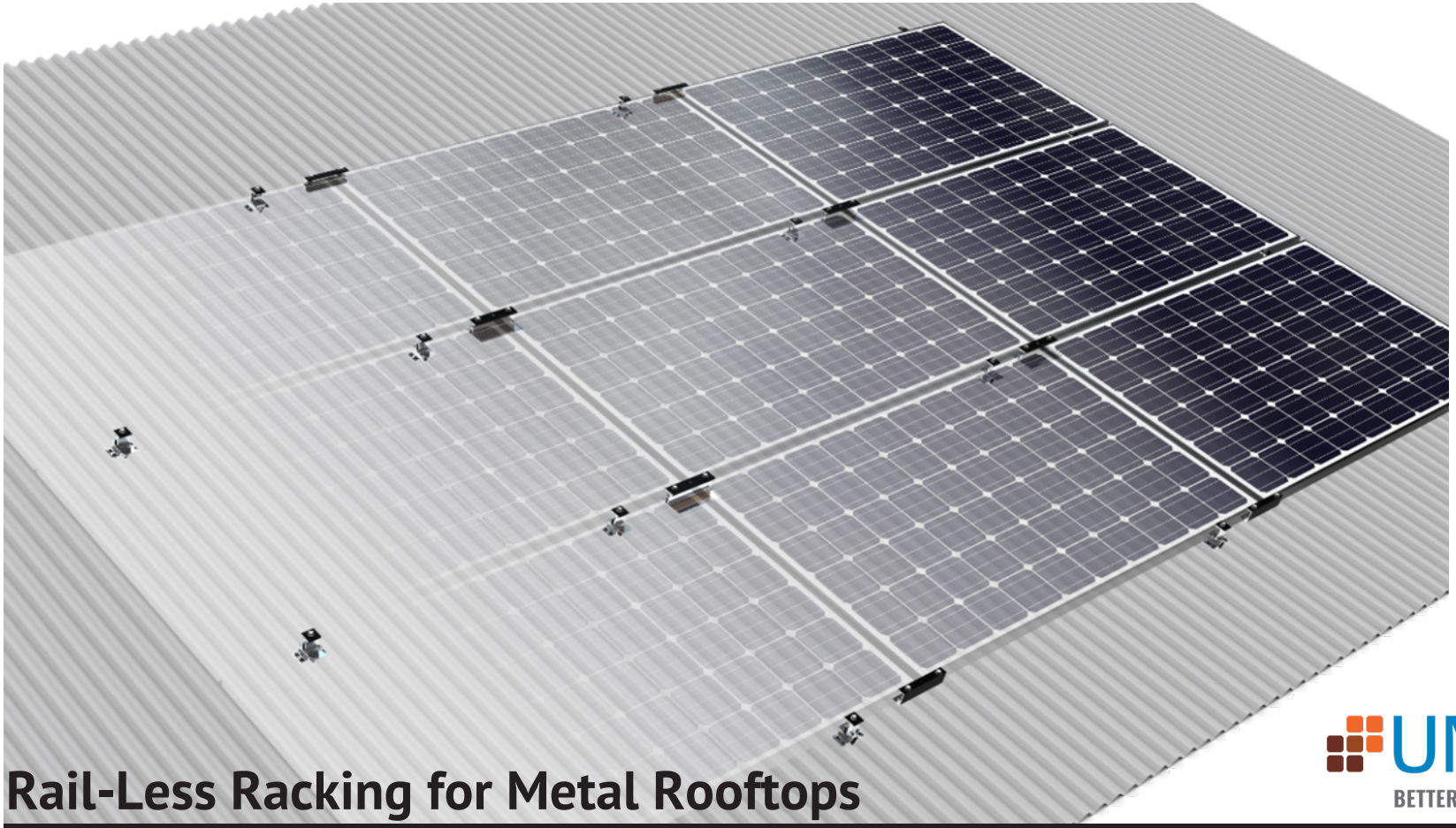
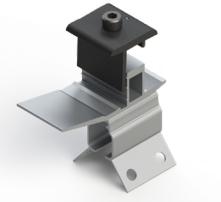
METALX
ROCKING METAL ROOFS EVERYWHERE

INSTALLATION GUIDE



Corrugated



R-Panel

Standing Seam

UNIRAC®
BETTER SOLAR STARTS HERE

Rail-Less Racking for Metal Rooftops

UNIRAC Code-Compliant Installation Manual

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PUB2024AUG23

METALX
ROCKING METAL ROOFS EVERYWHERE

INSTALLATION GUIDE

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Introduction

MetalX is the economical choice for corrugated, standing seam, and R-panel metal rooftops. The entire MetalX Racking System consists of XClamps, Couplings, and Roof Attachments. Components fit every module thickness ranging from 30 – 46mm, so any module can be installed on every metal roof.

MetalX utilizes EcoX Universal technology, the No. 1 Rail-less Racking System. By eliminating the mounting rail and offering simple components and organized wire management, MetalX provides a fast installation. Small components enable the transport of up to 300kW on 1 standard pallet, streamlining logistics. The combination of simplicity and efficiency makes MetalX Rail-Less Racking ultra cost-effective.

Field Support Contact Information

Unirac proudly offers dedicated engineering expertise and superior customer support. For questions about the installation procedures or a specific application, please contact our Field Support Specialists at FieldSupport@Unirac.com.

Installer Responsibility

Installer is solely responsible for:

- Ensuring all necessary safety equipment, installation methods and procedures are used as required by applicable rules and regulations, including OSHA safety standards.
- Complying with all applicable local and national building codes, including any that may supersede this manual.
- Meeting municipal, utility and inspector requirements.
- Ensuring that Unirac's MetalX and other products are appropriate for the specific installation and are designed for the installation environment.
- Confirming that the roof is adequately secured, and all building structural support members, connections, can support the array under all conditions and can withstand forces resulting from MetalX installation.
- Maintaining the waterproof integrity of all existing roof materials.
- Ensuring safe installation of all electrical aspects of the system
- Verifying all design criteria are correct and appropriate for the application and specific site
- Following all manufacturer's specifications, recommendations and manuals
- Checking that only UNIRAC approved materials are utilized during MetalX installation
- Guaranteeing array installation is completed by qualified and competent personnel
- Verifying all equipment and materials are appropriate for application and site conditions
- Determining that PV module is approved for use with MetalX and capable of withstanding the project specific conditions.
- UNIRAC recommends periodic re-inspection of the installation. Any deviations from the installation requirements of this guide are to be addressed immediately.

Warnings and Safety

Knowledge of electrical and roofing is required to correctly and safely install a solar photovoltaic system. Only qualified and certified installation professionals should install MetalX. Failure to follow the methods and procedures outlined in this guide may result in injury and/or damage to property.

MetalX components fit together tightly and could cause pinch injuries
MetalX components may be hot to the touch if left in the sun.

Disclaimer of Liability

UNIRAC does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of, or in any way connected with installation, operation, use, or maintenance by using this manual.

UNIRAC assumes no responsibility for any infringement of patents or other rights of third parties, which may result from use of modules. No license is granted by implication or under any patent or patent rights. The information in this manual is believed to be reliable but does not constitute an expressed and/or implied warranty.

UNIRAC reserves the right to make changes to the product, specifications, data sheets and this manual without prior notice. This document is not prescriptive regarding safety and does not purport to address all the safety concerns that may arise with its use. Contractors should become familiar with all applicable safety, health, and regulatory requirements before beginning work.

Unauthorized field modification of UNIRAC components or assemblies may affect UNIRAC warranty coverage.

MetalX General Application Notes

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

Site Specific System Design: UNIRAC provides site specific project layout, design package with engineering specs and bill of materials. To begin your array layout and obtain attachment spacing, bill of materials, and engineering analysis visit Unirac.com or contact sales at Sales@Unirac.com.

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

- Corrugated
- Standing Seam
- R-Panel

Wind Zone: MetalX mounting requirements are based on location specific wind speed values based on local building code. Refer to site-specific layout to determine requirements for a specific job site or contact sales at Sales@Unirac.com.

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

Roof Pitch: MetalX is designed to mount photovoltaic modules on roof surfaces between 0 and 90 degrees from horizontal.

Roof Zones: MetalX is designed to mount photovoltaic modules on roof surfaces in all roof zones.

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.

MetalX Certifications

MetalX Rail-Less Racking has been tested in accordance with the ANSI/UL2703 Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels. This testing standard includes subjecting samples of the racking to temperature and humidity cycling to simulate component aging, electrical bonding tests on all system components, system grounding tests, tests to verify that use of the system does not increase the risk of fire, and module-specific mechanical load testing.

UL2703 Qualification: In cases where UL 2703 certification is required, the MetalX system conforms to the UL2703 Standard for grounding and bonding, mechanical loading, and fire ratings. The MetalX system may be used to ground and/or mount a PV module complying with UL1703 only when the specific module has been evaluated for grounding and /or mounting in compliance with the included instructions. Specific modules evaluated and approved as part of UL2703 certifications can be found on ***pages 34 to 35***.

Module Types: MetalX is certified to be installed with standard framed PV modules according to the approved module list.

Mechanical Loading: MetalX is certified to UL2703 for mechanical loading. Tested modules are listed in “MetalX Install Guide Appendix - UL2703 Qualification,” which is located on our website: www.unirac.com. Contact Unirac.com to determine span requirements for specific jobsite.

Fire Testing: MetalX is certified to UL2703 Fire Resistance Standard with the following requirements:
• Instructions in this guide must be followed.
• The MetalX system must be mounted over a fire-resistant or non-combustible roof covering rated for the application
• Modules may be installed in landscape or portrait orientation.
For pitches greater than 2:12 (9.46 degrees):
• MetalX is certified to Class A with Type 1 and 2 modules.
For pitches less than 2:12 (9.46 degrees), aka “flat” or “low-slope“roofs:
MetalX is certified to Class A with Type 1 modules.

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

This racking system may be used to ground and/or mount a PV module complying with UL1703 or UL61730 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

Installation Requirements: This install guide officially documents the components used and proper methods for an MetalX installation. Bonding elements are incorporated into MetalX 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 MetalX.

UL2703 System Label: To document the UL2703 system rating, Installers shall apply a label to each array during installation as instructed in ***Step 9***. The label should be applied to the back of the uphill side of the East-most End Coupling Upper on the array's North edge. Following is an example of the label.

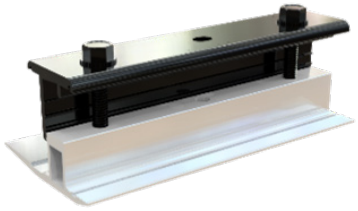
The Date Code ABCYZZ shown above will appear on production parts, letters defined as follows:

- 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

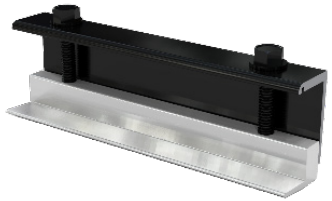
1 XClamp End
(P/N: ES10828/ S10835)

2 XClamp Mid
(P/N: ES10829/ ES10836)

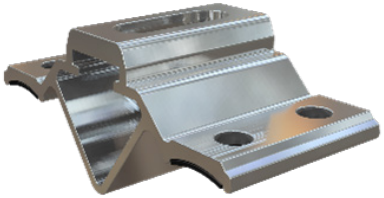
3 Coupling
(P/N: ES10616/ ES10924)



4 End Coupling (P/N: ES10146)



5 Corrugated Roof Attachment
(P/N: ES10830)
S-5! CorruBracket 100T
(Includes M8 Flange Nut)



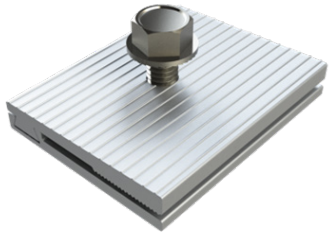
Roofing Screw for Corrugated Attachment
(Sold Separately)

6 Standing Seam Roof Attachment (P/N: ES10674)
Standard Mount shown

7 R-Panel Roof Attachment
(P/N: ES10875, ES10877, ES10879, & ES10881)

RibBracket I-IV – Includes M8 Flange Nut and 4 roof screws

8 MLPE Tiger Clip (P/N: ES11212)



9 Bonding Jumper
(P/N: ES10201)

Tools Required

- Tape Measure
- String Line
- Calibrated torque wrench
- ½" Socket
- 3/16" Allen Bit (Standing Seam Only)
- 5/16" Hex Drive (CorruBracket and RibBracket Only)

Torque Settings

1. **14 ft-lbs** for Bolt through XClamp, Couplings and End Couplings
2. Roof Attachments have specific torques and vary based on roof material thickness. See Roof Attachment manufacturer's instructions.

Note: 1. All parts in this page with bonding features are certified for single-use only.
2. P/N: means Part Number

10 **5/16” Serrated Flange Bolt (P/N: ES10003)**

11 **M8 Bolt & Washer**

M8 BOLT &WASHER	
PART NUMBER	**DESCRIPTION**
ES10889	BOLT, CAP HEX, M8 X 55
ES10890	BOLT, CAP HEX, M8 X 60
ES10891	BOLT, CAP HEX, M8 X 65
ES10892	BOLT, CAP HEX, M8 X 70
ES10893	BOLT, CAP HEX, M8 X 75
ES10894	WASHER, M8

System Core Component Overview

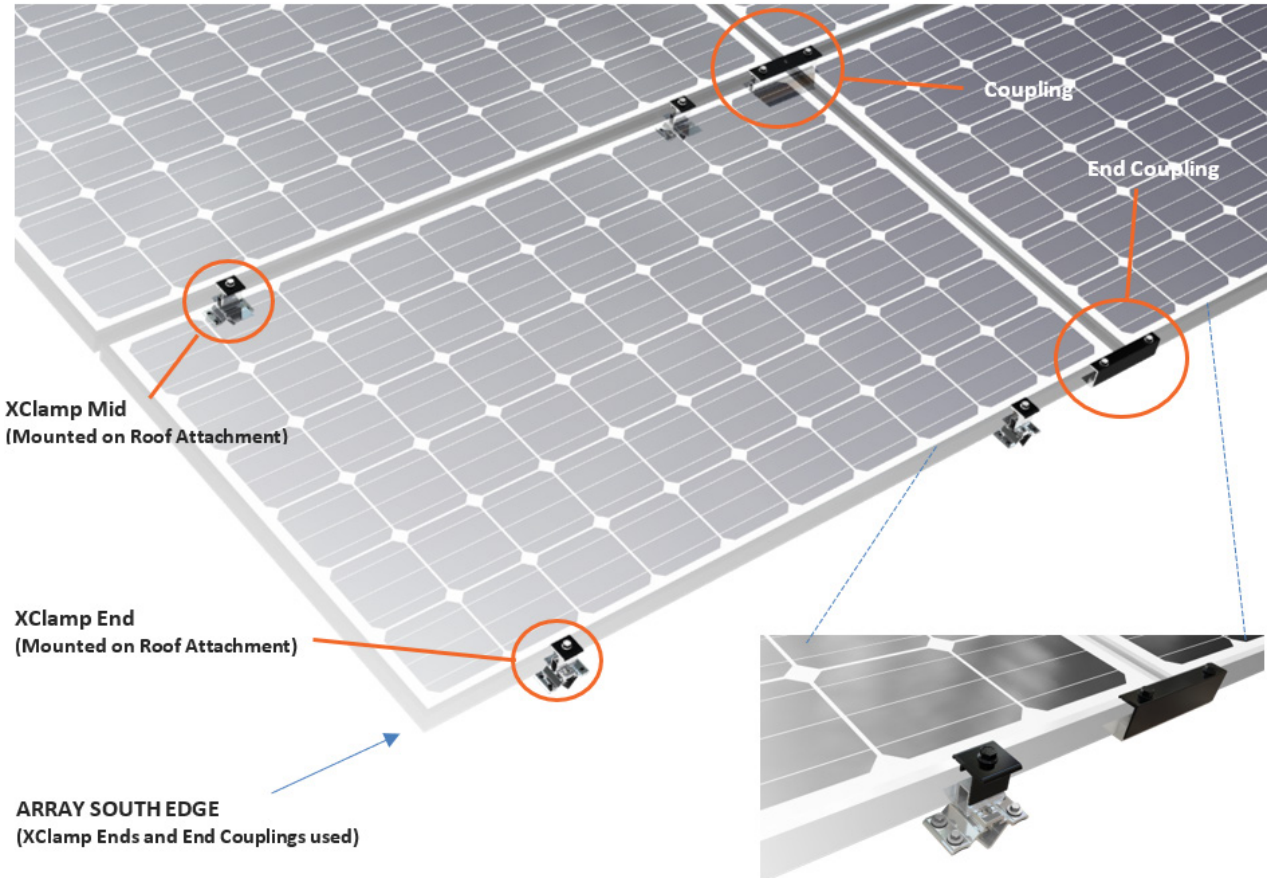
The illustration shows the typical configuration of MetalX Racking System securing PV modules to metal roofs. Mounting components required for this configuration are XClamps plus Roof Attachment for specific metal roof type (corrugated, standing seam, or R-panel), and Couplings.

Use XClamp Ends and End Couplings on array's uphill and downhill Edge.

Use XClamp Mids and Couplings between rows of modules. XClamp Mids and Couplings secure modules uphill and downhill of component.

Note: Specific site project plans may specify only XClamps plus Roof Attachments and no Couplings. Refer to job-specific system design

System Component Overview

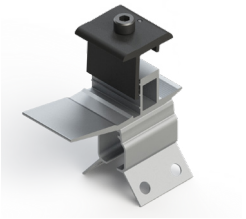


Roof Attachment Options

Corrugated

Standing Seam

R Panel

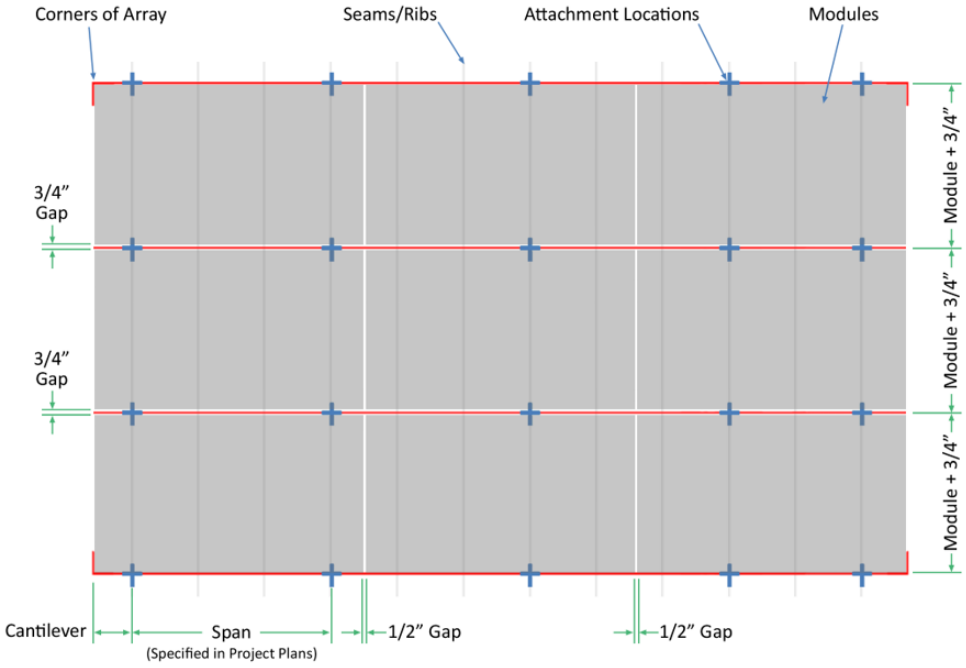


Step 1 – Mark Array Layout on Rooftop

Refer to project plans and mark array footprint. Look for obstructions on the rooftop that could prevent complete and correct installation of array. Start from south edge. When possible, allow 18" working clearance downhill of the array's south edge. Use module dimensions to:

- Include a ½" gap between columns of modules
- Include a ¾" gap between rows of modules
- Start from south edge. When possible, allow 18" working clearance downhill of the array's south edge. Use module dimensions to:
- Include a thermal break gap between modules every 50 ft or according to site specific maximum continuous array dimension provided in project design.
- Mark attachment row locations.

Layout Array



Tips

• When possible, allow 18" working clearance downhill of the array's south edge.

• Ensure attachment locations meet and do not exceed MetalX design specifications on allowable spans and cantilever distances.

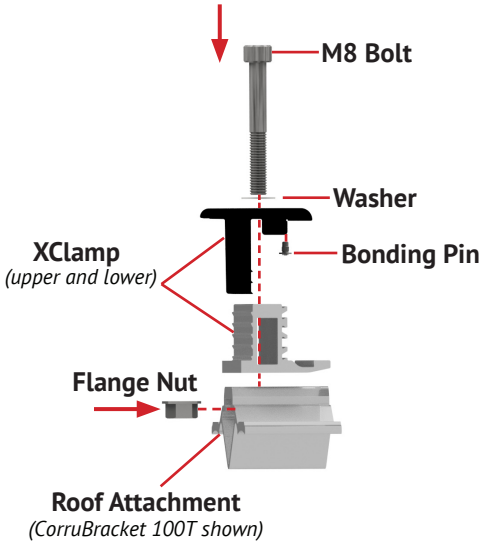
• Refer to project plan for maximum allowable span and cantilever.

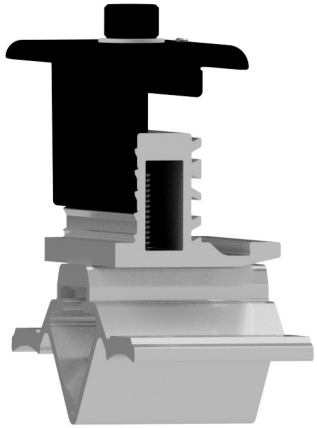
Step 2 – Assemble Attachments for Array

- Assemble XClamp Ends and Roof Attachments for use on array South and North Edge.
- Assemble XClamp Mids and Roof Attachments for use in all other locations.
- Follow assembly instructions below for your specific Roof Attachment.

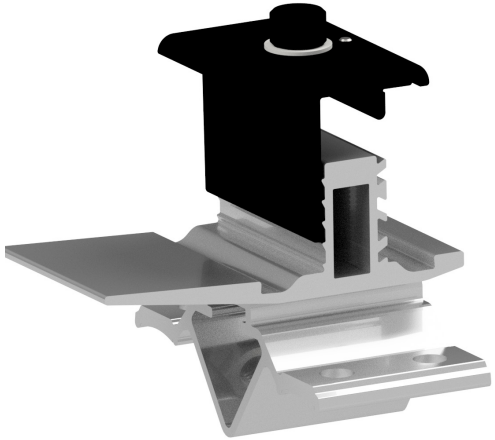
S-5! CorruBracket 100T or S-5! RibBracket I-IV

1. Slide M8 Flange Nut into bracket channel of Roof Attachment.
2. Insert M8 Bolt through washer, Upper, and Lower XClamp through Bracket slot, and thread into M8 Flange Nut.





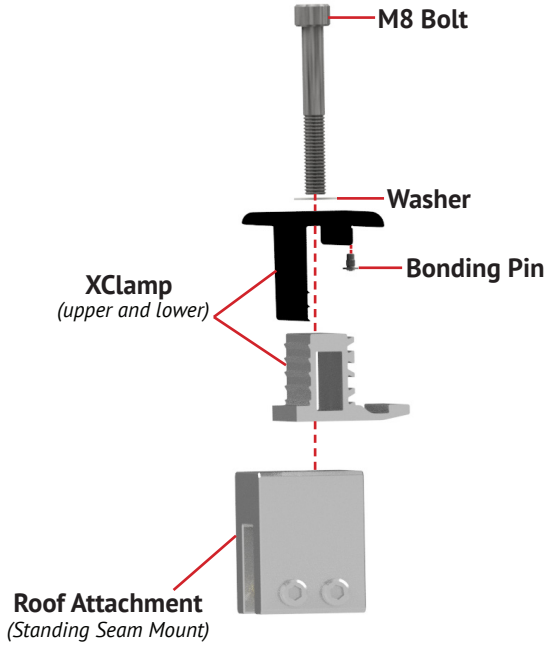
XCLAMP END ASSEMBLED
(XClamp End and CorruBracket 100T)

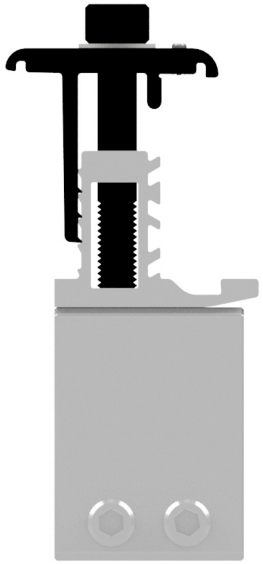


XCLAMP MID ASSEMBLED
(XClamp Mid and CorruBracket 100T)

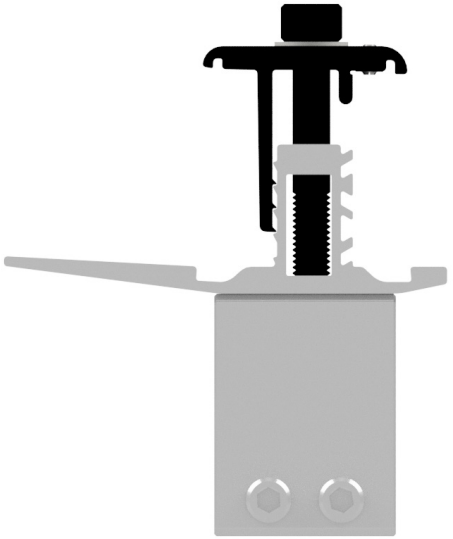
Standing Seam Mount

Insert bolt through washer, Upper, and Lower XClamp, and thread into Standing Seam Mount.





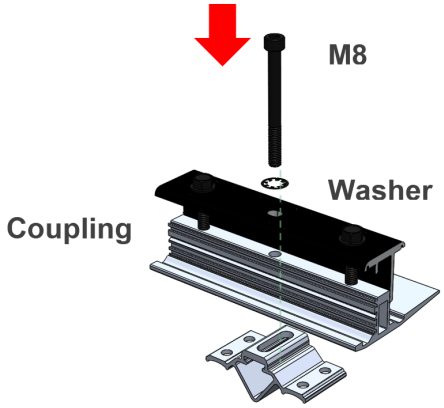
XCLAMP END ASSEMBLED
(XClamp End and Standing Seam Mount



XCLAMP MID ASSEMBLED
(XClamp Mid and Standing Seam Mount

How to Use Coupling instead of XClamp

When an attachment falls where two modules meet, the XClamp may be replaced with a Coupling.
Assemble Coupling to Roof Attachment as shown to the right.



Roof Attachment (*CorruBracket 100T shown*)

Step 3 – Install Prepped Roof Attachments on Array South Edge

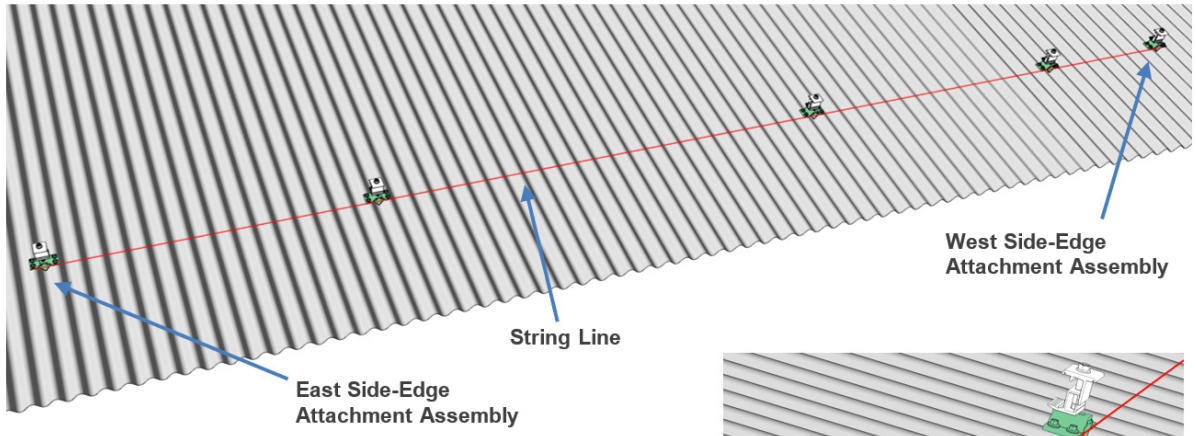
3.1. On south edge of the array's bottom row, install one Attachment at the east and west side-edges of the array. To ensure row is straight, use string line between side-edge Attachments.

3.2. Refer to Site Specific Project Design report for horizontal spacing of remaining bottom row XClamp/Roof Attachments. Do not exceed the maximum allowable span between XClamps or cantilever from XClamp to unsupported module edge.

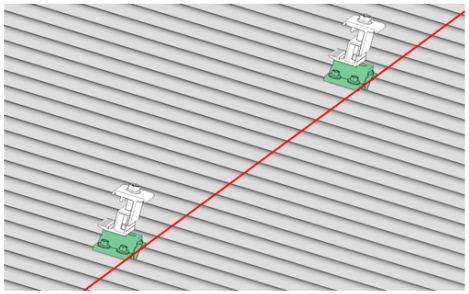
3.3. To install Roof Attachment, refer to manufacturer's installation instructions. Navigate by clicking product name below.

S-5! Components – ***https://www.s-5.com/***

Standing Seam Mount – ***https://solarconnections.com/***



ARRAY SOUTH EDGE

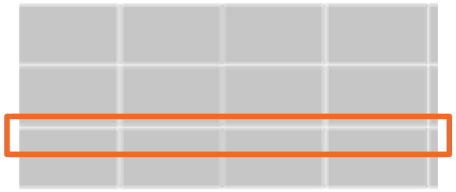


SIDE VIEW
(XClamp End and CorruBracket 100T)

Step 4 – Install Second Row of Attachments.

Important: Install rows of attachments as rows of modules are installed. Do not install all rows of attachments in case measurements are slightly off

4.1. Use XClamp Mids and your specific Roof Attachment on the second and subsequent attachment rows where an additional Module row will be installed.
4.2. Determine location of second row of Attachment Assemblies by measuring module dimension + 3/4" uphill from bottom row of attachments, as shown in Step 1.
4.3. Follow the installation instructions on the following pages for your specific Roof Attachment.



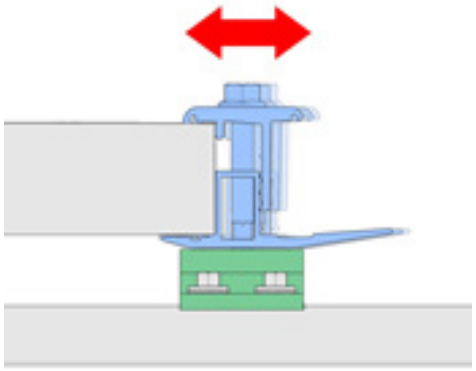
Second Row of Attachments

RibBracket I-IV and CorruBracket 100T

These Roof Attachments have North/South adjustability, which allows second row Attachment Assemblies to be installed before modules are placed.

- Install Attachment Assemblies before placing Modules.
- First, install east and west side-edge Attachment Assemblies at each end of second row. Ensure Long Flange of XClamps Mids face uphill.
- Install remaining second row Attachment Assemblies, using string line to ensure row is straight.
- See illustrations below.

RibBracket I-IV and CorruBracket 100T



- Install Attachment Assemblies before placing modules.
- Ensure Long Flange of XClamp Mid faces uphill.

Torque XClamp Bolt to 14 ft-lbs.

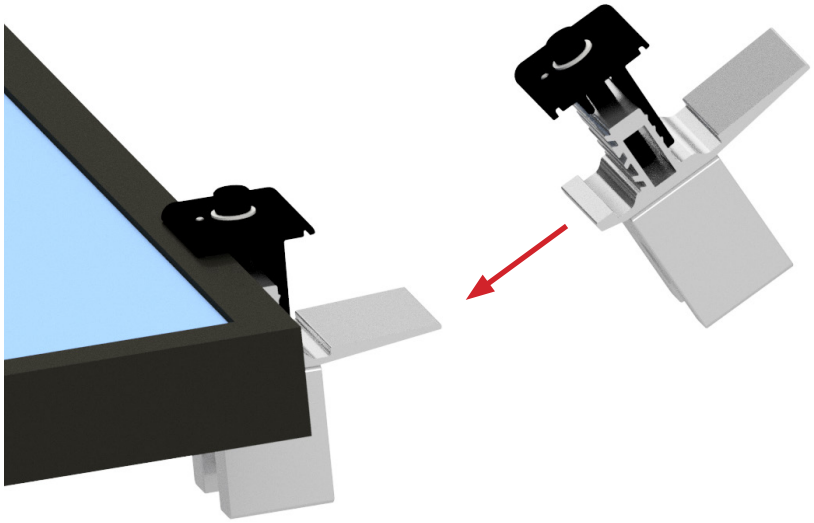
- Slot in top of CorruBracket and Rib-bracket enables North/South adjustments.

Standing Seam Mounts

Install Standing Seam Mount/ XClamp Attachment Assembly to roof as you install Modules to ensure accurate placement of Seam Mount.

- Ensure Long Flange of XClamps Mids face uphill.
- Refer to Step 5 for Module and End Coupling installation instructions.

Standing Seam Mounts



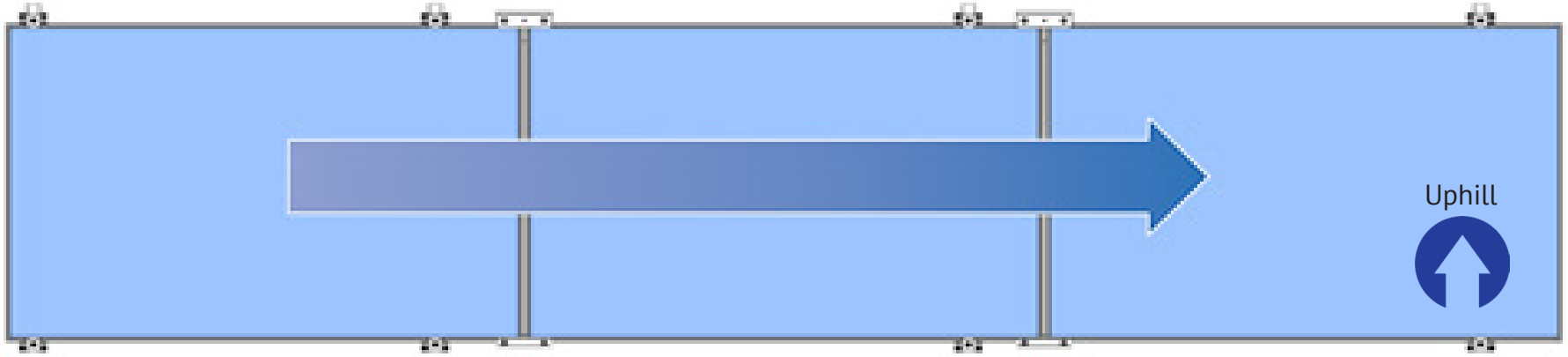
- Install Standing Seam Mount/ XClamp Attachment Assembly as Modules are installed.
- Standing Seam Mount can be adjusted North/ South as needed by loosening the set screws.
- Ensure Flange of XClamp Mid faces uphill.

Torque XClamp Bolt to 14 ft-lbs.

Note:
Affix Roof Attachment Bracket or Mount by following manufacturer's installation instructions

Step 5 – Install First Row of Modules.

5.1 Install South row of PV Modules by securing XClamp Ends and End Couplings to modules along downhill edge of array bottom row. Start at one end and work across south edge of array bottom row. Secure XClamp Ends to modules at attachment intervals specified on site-specific project plan.



5.2 Install End Couplings where two modules meet.

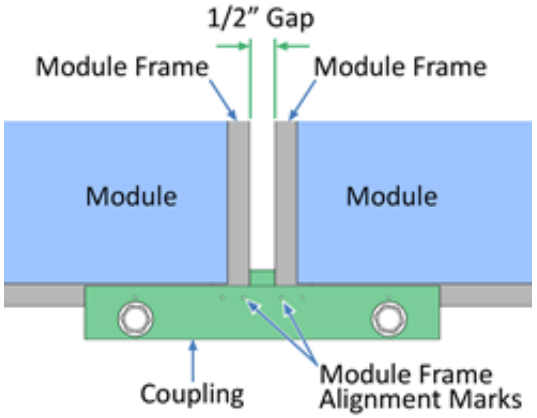
Between modules, set recommended ½" gap using alignment marks.

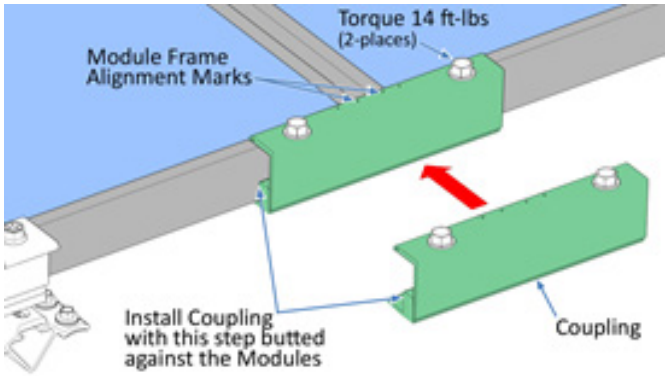
Leave a thermal expansion gap of at least ½" every 50 ft for temperature change of 150F or according to site specific maximum array dimension given in the project design and based on local climate.

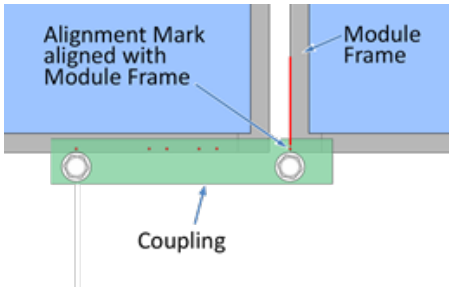
Ensure a minimum 1" overlap of End Couplings and Couplings on module frame.

When module corners are not metallic, coupling bolts must be attached on metallic part of frame, as shown below.

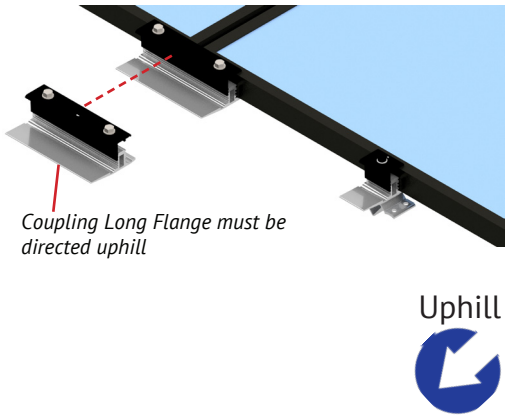
Torque each bolt on End Coupling and XClamp End to **14 ft-lbs**.



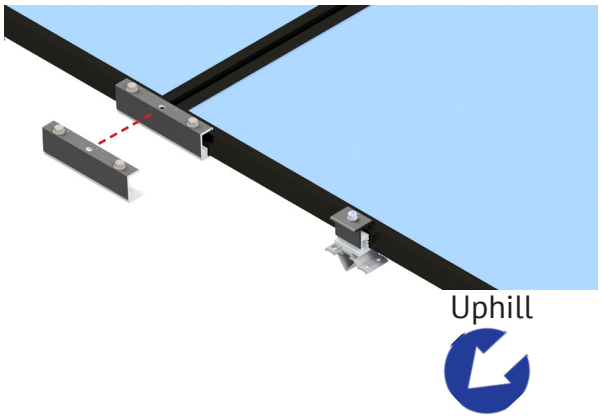




5.3 Move to top edge of first row of modules and secure XClamps and Couplings.

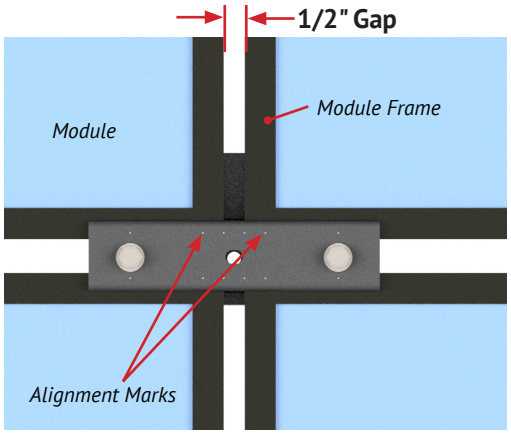


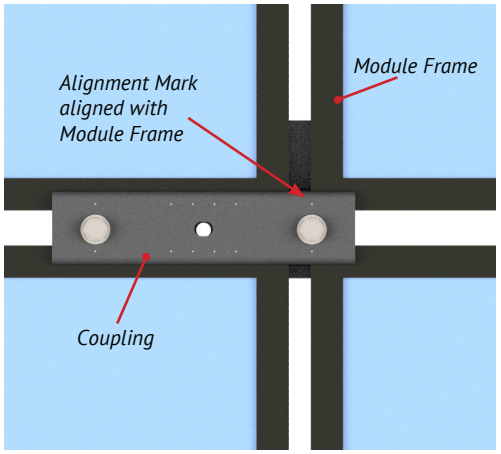
Secure Couplings on uphill edge of modules when an additional row will be installed.



Secure End Couplings on uphill edge of modules when an additional row will not be installed.

Align Couplings and End Couplings by using alignment marks to center component over ½" gap between Modules.





Installation Tips:

- Couplings and XClamp Mids, component Long Flange must point uphill.
- Use Coupling alignment marks to center Coupling over ½" gap between modules.
- Coupling can be adjusted left to right and offset of center, as shown in 5.2.
- Torque Coupling Bolts to 14 ft-lbs.

5.4 Complete wiring as each row of modules is installed.
Verify that all wire management clips and wires are properly arranged and off of the roof before installing next row of modules. Install home runs or trunk cable if needed. See ***Page 31*** for suggested routing and use of PV Clips.

Step 6 – Install Second Row of Modules

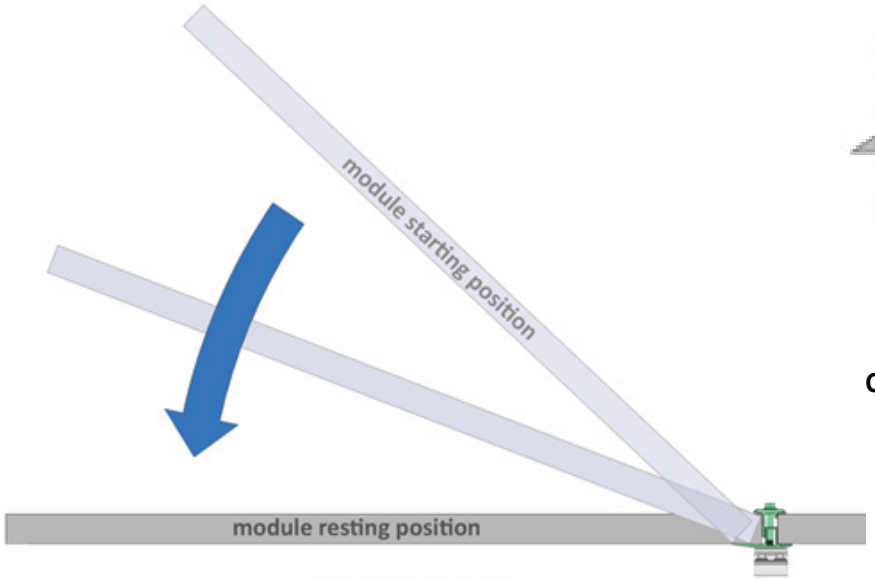
6.1 Determine placement of third row of Attachments prepped with XClamps.
Measure module dimension + ¾" uphill from second row of attachments.

6.3 Install third row of Attachments, following process in Step 5.

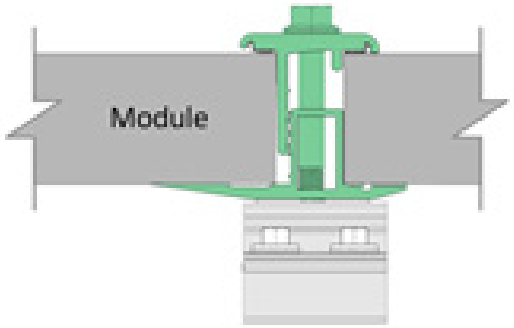
6.4 Drop-in Modules to second row of attachments.
- Hold module on uphill edge and place downhill edge on Long Flange of downhill XClamps and Couplings.
- Pivot module downward.
- Rest module on XClamp.
- Be certain module frame has fully seated into/against downhill XClamps and Couplings.

6.5 Secure XClamps and Couplings on top edge of row, as described in 5.3.

Drop-in Modules to Second Row of Attachment Assemblies.



View from left edge



Close-up View Prepped Attachment and Modules.

Step 7 – Complete Module Installation

7.1 Continue installing Attachment Assemblies, Module Rows and Couplings as described in the previous steps until array is complete.
Note: Use XClamp Ends and End Couplings on Array's uphill edge.

Step 8 – Complete Bonding

8.1 Preinstalled Bonding Pins in the Couplings and End Couplings bond modules left to right along the rows. Use Bonding Jumper to bond the system row-to-row. Row to row bonding must be completed in one location between every row and between every row of modules. Some installations do not use couplings, refer to specific project design. When Couplings are not used, a Row to Row Bonding Jumper must be used on every module to bond columns of modules together.

Columns of modules may be bonded together using:

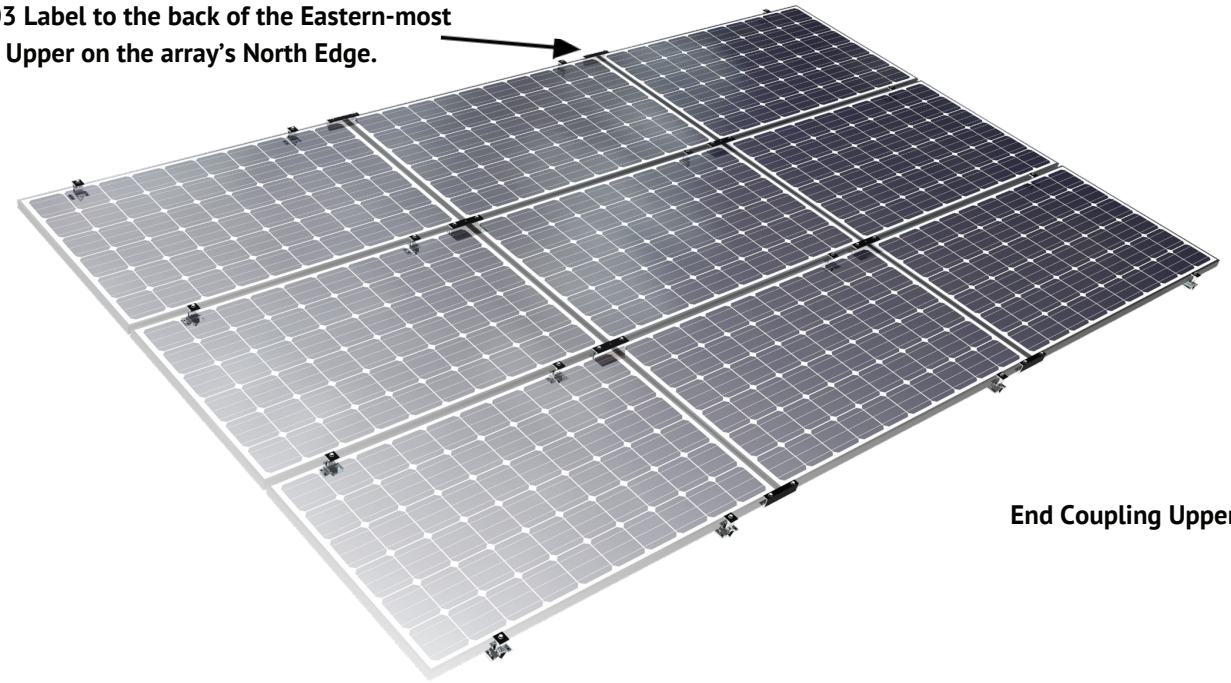
- End Couplings along the downhill edge of array.
- Bonding Jumpers along the uphill or downhill edge of the array.
- A ground lug on each column of modules with a continuous copper wire. Use a Bonding Jumper or ground lugs and copper wire to carry the bond across thermal breaks. See ***Page 22***.

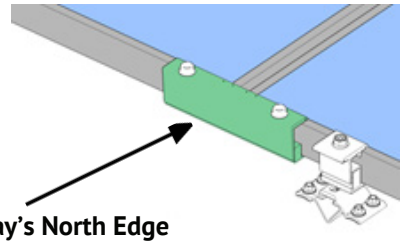
Note: Ensure bare copper wire is isolated from all aluminum components.

Step 9 – Apply UL2703 Label

9.1 The MetalX UL2703 Certification label is shipped with the product. Apply the label to the back of the uphill side of the East-most End Coupling Upper on the array's North edge.

Install UL2703 Label to the back of the Eastern-most End Coupling Upper on the array's North Edge.

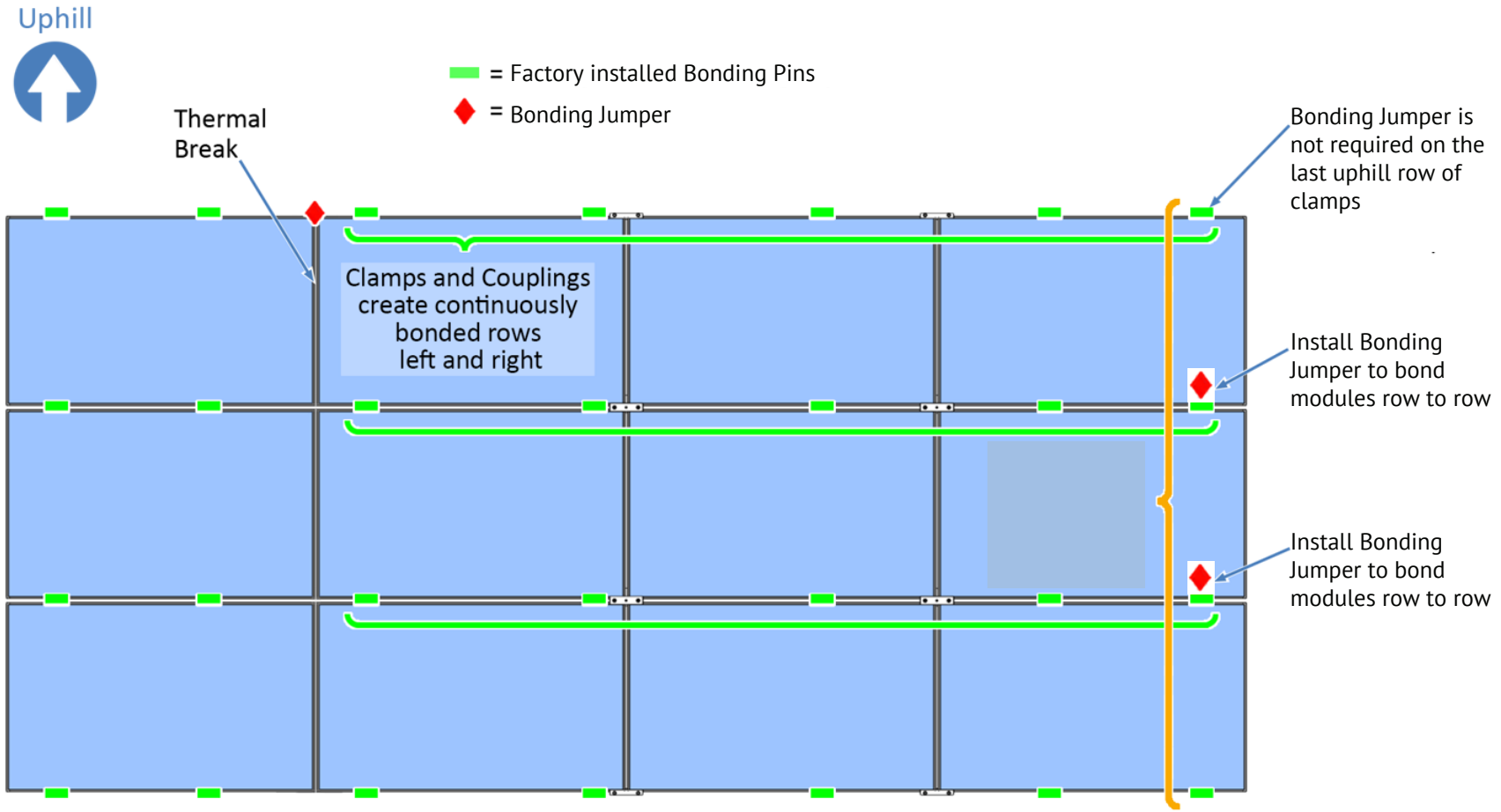




End Coupling Upper on array's North Edge

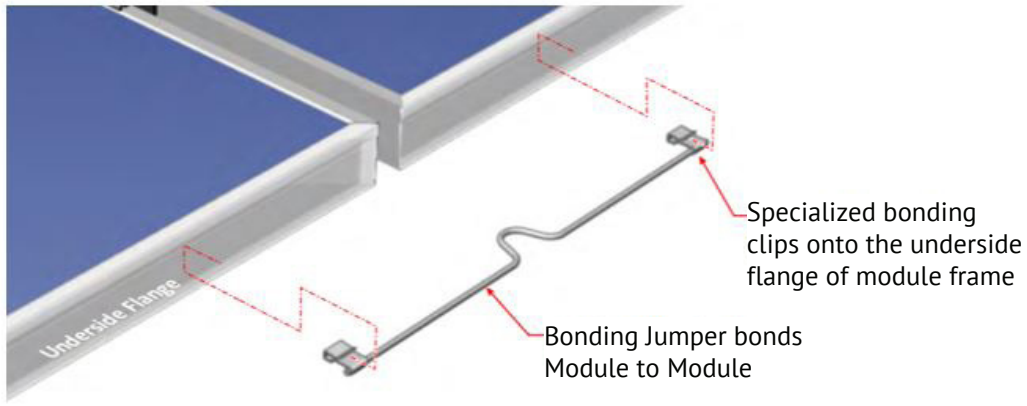
Uphill

Row to Row Bonding Within Array



Note: Bonding Jumper can be installed on either the right or left end of each row.

Bonding Jumper Installation:



NOTE

- **Fully seat bonding clip on each module flange to provide bond across N/S module gap.**
- **Bonding Jumpers are Single Use only**

Ground Lugs

Install a single ground lug to module frame on each array in a visible location. Follow Ground Lug and PV Module manufacturer's instructions when installing Ground Lugs. Use hardware and/or requirements provided by Ground Lug or PV Module Manufacturer.

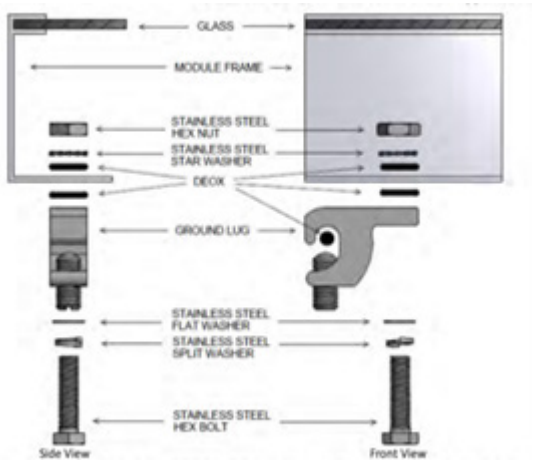
Each ground lug is to be grounded to the common ground identified for this system in accordance with the National Electric Code, ANSI/NFPA 70. Site specific plans are to identify grounding conductor size, type and temperature rating (if appropriate) as determined by a qualified engineer and approved 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.

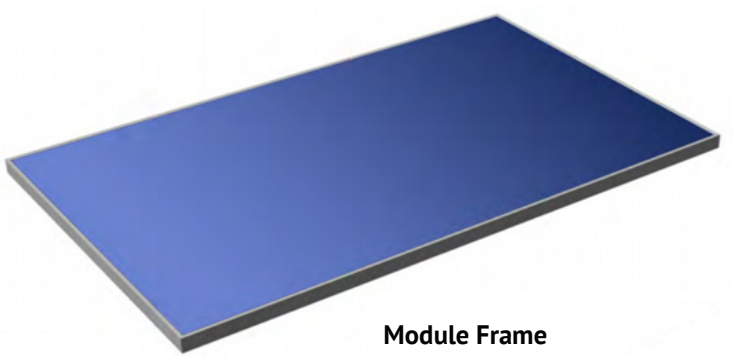
WEEB, ILSCO, or BURNDY Ground Lugs with a minimum of 10 AWG solid copper grounding conductor are recommended. Alternate Ground Lugs may be used.

Note: Ensure bare copper wire is isolated from all aluminum components.

ILSCO

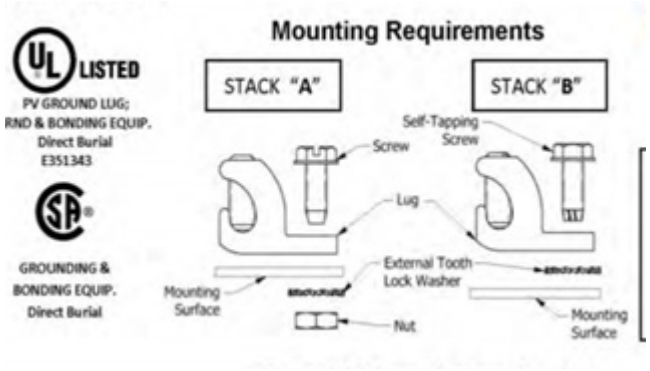


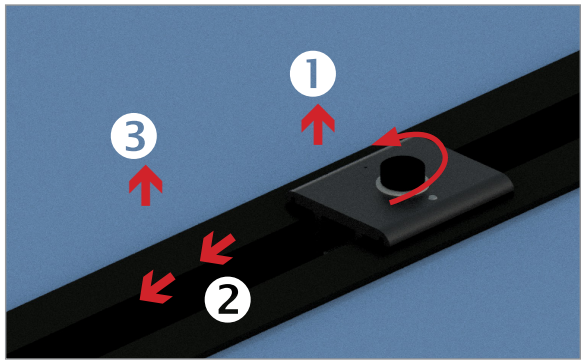
WILEY



Module Frame
(any location approved by Module manufacturer)

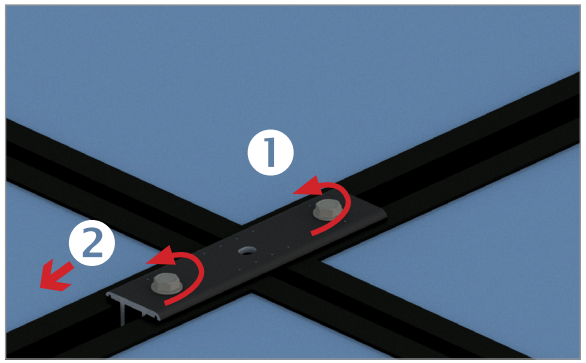
BURNDY





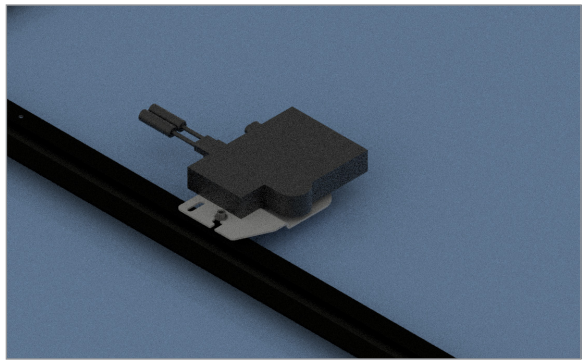
REMOVE XCLAMP MID CAPS:

1. Remove capbolt
2. Separate cap from base by moving east/west
3. Remove cap



SLIDE COUPLING:

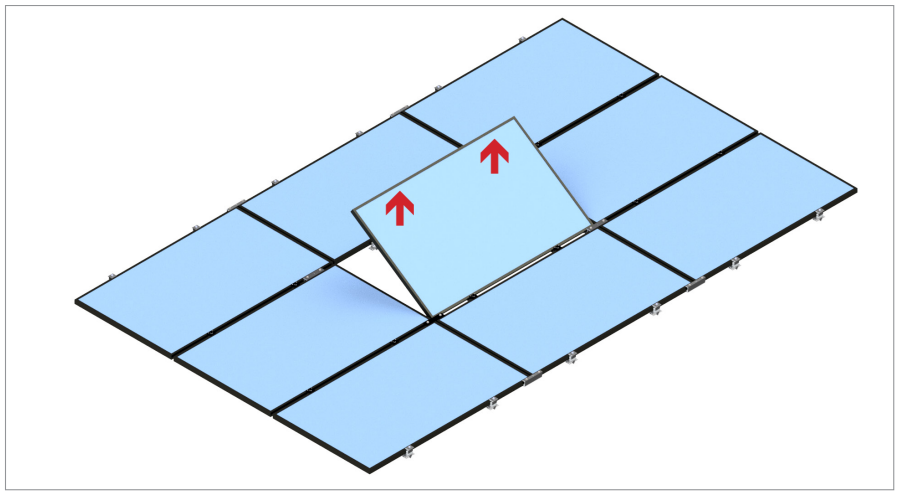
1. Loosen (2) cap bolts.
2. Slide entire coupling away from module being removed.



LIFT MODULE AND DISCONNECT MLPE CABLES

⚠ CAUTION

DO NOT FULLY REMOVE FASTENERS



REMOVE MODULE. REVERSE STEPS TO REPLACE MODULE REMOVED

BONDING NOTE:

- **If both sides of array are bonded with clamps, as recommended, then no additional bonding is required for module maintenance.**
- **If necessary, on the row of modules containing the module being removed, one additional bonding jumper can be added to the edge of the array opposite of the edge with bonding clips already installed. This is only necessary when the module removal would break the bonding path.**

⚠ CAUTION

- **Module removal may disrupt the bonding path and could introduce the risk of electric shock. Additional steps may be required to maintain the bonding path.**
- **Modules should only be removed by qualified persons in compliance with the instructions in this manual.**
- **When removing a module from the interior of a single row of modules, the adjacent modules must be bonded to maintain the bonding path.**

ELECTRICAL CONSIDERATIONS

METALX is intended to be used with PV modules that have a system voltage less than or equal to that allowable by the NEC. A minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary.

INTERCONNECTION INFORMATION

There is no size constraint beyond structural thermal expansion limits on how many SUNFRAME Microrails & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project. The grounding / bonding components may overhang parts of the array so care must be taken when walking around the array to avoid damage. Conductor fastener torque values depend on conductor size. 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 instruction

PERIODIC INSPECTION

Conduct periodic inspections for loose components, loose fasteners or any corrosion, immediately replace any affected components.

Wire Management and Accessories

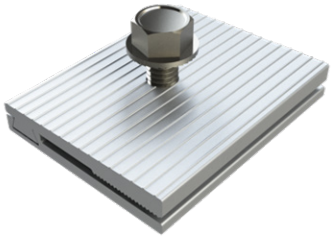
UNIRAC MLPE Tiger Clip

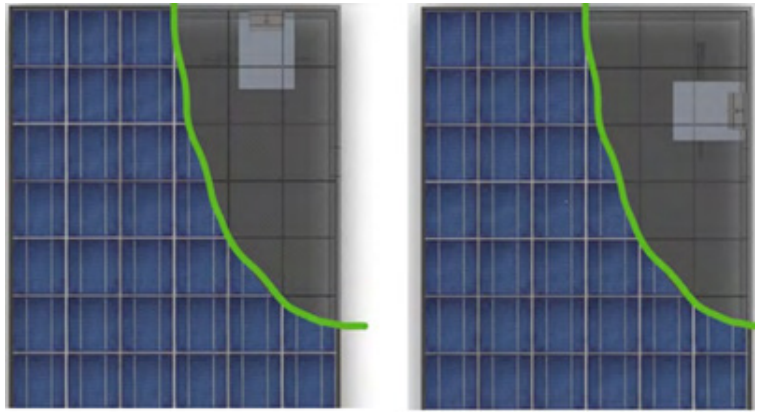
The UNIRAC MLPE Tiger Clip:

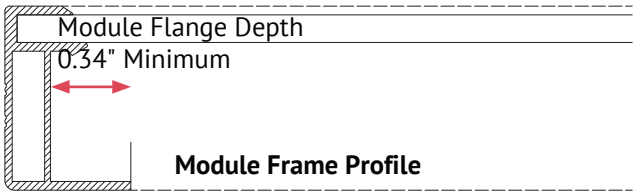
- Is tested to meet UL2703 standards for grounding and bonding.
- Is compatible with any UL2703 solar racking system.
- Provides an adequate system ground path through power accessories with integrated grounding systems.

For more information, please contact the UNIRAC sales team at sales@unirac.com.

MLPE Tiger Clip





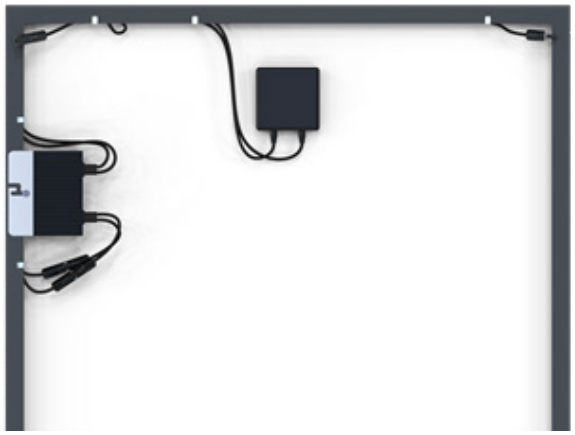


Module Frame Profile

The MLPE Tiger Clip provides a secure, UL2703 approved bonded connection when installed according to the following:

- Install center of bracket (installation bolt) within 12 in. of corner of PV module, as shown left. Power accessory unit may be installed on short or long edge of PV module.
- Fully insert bracket onto return flange of PV module as shown.
- The bonding feature needs to be completely engaged with the module return flange (requires at least 0.34" module return flange width).
- Ensure that the bonding feature does not get tightened into a hole or gap on the module return flange.
- See Tiger Clip Brochure for more detailed instructions.
- **Torque to 14 ft-lbs.**

How to Wire MetalX Array



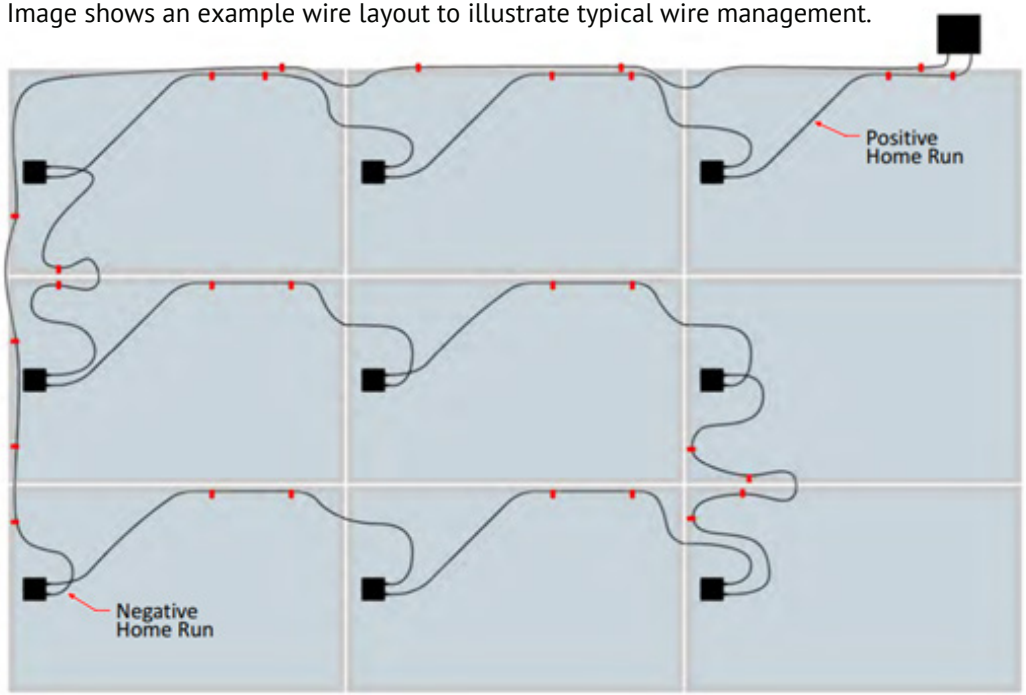
Prepare Modules as shown. This can be done as Attachment Assemblies are installed.
Finalize junction box location and string diagram as soon as array design is marked on the roof and confirmed.
Once Attachment Assemblies are installed, use Junction Box Bracket to mount junction box.
Use Power Accessory Bracket to mount micro inverters or power optimizers to Modules.

⚠ WARNING

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

Suggested Routing and use of PV Clips

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



PV Cable Clip

4 Wire Clip

Trunk Cable Clip

Thermal Expansion Allowance

When ambient temperatures fluctuate, thermal expansion and contraction occurs and can impact large arrays. To prevent impact to the array, install a thermal break every 50 ft for temperature change of 150F or according to site specific maximum array dimension given in the project design and based on local climate. Is tested to meet UL2703 standards for grounding and bonding.

• Install thermal expansion break array as shown to accommodate thermal expansion and contraction. Ensure each sub-array's left/right length “L” does not exceed 50 ft or the site specific maximum array width.

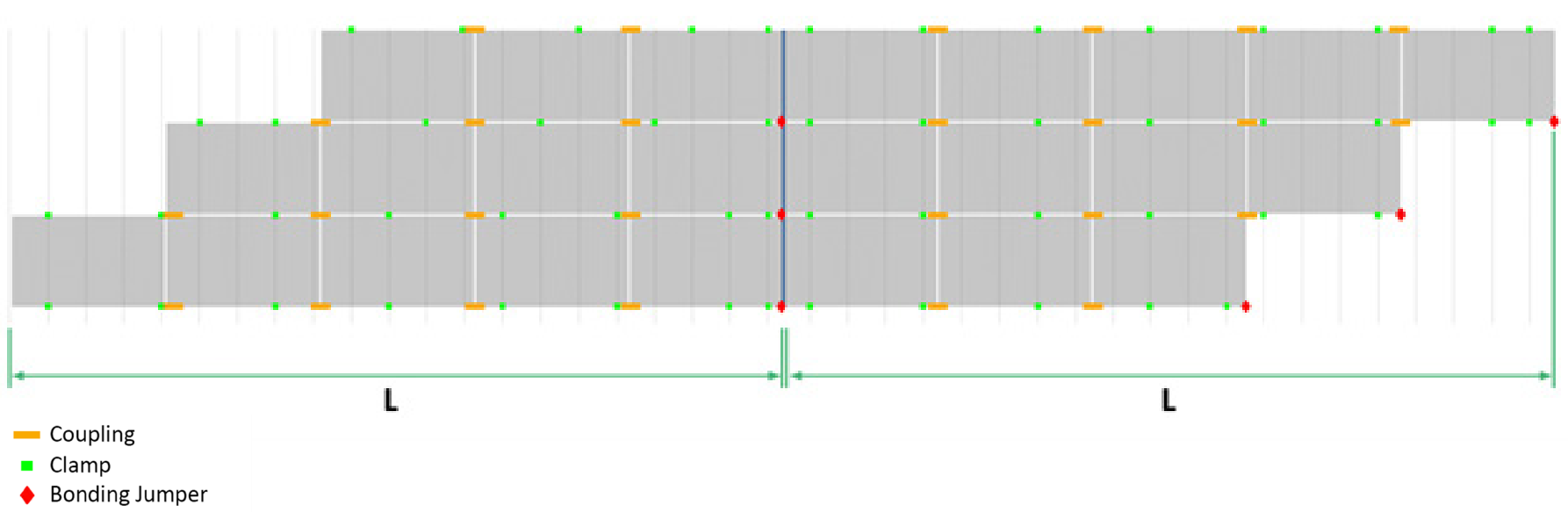
• Add XClamps as needed to support PV modules on each side of the thermal break. Do not exceed the allowable cantilever specified in the project specific engineering calculations.

• Left/right gap between sub-arrays should be a minimum of ½”. Note the gap shown in the illustration is much greater than ½” for demonstration purposes.

• Do not install Couplings or End Couplings across thermal break.

• 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.

Allow for Thermal Expansion



MECHANICAL LOAD TEST
SYSTEM CERTIFICATION

The MetalX system has been certified and listed to the UL 2703 standard (Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels). This standard includes electrical grounding, electrical bonding, mechanical load and fire resistance testing.

In conducting these tests, specific modules are selected for their physical properties so that the certifications can be broadly applied. The following lists the specific modules that were tested and the applicability of those certifications to other modules that might come onto the market. PV modules may have a reduced mechanical load rating, independent of the SM Ascender load rating. Please consult the PV module manufacturer's installation guide for more information.

In addition to UL 2703 certification, Unirac performs internal testing beyond the requirements of certification tests in order to establish system functional limits, allowable loads, and factors of safety. These tests include functional system tests, and destructive load testing.

Mechanical Load Test Modules

The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed cover the following basic module parameters:

- Frame thicknesses greater than or equal to 1.0 mm.
- Basic single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability).
- Clear and dark anodized aluminum frames.

MetalX			
Module Manufacturer	Model / Series	Area [sq ft]	Design Load [psf]
Boviet Solar	BVM6610P-xxx	17.51	40 down / 40 up / 23.3 downslope
Canadian Solar	CS6P-xxxM	17.31	40 down / 40 up / 23.3 downslope
Centrosolar	BM60-xxx BB	18.05	40 down / 40 up / 23.3 downslope
CertainTeed	CTxxxMxx-01	17.53	40 down / 40 up / 23.3 downslope
Flex	FLV-MA-xxxP60AB	17.60	40 down / 30 up / 23.3 downslope
Hansol	HSxxxTD-AN4	21.46	40 down / 30 up / 23.3 downslope
Hyundai	HiS-MxxxMG	21.06	40 down / 40 up / 23.3 downslope
Jinko	JKMxxxM-72	20.89	40 down / 30 up / 23.3 downslope
	JKMxxxM-72HL4-V	27.76	40.9 down / 45.7 up / 20.4 downslope
LG	LGxxxN2W-A5	22.31	40 down / 30 up / 23.3 downslope
	LGxxxN1C-G4	21.10	40 down / 40 up / 23.3 downslope
	LGxxxN1C-B3	17.65	30 down / 30 up / 23.3 downslope

Mechanical Load Test Modules

MetalX			
Module Manufacturer	Model / Series	Area [sq ft]	Design Load [psf]
LONGi	LR6-60-xxxM	17.60	40 down / 30 up / 23.3 downslope
Panasonic	VBHNxxxSA17	18.02	40 down / 30 up / 23.3 downslope
Q Cells	Q.PEAK DUO-G5	18.14	40 down / 40 up / 23.3 downslope
REC Solar	RECxxxTP2	17.97	40 down / 30 up / 23.3 downslope
S-Energy	SNxxxP-15	21.00	30 down / 30 up / 23.3 downslope
Silfab	SLG-M xxx	21.00	30.5 down / 30 up / 23.3 downslope
Solaria	PowerXT-xxxR-BX	19.47	40 down / 40 up / 23.3 downslope
SolarWorld	Sunmodule	18.04	40 down / 40 up / 23.3 downslope
SunEdison	SE-F2XXyyy-zz	17.69	40 down / 40 up / 23.3 downslope
Suniva	OPTxxx-60-4-100	17.69	40 down / 40 up / 23.3 downslope
SunPower	SPR-327NE-WHT-D	17.55	40 down / 26.1 up / 23.3 downslope
Trina	TSM-xxx PA05	17.64	40 down / 40 up / 23.3 downslope
	TSM-xxxDE14A(II)	20.93	40 down / 38.3 up / 23.3 downslope
VSUN	VSUNxxx-72MH	21.38	40 down / 30 up / 20 downslope
Winaico	WSP-xxxM6	17.90	40 down / 40 up / 23.3 downslope
Yingli	YLxxxP-29b	17.58	40 down / 40 up / 23.3 downslope
ZN Shine	ZXM6-72-xxxM	21.40	40 down / 30 up / 20 downslope

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the MetalX system.

Manufacture	Module Model / Series
Aionrise	AION60G1-xxx AION72G1-xxx
Boviet	BVM6610M-xxx BVM6610P-xxx BVM6610M-xxx (BB) BVM6610P-xxx (BB)
Canadian Solar	CS6P-xxxM CS6P-xxxP
Centrosolar	BM60-xxx BB
CertainTeed	CTXxxMxx-01 CTXxxMxx-02
Flex	FLV-MA-xxxP60AB
Hansol	HSxxxTD-AN4 HSxxxTD-AN3 HSxxxUD-AN1
Q-Cells	Q.PEAK BLK-G4 Q.PEAK BLK-G4.1 Q.PEAK DUO BLK-G5 Q.PEAK DUO-G5 Q.PEAK DUO L-6.2 Q.PEAK DUO L-G6.3 Q.PEAK DUO L-G7 Q.PEAK DUO L- G8 Q.PEAK DUO L- G8.1 Q.PEAK DUO L-G8.2 Q.PEAK DUO L-G8.3 Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G11.3/BFG Q.PEAK DUO XL-G9 Q.PEAK DUO XL-G9.2 Q.PEAK DUO XL-G9.3 Q.PEAK-G3 Q.PEAK-G4 Q.PEAK-G4.1

Manufacture	Module Model / Series
Q-Cells (Cont.)	Q.PLUS BFR-G4.1 Q.PLUS-G3 Q.PLUS-G4 Q.PRO-BFR-G3 Q.PRO-BFR-G4 Q.PRO-G3 Q.PRO-G4
Hyundai	HiS-SxxxRG HiS-MXxxMG HiS-MXxxRG HiS-MXxxRW
JA Solar	JAM72S09 xxx/PR JAM72S10 xxx/MR
Jinko	JKMXXXM-48 JKMXXXM-60 JKMXXXM-60B JKMXXXM-60-V JKMXXXM-72 JKMXXXM-72(Plus) JKMxxxM-72HL4-V JKMXXXPP-60 JKMXXXPP-60(Plus) JKMXXXPP-60-J4 JKMXXXPP-60-V JKMSXXXPP-60 JKMXXXPP-72 JKMXXXPP-72(Plus) JKMXXXPP-72-V
LG Electronics	LGXXXA1C-B3 LGXXXA1C-G4 LGXXXE1C-A5 LGXXXN1C-A5 LGXXXN1C-B3 LGXXXN1C-G4 LGXXXN1K-A5

Manufacture	Module Model / Series
LG Electronics (Cont.)	LGXXXN1K-G4 LGXXXN2W-A5 LGXXXQ1C-A5 LGXXXS1C-A5 LGXXXS1C-B3 LGXXXS1C-G4 LGXXXS1K-B3 LGXXXS1K-G4 LGXXXS2W-A5
LONGi	LR4-60HPB LR4-60HPH LR6-60BK-XXXM LR6-60PB-XXXM LR6-60PE-XXXM LR6-60PH-XXXM LR6-60-XXXM
Panasonic	VBHNXXXKA03 VBHNXXXSA17 VBHNXXXSA17E VBHNXXXSA17G
REC Solar	RECXXXPE RECXXXPE BLK RECXXXTP RECXXXTP2 RECXXXTP2 BLK RECXXXTP2 BLK2 RECXXXTP BLK
S-Energy	SNXXXM-10 SNXXXM-10 (40T) SNXXXP-10 SNXXXP-10 (40T) SNXXXP-15

Manufacture	Module Model / Series
Silfab	SIL-xxx BG SIL-xxx BK SIL-xxx HC+ SIL-xxx HM SIL-xxx QD SIL-xxx QM SLA-M xxx SLA-P xxx SLA-X xxx SLG-M xxx SLG-P xxx SLG-X xxx SSA-M xxx SSA-P xxx SSG-M xxx SSG-P xxx
Solaria	PowerXT-XXXR-BX PowerXT-XXXR-PX
SolarWorld	Plus-SW-XXX-Mono Plus-SW-XXX-Mono-Black Pro-SW-XXX-Poly Sunmodule SW-XXX
Suniva	OPTXXX-60-4-100 OPTXXX-60-4-1B0
SunEdison	SE-F2XXyyy-zz
SunPower	SPR-327NE-WHT-D SPR-E19-XX SPR-E19-XXX-D-AC SPR-E20-XXX SPR-E20-XXX-D-AC SPR-X20-XXX SPR-X20-XXX-BLK SPR-X20-XXX-BLK-D-AC SPR-X20-XXX-D-AC

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the MetalX system.

Manufacture	Module Model / Series
SunPower(Cont.)	SPR-X21-XXX SPR-X21-XXX-BLK SPR-X21-XXX-BLK-D-AC SPR-X21-XXX-C-AC SPR-X21-XXX-D-AC SPR-X22-XXX SPR-X22-XXX-D-AC SPR-X22-XXX-E-AC SPRXXXE-WHT-D
Talesun	TD6I72M
Trina	DEG15MC.20(II) TSM-DD05A.05(II) TSM-DD05A.08(II) TSM-DD05A.0X TSM-PX05.XX TSM-XXXDD14A(II) TSM-XXXDE14A(II) TSM-XXXPA05 TSM-XXXPD05 TSM-XXXPD14 TSM-XXXPE14A
VSUN	VSUNXXX-72MH VSUNXXX-72PH
Winaico	WSP-xxxM6
Yingli	YLxxxP-29b YLxxxP-30b
ZN Shine	ZXM6-72-XXXM ZXM6-T72-XXXM ZXP6-72-XXXP ZXP6-T72-XXXP

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A