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## EcoX Universal Product Overview

EcoX Universal takes the No. 1 Leading Universal Rail-less Racking System to the next level of simplicity, with universal clamps, couplings, and skirts that fit any PV module thickness.

By eliminating the mounting rail and offering simple, universal components, organized wire management, and optional accessories to meet the needs of each solar installation, EcoX Universal offers a flexible system layout and a streamlined installation process.

EcoX Universal utilizes aluminum components with stainless steel hardware, ensuring the system will withstand harsh installation environments. With EcoX Universal, the racking and modules work together as a system, creating an interconnected, continuously bonded structure.

It's easy to see why EcoX Rail-less Racking System is the No. 1 Universal Rail-less Racking System according to analysis by the research and advisory firm GTM Research.

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 Universal!

## 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 Bonding Clip may have sharp edges
- 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.

**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 )
- Membrane roof

Metal roofs are permitted as long as the method of bonding and grounding the metal roof is approved by AHJ. Contact Ecolibrium Solar if your project's roof surface type is metal, or not listed above.

**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 roof surfaces between 0 and 90 degrees from horizontal.

**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.

## 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 D 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 D. 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 UL2703/1703 Fire Resistance Standard with the following requirements:

- Instructions in this 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.
- 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).

For pitches greater than 2:12 (9.46 degrees):

- EcoX is certified to Class A with Type 1 and 2 modules.
- Junction box must be mounted away from the roof downhill edge.

For pitches less than 2:12 (9.46 degrees), aka “flat” or “low-slope” roofs:

- EcoX is certified to Class A with Type 1 modules.
- Junction box can be mounted at any location.

**Grounding and Bonding:** EcoX is certified to UL 2703 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. There are no specific array size limitations due to the flexible and expandable design of EcoX Universal.

**UL2703 System Documentation:** To document UL 2703 system rating, a label is factory-applied to the end of each skirt. For Skirt-Free configurations, apply one UL 2703 label on each sub-array. Follow the instructions included along with UL 2703 labels in every box of End Couplings. Below is an example of the label:



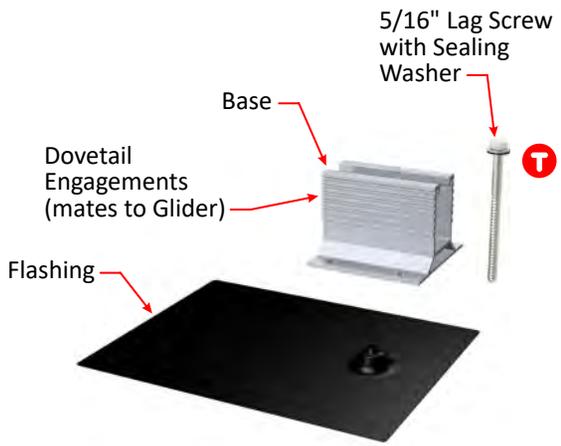
The Date Code **ABCYZZ** shown above will appear on production parts, letters defined as follows:  
**ABC** shall be an acronym for identifying the source factory.  
**Y** shall be the Quarter of the year (i.e. 1, 2, 3, 4) of manufacture.  
**ZZ** shall be the last 2 digits of the year of manufacture.

## Revision History - Install Guide

Revision	Description of Changes	Date
1.0	Initial Release	2017-October-10
1.1	Updated Appendix D	2017-November-29
1.2	Updated Appendix D	2018-January-24
1.3	Updated Appendix D	2018-April-12
1.4	Added Modules to Appendix D	2018-July-18
1.5	Update UL 2703 PTL Certification Label Add note in General Application Notes and Appendix F for installer to apply label on Skirt- Free configurations.  Added SunPower and Panasonic Modules to Appendix D	2020-January-24

# EcoX Universal Components

### Attachment Kit



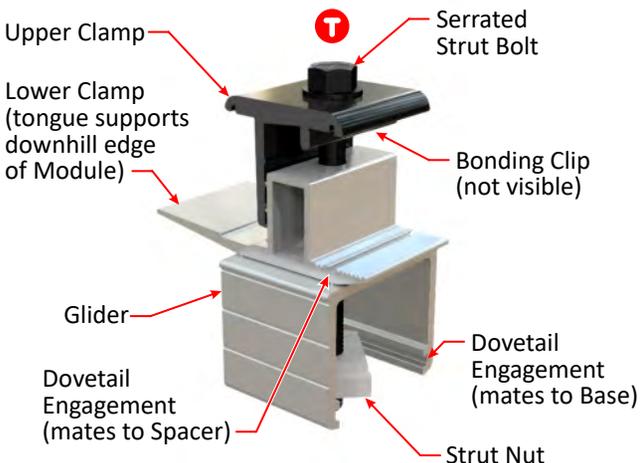
The Attachment Kit is secured to the roof and supports the array via the Clamp Assembly.

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.
- Lag Screw includes a factory pre-installed Sealing Washer.

**T Torque Spec: 14 ft-lbs**

### Clamp Assembly

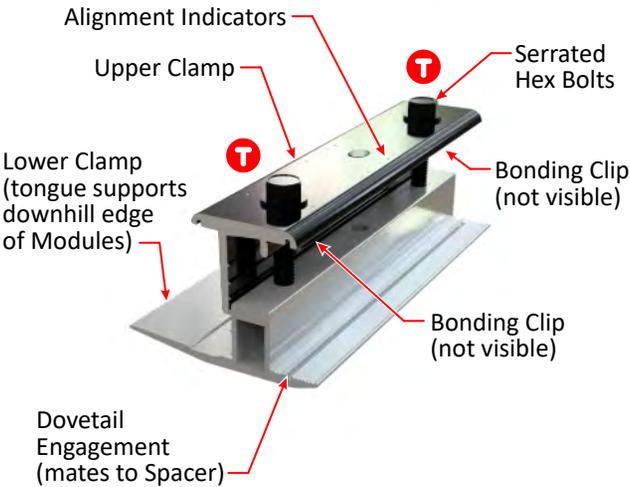


The Clamp Assembly is mounted to the Base of the Attachment Kit.

- Upper and Lower Clamp secure edges of Modules
- Upper and Lower Clamp engage Skirt on Skirt row.
- On the first downhill row, Clamps secure module-specific Spacer to position Skirt.
- 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.

**T Torque Spec: 14 ft-lbs**

### Coupling Assembly

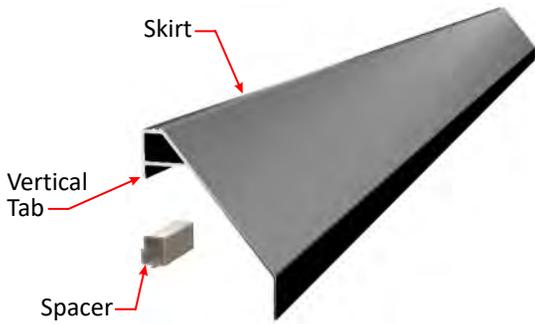


Couplings connect up to four Modules together.

- Couplings include indicator marks to set a 1/2" gap between Modules.
- On the first downhill row, Couplings and module-specific Spacers secure Skirts at their joint, while positioning the Skirt to accommodate module frame thickness.
- Factory installed Bond Clips (two per Coupling) bond Modules left and right.

**T Torque Spec: 14 ft-lbs**

### Skirts & Spacers



Skirts are used on the first downhill row to enhance the appearance along the edge of the array. Spacers (one per Clamp, two per Coupling) position Skirt to accommodate module frame thickness. Spacers are available in six Module thicknesses ranging from 32mm through 46mm.

- Vertical Tab Engages Spacers securing Skirt to Clamp Assemblies and Couplings.
- Skirts are factory cut to length to match specific Modules.

**i See Appendix G for skirt-less installation details.**

## EcoX Components (cont.)

### Power Accessory Bracket



Power Accessory Bracket mounts a micro-inverter or power optimizer to the Module.

- The serrated teeth ensure a secure connection to the module.
- The Power Accessory Bracket bonds the micro inverter or power optimizer to the Module.

**T** Torque Spec: 14 ft-lbs

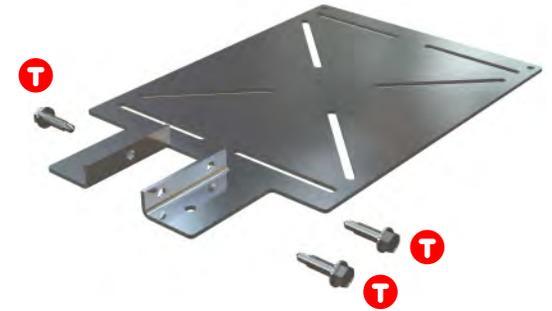
### Row to Row Bonding Clip



The Row to Row Bonding Clip bonds each row of modules to the next.

- Bonding Clip is added to the uphill side of one clamp per row.
- For systems using the skirt, Bonding Clip bonds skirt to first row of Modules.

### Junction Box Bracket

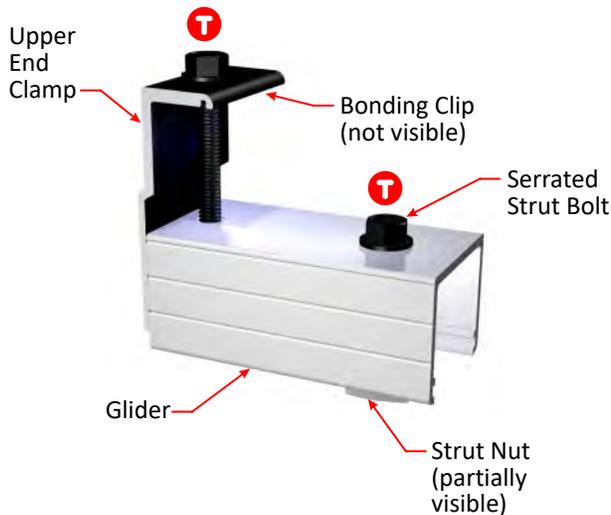


The Junction Box Bracket mounts to the Base, and acts as a support for a Junction Box.

- Can be installed to any base.
- Can be installed before or after modules are installed.

**T** Torque Spec: 10 ft-lbs

### End Clamp

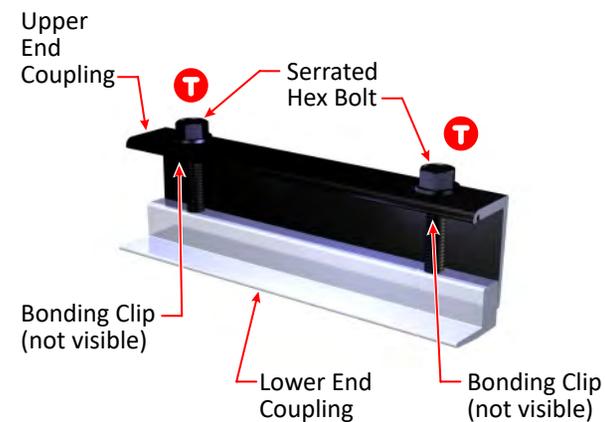


The End Clamp is mounted to the base on the downhill row, and may be used in place of the Skirt for a Skirt-Free installation.

- Dovetail Engagement to base for height and uphill/downhill adjustment.
- Upper End Clamp secures module.
- Integrated bonding clip bonds module to clamp and Attachment Kit.

**T** Torque Spec: 14 ft-lbs

### End Coupling

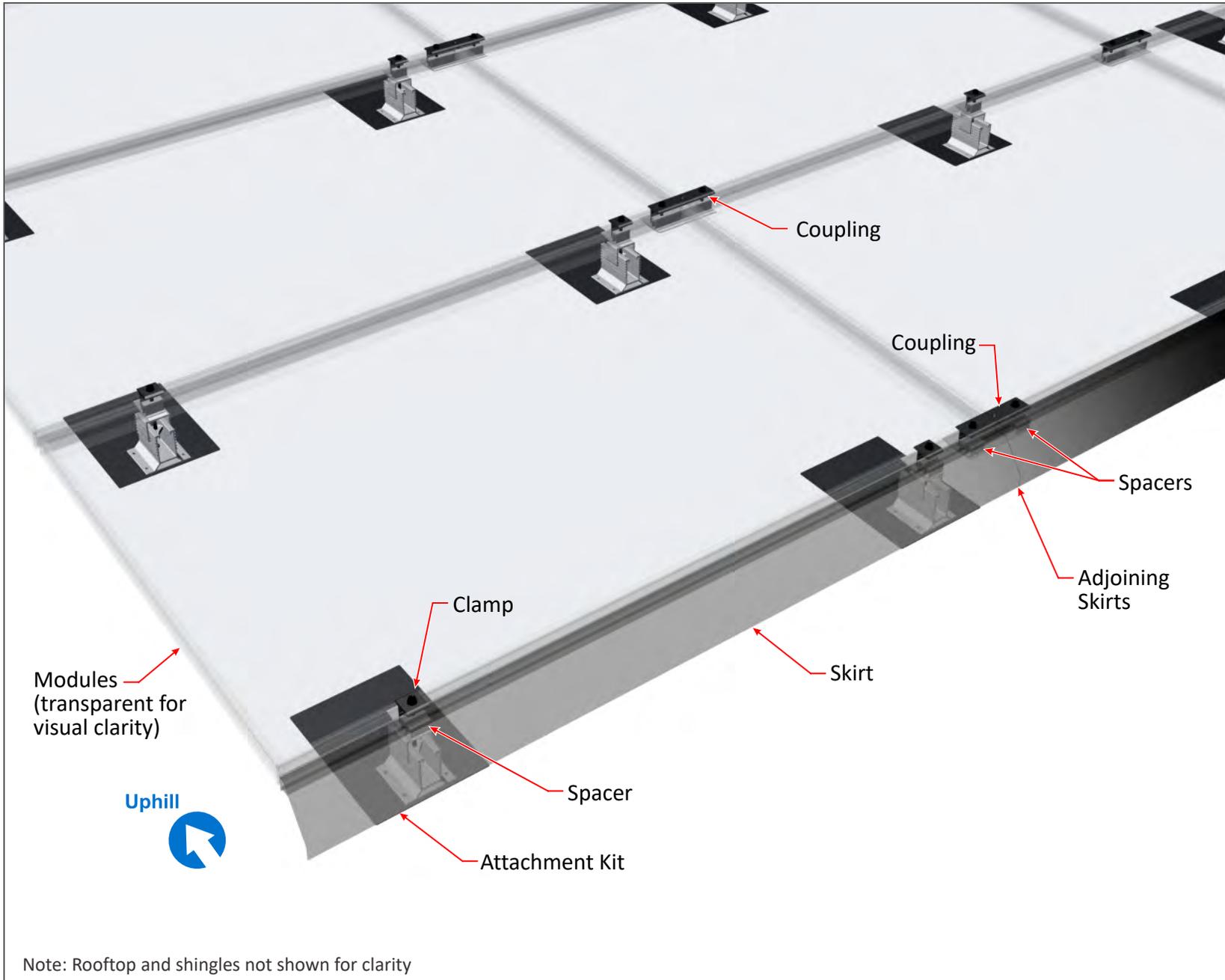


End Coupling connects two modules left to right.

- End Couplings include indicator marks to set a 1/2" gap between Modules.
- Factory installed Bonding Clips (two per End Coupling) bond modules left to right.

**T** Torque Spec: 14 ft-lbs

# Overview of Components



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

**Installation steps:**

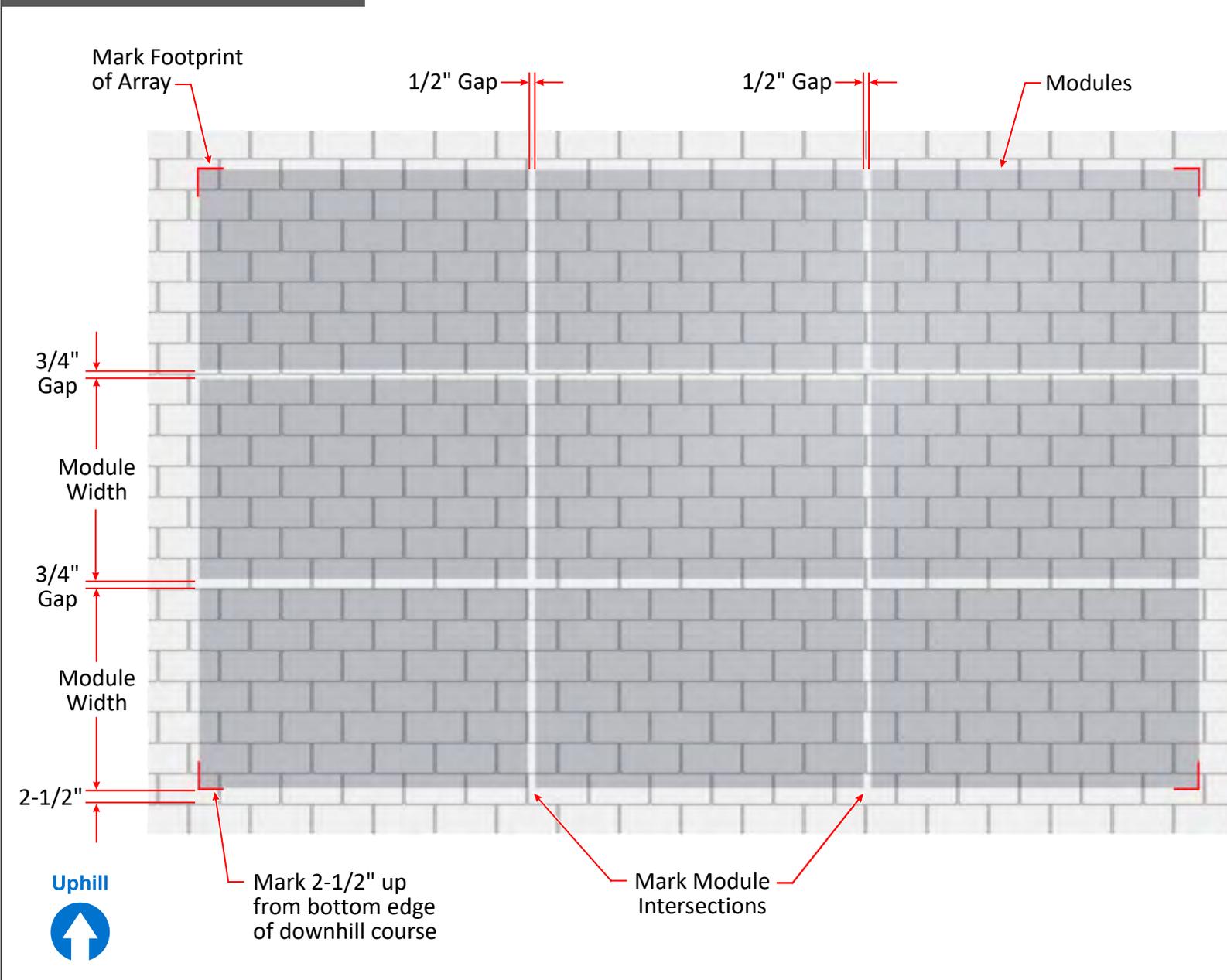
1. Layout Array on rooftop.
2. Install Attachment Kits to rooftop.
3. Install Junction Box Bracket.
4. Install Clamp Assemblies and Spacers on downhill row.
5. Install Spacers and Skirts on Clamps in first downhill row.
6. Install Couplings and Spacers to Skirts.
7. Install Modules.
8. Install Clamps 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.

- Starting from the downhill edge, place a mark 2-1/2" up from the bottom edge of the downhill course of shingles.
- 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.

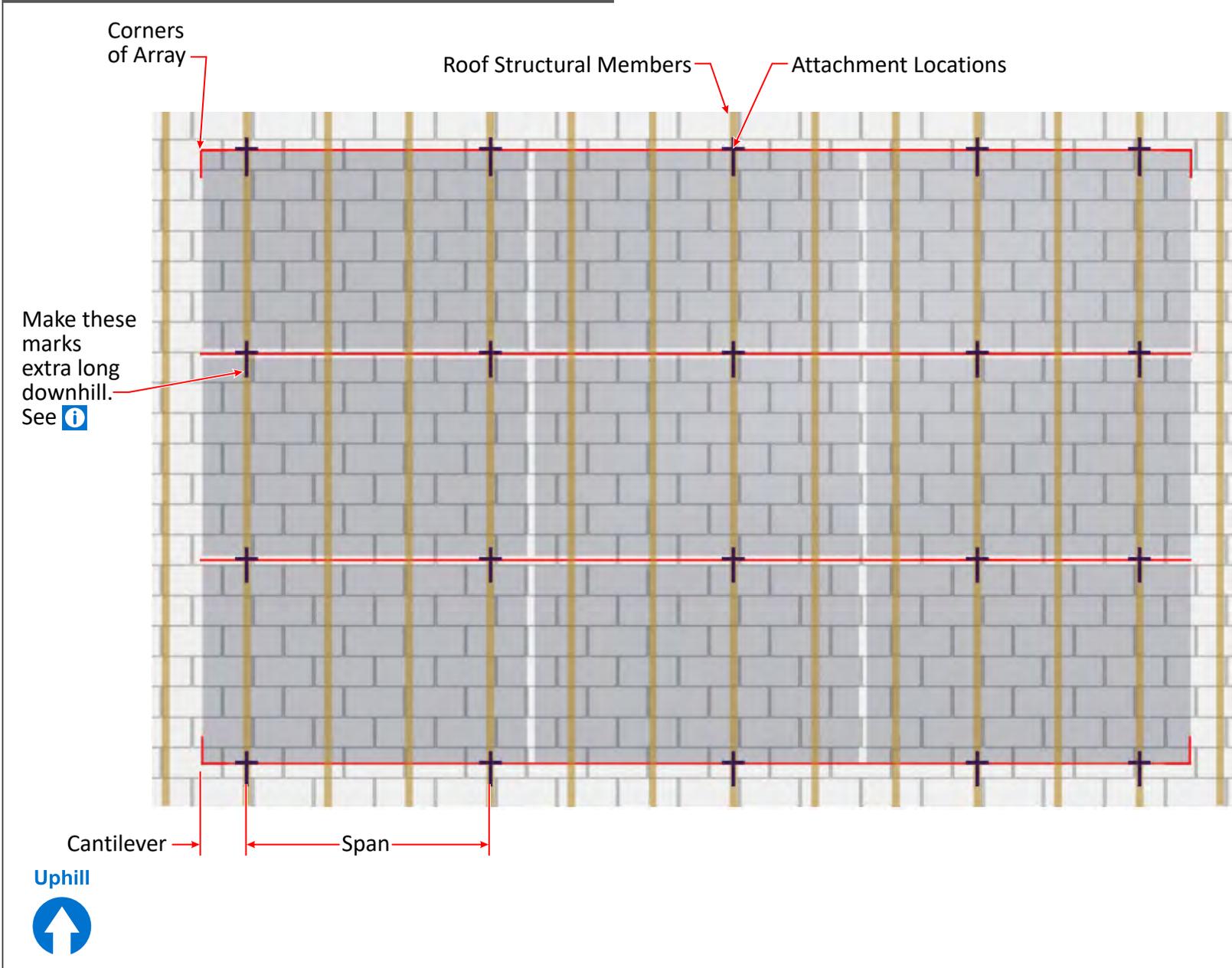
The following page continues this layout and illustrates a finished rooftop layout.

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

**i** Most AHJ's require a roof setback per their local fire code requirements. Make sure that the required setback is observed when marking the footprint of the array.

# 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.

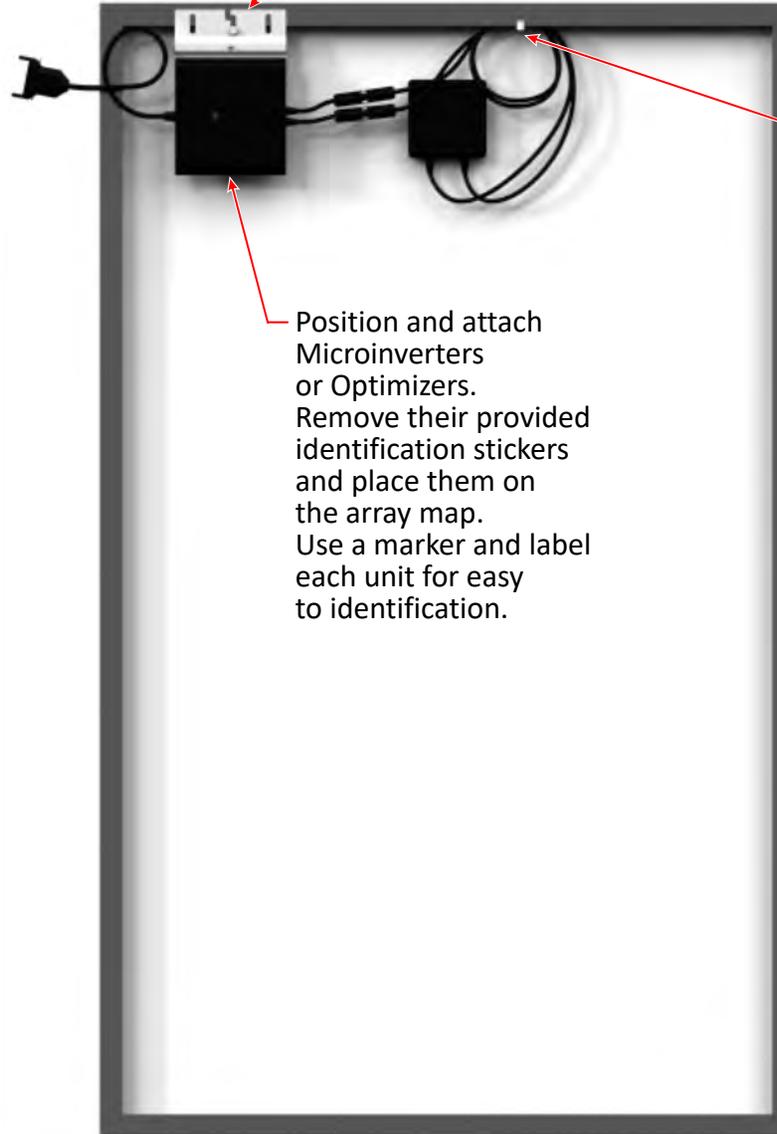
**i** When marking the attachment locations, make the downhill leg of the mark long enough to be visible from the downhill edge of the Flashing when the Flashing is in its installed position. This mark will accelerate the Flashing installation by quick alignment of the Flashing to the mark.

## 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.

Use the EcoX Power Accessory Bracket to attach Microinverters or Optimizers. See Appendix E for installation details.



Position and attach Microinverters or Optimizers. Remove their provided identification stickers and place them on the array map. Use a marker and label each unit for easy to identification.

Use wire management Clips to arrange wiring and keep away from roof top, and/or interfering with Clamps or Couplings.

**i** 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.

**i** The maximum OCP rating is 20A when using an Enphase micro-inverter for grounding.

### 3. The Basics on Wire Management

#### 3a. Suggested Routing and use of Clips

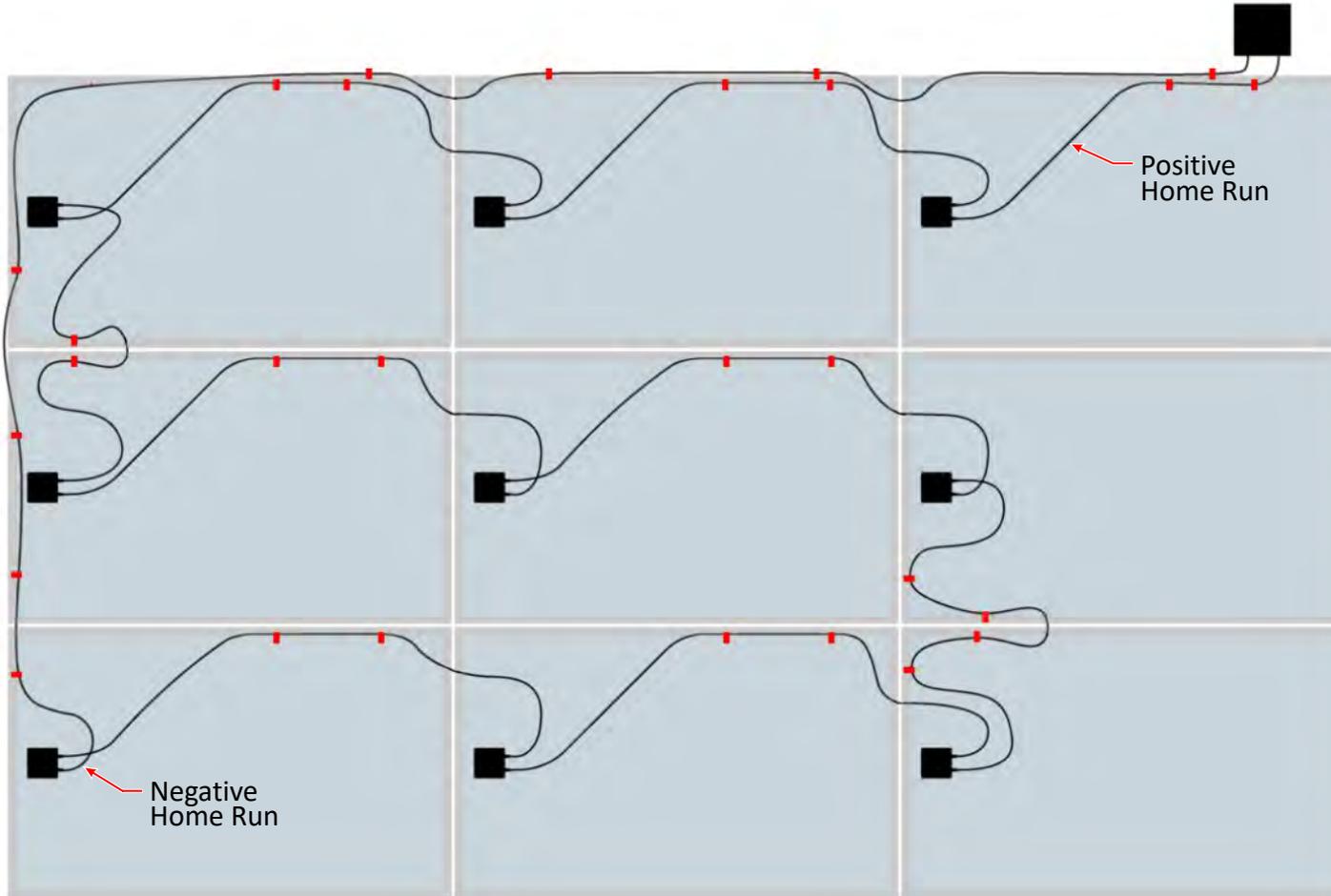
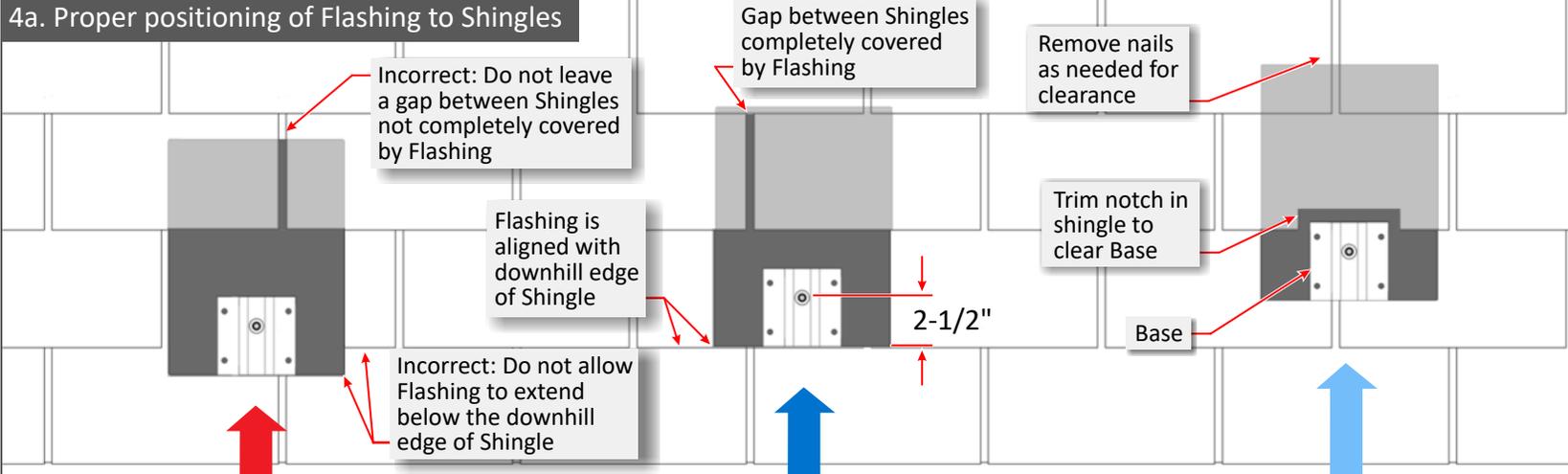


Image shows an example wire layout to illustrate typical wire management.

## 4. Install Attachments to Roof

### 4a. Proper positioning of Flashing to Shingles



**Positioned Incorrectly**

- Incorrect: Do not leave a gap between Shingles not completely covered by Flashing
- Flashing is aligned with downhill edge of Shingle
- Incorrect: Do not allow Flashing to extend below the downhill edge of Shingle

**Positioned Correctly**

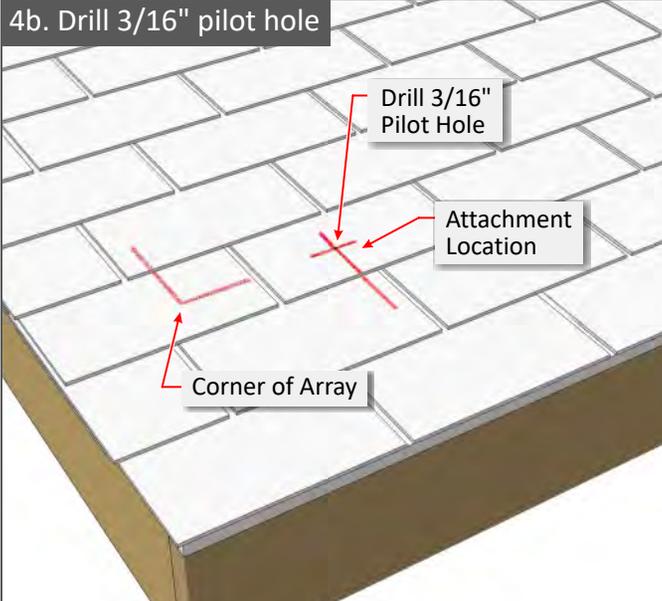
- Gap between Shingles completely covered by Flashing
- 2-1/2"

**Acceptable Position (when necessary)**

- Remove nails as needed for clearance
- Trim notch in shingle to clear Base
- Base

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

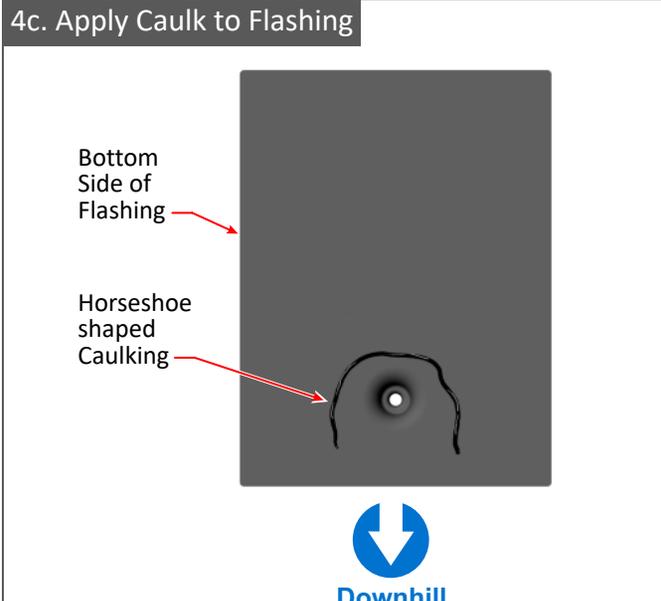


- Drill 3/16" Pilot Hole
- Attachment Location
- Corner of Array

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

- i** Prior to installing Flashing, apply caulk in hole as an added sealant against moisture.
- i** Seal any holes that missed a rafter.

### 4c. Apply Caulk to Flashing



- Bottom Side of Flashing
- Horseshoe shaped Caulking

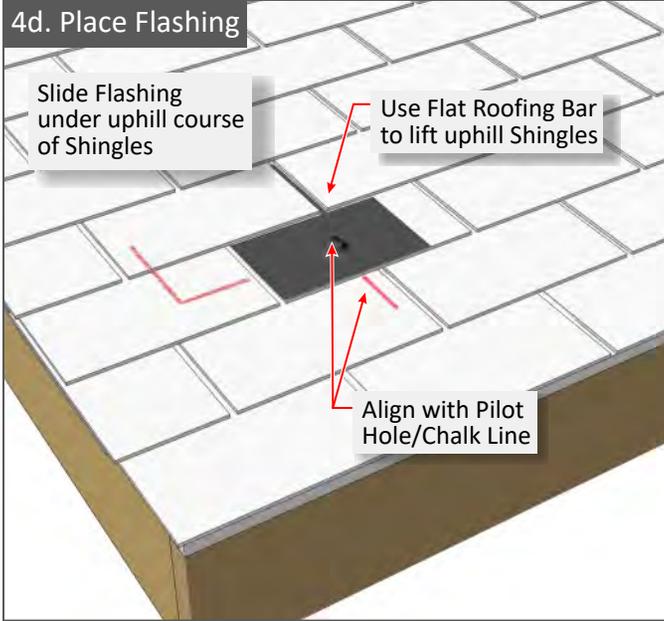
Downhill

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.

- i** Use roof compliant sealant.

## 4. Install Attachments onto Roof (cont.)

### 4d. Place Flashing



Slide Flashing under uphill course of Shingles

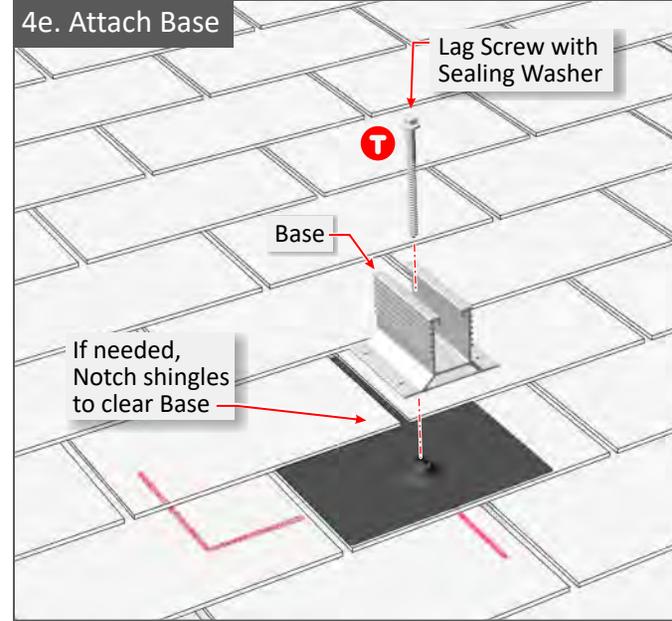
Use Flat Roofing Bar to lift uphill Shingles

Align with Pilot Hole/Chalk Line

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



Lag Screw with Sealing Washer

Base

If needed, Notch shingles to clear 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 to ensure seal.**

**T** Torque to: 14 ft-lbs

### Base Positioning - Skirt Row vs other Rows



Uphill

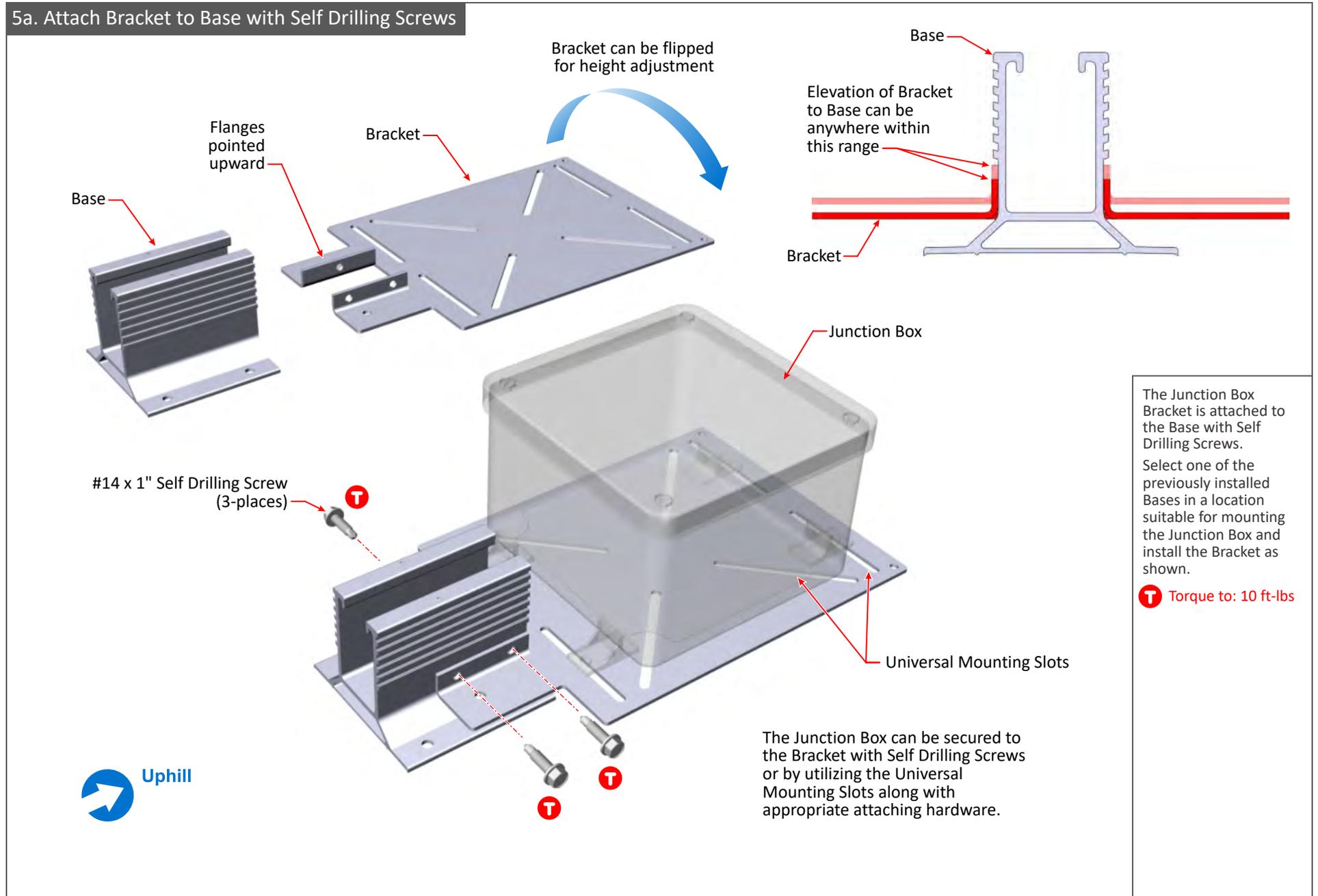
Base can be rotated 360 degrees to allow adjustability of Clamp position. Rotates around its offset mounting hole.

**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.

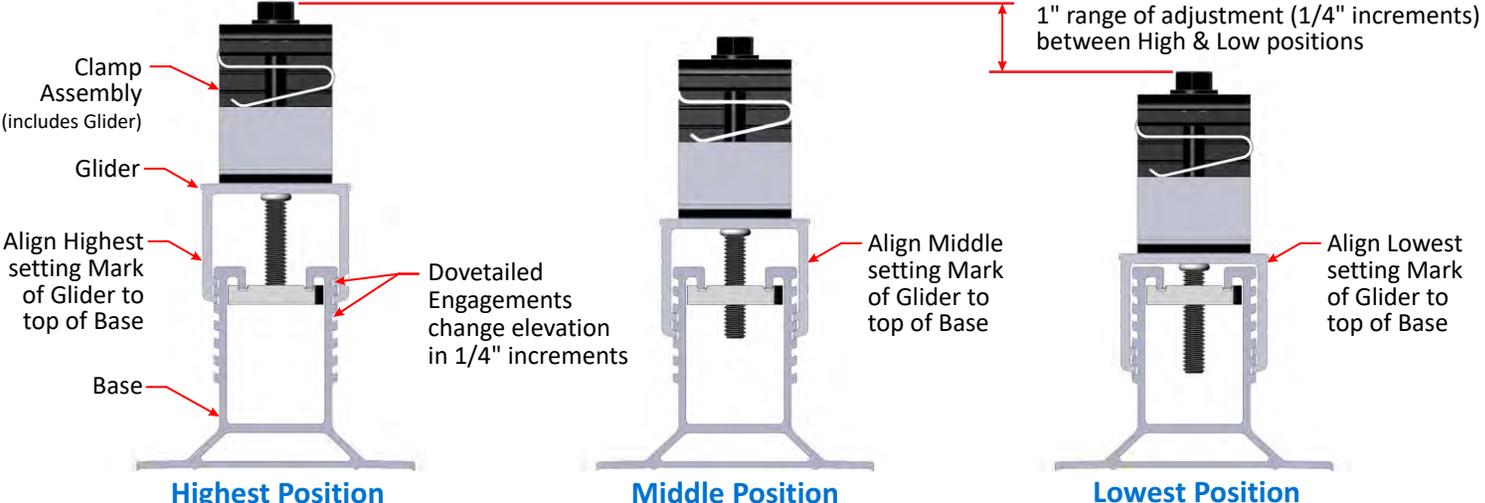
## 5. Install the Junction Box Bracket

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



## 6. Install the Clamp Assemblies (if installing Skirt-Less version skip to Appendix F)

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



1" range of adjustment (1/4" increments) between High & Low positions

Clamp Assembly (includes Glider)

Glider

Align Highest setting Mark of Glider to top of Base

Dovetailed Engagements change elevation in 1/4" increments

Align Middle setting Mark of Glider to top of Base

Align Lowest setting Mark of Glider to top of Base

Base

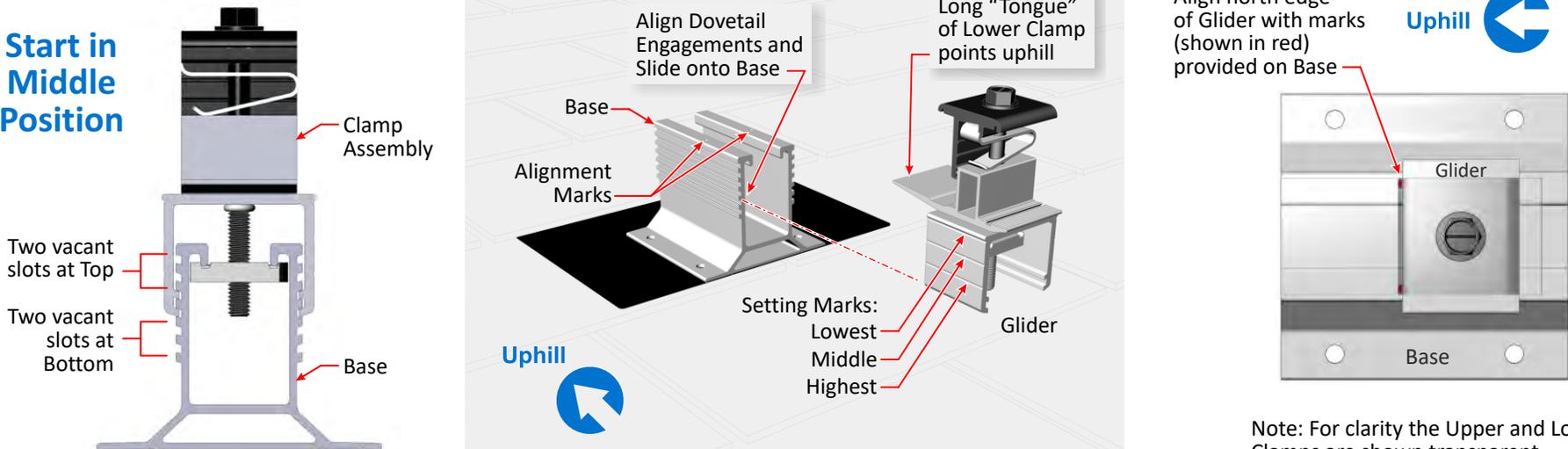
**Highest Position**

**Middle Position**  
(start here)

**Lowest Position**

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



**Start in Middle Position**

Clamp Assembly

Two vacant slots at Top

Two vacant slots at Bottom

Base

Align Dovetail Engagements and Slide onto Base

Base

Alignment Marks

Long "Tongue" of Lower Clamp points uphill

Setting Marks:  
Lowest  
Middle  
Highest

Glider

Align north edge of Glider with marks (shown in red) provided on Base

Uphill

Glider

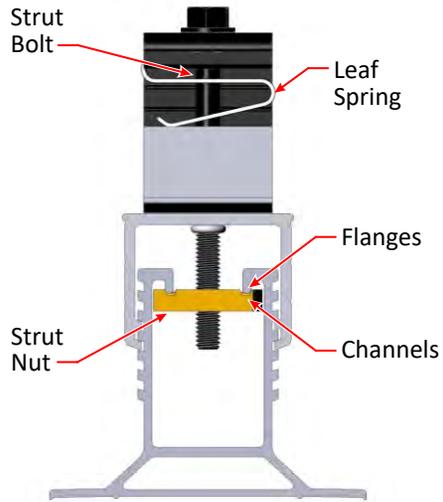
Base

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.



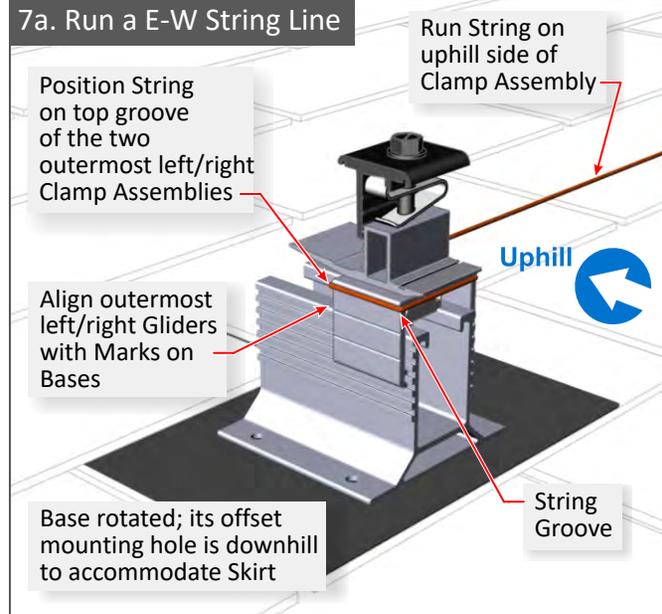
Use an impact driver to tighten the Strut Bolt and engage the Strut Nut channels with the two flanges of the Base. Leave the Clamp open to accept the Module. The Leaf Spring provides pressure to keep the Strut Nut engaged and in-position while the installation continues.

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



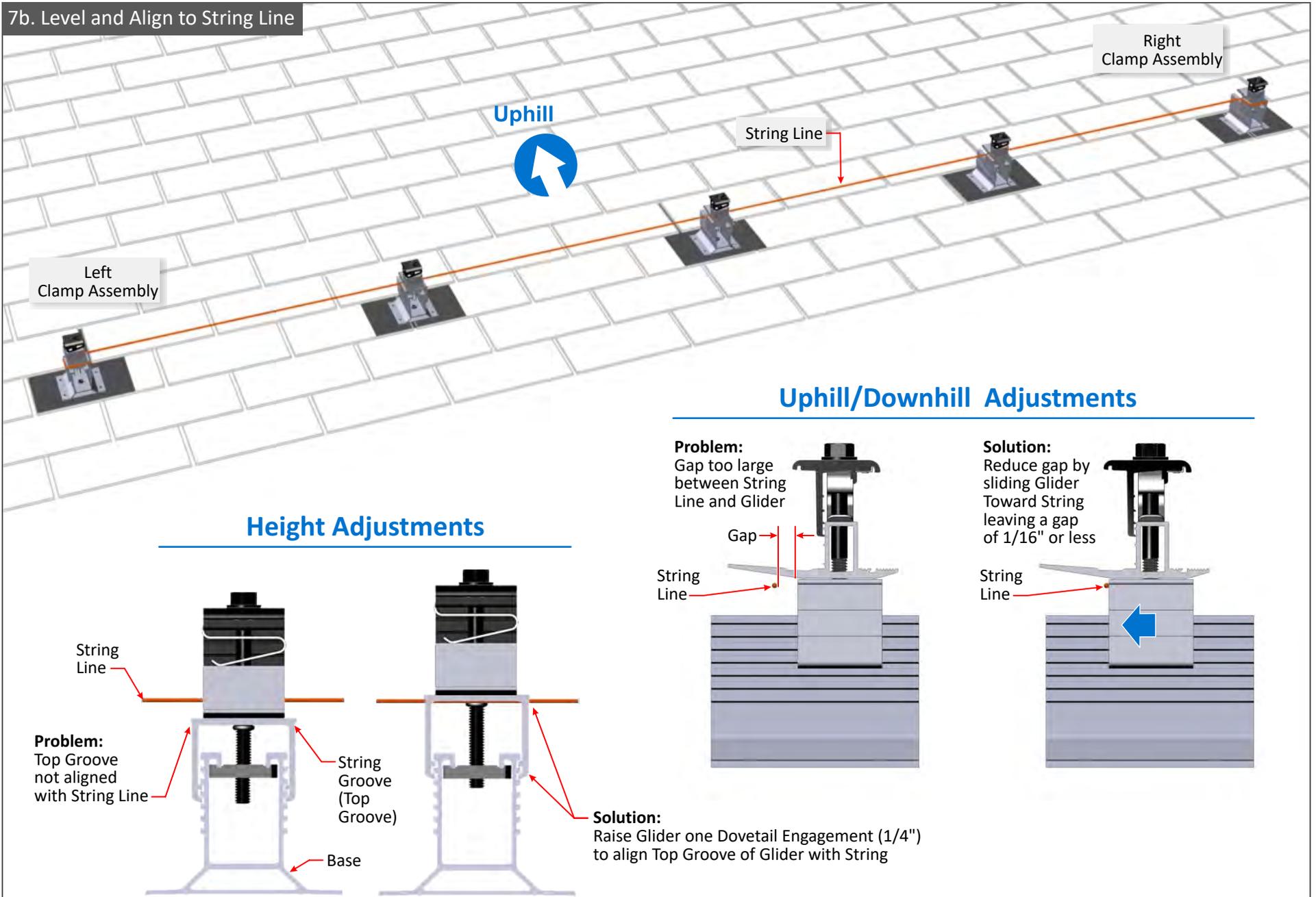
A String Line is used to level and align Clamp Assemblies on the first downhill row only.

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

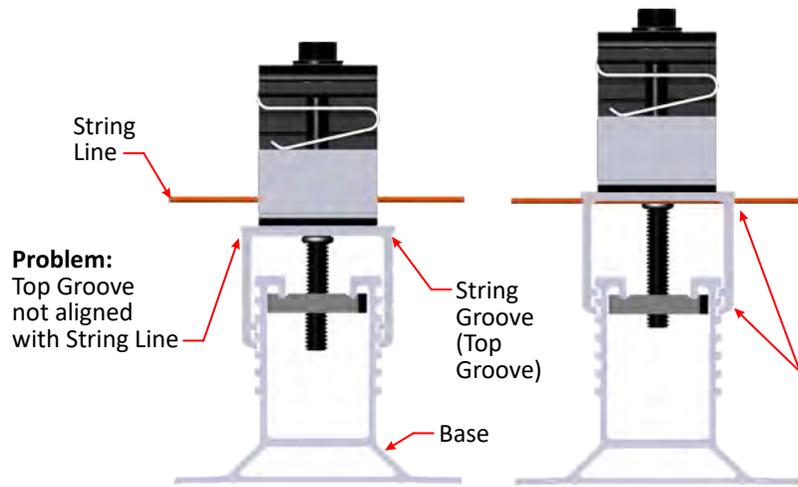
Run and secure the String Line between the two outermost left/right Clamp Assemblies. Place String on the top String Grooves, pulling it taught and securing its ends.

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

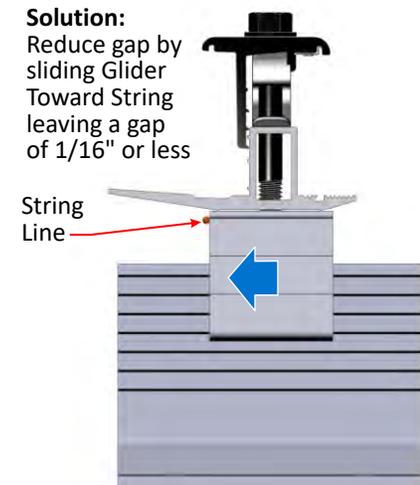
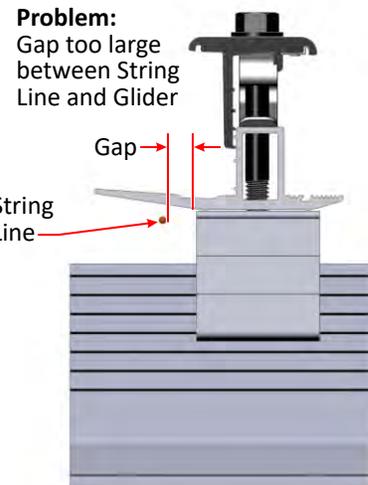
### 7b. Level and Align to String Line



### Height Adjustments



### Uphill/Downhill Adjustments

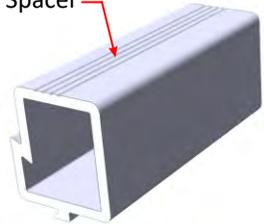


## 8. Install Skirts on Downhill Row

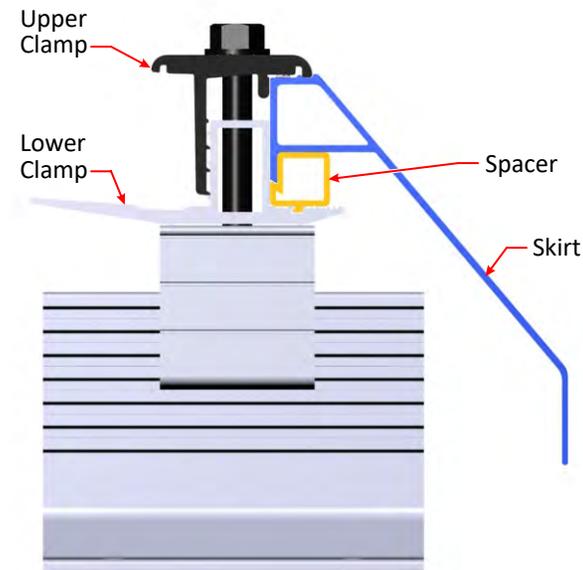
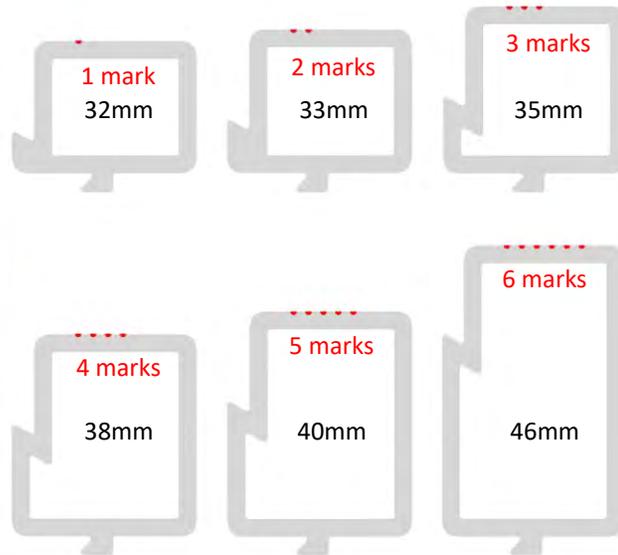
### 8a. Overview - Module Sizes, Spacers & Skirt

Use the Spacer that correlates to the Module thickness. Spacer size is indicated by the number of marks on its top surface.

Marks on Spacer



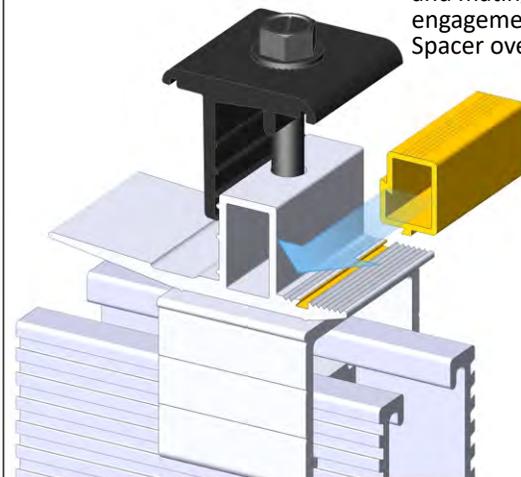
4 marks =  
38mm Module  
1-5/8" Thick



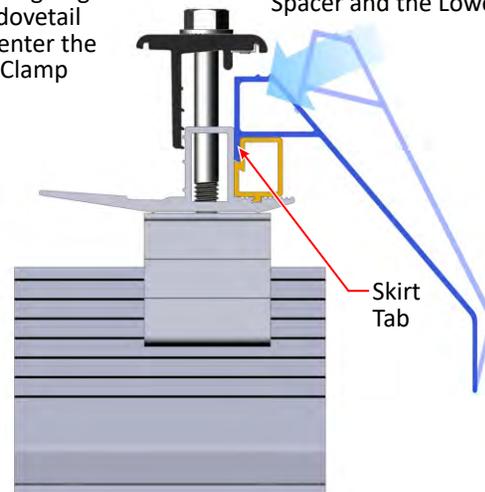
- Universal Skirts are installed along the first row, held in place by Clamps with a Spacer to set the position. Skirts are joined end-to-end by Couplings.
- One Universal Skirt is used with the range of Module thicknesses. Spacers are module-specific, with the correlating Module size shown by marks on the top of the Spacer.
- When the correct Spacer is installed with the Skirt, the Upper Clamp is positioned to match the Module thickness.

### 8b. Install the Spacers and Skirt

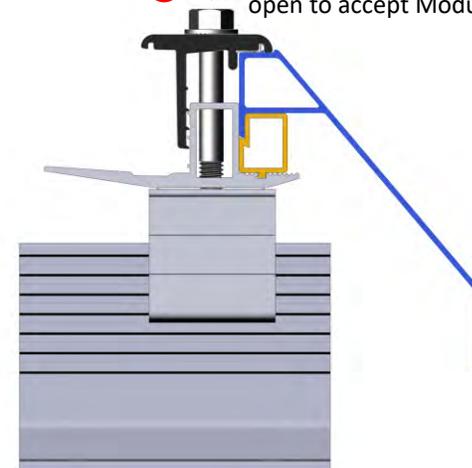
Install Spacer by aligning and mating the dovetail engagements. Center the Spacer over the Clamp



Tilt and roll the Skirt Tab into the slot between the Spacer and the Lower Clamp



Tighten Strut Bolts enough to hold Skirt in position - leave Clamps open to accept Modules

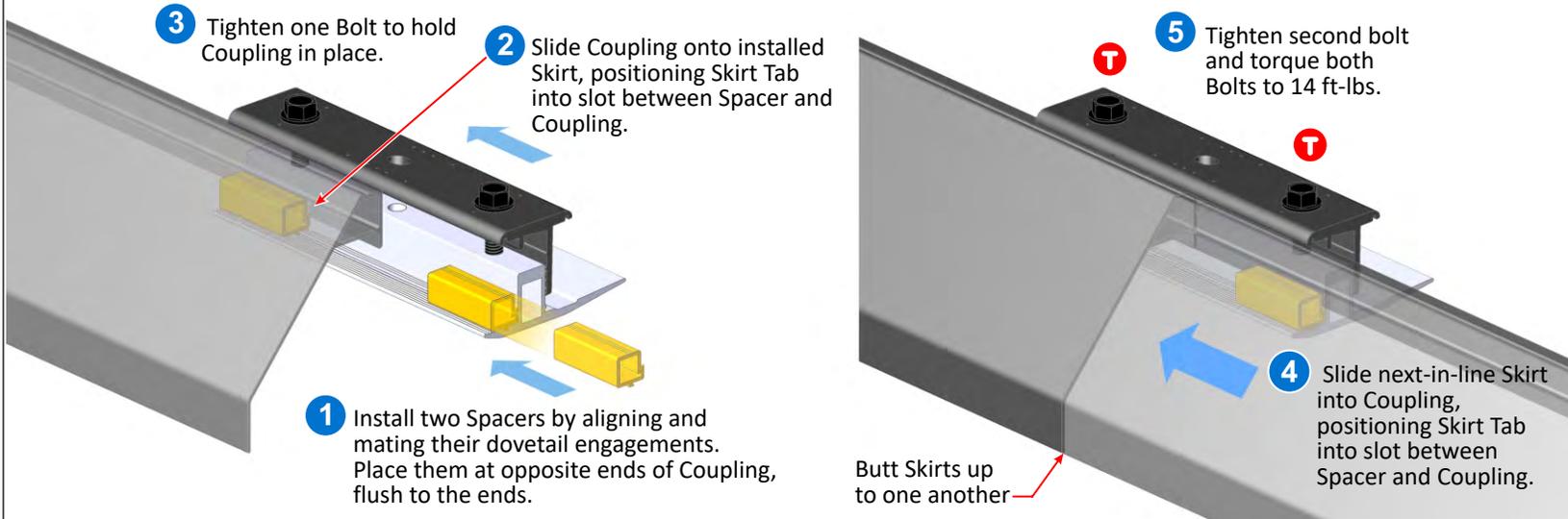


Align the left/right position of the Skirt with the outer edge of the array. Torque Clamps to 14 ft-lbs. Check to ensure north side of Clamp is positioned to accept Module.

**T** Torque to: 14 ft-lbs

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

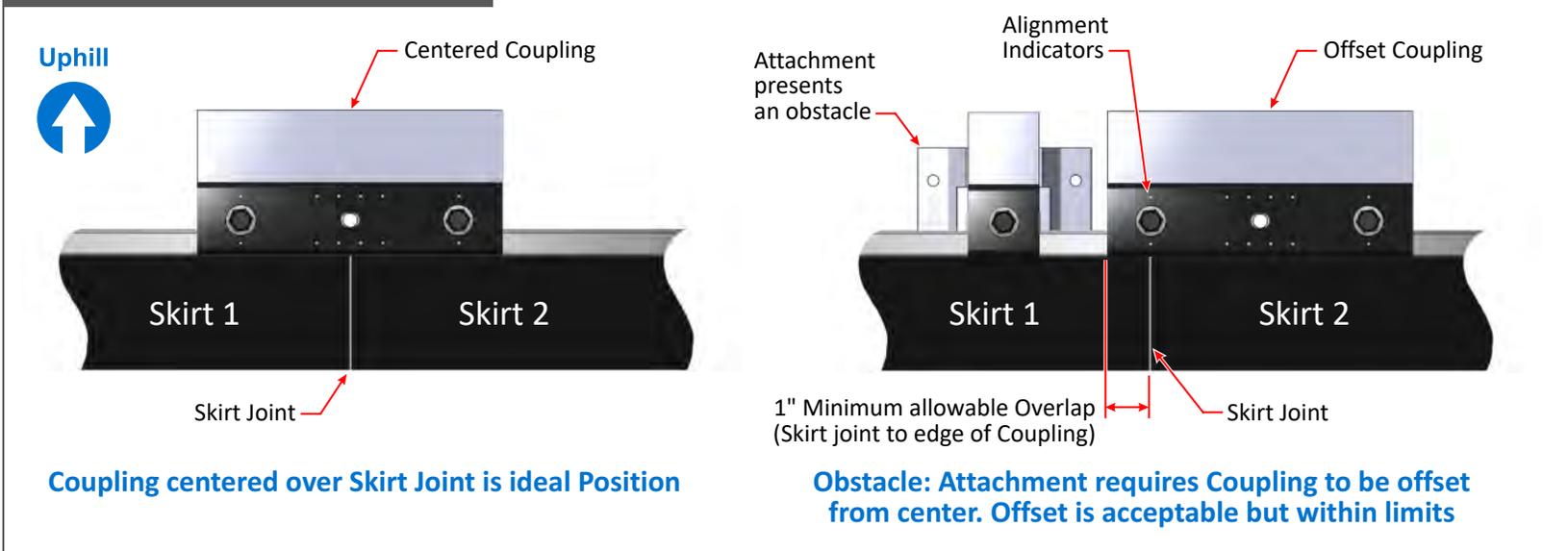
### 8c. Install Coupling and adjacent Skirt



As with Clamps, Couplings must be installed with appropriate Spacers - matching the specific Module thickness.

**T** Torque to: 14 ft-lbs

### 8d. Left/Right Positioning of Coupling



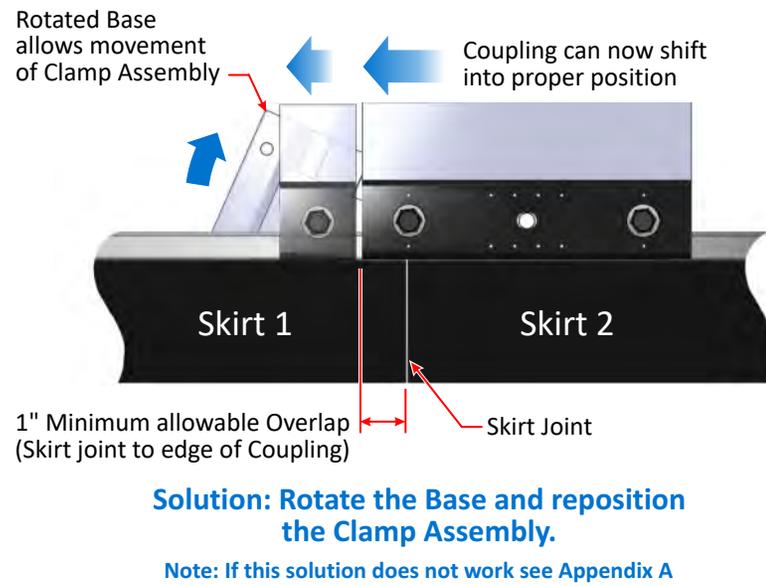
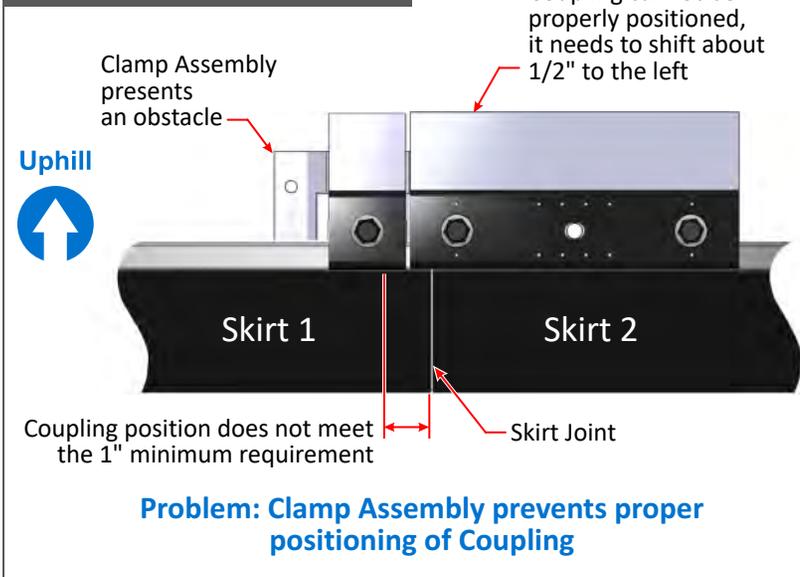
Left/Right positioning of Couplings is flexible. Couplings can be adjusted "off-center" of Skirt joint as needed to work around an Attachment or other roof obstacle.

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

**⚠** Do not offset Coupling less than 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.)

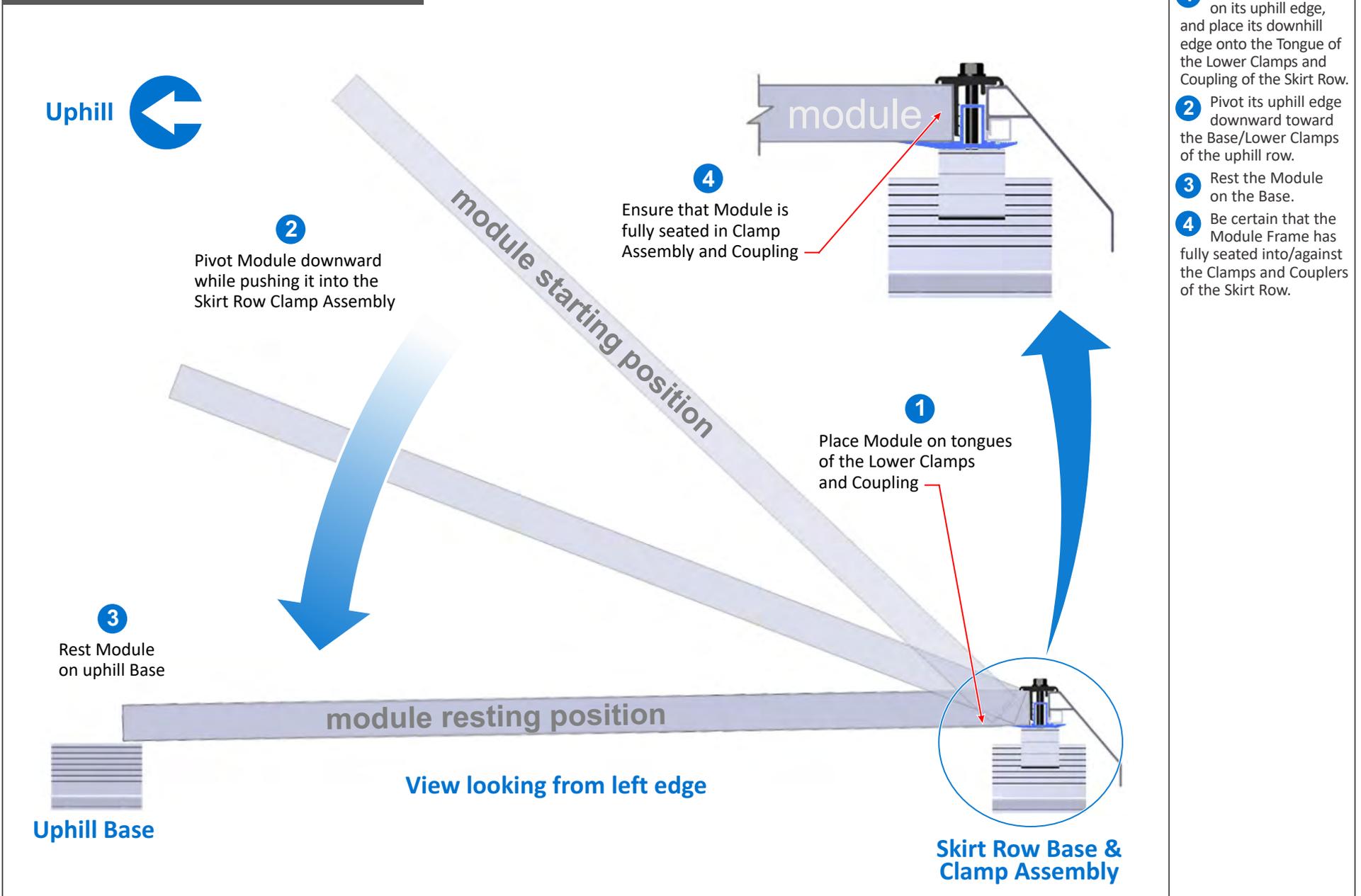
### 8e. Working around Obstacles



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



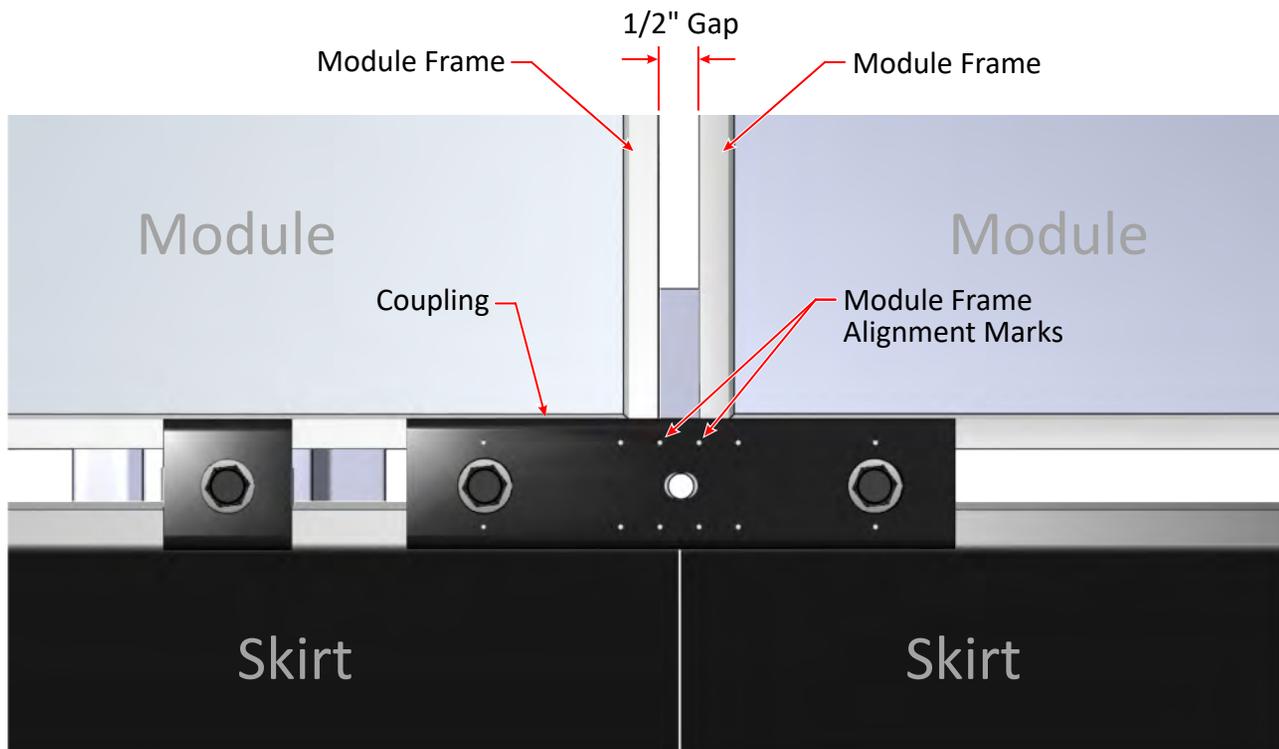
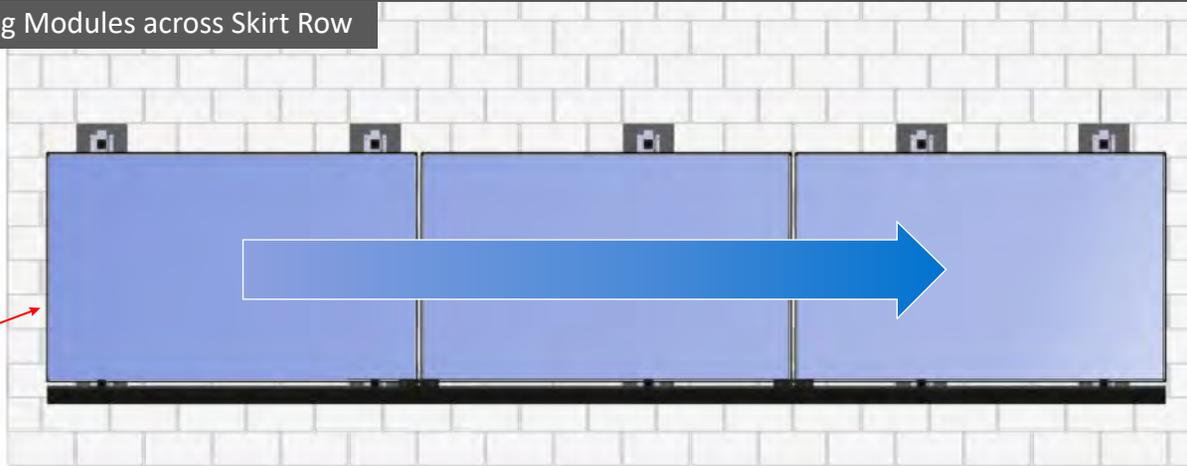
## 9. Install Modules (cont.)

### 9b. Continue installing Modules across Skirt Row

Uphill



Skirt Row



Working across the Skirt row set the Modules in place while leaving a 1/2" gap between them. Set the gap by the alignment marks on the Skirt row Coupling(s) and aligning the Module frames to these marks.

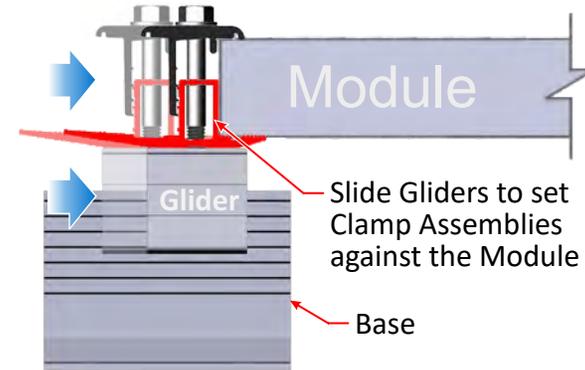
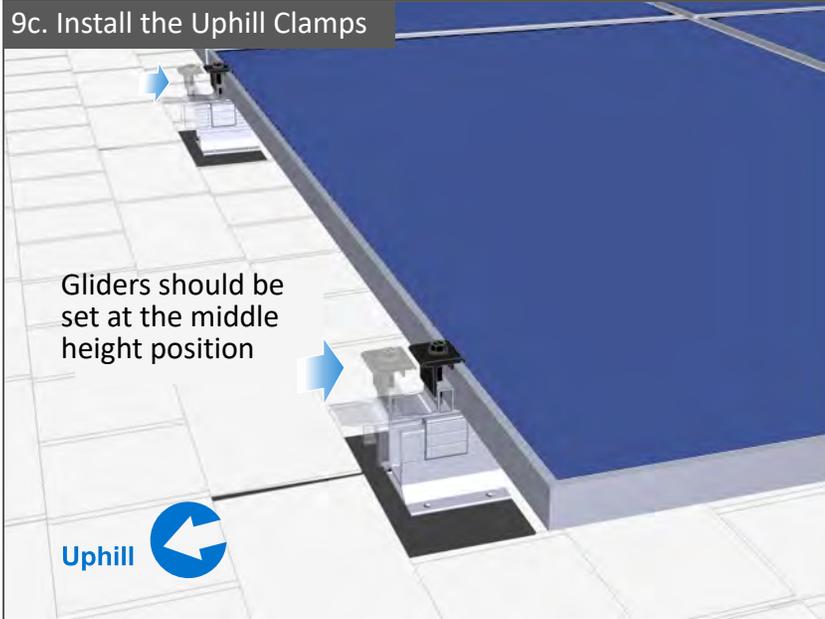
#### Wiring

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.

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

## 9. Install Modules (cont.)

### 9c. Install the Uphill Clamps

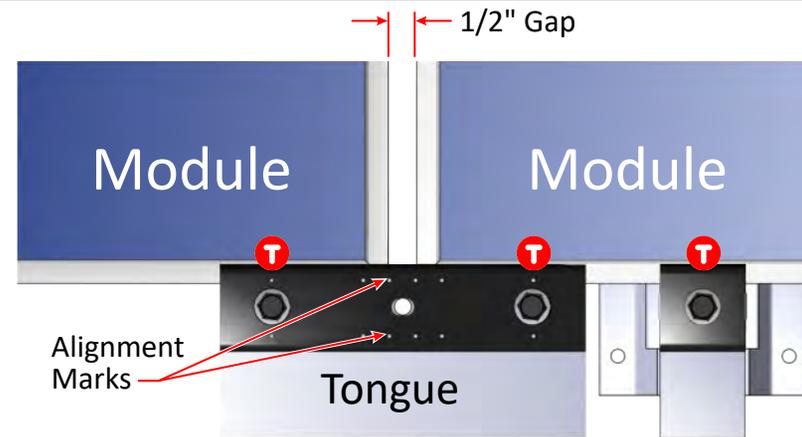
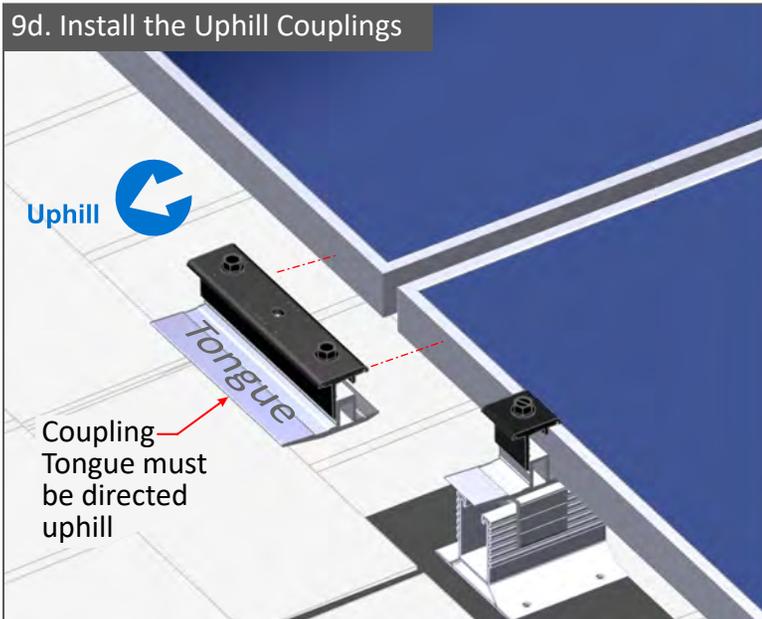


Slide the uphill Clamp Assemblies into place by sliding the Gliders toward the Module.

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.**

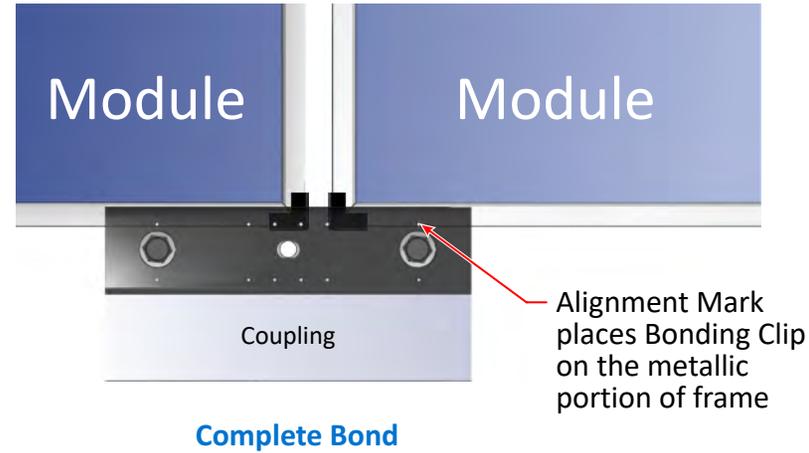
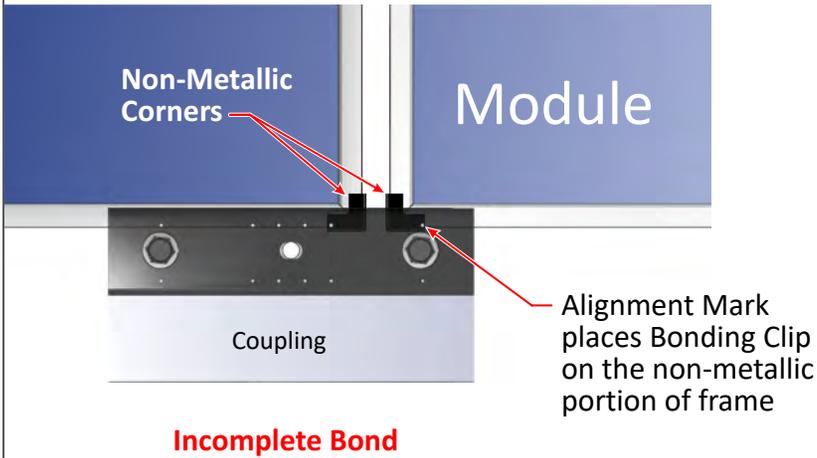
Coupling can be offset of center; the same procedures apply as identified in Step 9b Left/Right Positioning of Coupling

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

**T Torque to: 14 ft-lbs**

## 9. Install Modules (cont.)

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



**⚠** 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.

Note: For clarity the Couplings are shown transparent.

# 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

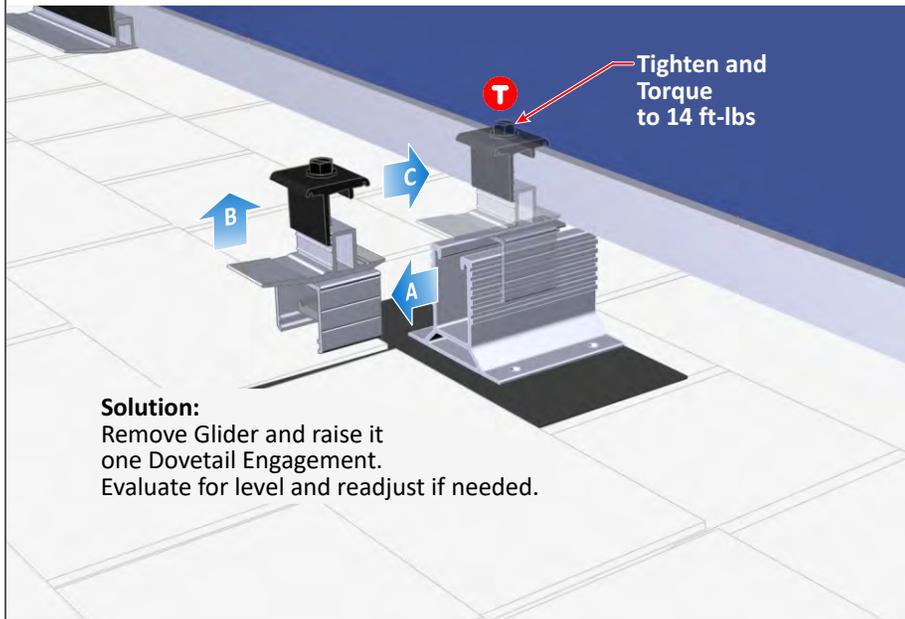
As work progresses the Modules will need to be evaluated by eye and leveled row-by-row.

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.

Clamps have been evaluated and rated for multiple use.

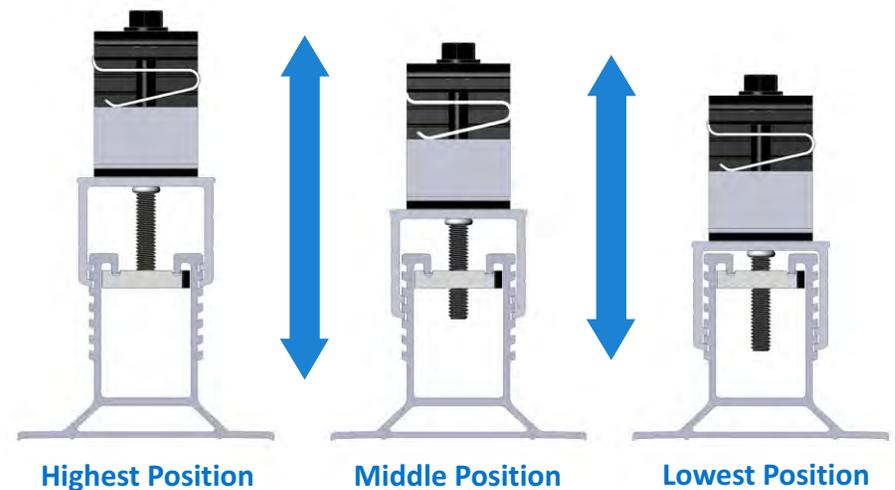
Repeat Steps 9a through 9e for the remaining rows of Modules.

**T** Torque to: 14 ft-lbs



**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



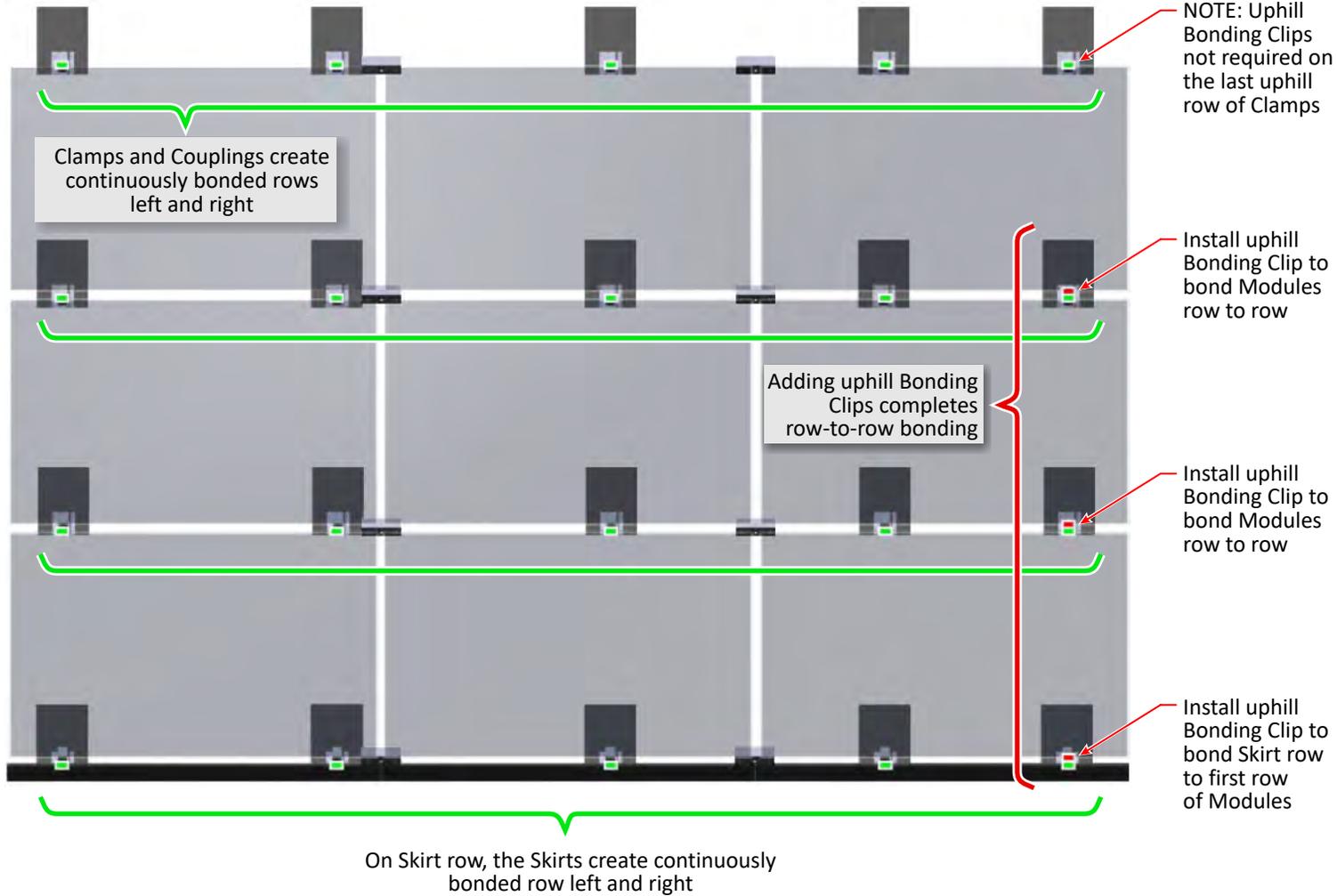
# 11. Grounding and Bonding

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

Uphill



- = Requires uphill Bonding Clip, in this example three Bonding Clips are required; one for each of the 3-rows
- = Factory installed Bonding Clips



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:

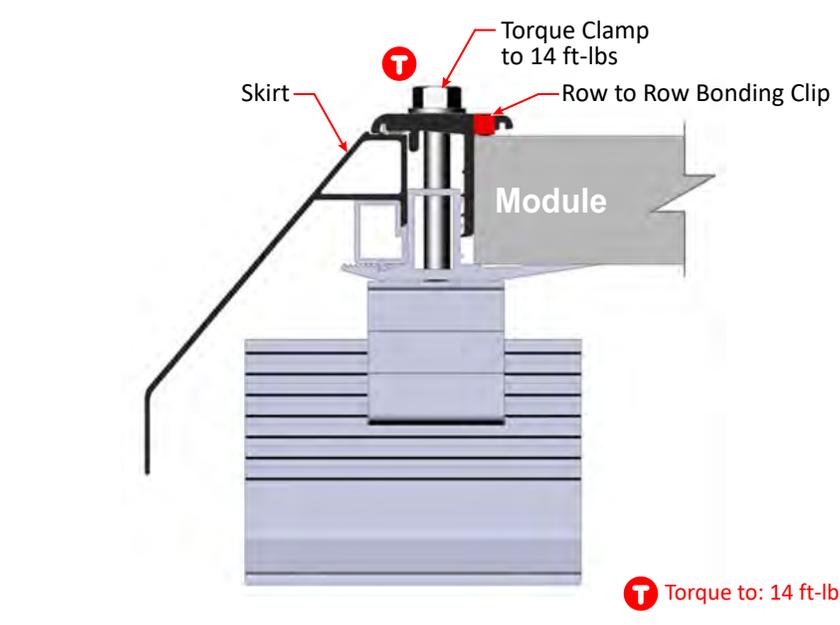
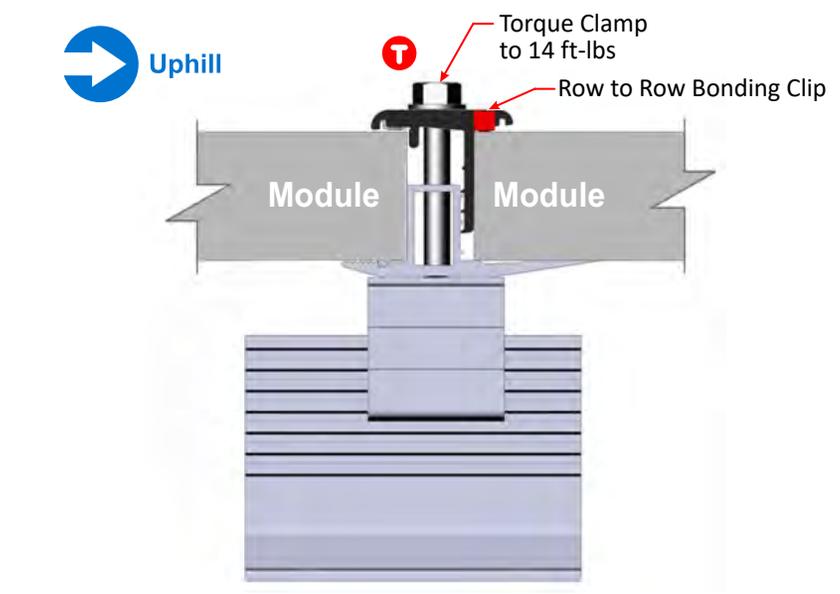
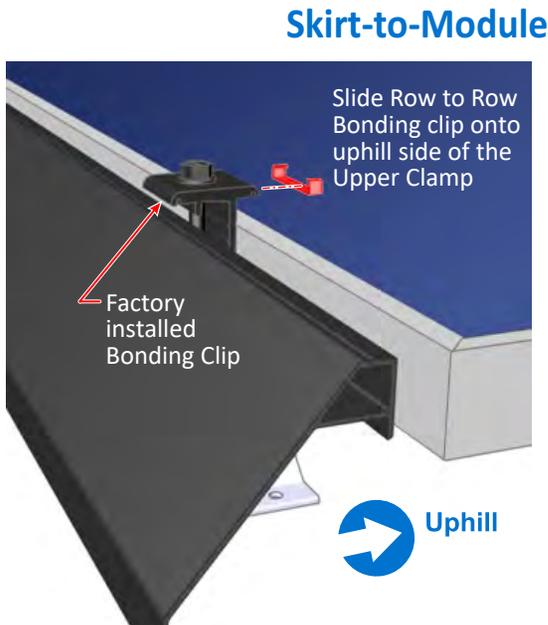
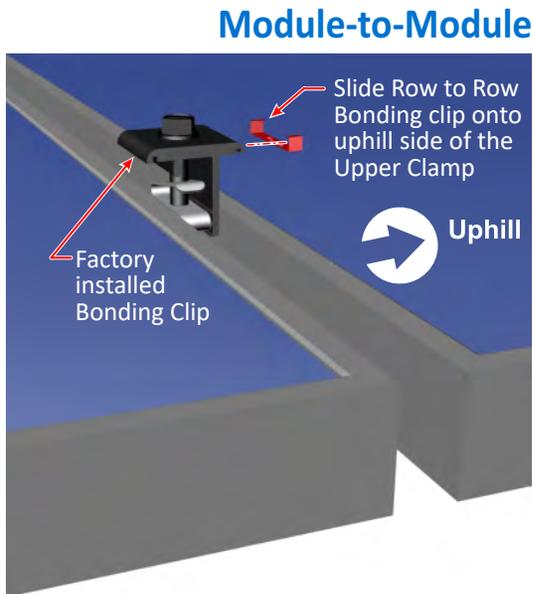
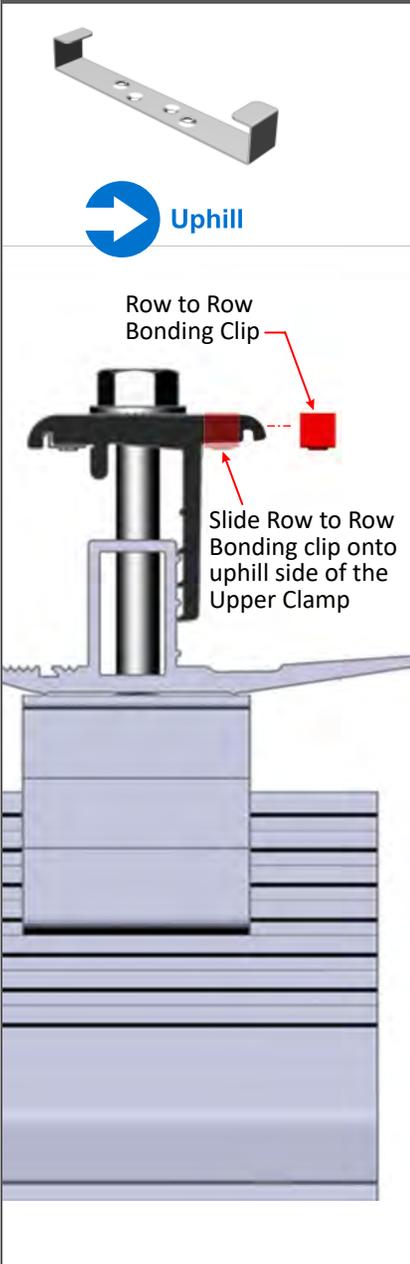
**Option 1** uses a bonding clip, added on the uphill side of any one clamp in each row.

**Option 2** is any bonding jumper that is tested to UL2703 (see the following page for details).

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.

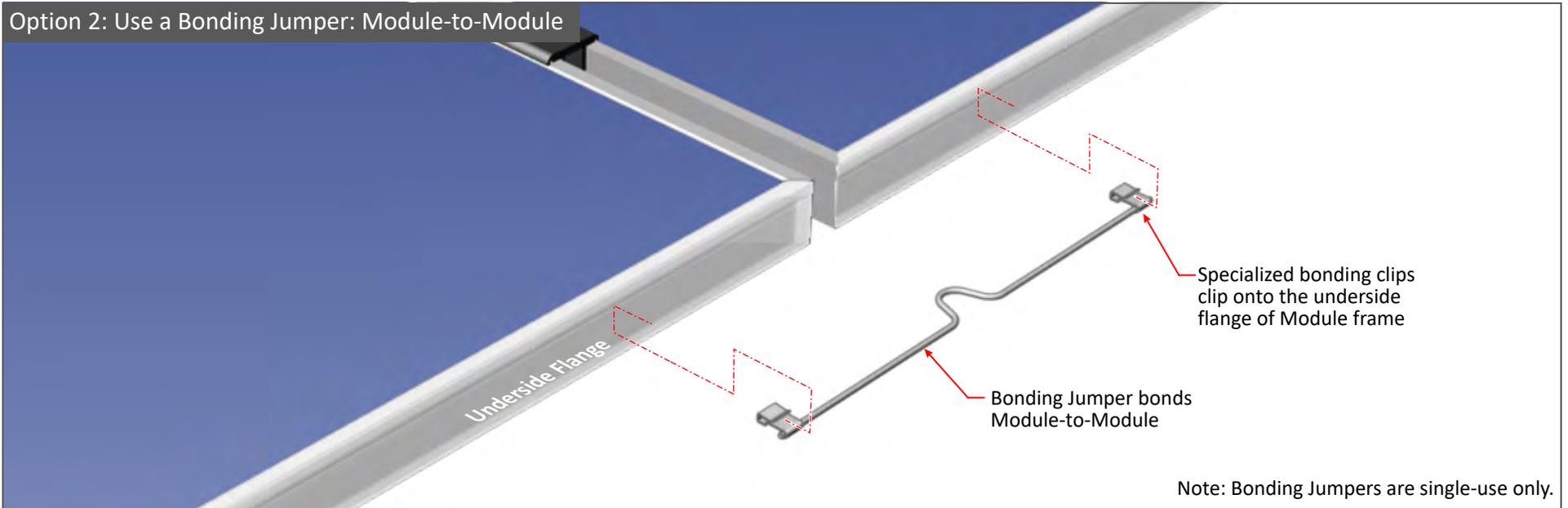
# 11. Grounding and Bonding (cont.)

## Option 1: Use our Bonding Clips

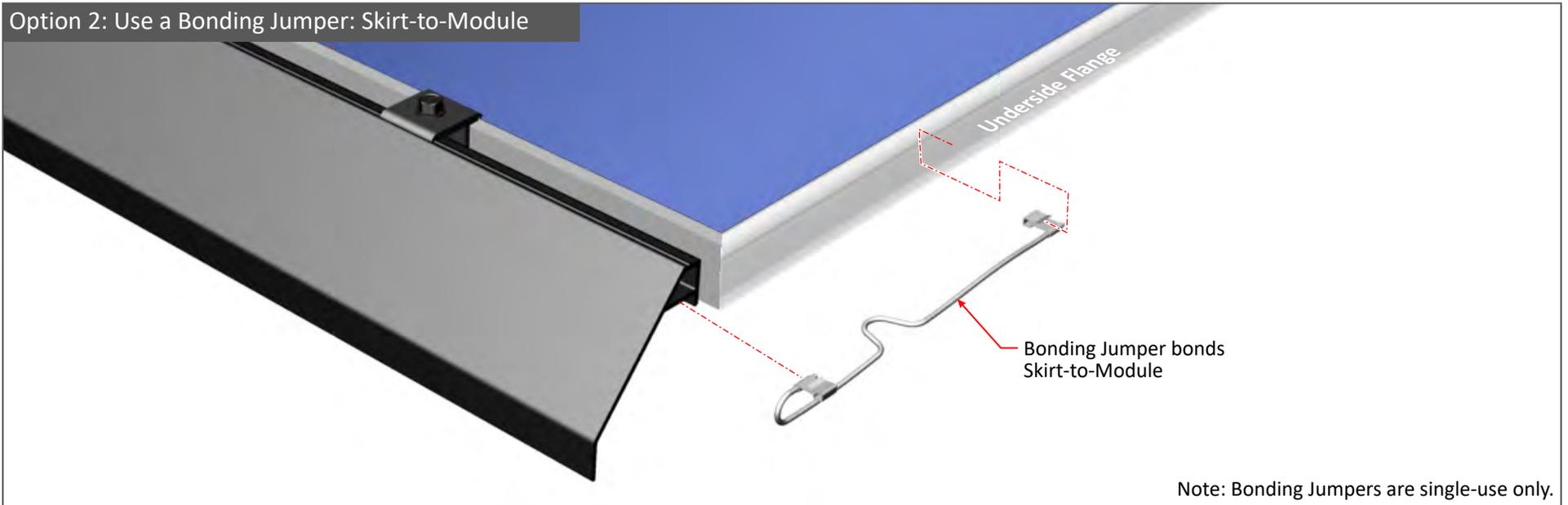


## 11. Grounding and Bonding (cont.)

Option 2: Use a Bonding Jumper: Module-to-Module

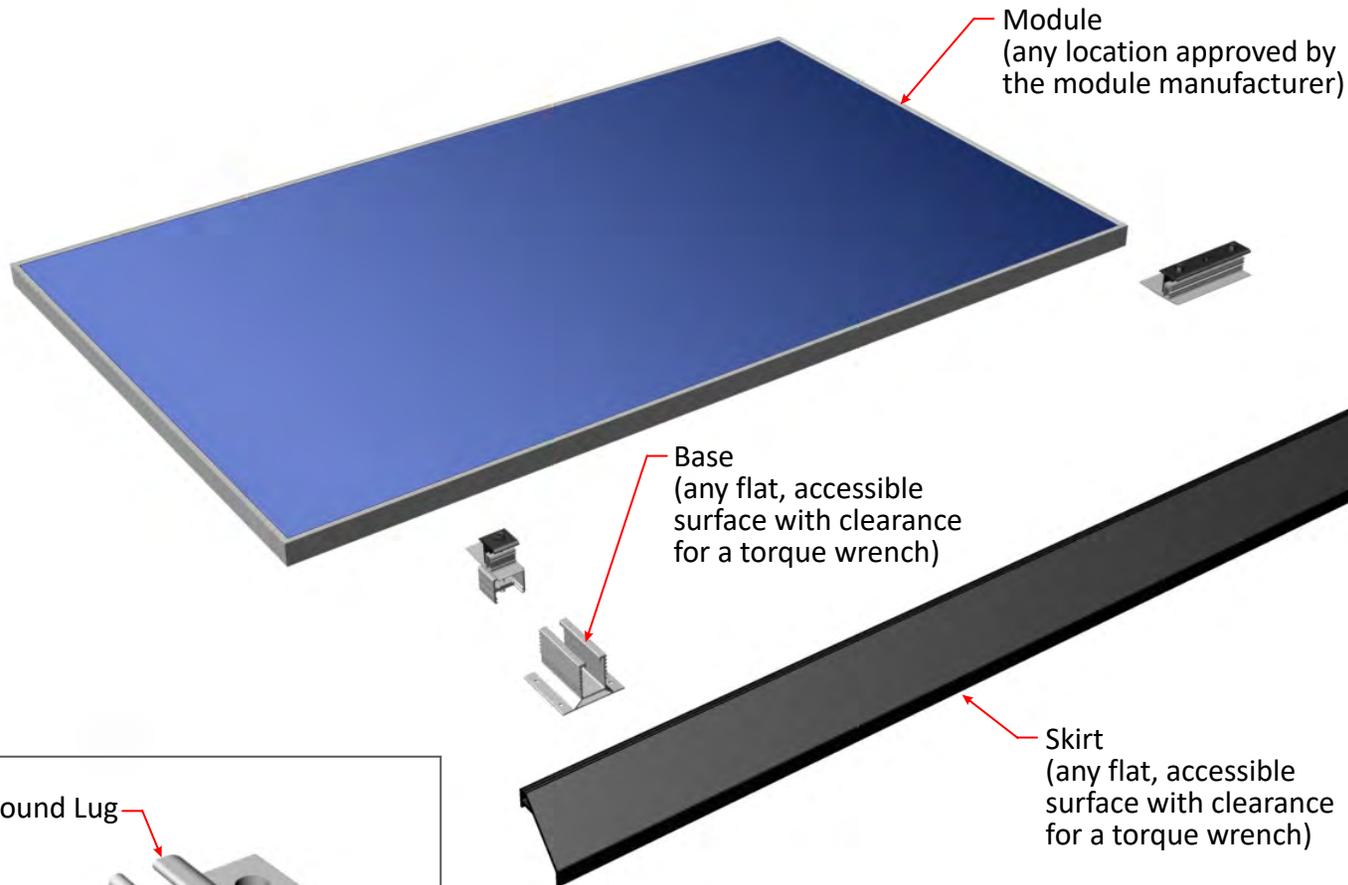


Option 2: Use a Bonding Jumper: Skirt-to-Module



# 11. Grounding and Bonding (cont.)

## Lugs and System Bonding



- Install approved grounding lug per lug manufacturer's instructions. Instructions included in the following pages.
- Deburr any field-drilled holes.
- Wiley WEEB Lugs are "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 and approved by the AHJ.

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, 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 Authority Having Jurisdiction (AHJ).

Site specific plans are to identify grounding conductor size, type and temperature rating (if appropriate) as determined by a qualified engineer and 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.

The installer is also responsible for obtaining prior approval from the AHJ for the use of any grounding lug not listed above.

**⚠ Ensure that bare copper wire is isolated from all aluminum components.**

# 11. Grounding and Bonding (cont.)

## Grounding Lugs



Constructed of corrosion resistant, tin-plated copper, the Wiley line of grounding lugs are high quality solutions for your solar PV system. The tin-plated lug assures minimum contact resistance and protection against corrosion. The low profile of the grounding lug allows it to be installed in a variety of positions with one solid or stranded copper wire (14 AWG to 6 AWG), or two copper wires (12 AWG to 10 AWG). Copper wire is secured by a 1/4-28 stainless steel screw, which is horizontal to the tang. This allows for easy access when mounted under a PV module. The result is a continuous ground on all solar applications.

### WEEB® Grounding Lug

The WEEB® Grounding Lug is installed using stainless steel mounting hardware. When the hardware is tightened, the WEEB® washer's specialized teeth embed into anodized aluminum or any electrically conductive metal to establish a gas tight electrical connection.

ITEM #	CATALOG #	LENGTH In. [mm]	WIDTH In. [mm]	HEIGHT In. [mm]	HOLE SIZE In. [mm]	MOUNTING HARDWARE	ASSEMBLED	TORQUE
30020109	WEEB-LUG-6.7	1.575 [40.00]	0.709 [18.00]	0.472 [12.00]	0.266 [6.76]	1/4 inch hardware included	N	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50045236	WEEB-LUG-6.7HS							
30020110	WEEB-LUG-6.7AS	1.575 [40.00]	0.709 [18.00]	0.472 [12.00]	0.266 [6.76]	1/4 inch hardware included	Y	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046747	WEEB-LUG-6.7ASHS							
30020111	WEEB-LUG-8.0	1.575 [40.00]	0.866 [22.00]	0.472 [12.00]	0.323 [8.20]	M8 or 5/16 inch hardware not included	N	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046750	WEEB-LUG-8.0HS							
50010335	WEEB-LUG-8.0AS	1.575 [40.00]	0.866 [22.00]	0.472 [12.00]	0.323 [8.20]	5/16 inch hardware included	Y	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046753	WEEB-LUG-8.0UNHS							
50023920	WEEB-LUG-8.0UN	1.575 [40.00]	0.866 [22.00]	0.472 [12.00]	0.323 [8.20]	5/16 inch hardware included	N	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046756	WEEB-LUG-8.0ASHS							
30020112	WEEB-LUG-15.8	1.575 [40.00]	0.709 [18.00]	0.472 [12.00]	0.323 [8.20]	M8 or 5/16 inch hardware not included	N	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046759	WEEB-LUG-15.8HS							
50021995	WEEB-LUG-8.2	1.575 [40.00]	0.709 [18.00]	0.472 [12.00]	0.323 [8.20]	M8 or 5/16 inch hardware not included	N	7 ft lbs for terminal screw, 10ft lbs for mounting hardware w/ Penetrox-A on threads
50046762	WEEB-LUG-8.2HS							

\*HS = HEX SOCKET CAP TERMINAL SCREW



- Made of corrosion-resistant, tin-plated copper
- No surface preparation on rail or module required
- Reliability throughout the lifetime of the PV system
- Multiple equipment ground conductor allowance: One 14 AWG to 6 AWG or two 10 AWG, two 12 AWG
- UL2703 Listed
- Listed to ANSI/JUL 467 by Intertek ETL
- CSA Certified to C22.2 No. 41

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# 11. Grounding and Bonding (cont.)



UL Listed and CSA Certified Grounding and Bonding Equipment\* investigated in accordance to standard ANSI/UL 467, CSA C22.2 No. 41, NMX-J-590-ANCE.  
 UL Listed Ground Lugs and Devices for use with Photovoltaic Modules and Panels investigated in accordance to standard ANSI/UL 2703.

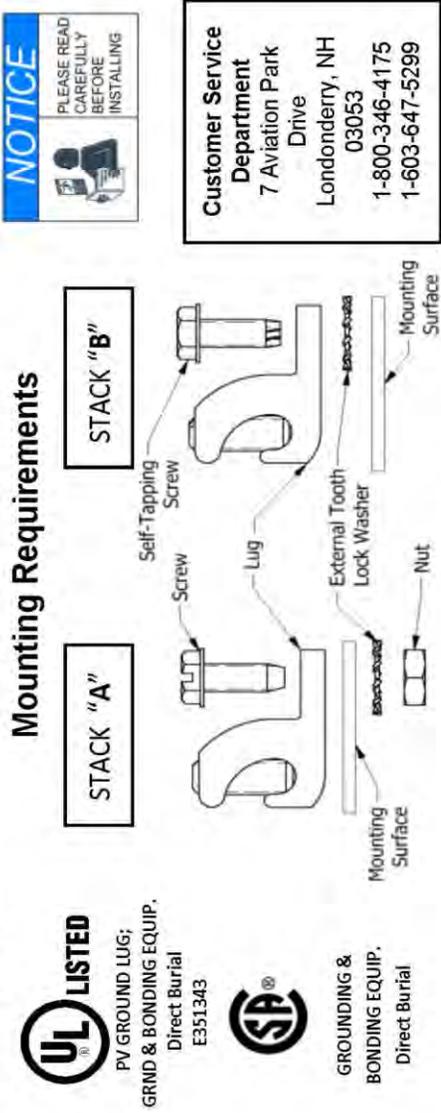


Figure 1: Minimum Hardware Required Page 1 of 2

CL501TNMHWSG1 and CL501DBKIT1 are packaged with required hardware as shown in stack "A"  
 CL501TNMHWSST and CL501DBKIT2 are packaged with required hardware as shown in stack "B"  
 CL501TN(BULK) and CL501TNMHWS are approved with hardware stack "A" or "B" as shown above.  
 \* For Grounding and Bonding applications per UL467/CSA 22.2 No. 41 use hardware stack "A".

Cat No.	Max OCPD (A)	Mounting Surface			Mounting Screw		Mounting Hole Size	Field Wiring				
		Stack Type	Min Thk (in)	Max Thk (in)	MH	Surface Prep		Size	Tightening Torque (in-lbs)	Wire Type	Wire Size (AWG)	Tightening Torque (in-lbs)
CL501TN CL501DBKIT2	150	B	.06"	.13"	AL	Anodized	10-32	25	#21 drill (.159")	Copper	14-10	20
	200		.13"	.13"	AL	Anodized	10-32					
CL501TN CL501DBKIT1	25	A	.06"	.25"	AL	Anodized	10-32	50	.200"±.010	SOL. or STR.	8	25
	200		.06"	.25"	Steel	Galvanized	10-32					

Table 1: Mounting Surface Requirements

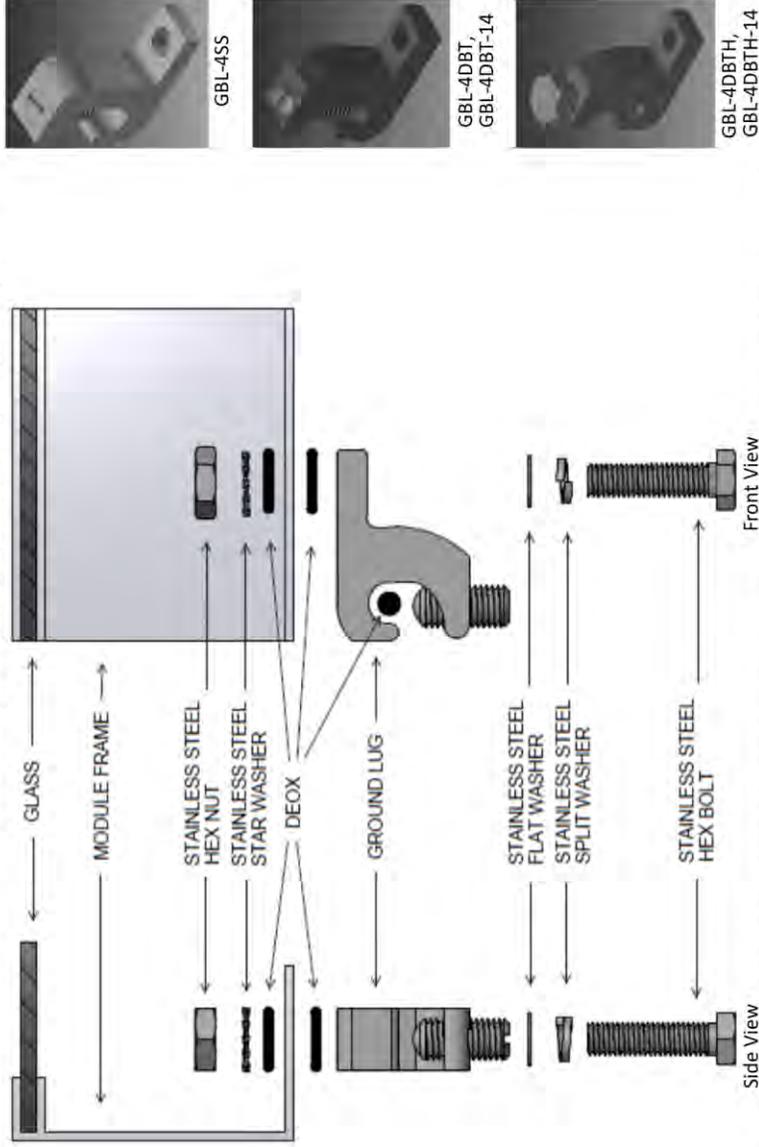
- Important notes:
- The NEC section 690.43 states, "Exposed non-current carrying metal parts of module frames, equipment, and conductor enclosures shall be grounded in accordance with 250.134 or 250.136 (A) regardless of voltage."
  - For Proper Equipment Grounding Conductor (EGC) and Overcurrent Protection Device (OCPD) sizing, refer to NEC sections 250.66, 250.122 and 250.166.

# 11. Grounding and Bonding (cont.)



## INFORMATION SHEET

GBL-4SS, GBL-4DBT, GBL-4DBTH, GBL-4DBT-14, and GBL-4DBTH-14 Ground Lugs  
Installation Instructions for Photo Voltaic Applications



- 1) Install GBL-4SS, GBL-4DBT, GBL-4DBTH, GBL-4DBT-14 or GBL-4DBTH-14 ground lug per diagram (use #10-32 mounting hardware for GBL-4SS, GBL-4DBT or GBL-4DBTH; use 1/4-28 mounting hardware for GBL-4DBT-14\* or GBL-4DBTH-14\*)
- 2) Apply a liberal amount of conductor (ILSCO DE-OX oxide inhibitor) on front and back side of module frame at mounting hole. Although not required, ILSCO strongly recommend the use of conductor compound between the mounting surfaces in order to better protect the connection in all environmental conditions and promote connection longevity
- 3) For GBL-4SS, GBL-4DBT or GBL-4DBTH, apply 35 in-lbs mounting torque to #10 mounting bolt
- 4) For GBL-4DBT-14 or GBL-4DBTH-14, apply 72 in-lbs mounting torque to 1/4" mounting bolt
- 5) Apply a liberal amount of conductor compound (ILSCO DE-OX oxide inhibitor) in wireway of ground lug
- 6) Install ground conductor in lug and torque wire screw to the following:
  - 4 - 6 AWG: 35 in-lbs.
  - 8 AWG: 25 in-lbs.
  - 10 - 14 AWG: 20 in-lbs.

\*Flat washer and split washer are not required

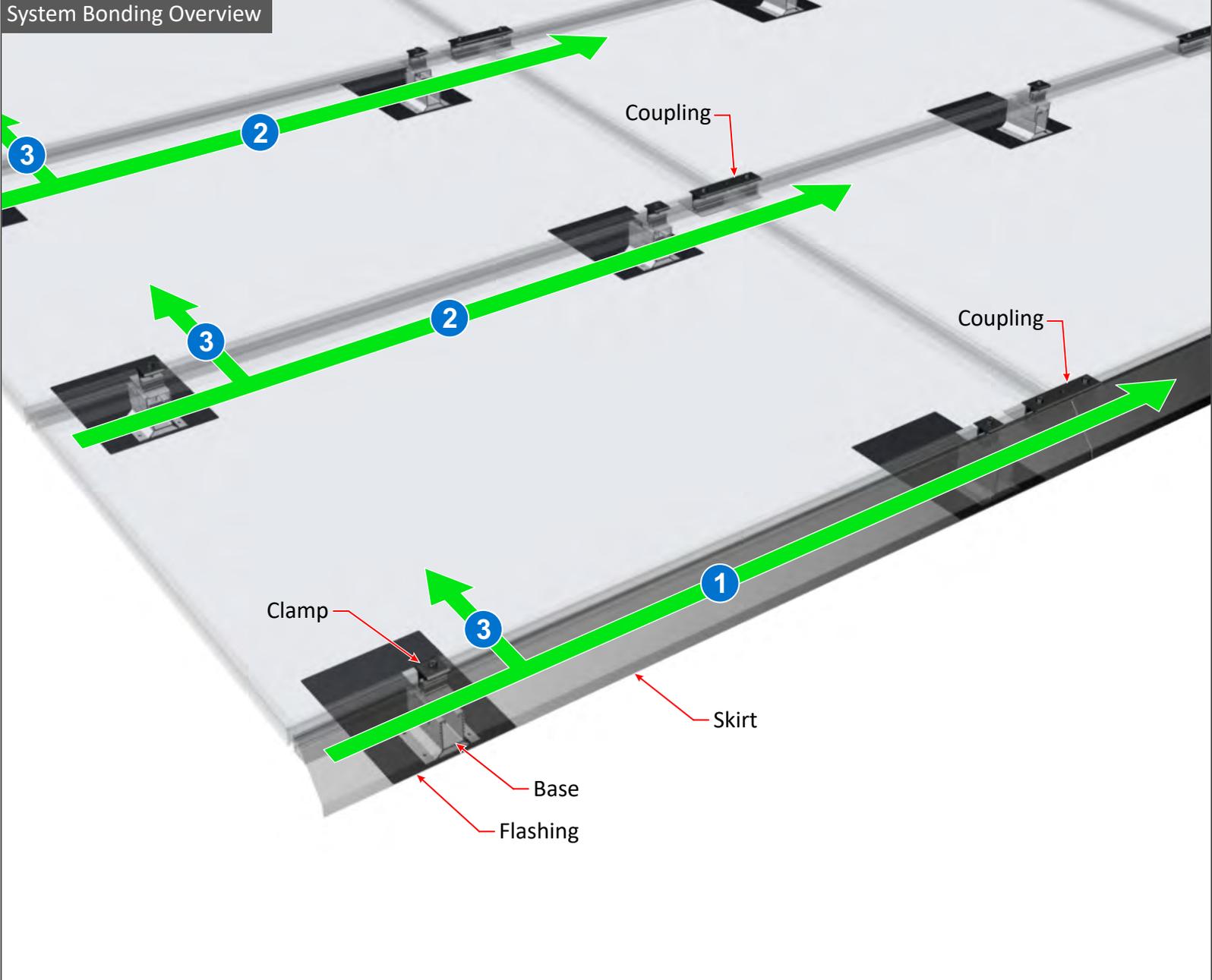
### Additional Information:

- a) GBL-4SS, GBL-4DBT, GBL-4DBTH are suitable for use with flat-surfaced anodized aluminum or galvanized steel designated G90 minimum. The acceptable mounting hole diameter is 0.196 inches  $\pm$  0.004 inches (4.98mm  $\pm$  .1mm).
- b) GBL-4DBT-14, GBL-4DBTH-14 are suitable for use with flat-surfaced galvanized steel designated G90 minimum. The acceptable mounting hole diameter is 0.270 inches  $\pm$  0.004 inches (6.86mm  $\pm$  0.1mm).
- c) The acceptable framing material thickness is a minimum of 0.062 inches (1.57mm) to 0.250 inches (6.35mm), with a flat surface area of no less than 34 by 12mm (bottom of the lug).
- d) For use with Listed Photovoltaic Modules or Listed Mounting systems where described in the Listed PV Modules or Listed Mounting System Installation Instructions.
- e) For sizing of an Equipment Grounding Conductor (EGC), the rating of the Overcurrent Protection Device (OCPD) in circuit ahead of the Equipment shall not exceed the values in NEC table 250.122 where the EGC is only required to be larger than the circuit conductors supplying the equipment.
- f) For use with a Grounding Electrode Conductor (GEC), the size of the conductor shall comply with NEC articles 250.66 for AC systems and 250.166 for DC systems.
- g) Rated maximum system overcurrent protection (Cu conductor):
 

14 AWG:	15A
12 AWG:	20A
10 AWG:	40A
8 AWG:	90 A
6 AWG:	150 A
4 AWG:	200 A

# 11. Grounding and Bonding (cont.)

**System Bonding Overview**



- 1 Skirt row continuous bond:**  
 Continuous bond from Base and Clamp to Skirt. Couplings bond Skirt to Skirt. Complete row of Skirts and EcoX components clamped to Skirt are bonded.
- 2 Module row continuous bond:**  
 Continuous bond from Flashing through Clamp to Module. Couplings bond Module-to-Module. Complete row of Modules and EcoX components clamped to Modules are bonded.
- 3 Row to row bonding:**  
 Bond Clip added to uphill side of one Clamp per row. This bonds Skirt row to Modules on downhill row, and Module row to next Module row on each subsequent row.

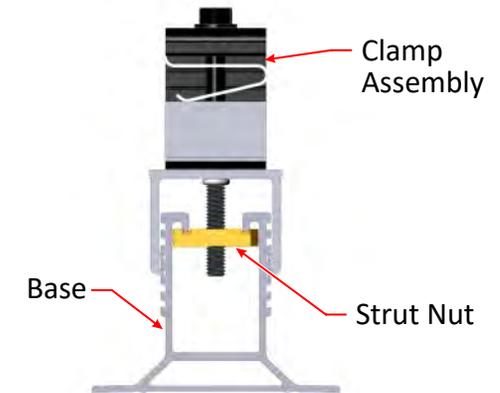
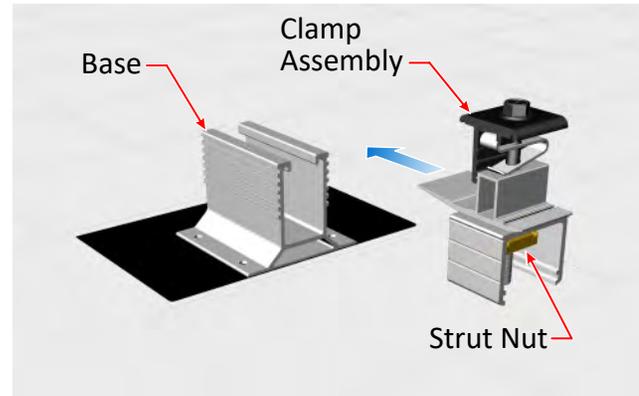
# 11. Grounding and Bonding (cont.)

## Component Connections

The following outlines bond connection mechanisms between Components:

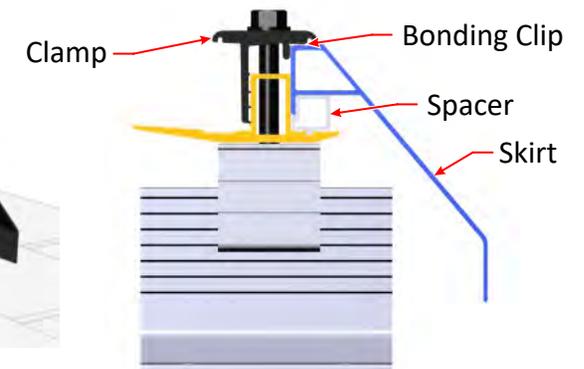
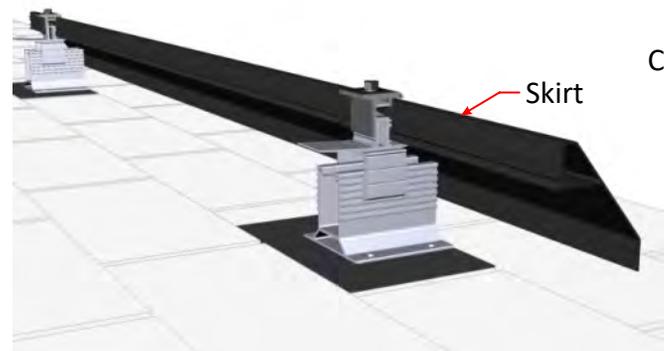
### Clamp Assembly to Base:

The Clamp Assembly slides onto the Base. The Strut Nut (highlighted in yellow) has teeth that embed in the Base.



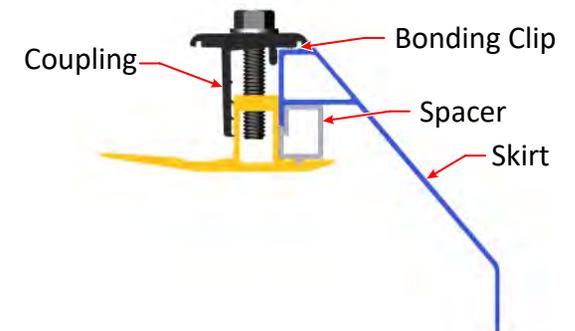
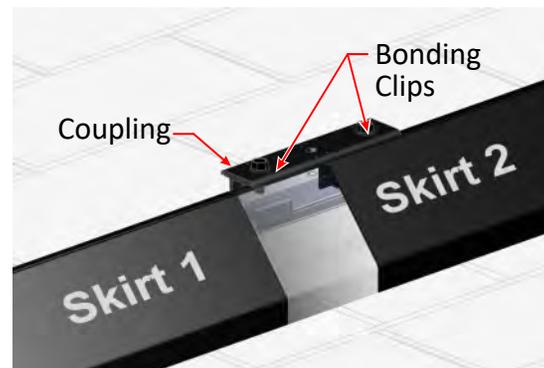
### Clamp to Skirt:

The Clamp features an integrated Bonding Clip. This Clip bites onto the Skirt on the downhill row.



### Coupling Bonds Skirt to Skirt:

The Coupling features two integrated Bond Clips. These clips bond each Skirt to the neighboring Skirt.

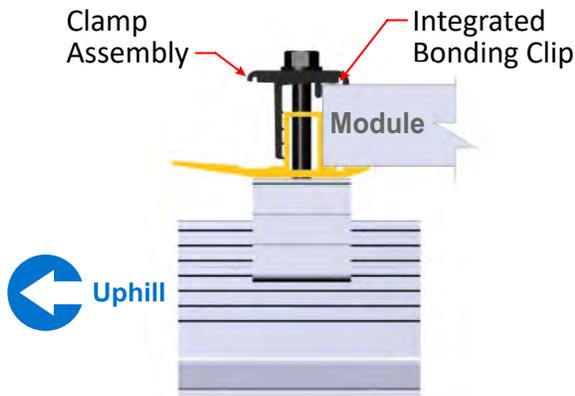


# 11. Grounding and Bonding (cont.)

## Component Connections (cont.)

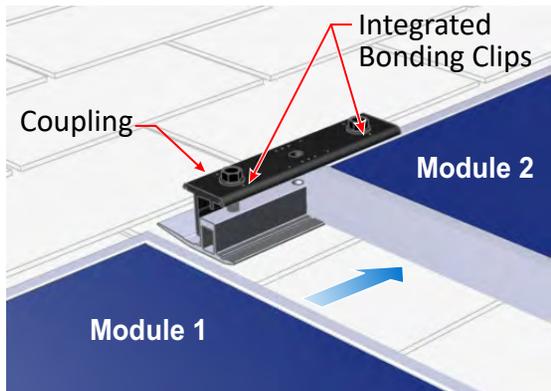
### Clamp to Module:

The Clamp features an integrated Bonding Clip. The Clamp bonds to the Module downhill from the Clamp.



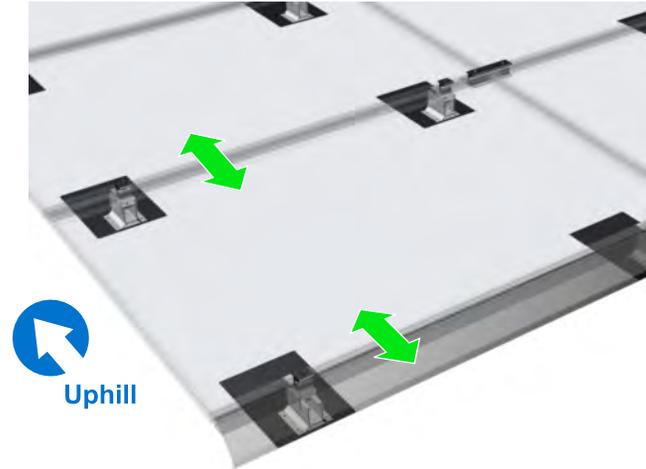
### Coupling Bonds Module to Module:

The Coupling features two integrated Bonding Clips. On module rows, the Coupling bonds each Module to the neighboring Module. The Coupling is not approved for bonding row-to-row.



### Bond Row to Row:

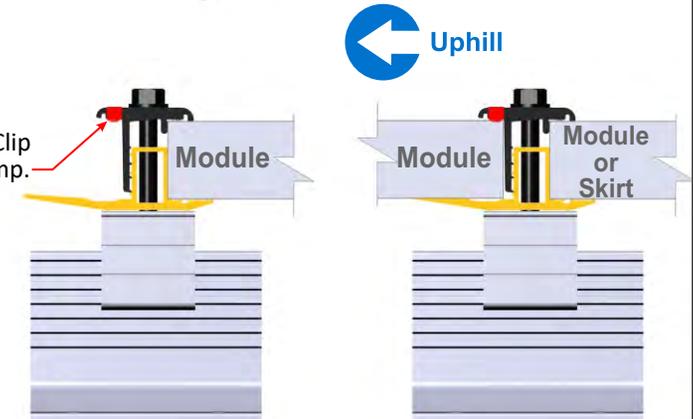
Additional bonding must be added to bond the Skirt row to the first row of Modules, and to bond each row of Modules together. There are two options to accomplish this, they are as follows:



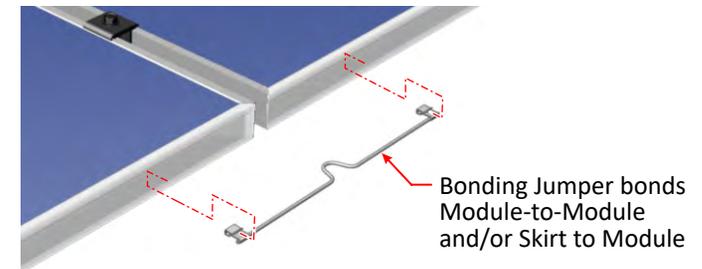
**Option 1:** Add a Bond Clip to the uphill side of each Clamp.



Install Bonding Clip onto Upper Clamp.



**Option 2:** Use an approved bonding jumper. A jumper is required between the Skirt and the first row of Modules, and between every row of Modules. Either side of the array is acceptable.

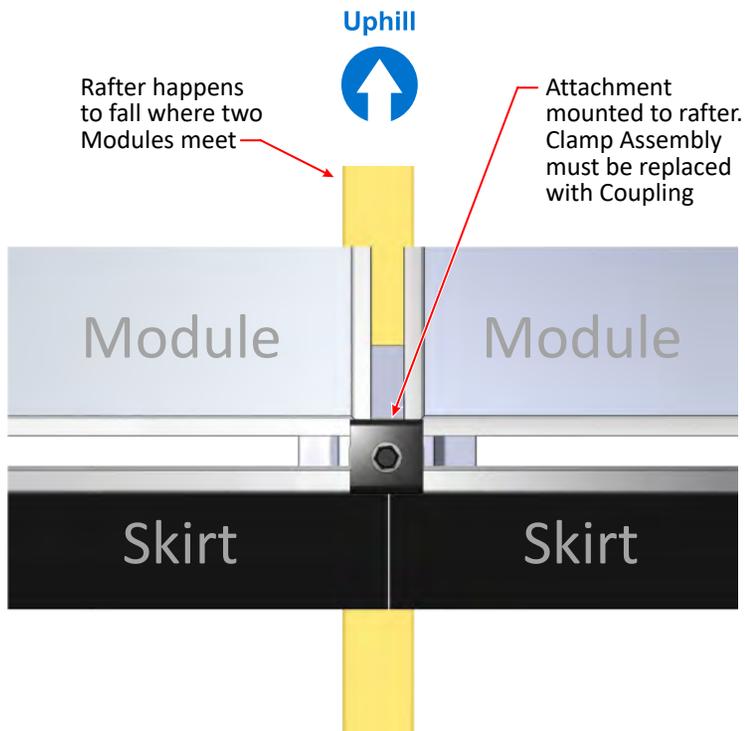


# Appendix A: How to replace the Clamp Assembly with a Coupling

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

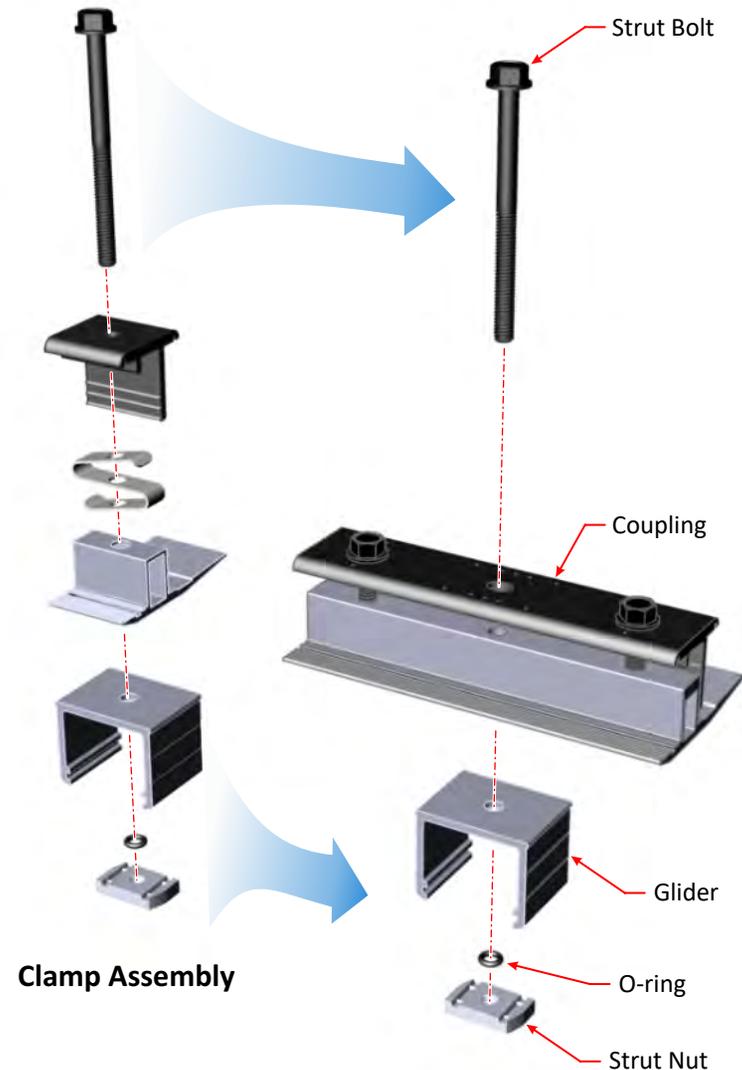
### This situation requires a Coupling:

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



**i** 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.

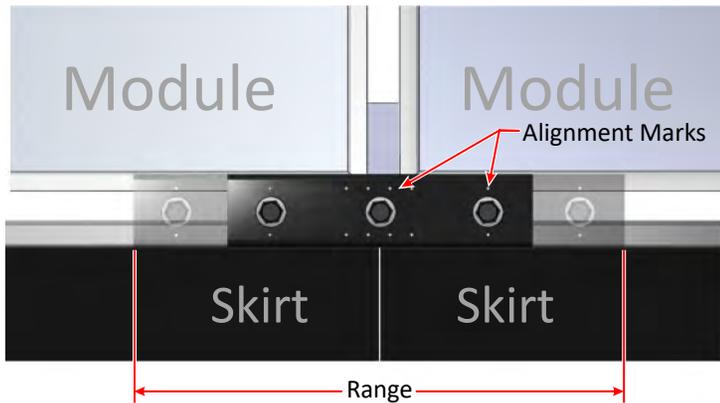
Remove the Glider and Clamp assembly from the Base. Next, remove the Upper and Lower Clamps from the Glider by removing the Strut Bolt and Strut Nut.

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.

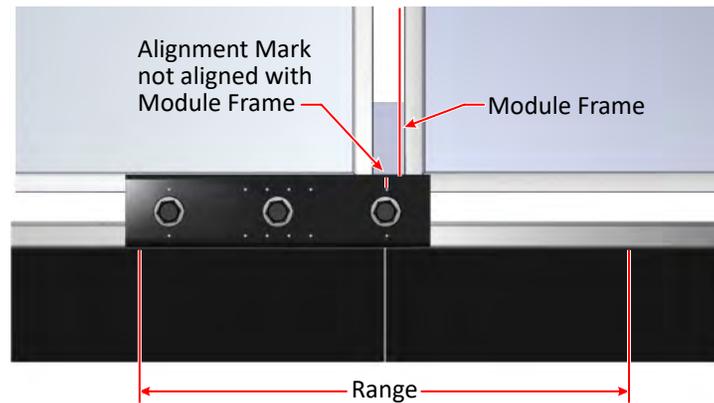
## Appendix A: How to replace the Clamp Assembly with a Coupling (cont.)

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



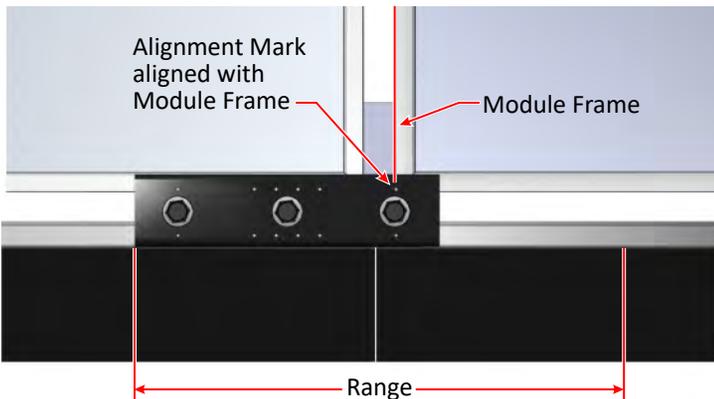
#### Acceptable Range of Positioning

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



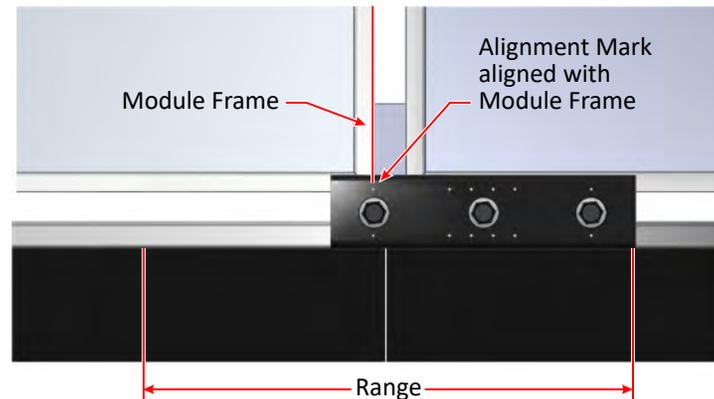
#### Incorrect

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.

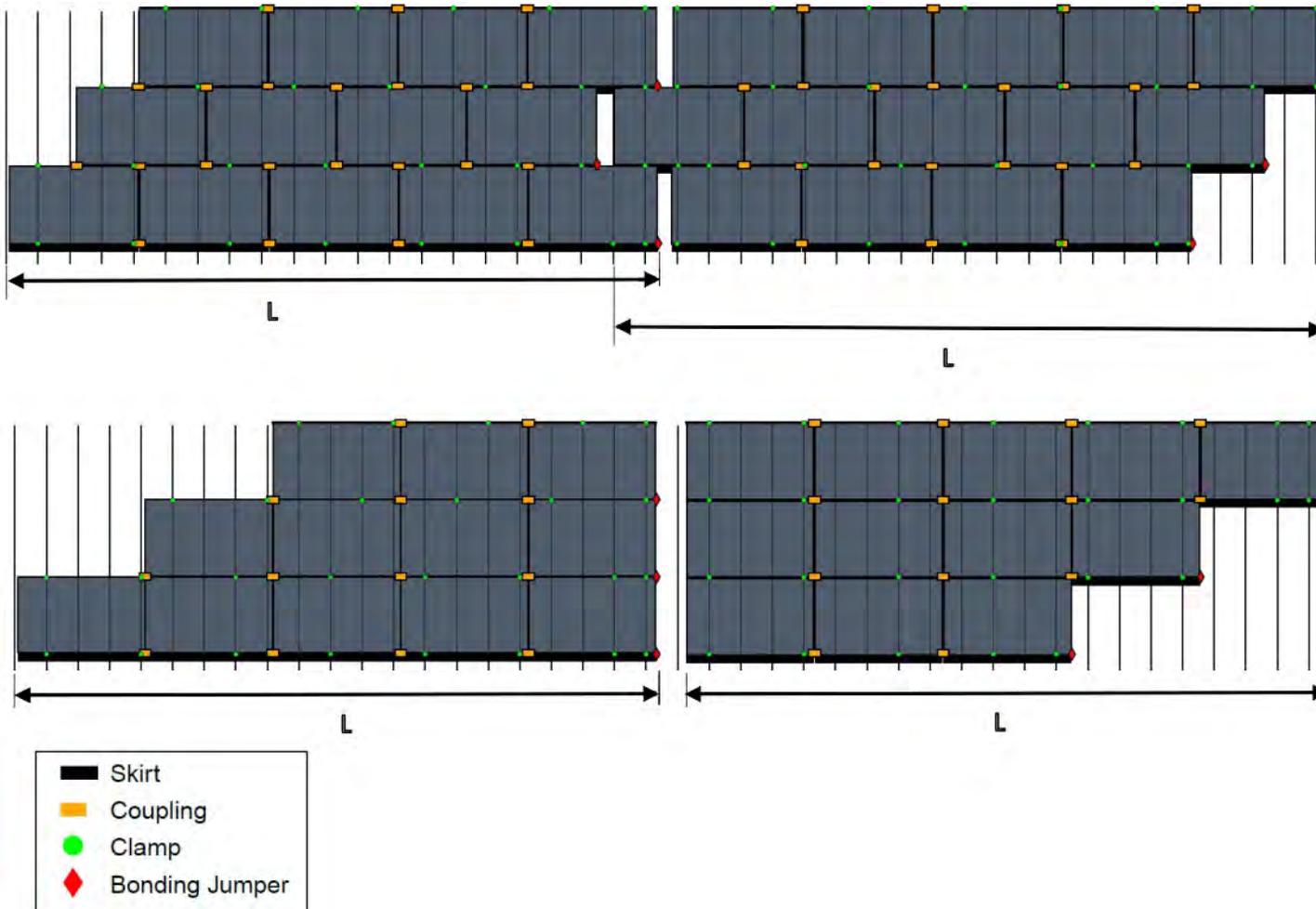
**i** For Modules that are constructed with non-metallic corners, ensure the Bonding Clip in the Coupling is fully engaged with the metallic frame of the Module as shown in step 9-e.

**!** 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: Thermal Expansion

Uphill



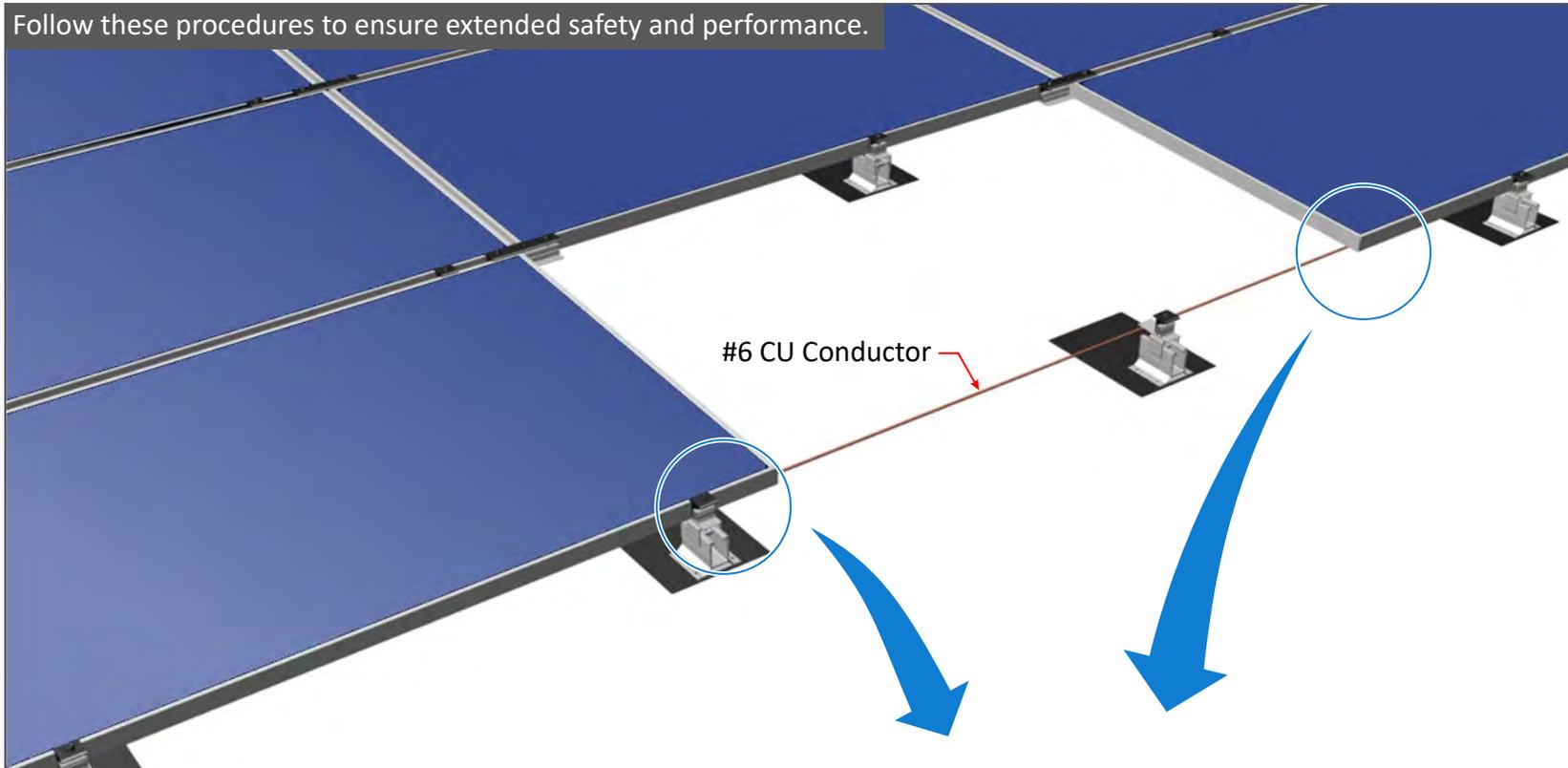
With natural ambient temperature fluctuations, thermal expansion and contraction can impact large arrays. To prevent excessive thermal movement in an array, thermal breaks should be installed for arrays longer than 35 ft.

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 left/right gap between sub-arrays should be set to a minimum of 1/2". Note that the gap shown at left is much greater than 1/2" for demonstration purposes.

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

## Appendix C: 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 an approved ground lug on adjacent modules.

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

Other UL 2703 listed, outdoor rated (by others) ground lugs may also be suitable for this system if approved by the AHJ (Authority Having Jurisdiction).

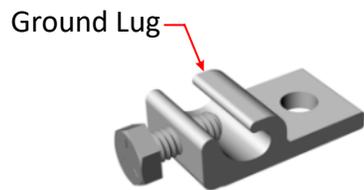
Install ground lug on both of the modules adjacent to the module to be removed. Use the grounding hole on the frame of the module. See section 10 for additional ground lug information.

B. Connect a Bonding Jumper.

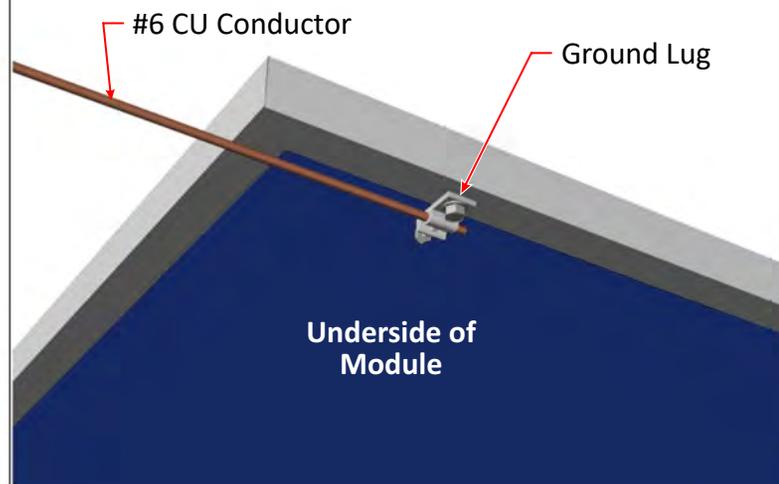
Lay a bare #6 CU conductor (by others) into the two lay in lugs connected to the adjacent modules.

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

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



- Install approved grounding lug per lug manufacturers instructions. See Section 10.
- Deburr any field-drilled holes.
- Wiley WEEB Lugs are "single use only".



## Appendix D: Modules Evaluated as part of EcoX UL 2703 Certification

EcoX is rated to be installed with the following Modules according to the approval list

Note: "XXX" represents module wattage

Manufacturer	Module Series	Downforce Design Load	Uplift Design Load	Downslope Design Load
<b>Boviet Solar Technologies</b>	BVM6610P-XXX	40 psf	40 psf	23.3 psf
	BVM6610M-XXX			
	BVM6610M(BB)-XXX			
	BVM6610P(BB)-XXX			
<b>Canadian Solar</b>	CS6P-XXXM	40 psf	40 psf	23.3 psf
	CS6P-XXXP			
<b>Centrosolar</b>	BM60-XXX BB	40 psf	40 psf	23.3 psf
<b>CertainTeed</b>	CTXXXMxx-01	40 psf	40 psf	23.3 psf
	CTXXXMxx-02			
<b>Flex</b>	FLV-MA-XXXP60AB	40 psf	30 psf	23.3 psf
<b>Hansol</b>	HSXXTD-AN4	40 psf	30 psf	23.3 psf
	HSXXTD-AN3			
	HSXXUD-AN1			
<b>Hanwha/Q-Cells</b>	Q.PEAK-G3	40 psf	40 psf	23.3 psf
	Q.PEAK-G4			
	Q.PEAK-G4.1			
	Q.PEAK BLK-G4			
	Q.PEAK BLK-G4.1			
	Q.PLUS-BFR-G4.1			
	Q.PEAK DUO-G5			
	Q.PEAK DUO BLK-G5			
	Q.PLUS-G3			
	Q.PLUS-G4			
	Q.PRO-G3			
	Q.PRO-G4			
	Q.PRO-BFR-G3			
	Q.PRO-BFR-G4			
<b>Hyundai</b>	HiS-MXXXMG	40 psf	40 psf	23.3 psf
	HiS-MXXXRG			
	HiS-MXXXRW			
	HiS-SXXXRG			
<b>Jinko</b>	JKMXXXM-48	40 psf	30 psf	23.3 psf
	JKMXXXM-60			
	JKMXXXM-60B			

Manufacturer	Module Series	Downforce Design Load	Uplift Design Load	Downslope Design Load
<b>Jinko (continued)</b>	JKMXXXM-60-V	40 psf	30 psf	23.3 psf
	JKMXXXPP-60			
	JKMXXXPP-60(Plus)			
	JKMXXXPP-60-J4			
	JKMXXXPP-60-V			
	JKMXXXPP-60			
	JKMXXXPP-72			
	JKMXXXM-72(Plus)			
	JKMXXXM-72			
	JKMXXXPP-72(Plus)			
JKMXXXPP-72-V				
<b>LG Electronics</b>	LGXXE1C-A5	40 psf	30 psf	23.3 psf
	LGXXN1K-A5			
	LGXXN1C-A5			
	LGXXN2W-A5			
	LGXXQ1C-A5			
	LGXXS1C-A5			
	LGXXS2W-A5			
	LGXXA1C-G4	40 psf	40 psf	23.3 psf
	LGXXN1C-G4			
	LGXXN1K-G4			
LGXXS1C-G4				
LGXXS1K-G4				
LGXXN1C-B3	30 psf	30 psf	23.3 psf	
LGXXS1K-B3				
LGXXS1C-B3				
LGXXA1C-B3				
LR6-60-XXXM				40 psf
LR6-60BK-XXXM				
LR6-60PB-XXXM				
LR6-60PH-XXXM				
<b>Panasonic</b>	VBHNXXXSA17	40 psf	30 psf	23.3 psf
	VBHNXXXSA17E			
	VBHNXXXSA17G			
	VBHNXXXKA03			

(continued)

## Appendix D: Modules Evaluated as part of EcoX UL 2703 Certification (cont.)

EcoX is rated to be installed with the following Modules according to the approval list

Note: "XXX" represents module wattage

Manufacturer	Module Series	Downforce Design Load	Uplift Design Load	Downslope Design Load
REC Solar	RECXXXPE RECXXXPE BLK RECXXTP RECXXTP BLK RECXXTP2 RECXXTP2 BLK RECXXTP2 BLK2	40 psf	30 psf	23.3 psf
	SLG-M XXX SLG-P XXX SLG-X XXX SSG-M XXX SSG-P XXX SLA-M XXX SLA-P XXX SLA-X XXX SSA-P XXX SSA-M XXX	30.5 psf	30 psf	23.3 psf
	SNXXM-10 SNXXP-10 SNXXP-15 SNXXM-10 (40T) SNXXP-10 (40T)	30 psf	30 psf	23.3 psf
	PowerXT-XXXR-BX PowerXT-XXXR-PX	40 psf	40 psf	23.3 psf
	Sunmodule SW-XXX Pro-SW-XXX-Poly Plus-SW-XXX-Mono Plus-SW-XXX-Mono-Black	40 psf	40 psf	23.3 psf
	OPTXXX-60-4-100 OPTXXX-60-4-1B0	40 psf	40 psf	23.3 psf

Manufacturer	Module Series	Downforce Design Load	Uplift Design Load	Downslope Design Load	
SunEdison	SE-F2Xxyyy-zz	40 psf	40 psf	23.3 psf	
SunPower	SPR-X21-XXX-C-AC SPR-X21-XXX-D-AC SPR-X20-XXX-D-AC SPR-X22-XXX-D-AC SPR-X22-XXX-E-AC SPR-X21-XXX-BLK-D-AC SPR-X20-XXX-BLK-D-AC SPR-E20-XXX-D-AC SPR-E19-XXX-D-AC SPR-X22-XXX SPR-327NE-WHT-D SPRXXXE-WHT-D SPR-X21-XXX SPR-X20-XXX SPR-X21-XXX-BLK SPR-X20-XXX-BLK SPR-E20-XXX SPR-E19-XX	40 psf	26.1 psf	23.3 psf	
	TSM-DD05A.05(II) TSM-DD05A.08(II) TSM-DD05A.0X TSM-PX05.XX TSM-XXXPA05 TSM-XXXPD05	40 psf	40 psf	23.3 psf	
	TSM-XXXDD14A(II) TSM-XXXDE14A(II) TSM-XXXPD14 TSM-XXXPE14A	40 psf	38.6 psf	23.3 psf	
	Winaico	WSP-XXXM6	40 psf	40 psf	23.3 psf
	Yingli	YLXXXP-29b YLXXXP-30b	40 psf	40 psf	23.3 psf

# Appendix E: Power Accessory Bracket Installation

## Ecolibrium Solar Power Accessory Bracket



Power Accessory Bracket  
P/N ES10072

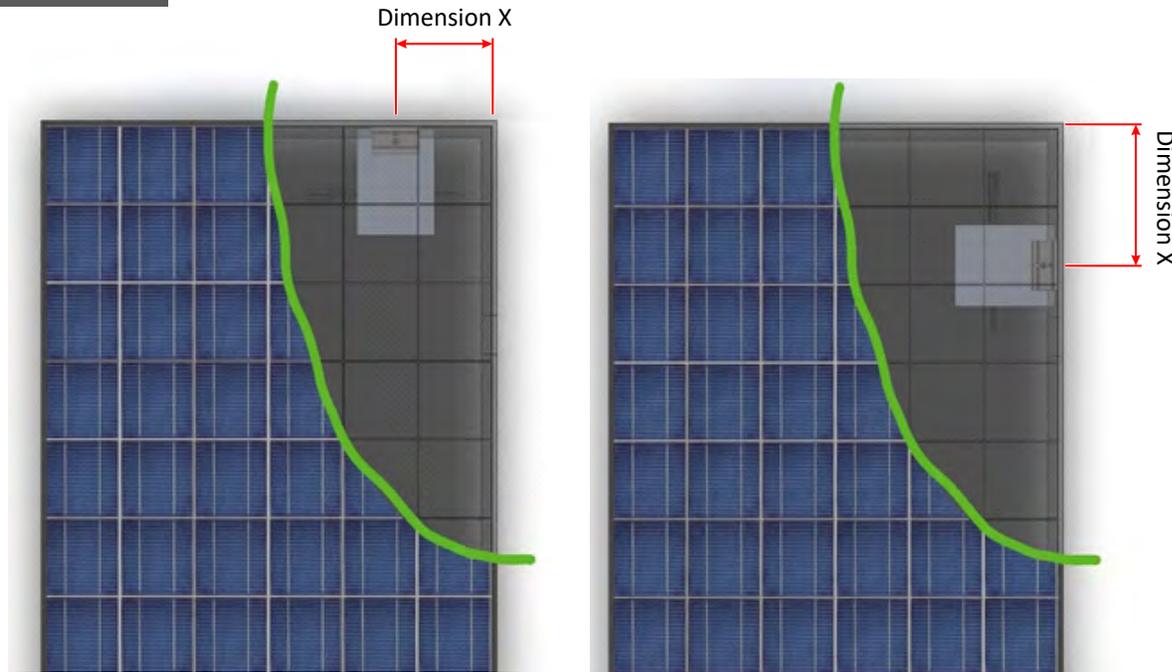


Figure 1: Dimension "X" ≤ 12 inches

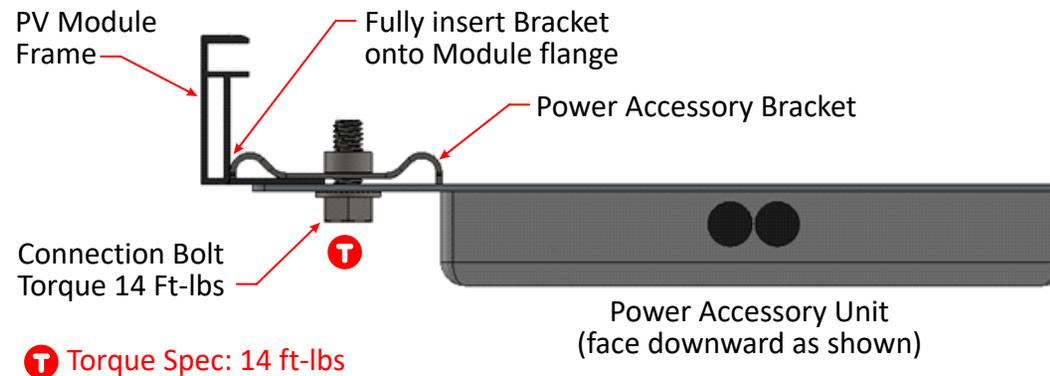


Figure 2: Power Accessory Bracket Installation

The Ecolibrium Solar Power Accessory Bracket is tested to meet the UL2703 standards for grounding and bonding, and is compatible with any UL2703 solar racking system. In addition, the Power Accessory Bracket provides an adequate system ground path through power accessories with integrated grounding systems.

The Power Accessory Bracket is easily installed, and provides a secure, UL2703 approved bonded connection when installed according to the following criteria:

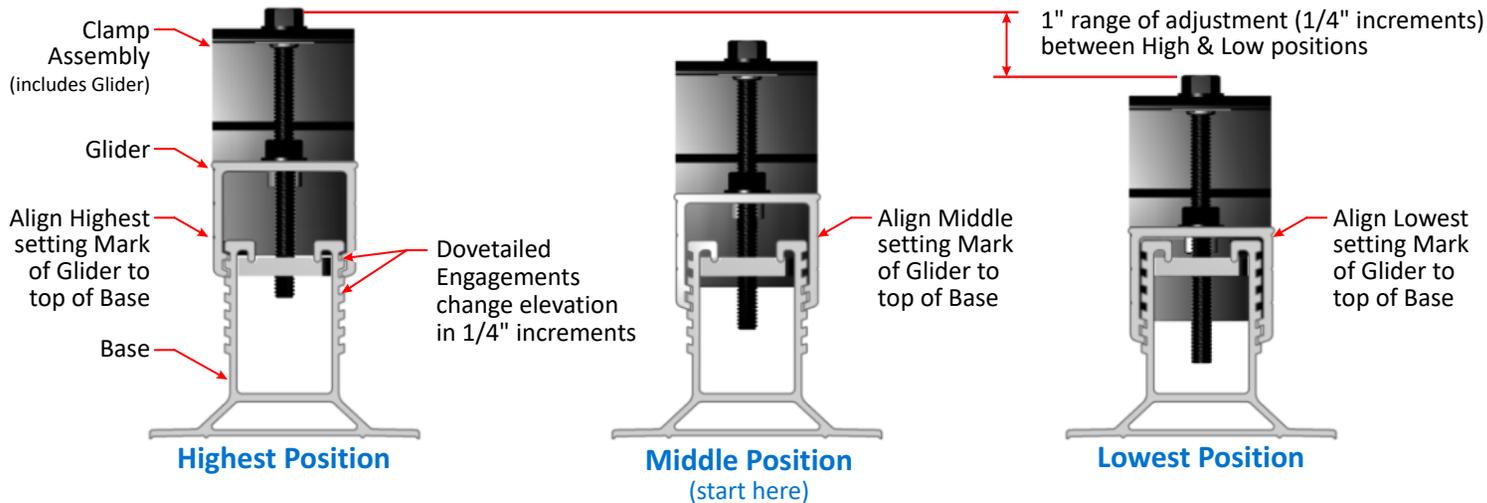
- The center of the bracket (installation bolt) must be placed within 12 in. of the corner of the PV module, as shown in Figure 1 (power accessory unit may be installed on short edge of PV module as well as on long edge as shown)
- The bracket must be fully inserted onto the return flange of the PV module (See Figure 2)
- The power accessory unit must face downward as shown in Figure 2
- The connection bolt must be tightened to a torque value of 14 ft-lbs as shown in Figure 2

Additionally, when the Power Accessory Bracket is used to install an Enphase unit with integrated grounding, the connection provides a UL2703 certified system ground path with a maximum OCP rating of 20 A.

(For more information, please contact the Ecolibrium Solar sales team at 1-720-249-1877)

# Appendix F: Installing the Skirt-Less Clamp Assemblies

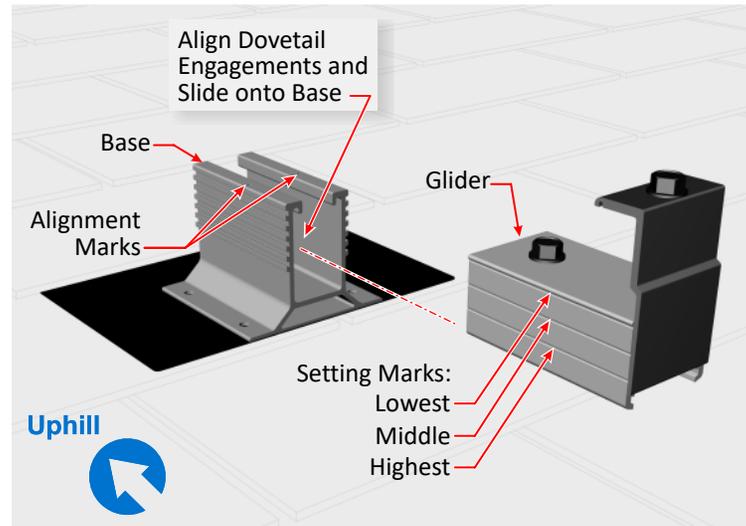
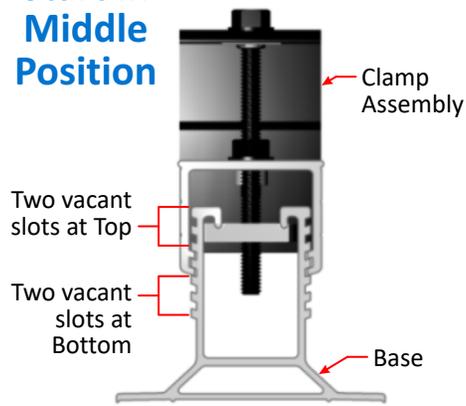
## 1a. How to Set the Clamp Assembly Height via the Glider



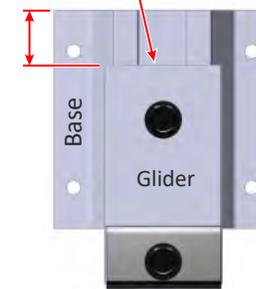
Height settings are made by utilizing the 5-position dovetailed engagements of the Glider-to-Base. The image to the left shows three of these positions. 1" range of travel is possible in 1/4" increments. This equates to 1/8" variation from Glider to adjacent Glider to adjustment and compensate for irregular or undulating roof tops. Start by setting the Glider on the end-of-row Clamps to their middle position and then adjust other Clamps along the row as needed to level the row.

## 1b. Install the Clamp Assemblies

**Start in Middle Position**



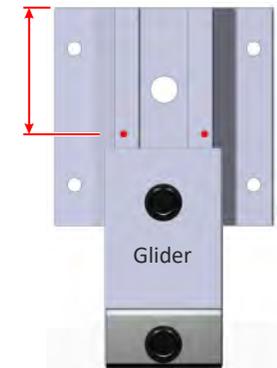
Set Glider at Approx. 1 inch



**Uphill**



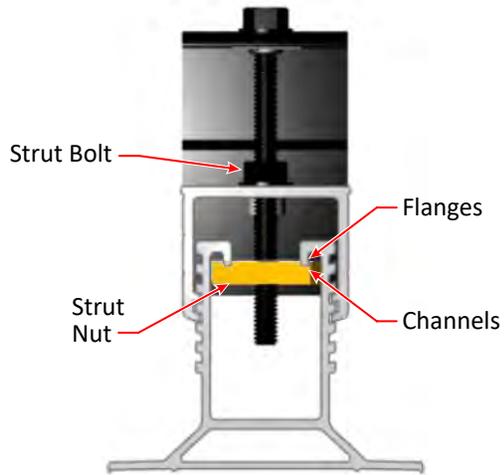
Acceptable range for uphill edge of Glider.



**⚠ This Glider is aligned outside of the acceptable range and must be repositioned.**

## App. F: Install the Skirt-Less Clamp Assemblies (cont.)

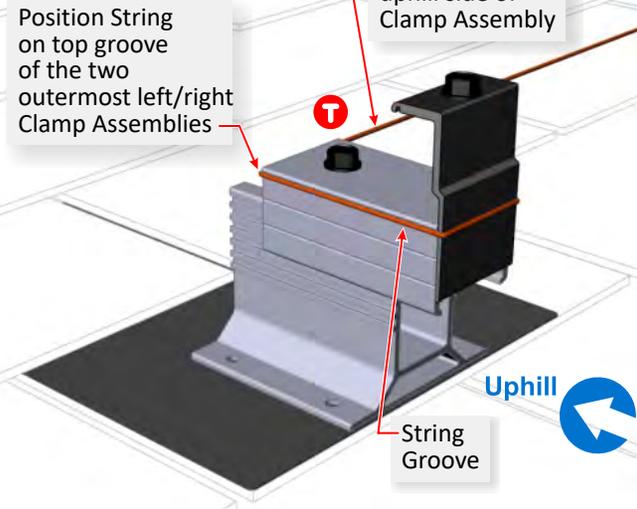
### 1c. Engage Strut Nut with Base



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. Further tightening will be done as the Modules are installed.

## App. F: Level and Align the Skirt-Less Clamp Assemblies

### 2a. Run a E-W String Line

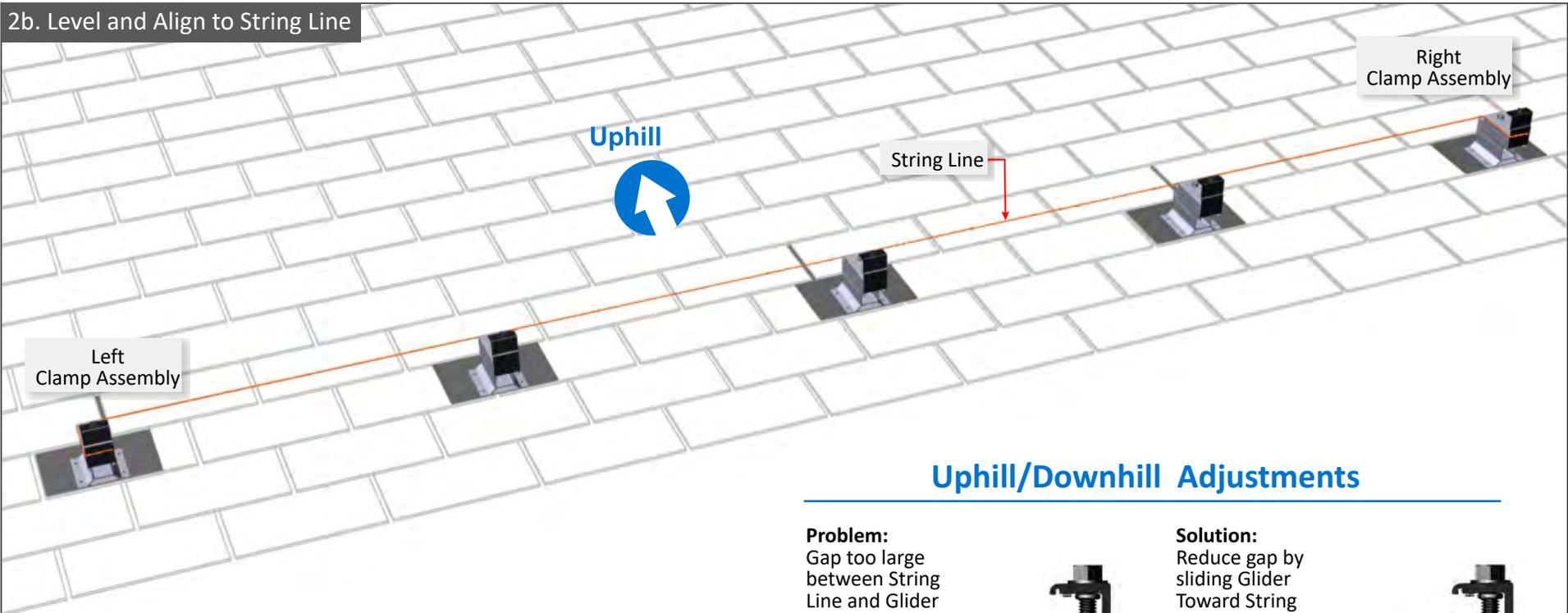


A String Line is used to level and align Clamp Assemblies on the first downhill row only. The body of the Glider includes one "String Groove" specifically designed to assist with this process. Run and secure the String Line between the two outermost left/right Clamp Assemblies. Place String on the top String Grooves, pulling it taught and securing its ends.

**T** Torque to: 14 ft-lbs

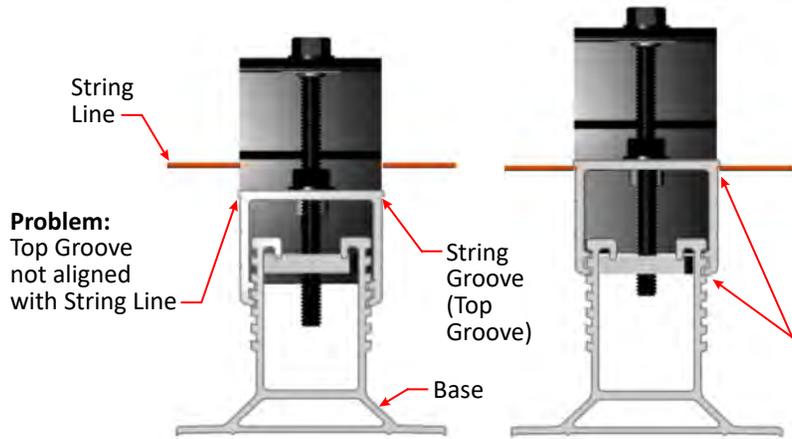
# Appendix F: Level and Align Clamp Assemblies (cont.)

## 2b. Level and Align to String Line

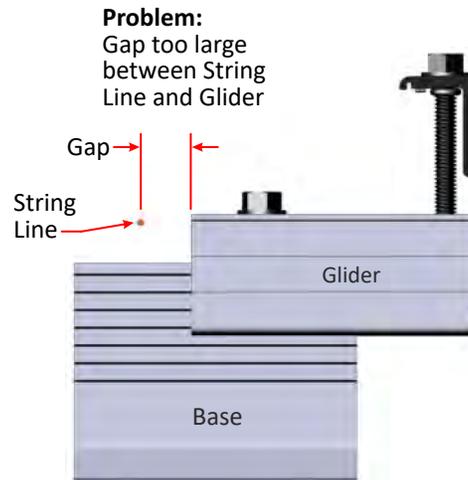


### Uphill/Downhill Adjustments

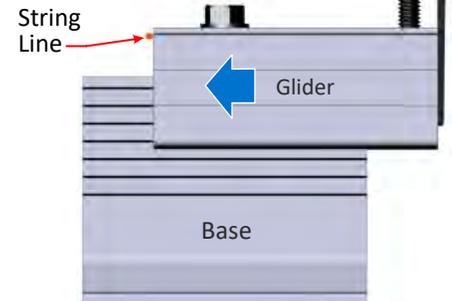
#### Height Adjustments



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

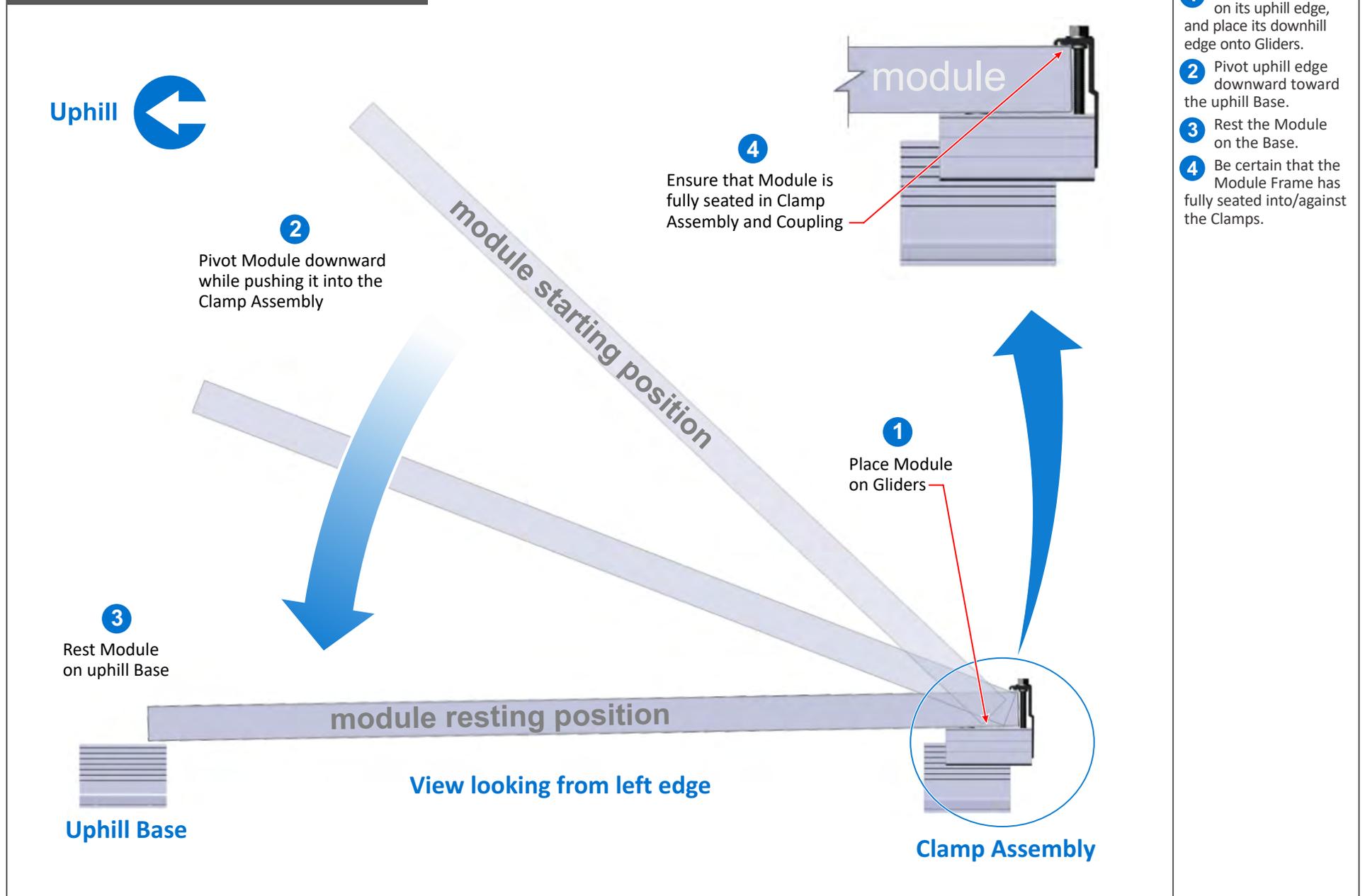


**Solution:**  
Reduce gap by  
sliding Glider  
Toward String  
leaving a gap  
of 1/16" or less



## Appendix F: Install Modules

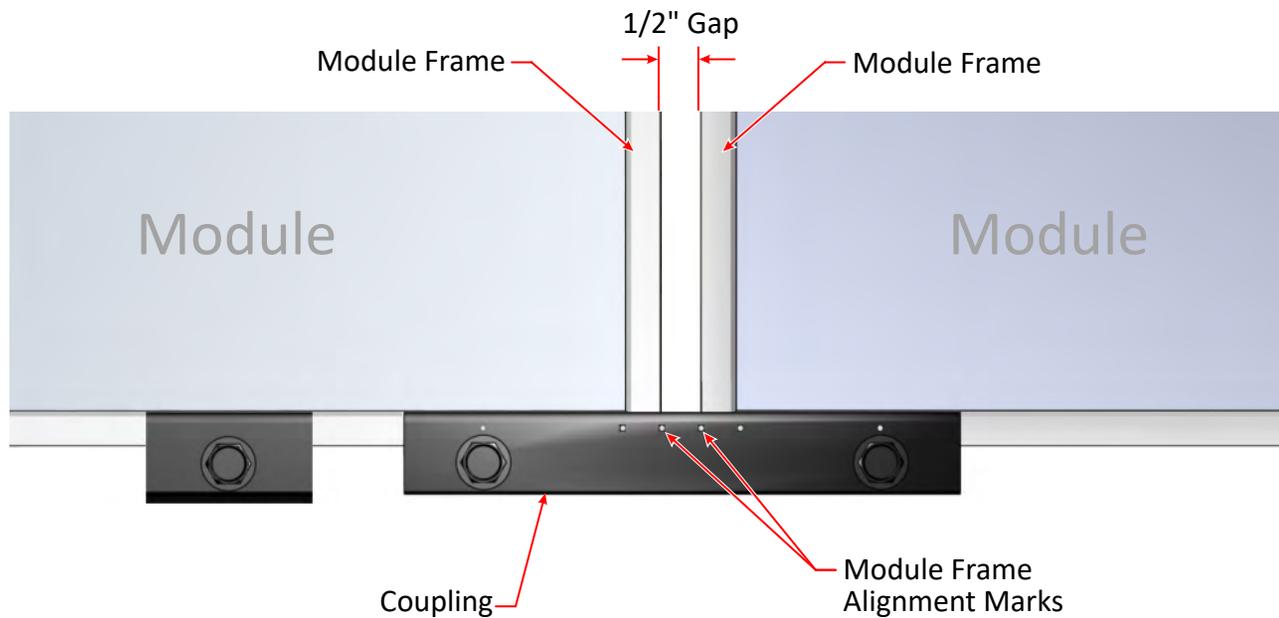
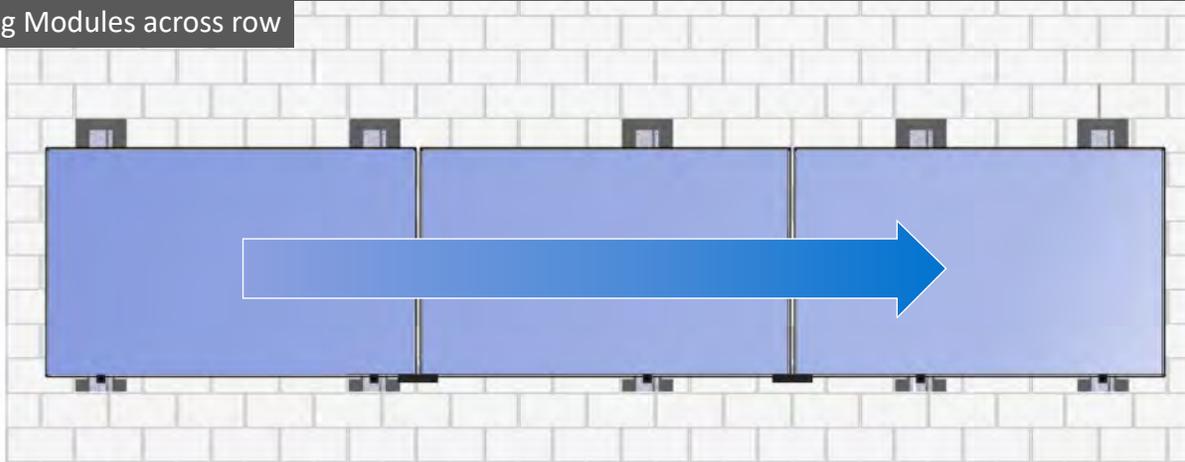
### 3a. Pivot Modules into Clamps & Couplings



## Appendix F: Install Modules (cont.)

### 3b. Continue installing Modules across row

Uphill



Note: See following step on installing the Coupling.

Working across the row set the Modules in place while leaving a 1/2" gap between them. Set the gap by the alignment marks on the Coupling(s) and aligning the Module frames to these marks.

#### Wiring

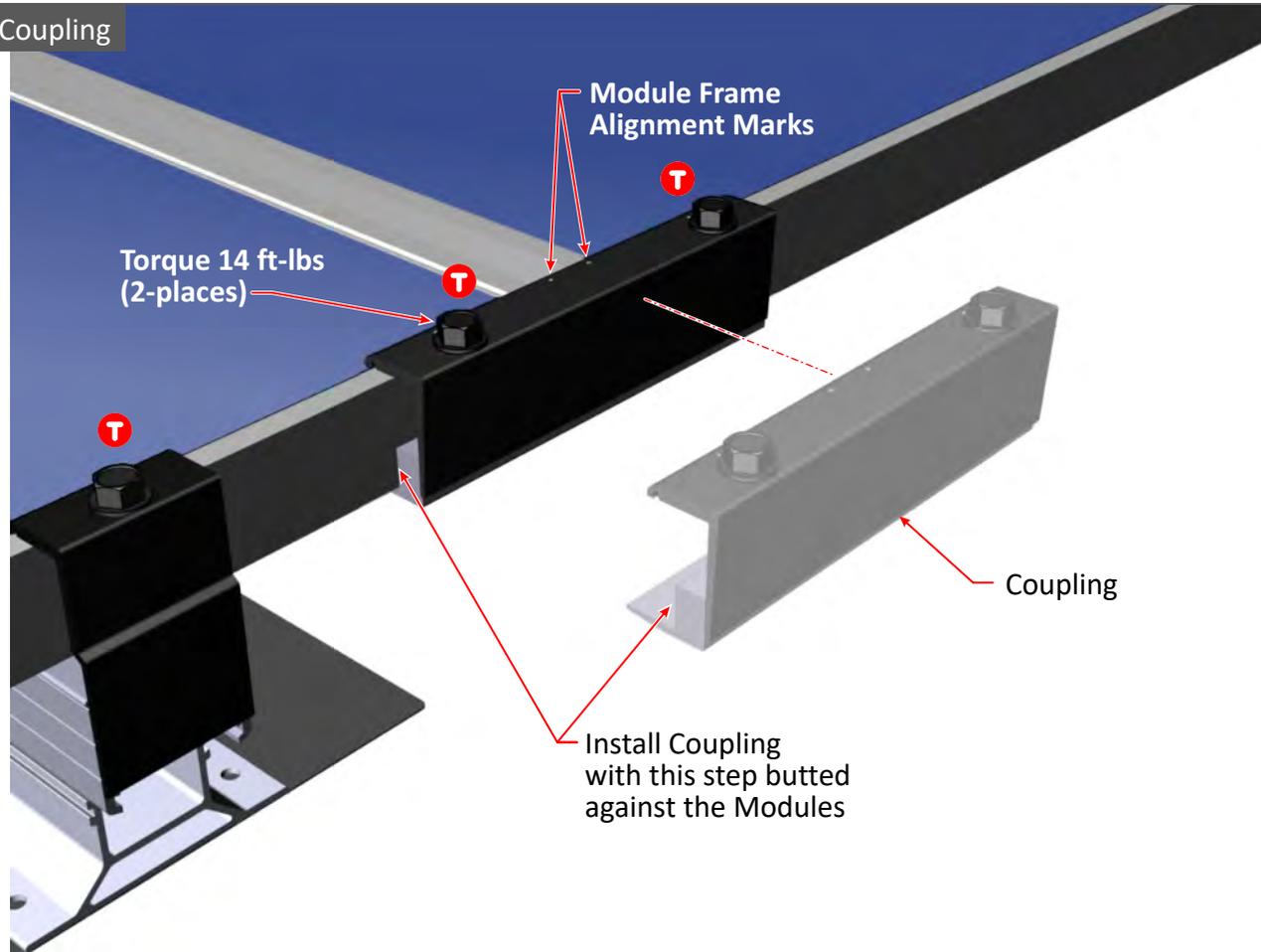
As each row of Modules is installed, complete all wiring connections and verify that all wire management clips and wires are properly arranged and off the rooftop before proceeding to the next row of Modules.

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

## Appendix F: Install Modules (cont.)

### 3c. Installing the Coupling

Uphill



Install Coupling as shown utilizing its alignment marks to set the gap of the Modules. Tighten the two bolts and torque to 14 ft-lbs. After installing the Couplings return to step 9c and continue the installation process.

**T** Torque to: 14 ft-lbs

### 4. Apply UL 2703 label

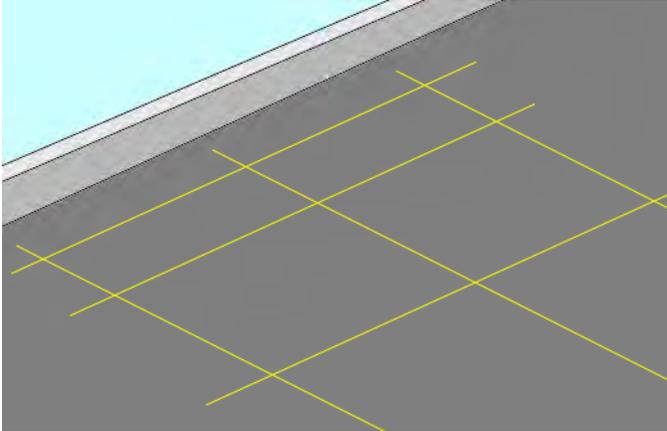
For Skirt-Free EcoX installations, apply one UL 2703 label per sub-array. Follow the instructions included along with UL 2703 labels in every box of End Couplings.

# Appendix G: Installing EcoX on a Membrane Roof

## Installing EcoX using Commercial Membrane Roof Attachments

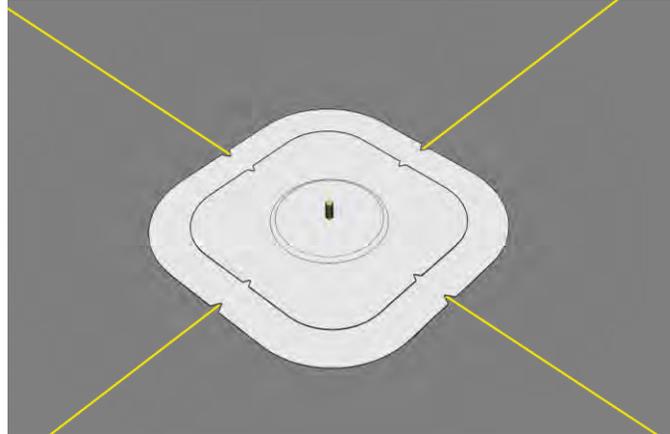
### 1. Determine attachment locations:

Plan out the array on the roof and mark the location of each clamp using a chalk line or other appropriate method.



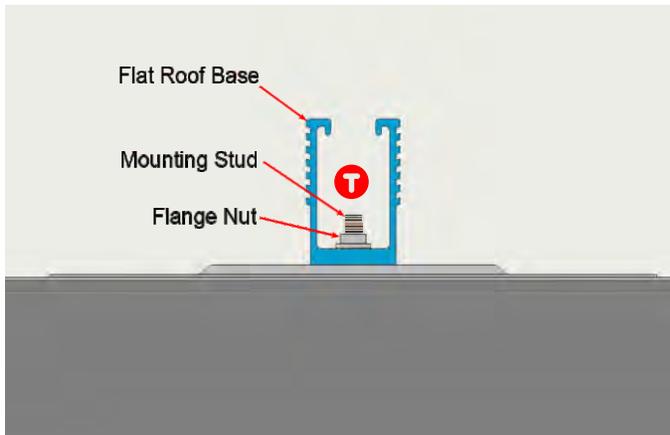
### 2. Install attachment flashings according to the manufacturer's requirements:

Install each attachment with the mounting stud centered on the locating mark from step 1.



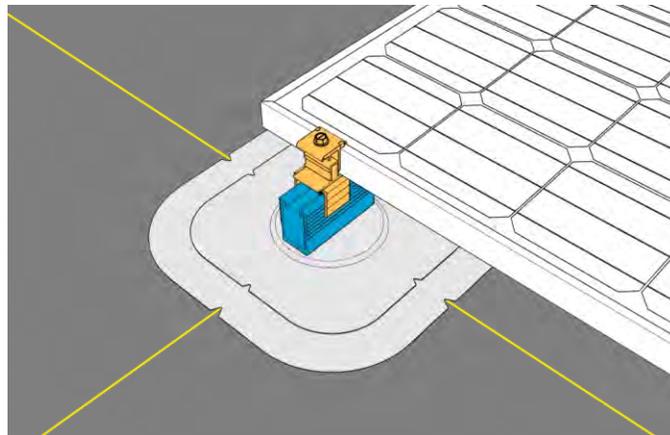
### 3. Install the Flat Roof Base to the mounting stud:

Place the mounting hole of the Flat Roof Base (ES10274) over the mounting stud and secure with the included Serrated Flange Nut. Tighten the nut to 14 ft-lbs.



### 4. Install modules and other components:

Follow the instructions starting with section 6 on page 11 to complete the assembly.



Plan out the array on the roof and mark the location of each clamp using a chalk line or other appropriate method. Install each attachment with the mounting stud centered on the locating mark from step 1. Place the mounting hole of the Flat Roof Base (ES10274) over the mounting stud and secure with the included Serrated Flange Nut. Tighten the nut to 14 ft-lbs. Follow the instructions starting with section 6 on page 11 to complete the assembly.

**T** Torque to: 14 ft-lbs

**!** Consult the manufacturer of the attachment flashing in use to obtain proper installation instructions.