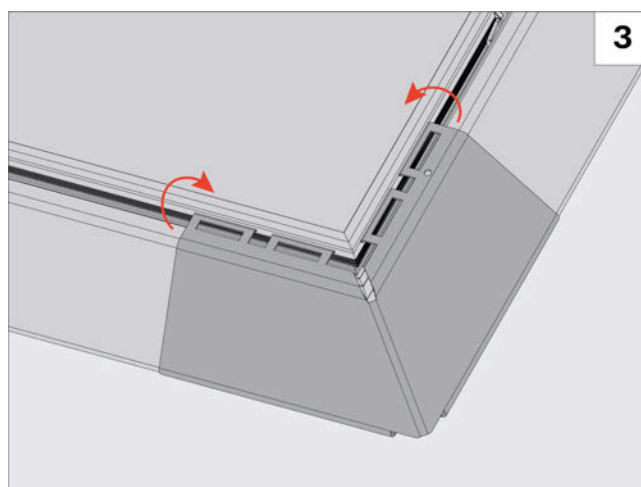


INSTALLATION PROCESS



- (1) - Installing Corner Cap at the junction between Front Skirt and Side Skirt
- (2) - Lower flange wraps around bottom edge

Fold the Corner Cap tabs down around the back of the Front Skirt and Side Skirt. Place the back of a slotted screwdriver between the module frame and the Corner Cap and twist gently to fully engage the tab.

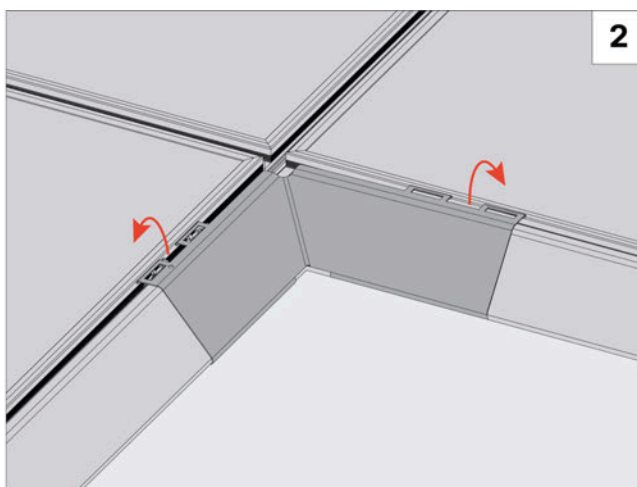
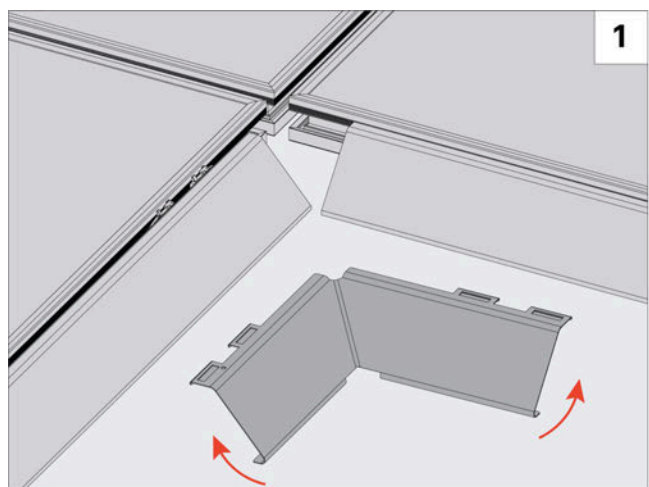


- (3) - Corner Cap tabs fold over the Front Skirt and Side Skirt
- (4) - Fully installed Corner Cap

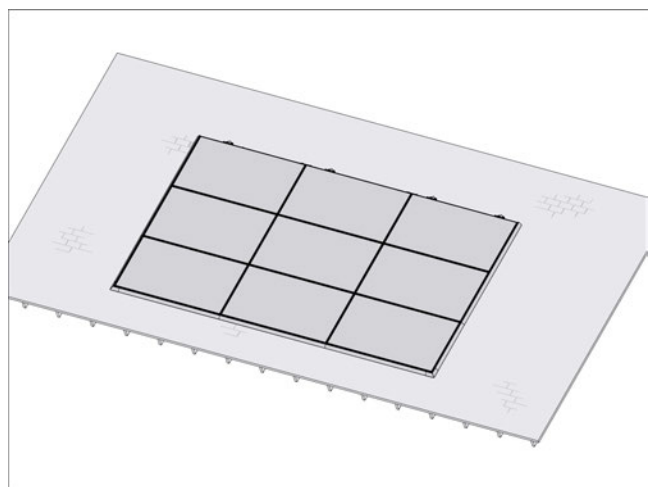
Install inside Corner Caps in the same manner where needed to complete the array.



INSTALLATION PROCESS



- (1) - Placement of inside Corner Cap
- (2) - Corner Cap tabs fold over the Front Skirt and Side Skirt



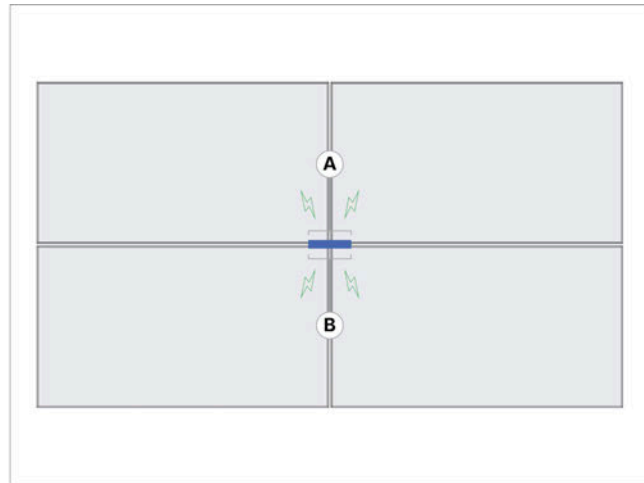
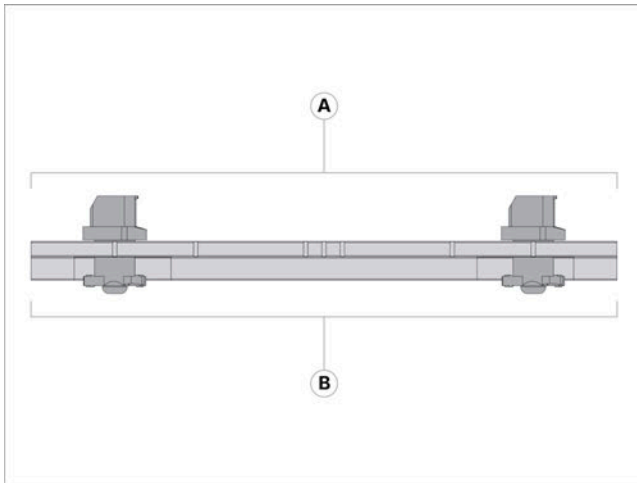
- Completed array



APPENDIX A: GROUNDING AND BONDING

Interlock Bonding

The Interlock bonds modules on all four sides and across the Interlock plate to create a redundantly-bonded array where every module is structurally and electrically bonded to the surrounding modules.



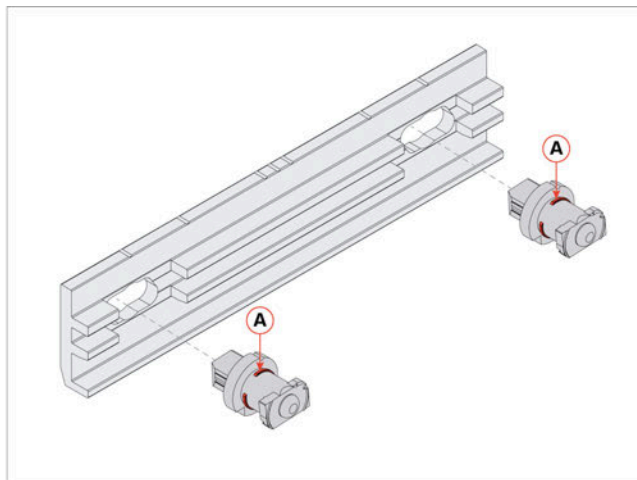
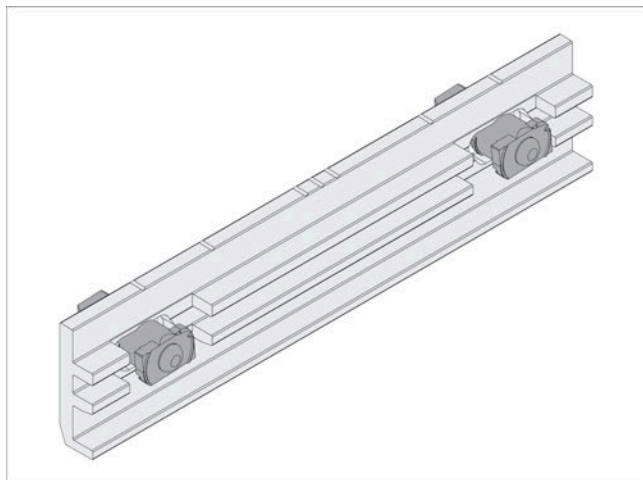
- (A) - Tongue side of the Interlock
- (B) - Key side of the Interlock
- ⚡ Bond path
- — Interlock



APPENDIX A: GROUNDING AND BONDING

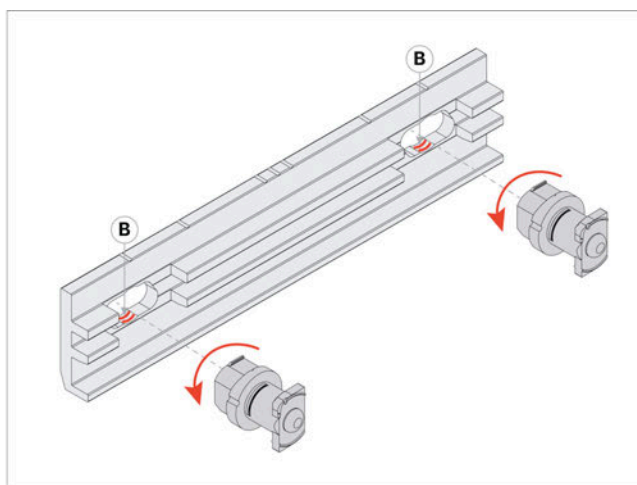
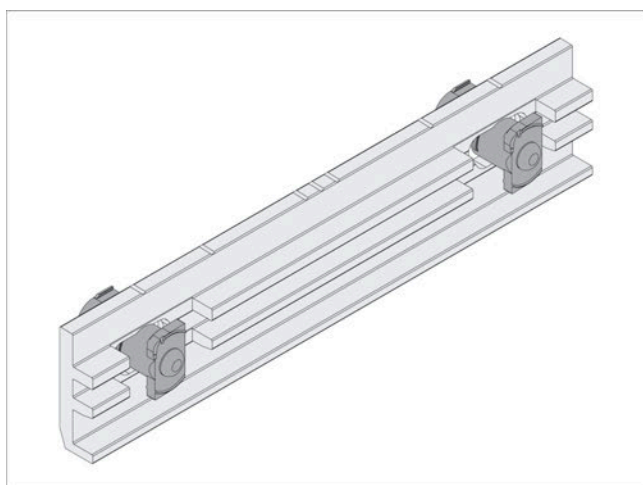
Interlock Lockit to Interlock Bonding

The rotating fastener attached to the Interlock plate, called the Lockit or Interlock Lockit, has two cutting teeth on the shaft that cut into the Interlock plate when the Lockit is tightened during normal installation, resulting in a robust and UL-certified bonding path. The Interlock may be re-installed up to 15 times.



- Lockit (A) in open position:

Lockit in locked position cuts into Interlock plate:



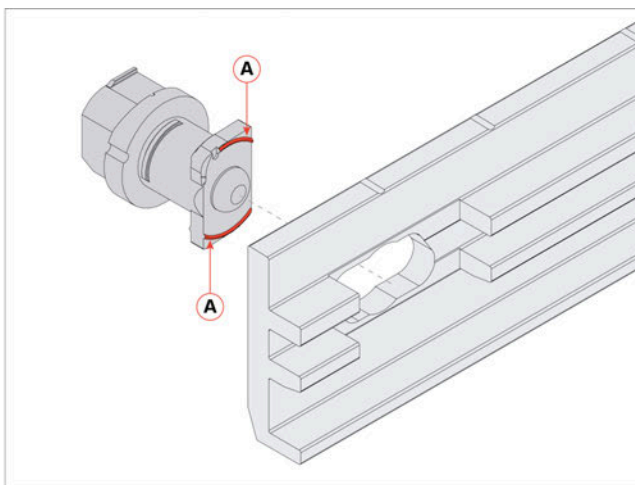
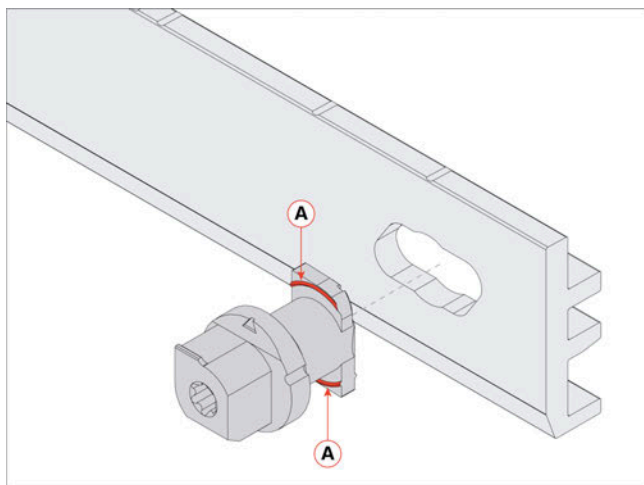
- Lockit in locked position cuts into Interlock plate (B)

Interlock Bonding to Module Frame

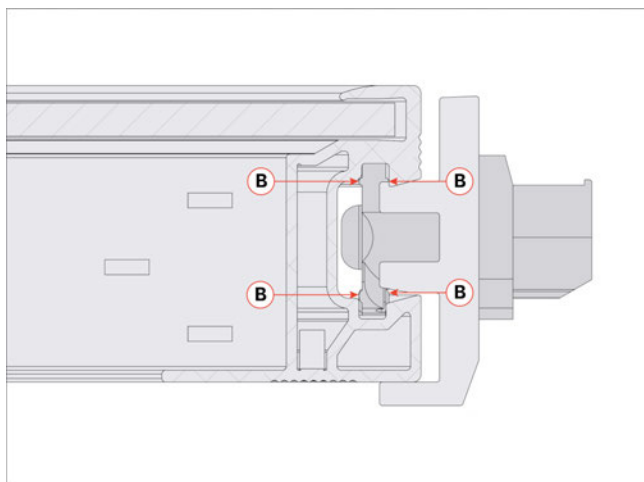
Forced interference during the rotation of the Interlock Lockit causes the teeth to cut through the coating on the module frame, resulting in a robust and UL-certified bonding path. The Key side of the Interlock Lockit bonds the down-roof edge of modules, as shown below:



APPENDIX A: GROUNDING AND BONDING

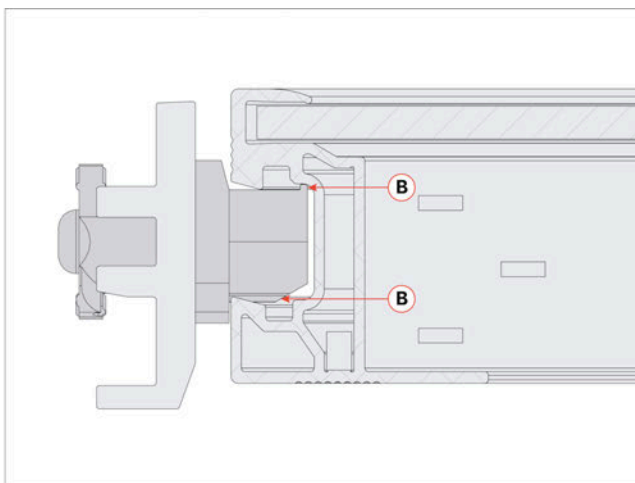
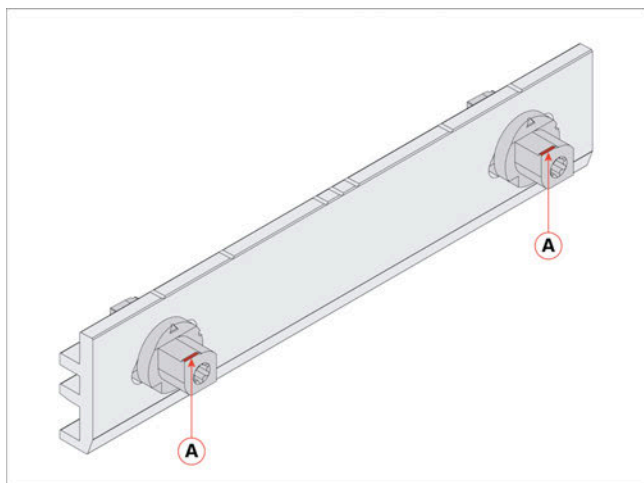


- (A) - Teeth on Interlock Lockit



- (B) - Forced interference bonding with module frame

The Tongue side of the Interlock Lockit bonds modules on the up-roof side in a similar manner, as shown below:



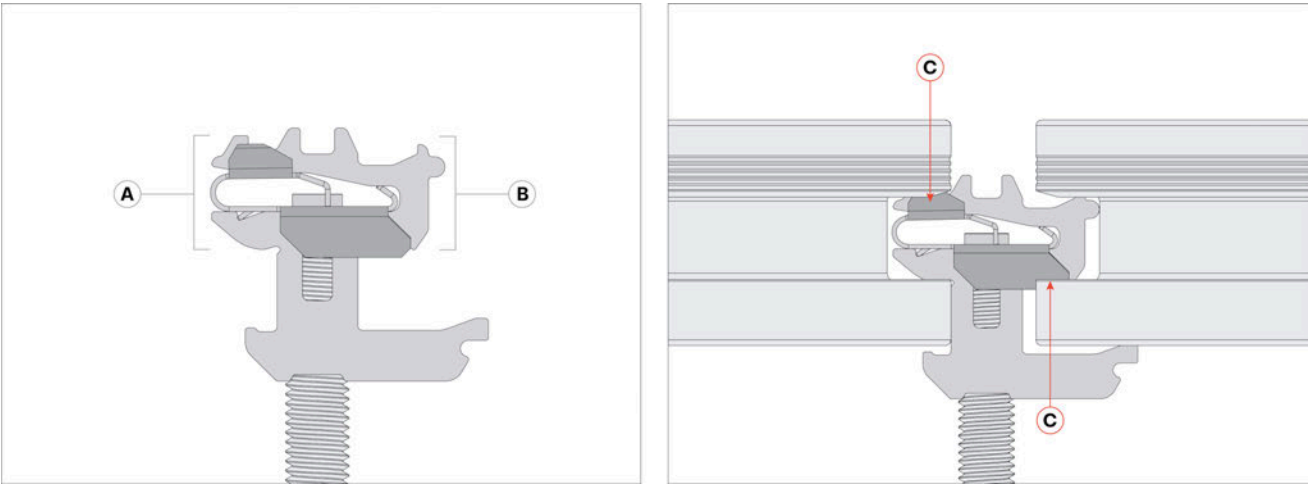
- (A) - Teeth on Interlock Lockit
- (B) - Forced interference bonding with module frame



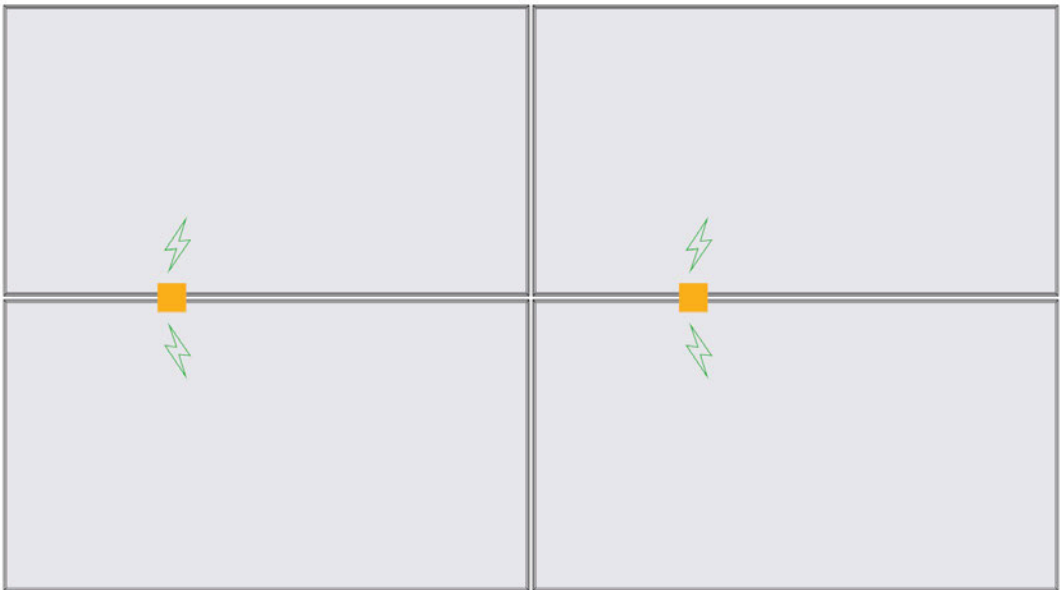
APPENDIX A: GROUNDING AND BONDING

Key & Tongue Side Bonding of the Rockit

The Rockit has a stainless-steel spring clip that bonds to the adjacent module frame on both Key and Tongue sides. A module can be pulled out to the edge of the lip and still be correctly installed, allowing for small variations in module sizes or module alignment.



- (A) - Key side of Rockit
- (B) - Tongue side of Rockit
- (C)- Bond location



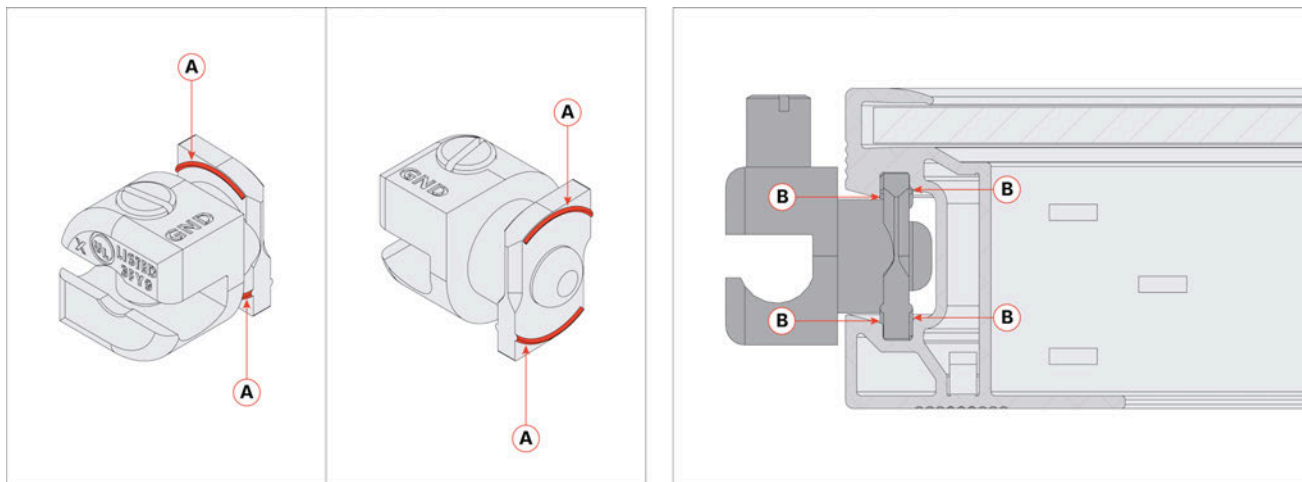
- ⚡ Bond path
- ■ Rockit



APPENDIX A: GROUNDING AND BONDING

Ground Lockit

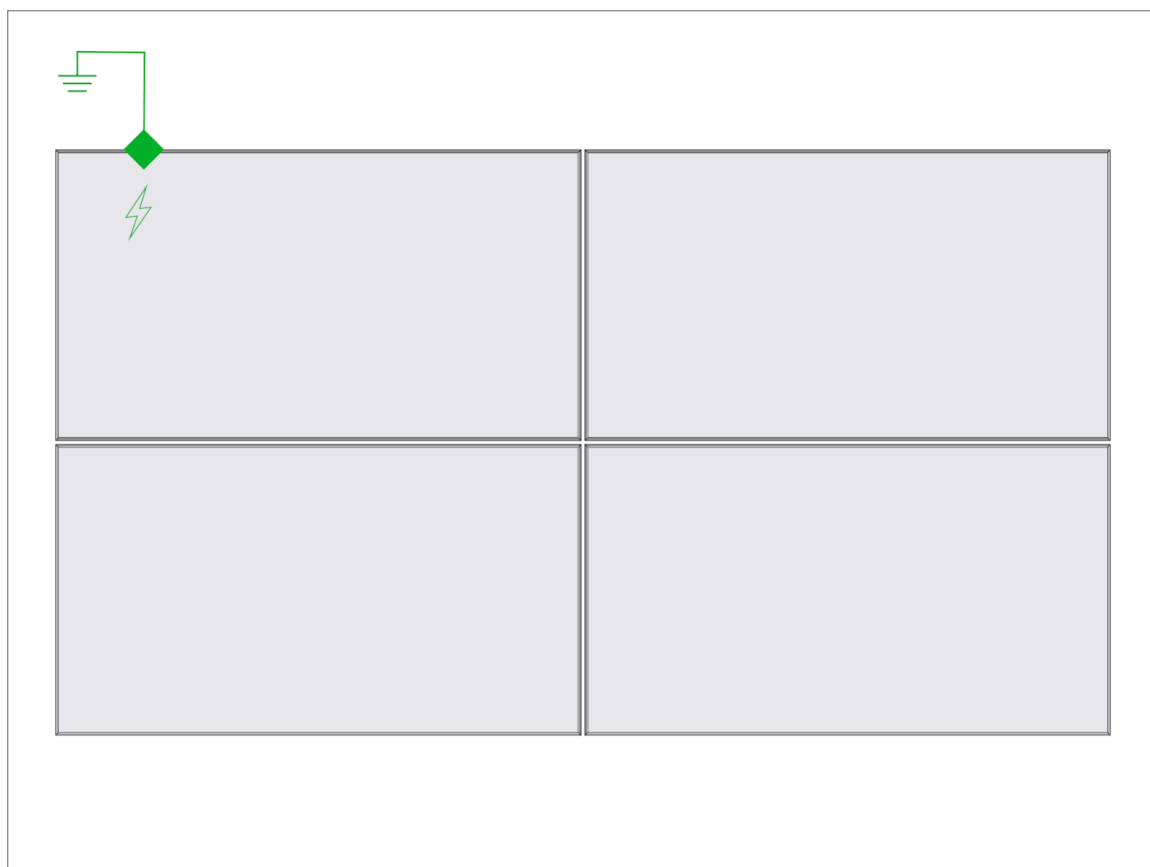
The Ground Lockit bonds to the modules in the same way as the Interlock with biting teeth that cause forced interference during rotation. The teeth cut through the coating on the module frame, resulting in a robust and UL-certified bonding path.



- (A) - Teeth on Ground Lockit
- (B) - Forced interference bonding with module frame



APPENDIX A: GROUNDING AND BONDING



-  Bond path
-  Ground Lockit
-  Equipment grounding conductor (EGC)
-  Earth ground

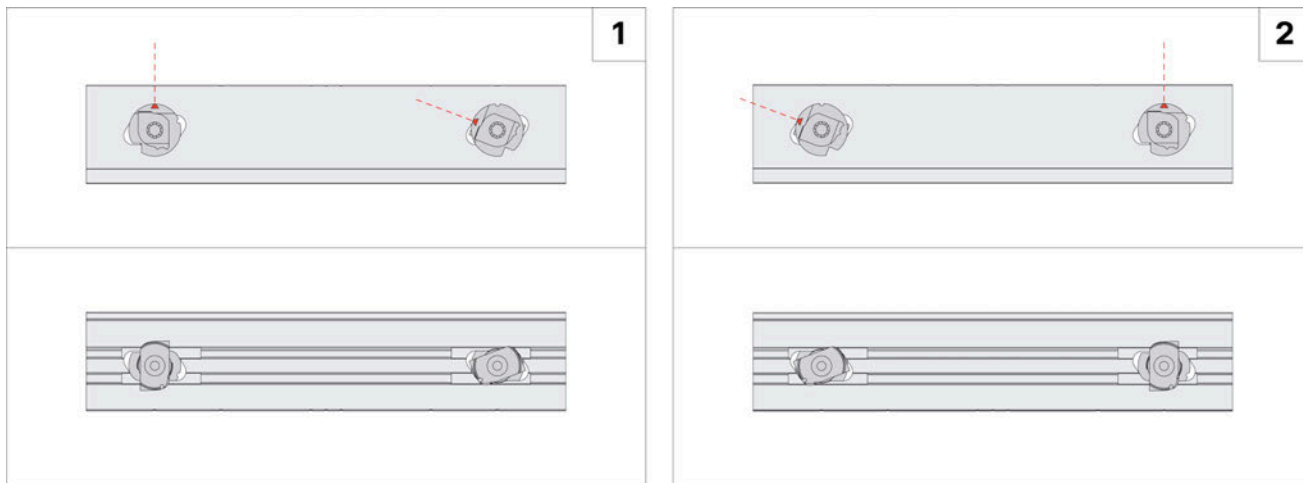


APPENDIX B: THERMAL EXPANSION

Installing Thermal Expansion Joints

Thermal expansion joints consist of Interlocks that are installed in a manner allowing modules a small amount of lateral movement for thermal expansion in response to daily temperature swings on the roof. In the up-roof/down-roof direction, a physical gap is required to allow for thermal expansion of the modules. A gap of at least 12 in. between sub-arrays is recommended, both for thermal expansion and to allow access by work crews for module servicing.

Rotate the Interlock Lockit on one side to Position 3 (locked position). Rotate the Interlock Key on the other side to Position 2. Position 2 provides a structural connection but does not establish an electrical bond.



- (1) - Thermal break right (Positions 3 and 2)
- (2) - Thermal break left (Positions 2 and 3)

 **NOTE:** Marking thermal breaks on the roof during array layout can help ensure they are completed as required.

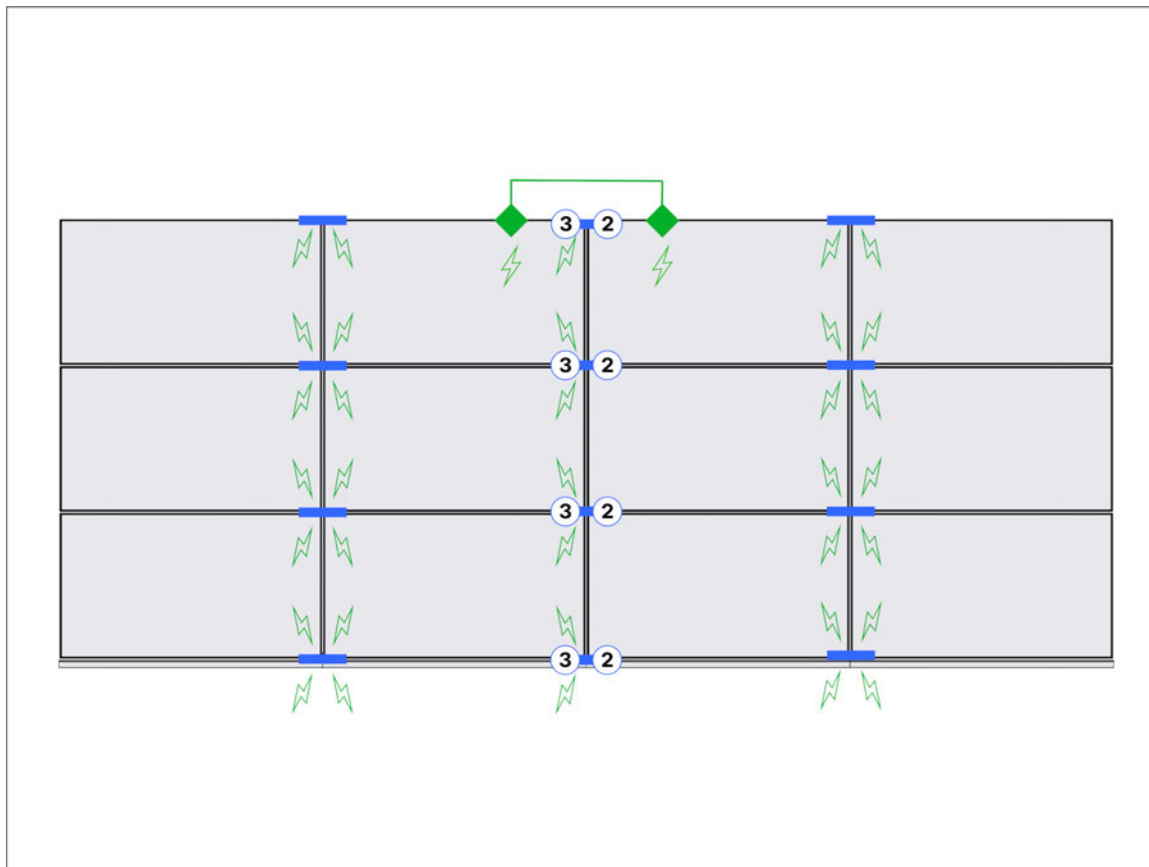
Thermal expansion joints require that a Ground Lockit be installed on both sides of the break.



APPENDIX B: THERMAL EXPANSION

Thermal Expansion Joints and Module Columns

When there is a continuous column of Interlocks all serving as a thermal expansion joint, all Interlocks must be set to Position 3 on the same side. This is because the Interlock also electrically bonds the up-roof module when turned to Position 3. Thermal expansion joints should also be included at the array skirt.



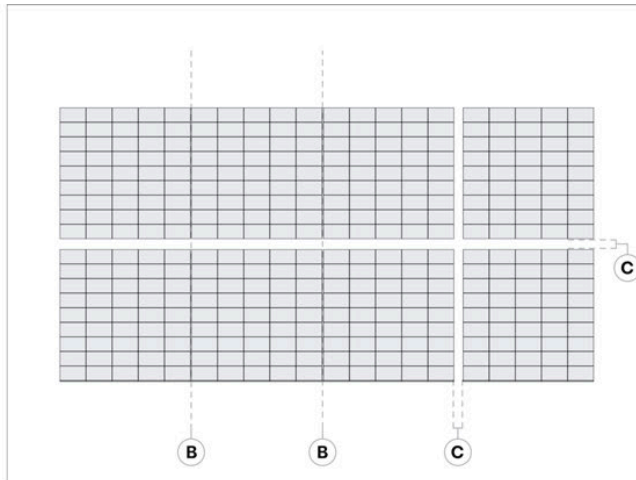
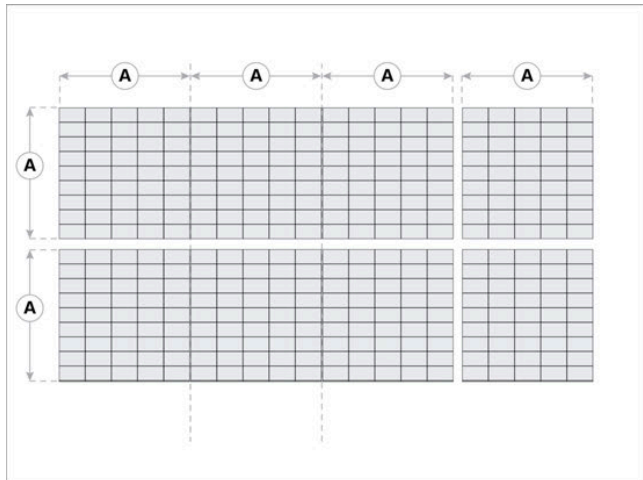
-  Bond path
-  Ground Lockit
-  Equipment grounding conductor (EGC)
-  Interlock



APPENDIX B: THERMAL EXPANSION

Physical Gaps Between Sub-Arrays

For arrays spanning more than 33 ft (10 m) in the Y direction, physical gaps will be needed to allow thermal expansion. At a minimum, the gap should be 4 in. (100 mm). However, a gap of 12 in. (300 mm) is recommended for ease of servicing.



- (A) - 33 ft (10 m) in X or Y direction
- (B) - Thermal expansion joints
- (C) - Physical gaps

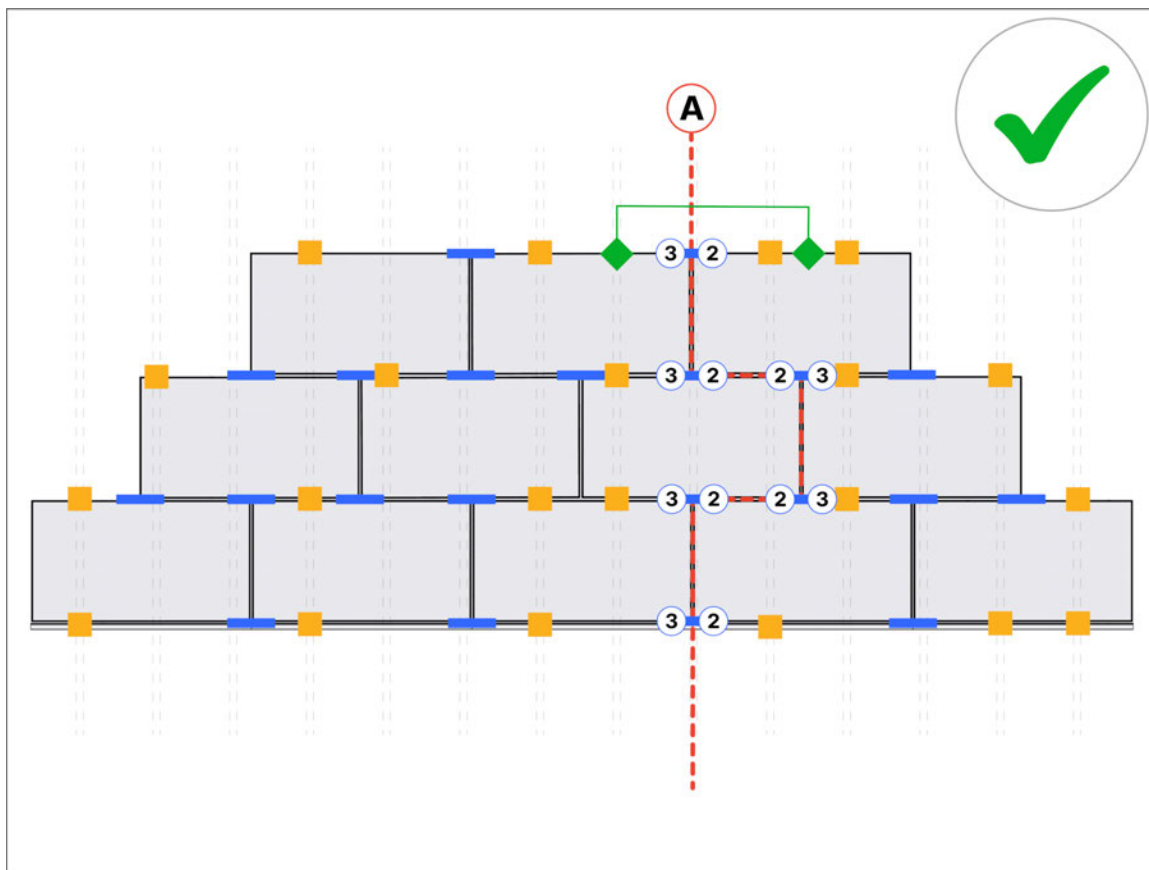


APPENDIX B: THERMAL EXPANSION

Thermal Expansion Joints in Staggered Arrays

When module rows are offset from one another, creating a thermal expansion joint is more complex, requiring additional Interlocks in a continuous path with no Rockits between them.

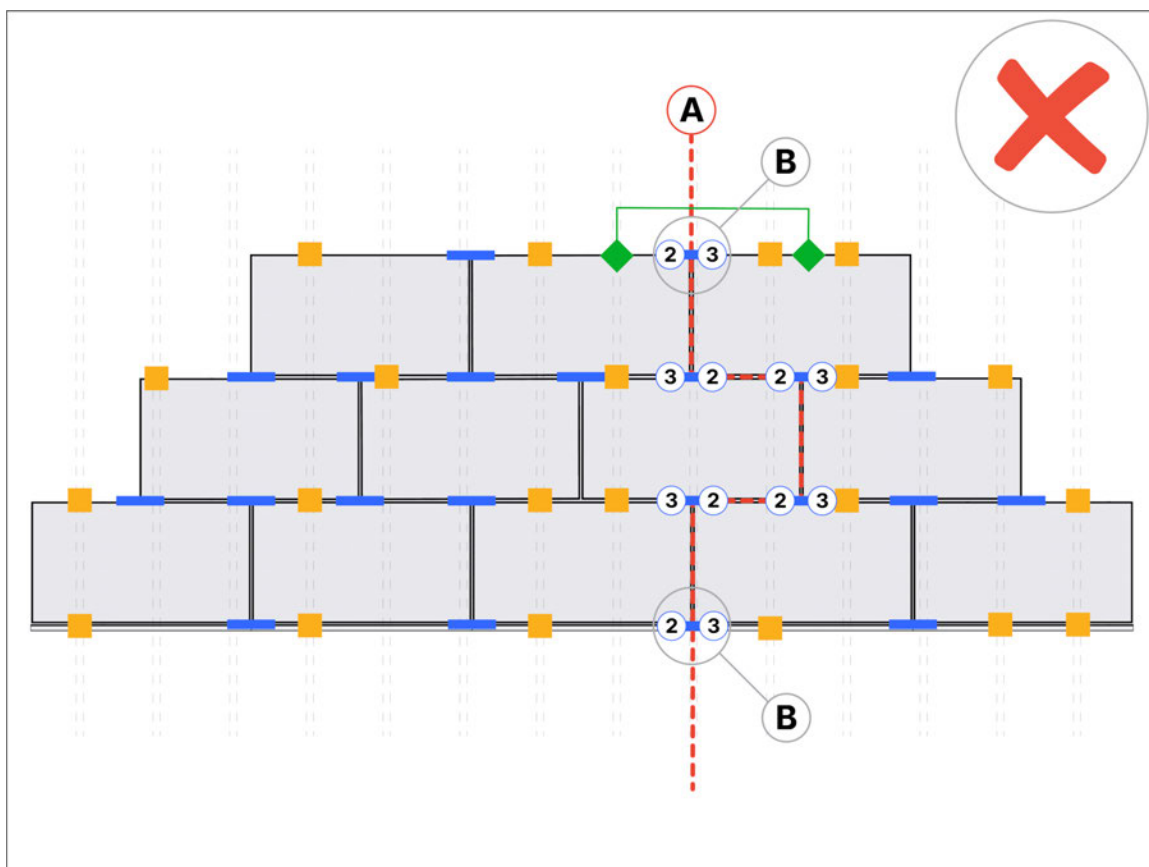
Thermal expansion joints on staggered arrays require Interlocks at each juncture where the array is intended to expand. Each Interlock Lockit is turned to Position 2 (the middle position - marked by a notch) on one side (allows thermal expansion) and Position 3 (fully locked - marked by an arrow) on the other, such that there is an unbroken line between the Lockits in Position 2. The installer must not place any Leveling Feet between these points as the Rockits do not allow any lateral movement.



- (A) - Thermal expansion joint



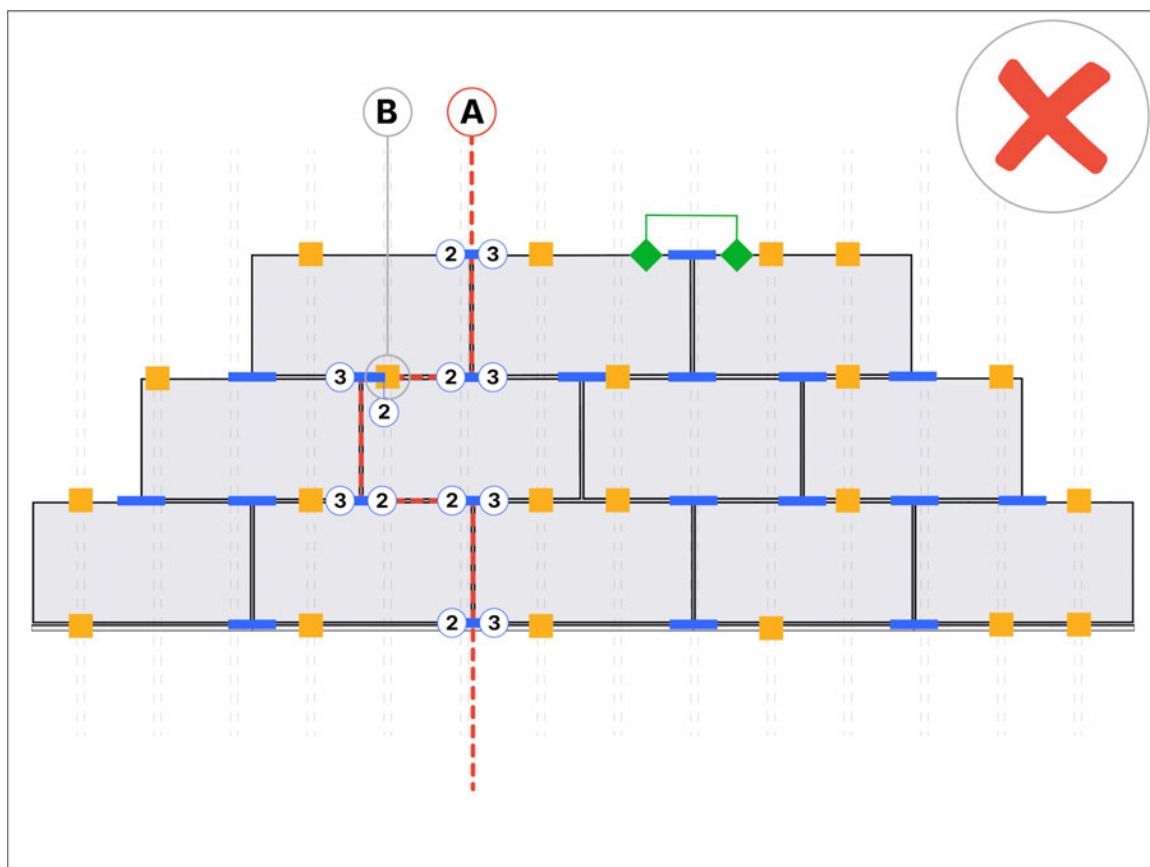
APPENDIX B: THERMAL EXPANSION



- (A) - Thermal expansion joint
- (B) - Incorrect Interlock Lockit positions



APPENDIX B: THERMAL EXPANSION



- (A) - Thermal expansion joint
- (B) - Rockit interfering with thermal expansion path



APPENDIX C: ALLOWABLE MOUNTING SYSTEM LOADING

Tesla Compatible modules have been evaluated for design loads on the back surface (e.g., wind load) and on the front surface (e.g., wind and snow load).

Allowable system-level pressures were evaluated using the maximum allowable hardware pressure and the maximum allowable panel pressure at various spans. The lower of the allowable pressures for a given span is shown in the table below. All calculated values result in system-level pressures lower than the UL 2703 listed rating of the hardware and panel combination.

The hardware allowable pressure is calculated as the maximum component allowable force over a specified tributary area defined by the X and Y spans of the hardware. The Y span of the hardware is equal to the panel Y dimension plus the 0.7 inch maximum gap between modules. The maximum allowable panel pressure is tested at various spans in a method similar to UL 2703. Linear interpolation is used to determine allowable panel pressures for intermediary spans.

For any framing member spans not listed, linear interpolation may be used to determine allowable system level pressure.

Tesla Solar Panels

Comp Rafter - Tesla Solar Panels :					
Tesla Solar Panel TSP 4XX					
	Horizontal Span (in.)	Allowable Cantilever (in.)	Uplift Pressure (psf)	Downforce Pressure (psf)	Down Slope Load (psf)
Landscape	72	26	25.5	38.4	10.8
	64	24	28.7	43.6	12.2
	48	18	34.8	54.0	16.2
	32	13	51.6	58.0	24.4
	24	14	60.0	60.0	30.0
	24	12	60.0	60.0	32.5
	16 ¹	6	60.0	60.0	37.0
Portrait	48 ¹	16	20.0	20.0	8.0
	32	11	20.0	20.0	8.0
	24	8	20.0	20.0	8.0
	16	6	20.0	20.0	8.0

¹ Indicated value evaluated as part of UL 2703 Listing with standard UL 2703 test method and acceptance criteria.



APPENDIX C: ALLOWABLE MOUNTING SYSTEM LOADING

Hanwha Qcells

Comp Rafter - Hanwha Qcells :					
Q.PEAK DUO BLK ML-G10+/TS & Q.PEAK DUO BLK ML-G10.a+/TS					
	Horizontal Span (in.)	Allowable Cantilever (in.)	Uplift Pressure (psf)	Downforce Pressure (psf)	Down Slope Load (psf)
Landscape	72	24	27.2	30	11.6
	64	22	30.6	36.7	13
	48	16	40.8	50	17.3
	32	11	61.1	73.3	26
	24	8	81.5	81.5	34.7
	16 ¹	6	85	85	37
Portrait	64	22	15	15	7.2
	48 ¹	16	20	20	8
	32	11	20	20	8
	24	8	20	20	8
	16	6	20	20	8

¹ Indicated value evaluated as part of UL 2703 Listing with standard UL 2703 test method and acceptance criteria.

Mounting system Model No.	Investigated for Bonding	Investigated for Mechanical Loading	System Fire Classification (A, B, or C)	Tested in Combination With
Tesla Panel Mount - Comp Rafter	Yes	Yes	A	NRTL Listed: Hanwha -Q.CELLS GmbH: Q.PEAK DUO BLK ML-G10+/TS XXX, where XXX is 395 to 415Q.PEAK DUO BLK ML-G10.a+/TS, where XXX is 370 to 425 Tesla -TSP-XXX, where XXX is 405 to 430

As specified in UL 61730-1 5.2.3DV, PV modules are considered to be in compliance with the mechanical loading and bonding and grounding requirements of UL 61730-1 when mounted, bonded, and grounded in the manner specified by either the PV module mounting instructions, or the mounting system manufacturer's instructions when the mounting, bonding, and grounding means have been evaluated with the PV module to UL 2703.

To be used only in combination with modules that include this specific rack system in the module manufacturer's installation manual.

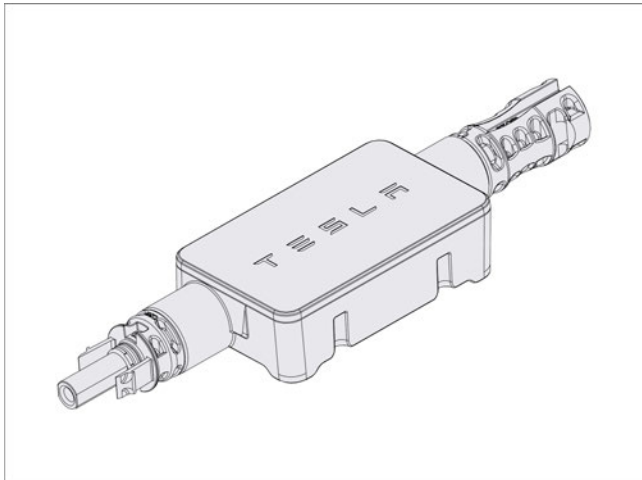


APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS

Installing Mid-Circuit Interrupters (MCIs) in PV Arrays

The Tesla Mid-Circuit Interrupter (MCI) is used within PV strings and arrays to meet the rapid shutdown requirements of NEC Article 690.12.

MCI-2



MCI Locations

The quantity and placement of MCIs necessary to meet rapid shutdown requirements in NEC Article 690.12 (B) is governed by the UL 3741 (PV Hazard Control System or PVHCS) listing applicable to various array types. Always refer to the applicable PVHCS datasheets and references included in the addendum for detailed instructions to ensure adequate compliance and safe operation.

WARNING: It is critical that the minimum number of required MCIs is installed. Without the appropriate number of MCIs, the MCIs may not function as intended, which could lead to equipment damage and risk of electrical shock.

NOTE: MCIs are not required if the system does not need to comply with rapid shutdown requirements (NEC 690.12).

Installation Best Practices

- Ensure that Tesla MCIs are not stored prior to installation in environments with moisture or dirt. Improper storage can lead to corrosion on the connector pins.
- Install the Tesla MCI in line with the PV modules using standard Staubli MC4 connectors. Incompatible connectors can lead to system failures.
- Ensure that the MCI is a minimum of ½ in. from the glass or backside of a PV module. This prevents overheating of the power electronics.
- Always secure the MCI with appropriate wire management. NEC 690.31(C)(1)(b) specifies that there must be a wire clip every 24 in. (600 mm). Wire clips should be at least 2 in. (50 mm) but not more than 6 in. (150 mm) from the connectors.
- Ensure that no more than 5 MCIs are connected per PV string.

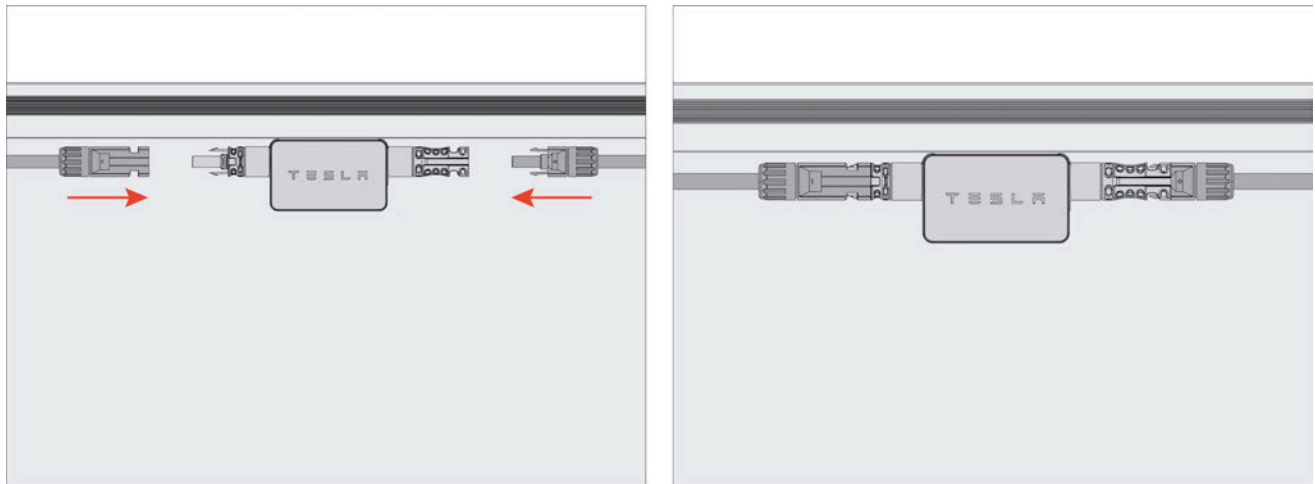


APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS

- Ensure that the total DC circuit length, from (+) MPPT terminal to (-) MPPT terminal (including module wire leads, jumper wires, and all wiring within the array boundary for any individual string), does not exceed 525 ft (160 m) for single strings or 394 ft (120 m) for parallel strings.
 - The total DC circuit length refers to the entire round trip wire length from the inverter to the roof, then back to the inverter.
 - Ensure that the parallel strings are the same length or as close in length as possible. If the parallel strings are different lengths, it is likely that the MCIs will not function properly. This likelihood increases the greater the difference in parallel string lengths.
- Keep a completed string diagram indicating the layout of the array and the placement of each MCI (either a paper copy, electronic copy available in the field, or both).

Installing MCIs

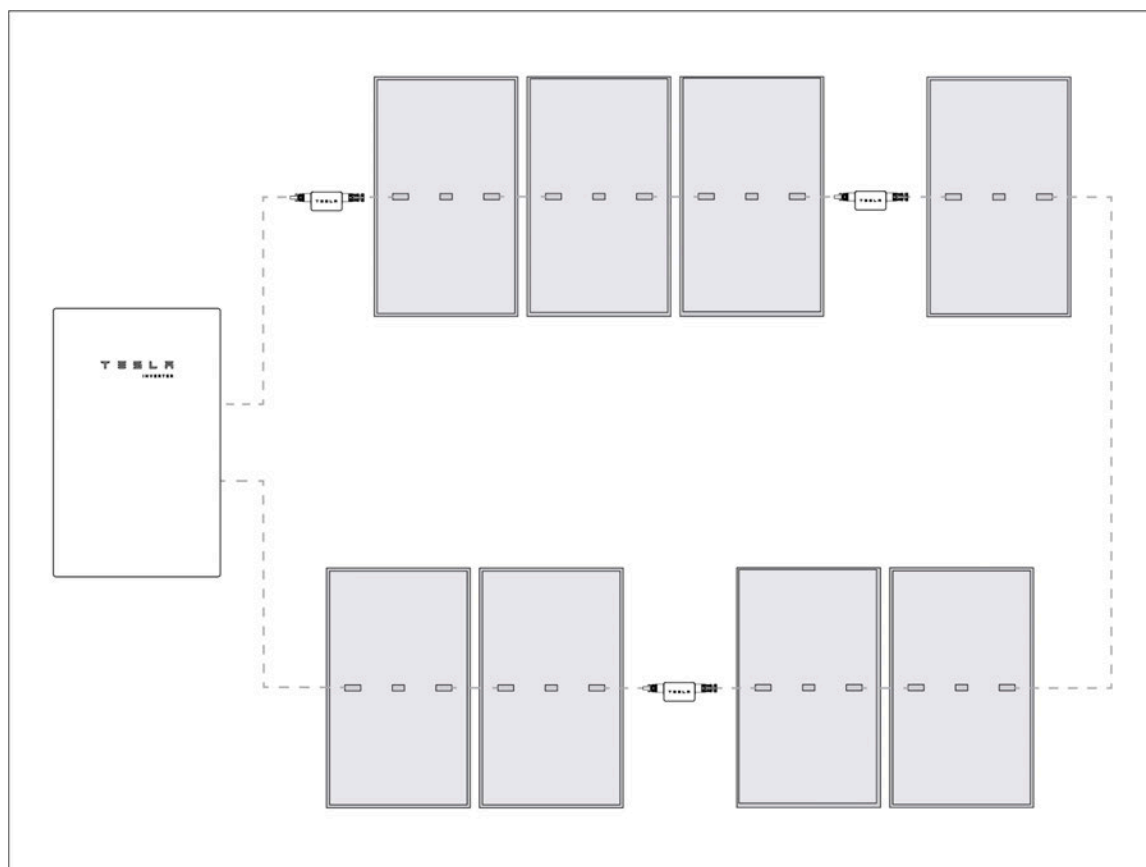
1. Connect the positive and negative leads of the MCI to the corresponding positive / negative MC4 terminals of the PV modules.



MCIs Installed in Line with PV Modules



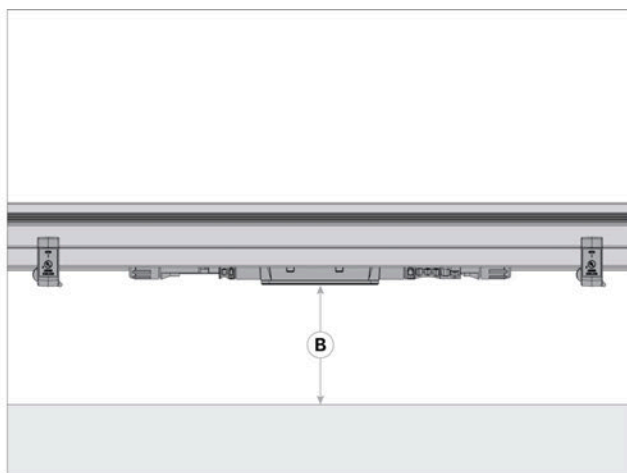
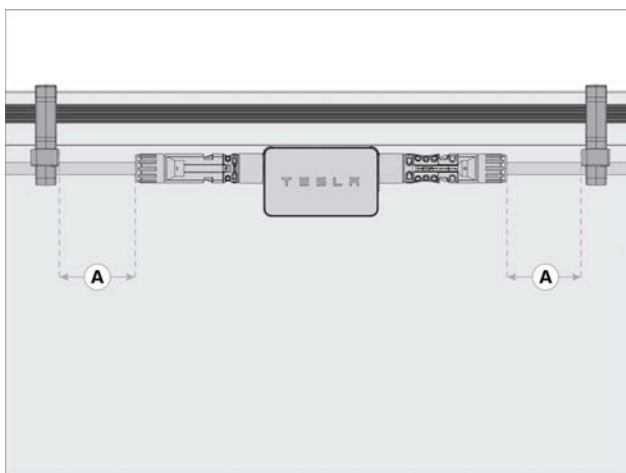
APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS



2. Attach the MCI under the module frame.

- To attach the MCI using DC Wire Clips or Home Run Wire Clips, install the (2x) clips to the module frame and clip both ends of the MCI leads, then slot the MCI underneath the metal frame.

MCI-2 Attached with Wire Clips



- (A) - Minimum distance from clips
- (B) - Minimum distance from roof



CAUTION: Do not twist the MC4 connectors on MCI-2. Twisting the connectors damages the electrical contacts inside, likely resulting in MCI failure.



APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS



NOTE: For MCI-2, place the wire clips at least 2 in. (50 mm) but not more than 6 in. (150 mm) from the connectors.



APPENDIX E: MODULE SERVICING

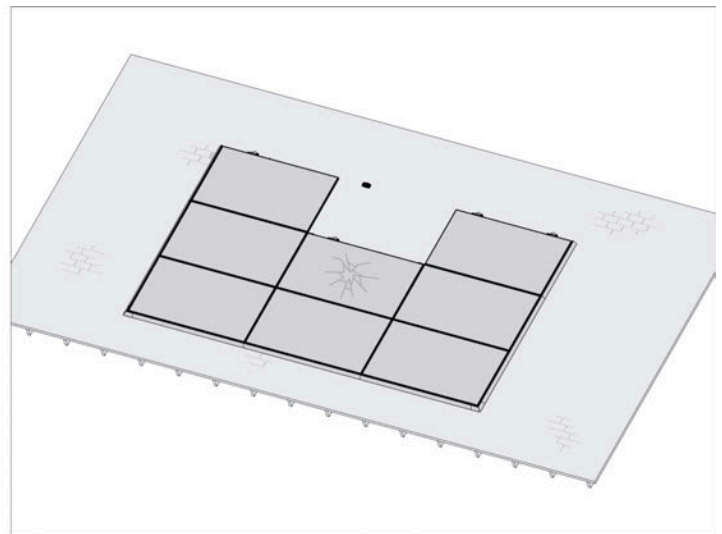
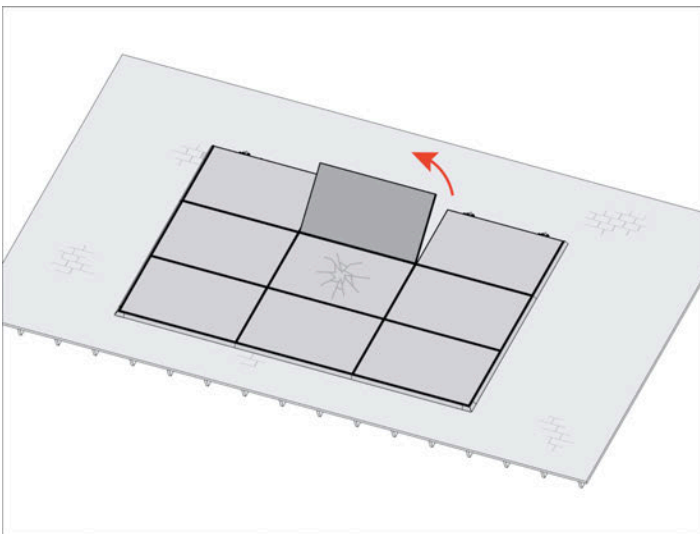


Hazards: Arc flash and electrical shock.

Tools and Equipment:

- 8 Cal/cm² arc-rated long-sleeved shirt and arc-rated pants
- Safety Glasses (ANSI Z87 rated)
- Class 0 insulated electrical gloves with leather protectors
- Lockout/Tagout equipment

To service installed modules, the hardware can be removed in the reverse operation from which it was installed, from the top of the array down. The Tesla Solar Wrench is a custom tool designed to aid in the servicing of Tesla Panel Mount systems. With this tool, a centrally-located module can be removed by first removing the modules in the column above it.

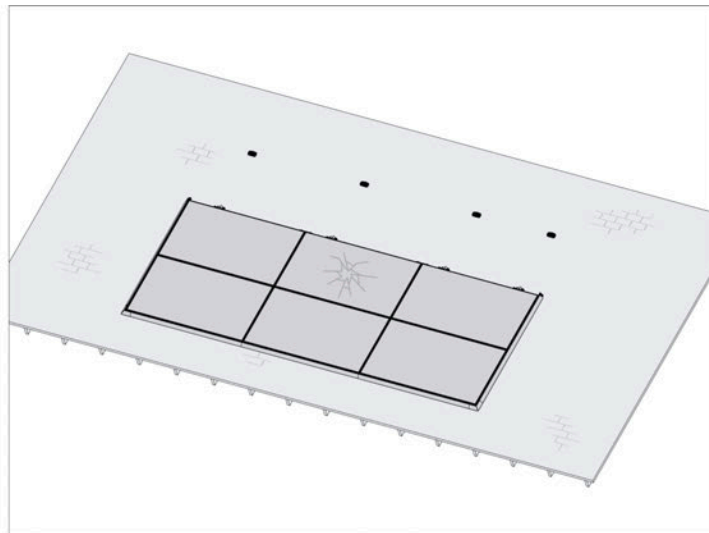
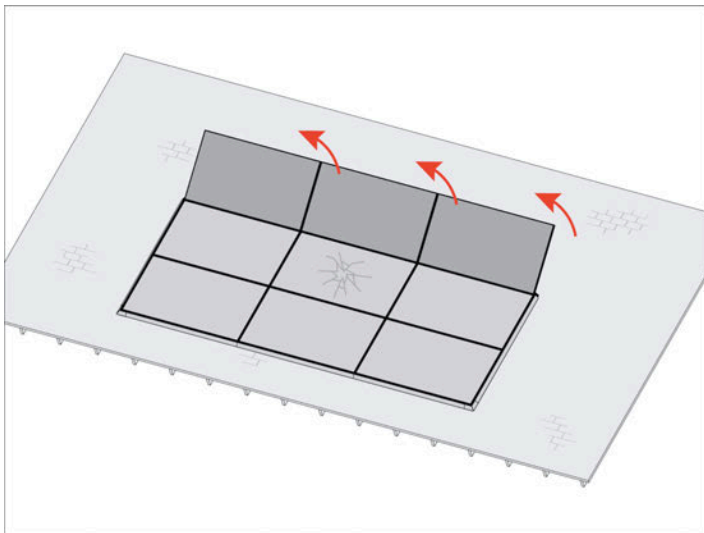


- *Top row module removal with Tesla Solar Wrench*

If you do not have the Tesla Solar Wrench, the array can be serviced with a T40 tool as well. The T40 tool will require entire rows to be removed down to the level of the suspect module.



APPENDIX E: MODULE SERVICING



- Top row removal is required if using T40 tool

1. De-energize PV array.



WARNING: This procedure is to be done before performing service on PV modules to prevent arc flash and electrical shock hazard.

While de-energizing the system the proper PPE must be worn to protect against the electrical hazards that are present. Ensure you have the proper PPE and are wearing it correctly.

Follow lock out/tag out procedures for AC and DC disconnects, wait five minutes and use a voltmeter to verify that the system has been de-energized before proceeding.

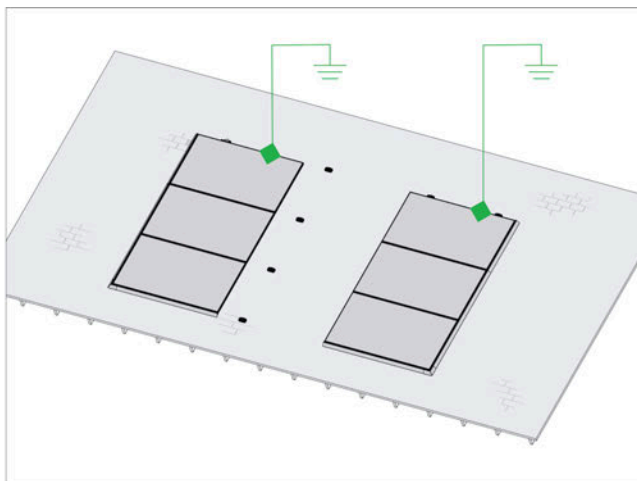
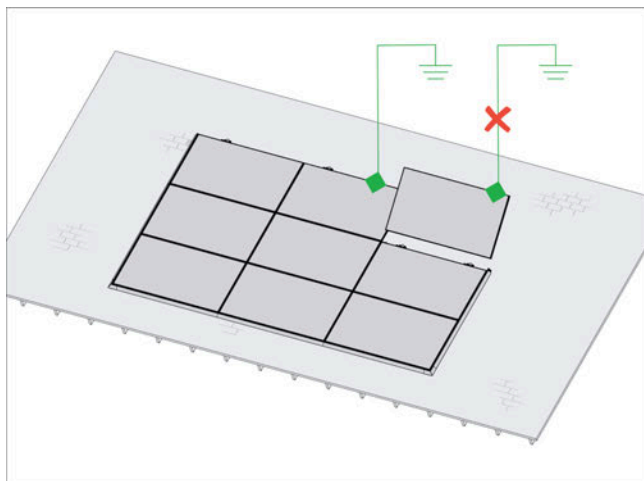
2. Maintain ground path.

If the module with the Ground Lockit must be removed for servicing, use additional Ground Lockits as needed to ensure the ground path is maintained.

If a group of modules is entirely disconnected from the module with the Ground Lockit, an additional Ground Lockit will need to be added to the isolated modules to ensure the ground path is maintained.

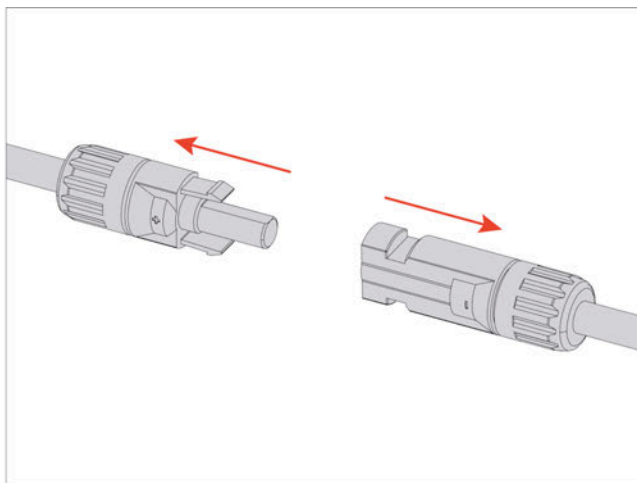
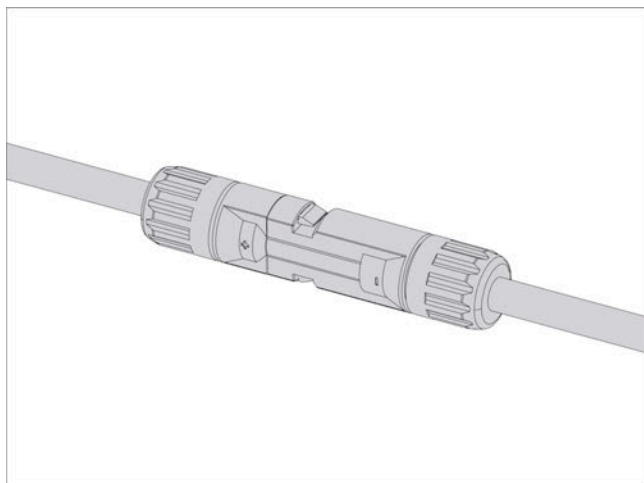


APPENDIX E: MODULE SERVICING



-  Ground Lockit
-  Equipment grounding conductor (EGC)
-  Earth ground

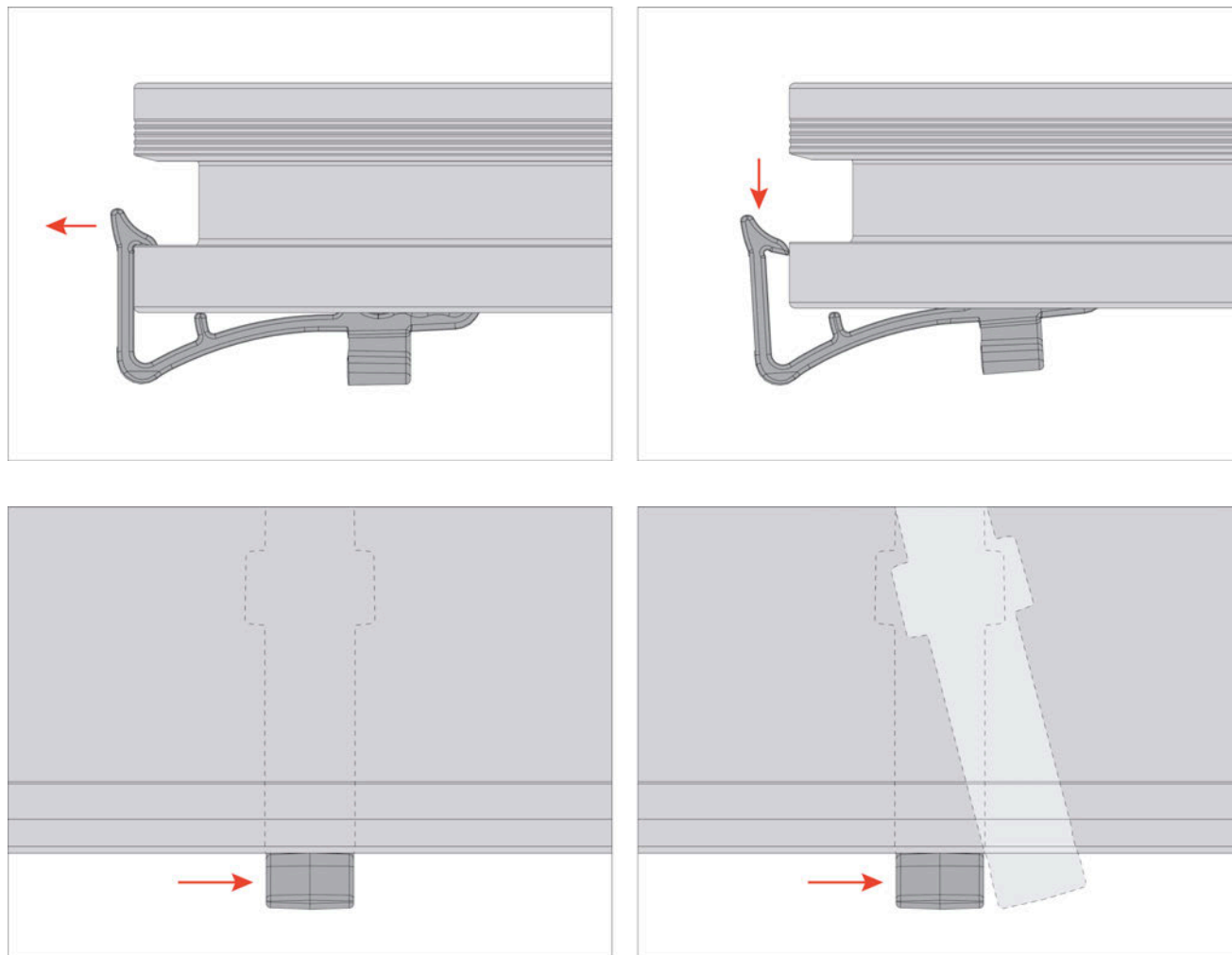
3. Disconnect the module wires, Wire Clips, and jumpers.



NOTE: Use an MC4 disconnect tool to release the connectors.



APPENDIX E: MODULE SERVICING

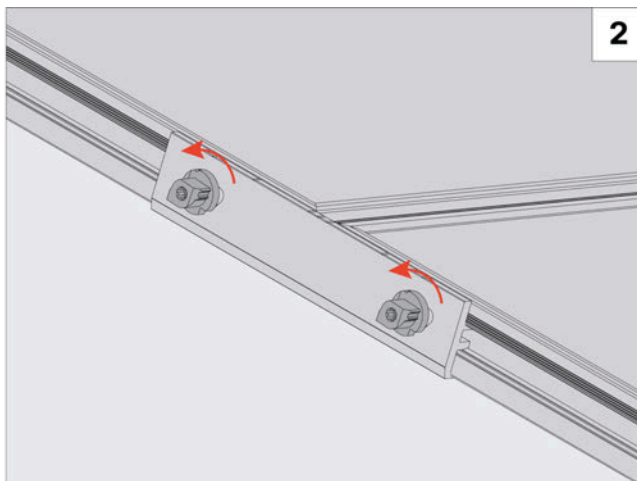
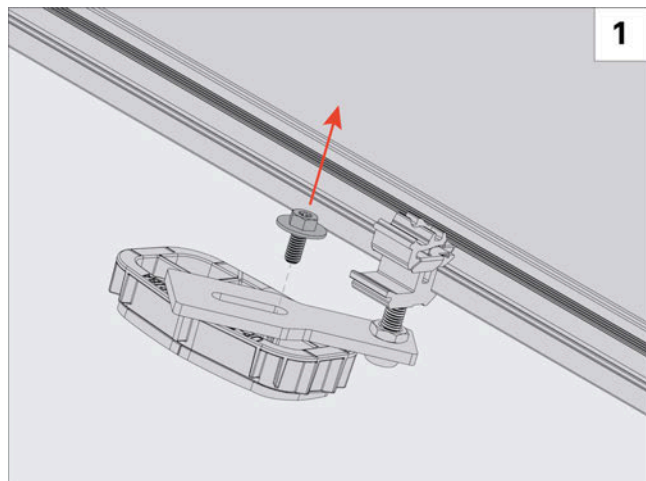


4. Release the up-roof modules.

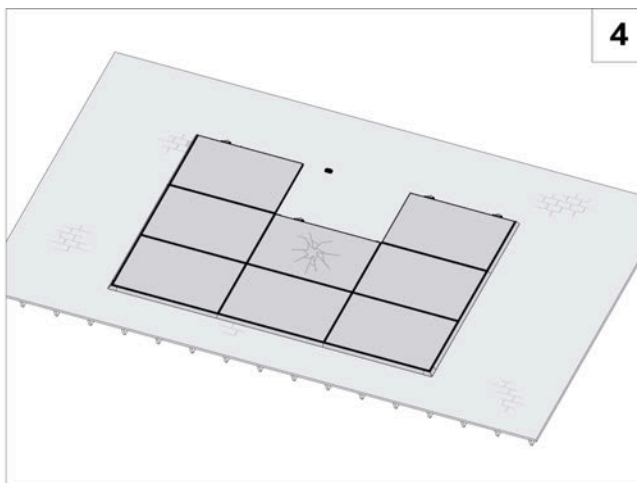
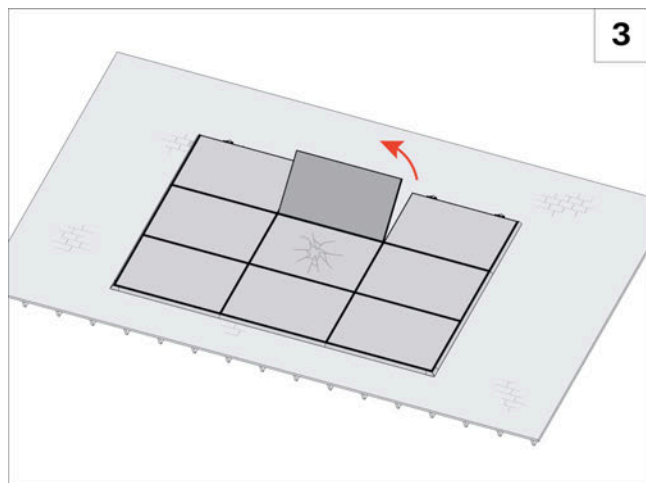
Remove all the Interlocks at the top of the column containing the module needing replacement and unbolt the Leveling Feet attached to the module. Remove the first module by lifting it above a 15° angle and pulling it off the front Leveling Feet and Interlocks.



APPENDIX E: MODULE SERVICING



- (1) - *Unbolt Leveling Foot*
- (2) - *Rotate Interlocks to Position 1*



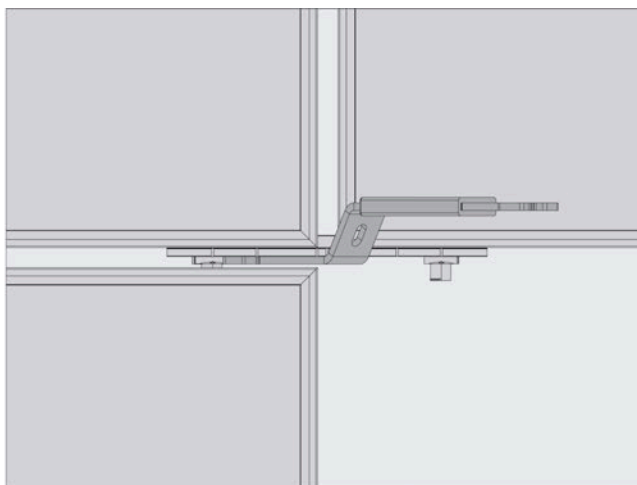
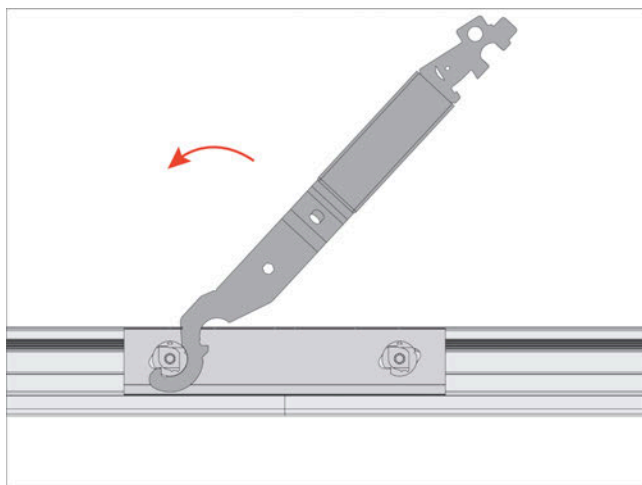
- (3) - *Rock the PV module up and out*
- (4) - *Remove PV module*



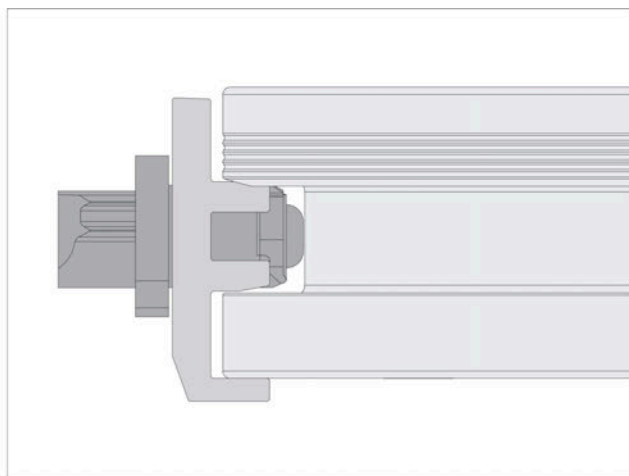
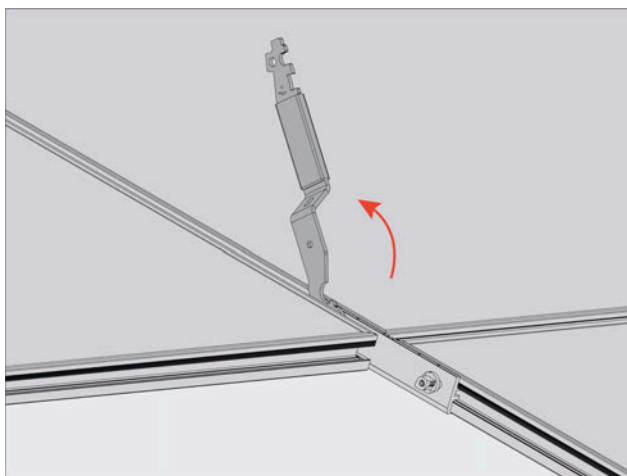
APPENDIX E: MODULE SERVICING

5. Release the mid-array modules.

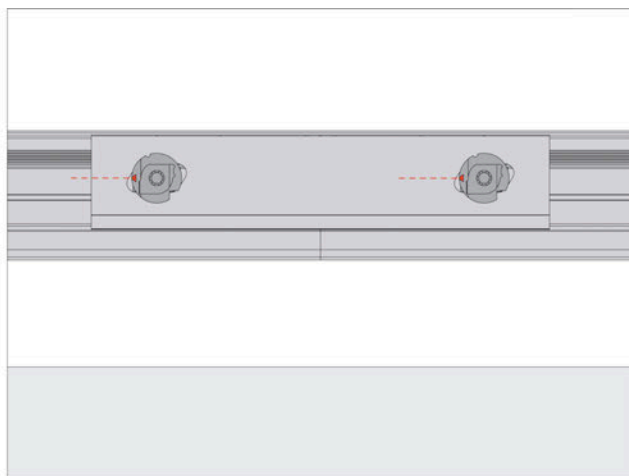
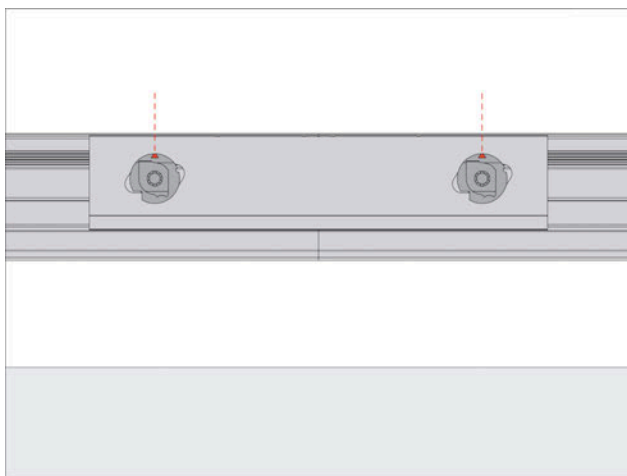
Use the Tesla Solar Wrench to unlock the mid-array Interlocks and release the modules.



a. Rotate both Lockits to Position 1.



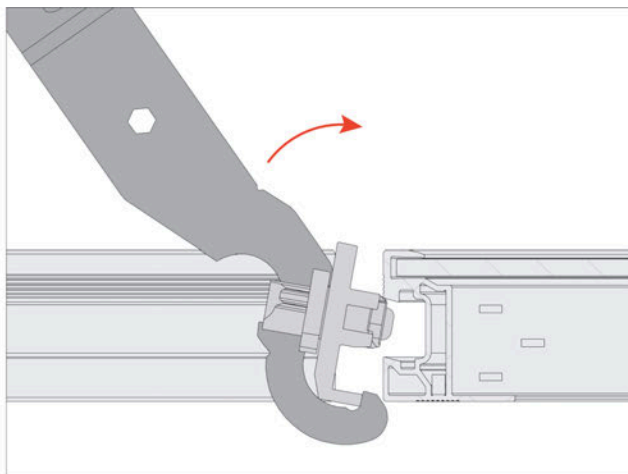
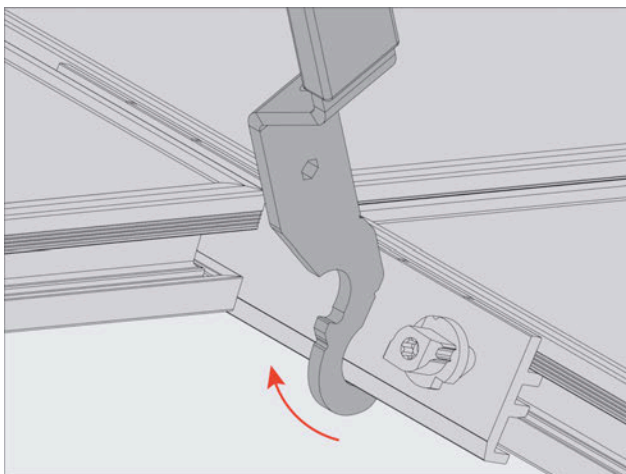
b. Position 1 is indicated by the timing mark on the Tesla Solar Wrench.



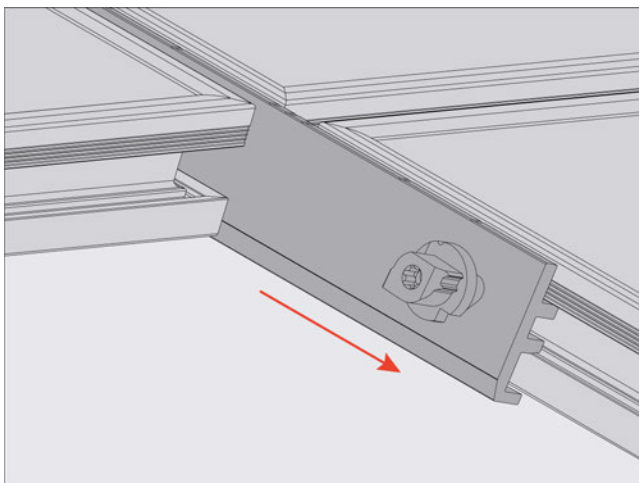


APPENDIX E: MODULE SERVICING

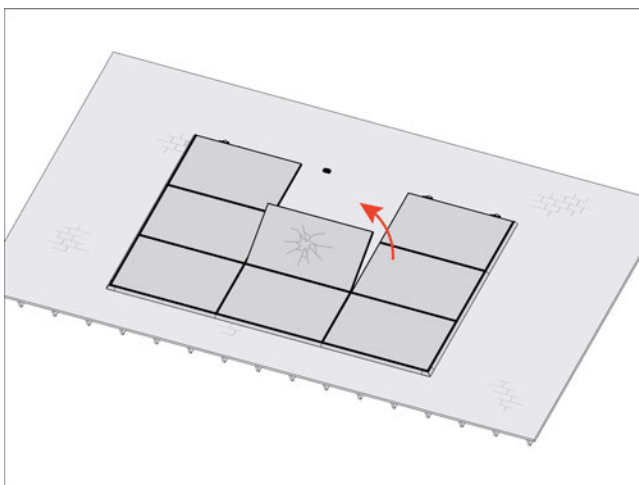
- c. Use the hook on the Tesla Solar Wrench to release the Interlock from the module frame.



- d. Slide the Interlock towards the opening to remove it fully.



- e. Unbolt the Leveling Feet and remove the module from the array.



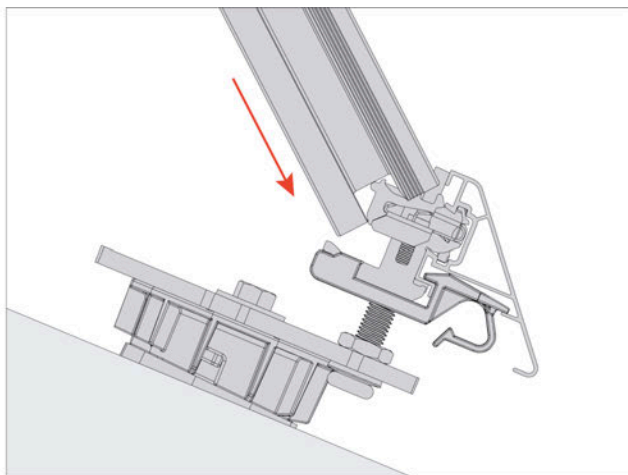
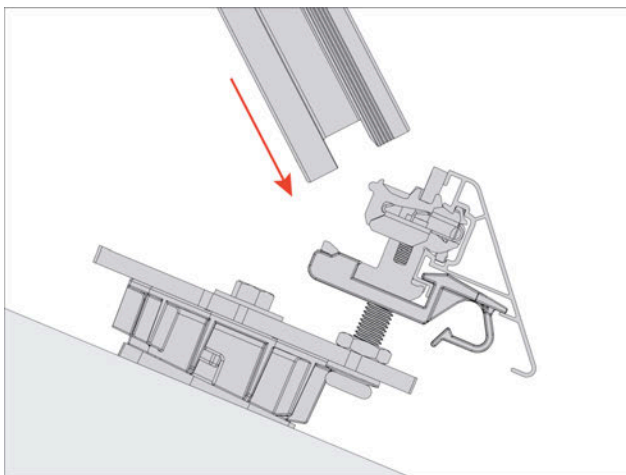
6. Re-assemble the array.



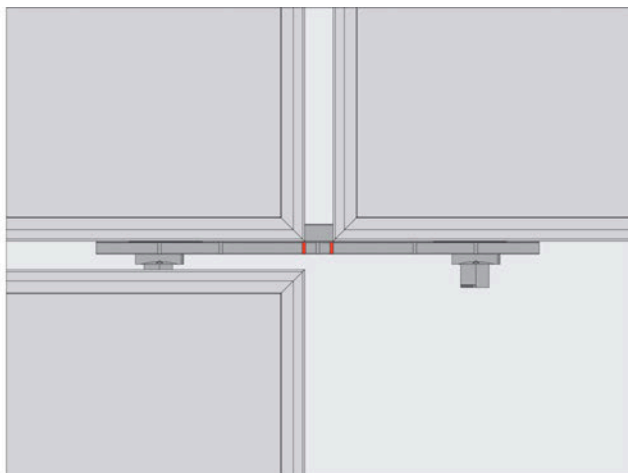
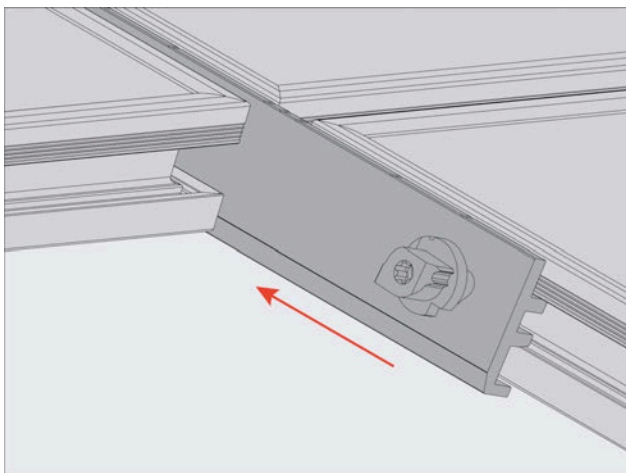
APPENDIX E: MODULE SERVICING

Replace the modules, Interlocks, and Leveling Feet until the array is complete. Use the Tesla Solar Wrench to fasten mid-array Interlocks.

- a. Place the module and manage the wires.



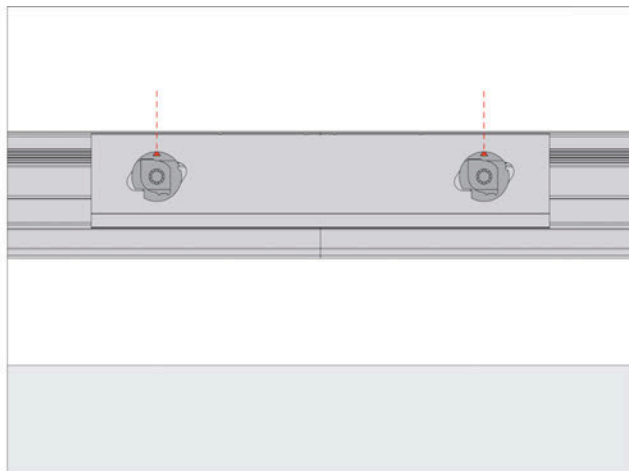
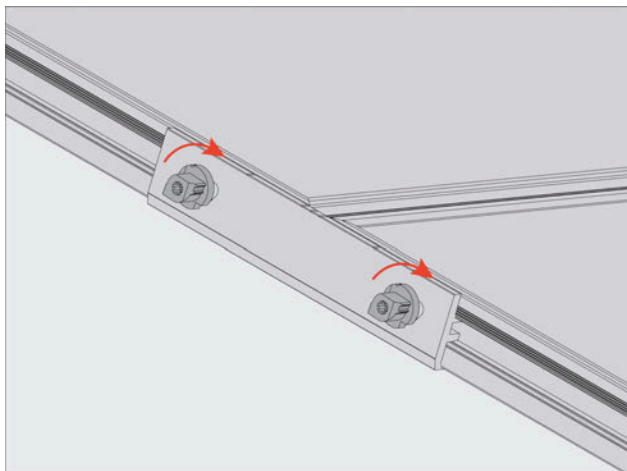
- b. Slide the Interlock into place between the modules and align the timing marks.



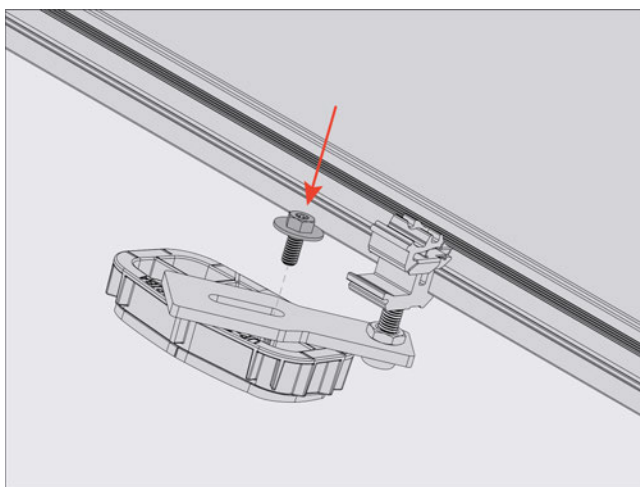
- c. Rotate both Lockits to Position 3 (or Position 2 if it's a thermal break), the Interlock will be pulled into place by the Lockit and reform the structural and electrical bond.



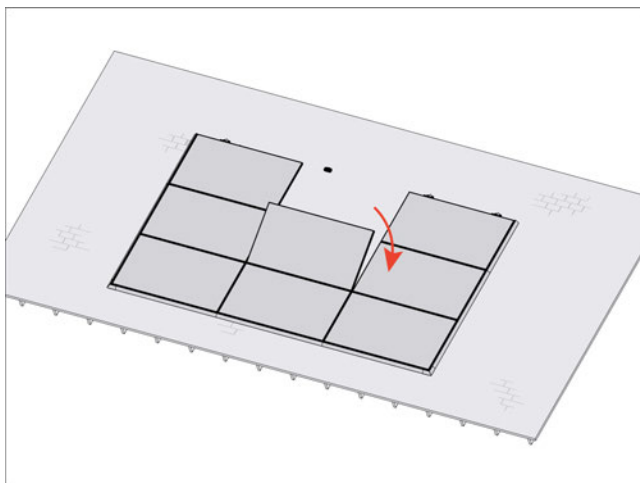
APPENDIX E: MODULE SERVICING



- d. Reinstall the Leveling Feet on the bases and torque the bolt to the required specification.



- e. Reinstall the module by placing it on the Interlocks and rocking it down into position.



- f. Repeat this process for each module in the column above.



APPENDIX E: MODULE SERVICING

