SnapNrack™

Solar Mounting Solutions

Ultra Rail

Residential Roof Mount System
Installation Manual

snapnrack.com

An Intro to SnapNrack Ultra Rail

SnapNrack Ultra Rail Solar Mounting System offers a low profile, visually appealing, photovoltaic (PV) module installation system. This innovative system simplifies the process of installing solar PV modules, shortens installation times, and lowers installation costs..

SnapNrack systems, when installed in accordance with this manual, will be structurally adequate for the specific installation site and will meet the local and International Building Code. Systems will also be bonded to ground, under SnapNrack's UL 2703 Listing.

The SnapNrack installation system is a set of engineered components that can be assembled into a wide variety of solar mounting structures. It is designed to be installed by qualified solar installation technicians. With SnapNrack you will be able to solve virtually any PV module mounting challenge.

Benefits of Installing the SnapNrack Ultra Rail System

Install With Existing Roof Attachments
> Compatible with existing SnapNrack roof attachments

Install With Very Few Tools
> All Ultra Rail hardware is attached using a standard 1/2" socket

Built in Wire Management and Aesthetics
> Extensive wire management solutions have been designed specifically for the system that adapts to multiple possible mounting positions.

> The system is designed to be aesthetically pleasing on its own, so it does not require an aesthetic skirt. SnapNrack does offer an optional skirt for those looking for a high end look to the system.

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Certification Details

SnapNrack Ultra Rail system has been evaluated by Underwriters Laboratories (UL) and Listed to UL/ANSI Standard 2703 for Grounding/Bonding, Mechanical Loading, and Fire Classification.

Grounding/Bonding

The Ultra Rail system has been designed in compliance with UL Standard 2703 Section 9.1 Exception, which permits accessible components that **are not part** of the fault current ground path to **not be electrically bonded** to the mounting system (e.g. roof attachments, array skirt, etc.). For more details on the integrated grounding functionality see the Grounding Specifications section.

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. See the Grounding Specifications for the list of modules tested with the Ultra Rail system for integrated grounding.

Ground Lugs have been evaluated to both UL 467 and UL 2703 Listing requirements.

Ultra Rail has been listed with a number of Module Level Power Electronic (MLPE) devices. A complete list can be found in the Grounding Specifications section.

The mounting system Bonding Listing is only valid when installed with a Non-Separately Derived PV system. The PV system is required to have a direct electrical connection to another source, such as connecting to the grid via a grid interactive inverter.

SnapNrack recommends that bare copper never come into contact with aluminum.

Mechanical Loading

The Ultra Rail system is Listed for mechanical loading for different load ratings depending on the mounting configuration and PV module installed. For more details on the mechanical loading details see the Mechanical Loading Specifications section.

SnapNrack engineered systems should only be used with SnapNrack components and hardware. Any application outside of those specified in this Installation Manual and the Structural Engineering Report may void the warranty and structural certification could become invalid.

If the module clamps have been engaged and need to be loosened and reengaged, SnapNrack recommends moving the module frame 3mm to engage the bonding pin in a new location.

The UL Listing covers mechanical load ratings for the various span lengths, module orientations and positive, negative, and side load ratings. These values can be found in the Mechanical Loading Specifications section.

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

Fire

The Ultra Rail system has been evaluated for a Class A System Fire Classification for a Steep-Sloped Roof ($\geq$ 2:12 pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 12 inches from the top and bottom edges of the module.

The Ultra Rail system has been evaluated for a Class A System Fire Classification for a Low-Sloped Roof (< 2:12 pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 16.3 inches from the top and bottom edges of the module.

The optional Array Skirt accessory has also been evaluated and the Ultra Rail system will maintain the Class A System Fire Classification detailed above if installed with the Skirt.

Because the system was tested at 5 inches above the test roof fixture Ultra Rail can be installed without any height restrictions and will maintain the Class A System Fire Classification. See Rail Installation section for potential module-specific height restrictions due to module temperature.
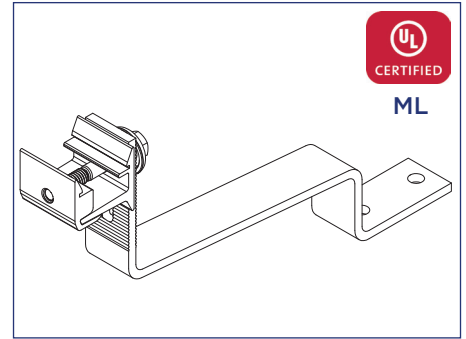
Structural Components
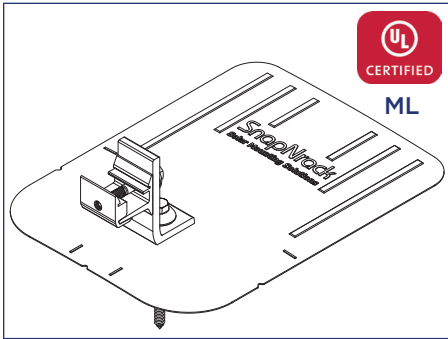
Composition Roof Attachment

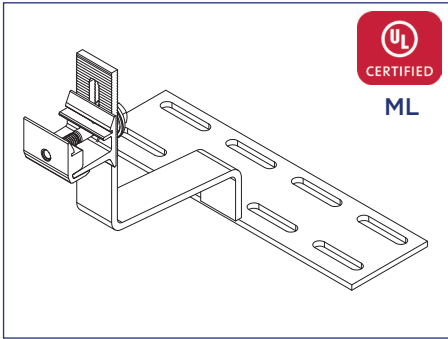Roof attachment kit for composition shingle roofs including L foot, umbrella lag screw, flashing, and hardware
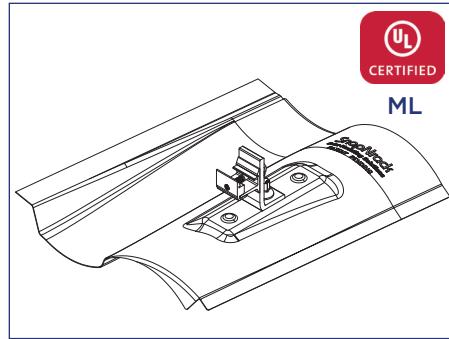
Tile Replacement Roof Attachment

Roof attachment kit for flat, S, and W tile roofs including base, riser, tile replacement flashing, L foot, and hardware
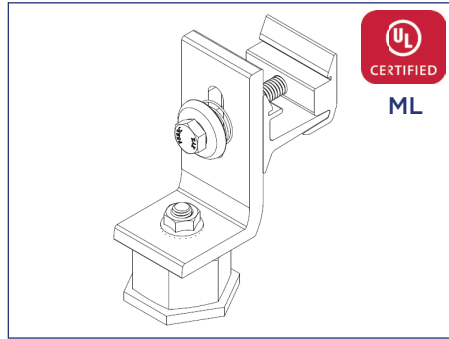
Flat Tile Roof Attachment

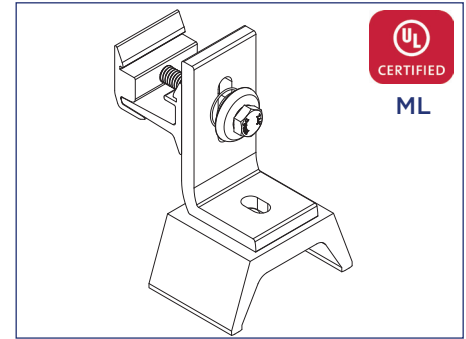Roof attachment kit for flat tile roofs including tile hook and hardware

W & S Tile Roof Attachment

Roof attachment kit for W and S tile roofs including tile hook and hardware

Metal Roof Base Attachment

Roof attachment kit for flat metal roofs including metal roof base, L foot, and hardware

Corrugated Roof Block Attachment

Roof attachment for sinusoidal corrugated metal roofs including roof block, L foot, and hardware
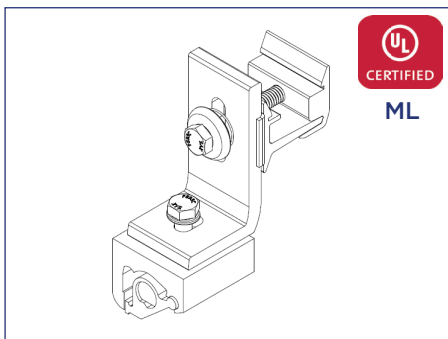
Seam Clamp Roof Attachment

Roof attachment for standing seam metal roofs including seam clamp, L foot, and hardware
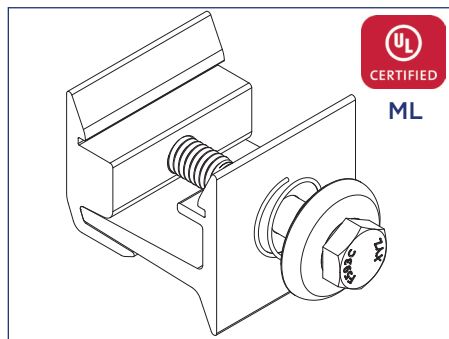
Ultra Rail Mounting Hardware

Hardware kit for attaching Ultra Rail to any roof attachment that uses an L foot or other slotted mount that accepts 5/16" hardware
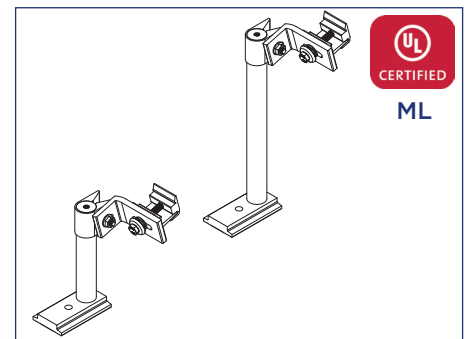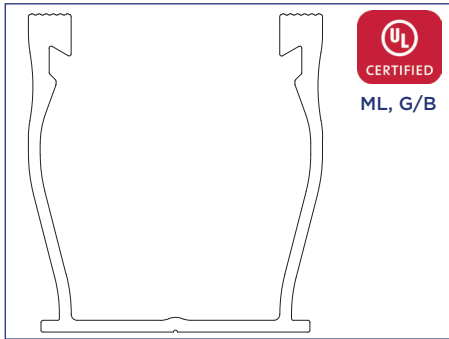
Fixed Tilt Standoff Roof Attachments

Roof attachment kits that provide additional tilt off roof surface including standoffs, bases, and hardware
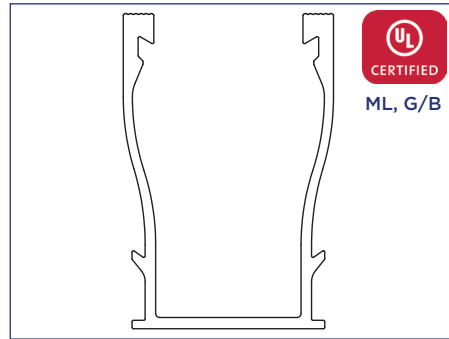
UL Listing Legend:

ML – Evaluated for Mechanical Loading

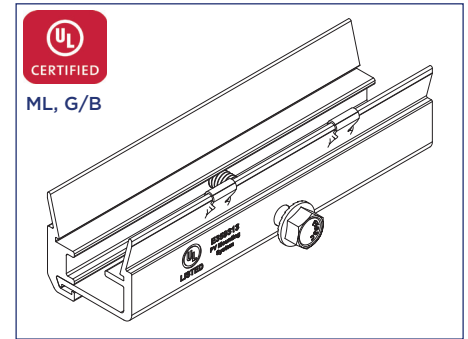G/B – Evaluated for Grounding/Bonding

Structural Components

UR-40 Rail

ML, G/B

UR-40 rail for Ultra Rail roof mount racking system

UR-60 Rail

ML, G/B

UR-60 rail for Ultra Rail roof mount racking system
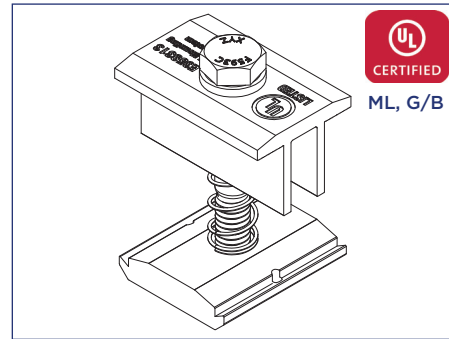

UR-40 Rail Splice

ML, G/B

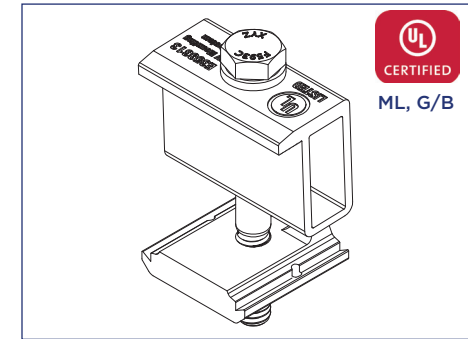UR-40 rail splice component including two splice halves and hardware

UR-60 Rail Splice

ML, G/B

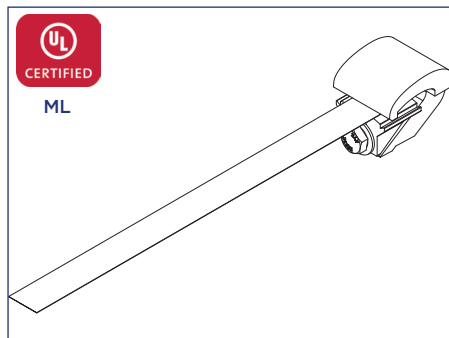UR-60 rail splice component including slide-on sleeve and hardware

Mid Clamp

ML, G/B

Top-down module mid clamp including clamp and hardware
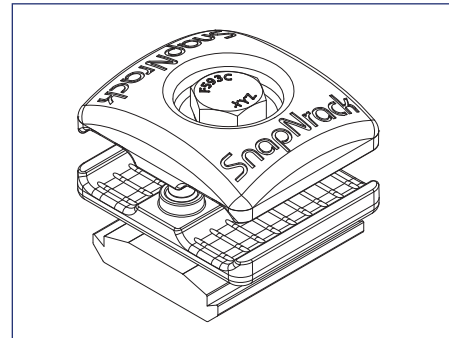

Adjustable End Clamp

ML, G/B

Top-down module end clamp including clamp and hardware
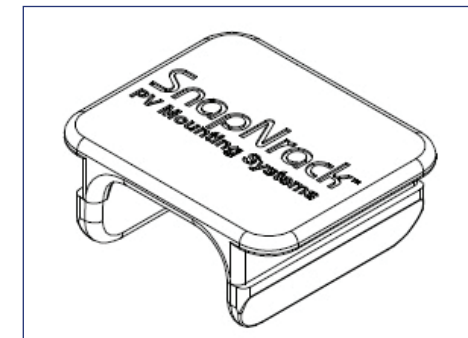
Wire Management/Grounding Component

Universal End Clamp

ML

Bottom-mount module end clamp including clamp and hardware

Universal Wire Clamp

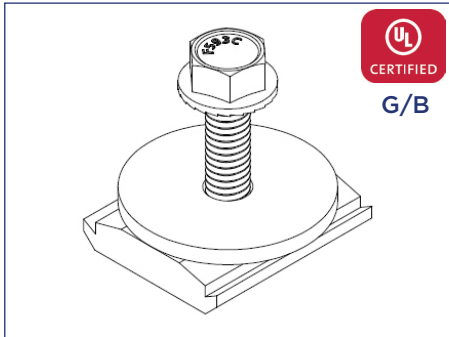Wire management component used to secure conductors between rails

Wire Retention Clip

Wire management component used to secure conductors in rails
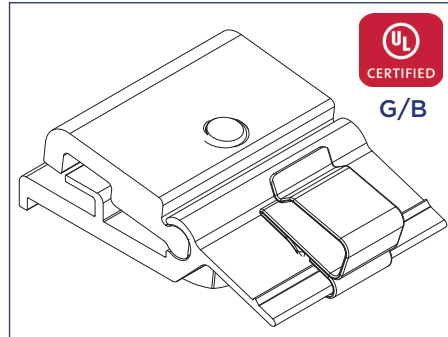
UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding
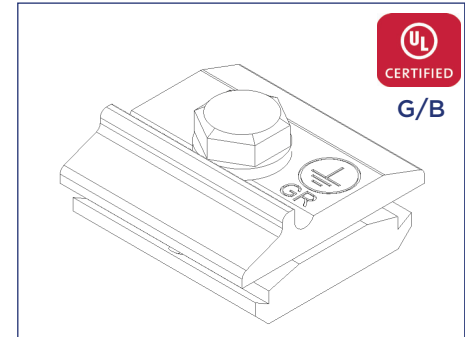
Wire Management/Grounding Component

G/B

MLPE Rail Attachment Kit

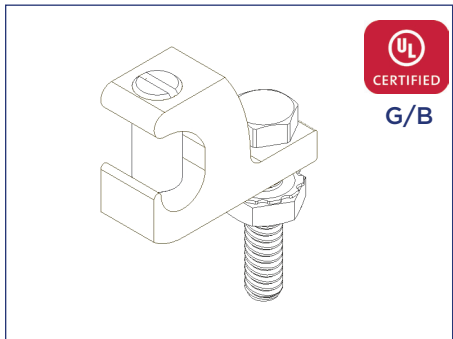Rail attachment for module level power electronics like microinverters and optimizers

G/B

MLPE Frame Attachment Kit

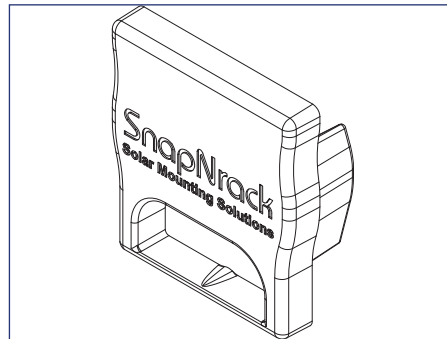Module frame attachment for module level power electronics like microinverters and optimizers
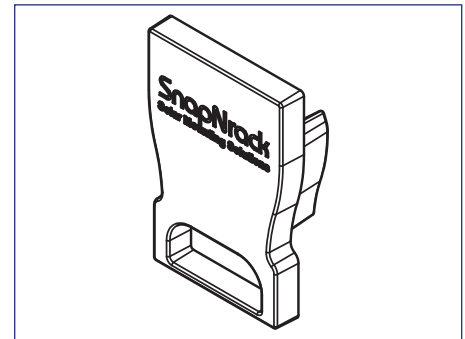

G/B

SnapNrack Ground Lug

G/B

Ilsco Lay-In Lug – GBL-4DBT

Aesthetic Components

UR-40 Rail End Cap

Plastic end cap for UR-40 Rail

UR-60 Rail End Cap

Plastic end cap for UR-60 Rail

Component Details

Hardware Torque Specifications

| Hardware Description	Torque Specification
SnapNrack Ground Lug model 242-02101 to Grounding Electrode Conductor (6-12 AWG Solid Copper)	16 ft-lbs (192 in-lbs)
SnapNrack Ground Lug model 242-92202 to Grounding Electrode Conductor and Module Frame	8 ft-lbs (96 in-lbs)
Ilsco Lay-in Lug GBL-4DBT to Rail or Module Frame	2.92 ft-lbs (35 in-lbs)
Ilsco Lay-in Lug GBL-4DBT to Grounding Electrode Conductor (10-14 AWG Solid Copper)	1.67 ft-lbs (20 in-lbs)
Ilsco Lay-in Lug GBL-4DBT to Grounding Electrode Conductor (8 AWG Stranded Copper)	1.04 ft-lbs (25 in-lbs)
Ilsco Lay-in Lug GBL-4DBT to Grounding Electrode Conductor (4-6 AWG Stranded Copper); Ground Lug SGB-4 to Grounding Electrode Conductor (4-14 AWG Solid or Stranded Copper)	1.46 ft-lbs (35 in-lbs)
Ilsco Ground Lug SGB-4 to Module Frame	6.25 ft-lbs (75 in-lbs)
Adjustable End Clamp, Mid Clamp, Universal End Clamp, Umbrella Nut for Tile Replacement Kits, Flange Nut for MRB	10 ft-lbs (120 in-lbs)
Rail Splice, Flashed L-Foot to Rail, Tile Hook F to Rail, Tile Hook WS to Rail, MRB to Rail, Seam Clamp to Rail	12 ft-lbs (144 in-lbs)
Standard Base Seam Clamp, Wide Base Seam Clamp	16.7 ft-lbs (200 in-lbs)
SolarEdge Frame Mounted Bracket to Module Frame	7 ft-lbs (84 in-lbs)
MLPE Rail Attachment Kit, MLPE Frame Attachment Kit	10 ft-lbs (120 in-lbs)
Enphase Frame Mounted Bracket to Module Frame	13 ft-lbs (156 in-lbs)

Site Survey

● Measure the roof surfaces and develop an accurate drawing, including any obstacles such as chimneys and roof vents.

● If plans are available, check to make sure that the plans match the final structure.

● Identify any roof access areas or keep-out areas as required by the local AHJ (i.e. fire lanes).

● Identify any construction issues that may complicate the process of locating roof framing members from the roof surface.

● If you find structural problems such as termite damage or cracked roof framing members that may compromise the structure's integrity, consult a structural engineer.
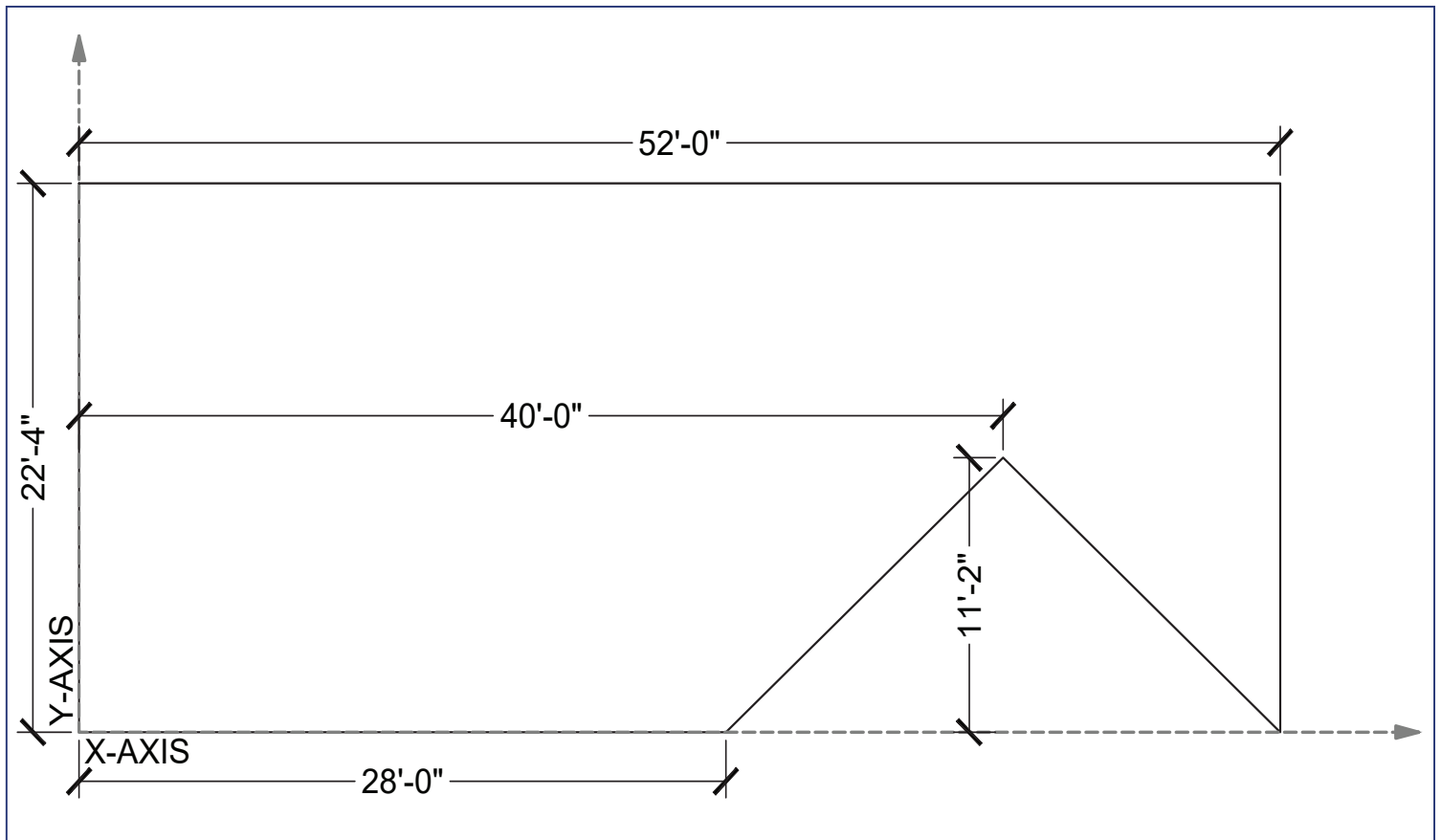
Design Guidance

1) Layout the modules in the available roof area. Adjacent modules in the same row are spaced 1/2" apart by Mid Clamps. Adjustable End Clamps require an additional 1" of rail extending past module frame, while Universal End Clamps require no extra rail. When installing multiple rows of modules, a minimum spacing gap of 1/8" should be used between rows.

2) Draw the roof framing member location on the layout to identify where roof attachments can be installed.

3) Determine site conditions for calculating the engineering values, confirm site conditions and code versions comply with local AHJ requirements.

4) Reference site conditions and system specifications in Ultra Rail Structural Engineering Report to determine maximum attachment spacing and resulting cantilever values (34% of maximum attachment spacing).

5) Draw roof attachment locations on layout based on maximum attachment spacing and cantilever values.

6) Confirm design complies with UL 2703 Listing for Mechanical Loading. For more details on the mechanical loading details see the Mechanical Loading Specifications section.

7) To simplify the design process and automatically generate a bill of materials (BOM) for the mounting system, use the Ultra Rail Configuration Tool located on the SnapNrack website. Always refer to Approved Module Lists in Installation Manuals to ensure installation complies with UL 2703 Listing.

8) Mark distance from array edge to identifiable roof features in x and y axes.

9) Insert SnapNrack installation details in to design set specific to the project requirements.
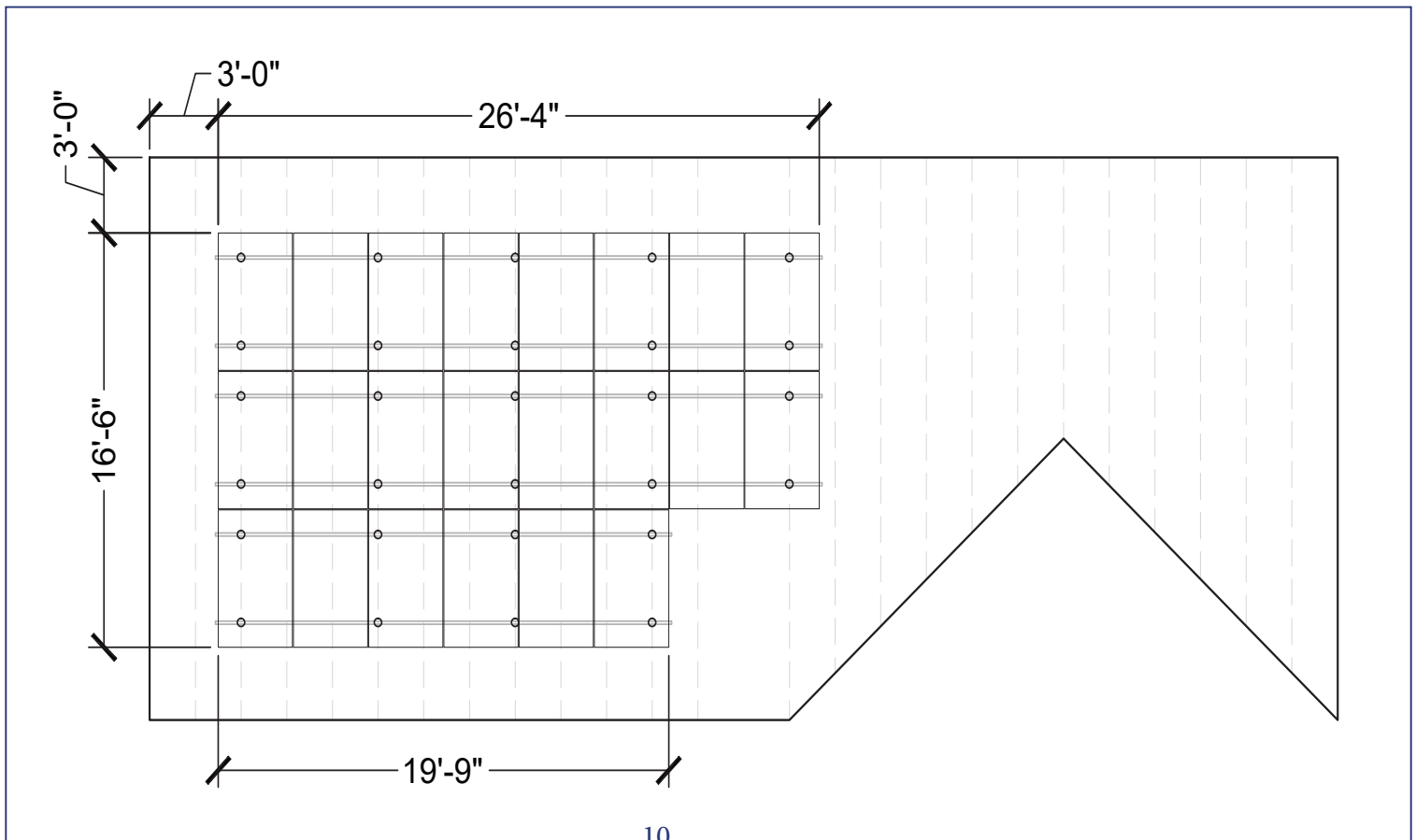
⚙ Design Note:

Ultra Rail allows for multiple mounting configurations. Modules can be mounted in portrait (long side of module perpendicular to ridge) or landscape (long side of module parallel to ridge) orientations. In addition, modules can also be short side-mounted (module clamps on short side) or long side-mounted (module clamps on long side). Long-side mounting is recommended for maximum material efficiency. Most residential structures utilize roof framing members that run in-slope with the roof, so a portrait orientation with long-side mounting is typically the most efficient use of materials.
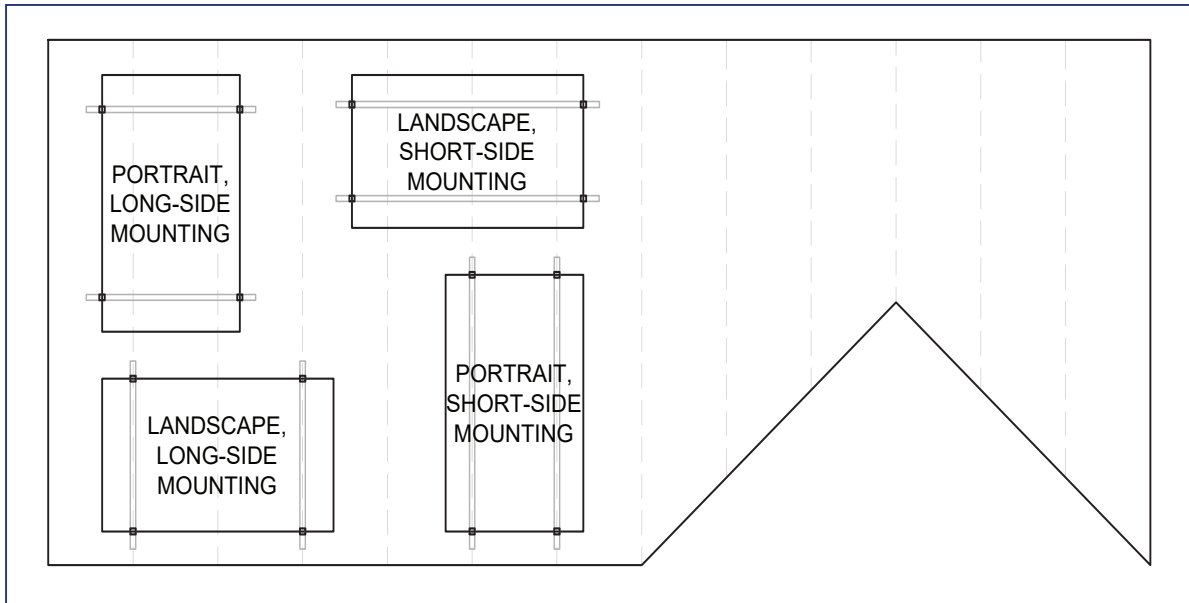
⚙ Installation Note:

● Ensure the lag screws will be installed in a solid portion of the roof framing member.

● If the roof framing member is not found then seal the pilot hole immediately with roofing sealant.

⚠ Safety Guidance

● Always wear appropriate OSHA approved safety equipment when at active construction site

● Appropriate fall protection or prevention gear should be used. Always use extreme caution when near the edge of a roof

● Use appropriate ladder safety equipment when accessing the roof from ground level

● Safety equipment should be checked periodically for wear and quality issues

● Always wear proper eye protection

System Layout

1) Transfer the array layout to the roof using a roof marking crayon to mark the inside and outside corners of the array.

2) Locate the estimated roof framing member positions and mark them in the array area with a roof marking crayon.

3) Transfer rail locations using a chalk line.

4) Mark roof attachment locations on the roof, noting that attachments will be located at intersections of rails and roof framing members. Layout rails such that module frames do not overhang mounting rails more than specified by module manufacturer, more than 25% of total module length, or more than required by the Class A Fire Certification (see Certification Details section).

> ⚙ **Layout Note:**
> Ensure final roof attachment locations do not exceed the maximum attachment spacing and cantilever specified in the design.
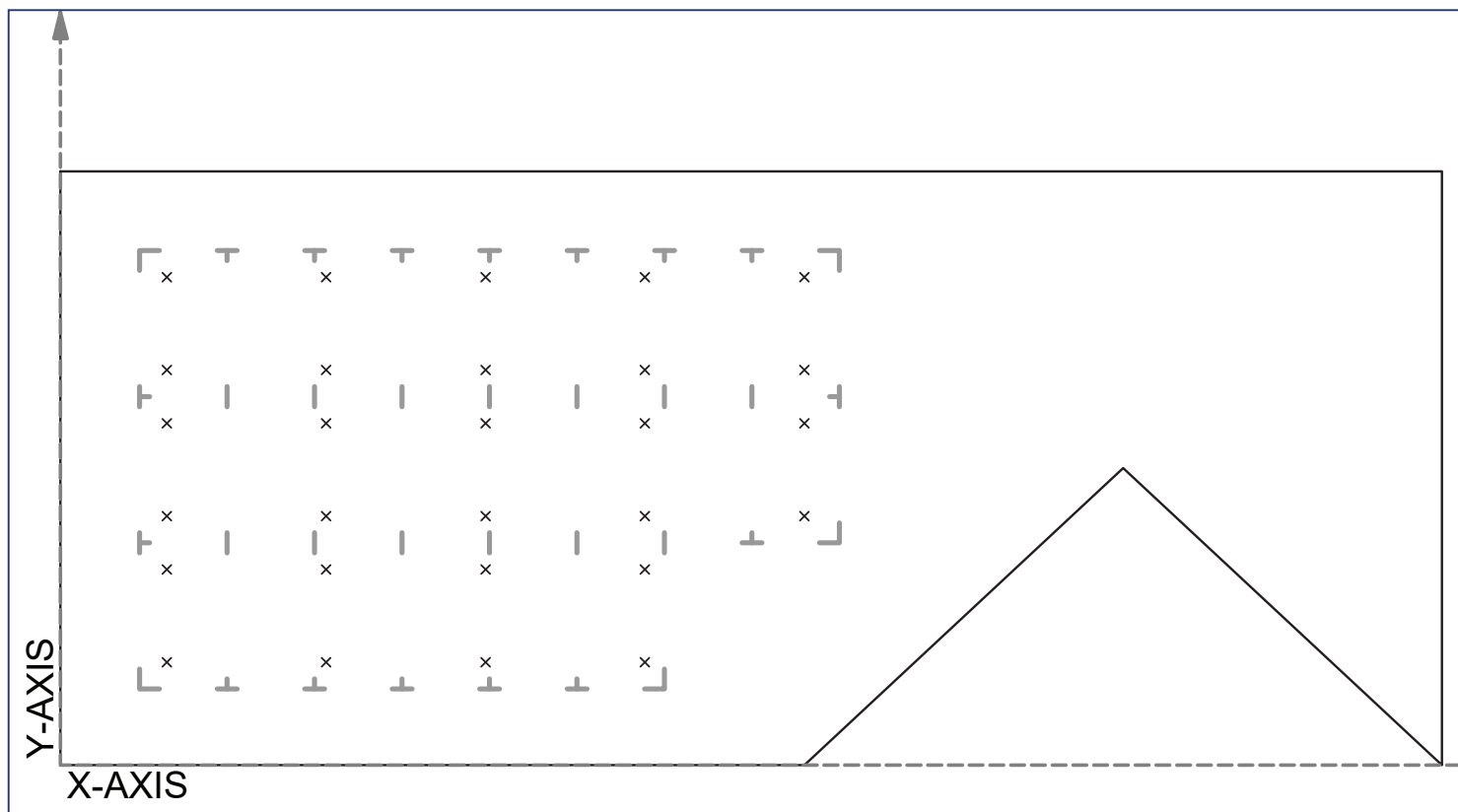
Y-AXIS

X-AXIS

Required Tools

- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16" Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2" Socket

Materials Included - L Foot Mount

1. (1) SnapNrack Comp Umbrella Flashing
2. (1) SnapNrack Umbrella Lag Screw
3. (1) SnapNrack Umbrella L Foot
4. (1) SnapNrack Ultra Mount (Tapped)
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount Spring
7. (1) SnapNrack Ultra Mount Spring Cage
8. (1) 5/16"-18 X 2-1/4" SS HCS Bolt
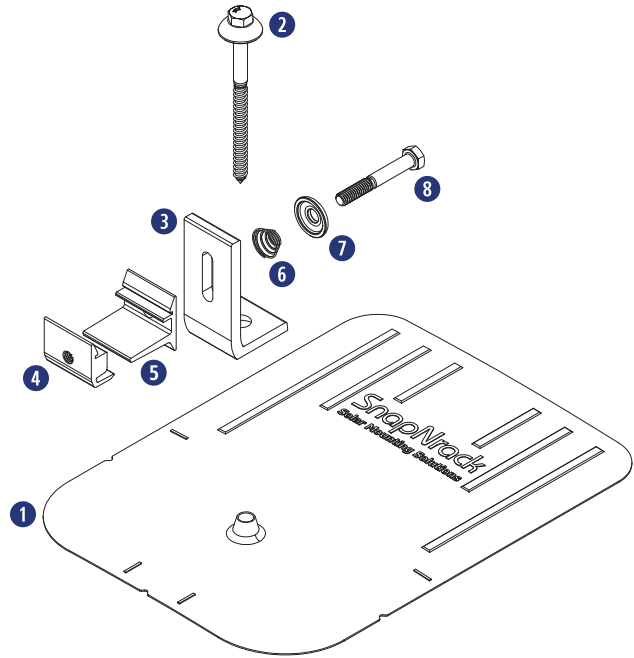
Application Note:
Install on composition shingle roofs.
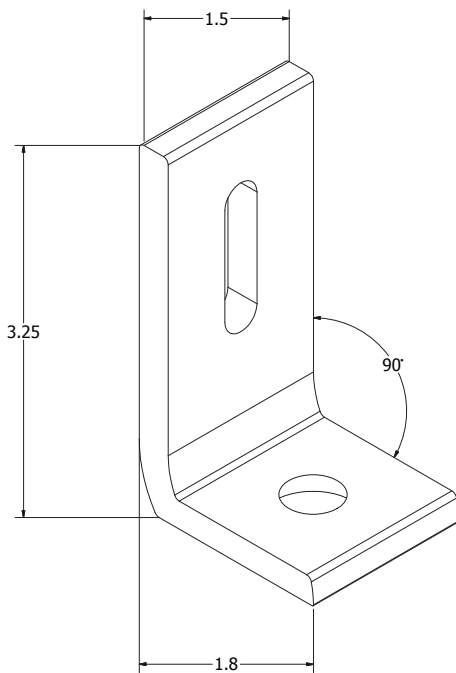
Dimensioned L Foot
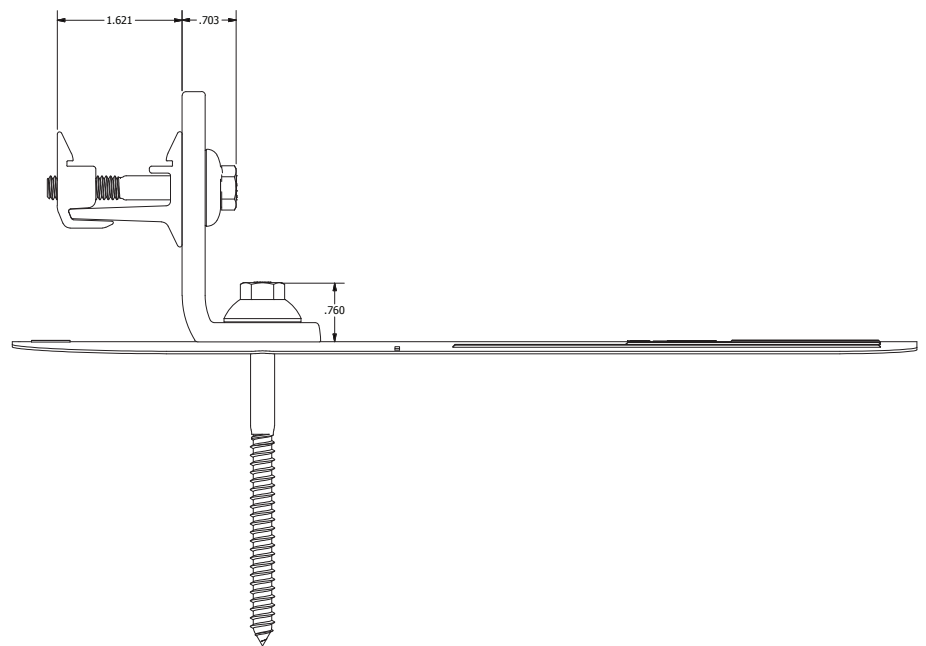
Dimensioned L Foot Assembly
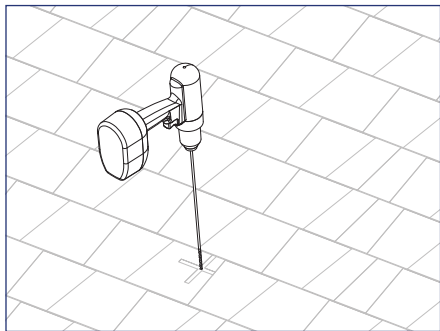
L Foot Mount

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, drill a pilot hole through the roofing material into the roof framing member.
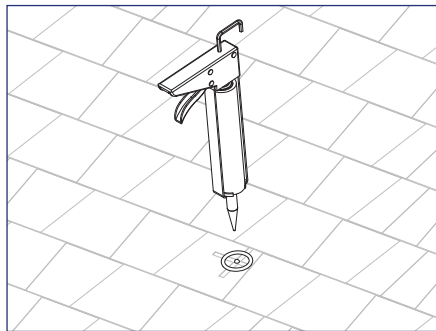
2) Apply roofing sealant in and around the pilot hole, and directly onto the lag screw to ensure a water tight seal.
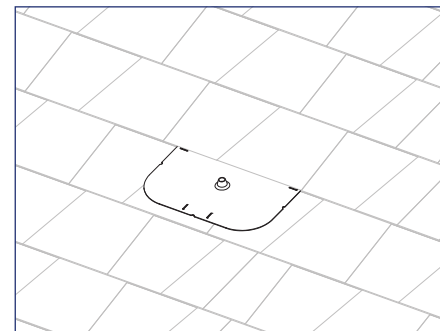
3) Pry up shingles with a breaker bar and install flashing underneath shingle course above pilot hole, and position flashing so cone is in line with pilot hole.
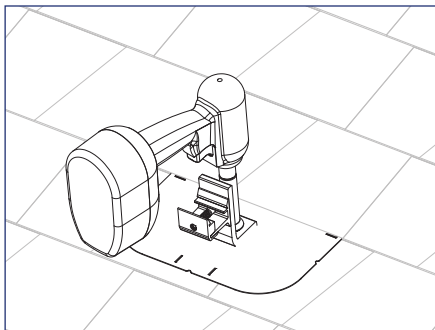
> **Install Note:**
>
> Ensure flashing extends minimum (2) courses above pilot hole, and does not overhang bottom edge of shingle course.
>
> Apply a horseshoe of sealant under flashing to direct water away from penetration.
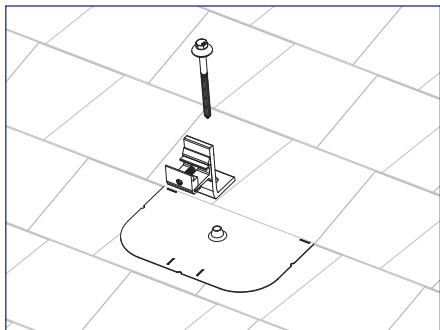
4) Insert Umbrella Lag Screw through Umbrella L Foot and cone in flashing, then drive lag screw for minimum 2.5" embedment into the roof framing member.

> **Install Note:**
>
> The L Foot can be attached in any orientation.

> **Best Practice:**
>
> If using an impact driver, finish tightening lag screw with a hand wrench to prevent L Foot from rotating.

Tile Replacement

Required Tools

- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16" Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2" Socket
- Flat Pry Bar
- Tape Measure
- SnapNrack Tile Replacement Installation Template (optional)

Materials Included - Tile Replacement

1. (1) SnapNrack Tile Replacement Base
2. (1) SnapNrack Tile Replacement Riser
3. (1) SnapNrack Tile Replacement Flashing
4. (1) SnapNrack Umbrella Nut
5. (1) SnapNrack Umbrella L Foot
6. (1) 5/16"-18 X 1-3/4" SS Set Screw
7. (1) 5/16"-18 X 1" SS Flange Bolt
8. (1) SnapNrack Ultra Mount (Tapped)
9. (1) SnapNrack Ultra Mount (Thru-Hole)
10. (1) SnapNrack Ultra Mount Spring
11. (1) SnapNrack Ultra Mount Spring Cage
12. (1) 5/16"-18 X 2-1/4" SS HCS Bolt
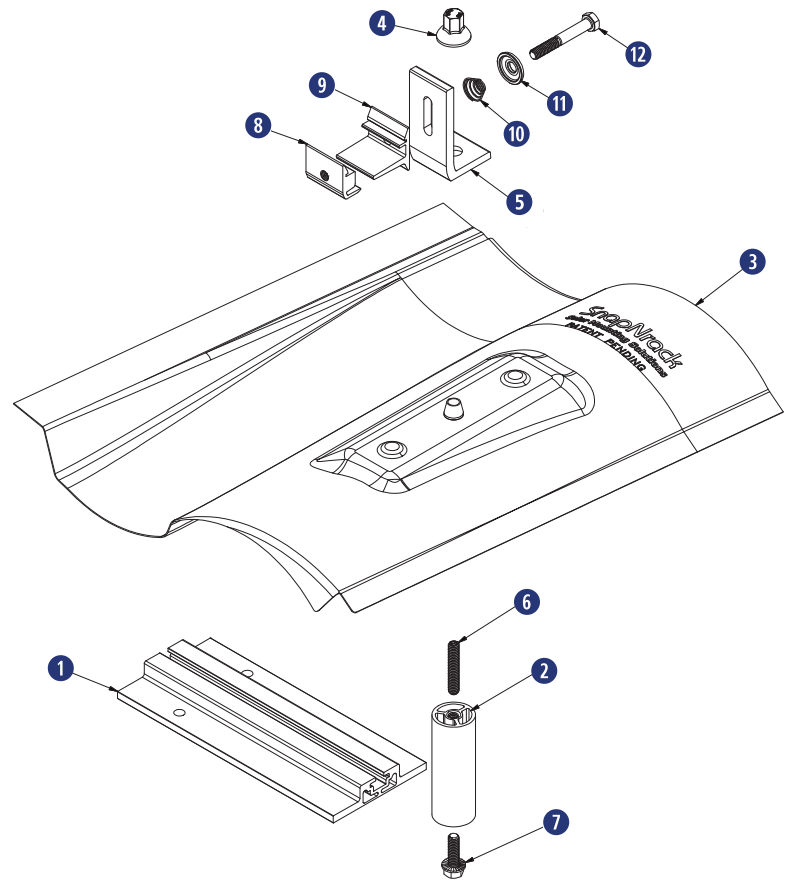
Other Materials Required - *Not Shown*

① (2) 5/16" Lag Screw

② (2) 5/16" Washer

③ Flexible Flashing (when required for deck level flashing)

> ### Application Note:
> Install on flat, W and S style concrete tile roofs.
> - Tile Course Spacing: 13"-16"
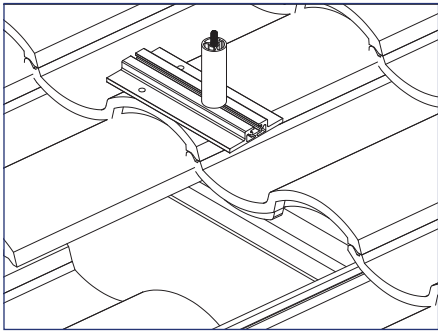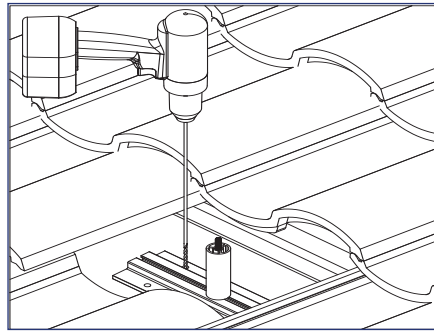> - Tile Thickness: 1-1/4"±1/8"
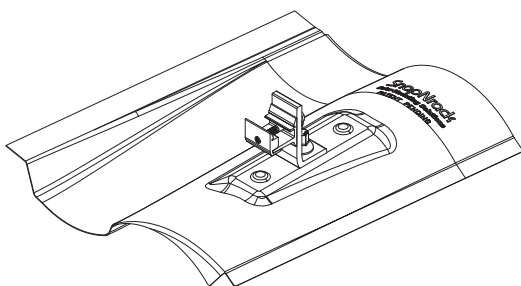
S Tile Replacement
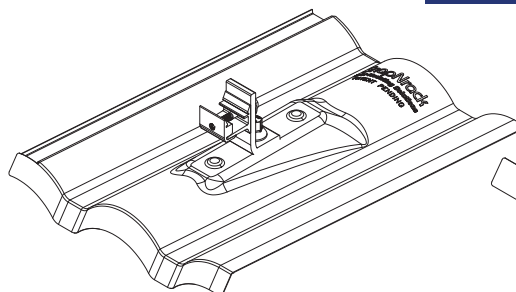
W Tile Replacement
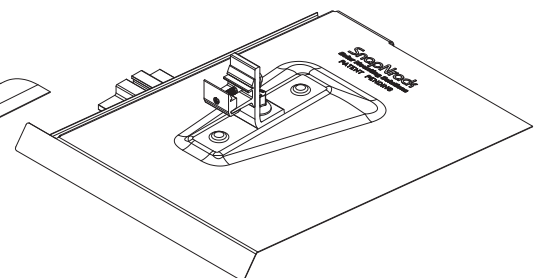
Flat Tile Replacement

Tile Replacement

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed. Slide riser assembly into base channel and snug by hand.

2) Locate base over rafter using riser position and Diagram 1 with measurements found in Table 1, then drill two pilot holes through the roofing material into the roof framing member.

Tile Profile	Riser Center to Tile Front Edge (A)	Riser Center Side – Side (B)
S	8.25"	Center of peak
W	8"	Center of peak
Flat	8"	5"

Table 1
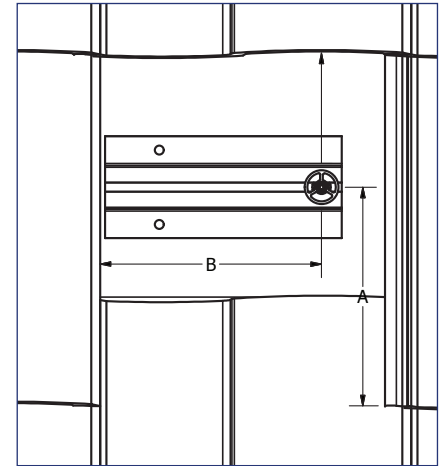
Diagram 1

Install Note:
Base can be flipped and neighboring tile may need to be removed to attach to the roof framing member and line up riser with flashing.

Working from RIGHT TO LEFT and UP THE ROOF will prevent neighboring tiles from lifting flashings.
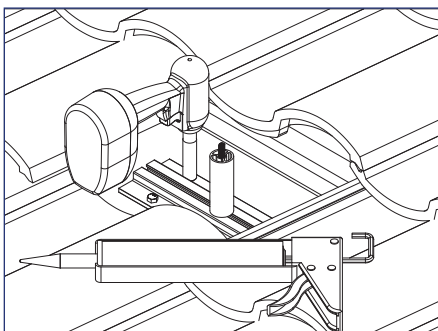
3) Apply roofing sealant and attach the base with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.
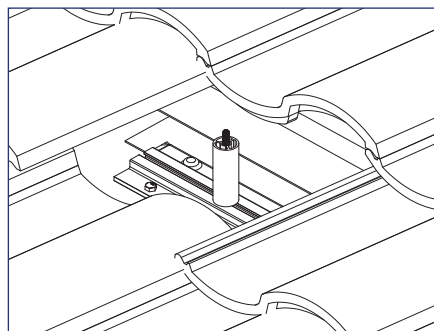
4) If deck level flashing is required, install flexible flashing per the Deck Level Flashing for Tile Replacement Installation Manual.
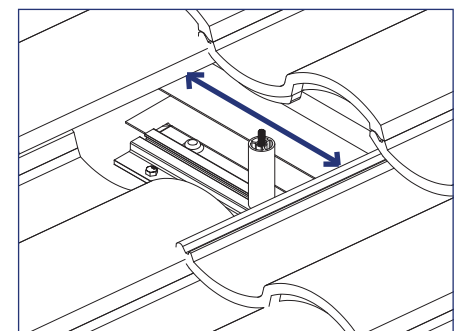
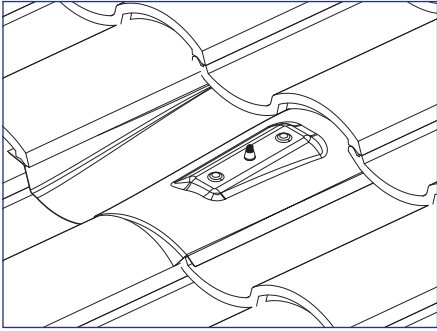5) Align the riser with the hole in the flashing and tighten riser.
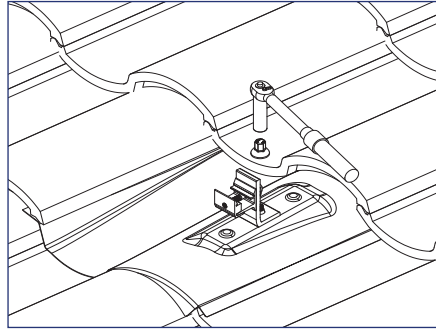
Best Practice:
Flashing can be used as a template for locating riser.

Tile Replacement

INSTALLATION INSTRUCTIONS

6) Install flashing into place on top of riser, allowing stud to come through hole in Tile Replacement flashing.


7) Install L Foot onto stud with Umbrella Nut, and tighten hardware to 10 ft-lbs.

Required Tools

- Hammer or Stud Finder
- Roof Sealant
- 1/2" Socket
- Roof Marking Crayon
- Torque Wrench
- Flat Pry Bar
- Drill with 3/16" Pilot Drill Bit
- Socket Wrench
- Tape Measure

Materials Included - Ultra Rail Tile Hook F

1. (1) SnapNrack Ultra Rail Flat Tile Hook
2. (1) 5/16"-18 x 1-3/4" SS Flange Bolt
3. (1) SnapNrack Ultra Mount Spring Cage
4. (1) SnapNrack Ultra Mount Spring
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount (Tapped)
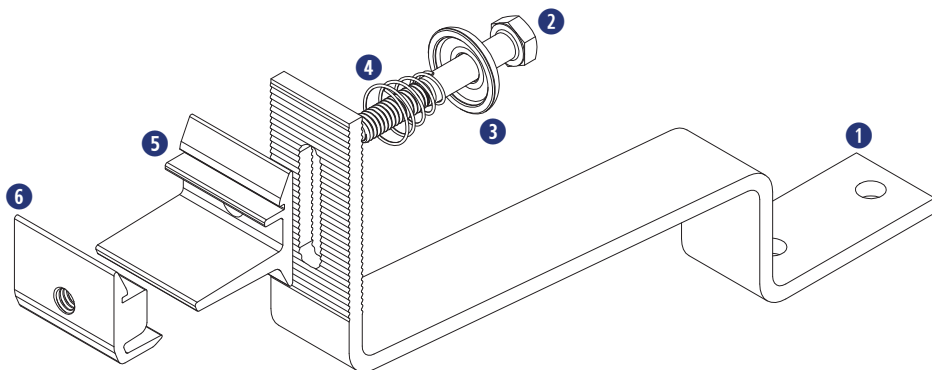
Other Materials Required (Not Shown)

1. (2) 5/16" Lag Screw
2. (2) 5/16" Washer
3. Flexible Flashing (when required for deck level flashing)

> **Application Note:**
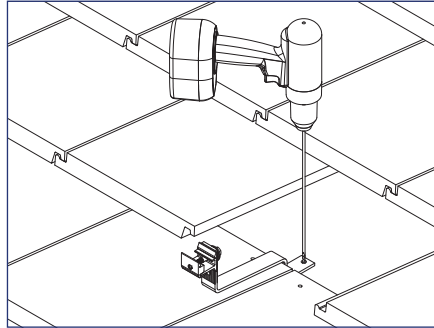> Install on flat concrete tile roofs.
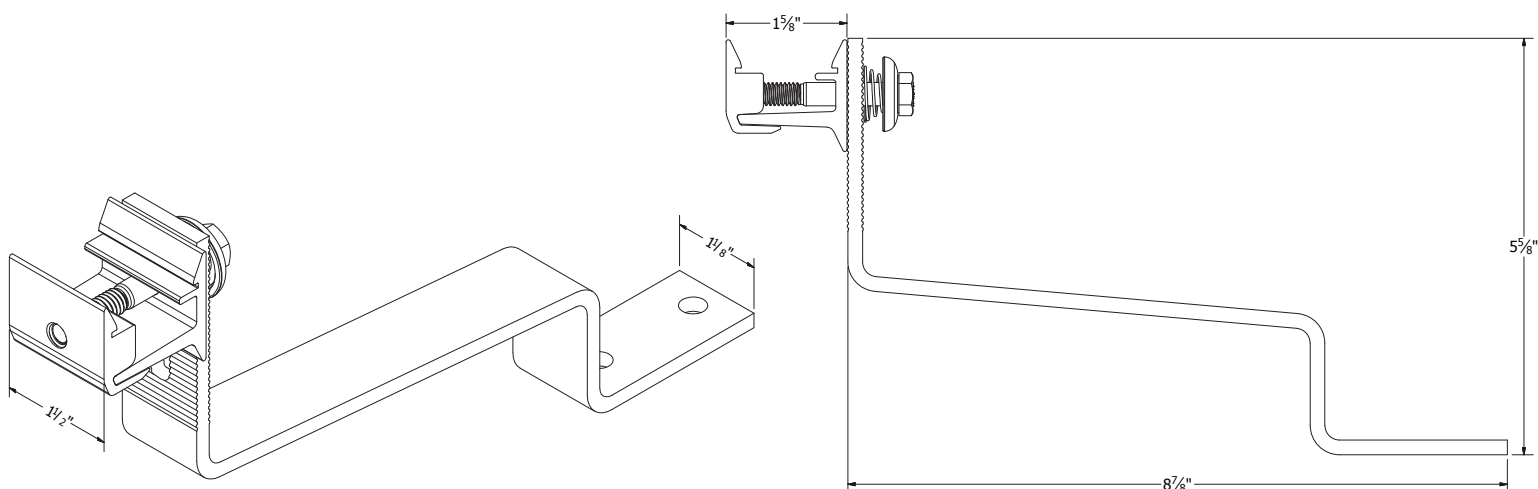
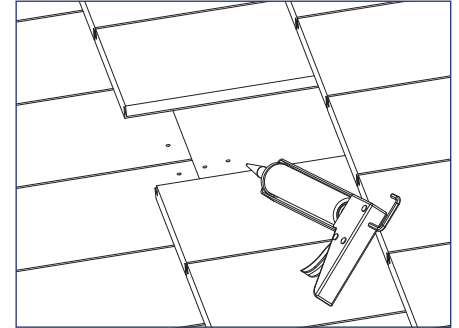**Dimensioned Ultra Rail Tile Hook F Assembly**

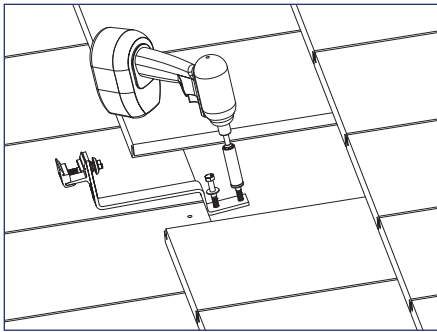# Tile Hook F

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed.
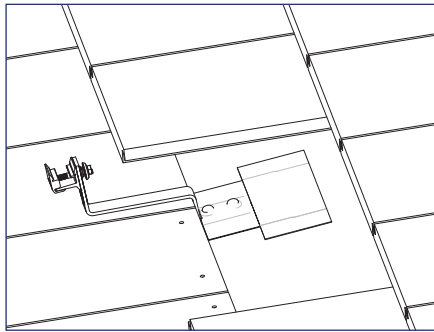

2) Align the hook over the rafter and drill two pilot holes through the roofing material into the roof framing member.
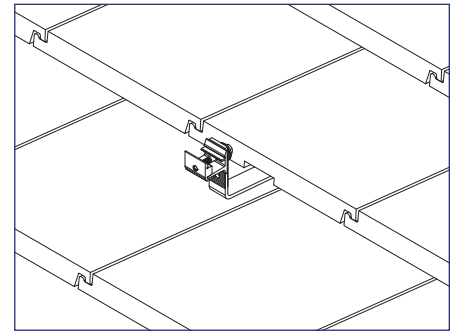

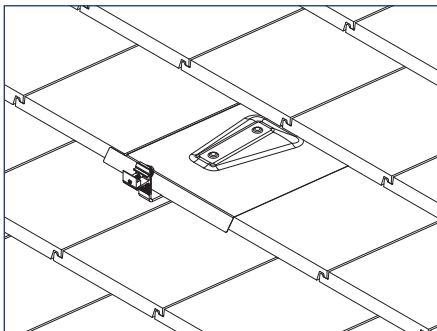3) Apply roofing sealant to pilot holes and Tile Hook.

4) Attach the base with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.

5) If deck level flashing is required, install flexible flashing per the following instructions.

6) Replace tile

7) **OPTIONAL:** Install Tile Replacement flashing in place of roof tile over tile hook.

⚙ Best Practice:

Mold or slightly trim flashing around hook to achieve desired fitment.

Tile Hook WS

Required Tools

- Hammer or Stud Finder
- Roof Sealant
- 1/2" Socket

- Roof Marking Crayon
- Torque Wrench
- Flat Pry Bar

- Drill with 3/16" Pilot Drill Bit
- Socket Wrench
- Tape Measure

Materials Included - Ultra Rail Tile Hook WS

1. (1) SnapNrack Ultra Rail Tile Hook WS
2. (1) 5/16"-18 x 1-3/4" SS Flange Bolt
3. SnapNrack Ultra Mount Spring Cage
4. (1) SnapNrack Ultra Mount Spring
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount (Tapped)
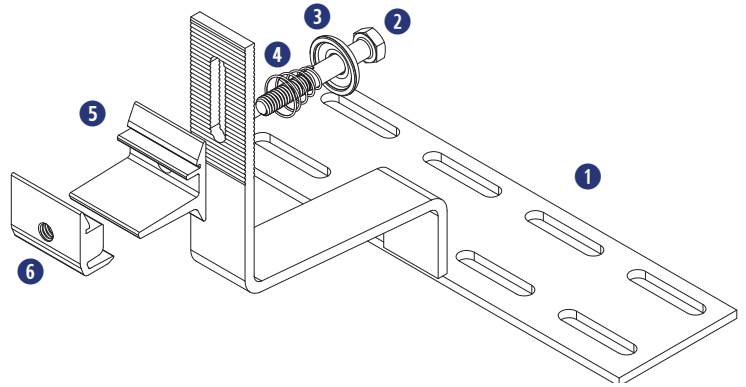
Other Materials Required (Not Shown)

1. (2) 5/16" Lag Screw
2. (2) 5/16" Washer
3. Flexible Flashing (when required for deck level flashing)

Application Note:

Install on W and S style concrete tile roofs.

1⅝"

6⅝"

6⅞"

1½"

1⅛"
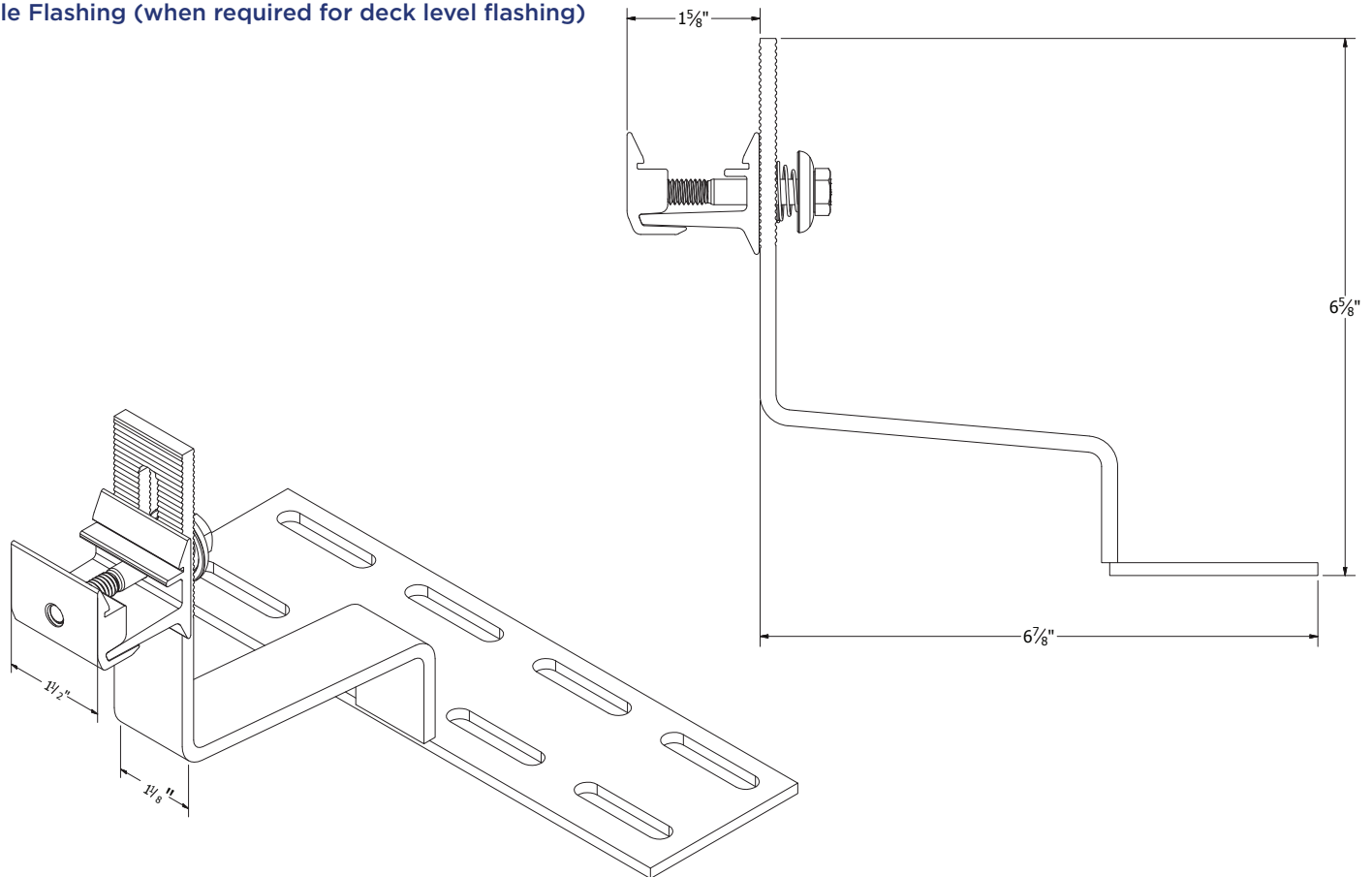
Dimensioned Ultra Rail Tile Hook WS Assembly

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Tile Hook WS

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed.
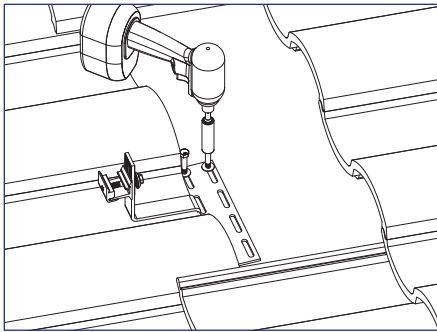
> ⚙ **Install Note:**
> A neighboring tile may need to be removed to attach to the roof framing member and line up hook with the tile.
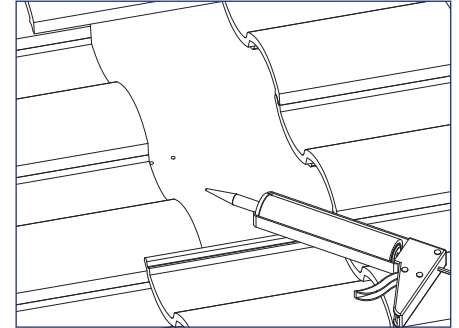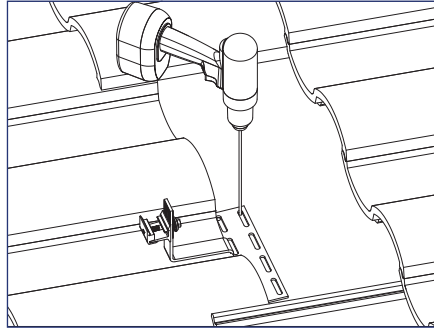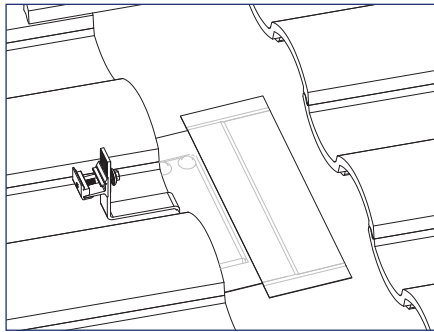

2) Align the base over the rafter so the hook can enter at the valley of a tile (W and S Tile). Drill two pilot holes through the roofing material into the roof framing member.
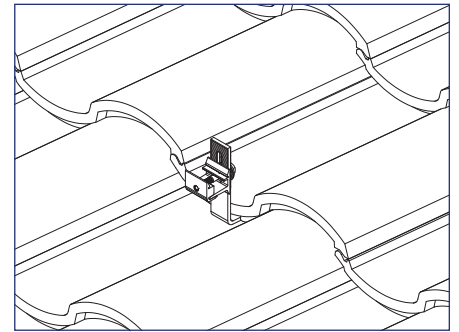

3) Apply roofing sealant to pilot holes and Tile Hook base.
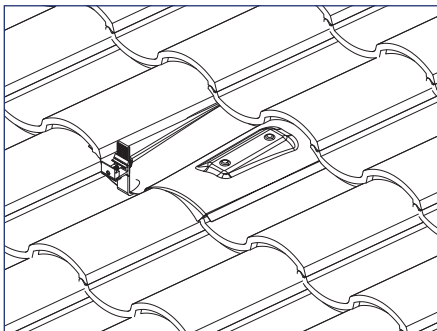

4) Attach the base with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.

5) If deck level flashing is required, install flexible flashing per the following instructions.

6) Replace tile

**7) OPTIONAL: Install Tile Replacement flashing in place of roof tile over tile hook.**

> ⚙ **Best Practice:**
> Mold or slightly trim flashing around hook to achieve desired fitment.

Required Tools

- Hammer Or Stud Finder
- Torque Wrench
- Roof Marking Crayon
- Socket Wrench
- Drill with 3/16" Pilot Drill Bit
- 1/2" Socket

Materials Included - Metal Roof Base

1. (1) SnapNrack Metal Roof Base
2. (1) SnapNrack All Purpose L Foot
3. (1) 5/16"-18 SS Flange Nut
4. (1) SnapNrack Ultra Mount (Tapped)
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount Spring
7. (1) SnapNrack Ultra Mount Spring Cage
8. (1) 5/16"-18 X 2-1/4" SS HCS Bolt
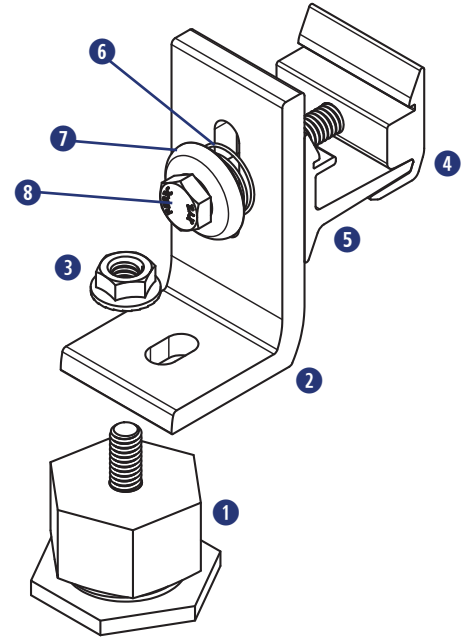
Other Materials Required - *Not Shown*

① (1) 5/16" Lag Screw or 1/4" Self-Drilling Screw

② (1) 5/16" or 1/4" Washer (3/4" max O.D.)

⚙ Application Note:

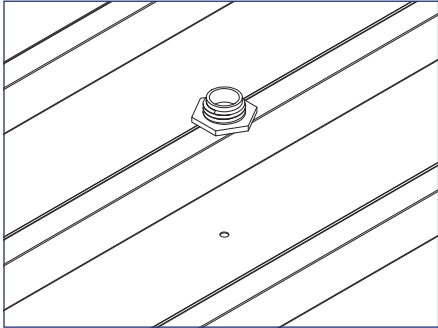Install on metal roof profiles with flat surface large enough to accommodate 1-5/8" wide base

⚙ Installation Note:

Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.
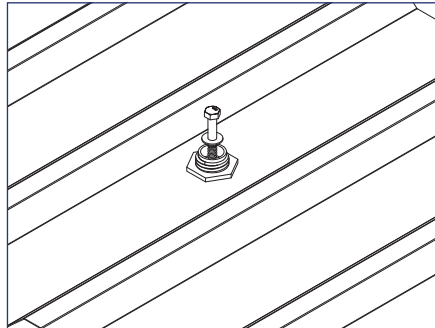
1-3/8" CAP

1-5/8" BASE

5/16"-18 x 5/8" STUD

1" INSTALLED HEIGHT
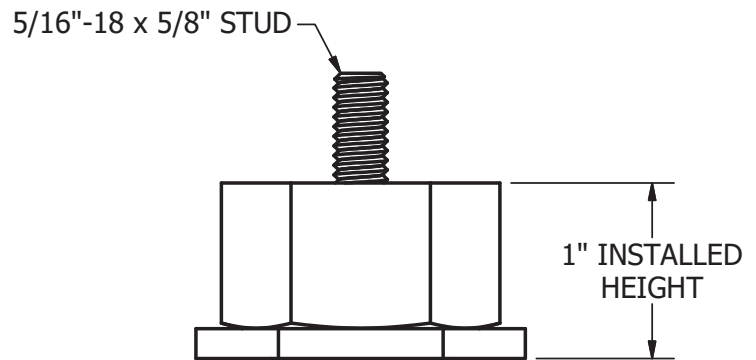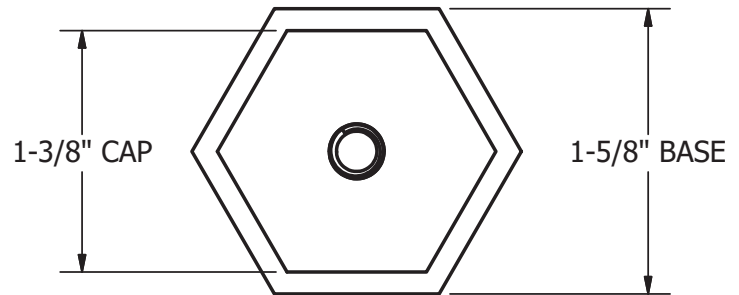
Dimensioned Metal Roof Base Assembly
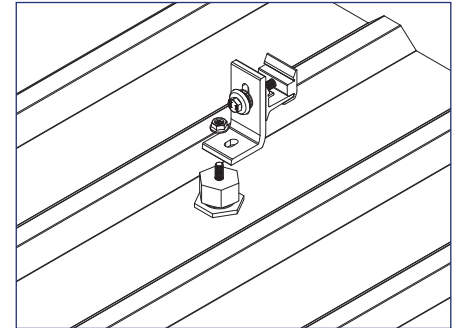
Metal Roof Base

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, drill a pilot hole through the roofing material into the roof framing member.

2) Attach the base with 5/16" lag screw (or 1/4" self-drilling screw for metal structures), drive screw for minimum 2.5" embedment into the roof framing member.

⚙ Install Note:

Ensure area is free from metal shavings and debris before installing Metal Roof Base. Metal roofs with excessive debris, corrosion, or non-factory coating should be evaluated for adequate sealing surface.

Additional roof sealant not required but can be applied after tightening the Metal Roof Base to roof, if desired.

3) Thread Metal Roof Base cap onto Metal Roof Base bottom, ensuring cap is fully seated to base.

⚙ Install Note:

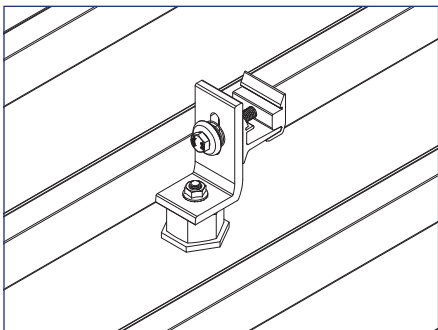Take care to ensure the base does not twist when cap is tightened.
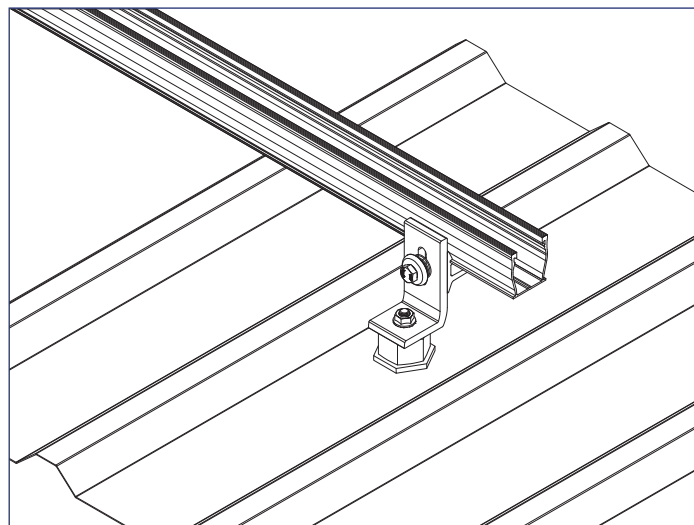

4) Attach L Foot to stud in Metal Roof Base cap and tighten hardware to 10 ft-lbs.

⚙ Best Practice:

Finish tightening hardware with a hand wrench to prevent L Foot from rotating.

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Corrugated Straddle Block

Required Tools

- Hammer Or Stud Finder
- Torque Wrench
- Drill with 3/16" Pilot Drill Bit
- Socket Wrench
- Roof Sealant
- 1/2" Socket

Materials Included - Corrugated Straddle Block

1. (1) SnapNrack Corrugated Straddle Block
2. (1) SnapNrack All Purpose L Foot
3. (1) SnapNrack Ultra Mount (Tapped)
4. (1) SnapNrack Ultra Mount (Thru-Hole)
5. (1) SnapNrack Ultra Mount Spring
6. (1) SnapNrack Ultra Mount Spring Cage
7. (1) 5/16"-18 X 2-1/4" SS HCS Bolt
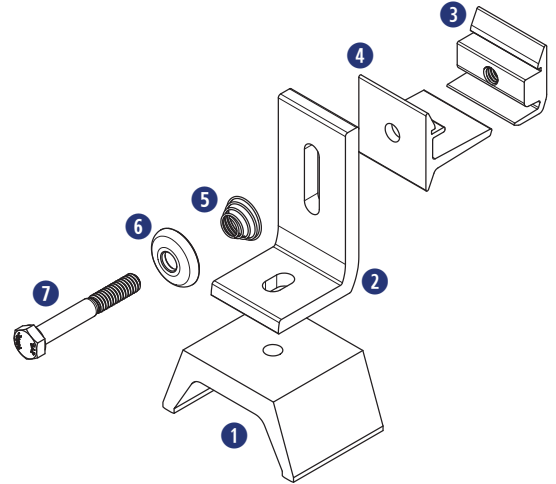
Other Materials Required - *Not Shown*

1. (1) 5/16" Lag Screw or 1/4" Self-Drilling Screw
2. (1) Washer

> **Application Note:**
> Use self-drilling screw for steel roofing members, lag screw for wooden roof framing members
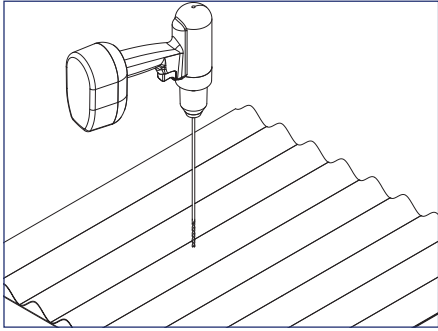
> **Application Note:**
> Install on sinusoidal style corrugated metal roofs

> **Installation Note:**
> Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.

Ø5/16"

1 3/16"

1 5/16"

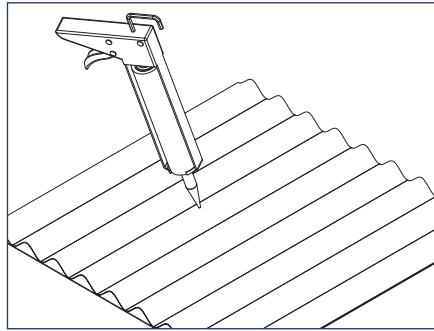7/8"

2 7/16"

2 15/16"
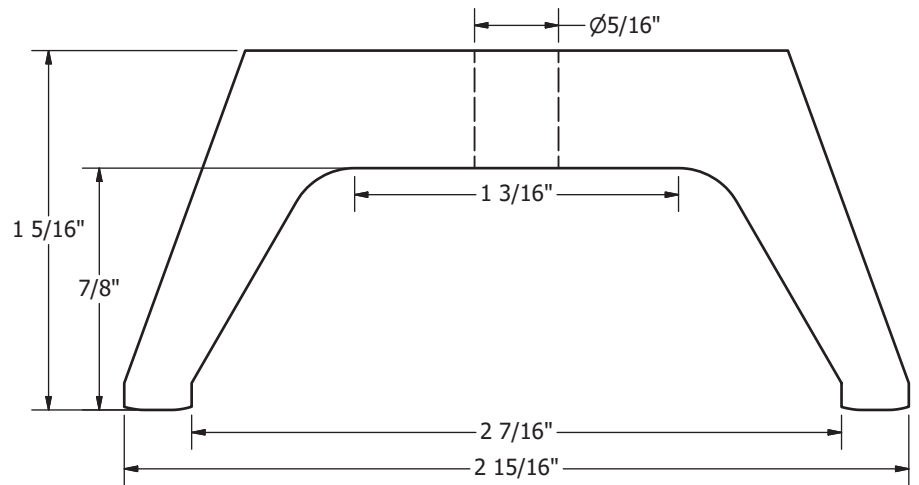
Dimensioned Corrugated Straddle Block

Corrugated Straddle Block

INSTALLATION INSTRUCTIONS

1) Using roof attachment locations drawn during system layout, drill a pilot hole through the high point of the roofing material into the roof framing member.

⚙ Install Note:

Ensure the lag or self-drilling screws will be installed in a solid portion of the roof framing member.

If the roof framing member is not found then seal the pilot hole immediately with roofing sealant.

2) Apply roofing sealant directly onto the pilot hole and the lag to ensure a water tight seal.
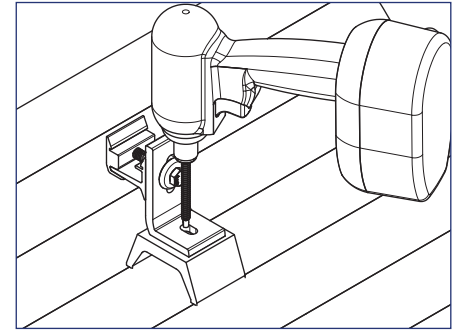
3) Attach the Straddle Block and L Foot with 5/16" lag screw (or 1/4" self-drilling screw for metal structures), drive screw for minimum 2.5" embedment into the roof framing member.

⚙Best Practice:

If using an impact driver, finish tightening lag screw with a hand wrench to prevent L Foot from rotating.
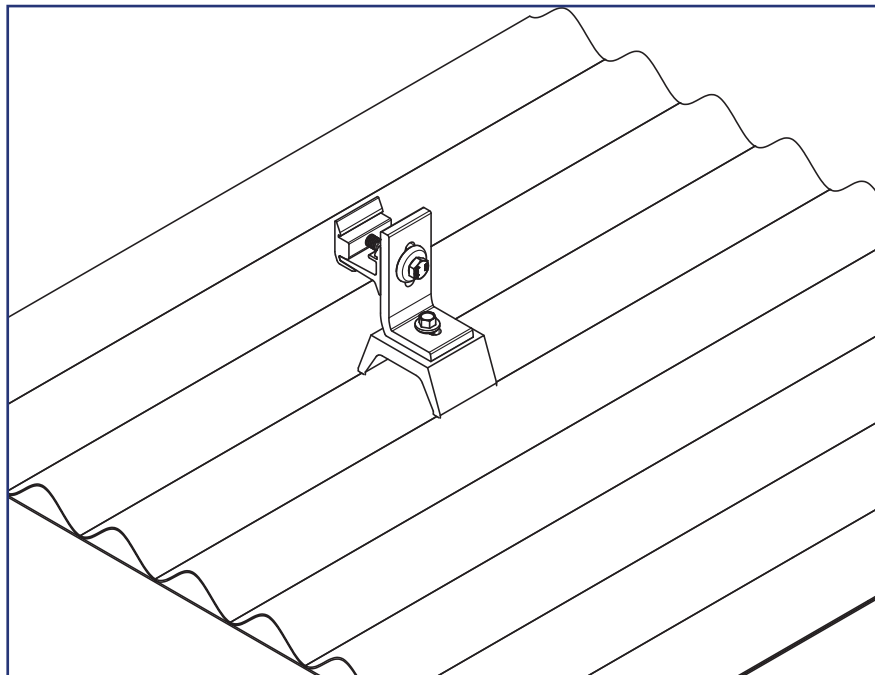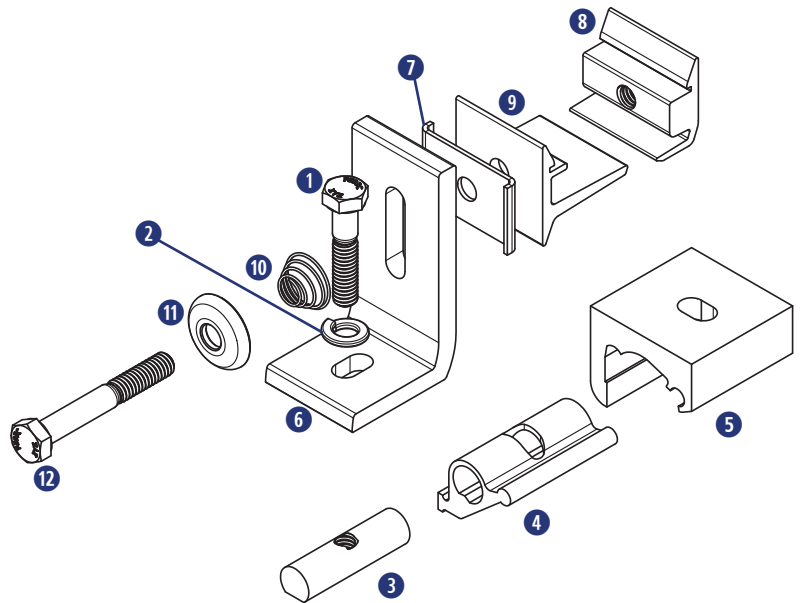
Required Tools

● Torque Wrench   ● Socket Wrench   ● 1/2" Socket

Materials Included - Standard Base Seam Clamp Kit

1. (1) 5/16"-18 X 1-1/2" SS HCS Bolt (Black)
2. (1) 5/16" SS Split Lock Washer
3. (1) SnapNrack Seam Clamp Insert
4. (1) SnapNrack Seam Clamp Cam
5. (1) SnapNrack Seam Clamp Standard Base
6. (1) SnapNrack All Purpose L Foot
7. (1) SnapNrack Rotation Lock
8. (1) SnapNrack Ultra Mount (Tapped)
9. (1) SnapNrack Ultra Mount (Thru-Hole)
10. (1) SnapNrack Ultra Mount Spring
11. (1) SnapNrack Ultra Mount Spring Cage
12. (1) 5/16"-18 X 2-1/4" SS HCS Bolt

## Materials Included - Wide Base Seam Clamp Kit

1. (1) 5/16"-18 X 1-1/2" SS HCS Bolt (Black)
2. (1) 5/16" SS Split Lock Washer
3. (1) SnapNrack Seam Clamp Insert
4. (1) SnapNrack Seam Clamp Cam
5. (1) SnapNrack Seam Clamp Wide Base
6. (1) SnapNrack All Purpose L Foot
7. (1) SnapNrack Rotation Lock
8. (1) SnapNrack Ultra Mount (Tapped)
9. (1) SnapNrack Ultra Mount (Thru-Hole)
10. (1) SnapNrack Ultra Mount Spring
11. (1) SnapNrack Ultra Mount Spring Cage
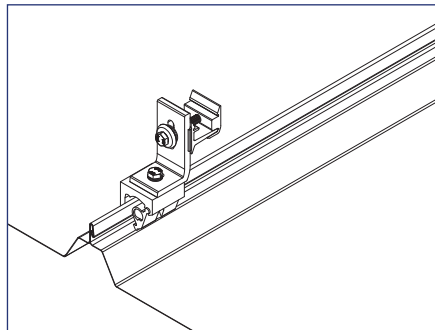12. (1) 5/16"-18 X 2-1/4" SS HCS Bolt
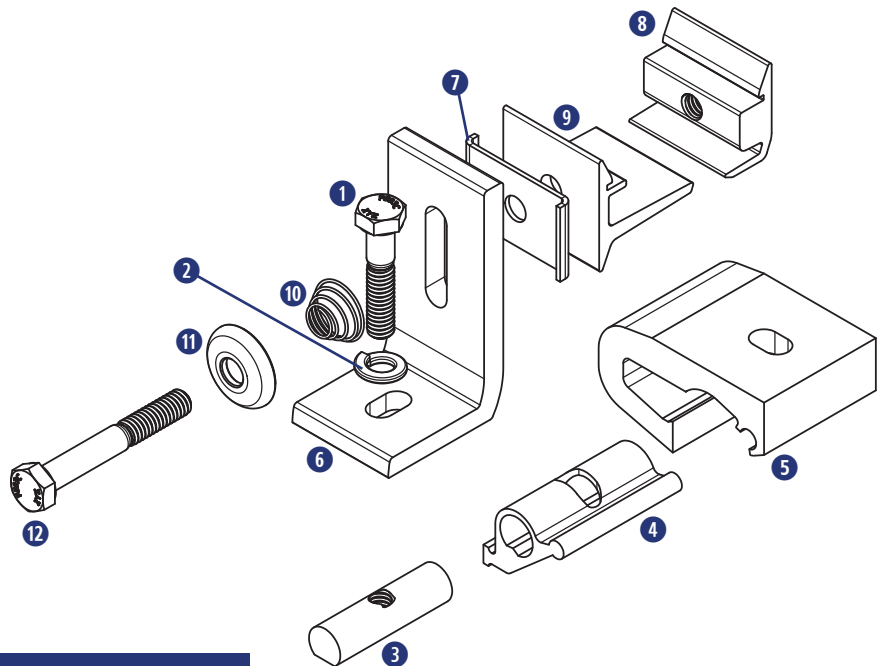
Application Note:
Install on standing metal seam roofs

Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.
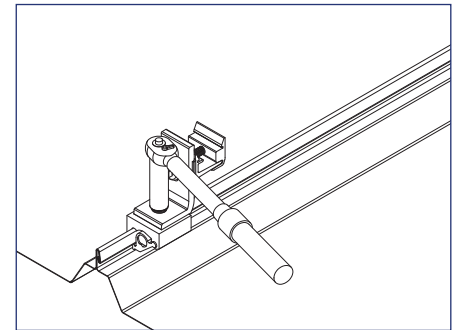
INSTALLATION INSTRUCTIONS
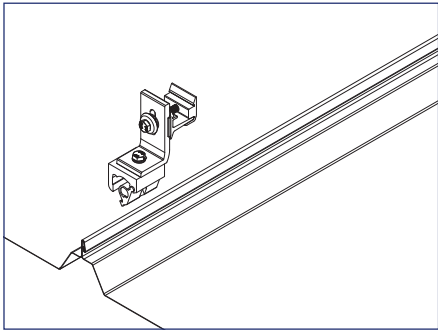
1) Loosen seam clamp hardware and use roof attachment locations to lay out seam clamps on roof.

2) Attach the seam clamp to the standing metal seam by opening the seam clamp cam and placing the clamp over the top of the standing metal seam.
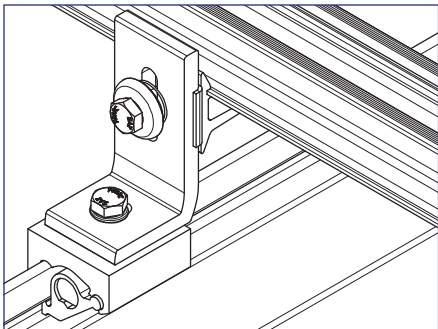

3) Torque black seam clamp bolt to 200 in-lbs (16.7 ft-lbs).
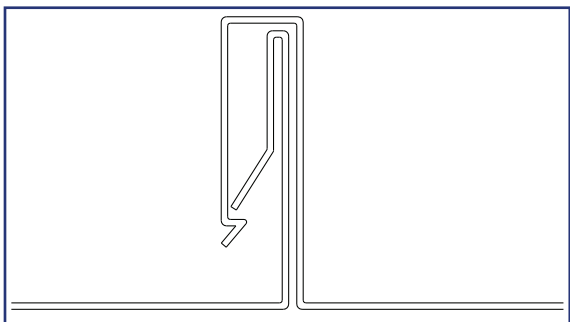
⚙ **Install Note:**

Seam clamps should never be installed using an impact driver.
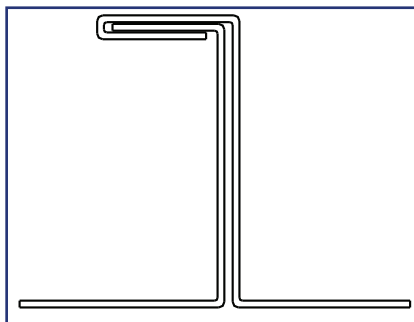

4) Ensure rotation lock is properly aligned with Ultra Mount and L foot during rail installation.
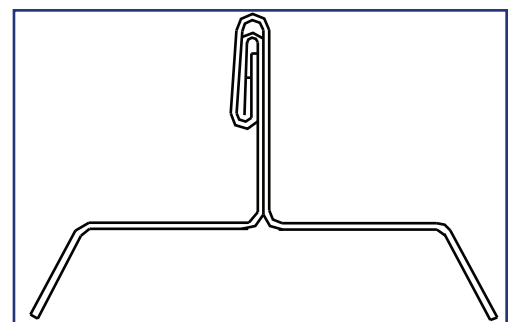
SnapNrack Seam Clamps have been designed to work with a variety of standing seam metal roofs, the most common seam types are:

Snap Lock

Single Lock


Double Lock

⚙ **Install Note:**

If a specific roof seam is not found on list, contact SnapNrack prior to installation.

Required Tools

● Torque Wrench   ● Socket Wrench   ● 1/2" Socket

Materials Included - Ultra Rail Mounting Hardware

1 (1) SnapNrack Ultra Mount (Tapped)

2 (1) SnapNrack Ultra Mount (Thru-Hole)

3 (1) SnapNrack Ultra Mount Spring

4 (1) SnapNrack Ultra Mount Spring Cage

5 (1) 5/16"-18 X 2-1/4" SS HCS Bolt
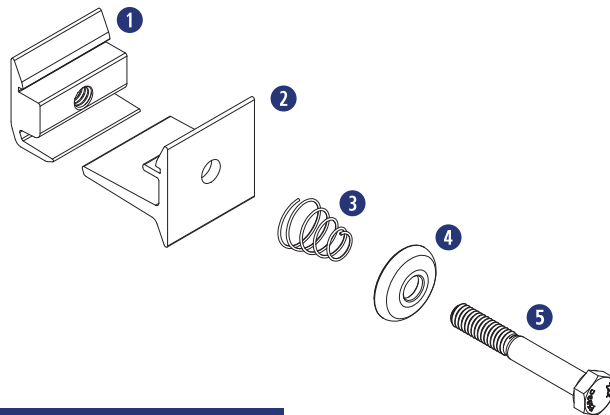
Other Materials Required - *Not Shown*

① Roof Attachment

⚙ Application Note:

Install Ultra Rail onto any roof attachment that uses an L foot or other slotted mount that accepts 5/16" hardware.
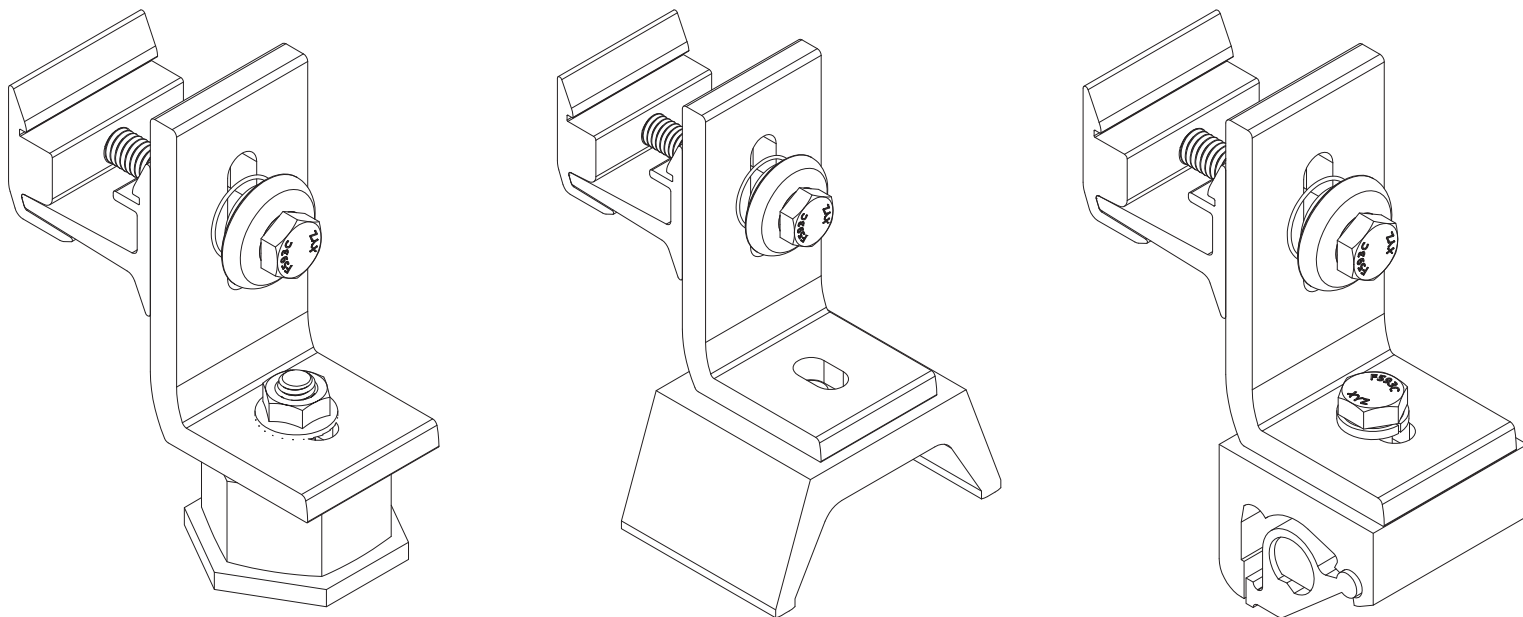
Ultra Rail Mounting Hardware Installed on Different Roof Attachments

⚙ Install Note:

Roof attachments used must always meet minimum structural requirements. Consult licensed structural engineer if necessary.

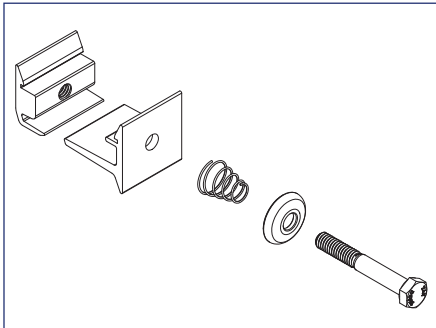## INSTALLATION INSTRUCTIONS

1) Disassemble Ultra Rail Mounting Hardware components, taking note of their installation order and orientation.

2) Re-assemble Ultra Rail Mounting Hardware components onto roof attachment in the following order:

Ultra Mount (tapped) – Ultra Mount (thru-hole) – roof attachment – spring – spring cage – bolt

⚙ Install Note:

See exploded view on previous page for clarification.

⚙ Best Practice:

Ensure bolt is threaded into mount, but leave assembly loose for rail installation.

1/8" - 3/8"
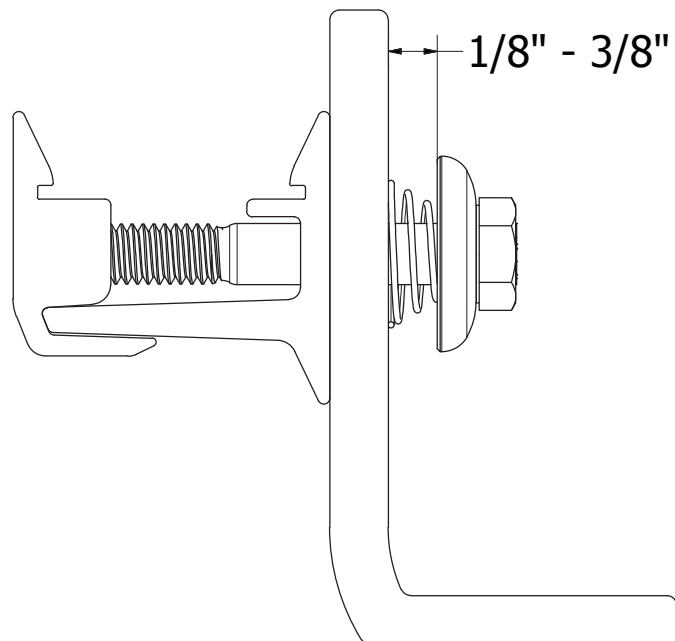
Recommended Ultra Rail Mounting Hardware Installation

Required Tools

- Hammer or Stud Finder
- Roof Sealant
- 1/2" Socket
- Roof Marking Crayon
- Socket Wrench
- Tape Measure
- Drill with 3/16" Pilot Drill Bit (wood roof structures)
- Torque Wrench
- Pitch Finder Tool (Inclinometer)

Materials Included - Ultra Rail Tilt & Bases

1. (2) 1-Hole Base or 4-Hole Base
2. (1) Standoff with Ultra Rail Tilt Clamp, 5-1/2"
3. (1) Standoff with Ultra Rail Tilt Clamp, 10", 14" or 23"
4. (2) Rubber Rain Collar (not required when sealing with pourable roof sealant)

Note:

Bases and Standoffs with Ultra Rail Tilt Clamp are ordered separately to configure desired tilt up arrangement for roof type.
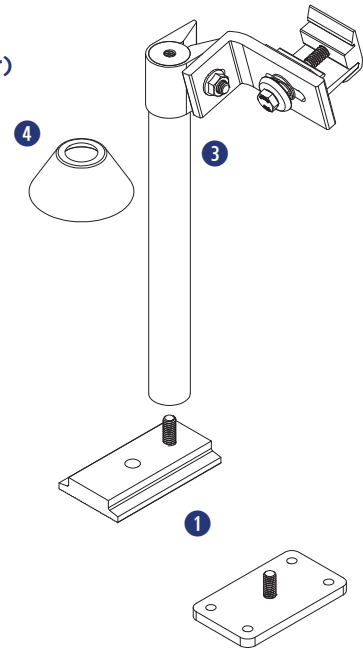
Other Materials Required - *Not Shown*

1-Hole Bases

1. (2) 5/16" SS Lag Screw (wood) or 1/4" SS Self-Drilling, Self-Tapping Screw (metal)
2. (2) 5/16" or 1/4" SS Washers

4-Hole Bases on metal frame structure

1. (2 - 4) 1/4" Lag Screw (wood) or 1/4" SS Self-Drilling, Self-Tapping Screw (metal)
   Note: (2) 1/4" x 3" lag screws are supplied, standard with 4-Hole Bases
2. (2) Conical flashings to match roof type or a pourable type roof penetration seal system
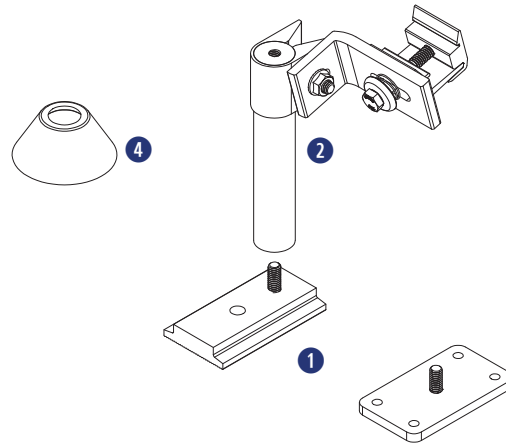
Application Note:

Install on flat roof, composition shingle roof, or tile roofs when additional tilt of solar array is required

Note:

5° - 30° is the approximate tilt angle relative to the roof surface, and is dependent on front to back standoff spacing and module orientation.
Approximate tilt angles (all arrangements are based on the requirement for the front leg to be limited to the 5-1/2" Standoff Shaft): See Tilt Angle Table to right.

Installation Parameters:

- Maximum tilt angle relative to horizontal =30° (+/- 2°)
- Module tilt to be in the same azimuth direction as roof they are to be mounted on
  Exception: Flat roofs (defined as having a slope of less than 7°)
- Maximum roof slope = 23°

Tilt Angle (nominal)

Front to back attachment	Landscape			Portrait		
	5-1/2" & 10" Standoffs	5-1/2" & 14" Standoffs	5-1/2" & 23" Standoffs	5-1/2" & 10" Standoffs	5-1/2" & 14" Standoffs	5-1/2" & 23" Standoffs
16	16°	28°	N/A	N/A	N/A	N/A
24	10°	20°	N/A	N/A	N/A	N/A
32	8°	15°	28°	8°	15°	28°
48	N/A	N/A	N/A	5°	10°	20°

Notes:
1. Table is based on 62 cell modules
2. Table assumes mounting zone on portrait modules not exceeding 25% of module length
3. Maximum tilt angle allowed = 30° relative to horizontal
4. All tilt ups must have 5-1/2" Standoff in front
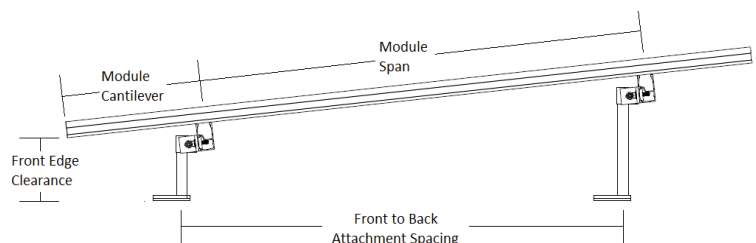
INSTALLATION INSTRUCTIONS
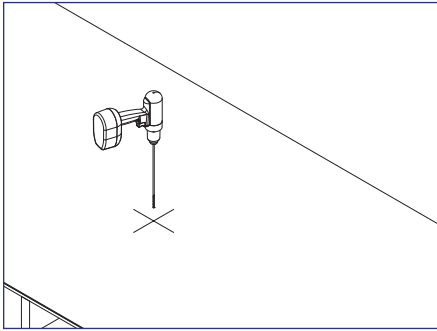
1) Using roof attachment locations drawn on roof during system layout, drill pilot hole(s) into roof framing member.

Install Note:

When installing only 2 fasteners (minimum required) for the 4-Hole Base, select two holes located diagonally from each other.

Ensure the lag or self-drilling screws are installed in a solid portion of the roof framing member. If roof framing member is not found, seal the pilot hole immediately with proper roof sealant.
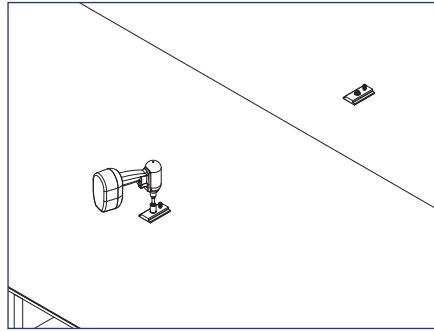
2) Apply roofing sealant to underside of Base and in pre-drilled pilot hole(s). Attach Base to roof with the following fasteners:
1-Hole Bases: 5/16" lag screw (wood roof framing) or 1/4" min. self-drilling screw (metal roof framing) and washer. Drive lag screws for a minimum 2.5" embedment into wood roof framing.
4-Hole Bases: (2-4) 1/4" lag screws (wood framing) or (2-4) 1/4" self-drilling screws (metal roof framing). (2) 1/4" x 3" lags are supplied with 4-hole bases. Drive lag screws for a minimum 1.25" embedment into wood roof framing.

Installation Sequence #'s 3 through 5 pertain to installations with cone type flashings at roof. See Installation Sequence #'s 6 through 7 for installations with pourable type roof penetration seal systems.
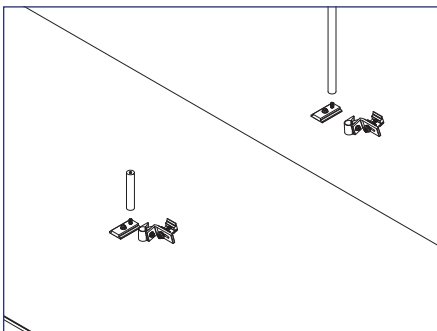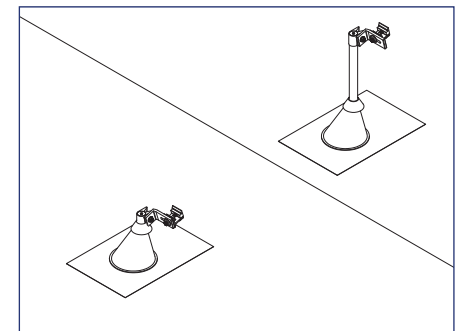

3) **Cone Type Flashings:** Remove the Ultra Rail Tilt Clamp assembly from the Standoff Shafts and set aside. Install Standoff shaft onto base.

Install Note:

Standoff shafts need to be tightened to base using channel lock pliers.
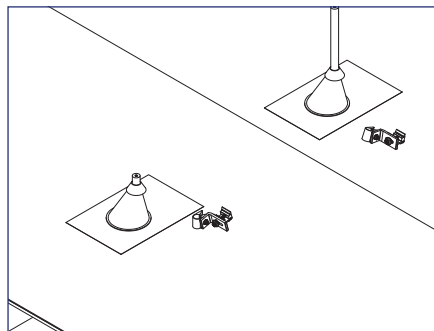
4) **Cone Type Flashings:** Install appropriate roof flashing over Standoff Shaft and seal to roof surface per roofing standards and best practices. Install Rubber Rain Collar over the Standoff Shaft.
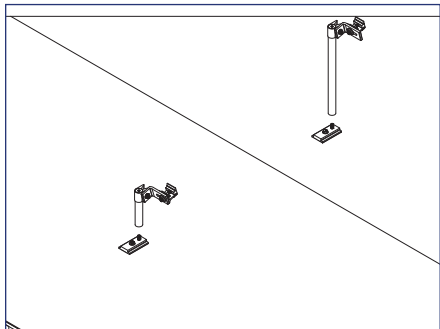

5) **Cone Type Flashings:** Install SnapNrack Ultra Rail Tilt Clamp assemblies back on to Standoff Shafts.
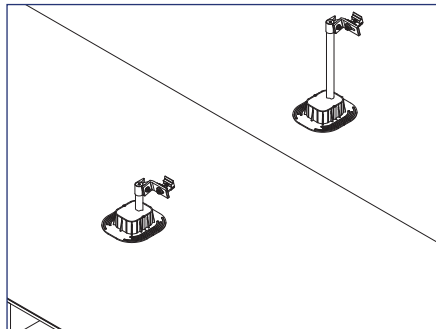
Install Note:

Set the Standoff Clamp assemblies approximately 1/2" below top of Standoff Shaft to accommodate final leveling adjustments.

Skip to installation sequence #8.

INSTALLATION INSTRUCTIONS

6) Pourable Type Roof Penetration Seal System: With Ultra Rail Tilt Clamp assembly on the Standoff Shaft, install Standoff shaft onto base.

> ⚙ **Install Note:**
>
> Standoff shafts need to be tightened to base using channel lock pliers.
>
> **Best Practice:**
> Set the Standoff Clamp assemblies approximately 1/2" below top of Standoff Shaft to accommodate final leveling adjustments.

7) Pourable Type Roof Penetration Seal System: Seal roof penetrations at bases by placing curb around Base then applying pourable sealant material.

> ⚙ **Install Note:**
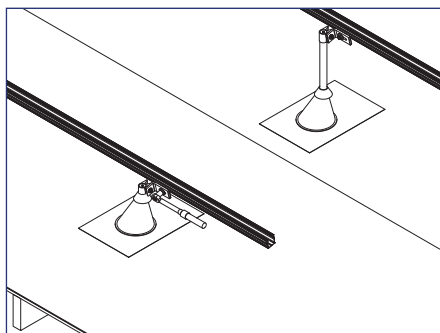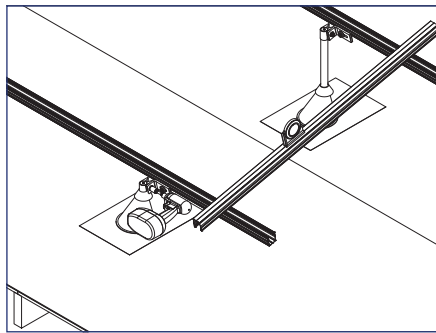>
> Follow manufacturer's instructions closely when applying this type of roof sealing system.

8) Set rails into the Ultra Rail Mounting Hardware on front and rear mounts then tighten the Ultra Rail Mounting Hardware. Connect multiple lengths of rail using the Ultra Rail Splice *(see "UR-40 or UR-60 Rail Splice" sections of manual)*

9) Set all Ultra Rail Mount angles to desired tilt angle using Inclinometer tool. Tighten bolts to 10+ ft-lbs.

> ⚙ **Best Practice:**
>
> Verify that tilt angles for both front and rear rails are in alignment and flush with each other by laying a section of rail (tilt setting rail) across both ails simulating an installed module.

Required Tools

- Level
- String Line or Spare Rail
- Pitch Meter
- Torque Wrench
- Socket Wrench
- 1/2" Socket
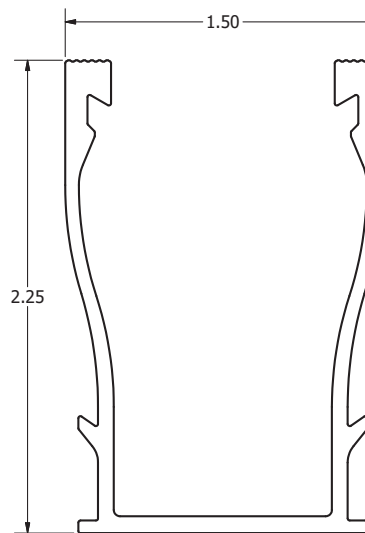
Materials Included - Installing and Leveling Rails

❶ SnapNrack Ultra Rail (UR-40 or UR-60)

❷ SnapNrack Ultra Rail Splice (UR-40 or UR-60)

❸ Pre-Installed SnapNrack Roof Attachments

(L Foot Mount, Tile Replacement, etc.)

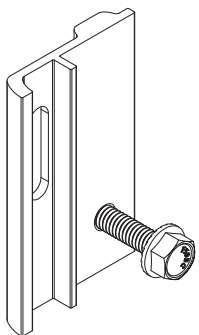## Other Materials Required - *Not Shown*
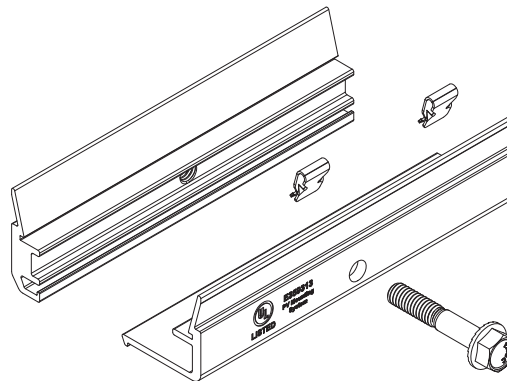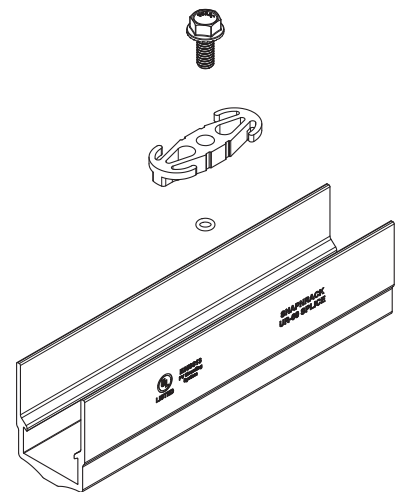
① SnapNrack L Foot Extension

UR-40 Rail Profile

1-1/2"

1-5/8"

UR-60 Rail Profile
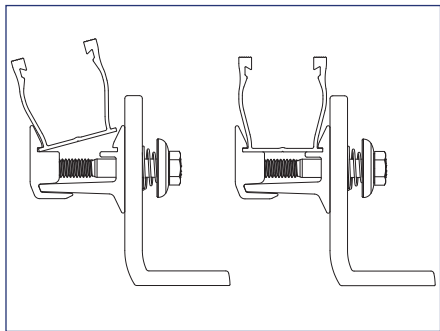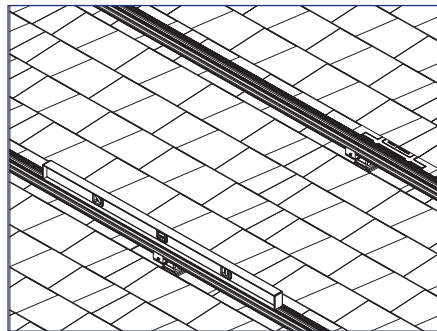
1.50

2.25
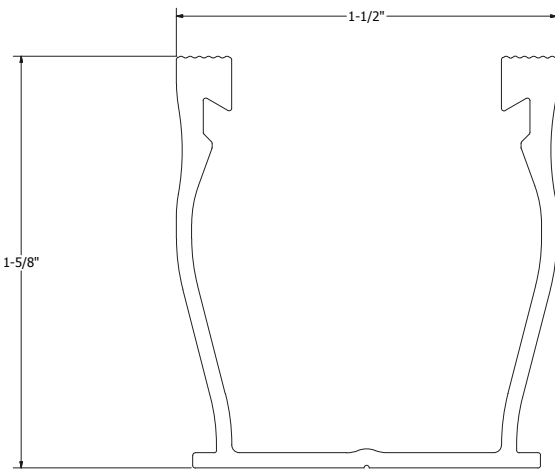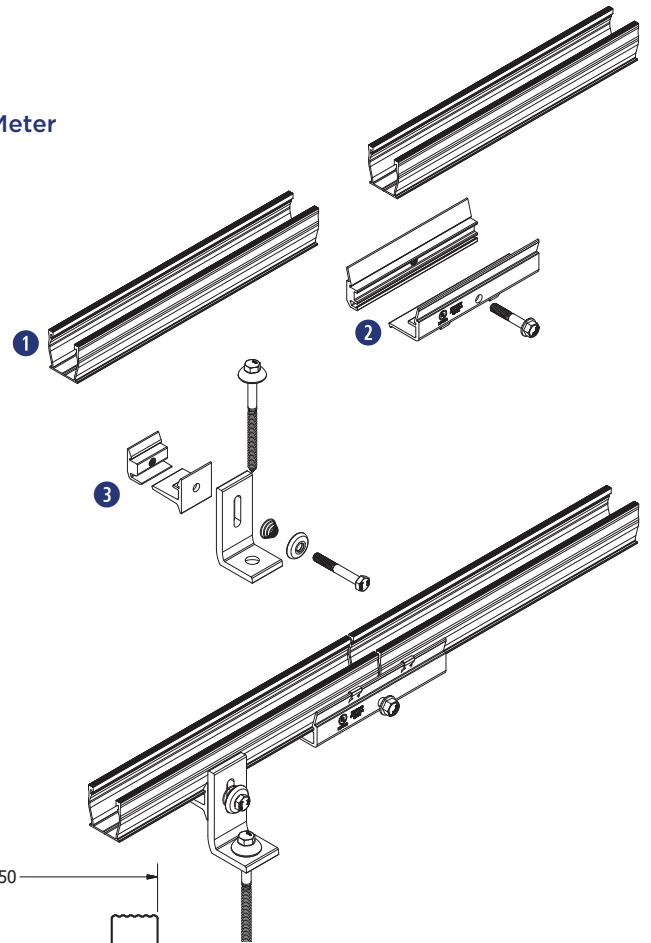
L Foot Extension
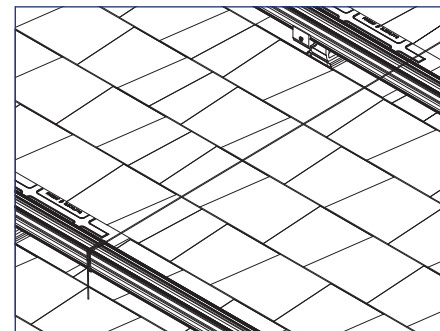
UR-40 Rail Splice

UR-60 Rail Splice

INSTALLATION INSTRUCTIONS

1) Set rails into the attachments by dropping and snapping into the mounts. Connect multiple lengths of rail end to end using the SnapNrack Ultra Rail Splice (see "Ultra Rail Splice" section).

> ⚙ Install Note:
>
> Slightly rocking rail into mounts can ease installation, leading first with side of rail furthest from mount.

2) Level the bottom rail of the array to the roof and tighten attachment points.

> ⚙ Best Practice:
>
> Set attachments in the middle of available leveling range to start.

3) Run a string line or spare rail from the bottom rail to the top rail and set desired pitch of the array by adjusting the top rail, add L Foot Extension if needed.

> ⚙ Install Note:
>
> See "Leveling Components" section for installation instruction and restrictions.

4) Level the top rail by moving the string line down the length of the rail, matching pitch over the entire length of the array.
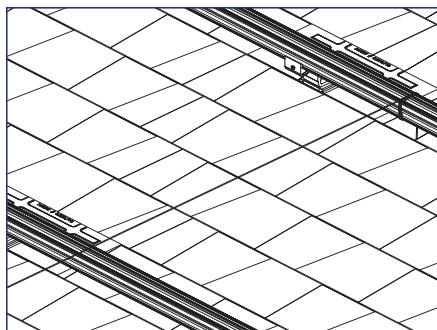
5) Level the remaining rails to the string line by working out from the middle rail, add L Foot Extensions or spacers if needed.
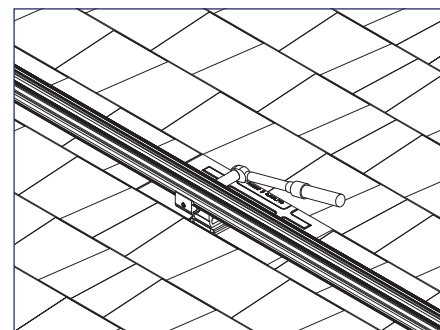
6) Tighten all racking hardware to 12 ft-lbs.

> ⚙ Note:
>
> The minimum standoff height between the modules and roof is as follows:
>
> ● REC Solar, Yingli, and Suniva modules: 4.00"
>
> ● ReneSola modules: 3.93" (100 mm)
>
> ● Trina Solar modules: 4.53" (115 mm)

INSTALLATION INSTRUCTIONS

SnapNrack L Foot Extension

1) Remove Ultra Mount components from roof attachment, taking note of their installation order and orientation.
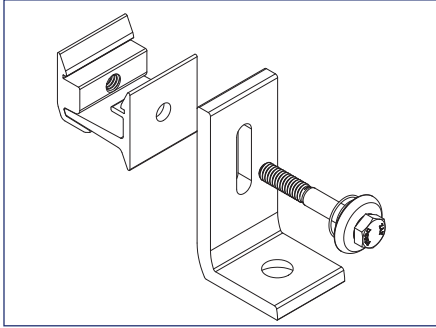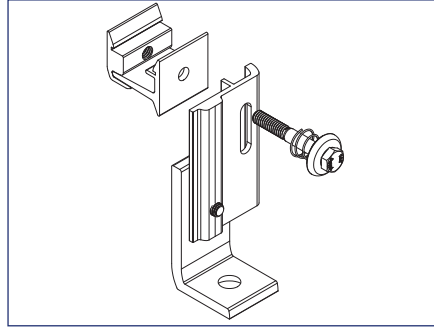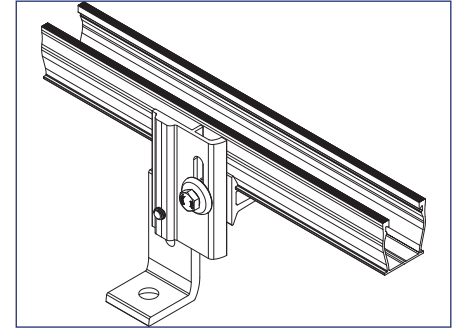

2) Remove bolt from L Foot Extension and install onto pre-installed roof attachment, then set desired height and tighten hardware to 12 ft-lbs.

3) Re-install Ultra Rail Mounting Hardware components onto L Foot Extension in the following order:

Ultra Mount (tapped) – Ultra Mount (thru-hole) – L Foot Extension – spring – washer – bolt

> ⚙ Install Note:
>
> **See exploded view in "Ultra Rail Mounting Hardware" section for clarification.**

> ⚙ Best Practice:
>
> **Ensure bolt is threaded into mount, but leave assembly loose for rail installation.**
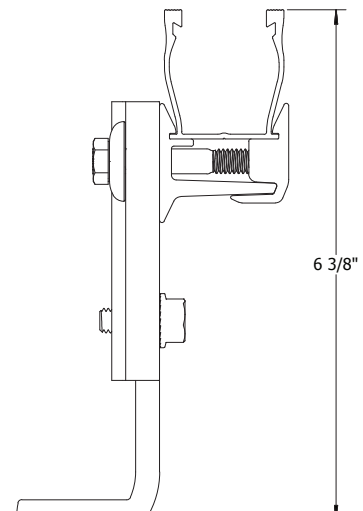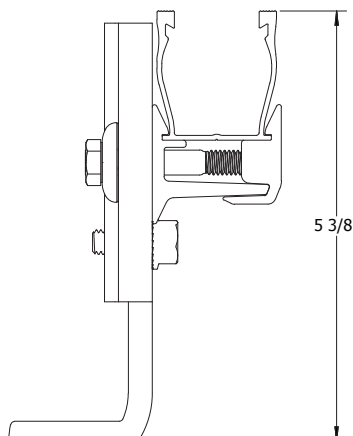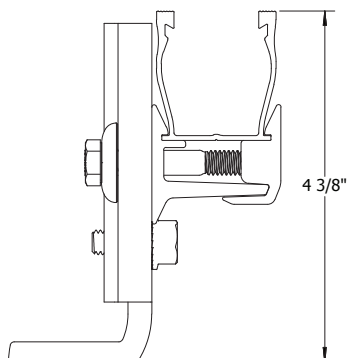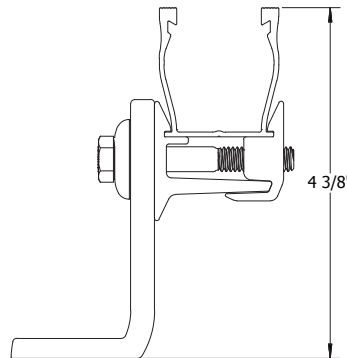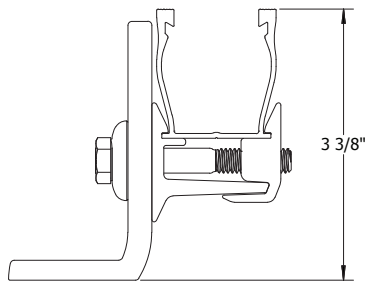
Use a single L Foot Extension on no more than 30% of attachment points.

3 3/8"

4 3/8"

6 3/8"

4 3/8"

5 3/8"

**L Foot Extension Provides Up To 3" of Height Adjustment
(UR-60 Rail Adds 5/8" To Overall Height)**

INSTALLATION INSTRUCTIONS
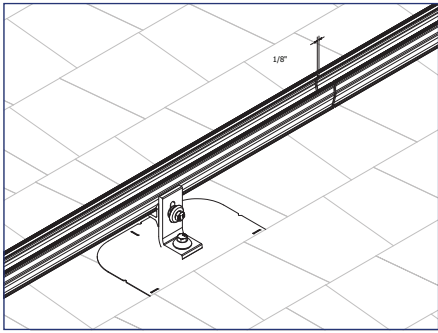
1) Align sections of rail and leave a 1/8" - 1/4" gap.

⚙ **Install Note:**

Leaving a gap between rails will allow for thermal expansion of rail and drainage.

Any section of rail that is spliced will need to be supported by a roof attachment on both sides. Splices are not allowed to be installed on rail cantilevers.
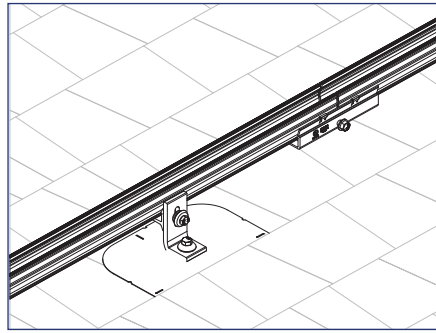
2) Install rail splice assembly onto bottom of rail, making sure both rails are seated in grooves of splice and that the splice is centered.

⚙ **Install Note:**

Gap between rails must land between bonding clips on splice.

⚙ **Best Practice:**

Hold sides of splice together on rails with one hand and tighten with the other.

3) Tighten splice hardware to 12 ft-lbs.

2" MAX

2" MAX

1/8" - 1/4" RAIL GAP

E359313
PV Mounting System

UL LISTED
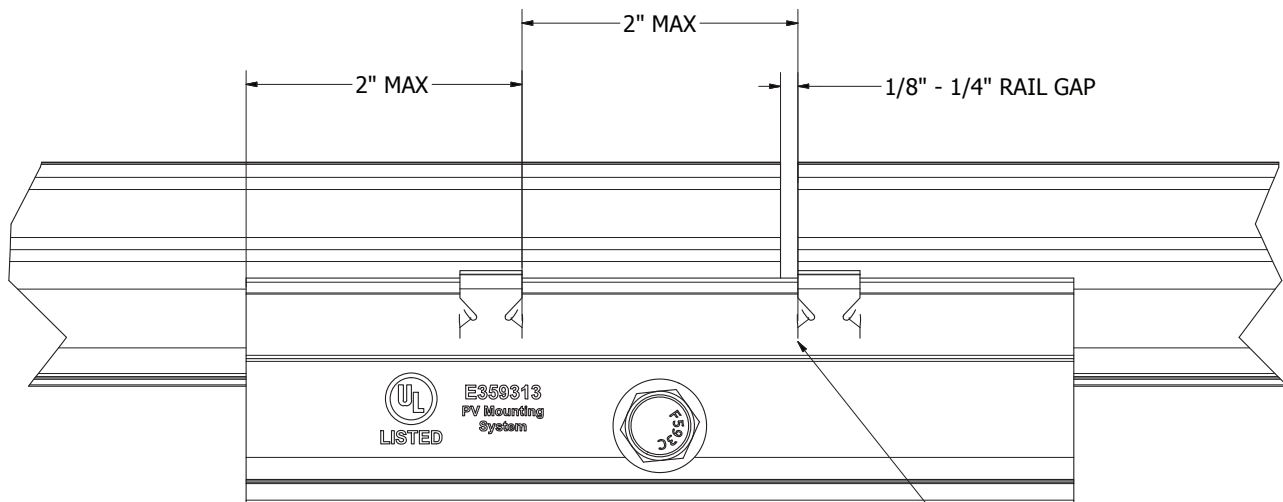
RAIL EDGE MUST NOT PASS CLIP EDGE, AS SHOWN

UR-40 Splice Installation Limitations

INSTALLATION INSTRUCTIONS
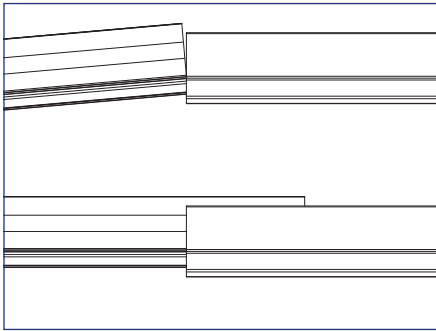
1) Slide first rail into splice, ensuring that BOTH rail flanges are engaged into lower section of splice.

> **⚙ Best Practice:**
> Rocking rail in slightly from the bottom can ease install.

> **⚙ Install Note:**
> Any section of rail that is spliced will need to be supported by a roof attachment on both sides. Splices are not allowed to be installed on rail cantilevers.
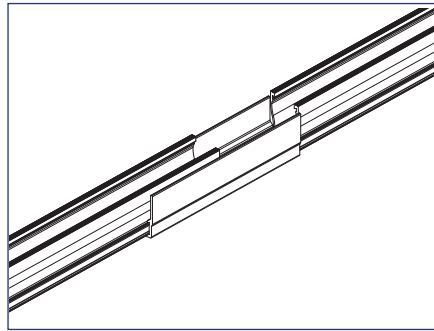
2) Slide second rail into splice, ensuring that BOTH rail flanges are engaged into lower section of splice.

> **⚙ Best Practice:**
> Rocking rail in slightly from the bottom can ease install.
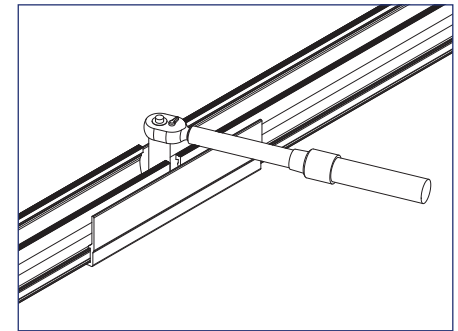
3) Tighten splice hardware to 12 ft-lbs

> **⚙ Install Note:**
> Line up rails with notches in bridge and leave approximately 1/2" gap between rails to allow for thermal expansion of rail.

3/8" - 5/8" RAIL GAP

LINE UP RAIL EDGE WITH NOTCH, AS SHOWN
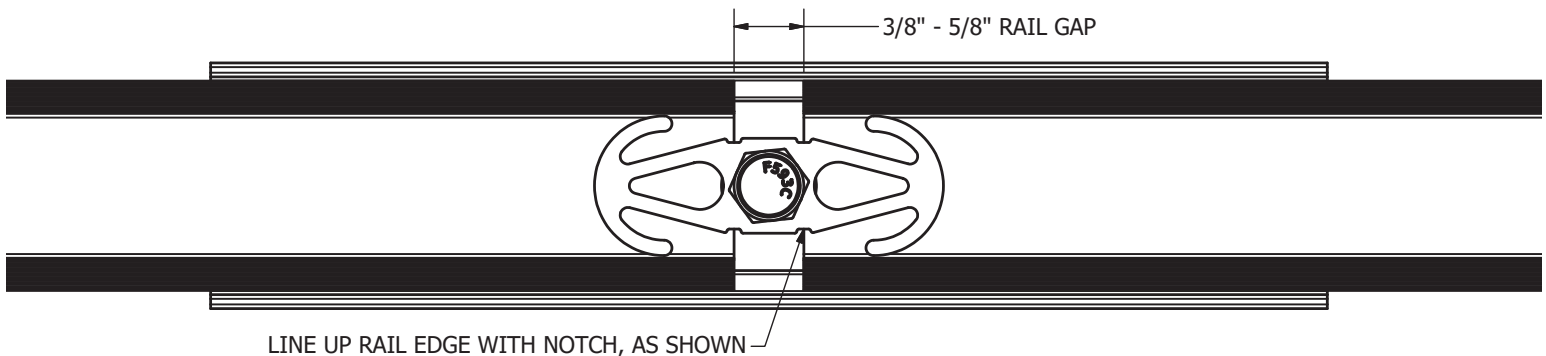
UR-60 Splice Installation Limitations

Module Installation

Required Tools

● Torque Wrench   ● Socket Wrench   ● 1/2" Socket

Materials Needed - Module Installation

❶ Pre-Installed SnapNrack Roof Attachments

❷ Pre-Installed SnapNrack Rails

❸ SnapNrack Mid Clamp Assemblies

❹ SnapNrack End Clamp Assemblies
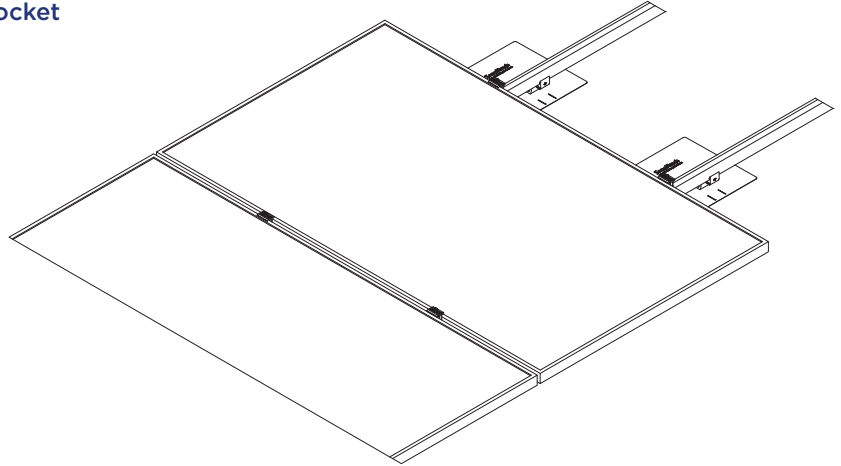
❺ PV Modules

Mid Clamp Assembly

❶ (1) 5/16"-18 SS HCS Bolt

❷ (1) 5/16" SS Split Lock Washer

❸ (1) SnapNrack Mid Clamp

❹ (1) SnapNrack SS Mid Clamp Spring

❺ (1) 5/16"-18 SnapNrack Channel Nut
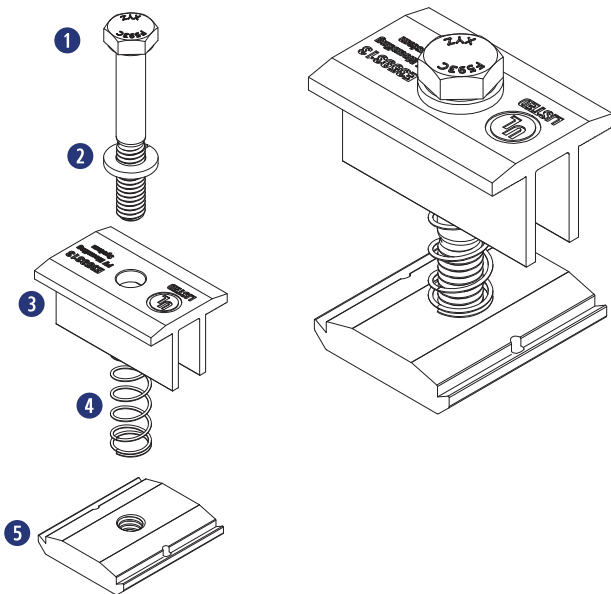
Adjustable End Clamp Assembly

❶ (1) 5/16"-18 SS HCS Bolt

❷ (1) 5/16" SS Split Lock Washer

❸ (1) SnapNrack Adjustable End Clamp Top

❹ (1) SnapNrack Adjustable End Clamp Bottom
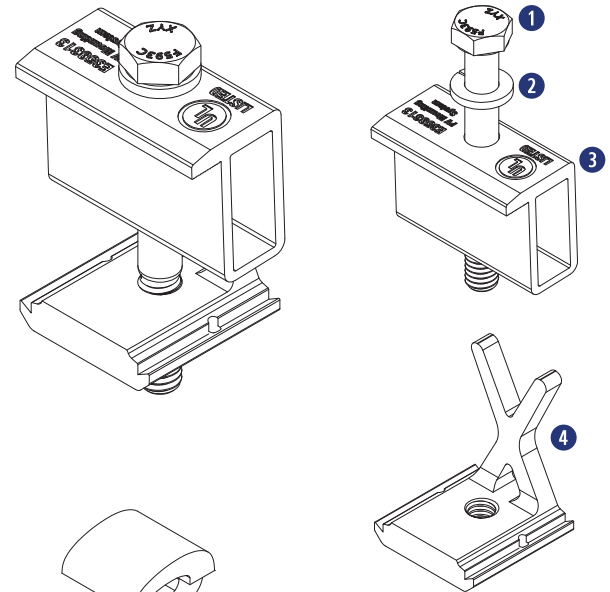
Universal End Clamp Assembly

❶ (1) 5/16"-18 X 1-1/2" SS HCS Bolt

❷ (1) 5/16" X 3/4" SS Flat Washer

❸ (1) SnapNrack Universal Wedge

❹ (1) SnapNrack Universal Wave
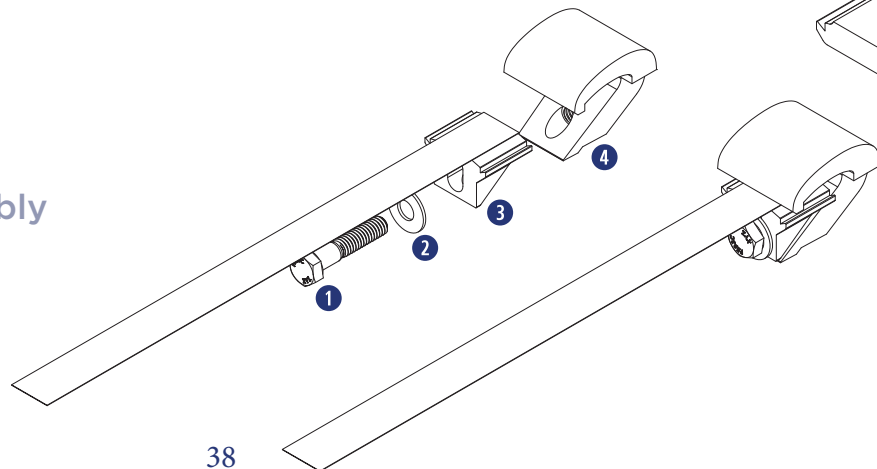
INSTALLATION INSTRUCTIONS

SnapNrack Mid Clamp
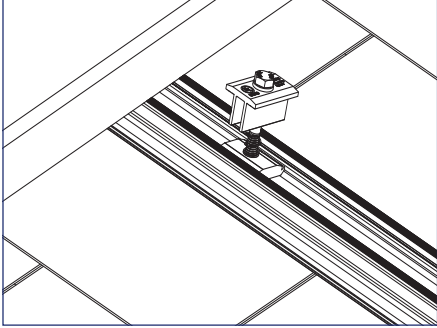
1) Snap the channel nut into the top channel of the rail.

> ⚙ **Best Practice:**
> Backing channel nut off bolt will ease installation into rail channel.
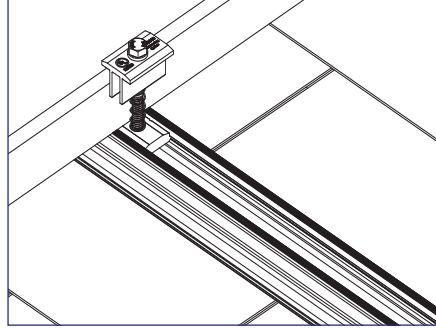
2) Slide the clamp flush to the module with the top lip of the mid clamp over the top edge of the module frame.

> ⚙ **Install Note:**
> Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.
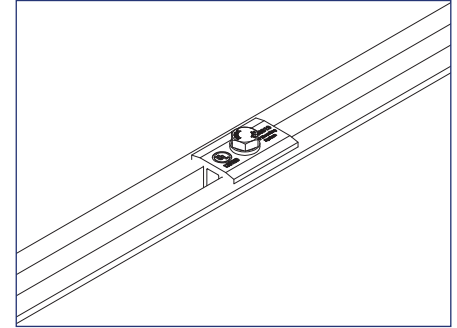
3) Place the next module flush to the other side of the mid clamp.

> ⚙ **Install Note:**
> Mid clamps create 1/2" gap between modules.
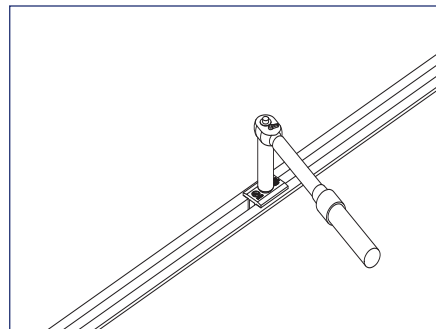
4) Tighten hardware to 10 ft-lbs.

> ⚙ **Install Note:**
> Mid clamps are Listed with and without springs.

INSTALLATION INSTRUCTIONS

SnapNrack Adjustable End Clamp
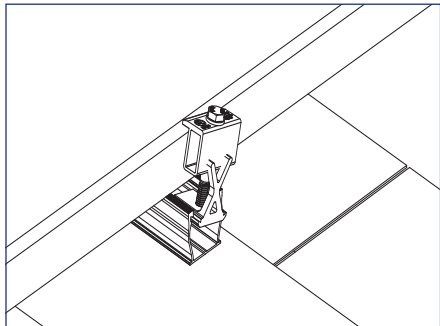
1) Snap the channel nut into the top channel of the rail.

> **⚙ Install Note:**
>
> Adjustable End Clamps require extra rail to ensure that channel nut is fully engaged.
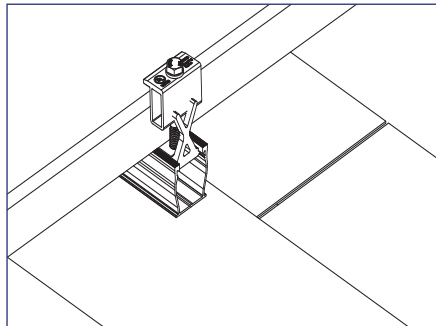
2) Slide the clamp flush to the module with the top lip of the end clamp over the top edge of the module frame.

> **⚙ Install Note:**
>
> Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.
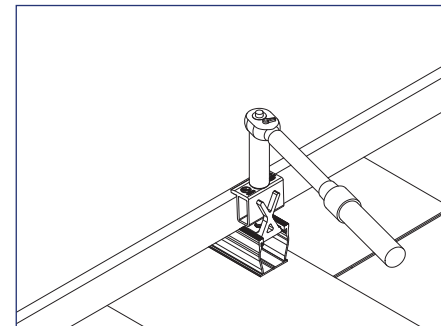
3) Tighten hardware to 10 ft-lbs.
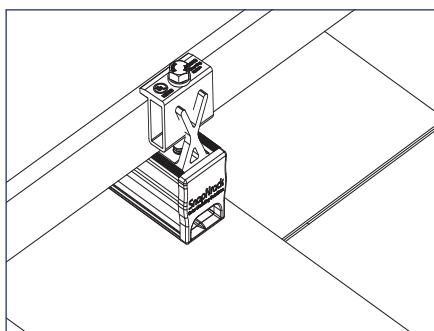
4) Install end cap to finish.

INSTALLATION INSTRUCTIONS

SnapNrack Universal End Clamp
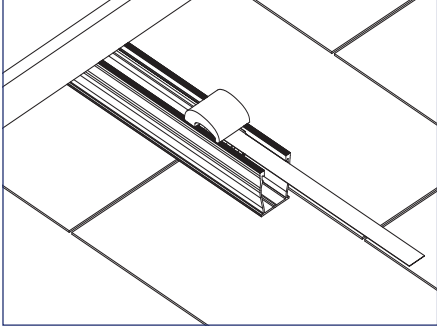
1) Slide the preassembled Universal End Clamp (UEC) into the end of the rail.
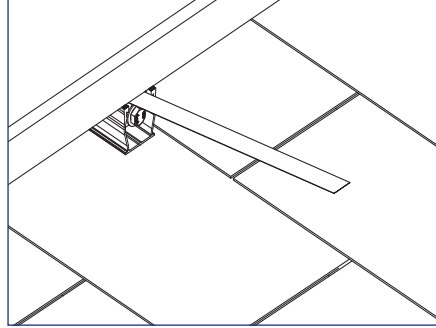
2) Lift the module and slide the clamp far enough under the module to pass the lip of the bottom edge of the module frame.

⚙ Install Note:

Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.
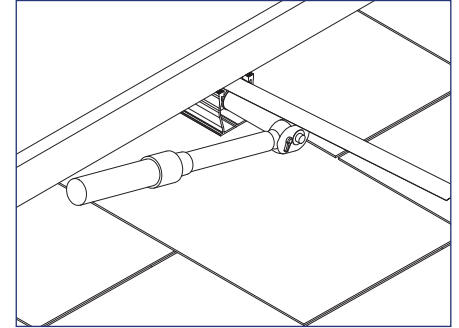
3) Use the pull tab to hold the UEC taut towards the end of the rail and tighten hardware to 10 ft-lbs.

⚙ Install Note:

Rail can be cut flush to the module when using UEC.
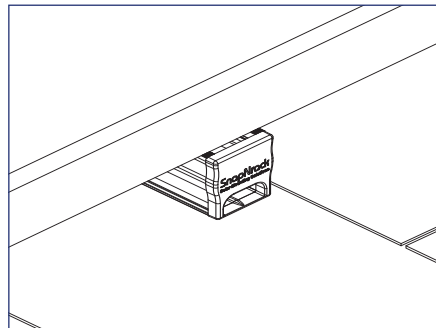
4) Install end cap to finish.

⚙ Install Note:

Modules need to be grounded separately when Universal End Clamps are the only type of clamp attaching a module.

Required Tools

● **Reciprocating Saw or Portable Band Saw**

Materials Included - Rail Cutting Tool and Rail End Cap

❶ **(1) SnapNrack Rail Cutting Tool**

❷ **(1) SnapNrack Ultra Rail End Cap (UR-40 or UR-60)**
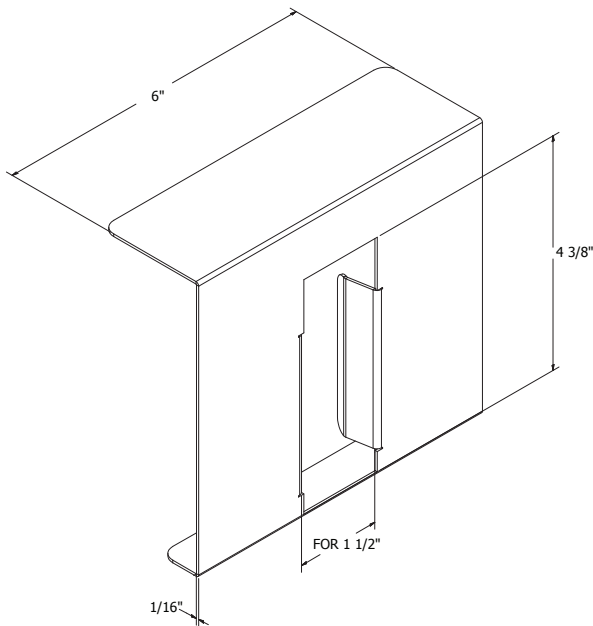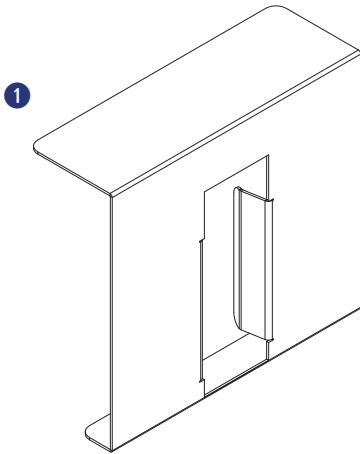
Dimensioned Rail Cutting Tool
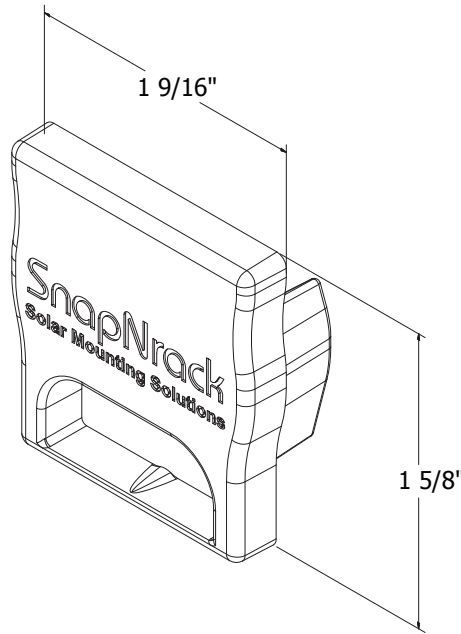
Dimensioned UR-40 Rail End Cap
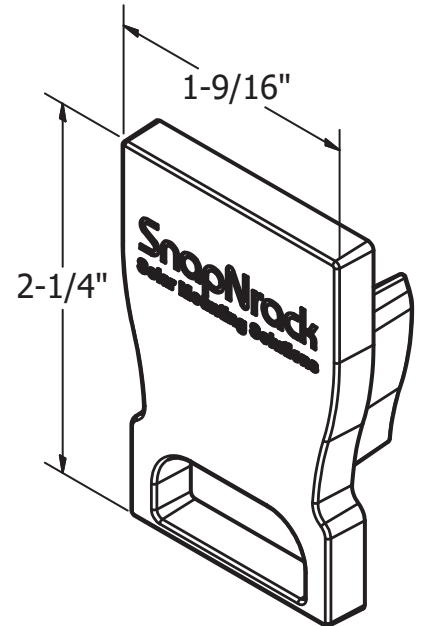
Dimensioned U-60 Rail End Cap

⚙ **Application Note:**

Use to cut rail flush to module frame when using Universal End Clamps (UEC).

Rail Finishing

INSTALLATION INSTRUCTIONS
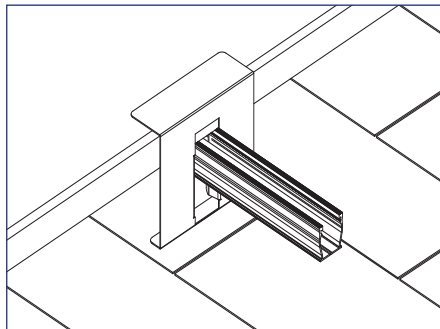
1) Slide the Rail Cutting Tool over the end of the rail and place it so that the upper lip is safely covering the edge of the module *(optional)*.
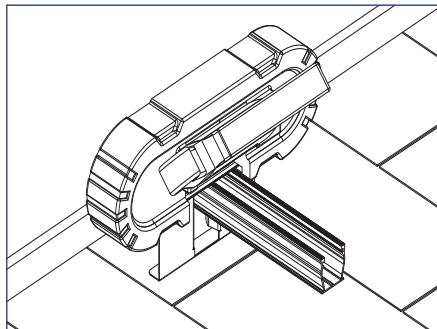
2) Use the reciprocating saw or band saw to cut off the end of the rail, then remove any sharp edges.
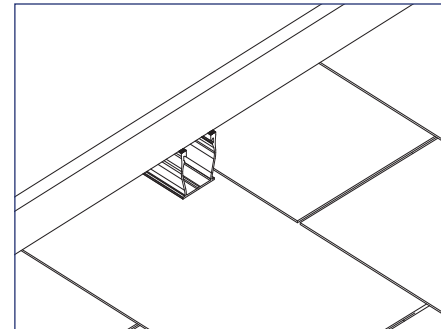
3) Remove the Cutting Tool from the rail, then remove any sharp edges.
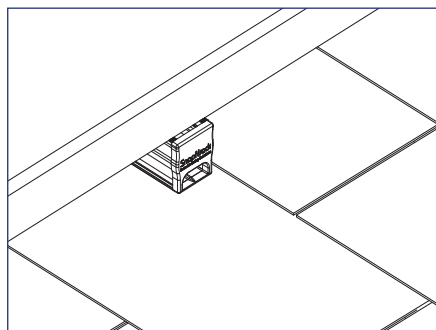
4) Insert SnapNrack Ultra Rail End Cap into the cut end of the rail to create a flush finish to the array.

Wire Management

Required Tools

- Reciprocating Saw or Chop Saw (Rail Cover)
- Socket Wrench (Wire Clamp)
- 1/2" Socket (Wire Clamp)

Materials Included - Rail Cover

1 (1) SnapNrack 48" Rail Cover

> ⚙ **Application Note:**
> Install to protect any conductors that are exposed to sunlight that are not approved for use in UV light.

48"
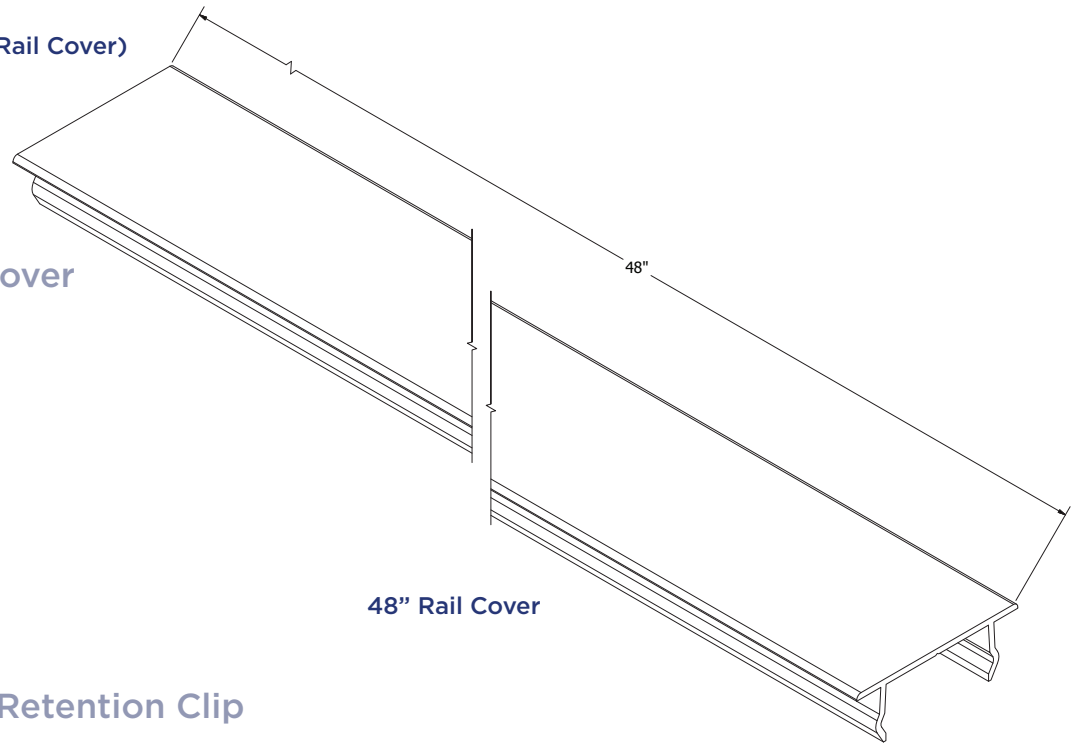
48" Rail Cover

Materials Included - Wire Retention Clip

1 SnapNrack Wire Retention Clip

> ⚙ **Application Note:**
> Install as necessary to manage and safely retain conductors within SnapNrack rails.

Wire Retention Clip

Materials Included - Wire Clamp

1 (1) SnapNrack 4-Wire Clamp, Trunk Cable Clamp, or Universal Wire Clamp

> ⚙ **Application Note:**
> Install as necessary to secure cables and conductors running from rail to rail, or transitioning out/in from a rail channel
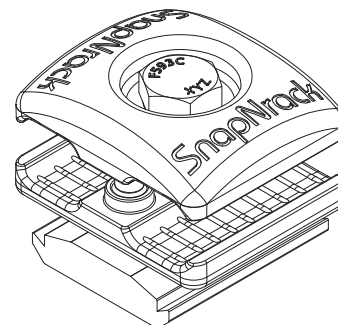
Universal Wire Clamp Assembly

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INSTALLATION INSTRUCTIONS

SnapNrack 48" Rail Cover
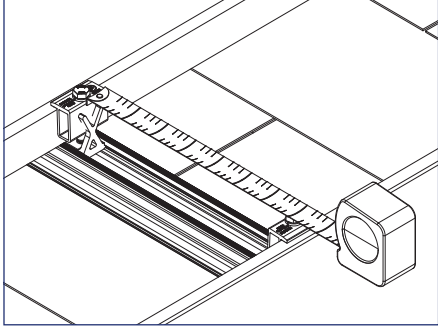
1) Measure the length of the SnapNrack 48" Rail Cover that is needed.
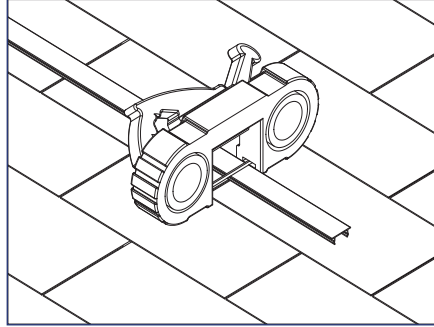
2) Cut the rail cover to length, then remove any sharp edges.
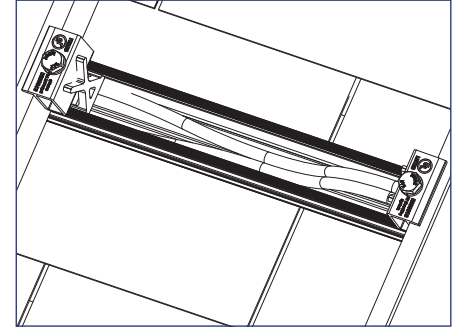
3) Place all electrical conductors in the bottom of the rail channel.
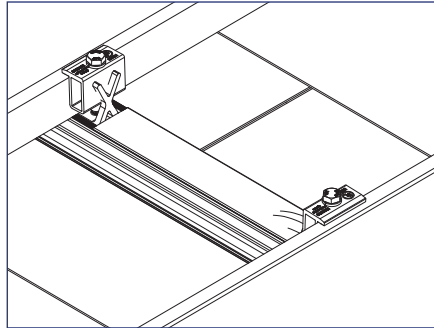
4) Snap Rail Cover into place, enclosing all conductors inside of rail channel.

⚙ Install Note:

SnapNrack Rail Cover is designed to stay in place once installed, use a flat blade screw driver if it needs to be relocated or removed.

INSTALLATION INSTRUCTIONS

SnapNrack Wire Retention Clip
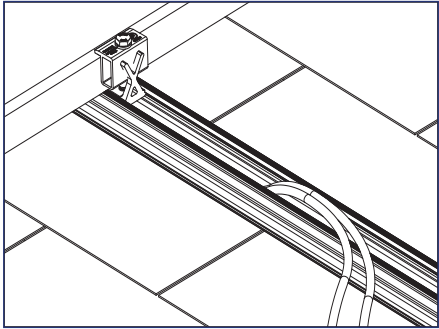
1) Place all electrical conductors in the bottom of the rail channel.
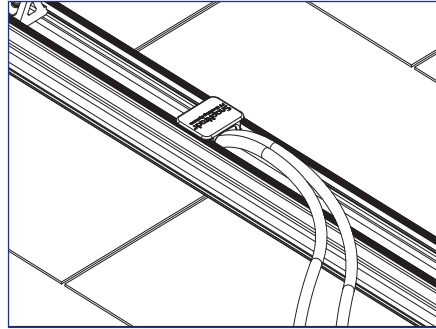
2) Install the Wire Retention Clip by snapping it into place on the rail.

SnapNrack 4-Wire, Trunk Cable, or Universal Wire Clamp
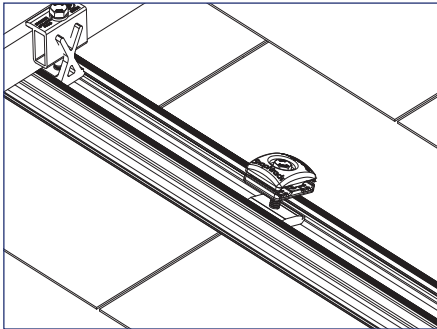
1) Snap Wire Clamp into top or side rail channel.
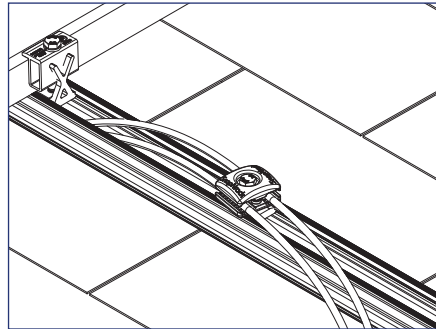
2) With Wire Clamp loose, place conductors or cables in slots.
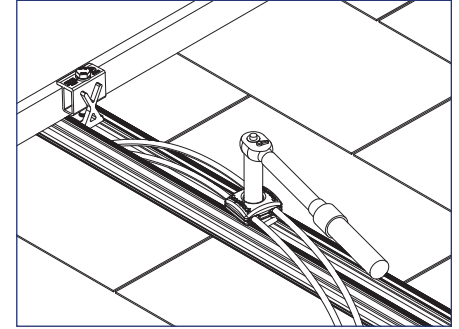
3) Tighten Wire Clamp with 1/2" socket, ensure cables and conductors are aligned in the clamp slots.

Install Note:
Wire Clamps can be rotated and oriented in any direction.
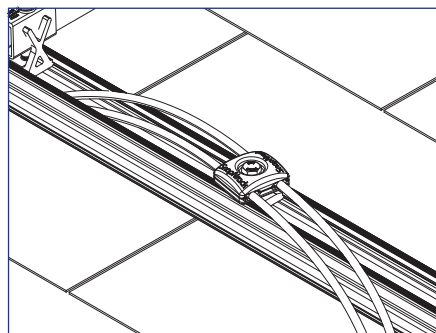
4) 4-Wire Clamp intended for PV Wire conductors, Trunk Cable Clamp intended for trunk cables, Universal Wire Clamp intended for both PV Wire conductors and AC trunk cables.

Install Note:
Conductors of different types should be placed under separate Universal Wire Clamps.

Required Tools

● Torque Wrench ● Socket Wrench ● 1/2" Socket

Materials Included - MLPE Rail Attachment Kit

1 (1) 5/16" X 1-1/2" X 0.125" SS Fender Washer

2 (1) SnapNrack Channel Nut

3 (1) 5/16"-18 X 1-1/4" SS Flange Bolt

Other Materials Required

① (1) MLPE Unit

BOLT-TO-PLATE BONDING

5/16"-18 SS FLANGE BOLT (TORQUE TO 16 FT-LBS)

MOUNTING PLATE

MIN 1/8" THICK SS FENDER WASHER

CHANNEL NUT

RAIL

SS BONDING PIN
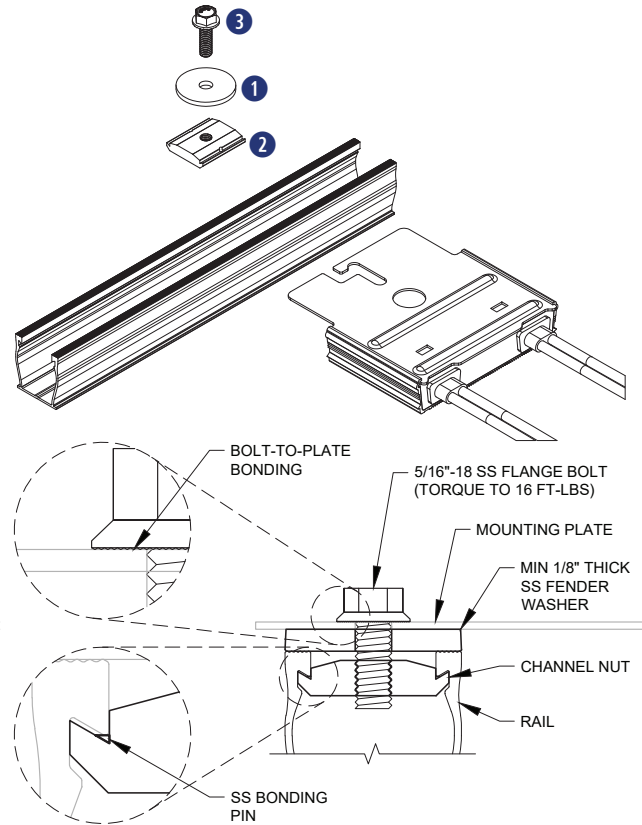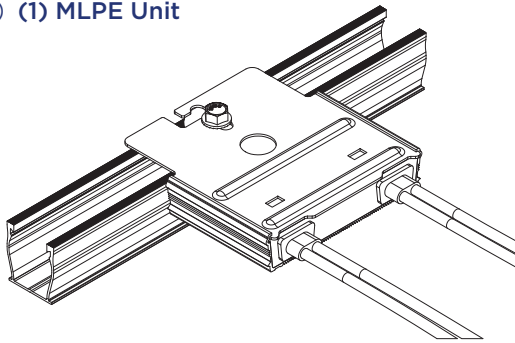
Materials Included - MLPE Frame Attachment Kit

1 (1) SnapNrack MLPE Frame Attachment Top

2 (1) SnapNrack MLPE Frame Attachment Bottom

3 (1) 5/16"-18 X 3/4" SS Flange Bolt

4 (1) SnapNrack Smart Clip II

5 (1) SnapNrack MLPE Frame Attachment SS Coil Spring

Other Materials Required

① (1) MLPE Unit

MODULE FRAME

SS BONDING PIN

BOLT-TO-PLATE BONDING

MOUNTING PLATE

5/16"-18 SS FLANGE BOLT (TORQUE TO 10 FT-LBS)
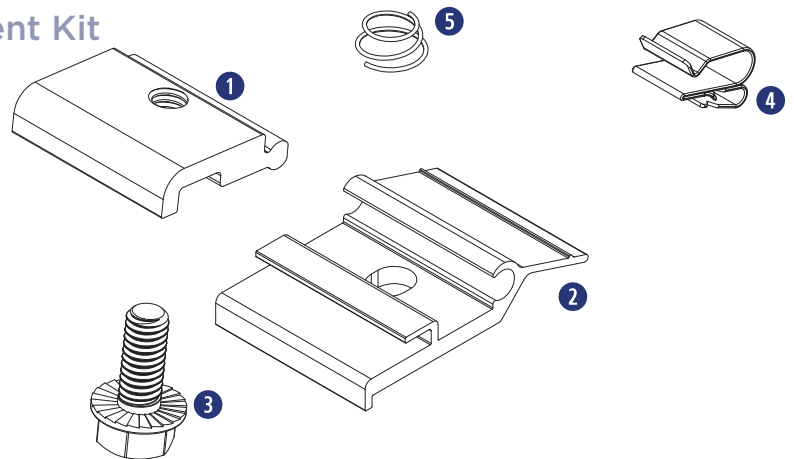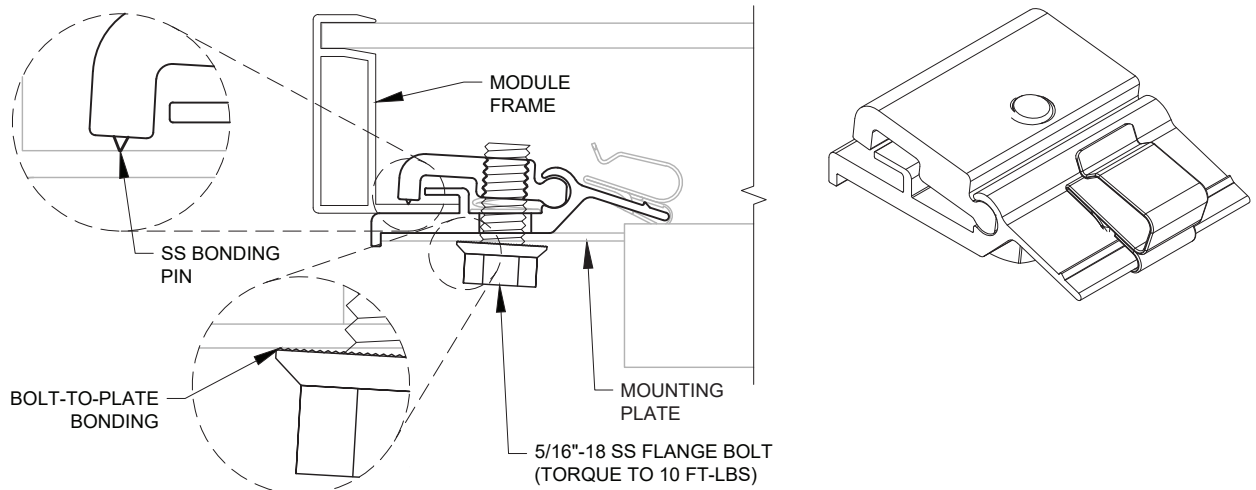
Materials Needed – SolarEdge Frame Mount

① **(1) SolarEdge Optimizer w/ Frame-Mounted Module Add-On**
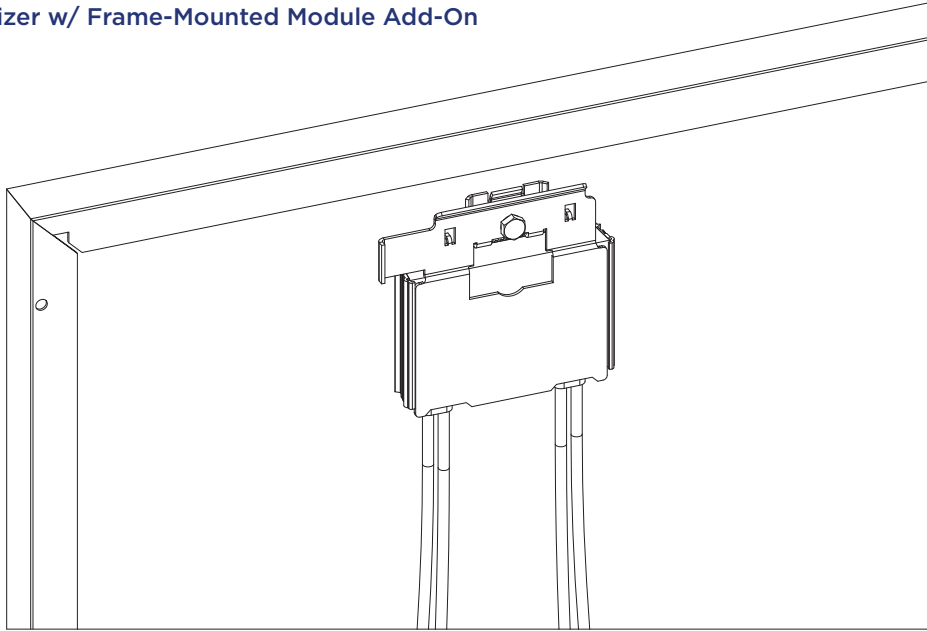
Materials Needed – Enphase Frame Mount

① **(1) Enphase Microinverter**

② **(1) Enphase Frame Mount**
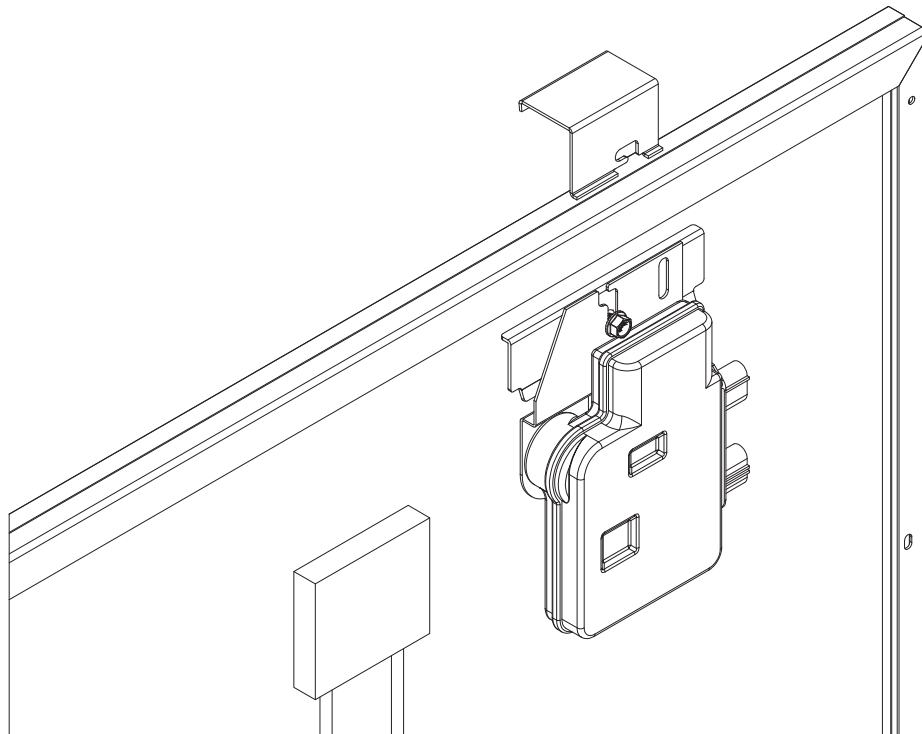
INSTALLATION INSTRUCTIONS - MLPE RAIL ATTACHMENT
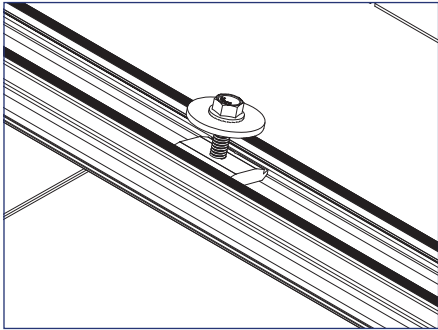
1) Snap the SnapNrack MLPE Rail Attachment Kit channel nut into the desired location on the rail where the microinverter will be installed.
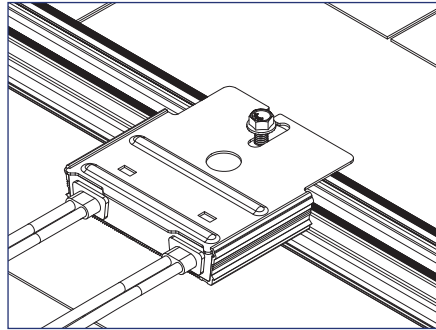
2) Install the microinverter mounting plate onto the bolt of the MLPE Rail Attachment Kit, ensuring that the large fender washer is between the rail and mounting plate.

⚙ **Install Note:**

Bolt and washers may need to be removed and then replaced.
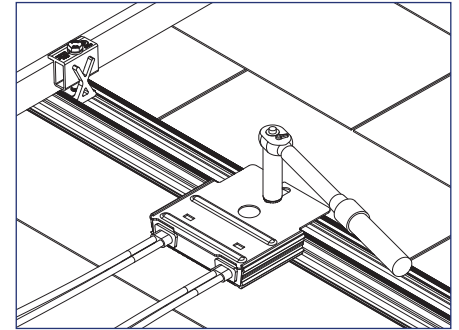
3) Tighten hardware to 10 ft-lbs.

⚙ **Install Note:**

MLPE Attachment Kits are approved for bolt lengths between 1" and 1-1/2" long.

INSTALLATION INSTRUCTIONS - MLPE FRAME ATTACHMENT
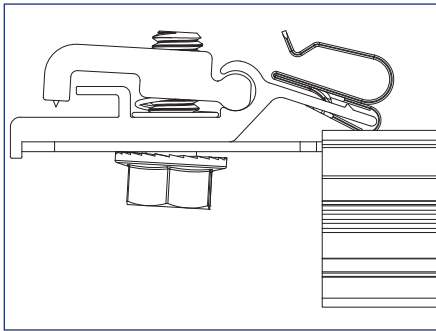
1) Slide the backplate channel of the MLPE device under the MLPE Frame Attachment Kit bolt. The MLPE mounting plate should rest against the MLPE mounting plate backstop on the MLPE Frame Attachment Kit.
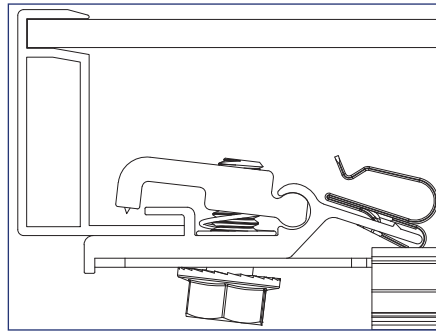
2) Position the MLPE Frame Attachment Kit on the module frame flange in a location that will not interfere with mounting system components. The module frame flange should rest against the module flange backstop on the MLPE Frame Attachment Kit.

⚙ **Install Note:**

Avoid blocking module frame drainage holes when installing the MLPE Frame Attachment Kit.

4) Connect the module leads to the input con-nectors on the MLPE device and manage con-ductors with the integrated Smart Clip.
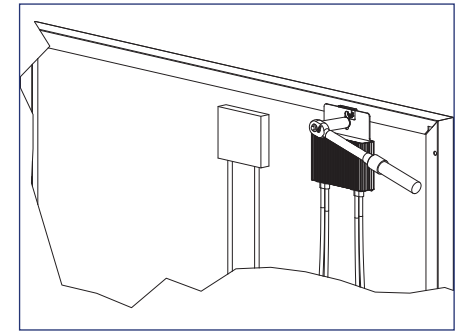
3) Tighten the mounting bolt on the MLPE Frame Attachment Kit to 10 ft-lbs.

⚙ **Install Note:**

The MLPE Frame Attachment Kit bonds the following components: Module Frame, MLPE backplate and Smart Clip.

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MLPE Installation

INSTALLATION INSTRUCTIONS - SOLAREDGE FRAME MOUNT
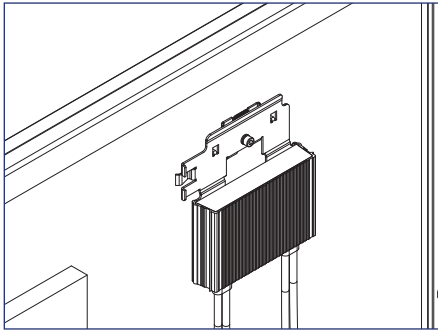
1) Locate the SolarEdge optimizer with Frame-Mounted Module Add-On at a location on the module frame that will not interfere with the SnapNrack rail.
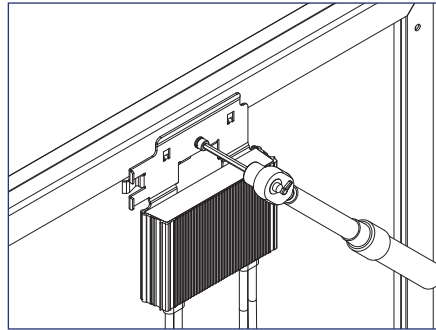
2) Install the optimizer mounting plate onto the module frame and tighten hardware to 7 ft-lbs.
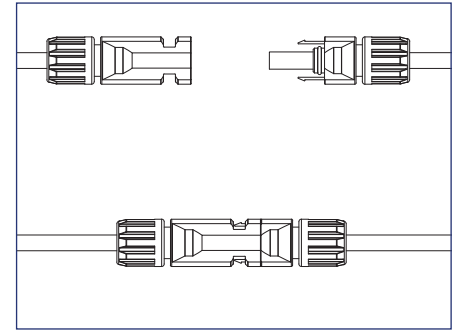
3) Connect the module leads to the input connectors on the optimizer.

⚙ Install Note:

Refer to the SolarEdge optimizer Frame-Mounted Module Add-On installation guide for additional instructions.

INSTALLATION INSTRUCTIONS - ENPHASE FRAME MOUNT
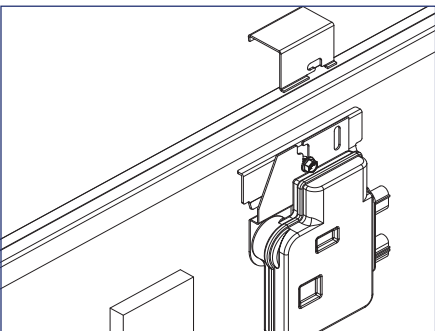
1) Locate the Enphase Frame Mount bracket clamp at a location on the module frame that will not interfere with the SnapNrack rail.
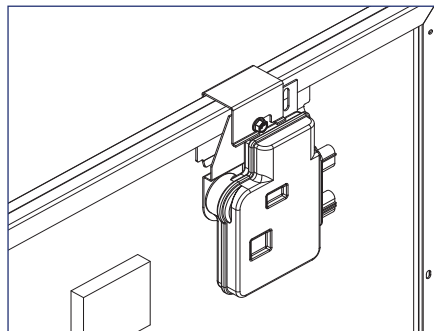
2) Slide the microinverter unit onto the bracket clamp, then move it slightly to the left.

⚙ Install Note:

The microinverter mounting flange should be on the outside of the module frame.
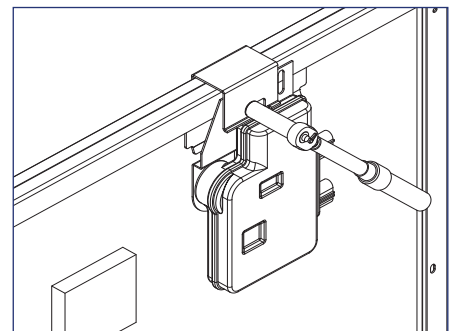
3) Tighten hardware to 13 ft-lbs
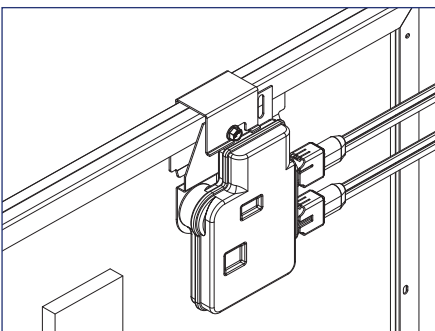
4) Connect the module leads to the microinverter DC connectors.

⚙ Install Note:

Refer to the Enphase Frame Mount installation guide for additional instructions.

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Grounding Specifications

System Bonding Methods

① **SnapNrack Mid Clamp**

② **SnapNrack Adjustable End Clamp**

③ **SnapNrack UR-40 Rail Splice**

④ **SnapNrack UR-60 Rail Splice**

MID CLAMP ASSEMBLY

SS BONDING PIN

MODULE FRAME

RAIL

CHANNEL NUT

SS BONDING CLIP (2 TOTAL)

RAIL

SPLICE ASSEMBLY

RAIL

SPLICE ASSEMBLY

SS BONDING PIN (2 TOTAL)
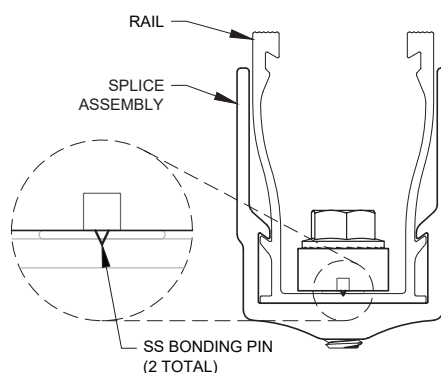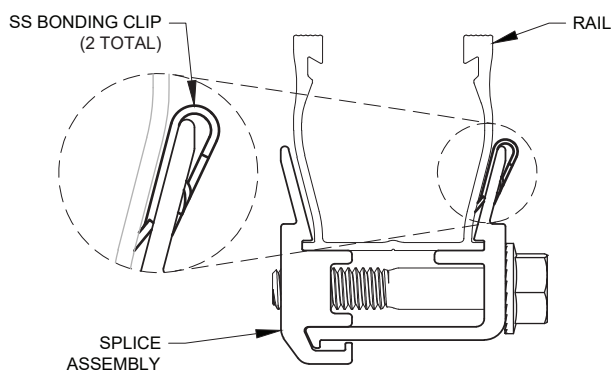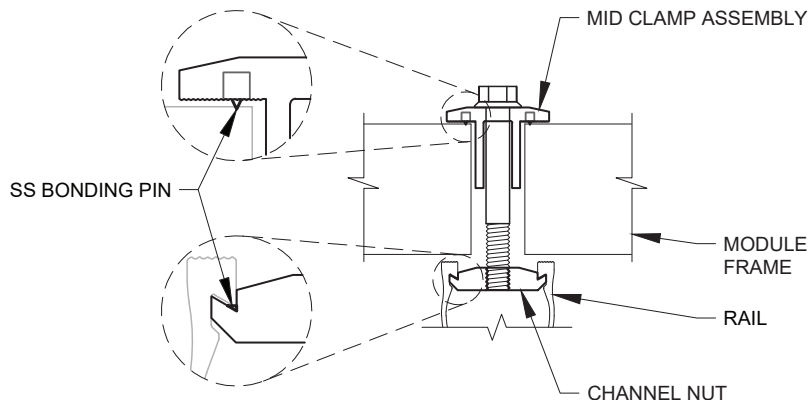
> **Note:**
> SnapNrack module clamps contain a SnapNrack Channel Nut with integral bonding clips or pins in assembly to properly bond the system (except Universal End Clamps).

> **Note:**
> SnapNrack Ultra Rail Splices contain integral bonding clips in assembly to properly bond the system.

SnapNrack Ground Lug Assembly

5/16"-18 X 1" BOLT S.S. WITH SPLIT LOCK WASHER S.S.

SNAPNRACK GROUND LUG, 6-12 AWG

COPPER WIRE, TYP.

SNAPNRACK ULTRA SERIES RAIL

SNAPNRACK BONDING CHANNEL NUT

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Grounding Specifications
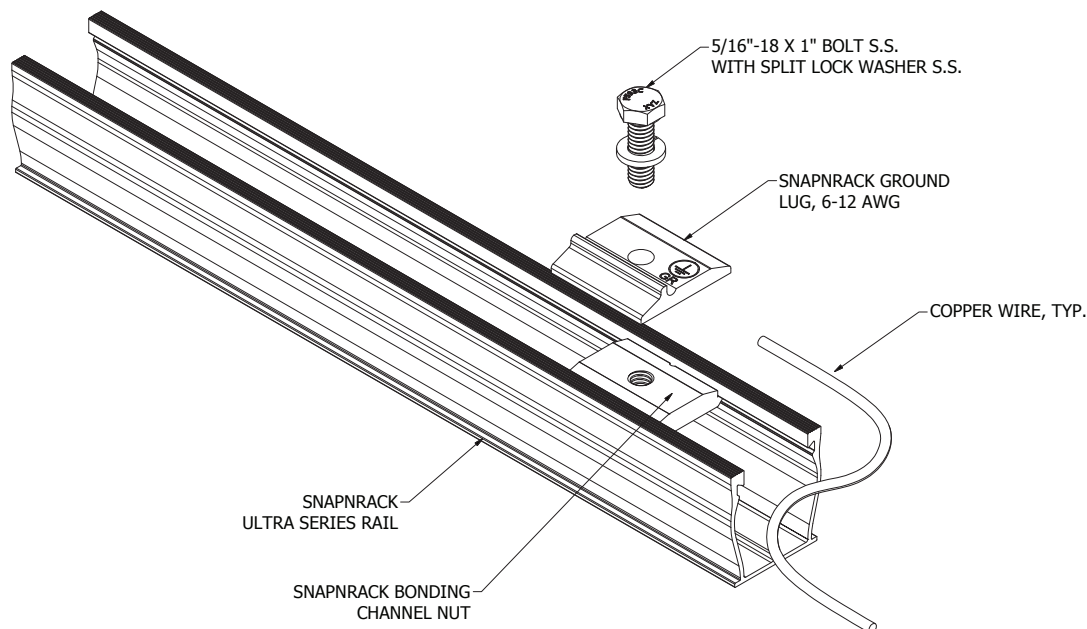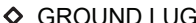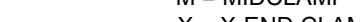
Ilsco Lay-in Lug Assembly

SNAPNRACK
ULTRA SERIES RAIL

#10 NUT SS
WITH STAR WASHER

ILSCO GBL-4DBT GROUND LUG

#10 BOLT SS

COPPER WIRE, TYP.

Ground Path Details

TO EGC

TO EGC

RAIL	RAIL SPLICE	⊗ MOUNT	◇ GROUND LUG	M MODULE CLAMP

GROUND PATH   EQUIPMENT GROUNDING CONDUCTOR

M = MIDCLAMP
X = X-END CLAMP
U = UNIVERSAL END
    CLAMP

Ground Path Details - SolarEdge

▭ RAIL	▬ RAIL SPLICE	⊠ MOUNT	◇ GROUND LUG	M MODULE CLAMP
⚡ GROUND PATH	⏚ EQUIPMENT GROUNDING CONDUCTOR	▢ SOLAREDGE OPTIMIZER		M = MIDCLAMP X = X-END CLAMP U = UNIVERSAL END CLAMP
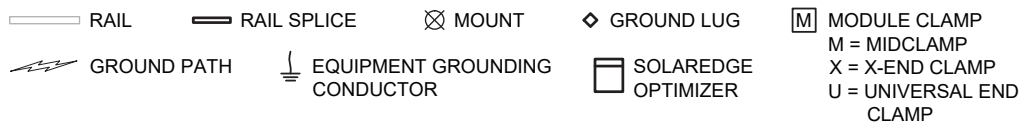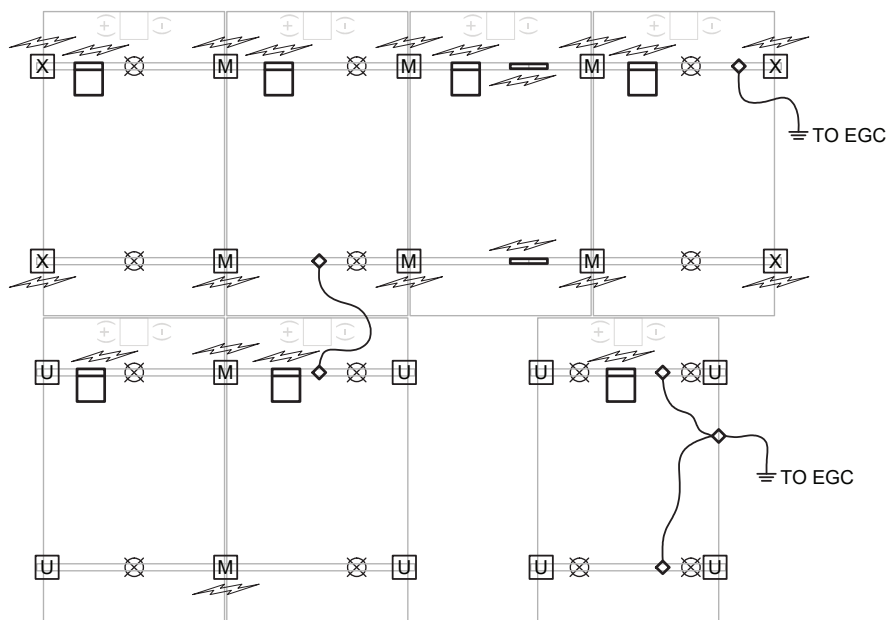
Ground Path Details - Enphase

▭ RAIL	▬ RAIL SPLICE	⊠ MOUNT	◇ GROUND LUG	M MODULE CLAMP
⚡ GROUND PATH	⏚ EQUIPMENT GROUNDING CONDUCTOR	▢ ENPHASE MICRO-INVERTER		M = MIDCLAMP X = X-END CLAMP U = UNIVERSAL END CLAMP

Grounding Specifications
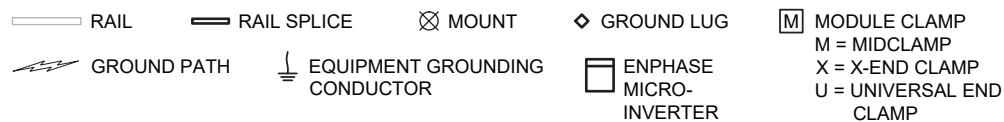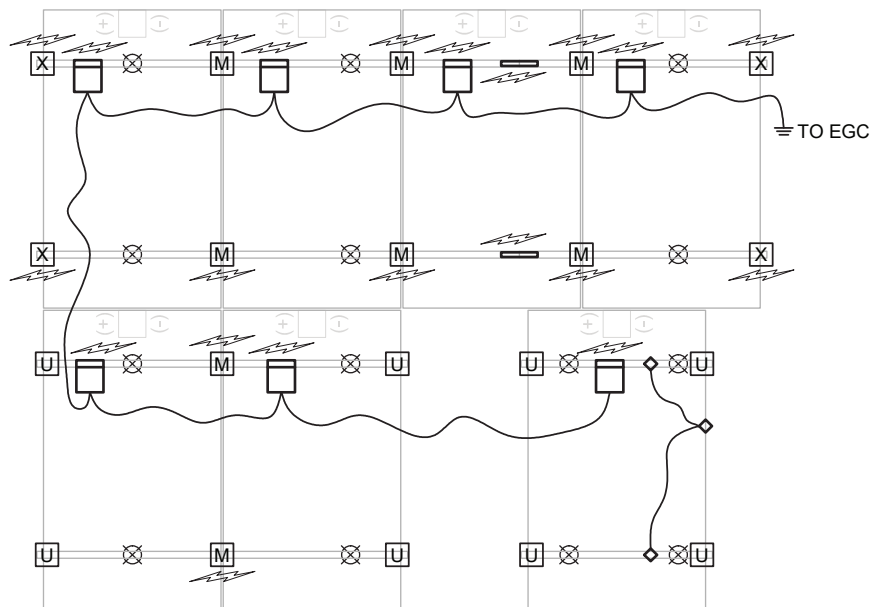
INSTALLATION INSTRUCTIONS - SNAPNRACK GROUND LUG
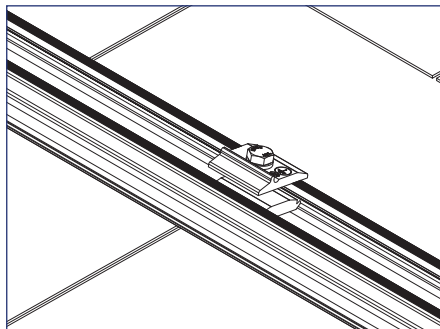
1) Snap the SnapNrack Ground Lug into the rail channel on one rail per module row.
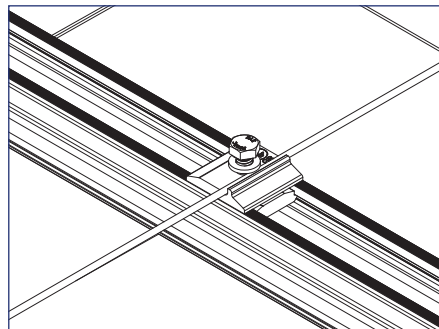
2) Place grounding conductor into slot underneath split ring washer.
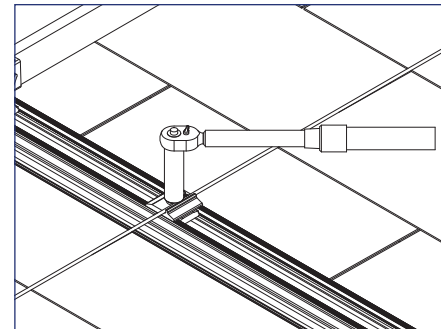
3) Tighten hardware to 16 ft-lbs.

⚙ Install Note:
SnapNrack Ground Lug may be used in side or top channel, and may be rotated 90 degrees relative to slot to facilitate running copper across top of rails.

⚙ Install Note:
SnapNrack Ground Lug only Listed for use with 6-12 AWG solid copper conductor.

INSTALLATION INSTRUCTIONS - ILSCO LAY-IN LUG
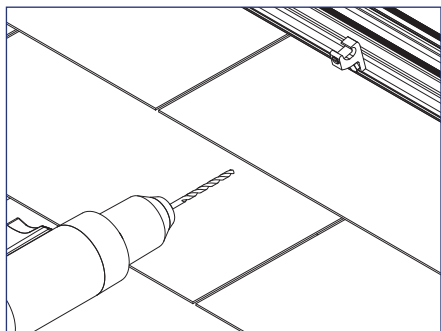
1) Drill and deburr a 1/4" hole in the back side of the rail for the Ilsco lug to attach to, place the bolt through the hole, and attach the lug assembly on one rail per module row.
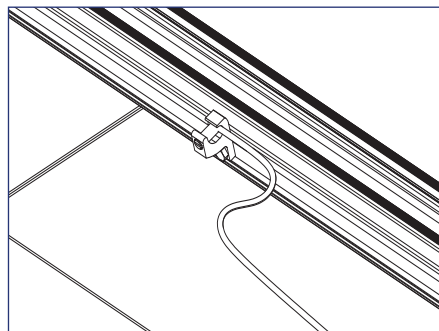
2) Place grounding conductor into slot.
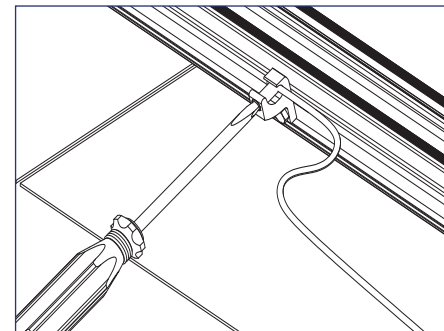
3) Tighten set screw per Ilsco's recommendation (see below).

⚙ Install Note:
Torque rail connection to 35 in-lbs.

⚙ Install Note:
Torque set screw to 20 in-lbs for #10-#14 solid and stranded copper, 25 in-lbs for #8 stranded copper, and 35 in-lbs for #4-#6 stranded copper.

⚙ Note:
- System has been evaluated to a maximum overcurrent device (OCD) protection level of 20 Amps.
- Universal End Clamp (UEC) does not bond module to rail. Be sure to separately ground any modules that are only secured by UECs, especially during servicing.
- SnapNrack recommends that bare copper never come into contact with aluminum.
- SnapNrack Ground Lug: torque bolt to 16 ft-lbs. The Ground Lug may be used in side or top channel. It may be rotated 90 degrees relative to slot to facilitate running copper across top of rails.
- Grounding with a standard Ilsco GBL-4DBT Lug is a listed alternate and requires drilling of a hole in the rail.
- Ilsco hardware connection to rail: 5 ft-lbs. Torque for lug set screw: #10-#14 solid and stranded copper- 20 in-lbs, #8 stranded copper- 25 in-lbs, #4-#6 stranded copper- 35 in-lbs.

Ground Path Details - DynoBond

▭ RAIL	▬ RAIL SPLICE	⊗ MOUNT	◇ GROUND LUG	M MODULE CLAMP
▬ DYNORAXX DYNOBOND		⏚ EQUIPMENT GROUNDING CONDUCTOR		M = MIDCLAMP E = END CLAMP
⚡ GROUND PATH				
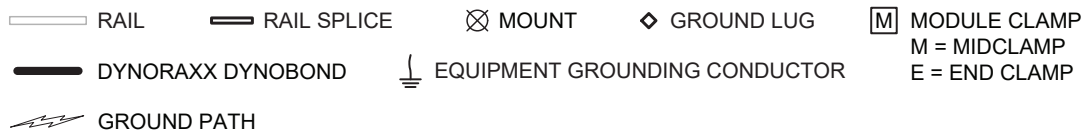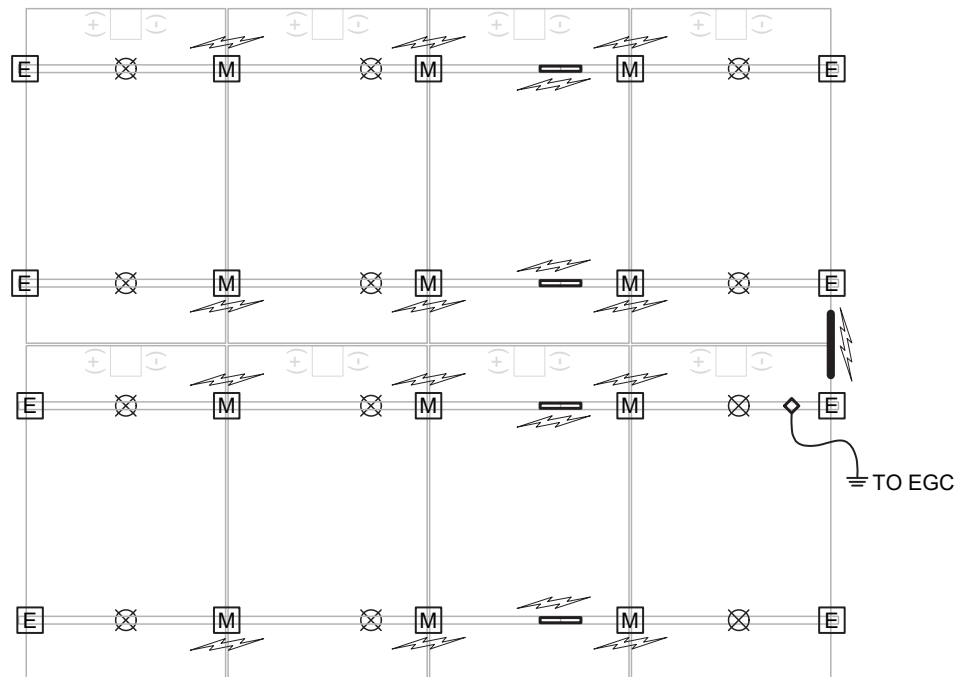
R/C (QIMS2), DynoRaxx (E357716) photovoltaic bonding jumper cat. no. DynoBond is an optional component that may be used with this system. The DynoBond jumper has been evaluated to provide module to module bonding. The DynoBond device attaches to the frame flange of adjacent modules.

GROUNDING MARKING DETAILS

All components included in the Ultra Rail UL 2703 Listing for grounding/bonding are packaged and marked with the UL logo, SnapNrack File E359313, and "PV Mounting System"

The SnapNrack Ground Lug is marked with the ground symbol
Ilsco Ground Lugs have green colored set screws or bolts to indicate connection to the grounding electrode conductor
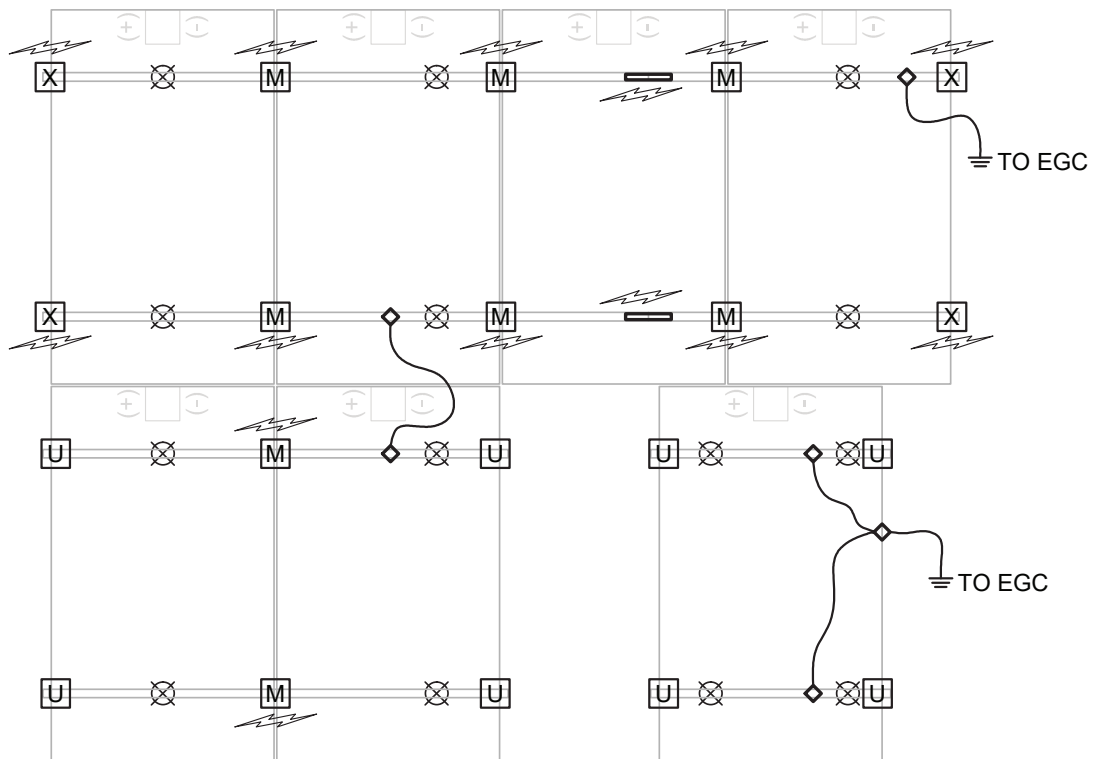
SnapNrack
Solar Mounting Solutions
www.snaprack.com

242-02054
SNAPNRACK,
BONDING MID CLAMP,
33-45MM (1.30-1.77IN),
BLACK

(UL) LISTED

installation manuals
1234567-001
10/23/18
QTY: 20
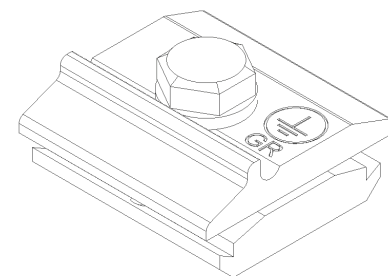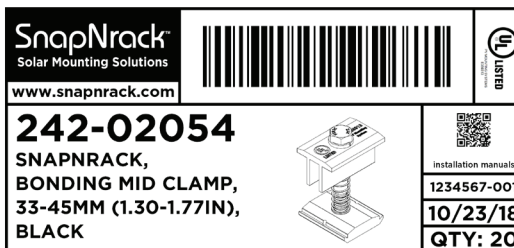
Ultra Rail has been tested with the following UL Listed modules:

The Ultra Rail System employs top-down clamps which have been evaluated for frame-to-system bonding, at specific mounting torques and with the specific modules listed below. The system has been assessed to a maximum Over-Current Device (OCD) protection level of 20 amps. The UL file number is included in parentheses below.

Hyundai Heavy Industries Co Ltd (E325005) - HiS-MXXXRG Series where XXX is 235 to 275; HiS-SXXXRG where XXX is 245 to 295; HiS-SXXXRW where XXX is 250 to 265; HiS-MXXXMG where XXX is 210 to 270; HiS-SXXXMG where XXX is 220 to 275. All may be followed by the suffix BK or blank.

Jinko Solar (E362479) - JKMXXXP-60, JKMXXXPP-60, JKMXXXP-60-V, JKMXXXP-60-J4, JKMXXXP-60B-J4 where XXX is 200 to 290; JKMXXXP-72, JKMXXXPP-72, JKMXXXP-72-V, JKMXXXPP-72-V where XXX is 250 to 360; JKMXXXM-60 where XXX is 200 to 305; JKMXXXM-72 where XXX is 250 to 365; JKMXXXM-60L where XXX is 305-325; JKMXXXM-60HBL (310-330); JKMXXXM-72L-V(370-390); JKMXXXM-72HL-V (380-400).

Kyocera (E467150) - KU-60 1000 V Series - KUXXX, where XXX is 250 to 275, followed -6BCA, -6BFA, -6BPA, -6DCA, -6DFA, -6DPA, -6MCA, -6MPA, -6XCA, -6XPA, -6ZCA, -6ZPA, -6ZPB, -6ZCB, -6ZPC, -6ZCC, -6ZPD, -6ZCD, -6ZPE, 6ZCE, -6MPC, -6MCC, -6MPB or -6MCB; KU-80 1000 V Series - KUXXX, where XXX is 315 to 335, followed by -8BCA, -8BFA or -8BPA.

LG (E329725) – LGXXXQ1C-A5 where XXX is 340 to 385; LGXXXQ1K-A5 where XXX is 315 to 375; LGXXXN1C-V5 where XXX is 320 to 350; LGXXXN1K-V5 where XXX is 320 to 340; LGXXXQ1C-V5 where XXX is 340 to 375; LGXXXQ1K where XXX is 350 to 365.

Panasonic (E181540) – VBHNXXXSA16 where XXX is 320 to 335; VBHNXXXKA01 and VBHNXXXKA02 where XXX is 310 to 325, VBHNXXXKA03 and VBHNXXXKA04 where XXX is 310 to 325; VBHNXXXSA17 and VBHNXXXSA18 where XXX is 325 to 335; VBHNXXXSA17E where XXX is 325 to 330.

REC Solar AS (E308147) - RECXXX, where XXX is 214 to 270, all may be followed by PE, PE(BLK), PE-US, PE-US(BLK), PEQ2 or PEQ3.

Renesola Jiangsu Ltd (E312637) - JCXXXM-24/Bb Series where XXX is 200 to 270; JCXXXM-24/BBh Series where XXX is 235 to 270.

Suniva Inc (E333709) - MVX-XXX-60-5-YYY where XXX is 235 to 265 and YYY is 701 or 7B1; OPT-XXX-60-4-YYY where XXX is 250 to 275 and YYY is 800 or 8B0.

*Sunpower (E246423)- Gen 3 or Gen 5 frame models SPR-XYY-### where YY represents numbers 18, 19, 20, 21 or 22, and ### represents any number from 365 to 310 and 274 to 233; Gen 3 or Gen 5 frame models SPR-EYY-### where YY represents numbers 18, 19, 20, 21 or 22, and ### represents any number from 345 to 285 and 250 to 225.

Talesun Solar (E359349) – TP660P-XXX where XXX is 235 to 285; TP660M-XXX where XXX is 240 to 300; TP672P-XXX where XXX is 280 to 345; TP672M-XXX where XXX is 290 to 360; TP672M-XXX where XXX is 360; TP660M-XXX where XXX is 295-300.

Talesun Solar (E349638) – TP660P-XXX where XXX is 210 to 255; TP660M-XXX where XXX is 215 to 260; TP672P-XXX where XXX is 260 to 300; TP672M-XXX where XXX is 270 to 310; all may be followed by "B".

Trina Solar Ltd (E306515) – TSM-XXXPA05, TSM-XXXPA05.05, TSM-XXXPA05.08, where XXX is 215 to 260; TSM-XXXPD05, TSM-XXXPD05.05, TSM-XXXPD05.08 where XXX is 240 to 280; TSM-XXXPD05.08D where XXX is 245 to 275; TSM-XXXXDD05A(II), TSM-XXXDD05A.05(II), TSM-XXXDD05A.08(II) where XXX is 260 to 300. All may be followed by Black or White.

Yingli Energy (China) Co Ltd (E320066) – YLXXXP-29b where XXX is 215 to 260; YLXXXA-29b where XXX is 220 to 255.

NRTL Listed PV Modules:

Boviet Solar - BVM6610P-XXX where XXX is 225 to 275; BVM6610M-XXX where XXX is 235 to 280; BVM6612P-XXX where XXX is 270 to 330; BVM6612M-XXX where XXX is 280 to 340.

Canadian Solar - CS6P-XXX-P, CS6P-XXX-M where XXX is 200 to 300; CS6P-XXX-P-SD, CS6K-XXX-P-SD where XXX is 240 to 300; CS6K-XXX-M, CS6K-XXX-MS, CS6K-XXX-M-SD where XXX is 240 to 305; CS6K-XXX-P where XXX is 220 to 300; CS6X-XXX-P where XXX is 250 to 360; CS6V-XXX-M where XXX is 215 to 225; CS6V-XXX-P where XXX is 250 to 255; CS3K-XXX-P where XXX is 250 to 310; CS3K-XXX-MS where XXX is 280 to 330; CS1K-XXX-MS where XXX is 285 to 345, CS1H-XXX-MS, CS1H-XXX-MS-AB where XXX is 310 to 350.

ET Solar - ET-P660XXXBB where XXX is 200 to 265; ET-P660XXXWB where XXX is 200 to 265; ET-P660XXXWW where XXX is 200 to 265; ET-P660XXXWWG where XXX is 235 to 265; P660XXXWB/WW where XXX is 200 to 265 and may be followed by WB or WW; P660XXXWWG where XXX is 240 to 250; M660XXXBB where XXX is 250 to 265; M660XXXWW where XXX is 200 to 270.

*Hanwha Q Cells - B.LINE PLUS BFR-G4.1-XXX, B.LINE PRO BFR-G4.1-XXX, Q.BASE GY-XXX, Q.PEAK G4-XXX, Q.PLUS BFR-G3.1-XXX, Q.PLUS BFR-G4-XXX, Q.PLUS BFR-G4.1-XXX, Q.PLUS BFR-G4.1/TAA-XXX, Q.PLUS BRF-GY-XXX, Q.PLUS GY-XXX, Q.PLUS G4-XXX, Q.PRO BFR-G4-XXX, Q.PRO BFR-G4.1-XXX, Q.PRO BFR-G4.3-XXX, Q.PRO BFR-GY-XXX, Q.PRO BLK-GY-XX, Q.PRO G4-XXX, Q.PRO GY-XXX, Q.PRO GY/SC-XXX, where XXX is 245 to 295; Q.PEAK BLK-G3.1-XXX, Q.PEAK BLK-G4.1-XXX, Q.PEAK BLK-G4.1/TAA-XXX, Q.PEAK G3.1-XXX, Q.PEAK G4.1-XXX, Q.PEAK G4.1/MAX-XXX, Q.PEAK G4.1/TAA-XXX where XXX is 270 to 325; Q.PEAK DUO BLK-G5-XXX, Q.PEAK DUO G5-XXX, Q.PLUS DUO-G5-XXX where XXX is 290 to 360; Q.PEAK DUO-G7-XXX, Q.PEAK DUO-G7.2-XXX where XXX is 310 to 350; Q.PEAK DUO-BLK-G7-XXX where XXX is 290 to 350; Q.PEAK DUO-G6-XXX, Q.PEAK DUO-G6+-XXX where XXX is 320 to 360; Q.PEAK DUO-BLK-G6-XXX, Q.PEAK DUO-BLK-G6+-XXX where XXX is 310 to 350; Q.PEAK DUO-G8-XXX, Q.PEAK DUO-BLK-G8-XXX, Q.PEAK DUO-G8+-XXX, Q.PEAK DUO-BLK-G8+-XXX where XXX is 290 to 360; Q.PLUS L-G4-XXX, Q.PLUS L-G4.1-XXX, Q.PLUS L-G4.2-XXX where XXX is 280 to 355; Q.PEAK L-G4.1-XXX, Q.PEAK L-G4.2-XXX where XXX is 330-390; Q.PLUS DUO-L-G5-XXX, Q.PLUS DUO-L-G5.1-XXX, Q.PLUS DUO-L-G5.2-XXX, Q.PLUS DUO-L-G5.3-XXX where XXX is 340 to 425; Q.PEAK DUO-L-G5.2-XXX, Q.PEAK DUO-L-G5.3-XXX where XXX is 360 to 425; Q.PEAK DUO-L-G7-XXX, Q.PEAK DUO-L-G7.1-XXX, Q.PEAK DUO-L-G7.2-XXX, Q.PEAK DUO-L-G7.3-XXX where XXX is 360 to 415; Q.PEAK DUO-L-G6-XXX, Q.PEAK DUO-L-G6.2-XXX, Q.PEAK DUO-L-G6.3-XXX, Q.PEAK DUO-L-G8-XXX, Q.PEAK DUO-L-G8.1-XXX, Q.PEAK DUO-L-G8.2-XXX, Q.PEAK DUO-L-G8.3-XXX where XXX is 360 to 430.

Hanwha SolarOne - HSL60P6-PB-X-YYYQ where X is 2 or 4, and YYY is 230 to 270, may be followed by additional suffixes.

JA Solar - JAP6-60-XXX/3BB where XXX is 235 to 265; JAM6-60-XXX/SI where XXX is 250 to 270; JAP72S01-XXX/SC where XXX is 315 to 335; JAP6(k)-72-XXX/4BB where XXX is 305 to 325.

LG Electronics Inc. - LGXXXS1C-G4 where XXX is 250 to 300; LGXXXN1K-G4 where XXX is 280 to 300; LGXXXN1C-G4 where XXX is 280 to 340; LGXXXN2C-G4, LGXXXN2W-G4, where XXX is 360 to 395; LGXXXN2K-G4, where XXX is 360 to 385; LGXXXS2C-G4, LGXXXS2W-G4, where XXX is 300 to 360; LGXXXN2C-B3, LGXXXN2W-B3, where XXX is 330 to 400; LGXXXS1C-A5 where XXX is 280 to 320; LGXXXN1C-A5 where XXX is 320 to 345; LGXXXN1K-A5 where XXX is 310 to 335.

Longi Green Energy Technology Co., Ltd.: LR6-60-XXXM, LR6-60BK-XXXM, LR60-HV-XXXM, where XXX is 270 to 300; LR6-60PB-XXXM, LR6-60PE-XXXM, LR6-60PH-XXXM, where XXX is 280 to 320; LR6-60HPB-XXXM where XXX is 295 to 320; LR6-60HPH-XXXM where XXX is 300 to 320.

Mission Solar: Models MSEXXXSO5T where XXX is 260 to 290; MSEXXXSO5K where XXX is 270 to 290; MSEXXXSQ5T where XXX is 280 to 300; MSEXXXSQ5K where XXX is 285 to 305; MSEXXXMM4J and MSEXXXMM6J where XXX is 320 to 330; MSEXXXSO6W where XXX is 320 to 340; MSEXXXSO4J and MSEXXXSO6J where XXX is 320 to 350; MSEXXXSQ4S and MSEXXXSQ6S where XXX is 345 to 365; MSEXXXSQ8K where XXX is 290 to 315; MSEXXXSQ8T where XXX is 285 to 310.

REC Solar PTE. LTD. - RECXXXPE where the XXX is 214 to 280; RECXXXTP where XXX is 260 to 300; RECXXXTP2 where XXX is 260 to 300; RECXXXTP IQ where XXX is 260 to 300; All may be followed by BLK; RECXXXTP72 where XXX is 330 to 345; RECXXX where XXX is 285 to 325, followed by PE72, PE72BLK, PE72 Q2 or PE72 Q3; RECXXXPE72XV where XXX is 295 to 325, followed by PE72 XV, PE72 XV Q2 or PE72 XV Q3; RECXXXNP, where XXX is 310-330; RECXXXTP2M, where XXX is 300-315.

Silfab - SLAXXX-M, where XXX is 280 to 300; SLGXXX-M, where XXX is 335 to 360; SLAXXX-P, where XXX is 250 to 265; SLGXXX-P, where XXX is 300 to 315; SSAXXX-M, where XXX is 280 to 300; SSGXXX-M, where XXX is 335 to 360; SSAXXX-P, where XXX is 250 to 260; SSGXXX-P, where XXX is 300 to 315.

Solaria: Solaria PowerXT-XXXR-PD and Solaria PowerXT-XXXR-BD, where XXX is 315 to 385.

Solar World - SWXXX-Mono where XXX is 200 to 300; SWXXX-Mono XL where XXX is 320 to 350. All may be followed by Black.

Suniva Inc – OPTXXX-60-4-YYY where XXX is 240 to 300 and YYY is 100; OPTXXX-60-4-YYY where XXX is 235 to 300 and YYY is 1B0.

Trina Solar Ltd - - TSM-XXXPD05.002, TSM-XXXPD05.082, TSM-XXXPD05.05S, TSM-XXXPD05.08S where XXX is 215 to 275; TSM-XXXDD05A.082(II) where XXX is 260 to 315; all may be followed by Black.

Ultra Rail has been tested with the following Module Level Power Electronic (MLPE) devices:

Celestica International – Listed, Rapid Shutdown Device models DG-006-F001201x and DG-006-F001401x.

Enphase – R/C (QIKH2) (QIMS2), Microinverter Models M250, M215 and C250. Provided with or without Enphase R/C (QIMS2) Model EFM-XXMM frame mount kit and Enphase R/C (QIMS2) Engage Cable Model ETXX-240, ETXX-208 or ETXX-277; NRTL Listed, IQ6-60-2-US, IQ6PLUS-72-2-US, IQ7-60-2-US, IQ7-60-B-US, IQ7PLUS-72-2-US, IQ7PLUS-72-B-US.

Ginlong Technologies – NRTL Listed, Rapid Shutdown Device Model Solis-RSD-1G; Solis-MLRSD-R1-1G and Solis-MLRSD-R2-1G.

SolarEdge – NRTL Listed, Optimizer Models P300-5NC4ARS, P320-5NC4ARS, P300-5NC4AFS, P320-5NC4AFS, P370-5NC4AFS, or P400-5NC4AFS.

Note: Ginlong Solis-MLRSD-R1-1G and Solis-MLRSD-R2-1G have not been investigated for bonding since the enclosures are constructed entirely of polymeric materials.

All MLPE models noted above have been evaluated for use with SnapNrack MLPE Rail Attachment Kit and MLPE Frame Attachment Kit except SolarEdge Models P300-5NC4ARS and P320-5NCARS.

The following MLPE devices have been evaluated for use with the SnapNrack MLPE Rail Attachment Kit only:

SMA – Rapid Shutdown Device Model RSB-2S-US-10

Only bonding to the backplates of these devices was evaluated. Functionality of the devices was not considered.

The SolarEdge Microinverter Frame Mounted Bracket of Models P300-5NC4AFS and P320-5NC4AFS has been evaluated for all modules within flange thickness range of 1.5 mm to 2.3 mm.

When adding modules for bonding, consideration must be given to the SolarEdge Microinverter Frame Mounted Models P300-5NC4AFS and P320-5NC4AFS. This product clamps onto the module flange using an integral bracket.

Suniva modules were not evaluated for bonding to the Mounting Bracket.

Additional MLPE devices were evaluated for attachment to the module frames through the device mounting means. These devices have not been evaluated for bonding:

Tigo – Monitoring Device models TS4-R-F, TS4-R-M, TS4-R-O, TS4-R-S, TS4-R-M-DUO, TS4-R-O-DUO, TS4-R-S-DUO

Not all UR-40 and UR-60 components have been evaluated for Mechanical Loading. The following structural components have been evaluated:

UR-40 Rail, UR-60 Rail, UR-40/UR-60, Mid Clamp, X End Clamp, Universal End Clamp, UR-40 and UR-60 Splice, UR-40/UR-60 Composition Mount Kits, Standard Standoff for UR-40/UR-60, Four Hole Standoff for UR-40/UR-60, Heavy Duty Standoff for UR-40/UR-60, Metal Roof Base Standoff for UR-40/UR-60, UR-40/UR-60 Corrugated Block, Standard Base Seam Clamp for UR-40/UR-60, Wide Base Seam Clamp for UR-40/UR-60, UR-40/UR-60 Universal Tile Hook, UR-40/UR-60 Flat Tile Hook, Flat Tile Replacement Kit for UR-40/UR-60, S Tile Replacement Kit for UR-40/UR-60, W Tile Replacement Kit for UR-40/UR-60, UR-40/UR-60 Tile Hook F, UR-40/UR-60 Tile Hook WS, UR-40/UR-60 Hanger Bolt Clamp, UR-40/UR-60 Tilt Kits.

The following non-structural components have not been evaluated for mechanical loading:

Skirt Assembly, MLPE Frame Attachment Kit, MLPE Rail Attachment Kit, Smart Clips, Ground Lugs.

The UL Listing covers mechanical load ratings for the following span lengths, module orientations and downforce, uplift, and down-slope ratings:

Span	Orientation	Direction	Load Rating (lb/ft^2)
4 or 6 feet	Long Side or Short Side Mounting	Downforce	10
		Uplift	5
		Down-Slope	5

Ultra Rail has been tested with the following UL Listed modules:

The Ultra Rail System has been evaluated for mechanical loading for its top-down clamps with the specific modules listed below. The UL file number is included in parentheses below. *(The following modules were also evaluated for bonding. Please see Grounding Specifications section.)*

Hyundai Heavy Industries Co Ltd (E325005): HiS-MXXXRG where XXX is 235 to 275; HiS-SXXXRG where XXX is 245 to 295; HiS-SXXXRW where XXX is 250 to 265.

JA Solar (E328263): AP6-60-XXX/3BB where XXX is 235 to 250.

Jinko Solar (E362479): JKMXXXP-60, JKMXXXPP-60, JKMXXXP-60-J4, JKMXXXP-60B-J4 where XXX is 200 to 290; JKMXXXM-60 where XXX is 200 to 305.

Panasonic (E181540) – VBHNXXXSA16 where XXX is 320 to 335; VBHNXXXKA01 and VBHNXXXKA02 where XXX is 310 to 325, VBHNXXXKA03 and VBHNXXXKA04 where XXX is 310 to 325; VBHNXXXSA17 and VBHNXXXSA18 where XXX is 325 to 335..

ReneSola (E312637): JCXXXM-24/Bbh where XXX is 235 to 270.

Trina Solar (E306515): TSM-XXXPD05, TSM-XXXPD05.05 and TSM-XXXPD05.08, where XXX 240 to 280; TSM-XXXDD05A(II), TSM-XXXDD05A.05(II), TSM-XXXDD05A.08(II) where XXX is 260 to 300.

Yingli Solar (E357540): YLXXXP-29b where XXX is 215 to 265.

NRTL Listed PV Modules:

Boviet Solar: Models BVM6610P-XXX where XXX is 225 to 275; BVM6610M-XXX where XXX is 235 to 280.

Canadian Solar: Models CS6P-XXX-P where XXX is 200 to 285; CS6P-XXX-P-SD where XXX is 240 to 285; CS6P-XXX-M where XXX is 200 to 290; CS6K-XXX-M where XXX is 240 to 305; CS6K-XXX-M-SD where XXX is 240 to 305; CS6K-XXX-P where XXX is 220 to 285; CS6K-XXX-P-SD where 220 to 285.

ET Solar: Models ET-P660XXXBB, ET-P660XXXWB, ET-P660XXXWW where XXX is 200 to 265; ET-P660XXXWWG where XXX is 235 to 265.

Hanwha Q Cells: Q.PRO BFR-G4-XXX where XXX is 205 to 295; Q.PRO BFR-G4.1-XXX where XXX is 245 to 295; Q.PLUS BFR-G4-XXX where XXX is 255 to 265; Q.PLUS BFR-G4.1-XXX where XXX is 270 to 280; Q.PEAK-G3.1-XXX and Q.PEAK BLK-G3.1-XXX where XXX is 270 to 325; Q.PLUS BFR-G3.1-XXX where XXX is 245 to 295.

LG Electronics: Models LGXXXN1C-G4 where XXX is 280 to 340; LGXXXS1C-G4 where XXX is 250 to 300; LGxxxN1K-G4 where xxx is 280 to 330; LGXXXN1K-A5 where XXX is 310 to 350.

Longi Green Energy Technology Co., Ltd.: LR6-60-XXXM, LR6-60BK-XXXM, LR60-HV-XXXM, where XXX is 270 to 300.

REC Solar PTE, LTD: RECXXXPE, RECXXXPE-BLK where XXX is 214 to 270; RECXXXTP, RECXXXTP-BLK, where the xxx is 260 to 300; RECXXXTP2, RECXXXTP2-BLK where XXX is 260 to 300.

SolarWorld: Models SW XXX mono where XXX is 200 to 300, may additionally be followed by "black".

Talesun: Models TP660P-XXX where XXX is 215 to 285; TP660M-XXX where XXX is 210 to 300.

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