MONTGOMERY COUNTY HISTORIC PRESERVATION COMMISSION
STAFF REPORT

Address:	3807 Williams Lane, Chevy Chase	**Meeting Date:**	11/13/2024
Resource:	Master Plan Site #35/077 **Frank Simpson House**	**Report Date:**	11/6/2024
		Public Notice:	10/28/2024
Applicant:	Peter Bass (Tina Crouse, Agent)	**Tax Credit:**	No
Review:	HAWP	**Staff:**	Laura DiPasquale
Permit No.:	1088533		
Proposal:	Solar panel installation		

STAFF RECOMMENDATION

Staff recommends that the HPC **approve with two conditions** the HAWP application with final approval delegated to staff:

1. The exterior conduit must be made as inconspicuous as possible and painted to match the underlying material.
2. The exterior equipment must be located to the left of the existing utility meter a minimum of six inches below the sill of the side window, or in another inconspicuous location.

ARCHITECTURAL DESCRIPTION

SIGNIFICANCE: Individually Listed Master Plan Site #35/77, *Frank Simpson House*
STYLE: Queen Anne
DATE: c. 1898

Excerpt from *Places from the Past*:

> The Simpson House was the first house built on the former Williams Farm on land sold by Clayton Williams to a non-family member. It represents the beginning of the Williams Station community that grew along Williams Lane providing newcomers with access to the Chevy Chase Land Company streetcar stop located on Connecticut Avenue. Frank Simpson built the house in 1898. Simpson was a prominent local builder whose extended family lived and worked in Chevy Chase in various branches of the construction business. The spacious frame residence is a fine example of Queen Anne architecture as interpreted by an accomplished local builder. The house retains a high level of architectural integrity.[1]

[1] Claire Lise Kelly, *Places from the Past: The Tradition of Gardez Bien in Montgomery County, Maryland, 10th Anniversary Edition*, 2011, p. 263: https://montgomeryplanning.org/wp-content/uploads/2017/12/Places-from-the-Past-web_with_cover.pdf

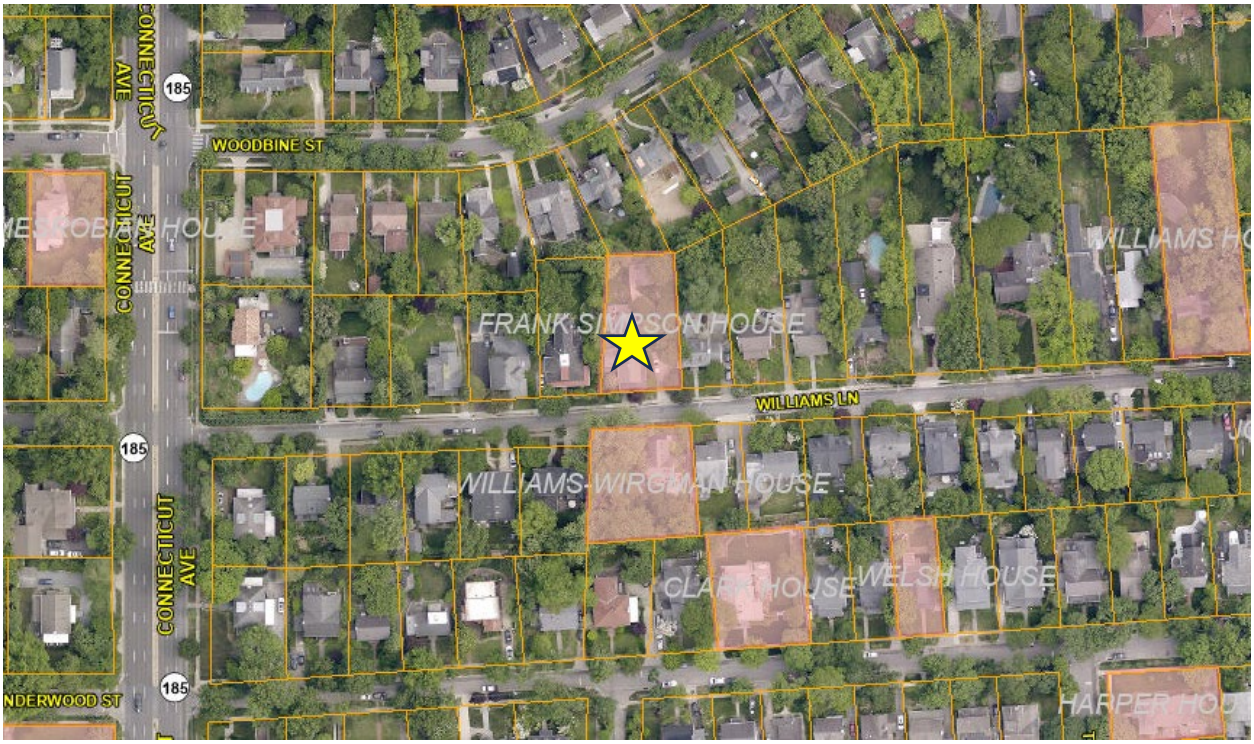

Figure 1: The Frank Simpson house at 3807 Williams Lane (shown with yellow star) is located in Chevy Chase Section Five on the north side of Williams Lane.

Figure 2: 3807 Williams Lane, Chevy Chase. The proposed panels would be visible from this location.

PROPOSAL

The applicant proposes to install 35 roof-mounted solar panels in three arrays, including one six-panel array on the rear half of the main house roof and two arrays on the non-historic rear addition (*Figure 3*). The Q.Tron BLK M-G2+ Series panels will be mounted to the asphalt shingle roof with SnapNrack mounts (Figure 5). The load center and disconnect switch are proposed adjacent to the existing utility meter to the left of the front porch.

Figure 3: The site plan (left) shows the proposed solar panel locations and the building's orientation toward Williams Lane. The roof plan (right) shows the proposed location of the solar panels.

Q.TRON BLK M-G2+ SERIES

■ Mechanical Specification

Format	67.8 in × 44.6 in × 1.18 in (including frame) (1722 mm × 1134 mm × 30 mm)
Weight	46.7 lbs (21.2 kg)
Front Cover	0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Black anodised aluminium
Cell	6 × 18 monocrystalline Q.ANTUM NEO solar half cells
Junction box	2.09-3.98 in × 1.26-2.36 in× 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 68.9 in (1750mm), (−) ≥ 68.9 in (1750mm)
Connector	Stäubli MC4; IP68

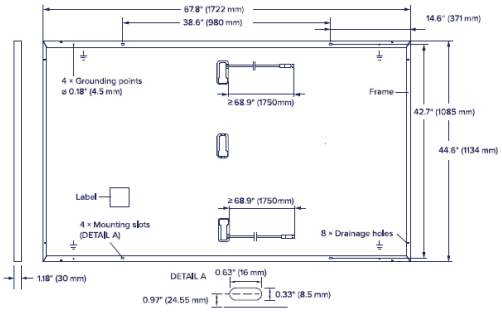

Figure 4: Specifications for the solar panels.

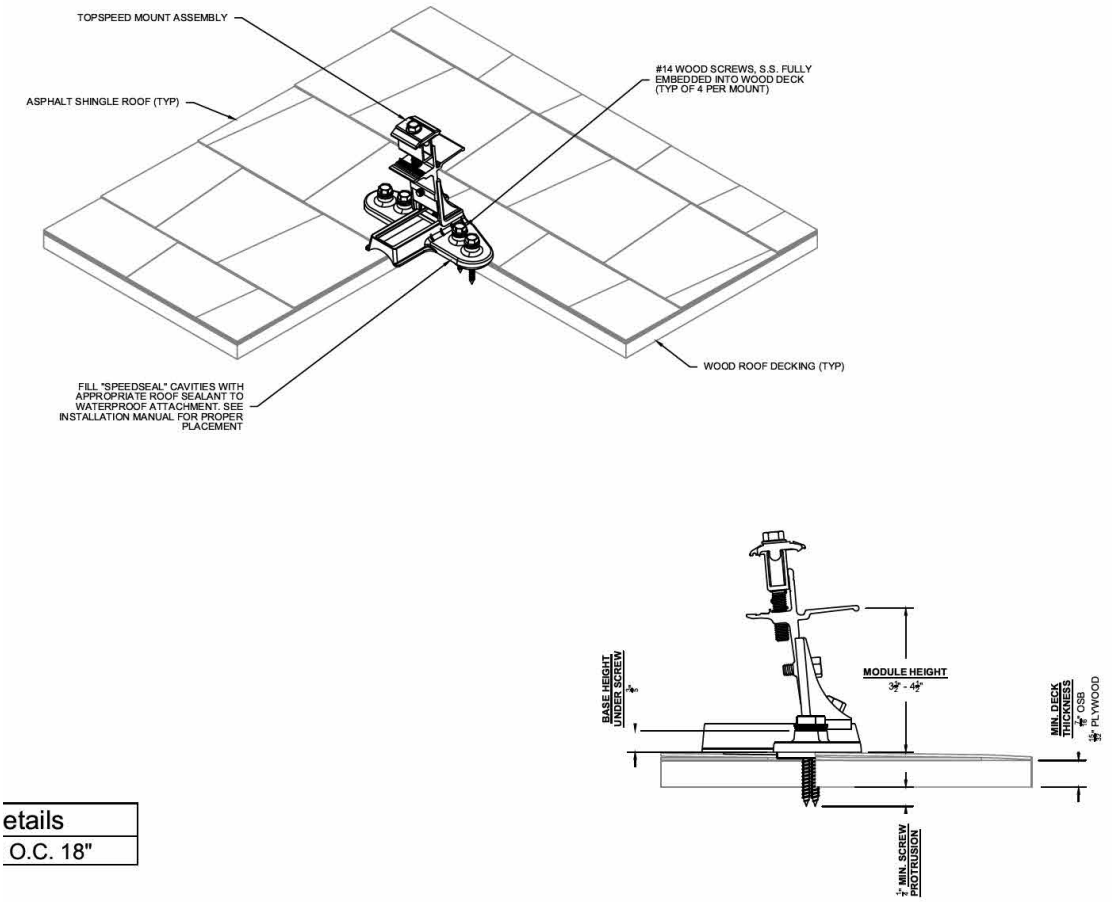

Figure 5: Installation details for the SnapNrack mounts.

APPLICABLE GUIDELINES

In accordance with section 1.5 of the Historic Preservation Commission Rules, Guidelines, and Procedures (Regulation No. 27-97) ("Regulations"), in developing its decision when reviewing a Historic Area Work Permit application for an undertaking at a Master Plan site the Commission uses section 24A-8 of the Montgomery County Code ("Chapter 24A"), the *Secretary of the Interior's Standards and Guidelines for Rehabilitation* ("Standards"), and the HPC's *Policy No. 20-01 ADDRESSING EMERGENCY CLIMATE MOBILIZATION THROUGH THE INSTALLATION OF ROOF-MOUNTED SOLAR PANELS* ("Policy"). The pertinent information in these four documents is outlined below.

Montgomery County Code Chapter 24A-8

(a) The commission shall instruct the director to deny a permit if it finds, based on the evidence and information presented to or before the commission that the alteration for which the permit is sought would be inappropriate, inconsistent with, or detrimental to the preservation, enhancement, or ultimate protection of the historic site or historic resource within an historic district, and to the purposes of this chapter.

(b) The commission shall instruct the director to issue a permit, or issue a permit subject to such conditions as are found to be necessary to ensure conformity with the purposes and requirements of this chapter, if it finds that:

(1) The proposal will not substantially alter the exterior features of an historic site or historic resource within an historic district; or

(2) The proposal is compatible in character and nature with the historical, archeological, architectural or cultural features of the historic site or the historic district in which an historic resource is located and would not be detrimental thereto or to the achievement of the purposes of this chapter.
(3) The proposal would enhance or aid in the protection, preservation and public or private utilization of the historic site or historic resource located within an historic district in a manner compatible with the historical, archeological, architectural or cultural value of the historic site or historic district in which an historic resource is located; or
(4) The proposal is necessary in order that unsafe conditions or health hazards be remedied; or
(5) The proposal is necessary in order that the owner of the subject property not be deprived of reasonable use of the property or suffer undue hardship; or
(6) In balancing the interests of the public in preserving the historic site or historic resource located within an historic district, with the interests of the public from the use and benefit of the alternative proposal, the general public welfare is better served by granting the permit.

(c) It is not the intent of this chapter to limit new construction, alteration or repairs to any 1 period or architectural style.

Secretary of the Interior's Standards for Rehabilitation

The Secretary of the Interior defines rehabilitation as "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features, which convey its historical, cultural, or architectural values." Because the property is a Master Plan Site, the Commission's focus in reviewing the proposal should be the *Secretary of the Interior's Standards for Rehabilitation*. The applicable *Standards* are as follows:

2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.
9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportions, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Historic Preservation Commission Policy No. 20-01: Addressing Emergency Climate Mobilization Through The Installation of Roof-Mounted Solar Panels

Now, THEREFORE:

WHEREAS, Historic Area Work Permit decisions are guided by the criteria in Section 24A, The Secretary of the Interior's Standards for Rehabilitation, and pertinent guidance from applicable master plan amendments and/or site or district-specific studies;

WHEREAS, The Secretary of the Interior's Standards for Rehabilitation as interpreted by the National Park Service limit the placement of rooftop solar panels under Standards 2, 9, and 10 to less conspicuous locations;

WHEREAS, the County Council has established a Climate Emergency;

WHEREAS, the Historic Preservation is a body established by the County Executive and County Council;

WHEREAS, Section 24-8(b)(6) states, "In balancing the interest of the public in preserving the historic site or historic resource located within an historic district, with the interests of the public from the use and benefit of the alternative proposal, the general public welfare is better served by granting the permit;"

WHEREAS, the widespread use of solar panels, both for hot water and for electricity production, will reduce greenhouse gases in the county, in accordance with the aims of the Emergency Climate Mobilization resolution (Resolution No.: 18-974), it shall be the policy of the Historic Preservation Commission that:

1. The preferred locations for solar panel installation(s) on a designated historic site or an historic resource located within an historic district is a) on the rear of the property, b) on non-historic building additions, c) on accessory structures, or d) in ground-mounted arrays;

2. If it is not feasible to install solar panels in one of the identified preferred locations due to resource orientation or other site limitations; and,

3. The roof is determined to be neither architecturally significant, nor a character-defining feature of the resource, nor is it a slate or tile roof, that unless it can be demonstrated that the solar array will be installed without damaging the historic character of the resource or historic fabric; then

4. The public welfare is better served by approving a Historic Area Work Permit for solar panels on all visible side or front roof slopes under Section 24A-8(b)(6).

A Historic Area Work Permit (HAWP) is required for all work referenced in this policy.

STAFF DISCUSSION

Staff supports the proposed installation the proposed 35 solar panels, provided steps are taken to conceal the associated equipment and conduit.

The HPC and staff utilize *Policy Guidance #20-01: Solar Technology* as the baseline for their review and to articulate their findings in the review of solar technology. The most preferred location for solar systems is a freestanding array in the rear yard, but this location is not feasible at the subject property due to the size of the lot and existing tree canopy. The second preferred location is a roof-mounted array on an accessory or non-historic building. This property has a non-historic freestanding accessory building at the rear of the property, approved by the HPC in 2005.[2] No panels are proposed for this location, although, based on the tree cover and low height of the accessory building roof, it does not appear to be an ideal location for solar panels. The third and fourth preferred locations are roof-mounted arrays on a non-historic addition or on the rear of the original house, respectively. The application proposes to cover the roof of the non-historic rear addition, approved by the HPC in 2002.[3]

[2] HAWP # 399201 for carriage house construction, approved in December 2005: https://mcatlas.org/tiles/06_HistoricPreservation_PhotoArchives/Padlock/HAR60640009/Box077/35-77-05A_Frank%20Simpson%20House_3807%20Williams%20Lane_12-05-2005.pdf

[3] HAWP application for construction of rear addition, approved in March 2002: https://mcatlas.org/tiles/06_HistoricPreservation_PhotoArchives/Padlock/HAR60640009/Box077/35-77-02A_Frank%20Simpson%20House_3807%20Williams%20Lane_03-27-2002.pdf

The Policy states that if it is not feasible to install panels in one of the identified preferred locations and the roof is determined to be neither architecturally significant, a character-defining feature, or slate or tile then the panels can be installed unless they will damage the historic character of the resource. The existing gable roof is clad in grey patterned asphalt shingles. While staff acknowledges that the proposed array on the front roof will be visible from the street, given the setback of over 20 feet from the front façade of the house, staff finds that the proposed panels are in keeping with the *Guidelines* and Chapter 24A-8(b)(1) and (2) and will not substantially alter the exterior features of the historic resource and are compatible with the historic resource.

Utility Meter after install. This is the only picture I have. The tree is in the way of the view of how the conduit to be run up through the attic to the array on the roof.

Figure 6: The applicant proposes to co-locate the new equipment and conduit with the existing electric meter and conduit.

The load center and disconnect are proposed to be installed on the northwest elevation of the main house, just beyond the front porch. Staff finds this location to be appropriate based on the existing presence of the electrical panel and meter, but notes that the annotated photograph of the proposed equipment and conduit location does not show the exact location of the new equipment, and that, given the proximity to the front of the house, has the potential to be conspicuous from the public right-of-way. Staff recommends that the new equipment be located below the window, at least six inches below the sill, if possible, and that the new conduit be run alongside existing conduit and painted to match the existing material.

Figure 7: View of the proposed equipment location from Williams Lane.

Staff finds that, in accordance with the *Standards*, the proposed work will not destroy the historic materials, features, or spatial relationships that characterize the property and will not be detrimental to the existing streetscape, satisfying *Standards* 2 and 9, if removed in the future, the essential form and integrity of the property would be unimpaired, satisfying *Standard* 10.

According to the shade map and corresponding statement provided by the applicant, the panels on the east-facing front roof plane will produce the most kilowatt-hours (kWh) with an average of 352 kWh per panel (as opposed to the rear east-facing roof plane which will have an average of 326 kWh per panel annually. Staff notes that the accessory building roof is not identified in this shade map.

Shade Map.

SolarEnergyWorld
Because Tomorrow Matters

- The home had an annual usage of roughly 36,215 kWh in 2023. Our proposed system is estimated to have 12,046 kWh in annual production.

The panels will vary in production based on their location on the structure, but this estimated production for the 35-panel system breaks down to roughly 344 kWh per panel annually. The panels on the rear, east-facing roof plane have an average of 326 kWh per panel annually. The panels on the front, east-facing roof plane have an average of 352 kWh per panel annually. The panels on the front, east-facing section produce slightly more than the panels on the rear, east-facing roof plane.

Justification for the Placement of the panels.

All usable space on the 2 rear roof planes was utilized first in this design, for both solar panels and the necessary fire safety pathways. The panels on the front, east-facing plane were shifted as close to the rear of the home as possible. The rear-facing dormer does not have sufficient space for those 6 panels, and the other remaining roof planes are also in the front of the home. Without the panels on the front, east-facing plane, the system would only produce 9,933 kWh annually (~18% less), hindering the homeowner's ability to offset their utility usage.

Figure 8: Shade map, left, and justification for panel location, right.

STAFF RECOMMENDATION

Staff recommends that the Commission **approve with two conditions** the HAWP application under the Criteria for Issuance in Chapter 24A-8(b)(1), (2), and (6), having found that the proposal, as modified by the conditions, will not substantially alter the exterior features of the historic resource and is compatible in character with the purposes of Chapter 24A;

1. The exterior conduit must be made as inconspicuous as possible and painted to match the underlying material.
2. The exterior equipment must be located to the left of the existing utility meter a minimum of six inches below the sill of the side window, or in another inconspicuous location.

and with the *Secretary of the Interior's Standards for Rehabilitation* # 2, 9, and 10;

and with the *Historic Preservation Commission Policy No. 20-01: Addressing Emergency Climate Mobilization Through the Installation of Roof-Mounted Solar Panels;*

and with the general condition that the applicant shall present an electronic set of drawings, if applicable, to HPC staff for review and stamping prior to submission for the Montgomery County Department of Permitting Services (DPS) building permits;

and with the general condition that final project design details, not specifically delineated by the Commission, shall be approved by HPC staff or brought back to the HPC as a revised HAWP application at staff's discretion;

and with the general condition that the applicant shall notify the HPC staff if they propose to make **any alterations** to the approved plans. Once the work is completed the applicant will contact the staff person assigned to this application at 301-495-2167 or laura.dipasquale@montgomeryplanning.org to schedule a follow-up site visit.

FOR STAFF ONLY:
HAWP# 1088533
DATE ASSIGNED_____

APPLICATION FOR HISTORIC AREA WORK PERMIT

HISTORIC PRESERVATION COMMISSION
301.563.3400

APPLICANT:

Name: Peter Bass E-mail: pebass@me.com

Address: 3807 Williams Lane City: Chevy Chase Zip: 20815

Daytime Phone: (202) 286-9252 Tax Account No.: 07-00468306

AGENT/CONTACT (if applicable):

Name: Tina Crouse E-mail: tcrouse@solarenergyworld.com

Address: 14880 Sweitzer Lane City: Laurel Zip: 20707

Daytime Phone: 410-216-5041 Contractor Registration No.: 127353

LOCATION OF BUILDING/PREMISE: MIHP # of Historic Property 1088533

Is the Property Located within an Historic District? X Yes/District Name Frank Simpson House
__No/Individual Site Name_____

Is there an Historic Preservation/Land Trust/Environmental Easement on the Property? If YES, include a map of the easement, and documentation from the Easement Holder supporting this application.

Are other Planning and/or Hearing Examiner Approvals /Reviews Required as part of this Application? (Conditional Use, Variance, Record Plat, etc.?) If YES, include information on these reviews as supplemental information.

Building Number: 3807 Street: Williams Lane

Town/City: Chevy Chase Nearest Cross Street: Connecticut Avenue

Lot: 12,828 SF Block: _____ Subdivision: 0014 Parcel: P413

TYPE OF WORK PROPOSED: See the checklist on Page 4 to verify that all supporting items for proposed work are submitted with this application. Incomplete Applications will not be accepted for review. Check all that apply:

- ☐ New Construction
- ☐ Addition
- ☐ Demolition
- ☐ Grading/Excavation
- ☐ Deck/Porch
- ☐ Fence
- ☐ Hardscape/Landscape
- ☐ Roof
- ☐ Shed/Garage/Accessory Structure
- ☑ Solar
- ☐ Tree removal/planting
- ☐ Window/Door
- ☐ Other:_____

I hereby certify that I have the authority to make the foregoing application, that the application is correct and accurate and that the construction will comply with plans reviewed and approved by all necessary agencies and hereby acknowledge and accept this to be a condition for the issuance of this permit.

Tina Crouse
Signature of owner or authorized agent

10/04/2024
Date

HAWP APPLICATION: MAILING ADDRESSES FOR NOTIFING
[Owner, Owner's Agent, Adjacent and Confronting Property Owners]

Owner's mailing address	**Owner's Agent's** mailing address
Peter Bass 3807 Williams Lane Chevy Chase, MD 20815	Solar Energy World 14880 Sweitzer Lane Laurel, MD 20707
Adjacent and confronting Property Owners mailing addresses	
William Sinclair 3811 Williams Lane Chevy Chase, MD 20815 (Adjoining Property)	Terrence Day 3805 Williams Lane Chevy Chase, MD 20815 (Adjoining Property)
Madeleine Lundberg 3806 Williams Lane Chevy Chase, MD 20815 (Confronting Property)	N Garland Miller Trust 3804 Williams Lane Chevy Chase, MD 20815 (Confronting Property)

Description of Property: Please describe the building and surrounding environment. Include information on significant structures, landscape features, or other significant features of the property:

Property Built in 1968

Description of Work Proposed: Please give an overview of the work to be undertaken:

-Install (35) roof mounted solar panels on detached structure

-Micro Inverters to be placed under each panel

-Utility disconnect to be installed next to utility meter along with electrical combiner box for micro inverters

-Galvanized steel conduit to run from equipment to through the attic and to the array on the roof.

Work Item 1: _____

Description of Current Condition:	Proposed Work:

Work Item 2: _____

Description of Current Condition:	Proposed Work:

Work Item 3: _____

Description of Current Condition:	Proposed Work:

HISTORIC AREA WORK PERMIT
CHECKLIST OF
APPLICATION REQUIREMENTS

	Required Attachments						
Proposed Work	I. Written Description	2. Site Plan	3. Plans/ Elevations	4. Material Specifications	5. Photographs	6. Tree Survey	7. Property Owner Addresses
New Construction	*	*	*	*	*	*	*
Additions/ Alterations	*	*	*	*	*	*	*
Demolition	*	*	*		*		*
Deck/Porch	*	*	*	*	*	*	*
Fence/Wall	*	*	*	*	*	*	*
Driveway/ Parking Area	*	*		*	*	*	*
Grading/Excavation/Landscaing	*	*		*	*	*	*
Tree Removal	*	*		*	*	*	*
Siding/ Roof Changes	*	*	*	*	*		*
Window/ Door Changes	*	*	*	*	*		*
Masonry Repair/ Repoint	*	*	*	*	*		*
Signs	*	*	*	*	*		*


Front of Home


Back Side of Home

Left Side of Home

Right Side of Home

Utility Meter beofre Install

Utility Meter after install. This is the only picture I have. The tree is in the way of the view of how the conduit to be run up through the attic to the array on the roof.

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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List of Approved Modules. 48

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 the following Enphase microinverter models for grounding/bonding: M215, M250, and C250. The Enphase microinverters are certified to be mounted to SnapNrack rail with the MLPE Attachment or to the module frame with the Enphase Frame Mount. When installing the Enphase microinverters per the specifications in the MLPE Installation section of this manual, the total roof-mounted PV system is bonded (modules, racking and microinverters) and grounded through the Enphase ground circuit when the Enphase units are properly grounded through to the service entrance. Therefore, no ground lugs or equipment grounding conductor (EGC) are required on the SnapNrack systems.

Ultra Rail has been Listed with the following SolarEdge optimizer models for grounding/bonding: P300-5NC4ARS, P320-5NC4ARS, P370-5NC4AFS, and P400-5NC4AFS. The SolarEdge optimizers are certified to be mounted to SnapNrack rail with the MLPE Attachment or to the module frame with the SolarEdge Power Optimizer Frame-Mounted Module Add-On. When installing the SolarEdge optimizers per the specifications in the MLPE Installation section of this manual, the total roof-mounted PV system is bonded to the optimizer backing plate (modules, racking and optimizers) and grounded through the ground lugs installed on the SnapNrack rail. Therefore, it is not necessary to run an EGC to each SolarEdge optimizer.

Note: Frame-Mounted Module Add-On has been evaluated for all modules except Suniva modules.

Ultra Rail has been Listed with the following Ginlong Rapid Shutdown Units for grounding/bonding: Solis-RSD-1G 1:1 and Solis-RSD-1G 2:2. The Ginlong Rapid Shutdown Units are certified to be mounted to SnapNrack rail with the MLPE Attachment.

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 (≥ 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.

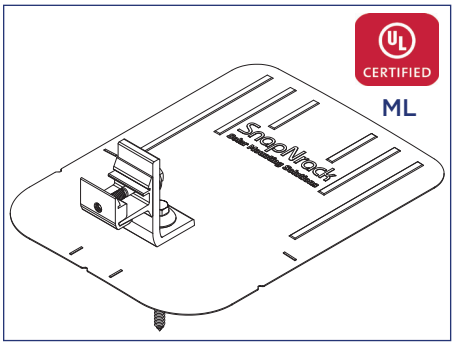
The Ultra Rail system has been evaluated for a Class A System Fire Classification for a Low-Sloped Roof (< 2:12 pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 16.3 inches from the top and bottom edges of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

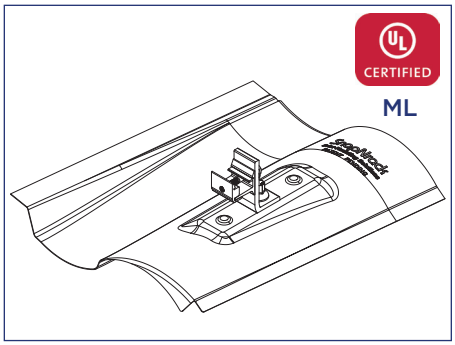
Component Details

Structural Components



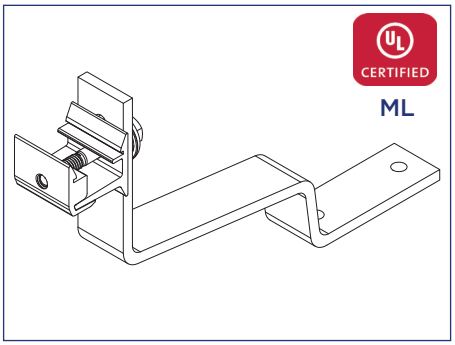
Composition Roof Attachment

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



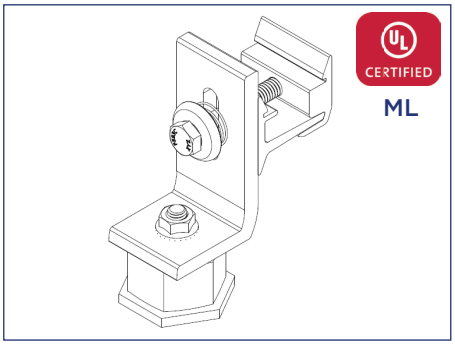
Tile Replacement Roof Attachment

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



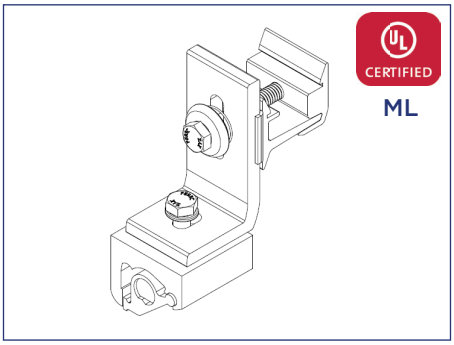
Flat Tile Roof Attachment

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



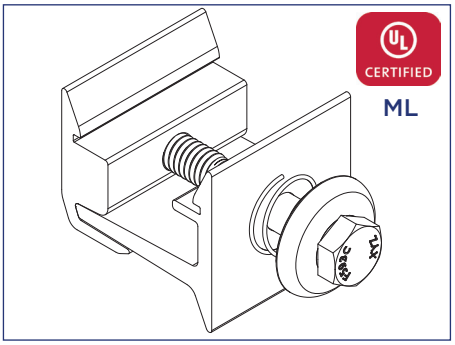
Metal Roof Base Attachment

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



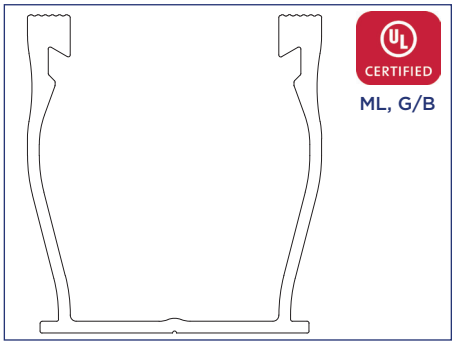
Seam Clamp Roof Attachment

Roof attachment for standing seam metal roofs including seam clamp, L foot, and hardware



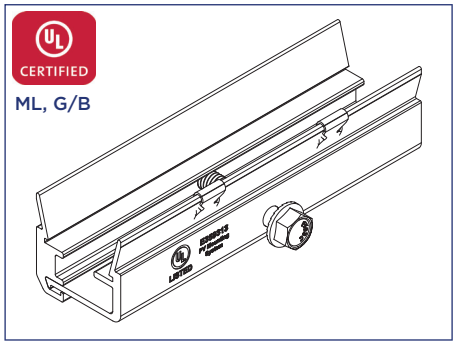
Ultra Rail Mounting Hardware

Hardware kit for attaching Ultra Rail to any roof attachment that uses an L foot or other slotted mount that accepts 5/16” hardware



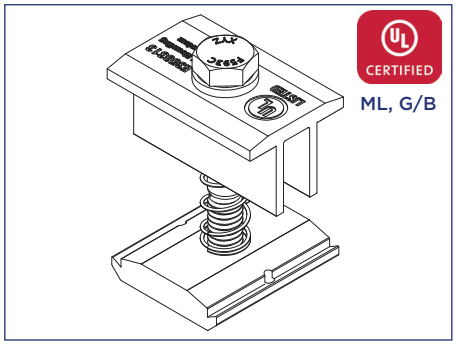
UR-40 Rail

UR-40 rail for Ultra Rail roof mount racking system



Ultra Rail Splice

Rail splice component including two splice halves and hardware



Mid Clamp

Top-down module mid clamp including clamp and hardware

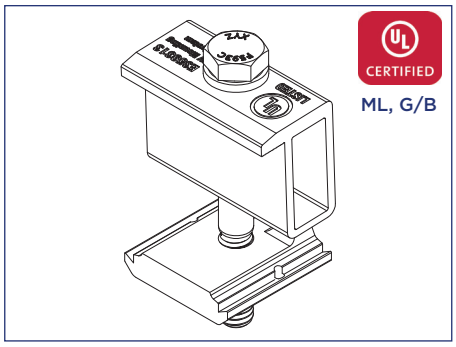
UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding

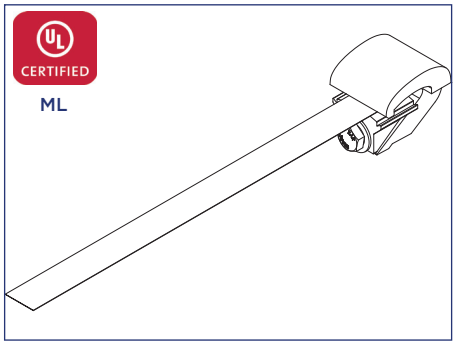
Component Details

Wire Management/Grounding Component



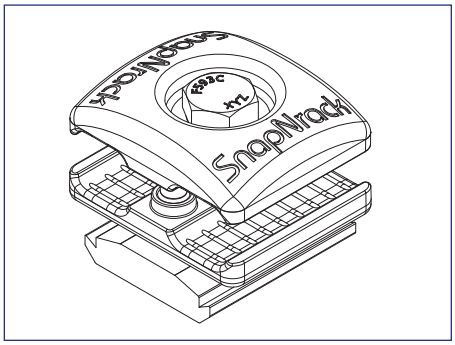
Adjustable End Clamp

Top-down module end clamp including clamp and hardware



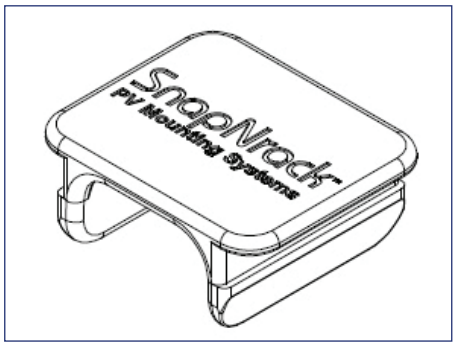
Universal End Clamp

Bottom-mount module end clamp including clamp and hardware



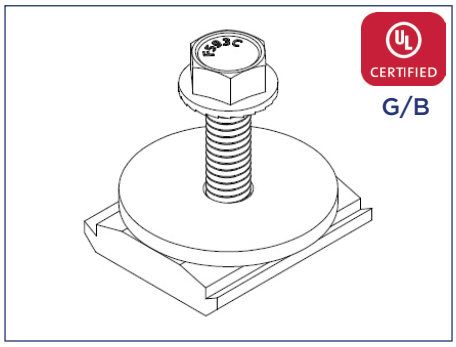
Universal Wire Clamp

Wire management component used to secure conductors between rails



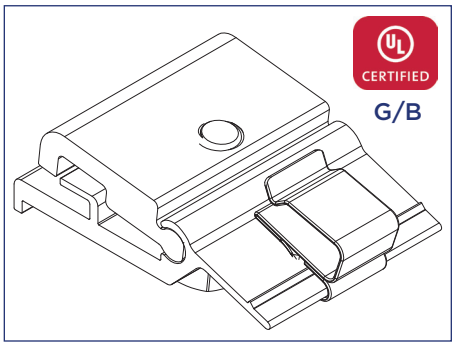
Wire Retention Clip

Wire management component used to secure conductors in rails



MLPE Rail Attachment Kit

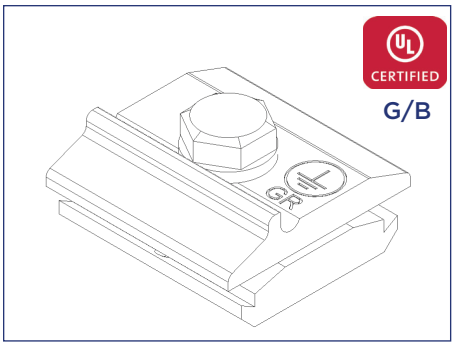
Rail attachment for module level power electronics like microinverters and optimizers



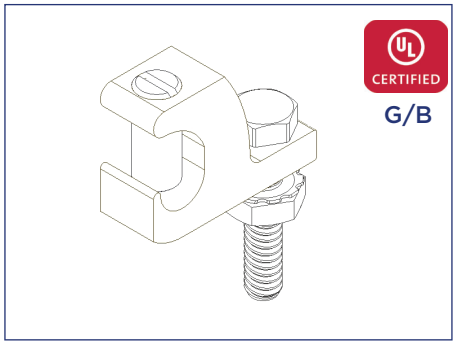
MLPE Frame Attachment Kit

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

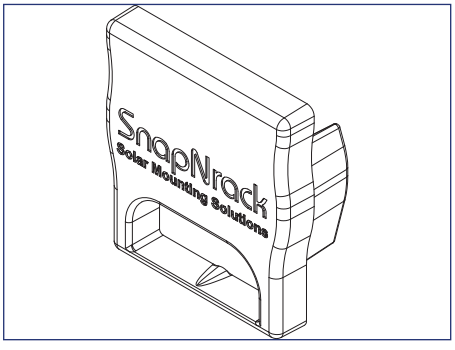
Aesthetic Components



SnapNrack Ground Lug



Ilsco Lay-In Lug – GBL-4DBT



UR-40 Rail End Cap

Plastic end cap for UR-40 Rail

UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding

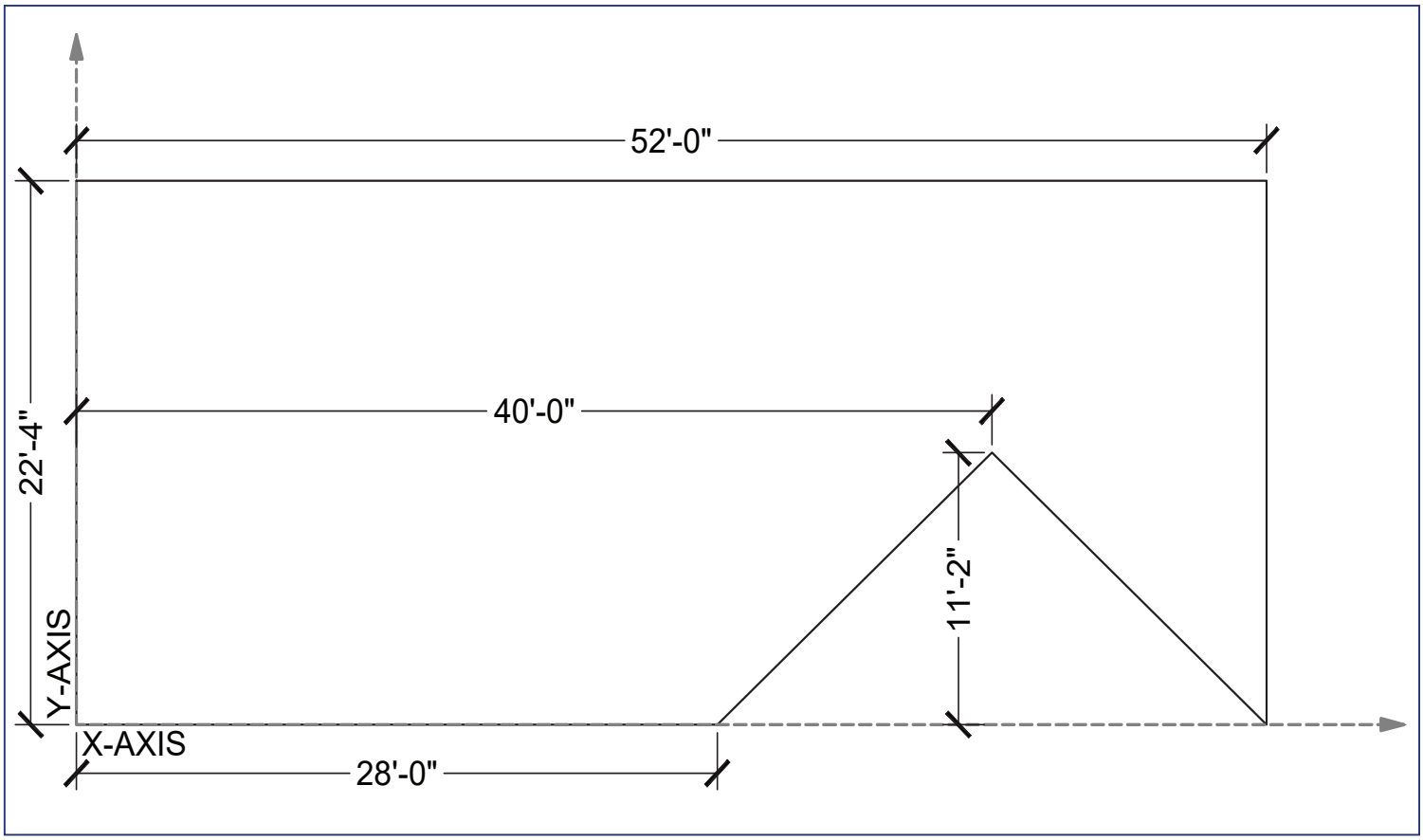
Hardware Torque Specifications

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, Flat Tile Roof Hook 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)

Pre-Installation Requirements

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.



Pre-Installation Requirements

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).

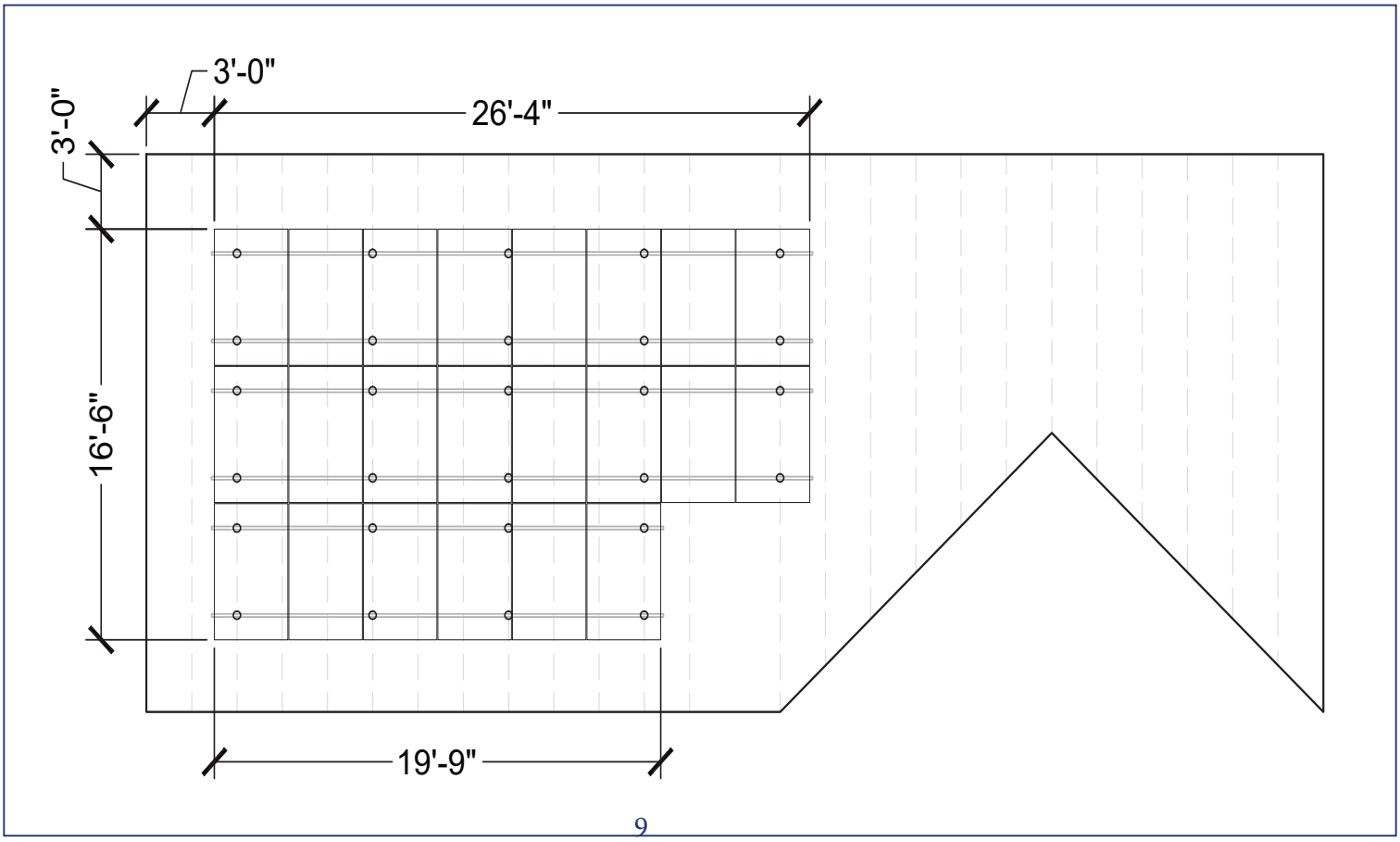
5) Draw roof attachment locations on layout based on maximum attachment spacing and cantilever values.

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.

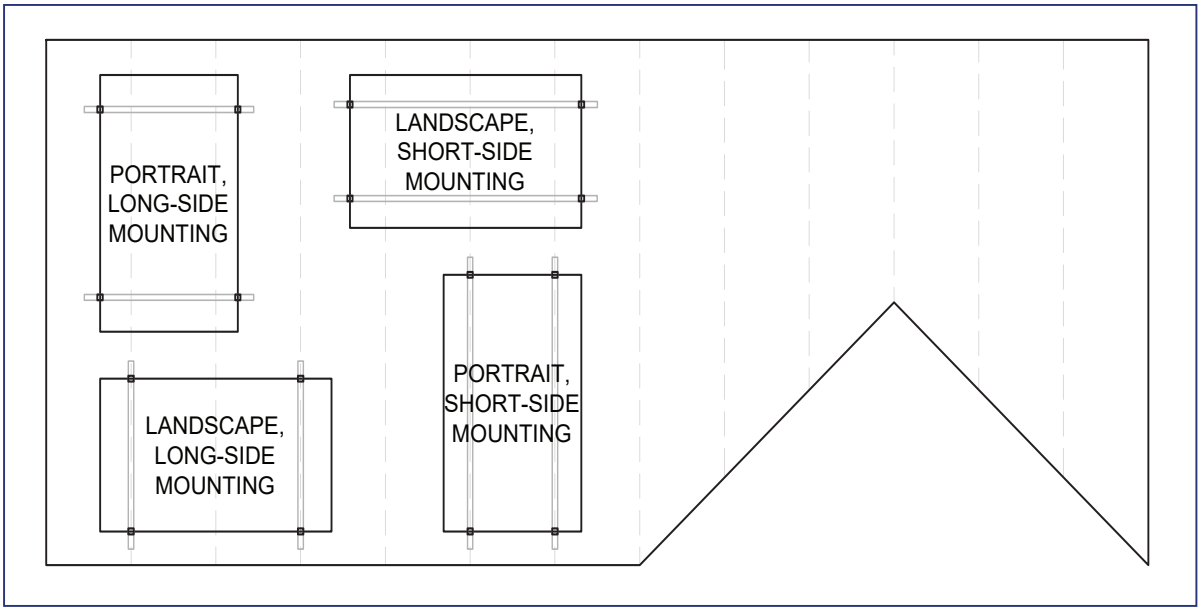
9) Insert SnapNrack installation details in to design set specific to the project requirements.



Pre-Installation 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.

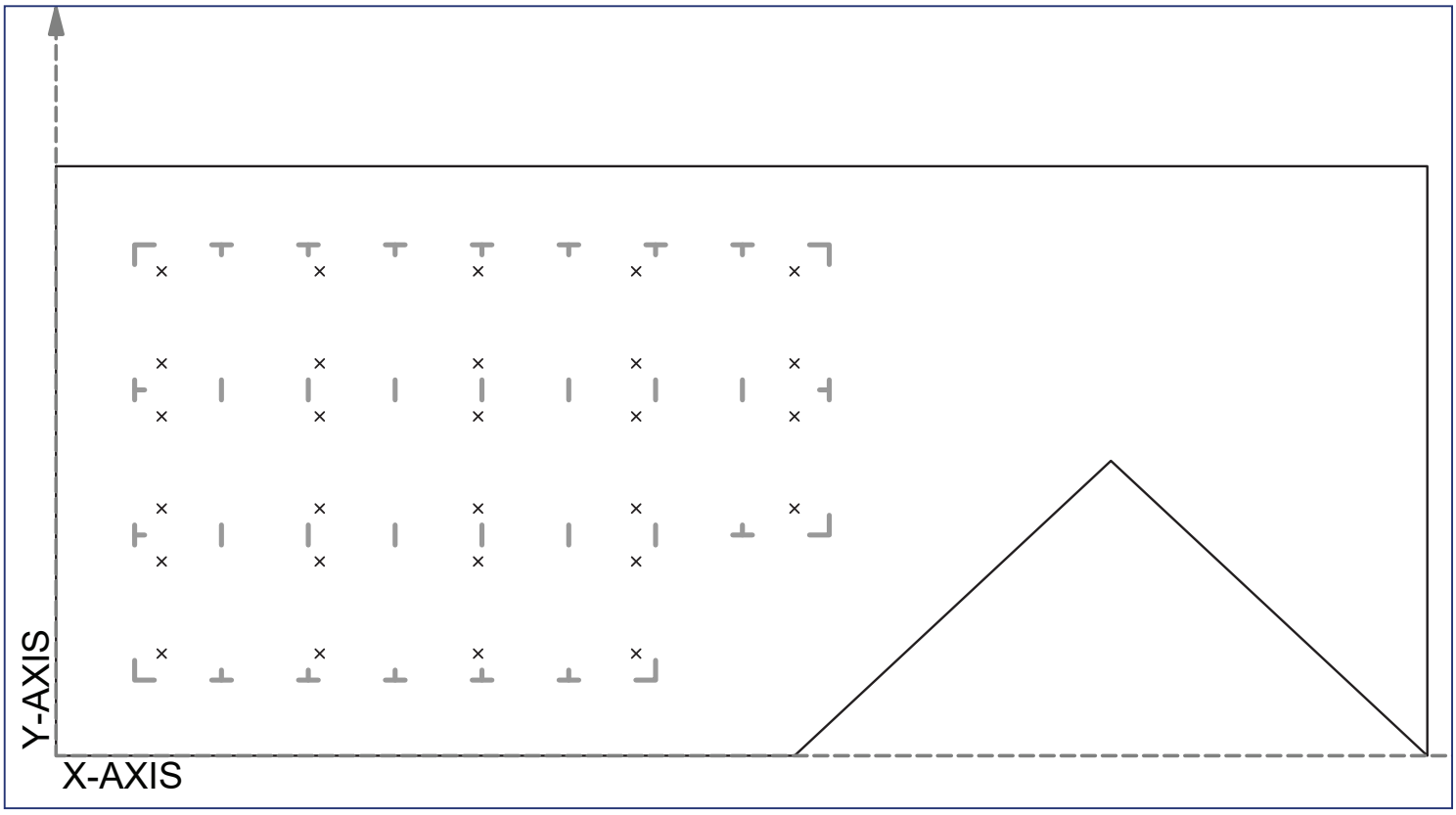
2) Locate the estimated roof framing member positions and mark them in the array area with a roof marking crayon.

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.



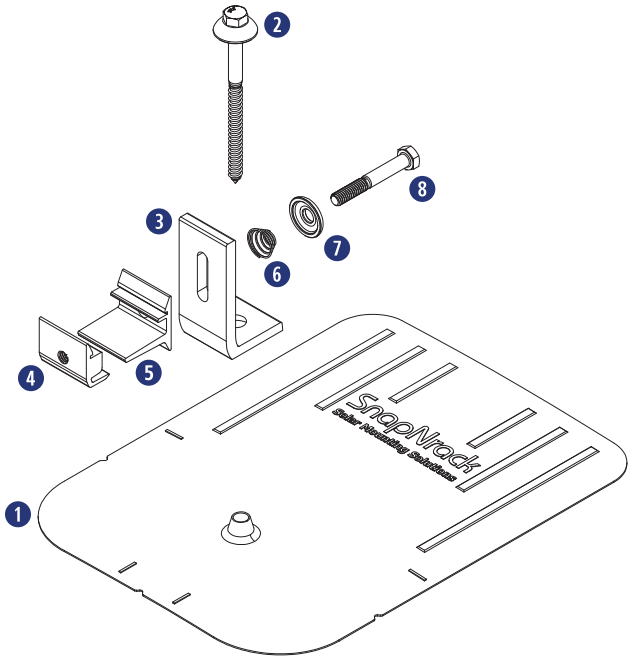
L Foot Mount

Required Tools

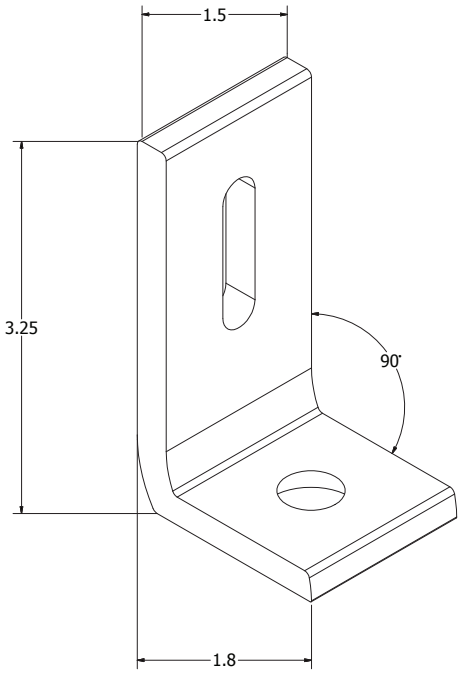
- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16” Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2” Socket

Materials Included - L Foot Mount

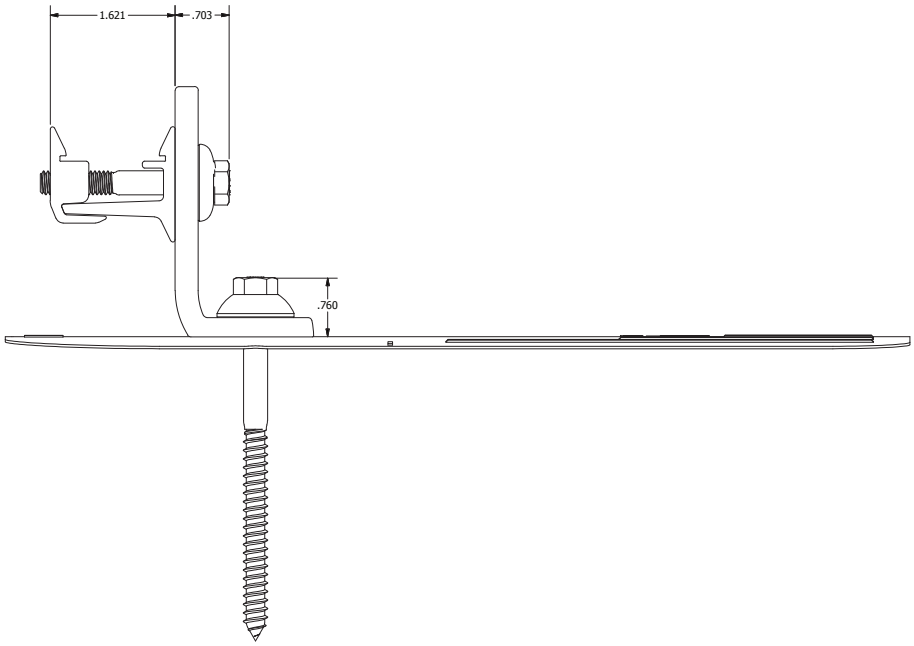
1. (1) SnapNrack Comp Umbrella Flashing
2. (1) SnapNrack Umbrella Lag Screw
3. (1) SnapNrack Umbrella L Foot
4. (1) SnapNrack Ultra Mount (Tapped)
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount Spring
7. (1) SnapNrack Ultra Mount Spring Cage
8. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



Application Note:
Install on composition shingle roofs.



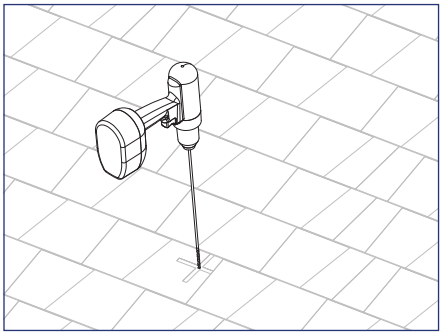
Dimensioned L Foot



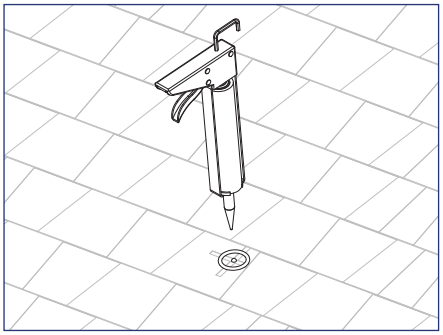
Dimensioned L Foot Assembly

L Foot Mount

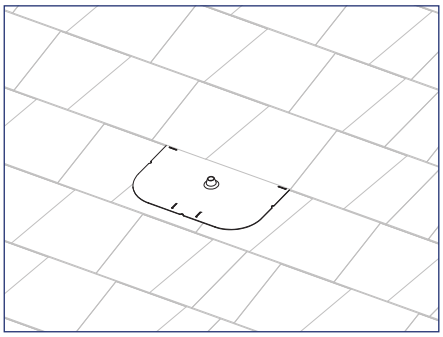
INSTALLATION INSTRUCTIONS



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.

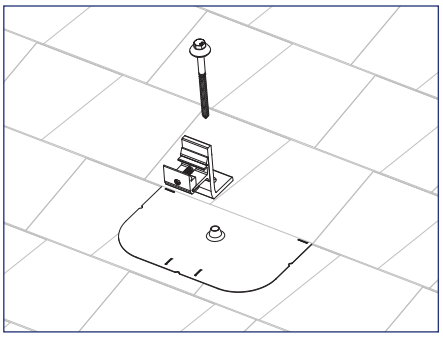


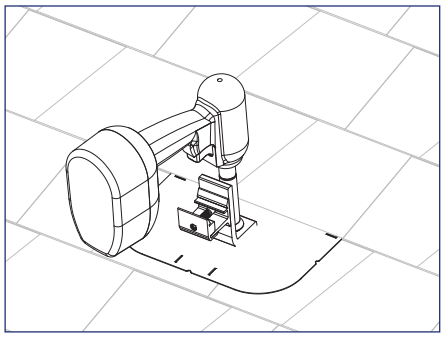
3) Pry up shingles with a breaker bar and install flashing underneath shingle course above pilot hole and, position flashing so cone is in line with pilot hole.

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.

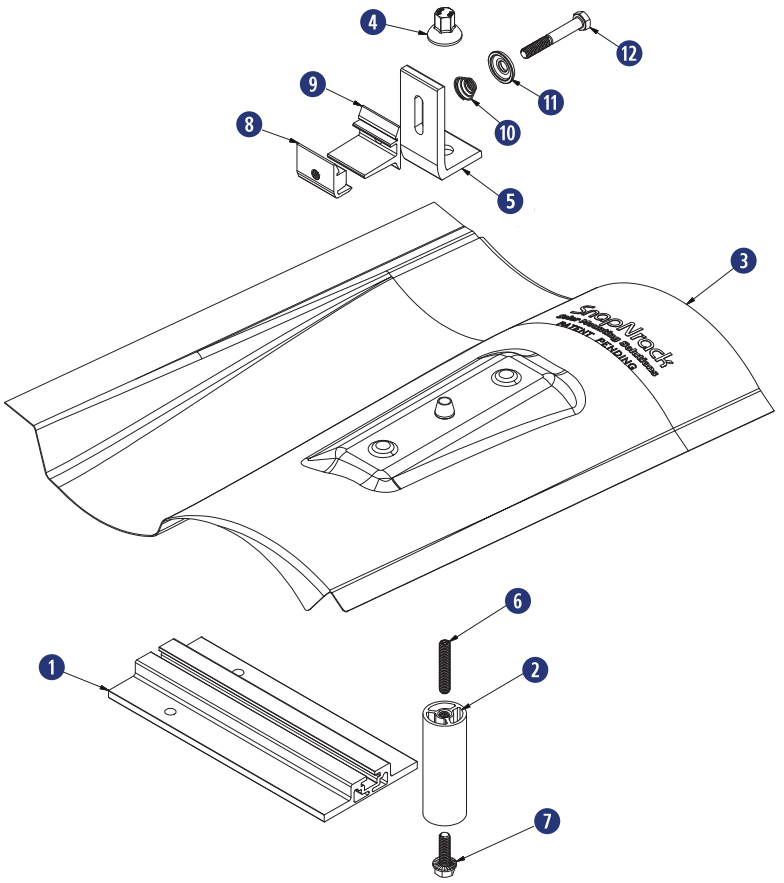
Tile Replacement

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

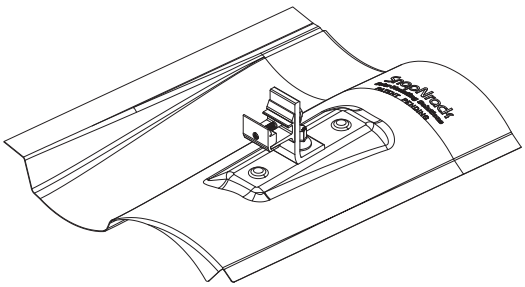
② (2) 5/16” Washer

③ Flexible Flashing (when required for deck level flashing)

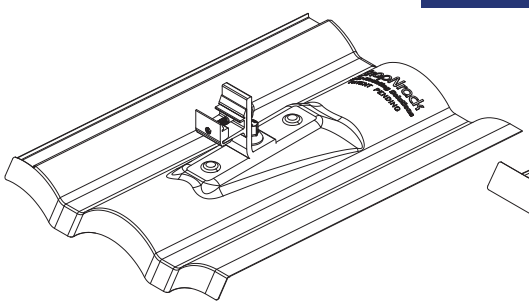
Application Note:

Install on flat, W and S style concrete tile roofs.

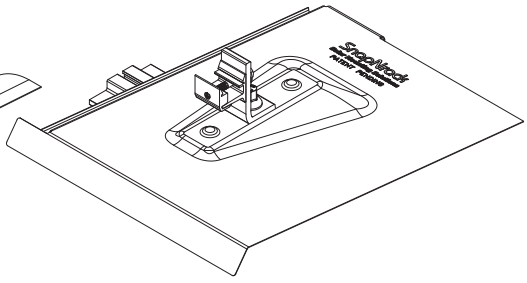
- Tile Course Spacing: 13”-16”
- Tile Thickness: 1-1/4”±1/8”



S Tile Replacement



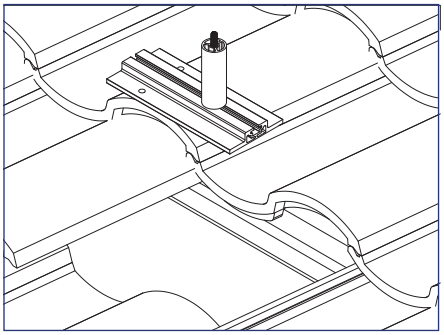
W Tile Replacement



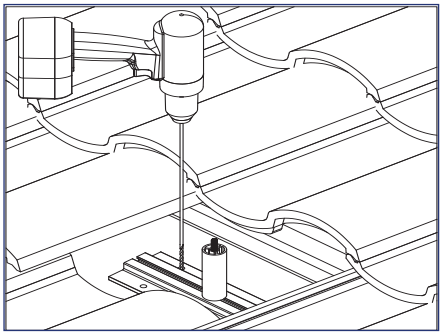
Flat Tile Replacement

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

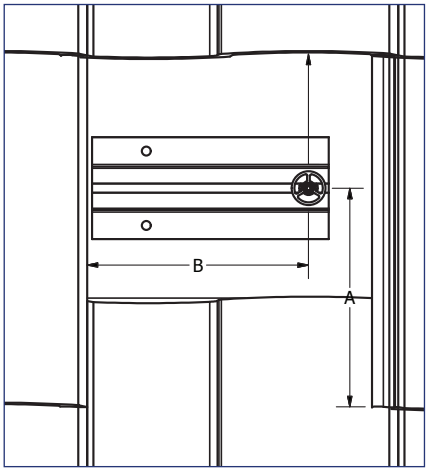
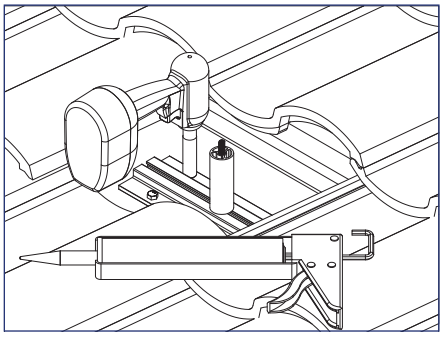


Diagram 1

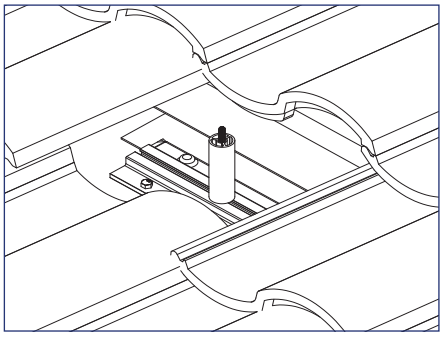
Install Note:

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.

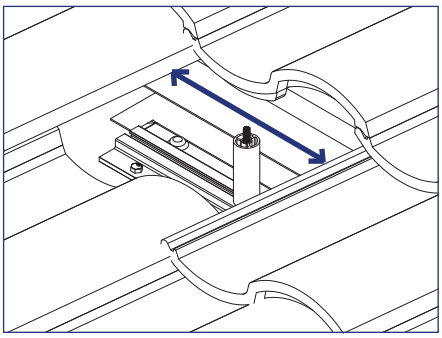
Working from RIGHT TO LEFT and UP THE ROOF will prevent neighboring tiles from lifting flashings.



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.



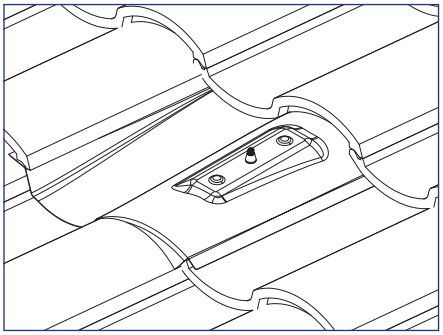
5) Align the riser with the hole in the flashing and tighten riser.

Best Practice:

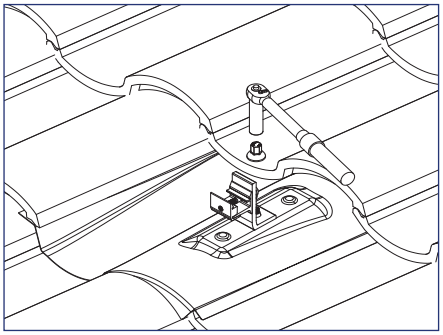
Flashing can be used as a template for locating riser.

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.

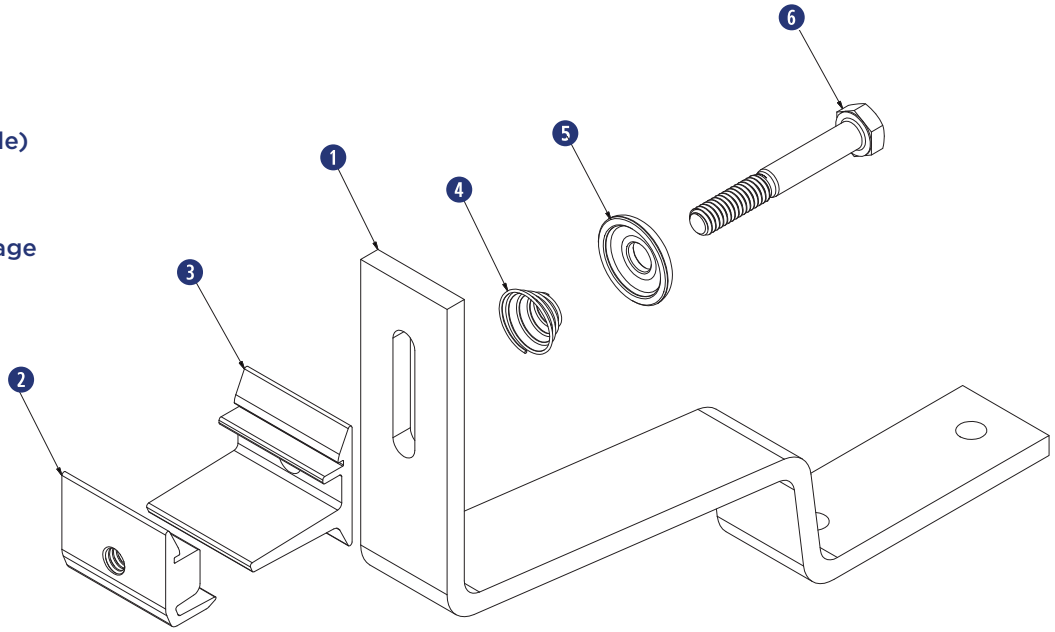
Flat Tile Hook

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

Materials Included - Flat Tile Hook

1. (1) SnapNrack Flat Tile Hook
2. (1) SnapNrack Ultra Mount (Tapped)
3. (1) SnapNrack Ultra Mount (Thru-Hole)
4. (1) SnapNrack Ultra Mount Spring
5. (1) SnapNrack Ultra Mount Spring Cage
6. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



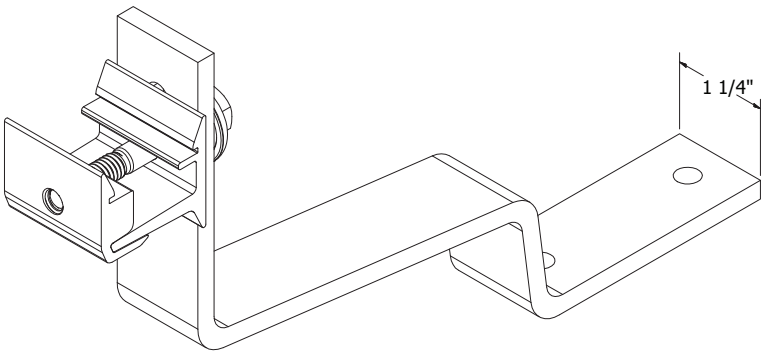
Other Materials Required - *Not Shown*

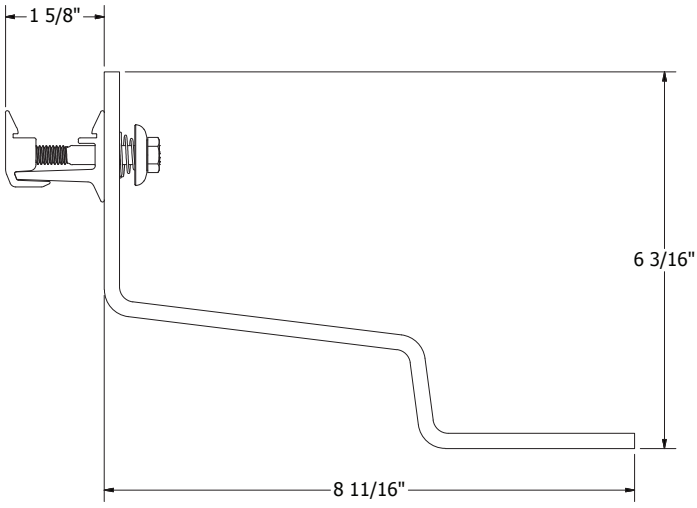
① (2) 5/16” Lag Screw

② (2) 5/16” Washer

③ Flexible Flashing (when required for deck level flashing)

Application Note:
Install on flat concrete tile roofs

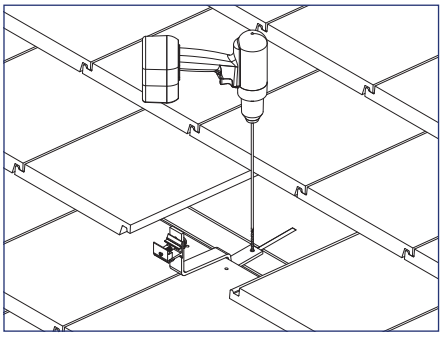




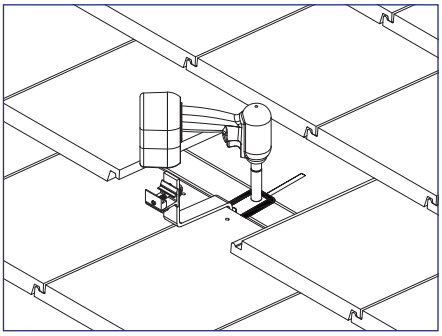
Dimensioned Flat Tile Hook Assembly

Flat Tile Hook

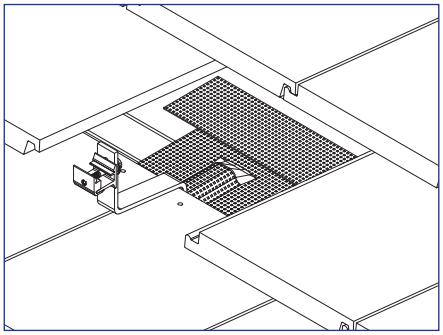
INSTALLATION INSTRUCTIONS



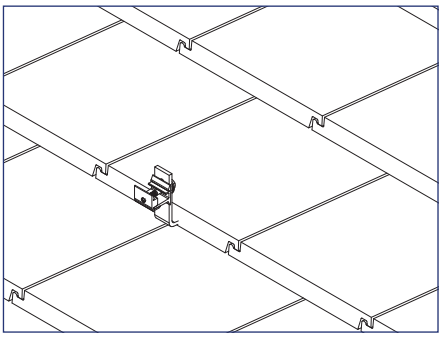
1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed and drill two pilot holes through the roofing material into the roof framing member.



2) Apply roofing sealant and attach the Tile Hook with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.



3) If deck level flashing is required, integrate roof felt or a flexible flashing with the existing underlayment and over the Tile Hook.



4) Replace the roof tiles.

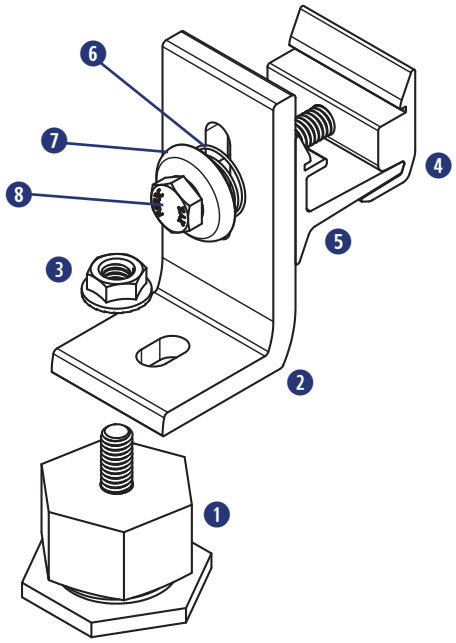
Metal Roof Base

Required Tools

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



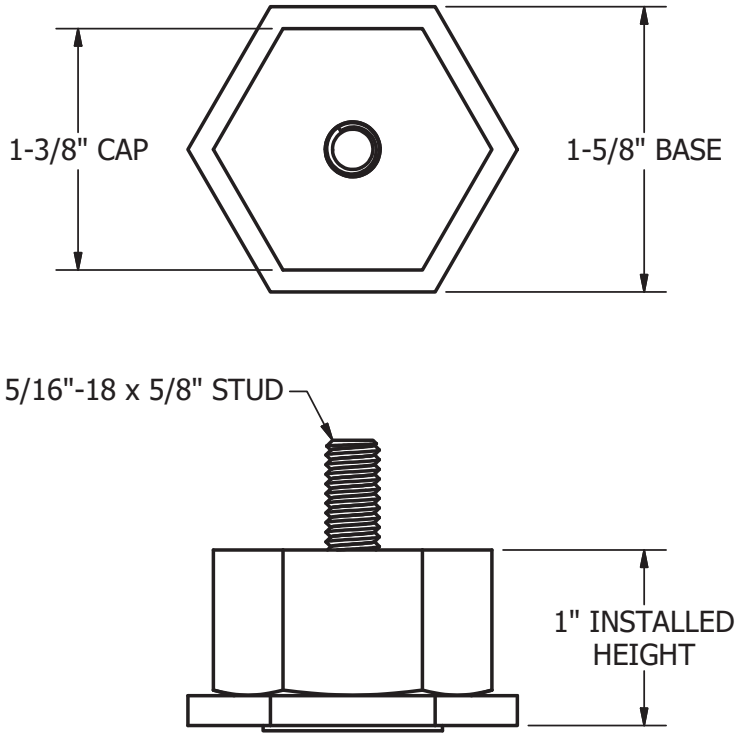
Other Materials Required - *Not Shown*

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

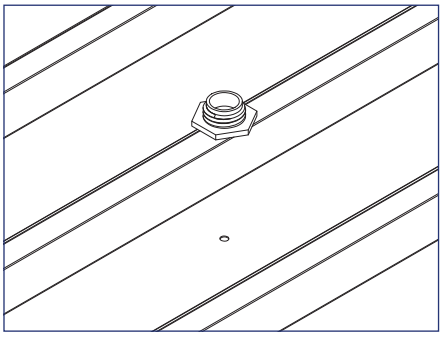
Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.



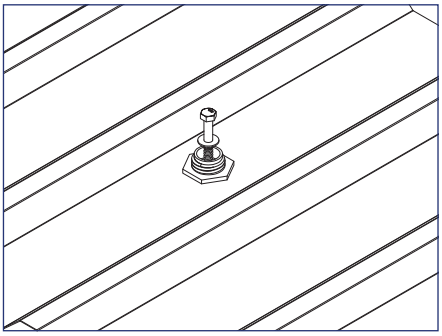
Dimensioned Metal Roof Base Assembly

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.

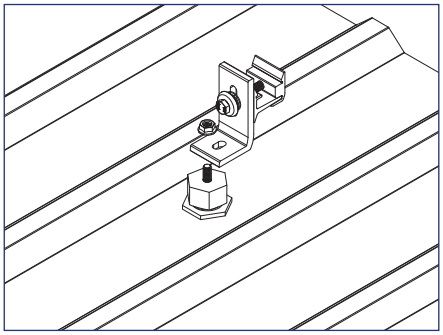


2) Attach the base with 5/16" lag screw (or 1/4" self-drilling screw for metal structures), drive screw for minimum 2.5" embedment into the roof framing member.

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.

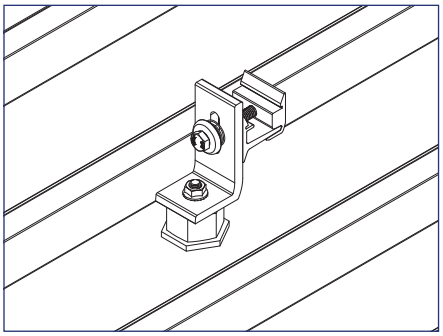
Additional roof sealant not required but can be applied after tightening the Metal Roof Base to roof, if desired.



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

Install Note:

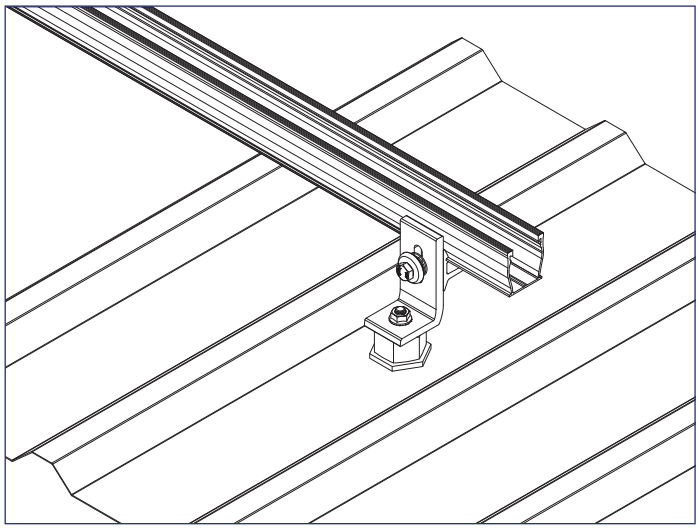
Take care to ensure the base does not twist when cap is tightened.



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.



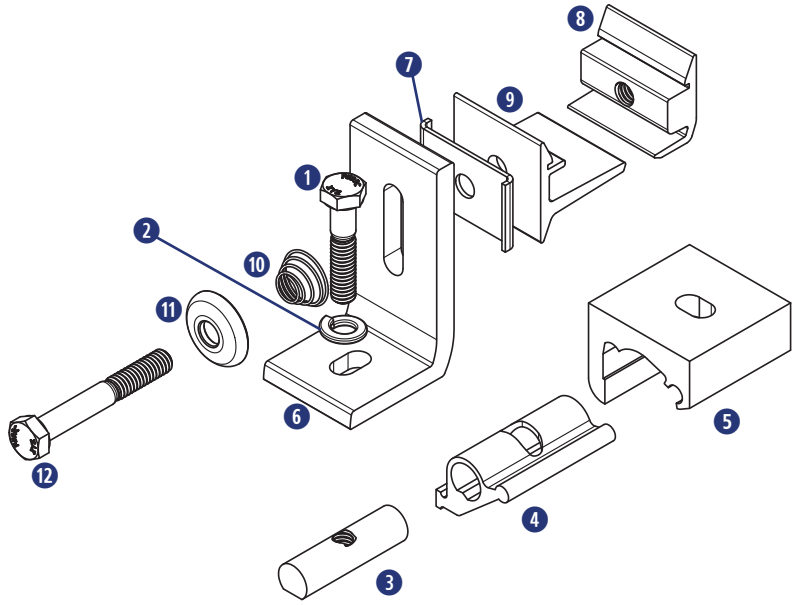
Seam Clamp

Required Tools

- Torque Wrench
- Socket Wrench
- 1/2" Socket

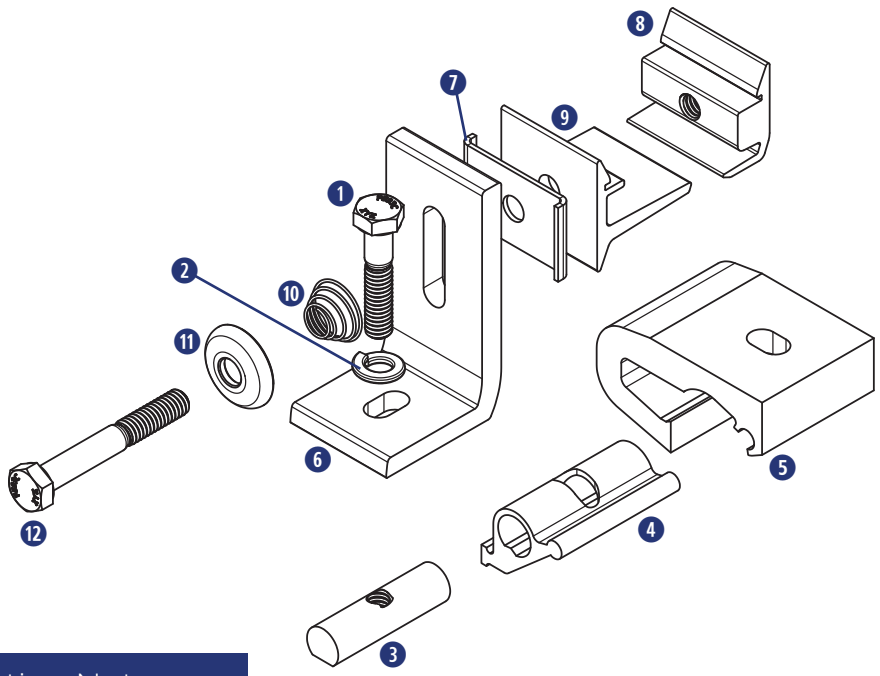
Materials Included - Standard Base Seam Clamp Kit

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

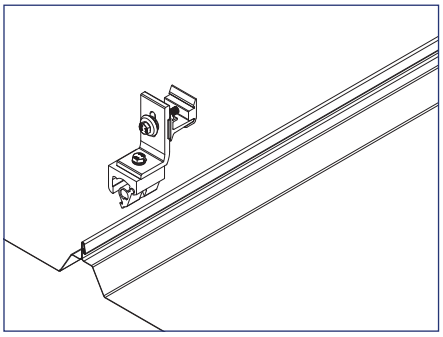


Application Note:
Install on standing metal seam roofs

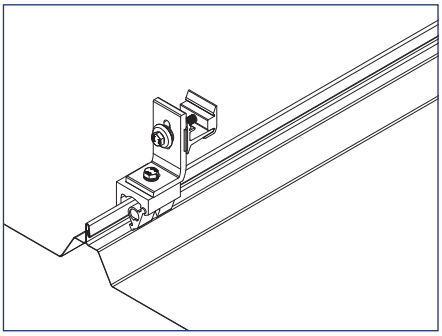
Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.

Seam Clamp

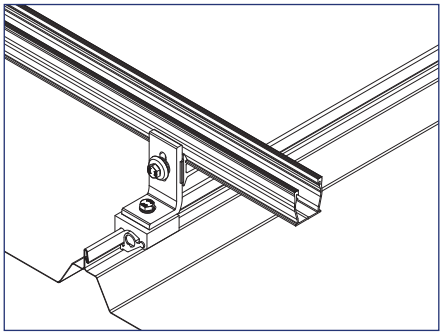
INSTALLATION INSTRUCTIONS



1) Loosen seam clamp hardware and use roof attachment locations to lay out seam clamps on roof.

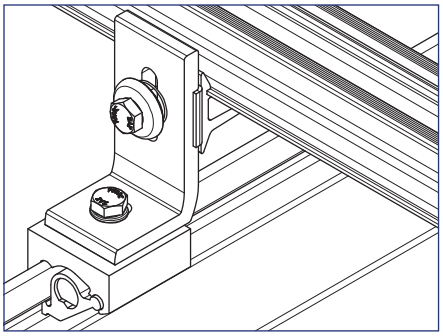


2) Attach the seam clamp to the standing metal seam by opening the seam clamp cam and placing the clamp over the top of the standing metal seam.



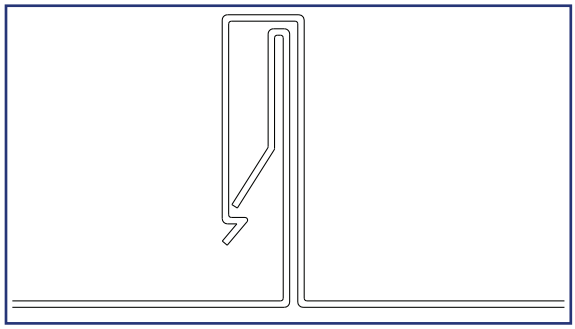
3) Torque black seam clamp bolt to 200 in-lbs (16.7 ft-lbs).

Install Note:
Seam clamps should never be installed using an impact driver.

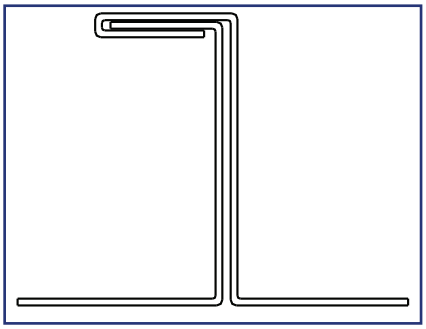


4) Ensure rotation lock is properly aligned with Ultra Mount and L foot during rail installation.

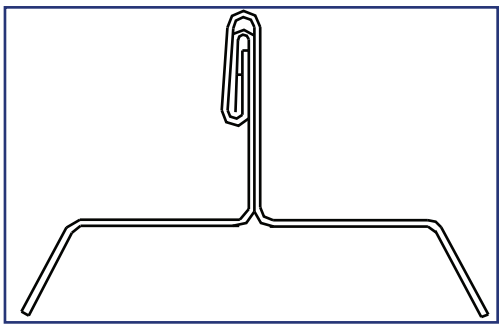
SnapNrack Seam Clamps have been designed to work with a variety of standing seam metal roofs, the most common seam types are:



Snap Lock



Single Lock



Double Lock

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

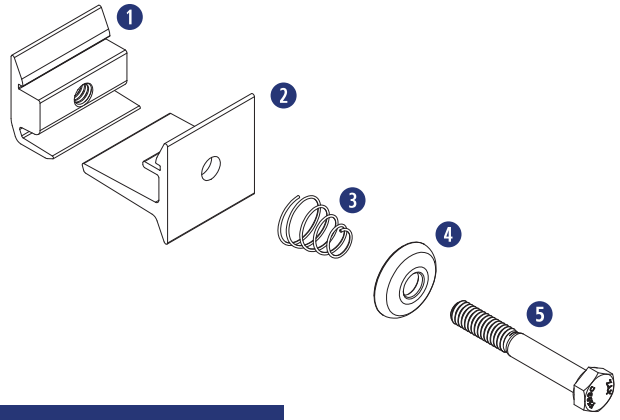
Ultra Rail Mounting Hardware

Required Tools

- Torque Wrench
- Socket Wrench
- 1/2” Socket

Materials Included - Ultra Rail Mounting Hardware

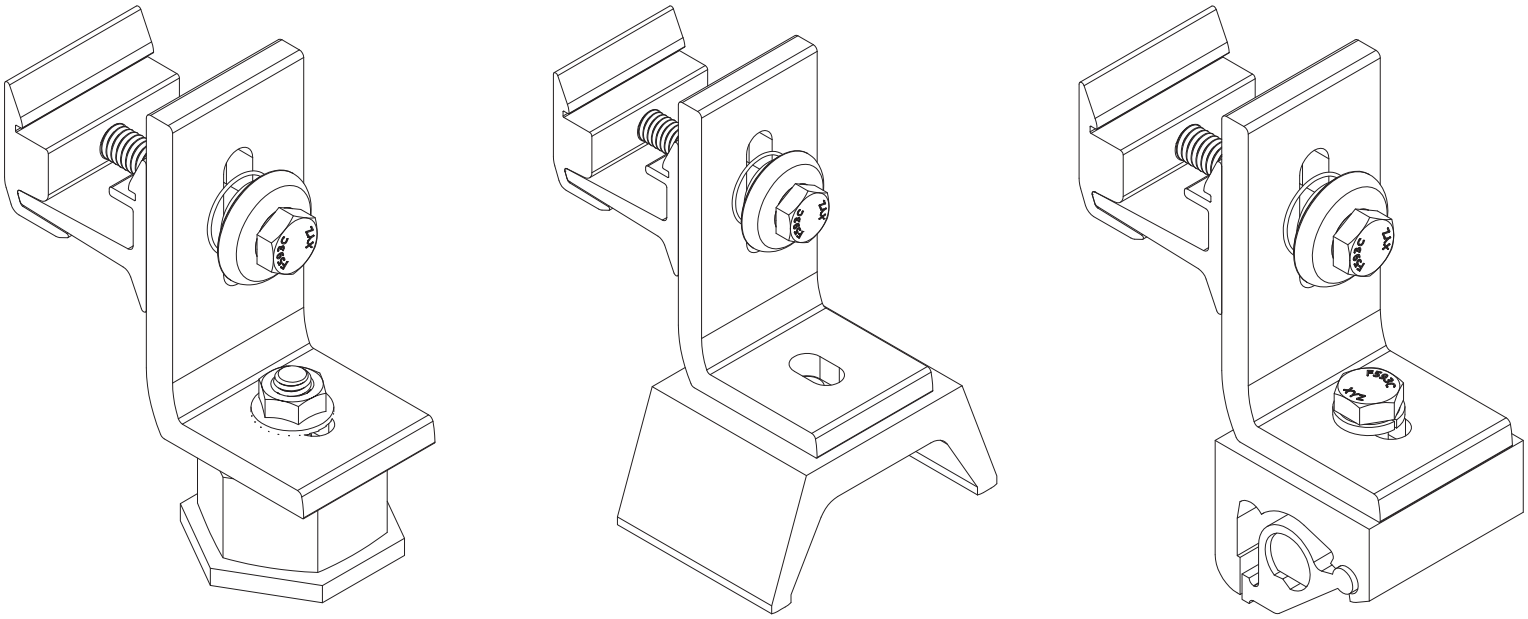
1. (1) SnapNrack Ultra Mount (Tapped)
2. (1) SnapNrack Ultra Mount (Thru-Hole)
3. (1) SnapNrack Ultra Mount Spring
4. (1) SnapNrack Ultra Mount Spring Cage
5. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



Other Materials Required - *Not Shown*

① Roof Attachment

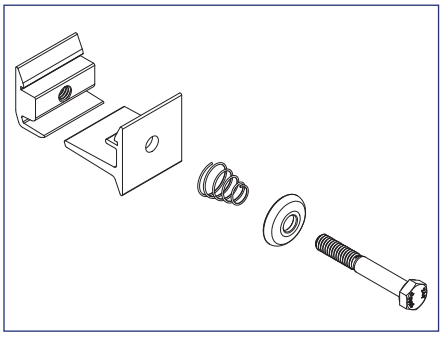
Application Note:
Install Ultra Rail onto any roof attachment that uses an L foot or other slotted mount that accepts 5/16” hardware.



Ultra Rail Mounting Hardware Installed on Different Roof Attachments

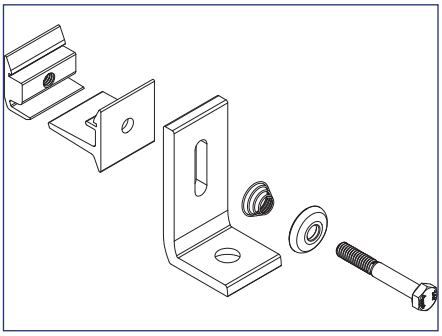
Install Note:
Roof attachments used must always meet minimum structural requirements. Consult licensed structural engineer if necessary.

INSTALLATION INSTRUCTIONS



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

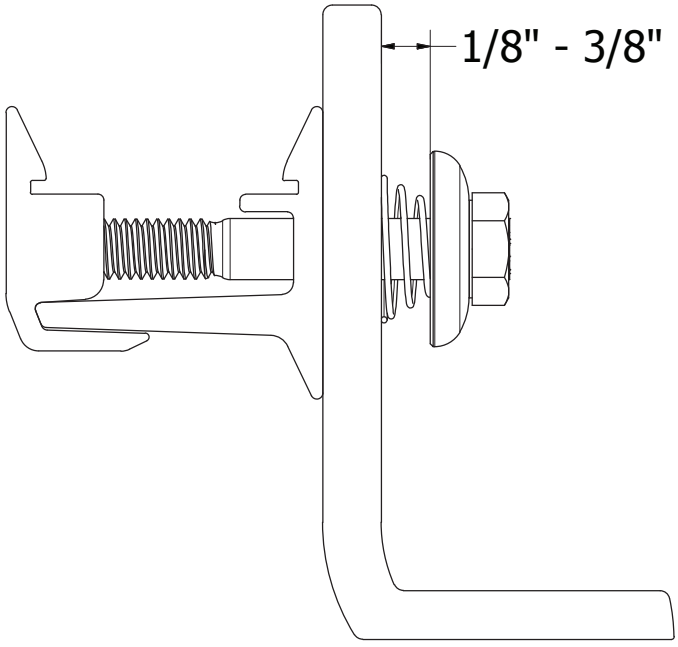
Install Note:
See exploded view on previous page for clarification.



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

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



Recommended Ultra Rail Mounting Hardware Installation

Installing and Leveling Rails

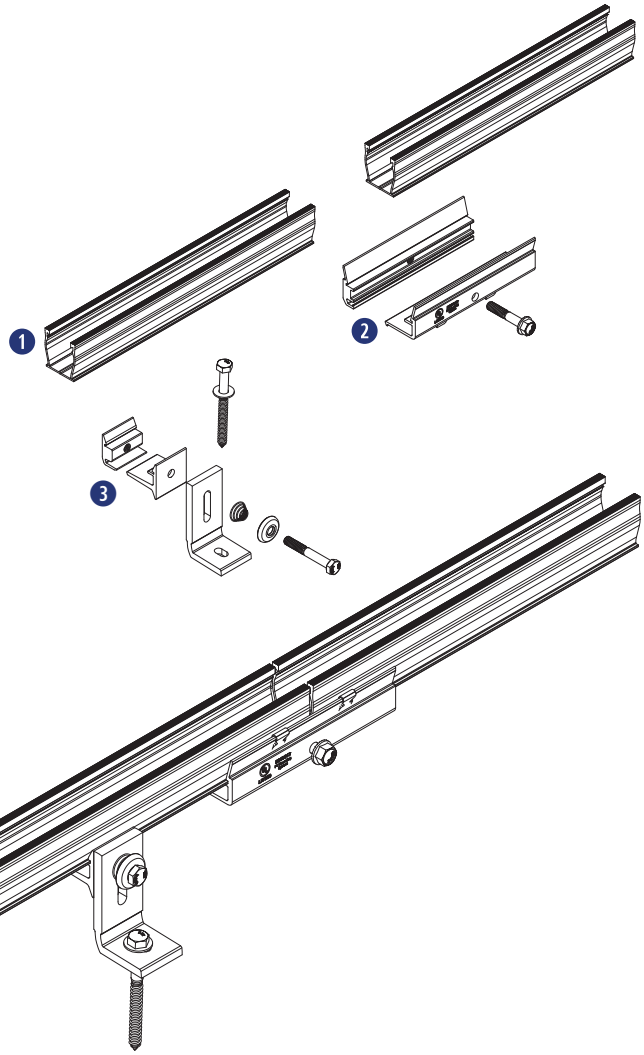
Required Tools

- Level
- String Line or Spare Rail
- Pitch Meter
- Torque Wrench
- Socket Wrench
- 1/2” Socket

Materials Included - Installing and Leveling Rails

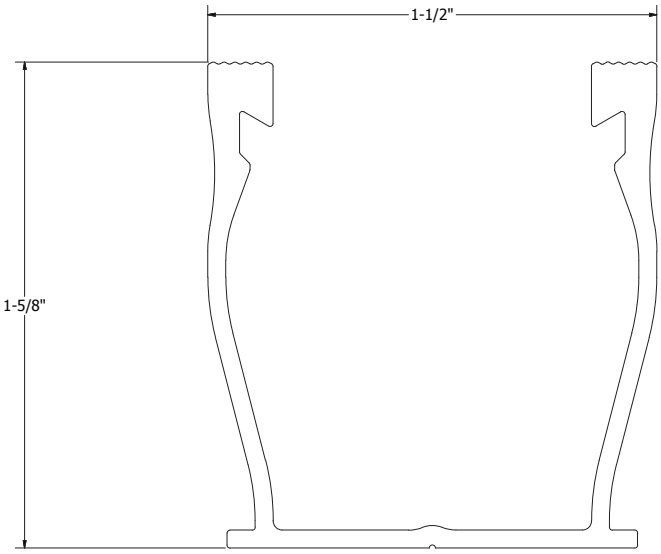
1. SnapNrack Ultra Rail
2. SnapNrack Ultra Rail Splice
3. Pre-Installed SnapNrack Roof Attachments

   (L Foot Mount, Tile Replacement, etc.)

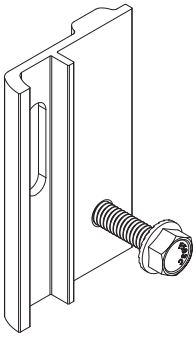


Other Materials Required - *Not Shown*

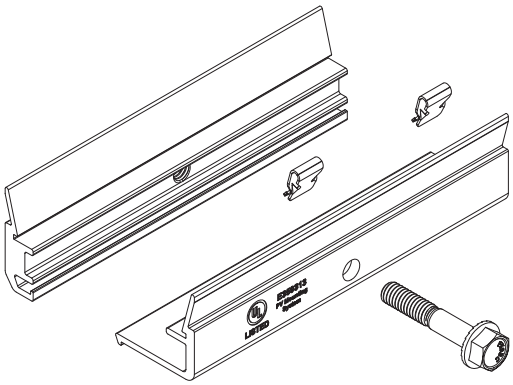
① SnapNrack L Foot Extension



UR-40 Rail Profile



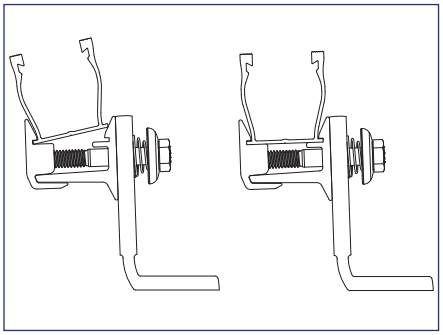
L Foot Extension



Ultra Rail Splice

Installing and Leveling Rails

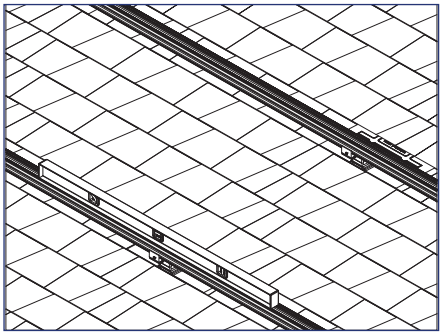
INSTALLATION INSTRUCTIONS



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:

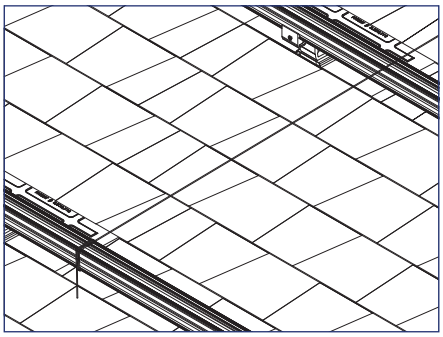
Slightly rocking rail into mounts can ease installation, leading first with side of rail furthest from mount.



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

Best Practice:

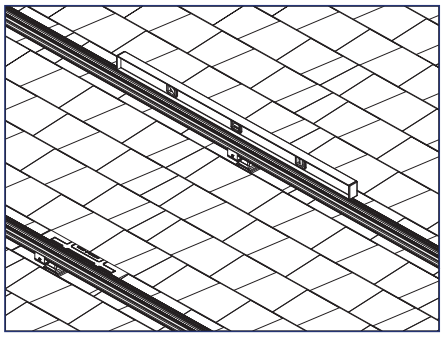
Set attachments in the middle of available leveling range to start.



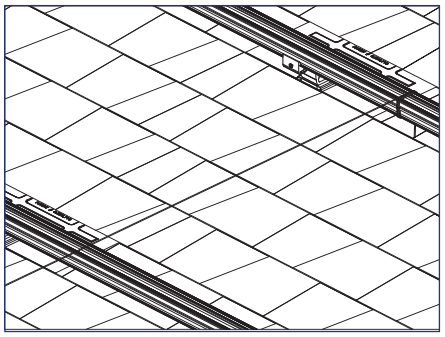
3) Run a string line or spare rail from the bottom rail to the top rail and set desired pitch of the array by adjusting the top rail, add L Foot Extension if needed.

Install Note:

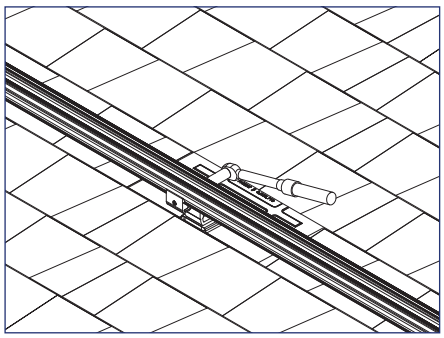
See "Leveling Components" section for installation instruction and restrictions.



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.

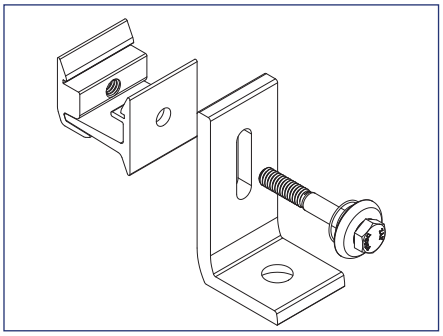
Note:

The minimum standoff height between the modules and roof is as follows:

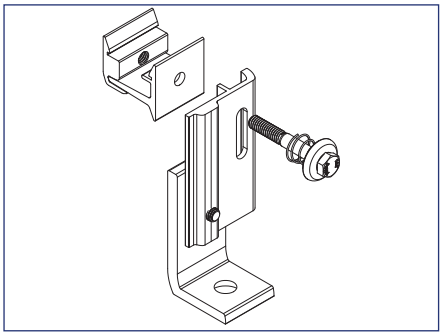
- REC Solar, Yingli, and Suniva modules: 4.00"
- ReneSola modules: 3.93" (100 mm)
- Trina Solar modules: 4.53" (115 mm)

INSTALLATION INSTRUCTIONS

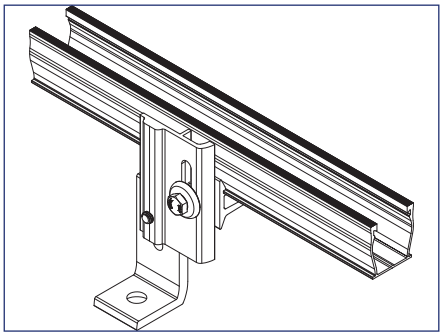
SnapNrack L Foot Extension



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:

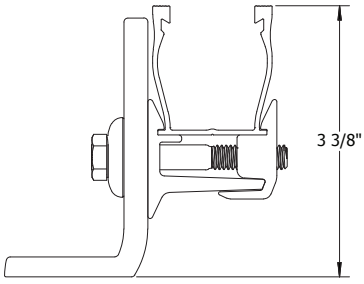
Ultra Mount (tapped) – Ultra Mount (thru-hole) – L Foot Extension – spring – washer – bolt

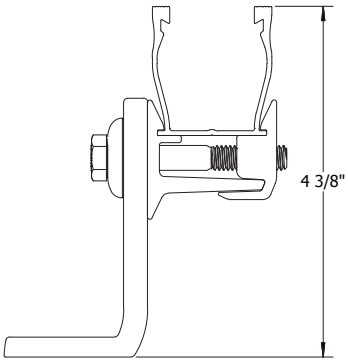
Install Note:

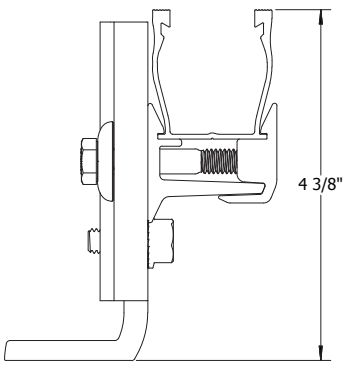
See exploded view in "Ultra Rail Mounting Hardware" section for clarification.

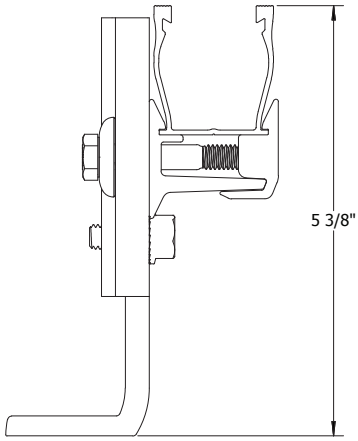
Best Practice:

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

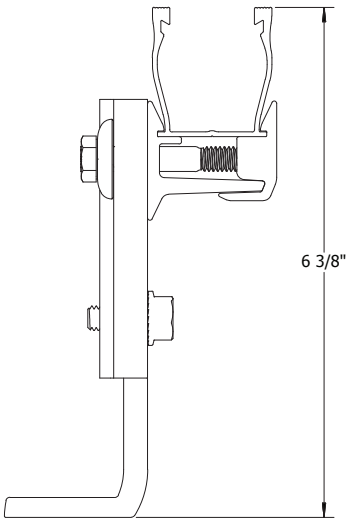






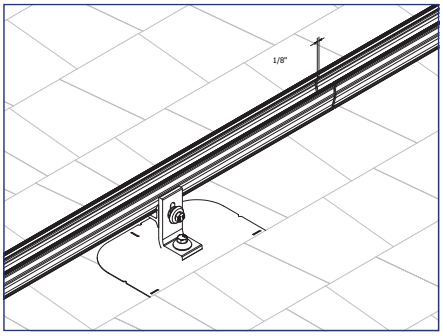


Use a single L Foot Extension on no more than 30% of attachment points.



L Foot Extension Provides Up To 3" of Height Adjustment

INSTALLATION INSTRUCTIONS

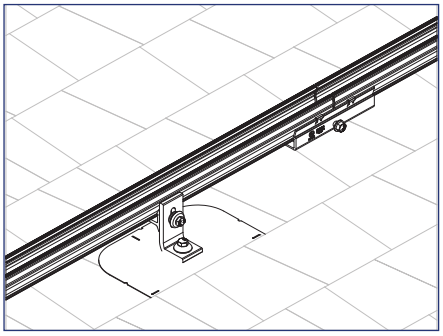


1) Align sections of rail so that ends butt up to each other.

Install Note:

Leave approximately 1/8" gap between rails to allow for thermal expansion of rail.

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.



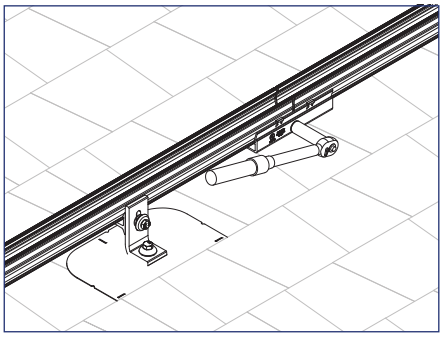
2) Install rail splice assembly onto bottom of rail, making sure both rails are seated in grooves of splice and that the splice is centered.

Install Note:

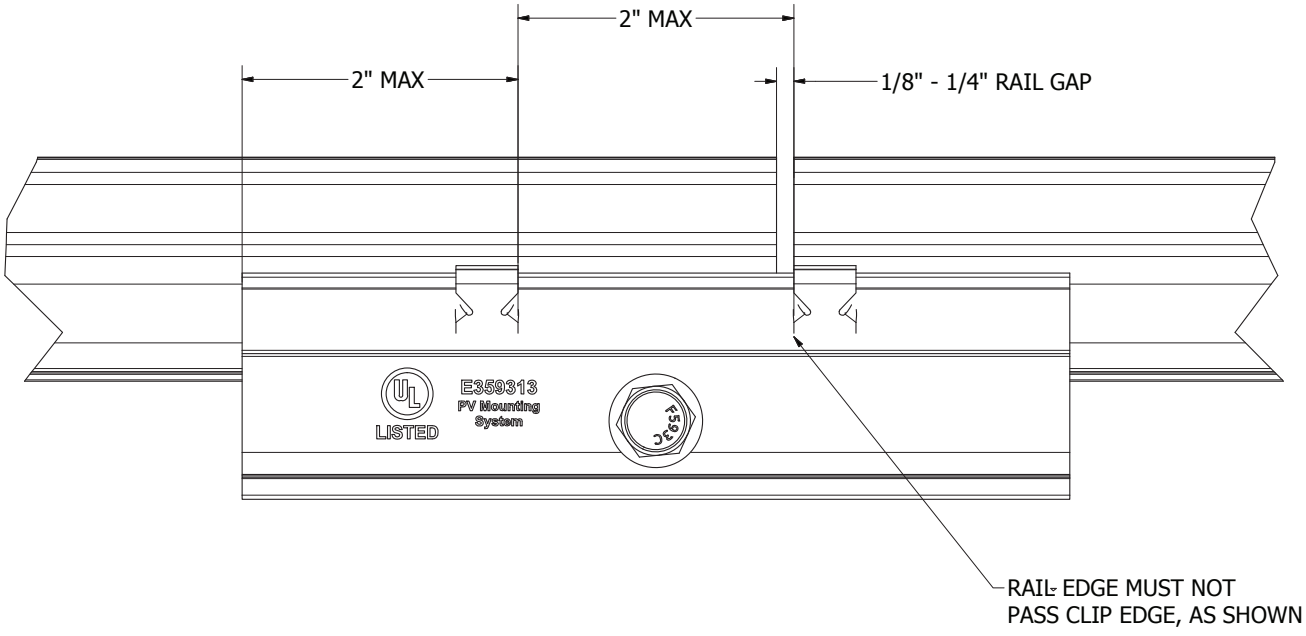
Gap between rails must land between bonding clips on splice.

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.

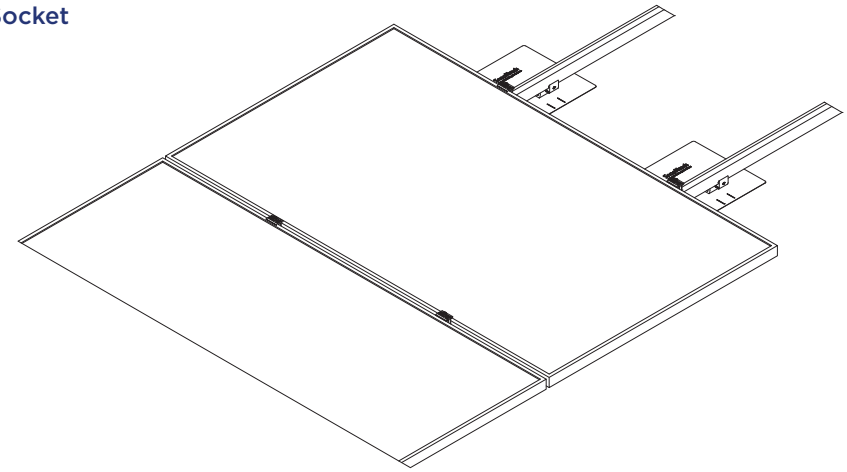


Splice Installation Limitations

Module Installation

Required Tools

- Torque Wrench
- Socket Wrench
- 1/2” Socket

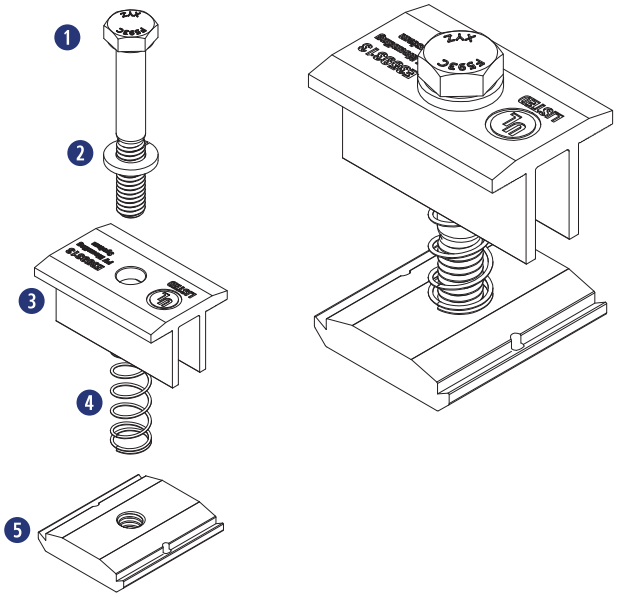


Materials Needed - Module Installation

1. Pre-Installed SnapNrack Roof Attachments
2. Pre-Installed SnapNrack Rails
3. SnapNrack Mid Clamp Assemblies
4. SnapNrack End Clamp Assemblies
5. PV Modules

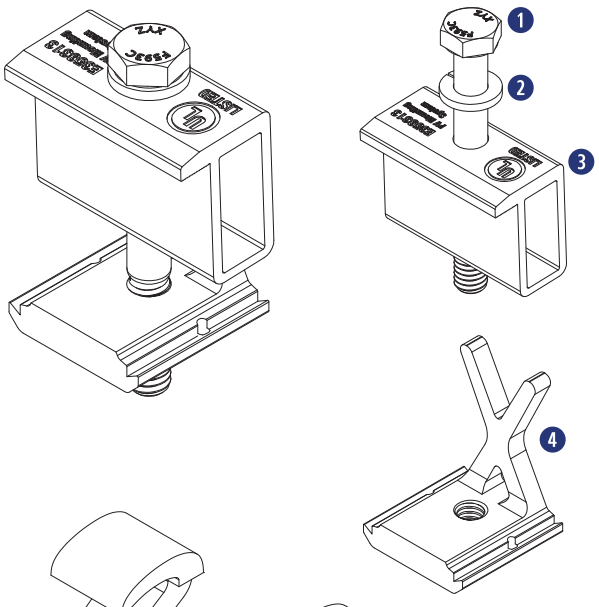
Mid Clamp Assembly

1. (1) 5/16”-18 SS HCS Bolt
2. (1) 5/16” SS Split Lock Washer
3. (1) SnapNrack Mid Clamp
4. (1) SnapNrack SS Mid Clamp Spring
5. (1) 5/16”-18 SnapNrack Channel Nut



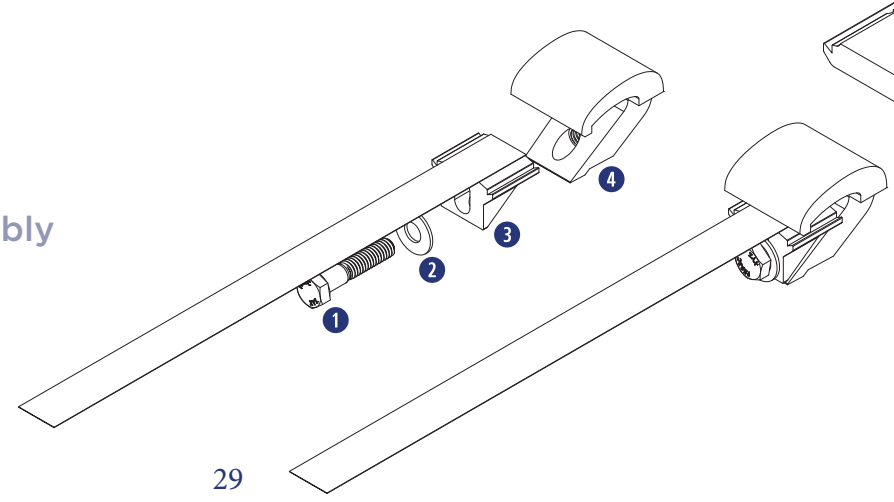
Adjustable End Clamp Assembly

1. (1) 5/16”-18 SS HCS Bolt
2. (1) 5/16” SS Split Lock Washer
3. (1) SnapNrack Adjustable End Clamp Top
4. (1) SnapNrack Adjustable End Clamp Bottom



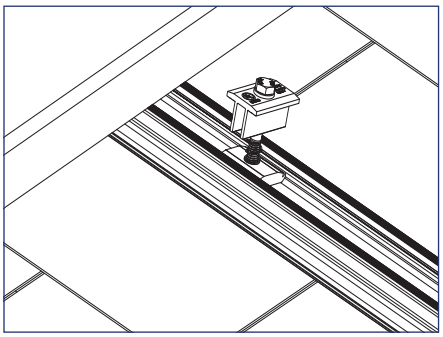
Universal End Clamp Assembly

1. (1) 5/16”-18 X 1-1/2” SS HCS Bolt
2. (1) 5/16” X 3/4” SS Flat Washer
3. (1) SnapNrack Universal Wedge
4. (1) SnapNrack Universal Wave



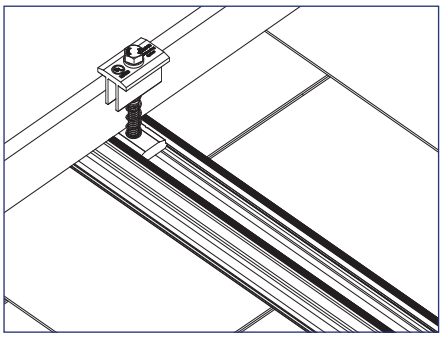
INSTALLATION INSTRUCTIONS

SnapNrack Mid Clamp



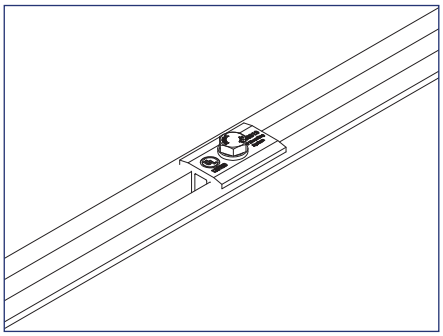
1) Snap the channel nut into the top channel of the rail.

Best Practice:
Backing channel nut off bolt will ease installation into rail channel.



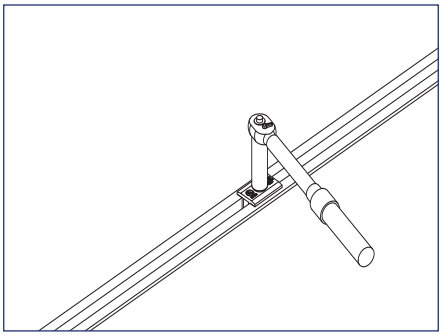
2) Slide the clamp flush to the module with the top lip of the mid clamp over the top edge of the module frame.

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.

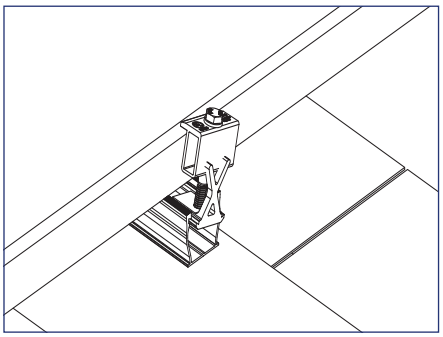


4) Tighten hardware to 10 ft-lbs.

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

INSTALLATION INSTRUCTIONS

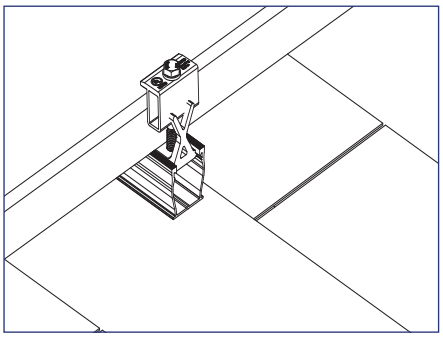
SnapNrack Adjustable End Clamp



1) Snap the channel nut into the top channel of the rail.

Install Note:

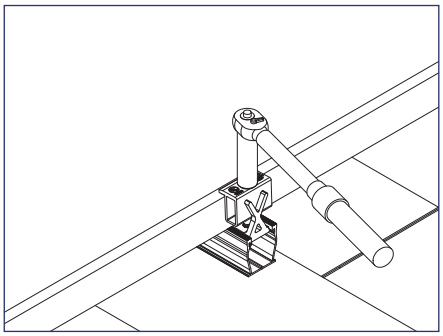
Adjustable End Clamps require extra rail to ensure that channel nut is fully engaged.



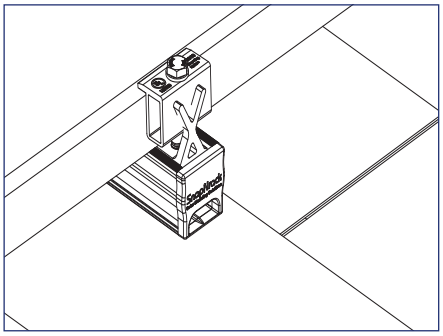
2) Slide the clamp flush to the module with the top lip of the end clamp over the top edge of the module frame.

Install Note:

Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.



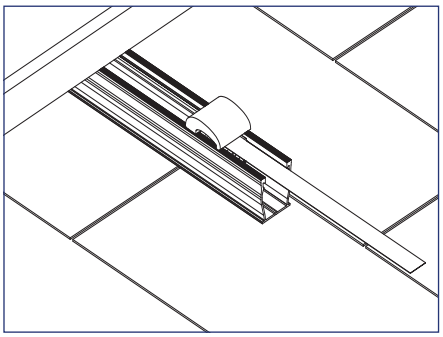
3) Tighten hardware to 10 ft-lbs.



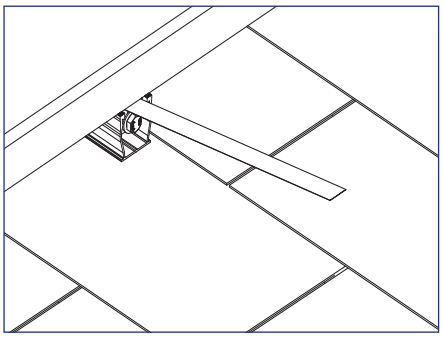
4) Install end cap to finish.

INSTALLATION INSTRUCTIONS

SnapNrack Universal End Clamp

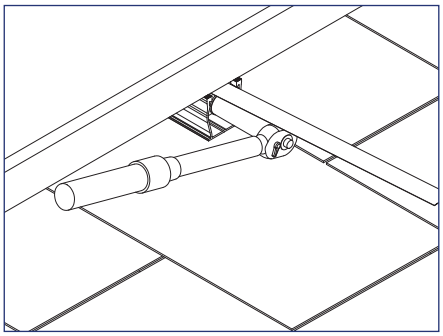


1) Slide the preassembled Universal End Clamp (UEC) into the end of the rail.



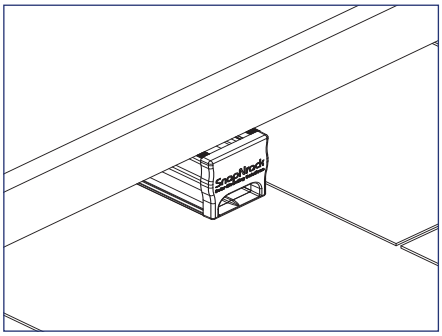
2) Lift the module and slide the clamp far enough under the module to pass the lip of the bottom edge of the module frame.

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.

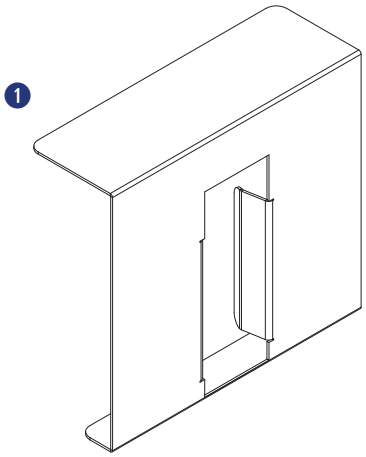
Rail Finishing

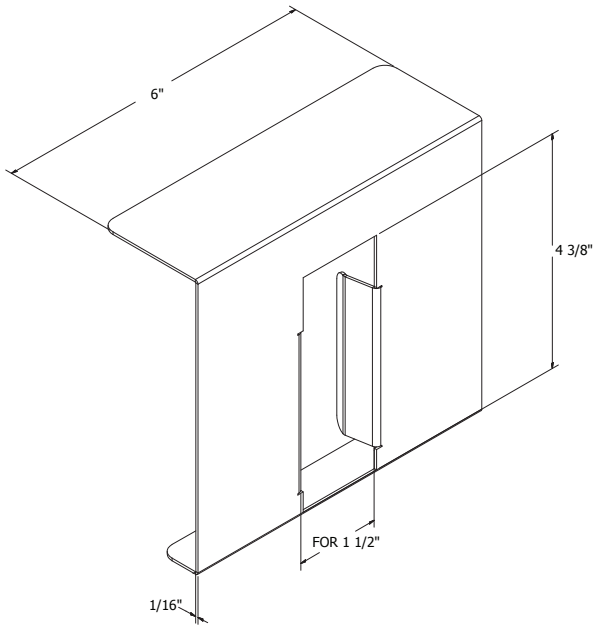
Required Tools

- Reciprocating Saw or Portable Band Saw

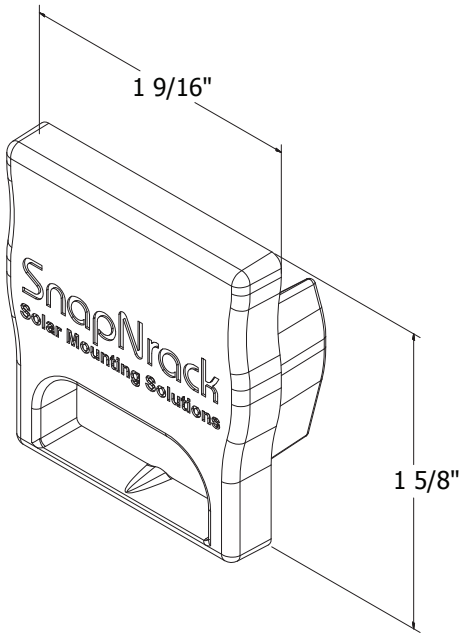
Materials Included - Rail Cutting Tool and Rail End Cap

1. (1) SnapNrack Rail Cutting Tool
2. (1) SnapNrack Ultra Rail End Cap





Dimensioned Rail Cutting Tool

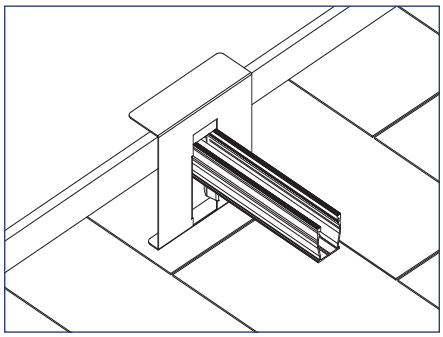


Dimensioned Ultra Rail End Cap

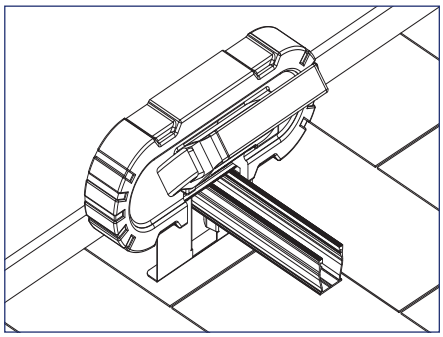
Application Note:

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

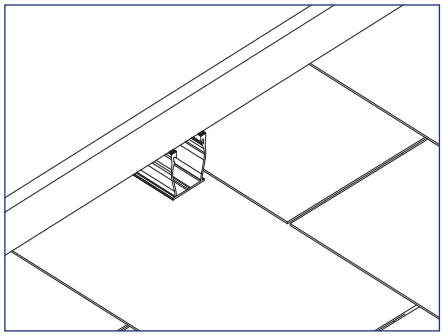
INSTALLATION INSTRUCTIONS



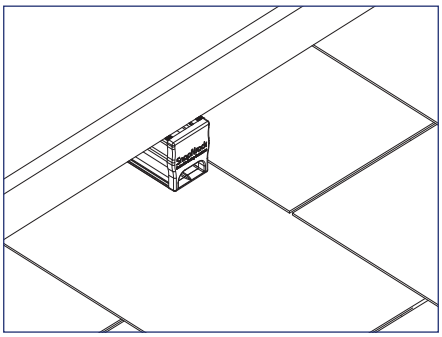
1) Slide the Rail Cutting Tool over the end of the rail and place it so that the upper lip is safely covering the edge of the module *(optional)*.



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

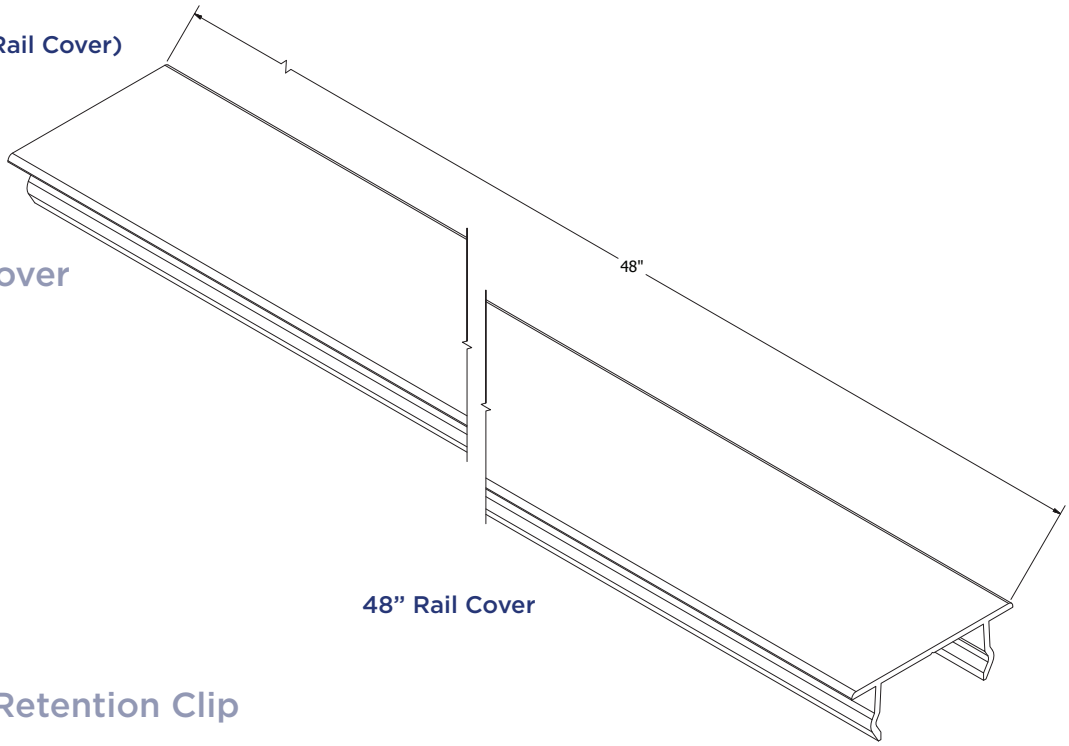
Required Tools

- 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” Rail Cover

Materials Included - Wire Retention Clip

1. SnapNrack Wire Retention Clip

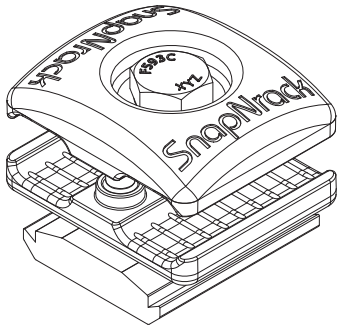
Wire Retention Clip

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

Materials Included - Wire Clamp

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

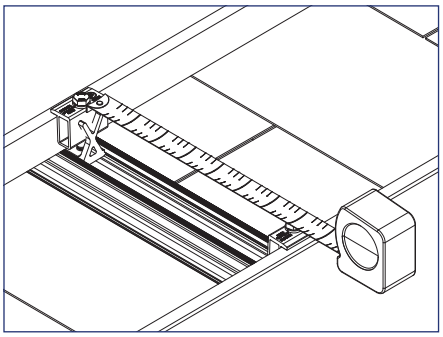
Application Note:
Install as necessary to secure cables and conductors running from rail to rail, or transitioning out/in from a rail channel



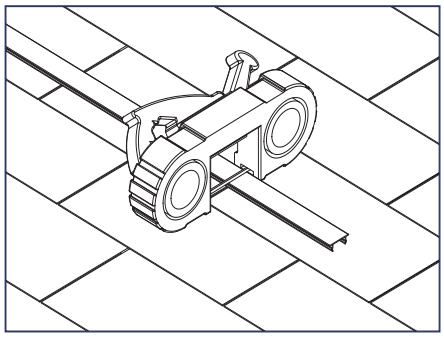
Universal Wire Clamp Assembly

INSTALLATION INSTRUCTIONS

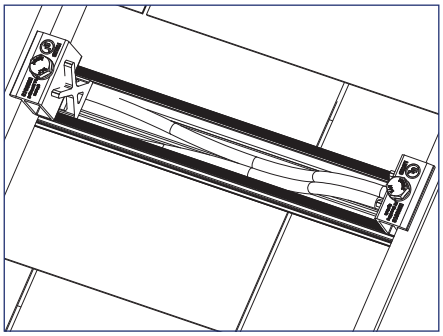
SnapNrack 48” Rail Cover



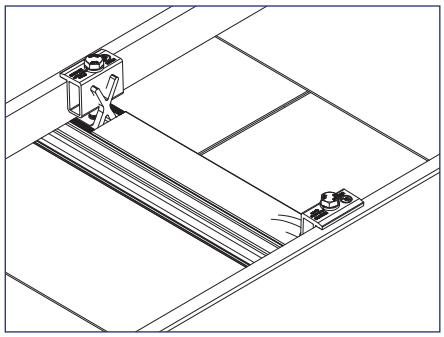
1) Measure the length of the SnapNrack 48” Rail Cover that is needed.



2) Cut the rail cover to length, then remove any sharp edges.



3) Place all electrical conductors in the bottom of the rail channel.



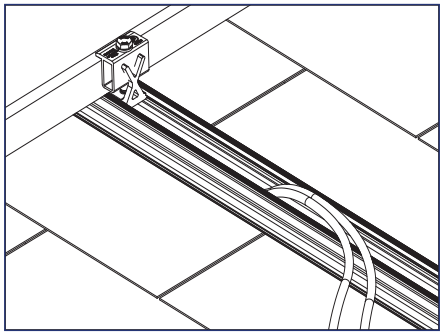
4) Snap Rail Cover into place, enclosing all conductors inside of rail channel.

Install Note:

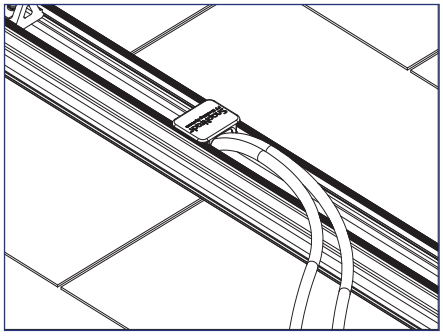
SnapNrack Rail Cover is designed to stay in place once installed, use a flat blade screw driver if it needs to be relocated or removed.

INSTALLATION INSTRUCTIONS

SnapNrack Wire Retention Clip

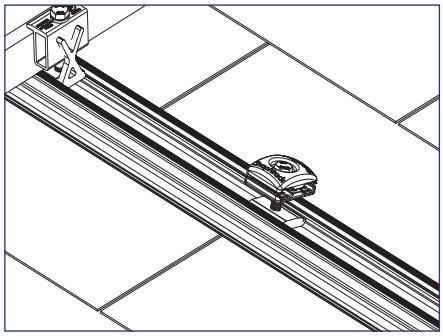


1) Place all electrical conductors in the bottom of the rail channel.

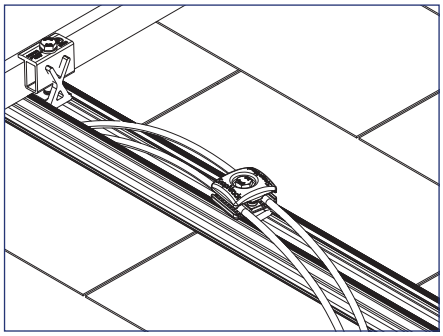


2) Install the Wire Retention Clip by snapping it into place on the rail.

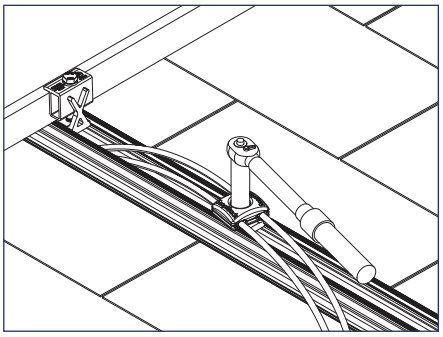
SnapNrack 4-Wire, Trunk Cable, or Universal Wire Clamp



1) Snap Wire Clamp into top or side rail channel.

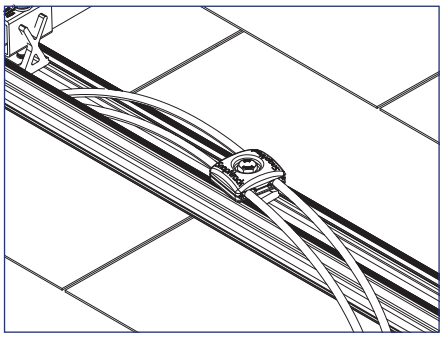


2) With Wire Clamp loose, place conductors or cables in slots.



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.

MLPE Installation

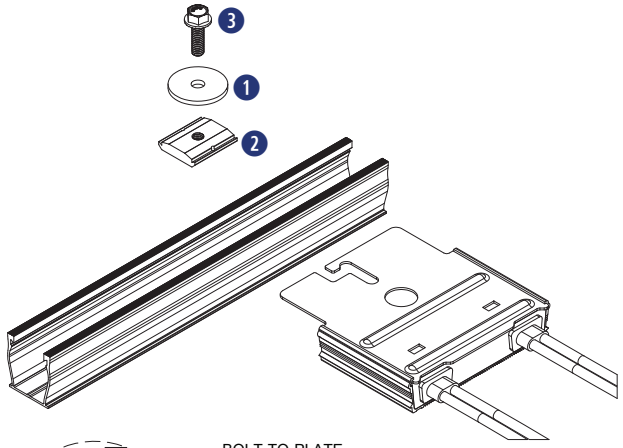
snapnrack.com

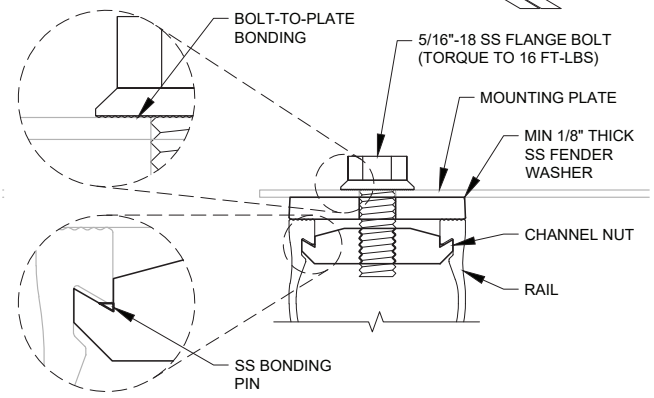
Required Tools

- Torque Wrench
- Socket Wrench
- 1/2" Socket

Materials Included - MLPE Rail Attachment Kit

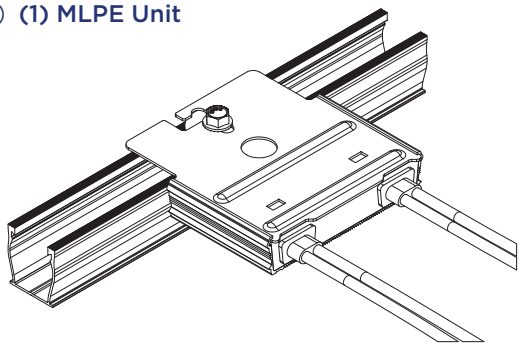
1. (1) 5/16" X 1-1/2" X 0.125" SS Fender Washer
2. (1) SnapNrack Channel Nut
3. (1) 5/16"-18 X 1-1/4" SS Flange Bolt





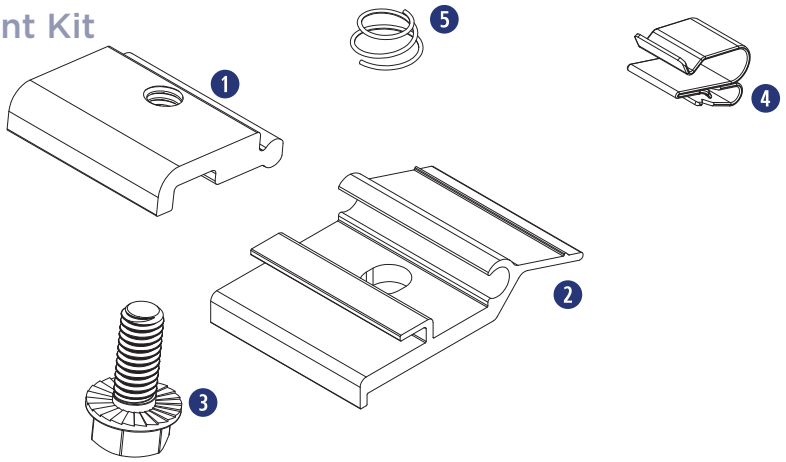
Other Materials Required

① (1) MLPE Unit



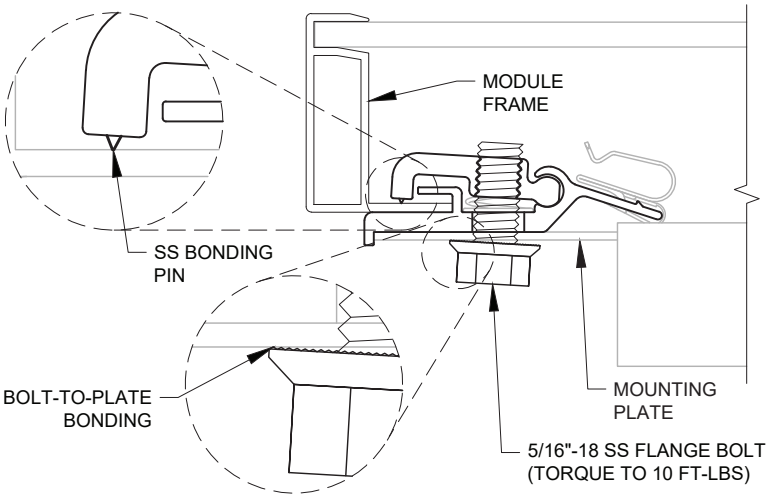
Materials Included - MLPE Frame Attachment Kit

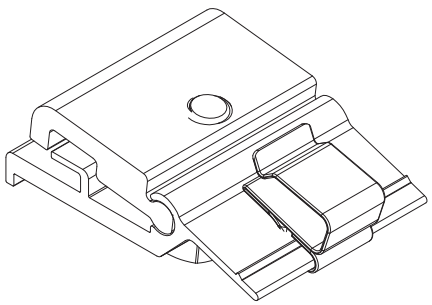
1. (1) SnapNrack MLPE Frame Attachment Top
2. (1) SnapNrack MLPE Frame Attachment Bottom
3. (1) 5/16"-18 X 3/4" SS Flange Bolt
4. (1) SnapNrack Smart Clip II
5. (1) SnapNrack MLPE Frame Attachment SS Coil Spring



Other Materials Required

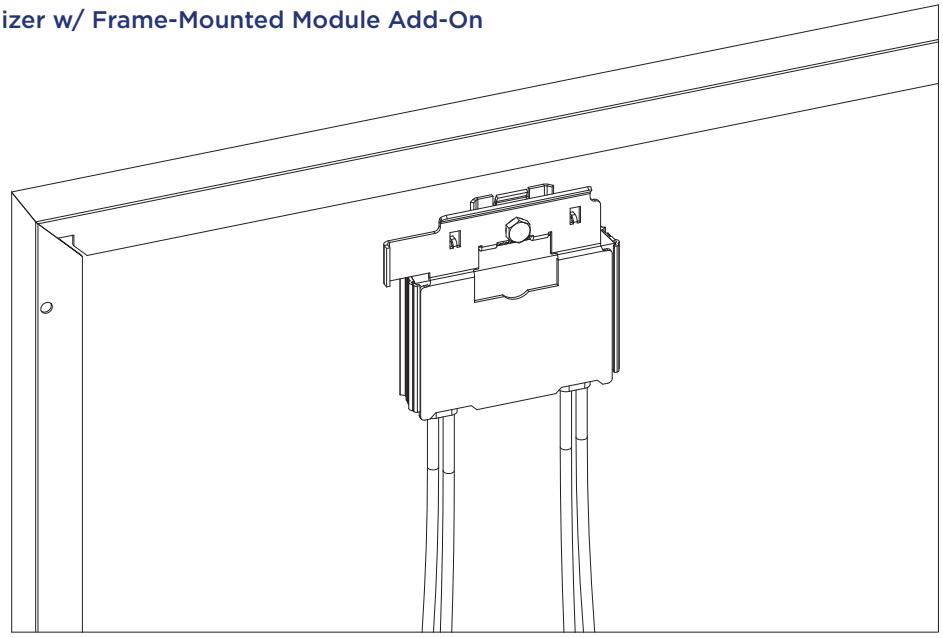
① (1) MLPE Unit





Materials Needed – SolarEdge Frame Mount

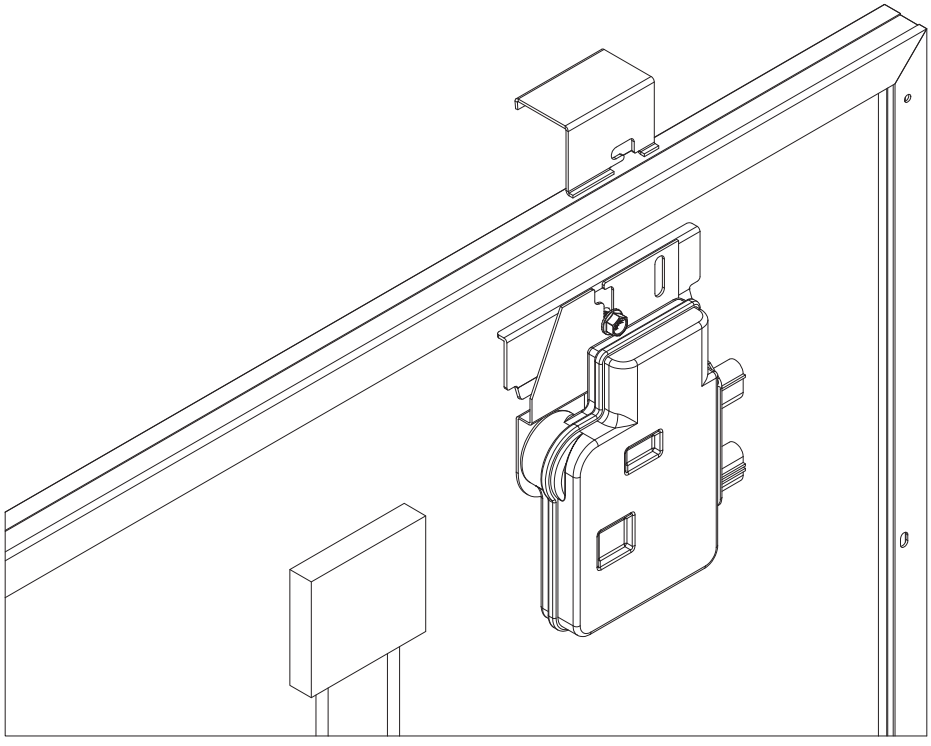
① (1) SolarEdge Optimizer w/ Frame-Mounted Module Add-On



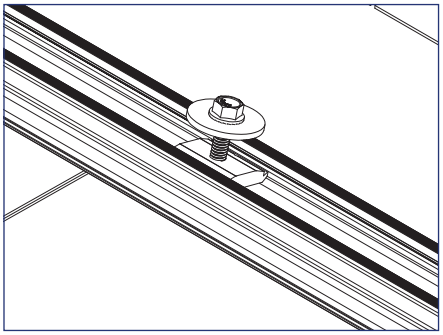
Materials Needed – Enphase Frame Mount

① (1) Enphase Microinverter

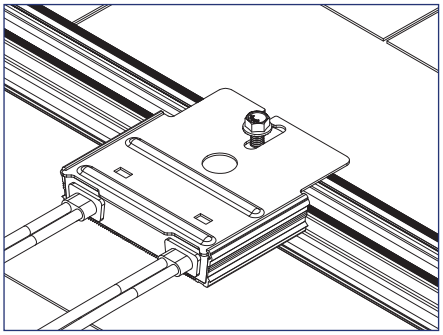
② (1) Enphase Frame Mount



INSTALLATION INSTRUCTIONS - MLPE RAIL ATTACHMENT



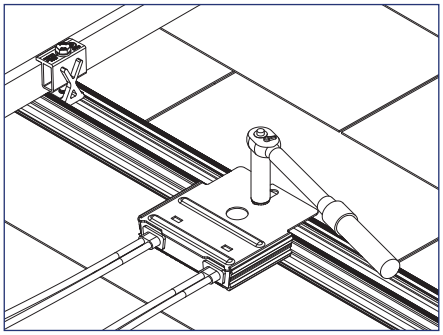
1) Snap the SnapNrack MLPE Rail Attachment Kit channel nut into the desired location on the rail where the microinverter will be installed.



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.

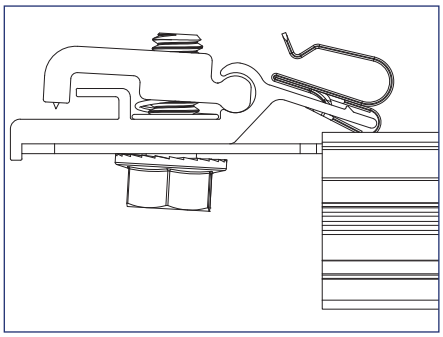


3) Tighten hardware to 10 ft-lbs.

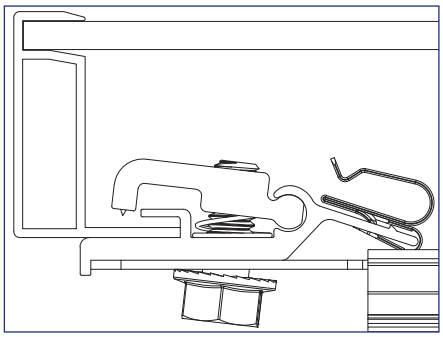
Install Note:

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

INSTALLATION INSTRUCTIONS - MLPE FRAME ATTACHMENT



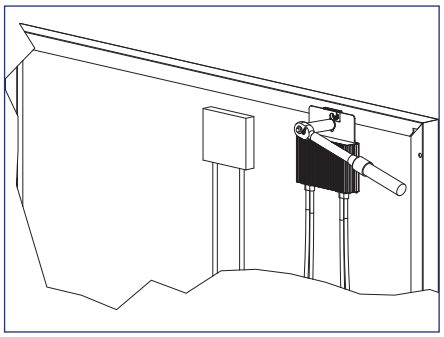
1) Slide the backplate channel of the MLPE device under the MLPE Frame Attachment Kit bolt. The MLPE mounting plate should rest against the MLPE mounting plate backstop on the MLPE Frame Attachment Kit.



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:

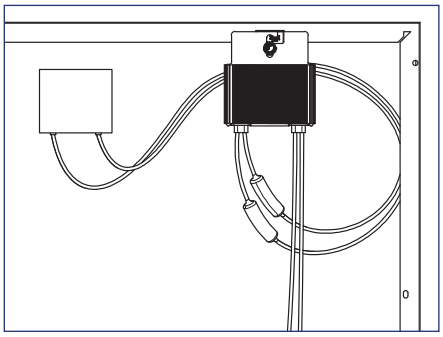
Avoid blocking module frame drainage holes when installing the MLPE Frame Attachment Kit.



3) Tighten the mounting bolt on the MLPE Frame Attachment Kit to 10 ft-lbs.

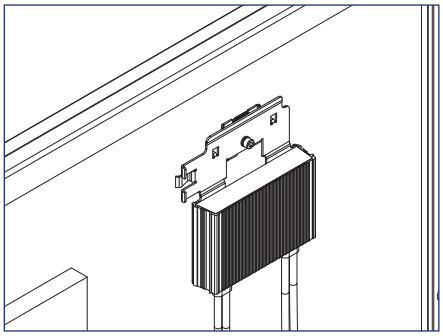
Install Note:

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

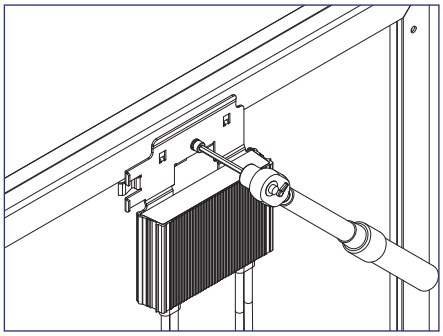


4) Connect the module leads to the input con-nectors on the MLPE device and manage con-ductors with the integrated Smart Clip.

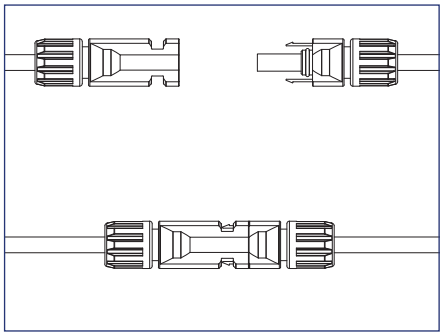
INSTALLATION INSTRUCTIONS - SOLAREDGE FRAME MOUNT



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.

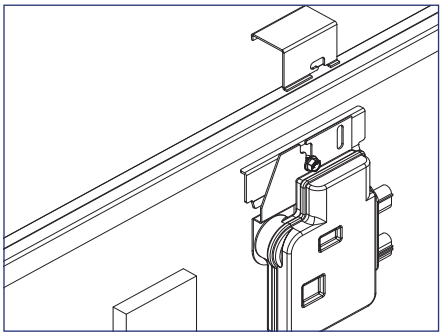


3) Connect the module leads to the input connectors on the optimizer.

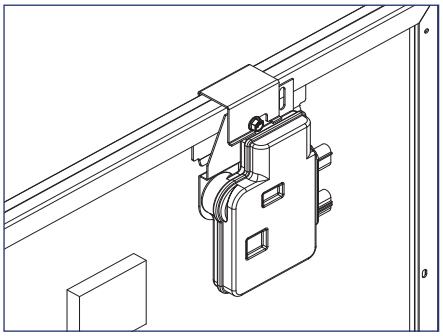
Install Note:

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

INSTALLATION INSTRUCTIONS - ENPHASE FRAME MOUNT



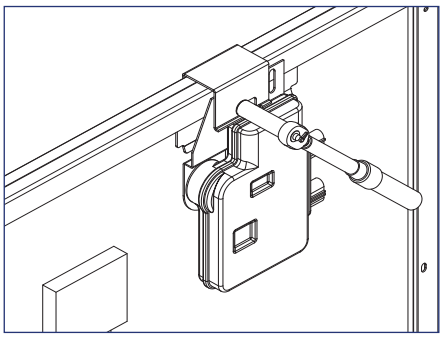
1) Locate the Enphase Frame Mount bracket clamp at a location on the module frame that will not interfere with the SnapNrack rail.



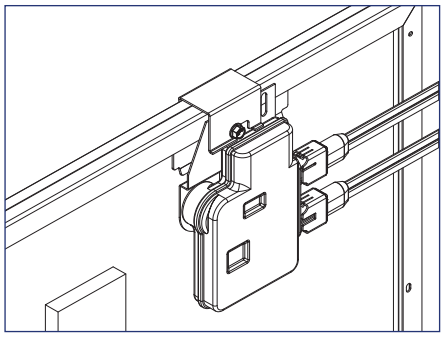
2) Slide the microinverter unit onto the bracket clamp, then move it slightly to the left.

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.

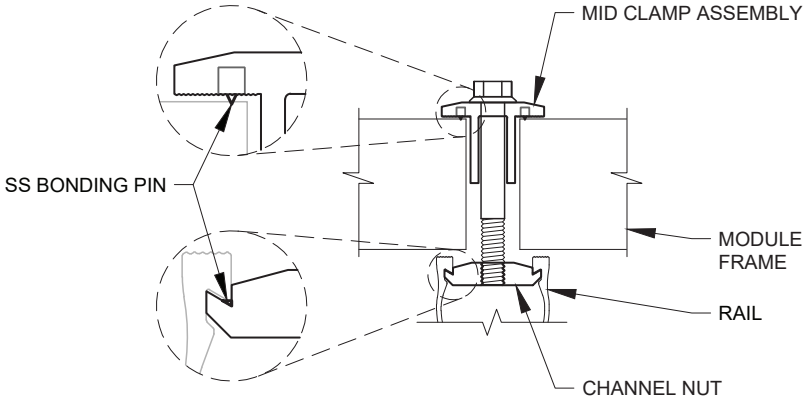
Install Note:

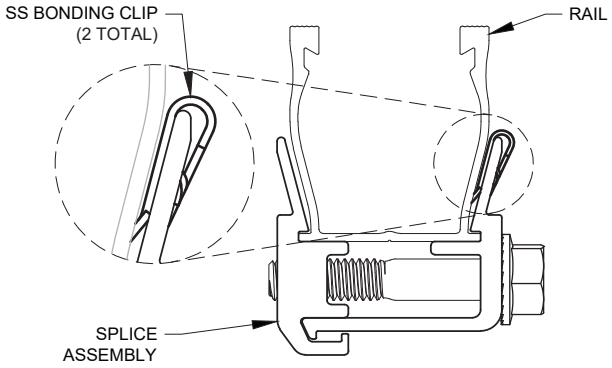
Refer to the Enphase Frame Mount installation guide for additional instructions.

Grounding Specifications

System Bonding Methods

1. SnapNrack Mid Clamp
2. SnapNrack Adjustable End Clamp
3. SnapNrack Ultra Rail Splice

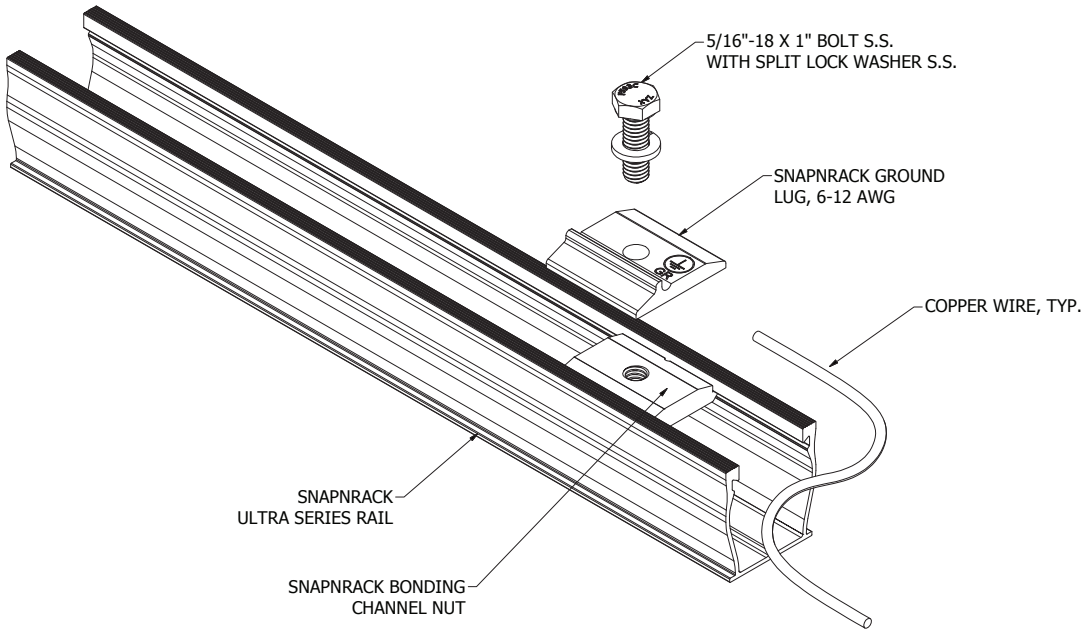




Note:
SnapNrack Ultra Rail Splices contain integral bonding clips in assembly to properly bond the system.

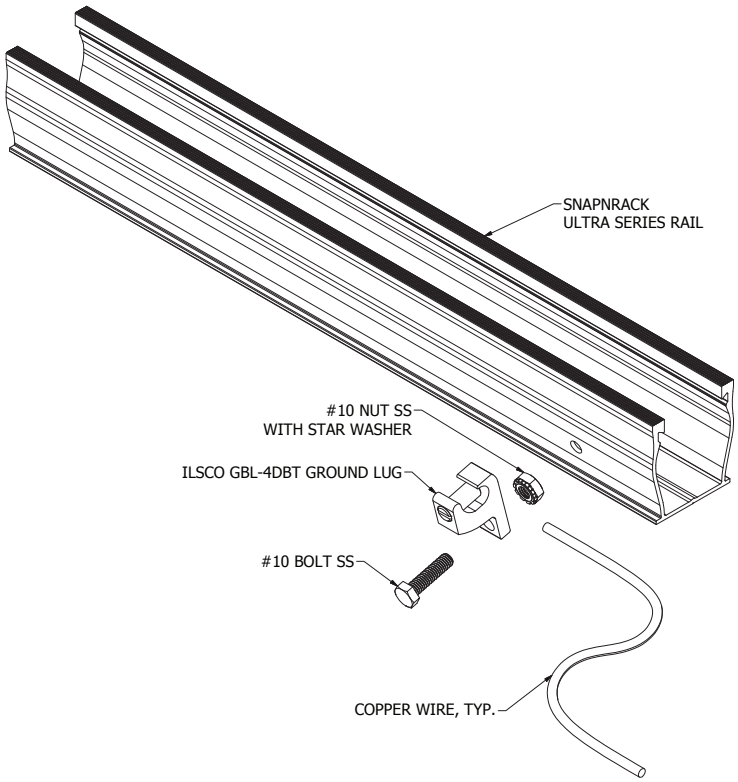
Note:
SnapNrack module clamps contain a SnapNrack Channel Nut with integral bonding pins in assembly to properly bond the system (except Universal End Clamps).

SnapNrack Ground Lug Assembly

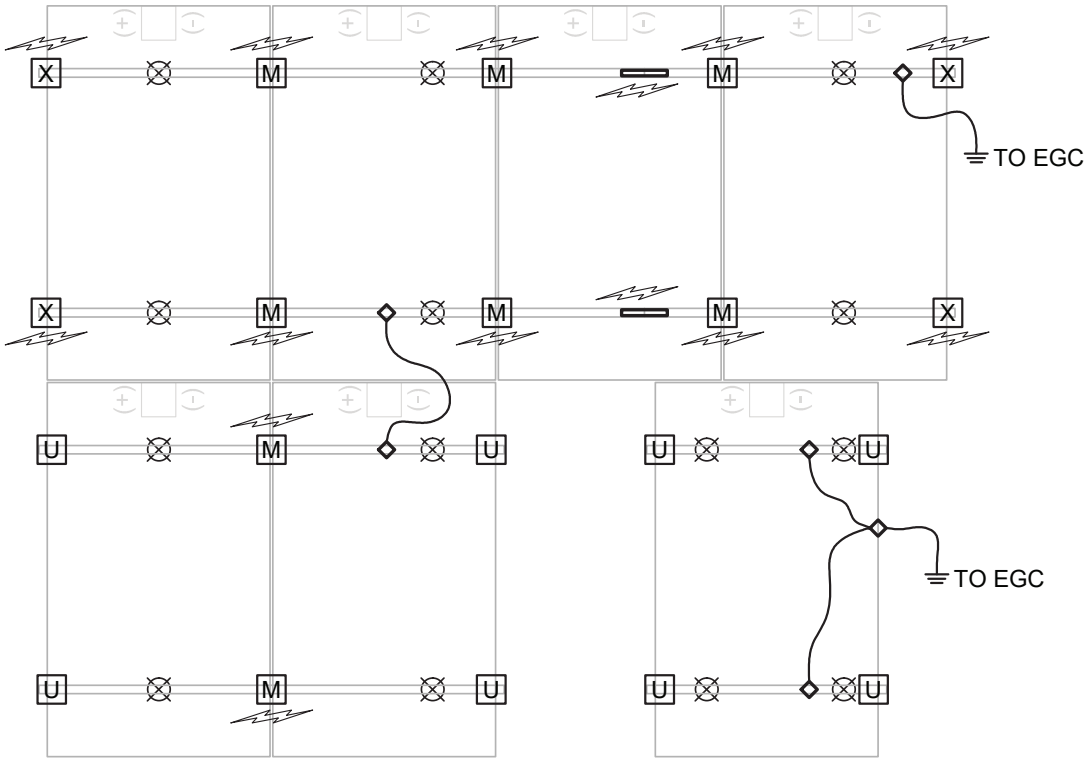


Grounding Specifications

Ilsco Lay-in Lug Assembly



Ground Path Details

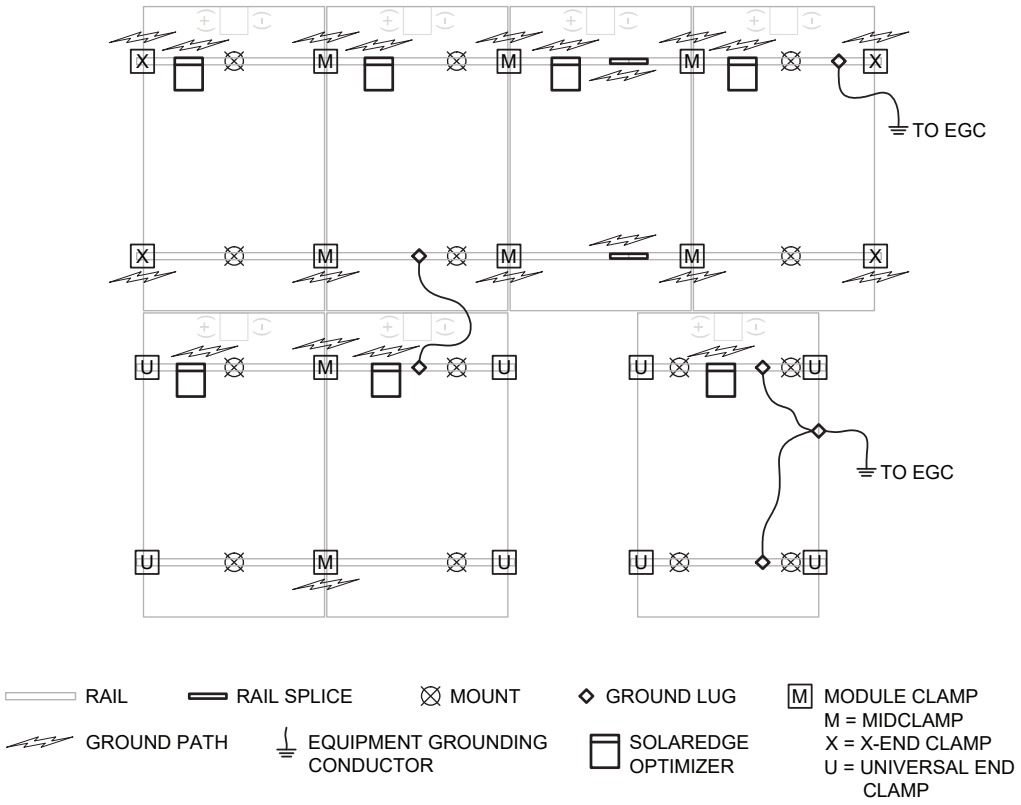


RAIL — RAIL SPLICE — MOUNT — GROUND LUG — M MODULE CLAMP

GROUND PATH — EQUIPMENT GROUNDING CONDUCTOR

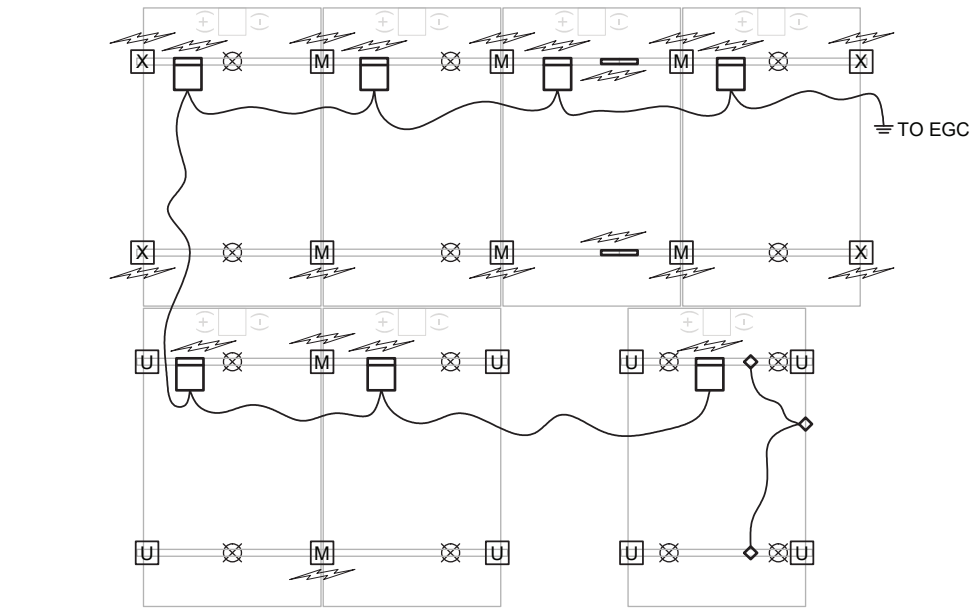
M = MIDCLAMP
X = X-END CLAMP
U = UNIVERSAL END CLAMP

Ground Path Details - SolarEdge



RAIL
RAIL SPLICE
MOUNT
GROUND LUG
M MODULE CLAMP
M = MIDCLAMP
X = X-END CLAMP
U = UNIVERSAL END CLAMP
GROUND PATH
EQUIPMENT GROUNDING CONDUCTOR
SOLAREDGE OPTIMIZER

Ground Path Details - Enphase

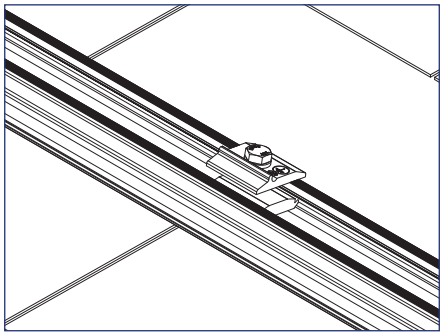


RAIL
RAIL SPLICE
MOUNT
GROUND LUG
M MODULE CLAMP
M = MIDCLAMP
X = X-END CLAMP
U = UNIVERSAL END CLAMP
GROUND PATH
EQUIPMENT GROUNDING CONDUCTOR
ENPHASE MICRO-INVERTER

Grounding Specifications

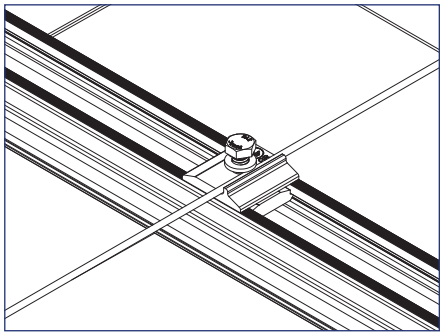
snapnrack.com

INSTALLATION INSTRUCTIONS - SNAPNRACK GROUND LUG



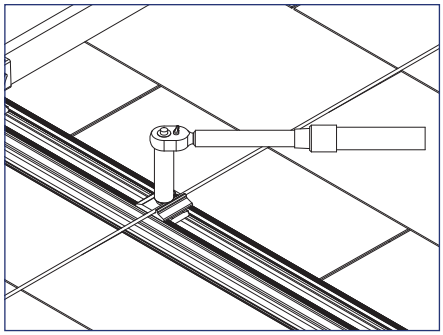
1) Snap the SnapNrack Ground Lug into the rail channel on **one rail per module row.**

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.



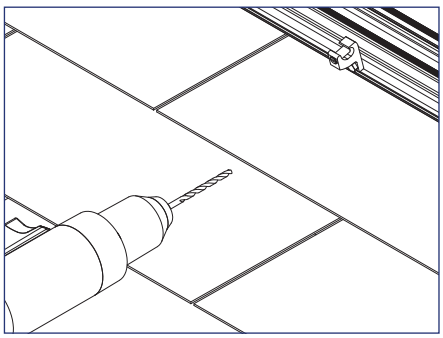
2) Place grounding conductor into slot underneath split ring washer.

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



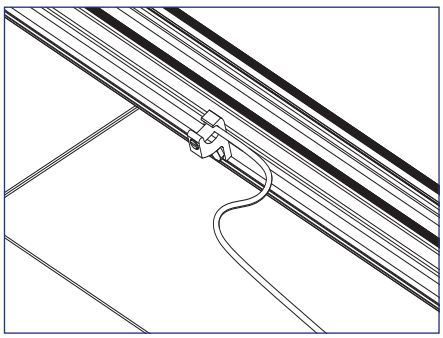
3) Tighten hardware to 16 ft-lbs.

INSTALLATION INSTRUCTIONS - ILSCO LAY-IN LUG

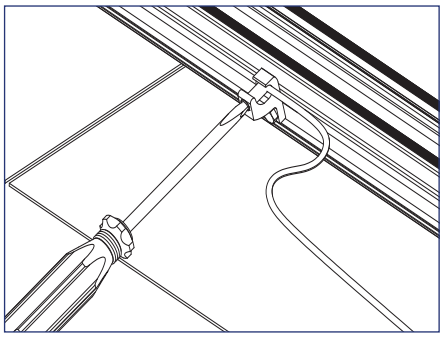


1) Drill and deburr a 1/4" hole in the back side of the rail for the Ilsco lug to attach to, place the bolt through the hole, and attach the lug assembly on **one rail per module row.**

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



2) Place grounding conductor into slot.



3) Tighten set screw per Ilsco's recommendation (see below).

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:

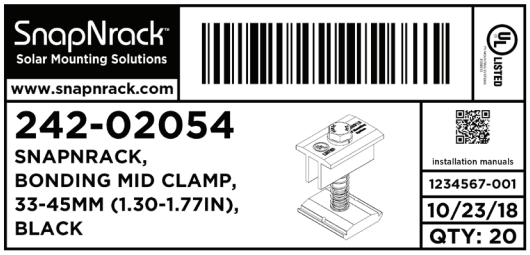
- System has been evaluated to a maximum overcurrent device (OCD) protection level of 20 Amps.
- Universal End Clamp (UEC) does not bond module to rail. Be sure to separately ground any modules that are only secured by UECs, especially during servicing.
- SnapNrack recommends that bare copper never come 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.

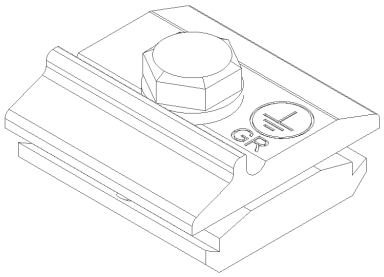
Grounding Specifications

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





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 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): Models 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 JKMXXXPP-60-V where XXX is 200 to 300; JKMSXXXP-72 where XXX is 250 to 330.

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.

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.

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 or 21, 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 or 21, 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.

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-XXXDD05A(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: Models 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: Models 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.

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 where XXX is 290 to 325.

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

JA Solar: Models 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.: Models 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 310.

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.

REC Solar PTE. LTD.: Models RECXXXPE where the XXX is 214 to 280; RECXXXTP where XXX is 260 to 300; RECXXXTP2 Series 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.

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.

Solar World: Models 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: Models 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.

Mechanical Loading Specifications

The following components have been evaluated for mechanical loading:

Ultra Rail, Mid Clamp, X End Clamp, Universal End Clamp, Ultra Rail Splice, Ultra Rail Composition Mount Kits, Standard Standoff for Ultra Rail, Four Hole Standoff for Ultra Rail, Heavy Duty Standoff for Ultra Rail, Metal Roof Base Standoff for Ultra Rail, Ultra Rail Corrugated Block, Standard Base Seam Clamp for Ultra Rail, Wide Base Seam Clamp for Ultra Rail, Ultra Rail Universal Tile Hook, Ultra Rail Flat Tile Hook, Flat Tile Replacement Kit for Ultra Rail, S Tile Replacement Kit for Ultra Rail, W Tile Replacement Kit for Ultra Rail.

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): JAP6-60-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): Models 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): Models 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, 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-M-SD where XXX is 240 to 305; CS6K-XXX-P where XXX is 220 to 300.

ET Solar: Models 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.

Mechanical Loading Specifications

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

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: Models RECxxxPE or RECXXXPE-BLK Series where XXX is 214 to 270; RECxxxTP RECXXXTP-BLK Series, where the xxx is 260 to 300; RECXXXTP2 or RECXXXTP2-BLK Series 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.

Q.TRON BLK M-G2+ SERIES

405 - 430 Wp | 108 Cells
22.0 % Maximum Module Efficiency

MODEL Q.TRON BLK M-G2+

High performance Qcells N-type solar cells

Q.ANTUM NEO Technology with optimized module layout boosts module efficiency up to 22.0 %.

A reliable investment

Inclusive 25-year product warranty and 25-year linear performance warranty[1].

Enduring high performance

Long-term yield security with Anti LeTID Technology, Anti PID Technology[2], Hot-Spot Protect.

Extreme weather rating

High-tech aluminium alloy frame, certified for high snow (8100 Pa) and wind loads (3600 Pa).

Innovative all-weather technology

Optimal yields, whatever the weather with excellent low-light and temperature behaviour.

The most thorough testing programme in the industry

Qcells is the first solar module manufacturer to pass the most comprehensive quality programme in the industry: The new "Quality Controlled PV" of the independent certification institute TÜV Rheinland.

[1] See data sheet on rear for further information.
[2] APT test conditions according to IEC/TS 62804-1:2015, method A (–1500 V, 96 h)

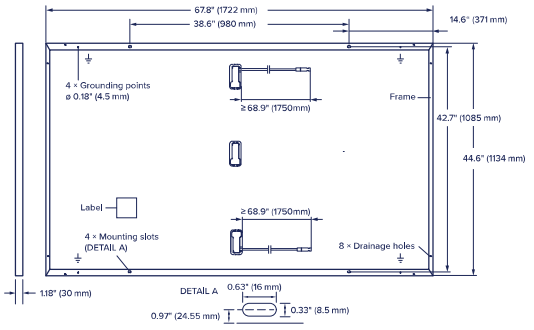
The ideal solution for:

Rooftop arrays on residential buildings

Q.TRON BLK M-G2+ SERIES

Mechanical Specification

Format	67.8 in × 44.6 in × 1.18 in (including frame) (1722 mm × 1134 mm × 30 mm)
Weight	46.7 lbs (21.2 kg)
Front Cover	0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Black anodised aluminium
Cell	6 × 18 monocrystalline Q.ANTUM NEO solar half cells
Junction box	2.09-3.98 in × 1.26-2.36 in× 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 68.9 in (1750mm), (−) ≥ 68.9 in (1750mm)
Connector	Stäubli MC4; IP68

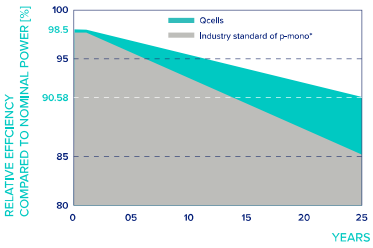


Electrical Characteristics

POWER CLASS				405	410	415	420	425	430
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / −0 W)									
Minimum	Power at MPP[1]	P_{MPP}	[W]	405	410	415	420	425	430
	Short Circuit Current[1]	I_{SC}	[A]	13.33	13.41	13.49	13.58	13.66	13.74
	Open Circuit Voltage[1]	V_{OC}	[V]	37.91	38.19	38.47	38.75	39.03	39.32
	Current at MPP	I_{MPP}	[A]	12.69	12.76	12.83	12.91	12.98	13.05
	Voltage at MPP	V_{MPP}	[V]	31.93	32.13	32.34	32.54	32.74	32.94
	Efficiency[1]	η	[%]	≥20.7	≥21.0	≥21.3	≥21.5	≥21.8	≥22.0
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]									
Minimum	Power at MPP	P_{MPP}	[W]	306.1	309.9	313.7	317.5	321.2	325.0
	Short Circuit Current	I_{SC}	[A]	10.74	10.81	10.87	10.94	11.00	11.07
	Open Circuit Voltage	V_{OC}	[V]	35.96	36.23	36.50	36.77	37.04	37.31
	Current at MPP	I_{MPP}	[A]	9.98	10.04	10.10	10.15	10.21	10.27
	Voltage at MPP	V_{MPP}	[V]	30.66	30.87	31.07	31.26	31.46	31.65

[1]Measurement tolerances P_{MPP} ±3%; I_{SC}; V_{OC} ±5% at STC: 1000 W/m², 25±2°C, AM 1.5 according to IEC 60904-3 • [2]800 W/m², NMOT, spectrum AM 1.5

Qcells PERFORMANCE WARRANTY

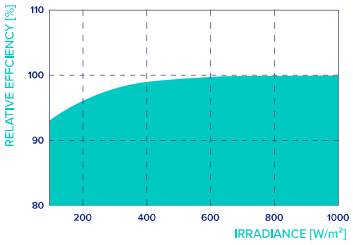


At least 98.5% of nominal power during first year. Thereafter max. 0.33% degradation per year. At least 95.53% of nominal power up to 10 years. At least 90.58% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Qcells sales organisation of your respective country.

*Standard terms of guarantee for the 5 PV companies with the highest production capacity in 2021 (February 2021)

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25°C, 1000 W/m²).

TEMPERATURE COEFFICIENTS

Temperature Coefficient of I_{SC}	α	[%/K]	+0.04	Temperature Coefficient of V_{OC}	β	[%/K]	−0.24
Temperature Coefficient of P_{MPP}	γ	[%/K]	−0.30	Nominal Module Operating Temperature	NMOT	[°F]	109±5.4 (43±3°C)

Properties for System Design

Maximum System Voltage	V_{SYS}	[V]	1000 (IEC) / 1000 (UL)	PV module classification	Class II
Maximum Series Fuse Rating		[A DC]	25	Fire Rating based on ANSI / UL 61730	C / TYPE 2
Max. Design Load, Push / Pull[3]		[lbs / ft²]	113 (5400 Pa) / 50 (2400 Pa)	Permitted Module Temperature on Continuous Duty	−40°F up to +185°F (−40°C up to +85°C)
Max. Test Load, Push / Pull[3]		[lbs / ft²]	169 (8100 Pa) / 75 (3600 Pa)		

[3] See Installation Manual

Qualifications and Certificates

UL61730-1 & UL61730-2, CE-compliant,
Quality Controlled PV - TÜV Rheinland,
IEC 61215:2016, IEC 61730:2016,
U.S. Patent No. 9,893,215 (solar cells).

*Contact your Qcells Sales Representative for details regarding the module's eligibility to be Buy American Act (BAA) compliant.

Qcells pursues minimizing paper output in consideration of the global environment.

Note: Installation instructions must be followed. Contact our technical service for further information on approved installation of this product.

Hanwha Q CELLS America Inc. 400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA I TEL +1 949 748 59 96 I EMAIL hqc-inquiry@qcells.com I WEB www.qcells.com

ENPHASE

DATA SHEET

IQ8M and IQ8A Microinverters

Our newest IQ8 Microinverters are the industry's first microgrid-forming, software defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently. The brain of the semiconductor-based microinverter is our proprietary application specific integrated circuit (ASIC) which enables the microinverter to operate in grid-tied or off-grid modes. This chip is built in advanced 55nm technology with high speed digital logic and has superfast response times to changing loads and grid events, alleviating constraints on battery sizing for home energy systems.

Part of the Enphase Energy System, IQ8 Series Microinverters integrate with the IQ Battery, IQ Gateway, and the Enphase App monitoring and analysis software.

Enphase 25 year limited warranty

IQ8 Series Microinverters redefine reliability standards with more than one million cumulative hours of power-on testing, enabling an industry-leading limited warranty of up to 25 years.

Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.

UL CERTIFIED SAFETY

IQ8 Series Microinverters are UL listed as PV Rapid Shutdown Equipment and conform with various regulations, when installed according to manufacturer's instructions.

*Only when installed with IQ System Controller 2, meets UL 1741.
**IQ8M and IQ8A support split-phase, 240V installations only.

Easy to install

- Lightweight and compact with plug-n-play connectors
- Power Line Communication (PLC) between components
- Faster installation with simple two-wire cabling

High productivity and reliability

- Produce power even when the grid is down*
- More than one million cumulative hours of testing
- Class II double-insulated enclosure
- Optimized for the latest high-powered PV modules

Microgrid-forming

- Complies with the latest advanced grid support**
- Remote automatic updates for the latest grid requirements
- Configurable to support a wide range of grid profiles
- Meets CA Rule 21 (UL 1741-SA) and IEEE 1547:2018 (UL 1741-SB 3rd Ed.)

Note:

IQ8 Microinverters cannot be mixed together with previous generations of Enphase microinverters (IQ7 Series, IQ6 Series, etc) in the same system.

IQ8M and IQ8A Microinverters

INPUT DATA (DC)		IQ8M-72-2-US	IQ8A-72-2-US
Commonly used module pairings[1]	W	260 – 460	295 – 500
Module compatibility		54-cell / 108 half-cell, 60-cell / 120 half-cell, 66-cell / 132 half-cell and 72-cell / 144 half-cell	
MPPT voltage range	V	30 – 45	32 – 45
Operating range	V	16 – 58	
Min. / Max. start voltage	V	22 / 58	
Max. input DC voltage	V	60	
Max. continuous input DC current	A	12	
Max. input DC short-circuit current	A	25	
Max. module I_{sc}	A	20	
Overvoltage class DC port		II	
DC port backfeed current	mA	0	
PV array configuration		1 x 1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit	

OUTPUT DATA (AC)		IQ8M-72-2-US	IQ8A-72-2-US
Peak output power	VA	330	366
Max. continuous output power	VA	325	349
Nominal (L-L) voltage / range[2]	V	240 / 211 – 264	
Max. continuous output current	A	1.35	1.45
Nominal frequency	Hz	60	
Extended frequency range	Hz	47 – 68	
AC short circuit fault current over 3 cycles	Arms	2	
Max. units per 20 A (L-L) branch circuit[3]		11	
Total harmonic distortion		<5%	
Overvoltage class AC port		III	
AC port backfeed current	mA	30	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging	
Peak efficiency	%	97.8	97.7
CEC weighted efficiency	%	97.5	97
Night-time power consumption	mW	60	

MECHANICAL DATA	
Ambient temperature range	-40°C to +60°C (-40°F to +140°F)
Relative humidity range	4% to 100% (condensing)
DC Connector type	MC4
Dimensions (H x W x D)	212 mm (8.3”) x 175 mm (6.9”) x 30.2 mm (1.2”)
Weight	1.08 kg (2.38 lbs)
Cooling	Natural convection – no fans
Approved for wet locations	Yes
Pollution degree	PD3
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure
Environ. category / UV exposure rating	NEMA Type 6 / outdoor

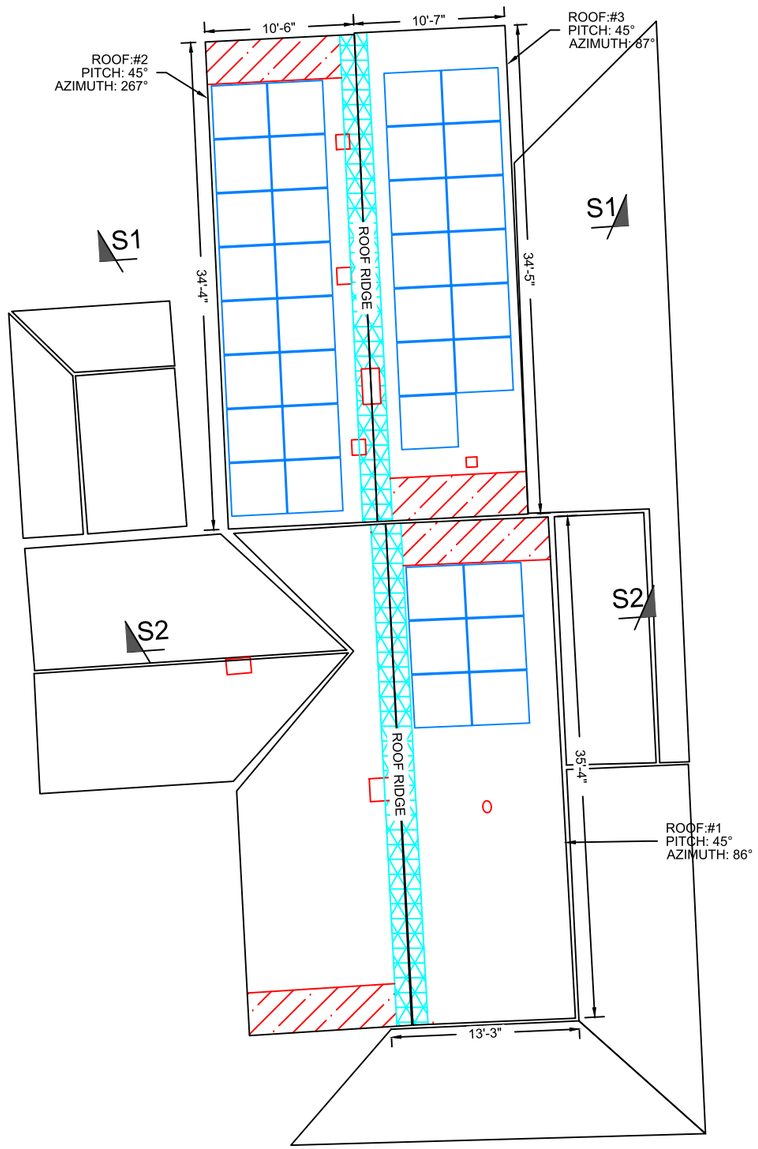
COMPLIANCE	
Certifications	CA Rule 21 (UL 1741-SA), UL 62109-1, IEEE 1547:2018 (UL 1741-SB 3rd Ed.), FCC Part 15 Class B, ICES-0003 Class B, CAN / CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shutdown Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer’s instructions.

(1) Pairing PV modules with wattage above the limit may result in additional clipping losses. See the compatibility calculator at https://link.enphase.com/module-compatibility. (2) Nominal voltage range can be extended beyond nominal if required by the utility.
(3) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

David C. Hernande
Digitally signed by David C. Hernande
Date: 2024.09.30 13:32:47 -04:00

STATE OF MARYLAND · DAVID C. HERNANDEZ · 49993 · PROFESSIONAL ENGINEER

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 49993, EXP. 10/06/2024



N
S

KEY FIRE SAFETY ZONE

3' PATHWAYS FROM LOWEST ROOF EDGE TO RIDGE PROVIDED PER R324.6.1

1'6" PATHWAYS PROVIDED ON BOTH SIDES OF RIDGE PER R324.6.2

PLAN VIEW TOTAL ROOF AREA: 3485 SQFT

SOLAR ARRAY AREA: 735.00 SQFT

THE SOLAR ARRAY IS 21.1% OF THE PLAN VIEW TOTAL ROOF AREA

NOTES:

1. THE SYSTEM SHALL INCLUDE (35) HANWHA Q.TRON BLK M-G2+ 425W.
2. SNAPNRACK TOPSPEED WILL BE INSTALLED IN ACCORDANCE WITH SNAPNRACK INSTALLATION MANUAL.
3. REFER TO STRUCTURAL DRAWING FOR SECTIONS MARKED AND ADDITIONAL NOTES.

SOLAR PANEL LAYOUT

Scale: 3/32" = 1'-0"

Solar Energy World
Because Tomorrow Matters

Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

Building Code	International Residential Code (IRC) 2018
Electrical Code	National Electrical Code (NEC) 2017
Wind Speed: 115 MPH	Snow Load: 30 PSF
Modules	(35) HANWHA Q.TRON BLK M-G2+ 425W
Inverter(s)	(35) IQ8M-72-2-US
DC System Size: 14.875 kW	AC System Size: 11.375 kW
Customer Information	Peter Bass 3807 Williams Lane Chevy Chase MD 20815
Partner/Lender	Dividend
AHJ: Montgomery	Utility: Pepco
Sheet Name	Solar Panel Layout
Drawn By: GORDON	Date: September 27, 2024
Scale: AS NOTED	Job Number: MD21291
Sheet: A-1	

David C. Hernande
Digitally signed by David C. Hernande
Date: 2024.09.30 13:32:47 -04:00

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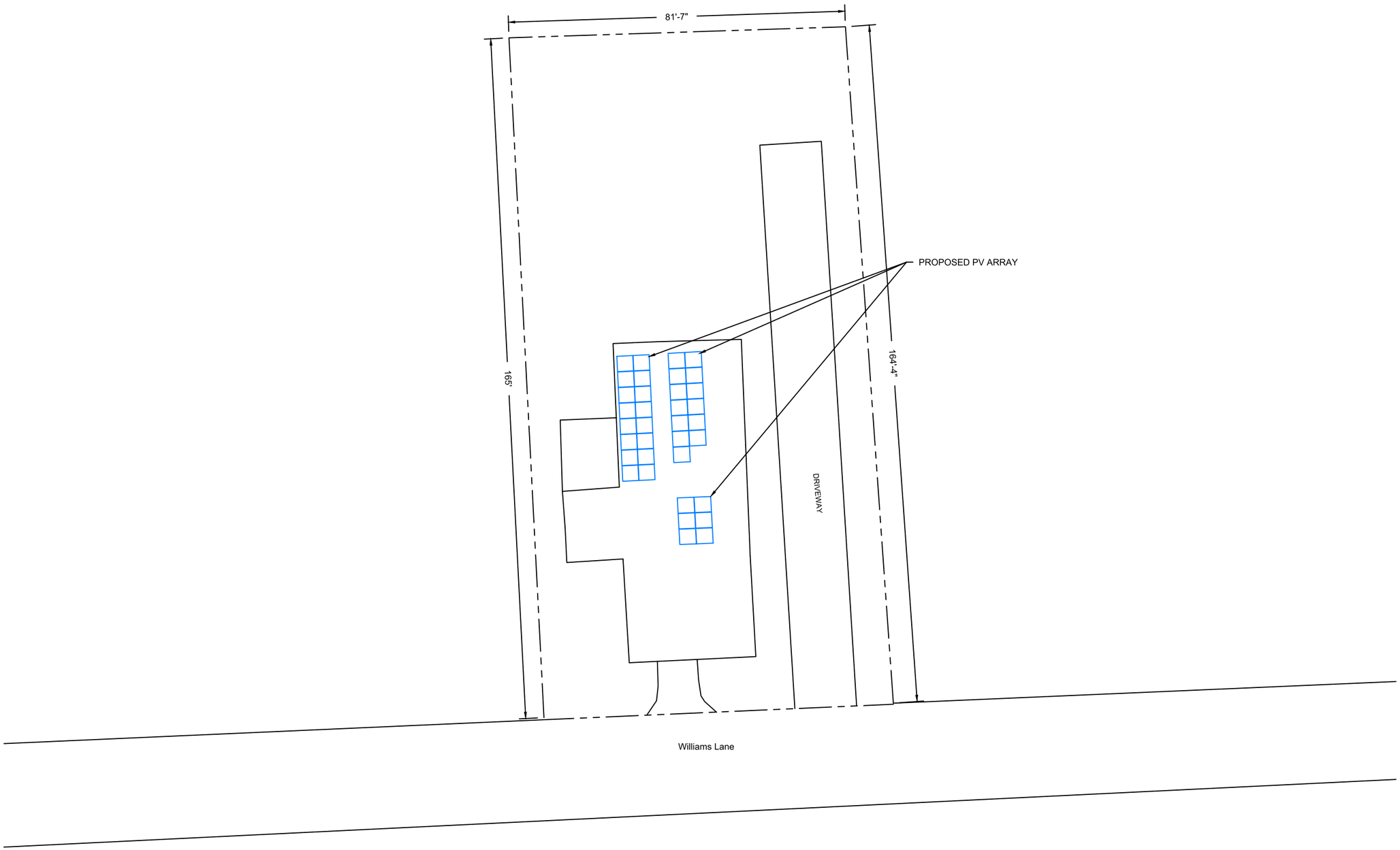


SITE PLAN
Scale: 1" = 25'-0"

Solar Energy World
Because Tomorrow Matters

Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

Building Code: International Residential Code (IRC) 2018

Electrical Code: National Electrical Code (NEC) 2017

Wind Speed	Snow Load
115 MPH	30 PSF

Modules: (35) HANWHA Q.TRON BLK M-G2+ 425W

Inverter(s): (35) IQ8M-72-2-US

DC System Size	AC System Size
14.875 kW	11.375 kW

Customer Information:
Peter Bass
3807 Williams Lane
Chevy Chase MD 20815

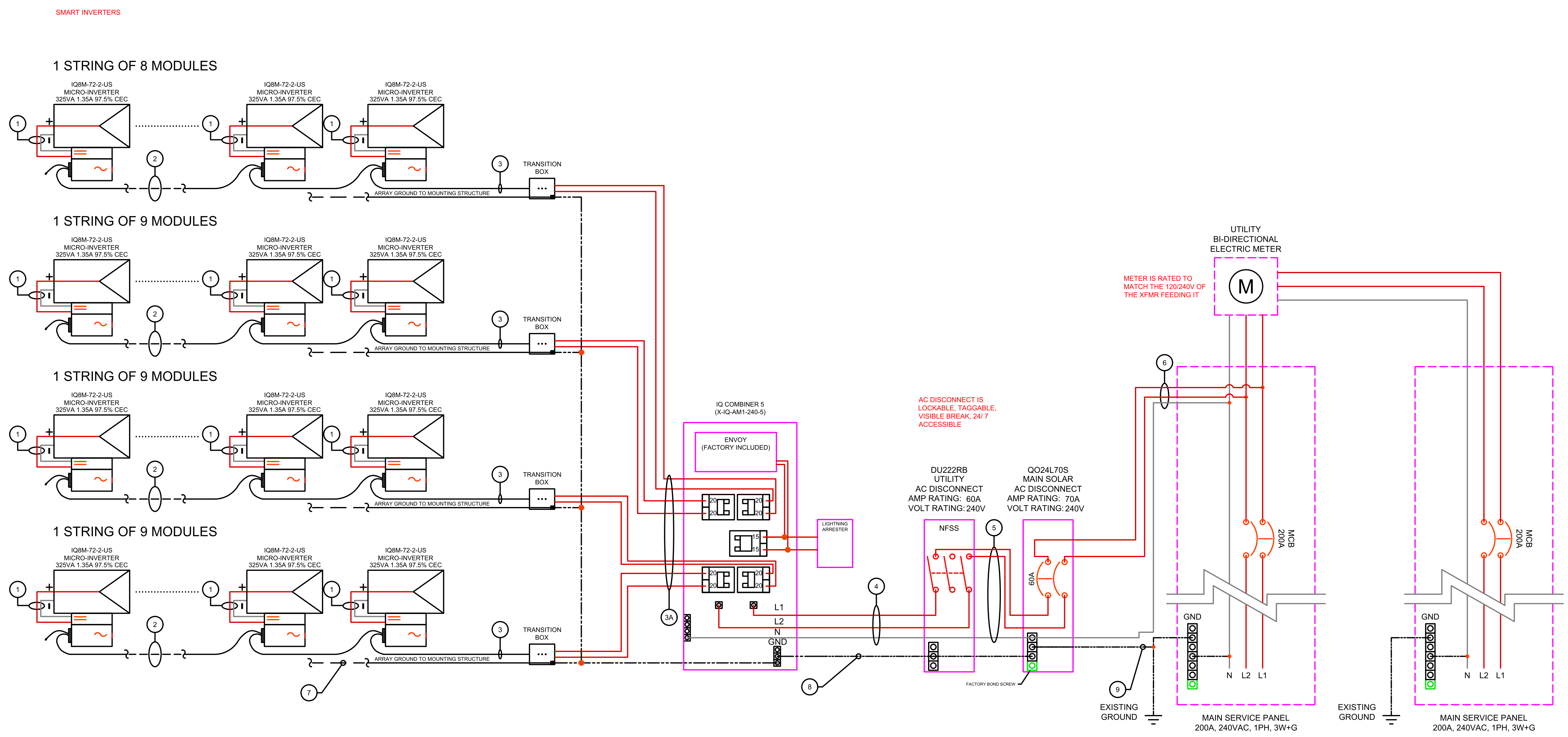
Partner/Lender: Dividend

AHJ	Utility
Montgomery	Pepco

Sheet Name: Site Plan

Drawn By	Date
GORDON	September 27, 2024

Scale	Job Number	Sheet
AS NOTED	MD21291	A-2



3-LINE DIAGRAM

MODULE SPECIFICATIONS	
MODEL NUMBER	QTRON BLK M-G2+ 425W
PEAK POWER	425 W
RATED VOLTAGE (Vmpp)	32.74 V
RATED CURRENT (Imp)	12.98 A
OPEN CIRCUIT VOLTAGE (Voc)	39.03 V
SHORT CIRCUIT CURRENT (Isc)	13.66 A
MAXIMUM SYSTEM VOLTAGE	1000VDC

INVERTER SPECIFICATIONS	
MODEL NUMBER	IQ8M-72-2-US
MAXIMUM DC VOLTAGE	60 V
MAXIMUM POWER OUTPUT	325 W
NOMINAL AC VOLTAGE	240 VAC
MAXIMUM AC CURRENT	1.35 A

ARRAY DETAILS		
NO. OF MODULES PER STRING	8	9
NO. OF STRINGS	1	3
ARRAY WATTS AT STC	3400	3825
MAX. VOLTAGE	480 V	480 V

WIRE/CONDUIT SCHEDULE ARRAY

TAG	DESCRIPTION	WIRE SIZE/TYPE	NOTES
1	Panel to Micro Inverter	PV Wire (Factory Made)	INTEGRATED
2	Micro Inverter to Micro Inverter	Pre-Manufactured Cable	
3	Micro Inverter to Transition Box	Pre-Manufactured Cable	
3A	Transition Box to Load Center	#10 THHN/THWN-2	INTEGRATED
4	Load Center to AC Disconnect	#6 Cu THHN/THWN-2	
5	AC Disconnect to AC Disconnect	#6 Cu THHN/THWN-2	
6	AC Disconnect to Interconnection Point	#6 Cu THHN/THWN-2	
7	Equipment Grounding Conductor	#8 Cu Bare Copper Wire	
8	Equipment Grounding Conductor	#8 Cu THHN/THWN-2	
9	Grounding Electrode Conductor	#6 Cu	

GENERAL ELECTRIC NOTES: NEC2017

1. EQUIPMENT USED SHALL BE NEW, UNLESS OTHERWISE NOTED.
2. EQUIPMENT USED SHALL BE UL LISTED, UNLESS OTHERWISE NOTED.
3. EQUIPMENT SHALL BE INSTALLED PROVIDING ADEQUATE PHYSICAL WORKING SPACE AROUND THE EQUIPMENT AND SHALL COMPLY WITH NEC.
4. COPPER CONDUCTORS SHALL BE USED AND SHALL HAVE AN INSULATION RATING OF 600V, 90°C, UNLESS OTHERWISE NOTED
5. CONDUCTORS SHALL BE SIZED IN ACCORDANCE TO THE NEC. CONDUCTORS AMPACITY SHALL BE DE-RATED FOR TEMPERATURE INCREASE, CONDUIT FILL AND VOLTAGE DROP.
6. ALL CONDUCTORS, EXCEPT PV WIRE SHALL BE INSTALLED IN APPROVED CONDUITS OR RACEWAY. CONDUITS SHALL BE ADEQUATELY SUPPORTED AS PER NEC.
7. AC DISCONNECT SHOWN IS REQUIRED IF THE UTILITY REQUIRES VISIBLE-BLADE SWITCH.
8. EXPOSED NON-CURRENT CARRYING METAL PARTS SHALL BE GROUNDED AS PER NEC.
9. LINE SIDE INTER-CONNECTION SHALL COMPLY WITH NEC.
10. SMS MONITORING SYSTEM AND IT'S CONNECTION SHOWN IS OPTIONAL. IF USED, REFER TO SMS INSTALLATION MANUAL FOR WIRING METHODS AND OPERATION PROCEDURE.
11. ASHRAE FUNDAMENTAL OUTDOOR DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE U.S. (PHOENIX, AZ OR PALM SPRINGS, CA)
12. FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF MOUNTED SUNLIGHT CONDUIT USING THE OUTDOOR TEMPERATURE OF 47°C
    12.1. 10AWG CONDUCTOR ARE GENERALLY ACCEPTABLE FOR MODULES WITH AN Isc OF 9.6 AMPS WITH A 15 AMP FUSE.

WIRE SIZING FOR OCPD

EX (Isc *(1.25)(1.25)(# OF STRINGS IN PARALLEL) = WIRE AMPACITY OR USING NEC TABLE 690.8

Solar Energy World
Because Tomorrow Matters

Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

Building Code: International Residential Code (IRC) 2018

Electrical Code: National Electrical Code (NEC) 2017

Wind Speed: 115 MPH | Snow Load: 30 PSF

Modules: (35) HANWHA Q.TRON BLK M-G2+ 425W

Inverter(s): (35) IQ8M-72-2-US

DC System Size: 14.875 kW | AC System Size: 11.375 kW

Customer Information:
Peter Bass
3807 Williams Lane
Chevy Chase MD 20815

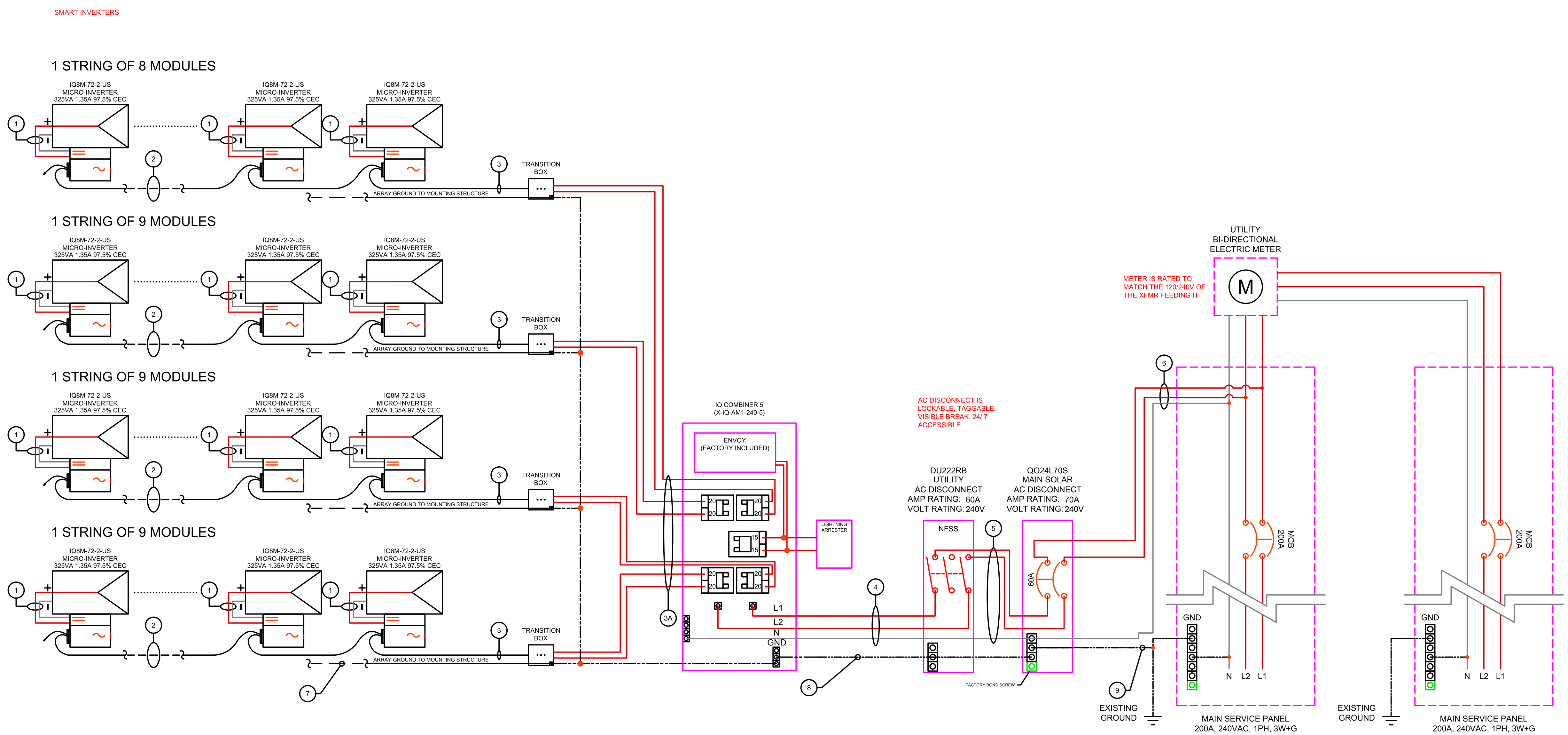
Partner/Lender: Dividend

AHJ: Montgomery | Utility: Pepco

Sheet Name: Electrical 3-Line Diagram

Drawn By: GORDON | Date: September 27, 2024

Scale: AS NOTED | Job Number: MD21291 | Sheet: E-2



3-LINE DIAGRAM

MODULE SPECIFICATIONS		
MODEL NUMBER	QTRON BLK M-G2+ 425W	
PEAK POWER	425 W	
RATED VOLTAGE (Vmpp)	32.74 V	
RATED CURRENT (Imp)	12.98 A	
OPEN CIRCUIT VOLTAGE (Voc)	39.03 V	
SHORT CIRCUIT CURRENT (Isc)	13.66 A	
MAXIMUM SYSTEM VOLTAGE	1000VDC	
INVERTER SPECIFICATIONS		
MODEL NUMBER	IQ8M-72-2-US	
MAXIMUM DC VOLTAGE	60 V	
MAXIMUM POWER OUTPUT	325 W	
NOMINAL AC VOLTAGE	240 VAC	
MAXIMUM AC CURRENT	1.35 A	
ARRAY DETAILS		
NO. OF MODULES PER STRING	8	9
NO. OF STRINGS	1	3
ARRAY WATTS AT STC	3400	3825
MAX. VOLTAGE	480 V	480 V

WIRE/CONDUIT SCHEDULE ARRAY

TAG	DESCRIPTION	WIRE SIZE/TYPE	NOTES
1	Panel to Micro Inverter	PV Wire (Factory Made)	INTEGRATED
2	Micro Inverter to Micro Inverter	Pre-Manufactured Cable	
3	Micro Inverter to Transition Box	Pre-Manufactured Cable	
3A	Transition Box to Load Center	#10 THHN/THWN-2	INTEGRATED
4	Load Center to AC Disconnect	#6 Cu THHN/THWN-2	
5	AC Disconnect to AC Disconnect	#6 Cu THHN/THWN-2	
6	AC Disconnect to Interconnection Point	#6 Cu THHN/THWN-2	
7	Equipment Grounding Conductor	#8 Cu Bare Copper Wire	
8	Equipment Grounding Conductor	#8 Cu THHN/THWN-2	
9	Grounding Electrode Conductor	#6 Cu	

GENERAL ELECTRIC NOTES: NEC2017

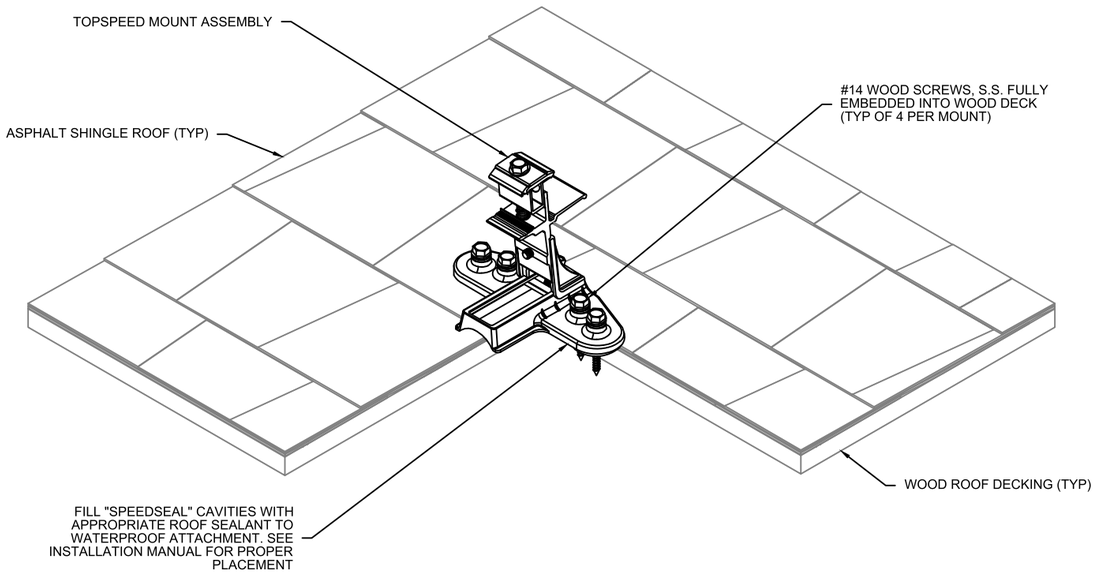
1. EQUIPMENT USED SHALL BE NEW, UNLESS OTHERWISE NOTED.
2. EQUIPMENT USED SHALL BE UL LISTED, UNLESS OTHERWISE NOTED.
3. EQUIPMENT SHALL BE INSTALLED PROVIDING ADEQUATE PHYSICAL WORKING SPACE AROUND THE EQUIPMENT AND SHALL COMPLY WITH NEC.
4. COPPER CONDUCTORS SHALL BE USED AND SHALL HAVE AN INSULATION RATING OF 600V, 90°C, UNLESS OTHERWISE NOTED
5. CONDUCTORS SHALL BE SIZED IN ACCORDANCE TO THE NEC. CONDUCTORS AMPACITY SHALL BE DE-RATED FOR TEMPERATURE INCREASE, CONDUIT FILL AND VOLTAGE DROP.
6. ALL CONDUCTORS, EXCEPT PV WIRE SHALL BE INSTALLED IN APPROVED CONDUITS OR RACEWAY. CONDUITS SHALL BE ADEQUATELY SUPPORTED AS PER NEC.
7. AC DISCONNECT SHOWN IS REQUIRED IF THE UTILITY REQUIRES VISIBLE-BLADE SWITCH.
8. EXPOSED NON-CURRENT CARRYING METAL PARTS SHALL BE GROUNDED AS PER NEC.
9. LINE SIDE INTER-CONNECTION SHALL COMPLY WITH NEC.
10. SMS MONITORING SYSTEM AND IT'S CONNECTION SHOWN IS OPTIONAL. IF USED, REFER TO SMS INSTALLATION MANUAL FOR WIRING METHODS AND OPERATION PROCEDURE.
11. ASHRAE FUNDAMENTAL OUTDOOR DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE U.S. (PHOENIX, AZ OR PALM SPRINGS, CA)
12. FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF MOUNTED SUNLIGHT CONDUIT USING THE OUTDOOR TEMPERATURE OF 47°C
    12.1. 10AWG CONDUCTOR ARE GENERALLY ACCEPTABLE FOR MODULES WITH AN Isc OF 9.6 AMPS WITH A 15 AMP FUSE.

WIRE SIZING FOR OCPD
EX (Isc *(1.25)(1.25)(# OF STRINGS IN PARALLEL) = WIRE AMPACITY OR USING NEC TABLE 690.8

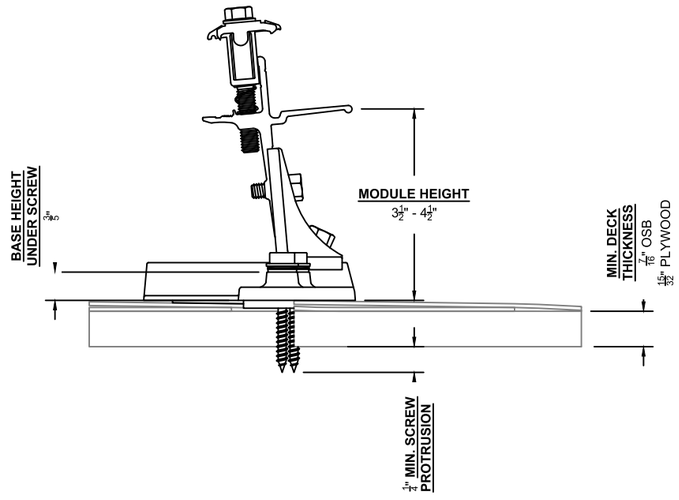
Solar Energy World
Because Tomorrow Matters
Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

Building Code: International Residential Code (IRC) 2018
Electrical Code: National Electrical Code (NEC) 2017
Wind Speed: 115 MPH
Snow Load: 30 PSF
Modules: (35) HANWHA Q.TRON BLK M-G2+ 425W
Inverter(s): (35) IQ8M-72-2-US
DC System Size: 14.875 kW
AC System Size: 11.375 kW
Customer Information: Peter Bass, 3807 Williams Lane, Chevy Chase MD 20815
Partner/Lender: Dividend
AHJ: Montgomery
Utility: Pepco
Sheet Name: Electrical 3-Line Diagram
Drawn By: GORDON
Date: September 27, 2024
Scale: AS NOTED
Job Number: MD21291
Sheet: E-2

David C. Hernande
Digitally signed by David C. Hernande
Date: 2024.09.30 13:32:47 -04:00



Structural Details		
S1	Rafters	2x4 O.C. 24"
S2	Rafter	2x4 O.C. 24"



STRUCTURAL ATTACHMENT DETAIL

NOTES:

1. ALL WORK SHALL COMPLY WITH REQUIREMENTS OF INTERNATIONAL RESIDENTIAL CODE (IRC 2018), LOADING CODE (ASCE 7-16), WOOD DESIGN CODE (NDS 2015), AND LOCAL REQUIREMENTS.
2. LOAD CRITERIA PER :
   - EXPOSURE CATEGORY "B"
   - GROUND SNOW LOAD, Pg = 30 PSF
   - LATERAL LOAD RISK CATEGORY "II"
   - ULTIMATE DESIGN WIND SPEED = 115 MPH
3. SOLAR PANELS AND RACKING SYSTEMS SHALL BE INSTALLED PER MANUFACTURER'S RECOMMENDATION.
4. FOLLOW ALL LOCAL AND FEDERAL SAFETY REQUIREMENTS.

Solar Energy World
Because Tomorrow Matters

Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

Building Code: International Residential Code (IRC) 2018

Electrical Code: National Electrical Code (NEC) 2017

Wind Speed: 115 MPH | Snow Load: 30 PSF

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Inverter(s): (35) IQ8M-72-2-US

DC System Size: 14.875 kW | AC System Size: 11.375 kW

Customer Information:
Peter Bass
3807 Williams Lane
Chevy Chase MD 20815

Partner/Lender: Dividend

AHJ: Montgomery | Utility: Pepco

Sheet Name: Structural Attachment Details

Drawn By: GORDON | Date: September 27, 2024

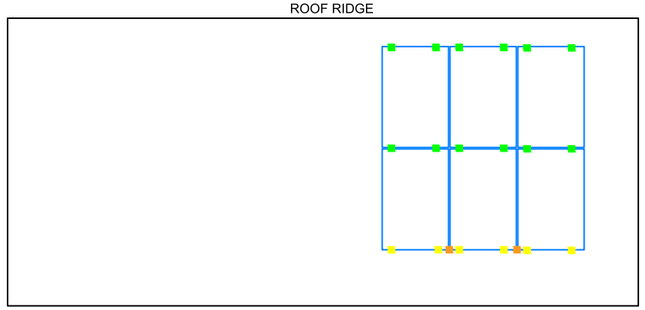
Scale: AS NOTED | Job Number: MD21291 | Sheet: S-1

David C. Hernande
Digitally signed by David C. Hernande
Date: 2024.09.30 13:32:47 -04:00

STATE OF MARYLAND
DAVID C. HERNANDEZ
49993
PROFESSIONAL ENGINEER

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 49993, EXP. 10/09/2024.

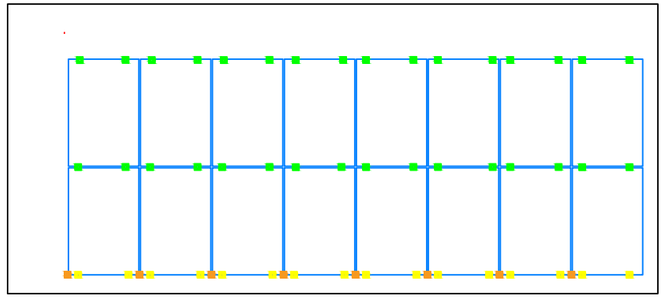
ROOF RIDGE



SOLAR PANEL FOOTING PLAN R1

Scale: 1/8" = 1'–0"

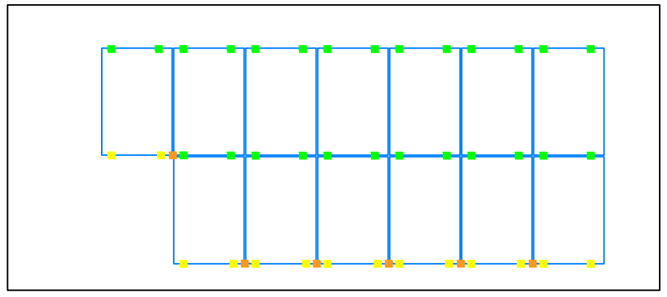
ROOF RIDGE



SOLAR PANEL FOOTING PLAN R2

Scale: 1/8" = 1'–0"

ROOF RIDGE



SOLAR PANEL FOOTING PLAN R3

Scale: 1/8" = 1'–0"

KEY

- MOUNTS WITHOUT SPACERS
- MOUNTS WITH SPACERS
- CLAMPS WITHOUT SPACERS
- CLAMPS WITH SPACERS

NOTES:

1. SNAPNRACK TOPSPEED SHALL BE INSTALLED IN ACCORDANCE WITH SNAPNRACK INSTALLATION MANUAL.
2. ADD TOPSPEED CLAMP IF GREATER THAN (SOLAR PANEL LENGTH / 4) FOR LANDSCAPE OR (SOLAR PANEL WIDTH /4) FOR PORTRAIT
3. NO SOLAR PANEL SHALL CANTILEVER MORE THAN 1/4 SOLAR PANEL LENGTH OR WIDTH DEPENDING ON ORIENTATION. UNLESS FOR MANUFACTURER SPECIFIED CLAMPING ZONE

Solar Energy World
Because Tomorrow Matters

Solar Energy World LLC.
14880 Sweitzer Lane
Laurel, MD 20707
(888) 497-3233

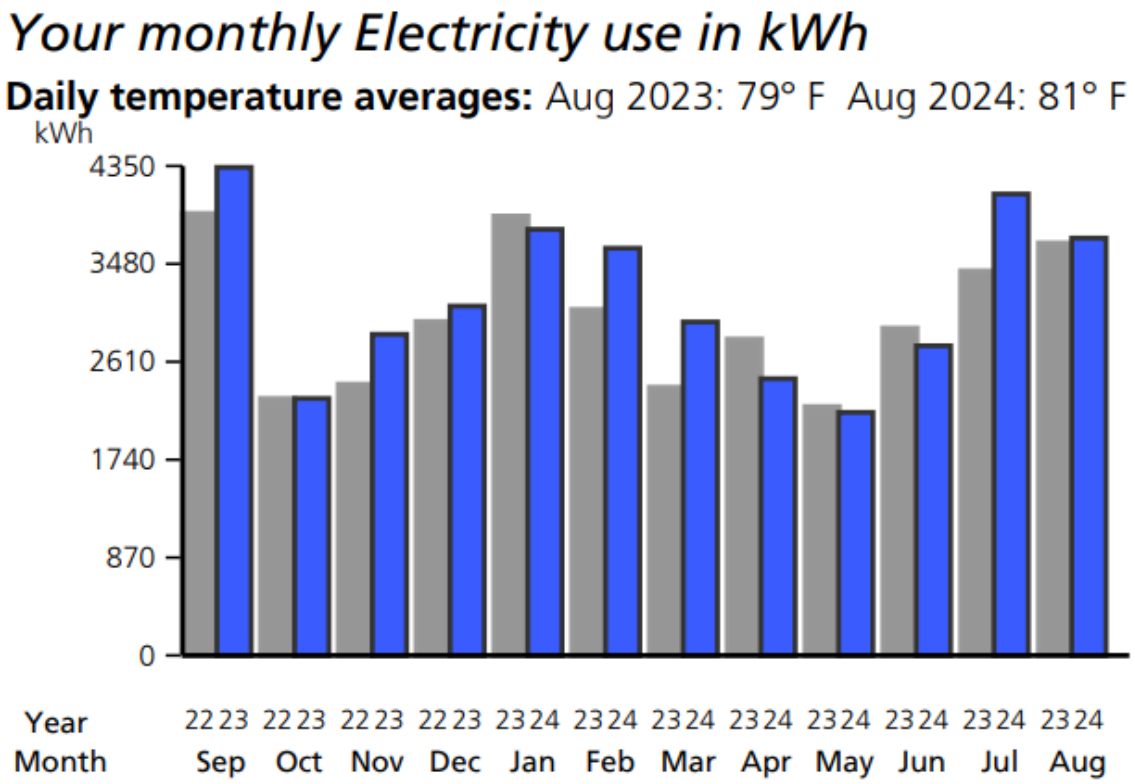
Building Code	International Residential Code (IRC) 2018
Electrical Code	National Electrical Code (NEC) 2017
Wind Speed	115 MPH
Snow Load	30 PSF
Modules	(35) HANWHA Q.TRON BLK M-G2+ 425W
Inverter(s)	(35) IQ8M-72-2-US
DC System Size	14.875 kW
AC System Size	11.375 kW
Customer Information	Peter Bass 3807 Williams Lane Chevy Chase MD 20815
Partner/Lender	Dividend
AHJ	Montgomery
Utility	Pepco
Sheet Name	Solar Panel Footing Plan
Drawn By	GORDON
Date	September 27, 2024
Scale	AS NOTED
Job Number	MD21291
Sheet	S-2

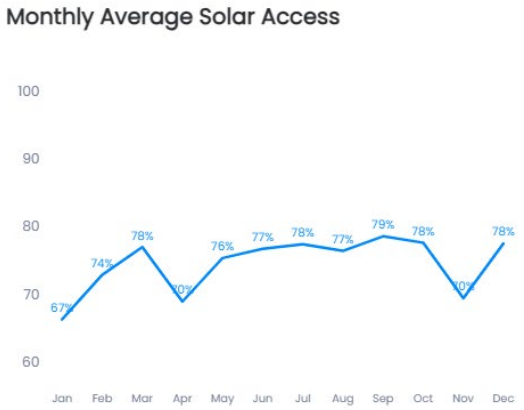
10/2/2024

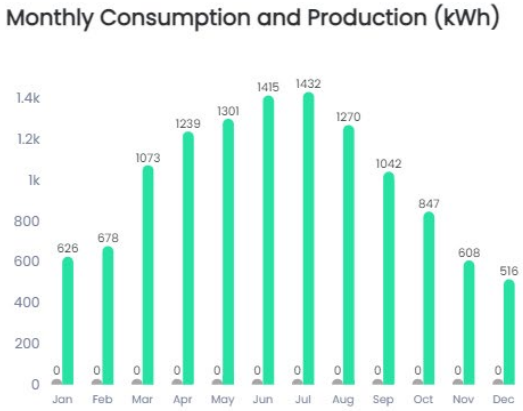
To whom it may concern,

- Justification of panels on the front of the house and heat map.

Monthly energy consumption for 3807 Williams Ln. Chevy Chase, MD, 20815 vs the proposed system monthly production







- The home had an annual usage of roughly 36,215 kWh in 2023. Our proposed system is estimated to have 12,046 kWh in annual production.

  The panels will vary in production based on their location on the structure, but this estimated production for the 35-panel system breaks down to roughly 344 kWh per panel annually. The panels on the rear, east-facing roof plane have an average of 326 kWh per panel annually. The panels on the front, east-facing roof plane have an average of 352 kWh per panel annually. The panels on the front, east-facing section produce slightly more than the panels on the rear, east-facing roof plane.

  Justification for the Placement of the panels.

  All usable space on the 2 rear roof planes was utilized first in this design, for both solar panels and the necessary fire safety pathways. The panels on the front, east-facing plane were shifted as close to the rear of the home as possible. The rear-facing dormer does not have sufficient space for those 6 panels, and the other remaining roof planes are also in the front of the home. Without the panels on the front, east-facing plane, the system would only produce 9,933 kWh annually (~18% less), hindering the homeowner's ability to offset their utility usage.

  Shade Map.

Thank you,
Aley Oberdorf
Design Engineer.

DAVID C. HERNANDEZ, PE

513-418-8812 4912 Prospect Ave., Blue Ash OH 45242 davehernandezpe@gmail.com

DATE: September 30, 2024

RE: 3807 Williams Lane, Chevy Chase, MD 20815, USA

To Whom It May Concern,

As per your request, Exactus Energy has conducted a site assessment of the building at the above address.

PV solar panels are proposed to be installed on roof areas as shown in the submitted plans. The panels are clamped and attached to the roof decking with a rail-less mounting system. The PV system (PV modules, racking, mounting hardware, etc.) shall be installed according to the manufacturer's approved installation specifications. The Engineer of Record and Exactus Energy claim no responsibility for misuse or improper installation.

It was found that the roof structures satisfactorily meet the applicable standards included in the 2018 IBC/IRC, 2018 IEBC, and ASCE 7-16 as well as the design criteria shown below:

Design Criteria:

Risk Category	= II
Exposure Category	= B
Wind speed	= 115 mph
Ground snow load	= 30 psf
Roof dead load	= 12 psf
Solar system dead load	= 3 psf

Overall, the roof area is structurally adequate to support the PV alteration with no modifications or reinforcements as required per 2018 IEBC Sections 502.4 and 502.5

This letter was completed in accordance to recognized design standards, professional engineering experience, and judgement. Prior to installation, the on-site contractor must notify Exactus Energy if there are any discrepancies, or damages to the members, that was not addressed in the plan set. The on-site contractor must confirm that the rails will run perpendicular to the rafters.

If you have any further questions, please do not hesitate to contact me.

Acknowledged by:

aee Green Building Engineer #832

STATE OF MARYLAND
DAVID C. HERNANDEZ
49993
PROFESSIONAL ENGINEER

David C. Hernandez, PE Digitally sign Date: 2024.0

PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 49993, EXP 10/06/2024.
2024-09-30

DAVID C. HERNANDEZ, PE

513-418-8812 4912 Prospect Ave., Blue Ash OH 45242 davehernandezpe@gmail.com

ASCE 7-16

IEBC IMPACT CHECK				
Inputs	Roof 1	Roof 2	Roof 3	Unit
Existing Gravity Loads				
Roof Dead Load (DL_r)	12	12	12	psf
Roof Live Load (LL_r)	20	20	20	psf
Roof Snow Load (SL_r)	23.1	23.1	23.1	psf
(DLr+LLr)/Cd =	25.6	25.6	25.6	psf
(DLr+SLr)/Cd=	30.52	30.52	30.52	psf
Max. Existing Gravity Load	**30.52**	**30.52**	**30.52**	psf
Proposed Gravity Loads				
Roof Dead Load with PV Panel Load (DL)	15	15	15	psf
Roof Live Load (LL)	0	0	0	psf
Roof Snow Load (SL)	9.7	9.7	9.7	psf
(DL+LL)/Cd =	16.67	16.67	16.67	psf
(DL+SL)/Cd=	21.48	21.48	21.48	psf
Max. Proposed Gravity Load	**21.48**	**21.48**	**21.48**	psf
% Change =	**-29.62**	**-29.62**	**-29.62**	%

The change in gravity loads for Roofs 1, 2, and 3 after the proposed solar installation is less than 5%, therefore passes the Impact Check.

DAVID C. HERNANDEZ, PE

513-418-8812 4912 Prospect Ave., Blue Ash OH 45242 davehernandezpe@gmail.com

SEISMIC CHECK

Breakdown of Loads		
Asphalt Shingles:	7	psf
Insulation:	1.5	psf
Plywood Sheathing:	1.5	psf
Rafters:	1	psf
Misc:	1	psf
Live load:	20	psf

Existing Roof Seismic Weight			
Element	Unit Weight (psf)	Area (Sq.ft)	Weight (lbs)
Roof DL	12	3485.00	41820
Exterior Walls	8	4804.17	38433.36
Interior Walls	6	4804.17	28825.02
Existing Seismic Weight @Roof Level, We =			109078.38

New PV System Seismic Weight			
Element	Unit Weight (psf)	Area (Sq.ft)	Weight (lbs)
Pv System	3	735.00	2205.00
Seismic Weight of New PV System, Wpv =			2205.00

% Increase in Lateral (Seismic) Weight @Roof Level Due to PV System Addition, %-increase = Wpv / We	2.02%	< 10% - Pass

Solar Energy World
Because Tomorrow Matters

Project Property Owner Peter Bass

Address 3807 Williams Lane, Chevy Chase, MD 20815, USA

☑ I reviewed the design of the photovoltaic (PV) system, as designed by the manufacturer, and the design criteria utilized for the mounting equipment and panel mounting assembly (rack system) for the installation of (35) panels supported by the rack system, as shown on the drawings prepared for the above referenced address. I certify that the configurations and design criteria meet the standards and requirements of the International Residential Code (IRC) and International Existing Building Code (IEBC) adopted by Montgomery County in COMCOR08.00.02.

☑ The attachment of the rack system to the building at the above address, including the location, number, and type of attachment points; the number of fasteners per attachment point; and the specific type of fasteners (size, diameter, length, minimum embedment into structural framing, etc.) meets the standards and requirements of the IRC and IEBC adopted by Montgomery County in COMCOR 08.00.02.

☑ I evaluated the existing roof structure of the building at the above address and analyzed its capacity to support the additional loads imposed by the PV system. I certify that no structural modifications of the existing roof structure are required. The existing roof structure meets the standards and requirements of the IRC and IEBC, adopted by Montgomery County in COMCOR 08.00.02, necessary to support the PV system.

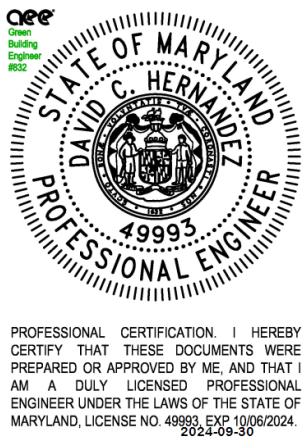
□ I evaluated the existing roof structure of the building at the above address and analyzed its capacity to support the additional loads imposed by the PV system. Structural modifications of the existing roof structure are required. Icertify that the roof structure, as modified on the drawings for this project, will support the additional loads imposed by the PV system. I further certify that design of the modified roof structure meets the standards and requirements of the IRC and IEBC, adopted by Montgomery County in COMCOR 08.00.02.

☑ I prepared or approved the construction documents for the mounting equipment, rack system, roof structure forthis project.

49993
Maryland PE License Number

Date 9/30/2024

Seal



PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 49993, EXP 10/06/2024.
2024-09-30

Signature David C. Hernandez, PE

Digitally signed by David C. Hernandez, PE
Date: 2024.09.30 13:32:47 -04:00

Must be submitted with plans

SolarEnergyWorld
Because Tomorrow Matters

Property Owners Name: Property Built in 1968

Property Owners Address: -Install (35) roof mounted solar panels on detached structure

Address of installation if different than owner's address:

I certify that:

- ☐ I prepared or approved the electrical drawings and related documents for the photovoltaic {PV) system at the above location.
- ☐ The design of the PV system, and all electrical Installations and equipment, meets the standards and requirements of the National Electrical Code as adopted by Montgomery County *in* COMCOR 17.02.01.
- ☐ I reviewed and completed the Worksheet for PV System, which was attached to the permit application for the PV system at the **above** location.

15732

State Master Electrician License Number

Date: 10/01/2024

Signature: Matt Kuss

DEPARTMENT OF PERMITTING SERVICES

Marc Elrich
County Executive

Rabbiah Sabbakhan
Director

HISTORIC AREA WORK PERMIT APPLICATION

Application Date: 10/1/2024

Application No: 1088533
AP Type: HISTORIC
Customer No: 1408761

Affidavit Acknowledgement

The Contractor is the Primary applicant authorized by the property owner
This application does not violate any covenants and deed restrictions

Primary Applicant Information

Address	3807 WILLIAMS LN CHEVY CHASE, MD 20815
Othercontact	Solar Energy World (Primary)

Historic Area Work Permit Details

Work Type	ALTER
Scope of Work	Install (35) roof mounted solar panels, 14.87 kW