EcoX

# Installation Guide

Ecolibrium Solar

Gen2

## Introduction

EcoX is an innovative, simple, and easy to install flush-mount solar racking system. By eliminating the mounting rail, EcoX offers a flexible system layout and streamlines the installation process. EcoX utilizes aluminum components with stainless steel hardware, ensuring the system will withstand harsh installation environments. With EcoX, the racking and modules work together as a system, creating an interconnected, continuously bonded structure.

This install guide outlines the overall installation process, and details the steps involved. Ecolibrium support staff are available to answer questions or offer support. Feel free to contact us, and thank you for installing EcoX!

## Installer Responsibility

The installer is solely responsible to:

- Comply with all applicable building and electrical codes
- Meet municipal, utility and inspector requirements
- Ensure installation methods and procedures meet all applicable OSHA safety standards
- Confirm all building structural members and related connections can withstand all forces resulting from the EcoX installation
- Maintain waterproof integrity of all existing roofing materials
- Verify all design criteria are correct and appropriate for the application and specific site
- Follow all manufacturer's specifications, recommendations and manuals
- Check that only Ecolibrium Solar approved materials are utilized during EcoX installation
- Guarantee array installation is completed by qualified and competent personnel
- Verify all equipment and materials are appropriate for application and site conditions
- Establish that anchoring devices, including lag screws, have adequate pullout strength and shear capacities as installed
- Determine that PV module is approved for use with EcoX and is capable of withstanding the project specific conditions.

## Warnings & Safety

Both electrical and roofing knowledge is required to correctly and safely install a solar photovoltaic system. Only qualified and certified installation professionals should install EcoX. Failure to follow the methods and procedures outlined in this guide may result in injury and/or damage to property. Carefully read this guide before starting any work. Store a copy of this guide on the job site at all times and contact Ecolibrium Solar with any installation questions related to EcoX.

Please note the following warnings when installing EcoX:

- EcoX components may be sharp and may cause skin lacerations
- EcoX components fit together tightly and could cause pinch injuries
- EcoX components may be hot to the touch if left in the sun.

Please follow the safety requirements below when installing EcoX:

- Always keep children and unauthorized people away from work areas
- Always wear required OSHA approved Personal Protective Equipment (PPE)
- Always use insulated tools when working with or near electrical systems
- Always provide OSHA approved fall protection for all installation personnel
- Never wear jewelry during mechanical and electrical installation work
- Never work in rain, snow or extremely windy conditions
- Never leave a module unsupported or unsecured on the roof
- Never install broken photovoltaic modules
- Never use photovoltaic modules as a work surface

## EcoX General Application Notes

**System Design and Span Requirements:** EcoX is designed to flush-mount photovoltaic modules on pitched roofs as described in this guide. The span between attachment locations depends on the module, the site conditions, and the system layout.

**Site Specific System Design:** The EcoX Estimator is a powerful system design tool. The user inputs all site conditions and can layout multiple roof surfaces. The EcoX Estimator outputs a site specific design package with engineering specs and bill of materials.

Visit the EcoX Estimator at http://ecox-estimator.ecolibriumsolar.com to layout your array and instantly obtain attachment spacing, bill of materials, and engineering analysis.

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**Roof Type:** EcoX is designed to mount photovoltaic modules to a range of roof surfaces, including :

- Asphalt or composite shingles
- Concrete or clay tiles (see Addendum )

Please contact Ecolibrium Solar if your project's roof surface type is not listed.

**Wind Zone:** EcoX is designed to mount photovoltaic modules on pitched roof surfaces in areas with extreme wind conditions. Please contact Ecolibrium Solar if your project's wind speed exceeds the zone allowable in the EcoX Estimator.

**Roof Height:** EcoX is designed to mount photovoltaic modules on pitched roof surfaces with a mean roof height up to 60 feet. Please contact Ecolibrium Solar if your project's mean roof height exceeds 60 feet.

**Roof Pitch:** EcoX is designed to mount photovoltaic modules on pitched roof surfaces between 0 and 90 degrees from horizontal. The UL 2703/1703 fire certification is applicable only to “steep-sloped” systems with a roof slope greater than or equal to 2 in/ft (9.46 degrees).

**Roof Zones:** EcoX is designed to mount photovoltaic modules on pitched roof surfaces in all roof zones with attachment spacing as prescribed in the EcoX Estimator.

**Roof Orientation:** Throughout this manual, “downhill” is used to reference the direction of the lower or leading edge of the array, and “uphill” is used to reference the direction of the trailing or back edge of the array.

**Torque Requirements:** Unless otherwise noted, torque all fasteners to **14 ft-lbs.**

## EcoX Certifications

**Approved Modules:** This racking system may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. Specific modules included in EcoX certifications are documented in Appendix B at the end of this install guide.

**Module Types:** EcoX is certified to be installed with standard framed 60 cell modules according to the approved module list.

**Mechanical Loading:** EcoX is certified to UL2703 for mechanical loading. Tested modules are listed in Appendix B. Span requirements for a given jobsite can be determined using the EcoX Estimator design tool: http://ecox-estimator.ecolibriumsolar.com

**Fire Testing:** EcoX is certified to UL2703/UL1703 Fire Testing with a Class A Fire Rating for Type 1 and Type 2 modules with the following requirements:

- Instructions in this install guide must be followed.
- The EcoX system must be mounted over a fire resistant roof covering rated for the application.
- Modules may be installed in landscape or portrait
- Modules must be installed on roof pitches greater than 2:12
- There is no skirt requirement. The EcoX fire rating is valid with or without a skirt.
- All height settings of EcoX product are valid, up to highest setting (corresponds to 4 ¼” from roof surface to lower edge of module frame).
- Junction box must be mounted away from the roof downhill edge.

**Grounding and Bonding:** EcoX is certified to UL2703 for grounding and bonding. The grounding and bonding test evaluates EcoX as a system with approved modules. When installed per the requirements outlined in this installation guide, EcoX with approved modules are rated as a system to create a continuous bonded structure.

**Installation Requirements:** This install guide officially documents the components used and proper methods for an EcoX installation. Bonding elements are incorporated into EcoX components. As the system is built on the roof, components and modules are bonded together. Specific steps to ensure a bonded system are described through the installation guide. It is the installer's responsibility to ensure that the system is safely and properly installed, and that the system is bonded back to a final ground point.

**UL2703 System Documentation:** To document the UL2703 system rating, a label is applied to the back of the Skirt. For skirt-less configuration, a label is to be applied to the side of the end clamp. Below is an example of the label:

# Table of Contents

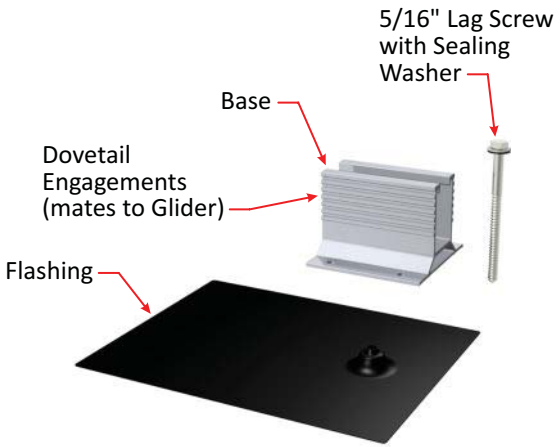


**Revisions**

Rev 1.0 Initial Release .....July 2015
Rev 1.1 Updated UL 2703 Specifications.....August 2015
Rev 1.2 Updated UL 2703 Specifications.....September 2015

# EcoX Components

## Attachment Kit

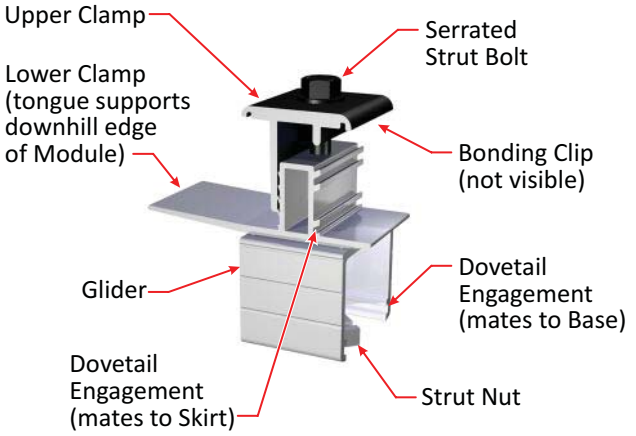



The Attachment Kit is secured to the roof and supports the array via the Clamp Assembly.

Its features include:

- Grooves along sides of Base are Dovetail Engagements which provide adjustability of the Clamp Assembly in *height* and *uphill-downhill* directions.
- Base is attached via a single Lag Screw or utilizing its alternate four attachment holes.
- Lag Screw includes a factory pre-installed Sealing Washer.

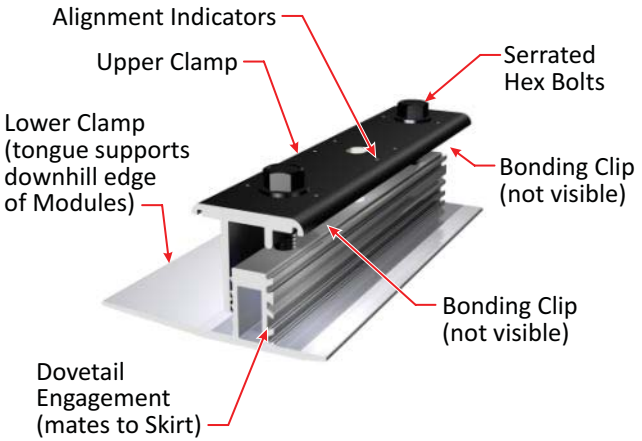
## Clamp Assembly




The Clamp Assembly is mounted to the Base of the Attachment Kit.

- Dovetail Engagement to Base for height and uphill/downhill adjustments.
- Upper and Lower Clamp secures edges of Modules
- Upper and Lower Clamp engage Skirt on Skirt row.
- Strut Bolt and Strut Nut secure Clamp Assembly to Base and Modules to Clamp Assembly.
- Factory installed Bond Clip bonds Skirt to Attachment Kit on south row, and Module to Attachment Kit on subsequent rows.

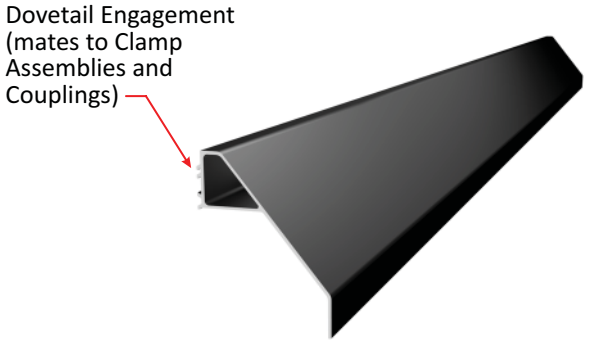
## Coupling Assembly




Couplings connect up to four Modules together.

- Couplings include indicator marks to set a 1/2" gap between Modules.
- On the first downhill row, Couplings secure adjacent Skirts at their joints.
- Factory installed Bond Clips (two per Coupling) bond Modules left and right.

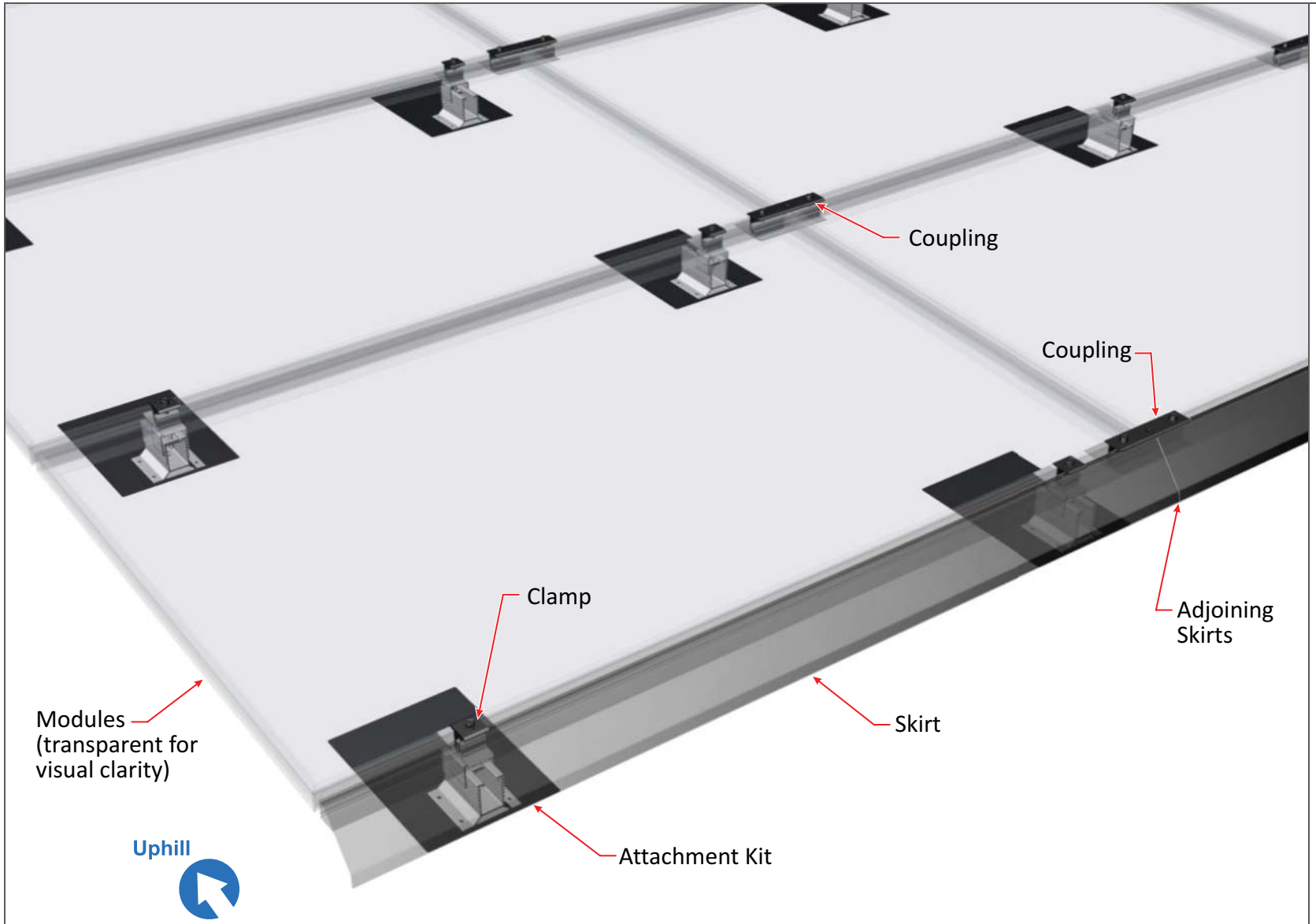
## Skirts (optional item)




Skirts are used on the first downhill row to enhance the appearance along the edge of the array.

- Dovetail Engagement positions height of and locks Skirt to Clamp Assemblies and Couplings.
- Factory cut to length to match specific Modules.
- Available in three configurations (height variances) to fit the most common Module sizes.

# Overview of Components




Note: Rooftop and shingles not shown for clarity

The EcoX installation begins at the downhill edge of the roof and progresses uphill. Installation is sequential and requires minimal hand tools.

**Installation steps:**

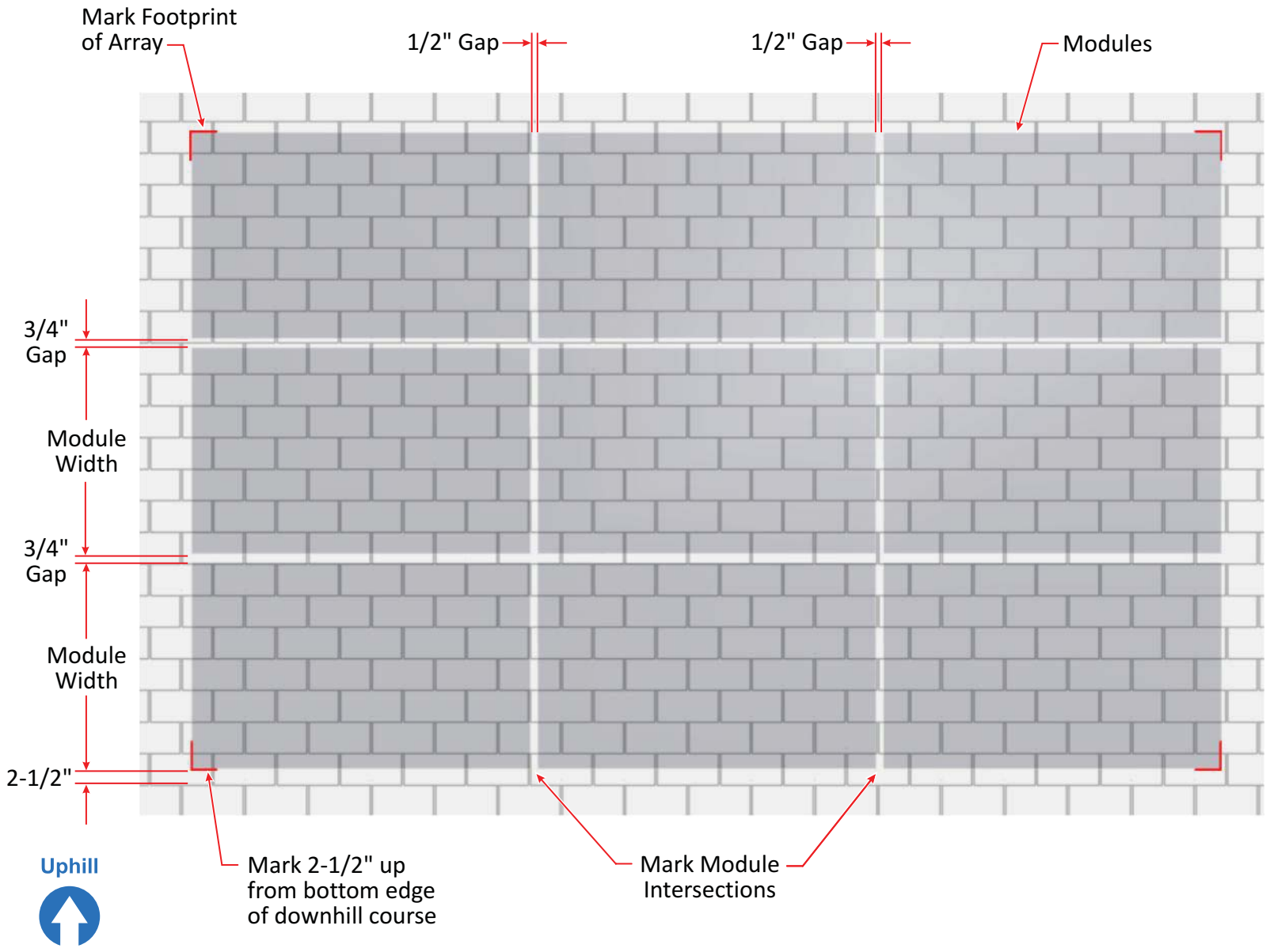
1. Layout Array on rooftop.
2. Install Attachment Kits to rooftop.
3. Install the Junction Box Bracket.
4. Install Clamp Assemblies on downhill row.
5. Install the Skirts.
6. Install Couplings to Skirts.
7. Install Modules
8. Install Clamps and Couplings on uphill side of Modules.
9. Level the row of Modules.
10. Repeat Module install on subsequent rows.
11. Install additional Bonding Clips at one end of each row to complete row to row bonding.

**Required Tools:**

- Tape Measure
- Chalk Line
- Hammer
- Drill with 3/16" Bit
- Flat Roofing Bar
- Impact Driver
- 1/2" Socket
- String Line
- Torque Wrench
- Chalk

# 1. Layout Array on Rooftop

## 1a. Mark the Four Corners of Array




Using chalk, layout the footprint of the array on the rooftop. Look for any obstructions on the rooftop that could prevent a complete and proper installation of the array.

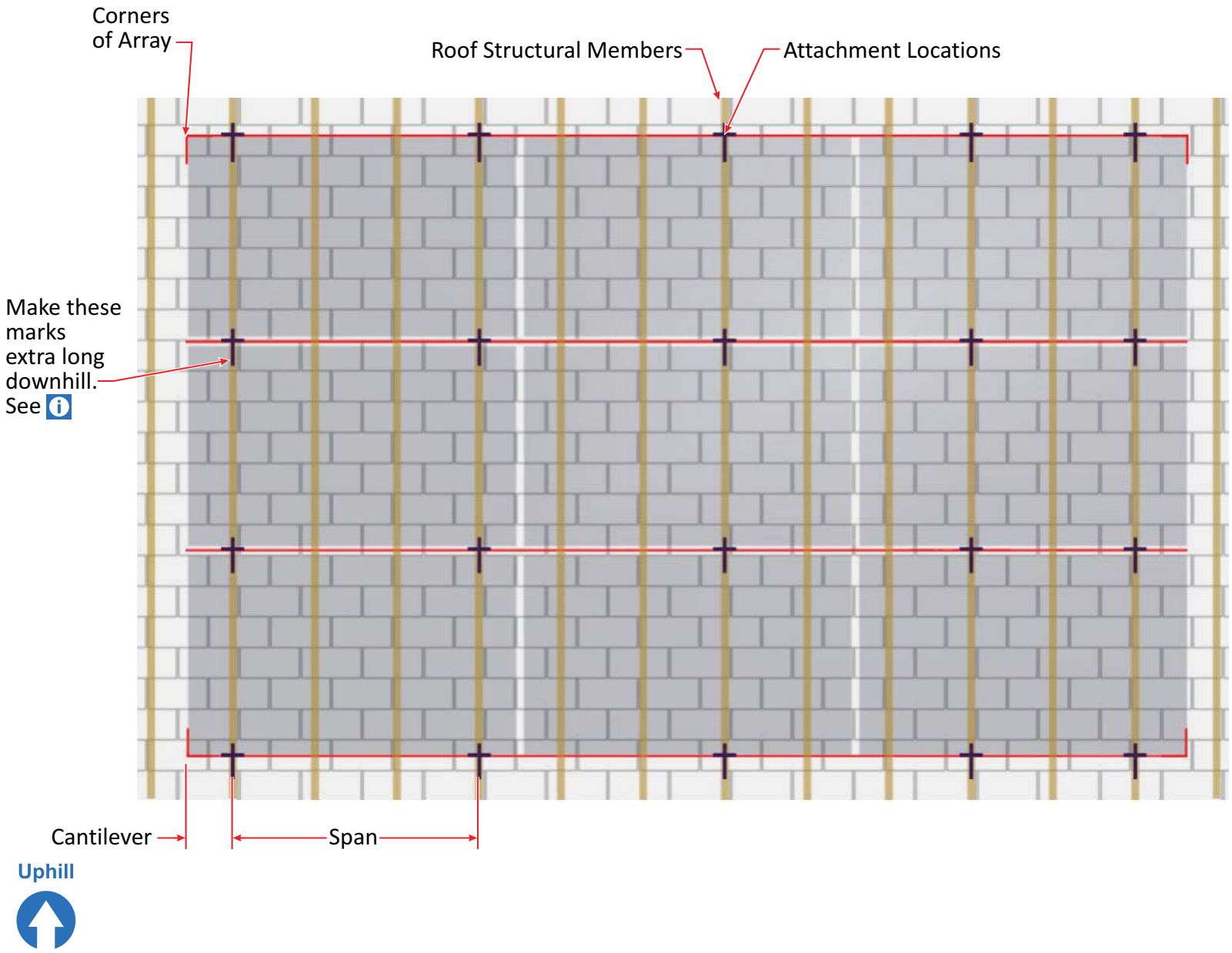
1. Starting from the downhill edge, place a mark 2-1/2" up from the bottom edge of the downhill course of shingles.
2. Using the Module dimensions include the following:
   - Left/right include a 1/2" gap between Modules.
   - Uphill/downhill includes a 3/4" gap between Modules.

The following page continues this layout and illustrates a finished rooftop layout.

Knowing where the Modules intersect will identify potential interferences between Attachments and Couplers.

# 1. Layout Array on Rooftop (cont.)

## 1b. Snapping Chalk Lines and Marking Attachment Locations




1. Snap left/right chalk lines.
2. Mark the attachment locations by locating the structural members of the roof. Refer to the EcoX Calculator for maximum allowable span and cantilever.

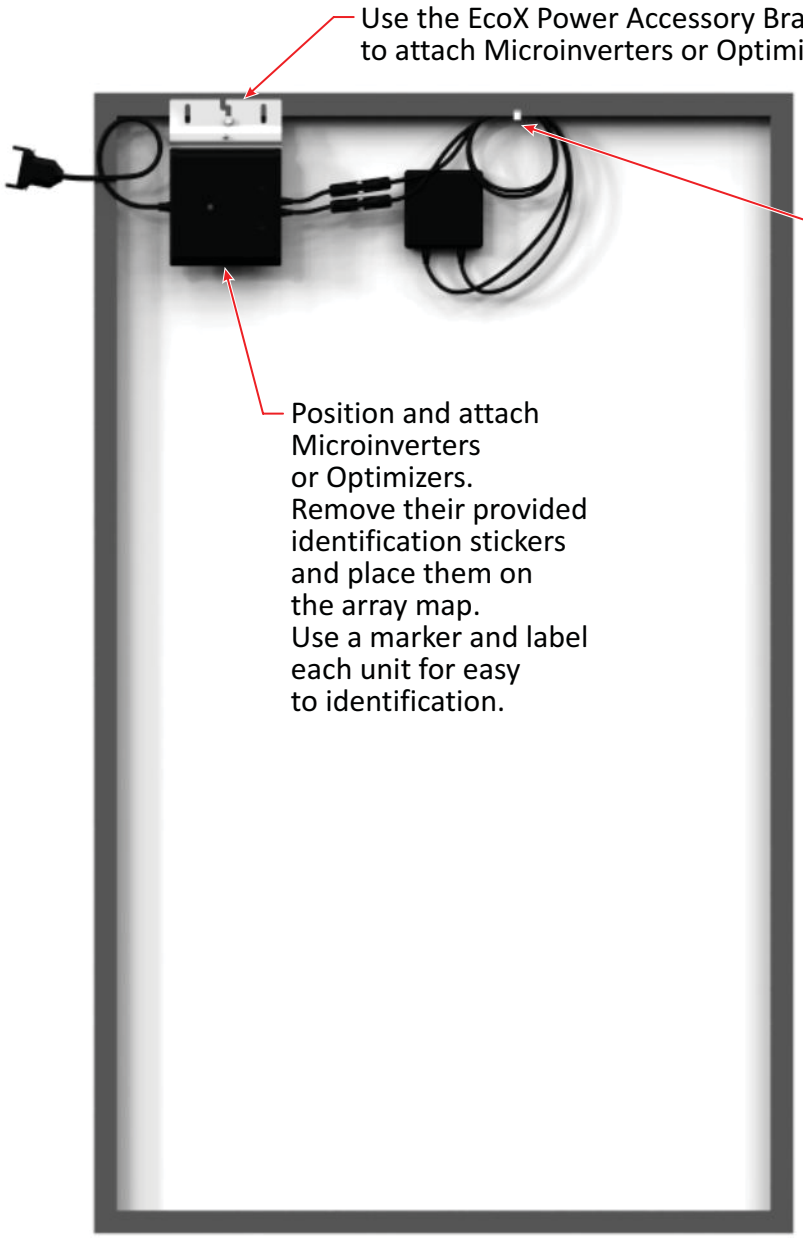
**Ensure that attachment locations meet and do not exceed, the EcoX design specifications on allowable spans and cantilever distances.**

**When marking the attachment locations, make the downhill leg of the mark long enough to be visible from the downhill edge of the Flashing when the Flashing is in its installed position. This mark will accelerate the Flashing installation by quick alignment of the Flashing to the mark.**

# 2. Prepare the Modules - Before moving them to rooftop

## 2a. Wire Management: Position Leads, install Clips

Arrange leads for easy access.
Use a string map to determine the direction that + and – leads will face for each row.




What follows is basic information on wiring an EcoX array.

Warning: All wiring must be done in compliance with NEC and AHJ requirements.

It is advisable to prepare Modules on the ground before moving them to the rooftop. This can be done as penetrations are installed.

1. Finalize the junction box location and string diagram as soon as the array design is marked on the roof and confirmed.
2. Once the EcoX bases are installed use the Junction Box Bracket to mount the junction box.
3. Use the EcoX Power Accessory Bracket to mount micro-inverters or power optimizers to the modules.
4. Prepare modules on the ground for easy wiring on the roof.

# 3. The Basics on Wire Management

## 3a. Suggested Routing and use of Clips

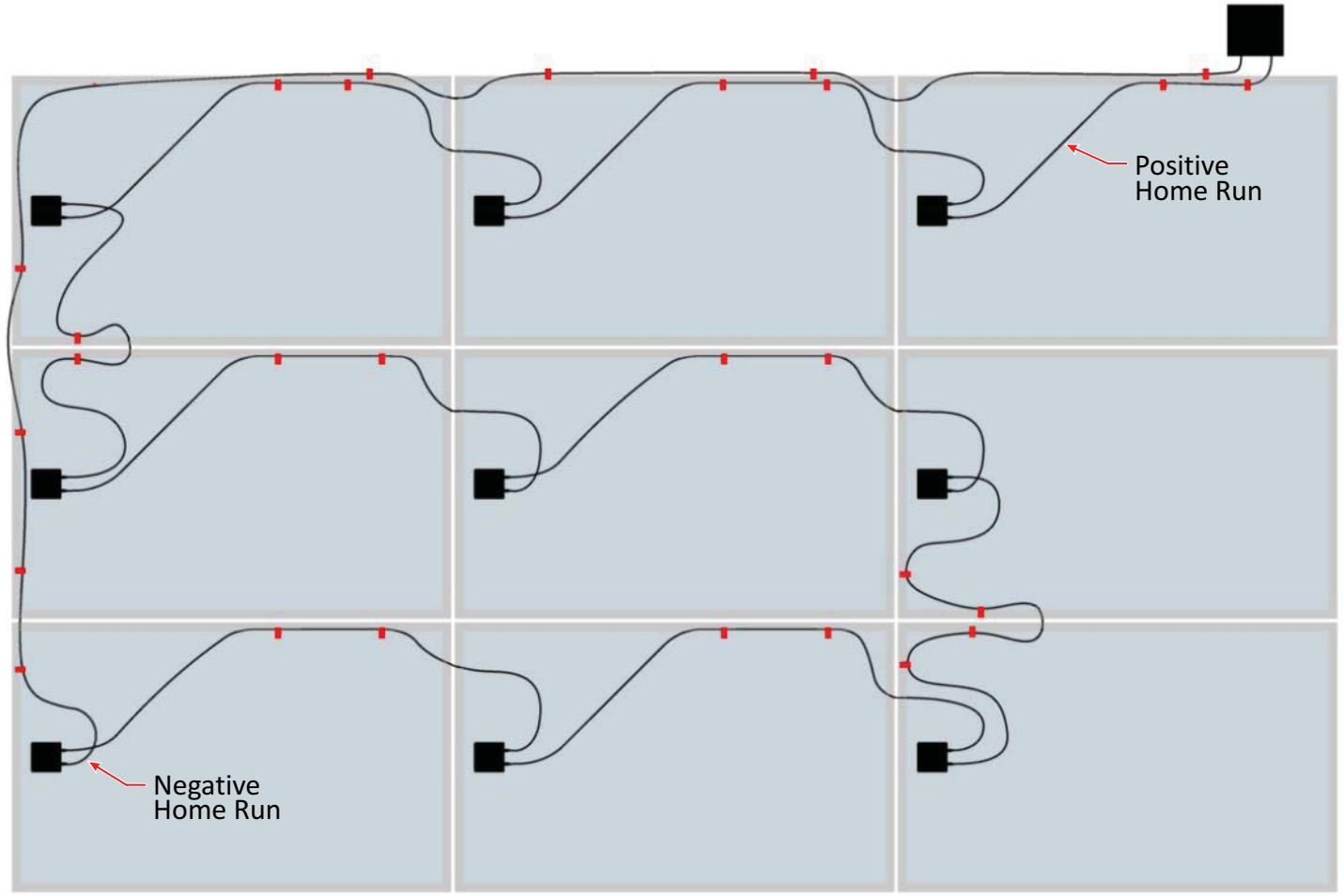
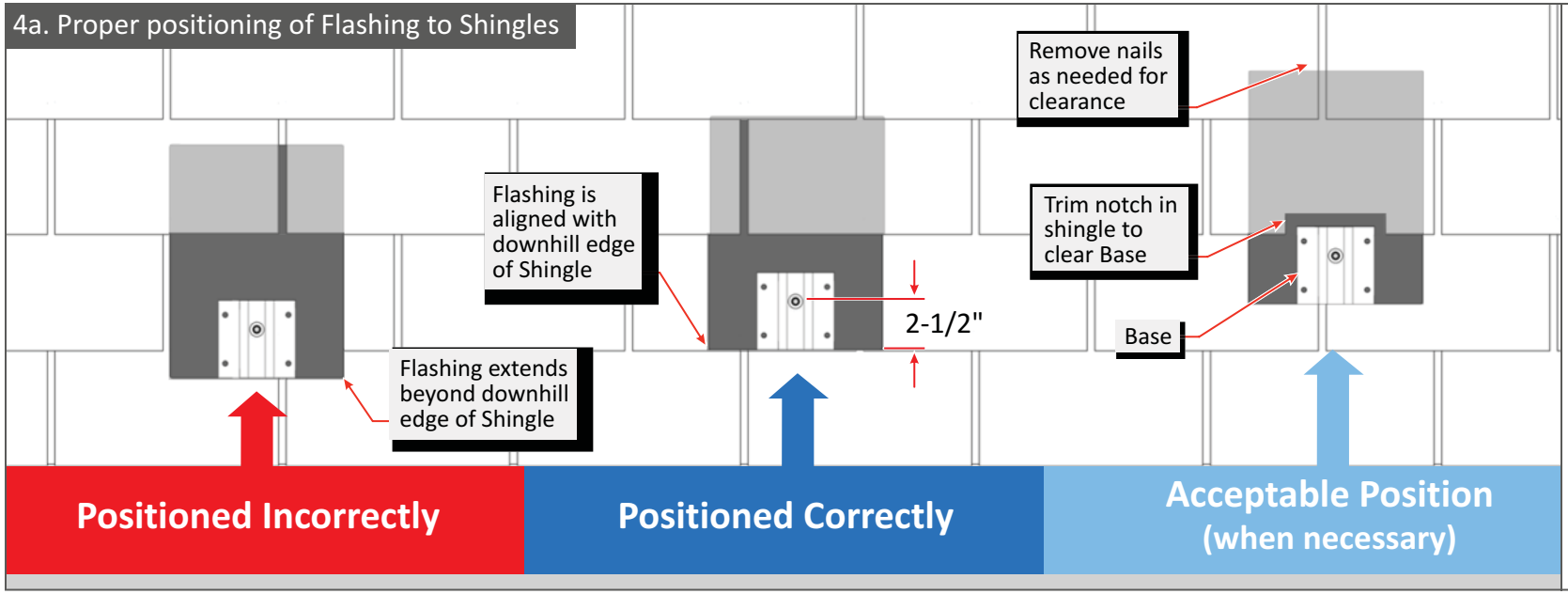



Image shows an example wire layout to illustrate typical wire management.

# 4. Install Attachments to Roof

## 4a. Proper positioning of Flashing to Shingles

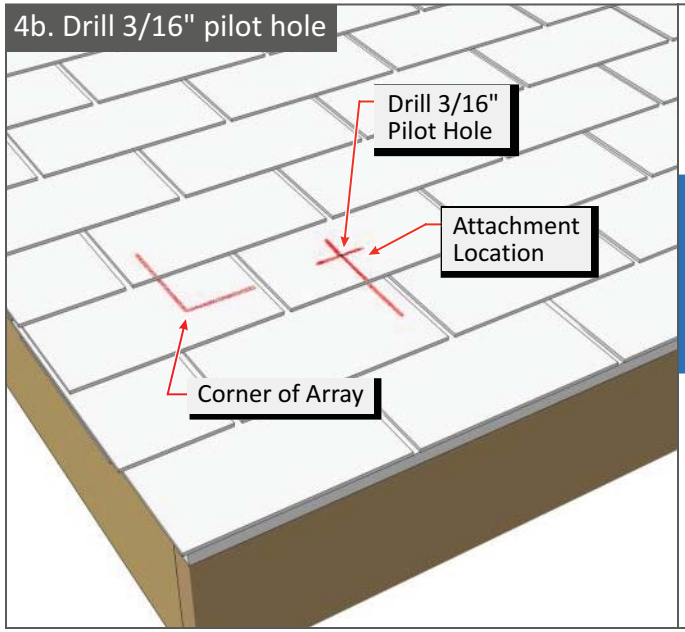



When correctly positioned the Flashing will prevent water damage to roof from water seepage and/or freeze/thaw cycles.

Best practice is to position the Flashing mounting hole 2-1/2" up from the bottom edge of the shingle course. This places the Flashing downhill edge flush with the edge of the shingle course its mounted on.

It is acceptable to shift a Flashing uphill on its shingle course and to trim the uphill shingle to clear the Base.

## 4b. Drill 3/16" pilot hole

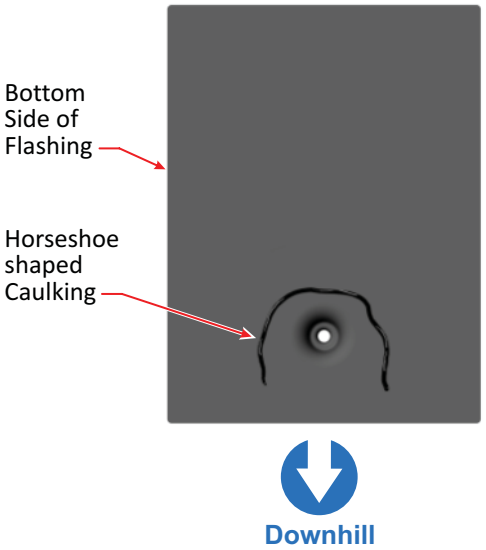



At the attachment locations drill a 3/16" piolt hole at a sufficient depth to fully secure the Lag Screw and Flashing to roof.

Prior to installing Flashing, apply caulk in hole as an added sealant against moisture.

Seal any holes that missed a rafter.

## 4c. Apply Caulk to Flashing

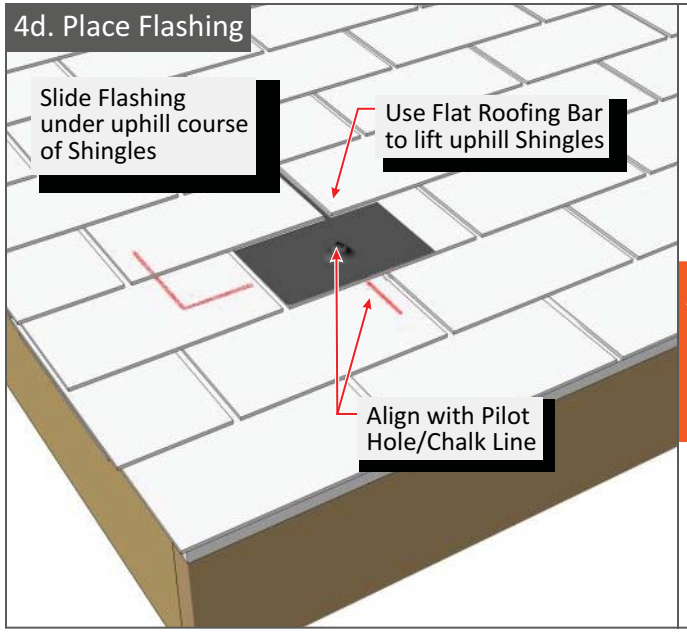



Apply a horseshoe shaped generous bead of caulking on the roof surface or the bottom of the Flashing with the opening downhill. Start and end the bead near the Flashing's downhill edge.

Use roof compliant sealant.

# 4. Install Attachments onto Roof (cont.)

## 4d. Place Flashing

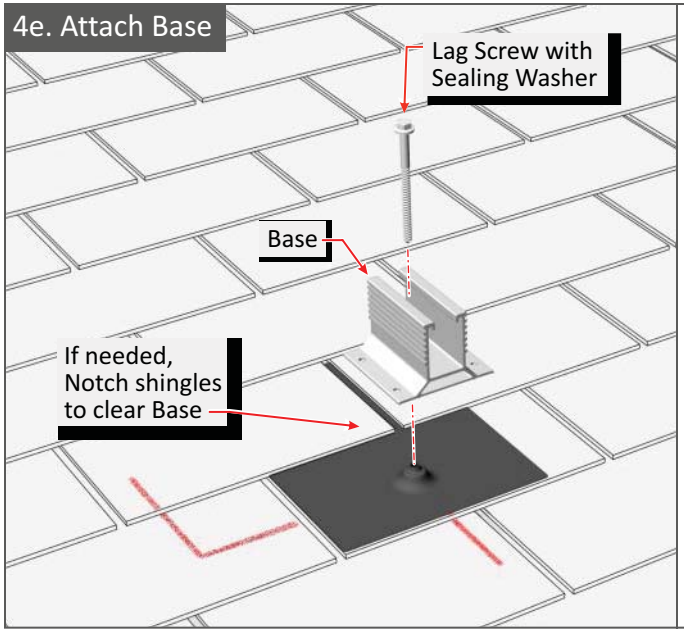



If necessary, clearance trim the up-course Shingles to clear the Base.

Line up the Flashing's mounting hole to pre-drilled pilot hole and square the Flashing to the Shingles.

⚠ The bottom or downslope edge of the Flashing must not extend beyond the course of Shingles that it's attached to.

## 4e. Attach Base

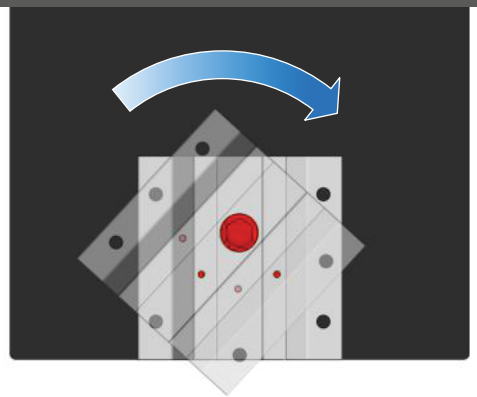



Be sure to orient the Base as shown with its offset mounting hole directed uphill. On the Skirt row the Base can be rotated 180 degrees which helps hide the Base behind the Skirt (see examples below).

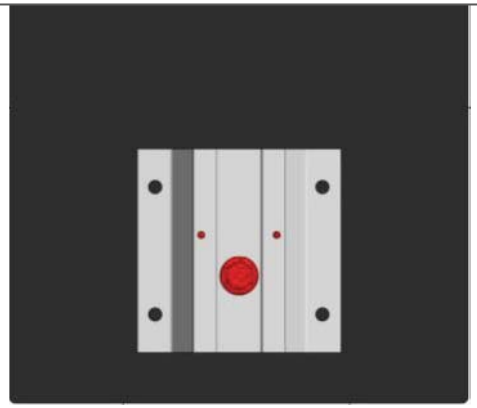
Install the Base using the Lag Screw with its pre-installed Sealing Washer. Drive the Lag Screw into the roof structure securing the Base and Flashing to the roof top. Torque to 14 ft-lbs.

## Base Positioning - Skirt Row vs other Rows

Uphill

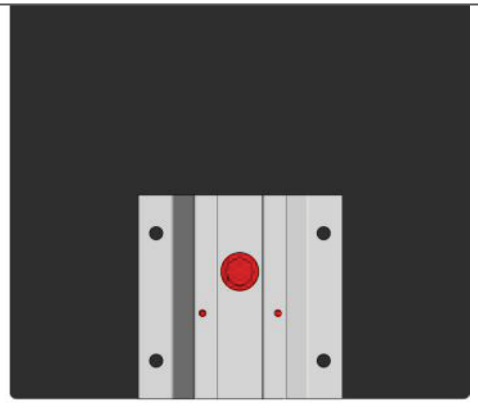


**Base can be rotated 360 degrees to allow adjustability of Clamp position. Rotates around its offset mounting hole.**



**Skirt row Base Position**

**It's recommended to rotate the Base so its offset mounting hole is downhill. This helps hide the Base behind the Skirt.**

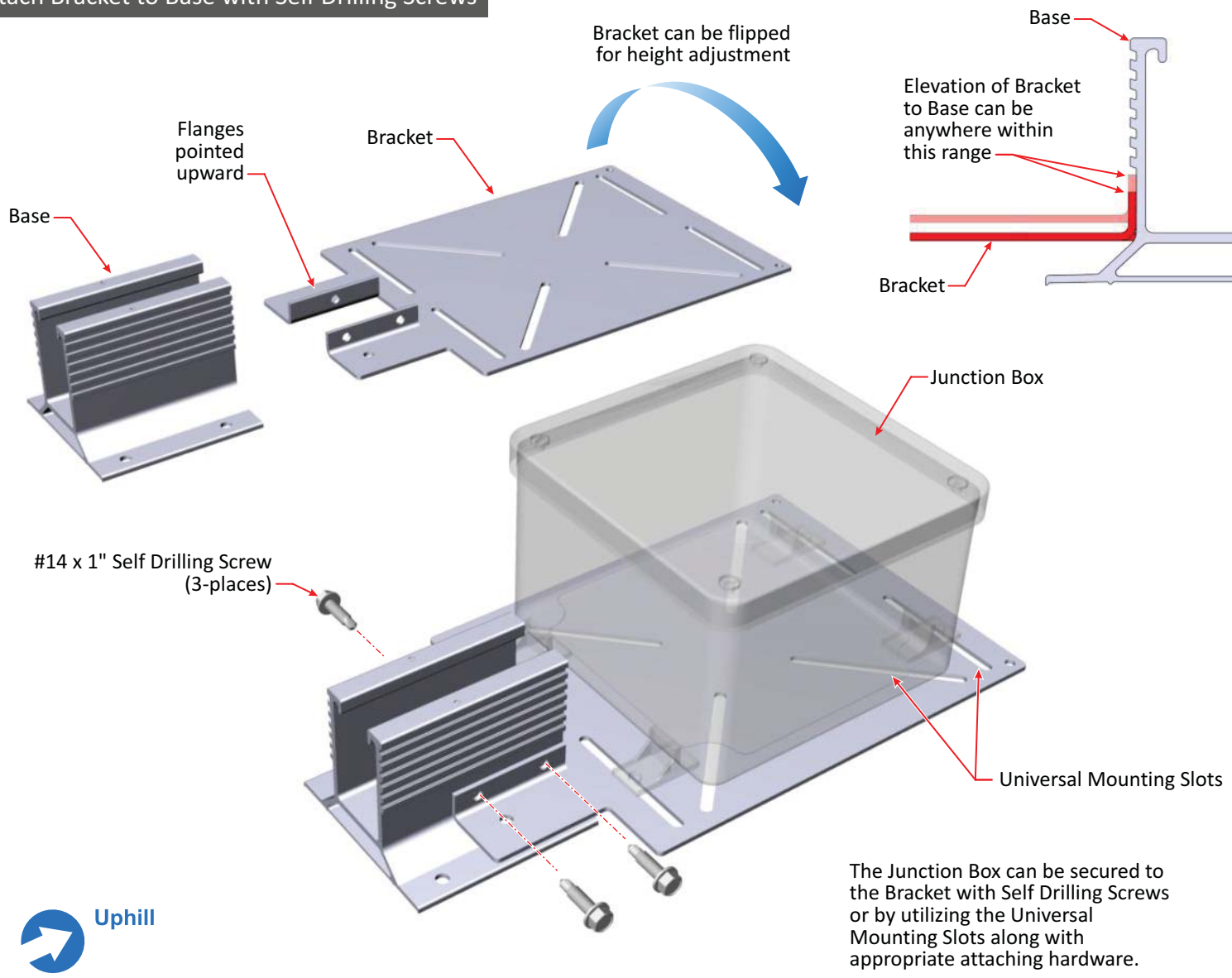


**Standard Base Position**

**Offset mounting hole is uphill.**

# 5. Install the Junction Box Bracket

## 5a. Attach Bracket to Base with Self Drilling Screws







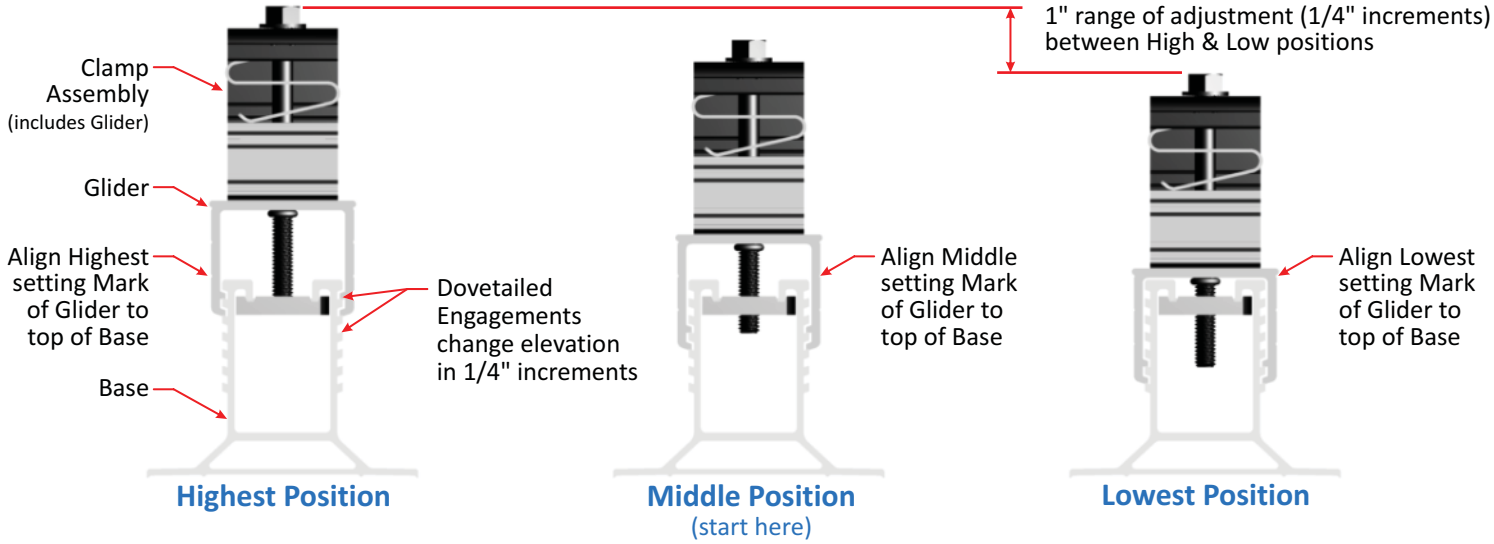
The Junction Box can be secured to the Bracket with Self Drilling Screws or by utilizing the Universal Mounting Slots along with appropriate attaching hardware.

The Junction Box Bracket is attached to the Base with Self Drilling Screws.

Select one of the previously installed Bases in a location suitable for mounting the Junction Box and install the Bracket as shown.

# 6. Install the Clamp Assemblies

## 6a. How to Set the Clamp Assembly Height via the Glider

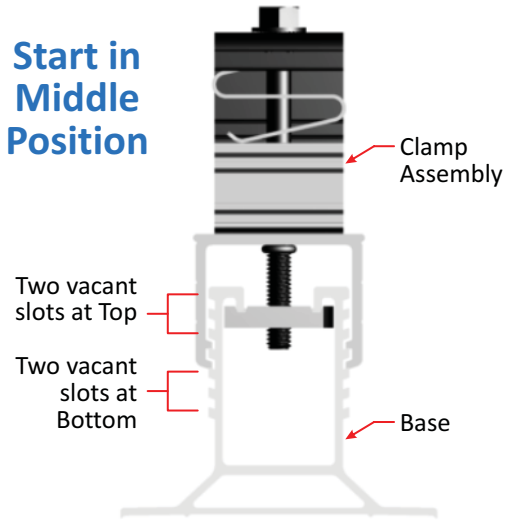


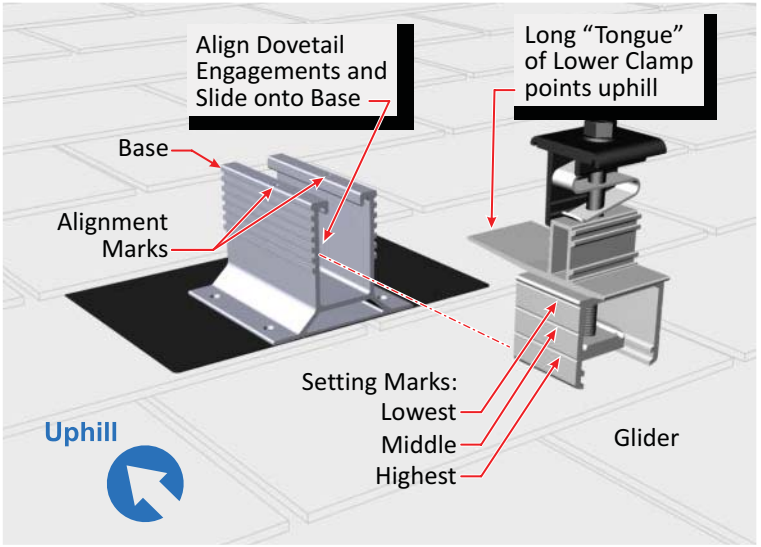

Height settings are made by utilizing the 5-position dovetailed engagements of the Glider-to-Base. The image to the left shows three of these positions.

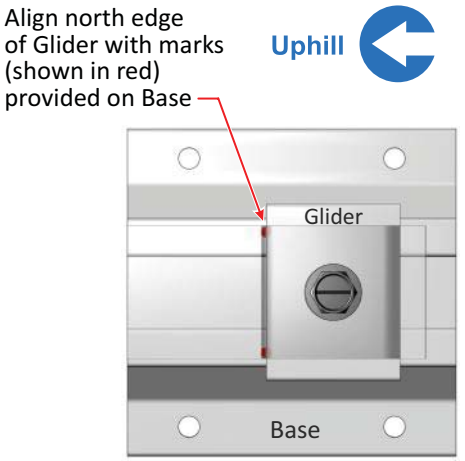
1" range of travel is possible in 1/4" increments. This equates to 1/8" variation from Glider to adjacent Glider to adjustment and compensate for irregular or undulating roof tops.

Start by setting the Glider on the end-of-row Clamp Assemblies to their middle position and then adjust other Clamps along the row as needed to level the row.

## 6b. Install the Clamp Assemblies



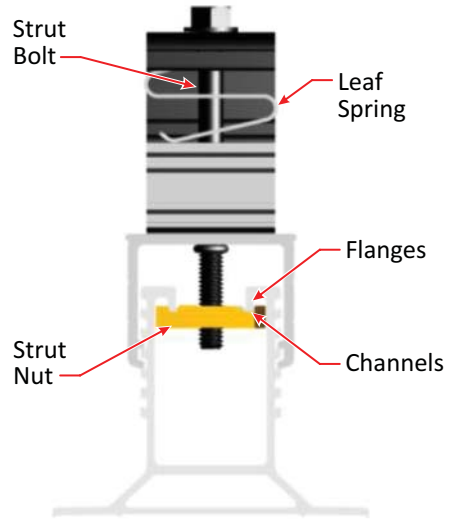




Note: For clarity the Upper and Lower Clamps are shown transparent.

# 6. Install Clamp Assemblies (cont.)

## 6c. Engage Strut Nut with Base

Note: For Skirt row Clamp installation only.



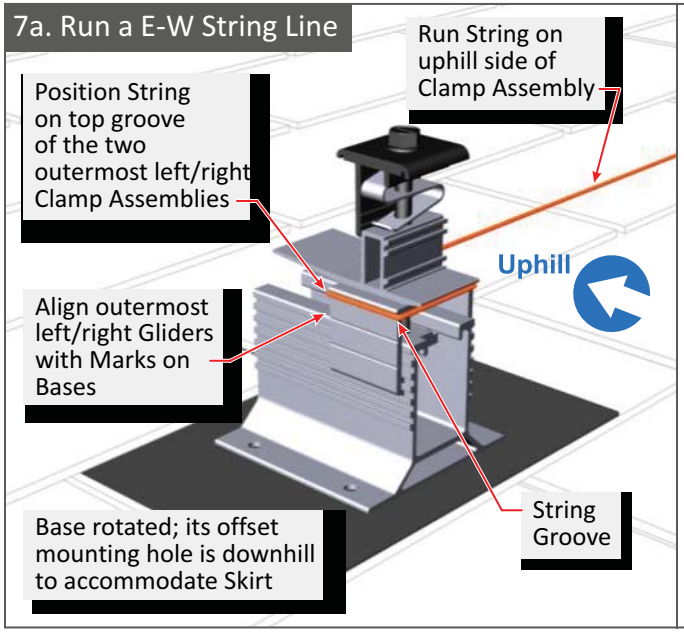

Use an impact driver to tighten the Strut Bolt and engage the Strut Nut channels with the two flanges of the Base. Leave the Clamp open to accept the Module. The Leaf Spring provides pressure to keep the Strut Nut engaged and in-position while the installation continues.

Further tightening will be done as the Modules are installed.

⚠ Do not over tighten the Clamps on the Skirt row. They need to be open enough to accept the Skirts. All non-Skirt row Clamps will be tightened as they are installed.

# 7. Level and Align Clamp Assemblies on Southern Row

## 7a. Run a E-W String Line



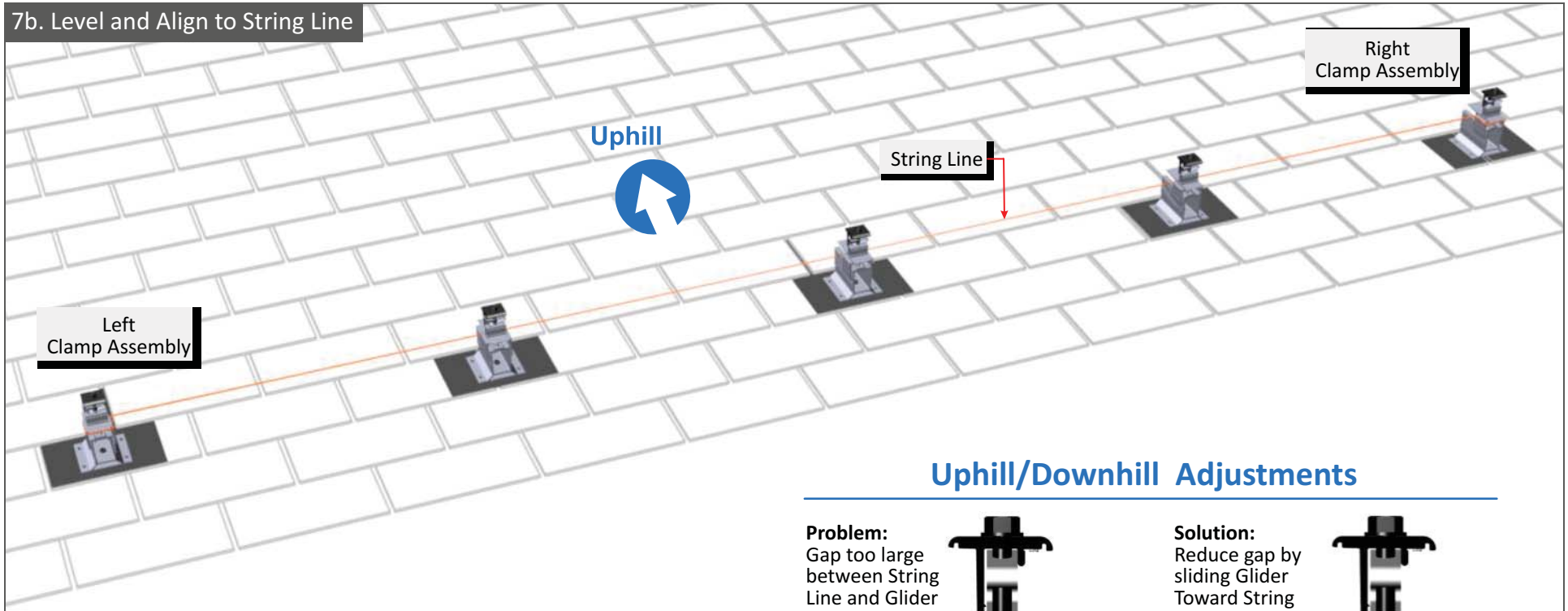

A String Line is used to level and align Clamp Assemblies on the first downhill row only.

The body of the Glider includes one “String Groove” specifically designed to assist with this process.

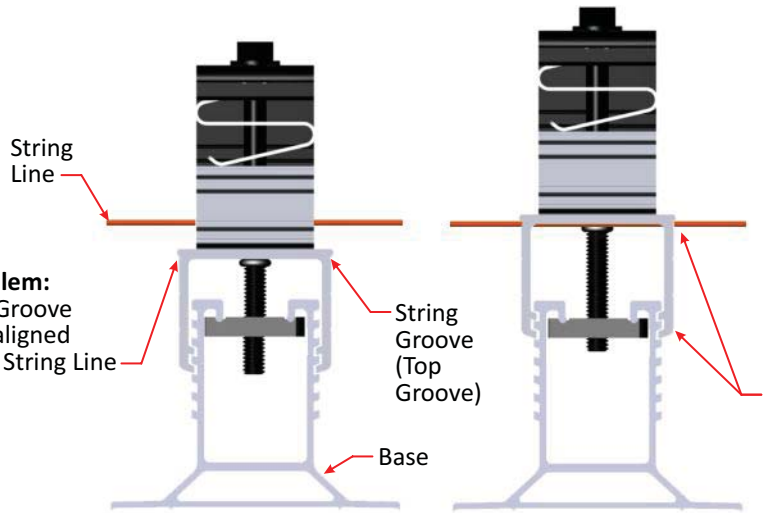
Run and secure the String Line between the two outermost left/right Clamp Assemblies. Place String on the top String Grooves, pulling it taught and securing its ends.

# 7. Level and Align Clamp Assemblies (cont.)

## 7b. Level and Align to String Line

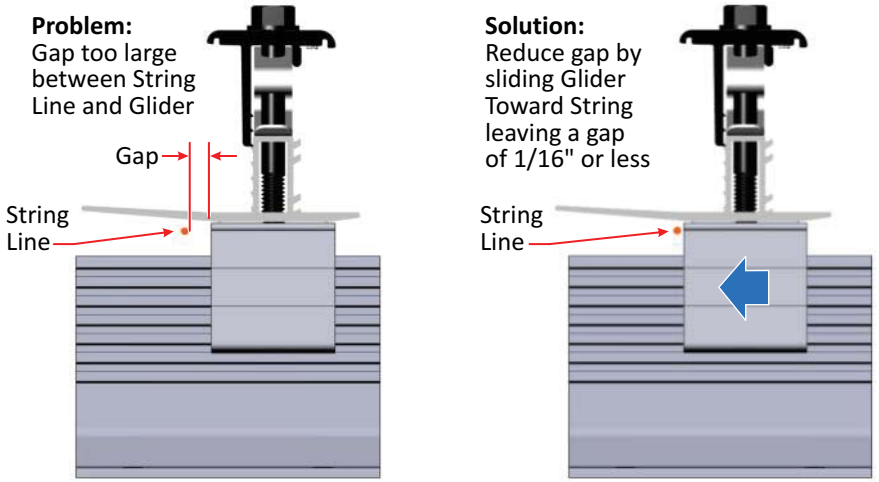



### Height Adjustments




**Solution:**
Raise Glider one Dovetail Engagement (1/4")
to align Top Groove of Glider with String

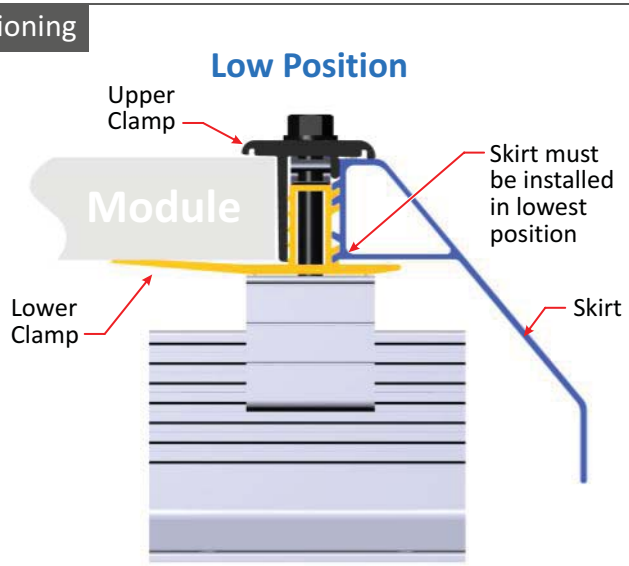
### Uphill/Downhill Adjustments



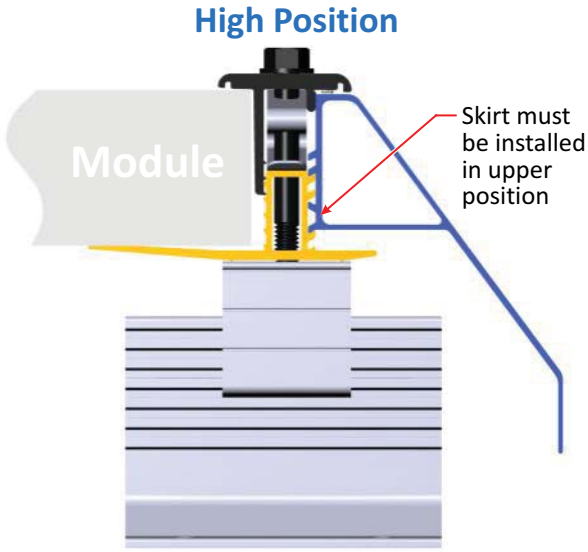
# 8. Install Skirts on Downhill Row

## 8a. Skirt to Lower Clamp Positioning

| Module Thickness | |
|---|---|
| Metric | Inches (approx) |
| 33mm | 1-5/16 |
| 35mm | 1-3/8 |
| 40mm | 1-5/8 |
| 50mm | 1-11/16 |
| 55mm | 2 |




33, 35 & 45mm Skirt Position



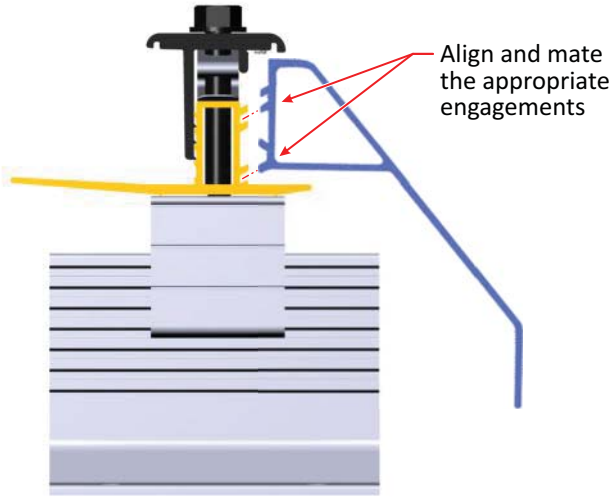

40 & 50mm Skirt Position

Skirts are held in place by the Clamps and joined (end-to-end) by Couplings.

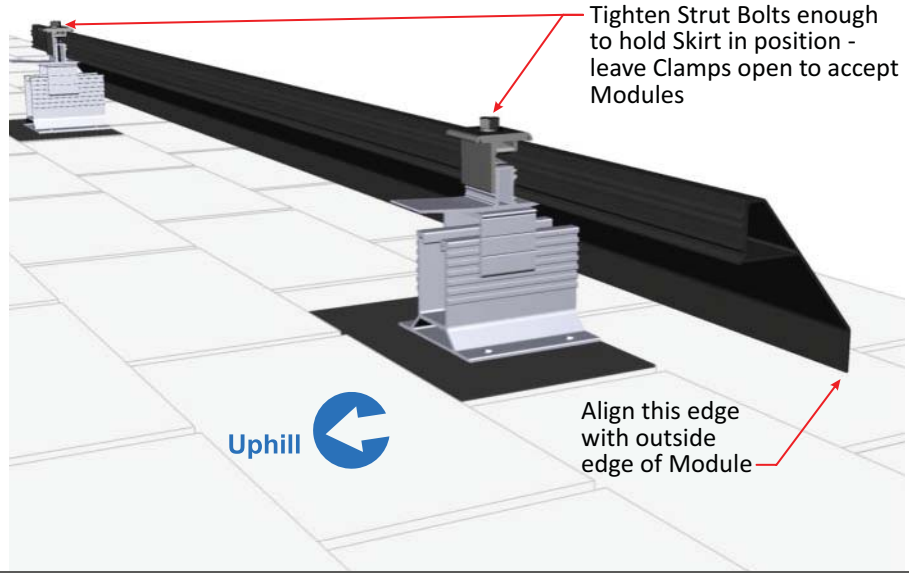
Three Skirt types are available fitting the most common Module frame thickness (see table). The Skirt type is stamped on the inside face of Skirt.

Skirts must be installed in the correct dovetail engagement (Skirt-to-Clamp) to match the Module in use. Once installed, the Skirt sets the Upper Clamp position matching it to the Module thickness.

## 8b. Install the First Skirt



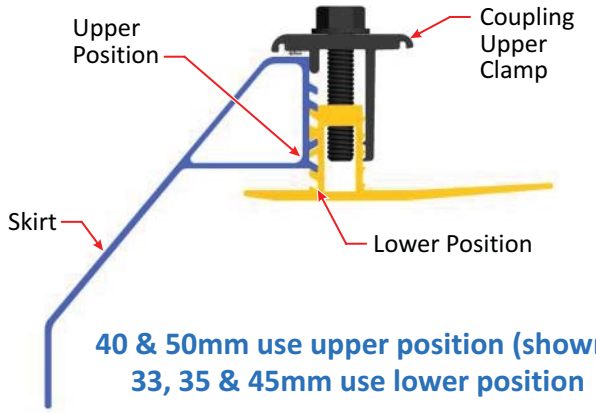

40 & 50mm Skirt Position



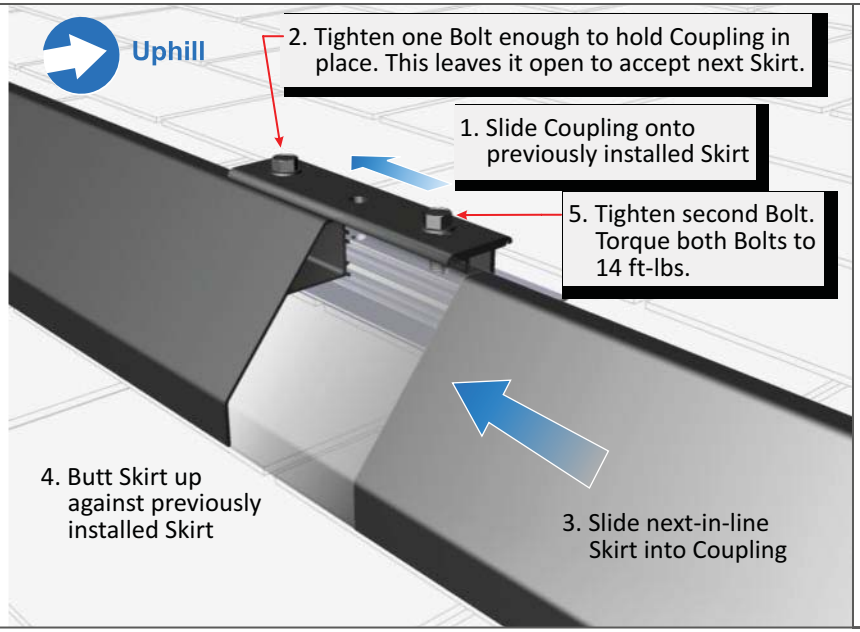

Align the left/right position of the Skirt with the outer edge of the array. Torque Clamps to 14 ft-lbs. Check to ensure north side of Clamp is positioned to accept Module.

# 8. Install Skirts on Downhill Row (cont.)

## 8c. Install Coupling and adjacent Skirt



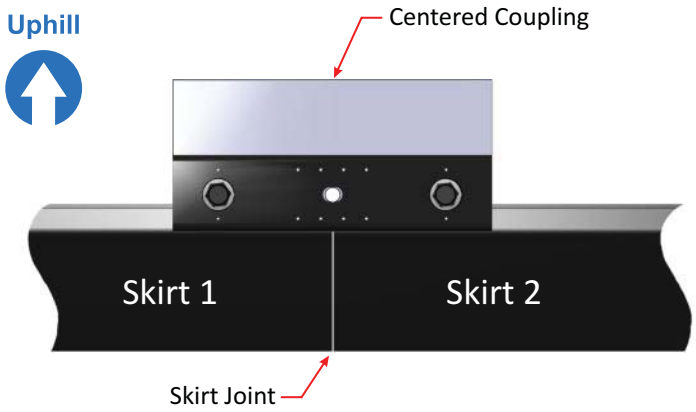

**40 & 50mm use upper position (shown)**
**33, 35 & 45mm use lower position**



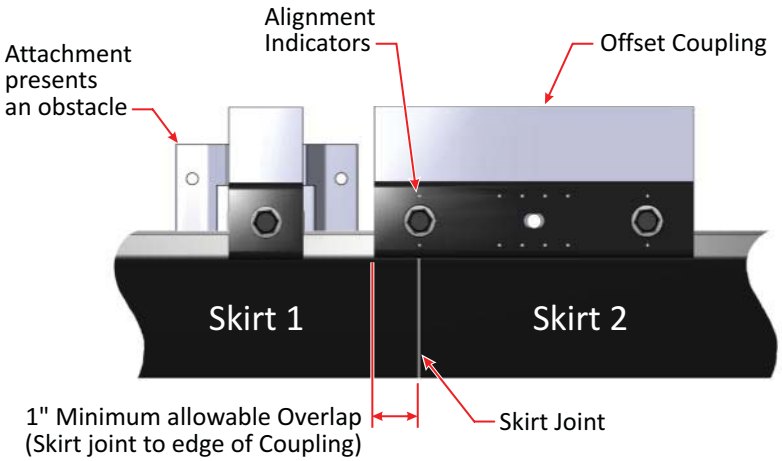

Just as with the Clamps, the Skirts must be installed in the correct dovetail engagement to match the specific Module thickness.

The Lower Clamp provides two height positions. The upper position is used on 40 & 50mm Modules while the lower position is used on 33 & 35mm Modules.

## 8d. Left/Right Positioning of Coupling




**Coupling centered over Skirt Joint is ideal Position**




**Obstacle: Attachment requires Coupling to be offset from center. Offset is acceptable but within limits**

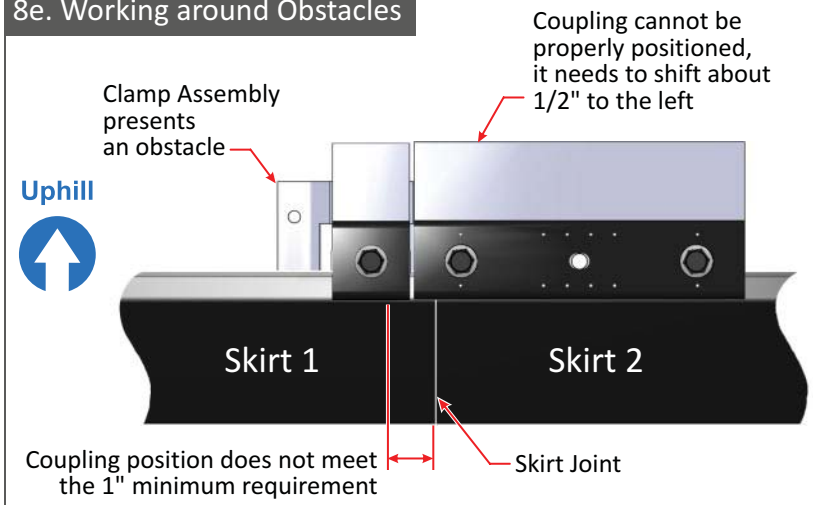
Left/Right positioning of the Couplings is flexible. Couplings can be adjusted "off-center" of the Skirt joint as needed to work around an Attachment or other roof obstacle.

If Coupling must be moved off-center, utilize its alignment indicators as guides and offset the Coupling no less than the 1" minimum allowable overlap.

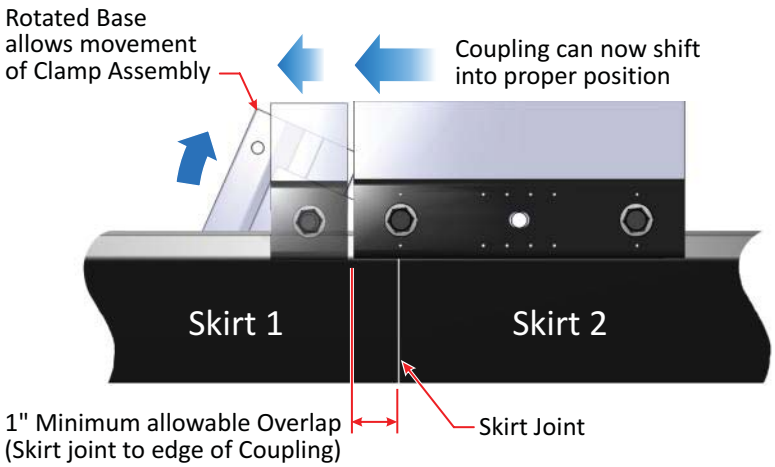
⚠ Do not offset the Coupling less than the minimum allowable 1" overlap. Doing so will cut the electrical bond of the array and reduce structural integrity.

# 8. Install Skirts on Downhill Row (cont.)

## 8e. Working around Obstacles




**Problem: Clamp Assembly prevents proper positioning of Coupling**




**Solution: Rotate the Base and reposition the Clamp Assembly.**

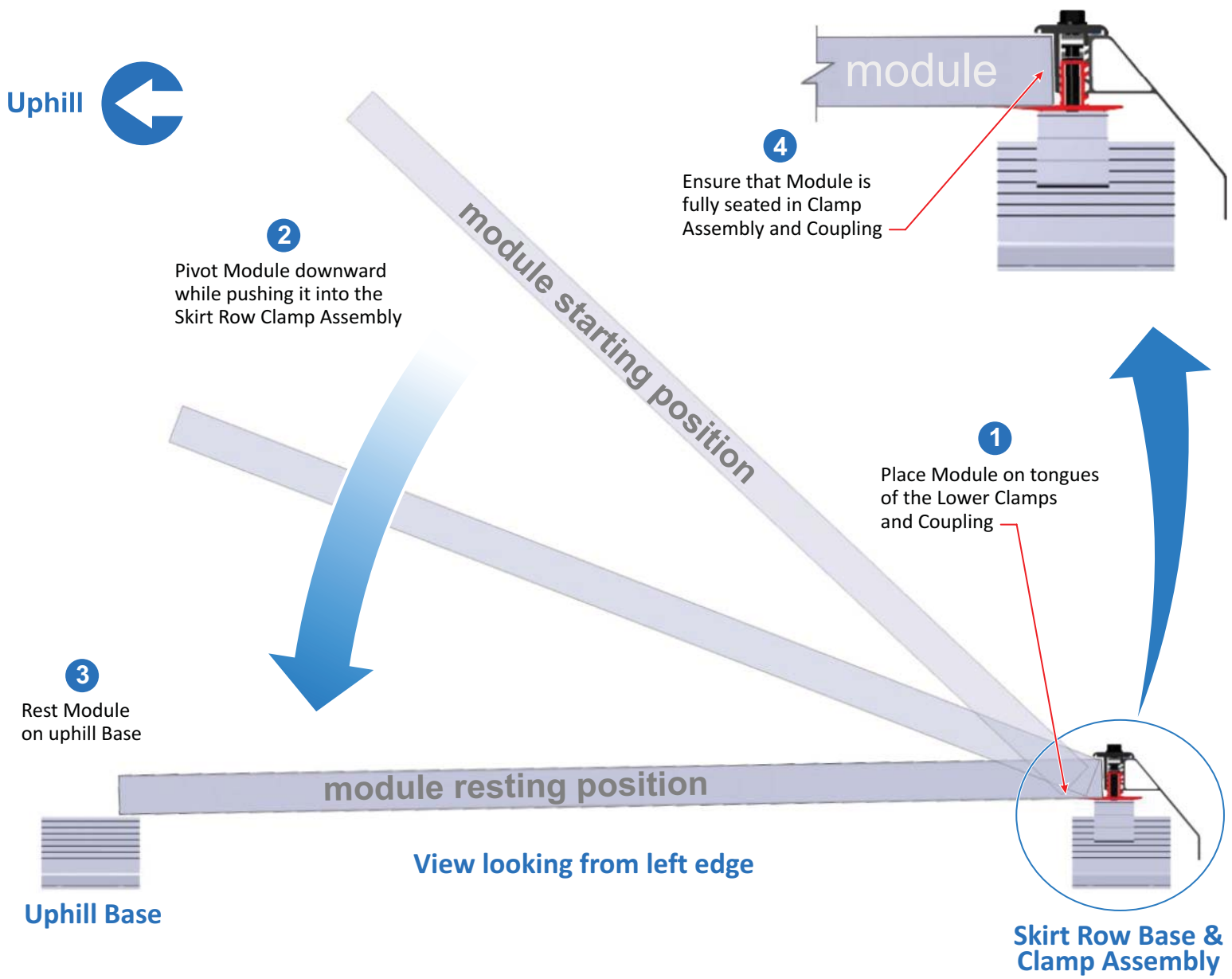
**Note: If this solution does not work see Appendix A**

The example at far left demonstrates how a Clamp Assembly might become an obstacle to the Coupling. If a Clamp Assembly obstructs the proper positioning, the Clamp Assembly position can be altered by simply rotating its Base via the Lag Screw.

First, loosen the Lag Screw securing the Base to the roof, then rotate the Base and re-position the Clamp Assembly by sliding the Glider as needed in order to properly place the Clamp Assembly in relation to the Skirt. (See the second example at left)

# 9. Install Modules

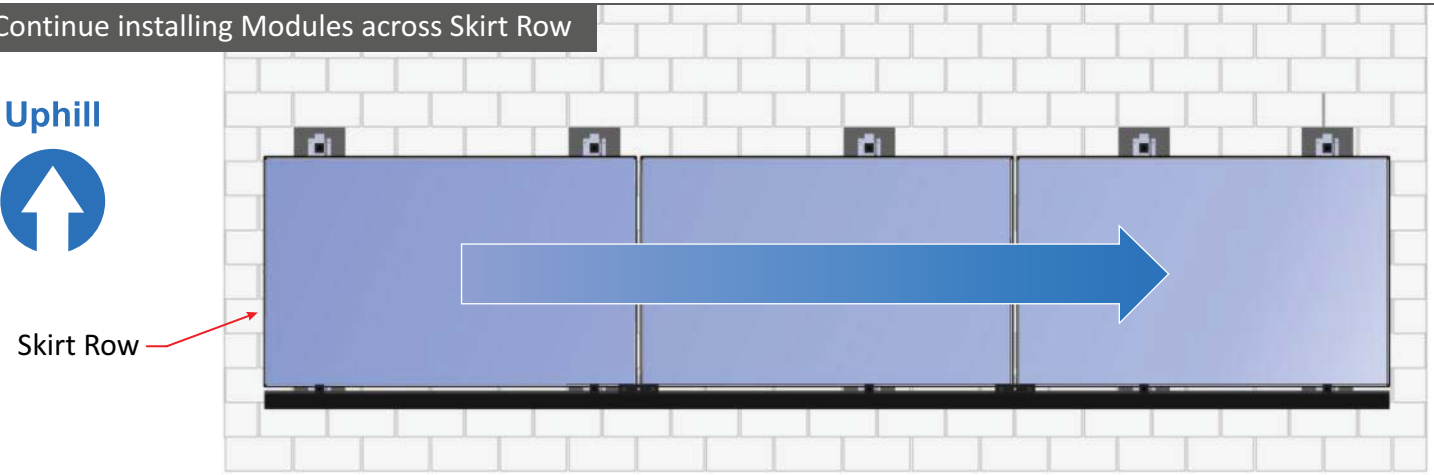
## 9a. Pivot Modules into Clamps & Couplings

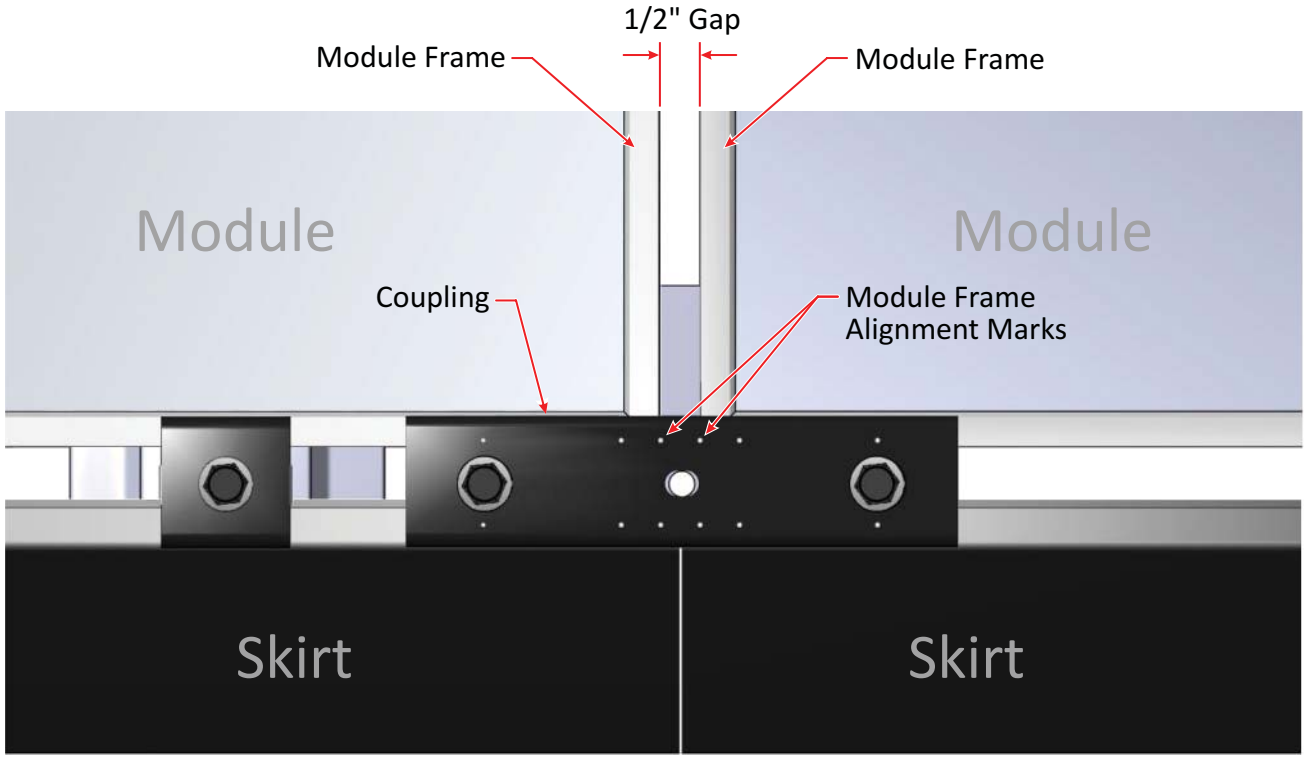



1. Hold the module on its uphill edge, and place its downhill edge onto the Tongue of the Lower Clamps and Coupling of the Skirt Row.
2. Pivot its uphill edge downward toward the Base/Lower Clamps of the uphill row.
3. Rest the Module on the Base.
4. Be certain that the Module Frame has fully seated into/against the Clamps and Couplers of the Skirt Row.

# 9. Install Modules (cont.)

## 9b. Continue installing Modules across Skirt Row




Working across the Skirt row set the Modules in place while leaving a ½" gap between them. Set the gap by the alignment marks on the Skirt row Coupling(s) and aligning the Module frames to these marks.

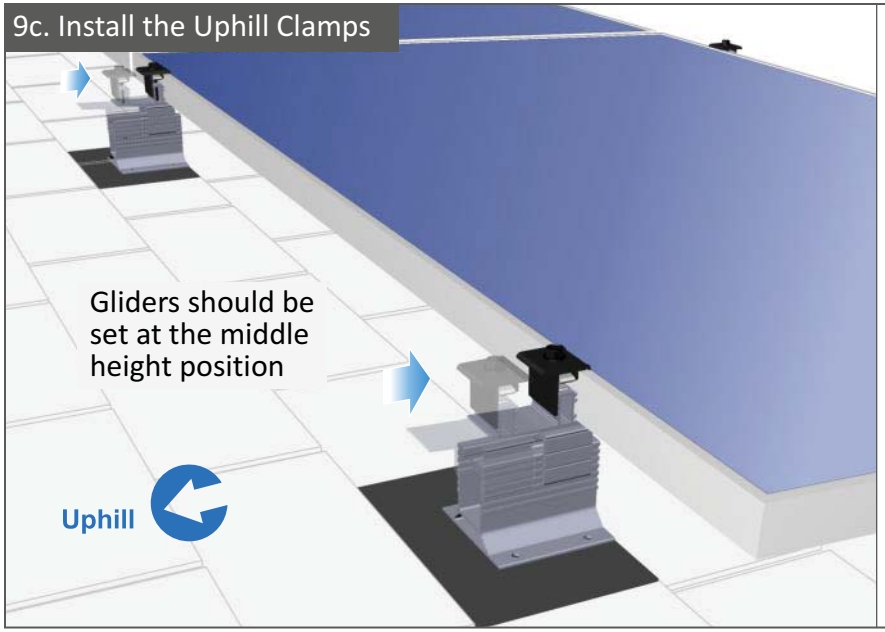
### Wiring

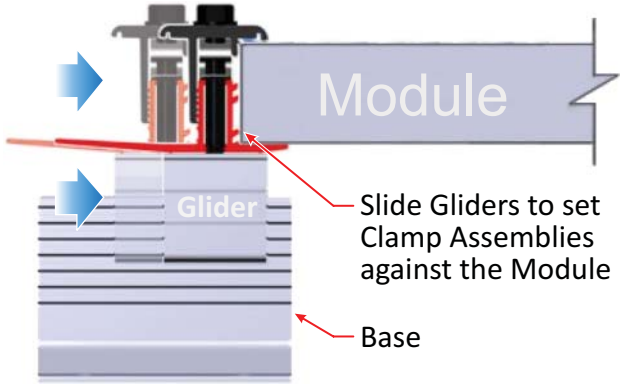
As each row of Modules is installed, complete all wiring connections and verify that all wire management clips and wires are properly arranged and off the rooftop before proceeding to the next row of Modules.

Install home runs or trunk cable if necessary as each row of modules is installed.

# 9. Install Modules (cont.)

## 9c. Install the Uphill Clamps



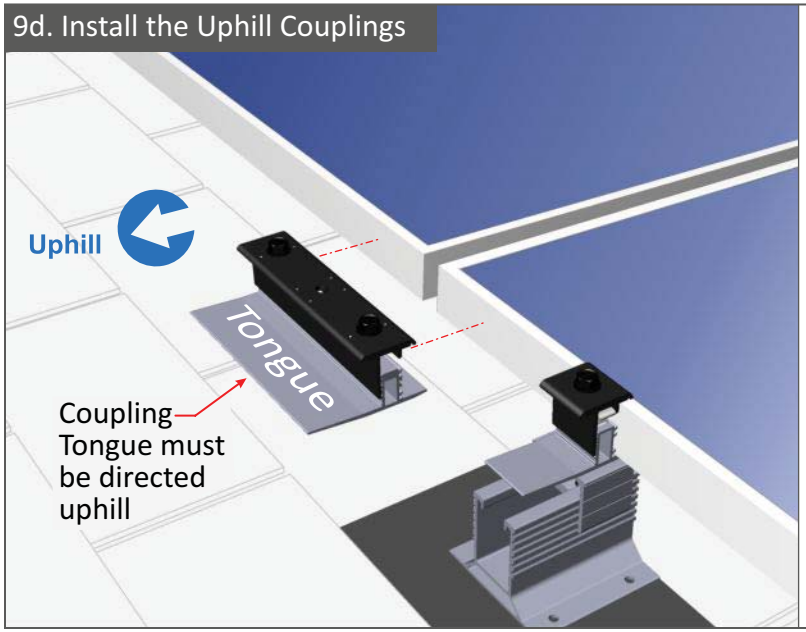



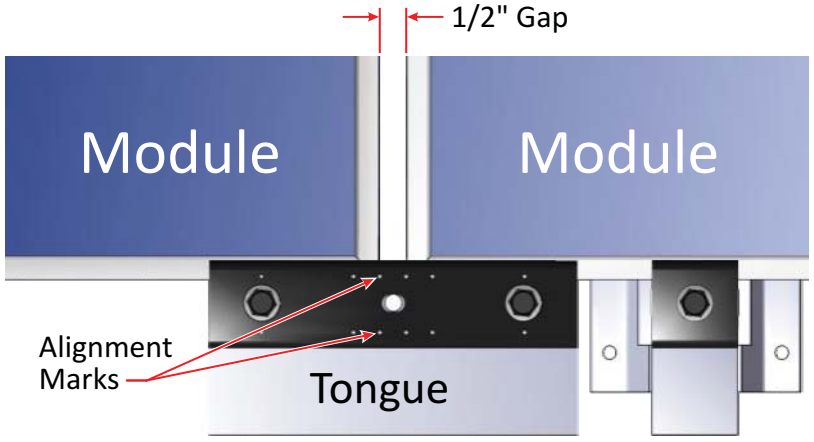

Slide the uphill Clamp Assemblies into place by sliding the Gliders toward the Module.

Lift the uphill edge of the module as needed to slide the Clamps onto the Module, pressing them against the Module as shown at left.

Leave the Clamp Assembly loose while you position the remaining Clamps and install the Couplings.

## 9d. Install the Uphill Couplings



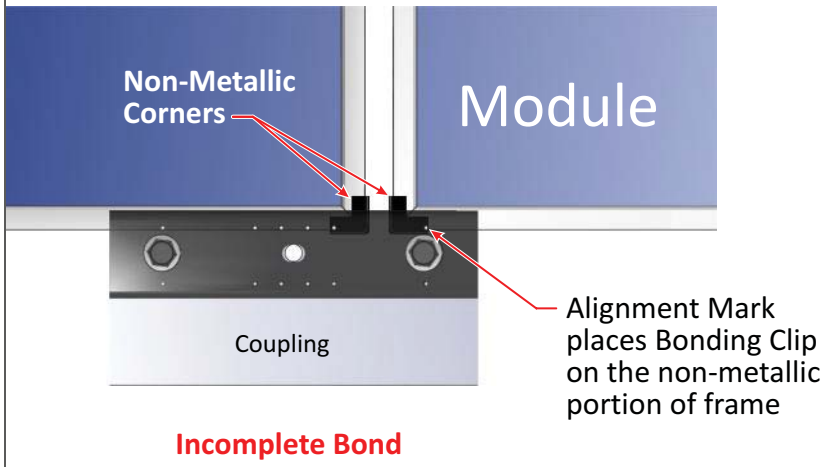

**Use Coupling alignment marks to center Coupling over the 1/2" gap.**

**Coupling can be offset of center; the same procedures apply as identified in Step 9b Left/Right Positioning of Coupling**

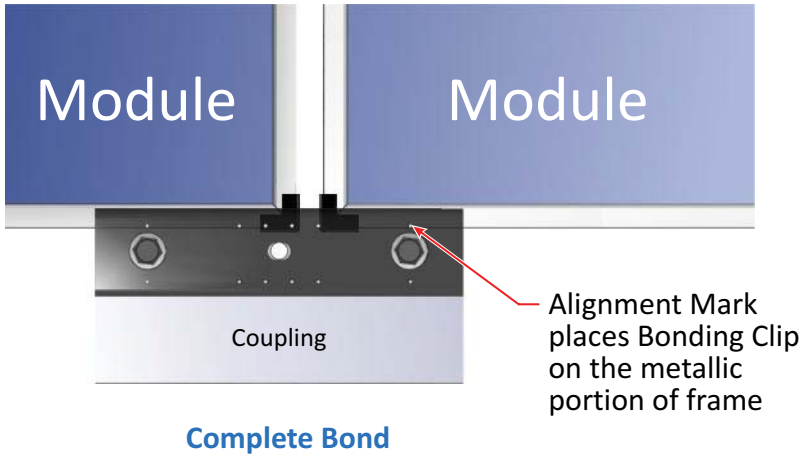
After the Coupling has been positioned tighten and torque to 14 ft.-lbs.

# 9. Install Modules (cont.)

## 9e. Coupling alignment on Modules with Non-Metallic Corners




**Incomplete Bond**




**Complete Bond**

Note: For clarity the Couplings are shown transparent.

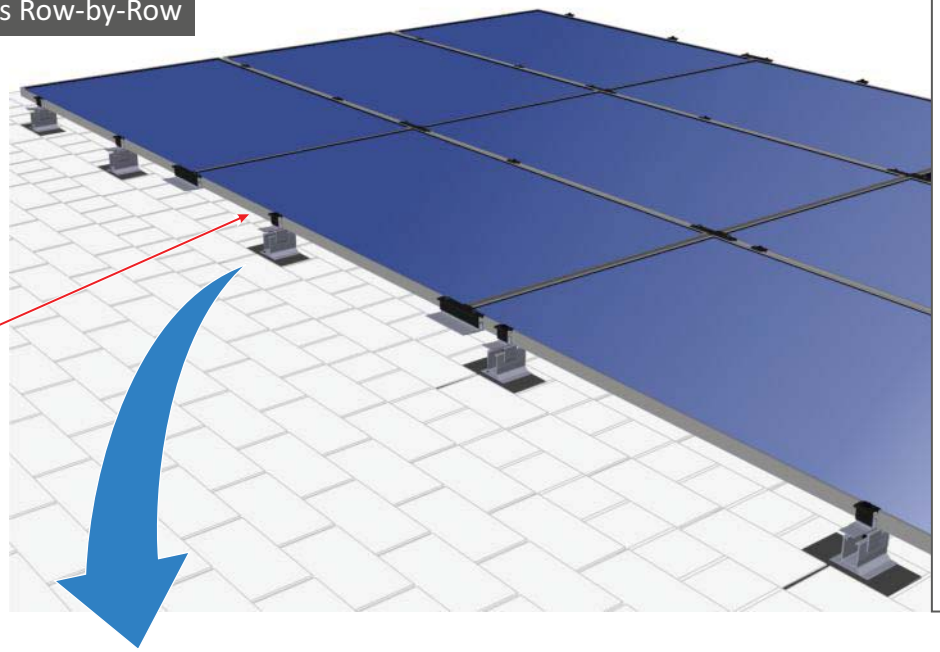
⚠ For Modules that are constructed with non-metallic corners, ensure the Bonding Clip in the Coupling is fully engaged with the metallic frame of the Module.

When setting the Couplings position on Modules with non-metallic corners, the Couplings left/right range of adjustability is reduced due to the non-metallic area of influence.

This area of influence varies by Module make and therefore a close visual inspection must be done to ensure that the Bonding Clip has cleared these areas.

# 10. Level the Modules

## Level Modules Row-by-Row



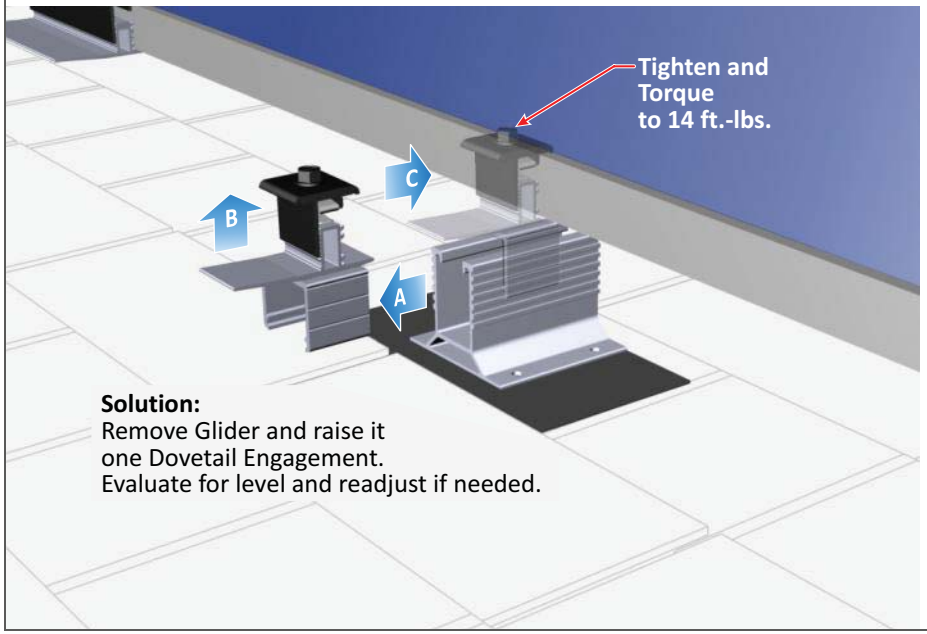
**Problem:**
This Module is lower than the others and needs to be elevated.

### Leveling the Modules

As work progresses the Modules will need to be evaluated by eye and leveled row-by-row.

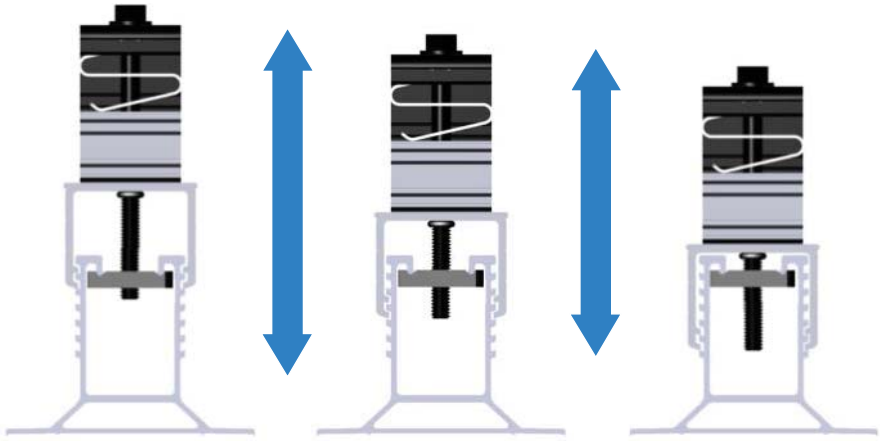
1. From the roof, visually evaluate the rows for a consistent level left to right, uphill, downhill and to the row below. Ideally, get an evaluation from someone on the ground as well.
2. If elevation adjustments are required, raise or lower the Glider positions (as needed) on their respective Bases to bring things into level.
3. After leveling, tighten the Clamps to 14 ft.-lbs.

Repeat Steps 9a through 9e for the remaining rows of Modules.



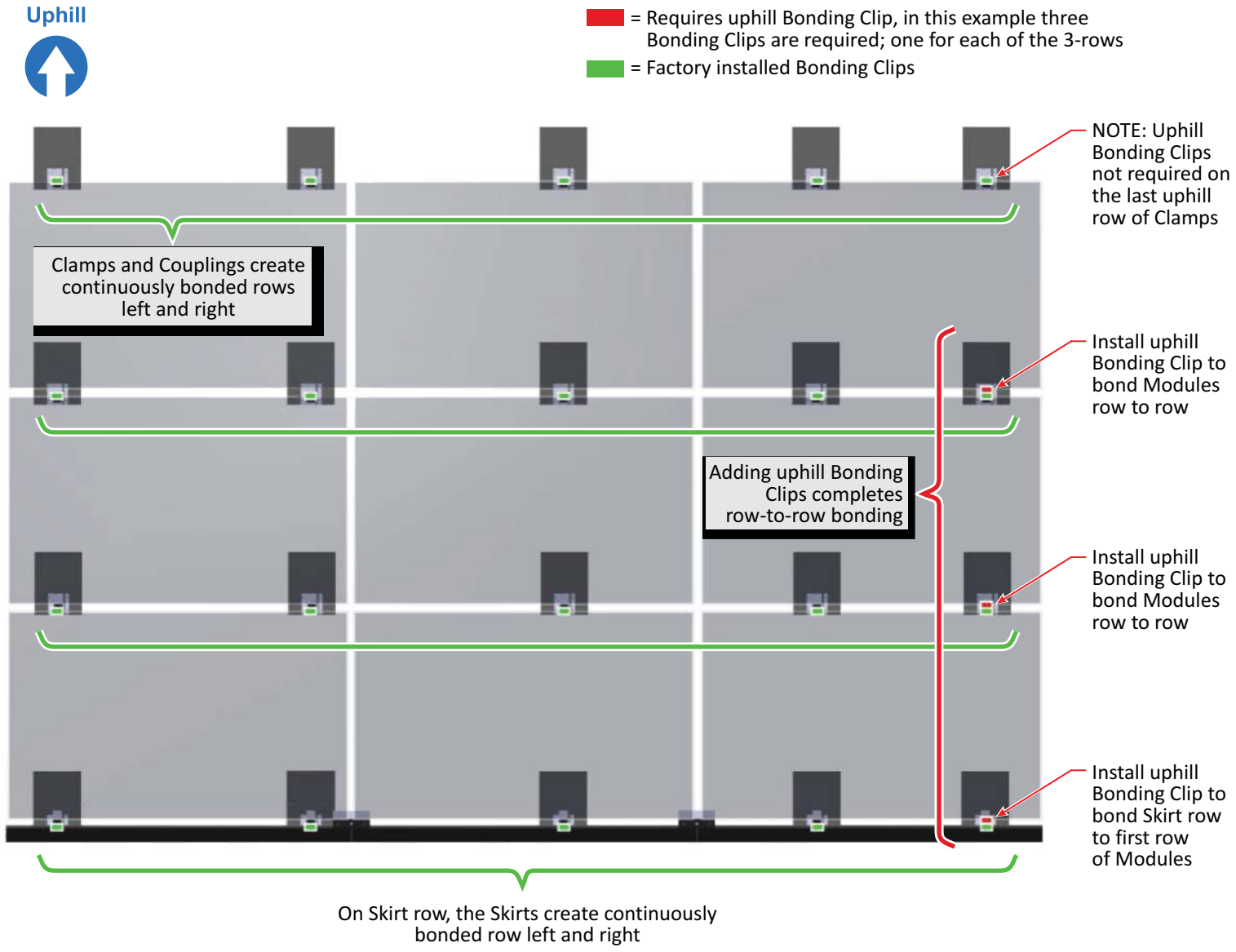

**Solution:**
Remove Glider and raise it one Dovetail Engagement.
Evaluate for level and readjust if needed.

**Remember:** Each dovetail engagement equals 1/4" elevation change



# 10. Row to Row Bonding

## Adding uphill Bonding Clips Connect Row-to-Row




Note: Although the uphill Bonding Clips are shown on the right end of the rows, they can be installed on either end of each row.

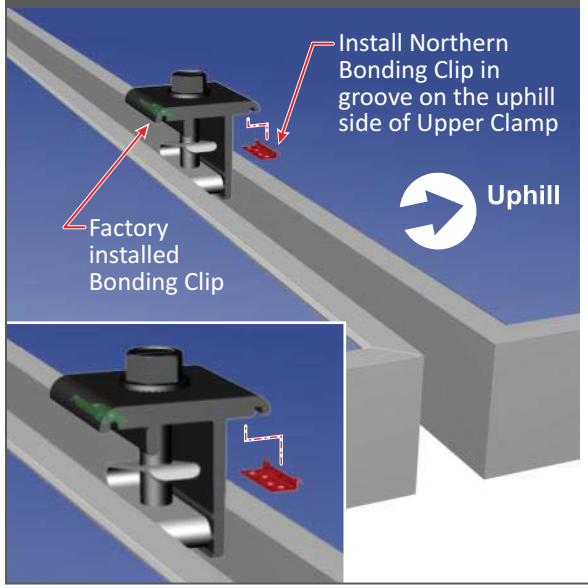
Now that the system is installed, its time to add additional Bonding Clips (referred to as "uphill Bonding Clips") to bond the system *row-to-row*.

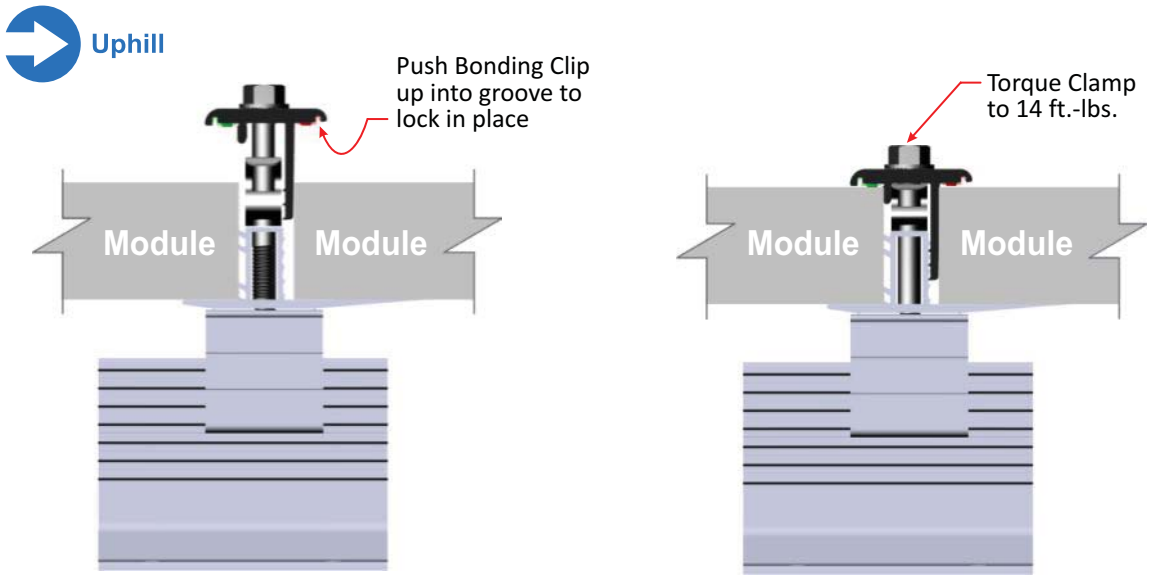
⚠ Row to row bonding must be completed in one location at the end of every row. This must be done between the skirt and the first row of modules, and between every row of modules. The image at left shows the general location of row to row bonding within an array.

There are two options for row to row bonding: Option 1 uses a bonding clip, added on the uphill side of any one clamp in each row. Option 2 is any bonding jumper that is tested to UL2703 (see the following page for details).

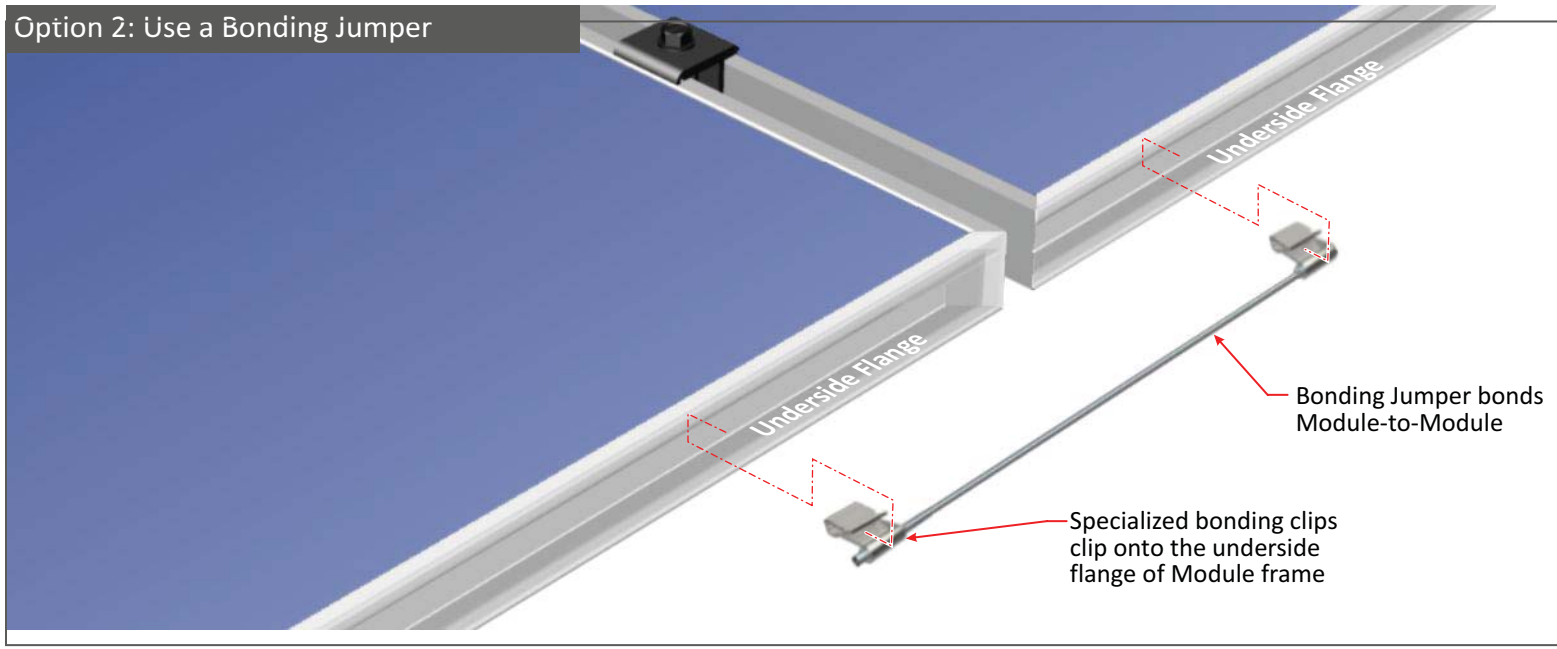
# 10. Row to Row Bonding (cont.)

## Option 1: Use our Bonding Clips



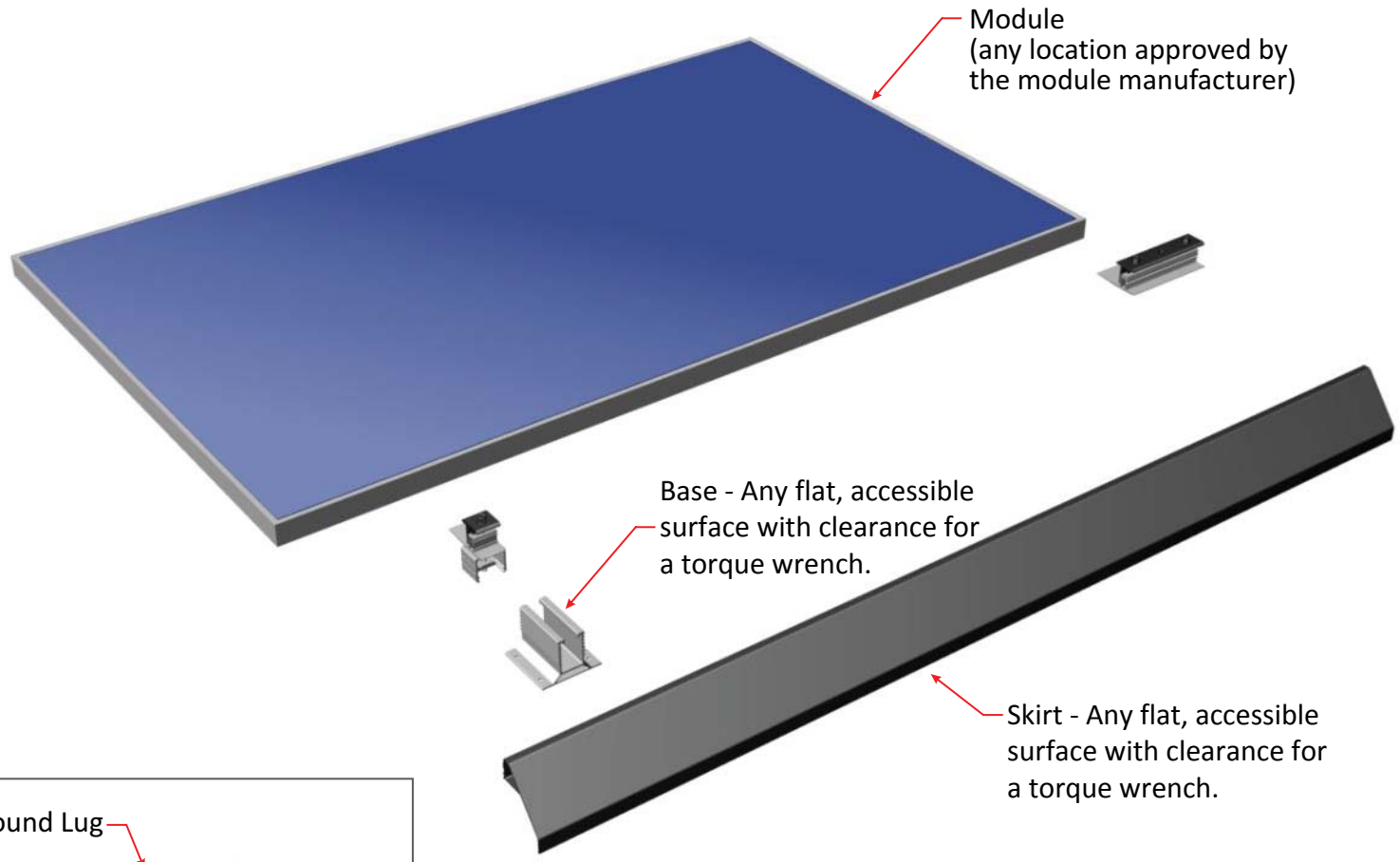




## Option 2: Use a Bonding Jumper



# 10. Row to Row Bonding (cont.)

## Lugs and System Bonding




Ground Lug

* Install approved grounding lug per lug manufacturers instructions.
* Never connect copper wire directly to an aluminum component.
* Lugs are for single use only.

One ground lug per array must be installed. Ground lug can be installed on the module frame at the end of the array or on the EcoX Skirt or Base components as indicated in the drawing above.

Install a single ground lug on each array in a visible location. Each ground lug is to be grounded to the common ground identified for this system in accordance with the National Electric Code (NEC), ANSI/NFPA 70.

- Wiley WEEB-LUG-6.7
- Ilsco Lay-in Lug GBL-4DBT
- Burndy CL50-1TN

Other UL 2703 listed ground lugs may also be suitable for this system if approved by the AHJ.

The installer is responsible for ensuring the ground connection is properly installed per NEC requirements, including the gage of the EGC wire to be used.

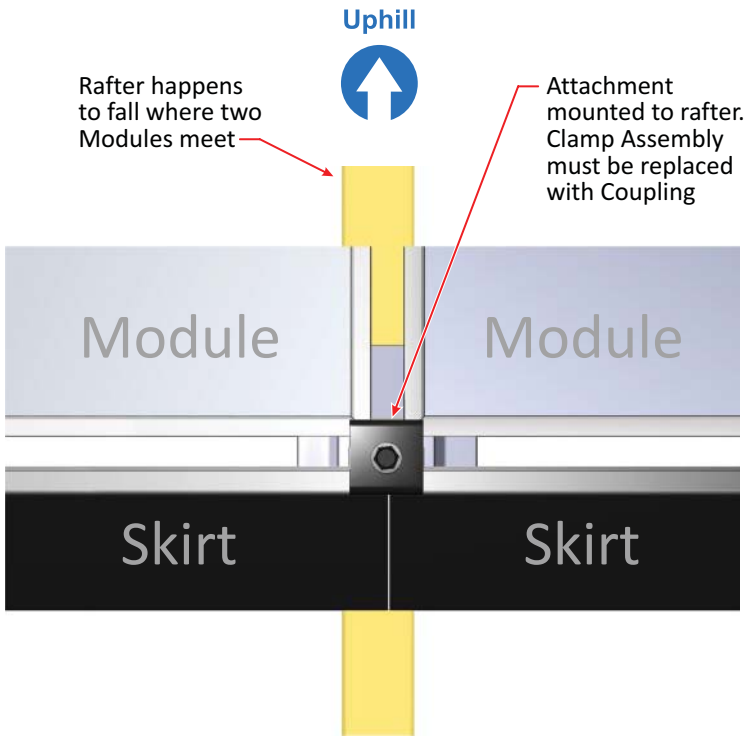
Note:
The maximum OCP rating is 20A when using Enphase micro-inverter for grounding.

# Appendix A: How to replace the Clamp Assembly with a Coupling

## A1. Disassemble Clamp Assembly and Rebuild using a Coupling

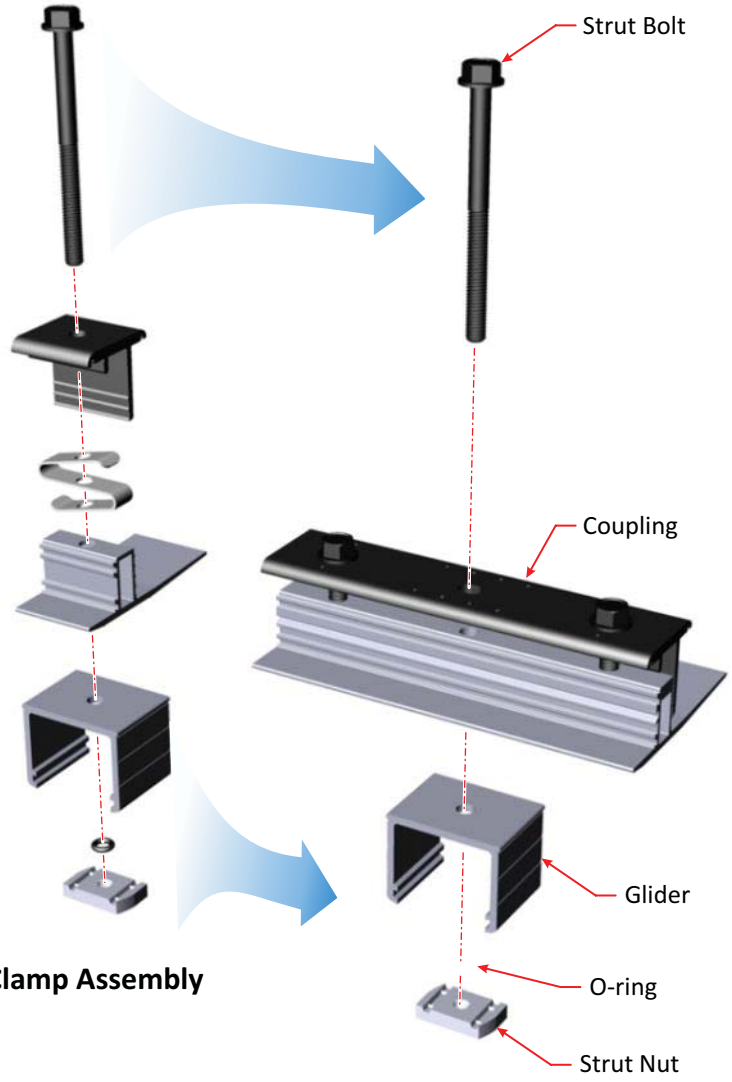
### This situation requires a Coupling:

When a Rafter falls where two Modules meet, the Clamp Assembly must be removed and replaced with a Coupling.




### Swap Clamp Assembly for Coupling:

Disassemble and reassemble with Coupling. Reuse Strut Bolt, Glider, O-ring and Strut Nut




**Clamp Assembly**

This procedure is used only in those situations wherein adjusting Attachments (Step 8e), fails to resolve interference issues between an Attachment and a Coupling. A common example of this is shown at left when a rafter falls where two modules meet.

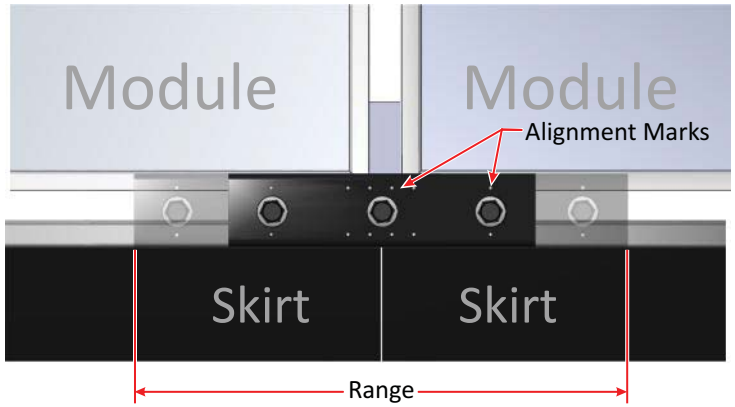
Remove the Glider and Clamp assembly from the Base. Next, remove the Upper and Lower Clamps from the Glider by removing the Strut Bolt and Strut Nut.

Position the Coupling onto the Glider and re-install the Strut Bolt and Strut Nut. Return the Glider to its original position on the Base. Align the Glider and Coupling to the Modules as described in sections 8, 9, and A-2. Tighten and torque the Strut Bolt and Coupling Clamp to 14 ft.-lbs.

To ensure proper electrical bonding install the modified Coupling within the allowable left/right limits. The following page demonstrates the maximum allowable range of positions between the Coupling and Module Frame(s). Use the Alignment Marks and align to the Module Frame. Any less overlap inhibits proper bonding and may not properly support components.

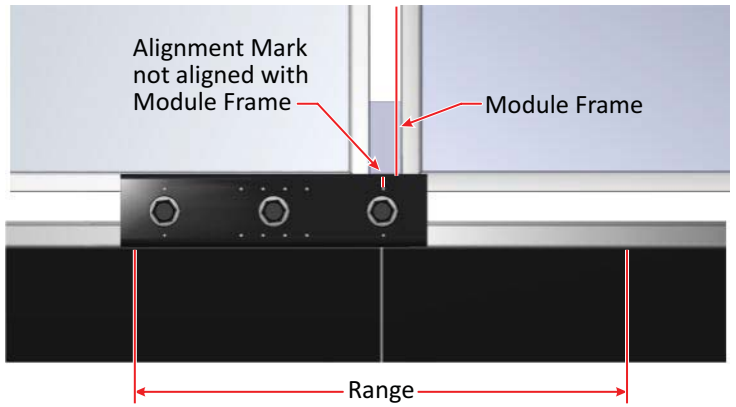
# Appendix A: How to replace the Clamp Assembly with a Coupling (cont.)

## A2. Utilizing the Alignment Marks for Proper alignment of Coupling to Modules and Skirts



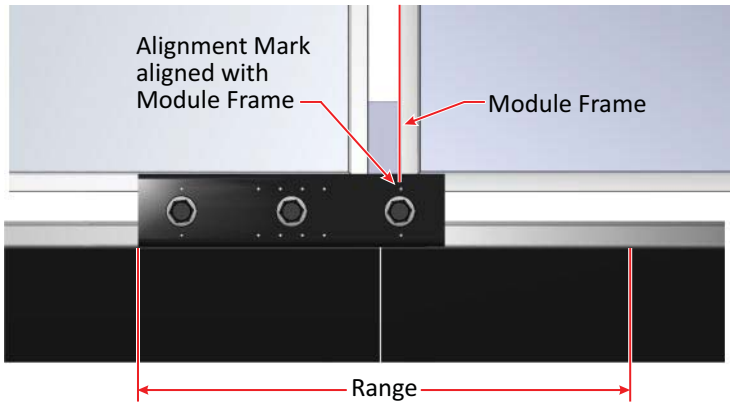

**Acceptable Range of Positioning**

Coupling has a maximum allowable range of positioning and must not exceed this range.
Using Alignment Marks keeps the range in check.



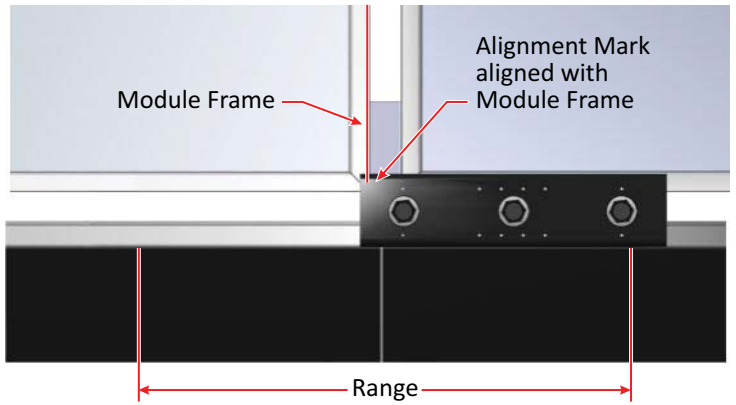

**Incorrect**

Coupling position exceeds the allowable range. Alignment Mark is not in-line with Module Frame. Inadequate Module and Skirt support. Bonding will be inhibited.




**Outermost Positioning - Scenario One**

Alignment Marks properly aligned with Module Frame




**Outermost Positioning - Scenario Two**

Alignment Marks properly aligned with Module Frame

Just as in earlier steps, the Coupling must be properly aligned in order for bonding to occur and also to properly support the Modules and/or skirts.

For Modules that are constructed with non-metallic corners, ensure the Bonding Clip in the Coupling is fully engaged with the metallic frame of the Module as shown in step 9-e.

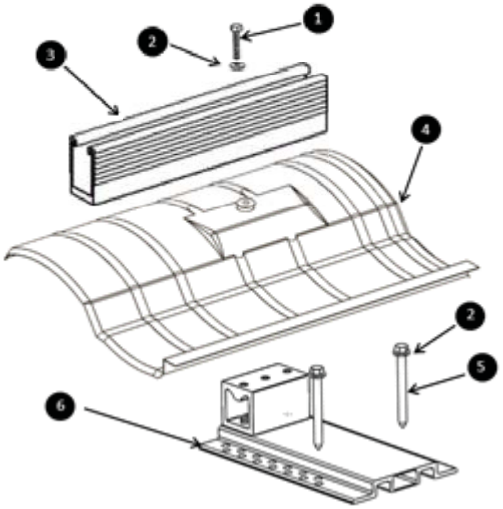
If the Coupling is not within the acceptable range of positioning the Bonding Clips (within its Upper Clamp) will fail to make proper contact with the Modules and/or Skirts. Correct positioning to the Alignment Marks ensures the Bonding Clips are making contact with the Modules and/or Skirts concluding in a proper bond.

When replacing a Clamp Assembly with a Coupling verify that the left/right positioning of the Coupling will fall within the acceptable range of positioning as shown to the left. Remember, after the Coupling is installed it is in a fixed left/right position and cannot be adjusted because it is secured to the Glider and Base attachment to the rooftop.

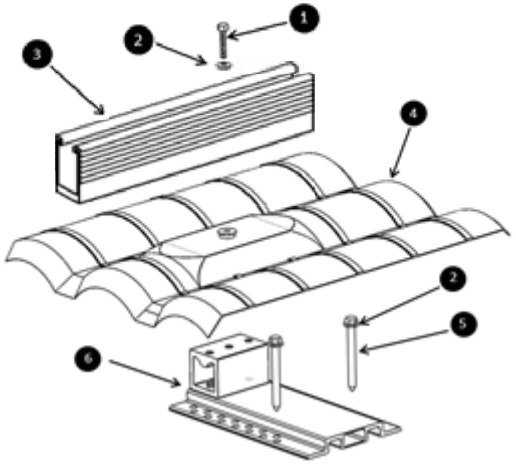
# Appendix B: Tile Roof Attachments - S Tile

## B1. Part Identification

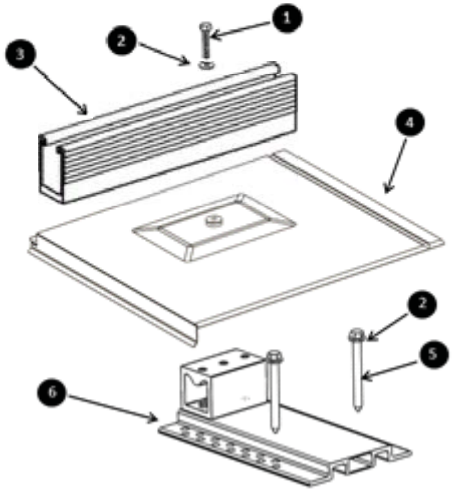
### S Tile Flashing



### W Tile Flashing



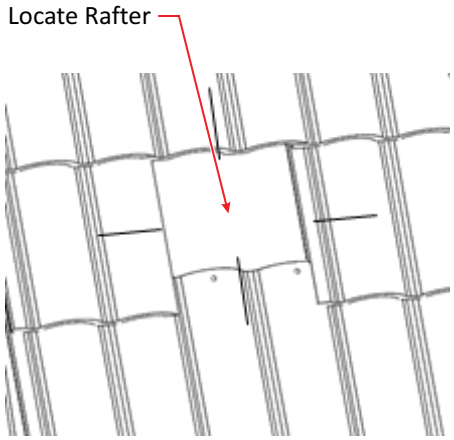
### Flat Tile Flashing



| Item No. | Description | Qty |
|---|---|---|
| 1 | 5/16"-18 X 1.5" Fully Threaded Hex Head Cap Screw 18-8 SS | 1 |
| 2 | 5/16" ID EPDM Bonded Washer 18-8 SS | 3 |
| 3 | Tile Base | 1 |
| 4 | EcoFasten Solar Tile Flashing (W, S, or Flat) | 1 |
| 5 | 5/16" X 4" Hex Head Lag Screw 18-8 SS | 2 |
| 6 | EcoFasten Solar Tile Base | 1 |

# Appendix B: Tile Roof Attachments - S Tile (cont.)

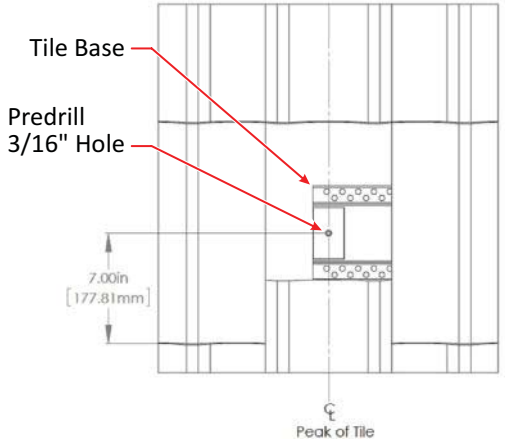
## B2. Install Attachments




### 2a. Remove Tile

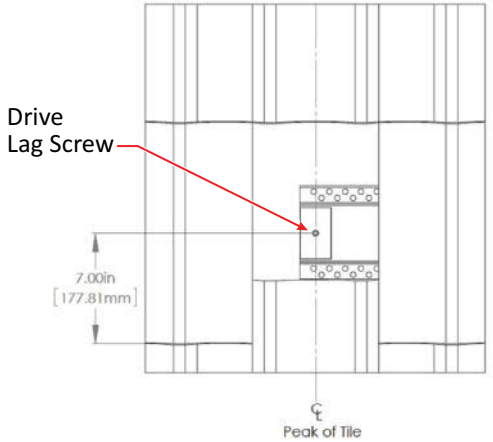
Remove the tile at rafter location nearest to desired mounting location. Locate the rafter and place the tile base on the roof deck.

Depending on rafter location relative to desired mounting point, east west orientation of tile base may need to be adjusted.




### 2b. Predrill Lag Screw Holes

Find intersection of each selected rafter and marked row. Predrill 3/16” hole through the roof sheathing and into the roof structural member.



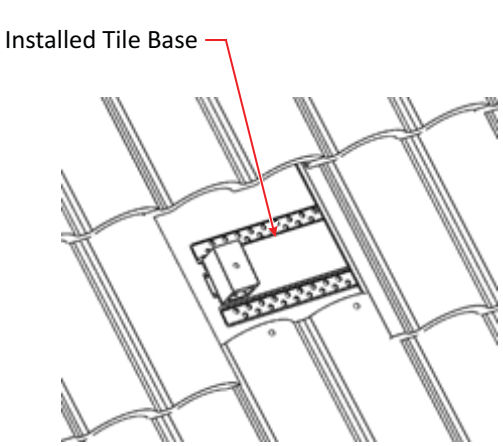

### 2c. Install Tile Base

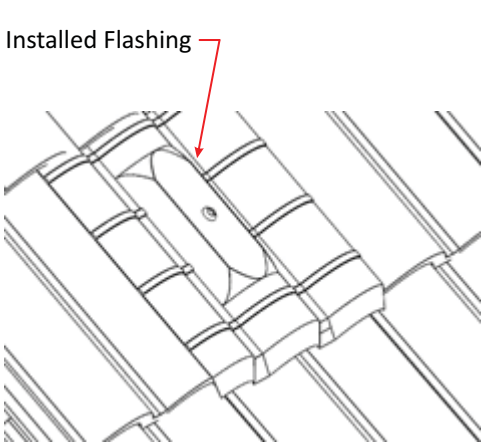
Find predrilled holes from previous step. Locate the Tile Base by sliding it underneath the adjacent tile. Using ½” Hex Driver, drive Lag Screws through the Washers and the tile base and into the predrilled hole in the roof structural member.

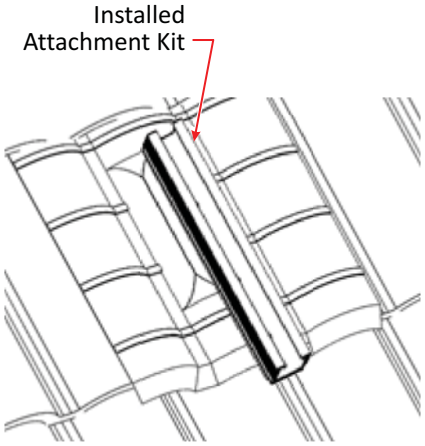
To provide an additional layer of waterproofing, fill the predrilled holes with caulk.

# Appendix B: Tile Roof Attachments - S Tile (cont.)

## B3. Install Tile Flashing and Attachment Kits




### 3a. Install Tile Flashing

With the tile base installed, tilt the tile flashing into place. To do this, it may be helpful to push the tile in the next course up slightly to allow the tile flashing to easily align with the base. Re-align adjacent tiles as necessary to create a watertight roof connection.

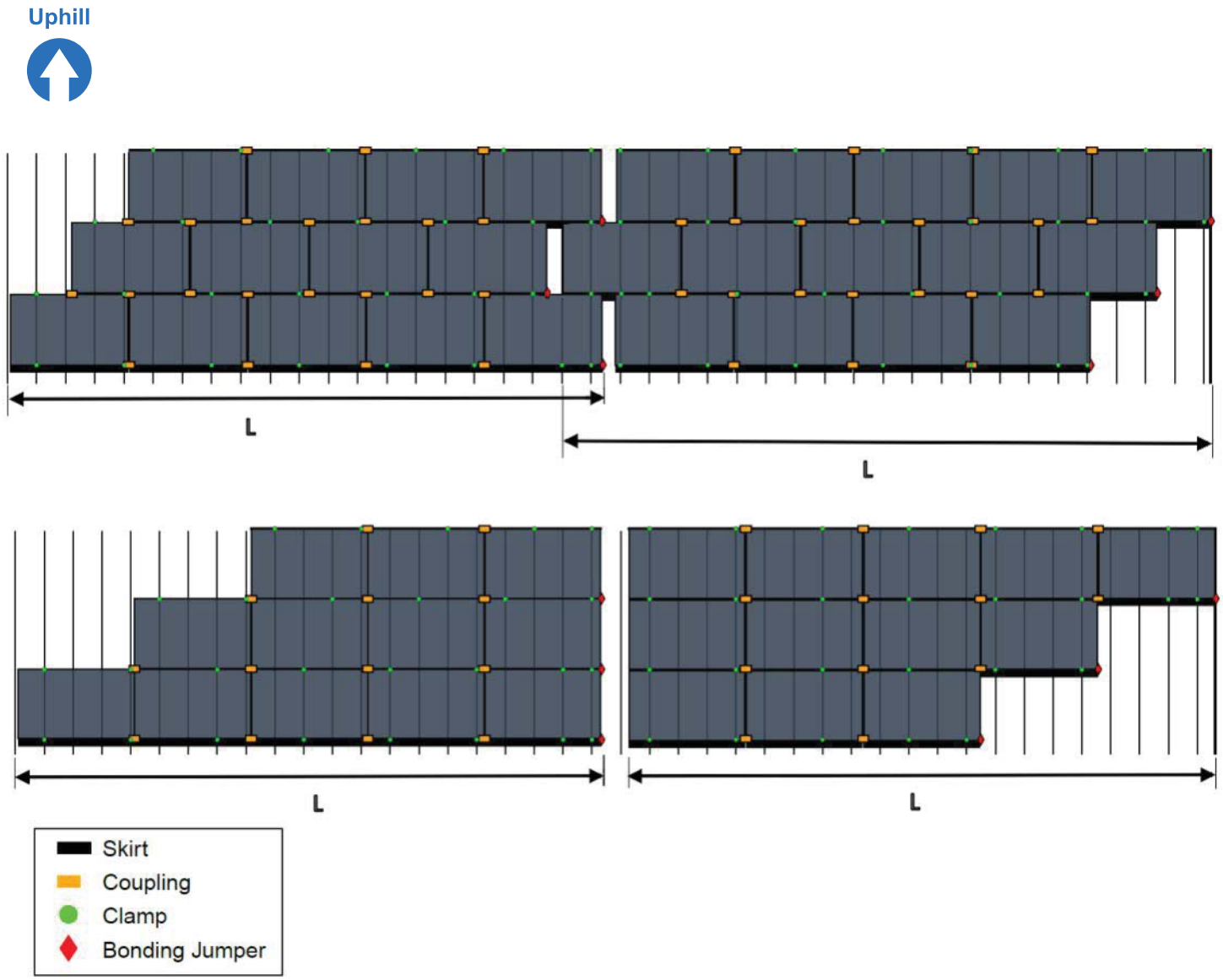
Please reference manufactures install guide for complete waterproofing instructions.

### 3b. Install Attachment Kits

Using the provided 5/16" – 18 hex head cap screw to attach the lower support to the tile base.

Continue with Step 2 in the general instructions.

# Appendix C: Thermal Expansion



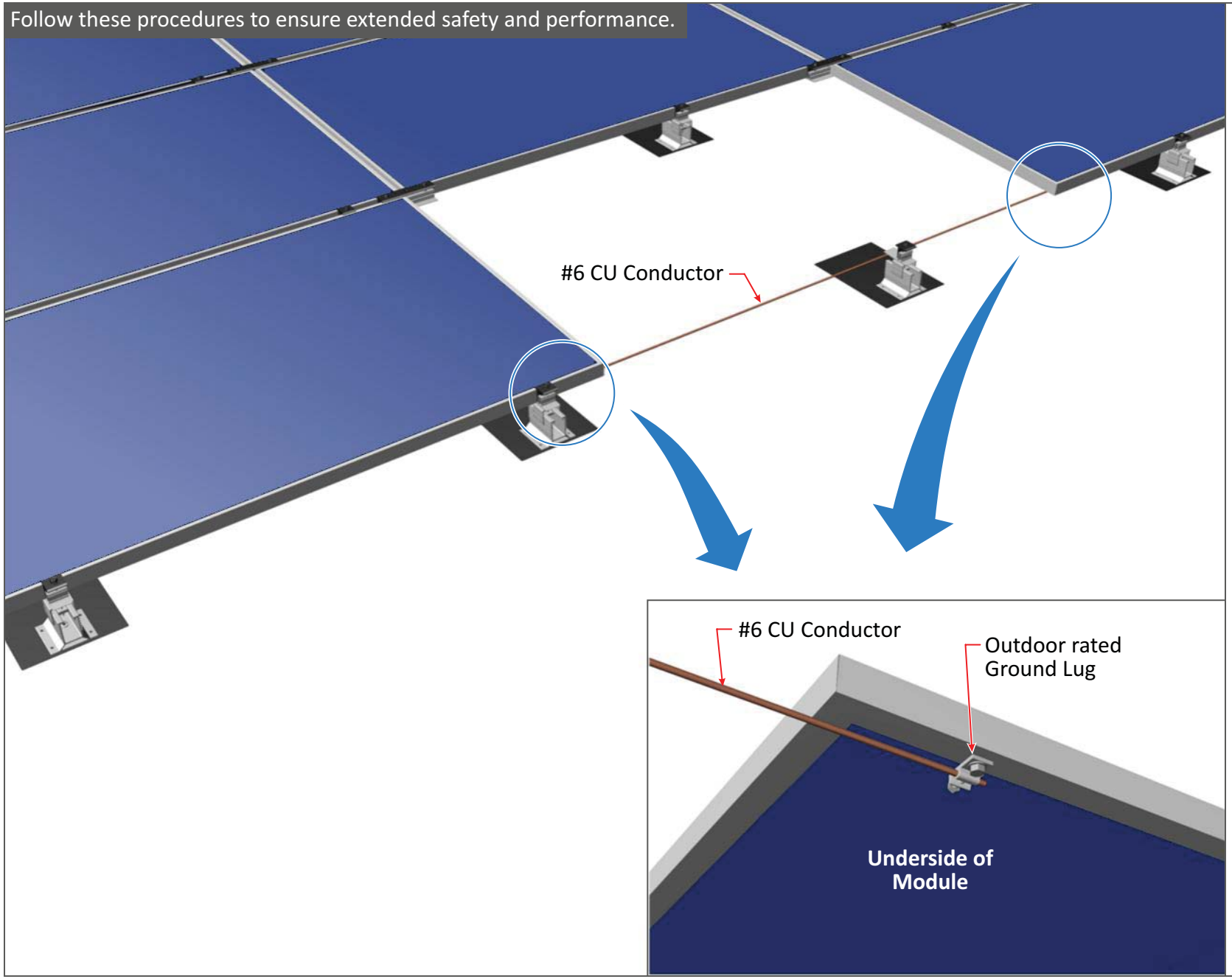

With natural ambient temperature fluctuations, thermal expansion and contraction can impact large arrays. To prevent excessive thermal movement in an array, thermal breaks should be installed for arrays longer than 35 ft.

If the total left/right dimension of an array exceeds 35 ft., break array as shown to accommodate thermal expansion and contraction. Ensure each sub-array's left/right length “L” do not exceed 35 ft. Add Clamps as necessary to support PV modules on each side of the thermal break without exceeding the allowable cantilever specified in the project specific engineering calculations. The lefft/right gap between sub-arrays should be set to a minimum of ½”. Note that the gap shown at left is much greater than ½” for demonstration purposes.

Use a bonding jumper to bond the two sub-arrays together. Alternatively, connect a separate EGC (Equipment Grounding Connector) to a single point on each sub-array.

# Appendix D: Service and Maintenance

Follow these procedures to ensure extended safety and performance.




Ecolibrium recommends periodic re-inspection of the installation for loose components, loose fasteners, and any corrosion, such that if found, the affected components are to be immediately replaced.

If module removal is required, it is the installers responsibility to ensure the ground path is maintained when the module is removed. One of two bonding options may be utilized:

**Option 1** (for use on a single row array):

A. Install a ground lug on adjacent modules. Install a WEEB Lug 6.7 or other outdoor rated ground lug (by others) on both of the modules adjacent to the module to be removed. Utilize the grounding hole on the frame of the module.

B. Connect a Bonding Jumper.
Lay a bare #6 CU conductor (by others) into the two lay in lugs connected to the adjacent modules.

**Option 2** (for use on a multiple row array):

Install a row to row bonding on either end of the row.

# Appendix E: UL 2703 System Approval

EcoX is rated to be installed with 60-cell Modules according to the approval list

| Manufacturer | Module Series | Max. Downforce | Max. Uplift | Max. Downslope |
|---|---|---|---|---|
| **Canadian Solar** | CS6P-XXX | 40 psf | 40 psf | 23.3 psf |
| **Hyundai** | HiS-XXXXMG<br>HiS-XXXXRG<br>HiS-XXXXRW | 40 psf | 40 psf | 23.3 psf |
| **Jinko** | JKMXXXM-60<br>JKMXXXMM-60<br>JKMXXXP-60<br>JKMXXXPP-60<br>JKMSXXXP-60 | 40 psf | 40 psf | 23.3 psf |
| **LG Electronics** | LGXXXN1C-X3<br>LGXXXS1K-X3<br>LGXXXS1C-X3<br>LGXXXA1C-X3 | 30 psf | 30 psf | 23.3 psf |
| **Q-Cells** | Q.PLUS-G3<br>Q.PEAK-G3<br>Q.PRO-G4 | 40 psf | 40 psf | 23.3 psf |
| **SolarWorld** | SW XXX | 40 psf | 40 psf | 23.3 psf |
| **SunEdison** | F2XXXXX-XX | 40 psf | 40 psf | 23.3 psf |
| **Trina** | TSM-PX05.XX | 40 psf | 40 psf | 23.3 psf |
| **Yingli** | YL2XXP-29b<br>YL2XXC-30b | 40 psf | 40 psf | 23.3 psf |