

**MONTGOMERY COUNTY HISTORIC PRESERVATION COMMISSION**  
**STAFF REPORT**

<b>Address:</b>	17501 Barnesville Road, Barnesville	<b>Meeting Date:</b>	8/14/2024
<b>Resource:</b>	Master Plan Historic Site <b>Frederick Hays House #12/11</b>	<b>Report Date:</b>	8/7/2024
<b>Applicant:</b>	Stephen Seeger (Tina Crouse, agent)	<b>Public Notice:</b>	7/31/2024
<b>Review:</b>	HAWP	<b>Tax Credit:</b>	No
<b>Permit Number:</b>	1078219	<b>Staff:</b>	Chris Berger
<b>PROPOSAL:</b>	Solar panel installation.		

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**STAFF RECOMMENDATION**

Staff recommends that the Historic Preservation Commission (HPC) **approve** the Historic Area Work Permit (HAWP) application.



**Figure 1: The Frederick Hays House Master Plan Historic Site is shaded in pink on the north side of Barnesville Road.**

## ARCHITECTURAL DESCRIPTION

SIGNIFICANCE: Master Plan Site #12/11  
Frederick Hays House

DATE: circa 1850-64

Excerpt from *Places From the Past*:

The Frederick Hays House is a well-preserved mid-1800s farmhouse built by a prosperous farming family. The ell-shaped dwelling is stylistically transitional, with Greek Revival cornice returns and lintels, and Gothic Revival center gable with bargeboard or gingerbread. The property is named for Frederick Hays who inherited the land upon the 1864 death of his father, influential landowner Leonard Hays. It is thought that the elder Hays, who owned extensive properties in and around Barnesville, built the house for his children or a farm manager. Frederick married Ida Hempstone in 1881 and they raised their family on the farm. The property was well situated along the Baltimore Road. After the Metropolitan Branch of the B&O Railroad opened in 1873, the family had easier access to markets to sell crops and purchase fertilizer. The property includes a substantial bank barn with closed forebay and stone foundation.

## PROPOSAL

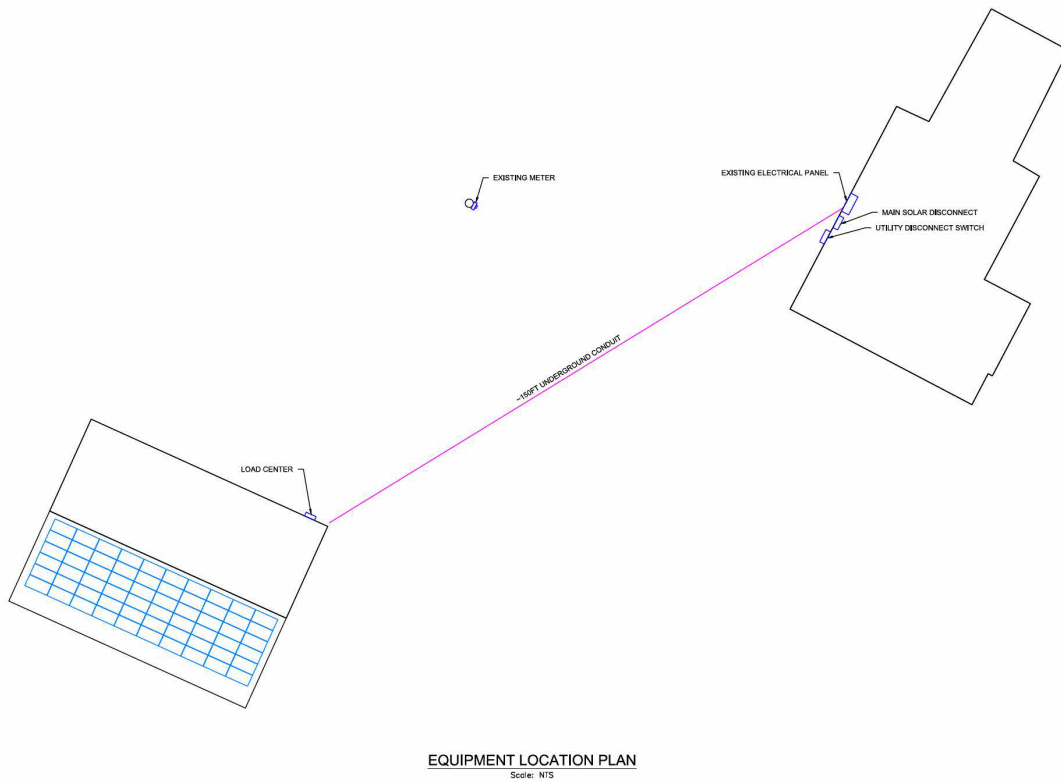
The applicant proposes to install 60 LR4-60HPH Longi solar panels on the south-facing roof of the bank barn that faces the Barnesville Road right of way (*Figures 3 and 4*). Each panel will measure 5.82 feet-by-3.45 feet. The panels will be affixed to the standing-seam metal roof by SnapNrack mounts, and the existing snowbirds will be removed. The load center will be on back of the barn, and the disconnects switches and panels will be installed approximately 130 feet away on the residence via an underground trench.



**Figure 2:** The bank barn where the solar panels will be installed is circled in red in this oblique aerial from 2023.  
Source: CONNEXplorer



**Figure 3:** This 2021 photo shows the south-facing roof indicated with a red arrow where the panels will be installed as seen from the Barnesville Road right of way, which is approximately 200 feet away. Source: Google



**Figure 4:** The equipment location plan for the solar panels.



**Figure 5: The specification for the panels (left) and the proposed mounting plan for the standing seam roof (right).**

### **APPLICABLE GUIDELINES**

The Historic Preservation Office and HPC consult several documents when reviewing alterations and new construction within the Takoma Park Historic District. These documents include the HPC's *Policy No. 20-01 Addressing Emergency Climate Mobilization Through the Installation of Roof-Mounted Solar Panels*; *Montgomery County Code Chapter 24A (Chapter 24A)*; and *the Secretary of the Interior's Standards for Rehabilitation (Standards)*. The pertinent information in these documents is outlined below.

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

#### Solar Panels in Rural Historic Sites or Districts

Traditional roof-mounted solar panels should:

1. Have a low-profile.
2. Be mounted less than or equal to six inches above the surface of the roof (to the face of the panel).
3. Be consistent with the existing slope of the supporting roof.
4. Setback solar panels from the edges and ridge of the roof.
5. Place any conduits for connections to electrical meters on the inside of the building or on a secondary elevation.
6. Locate conduits, inverters, storage units, or other hardware associated with the panels on the interior or on secondary elevations with limited visibility from the public rights-of-way.
7. Blend with the surrounding features of the historic resource with respect to color of the panel, support racks, and conduits.
8. Be arranged in an organized configuration and avoid disjointed and multi-roof solutions. This may require the relocation of modern vents, pipes, etc.

#### ***Montgomery County Code Chapter 24A-8***

The following guidance which pertains to this project are as follows:

- (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; or
  - (6) 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;

#### ***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.” The applicable *Standards* are as follows:

2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces and spatial relationships that characterize a property will be avoided.
9. New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic 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.

### **STAFF DISCUSSION**

Staff supports the solar panels proposed for the subject property and recommends approval. HPC Policy 20-01 regarding solar panels states that the order of preference for panels is first in-ground mounted arrays. Though the property measures approximately 14 acres, a significant portion is either used for pasture or encumbered by wetlands. The applicant instead selected the second preferred option to install the panels on an accessory building, in this case on the south-facing elevation of the bank barn that will be visible from the right of way. The barn is historic in its own right, but its standing-seam metal roof was recently replaced in kind (*Figure 6*), and according to the provided specifications the panels will be affixed to the seams of the roof.



*Figure 6: The standing-seam metal roof on the barn is recently installed.*

The policy continues that: “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).” According to information provided by the applicant, the panels as proposed will produce 83 percent of the property’s needs. If the panels were installed only the north-facing roof would produce nearly half as much energy.

The Policy provides direction for traditional roof-mounted solar panels in rural historic sites such as the subject property, and the meets all requirements because the panels will have a low profile; be mounted six inches or less from the surface of the roof seams; follow the slope of the existing roof; will be set back from the from the edges and ridge of the roof; electrical equipment will be on the rear-facing elevation; the panels, support racks, and conduits will blend with the surrounding features; and the panels will be arranged in an organized configuration.

In accordance with Chapter 24A-8(b)(1), the installation of the panels will not substantially alter the exterior features of the historic site. The panels will be installed on top of the recently replaced standing seam roof in a symmetric rectangular pattern to minimize their visual impact from the Barnesville Road right of way, which is about 200 feet away. No panels will be visible from the historic Hays House, approximately 130 feet away to the northeast. While the view from the road will be altered, the view from within the farmyard will not be altered.

In accordance with the *Standards*, the historic character of the property will be retained and preserved by the installation of the panels; the exterior alterations will not destroy historic materials that characterize the property and the new work shall be differentiated from the old; and the essential form and integrity of the historic property will be unimpaired if the panels are removed in the future.

### **STAFF RECOMMENDATION**

Staff recommends that the Commission **approve** the HAWP application:

under the Criteria for Issuance in Chapter 24A-8(b)(1) and (6) having found that the proposal is consistent with the *Historic Preservation Commission Policy No. 20-01: Addressing Emergency Climate Mobilization Through the Installation of Roof-Mounted Solar Panels*, and therefore will not substantially alter the exterior features of the historic resource and is compatible in character with the district and the purposes of Chapter 24A;

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

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 Commission as a revised HAWP application at staff's discretion;

and with the general condition that the applicant shall notify the Historic Preservation 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 301-495-4571 or [chris.berger@montgomeryplanning.org](mailto:chris.berger@montgomeryplanning.org) to schedule a follow-up site visit.



**APPLICATION FOR  
HISTORIC AREA WORK PERMIT**  
HISTORIC PRESERVATION COMMISSION  
301.563.3400

**FOR STAFF ONLY:**  
HAWP# 1078219  
DATE ASSIGNED \_\_\_\_\_

**APPLICANT:**

Name: Stephen Seeger  
Address: 17501 Barnesville Road  
Daytime Phone: 202-391-1185

E-mail: seegerpc@gmail.com  
City: Barnesville Zip: 20838  
Tax Account No.: 11-01743258

**AGENT/CONTACT (if applicable):**

Name: Tina Crouse  
Address: 14880 Sweitzer Lane  
Daytime Phone: 410-579-2009

E-mail: tcrouse@solarenergyworld.com  
City: Laurel Zip: 20707  
Contractor Registration No.: 127353

**LOCATION OF BUILDING/PREMISE:** MIHP # of Historic Property 1078219

Is the Property Located within an Historic District?  Yes/District Name Frederick Hayes House District  
 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: 17501 Street: Barnesville Road  
Town/City: Barnesville Nearest Cross Street: W' Old Baltimore Road  
Lot: 13.1900 Acres Block: \_\_\_\_\_ Subdivision: 0001 Parcel: P709

**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:**

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> New Construction   | <input type="checkbox"/> Deck/Porch          | <input type="checkbox"/> Shed/Garage/Accessory Structure |
| <input type="checkbox"/> Addition           | <input type="checkbox"/> Fence               | <input checked="" type="checkbox"/> Solar                |
| <input type="checkbox"/> Demolition         | <input type="checkbox"/> Hardscape/Landscape | <input type="checkbox"/> Tree removal/planting           |
| <input type="checkbox"/> Grading/Excavation | <input type="checkbox"/> Roof                | <input type="checkbox"/> Window/Door                     |
|   |  | <input type="checkbox"/> 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.

\_\_\_\_\_  
Signature of owner or authorized agent

\_\_\_\_\_  
Date



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

<b>Owner's mailing address</b>	<b>Owner's Agent's mailing address</b>
Stephen Seeger 17501 Barnesville Road Barnesville, Md 20838	Solar Energy World 14880 Sweitzer Road Laurel, MD 20707
<b>Adjacent and confronting Property Owners mailing addresses</b>	
17401 W Old Baltimore Road, Boyds 20841	17610 Conoy Road, Barnesville 20838
17601 Conoy Road, Barnesville 20838	17700 Barnesville Road Barnesville 20838
17501 Conoy Road, Barnesville 20838	17410 Barnesville Road, Boyds 20841

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

**-House Built in 1850**

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

**-Install (60) roof mounted solar panels, 21.30 kW**

**-Install (60) micro inverters under each panel**

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/Landscaping	*	*		*	*	*	*
Tree Removal	*	*		*	*	*	*
Siding/ Roof Changes	*	*	*	*	*		*
Window/ Door Changes	*	*	*	*	*		*
Masonry Repair/ Repoint	*	*	*	*	*		*
Signs	*	*	*	*	*		*



Front of Structure



Left Side of House



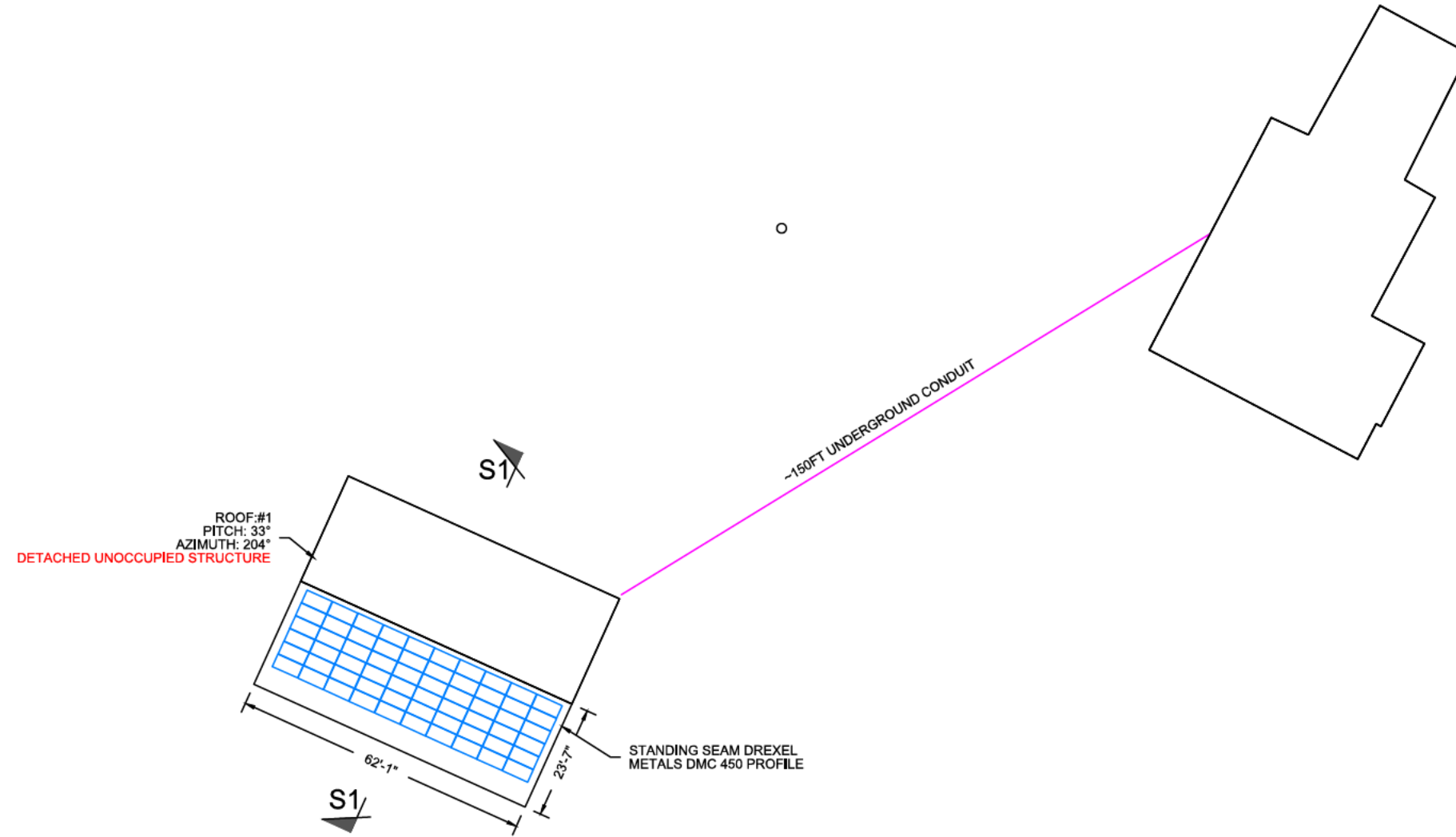
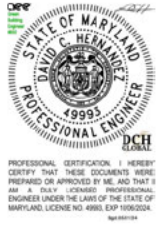
Right Side of Structure



Back Side of Structure

Metal Roof  
S-5-S Mini Seam Clamp

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Date: 2024,05,01 11:14:35 -04:00



PLAN VIEW TOTAL ROOF AREA: 3519 SQFT  
SOLAR ARRAY AREA: 1182.00 SQFT  
THE SOLAR ARRAY IS 33.6% OF THE PLAN VIEW TOTAL ROOF AREA

NOTES:

1. THE SYSTEM SHALL INCLUDE (60) LONGI LR4-60HP-355M.
2. SNAPRACK SOLAR RAIL WILL BE INSTALLED IN ACCORDANCE WITH SNAPRACK INSTALLATION MANUAL.
3. REFER TO STRUCTURAL DRAWING FOR SECTIONS MARKED AND ADDITIONAL NOTES.

**SOLAR PANEL LAYOUT**  
Scale: 1/32" = 1'-0"





**Solar Energy World**  
Because Tomorrow Matters

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


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<b>Building Code</b>	
International Residential Code (IRC) 2018	
<b>Electrical Code</b>	
National Electrical Code (NEC) 2017	
<b>Wind Speed</b>	<b>Snow Load</b>
115 MPH	30 PSF
<b>Modules</b>	
(60) LONGi LR4-60HP-355M	
<b>Inverter(s)</b>	
(60) IQ8-60-2-US	
<b>DC System Size</b>	<b>AC System Size</b>
21,300 kW	14,400 kW
<b>Customer Information</b>	
Stephen Seeger 17501 Barnesville Road Barnesville, MD, 20841	
<b>Partner/Leader</b>	
IGS	
<b>City</b>	<b>Utility</b>
Montgomery County	Potomac Edison
<b>Sheet Name</b>	
Solar Panel Layout	
<b>Drawn By</b>	<b>Date</b>
AO	April 10, 2024
<b>Scale</b>	<b>Job Number</b>
AS NOTED	MD18606
<b>Sheet</b>	
A-1	

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**SITE PLAN**  
 Scale: 1" = 40'-0"



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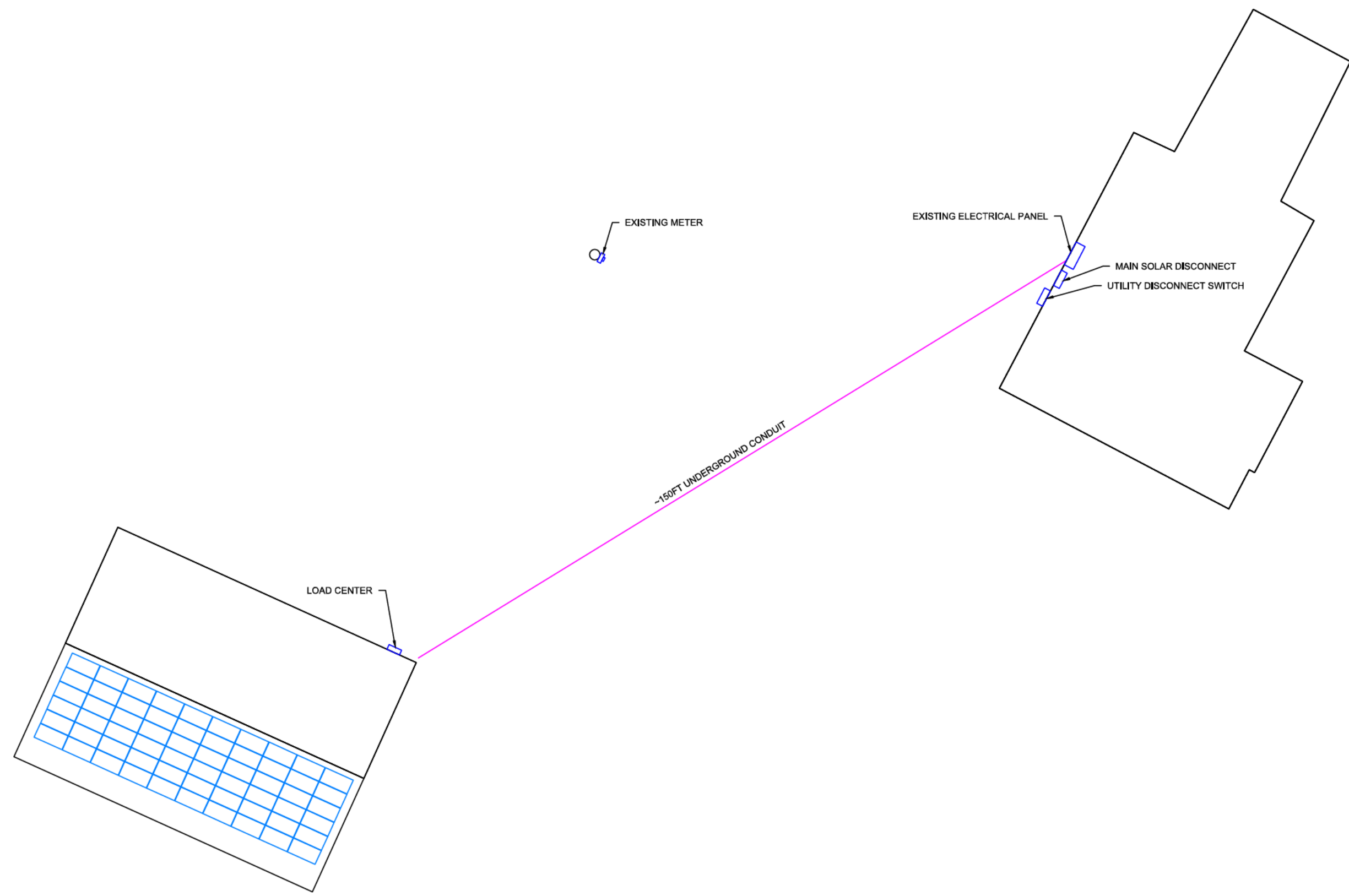
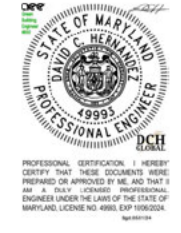
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Stephen Seeger 17501 Barnesville Road Barnesville, MD, 20841	
<b>Partner/Lender</b>	
IGS	
<b>Area</b>	<b>Utility</b>
Montgomery County	Potomac Edison
<b>Sheet Name</b>	
Site Plan	
<b>Drawn By</b>	<b>Date</b>
AO	March 28, 2024
<b>Scale</b>	<b>Job Number</b>
AS NOTED	MD18606
<b>Sheet</b>	
A-2	




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**EQUIPMENT LOCATION PLAN**  
 Scale: NTS

**NOTE:**  
 EQUIPMENT LOCATION PLAN IS APPROXIMATE, EXACT LOCATION TO BE VERIFIED WITH INSTALLATION CREW AND HOME OWNER AT THE TIME OF INSTALLATION.

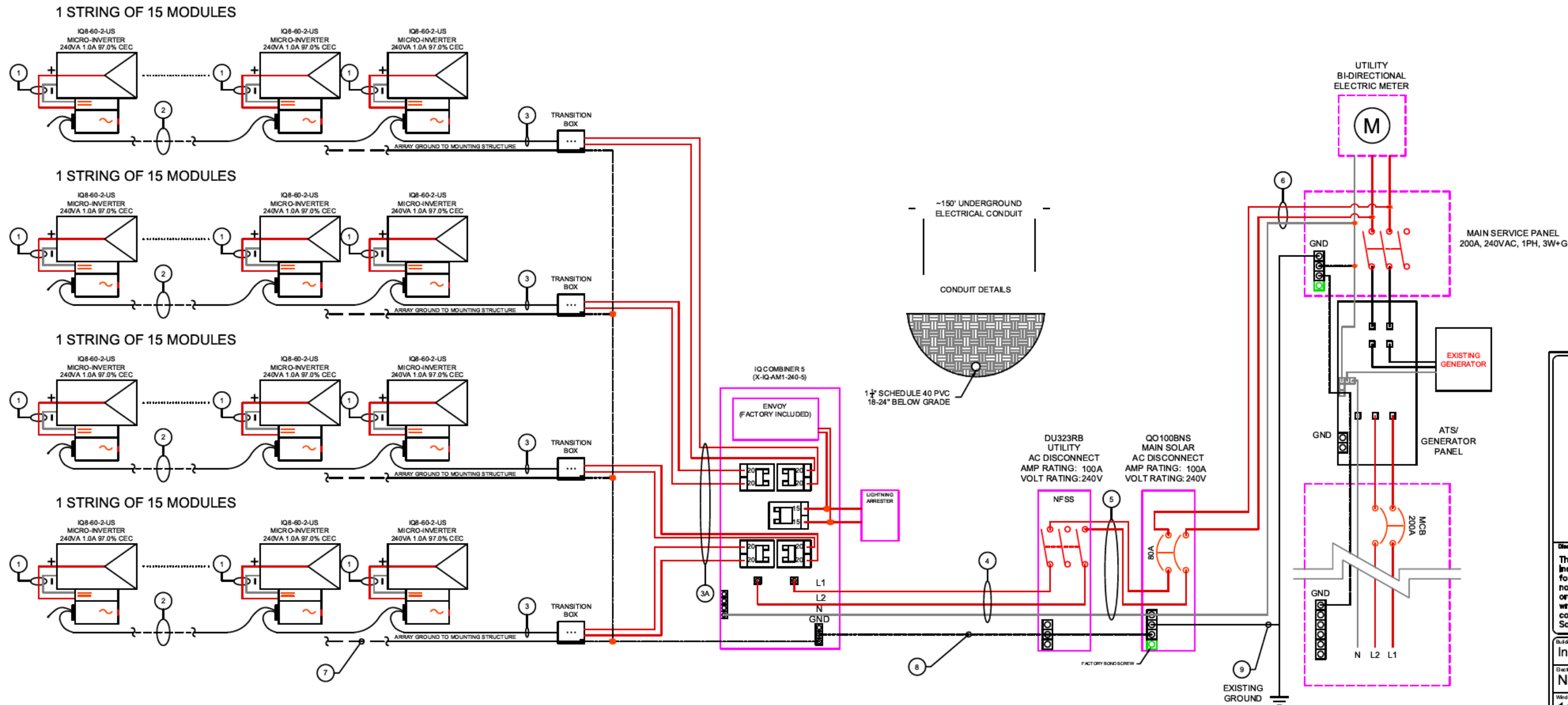


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IGS	
<b>City</b>	<b>Utility</b>
Montgomery County	Potomac Edison
<b>Sheet Name</b>	
Equipment Location Plan	
<b>Drawn By</b>	<b>Date</b>
AO	March 28, 2024
<b>Scale</b>	<b>Job Number</b>
AS NOTED	MD18606
<b>Sheet</b>	
E-1	




### 3-LINE DIAGRAM

MODULE SPECIFICATIONS	
MODEL NUMBER	LR4-60HPB-355M
PEAK POWER	355 W
RATED VOLTAGE (V <sub>mpp</sub> )	34.60 V
RATED CURRENT (I <sub>mp</sub> )	10.27 A
OPEN CIRCUIT VOLTAGE (V <sub>oc</sub> )	40.60 V
SHORT CIRCUIT CURRENT (I <sub>sc</sub> )	11.25 A
MAXIMUM SYSTEM VOLTAGE	1000VDC
INVERTER SPECIFICATIONS	
MODEL NUMBER	IQ8-60-2-US
MAXIMUM DC VOLTAGE	60 V
MAXIMUM POWER OUTPUT	240 W
NOMINAL AC VOLTAGE	240 VAC
MAXIMUM AC CURRENT	1.00 A
ARRAY DETAILS	
NO. OF MODULES PER STRING	15
NO. OF STRINGS	4
ARRAY WATTS AT STC	5325
MAX. VOLTAGE	480 V

WIRE/CONDUIT SCHEDULE ARRAY			
TAG	DESCRIPTION	WIRE SIZE/TYPER	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	#4 Cu THHN/THWN-2	
5	AC Disconnect to AC Disconnect	#4 Cu THHN/THWN-2	
6	AC Disconnect to Interconnection Point	#4 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

- EQUIPMENT USED SHALL BE NEW, UNLESS OTHERWISE NOTED.
- EQUIPMENT USED SHALL BE UL LISTED, UNLESS OTHERWISE NOTED.
- EQUIPMENT SHALL BE INSTALLED PROVIDING ADEQUATE PHYSICAL WORKING SPACE AROUND THE EQUIPMENT AND SHALL COMPLY WITH NEC.
- COPPER CONDUCTORS SHALL BE USED AND SHALL HAVE AN INSULATION RATING OF 600V, 90°C, UNLESS OTHERWISE NOTED.
- CONDUCTORS SHALL BE SIZED IN ACCORDANCE TO THE NEC. CONDUCTORS AMPACITY SHALL BE DE-RATED FOR TEMPERATURE INCREASE, CONDUIT FILL AND VOLTAGE DROP.
- EXPOSED NON-CURRENT CARRYING METAL PARTS SHALL BE GROUNDED AS PER NEC.
- CONDUITS SHALL BE ADEQUATELY SUPPORTED AS PER NEC.
- AC DISCONNECT SHOWN IS REQUIRED IF THE UTILITY REQUIRES VISIBLE-BLADE SWITCH.
- EXPOSED NON-CURRENT CARRYING METAL PARTS SHALL BE GROUNDED AS PER NEC.
- LINE SIDE INTER-CONNECTION SHALL COMPLY WITH NEC.
- SMS MONITORING SYSTEM AND IT'S CONNECTION SHOWN IS OPTIONAL. IF USED, REFER TO SMS INSTALLATION MANUAL FOR WIRING METHODS AND OPERATION PROCEDURE.
- ASHRAE FUNDAMENTAL OUTDOOR DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE U.S. (PHOENIX, AZ OR PALM SPRINGS, CA)
- FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF MOUNTED SUNLIGHT CONDUIT USING THE OUTDOOR TEMPERATURE OF 47°C
  - 10AWG CONDUCTOR ARE GENERALLY ACCEPTABLE FOR MODULES WITH AN I<sub>sc</sub> OF 9.6 AMPS WITH A 15 AMP FUSE.
- WIRE SIZING FOR OCPD  
EX (I<sub>sc</sub> \* (1.25)(1.25)) / # OF STRINGS IN PARALLEL = WIRE AMPACITY OR USING NEC TABLE 690.8



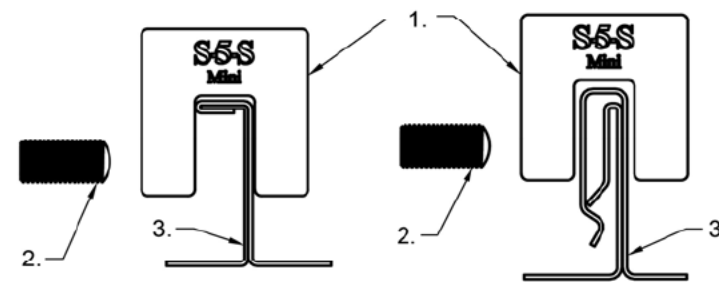
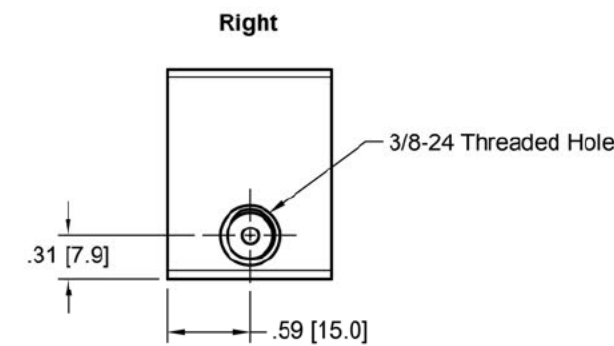
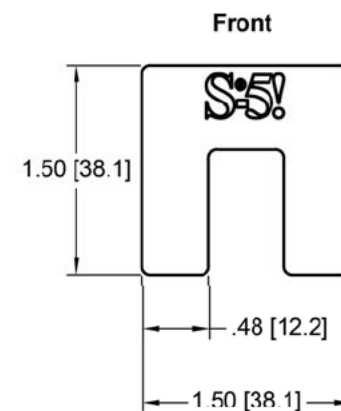
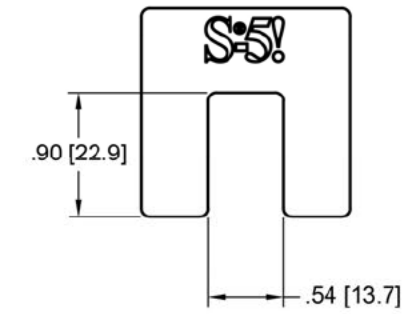
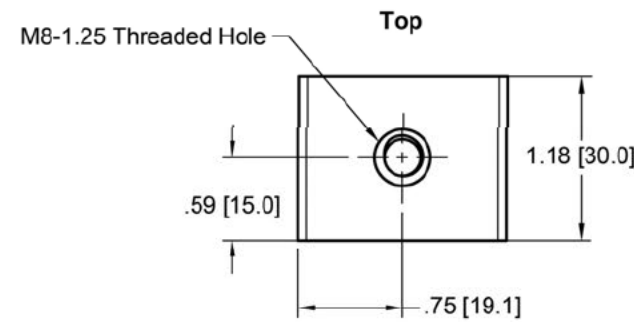
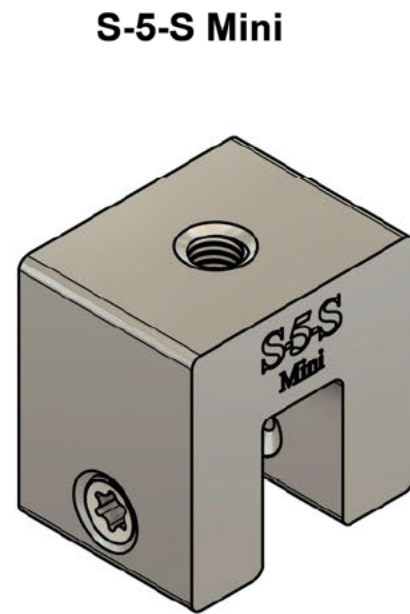
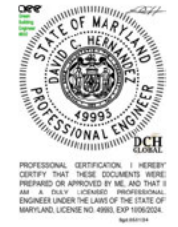
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Because Tomorrow Matters

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

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Building Code	International Residential Code (IRC) 2018
Electrical Code	National Electrical Code (NEC) 2017
Wind Speed	115 MPH
Snow Load	30 PSF
Module	(60) LONGi LR4-60HP-355M
Inverter(s)	(60) IQ8-60-2-US
DC System Size	21.300 kW
AC System Size	14.400 kW
Customer Information	Stephen Seeger 17501 Barnesville Road Barnesville, MD, 20841
Permitting	IGS
City	Montgomery County
City	Potomac Edison
Sheet Name	Electrical 3-Line Diagram
Drawn By	AO
Date	March 28, 2024
Scale	AS NOTED
Job Number	MD18606
Sheet	E-2

David C. Hernandez  
 Digitally signed by David C. Hernandez  
 Date: 2024.05.01 11:14:35 -04:00



**General Notes:**

1. S-5-S Mini
2. 0.9" 3/8-24 T30 Drive SetScrew
3. Example roof

MATERIAL: 6000 Series AL	<b>S-5!</b>	METAL ROOF INNOVATIONS, LTD. 8750 WALKER RD COLORADO SPRINGS, CO 80908 719-495-0518 719-495-0045 (FAX)
EST ASSEMBLY WT: 0.214 lbs		
HARDWARE: 0.9" 3/8-24 T30 Drive SetScrew	TITLE S-5-S MINI [CCD]	
	DRAWING NO. S08-A-25-A	DRAWN BY SNLR DATE 3/2/2022
	SCALE 1:1	FILE NAME S08-A-25-A (S-5-S MINI) [CCD]
	S-5!® PRODUCTS ARE PROTECTED BY MULTIPLE U.S. AND FOREIGN PATENTS. VISIT OUR WEBSITE AT WWW.S-5.COM FOR COMPLETE INFORMATION ON PATENTS AND TRADEMARKS	

DrexelMetals DMC 450 Profile

Width : 16" / 24ga

DMC 450 Clip with #10-13 x 1"  
PHW (2 Per Clip) into the Decking,  
2X12 Planks

**Structural Details**

S1	Rafter	2x6 O.C. 24"
----	--------	--------------

**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, P<sub>g</sub> = 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.

**STRUCTURAL ATTACHMENT DETAIL**

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Building Code  
**International Residential Code (IRC) 2018**

Electrical Code  
**National Electrical Code (NEC) 2017**

Wind Speed  
**115 MPH**

Snow Load  
**30 PSF**

Module  
**(60) LONGi LR4-60HP-355M**

Inverter(s)  
**(60) IQ8-60-2-US**

DC System Size  
**21,300 kW**

AC System Size  
**14,400 kW**

Customer Information  
**Stephen Seeger**  
 17501 Barnesville Road  
 Barnesville, MD, 20841

Partner/Leader  
**IGS**

City  
 Montgomery County

Utility  
 Potomac Edison

Sheet Name  
**Structural Attachment Details**

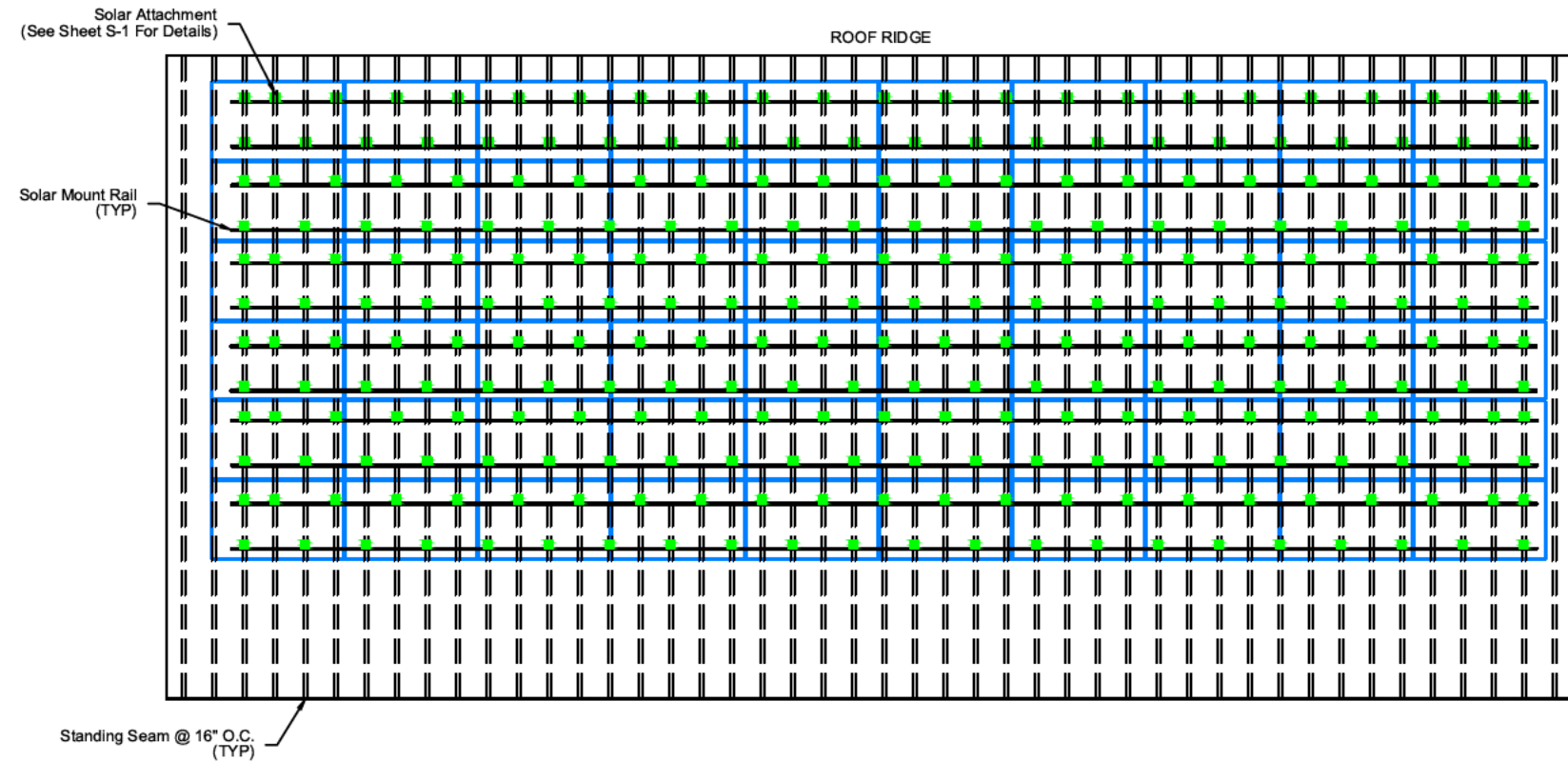
Drawn By  
**AO**

Date  
**April 10, 2024**

Scale  
**AS NOTED**

Job Number  
**MD18606**


Sheet  
**S-1**



**SOLAR PANEL FOOTING PLAN R1**  
 Scale: 1/8" = 1'-0"

**NOTES:**

1. SNAPRACK SOLAR MOUNT RAIL SHALL BE INSTALLED IN ACCORDANCE WITH SNAPRACK INSTALLATION MANUAL.
2. "L" FEET SHALL BE SPACED AT A MAXIMUM OF 4' O/C.
3. AN "L" FOOT SHALL BE PLACED WITHIN 25% OF MAXIMUM "L" FOOT SPACING (16" MAX.) AT THE CANTILEVERED END OF EACH SECTION OF RAIL.
4. MAX OVERHANG (CANTILEVER) OF MODULES SHALL NOT EXCEED 12".



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<b>Building Code</b> International Residential Code (IRC) 2018	
<b>Electrical Code</b> National Electrical Code (NEC) 2017	
<b>Wind Speed</b> 115 MPH	<b>Snow Load</b> 30 PSF
<b>Module</b> (60) LONGi LR4-60HP-355M	
<b>Inverter(s)</b> (60) IQ8-60-2-US	
<b>DC System Size</b> 21.300 kW	<b>AC System Size</b> 14.400 kW
<b>Customer Information</b> Stephen Seeger 17501 Barnesville Road Barnesville, MD, 20841	
<b>Permitting</b> IGS	
<b>City</b> Montgomery County	<b>Utility</b> Potomac Edison
<b>Sheet Name</b> Solar Panel Footing Plan	
<b>Drawn By</b> AO	<b>Date</b> March 28, 2024
<b>Scale</b> AS NOTED	<b>Job Number</b> MD18606
<b>Sheet</b> S-2	



# Don't Leave Performance to Chance.

S-5! performs extensive and rigorous testing to ensure safety and to maintain the structural integrity of the roof. We use a third-party A2LA accredited lab—the highest-regarded in the industry—and follow strict ASTM standards.

**Learn More about our Parallel-to-Seam Load Testing (Click to expand)**



---

**Learn More about our Normal-to-Seam Load Testing (Click to Expand)**





### Grab Load Tests

Measurement Units

Imperial

Safety Factor

3

Recalculate Results

Scroll

Filter by panel:

450 SL

Clamp Name	Manufacturer	Roof Panel	Thickness Material	Screw Tension (lbs)	Ultimate Load (lbs)	Failure Mode	Allowable Load (lbs)	Notes
S-5-S Mini	Drexel Metals	450 SL	24 ga Steel	115	603	D	201	



How to Buy

### Standing Seam / Concealed Fix Load Testing Negative Load Normal to Seam

This table represents ultimate and allowable tensile loads applied to the clamp in a negative load direction normal to the panel seam. Please note that this protocol isolates failure to the clamp-seam connection. It is possible that in an actual construction assembly some other mode of failure may occur at lower loads than those produced with this protocol. Loads imposed on the S-5!® clamps will be transferred to the panels and their attachment. Panel seams must have sufficient flexural strength to carry these loads when clamp is used mid-span. Panel attachment and building structure must also be sufficient to carry these loads. The makers of S-5!® clamps make no representations with respect to these variables. It is the responsibility of the user to verify this information, or seek assistance from a qualified design professional, if necessary.

Allowable loads are listed utilizing a default Factor of Safety (FS) = 3.0. Actual factor of safety is the responsibility of the designer and should be employed as appropriate. Enter desired Factor of Safety and reset/re-tabulate.

All tabled values are dependent upon setscrew tension. Load testing of S-5!® clamps is conducted with setscrews tensioned at 150 inch pounds (22 gauge steel profiles) or 115 inch pounds (24 gauge steel and all other metals). When relying upon published load values, setscrews should be tensioned and verified using a calibrated torque wrench between 160 and 180 inch pounds when used on 22 ga steel and between 130 and 150 inch pounds for all other metals and thinner gauges of steel.





## Notes

1. CAUTION: Note screw tension to avoid damage to this profile.
2. CAUTION: These are cap-seam type profiles. The cap of this profile should be mechanically fastened to the seam somewhere along its length with one lap tek.
3. SINGLE FOLD: These profiles are seamed to 90 degrees.
4. ATTENTION: The dimensioning on these seams is such that the clamp will not slip over the seam. Some hand crimping at the clamp location will resolve this problem.
5. ATTENTION: Two piece clamp utilizes two M8 bolts & GX50, not setscrews.
6. ATTENTION: Two piece clamp utilizes one M8 bolt & GXM50, not setscrews.
7. SETSCREW TENSION: Please note the setscrew tension. Panel has been tested with increased setscrew tension.
8. ATTENTION: Load values averaged and reported based on 4 or more test repetitions performed.
9. ATTENTION: Test protocol preformed utilizing concealed standing seam clip.
10. ATTENTION: Clamp utilizes opposing setscrews.
11. ATTENTION: Two piece clamp utilizes one M8 bolt & GXM10, not setscrews.
12. ATTENTION: Two piece clamp utilizes two M8 bolts & GX10, not setscrews.
13. ATTENTION: Testing conducted utilizing a stainless steel saddle at clamp locations.

## Failure Modes

- A. Separation of the clamp from the seam
- B. Breakage of any part of the clamp
- C. Tearing or otherwise yielding of the seam
- D. Any other yielding of clamp-to-seam connection





How to Buy

## protocols?

Learn More

Project Dashboa



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Fax: 719-495-0045

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- [Fall Protection](#)
- [Metal Roof Clamps](#)
- [Metal Roof Brackets](#)
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- [Our Manufacturing Facility](#)
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- [S-5! Company Style Guide](#)

↑  
TO TOP

# S-5!®

The Right Way!

The right way to attach almost anything to metal roofs!

## Installation Instructions

**S-5!® Warning!** Please use these products responsibly! Visit our website or contact your S-5! distributor for available load test results. The user and/or installer of these parts is responsible for all necessary engineering and design to ensure the S-5! clamps have been properly spaced and configured. **Notice to S-5! users:** Due to the many variables involved with specific panel products, climates, snow melt phenomena, and job particulars, the manufacturer cannot and does not express any opinions as to the suitability of any S-5! assembly for any specific application and assumes no liability with respect thereto. S-5! products are tested for ultimate holding strength on various profile types and materials. Visit [www.S-5.com](http://www.S-5.com) for more details. This document is an installation guide only and the photographs and drawings herein are for the purpose of illustrating installation, tools and techniques, not system designs. Information contained within is intended to apply to the document as a whole.

**The S-5-U, S-5-S, S-5-E, S-5-B, and S-5-V clamps are made for standing seam profiles.** For horizontal seam applications, the setscrew(s) must be accessible from the top for tightening. S-5-U clamps have two bolt holes to accommodate either vertical or horizontal seam applications; visit [www.S-5.com](http://www.S-5.com) for more details.

## Tools Needed

- Screw Gun\*
- 3/16" Allen Bit Tip (provided)
- Dial-Calibrated Torque Wrench  
(For accurate tension values, do NOT use a clicking torque wrench; inquire with S-5! for proper tool sourcing)

## To Install the S-5-U, S-5-S, S-5-E, S-5-B, and S-5-V

1. Partially thread the setscrews into the clamp by hand. (The S-5-U has four setscrew locations to make the clamp more versatile; however, only two setscrews are used per clamp. Both setscrews should always be loaded into the same side of the clamp.)
2. Determine how to position the clamp. When attaching to machine-folded seams (regardless of panel profile and geometry), S-5! clamps are designed to engage the seam as shown in Illustration A; with setscrew opposite seam fold. On many snap-together type seams, the setscrews are on the open (or overlap) side of the seam. On some seams, this aspect of clamp orientation is not critical.
3. Tighten the setscrews using a screw gun\* and the included screw gun bit tip. Setscrews should be tensioned and re-tensioned as the seam material compresses, i.e. tighten the first setscrew, then the second; then repeat until each setscrew achieves the recommended torque. The setscrews will dimple the seam material but will not penetrate it. When relying on published load values, setscrew tension should be verified periodically using a calibrated torque wrench as indicated below to ensure the tool is consistently achieving the proper torque range.

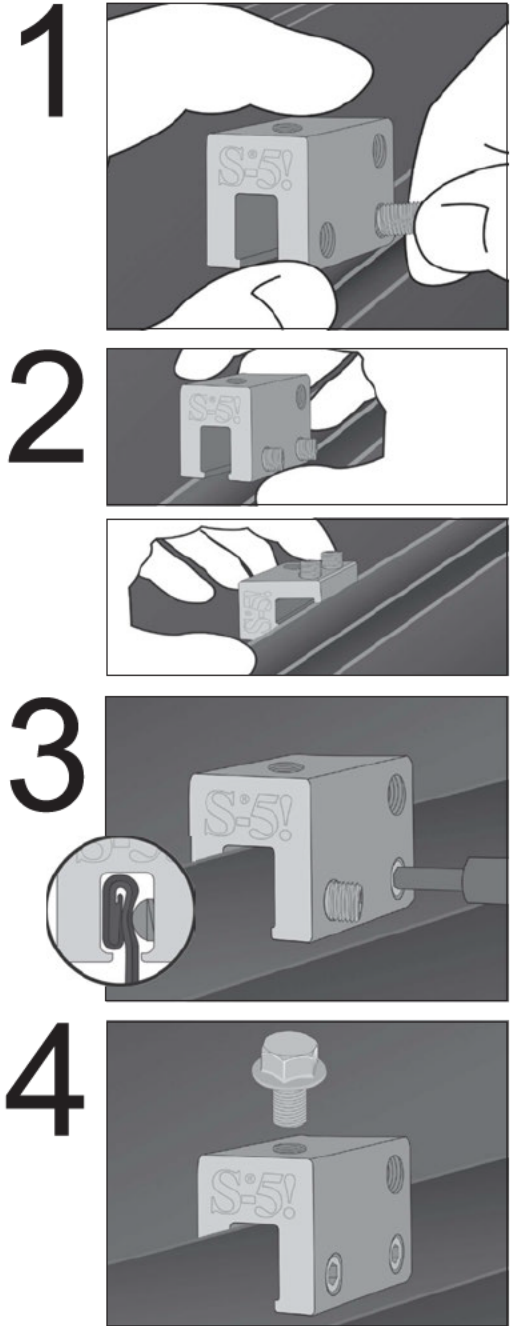
\* For time-saving tool recommendations, call S-5!

Specified Torque	Inch Pounds	Foot Pounds	Nm
22ga steel	160-180	13-15	18-20
All other metals and thinner gauges of steel	130-150	11-12.5	15-17

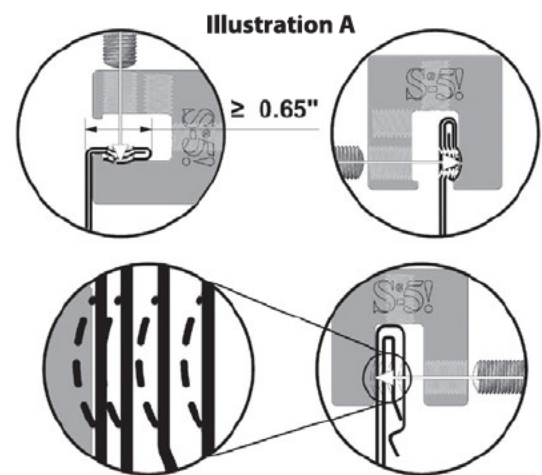
Once installed correctly, these clamps require no maintenance or re-inspection for the life of the roof.

4. For critical attachment applications utilizing an M8-1.25 X 16 mm Hex Flange Bolt, tighten the included M8 bolt to 160 inch pounds (13 foot pounds).

These instructions are for use by those experienced in the trade. Always follow appropriate safety precautions and use appropriate tools.



Above illustrations show S-5-U clamp on a vertical seam. Step 2 shows both vertical and horizontal applications.



(Top) S-5-U clamp on both vertical and horizontal seams. (Bottom) S-5-S on a snap together seam with blow up illustrating deformation of seam as setscrew is tightened. **For horizontal seams equal to or greater than .65" use the S-5-U in its horizontal orientation.** **For horizontal seams equal to or less than .50" use the S-5-S mounted vertically.**

S-5-U Mini, S-5-S Mini, S-5-E Mini, S-5-B Mini, and S-5-V Mini  
Installation Instructions

## To Install the S-5-U Mini, S-5-S Mini, S-5-E Mini, S-5-B Mini, and S-5-V Mini

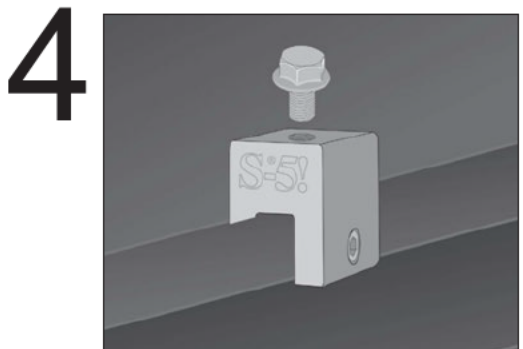
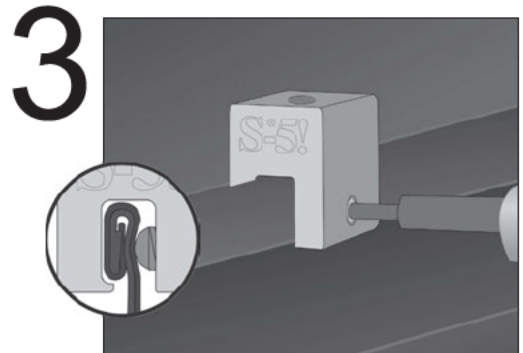
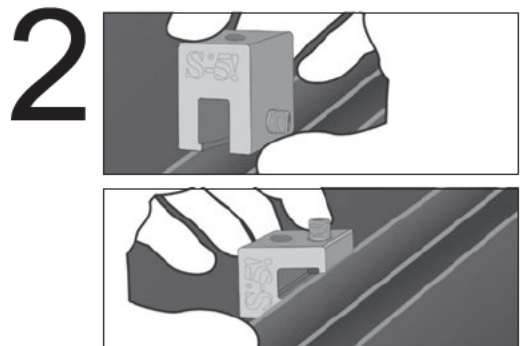
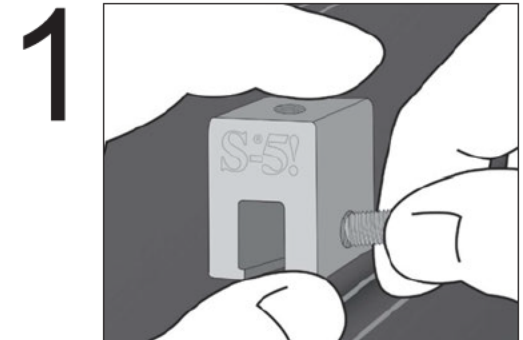
1. Partially thread the setscrew into the clamp by hand.
2. Determine how to position the clamp. When attaching to machine-folded seams (regardless of panel profile and geometry), S-5!® clamps are designed to engage the seam as shown in Illustration A on the front page; with setscrew opposite seam fold. On many snap-together type seams, the setscrew is on the open (or overlap) side of the seam. On some seams, this aspect of clamp orientation is not critical.
3. Tighten the setscrew using a screw gun\* and the included screw gun bit tip. The setscrew will dimple the seam material but will not penetrate it. When relying on published load values, setscrew tension should be verified periodically using a calibrated torque wrench as indicated below to ensure the tool is consistently achieving the proper torque range.

\*For time-saving tool recommendations, call S-5!

Specified Torque	Inch Pounds	Foot Pounds	Nm
22ga steel	160–180	13–15	18–20
All other metals and thinner gauges of steel	130–150	11–12.5	15–17

Once installed correctly, these clamps require no maintenance or re-inspection for the life of the roof.

4. For critical attachment applications utilizing an M8-1.25 X 16 mm Hex Flange Bolt, tighten the included M8 bolt to 160 inch pounds (13 foot pounds).



Above illustrations show S-5-E Mini clamp on a vertical seam. Step 2 shows S-5-E Mini on vertical applications and S-5-U Mini on horizontal applications.

### S-5!® Warning! Please use this product responsibly!

Products are protected by multiple U.S. and foreign patents. Visit the website at [www.S-5.com](http://www.S-5.com) for complete information on patents and trademarks. For maximum holding strength, setscrews should be tensioned and re-tensioned as the seam material compresses, i.e. tighten the first setscrew, then the second; then repeat until each setscrew achieves the recommended torque. Clamp setscrew tension should be verified using a calibrated torque wrench between 160 and 180 inch pounds when used on 22ga steel, and between 130 and 150 inch pounds for all other metals and thinner gauges of steel. Consult the S-5! website at [www.S-5.com](http://www.S-5.com) for published data regarding holding strength.

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USEBVI-V1.0-0915



# SnapNrack™

Solar Mounting Solutions

---

## Ultra Rail

Residential Roof Mount System  
Installation Manual

---

[snapnrack.com](http://snapnrack.com)

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.

## Step 1: Project Plans

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## Certification Details

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

### Grounding/Bonding

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

This racking system may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. See the [Grounding Specifications](#) for the list of modules tested with the Ultra Rail system for integrated grounding.

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

Ultra Rail has been listed with 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 ( $\geq 2:12$  pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 12 inches from the top and bottom edges of the module.

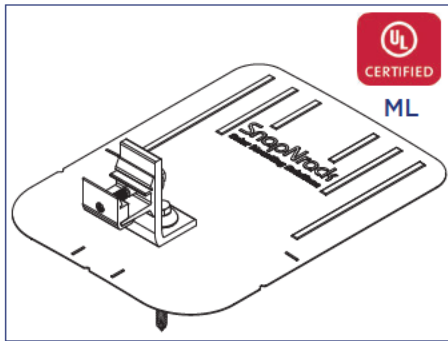
The Ultra Rail system has been evaluated for a Class A System Fire Classification for a Low-Sloped Roof ( $< 2:12$  pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 16.3 inches from the top and bottom edges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

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

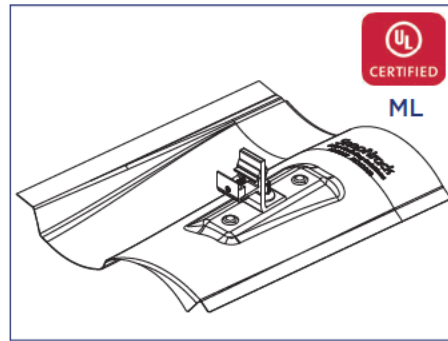
Because the system was tested at 5 inches above the test roof fixture Ultra Rail can be installed without any height restrictions and will maintain the Class A System Fire Classification. See [Rail Installation](#) section for potential module-specific height restrictions due to module temperature.



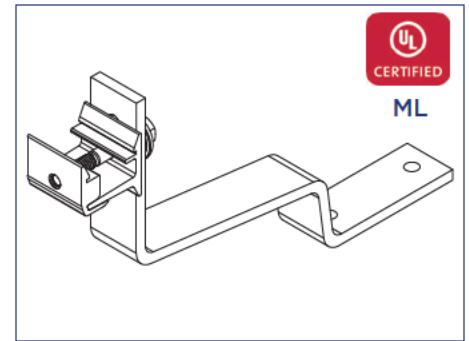
## Structural Components



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



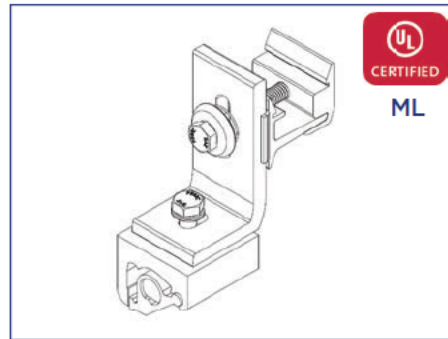
**Tile Replacement Roof Attachment**  
Roof attachment kit for flat, S, and W tile roofs including base, riser, tile replacement flashing, L foot, and hardware



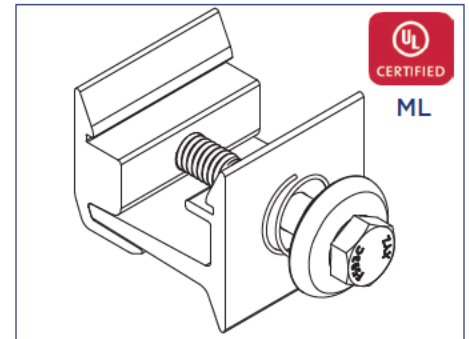
**Flat Tile Roof Attachment**  
Roof attachment kit for flat tile roofs including tile hook and hardware



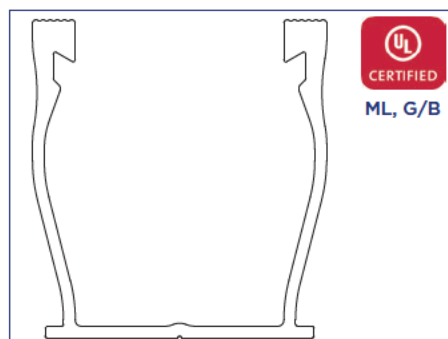
**Metal Roof Base Attachment**  
Roof attachment kit for flat metal roofs including metal roof base, L foot, and hardware



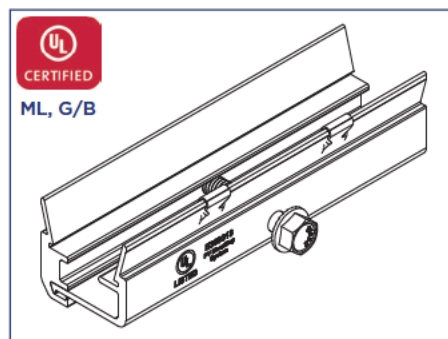
**Seam Clamp Roof Attachment**  
Roof attachment for standing seam metal roofs including seam clamp, L foot, and hardware



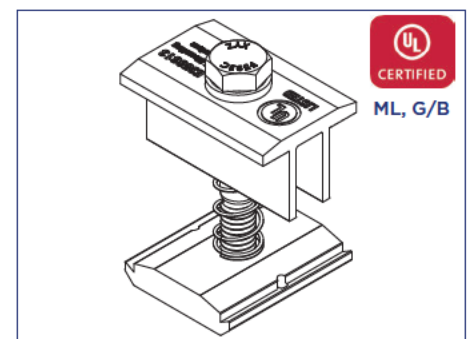
**Ultra Rail Mounting Hardware**  
Hardware kit for attaching Ultra Rail to any roof attachment that uses an L foot or other slotted mount that accepts 5/16" hardware



**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

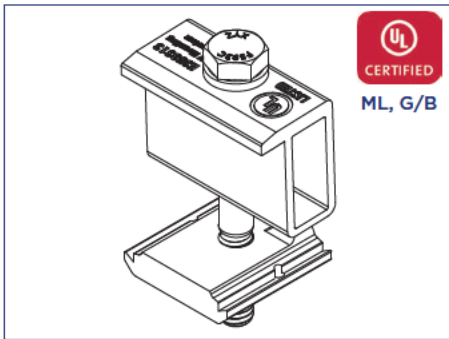


**Mid Clamp**  
Top-down module mid clamp including clamp and hardware

### UL Listing Legend:

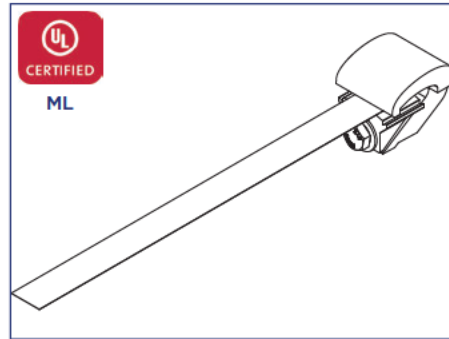
- ML - Evaluated for Mechanical Loading
- G/B - Evaluated for Grounding/Bonding

## Wire Management/Grounding Component



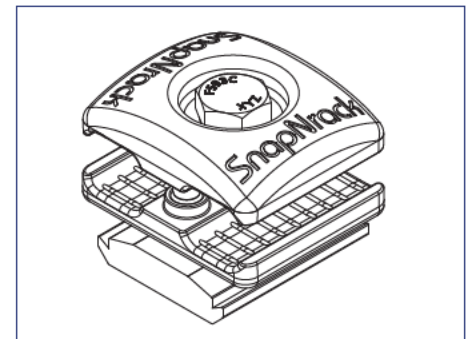
**Adjustable End Clamp**

Top-down module end clamp including clamp and hardware



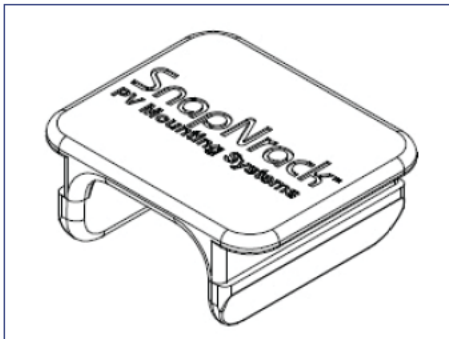
**Universal End Clamp**

Bottom-mount module end clamp including clamp and hardware



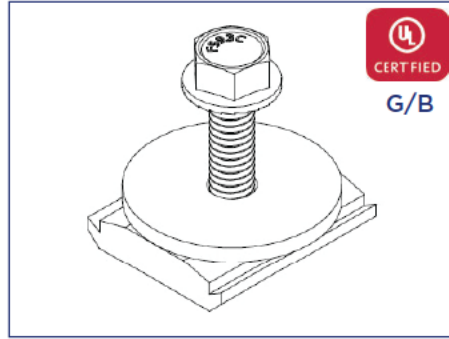
**Universal Wire Clamp**

Wire management component used to secure conductors between rails



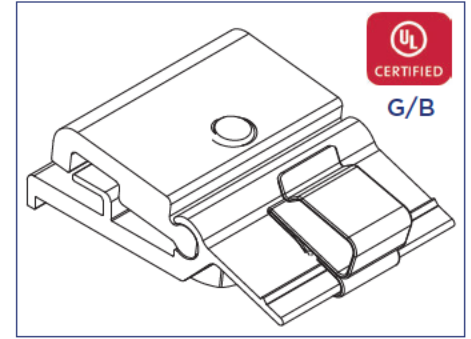
**Wire Retention Clip**

Wire management component used to secure conductors in rails



**MLPE Rail Attachment Kit**

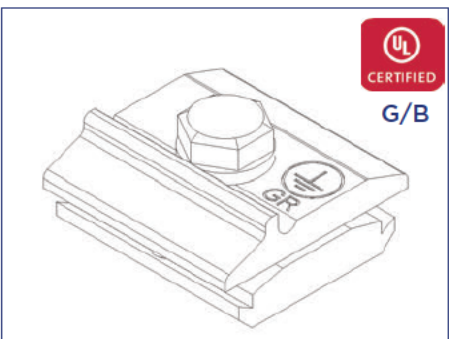
Rail attachment for module level power electronics like microinverters and optimizers



**MLPE Frame Attachment Kit**

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

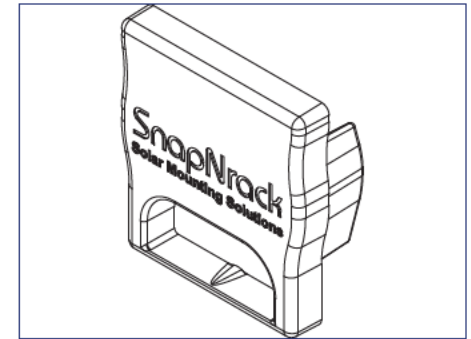
## Aesthetic Components



**SnapNrack Ground Lug**



**IlSCO Lay-In Lug - GBL-4DBT**



**UR-40 Rail End Cap**

Plastic end cap for UR-40 Rail

### UL Listing Legend:

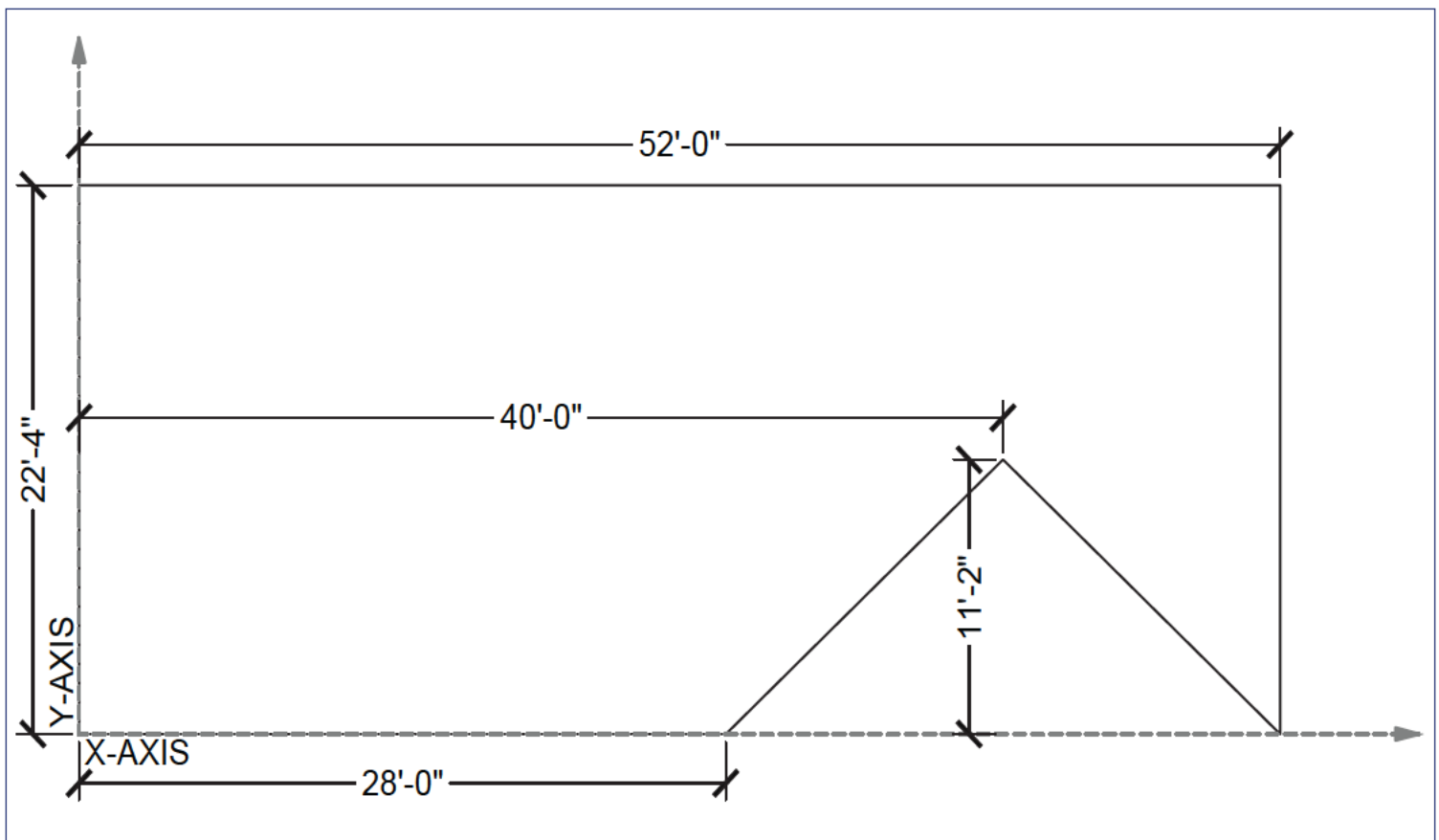
- ML - Evaluated for Mechanical Loading
- G/B - Evaluated for Grounding/Bonding

## 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)

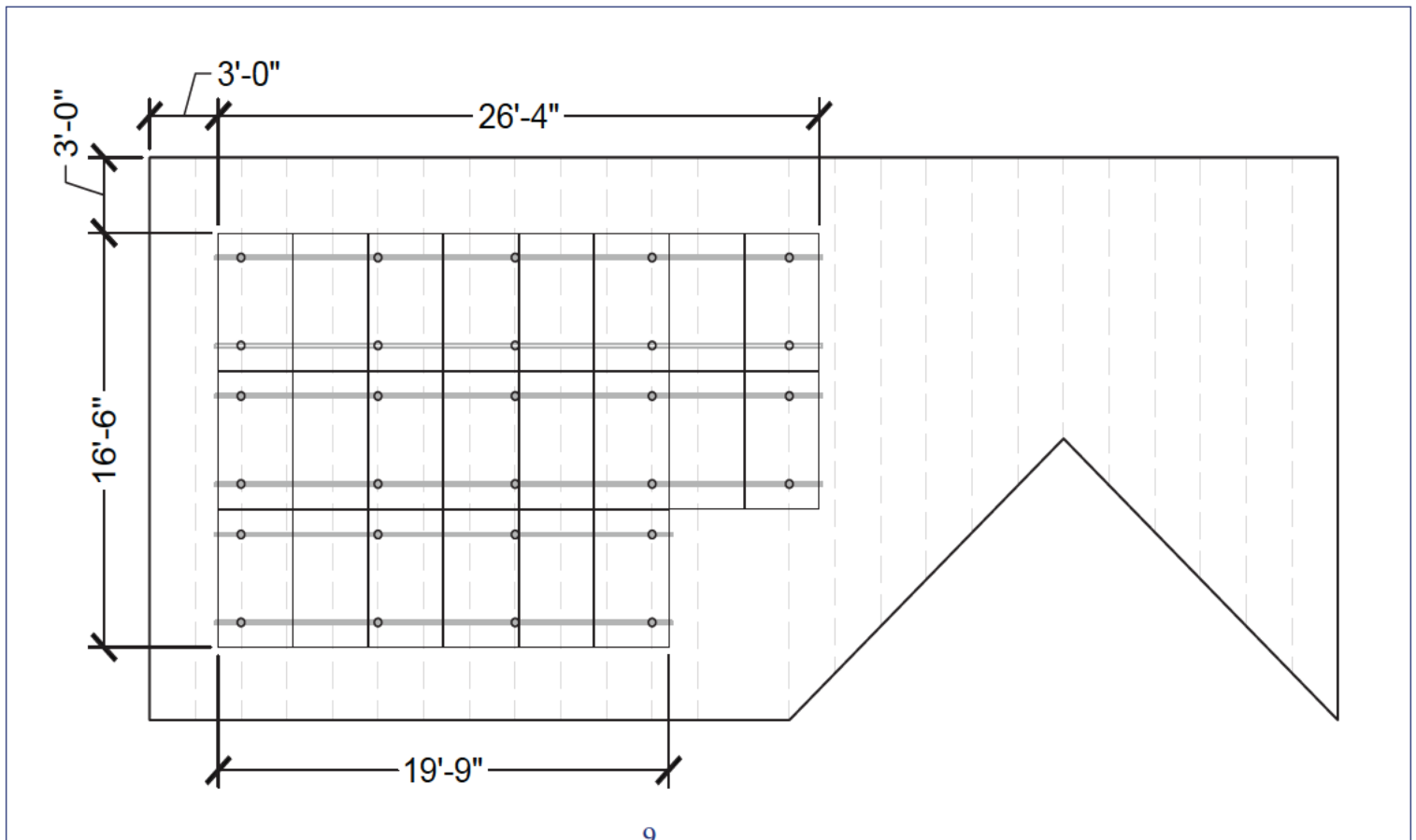
## Site Survey

- Measure the roof surfaces and develop an accurate drawing, including any obstacles such as chimneys and roof vents.
- If plans are available, check to make sure that the plans match the final structure.
- Identify any roof access areas or keep-out areas as required by the local AHJ (i.e. fire lanes).
- Identify any construction issues that may complicate the process of locating roof framing members from the roof surface.
- If you find structural problems such as termite damage or cracked roof framing members that may compromise the structure's integrity, consult a structural engineer.



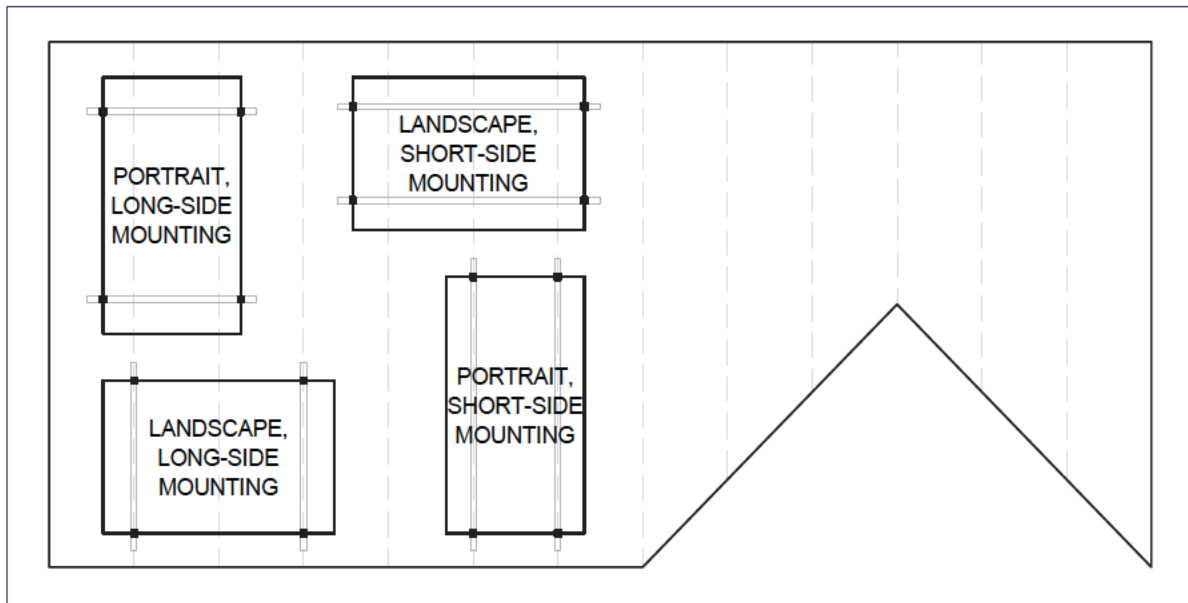
## Design Guidance

- 1) Layout the modules in the available roof area. Adjacent modules in the same row are spaced 1/2" apart by Mid Clamps. Adjustable End Clamps require an additional 1" of rail extending past module frame, while Universal End Clamps require no extra rail. When installing multiple rows of modules, a minimum spacing gap of 1/8" should be used between rows.
- 2) Draw the roof framing member location on the layout to identify where roof attachments can be installed.
- 3) Determine site conditions for calculating the engineering values, confirm site conditions and code versions comply with local AHJ requirements.
- 4) Reference site conditions and system specifications in Ultra Rail Structural Engineering Report to determine maximum attachment spacing and resulting cantilever values (34% of maximum attachment spacing).
- 5) Draw roof attachment locations on layout based on maximum attachment spacing and cantilever values.
- 6) Confirm design complies with UL 2703 Listing for Mechanical Loading. For more details on the mechanical loading details see the [Mechanical Loading Specifications](#) section.
- 7) To simplify the design process and automatically generate a bill of materials (BOM) for the mounting system, use the Ultra Rail Configuration Tool located on the SnapNrack website. Always refer to Approved Module Lists in Installation Manuals to ensure installation complies with UL 2703 Listing.
- 8) Mark distance from array edge to identifiable roof features in x and y axes.
- 9) Insert SnapNrack installation details in to design set specific to the project requirements.



## Design Note:

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



## Installation Note:

- Ensure the lag screws will be installed in a solid portion of the roof framing member.
- If the roof framing member is not found then seal the pilot hole immediately with roofing sealant.

## Safety Guidance

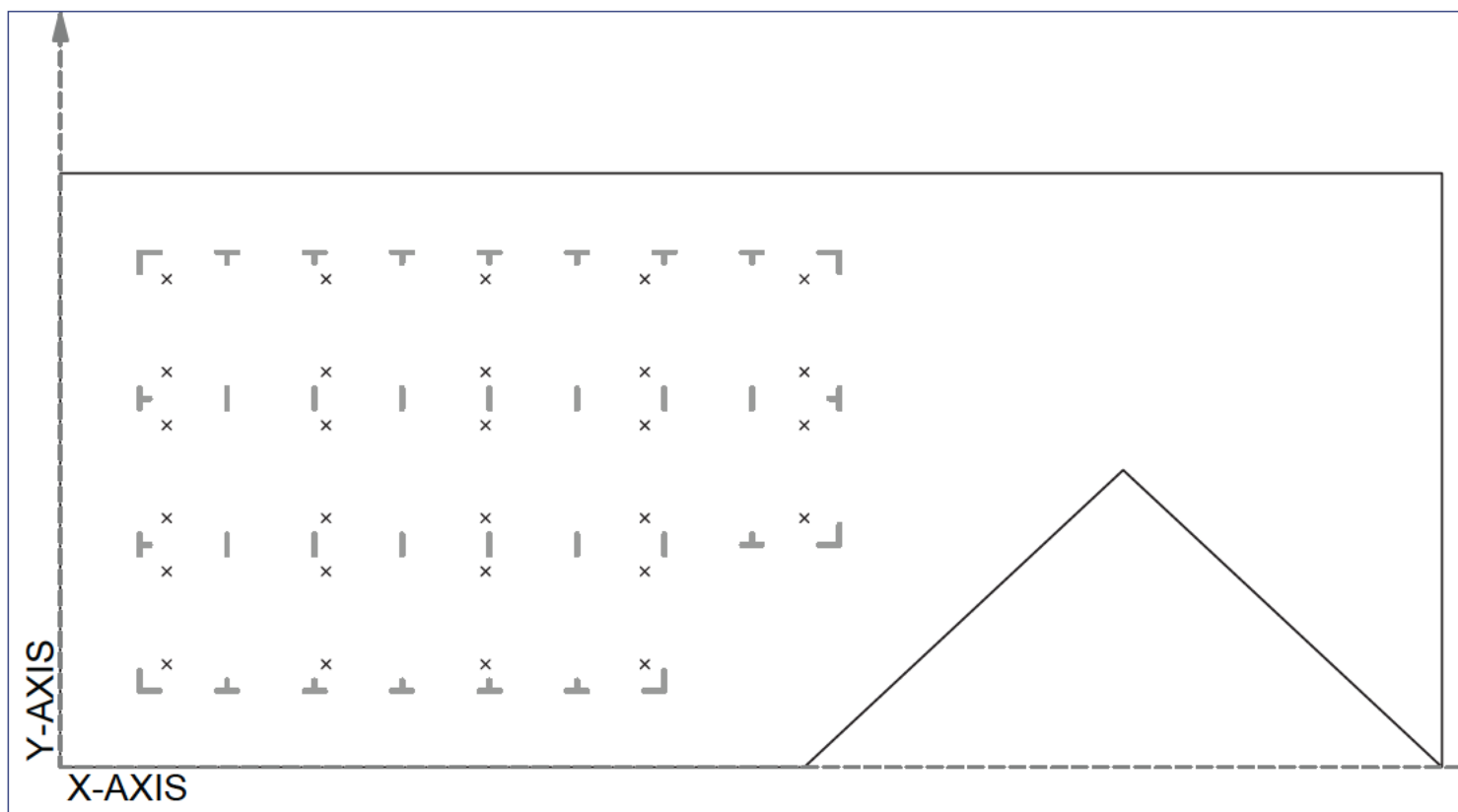
- Always wear appropriate OSHA approved safety equipment when at active construction site
- Appropriate fall protection or prevention gear should be used. Always use extreme caution when near the edge of a roof
- Use appropriate ladder safety equipment when accessing the roof from ground level
- Safety equipment should be checked periodically for wear and quality issues
- Always wear proper eye protection

## System Layout

- 1) Transfer the array layout to the roof using a roof marking crayon to mark the inside and outside corners of the array.
- 2) Locate the estimated roof framing member positions and mark them in the array area with a roof marking crayon.
- 3) Transfer rail locations using a chalk line.
- 4) Mark roof attachment locations on the roof, noting that attachments will be located at intersections of rails and roof framing members. Layout rails such that module frames do not overhang mounting rails more than specified by module manufacturer, more than 25% of total module length, or more than required by the Class A Fire Certification (see Certification Details section).

### Layout Note:

Ensure final roof attachment locations do not exceed the maximum attachment spacing and cantilever specified in the design.

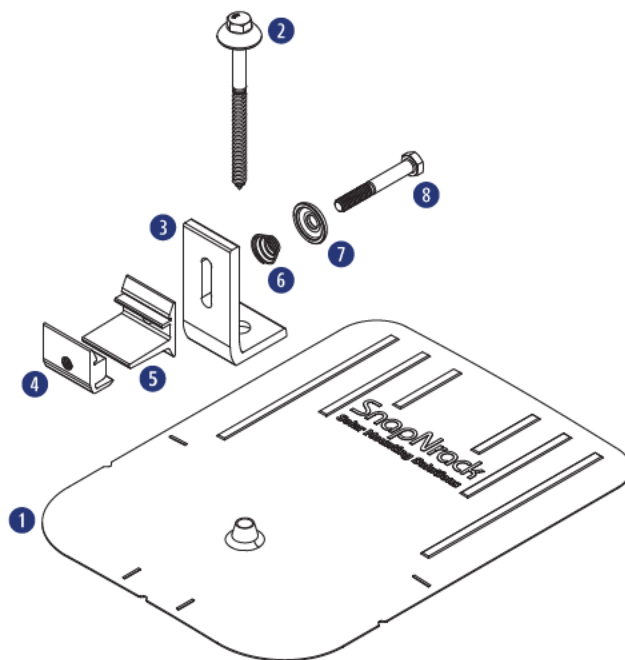


## Required Tools

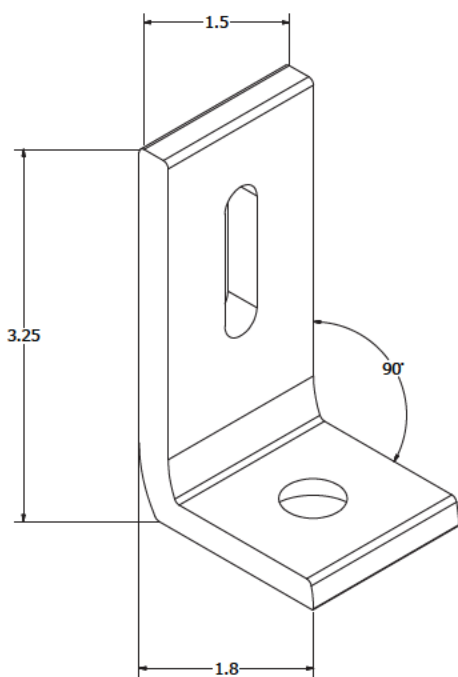
- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16" Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2" Socket

## Materials Included - L Foot Mount

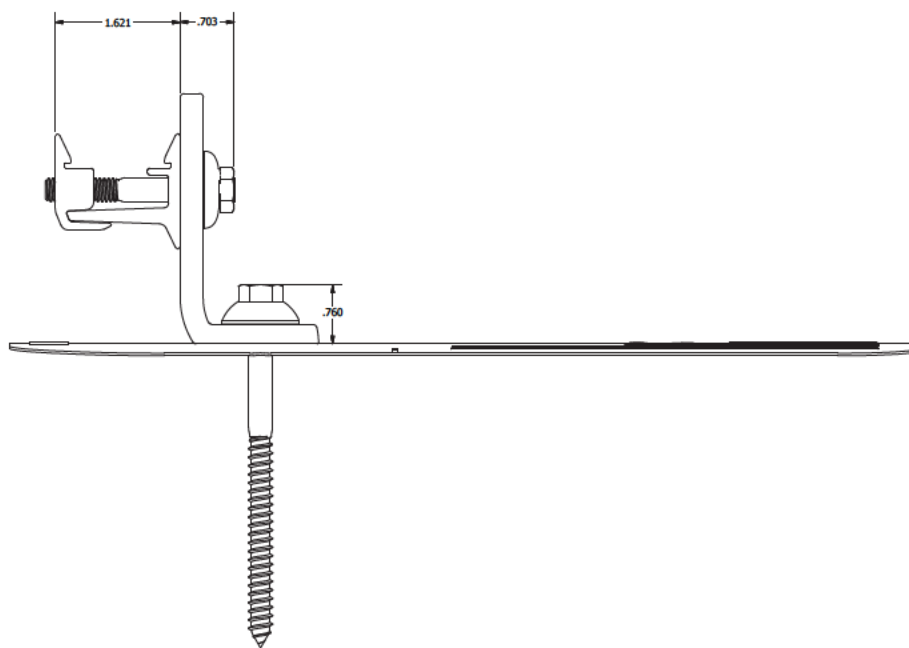
- ① (1) SnapNrack Comp Umbrella Flashing
- ② (1) SnapNrack Umbrella Lag Screw
- ③ (1) SnapNrack Umbrella L Foot
- ④ (1) SnapNrack Ultra Mount (Tapped)
- ⑤ (1) SnapNrack Ultra Mount (Thru-Hole)
- ⑥ (1) SnapNrack Ultra Mount Spring
- ⑦ (1) SnapNrack Ultra Mount Spring Cage
- ⑧ (1) 5/16"-18 X 2-1/4" SS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



**Application Note:**  
Install on composition shingle roofs.



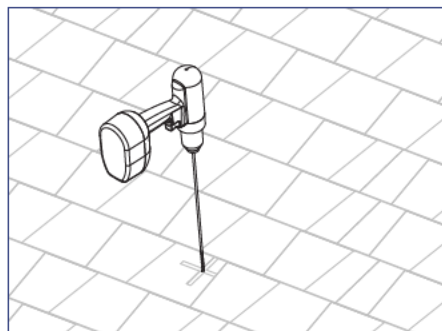
Dimensioned L Foot



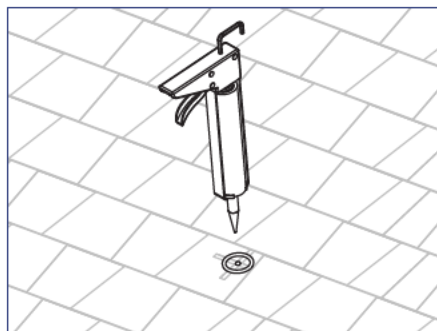
Dimensioned L Foot Assembly



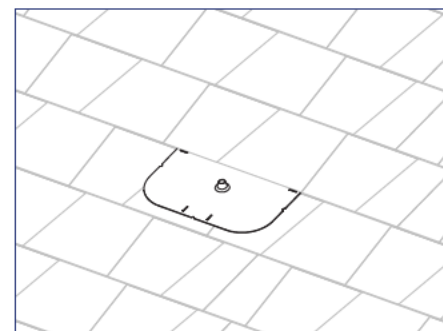
## INSTALLATION INSTRUCTIONS



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.



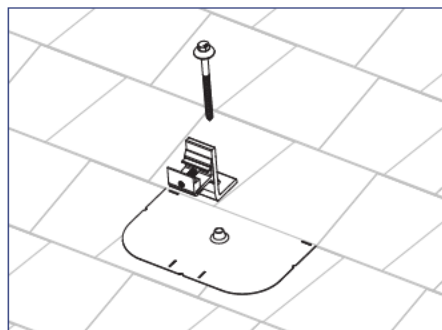
3) Pry up shingles with a breaker bar and install flashing underneath shingle course above pilot hole and, position flashing so cone is in line with pilot hole.



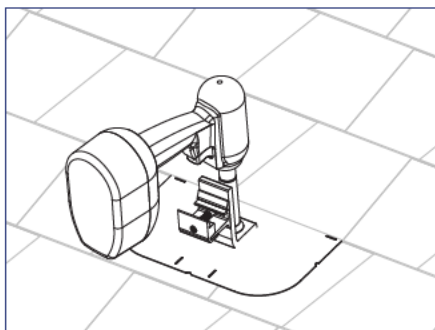
### Install Note:

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:

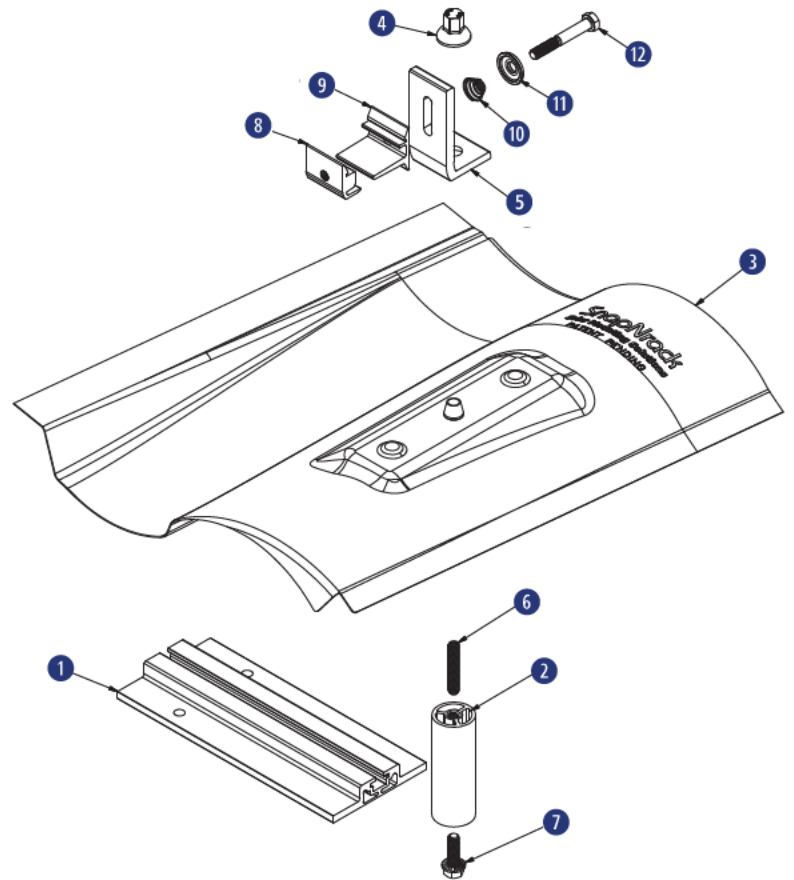
If using an impact driver, finish tightening lag screw with a hand wrench to prevent L Foot from rotating.

## Required Tools

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

## Materials Included - Tile Replacement

- ① (1) SnapNrack Tile Replacement Base
- ② (1) SnapNrack Tile Replacement Riser
- ③ (1) SnapNrack Tile Replacement Flashing
- ④ (1) SnapNrack Umbrella Nut
- ⑤ (1) SnapNrack Umbrella L Foot
- ⑥ (1) 5/16"-18 X 1-3/4" SS Set Screw
- ⑦ (1) 5/16"-18 X 1" SS Flange Bolt
- ⑧ (1) SnapNrack Ultra Mount (Tapped)
- ⑨ (1) SnapNrack Ultra Mount (Thru-Hole)
- ⑩ (1) SnapNrack Ultra Mount Spring
- ⑪ (1) SnapNrack Ultra Mount Spring Cage
- ⑫ (1) 5/16"-18 X 2-1/4" SS HCS Bolt



## Other Materials Required - Not Shown

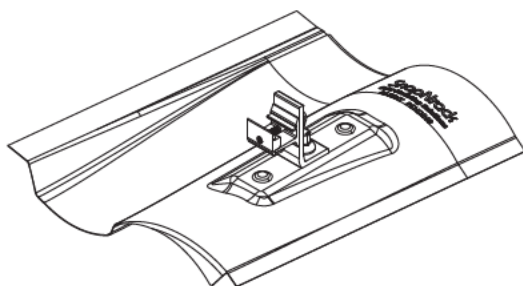
- ① (2) 5/16" Lag Screw
- ② (2) 5/16" Washer
- ③ Flexible Flashing (when required for deck level flashing)



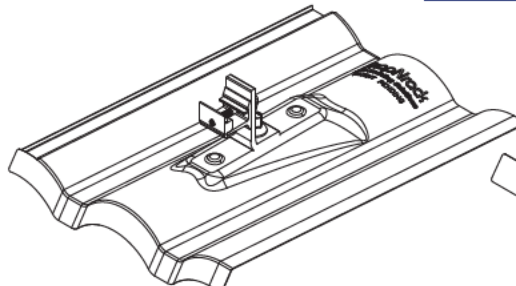
### Application Note:

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

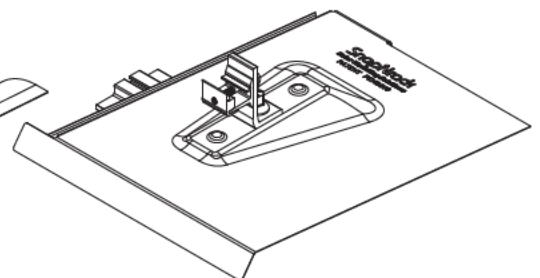
- Tile Course Spacing: 13"-16"
- Tile Thickness: 1-1/4" ±1/8"



S Tile Replacement



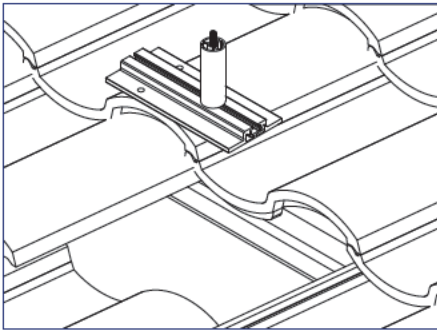
W Tile Replacement



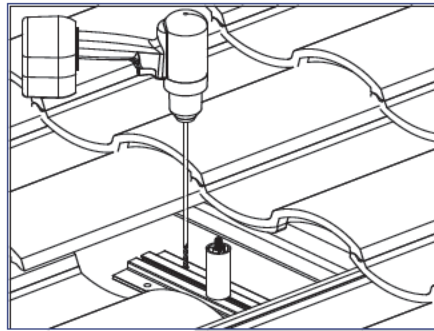
Flat Tile Replacement

# Tile Replacement

## INSTALLATION INSTRUCTIONS



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



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

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

Table 1

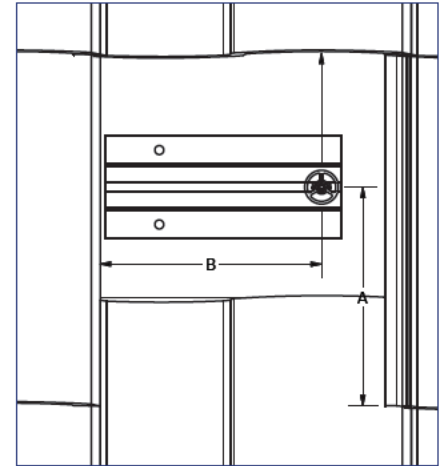


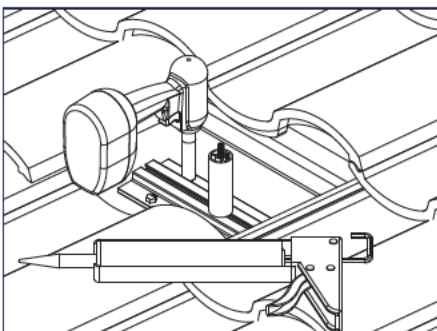
Diagram 1



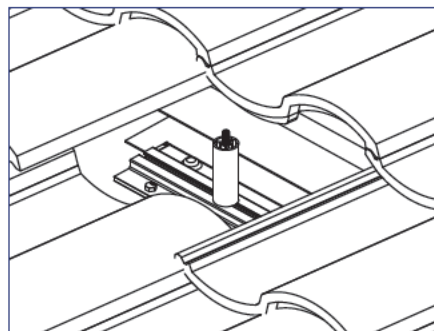
### Install Note:

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

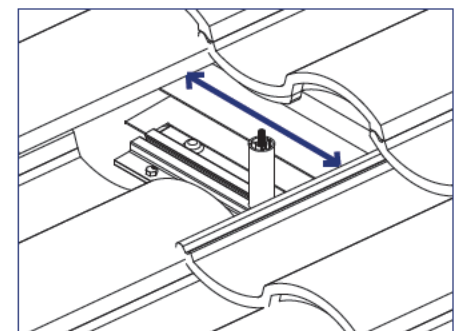
Working from RIGHT TO LEFT and UP THE ROOF will prevent neighboring tiles from lifting flashings.



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



4) If deck level flashing is required, install flexible flashing per the Deck Level Flashing for Tile Replacement Installation Manual.



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

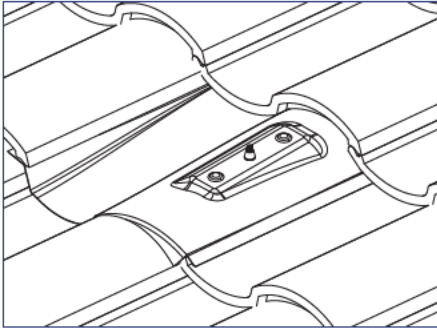


### Best Practice:

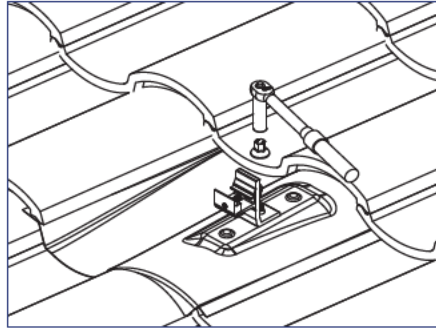
Flashing can be used as a template for locating riser.

# Tile Replacement

## INSTALLATION INSTRUCTIONS



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



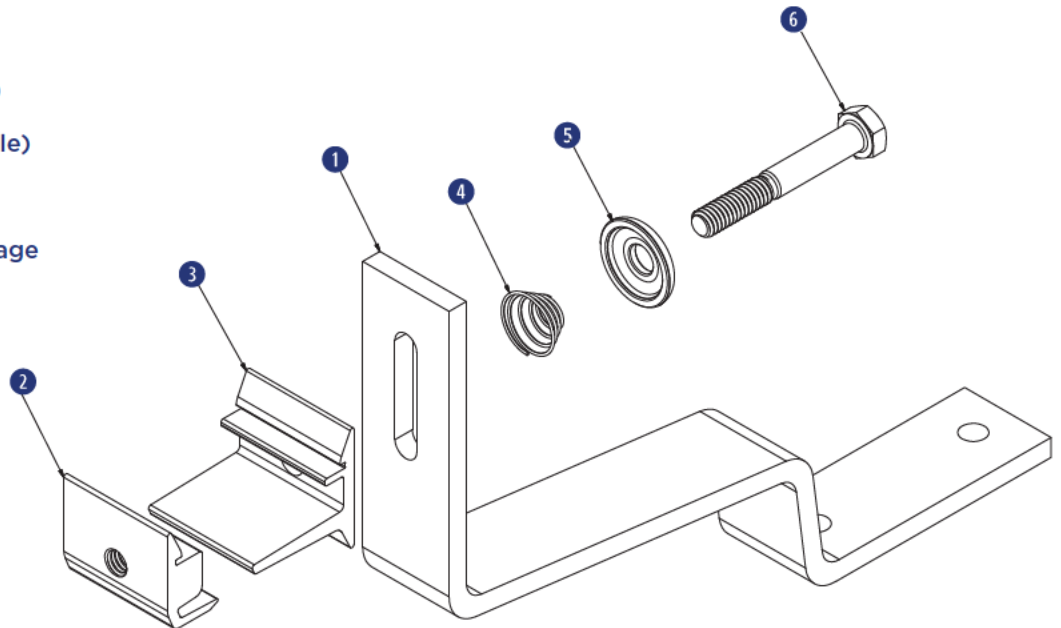
7) Install L Foot onto stud with Umbrella Nut, and tighten hardware to 10 ft-lbs.

## Required Tools

- Hammer or Stud Finder
- Roof 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

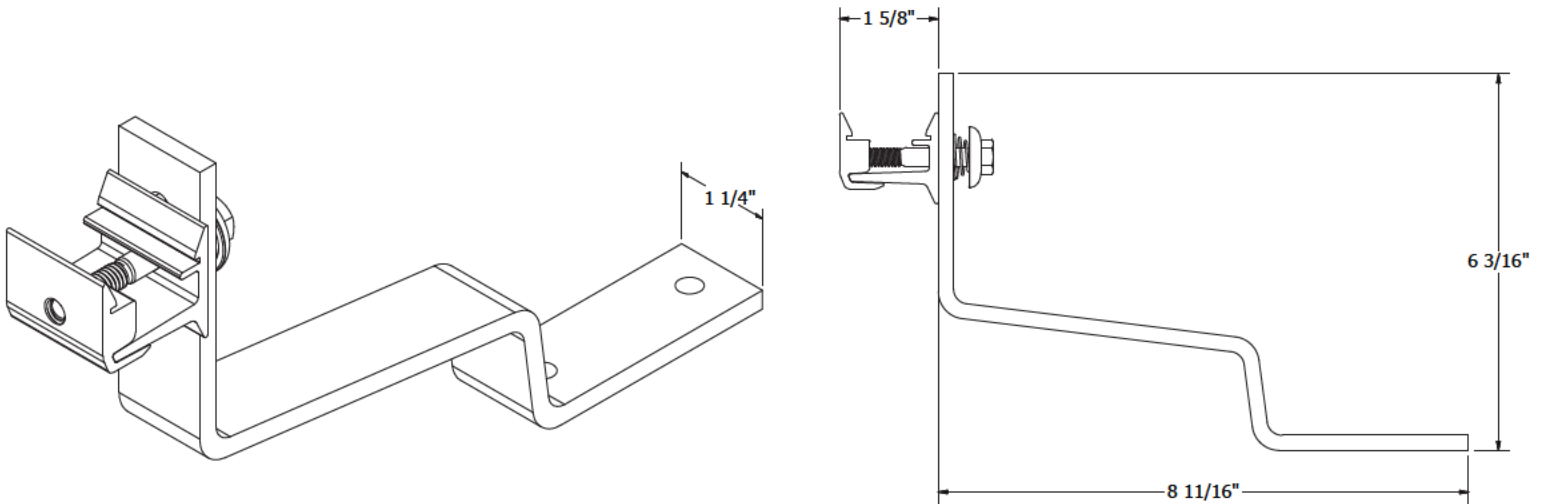
- ① (1) SnapNrack Flat Tile Hook
- ② (1) SnapNrack Ultra Mount (Tapped)
- ③ (1) SnapNrack Ultra Mount (Thru-Hole)
- ④ (1) SnapNrack Ultra Mount Spring
- ⑤ (1) SnapNrack Ultra Mount Spring Cage
- ⑥ (1) 5/16"-18 X 2-1/4" SS HCS Bolt



## Other Materials Required - Not Shown

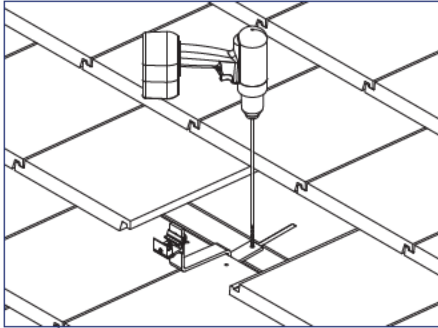
- ① (2) 5/16" Lag Screw
- ② (2) 5/16" Washer
- ③ Flexible Flashing (when required for deck level flashing)

**Application Note:**  
Install on flat concrete tile roofs

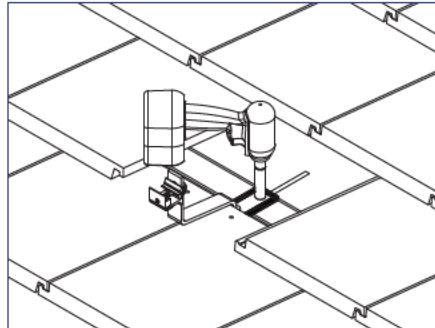


Dimensioned Flat Tile Hook Assembly

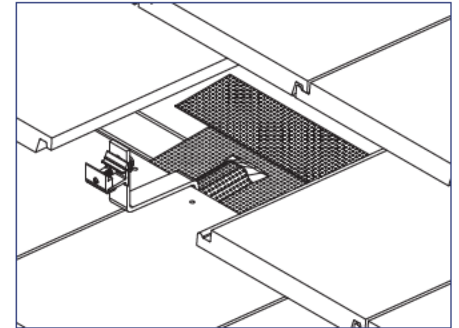
## INSTALLATION INSTRUCTIONS



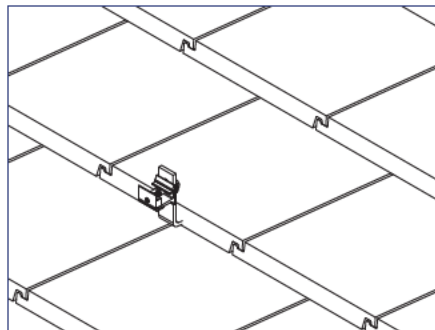
1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed and drill two pilot holes through the roofing material into the roof framing member.



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.



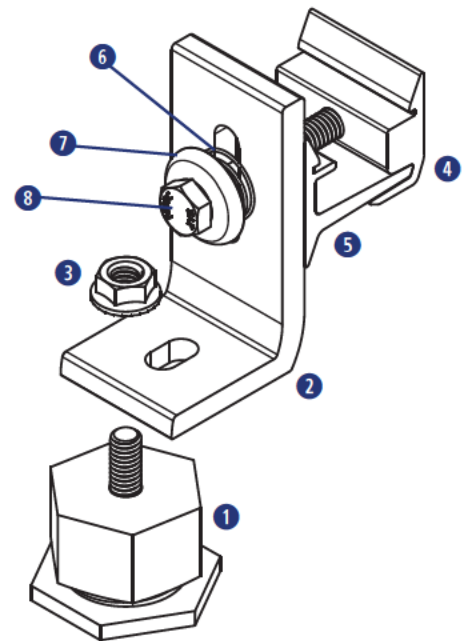
4) Replace the roof tiles.

## 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

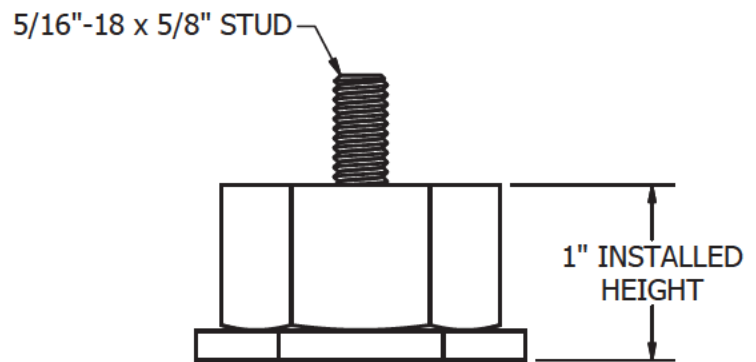
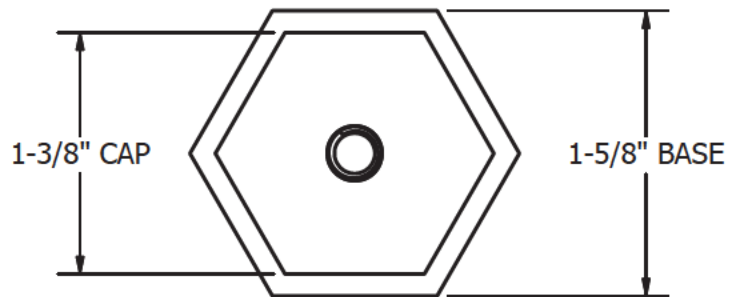


## Other Materials Required - Not Shown

- 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.)

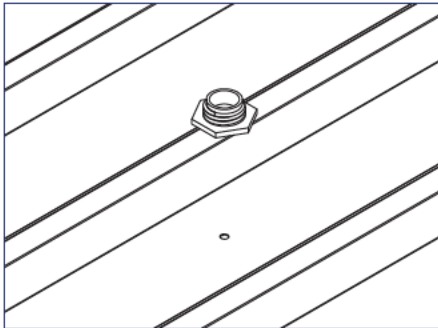
**Application Note:**  
Install on metal roof profiles with flat surface large enough to accommodate 1-5/8" wide base

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

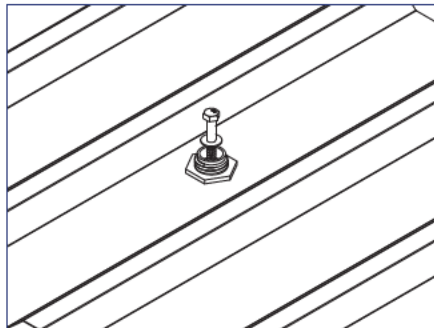


Dimensioned Metal Roof Base Assembly

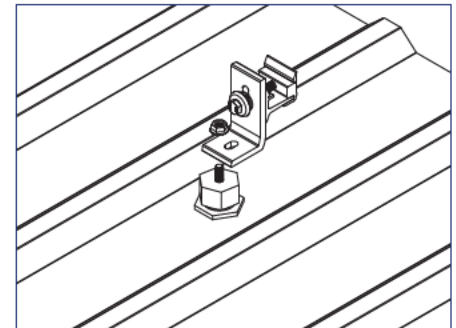
## INSTALLATION INSTRUCTIONS



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.



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



### Install Note:

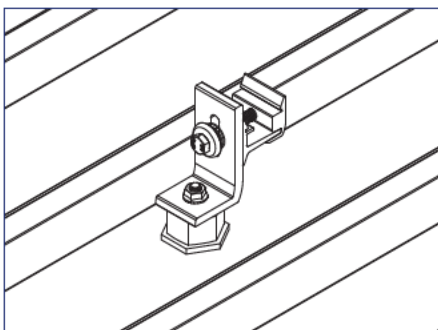
Take care to ensure the base does not twist when cap is tightened.



### 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.

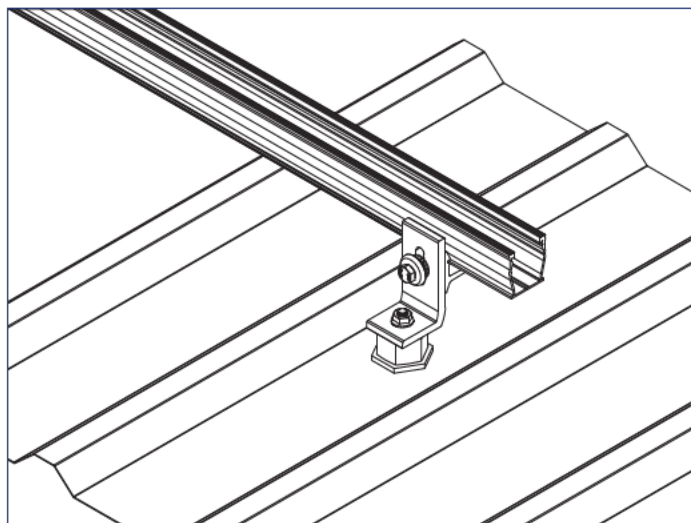


4) Attach L Foot to stud in Metal Roof Base cap and tighten hardware to 10 ft-lbs.



### Best Practice:

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



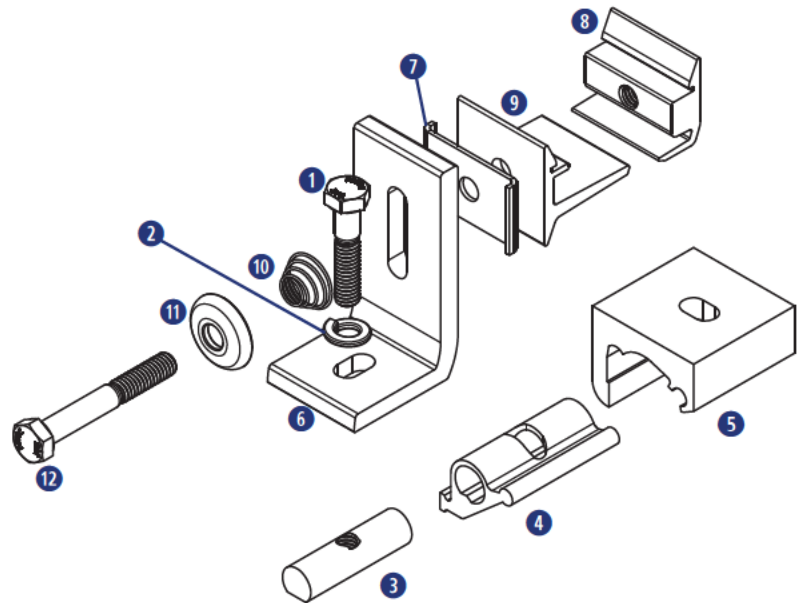


## Required Tools

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

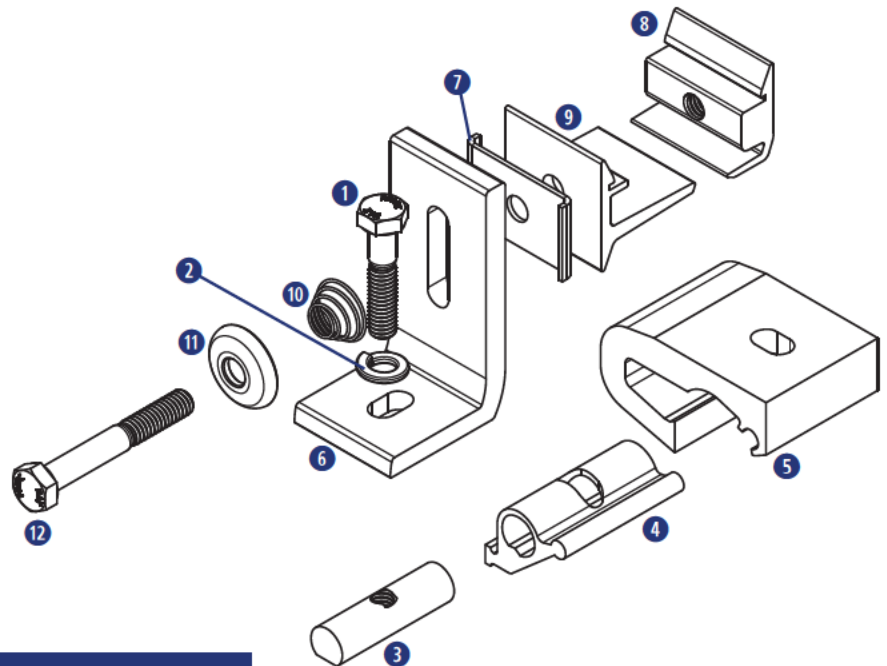
## Materials Included - Standard Base Seam Clamp Kit

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



## Materials Included - Wide Base Seam Clamp Kit

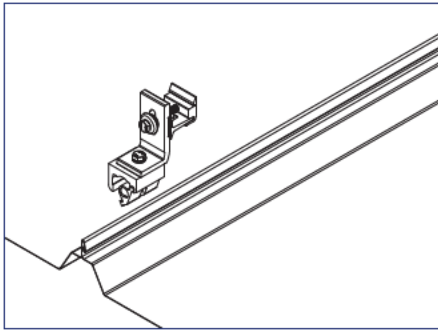
- ① (1) 5/16"-18 X 1-1/2" SS HCS Bolt (Black)
- ② (1) 5/16" SS Split Lock Washer
- ③ (1) SnapNrack Seam Clamp Insert
- ④ (1) SnapNrack Seam Clamp Cam
- ⑤ (1) SnapNrack Seam Clamp Wide Base
- ⑥ (1) SnapNrack All Purpose L Foot
- ⑦ (1) SnapNrack Rotation Lock
- ⑧ (1) SnapNrack Ultra Mount (Tapped)
- ⑨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



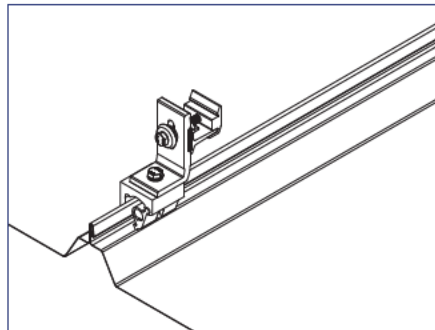
**Application Note:**  
Install on standing metal seam roofs

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

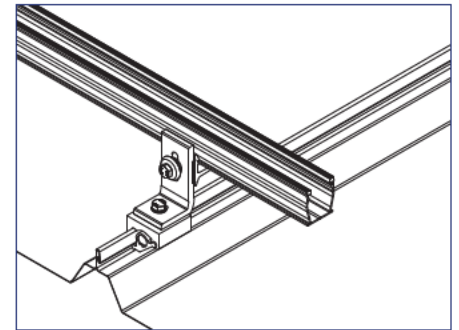
## INSTALLATION INSTRUCTIONS



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



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

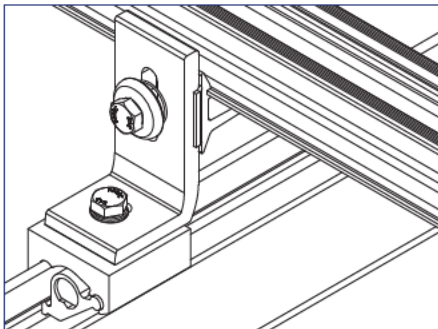


3) Torque black seam clamp bolt to 200 in-lbs (16.7 ft-lbs).



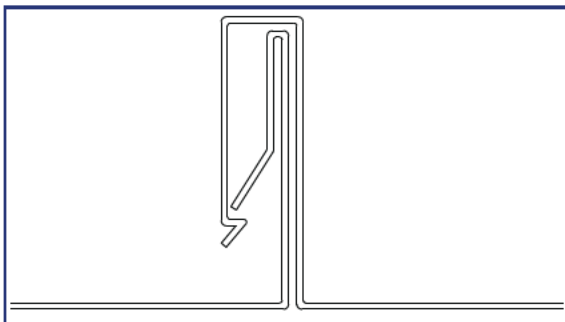
### Install Note:

Seam clamps should never be installed using an impact driver.

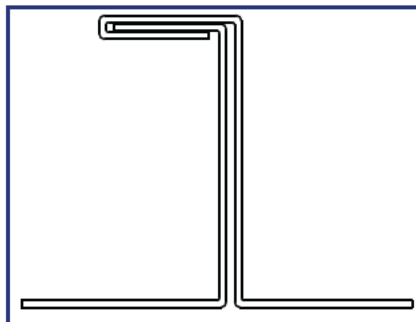


4) Ensure rotation lock is properly aligned with Ultra Mount and L foot during rail installation.

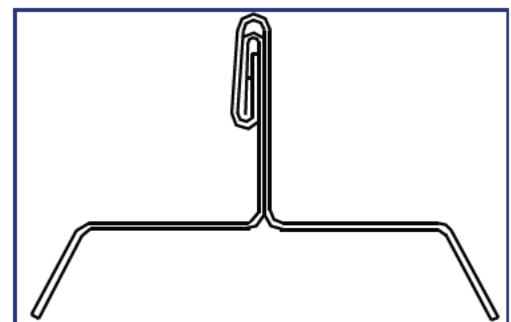
SnapNrack Seam Clamps have been designed to work with a variety of standing seam metal roofs, the most common seam types are:



Snap Lock



Single Lock



Double Lock



### Install Note:

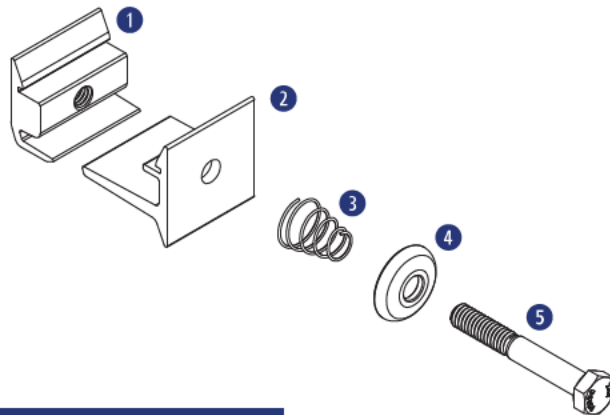
If a specific roof seam is not found on list, contact SnapNrack prior to installation.

## Required Tools

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

## Materials Included - Ultra Rail Mounting Hardware

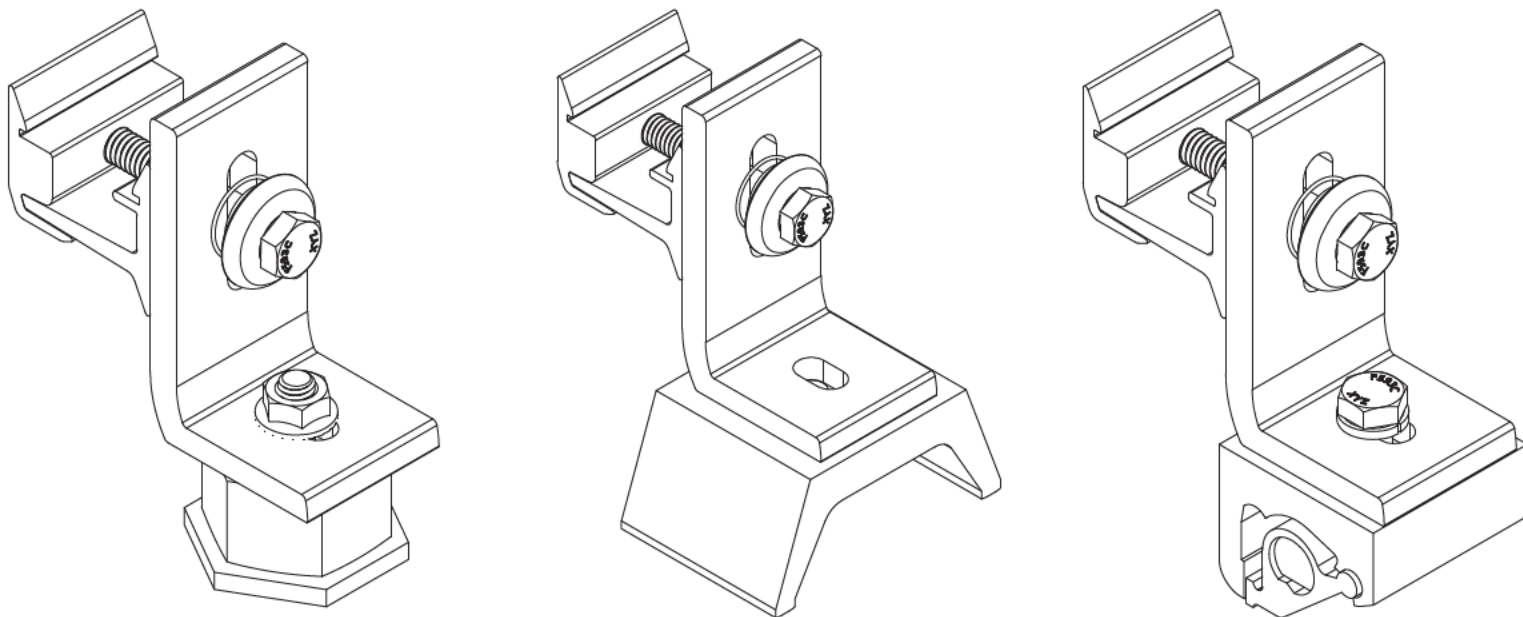
- ① (1) SnapNrack Ultra Mount (Tapped)
- ② (1) SnapNrack Ultra Mount (Thru-Hole)
- ③ (1) SnapNrack Ultra Mount Spring
- ④ (1) SnapNrack Ultra Mount Spring Cage
- ⑤ (1) 5/16"-18 X 2-1/4" SS HCS Bolt



## Other Materials Required - Not Shown

- ① Roof Attachment

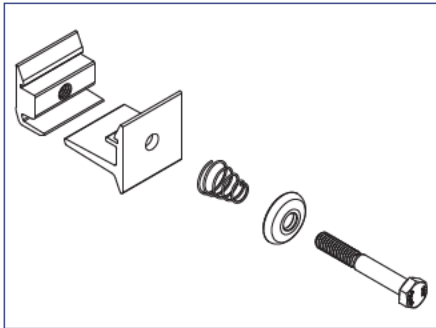
**Application Note:**  
Install Ultra Rail onto any roof attachment that uses an L foot or other slotted mount that accepts 5/16" hardware.



Ultra Rail Mounting Hardware Installed on Different Roof Attachments

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

## INSTALLATION INSTRUCTIONS

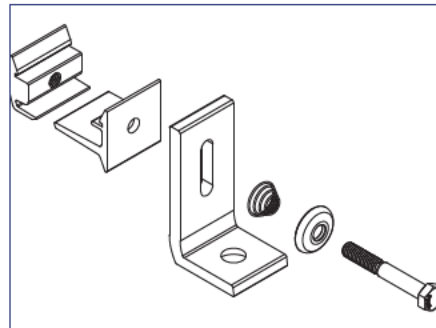


1) Disassemble Ultra Rail Mounting Hardware components, taking note of their installation order and orientation.



### Install Note:

See exploded view on previous page for clarification.



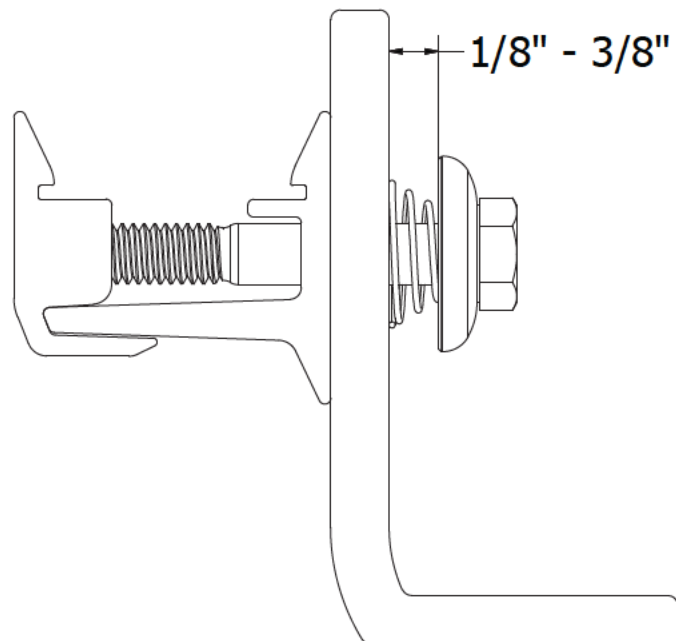
2) Re-assemble Ultra Rail Mounting Hardware components onto roof attachment in the following order:

*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.



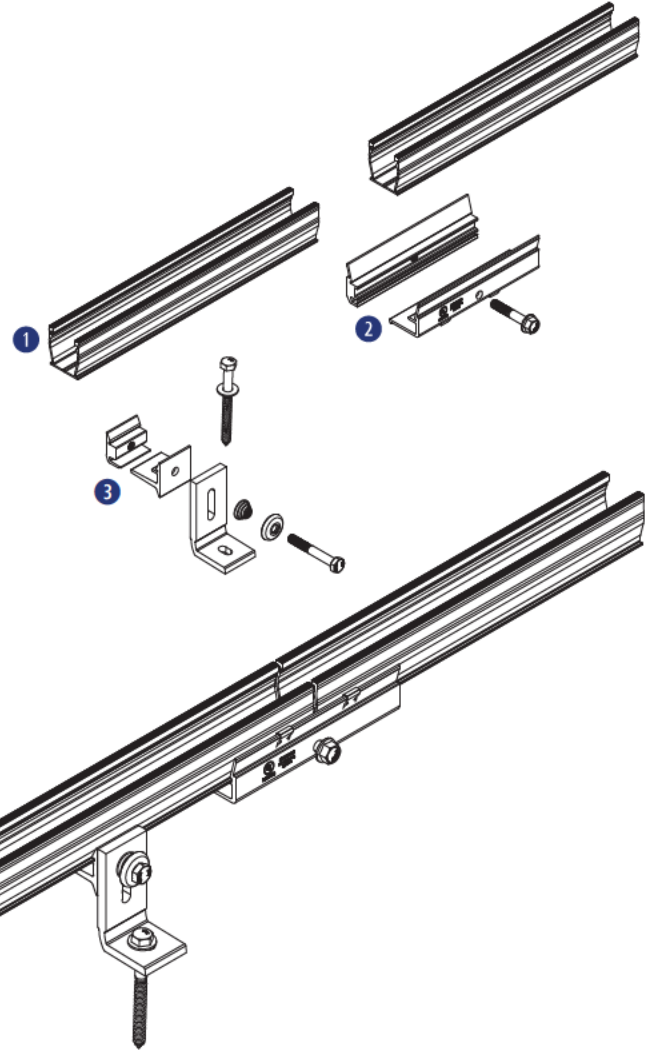
Recommended Ultra Rail Mounting Hardware Installation

## Required Tools

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

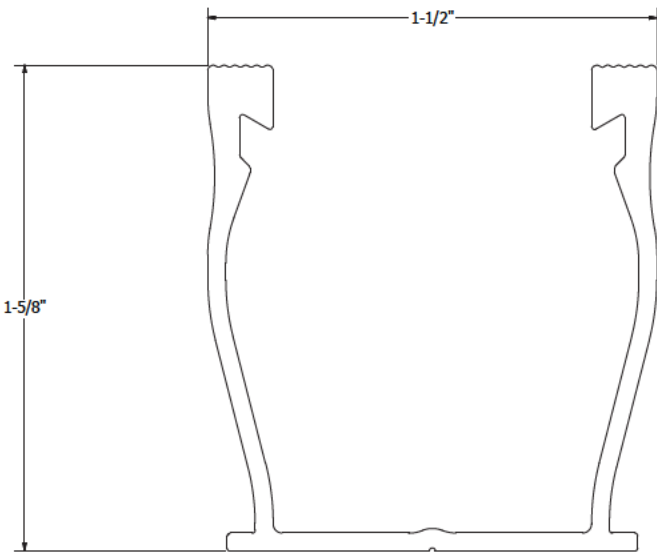
## Materials Included - Installing and Leveling Rails

- ① SnapNrack Ultra Rail
- ② SnapNrack Ultra Rail Splice
- ③ Pre-Installed SnapNrack Roof Attachments  
(L Foot Mount, Tile Replacement, etc.)

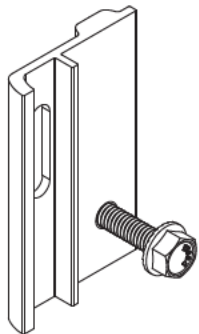


## Other Materials Required - Not Shown

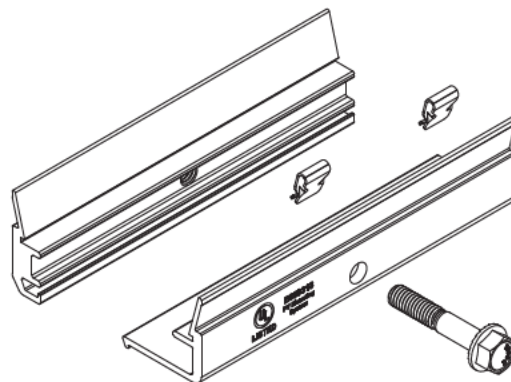
- ① SnapNrack L Foot Extension



UR-40 Rail Profile

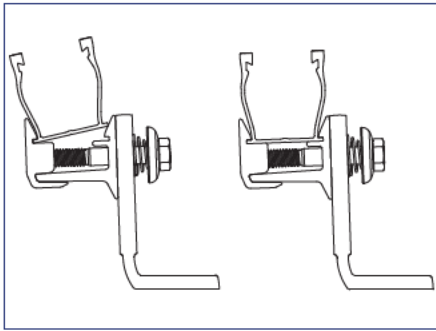


L Foot Extension

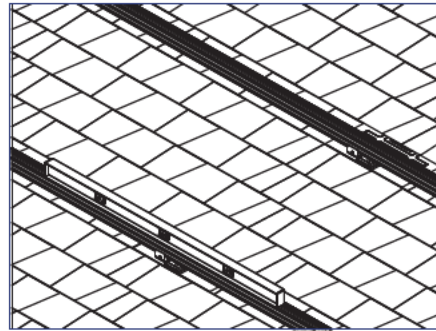


Ultra Rail Splice

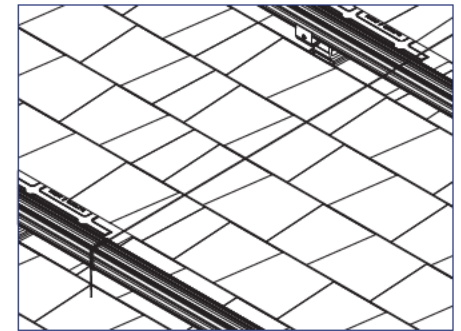
## INSTALLATION INSTRUCTIONS



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).



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



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.



### Best Practice:

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



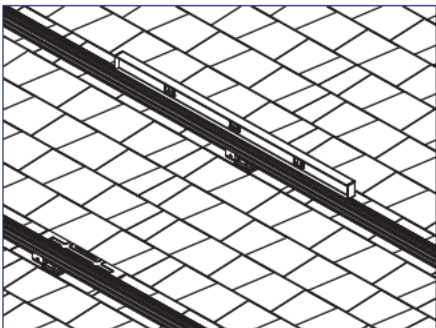
### Install Note:

See “Leveling Components” section for installation instruction and restrictions.

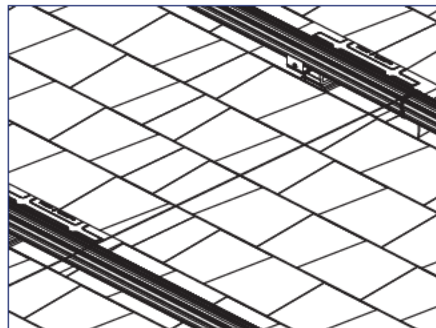


### Install Note:

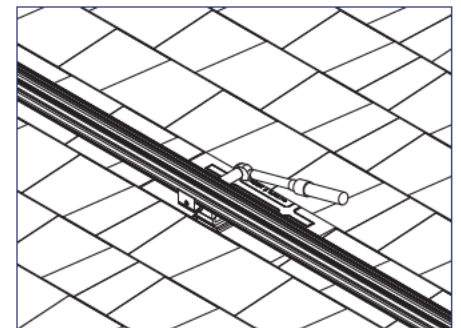
Slightly rocking rail into mounts can ease installation, leading first with side of rail furthest from mount.



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.



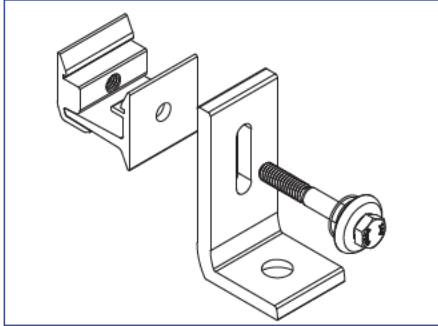
### Note:

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

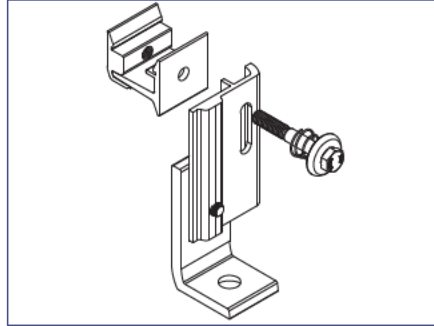
- REC Solar, Yingli, and Suniva modules: 4.00"
- ReneSola modules: 3.93" (100 mm)
- Trina Solar modules: 4.53" (115 mm)

## INSTALLATION INSTRUCTIONS

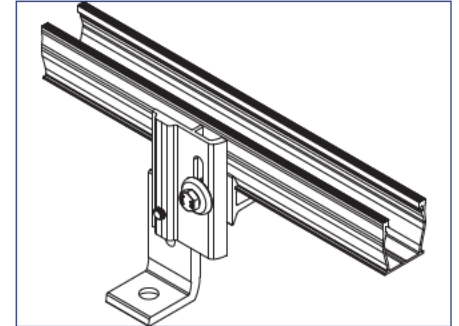
### SnapNrack L Foot Extension



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:

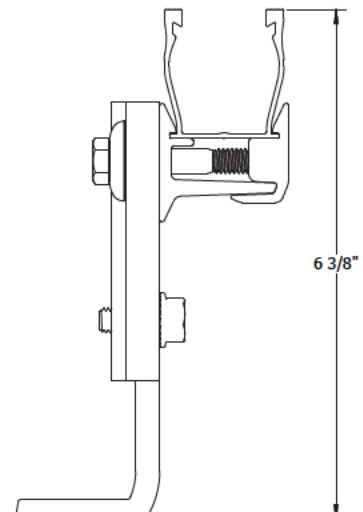
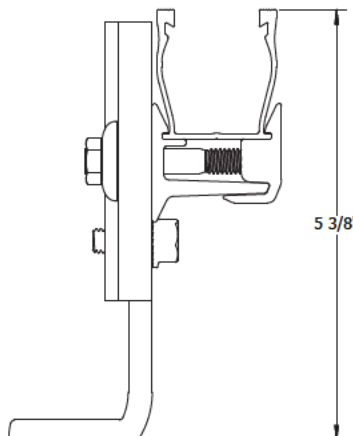
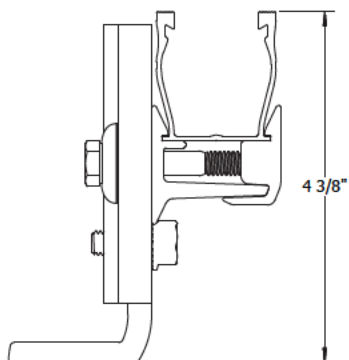
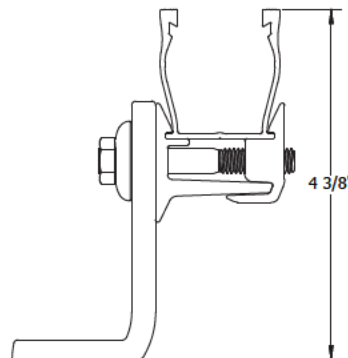
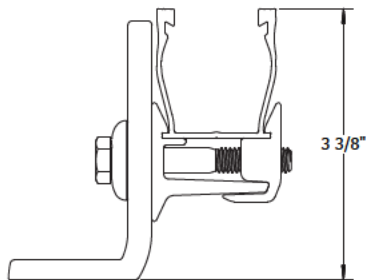
*Ultra Mount (tapped) - Ultra Mount (thru-hole) - L Foot Extension - spring - washer - bolt*

#### Install Note:

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

#### Best Practice:

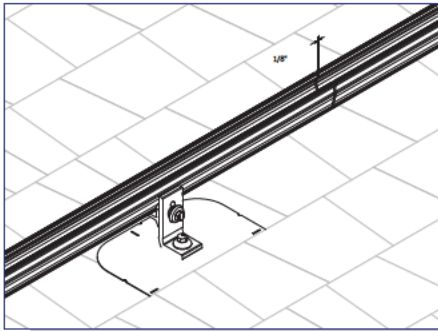
Ensure bolt is threaded into mount, but leave assembly loose for rail installation.



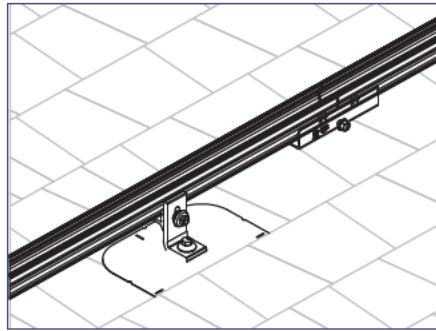
Use a single L Foot Extension on no more than 30% of attachment points.

L Foot Extension Provides Up To 3" of Height Adjustment

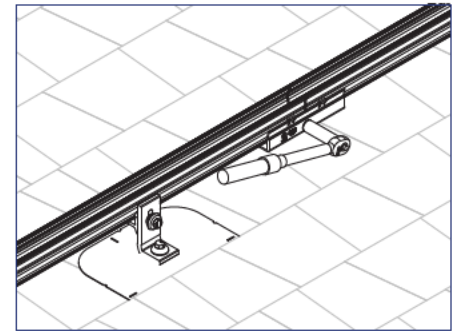
## INSTALLATION INSTRUCTIONS



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



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.



3) Tighten splice hardware to 12 ft-lbs.

### Install Note:

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

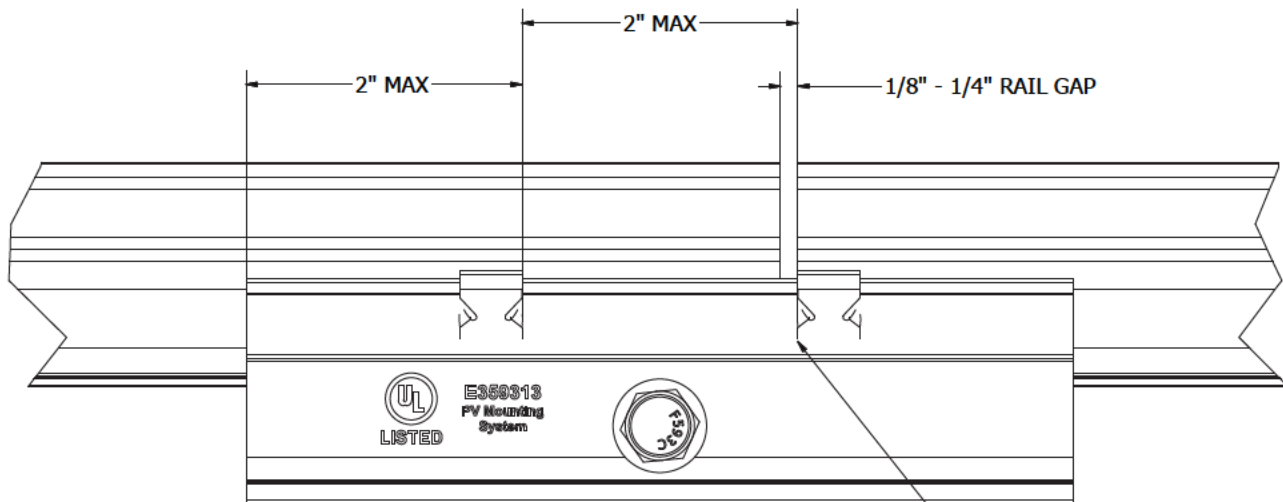
Any section of rail that is spliced will need to be supported by a roof attachment on both sides. Splices are not allowed to be installed on rail cantilevers.

### 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.



RAIL EDGE MUST NOT PASS CLIP EDGE, AS SHOWN

### Splice Installation Limitations

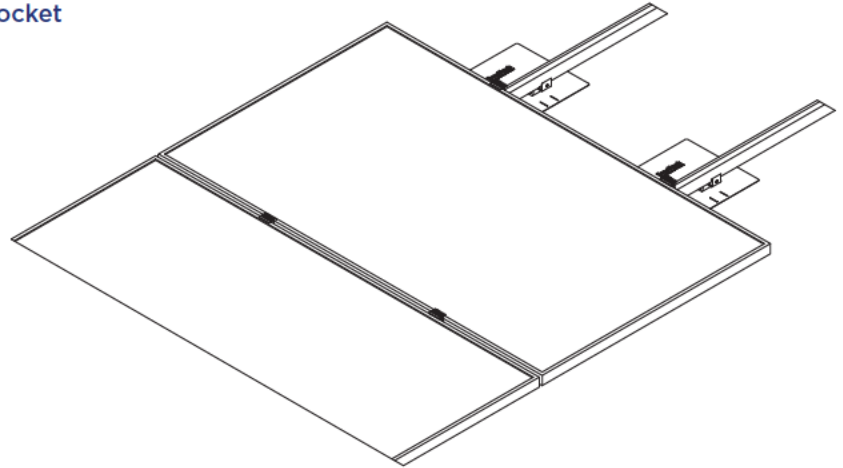


## Required Tools

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

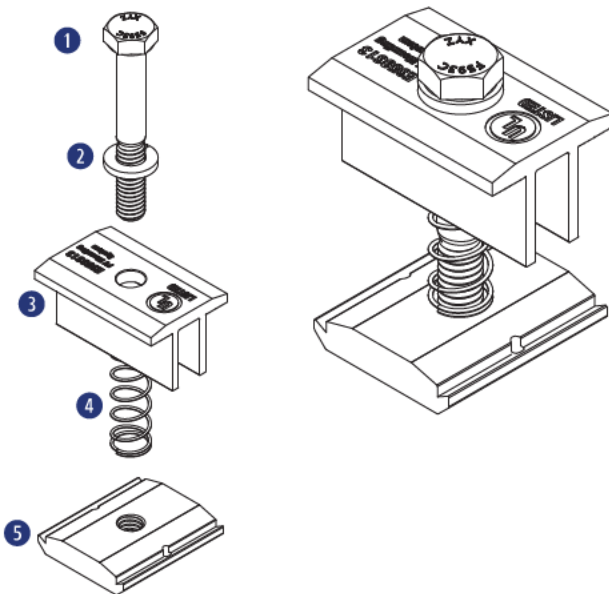
## Materials Needed - Module Installation

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



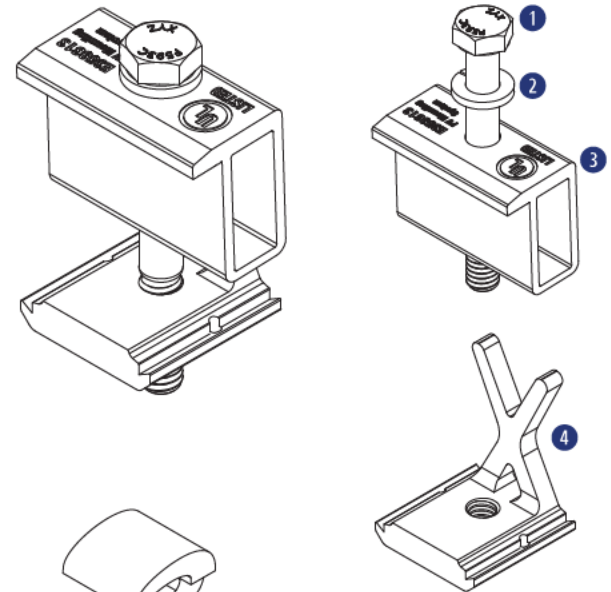
## Mid Clamp Assembly

- 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



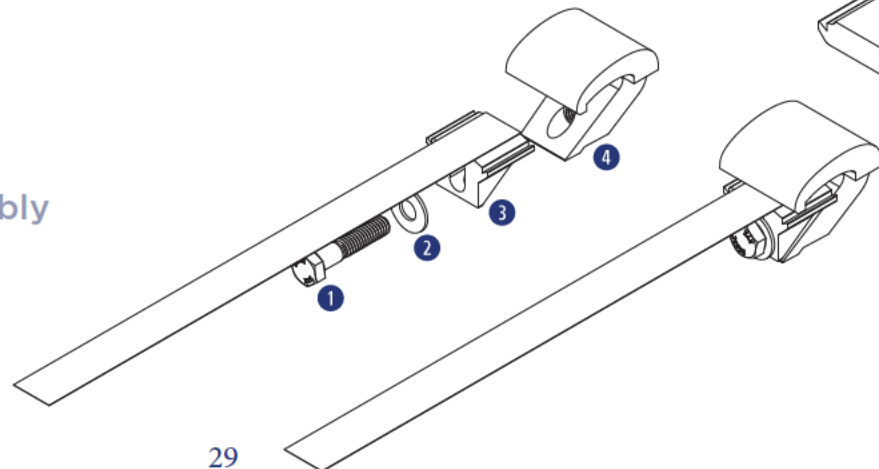
## Adjustable End Clamp Assembly

- 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



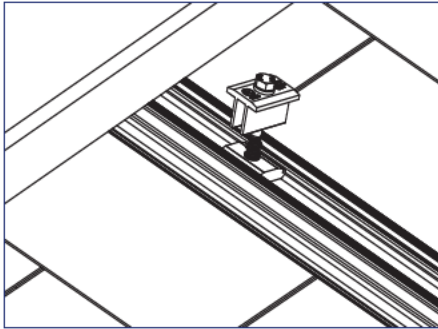
## Universal End Clamp Assembly

- 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

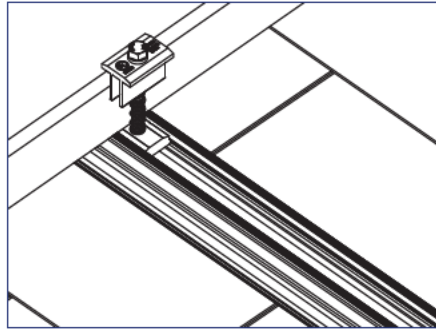
### SnapNrack Mid Clamp



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

#### Best Practice:

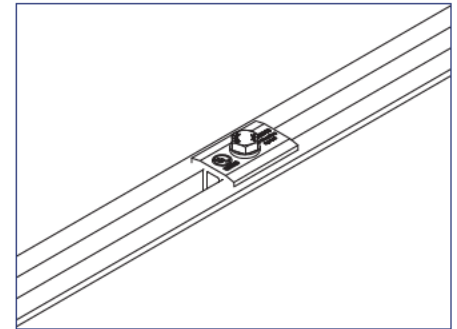
Backing channel nut off bolt will ease installation into rail channel.



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:

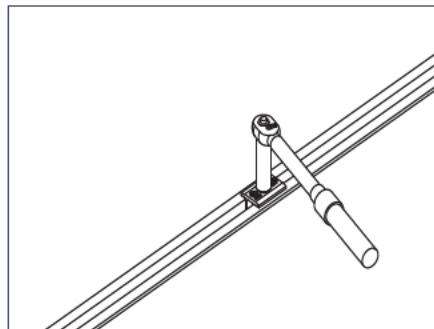
Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.



3) Place the next module flush to the other side of the mid clamp.

#### Install Note:

Mid clamps create 1/2" gap between modules.



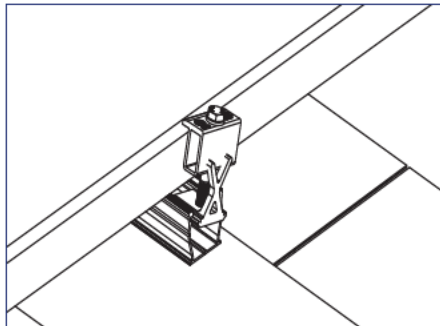
4) Tighten hardware to 10 ft-lbs.

#### Install Note:

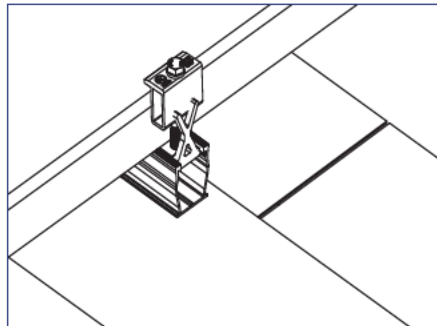
Mid clamps are Listed with and without springs.

## INSTALLATION INSTRUCTIONS

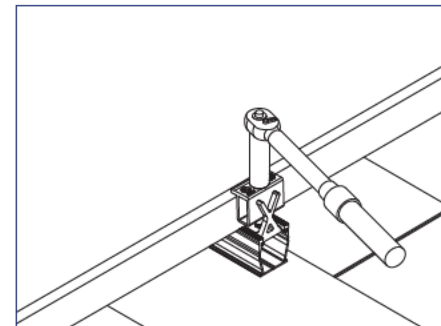
### SnapNrack Adjustable End Clamp



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



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



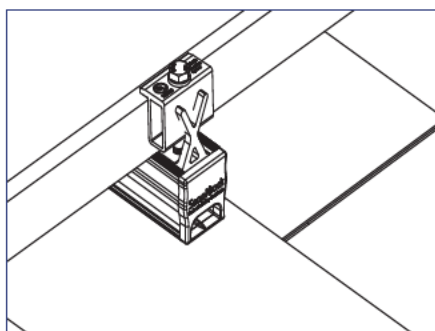
3) Tighten hardware to 10 ft-lbs.

#### Install Note:

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

#### Install Note:

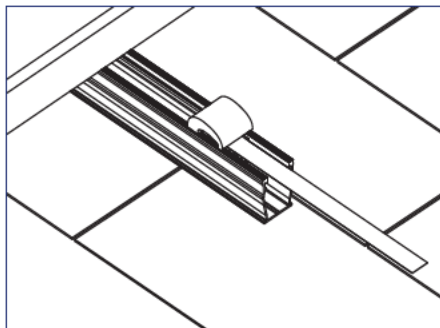
Take care to avoid having wires pinched between modules and rails, as this can lead to system failure and be dangerous.



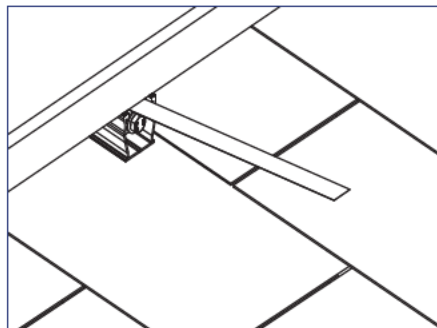
4) Install end cap to finish.

## INSTALLATION INSTRUCTIONS

### SnapNrack Universal End Clamp



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

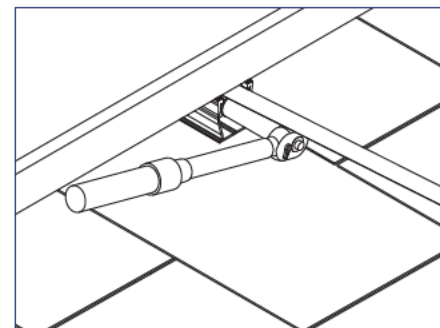


2) Lift the module and slide the clamp far enough under the module to pass the lip of the bottom edge of the module frame.



#### Install Note:

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

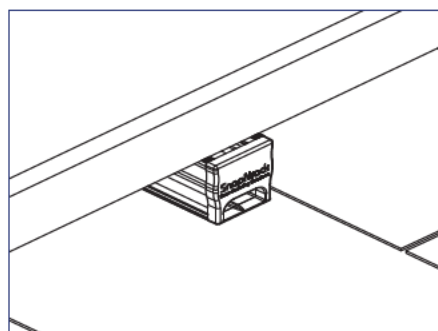


3) Use the pull tab to hold the UEC taut towards the end of the rail and tighten hardware to 10 ft-lbs.



#### Install Note:

Rail can be cut flush to the module when using UEC.



4) Install end cap to finish.



#### Install Note:

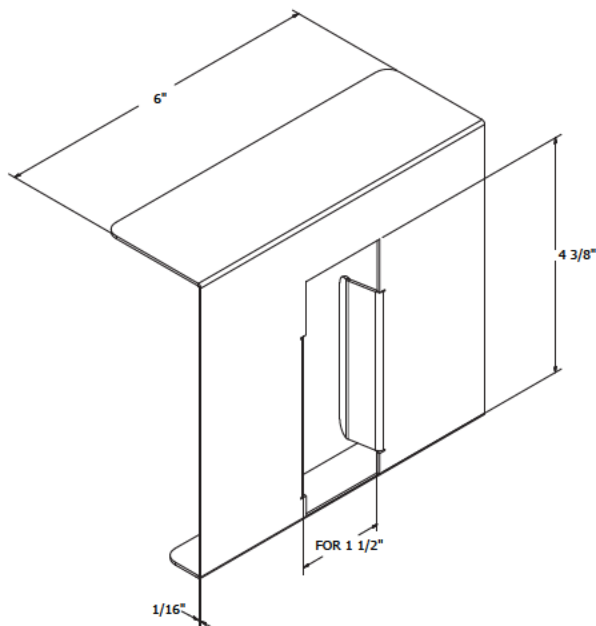
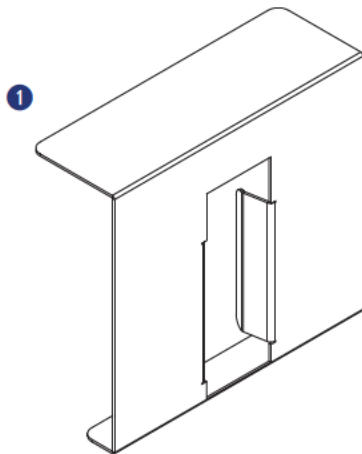
Modules need to be grounded separately when Universal End Clamps are the only type of clamp attaching a module.

## Required Tools

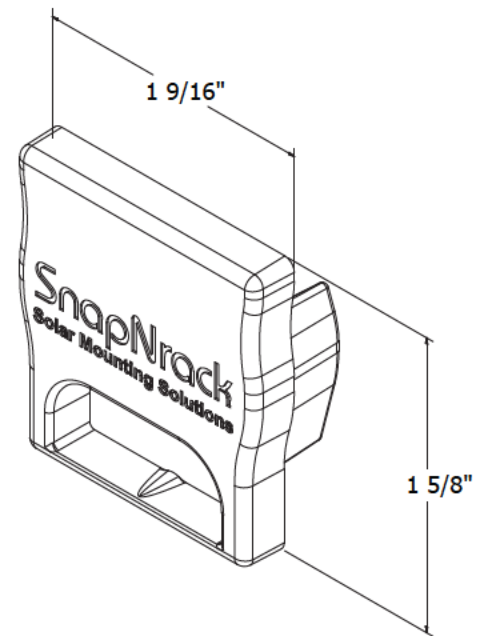
- Reciprocating Saw or Portable Band Saw

## Materials Included - Rail Cutting Tool and Rail End Cap

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



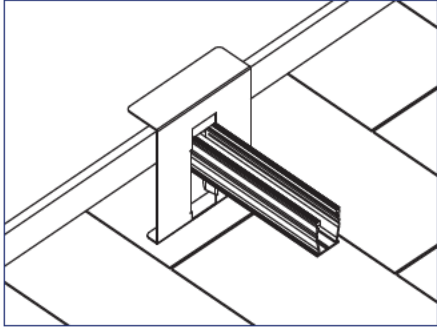
Dimensioned Rail Cutting Tool



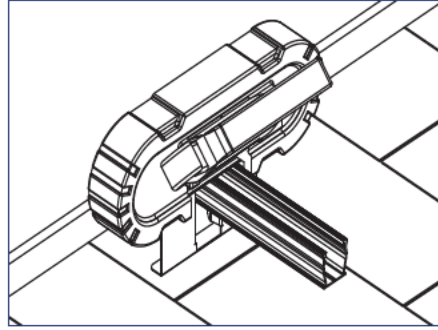
Dimensioned Ultra Rail End Cap

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

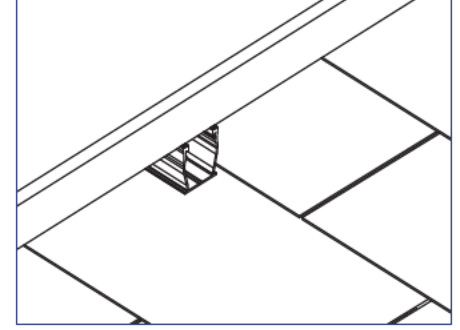
## INSTALLATION INSTRUCTIONS



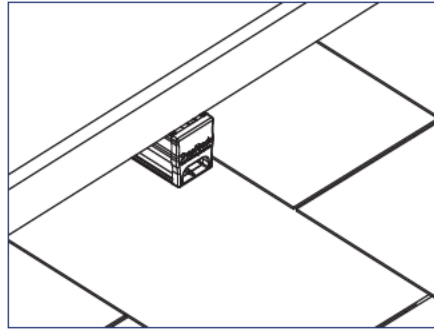
1) Slide the Rail Cutting Tool over the end of the rail and place it so that the upper lip is safely covering the edge of the module (*optional*).



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.

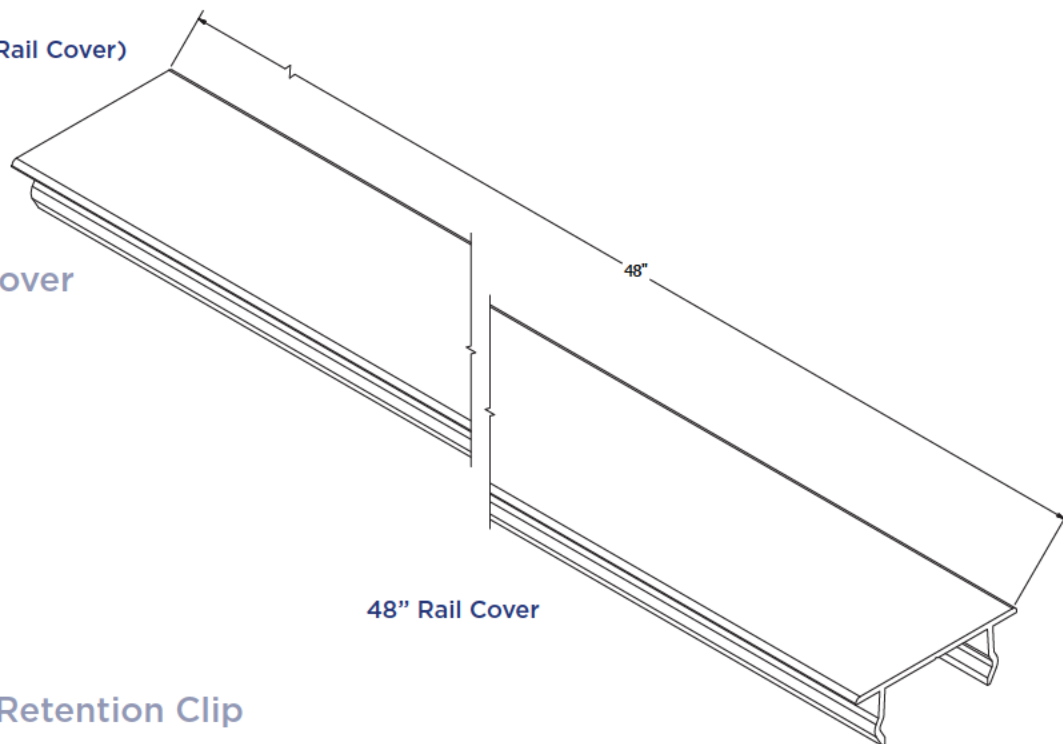
## Required Tools

- 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



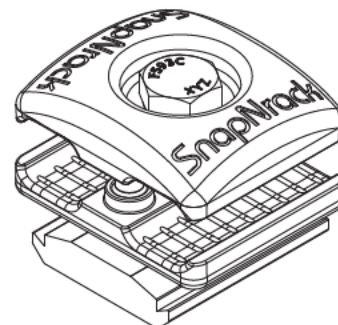
Wire Retention Clip

**?** 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

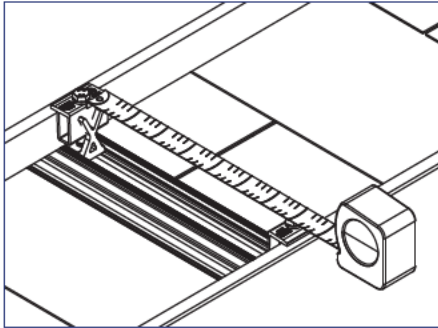
**?** Application Note:  
Install as necessary to secure cables and conductors running from rail to rail, or transitioning out/in from a rail channel



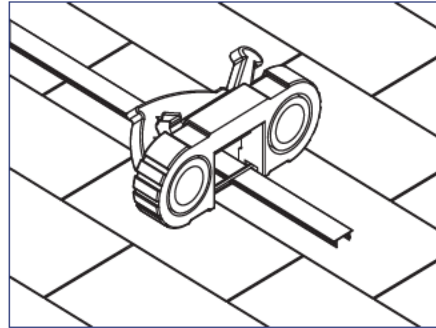
Universal Wire Clamp Assembly

## INSTALLATION INSTRUCTIONS

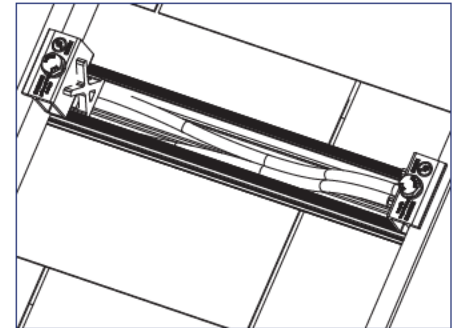
### SnapNrack 48" Rail Cover



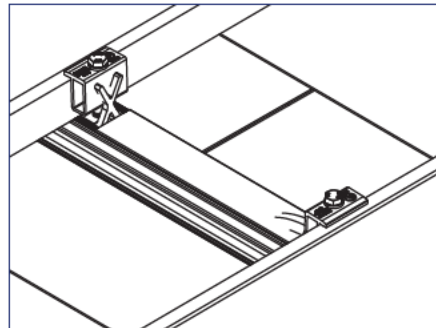
1) Measure the length of the SnapNrack 48" Rail Cover that is needed.



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.

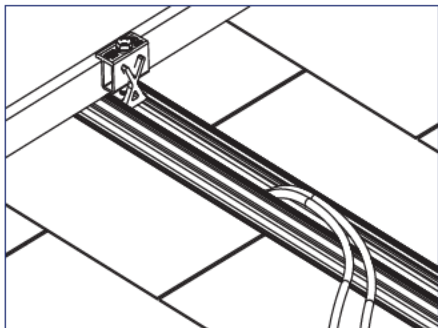
#### Install Note:

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.

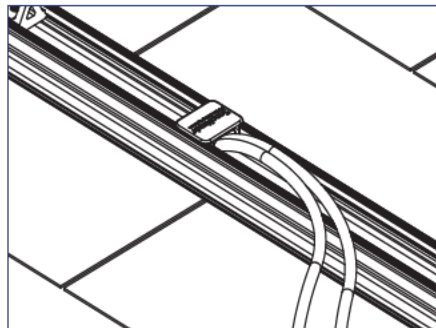


## INSTALLATION INSTRUCTIONS

### SnapNrack Wire Retention Clip

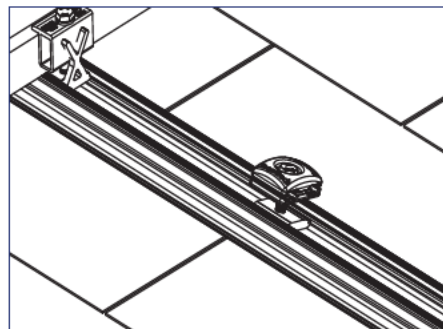


1) Place all electrical conductors in the bottom of the rail channel.

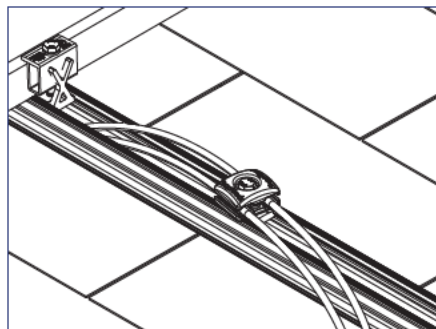


2) Install the Wire Retention Clip by snapping it into place on the rail.

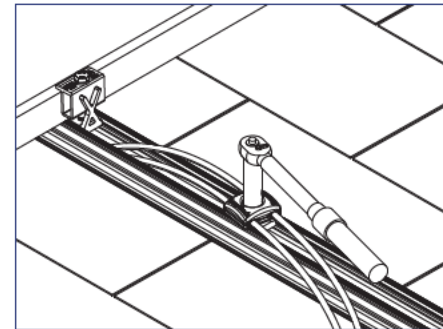
### SnapNrack 4-Wire, Trunk Cable, or Universal Wire Clamp



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



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

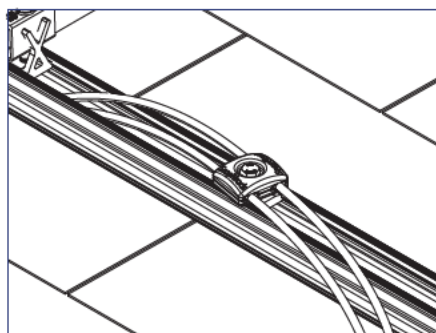


3) Tighten Wire Clamp with 1/2" socket, ensure cables and conductors are aligned in the clamp slots.



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.

## Required Tools

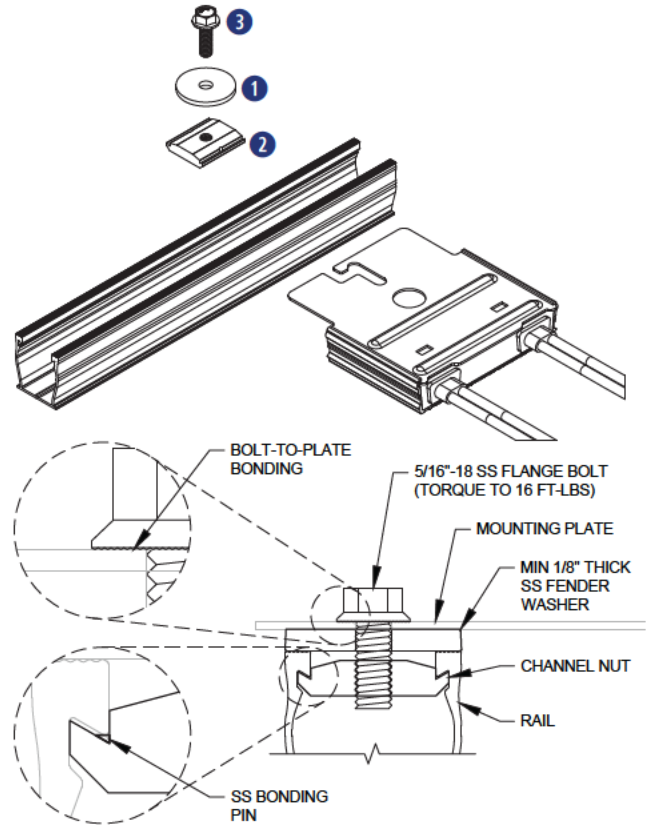
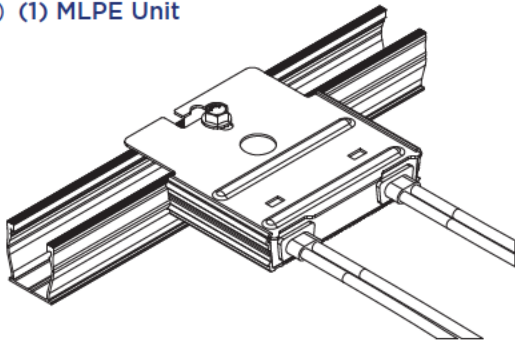
- Torque Wrench
- Socket Wrench
- 1/2" Socket

## 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

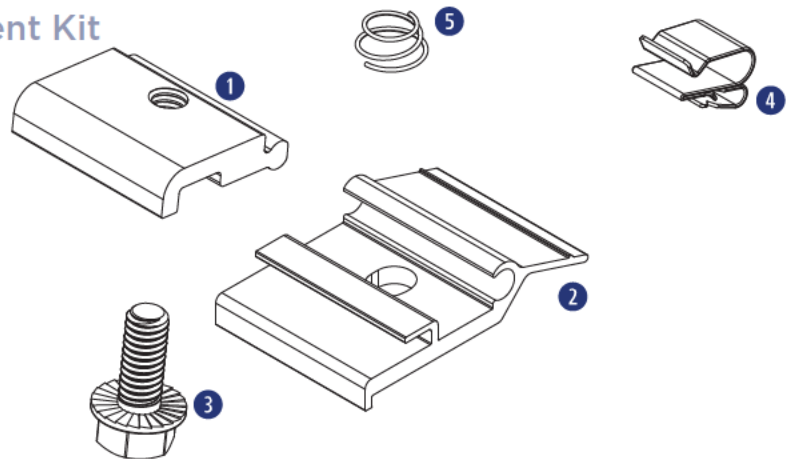
## Other Materials Required

- ① (1) MLPE Unit



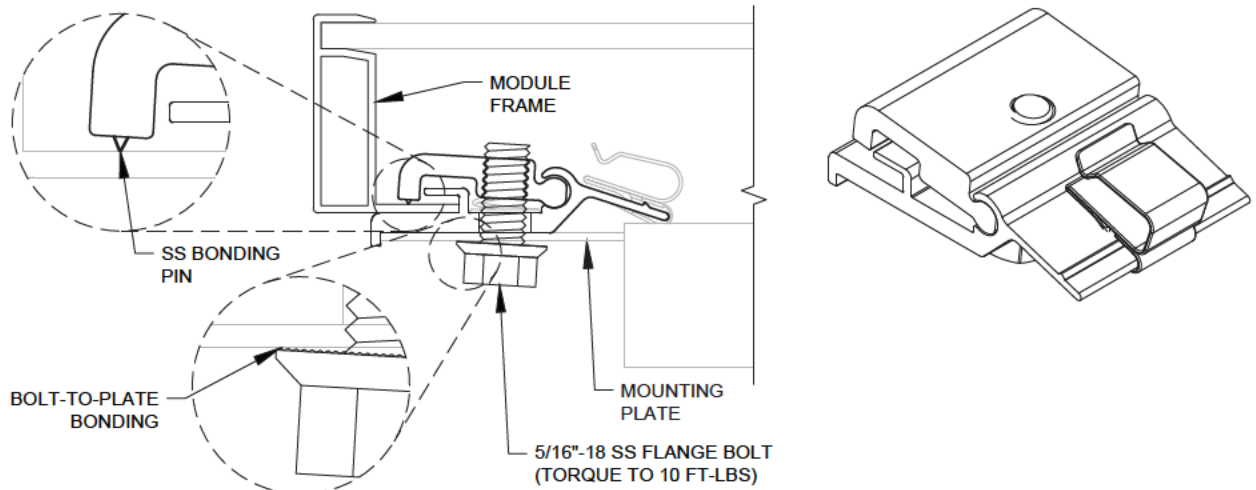
## Materials Included - MLPE Frame Attachment Kit

- 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



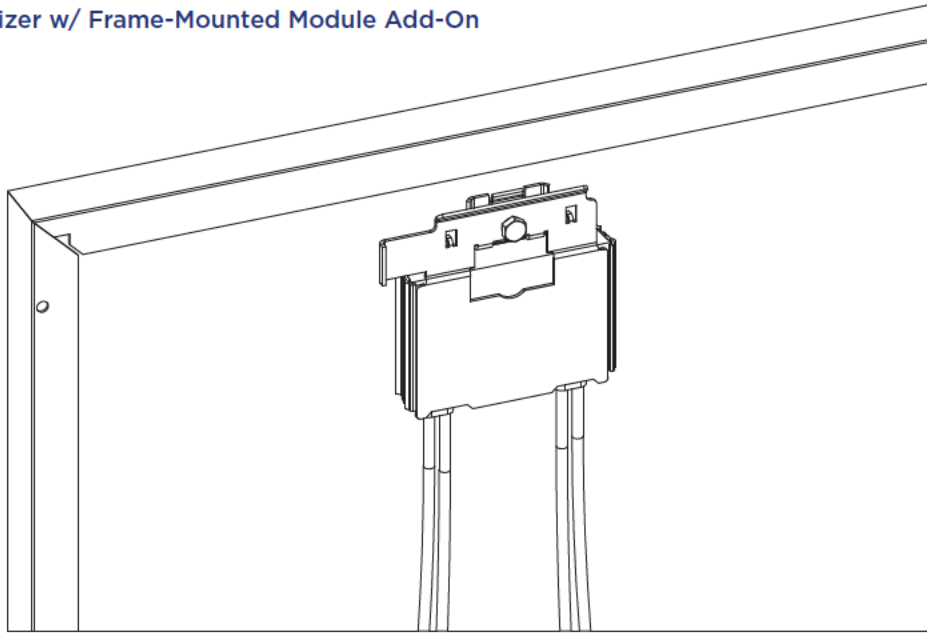
## Other Materials Required

- ① (1) MLPE Unit



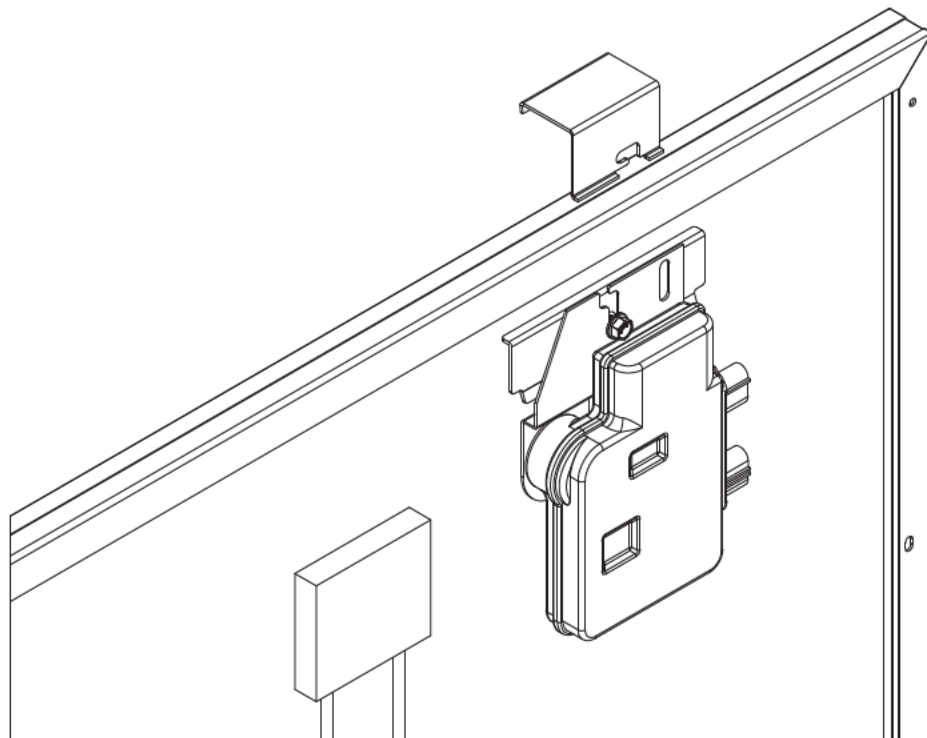
## Materials Needed - SolarEdge Frame Mount

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

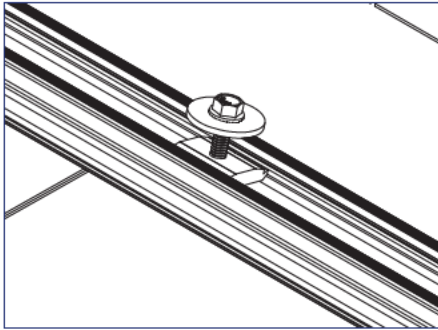


## Materials Needed - Enphase Frame Mount

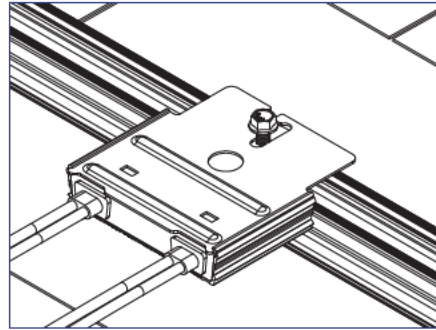
- ① (1) Enphase Microinverter
- ② (1) Enphase Frame Mount



## INSTALLATION INSTRUCTIONS - MLPE RAIL ATTACHMENT



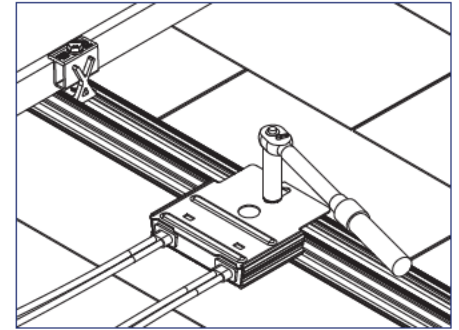
1) Snap the SnapRack MLPE Rail Attachment Kit channel nut into the desired location on the rail where the microinverter will be installed.



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.

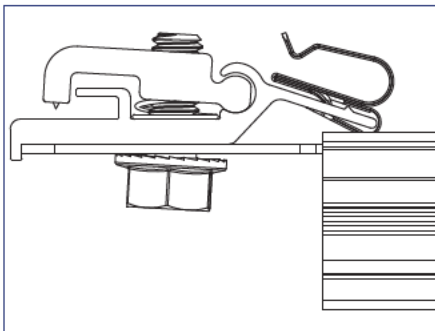


3) Tighten hardware to 10 ft-lbs.

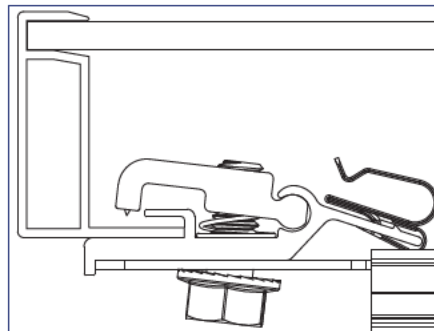
### Install Note:

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

## INSTALLATION INSTRUCTIONS - MLPE FRAME ATTACHMENT



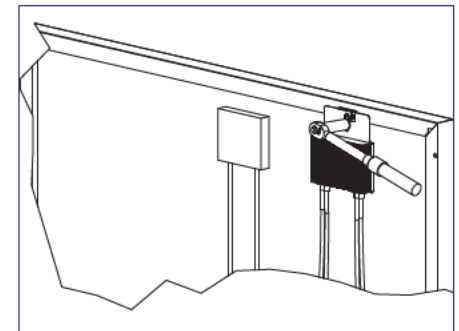
1) Slide the backplate channel of the MLPE device under the MLPE Frame Attachment Kit bolt. The MLPE mounting plate should rest against the MLPE mounting plate backstop on the MLPE Frame Attachment Kit.



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:

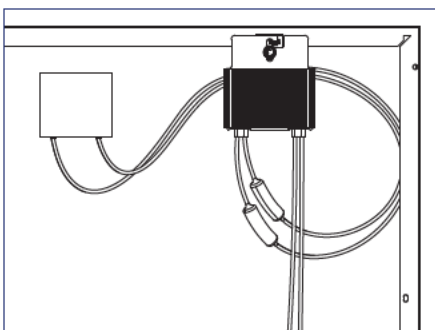
Avoid blocking module frame drainage holes when installing the MLPE Frame Attachment Kit.



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

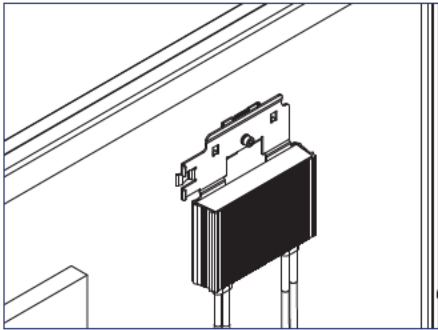
### Install Note:

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

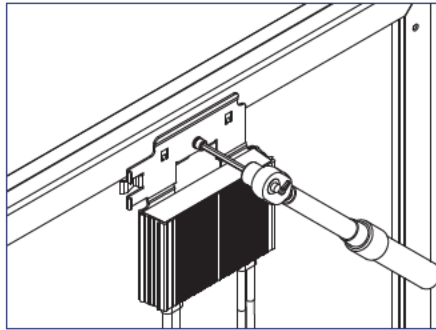


4) Connect the module leads to the input connectors on the MLPE device and manage conductors with the integrated Smart Clip.

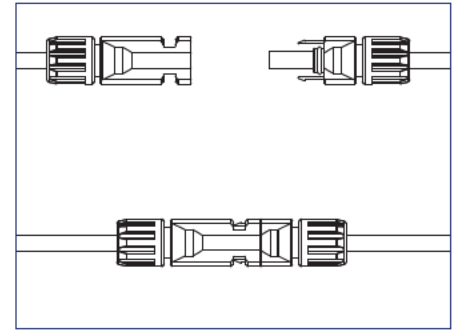
## INSTALLATION INSTRUCTIONS - SOLAREEDGE FRAME MOUNT



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.

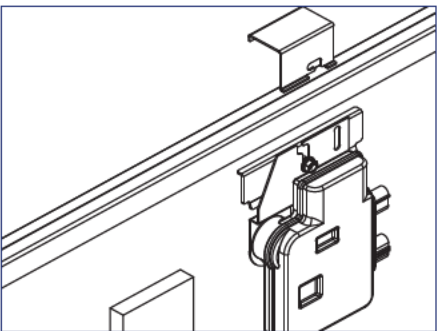


3) Connect the module leads to the input connectors on the optimizer.

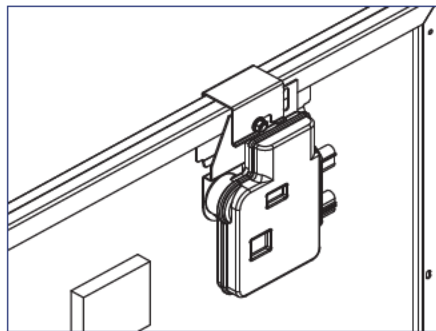
### Install Note:

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

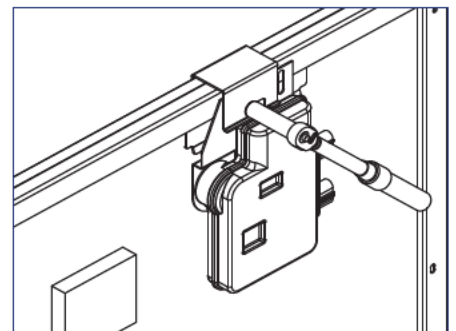
## INSTALLATION INSTRUCTIONS - ENPHASE FRAME MOUNT



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



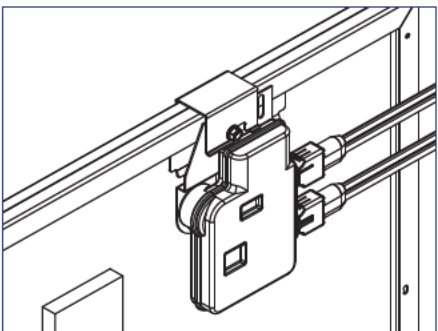
2) Slide the microinverter unit onto the bracket clamp, then move it slightly to the left.



3) Tighten hardware to 13 ft-lbs

### Install Note:

The microinverter mounting flange should be on the outside of the module frame.



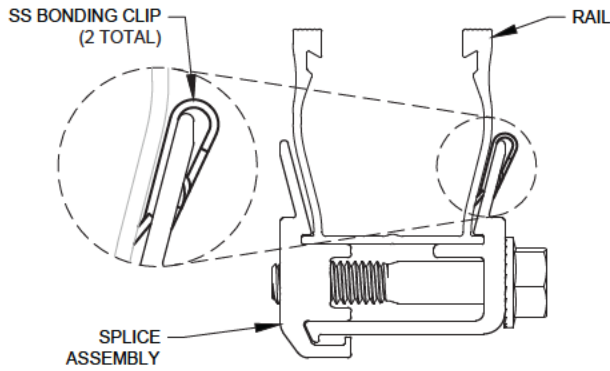
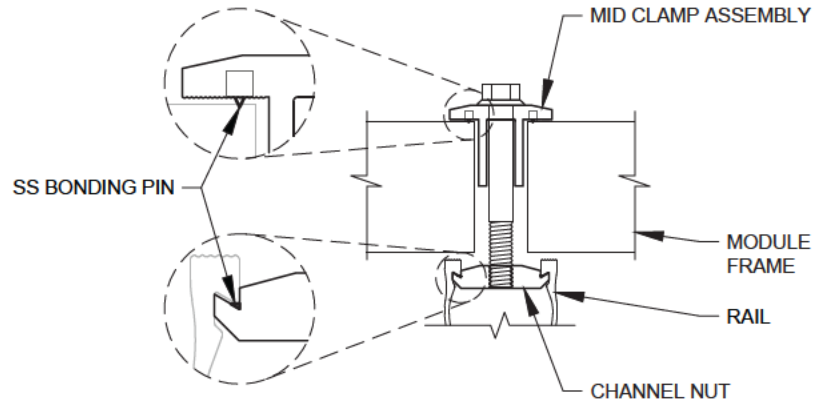
4) Connect the module leads to the microinverter DC connectors.

### Install Note:

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

## System Bonding Methods

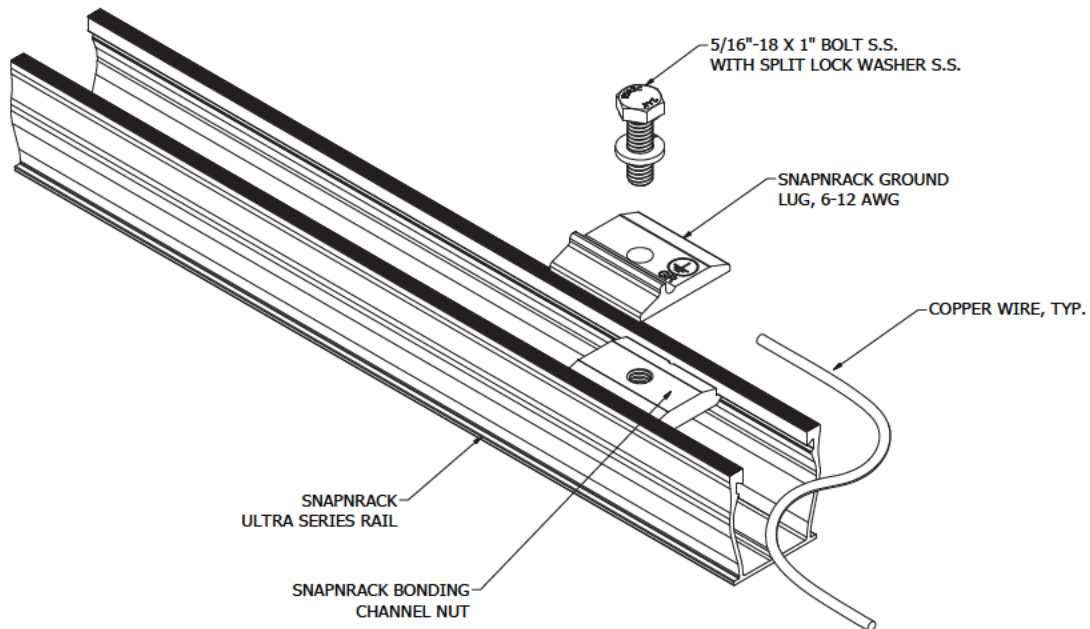
- 1 SnapNrack Mid Clamp
- 2 SnapNrack Adjustable End Clamp
- 3 SnapNrack Ultra Rail Splice



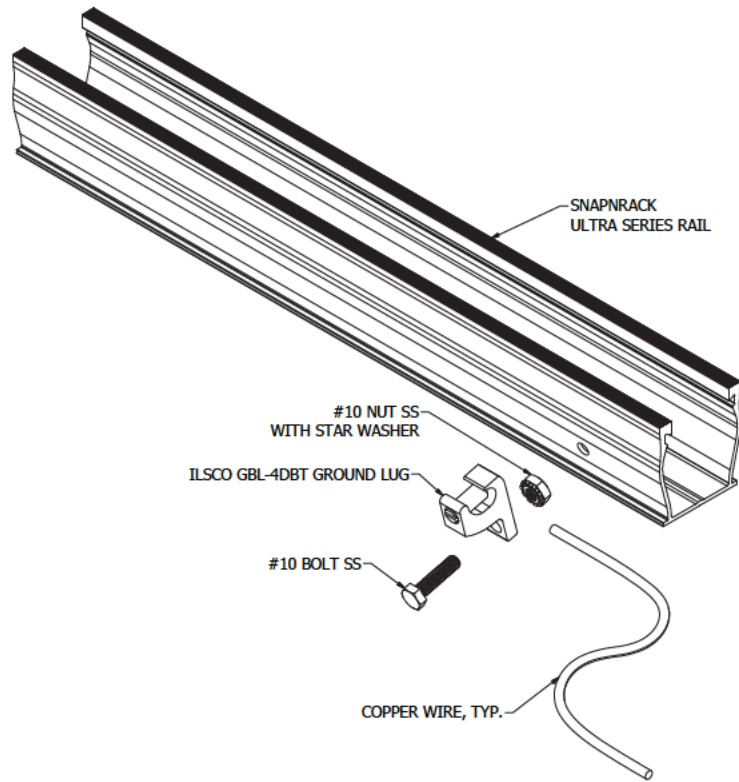
**Note:**  
SnapNrack module clamps contain a SnapNrack Channel Nut with integral bonding pins in assembly to properly bond the system (except Universal End Clamps).

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

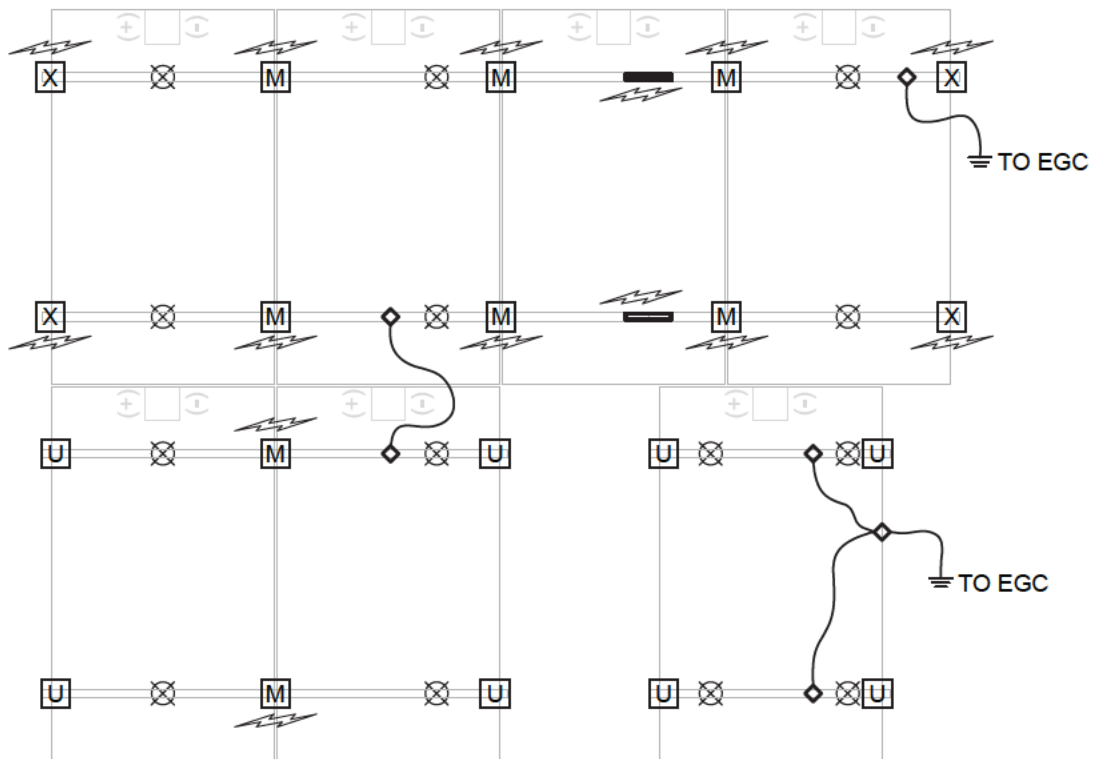
## SnapNrack Ground Lug Assembly



## IlSCO Lay-in Lug Assembly

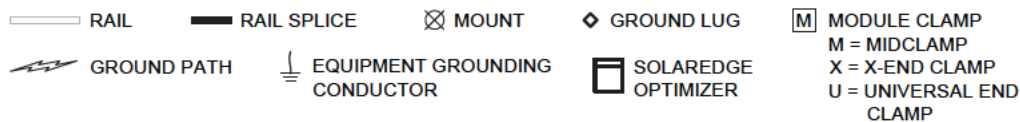
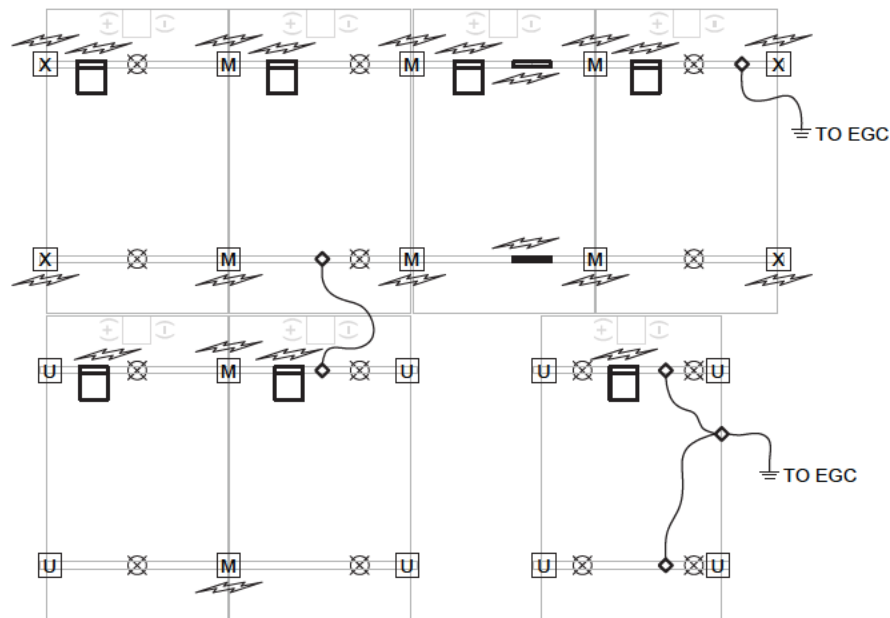


## Ground Path Details

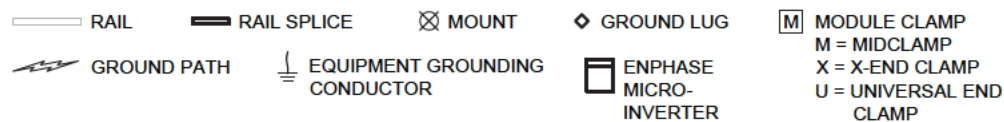
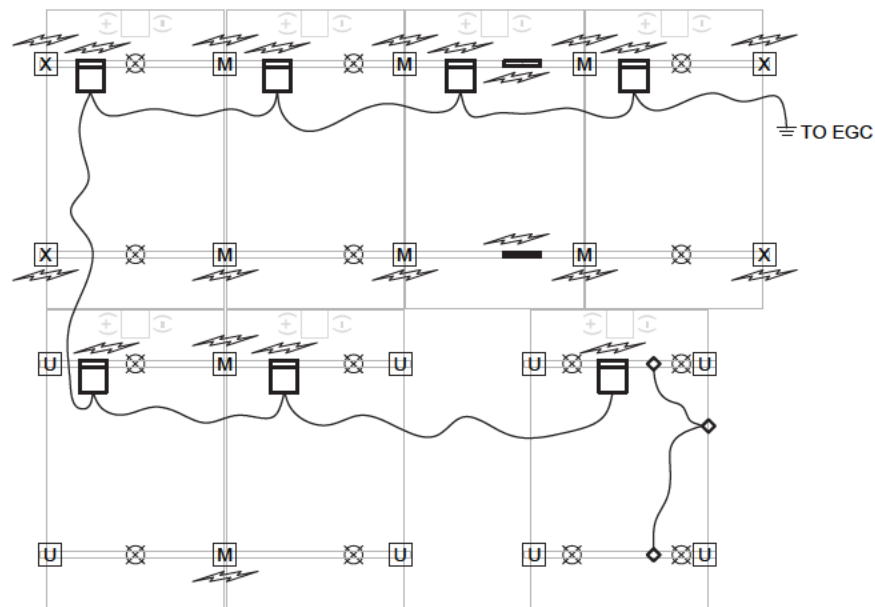


- |             |                               |       |            |                         |
|-------------|-------------------------------|-------|------------|-------------------------|
| RAIL        | RAIL SPLICE                   | MOUNT | GROUND LUG | MODULE CLAMP            |
| GROUND PATH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

## Ground Path Details - SolarEdge

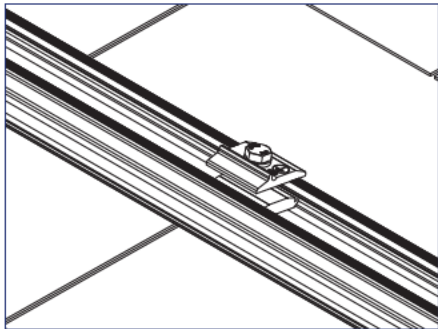


## Ground Path Details - Enphase

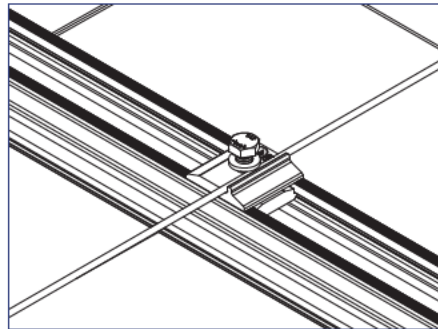




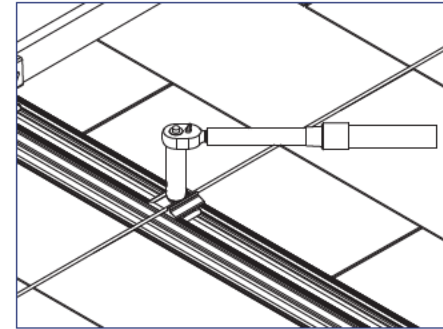
## INSTALLATION INSTRUCTIONS - SNAPNRACK GROUND LUG



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



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



3) Tighten hardware to 16 ft-lbs.

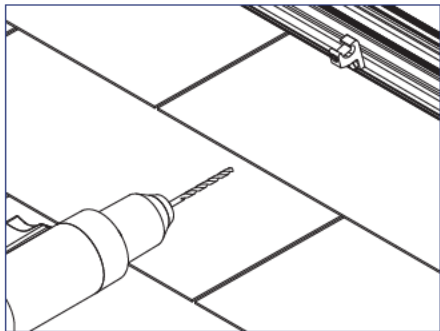
### Install Note:

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

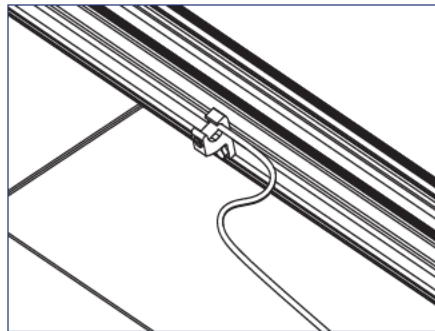
### Install Note:

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

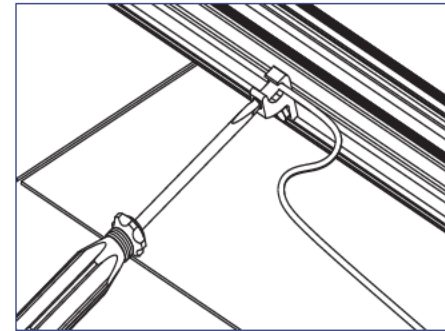
## INSTALLATION INSTRUCTIONS - ILSCO LAY-IN LUG



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



2) Place grounding conductor into slot.



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

### Install Note:

Torque rail connection to 35 in-lbs.

### Install Note:

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

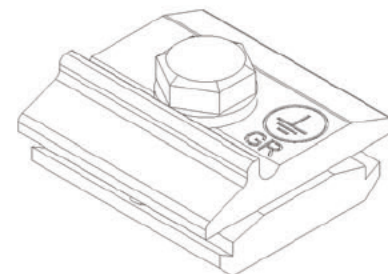
### Note:

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

## 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-YYY-### 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 BFR-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.

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 <sup>2</sup> )
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.

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.

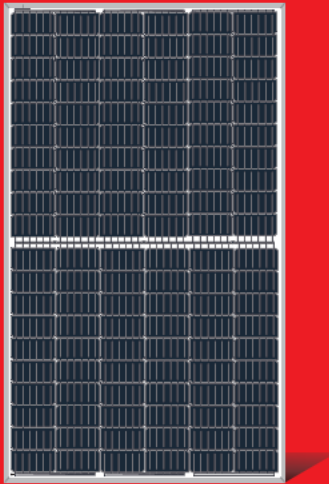
Longi Green Energy Technology Co., Ltd.: LR6-60-XXXM, LR6-60BK-XXXM, LR60-HV-XXXM, where XXX is 270 to 300.

REC Solar PTE, LTD: Models RECxxxPE or RECXXXPE-BLK Series where XXX is 214 to 270; RECxxxTP RECXXTP-BLK Series, where the xxx is 260 to 300; RECXXTP2 or RECXXTP2-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”.

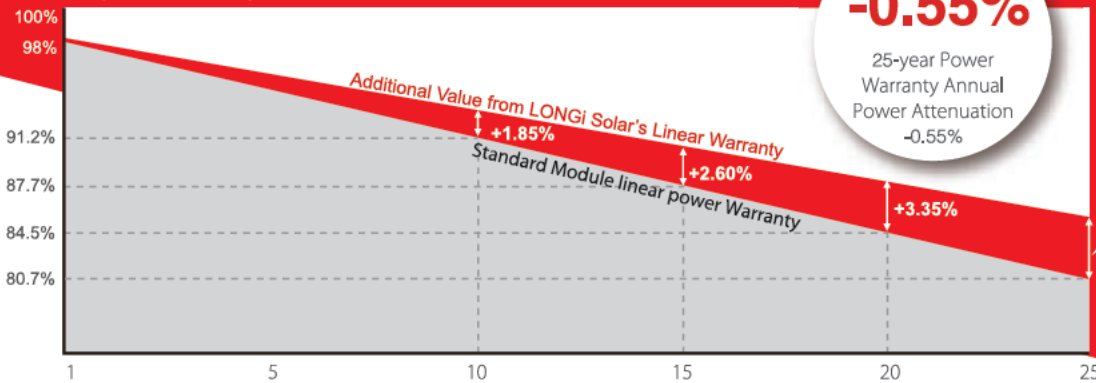
Talesun: Models TP660P-XXX where XXX is 215 to 285; TP660M-XXX where XXX is 210 to 300.

# LR4-60HPH 350~370M



**High Efficiency  
Low LID Mono PERC with  
Half-cut Technology**

10-year Warranty for Materials and Processing;  
25-year Warranty for Extra Linear Power Output



**-0.55%**

25-year Power  
Warranty Annual  
Power Attenuation  
-0.55%

**+4.10%**

### Complete System and Product Certifications

- IEC 61215, IEC61730, UL1703
- ISO 9001:2008: ISO Quality Management System
- ISO 14001: 2004: ISO Environment Management System
- TS62941: Guideline for module design qualification and type approval
- OHSAS 18001: 2007 Occupational Health and Safety



\* Specifications subject to technical changes and tests. LONGi Solar reserves the right of interpretation.

**Positive power tolerance** (0 ~ +5W) guaranteed

**High module conversion efficiency** (up to 19.8%)

**Slower power degradation** enabled by Low LID Mono PERC technology: first year <2%, 0.55% year 2-25

**Solid PID resistance** ensured by solar cell process optimization and careful module BOM selection

**Reduced resistive loss** with lower operating current

**Higher energy yield** with lower operating temperature

**Reduced hot spot risk** with optimized electrical design and lower operating current

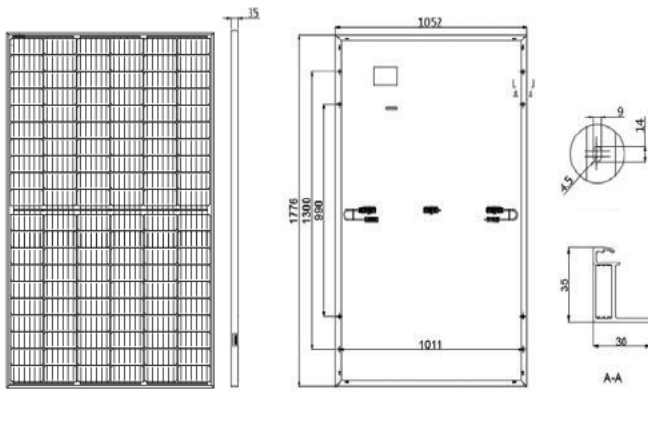


Room 801, Tower 3, Lujiazui Financial Plaza, No.826 Century Avenue, Pudong Shanghai, 200120, China  
Tel: +86-21-80162606 E-mail: module@longi-silicon.com Facebook: www.facebook.com/LONGi Solar

Note: Due to continuous technical innovation, R&D and improvement, technical data above mentioned may be of modification accordingly. LONGi Solar have the sole right to make such modification at anytime without further notice; Demanding party shall request for the latest datasheet for such as contract need, and make it a consisting and binding part of lawful documentation duly signed by both parties.

# LR4-60HPH 350~370M

## Design (mm)



## Mechanical Parameters

Cell Orientation: 120 (6×20)  
 Junction Box: IP68, three diodes  
 Output Cable: 4mm<sup>2</sup>, 300mm in length,  
 length can be customized  
 Glass: Single glass  
 3.2mm coated tempered glass  
 Frame: Anodized aluminum alloy frame  
 Weight: 20 kg  
 Dimension: 1776×1052×35mm

Packaging: 30pcs per pallet  
 180pcs per 20'GP  
 720pcs per 40'HC

Units: mm(inch)  
 Tolerance:  
 Length: ±2mm  
 Width: ±2mm  
 Height: ±1mm  
 Pitch: ±1mm

## Operating Parameters

Operational Temperature: -40℃ ~ +85℃  
 Power Output Tolerance: 0 ~ +5 W  
 Voc and Isc Tolerance: ±3%  
 Maximum System Voltage: DC1500V (IEC/UL)  
 Maximum Series Fuse Rating: 20A  
 Nominal Operating Cell Temperature: 45±2℃  
 Safety Class: Class II  
 Fire Rating: UL type 1 or type 2

## Electrical Characteristics

Test uncertainty for Pmax: ±3%

Model Number	LR4-60HPH-350M		LR4-60HPH-355M		LR4-60HPH-360M		LR4-60HPH-365M		LR4-60HPH-370M	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	350	259.3	355	263.0	360	266.7	365	270.4	370	274.1
Open Circuit Voltage (Voc/V)	40.5	37.8	40.7	38.0	40.9	38.2	41.1	38.4	41.3	38.5
Short Circuit Current (Isc/A)	11.02	8.89	11.10	8.95	11.20	9.03	11.28	9.09	11.37	9.17
Voltage at Maximum Power (Vmp/V)	33.3	30.8	33.5	30.9	33.7	31.1	33.9	31.3	34.1	31.5
Current at Maximum Power (Imp/A)	10.52	8.44	10.60	8.50	10.69	8.57	10.77	8.64	10.86	8.71
Module Efficiency(%)	18.7		19.0		19.3		19.5		19.8	

STC (Standard Testing Conditions): Irradiance 1000W/m<sup>2</sup>, Cell Temperature 25℃, Spectra at AM1.5

NOCT (Nominal Operating Cell Temperature): Irradiance 800W/m<sup>2</sup>, Ambient Temperature 20℃, Spectra at AM1.5, Wind at 1m/s

## Temperature Ratings ( STC )

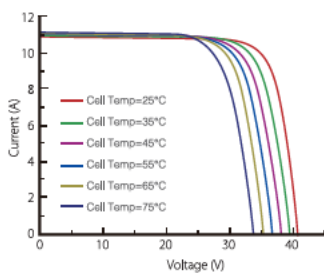
Temperature Coefficient of Isc	+0.057%/℃
Temperature Coefficient of Voc	-0.286%/℃
Temperature Coefficient of Pmax	-0.370%/℃

## Mechanical Loading

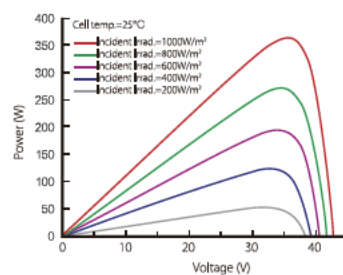
Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

## I-V Curve

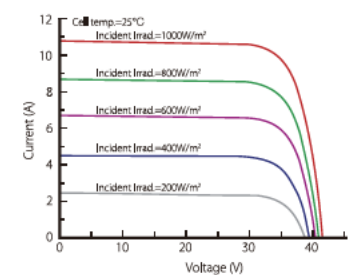
Current-Voltage Curve (LR4-60HPH-360M)



Power-Voltage Curve (LR4-60HPH-360M)



Current-Voltage Curve (LR4-60HPH-360M)



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Note: Due to continuous technical innovation, R&D and improvement, technical data above mentioned may be of modification accordingly. LONGI Solar have the sole right to make such modification at anytime without further notice; Demanding party shall request for the latest datasheet for such as contract need, and make it a consisting and binding part of lawful documentation duly signed by both parties.



# IQ8 and IQ8+ 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 using advanced 55-nm 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.



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-and-play MC4 connectors.



IQ8 Series Microinverters are UL Listed as PV rapid shutdown equipment and conform with various regulations, when installed according to the manufacturer’s instructions.

### Easy to install

- Lightweight and compact with plug-and-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

- Compliant 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)

### NOTE:

- IQ8 Microinverters cannot be mixed with previous generations of Enphase microinverters (IQ7 Series, IQ6 Series, and so on) in the same system.
- IQ Microinverters ship with default settings that meet North America’s IEEE 1547 interconnection standard requirements. Region-specific adjustments may be requested by an Authority Having Jurisdiction (AHJ) or utility representative according to the IEEE 1547 interconnection standard. An IQ Gateway is required to make these changes during installation.

\*Meets UL 1741 only when installed with IQ System Controller 2 or 3.  
 \*\*IQ8 and IQ8+ support split-phase, 240 V installations only.



# IQ8 and IQ8+ Microinverters

INPUT DATA (DC)		UNITS	IQ8-60-2-US	IQ8PLUS-72-2-US
Commonly used module pairings <sup>1</sup>	W		235–350	235–440
Module compatibility	—	To meet compatibility, PV modules must be within maximum input DC voltage and maximum module $I_{sc}$ listed below. Module compatibility can be checked at <a href="https://enphase.com/installers/microinverters/calculator">https://enphase.com/installers/microinverters/calculator</a> .		
MPPT voltage range	V		27–37	27–45
Operating range	V		16–48	16–58
Minimum/Maximum start voltage	V		22/48	22/58
Maximum input DC voltage	V		50	60
Maximum continuous input DC current	A		10	12
Maximum input DC short-circuit current	A			25
Maximum module ( $I_{sc}$ )	A			20
Overvoltage class DC port	—			II
DC port backfeed current	mA			0
PV array configuration	—	Ungrounded array; no additional DC side protection required; AC side protection requires maximum 20 A per branch circuit.		
OUTPUT DATA (AC)		UNITS	IQ8-60-2-US	IQ8PLUS-72-2-US
Peak output power	VA		245	300
Maximum continuous output power	VA		240	290
Nominal grid voltage (L-L)	V		240, split-phase (L-L), 180°	
Minimum and Maximum grid voltage <sup>2</sup>	V		211–264	
Maximum continuous output current	A		1.0	1.21
Nominal frequency	Hz		60	
Extended frequency range	Hz		47–68	
AC short-circuit fault current over three cycles	Arms		2	
Maximum units per 20 A (L-L) branch circuit <sup>3</sup>	—		16	13
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	%		97.7	
CEC weighted efficiency	%		97	
Nighttime power consumption	mW		23	25
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 × W × D)			212 mm (8.3 in) × 175 mm (6.9 in) × 30.2 mm (1.2 in)	
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	
Environmental category/UV exposure rating			NEMA Type 6/Outdoor	

(1) No enforced DC/AC ratio.

(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.

COMPLIANCE

Certifications


CA Rule 21 (UL 1741-SA), UL 62109-1, IEEE 1547:2018 (UL 1741-SB), 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, NEC 2020, and NEC 2023 section 690.12 and C22.1-2018 Rule 64-218 rapid shutdown of PV Systems, for AC and DC conductors, when installed according to the manufacturer's instructions.

## Revision history

REVISION	DATE	DESCRIPTION
DSH-00207-3.0	February 2024	Updated the information about IEEE 1547 interconnection standard requirements.
DSH-00207-2.0	October 2023	Included NEC 2023 specification in the “Compliance” section.
DSH-00207-1.0	September 2023	Updated module compatibility specification.



# DAVID C. HERNANDEZ, PE

513-418-8812 

4912 Prospect Ave., Blue Ash OH 45242 

davehernandezpe@gmail.com 

DATE: March 29, 2024

RE: 17501 Barnesville Road, Barnesville, MD, 20841

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 to rails which are attached to the roof with a clamped 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 systems satisfactorily meet the applicable code standards included in the IBC 2018, IRC 2018, IEBC 2018 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 = 9psf
- Solar system dead load = 3 psf

Overall, the roof systems integrity is 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.

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

Acknowledged by:

David C. Hernandez, PE

Digitally signed by David C. Hernandez,  
Date: 2024.03.29 11:44:32 -04:00



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.  
Sgd:03/29/24



Solar Energy World  
Because Tomorrow Matters

Project Property Owner Stephen Seeger

Address 17501 Barnesville Rd, Barnesville, MD 20841

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 (60) 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. I certify 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 for this project.

49993  
Maryland PE License Number

Date 05/01/24

Signature David C. Hernandez, Digitally signed by David C. Hernandez,  
Date: 2024.05.01 11:14:35 -04:00

Seal



PROFESSIONAL CERTIFICATION. I HEREBY CERTIFY THAT THESE DOCUMENTS WERE PREPARED OR APPROVED BY ME, AND THAT I AM A FULLY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MARYLAND, LICENSE NO. 49993, EXP 10/06/2024.  
Sgd. 05/01/24

Must be submitted with plans





Property Owners Name: Stephen Seeger

Property Owners Address: 17501 Barnesville Road, Barnesville, MD 20841

Address of installation if different than owner's address:  
  

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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: 07/11/2024

Signature: *Matt Huser*



DEPARTMENT OF PERMITTING SERVICES

Marc Elrich  
*County Executive*

Rabbiah Sabbakhan  
*Director*

# HISTORIC AREA WORK PERMIT APPLICATION

Application Date: 7/12/2024

Application No: 1078219  
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 17501 BARNESVILLE RD  
BARNESVILLE, MD 20838

Othercontact Solar Energy World (Primary)

## Historic Area Work Permit Details

Work Type ALTER

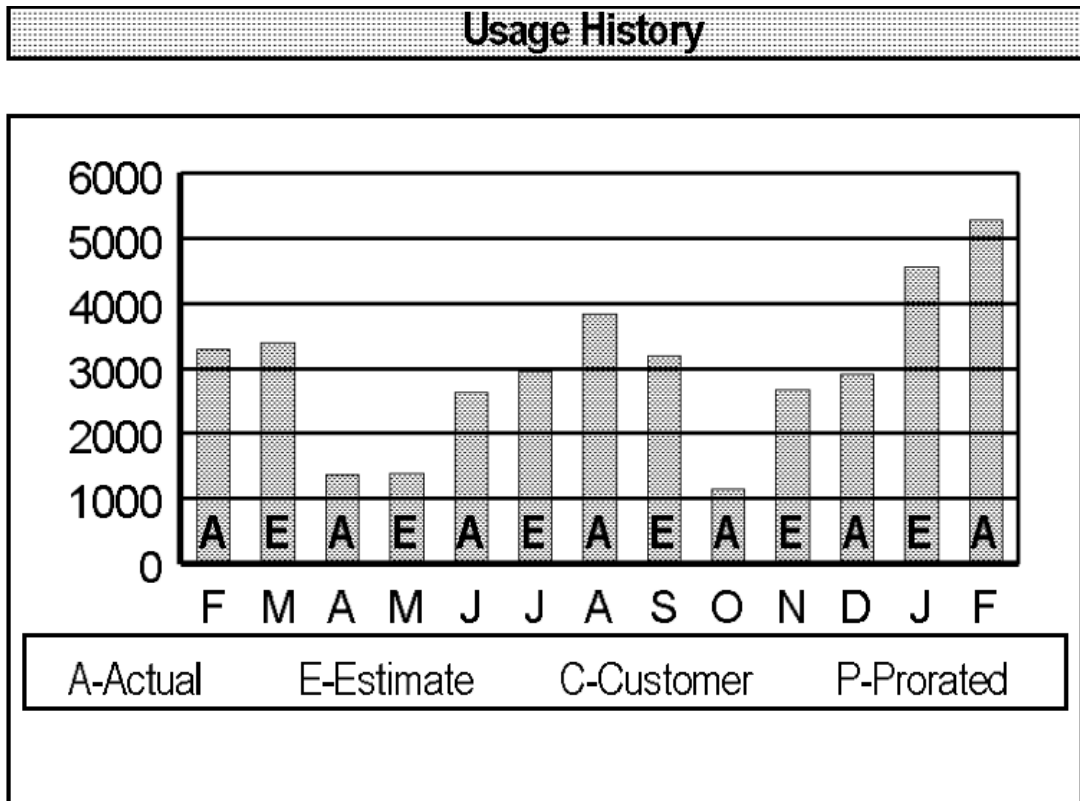
Scope of Work Install (60) roof mounted solar panels, 21.30 kW

7/29/24

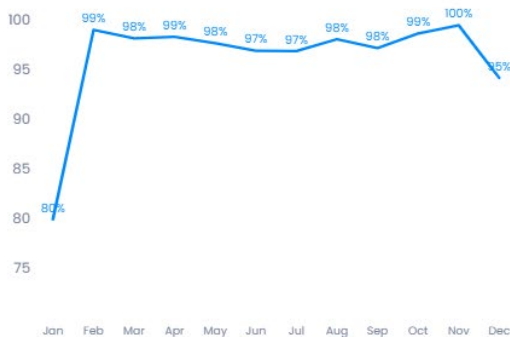
To whom it may concern,

- Justification of panels on the front of the detached barn and heat map.

Monthly energy consumption for 1705 Barnesville Road, Barnesville, MD 20838 vs the proposed system monthly production



Monthly Average Solar Access



Monthly Consumption and Production (kWh)





- The home had an annual usage of roughly 35,306 kWh in 2023. Our proposed system is estimated to have 29,292 kWh in annual production.

The panels will vary in production based on their location on the detached barn, but this estimated production for a 60-panel system breaks down to roughly 488 kWh per panel annually. The south-facing roof plane has an average of 488 kWh per panel annually, while the north-facing roof plane would only produce an average of 257 kWh per panel annually. The system production estimate of 29,292 kWh is 6,014 kWh less than the consumption for the household.

**Justification for the Placement of the panels.**

- The south-facing roof plane will yield almost twice the average annual production of the north-facing roof plane.

**Shade Map.**



Thank you,  
Aley Oberdorf  
Design Engineer.