



TESLA PANEL MOUNT - FLAT

INSTALLATION MANUAL

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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.

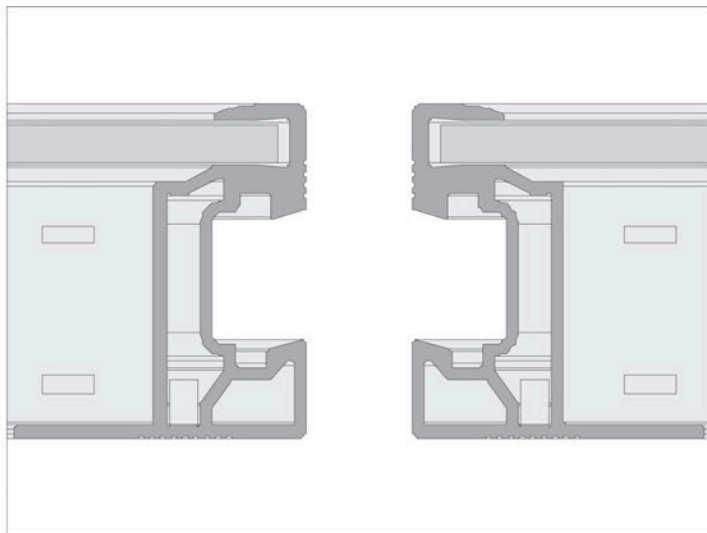
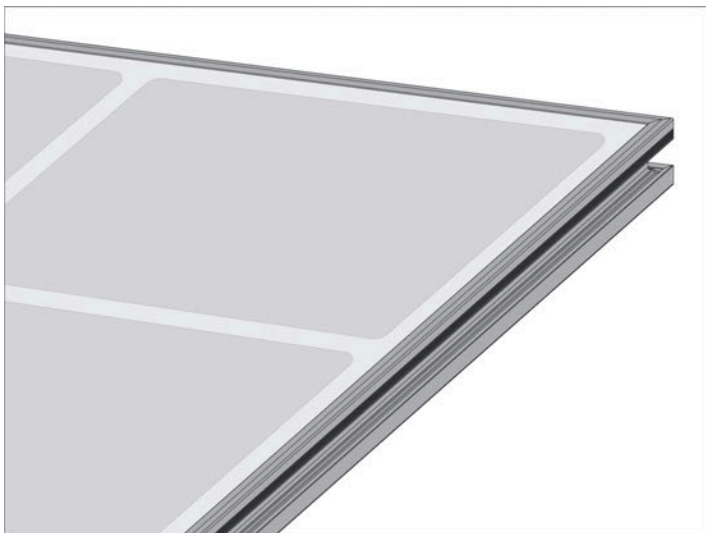


INTRODUCTION TO TESLA PANEL MOUNT - FLAT MOUNTING SYSTEM

The Tesla Panel Mount - Flat mounting system is designed for installing PV modules manufactured with Tesla's proprietary frame groove on standing seam metal roofs. The PV module frames are mechanically connected by Interlocks, creating continuous beams for a simultaneous structural and electrical bond. 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.



- *PV module frame with Tesla Groove*

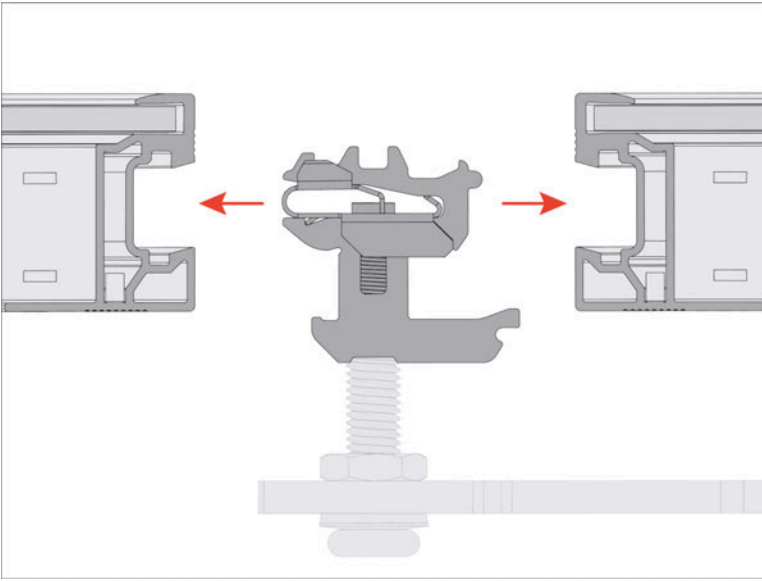
The Key and Tongue Concept

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.

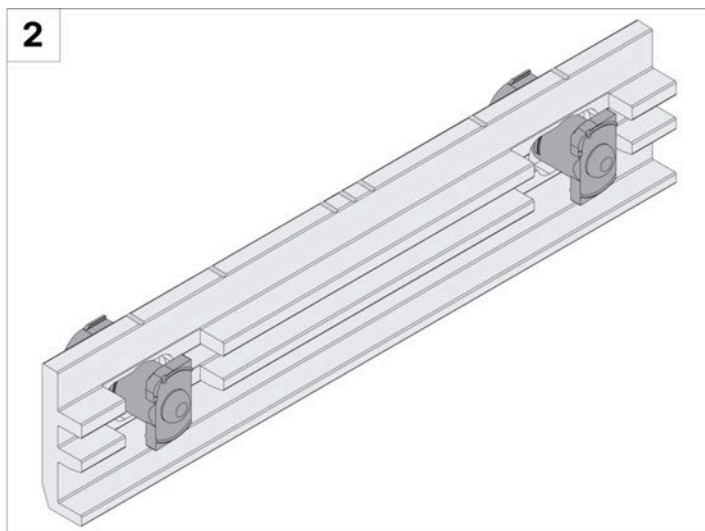
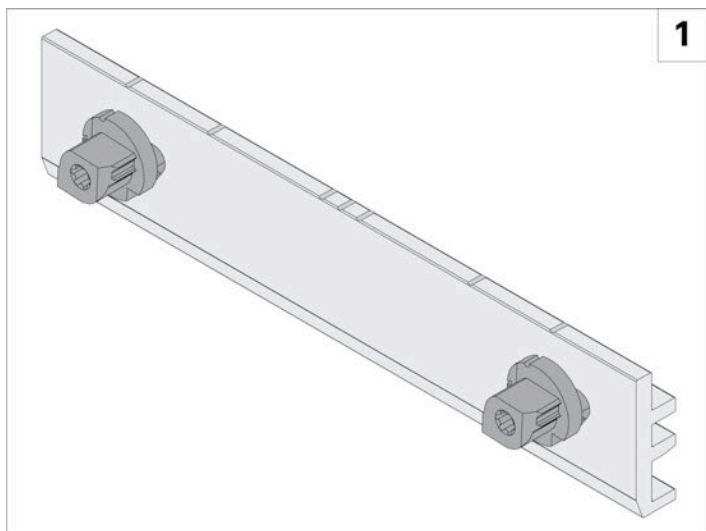
- (A) - *Rockit*
- (B) - *Key side*
- (C) - *Tongue side*

INTRODUCTION TO TESLA PANEL MOUNT - FLAT MOUNTING SYSTEM

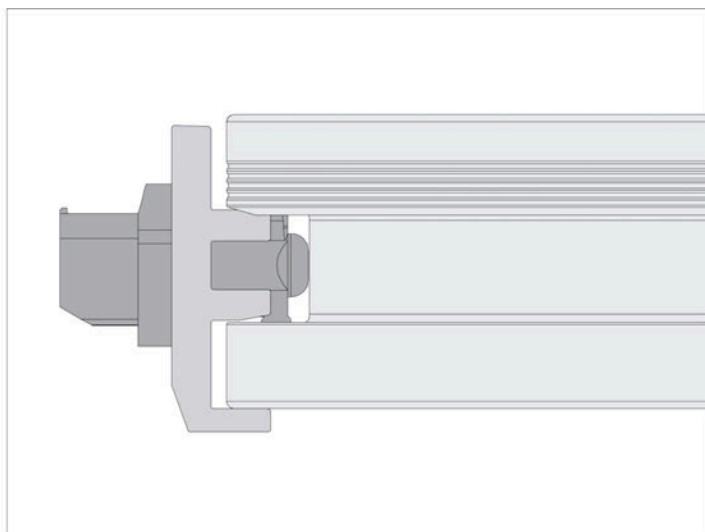
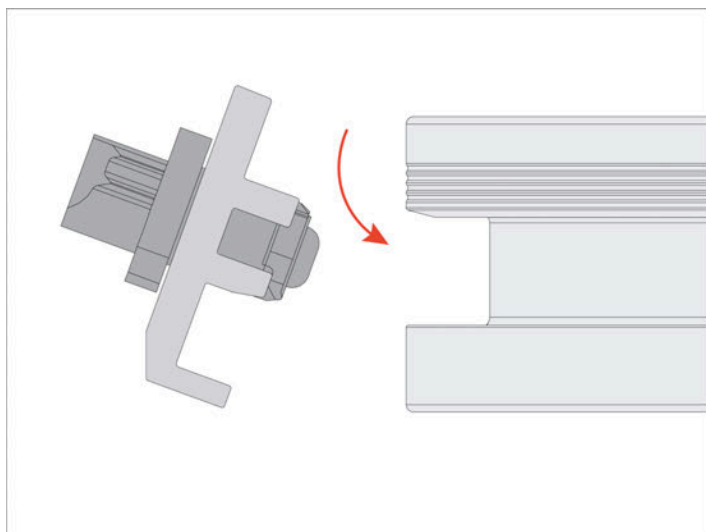


The Key and Tongue design is also used with the Interlock, a component that mechanically connects and bonds two modules together. Here, the Key and Tongue are differently shaped, but they fit into the Tesla Groove in a similar manner to the Rockit.

INTRODUCTION TO TESLA PANEL MOUNT - FLAT MOUNTING SYSTEM



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



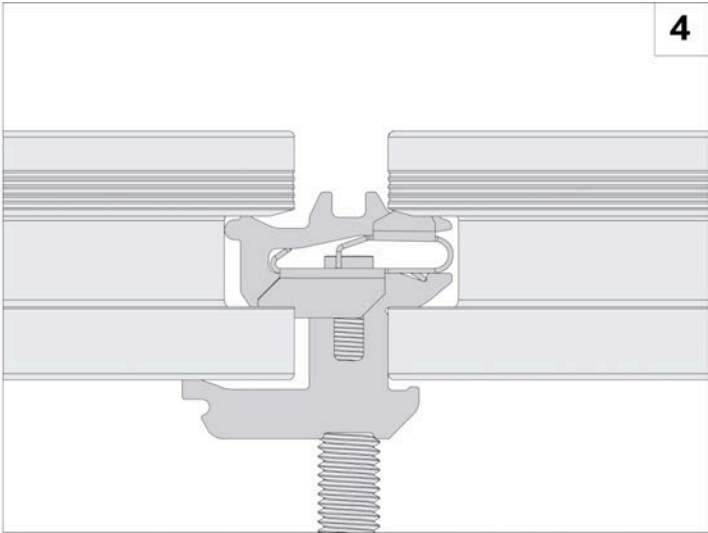
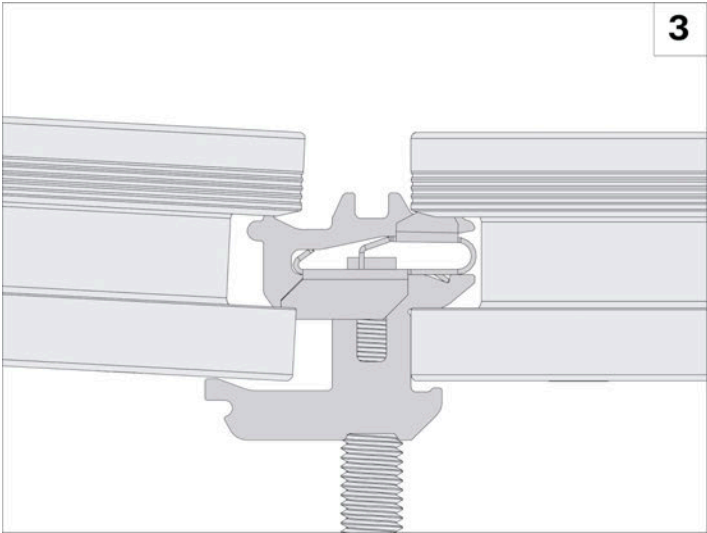
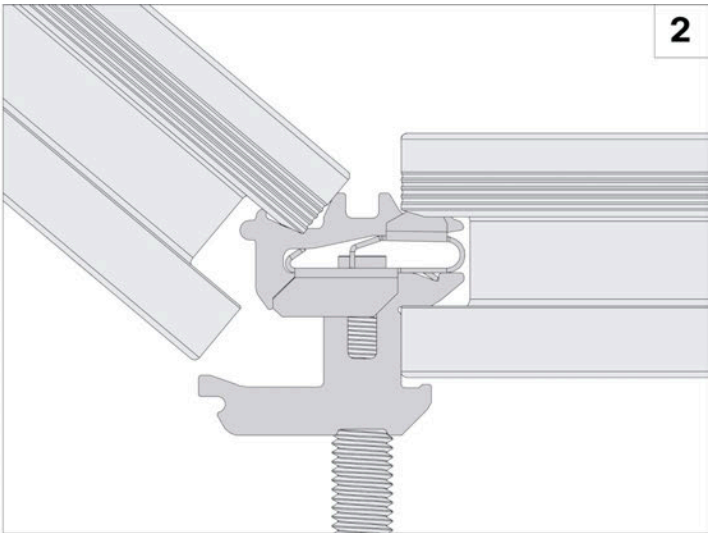
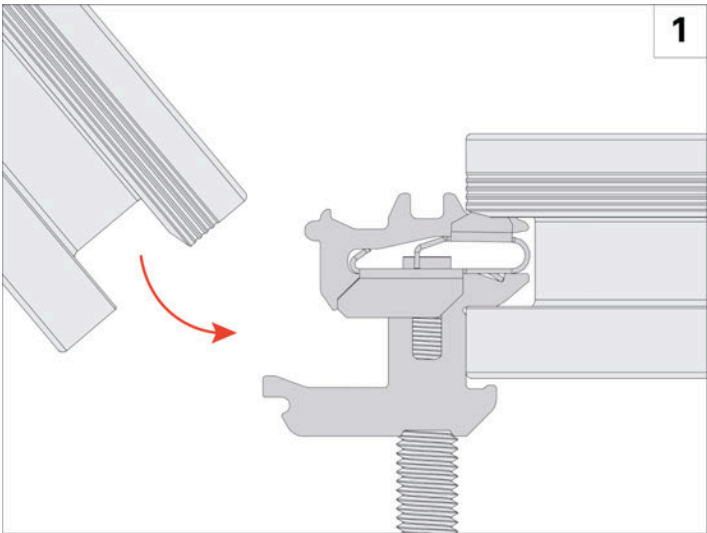
- Interlock inserting into the Tesla Groove

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 - FLAT MOUNTING SYSTEM

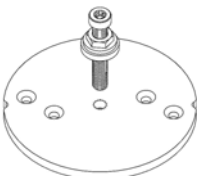
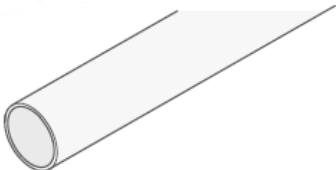
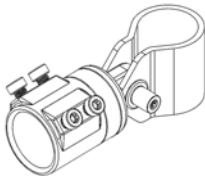




TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS

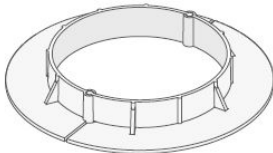
System Components

Mounting Components

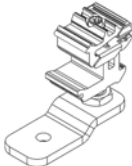
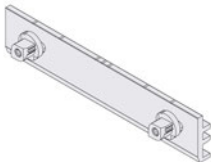
Part	Description	Part #
Base Foot 	Roof attachment point for anchoring Mechanical Tubing. Listed to UL 2703	1577562-00-X
Roof Deck Adapter 	Component for mounting a Base Foot directly to the roof deck.	1577203-00-X
Lag Screw 	Attaches the Base Foot to the roof rafter.	1576694-00-X
Mechanical Tubing 	Basic structural element of Tesla Panel Mount - Flat system. Listed to UL 2703	1577385-00-X
Cross Brace Assembly 	Provides lateral support between adjacent columns. Listed to UL 2703	1576606-00-X
Sealing Ring	Part of the Base Foot assembly.	1576852-00-X



TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS

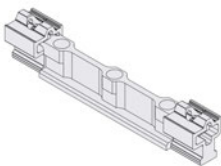
Part	Description	Part #
		

Structural and Bonding Components

Part	Description	Part #
Post Mount 	Provides an attachment point between Mechanical Tubing and Spanner Bars. Listed to UL 2703	2233066-00-X
Leveling Foot 	Secures PV modules to the Spanner Bar, bonds connected modules, and enables array leveling. Listed to UL 2703	2133094-00-X
Spanner Bar 	Provides an attachment point between the Leveling Foot and Tile Hook.	2129978-01-X (1178 mm, 1x) 2129978-02-X (2248 mm, 2x) 2129978-03-X (3306 mm, 3x)
Spanner Splice 	Provides connection between adjacent Spanner Bar lengths.	2129977-00-X
Interlock 	Provides structural and electrical bonding between PV modules within each sub-array. Listed to UL 2703 UL Model # 850-1613	1576999-00-X
Hybrid Interlock	Combines the functions of an Interlock and Leveling Foot for attachment points where space is restricted.	1578969-00-X



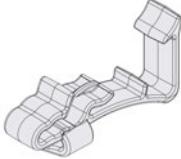
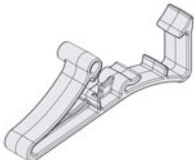
TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS

Part	Description	Part #
		
Ground Lockit 	Provides a single point for grounding a PV array. Listed to UL 467 and UL 2703 UL Model # 850-1511	1578119-00-X

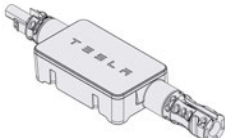
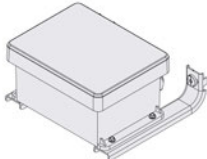


TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS

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 • UL Model # 850-1509	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 • UL Model # 850-1510	1578389-00-X

Electrical Accessories

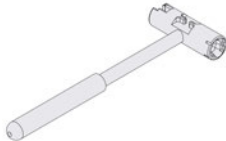
Part	Description	Part Number
MCI-2 (Mid-Circuit Interrupter) 	Tesla's rapid shutdown solution, which is compatible with Tesla power electronics. • Listed to UL 1741	1879359-00-X
Combiner Box 	Provides terminal blocks to make parallel connections and transition wire. Connects directly to the Tesla Groove. • Listed to UL 1741	1571739-00-X

Recommended Tools

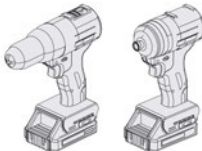
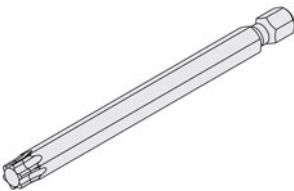
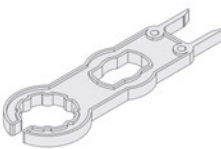
Part	Description	Part Number
Tesla Solar Wrench 	A multifunctional tool for Tesla Solar installation. Includes every feature needed for speedy installation, removal, and service of installed systems.	2066971-00-X



TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS

Part	Description	Part Number
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

Required Tools

Part		
Drill and Impact Driver 	3/16 in or 7/32 in Drill Bit 	Roof Crayon or Chalk 
Tape Measure 	String Line 	#40 Torx Bit Socket and Ratchet Wrench 
#40 Torx Bit 	Slotted Screwdriver 	MC4 Disconnect Tool 
Protractor 	Caulking Gun 	Sealant Cartridge 



TESLA PANEL MOUNT - FLAT SYSTEM COMPONENTS



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.

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

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 X Cantilever:

The maximum module X cantilever distance is always 1/3 of the maximum allowable X span.

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

Maximum Y Cantilever

- The maximum module Y cantilever distance is always 1/2 of the maximum allowable Y span, up to 26 in.

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.

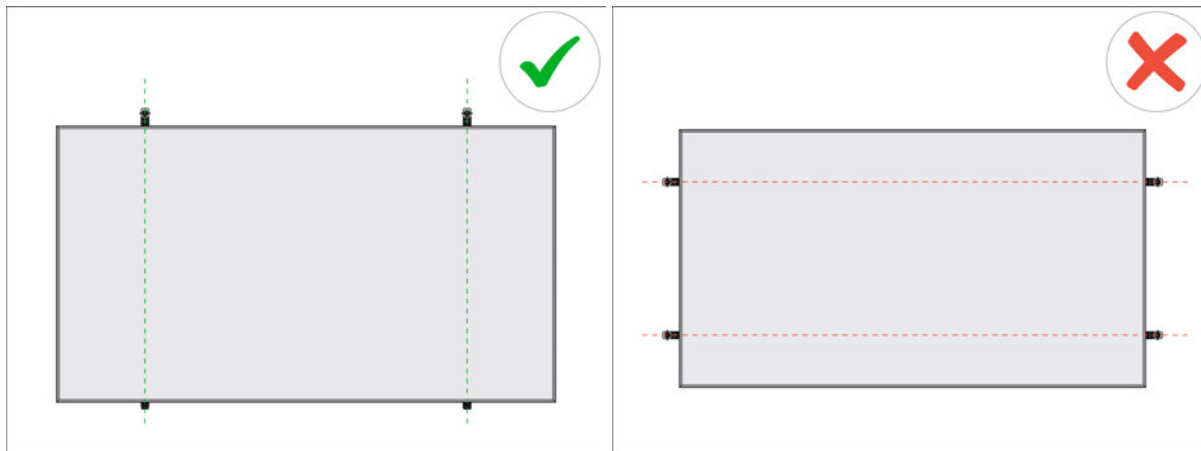
- (A) - 2 in (50 mm) distance from module corner to center of Rockit



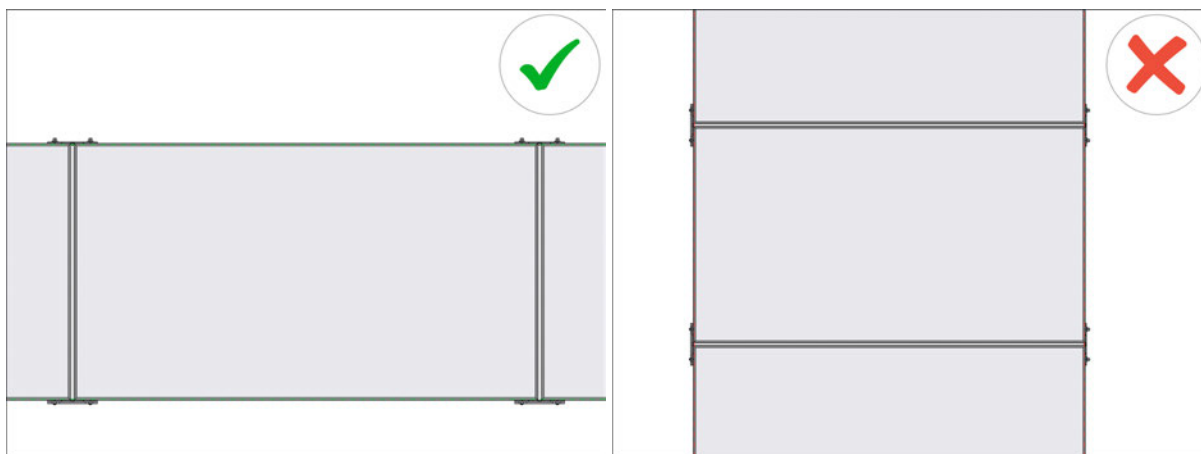
DESIGN AND LAYOUT RULES

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.



2. **Interlocks must be parallel with the X-axis:** Interlocks should be attached along the upper edge of each module row, parallel with the X-axis.



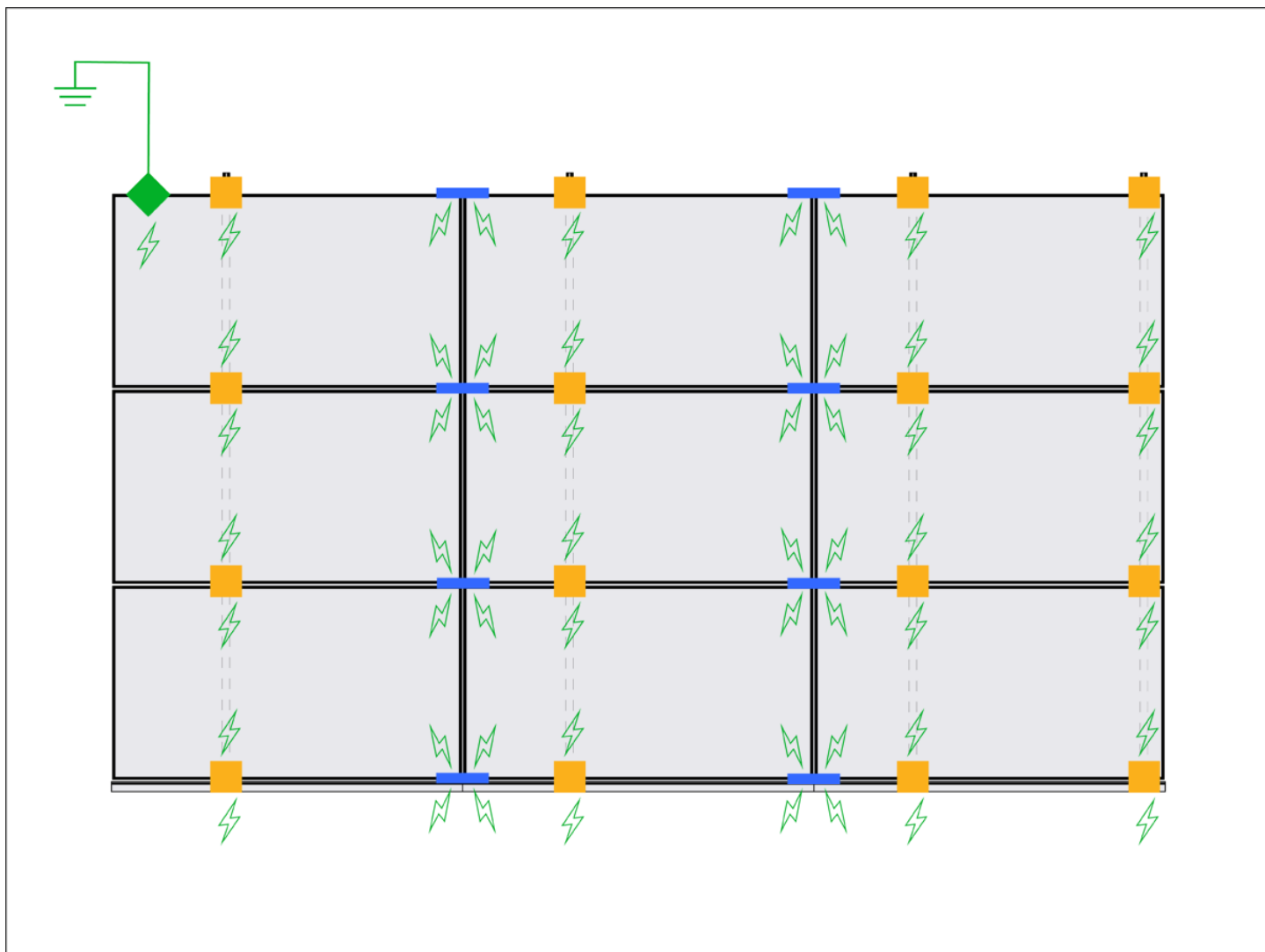
3. **Single Module Installation:** A standalone module requires two Leveling Feet on each side, for a total of four Leveling Feet. This remains true regardless of module orientation.

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.



DESIGN AND LAYOUT RULES



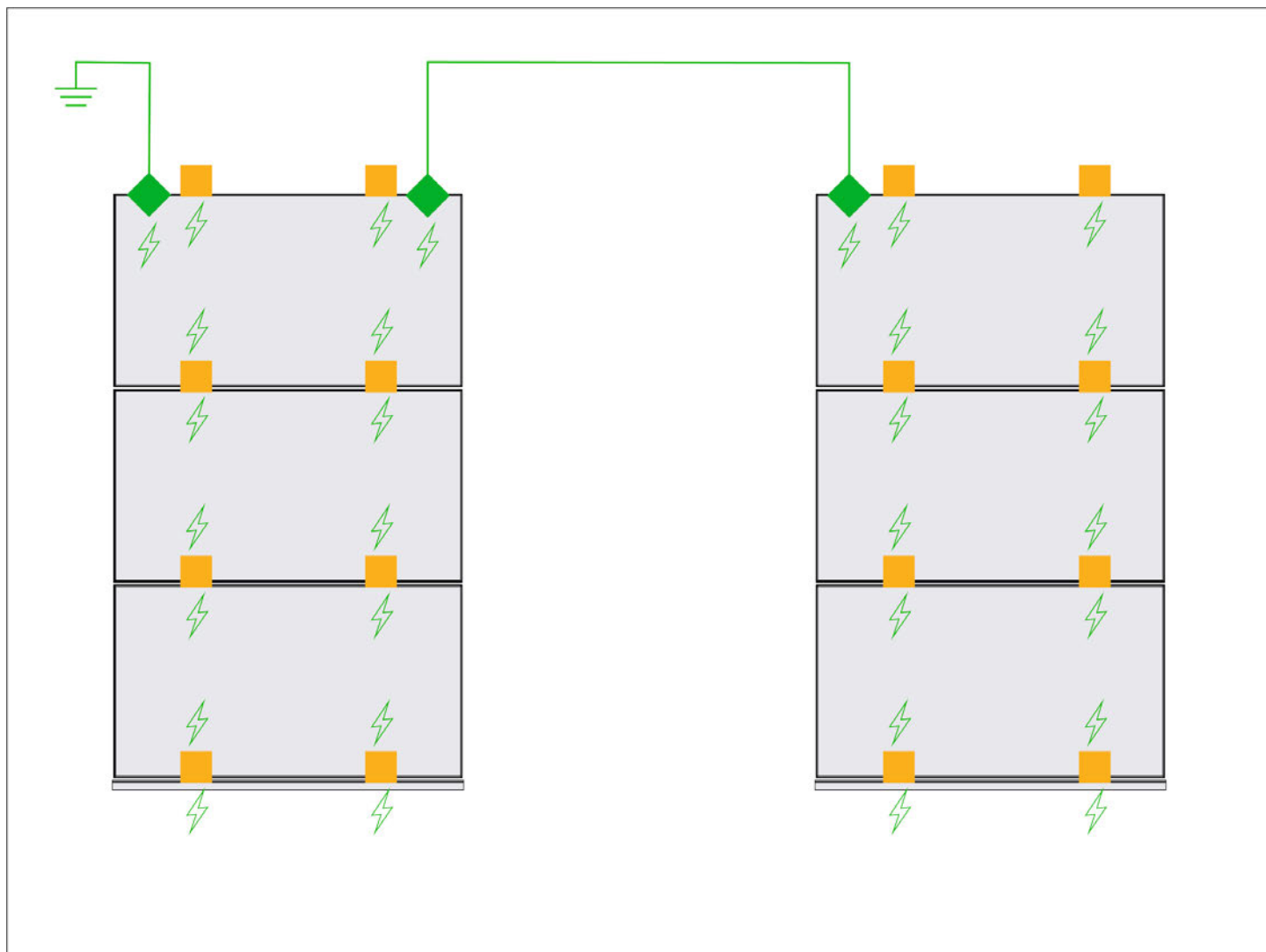
-  Bond path
-  Ground Lockit
-  Equipment grounding conductor (EGC)
-  Interlock
-  Earth ground
-  Rockit

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. For details on how this bonding occurs, refer to [Appendix A: Grounding and Bonding on page 54](#).

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.)



DESIGN AND LAYOUT RULES



- ⚡ 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.



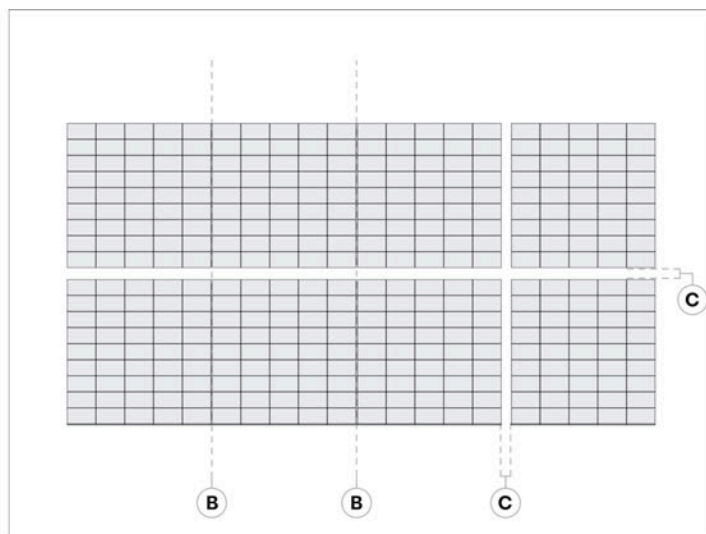
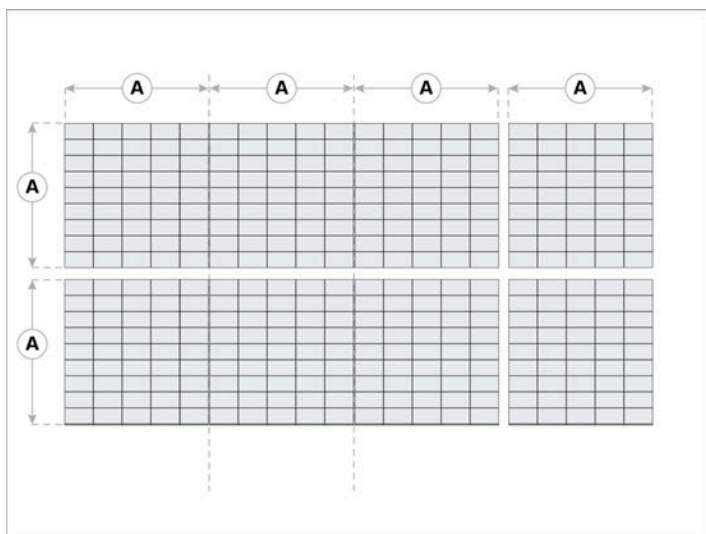
Thermal Expansion

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 61](#).



ARRAY DESIGN

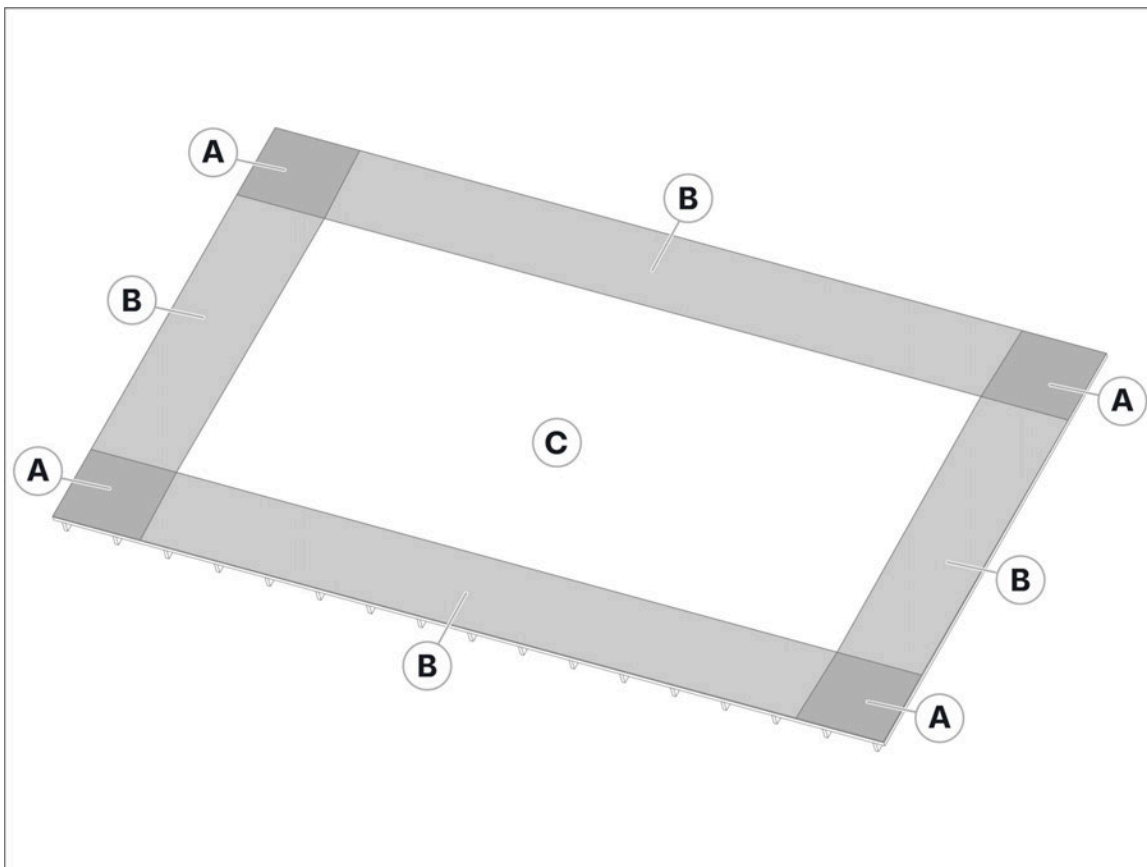
Gather Project Data

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 condition, 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.





Calculate Span and Cantilever Allowances

Once project data has been gathered, the allowable capacities of the system must be compared to the site-specific loading. 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. Tesla Panel Mount - Flat Component Allowable Forces

Component	Uplift	Downforce	Shear
Leveling Foot Assembly	440 lbf (1959 N)	817 lbf (3636 N)	389.7 lbf (1733 N)
Spanner Bar	8380 in*lbf (947 Nm)	8380 in*lbf (947 Nm)	-

A safety factor of 2 was applied to the uplift and 1.67 to the downforce and lateral loads.

Refer to [Appendix C: Allowable Mounting System Loading on page 67](#) for maximum pressure capacities (UL 2703 testing.)

Determine Hardware Attachment Placement

Mark the array boundaries for the PV modules on the roof section in the desired location. Plan Spanner Bar placement to maximize X spacing. Locate the hardware attachment points on the rafters based on the calculated span. Be sure to abide by the span and cantilever rules from the previous steps. Only attach the system within wind pressure zones that have a site-specific loading below the system capacity.



NOTE: Install modules with a ½ in gap (+/- ¼ in) in both X and Y directions.



INSTALLATION OVERVIEW

1. Array layout.
2. Install Base Feet and tubing.
3. Install cross braces and Post Mounts.
4. Install Spanner Bars.
5. Install front row Leveling Feet.
6. Install PV modules (SMILES).
7. Complete wire management and bonding.
8. Install sealing rings.



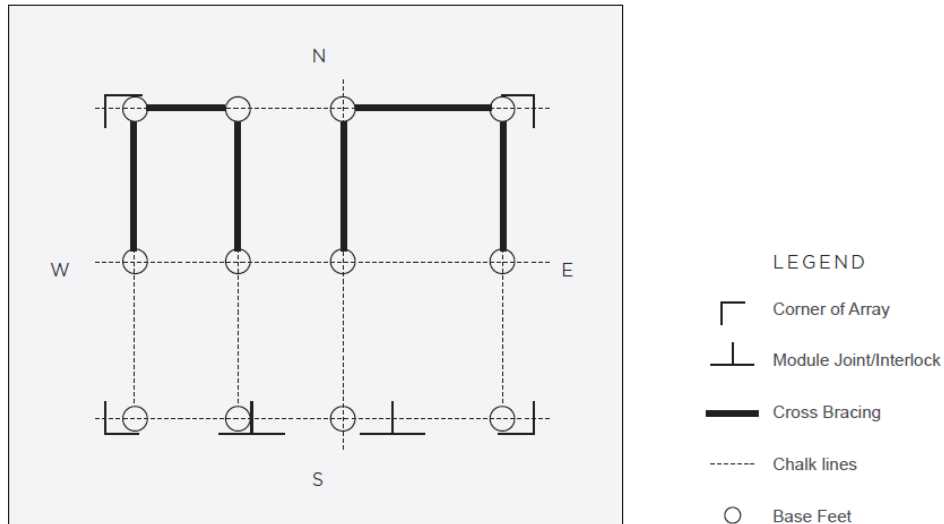
STEP 1: ARRAY LAYOUT

1. Check planset and 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.

Example planset:



2. Mark out the array.

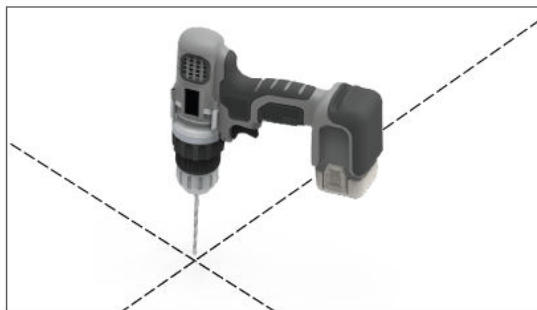
- Mark out the perimeter of the array, module intersections, and rafter locations.
- Mark the locations of the Base Feet.



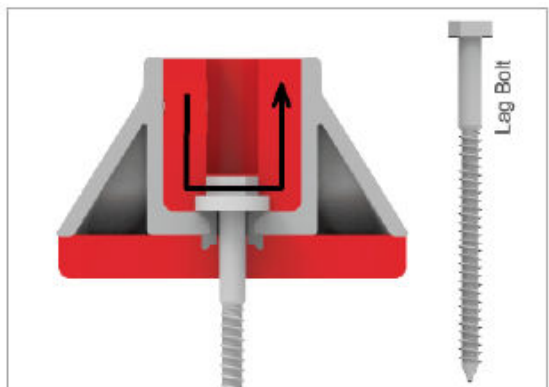
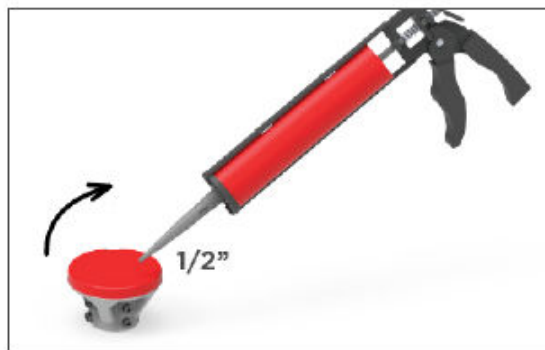
STEP 2: INSTALL BASE FEET AND TUBING

1. Drill pilot holes.

Drill pilot holes at the marked locations for the Base Feet.



2. Seal and fasten the Base Feet.



- Cover the underside of the Base Feet with a 1/2 in bead of sealant.
- Place the Base Feet at the marked locations and secure in place with a lag bolt.
- Cover the inside of the Base Feet around the fastener with a 1/2 in bead of sealant for a waterproof seal.

3. Cut tubing to length.

Cut pieces of tubing to the heights specified in the planset plus 6 inches.



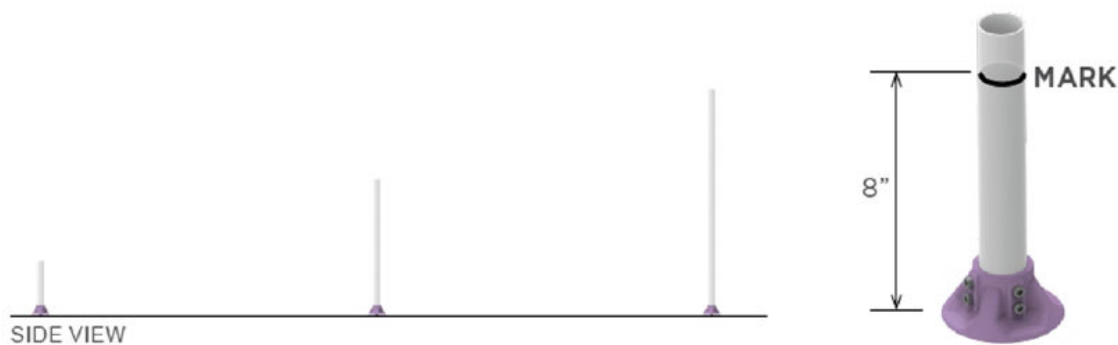
STEP 2: INSTALL BASE FEET AND TUBING

4. Mount tubing to Base Feet.



- Insert the tubing into the Base Feet and fasten the set screws. Torque the carriage bolts on Post Mounts and Cross Brace Assemblies to 16 ft-lbs and torque the set screws to 9 ft-lbs.
- Apply sealant between the Base Foot and tubing.

5. Measure and mark the slope of the first column.



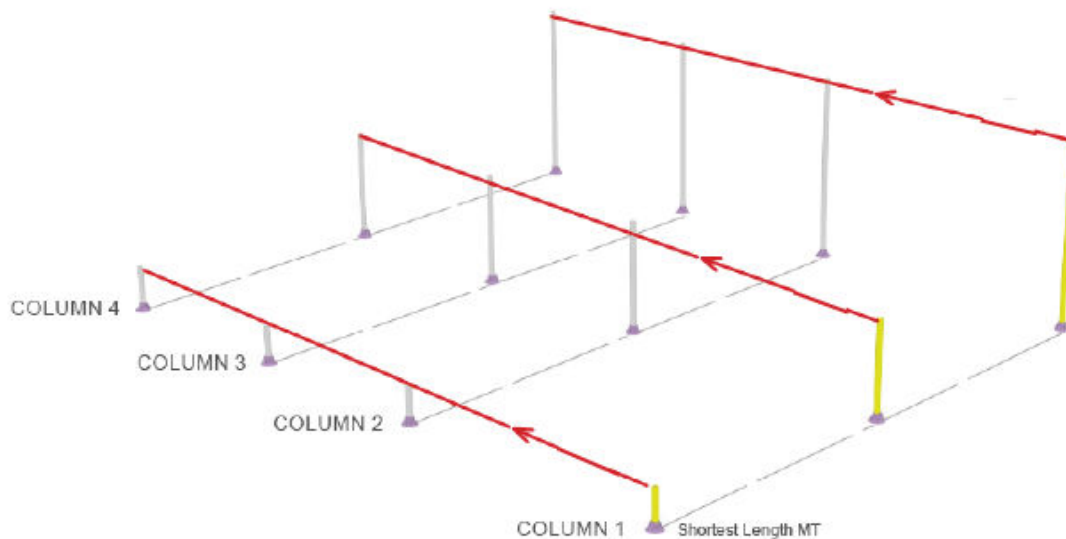
- Mark the shortest piece of tubing at the height specified in the planset.
- Use a stringline and protractor to mark the tubing in the same column according to the slope specified in the planset.

6. Measure and mark the height of the tubing in other columns.

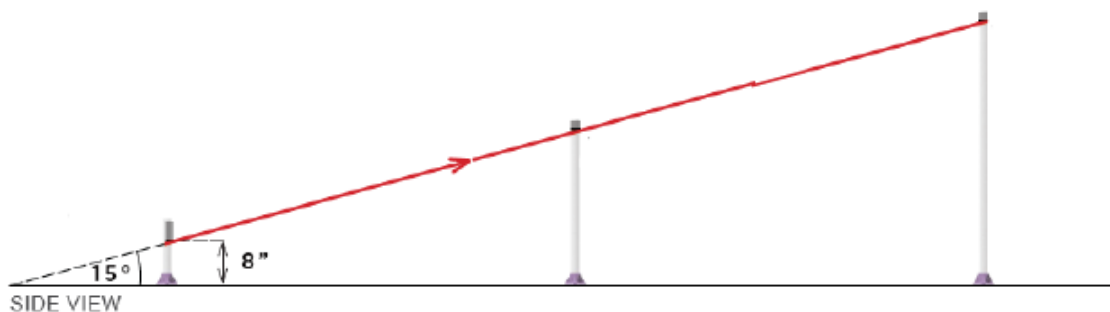


STEP 2: INSTALL BASE FEET AND TUBING

- a. Use a stringline and line level to mark the remaining columns at the same height in each row.



- b. Use a protractor to verify that the slope of the individual columns matches the planset.



- c. Make adjustments as needed.

7. Cut tubing to the marked heights.



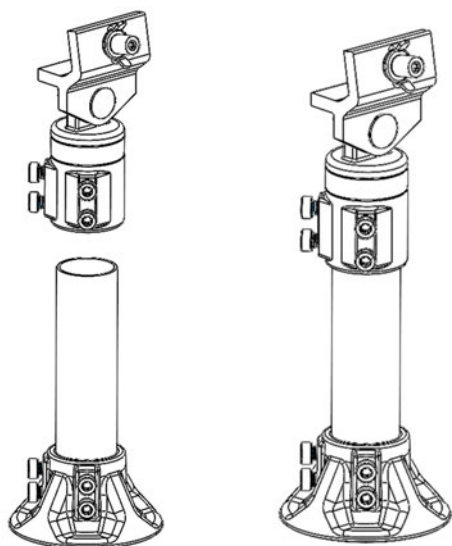
STEP 3: INSTALL CROSS BRACES AND POST MOUNTS

1. Install Cross Brace Assemblies.

- Slide Cross Brace Assemblies onto the sections of tubing identified in the planset as needing reinforcement.

Install two Cross Brace Assemblies on the same piece of tubing if braces are needed in both the X and Y directions.

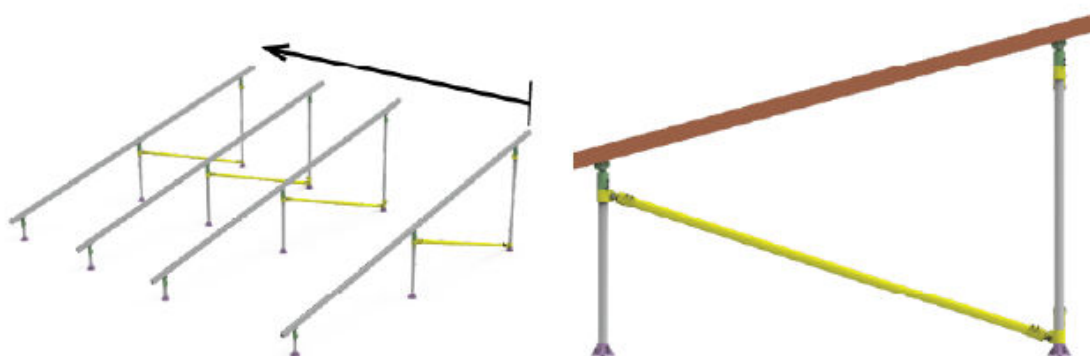
2. Set the Post Mounts in place on top of the tubing without tightening the fasteners.



3. Install cross bracing in the Y direction.



NOTE: If cross bracing is required in the Y direction it must be installed on each column of tubing in the Y-axis.





STEP 3: INSTALL CROSS BRACES AND POST MOUNTS

- a. Set a Tube Head into the up-roof Cross Brace Assembly nearest to the roof deck and fasten it using an impact driver and socket.

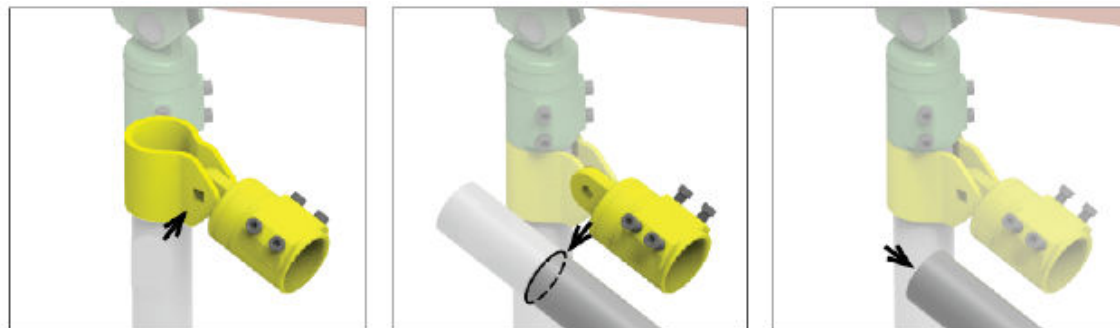


- b. Insert one end of a section of tubing into the Tube Head and fasten it with a T40 Torx bit.

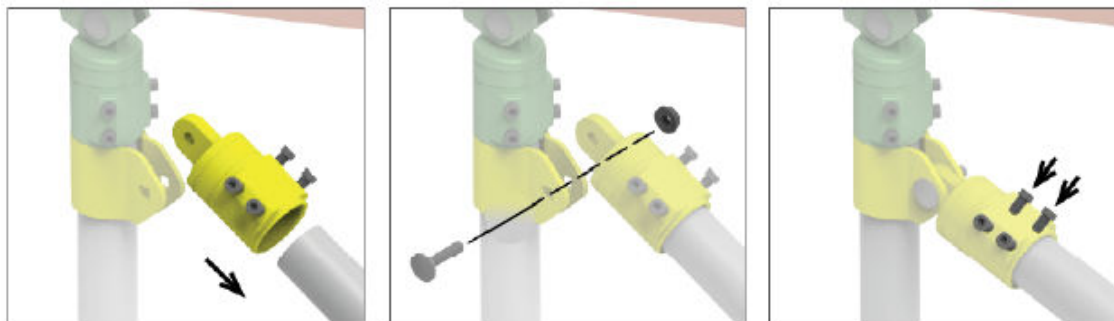
- c. Set a Tube Head into the Cross Brace Assembly opposite the one fastened in the previous step.

- d. Raise the end of the brace up to the Cross Brace Assembly and mark the tubing between the timing marks on the Tube Head.

- e. Cut the tubing to length and install the Tube Head.



- f. Check the fit and fasten the Tube Head in place on the Cross Brace Assembly.

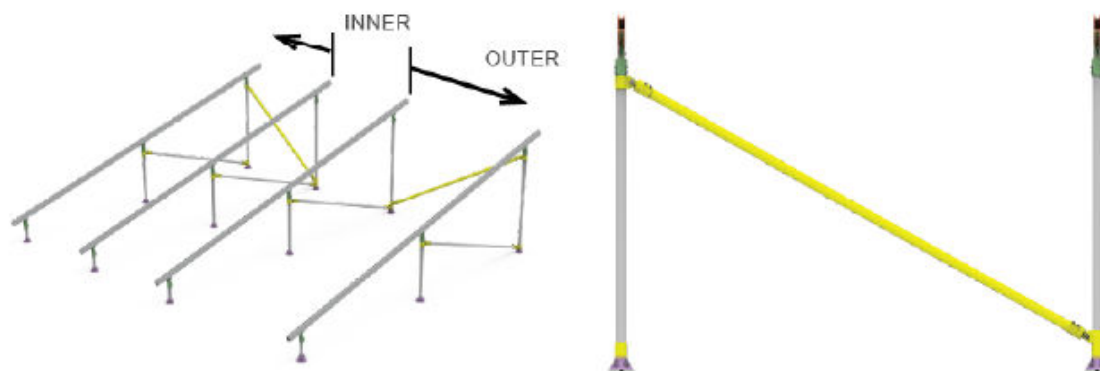


- g. Repeat for each cross brace in the Y direction.



STEP 3: INSTALL CROSS BRACES AND POST MOUNTS

4. Install cross bracing in the X direction.



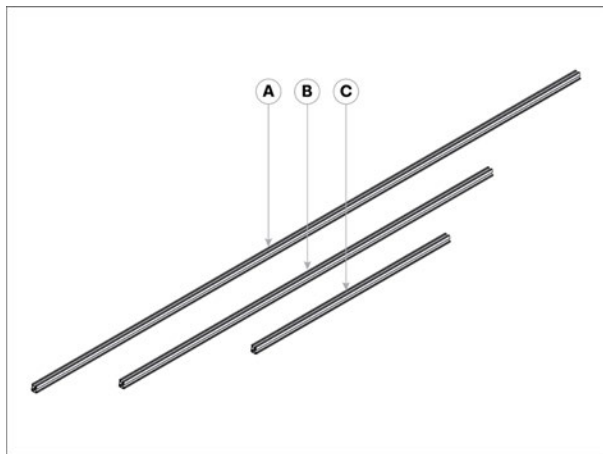


STEP 4: INSTALL SPANNER BARS

Spanner Bars are installed in the up-roof/down-roof direction and are secured to the Post Mounts by T-bolts.

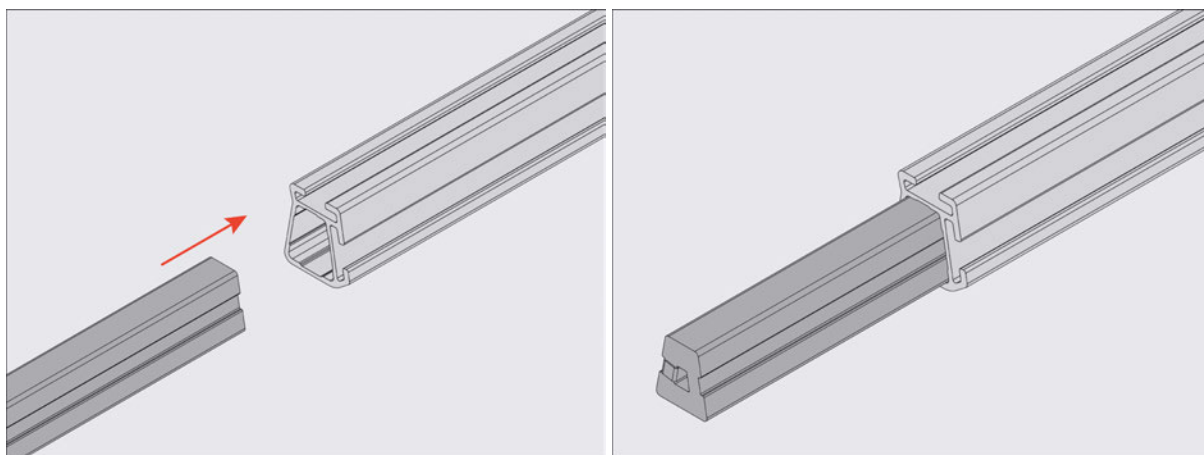
1. Determine Spanner Bar lengths.

Spanner Bars are available in 1x, 2x, and 3x lengths. Select the correct pre-cut lengths and assemble them based on the up-roof dimension of the array design. When Spanner Bar ends meet in the Y direction, install a Spanner Splice to connect them structurally.



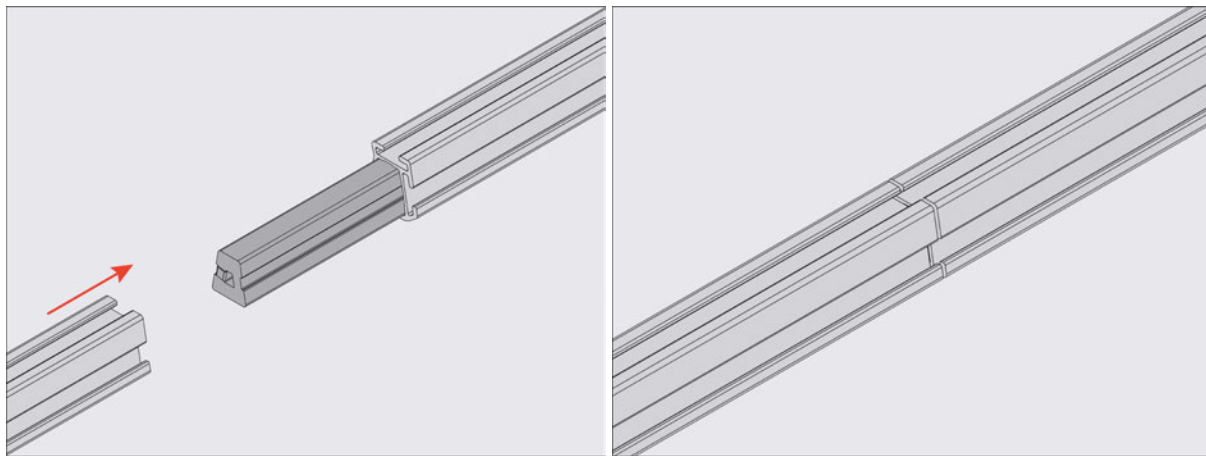
- (A) - 3x Spanner Bar length
- (B) - 2x Spanner Bar length
- (C) - 1x Spanner Bar length

To install a Spanner Splice, insert it into the channel on the Spanner Bars by hand and slide it in until it stops. The Spanner Bar ends should meet in the middle of the Spanner Splice when it is fully inserted, and a small gap between the Spanner Splice ends is expected due to the geometry of the splice spring.



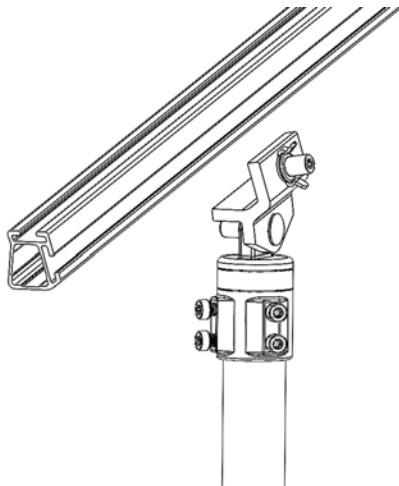


STEP 4: INSTALL SPANNER BARS



2. Install Spanner Bars along each column of Post Mounts.

- Align the down-roof end of the Spanner Bar with the marked module edge with the tapered side up.



- Insert the T-Bolt into the channel of the Spanner Bar and rotate it 90° clockwise to hold the Spanner Bar in place.

3. Fasten the up-roof and down-roof ends of the outside Spanner Bars.

Fasten the T-Bolt into the channel of the Spanner Bar with the impact driver. When the T-Bolt rotates 90° clockwise and is fully fastened, the Spanner Bar will lock into place and the bolt will prevent it from sliding along the channel.



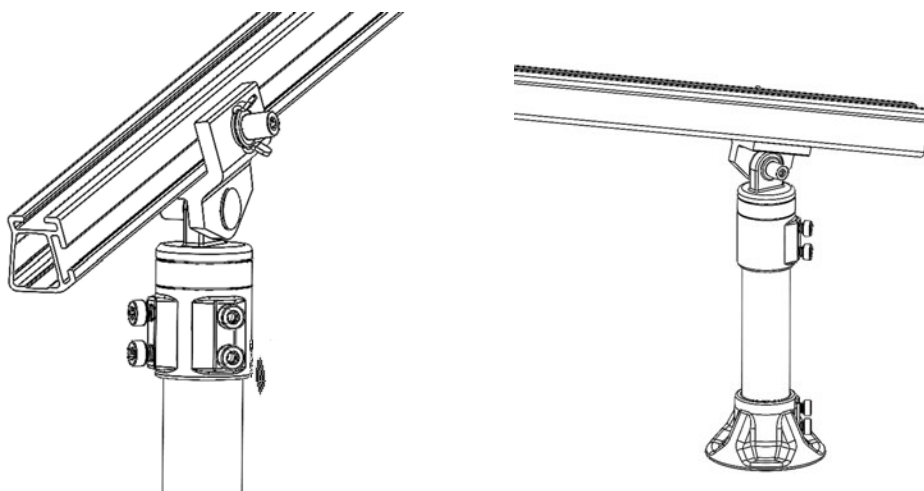
NOTE: When fully engaged with the channel, the indicator tabs on the T-Bolt will rotate 90° and be perpendicular to the Spanner Bar. Failure to rotate the T-Bolt fully will result in an insufficient structural connection.



NOTE: Torque to a range of 13-20 ft-lbs. Verify that the Spanner Bar cannot be moved by hand.

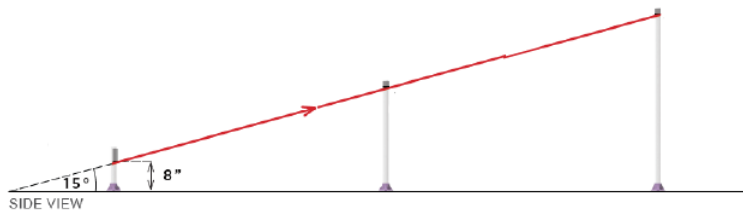


STEP 4: INSTALL SPANNER BARS

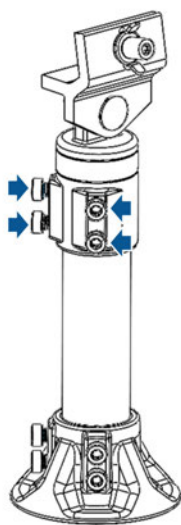


4. Fasten the Post Mounts.

- Once the Spanner Bars are installed and fastened to the Post Mounts, adjust the height of the Post Mounts as needed to achieve the slope specified in the planset.



- Secure the Post Mounts on the tubing by fastening the set screws. Torque the set screws to 9 ft-lbs.



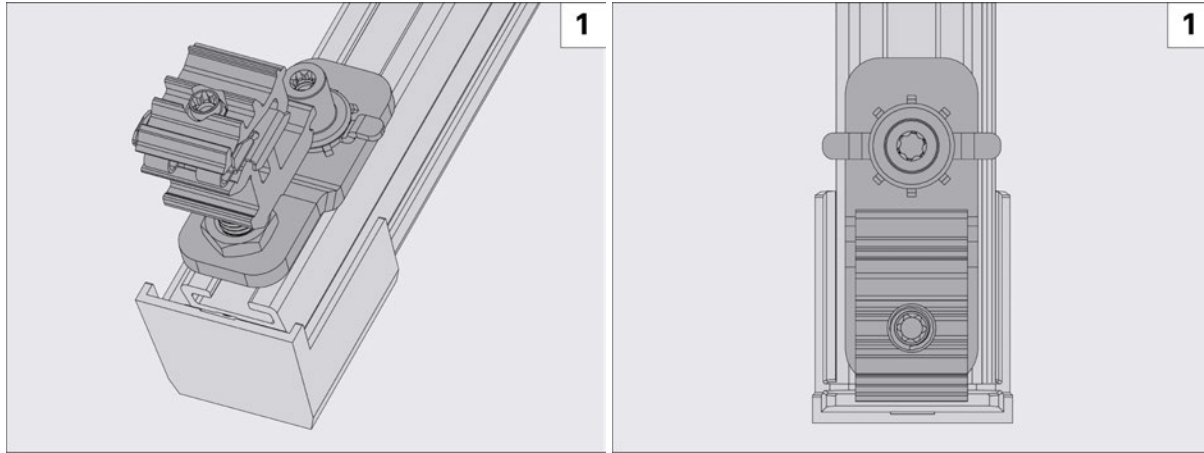


STEP 5: INSTALL THE FRONT ROW LEVELING FEET

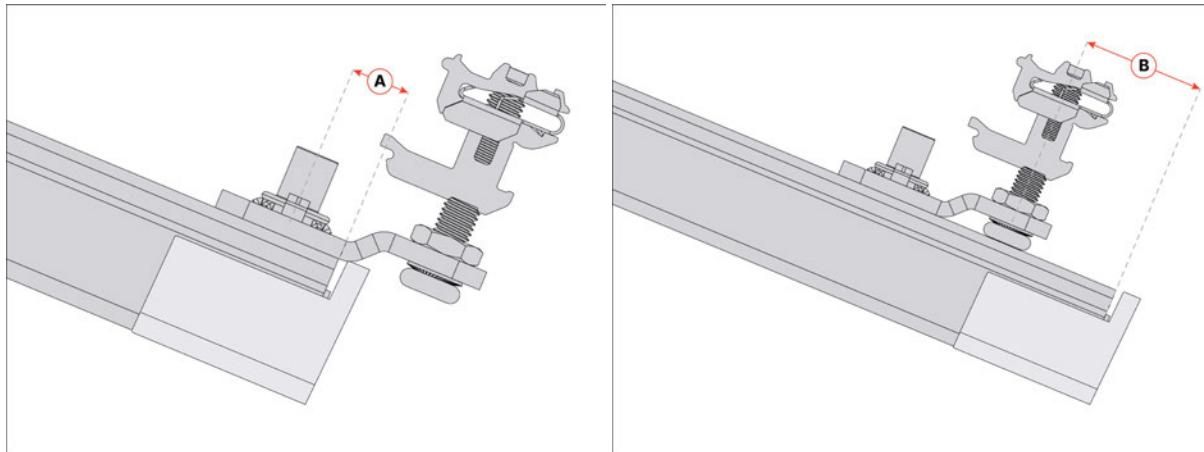
1. Install the Leveling Feet at the corners of the first row.

Set the Leveling Feet in the nominal position by aligning them flush with the down-roof ends of the Spanner Bars.

The Key side of the Rockit should face down-roof, with the Tongue side facing up-roof.



- (1) - Leveling Foot, nominal position on Spanner Bar



- (A) - Minimum distance between Leveling Foot T-Bolt and front of Spanner Bar (5/8 in)
- (B) - Maximum distance between Leveling Foot stud and front of Spanner Bar (1 5/8 in)

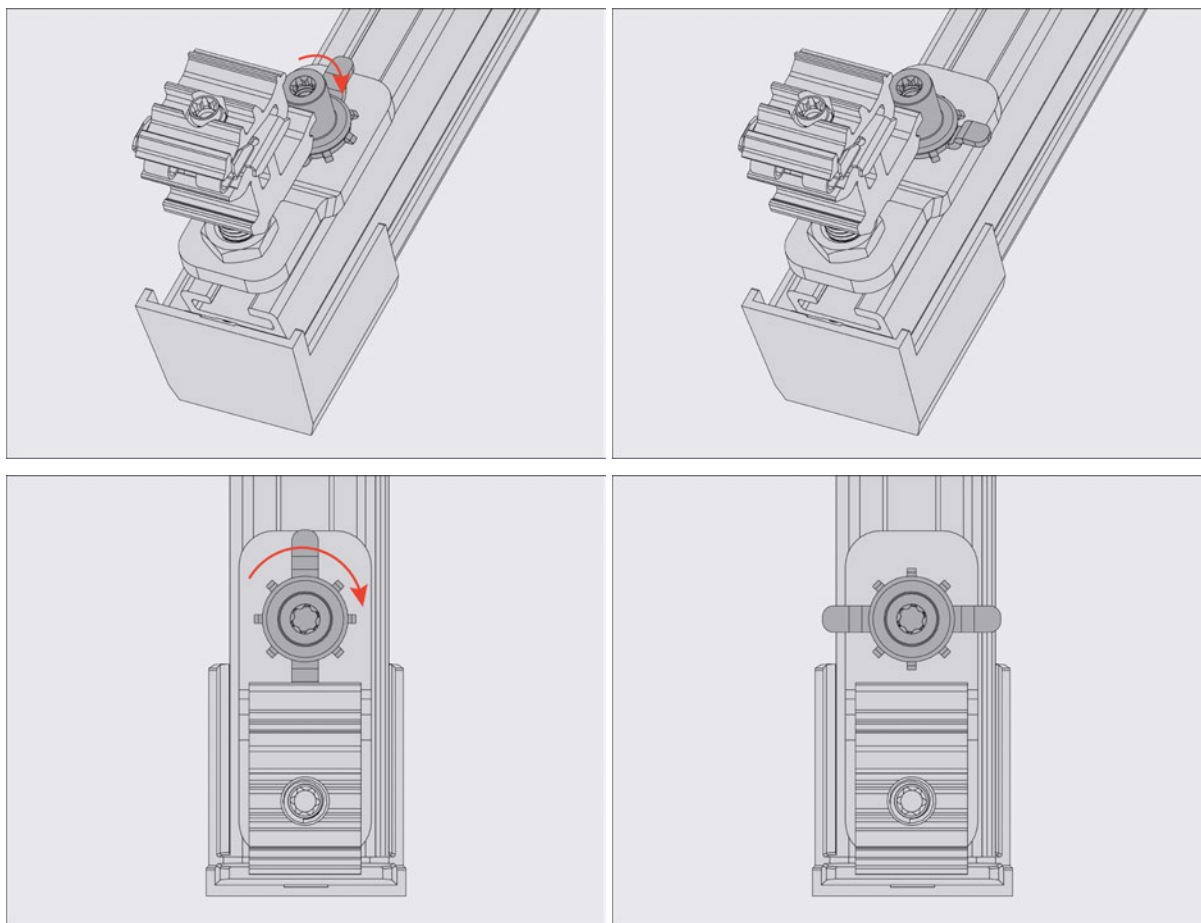
Secure the Leveling Feet to the Spanner Bar using the included T-Bolt.



NOTE: When fully engaged with the channel, the indicator tabs on the T-Bolt will rotate 90° and be perpendicular to the Spanner Bar. Failure to rotate the T-Bolt fully will result in an insufficient structural connection.

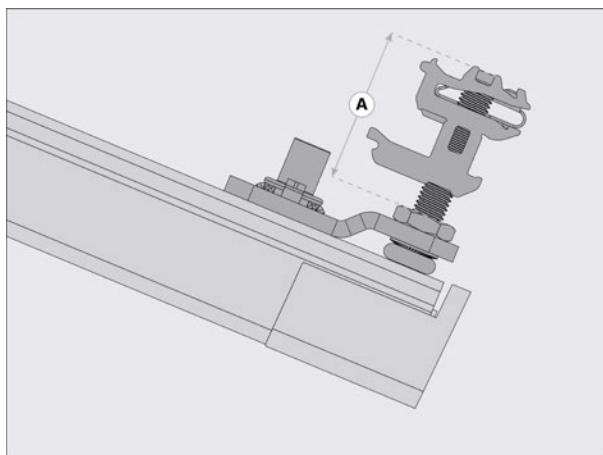


STEP 5: INSTALL THE FRONT ROW LEVELING FEET



2. Anchor a string line between the outside 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 flush with the top of the Rockit.

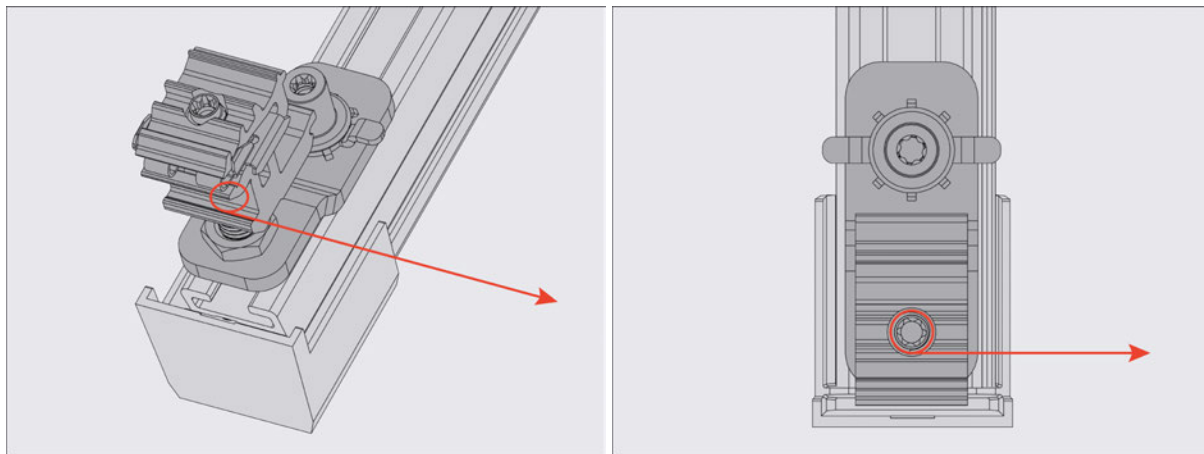


- (A) - Nominal Rockit height on Leveling Foot, Rockit at same height as bolt on Leveling Foot

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.

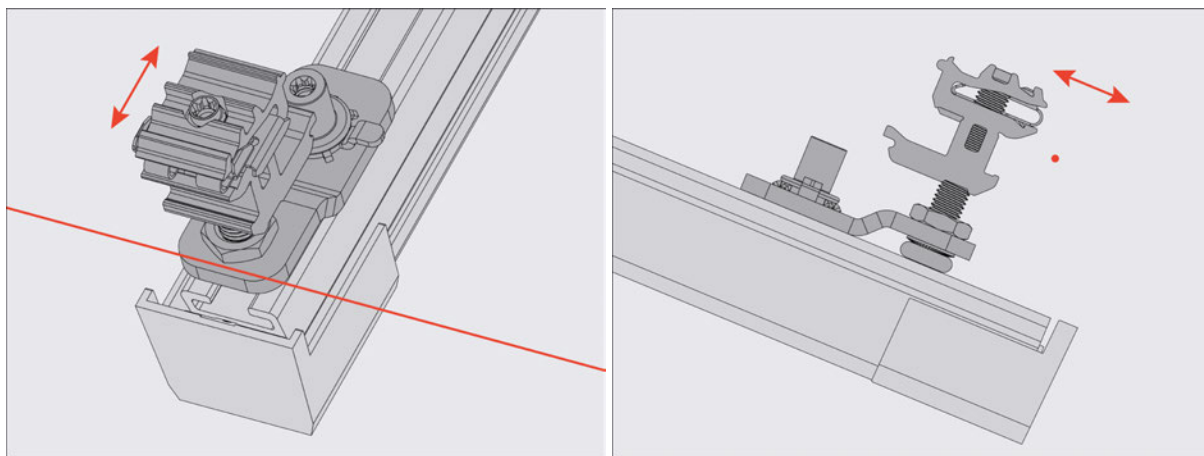


STEP 5: INSTALL THE FRONT ROW LEVELING FEET



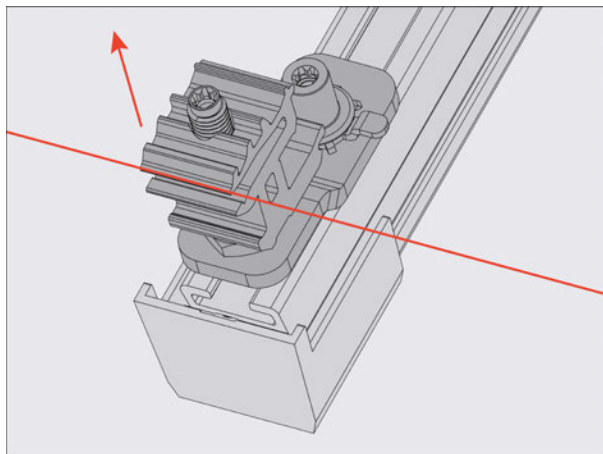
3. Align the remaining first row Leveling Feet to the string line.

Set the inner Leveling Feet in the nominal position, and align the Leveling Feet with the string line before tightening the T-Bolts.



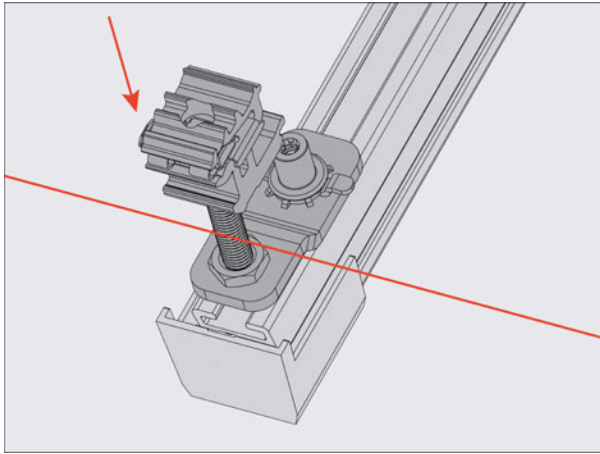
Install the remaining Leveling Feet in the first row and adjust them so that the Leveling Foot stud is as close to the string line as possible without pushing on the string line.

To accommodate for sags or humps in the roof surface, the Rockits can be adjusted up or down by 3/8 in.





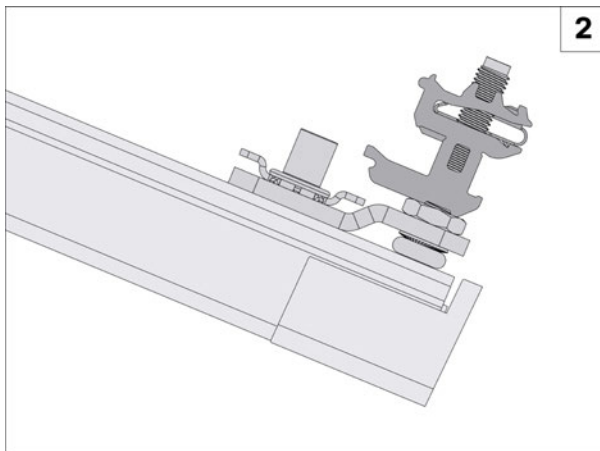
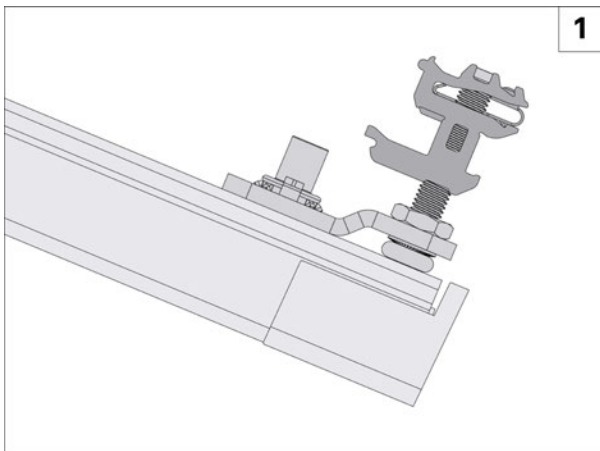
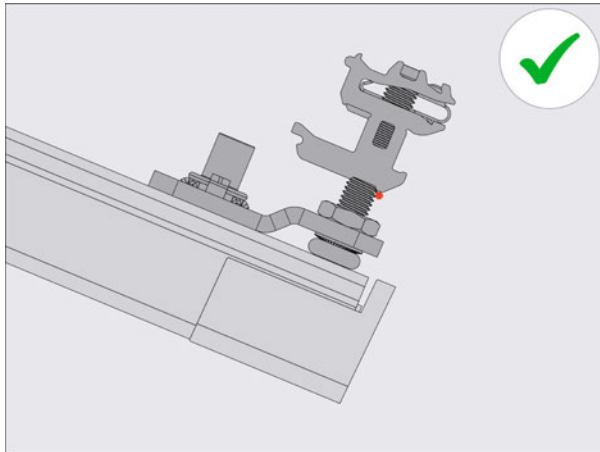
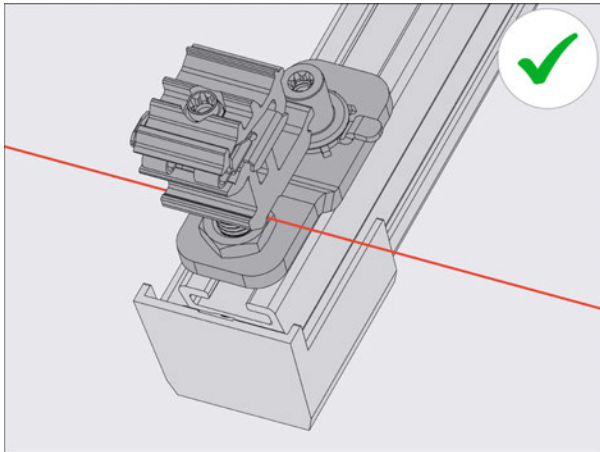
STEP 5: INSTALL THE FRONT ROW LEVELING FEET



- 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.

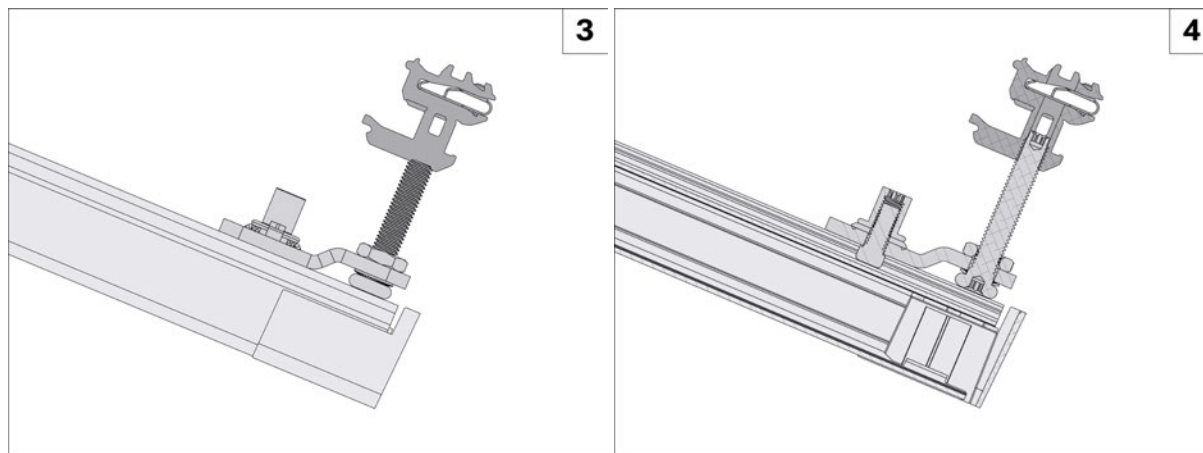
4. Leveling Feet



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



STEP 5: INSTALL THE FRONT ROW LEVELING FEET



- (3) - Maximum height (stud flush with bottom of window)
- (4) - Maximum height (cross section)

5. Tighten the Leveling Foot T-Bolts.

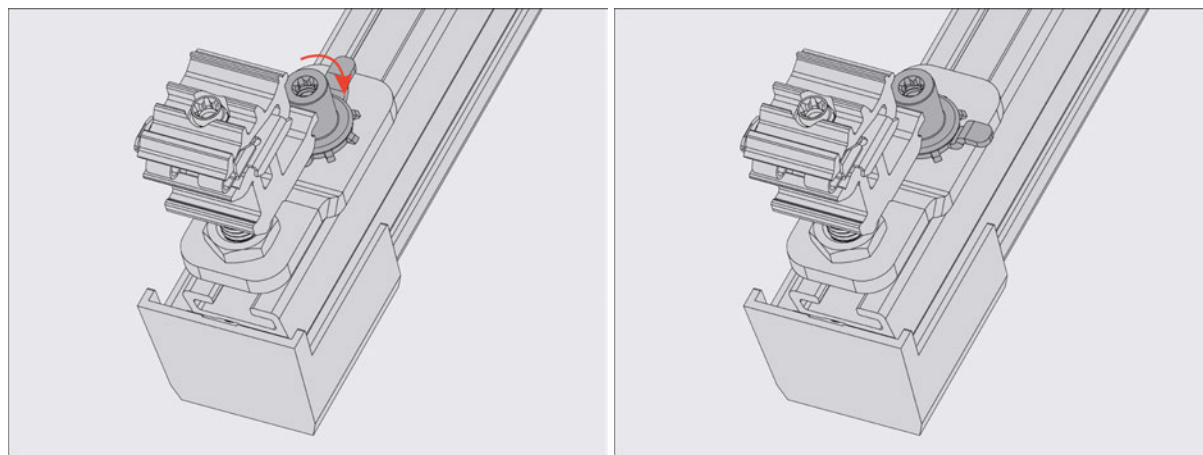
Fasten the Leveling Feet in place once the Rockits are aligned with the string line.



NOTE: When fully engaged with the channel, the indicator tabs on the T-Bolt will rotate 90° and be perpendicular to the Spanner Bar. Failure to rotate the T-Bolt fully will result in an insufficient structural connection.

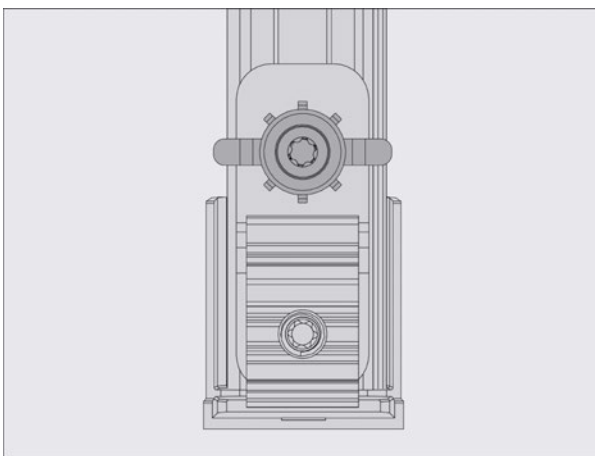
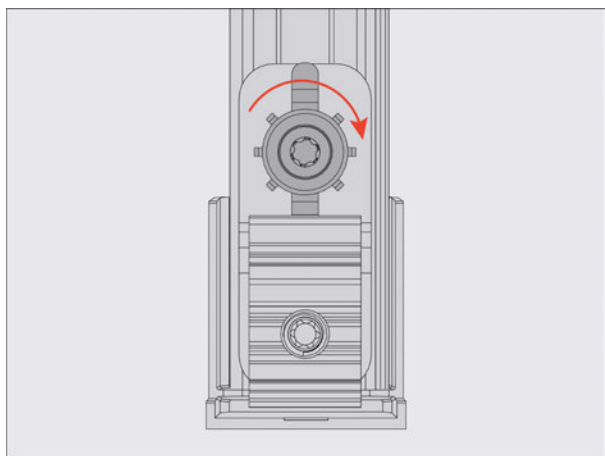


NOTE: Torque to a range of 13-20 ft-lbs. Verify that the Leveling Foot cannot be moved by hand.





STEP 5: INSTALL THE FRONT ROW LEVELING FEET





STEP 6: 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. Set the module (**SMILES**).

Position the first module on the Tongue side of the Rockits at a steep angle. Align the module edges to the marked array boundary.



NOTE: Use two technicians to place modules.

Rock the module down almost flat, while pushing the module onto the Tongues of the Rockits. 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.

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.

Install a full row of modules.

Install an Interlock on the down-roof side of the first module, with the tongue side pointing up-roof.

Set the next module in the row on the Interlock and Rockit, using the center 1/2 in timing marks on the Interlock to create a 1/2 in gap between modules. The system allows for +/- 1/4 in of adjustability in the module gap.

If a module does not sit parallel with the adjacent module, this indicates that the front row Leveling Feet were not installed straight. Adjust the Leveling Feet in the Y direction to establish a straight line along the up-roof edge of the modules.

Repeat these steps to install the full row of modules, ensuring that the locations of the Rockits comply with cantilever and X span.

- (A) - X cantilever
- (B) - X Span

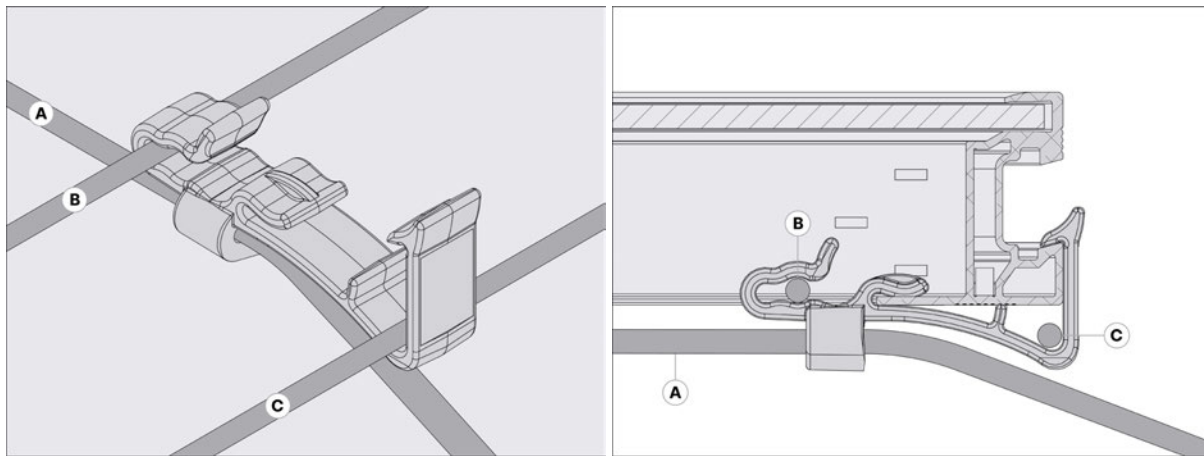
2. Manage the wires (**SMILES**).

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

The DC Wire Clip is UL listed to UL 1565 as a "wire positioning device." The DC Wire Clip accommodates up to three wires.

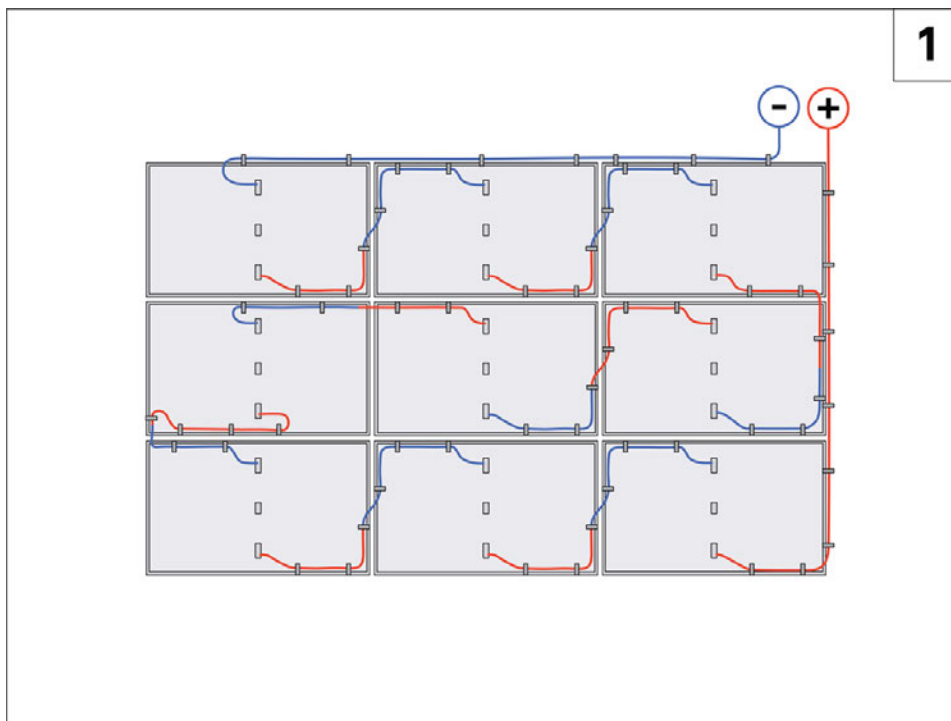


STEP 6: INSTALL THE PV MODULES (SMILES)



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

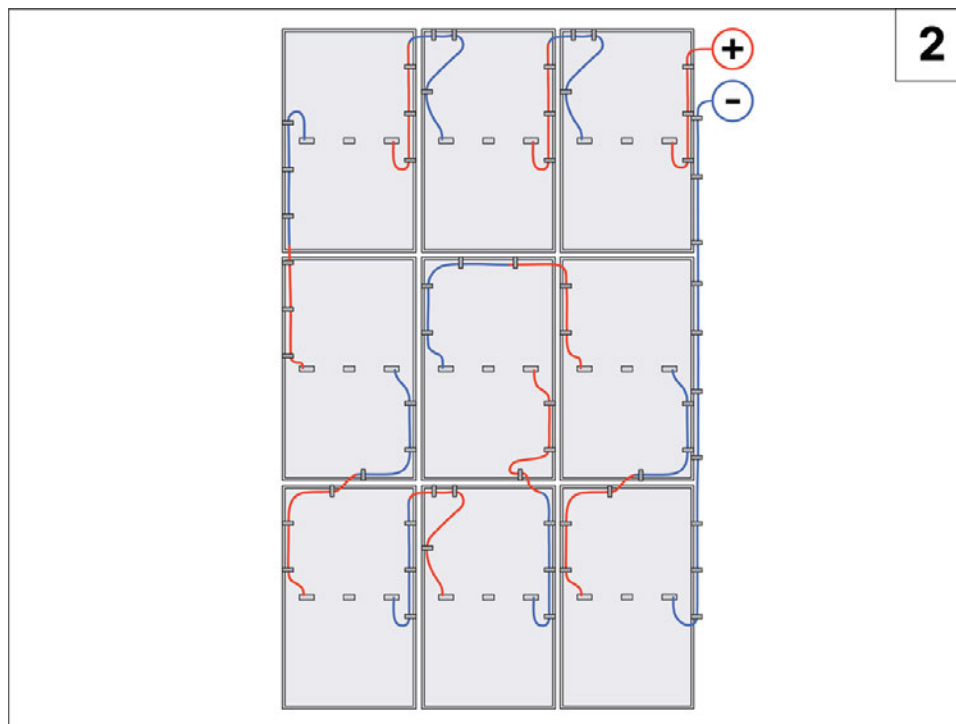
Example Array Wiring:



- (1) - Landscape orientation



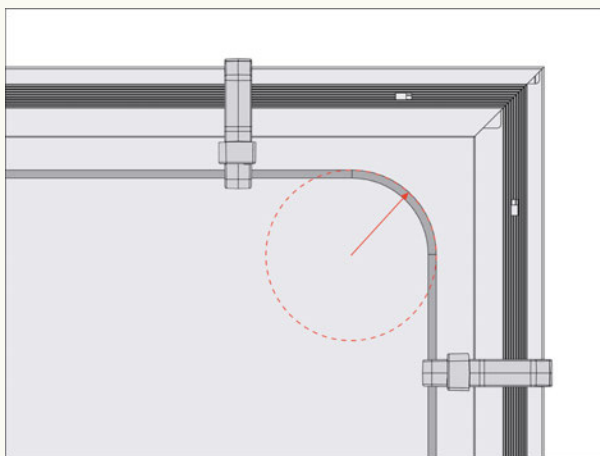
STEP 6: INSTALL THE PV MODULES (SMILES)



- (2) - Portrait orientation



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

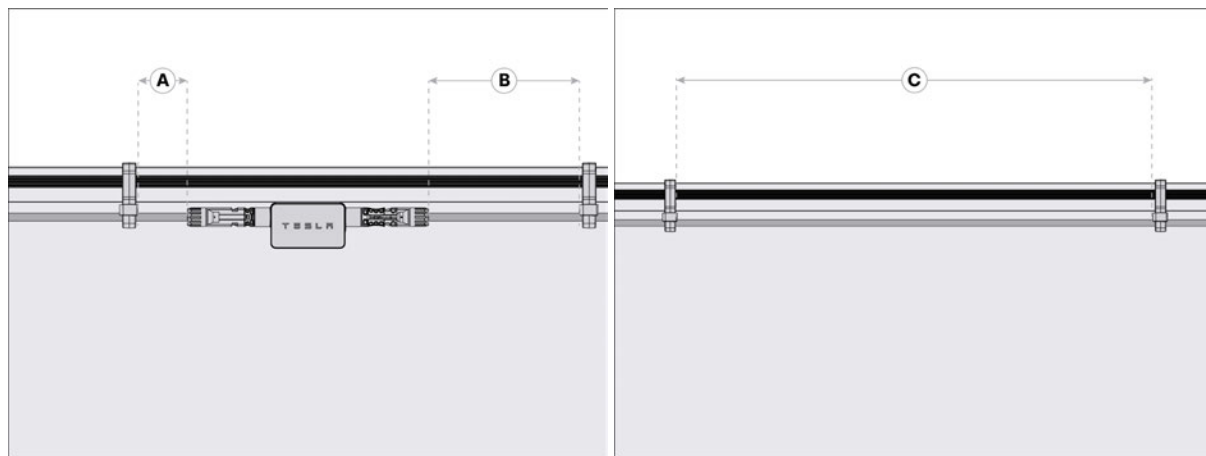


NEC 690.31(C)(1)(b) specifies that there must be a wire clip every 24 in (600 mm).

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

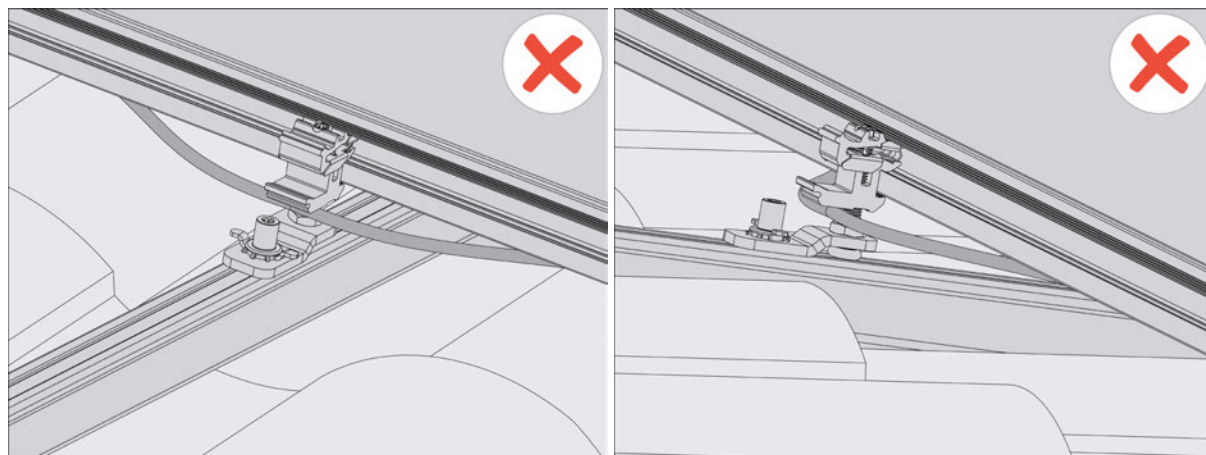


STEP 6: INSTALL THE PV MODULES (SMILES)



- (A) - Minimum distance between DC Wire Clip and connector (2 in)
- (B) - Maximum distance between DC Wire Clip and connector (6 in)
- (C) - Maximum distance between DC Wire Clips (24 in)

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



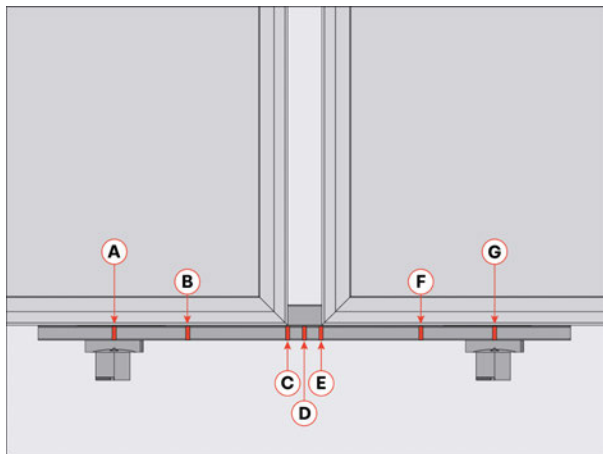
Refer to [Appendix D: Wire Management Recommendations on page 69](#) for more information on wire management of Tesla MCI systems.

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.

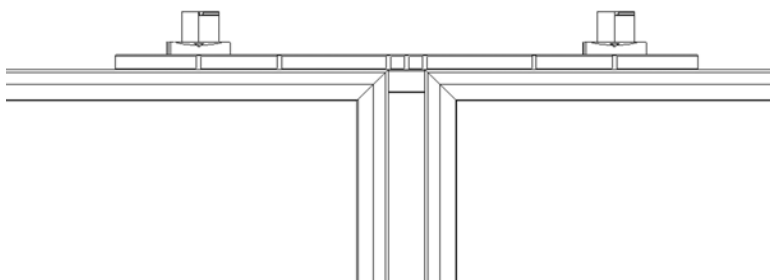
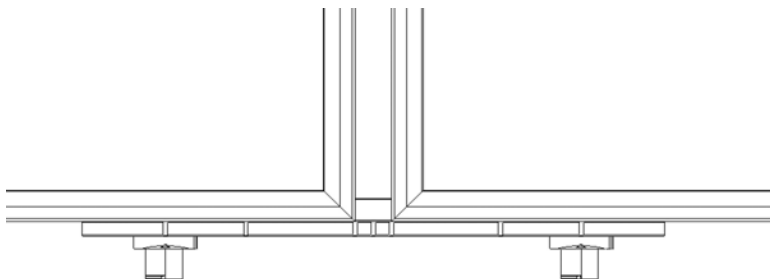


STEP 6: INSTALL THE PV MODULES (SMILES)



- (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 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

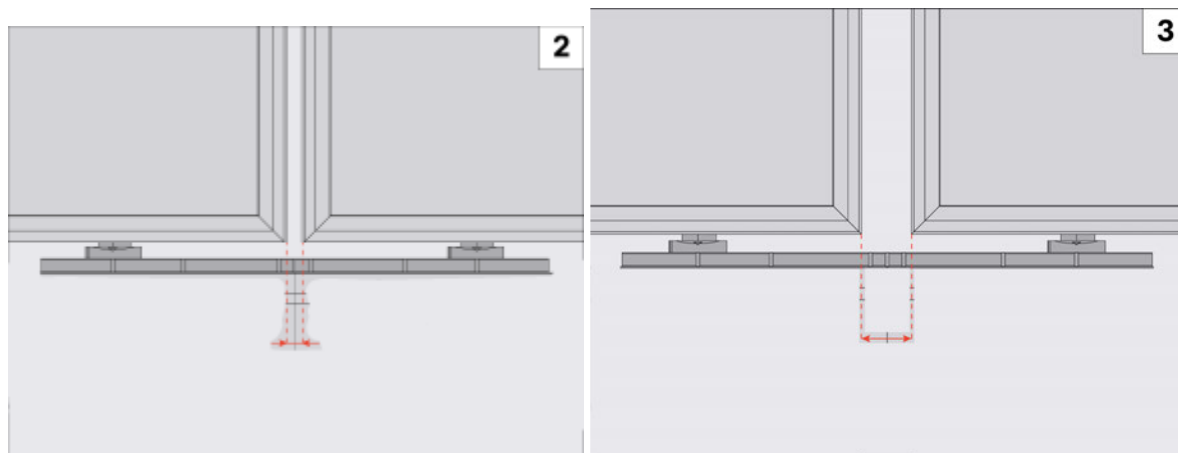
Adjust modules if necessary to ensure alignment at the up-roof edge of the module. The X gap between module corners should be $\frac{1}{2}$ in with $\pm \frac{1}{4}$ in of tolerance.



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

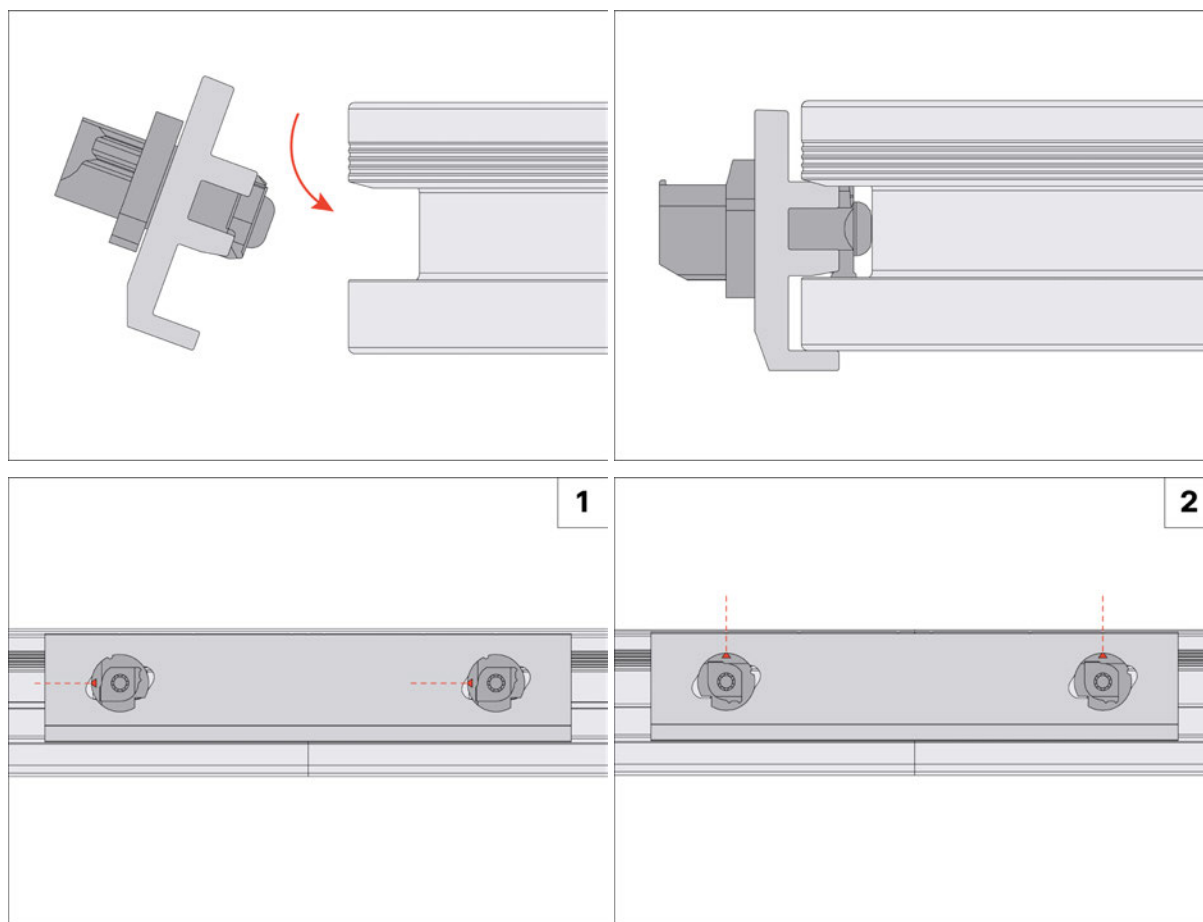


STEP 6: INSTALL THE PV MODULES (SMILES)



- (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.



- (1) - Position 1: open Interlock
- (2) - Position 3: locked Interlock

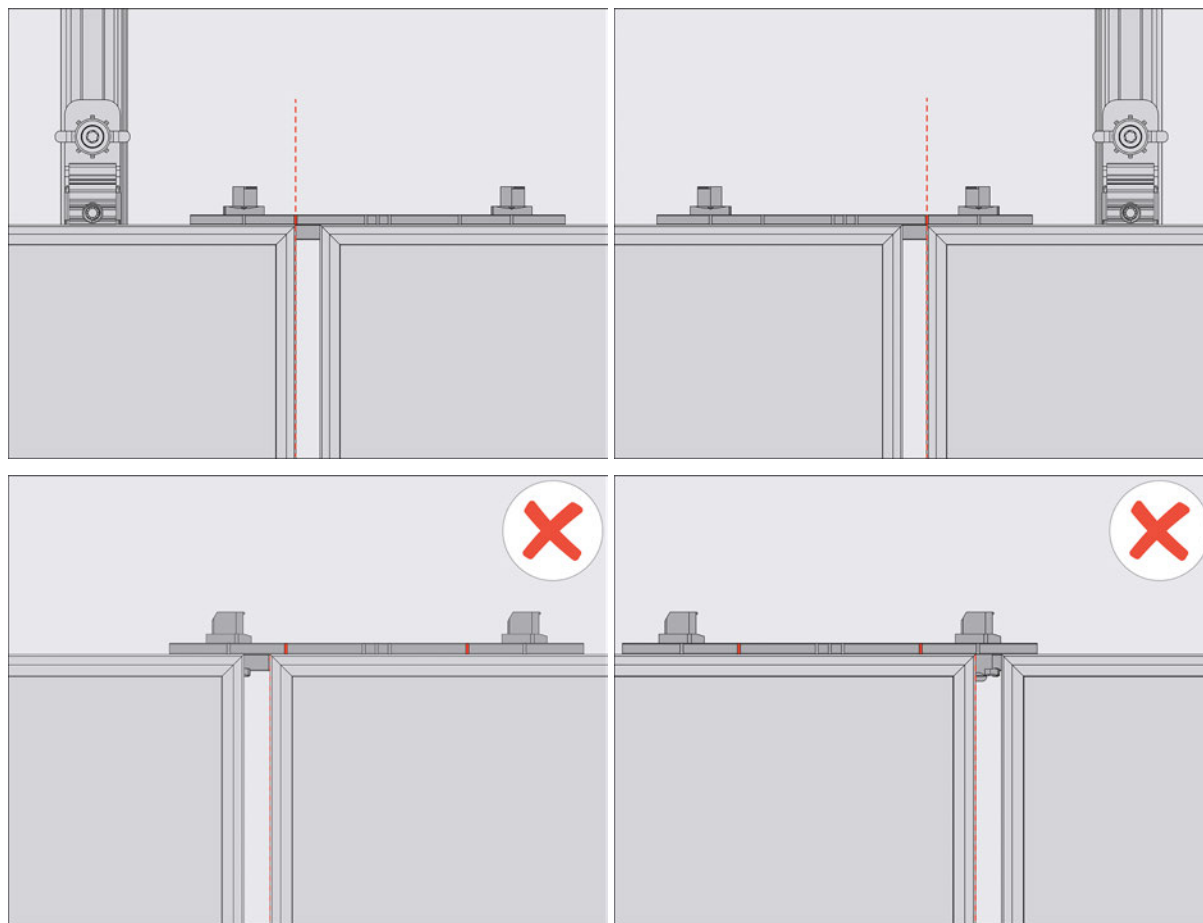


NOTE: The Interlock may not fully seat into the Tesla Groove with hand pressure only. Rotate both Keys to Position 3 to form a structural and electrical bond with the modules. This motion will pull the Interlock into the module frame and an audible grinding sound indicates that the bond is being made.



STEP 6: INSTALL THE PV MODULES (SMILES)

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.



If adjusting the X position of the Interlock is insufficient to remove the interference with the Rockit, use a Hybrid Interlock instead.



STEP 6: INSTALL THE PV MODULES (SMILES)

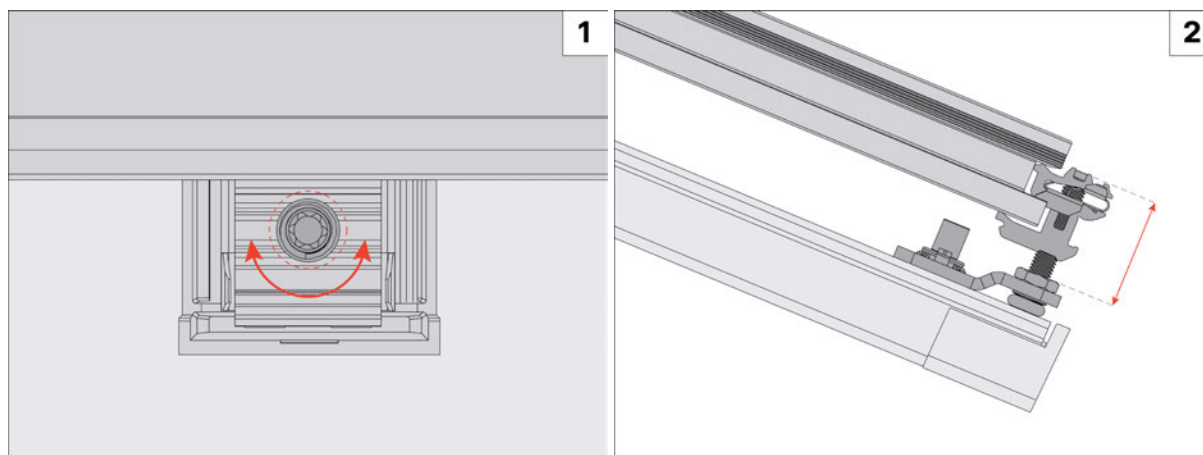
4. Level (SMILES).

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.

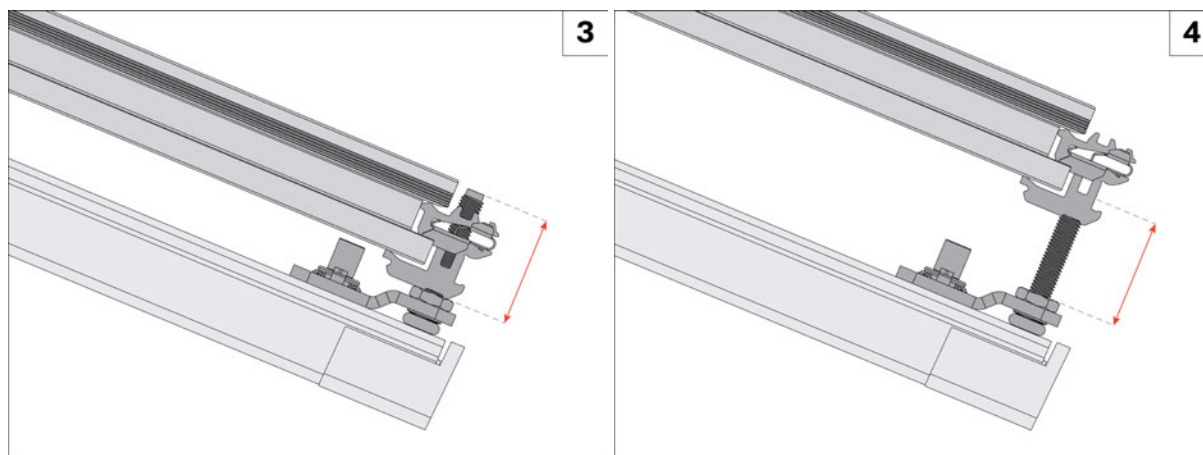
- (1) - *Uneven leveling*
- (2) - *Even leveling*

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, stud flush with top of the Rockit*

Do not raise the Rockit 1¼ in above the Leveling Foot nut. The stud will be flush with the bottom of the window of the Rockit at maximum height.



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

5. Evaluate (SMILES).



STEP 6: INSTALL THE PV MODULES (SMILES)

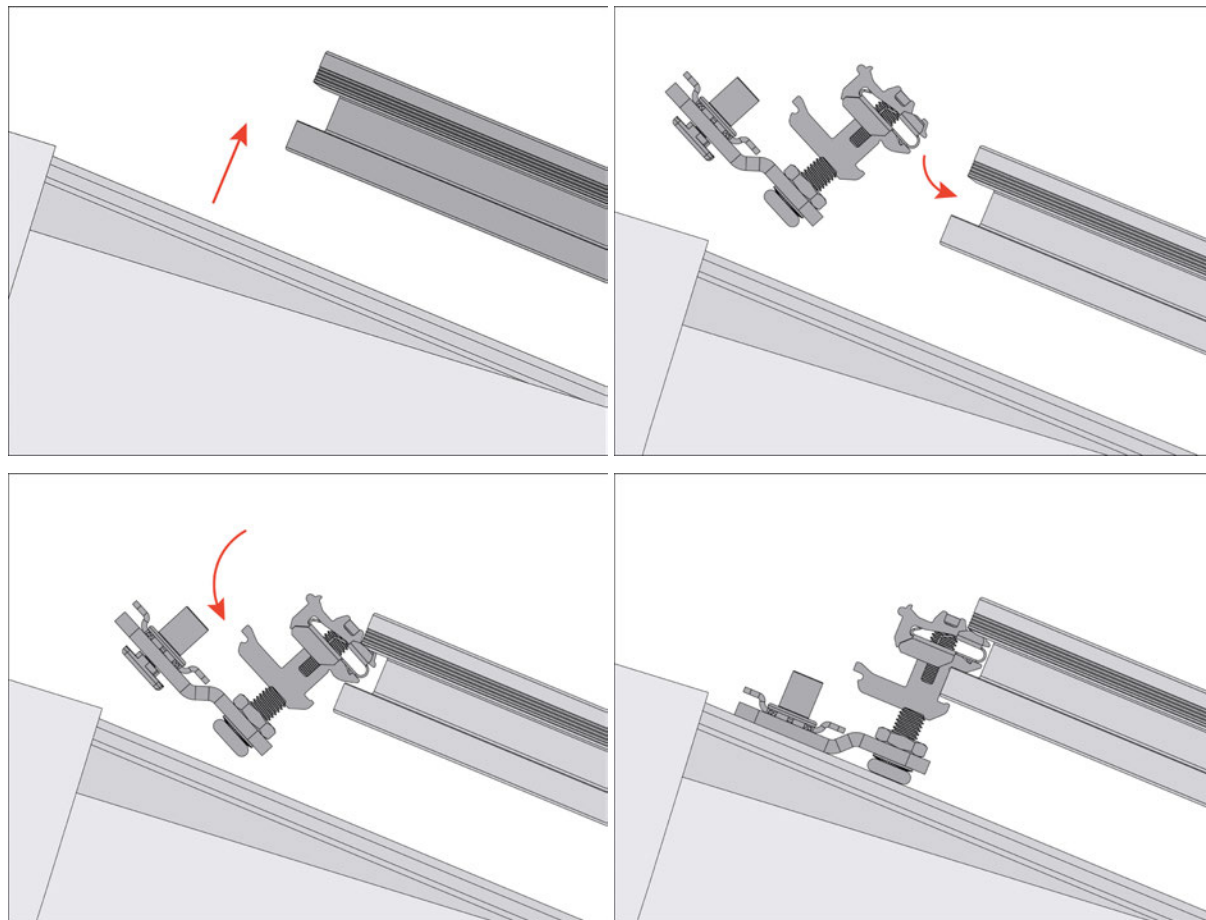
At this point, pause and evaluate the work done so far. Check that all wire management is proper and there are no hanging wires present, there are no missed connections or any that are touching the roof.

While evaluating the installation of the first row, lower the PV modules and ensure that the up-roof side of the module is resting directly on the Spanner Bar.

Once all checks are done, move on to the next step to secure the modules to the roof.

6. **Secure (SMILES).**

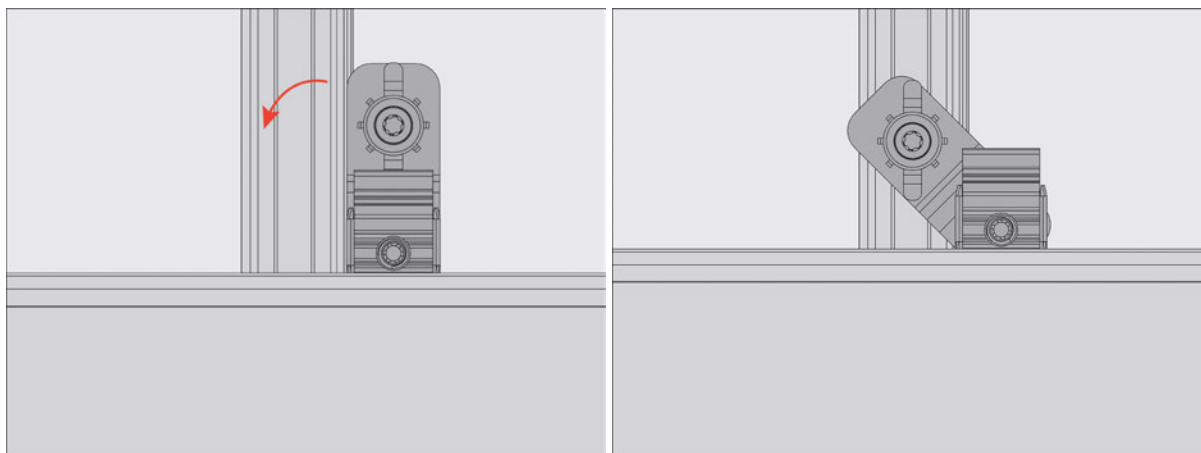
Lift the up-roof side of the PV module and attach the Leveling Foot into the PV module frame.



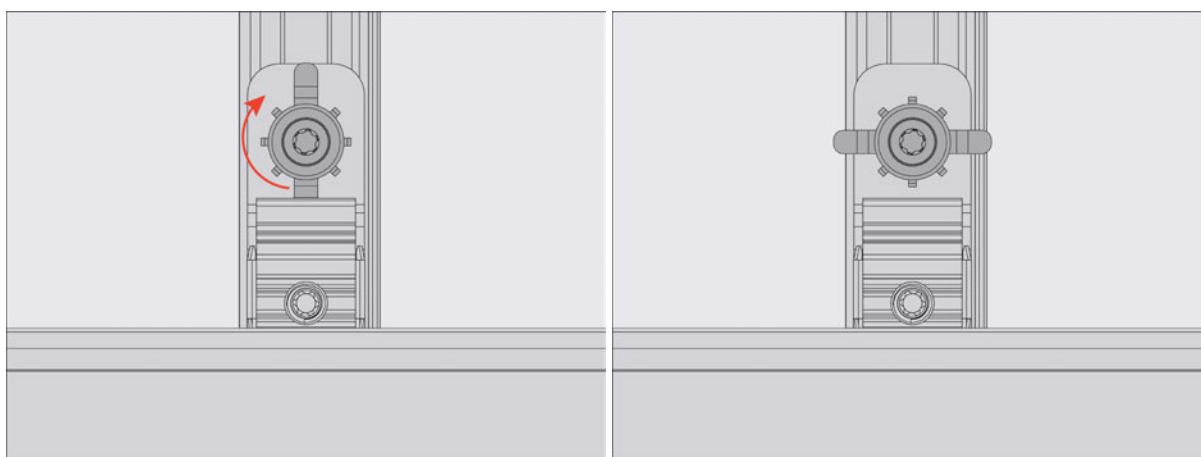
Swivel the Leveling Foot and insert the T-bolt into the top channel on the Spanner Bar.



STEP 6: INSTALL THE PV MODULES (SMILES)



Secure the up-roof Leveling Feet by fastening the T-bolt on the Leveling Foot into the Spanner Bar.



 **NOTE:** Torque to a range of 13-20 ft-lbs. Verify that the Leveling Foot cannot be moved by hand.

Check the indicator tabs on the T-Bolts to ensure that they are perpendicular to the Spanner Bars.



STEP 6: INSTALL THE PV MODULES (SMILES)

7. Repeat **SMILES**.

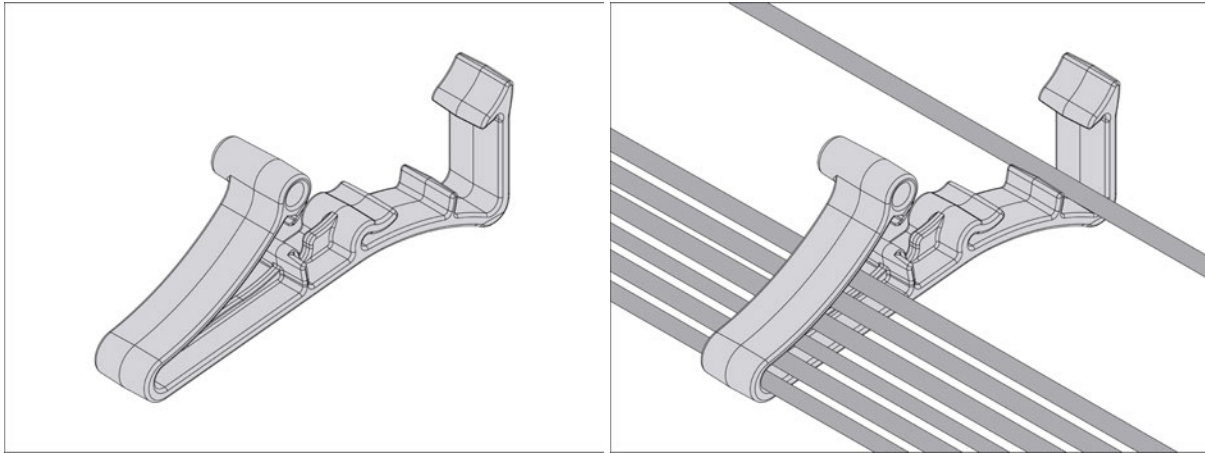
Continue to install the modules, Leveling Feet, and Interlocks until the array is complete. Complete all steps of "SMILES" for each row.



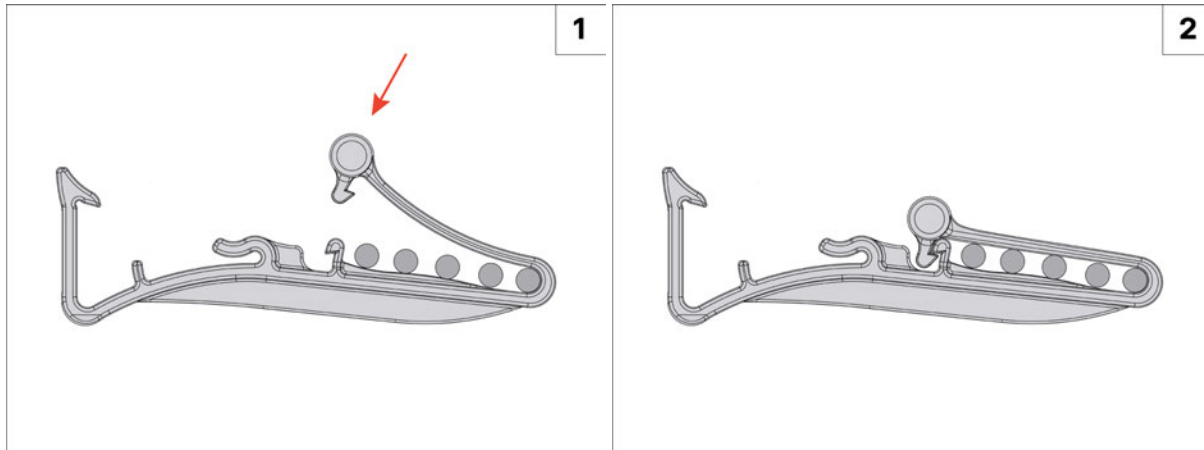
STEP 7: COMPLETE WIRE MANAGEMENT AND BONDING

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.



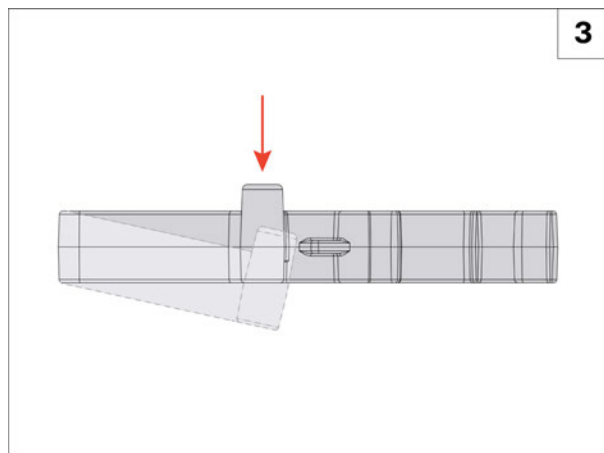
Close the Home Run Wire Clip by snapping the clip together. To open the clip, push the tab to the side.



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



STEP 7: COMPLETE WIRE MANAGEMENT AND BONDING

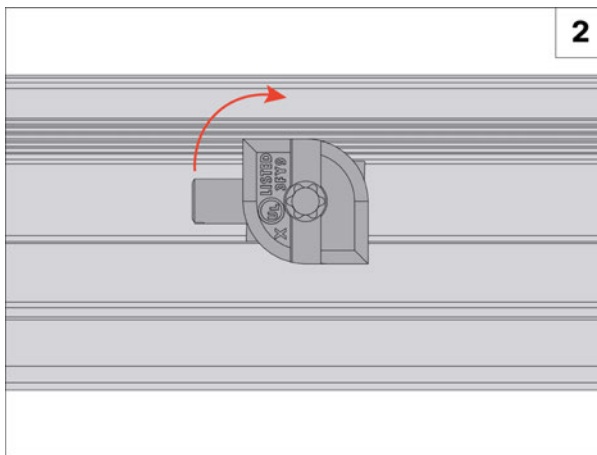
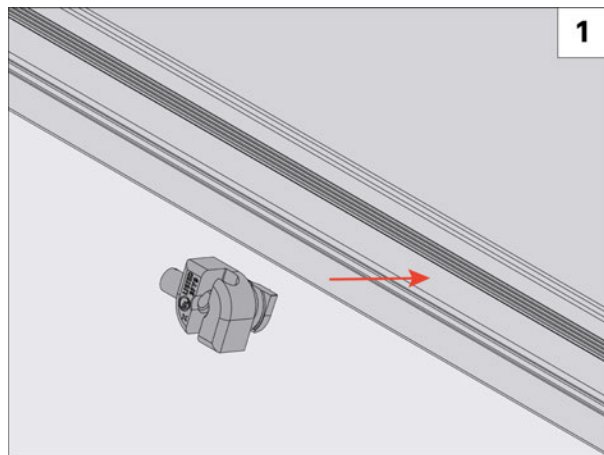


- (3) - To open the clip, push the tab to the side

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 should be placed on the module frame where the DC wiring meets the array. This should be repeated for each sub-array.

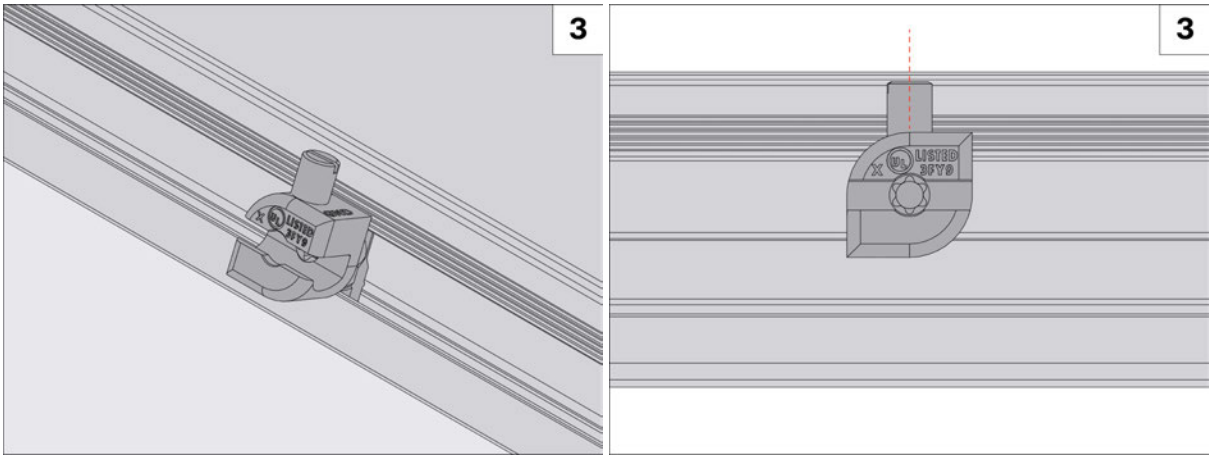
Insert a Ground Lockit into the Tesla Groove with the set screw pointing left. Rotate the Ground Lockit into place with a 90° clockwise turn.



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



STEP 7: COMPLETE WIRE MANAGEMENT AND BONDING



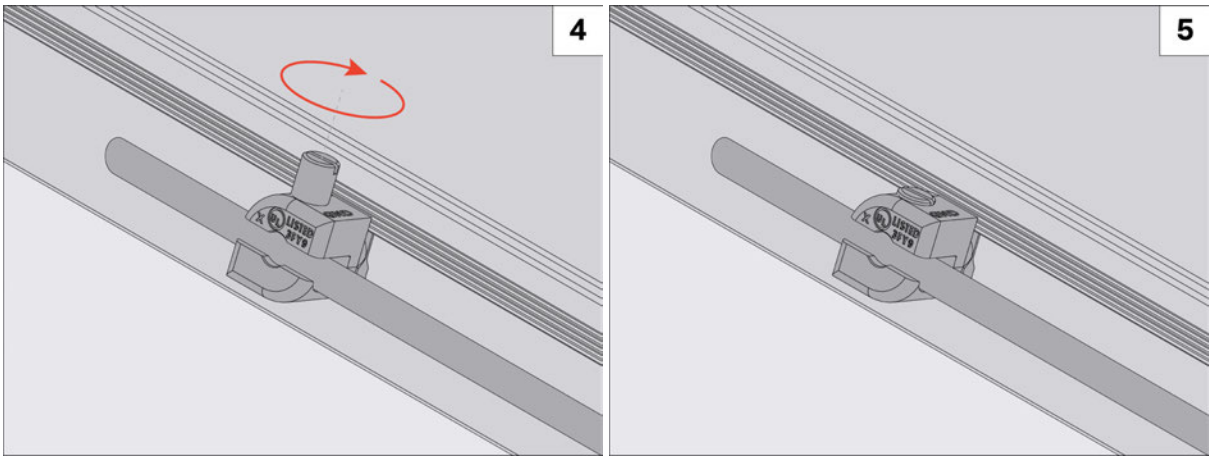
- (3) - Installed and rotated Ground Lockit



NOTE: The set screw should 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.



- (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

- **14-10 AWG:** 40 in-lbs
- **8 AWG:** 45 in-lbs
- **6 AWG:** 50 in-lbs
- **4 AWG:** 55 in-lbs



STEP 7: COMPLETE WIRE MANAGEMENT AND BONDING

Refer to [Appendix D: Wire Management Recommendations on page 69](#) for additional information on wire management.

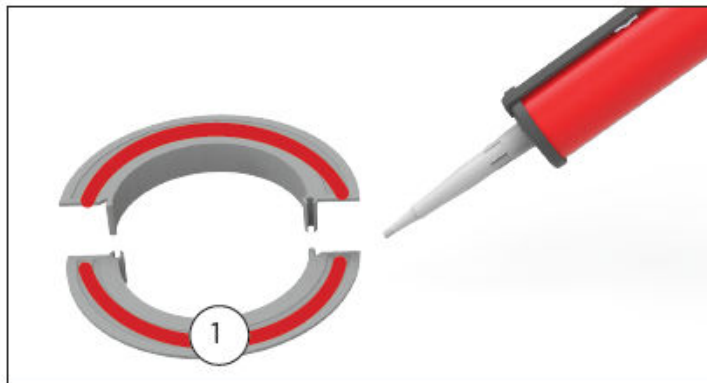


STEP 8: INSTALL SEALING RINGS

The Sealing Ring serves as a waterproofing dam at each Base Foot. The Sealing Ring is used with solar arrays installed on low-slope residential roofs. Sealing Rings must be installed on a clean roof surface.

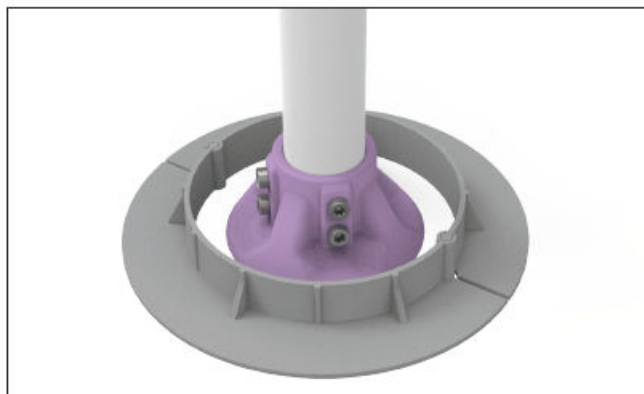
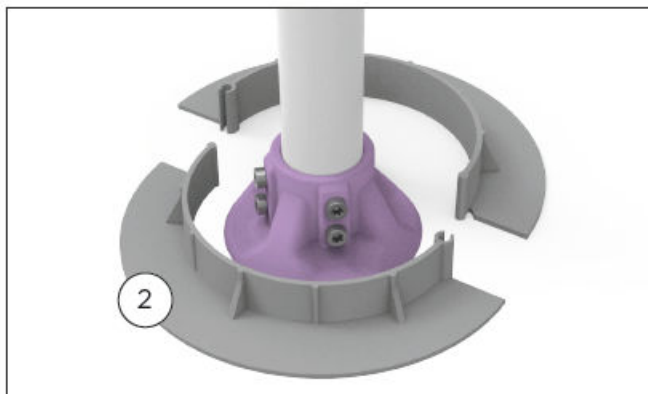
1. Apply the sealant.

Apply a bead of sealant on the bottom of each half of the Sealing Ring. Refer to [Approved Sealants on page 81](#).



2. Connect the two halves of the Sealing Ring.

Set each half of the Sealing Ring around the Base Foot, connecting the joints of both halves.



3. Option A: Pourable Sealant

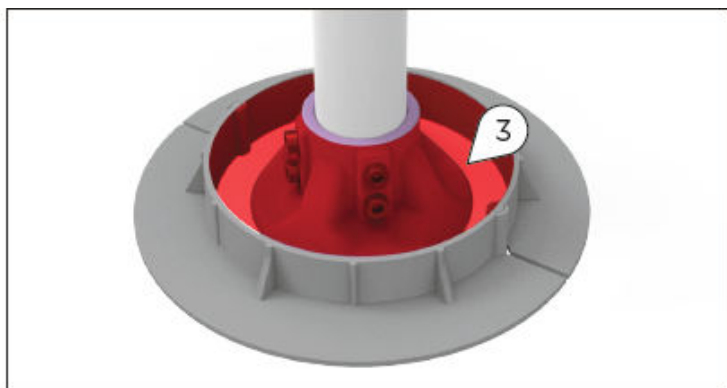
On roofs with a pitch of 1:12 or less, apply sealant to all surfaces with potential water infiltration as indicated below (refer to [Approved Sealants on page 81](#)). Fill the Sealing Ring with pourable sealant. Do not overfill the Sealing Ring.

Option B: High Viscosity Sealant

On roofs with a pitch greater than 1:12 and up to 2:12, apply sealant to all surfaces with potential water infiltration. Fill the Sealing Ring with high viscosity sealant.



STEP 8: INSTALL SEALING RINGS

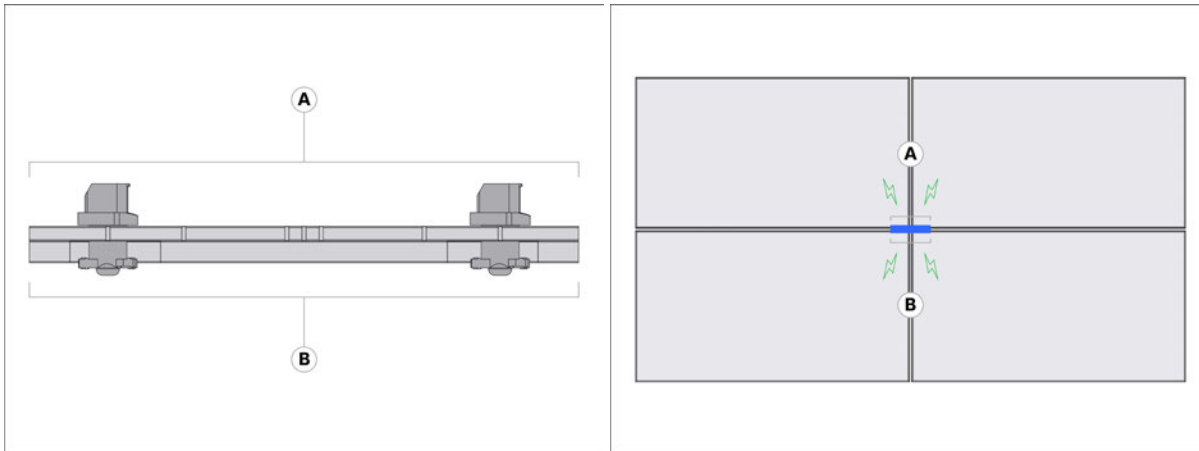




APPENDIX A: GROUNDING AND BONDING

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.



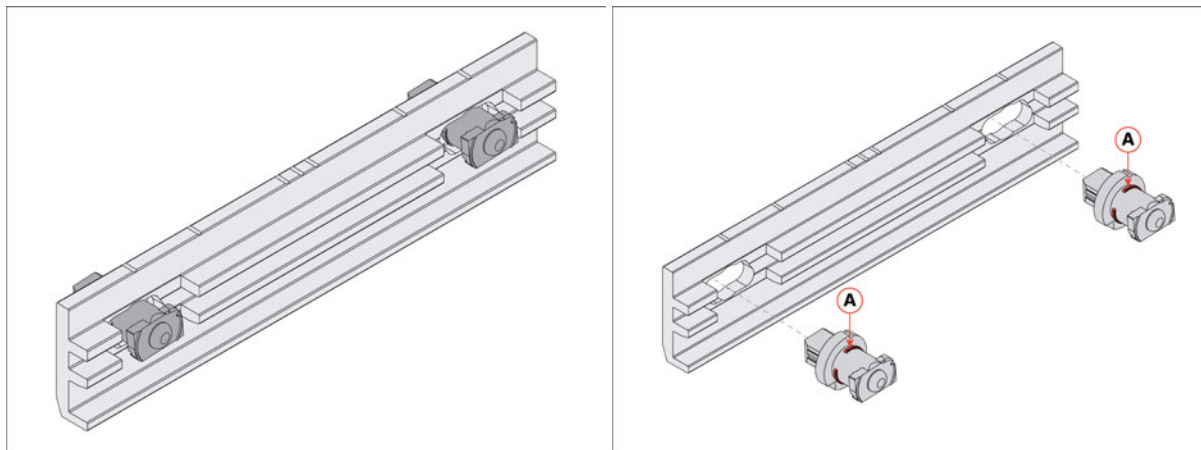
- (A) - Tongue side of the Interlock
- (B) - Key side of the Interlock
- ⚡ Bond path
- — Interlock



APPENDIX A: GROUNDING AND BONDING

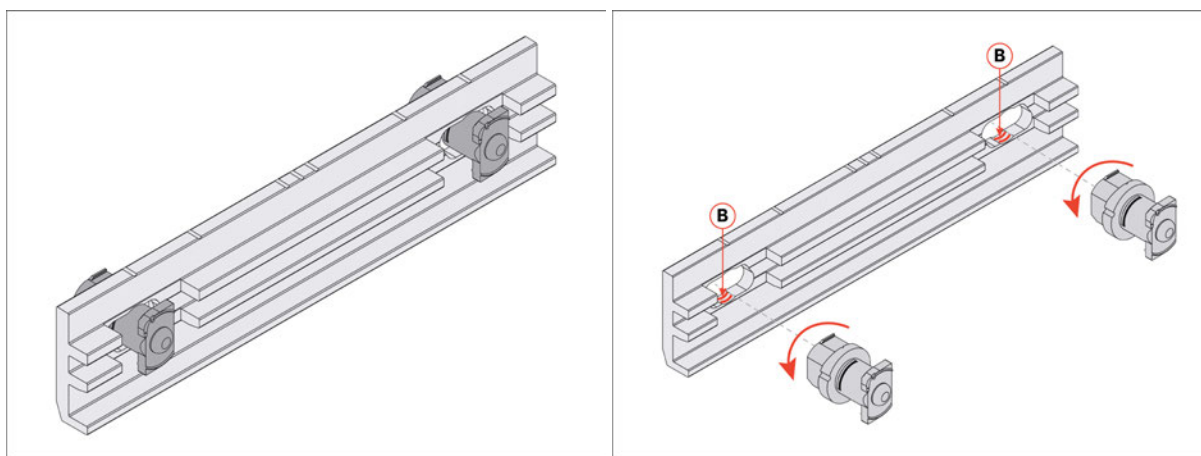
Interlock Lockit to Interlock Bonding

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:



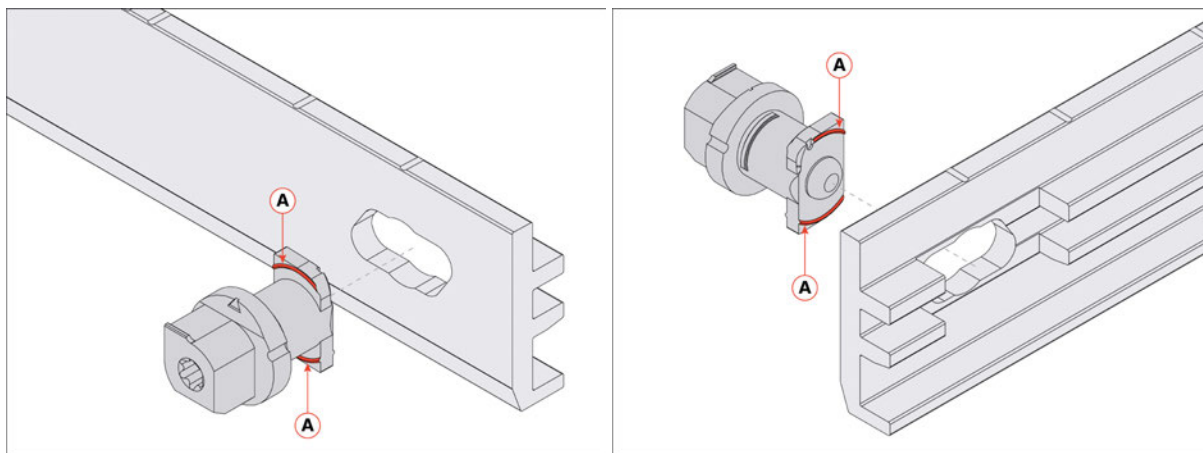
- Lockit in locked position cuts into Interlock plate (B)

Interlock Bonding to Module Frame

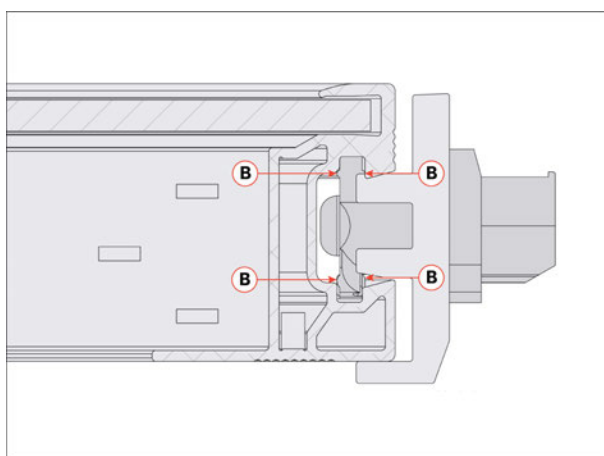
Forced interference during the rotation of the Interlock Lockit causes the teeth to cut through the coating on the module frame, resulting in a robust and UL-certified bonding path. The Key side of the Interlock Lockit bonds the down-roof edge of modules, as shown below:



APPENDIX A: GROUNDING AND BONDING

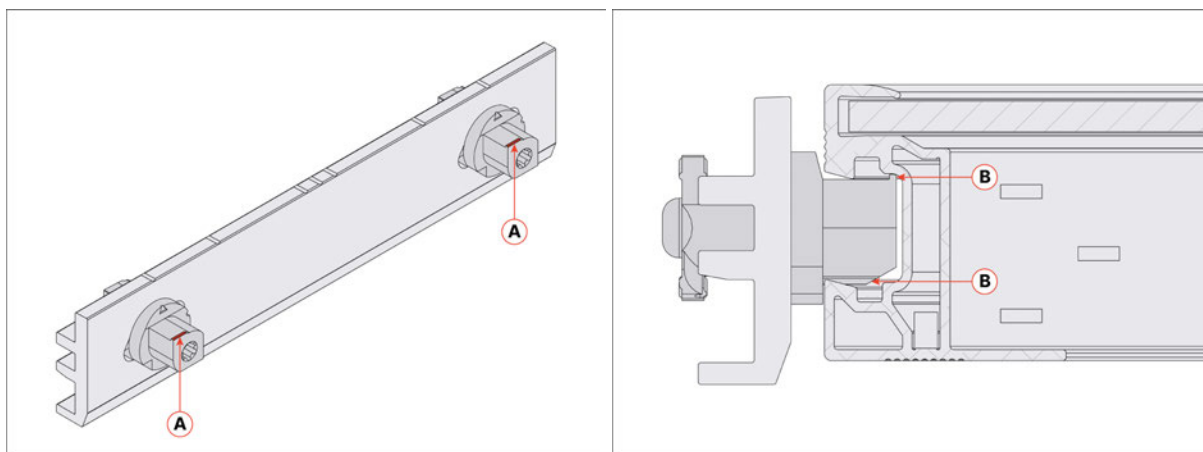


- (A) - Teeth on Interlock Lockit



- (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:

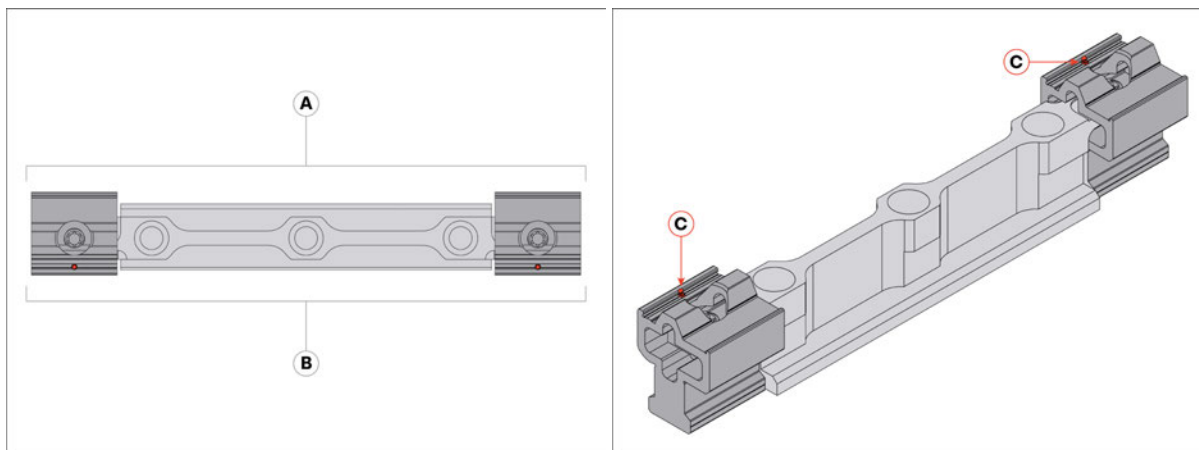


- (A) - Teeth on Interlock Lockit
- (B) - Forced interference bonding with module frame

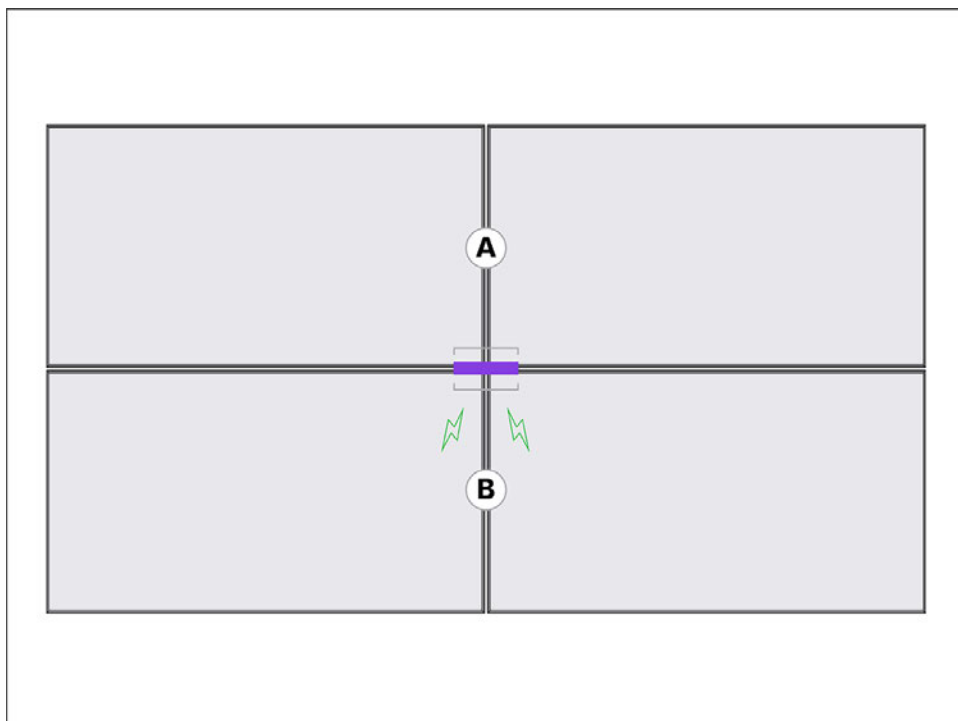


APPENDIX A: GROUNDING AND BONDING

Hybrid Interlock Bonding



- (A) - Tongue side of the Hybrid Interlock
- (B) - Key side of the Hybrid Interlock
- (C) - Bonding pins



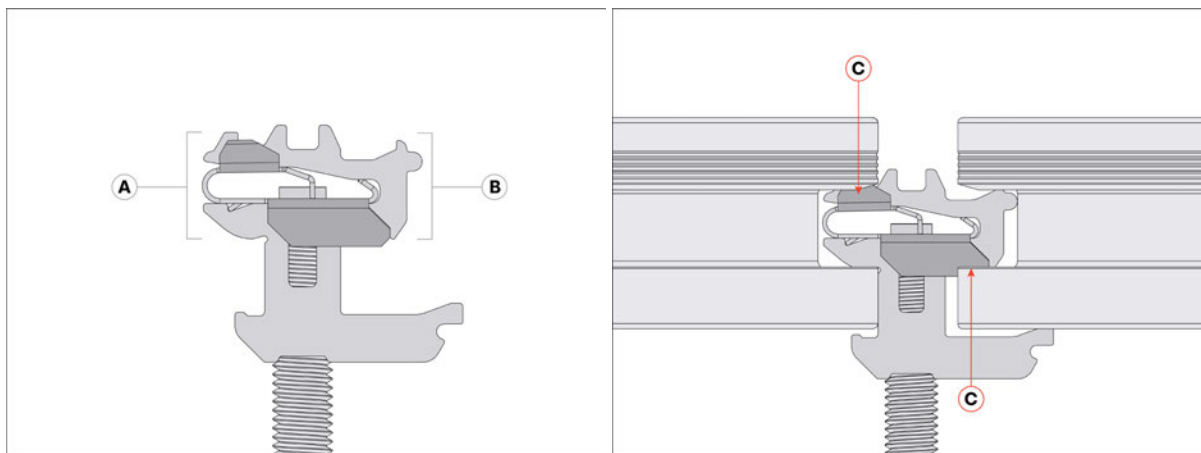
Hybrid Interlocks only bond the two down-roof modules.

Key & Tongue Side Bonding of the Rockit

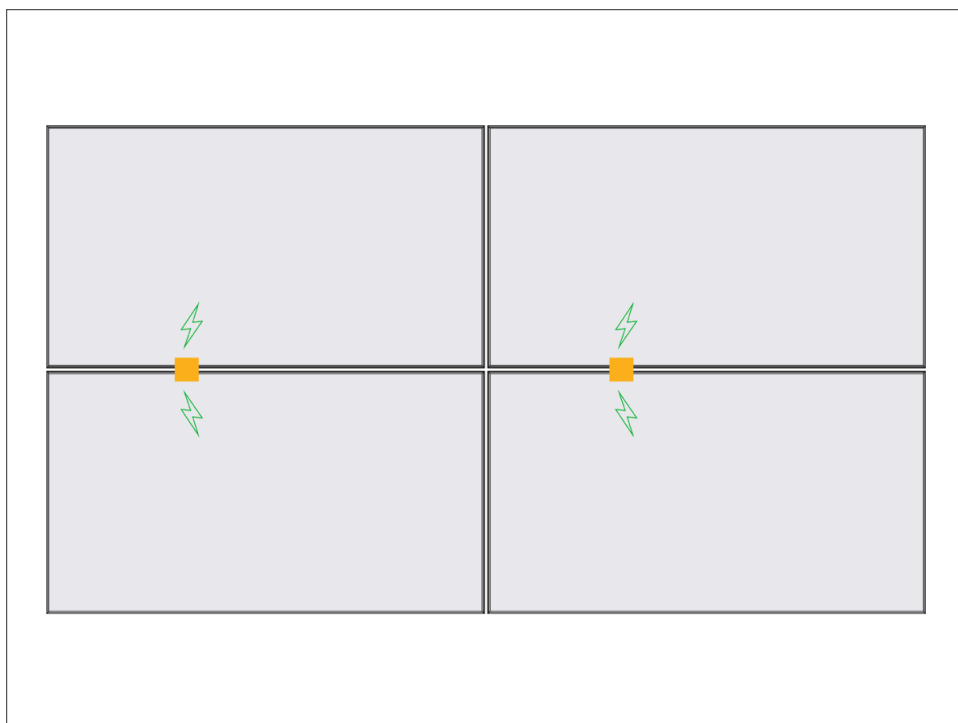
The Rockit has a stainless-steel spring clip that bonds to the adjacent module frame on both Key and Tongue sides. A module can be pulled out to the edge of the lip and still be correctly installed, allowing for small variations in module sizes or module alignment.



APPENDIX A: GROUNDING AND BONDING



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



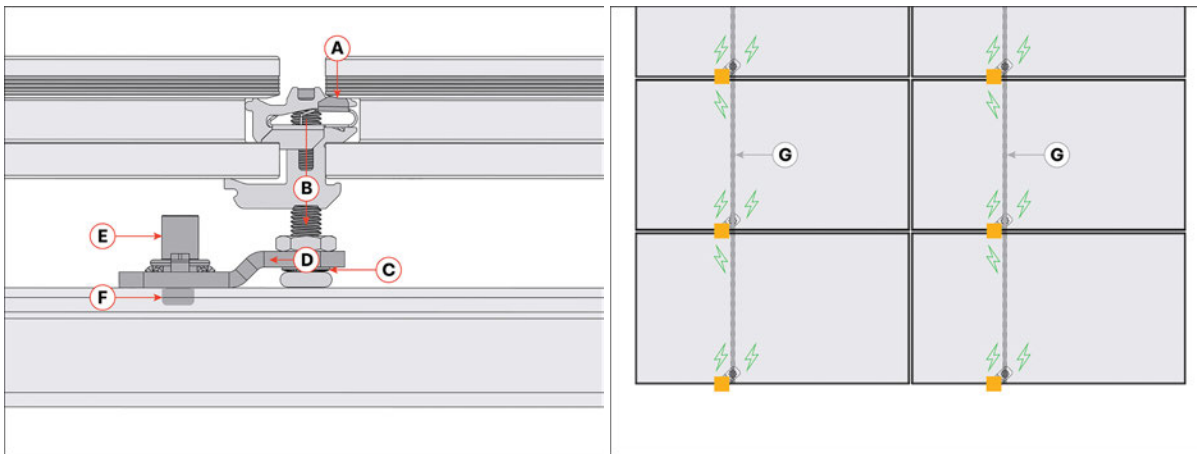
- ⚡ Bond path
- ■ Rockit

Leveling Foot to Spanner Bar Bonding

In the Tesla Panel Mount - Tile system, the Spanner Bars are also electrically bonded to the EGC through the leveling foot. Both Round Tile Leveling Feet and Flat Tile Leveling Feet complete this bonding in a similar manner.



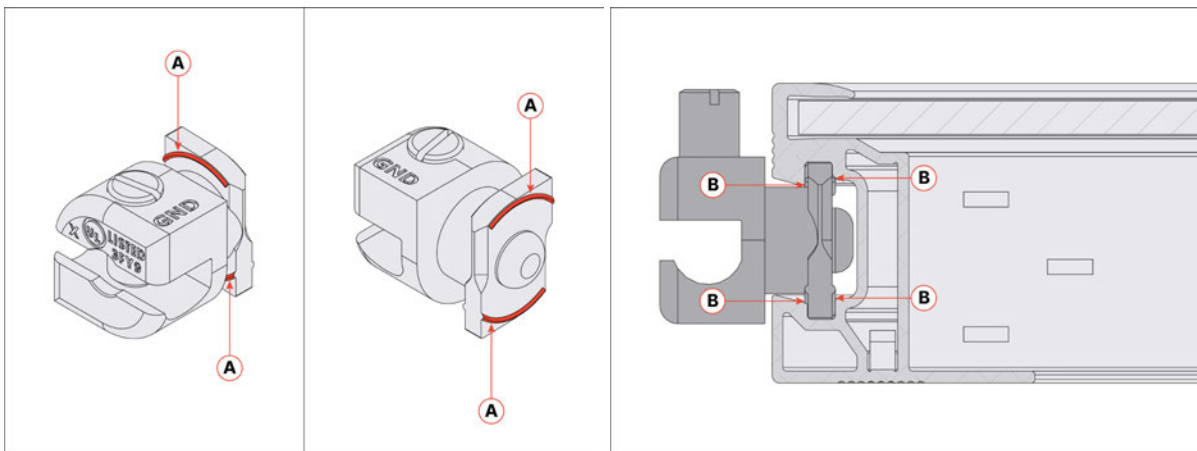
APPENDIX A: GROUNDING AND BONDING



- (A) - Stainless steel spring in the Rockit cuts through the coating on the module frame
- (B) - Rockit connects to the stud at the threaded connection
- (C) - Stud head connects to the serrated washer
- (D) - Serrated washer connects to the Leveling Foot bracket
- (E) - Winged washer connects the Leveling Foot bracket to the T-Bolt assembly
- (F) - T-Bolt connects to the Spanner Bar with serrated teeth
- (G) - Spanner Bar

Ground Lockit

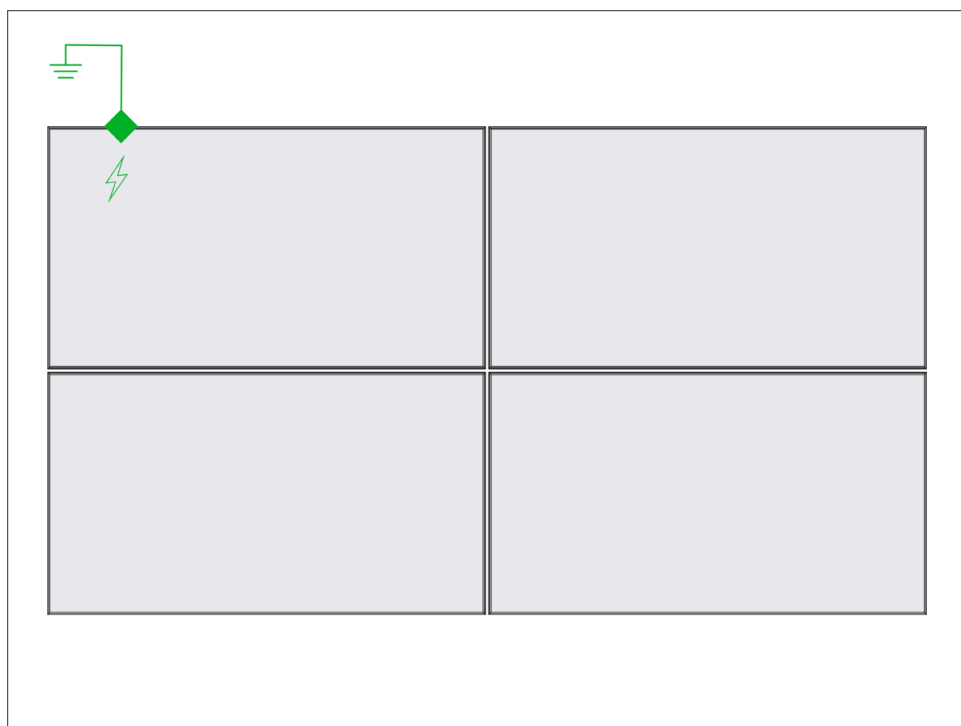
The Ground Lockit bonds to the modules in the same way as the Interlock with biting teeth that cause forced interference during rotation. The teeth cut through the coating on the module frame, resulting in a robust and UL-certified bonding path.



- (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

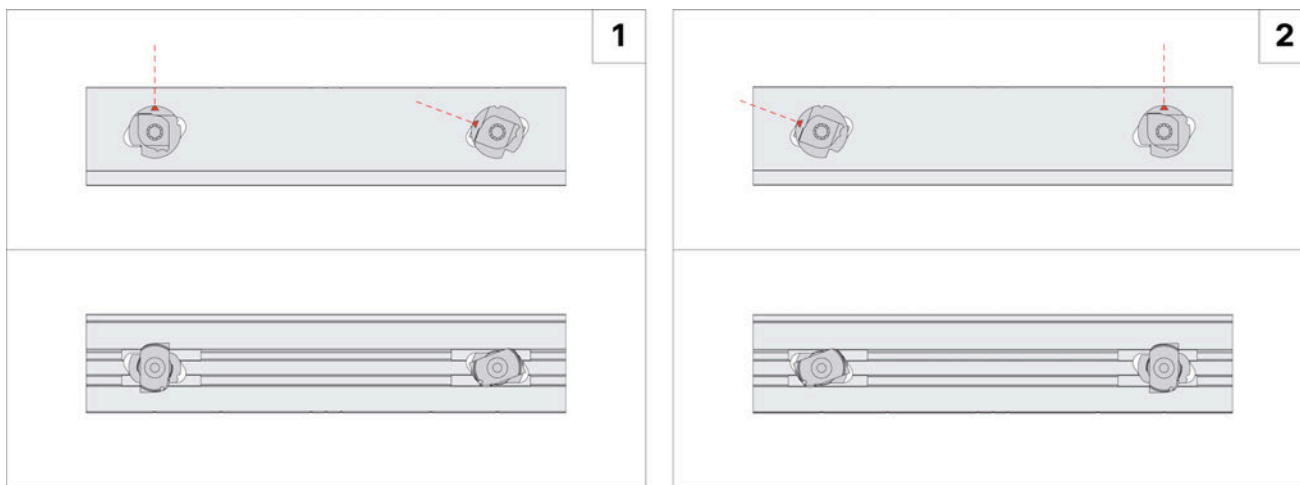


APPENDIX B: THERMAL EXPANSION

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.

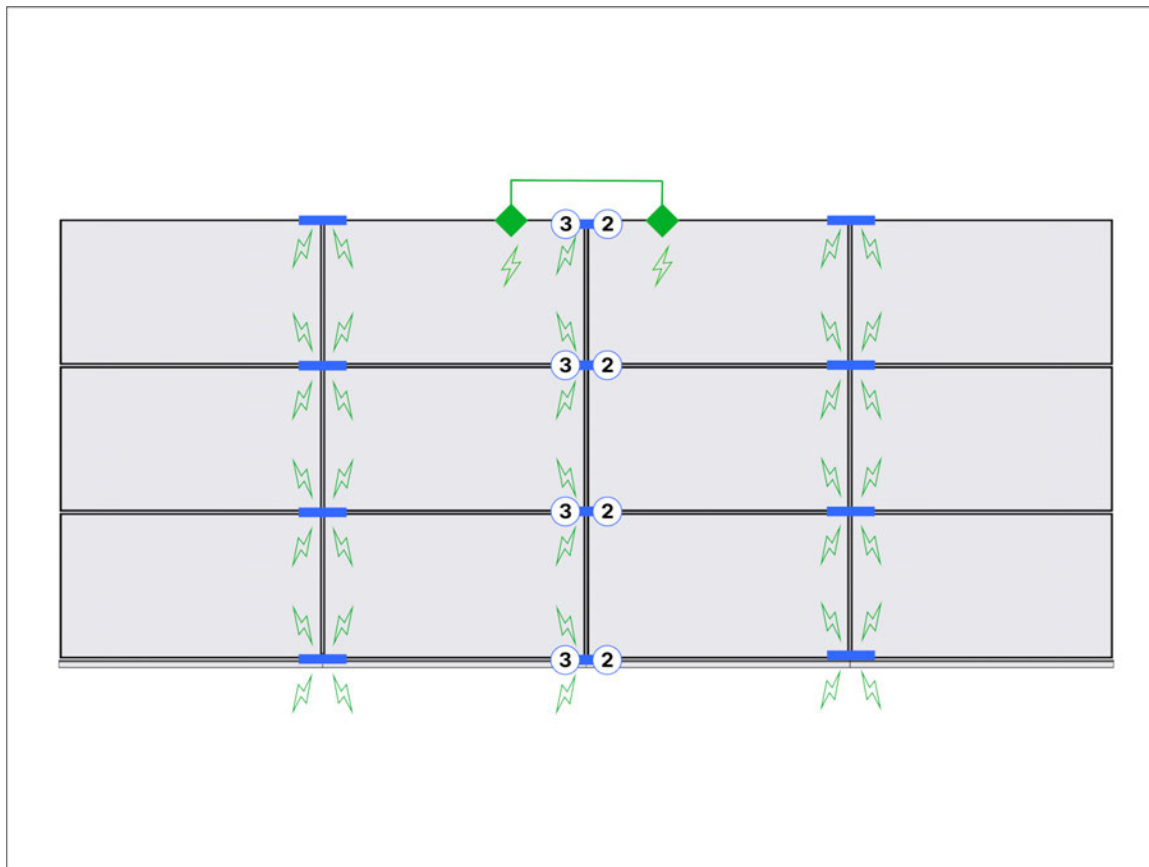
Thermal expansion joints require that a Ground Lockit be installed on both sides of the break.



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.



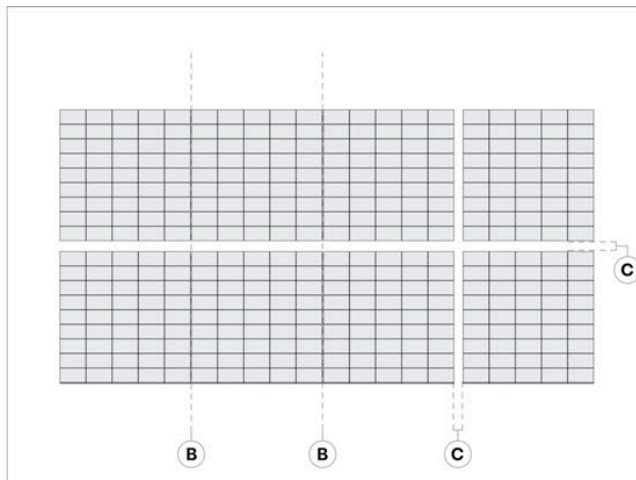
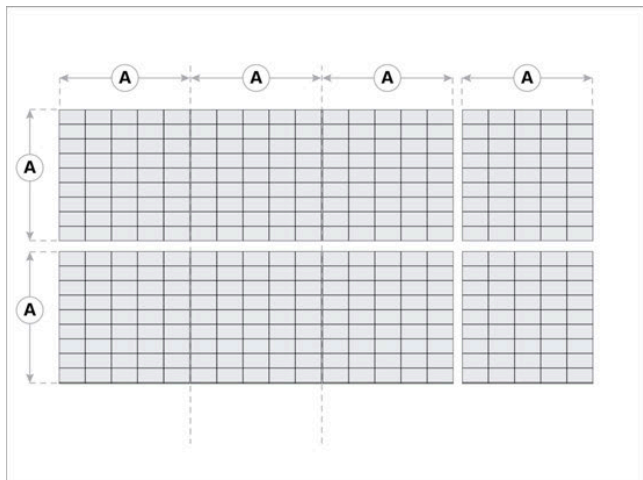
-  Bond path
-  Ground Lockit
-  Equipment grounding conductor (EGC)
-  Interlock



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

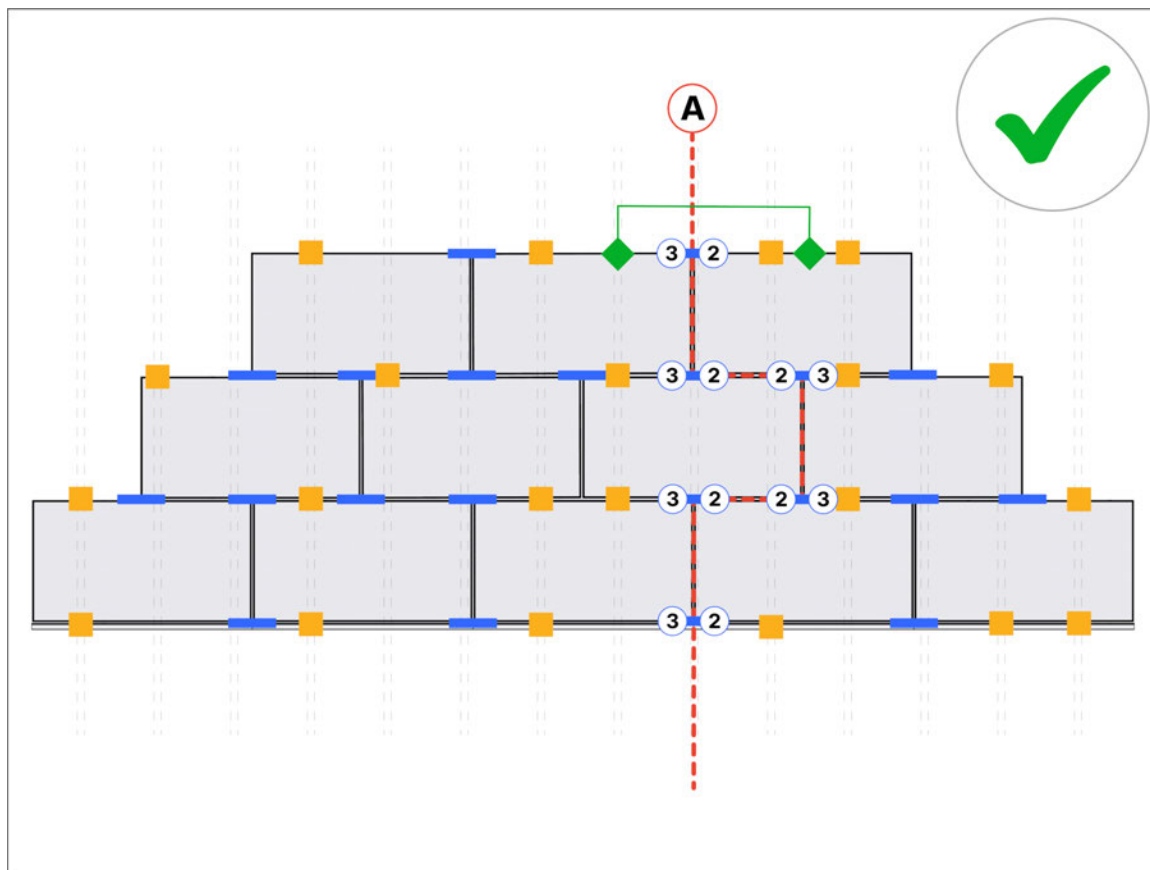


APPENDIX B: THERMAL EXPANSION

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.

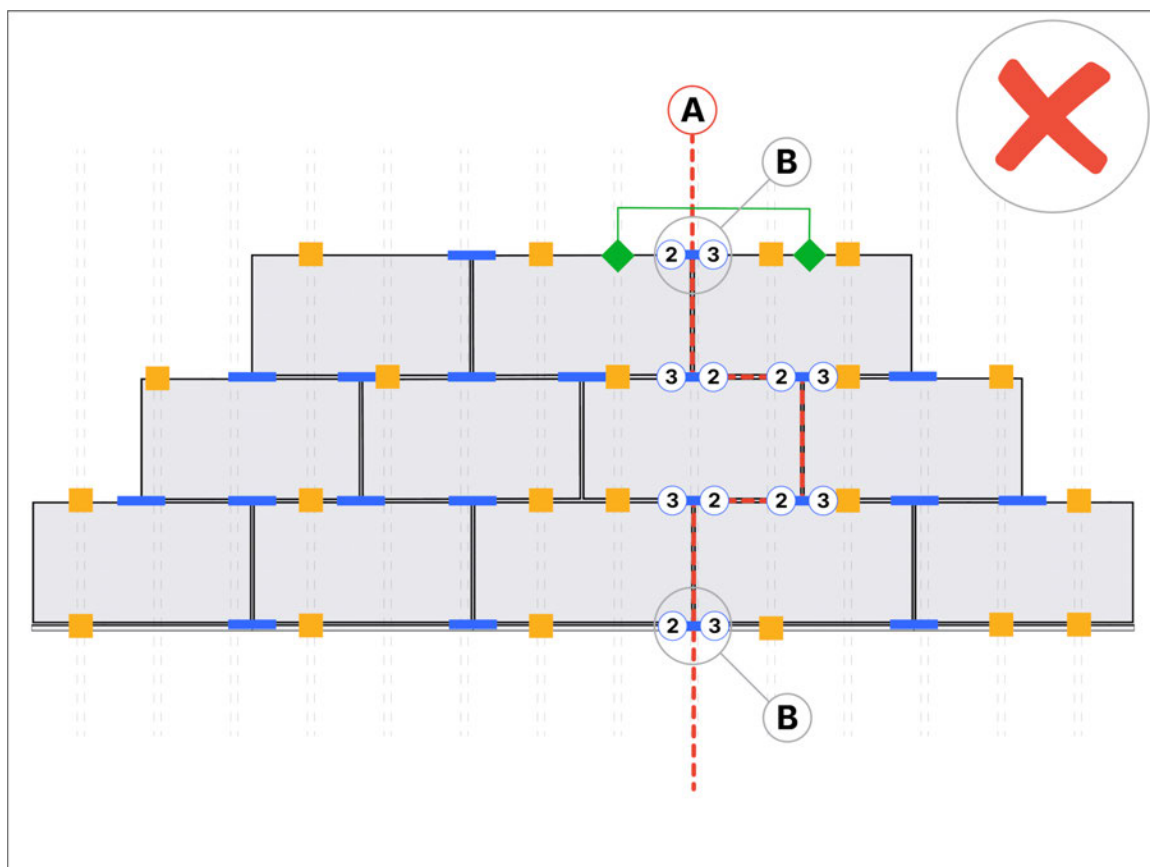
Thermal expansion joints on staggered arrays require Interlocks at each juncture where the array is intended to expand. Each Interlock Lockit is turned to Position 2 (the middle position - marked by a notch) on one side (allows thermal expansion) and Position 3 (fully locked - marked by an arrow) on 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



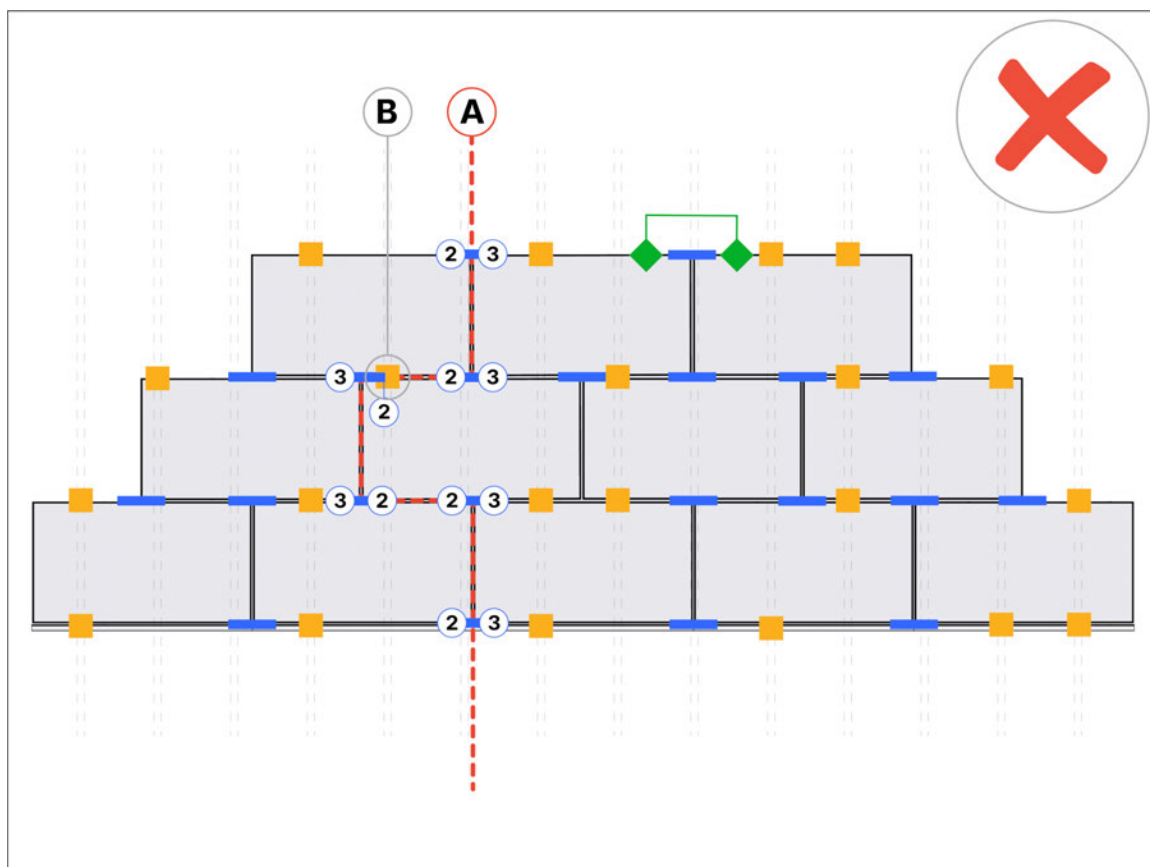
APPENDIX B: THERMAL EXPANSION



- (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).

UL 2703 Requirements:

PV modules were evaluated at the following attachment spans in order for Tesla Solar hardware to obtain load ratings using specified test procedures:

Tesla Solar Panels

Tesla Panel Mount - Flat - Tesla Solar Panels - TSP-4XX System Allowable Pressures							
Spans					Flat Roofs		
	Horizontal Span (Rail X Spacing)	Allowable Panel X Cantilever	Vertical Span (MH Y Spacing)	Allowable Spanner Bar Y Cantilever	Uplift	Downforce	Shear
	in	in	in	in	psf	psf	psf
Landscape	72	26	72	26	19.7	20.8	4.6
	64	24	72	26	22.2	23.4	5.1
	48	18	72	26	29.6	31.3	6.8
	32	13	72	26	44.4	46.9	10.3
	24	14	72	26	46.8	57.7	12.6
	24	12	72	26	50.7	60.0	13.7
	16 ¹	6	72	26	60.0	60.0	20.5
Portrait	48	16	72	26	18.6	19.7	6.8
	32	11	72	26	27.0	28.8	10.3
	24 ¹	8	72	26	27.0	28.8	13.7

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

Hanwha Qcells

Tesla Panel Mount - Flat - Hanwha Q-Cells: Q.PEAK DUO BLK ML-G10+/TS & Q.PEAK DUO BLK ML-G10.a+/TS System Allowable Pressures	
Spans	Flat Roofs



APPENDIX C: ALLOWABLE MOUNTING SYSTEM LOADING

Tesla Panel Mount - Flat - Hanwha Q-Cells:

Q.PEAK DUO BLK ML-G10+/TS & Q.PEAK DUO BLK ML-G10.a+/TS System Allowable Pressures

	Horizontal Span (Rail X Spacing)	Allowable Panel X Cantilever	Vertical Span (MH Y Spacing)	Allowable Spanner Bar Y Cantilever	Uplift	Downforce	Shear
	in	in	in	in	psf	psf	psf
Landscape	72	24	72	26	21.4	22.6	4.6
	64	22	72	26	24.1	25.4	5.1
	48	16	72	26	32.1	33.9	6.8
	32	11	72	26	48.1	50.9	10.3
	24	8	72	26	55.0	67.8	13.7
	16 ¹	6	72	26	75.0	85.0	20.5
Portrait	48	16	72	26	17.8	18.8	6.8
	32	11	72	26	26.6	28.2	10.3
	24 ¹	8	72	26	35.5	37.5	13.7

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 - Flat	Y	Y	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.

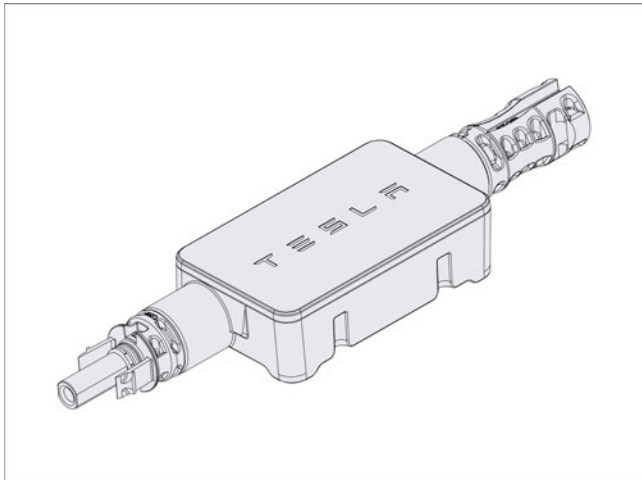


APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS

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.

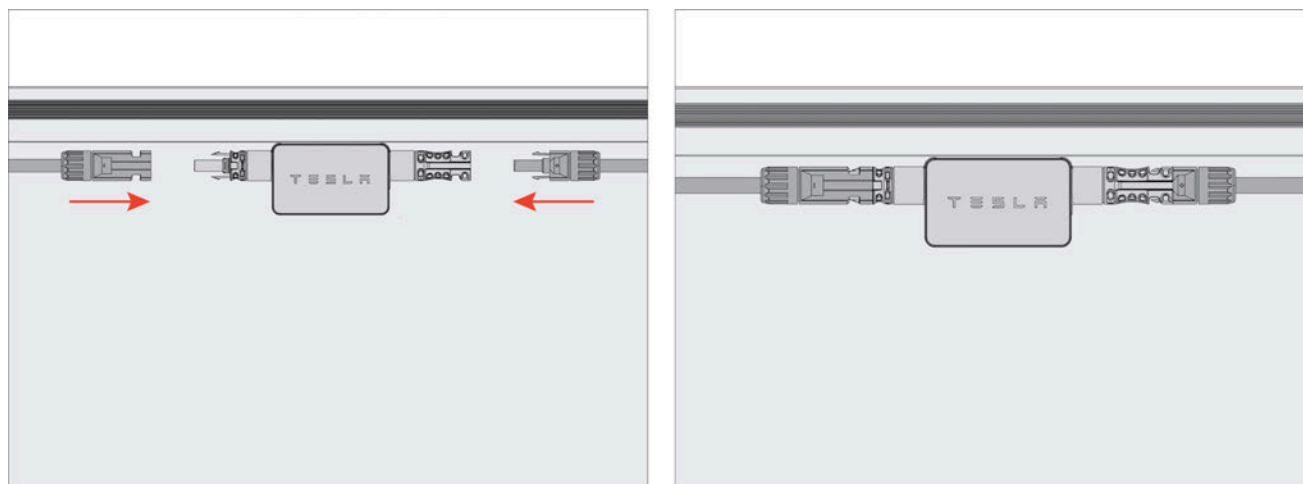


APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS

- 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

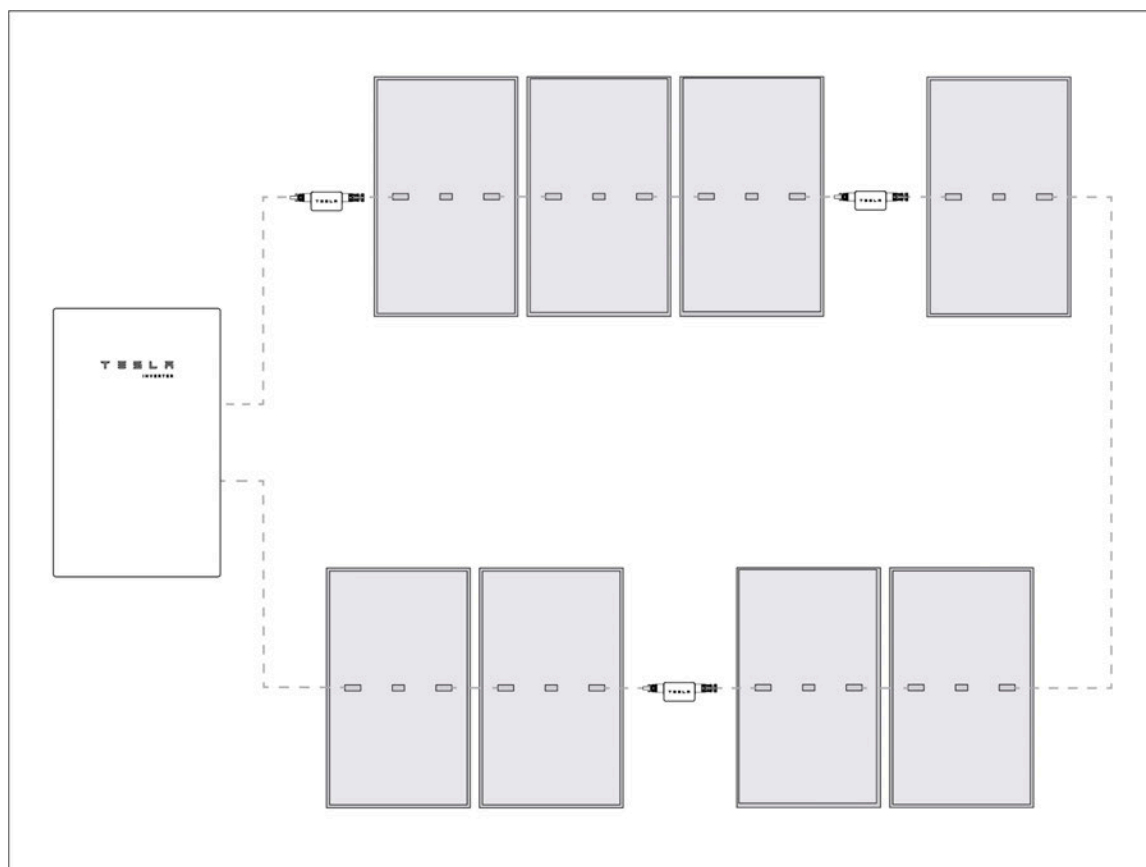
1. Connect the positive and negative leads of the MCI to the corresponding positive / negative MC4 terminals of the PV modules.



MCIs Installed in Line with PV Modules



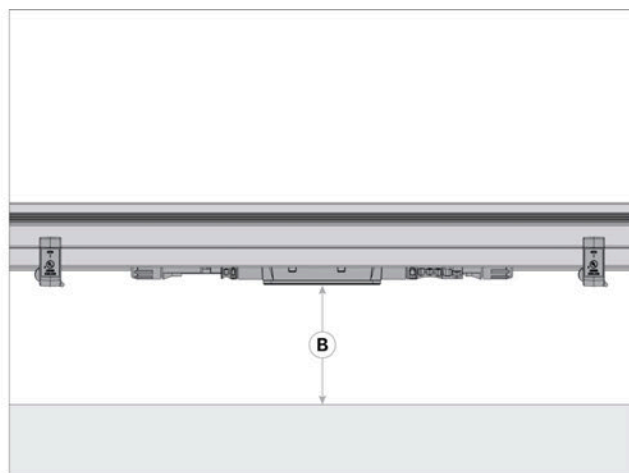
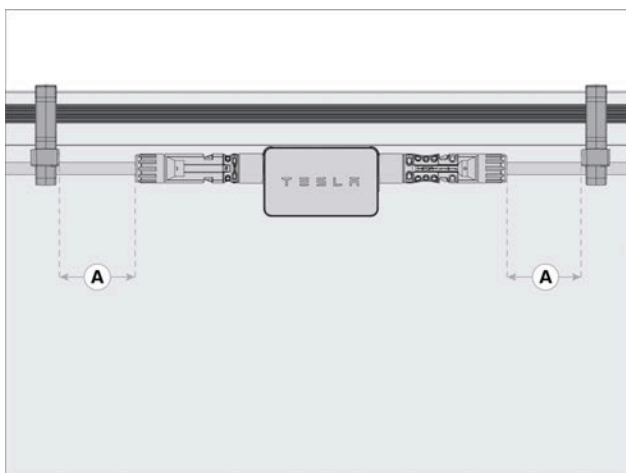
APPENDIX D: WIRE MANAGEMENT RECOMMENDATIONS



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

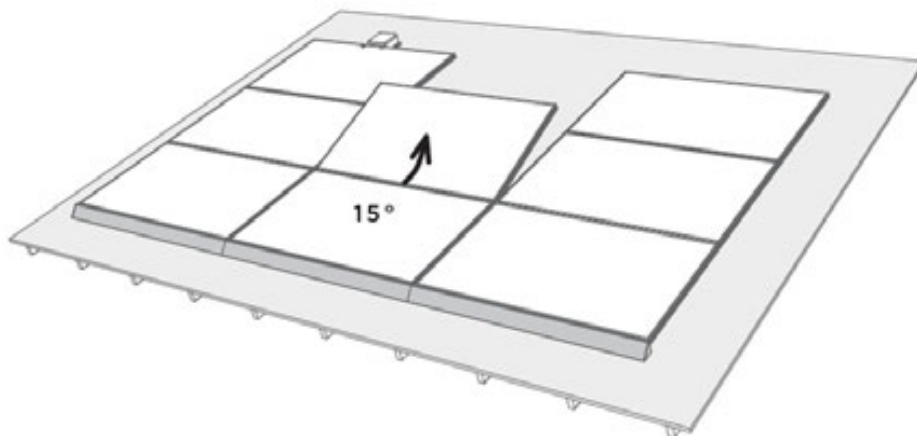
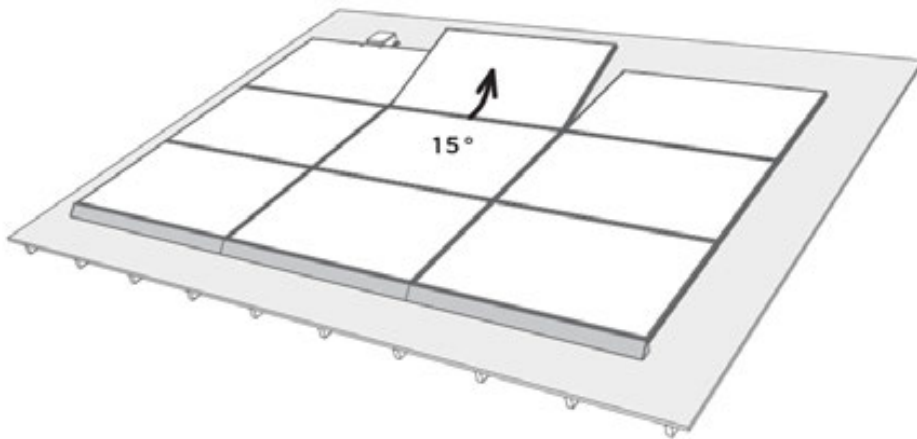


Hazards: Arc flash and electrical shock.

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*



APPENDIX E: MODULE SERVICING

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.

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.

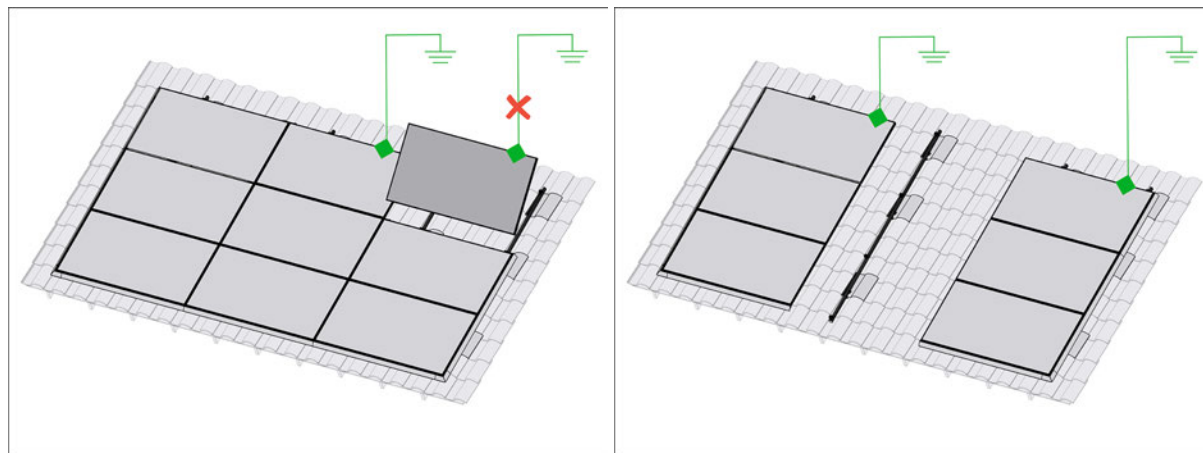
While de-energizing the system the proper PPE must be worn to protect against the electrical hazards that are present. Ensure you have the proper PPE and are wearing it correctly.

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.

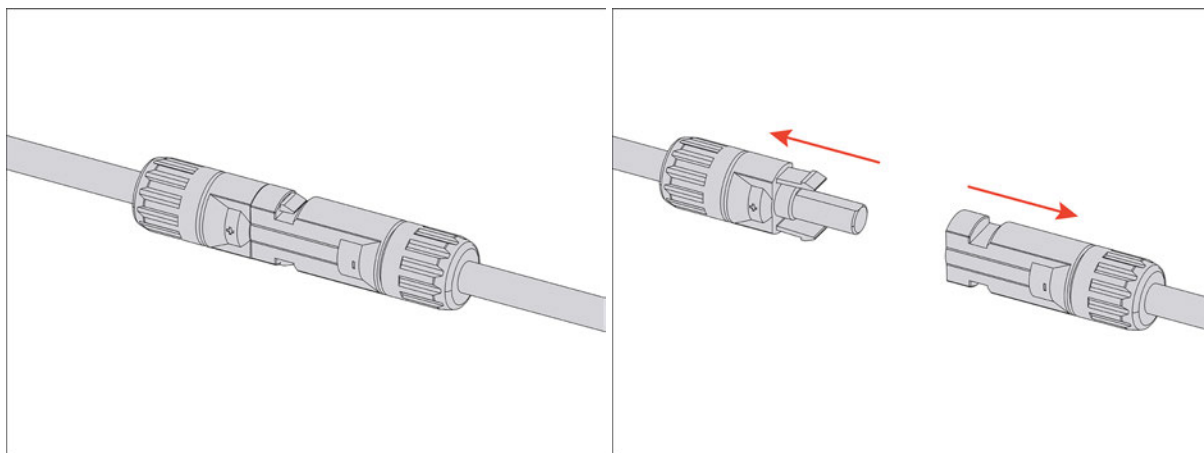


-  *Ground Lockit*
-  *Equipment grounding conductor (EGC)*
-  *Earth ground*

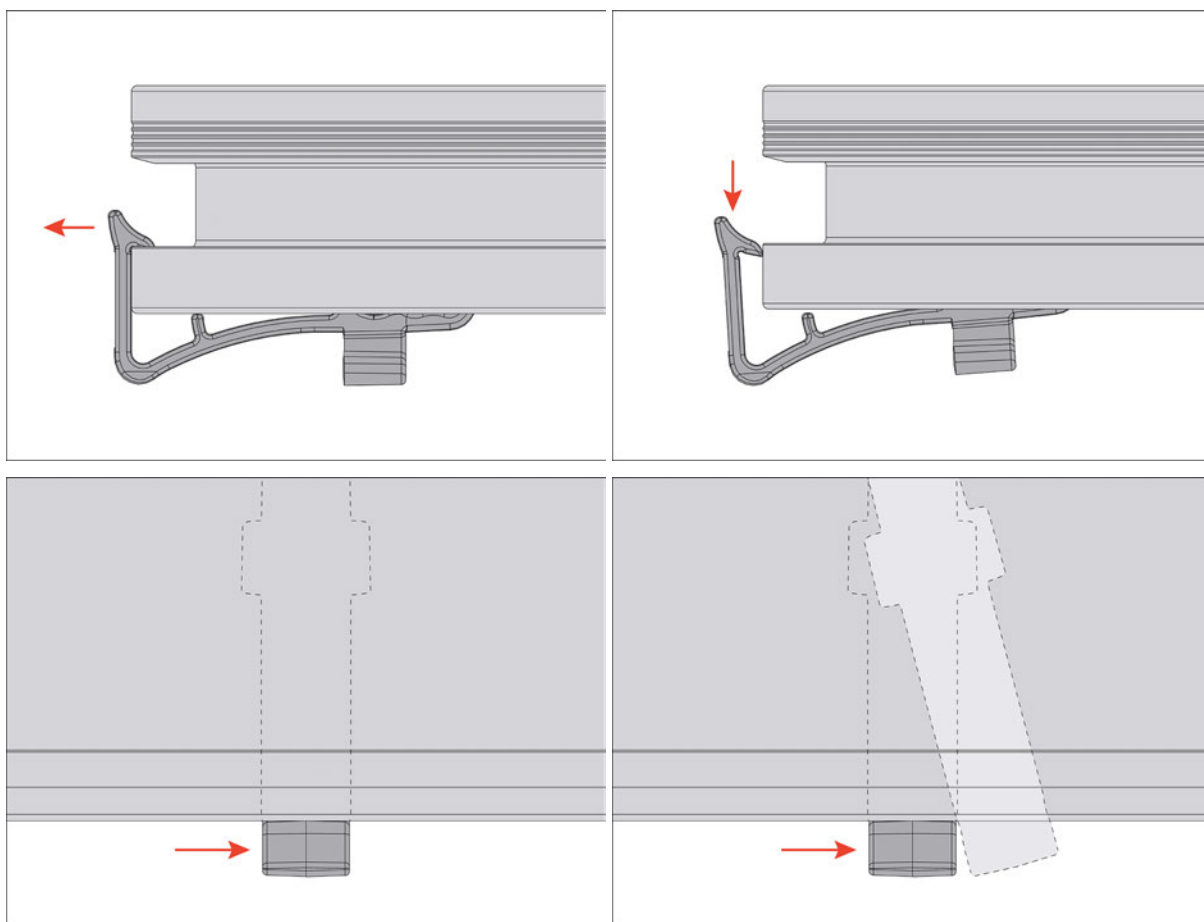
3. Disconnect the module wires, Wire Clips, and jumpers.



APPENDIX E: MODULE SERVICING



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

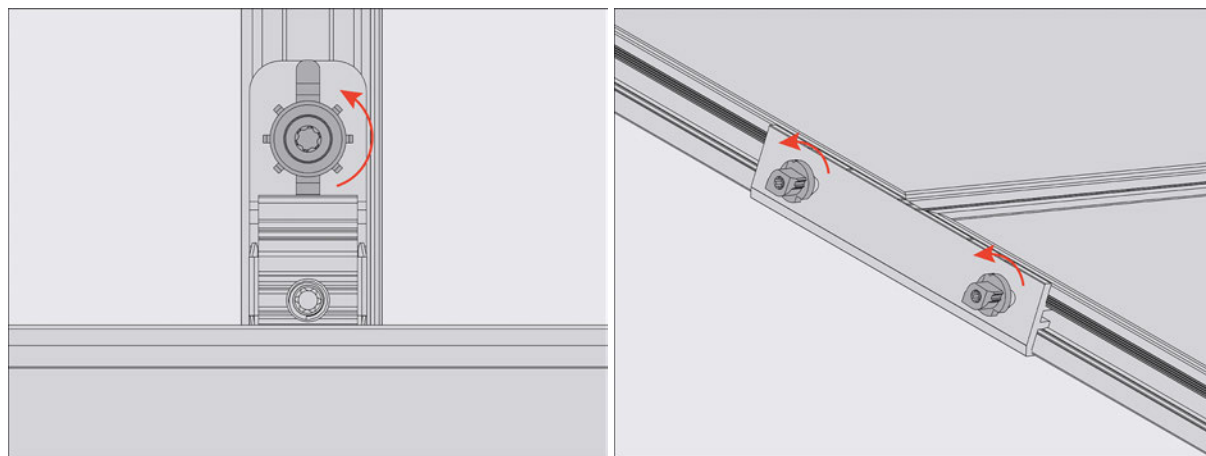


4. Release the up-roof modules.

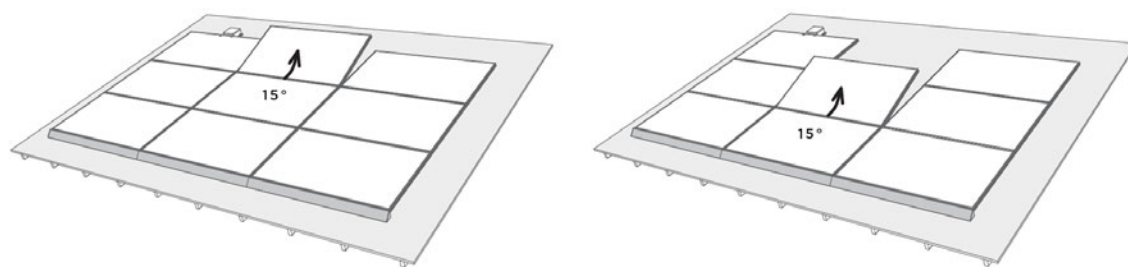
Remove all the Interlocks at the top of the column containing the module needing replacement and unbolt the Leveling Feet attached to the module.



APPENDIX E: MODULE SERVICING



Remove the first module by lifting it above a 15° angle and pulling it off the front Leveling Feet and Interlocks.

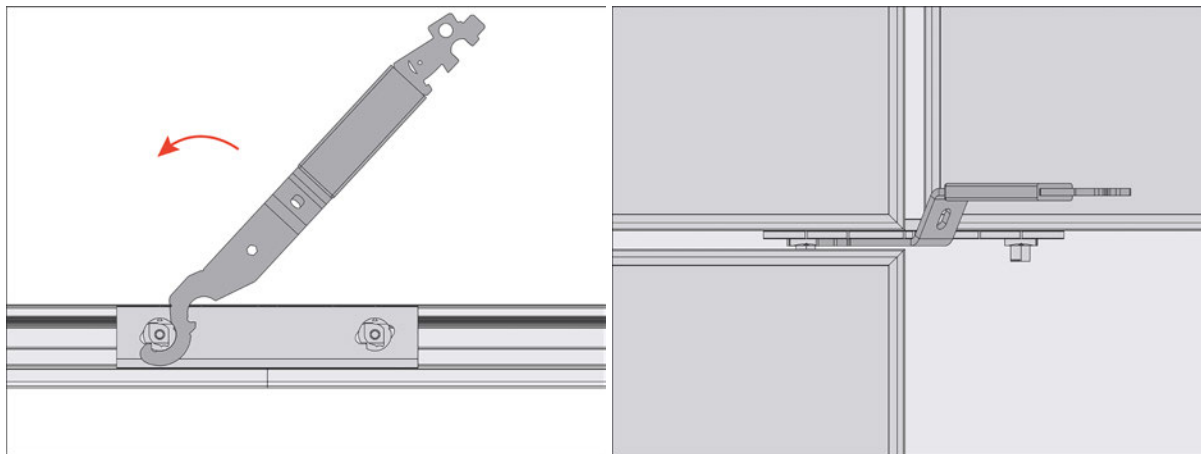




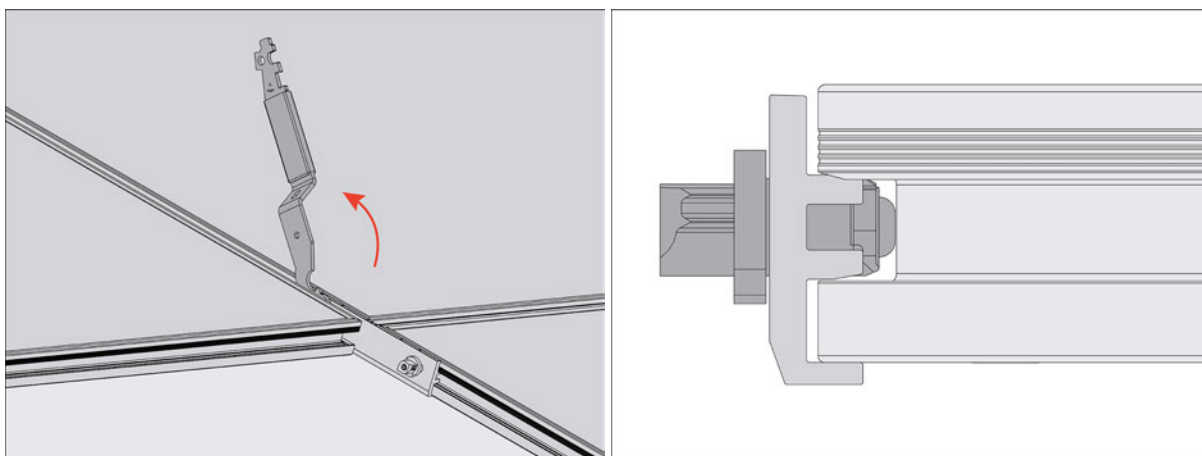
APPENDIX E: MODULE SERVICING

5. Release the mid-array modules.

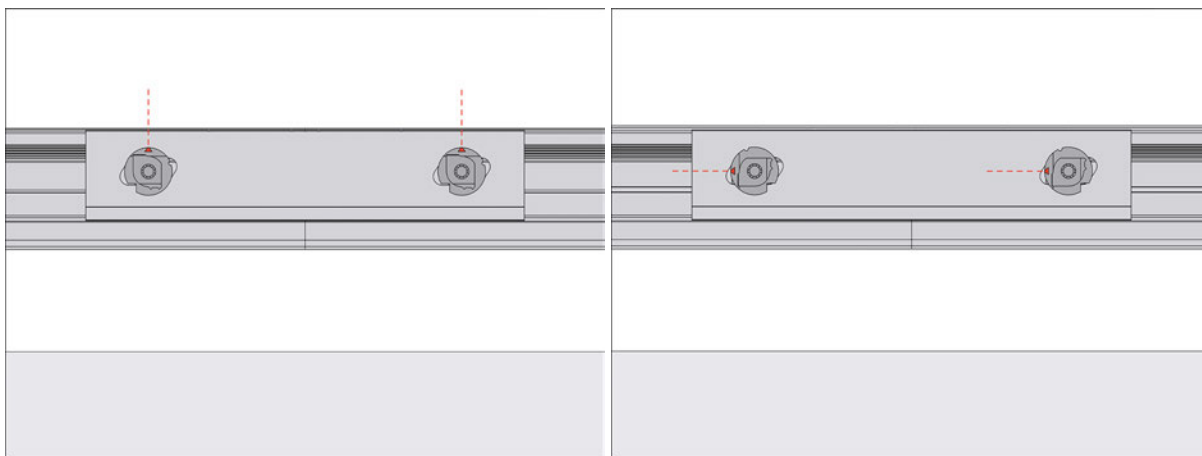
Use the Tesla Solar Wrench to unlock the mid-array Interlocks and release the modules.



a. Rotate both Lockits to Position 1.



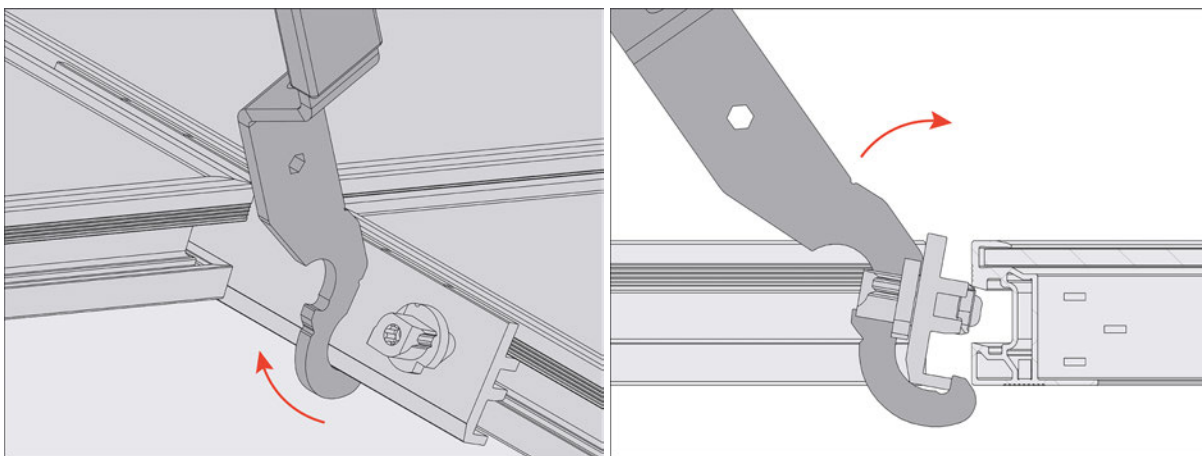
b. Position 1 is indicated by the timing mark on the Tesla Solar Wrench.



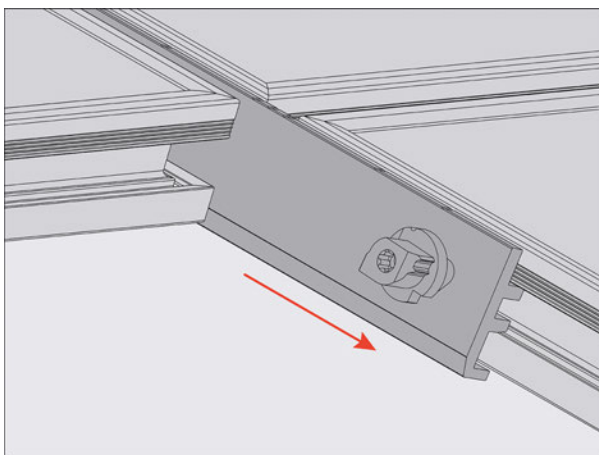
c. Use the hook on the Tesla Solar Wrench to release the Interlock from the module frame.



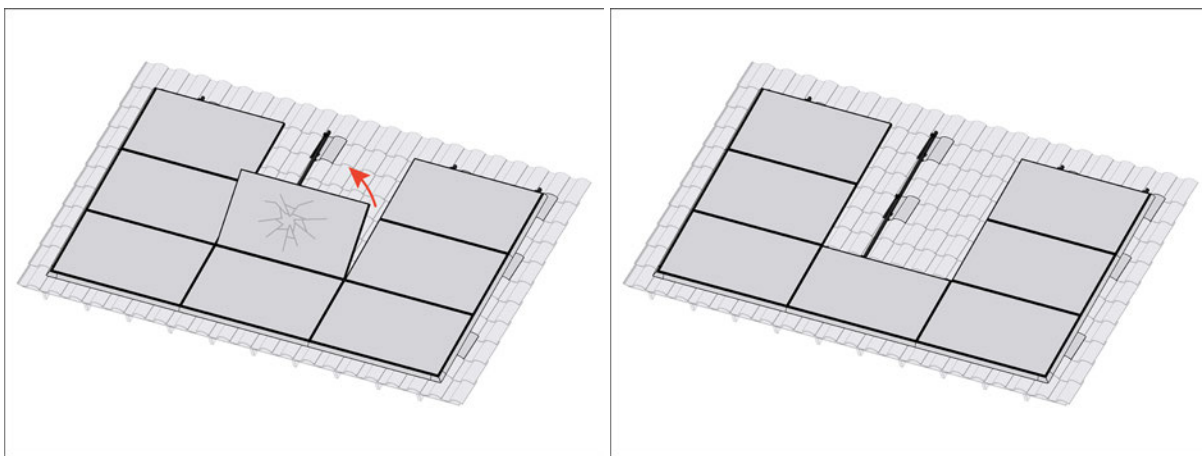
APPENDIX E: MODULE SERVICING



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



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



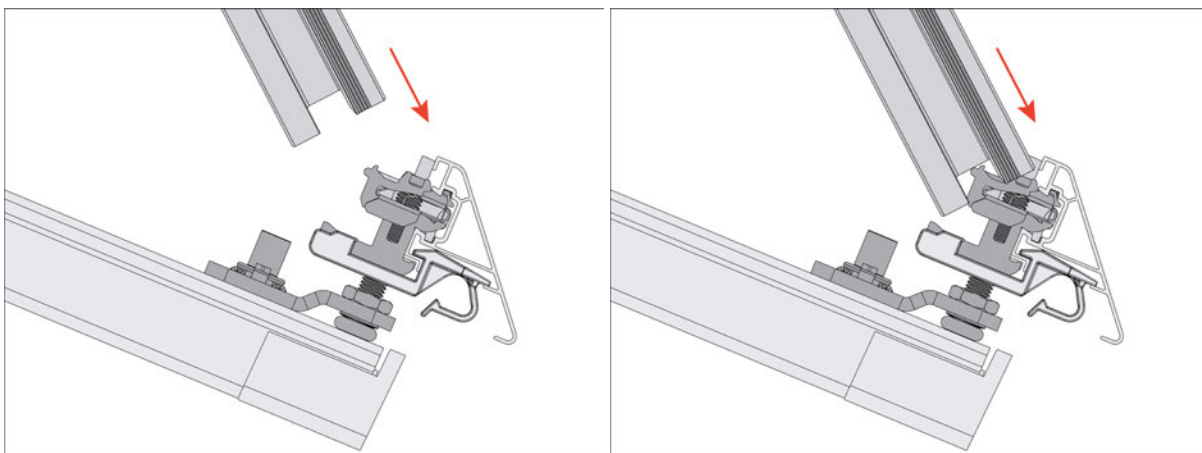
6. Re-assemble the array.

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

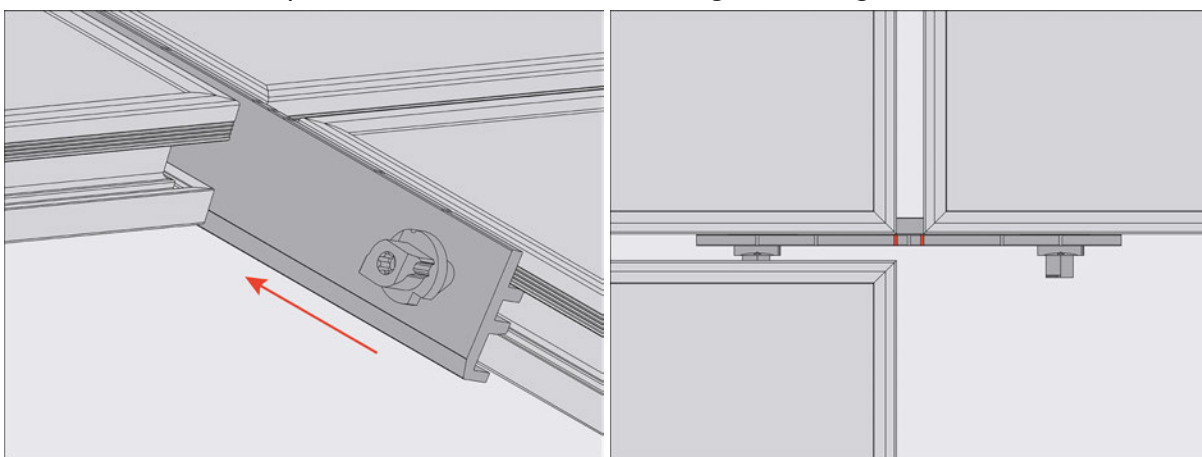
a. Place the module and manage the wires.



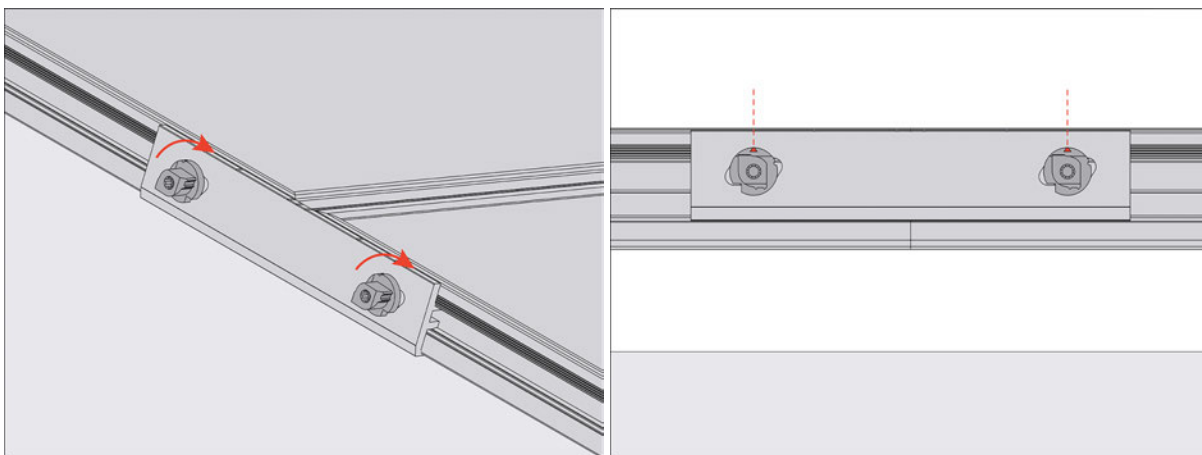
APPENDIX E: MODULE SERVICING



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



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



- d. Reinstall the Leveling Feet on the Spanner Bars and torque the bolts to the required specification.

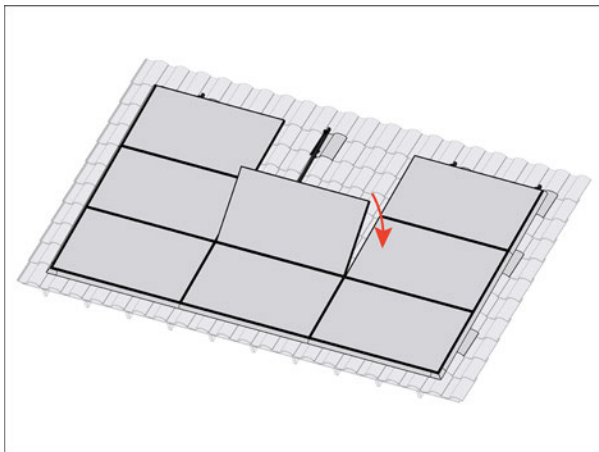


APPENDIX E: MODULE SERVICING

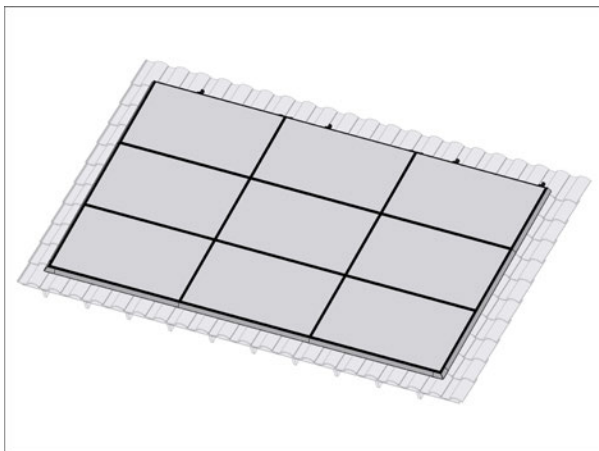


NOTE: When fully engaged with the channel, the indicator tabs on the T-Bolt will rotate 90° and be perpendicular to the Spanner Bar. Failure to rotate the T-Bolt fully will result in an insufficient structural connection.

- 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.





APPROVED SEALANTS

Here is a list of Tesla's approved sealants and their use cases.

Use Case Category	Tesla Panel Mount - Comp Rafter	Tesla Panel Mount - Tile	Tesla Panel Mount - Flat	Solar Roof
Anchor Pilot Hole	GC4500/MS-1937	GC4500	N/A	DL35
Hook Pilot Hole	N/A	GC4500	N/A	N/A
Comp Rafter Base	MS-1937	N/A	N/A	N/A
Base Feet	N/A	N/A	M-1 + One-part pourable	N/A
Conduit (On Roof)	GC4500/MS-1937	N/A	N/A	N/A
Conduit (Exterior)	TEC 133	TEC 133	TEC 133	TEC 133
BOS (PVI, PW)	TEC 133	TEC 133	TEC 133	TEC 133
Junctions/Counterflashing (Mortar)	N/A	N/A	N/A	DL 35
Replacing Tiles Outside Mounting Hardware Locations	N/A	Seal Bond 500	N/A	N/A

Sealant Type	Image
GC4500	



APPROVED SEALANTS

Sealant Type	Image
MS-1937 (Tonsan)	 The image shows two tubes of MS-1937 sealant. One tube is standing upright, showing its blue and white packaging with the TONSAN logo and 'MS1937' printed vertically. The other tube is lying horizontally in front of it, also showing the product name and a small '937' label.
DL35 (Dura Link 35)	 The image shows three tubes of DuraLink 35 sealant. Two tubes are standing upright, showing their blue and white packaging with the CHEM LINK logo and 'DuraLink 35' printed vertically. The third tube is lying horizontally in front of them, also showing the product name and a small '35' label.
M-1 (ChemLink)	 The image shows a single tube of M-1 sealant. The tube is white with a grey and black label. The label features the CHEM LINK logo at the top, followed by 'M-1' in large letters, and then 'SEALANT' and 'ATTENTION/CAUTION' at the bottom. The tube has a white nozzle.



APPROVED SEALANTS

Sealant Type	Image
One Part Pourable (ChemLink)	 A silver and blue pouch of ChemLink 1-Part Pourable Penetration Sealant. The pouch has a white cap and features the ChemLink logo and product name in English and French. It also includes application instructions and a caution label.
TEC 133 Clear Silicone Sealant (HB Fuller)	 A white tube of TEC 133 Clear Silicone Sealant with a green and white label. The label features the TEC logo and product name in English and French. It also includes application instructions and a caution label.



APPROVED SEALANTS

Sealant Type	Image
Seal Bond 500	