Invoice

Buildings And More

792 SW Bascom Norris Dr. • Lake City, Florida 32025
Phone (386) 755-6449 • Fax (386) 758-6927

INVOICE

CUSTOMER

NAME DON MUDDIMAN

ADDRESS 551 HAMMOCK HILL CIRCLE

CITY LAKE CITY STATE FL ZIP 32024

PHONE 407-301-6080

DATE 2/23/15

SERIAL NO. STEEL BUILDING

REP. KEVIN

COUNTY COLUMBIA

DESCRIPTION	CASH PRICE	TOTAL
BENNETT STEEL STRUCTURE 28W x 56L x 10H		13,665
(2) 10x8 SECTIONAL DOORS W/ELECTRIC OPENERS		1,958

PAYMENT DETAILS

○ Cash ○ Check ○ Visa ○ Discover
○ Financed ○ Master Card ○ American Express

Sub Total	15,623
Sales Tax	987.38
Down Payment	2343.45
TOTAL	14,266.93

28W x 56L x 10H

- 2x3 Steel Framing
- Galvalume Vertical Roof
- Framing on 4' Centers
- B-Lap Steel Siding (White)
- (2) 10x8 Sectional Garage Doors w/electric openers
- (1) 8x8 Roll up door with Top Draft Stop
- (2) 36"x80" Entry Doors
- (4) Windows
- Closure Strips
- Florida Certified - Wind Rated 170MPH

Your Authorized Dealer For:

Lark · Robin · Bennett Building Systems, LLC · TNT Steel Buildings

ACCEPTED BY BUYER:

Buyer's Signature Date

ACCEPTED BY SELLER:

Seller's Signature Date

B.A.M. Buildings And More

Bennett Building Systems, LLC

QUALITY BUILDINGS. INFINITE POSSIBILITIES.

BSS Form 2.2 Rev. 5-10-14

Steel Structures Division
1660 Dixon Airline Road
Augusta, GA 30906
Toll-Free: 1-877-830-7086
Fax: 1-877-880-0048

Sales Order Form

Buyers Name(s) DON MUDDIMAN **Date** 2/20/15

Address 551 HAMMOCK HILL CIRCLE **County** COLUMBIA **Dealer** BAM / GRAYS

City LAKE CITY **ST** FL **ZIP** 32024

Office Use Only

Phone 407-301-6080 **Evening**

Serial No:

e-mail **Cell**

Run:

Installation Site (if different from above)

Building Type	☐ Barn	☐ Carport	☒ Garage Storage	☐ RV Carport	☐ Utility	☐ Other
Size	**Width:** 28	**Roof Length:** 56	**Frame Length:** 55	**Leg Height:** 10		
Installation	☐ Ground	☒ Cement	☐ Asphalt	☐ Other	**Permits** ☐ Yes ☒ No	**Electric Available** ☐ Yes ☒ No
Color	**Roof:** GALVALUME	**Sides:** WHITE	**End:** WHITE	**Trim:** CHARCOAL		

X	Standard Carport	4,990.00	4	Window- 24" X 36"		600.00
X	Optional Roof Style: ☐ Boxed Eave ☒ Vertical	1,100.00		Extra Panels		
X	2" X 3" Framing Upgrade	0.00		40 Year Panel Upgrade		
X	Certified: ☐ 140 MHP ☒ 170 MPH	850.00		Connection Fee: Side to Side		
	Extra Braces: ☐ 2' ☐ 4' ☐ 6'			Connection Fee: End to End		
	"J" Trim			Gable Ends: ☐ Non-certified ☐ Certified		
10'	Side Height: 10'	540.00		High Wind Anchors (Standard on Certied Buildings)		
X	Enclose Both Sides	1,360.00		Concrete Anchors (Standard on Buildings installed on concrete)		
X	Enclose Each End BOTH	2,950.00		Extra Rebar Anchors (Standard on ground installations)		
	Frameout- Window		X	Miscellaneous: B-LAP SIDING *NO CHARGE*		0.00
	Frameout- Door		X	Miscellaneous: CLOSURE STRIPS		200.00
2	Frameout- Garage Door 10X8'S	250.00		Miscellaneous:		
	Header for Side Entrance		**A.**	**Sales Total**		13,665.00
1	Side Frameout- Square (Plus Side Closed Price) 8X8	125.00	**B.**	**Lift Fee**		
	Side Frameout- Dutch (Plus Side Closed Price)		**C.**	**Subtotal** (A + B)		13,665.00
1	Garage Door: Size (W'XH') 8X8	300.00	**D.**	**Sales Tax** (C X Sales Tax Rate) 6%*50	**Rate**	869.90
	Garage Door: Size (W'XH')		**E.**	**Grand Total** (C + D)		14534.90
	Garage Door: Size (W'XH')		**F.**	**Deposit** (A X Deposit Rate)	**Rate** 15%	2,049.75
2	36" x 80" Walk-in Door	400.00		**Balance Due** (E - F)		12485.15

NOTICE TO BUYER: This order shall only become effective upon execution and acceptance by Seller-Bennett Buildings Systems at its offices in Augusta, Georgia and upon acceptance by Seller shall constitute the contract between Seller and Buyer, subject to the Terms and Conditions on the reverse side hereof. Dealer is an independent contractor, and not the agent of Seller, except for receipt of the deposit described above, and no representation of Dealer shall be binding on Seller until and except to the extent accepted in writing by Seller. This contract includes cost of installation of the Unit at the address of Buyer indicated above upon receipt of they full purchase price; provided, however, Buyer shall be responsible for properly preparing the site for installation, obtaining any required permits for installation of the Unit and all other terms contained on the reverse side, which Buyer hereby acknowledges by its signature below to having read and understood, including without limitation, any conditions of site preparation, permits, warrantees and additional charges and responsibilities.

BBS Steel Structures accepts for payment: Check-by-Phone, Visa and Master Card

VISA MasterCard

Buyers Signature **Date**

Dealer Signature **Date**

Order Accepted by BBS
Initials
Date

Subject: Fwd: Muddiman 28x56 Metal Building
From: "Kevin Gray" <khgray418@gmail.com>
Sent: 2/18/2015 2:01:05 PM
To: donmuddiman@gmail.com;

Mr. Muddiman,

Here is the building and concrete quotes as we discussed:

28W x 56L x 10H

- 2x3 Steel Framing
- Galvalume Vertical Roof
- Framing on 4' Centers
- B-Lap Steel Siding (White)
- (2) 10x8 Sectional Garage Doors w/electric openers
- (1) 8x8 Roll up door with Top Draft Stop
- (2) 36"x80" Entry Doors
- (4) Windows
- Closure Strips
- Florida Certified - Wind Rated 170MPH

Building Price = $15,671 plus tax.

If you go with (2) 10x8 Manual Roll Up Doors instead of Sectional Doors, **subtract $1158.**

Concrete Price = $7,950.

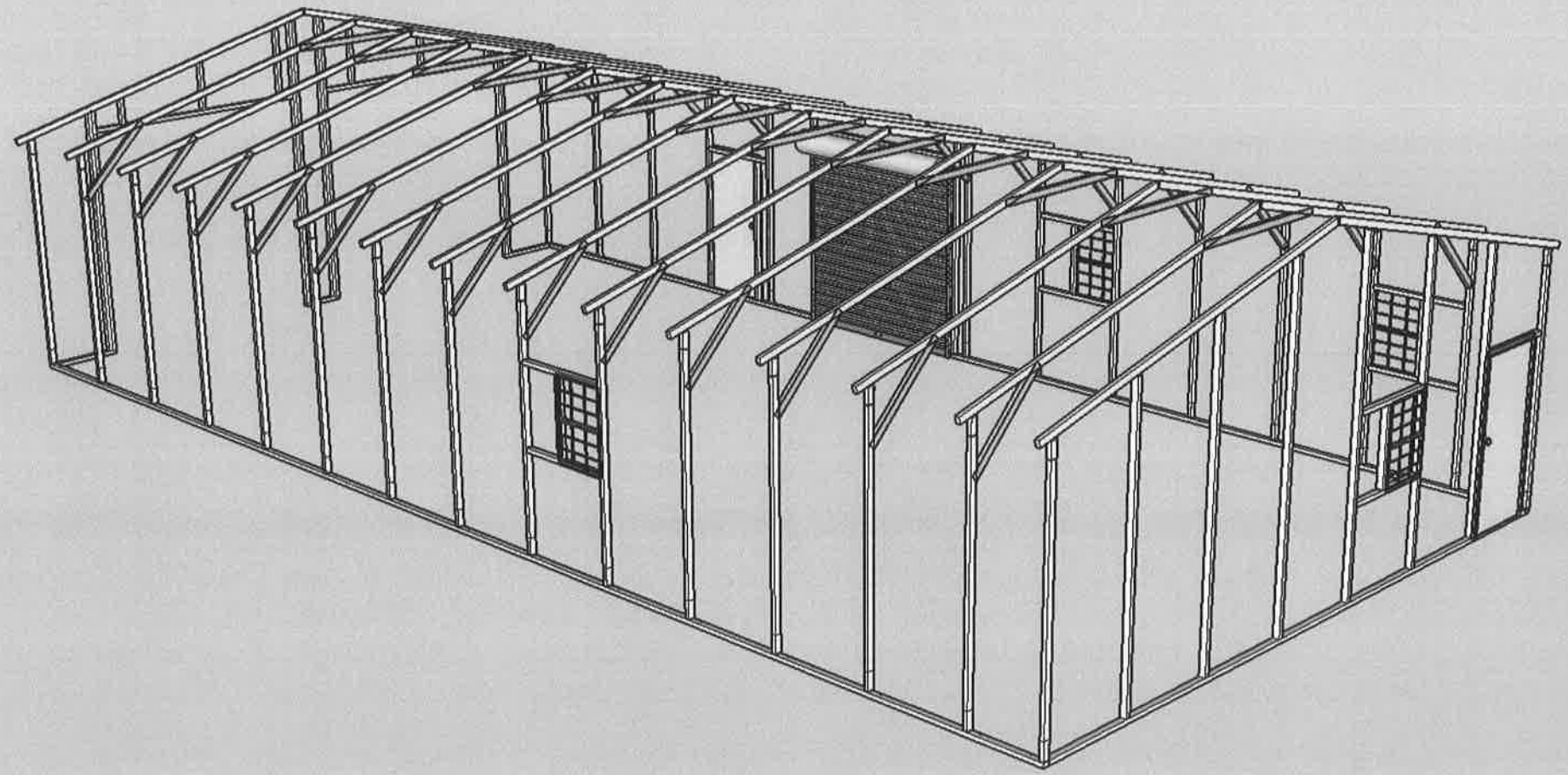
Concrete specs:

- 28x55 slab 4" thick
- 3' aprons in front of all garage doors
- 3000 psi concrete
- Fiber Mesh
- 4x4 Mat of 1/2" Rebar
- 13 Loads of Fill
- Slick Finish? (he'll need to know what kind of finish you want on the concrete surface)
- Saw lines

Let me know if you have any questions or comments. I've also included a picture of a 28x51 building we completed recently that has the White B-Lap Steel siding on it.

Thank you for your business, and let me know if there is anything else I can do for you.

SKELETON WITH ACCESSORIES



Phono® Solar
SHARE THE SUN, POWER THE FUTURE!

Phono Solar Technology Co., Ltd.

Address : No. 1 Xinghuo Rd., Nanjing Hi-tech Zone, Nanjing, China
Tel: +86 25 5863 8000 Fax: +86 25 5863 8009
E-mail: support@phonosolar.com Website: www.phonosolar.com

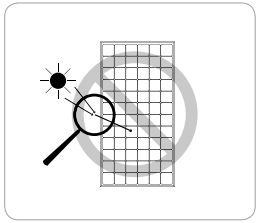
PHONO SOLAR TECHNOLOGY CO., LTD.

Photovoltaic Module Installation Manual (UL)

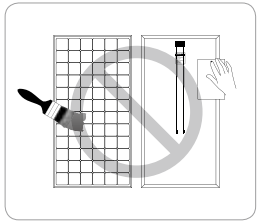
Version: EN-IM-UL-20191011

Phono® Solar
SHARE THE SUN, POWER THE FUTURE!

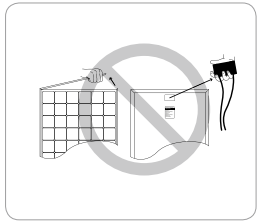
CONTENTS



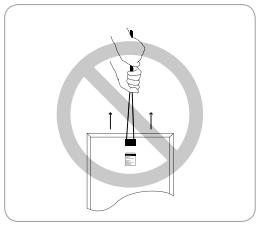
DO NOT use mirrors or magnifiers to concentrate sunlight onto the module.



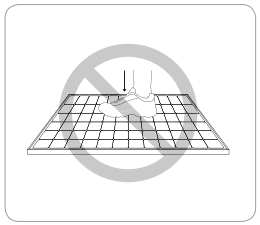
DO NOT paint the module or attach anything on to the back of the module.



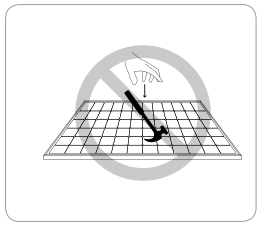
DO NOT attempt to disassemble the modules, and do not remove any attached nameplates or components from the module.



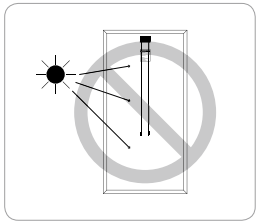
DO NOT lift or move the module by holding the junction box or cable.



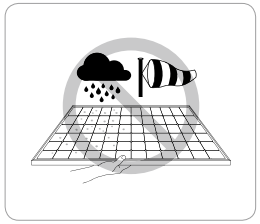
DO NOT place anything on the module or press on the module surface.



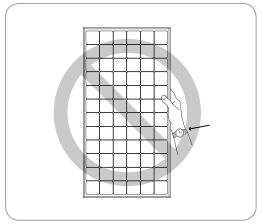
DO NOT drop the module or allow objects to fall on the module.



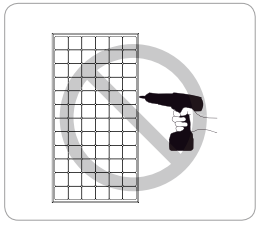
DO NOT expose the back of the module to direct sunlight.



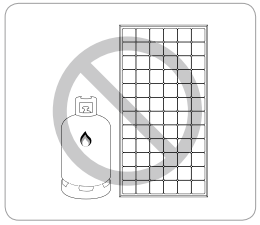
DO NOT install or handle module in wet or strong windy conditions.



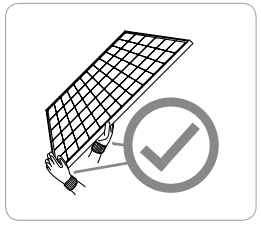
DO NOT wear metal ornaments while handling the module or during the installation.



DO NOT drill holes in the frame.



DO NOT use module near equipment or in places where flammable gases may be generated or collected.



Insulated gloves must be worn while handling the module and during the installation.

❶ IMPORTANT SAFETY GUIDE

This manual contains information regarding product identification and the safe installation and maintenance of photovoltaic modules (hereafter referred to as “module”) supplied by PHONO SOLAR TECHNOLOGY CO., LTD. (hereafter referred to as “PHONO SOLAR”). The term “module” can be interpreted as a single module or multiple modules depending on the context.

Installers must already be familiar with the mechanical and electrical requirements for a photovoltaic system. Installers must also read this manual carefully prior to installation. We recommend that you keep this manual in a safe place for future reference and in case of future sale or disposal of the module.

1.1 General Safety

- The installation of a photovoltaic system requires specialized skills and knowledge and must only be carried out by licensed/qualified persons.
- Installers should assume all risks of injury and do everything to avoid potential damages and risks that might occur during installation, including but not limited to, the risks of electric shock.
- PHONO SOLAR modules do not need special cables for connection. All of the modules have permanent junction boxes, cables and connectors.
- Do not use mirrors or magnifiers to concentrate sunlight onto the modules.
- The modules generate DC electrical energy from sunlight. They are designed for outdoor use and can be mounted onto frames on rooftops or in the ground etc.
- Do not paint the module or attach anything on to the back of the module.
- Do not attempt to disassemble the modules, and do not remove any attached nameplates or components from the modules.

1.2 Handling safety

- When handling the module insulated gloves must be worn.
- Inappropriate transportation and installation may break the module.
- Do not lift or move the module by holding the junction box or cable.
- Do not place anything on the module or press on the module surface.
- Do not drop the module or allow objects to fall on the module.
- Do not expose the back of the module to direct sunlight.

- Do not wear metal ornaments while handling the module.
- Do not install or handle modules in wet or strong windy conditions.

1.3 Installation safety

- Local, regional and state laws and regulations must be adhered to while installing a photovoltaic system. For example, any necessary licenses must be obtained prior to the installation commencing. Regulations around vehicles and ships must also be observed during the installation.
- Observe all safety rules for the other system components, including the cables, connectors, charging controllers, inverter and storage battery etc.
- Do not place the modules near a location where flammable gases are either generated or collected.
- Insulated gloves must be worn during the installation.
- Do not wear metal ornaments during the installation.
- Do not drill holes in the frame.
- Under normal conditions, a module is likely to produce more current and/or voltage than reported under Standard Test Conditions (STC). Accordingly, the values of Isc and Voc marked on the module nameplate should be multiplied by a factor when determining the component voltage ratings, conductor current ratings, fuse sizes, and the size of controllers connected to the photovoltaic system. The exact factor value should be suggested by a licensed/qualified person.
- The live connector may cause fire. spark or lethal shocks even when the modules are not connected.
- Electricity can be generated when the modules are exposed to sunlight, even if they are not connected. It is dangerous to touch 30V DC or higher, so never open the electrical connectors or unplug the electrical connectors while the circuit is under load, and do not touch the live connectors during the installation when the modules are exposed to sunlight.
- Children should be kept away from the photovoltaic system.
- In order to prevent current and voltage generation during installation an opaque board can be used to cover the modules.
- Only use licensed/qualified insulated tools.
- The frame of the modules may be grounded according to local, regional and state safety and electrical standards.

- Only Balance of System (BOS) components that conform with local, regional and state safety electricity standards should be used to avoid affecting module performance and/or module damage.

1.4 Fire Safety

- Consult your local authority for guidelines and requirements for building or structural fire safety.
- Roof constructions and installations may affect the fire safety of a building; an improper installation may create a hazard in the event of a fire.
- Use components such as ground fault circuit breakers and fuses as required by the local authorities.
- Do not use the modules near a location where flammable gases are either generated or collected.
- The modules have been rated Fire Class C complying with ULC/ORD-C1703-01, and Type 1 complying with UL1703. So the system fire class of module with appropriate mounting system in combination with a rated roof covering can achieve Class A.

2 PRODUCT IDENTIFICATION

On the back of each module there are 2 labels that provide the following information:

Nameplate: Describes the product type, rated power, rated current, rated voltage, open circuit voltage, short circuit current, all as measured under STC; weight, dimensions etc.; the maximum system voltage of 1000V/1500V DC.

Warning: The value of Voc times the number of modules in series should not be bigger than the maximum system voltage marked in the nameplate.

Barcode: This is used to identify each module. Each module has a unique and traceable serial number in the form of barcode. The barcode of each PHONO SOLAR module has 15 letter/digits.

Warning: Do not remove the nameplate or barcode. The PHONO SOLAR product warranty will be void if either the module nameplate or barcode is removed.

❸ MECHANICAL INSTALLATION

(Note: All instructions hereafter are for reference only. A licensed/qualified person or installer must be responsible for the design, installation, mechanical load calculation and security of the photovoltaic system.)

3.1 Select suitable locations for installation

- Select a suitable location for installing the modules.
- PHONO SOLAR recommends that to achieve the best performance the modules should face south in northern latitudes and north in southern latitudes. The exact tilt angle and orientation of mounted modules should be recommended by a licensed/qualified installer.
- The modules should be completely free of shade at all times.
- Do not place the modules near a location where flammable gases are either generated or collected.

Note1: Saline environments can accelerate the processes of electrical insulation losses and galvanic corrosion, especially when different metals with high electrochemical potential come into contact each other.

In saline environments, based on the distance to seashore, Phono Solar generally classifies coastal PV installation into three different levels:

- From 0 up to 50 meters, Phono Solar does not recommend any installation due to concerns for salt-mist corrosion.
- From 50 to 500 meters, Phono Solar regards this as "Near-Coast" installation requiring adherence to salt-mist corrosion prevention.
- From 500 meters and onwards, Phono Solar estimates the risk of salt mist corrosion is minor and only requires annual preventive maintenance.

In "Near-Coast" installation, Phono Solar PV modules must be installed under the following conditions:

- During the installation, do not scratch or break the corrosion-resistant coating (e.g. electroplated layer, oxidized coating, etc.) on the modules and mounting systems.
- The modules shall be mounted with a minimum tilt angle of 10°in respect to the horizon.
- Use corrosion-resistant materials (e.g. stainless steel SUS 316) for components (nut, bolt, gasket, etc.) to fixing the modules and mounting systems.
- To avoid possible galvanic corrosion between the aluminum frame and the support structure, mica lamination, or other silicone, or fluoride made gasket shall be interposed between the two metals
- When grounding the module frames, stainless steel hardware must also be used. To prevent salt corrosion to grounding block, fluorocarbon varnish could be sprayed on the grounding block thoroughly to form an anti-corrosion coating (at least 40um thick) or a pad of butyl plaster covering could be placed on the grounding block completely.

To ensure optimum module performance for near- coast installation, a system maintenance service of every three months is generally recommended and additionally the following maintenance measures shall be taken:

- Check the frame, mounting system, grounding block and other junction areas for potential signs of corrosion.
- Clean the frame, mounting system, grounding block and other junction areas from salt and dust accumulation.
- To repair the rusty areas, apply butyl plaster or fluorocarbon varnish spray to cover the area thoroughly after clean the salt and other dust accumulations around the rusty areas.

Note2: In environments where ammonia is present, Phono Solar PV modules must be installed under the following conditions:

- When fixing the modules using the 8 mounting slots, all the hardware (washers, screws and nuts) shall be made of stainless steel;
- To avoid possible galvanic corrosion between the aluminum frame and the support structure, PVC washers or neoprene tape shall be interposed between the two metals;
- When grounding the module frames, stainless steel hardware must also be used.

Note3: If you are planning to use the PV modules where the water damage (Humidity: > 85RH%) may be possible, please consult with Phono Solar technical support first to determine an appropriate installation method and module type , or to determine whether the installation is possible.

3.2 Select suitable mounting rails

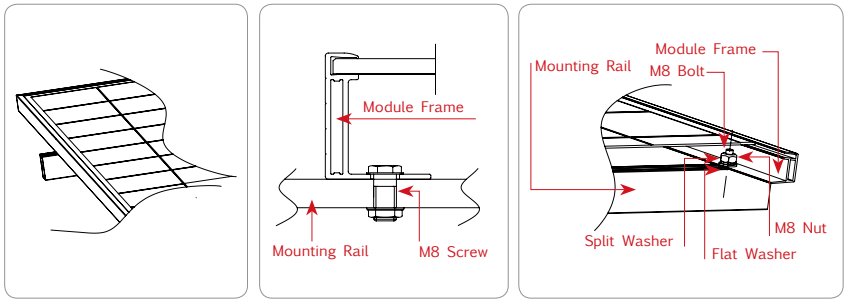
- Please observe the safety regulations and installation instructions included with the mounting rail. If necessary please contact the supplier directly for further information.
- The modules must be safely set onto the mounting rail. The whole rail supporting the photovoltaic system must be strong enough to resist potential mechanical pressures caused either by wind or snow, in accordance with local, regional and state safety (and other associated) standards.

- Make sure that the mounting rail will not deform or affect the modules when it expands as a result of thermal expansion.
- The mounting rail must be made of durable, anti-corrosive and UV-resistant materials.

3.3 Select suitable mounting methods

PHONO SOLAR modules can be mounted using two methods:

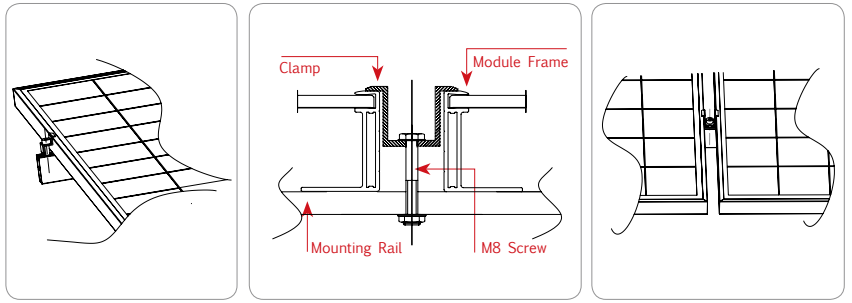
Screw Fitting: Use corrosion-proof screws in the existing installing holes in the module frame. Each module has 8 mounting holes for securing the module on the mounting rail. The module frame must be attached to a mounting rail using M8 corrosion-proof screws together with spring washers and flat washers in symmetrical locations on the module. The applied torque should be approximately 16~20Nm. Please find detailed mounting information in the below illustration:



Module installed using Screw Fitting method

Clamp fitting: Using suitable module clamps on the LONG side of the module frame to mount the modules is “portrait orientation” mode, while on the SHORT side of the module frame is “landscape orientation” mode.

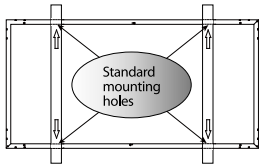
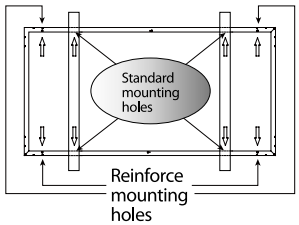
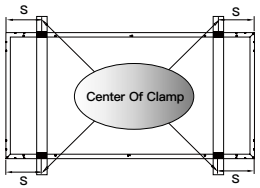
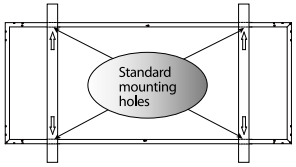
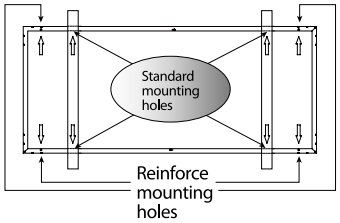
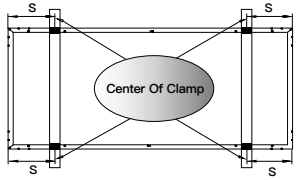
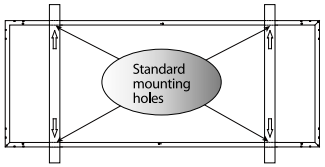
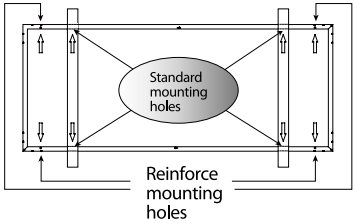
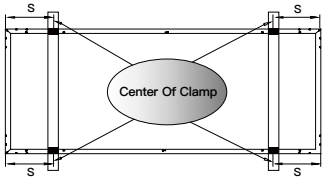
The module clamps should not come into contact with the front glass and must not deform the module frame. Avoid any shadowing effects from the module clamps. The module frame can not be modified under any circumstances. Regardless of the orientation chosen, at least 4 clamps must be used on each module. For portrait orientation, 2 clamps should be attached to the long sides of the module and for landscape orientation 2 clamps should be attached to the short sides of the module. Depending on the local wind and snow loads, additional clamps may be required. The applied torque should be about 16~20Nm. Please find detailed mounting information in the below illustration:



Module installed using Clamp Fitting method (The minimum recommended length for each clamp is 50 mm)

Select the appropriate installation method depending on the load (see below for more detailed information).

F Type	1580mm × 808mm × 35mm
U Type	1640mm × 992mm × 35/40/45mm 1675mm × 992mm × 35/40/45mm 1664mm × 998mm × 20/30mm 1684mm × 998mm × 30mm 1666mm × 1000mm × 35/40mm 1686mm × 1000mm × 35/40mm
T Type	1956mm × 992mm × 40/45/50mm 2000mm × 992mm × 40/45/50mm 2006mm × 998mm × 30 mm 1980mm × 1000mm × 40/45mm 2010mm × 1000mm ×40/45mm

Installation	Mounting system		Clamping system
	Maximum Load: Uplift load ≤ 2400 Pa Downforce load ≤ 2400 Pa	Maximum Load: Uplift load ≤ 2400 Pa Downforce load ≤ 5400 Pa	Maximum Load: Uplift load ≤ 2400 Pa Downforce load ≤ 5400 Pa
F Type module	Use standard mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use standard mounting holes and reinforce mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use four clamps 125mm＜S＜375mm ■ Pemissible Clamp Range  The guide rail should be installed perpendicular to the long side of the frame.
U Type module	Use standard mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use standard mounting holes and reinforce mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use four clamps 205mm＜S＜455mm ■ Pemissible Clamp Range  The guide rail should be installed perpendicular to the long side of the frame.
T Type module	Use standard mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use standard mounting holes and reinforce mounting holes  The guide rail should be installed perpendicular to the long side of the frame.	Use four clamps 300mm＜S＜350mm ■ Pemissible Clamp Range  The guide rail should be installed perpendicular to the long side of the frame.

Warning: Do not attempt to drill holes in the module frame or in the glass surface of the module. Any such modifications will void the PHONO SOLAR product warranty.

3.4 When installing a module on a pole ensure that the pole and mounting rail can withstand anticipated local winds. The pole must be installed on a hard base.

3.5 Ensure that the installation height is such that the lowest modules will not be covered by accumulated snow or shaded by the surroundings.

3.6 Ensure that there is adequate ventilation under the modules, conforming to local, regional and state standards and regulations.

3.7 A minimum distance of 10cm, between the roof plane and the frame of the module is generally recommended.

3.8 Observe the linear thermal expansion of the module frames. A minimum distance of 1cm between two modules is generally recommended.

4 ELECTRICAL INSTALLATION

(Note: All instructions hereafter are for reference only. A licensed/qualified person or installer must be responsible for the design, installation, mechanical load calculation and security of the photovoltaic system.)

4.1 Any hardware used must be compatible with the mounting material to avoid galvanic corrosion.

4.2 Only use connectors that are designed for photovoltaic systems and that match PHONO SOLAR modules.

4.3 When working with the connectors only use tools as recommended by the connector manufacturer.

4.4 PHONO SOLAR recommends that the same type of modules are connected together in order to avoid any system power loss.

4.5 The maximum number of series connected modules depends on system design, the type of inverter used and environmental conditions.

4.6 Select insulated cables that are able to resist to ultraviolet radiation and extreme weather conditions.

4.7 The rated voltage of the cable chosen must be appropriate to the overall maximum voltage of the system.

4.8 The module frame may be grounded according to local, regional and state safety and electrical standards. Ensure that a recommended connector or equivalent is used for the grounding cable. The grounding cable must be properly fastened to the module frame.

4.9 In order to reduce the risk of potential induced degradation (PID), Phono Solar strongly recommends to use anti-PID solar modules in wet regions (i.e. shores, wetlands), or to use the system negative grounding where the negative polarity of the PV modules array (i.e. negative grounding at the DC bus bar level) is connected to the ground. Failure to comply with this recommendation may reduce the module performance and will invalidate the limited power warranty of the module.

5 GROUDING

5.1 For grounding and bonding requirements, please refer to regional and national safety and electricity standards. If grounding is required, use a recommended connector type for the grounding wire.

5.2 For grounding, this guide refers to module frame grounding. If grounding is required, make sure module frames (metal exposed to touch) are always grounded.

5.3 System grounding is not mandatory for Phono Solar modules, however negative system grounding may be required by local authorities and can therefore be recommended.

5.4 Phono Solar recommends the Grounding Clip (Cat. No. 1954381 (Supplier: TE)) when grounding.

5.5 The grounding lug must be a tin-coated copper lug, silver in color. Do NOT use a bare copper lug, which is brown.

Please refer to relevant connector specifications for instructions.

For grounding clip, using a cross-recessed screwdriver, thread the screw into the hole until the head is flush with the base and the base is flush with the frame, then tighten the screw with another 1/4 to 1/2 turn. Insert the wire into the wire slot. Press down on both ends of the wire (the wire slot will cause the wire to form a slight curve). Manually, or using channel lock pliers, push the slider over the base until it covers the base. This will terminate the wire.

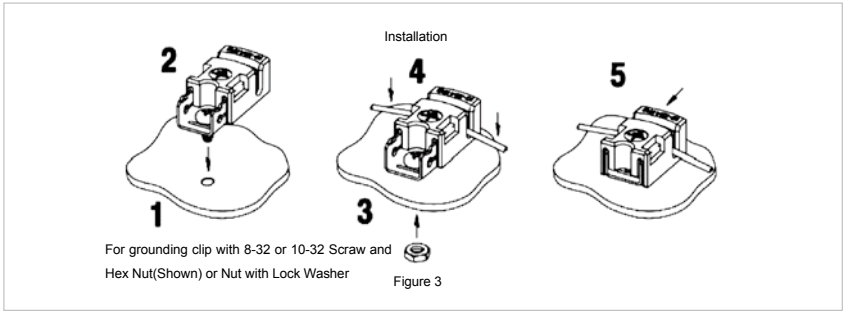


Figure 3

⑥ MAINTENANCE

6.1 The amount of electricity generated by a solar module is proportionally correlated with the light absorbed by the module with a factor equivalent to module conversion efficiency. Cells shaded by leaves and dust accumulated on the surface will reduce the light absorption and power generation, and therefore it is important to keep modules unshaded and clean. To ensure the optimum module performance, PHONO SOLAR recommends the following:

- PV modules can be cleaned only if the solar irradiance is below 200W/m2; Cleaning water or solution with a large temperature difference from the modules shall not be used for cleaning the modules;
- It is forbidden to clean PV modules under the weather conditions of heavy rain, heavy snow or wind grade higher than 4;
- If pressurized water is employed in cleaning, the water pressure applied on the glass surface of the module shall not exceed 4MPa (40bar); the module is prohibited to bear the extra force;
- When cleaning PV modules, do NOT step on the modules; do NOT spay water on the backside of the module or the cables; keep the connectors clean and dry; prevent fire and electrical shock from occurring; do NOT use a steam cleaner;
- When cleaning the modules, use soft cloth and clean water together with a mild detergent. The temperature of the water applied shall be close to that of the module being cleaned.
- Use dry or wet soft clean cloth to clean the PV modules; Corrosive solvents hard objects are strictly prohibited;
- If there are greasy dirt and other substances on the surface of the PV module
- which are difficult to clean, conventional household glass cleaning agents can be used; Do NOT use the alkaline and strong acid solvents.
- Modules that are mounted flat (0° tilt angle) should be cleaned more often, as they will not "self-clean" as effectively as modules mounted at a 10° tilt or greater.
- The back surface of the module normally does not need to be cleaned, but in the event this is deemed necessary, avoid the use of any sharp objects that might damage or penetrate the substrate material.
- Check the electrical and mechanical connections routinely and make sure they are clean, safe, complete and secure.
- In the event of a problem, please consult with a licensed/qualified person.

6.2 Requirements for Water Quality

- PH: 5 ~7;
- Chloride and Salinity: 0 - 3,000 mg/L
- Turbidity: 0-30 NTU
- Conductivity: 1500~3000 μs/cm
- Total dissolved solids (TDS): ≤1000 mg/L
- Water Hardness—calcium and magnesium ions: 0-40 mg/L
- Non-alkaline water must be used; demineralized water shall be used if the condition permits.

6.3 Safety Warning

- Cleaning work might impose the risk of damaging the a component or a series of components, and might also increase the risk of electric shock.
- Broken or damaged components may present a risk of electric shock due to current leakage, and this risk may be exacerbated by the moisture in the components. Before cleaning, ensure to check all wiring for possible rodent damage, weathering and that all connections are tight and corrosion free.
- During the day, the voltage and current present in the array are sufficient to cause a fatal electric shock. Before cleaning, make sure the array is disconnected from live parts (such as inverters, etc.).
- Wear protective equipment (clothes, insulated gloves, etc.) while cleaning
- Do not immerse components partially or completely in water or any kind of liquid.

⑦ DISCLAIMER OF LIABILITY

Since it is impossible for PHONO SOLAR to control installation, operation, application and maintenance of the photovoltaic system according to this instruction, PHONO SOLAR does not accept responsibility and expressly disclaims liability for any loss, damage, or expense arising out of or in any way connected with such installation, operation, use or maintenance.

PHONO SOLAR will not take any responsibilities for any possible violation of patent rights and third party rights that are related to application of the solar energy system. No permission of patents is given through implication.

The information of this instruction is from knowledge and experience of PHONO SOLAR, and so it is reliable. However, the instructions and suggestions of this instruction do not make an external or internal of guarantee. PHONO SOLAR reserves the right to revise this instruction, products and all the information about products without prior notification to customers.

Failure of the customer to follow the requirements outlined in this Manual during the installation of the module will result in the invalidity of the PHONO SOLAR product warranty.

Phono® Solar

TWINPLUS MODULE SERIES

HIGH EFFICIENCY MONO-PERC M4-9B-R

435-455W

OUTSTANDING PRODUCT PERFORMANCE

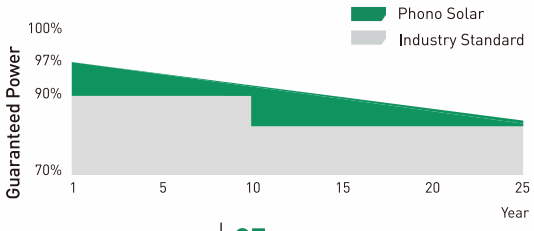
- Competitive high-temperature performance with ameliorated temperature coefficient
- Minimized power loss in cell connection
- Better performance under shading effect
- Decreased nominal operating cell temperature to 43 ± 2°C
- Higher power generation with multi-busbar and half-cut technology

TRUSTWORTHY QUALITY AND RELIABILITY

- Guaranteed 0~+5W positive tolerance secures reliable power output
- 5400Pa maximum snow load, 2400Pa maximum wind load
- Optimized electrical design lowers hot spot risk and operating current

PID RESISTANT

- Industry-leading cell processing technology and electrical design ensure solid PID resistance



12-year Product Warranty | **25-year** Linear Performance Warranty

MANAGEMENT SYSTEM CERTIFICATES

IEC 61215, IEC 61730
ISO 9001:2015 / Quality management system
ISO 14001:2015 / Standards for environmental management system
OHSAS 18001:2007 / International standards for occupational health & safety
IEC TS 62941: 2016 Terrestrial photovoltaic (PV) modules-guidelines for increased confidence in PV module design qualification and type approval

Bloomberg NEW ENERGY FINANCE Tier1

2019 TOP PERFORMER
PVEL | DNV·GL
PV MODULE RELIABILITY SCORECARD

ELECTRICAL TYPICAL VALUES

Model	PS435M4-24/TH PS435M4H-24/TH		PS440M4-24/TH PS440M4H-24/TH		PS445M4-24/TH PS445M4H-24/TH		PS450M4-24/TH PS450M4H-24/TH		PS455M4-24/TH PS455M4H-24/TH	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Rated Power (Pmpp)	435	322	440	325	445	329	450	333	455	336
Rated Current (Impp)	10.66	8.61	10.73	8.67	10.80	8.73	10.87	8.78	10.94	8.84
Rated Voltage (Vmpp)	40.81	37.33	41.01	37.51	41.21	37.70	41.40	37.87	41.60	38.05
Short Circuit Current (Isc)	11.13	8.99	11.21	9.06	11.29	9.12	11.38	9.20	11.47	9.27
Open Circuit Voltage (Voc)	48.85	44.69	48.98	44.81	49.11	44.93	49.24	45.04	49.37	45.16
Module Efficency (%)	19.89		20.12		20.35		20.58		20.80	

STC(Standard Testing Conditions):Irradiance 1000W/m², AM 1.5, Cell Temperature 25'C

NOCT (Nominal Operation Cell Temperature): Irradiance 800W/m², Ambient Temperature 20'C, Spectra at AM1.5, Wind at 1m/S

MECHANICAL CHARACTERISTICS

Cell Type	Monocrystalline 166mm x 83mm
Dimension (L× W × H)	Length: 2103mm (82.79 inch) Width: 1040mm (40.94 inch) Height: 35mm (1.38 inch)
Weight	25.0kg (55.12 lbs)
Front Glass	3.2mm Toughened Glass
Frame	Anodized Aluminium Alloy
Cable	4mm² (IEC), Length:350mm (vertical) 1250mm (horizontal) or Customized Length
Junction Box	IP 68 Rated

TEMPERATURE RATINGS

Voltage Temperature Coefficient	-0.30%/'C
Current Temperature Coefficient	+0.05%/'C
Power Temperature Coefficient	-0.38%/'C
Tolerance	0~+5w
NOCT	43±2'C

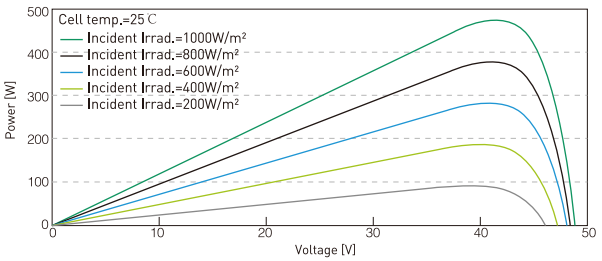
ABSOLUTE MAXIMUM RATING

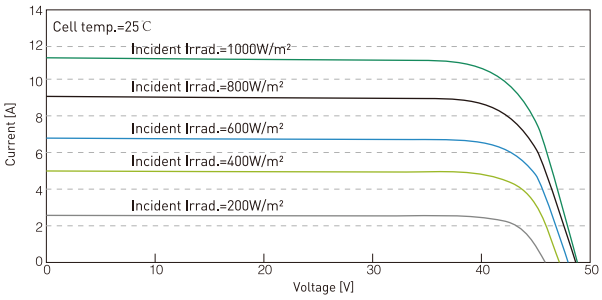
Operating Temperature	From -40 to +85'C
Hail Diameter @ 80km/h	Up to 25mm
Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Maximum Series Fuse Rating	20A
PV Module Classification	II
Fire Rating (IEC 61730)	C
Module Fire Performance(UL 61730)	Type 4
Maximum System Voltage	DC 1500V/1000V

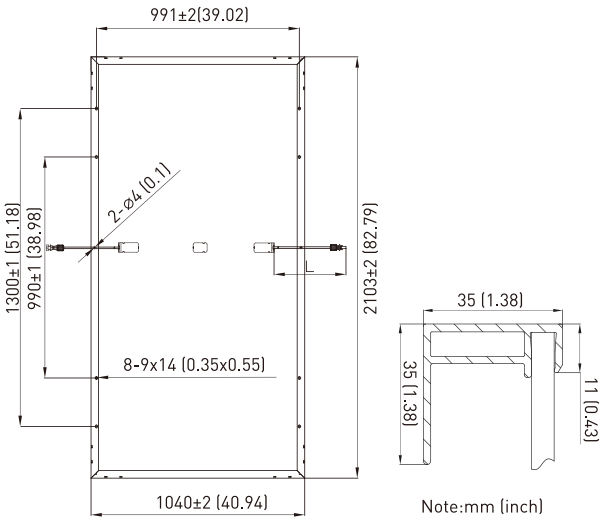
PACKING CONFIGURATION

Container	20' GP	40' HQ
Pieces/Container	255	682

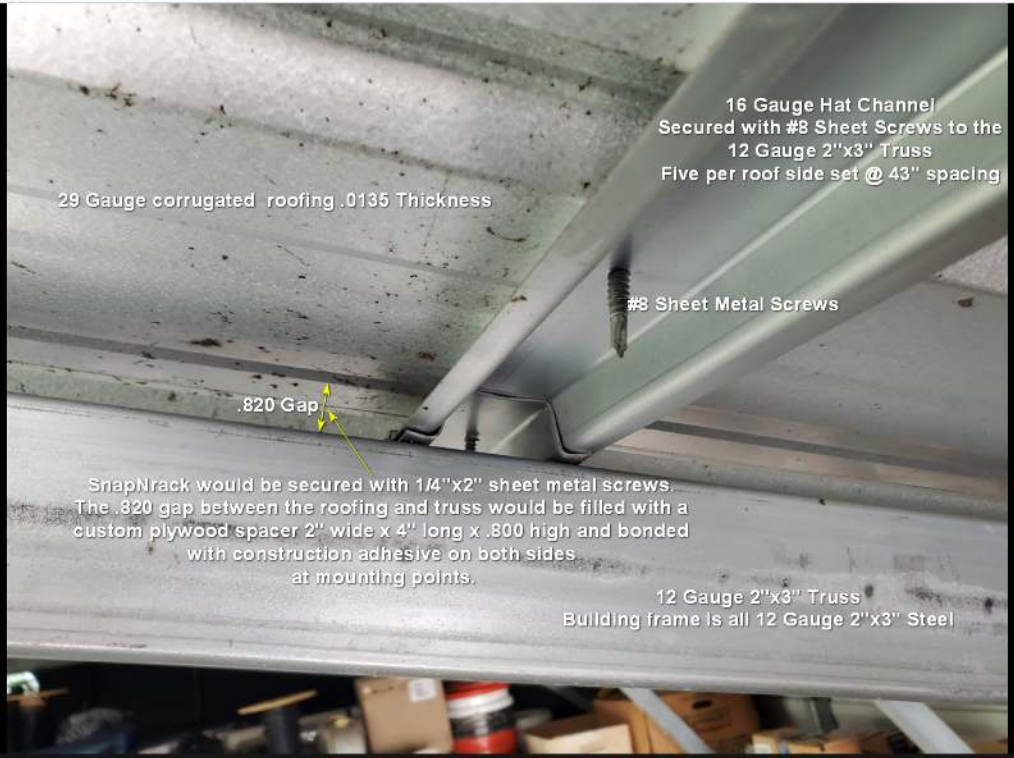
ELECTRICAL CHARACTERISTICS

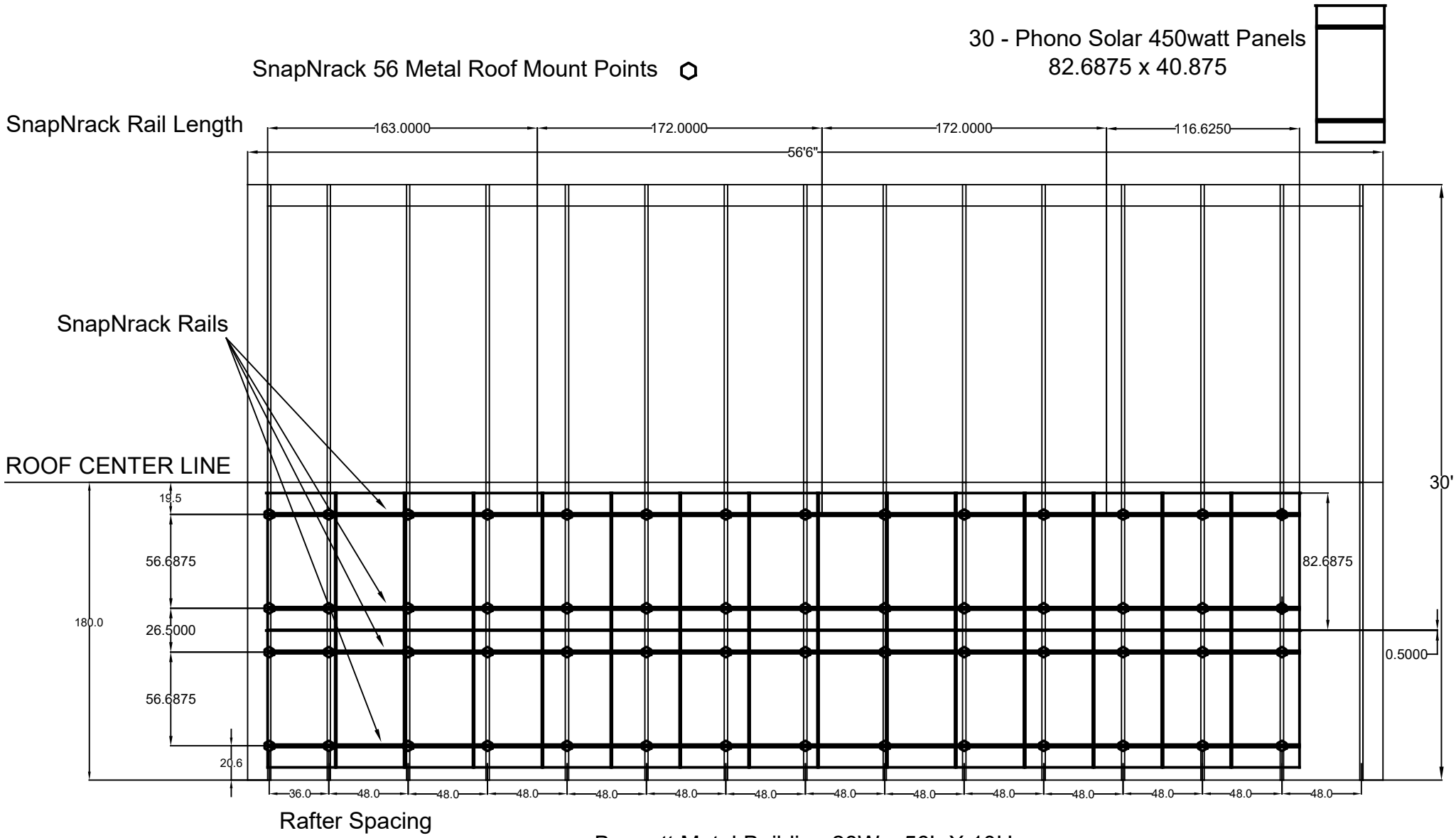






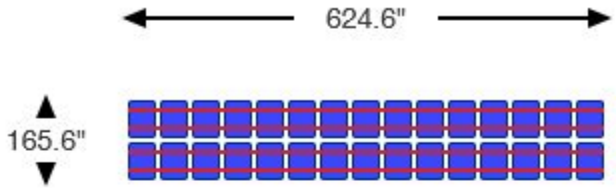
Phono® Solar


16 Gauge Hat Channel
Secured with #8 Sheet Screws to the
12 Gauge 2"x3" Truss
Five per roof side set @ 43" spacing
29 Gauge corrugated roofing .0135 Thickness
#8 Sheet Metal Screws
.820 Gap
SnapNrack would be secured with 1/4"x2" sheet metal screws.
The .820 gap between the roofing and truss would be filled with a
custom plywood spacer 2" wide x 4" long x .800 high and bonded
with construction adhesive on both sides
at mounting points.
12 Gauge 2"x3" Truss
Building frame is all 12 Gauge 2"x3" Steel



Bennett Metal Building 28W x 56L X 10H
2x3 Steel Framing 12 gauge
Galvalume Verticle Roof size 30'x 56'6'
Florida Certified - Wind Rated 170MPH

Module rails run left to right on screen (represented by red lines in array).



Click module to change color

- Regular - Edge Zone - No Module

Array Pitch	3	**degrees**
Mean Roof Height	13	**feet**
Attachment Spacing	48	**Inches**

Recommended maximum attachment spacing: **48**

Rows	2	
Columns	15	
Orientation	Portrait	

Reset

Prev Step | Configure Extra Materials

Ultra Rail Configuration Tool Report

Company Name: Muddiman
Project Name: Shop Roof

Create Date: 2022-07-16T13:28:09-0400
Bill of Materials #203286

PV Module Data:

Module brand:	**Phono Solar**	Length:	**82.8 inches**	Frame color:	**Silver**
Model:	**PS450M4-24/TH**	Width:	**40.94 inches**	Weight:	**55.12 pounds**
Rated power @ STC:	**450 W**	Depth:	**1.38 inches**		

Environmental Requirements:

Wind Speed Standard:	**IBC 2018**	Exposure Category:	**B**
Snow Load:	**20 psf**	Rafter Spacing:	**48 inches**
Wind Speed:	**130 mph**		

System Style:

Roof Attachments:	**Metal Roof Base with Ultra L Foot**	Edge Screen Trim?:	**No**	Tilt Up?:	**No**
Rail Type:	**UR-40**	Edge Screen Trim Size:	**- inches**		
Rail Finish:	**Silver**	Microinverter Attachment Kits:	**No**		
End Clamp Preference:	**Universal**	Array Skirt(s)?:	**No**		
Grounding Method:	**UL 2703 Listed**				

Sub-Array Summary:

Sub-Array	Sub-Array Modules	172" Rail	Rail Splices	Mid Clamps	End Clamps	Roof Attachments	Maximum Rail Span
1	30	16	12	56	8	56	48
Totals:	**30**	**16**	**12**	**56**	**8**	**56**	**-**

Total System Size: 13.50 kW

System Weights and Square Footage

SnapNrack System Weight	192.33	lbs
Total Module Weight	1653.60	lbs
Microinverter/Optimizer Weight	0.00	lbs
Total System Weight	1845.93	lbs
Array Square Footage	706.22	ft2
Distributed Load	2.61	psf

Links to Relevant Information

Engineering Documents
Installation Manuals
System Drawings
Video Tutorials
Distributors
Warranty

Ultra Rail Configuration Tool Report

Company Name: Muddiman
Project Name: Shop Roof

Create Date: 2022-07-16T13:28:09-0400
Bill of Materials #203286

Proposed Bill of Materials:

Part Number	Description	Qty
232-02537	SNAPNRACK, UR-40 RAIL, 172IN, SILVER	16
242-01213	SNAPNRACK, UR-40 SPLICE, SILVER	12
242-02070	SNAPNRACK, ULTRA RAIL MID CLAMP, SILVER	56
242-02215	SNAPNRACK, UNIVERSAL END CLAMP	8
232-02452	SNAPNRACK, UR-40 END CAP	8
232-01173	SNAPNRACK, SMART CLIP II	200
242-02158	SNAPNRACK, ULTRA RAIL METAL ROOF BASE WITH ALL PURPOSE L FOOT	56
242-02101	SNAPNRACK, GROUND LUG ASSEMBLY, 6-12 AWG	2
242-02731	SNAPNRACK, CONDUIT SUPPORT ASSEMBLY, 1IN EMT	2
232-01106	SNAPNRACK, WIRE RETENTION CLIP, COMPOSITE, BLACK	30
242-02150	SNAPNRACK, UNIVERSAL WIRE CLAMP	8
	System Total Weight:	**1845.93 lbs**

Ultra Rail Configuration Tool Report

Company Name: Muddiman
Project Name: Shop Roof

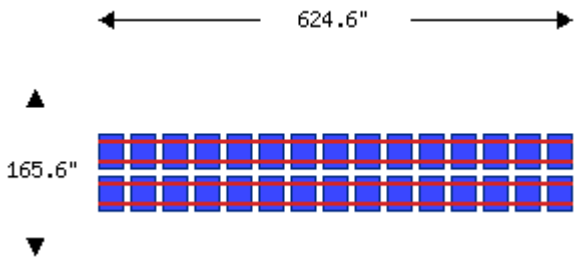
Create Date: 2022-07-16T13:28:09-0400
Bill of Materials #203286

Sub-Array #1 P(2x15)

The maximum recommended Rail Span for this sub-array is **48 inches**.

Group 1 Rail Length	Group 2 Rail Length	Group 3 Rail Length	Group 4 Rail Length	Group 5 Rail Length	Rail Qty	Row Mid Clamps	Row End Clamps	Row Splices	Attach-ments	Module Bonding	Rail Bonding
624.6	-	-	-	-	8	28	4	6	28	0	1
624.6	-	-	-	-	8	28	4	6	28	0	1
				Sub-Array Totals:	**16**	**56**	**8**	**12**	**56**	**0**	**2**

Orientation	Rows	Columns	Array Pitch	Mean Roof Height
Portrait	2	15	3 degrees	13 feet



Engineering Bin	
Type	**Number**
72-cell	Bin 5

Structural Engineering Report					
Maximum Rail Span			**Maximum Rail Cantilever**		
Zone 1	**Zone 2**	**Zone 3**	**Zone 1**	**Zone 2**	**Zone 3**
57 inches	41 inches	29 inches	19 inches	13 inches	9 inches

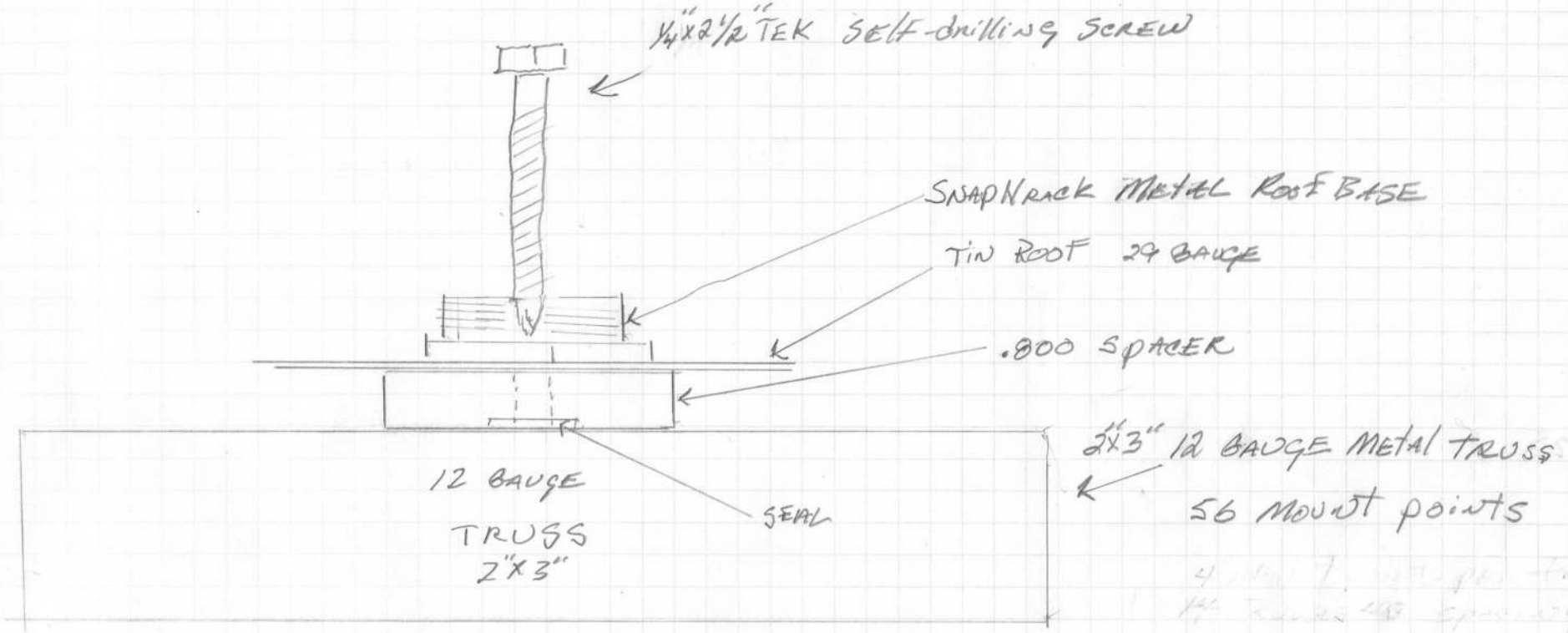
Attachment Spacing Adjusted for Rafter Spacing						
Rafter Spacing	**Max Attachment Spacing**			**Max Cantilever**		
	Zone 1	**Zone 2**	**Zone 3**	**Zone 1**	**Zone 2**	**Zone 3**
48 inches	48 inches	0 inches	0 inches	19 inches	0 inches	0 inches

Sub-Array Modules	Edge Screen	Array Power
30	0 ft	13.5 kW

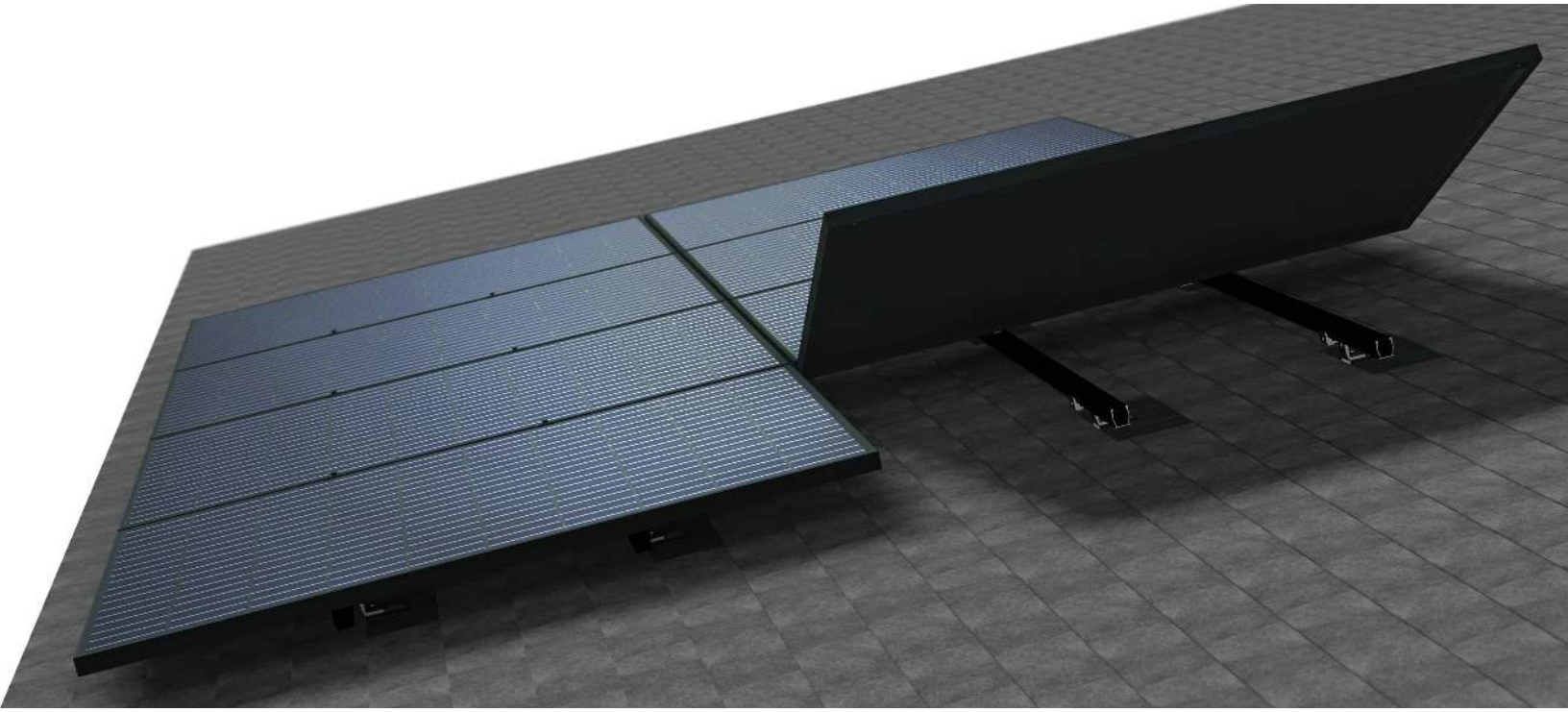
Maximum Reaction Forces			
Zone	**per inch of Span (lbs)**		
	Down	**Up**	**Lateral**
Interior (Zone 1)	6.61	7.09	0.91
Edge Zone (Zone 2)	6.61	9.73	0.9
Corner Zone (Zone 3)	6.62	13.69	0.93

Design Reaction Forces			
Zone	**per Attachment (lbs)**		
	Down	**Up**	**Lateral**
Interior (Zone 1)	317.28	340.32	43.68
Edge Zone (Zone 2)	0	0	0
Corner Zone (Zone 3)	0	0	0

CROSS SECTION SNAPNRACK BASE MOUNTING



Ultra Rail



The Ultimate Value in Rooftop Solar

- Industry leading Wire Management Solutions
- Mounts available for all roof types
- An install experience unlike any other
- Compatible with all Series 100 Module Clamps & Accessories

Start Installing Ultra Rail Today

RESOURCES	snapnrack.com/resources
DESIGN	snapnrack.com/configurator
WHERE TO BUY	snapnrack.com/where-to-buy

The SnapNrack Ultra Rail

is a sleek, lightweight rail solution for mounting solar modules on the roof.

The Entire System is a Snap to Install

- New Ultra Rail Mounts include snap-in brackets for attaching rail
- Compatible with all the SnapNrack Mid Clamps and End Clamps customers love
- Universal End Clamps and snap-in End Caps provide a clean look to the array edge

Unparalleled Wire Management

- Open rail channel provides room for running wires resulting in a long-lasting quality install
- Industry best wire management offering includes Junction Boxes, Universal Wire Clamps, MLPE Attachment Kits, and Conduit Clamps
- System is fully bonded and listed to UL 2703 Standard

The Largest Span Capabilities of any Light Rail Solution

This table was prepared in compliance with applicable engineering codes and standards. Values are based on the following:

- ASCE 7-10
- Chapter 30 Wind Loads & Chapter 7 Snow Loads
- Roof Slope: 7 - 27 deg
- Roof Height: 0 - 30 ft
- Exposure: B
- Roof Zone: 1
- Module Orientation: Portrait
- Roof Type: Comp

Visit SnapNrack.com for detailed span tables and certifications.

System Span Key
6 ft Spans
4 ft Spans
2 ft Spans

Ultra Rail, UR-40 Rail System Spans

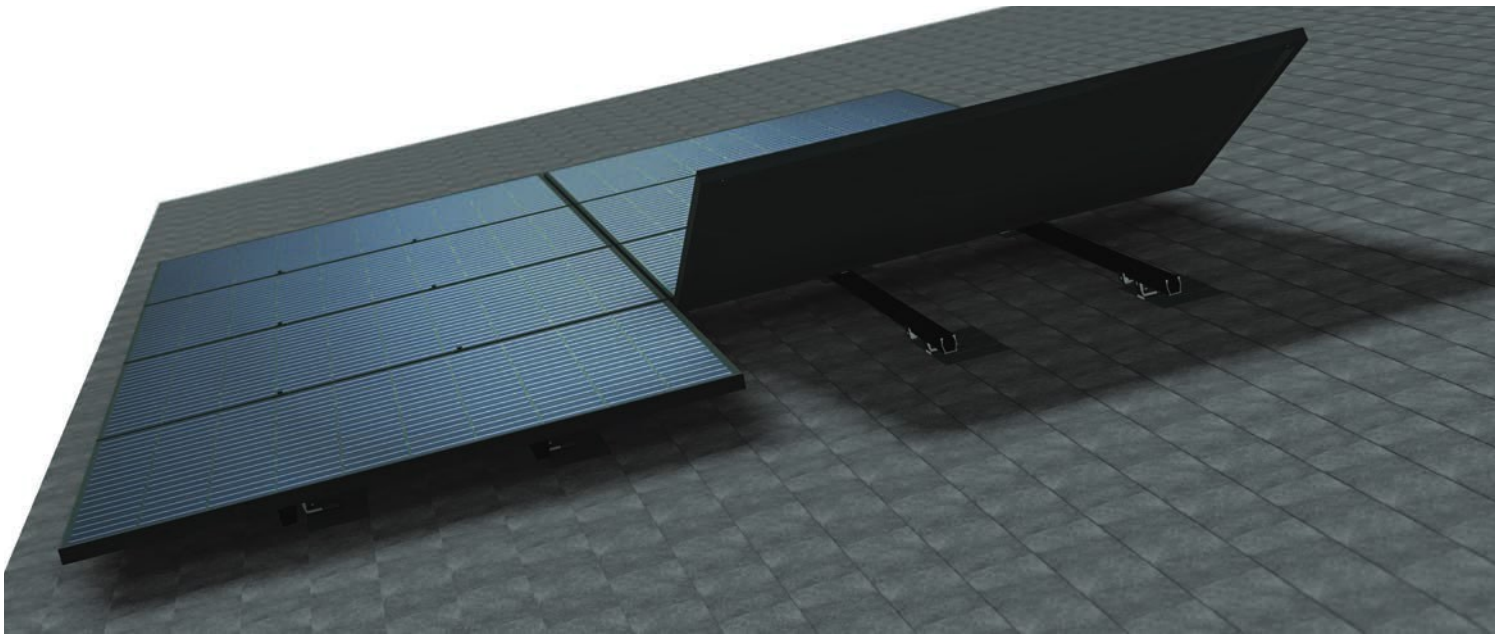
Snow (psf) \ Wind (mph)	110	115	120	125	130	135	140	145	150	155	160	165	170	175	180	190
0																
5																
10																
15																
20																
25																
30																
35																
40																
45																
50																
60																
70																
80																
90																
100																
110																
120																

Quality. Innovative. Superior.

SnapNrack Solar Mounting Solutions are engineered to optimize material use and labor resources and improve overall installation quality and safety.

877-732-2860 **www.snapnrack.com** **contact@snapnrack.com**

Ultra Rail | *Rail-based Mounting*



SnapNrack Ultra Rail
The Ultimate Value in Rooftop Solar

Ultra Rail is the ultimate rail solution for mounting solar modules on the roof. The entire system is a snap to install utilizing new pre-assembled Ultra Rail Mounts that include snap-in brackets for attaching rail. Snap-in module clamps provide an intuitive install experience installers know and love.

- Industry-leading aesthetics with Universal End Clamps and snap-in End Caps that make the mounting system invisible underneath the array
- Unparalleled wire management solutions with accessories such as Junction Boxes, Universal Wire Clamps, MLPE Attachment Kits, and Conduit Clamps
- Low profile rail maintains the open channel with room for running wires resulting in a top quality finished install
- UR-40 has the largest span capabilities of any light rail solution
- UR-60 is a heavy duty profile for higher loading conditions

More Info
Ultra Rail Product Page

Ultra Rail Configuration Tool
Design a system & download a BOM to quote with the online Configuration Tool

Visit Resource Library
Download Structural Engineering, Installation Manuals & System Drawings

UR-40/60 Rail & Accessories

UR-40 Rail, Black

UR-40 Splice

UR-40 End Cap

UR-60 Rail, Black

UR-60 Splice

UR-60 End Cap

UR-40 Rail			
Description	**SKU**	**MSRP**	**QTY***
UR-40 Rail, 172", Black (Bundle of 144, priced as each)	232-02538	$60.91	144 EA
UR-40 Rail, 172", Silver (Bundle of 144, priced as each)	232-02537	$59.79	144 EA
UR-40 Rail, 172", Mill (Bundle of 144, priced as each)	232-02536	$55.75	144 EA
UR-40 Rail, 172", Black (Box of 4)	015-10207	$271.19	1 Box
UR-40 Rail, 172", Silver (Box of 4)	015-10208	$266.67	1 Box
UR-40 Rail, 172", Mill (Box of 4)	015-10209	$255.22	1 Box
UR-60 Rail			
Description	**SKU**	**MSRP**	**QTY***
UR-60 Rail 172", Black (Bundle of 120, priced as each)	232-02541	$79.81	120 EA
UR-60 Rail 172", Silver (Bundle of 120, priced as each)	232-02540	$78.96	120 EA
UR-60 Rail 172", Mill (Bundle of 120, priced as each)	232-02539	$72.50	120 EA
UR-60 Rail Set, 172", Black (Box of 4)	015-10210	$373.78	1 Box
UR-60 Rail Set, 172", Silver (Box of 4)	015-10211	$369.79	1 Box
UR-60 Rail Set, 172", Mill (Box of 4)	015-10212	$346.72	1 Box
UR-40 Rail Accessories			
Description	**SKU**	**MSRP**	**QTY***
UR-40 Splice, Silver	242-01213	$8.70	20 EA
UR-40 Splice, Black	242-01214	$9.24	20 EA
UR-40 End Cap	232-02452	$0.70	20 EA
UR-60 Rail Accessories			
Description	**SKU**	**MSRP**	**QTY***
UR-60 Splice, Silver	242-01270	$9.99	20 EA
UR-60 Splice, Black	242-01271	$10.29	20 EA
UR-60 End Cap	232-02484	$0.70	20 EA

*** QTY (Quantity) listed is the standard package and minimum order quantity. SnapNrack products are sold through distribution and may be available as individual units.**

December 29, 2020

SnapNrack
775 Fiero Lane, Ste. 200
San Luis Obispo, CA 93401
TEL: (877) 732-2860

Attn.: SnapNrack - Engineering Department

Re: SnapNrack pre-engineered PV racking systems:

- RL Universal System (Report # 2019-02916A.01 and B.01)
- S200 Ground Mount System (Report # 2017-00240-D.02)
- UR40 Railed System (Report # 2017-03227.11 and .12)
- UR60 Railed System (Report # 2018-11940.03 and .04)

PAUL K. ZACHER LICENSE No. 73522 STATE OF FLORIDA PROFESSIONAL ENGINEER EXP. 02/28/2023

5-28-2021

THIS ITEM HAS BEEN ELECTRONICALLY SIGNED AND SEALED BY PAUL K. ZACHER, PE ON 12/29/2020 USING A SHA-1 AUTHENTICATION CODE.

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SHA-1 AUTHENTICATION CODE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.

Subject: Engineering certification for the State of Florida.

PZSE, Inc. - Structural Engineers has provided engineering and span tables as presented in the above referenced reports. All information, data, and analysis therein are based on, and comply with, the following building codes and typical specifications:

Building Codes:

1. ASCE/SEI 7-16 & 7-10 Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers
2. 2020 Florida Building Code, 7th Edition and 2017 Florida Building Code 6th Edition
3. 2020 Florida Residential Code, 7th Edition and 2017 Florida Residential Code 6th Edition
4. AC428 Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012, by ICC-ES
5. Aluminum Design manual 2015, by The Aluminum Association, Inc.
6. ANSI/AWC NDS-2018 & 2015, National Design Specification for Wood Construction, by the American Wood Council

This letter certifies that the design criteria and design methodology for the SnapNrack product span tables are in compliance with the above codes. Please refer to the system specific Engineering Certification Reports (listed above) for system specific design criteria and limitations.

If you have any questions on the above, do not hesitate to call.

Prepared by:
PZSE, Inc. – Structural Engineers
Roseville, CA

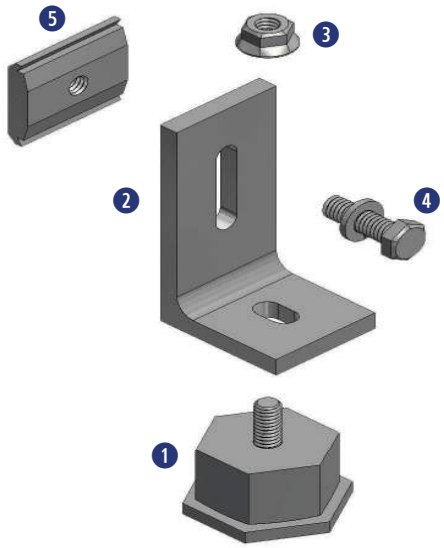
Metal Roof Base

Required Tools

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

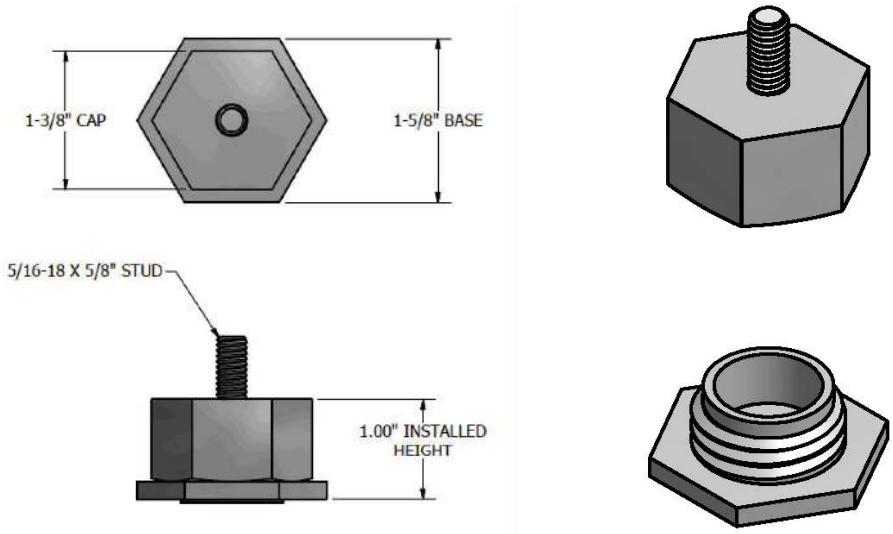
Materials Included - Metal Roof Base

1. (1) SnapNrack Metal Roof Base
2. (1) SnapNrack All Purpose L Foot
3. (1) 5/16”-18 SS Flange Nut
4. (1) 5/16”-18 X 1-1/4” SS Flange Bolt
5. (1) SnapNrack Channel Nut



Other Materials Required

① (1) 5/16” Lag Screw or 1/4” Self-drilling Screw (Not Shown)



Dimensioned Metal Roof Base Assembly

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

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

INSTALLATION INSTRUCTIONS

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

Install Note:

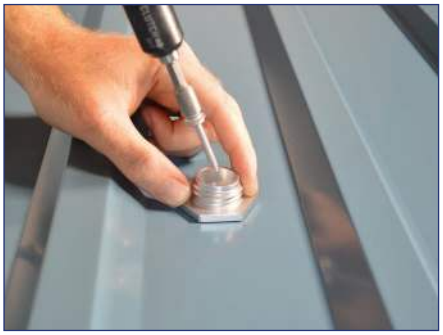
Ensure the lag or self-drilling screws will be installed in a solid portion of the roof framing member.

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

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.



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

Install Note:

Ensure area is free from metal shavings and debrris 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.

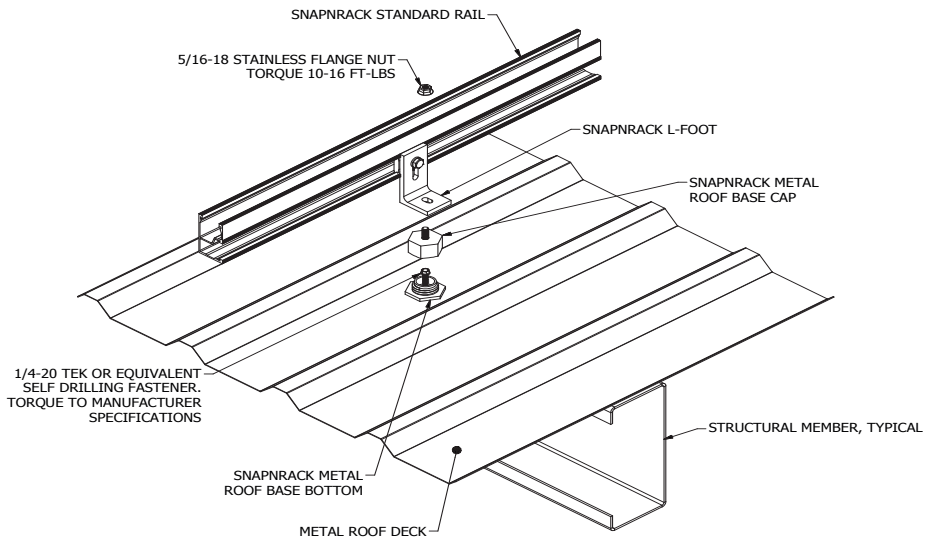
Best Practice:

If using an impact driver, finish tightening lag screw with a hand wrench.

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

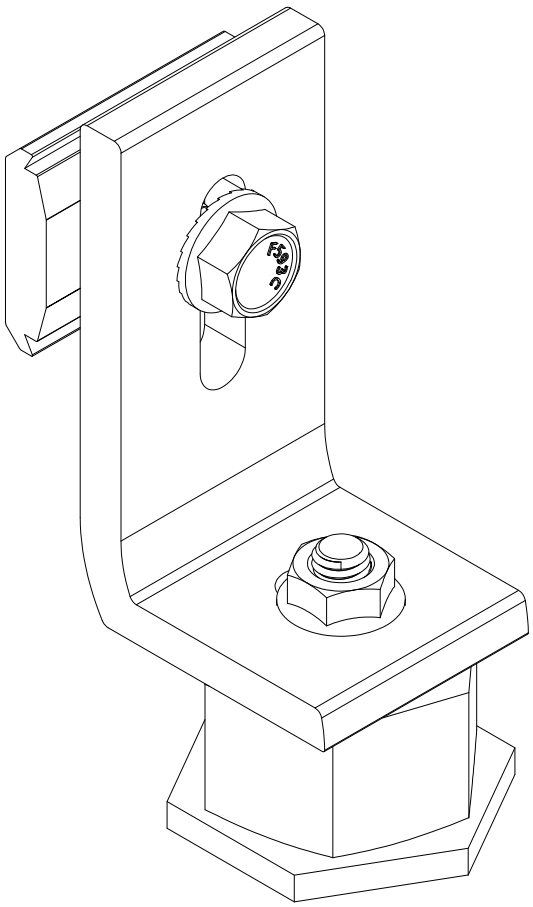
Install Note:

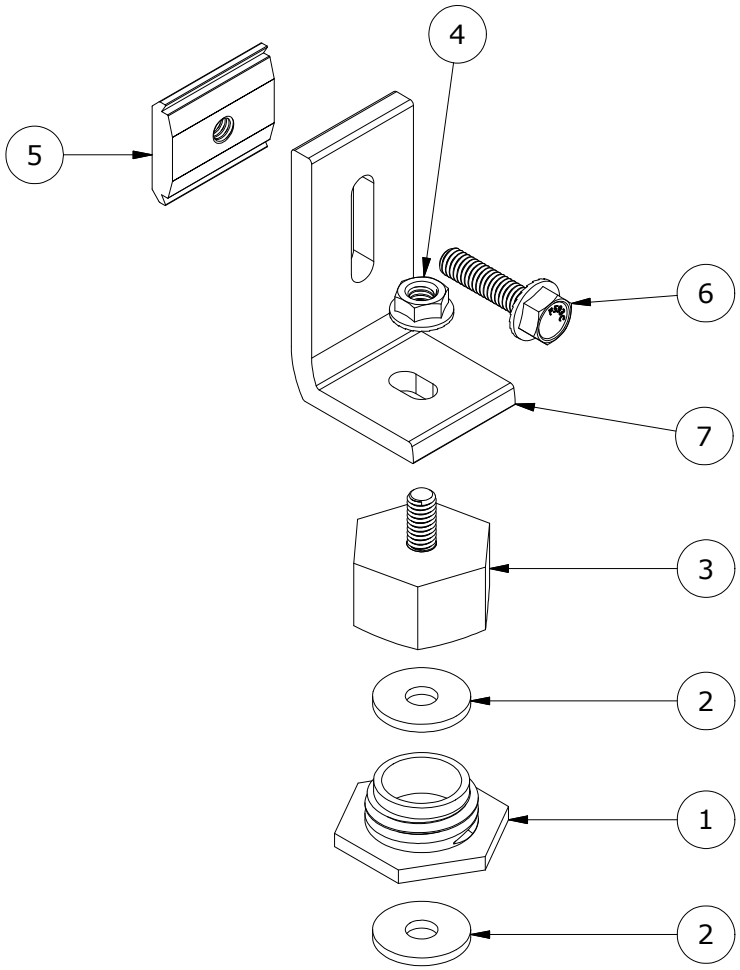
Take care to ensure the base does not twist when cap is tightened.



DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, METAL ROOF BASE	D.Ryan	
PART NUMBER(S):	REVISION:	
242-02037	B	

595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902

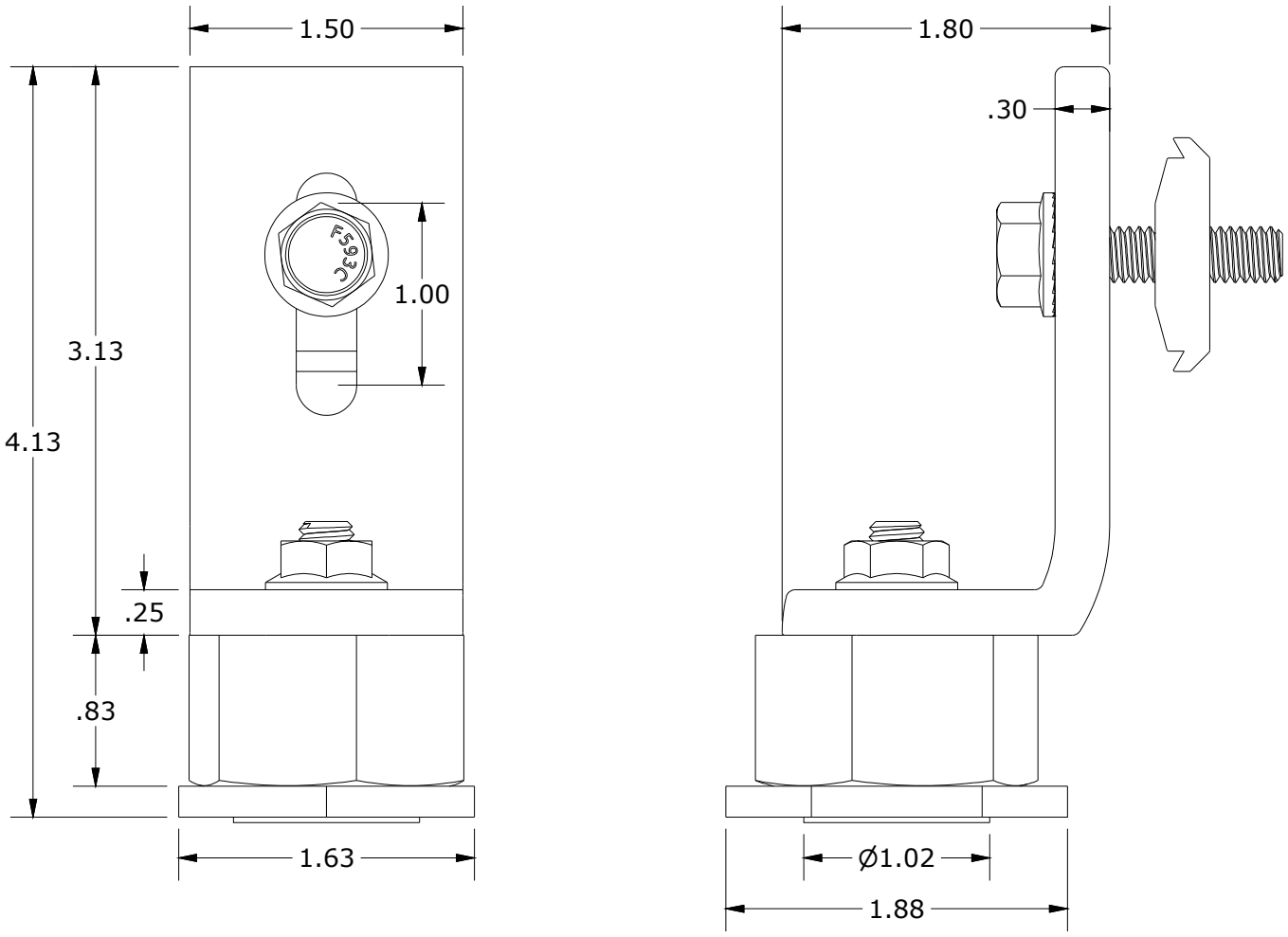




PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK METAL ROOF BASE BOTTOM
2	2	SNAPNRACK METAL ROOF BASE SEALING WASHER
3	1	SNAPNRACK METAL ROOF BASE CAP
4	1	NUT, FLANGE, SERRATED, 5/16IN-18, SS
5	1	SNAPNRACK CHANNEL NUT 5/16IN-18
6	1	BOLT, FLANGED HEX, 5/16IN-18 X 1-1/4IN, SS
7	1	SNAPNRACK, AP90 L FOOT PRC, CLEAR

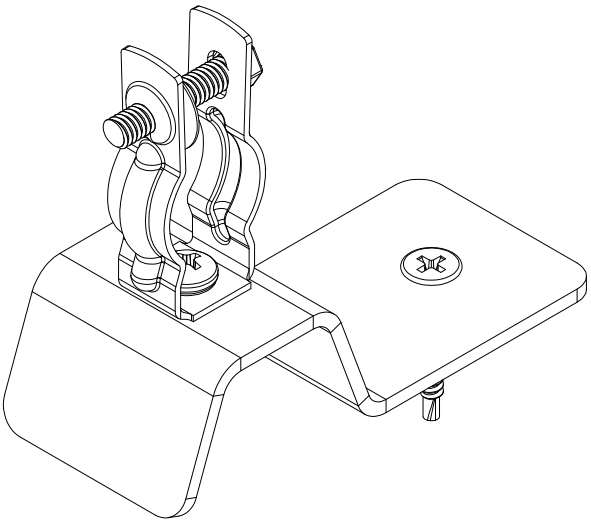
MATERIALS:	6000 SERIES ALUMINUM, STAINLESS STEEL	OPTIONS:
DESIGN LOAD (LBS):	405 UP, 788 DOWN, 236 SIDE	
ULTIMATE LOAD (LBS):	1098 UP, 3364 DOWN, 1340 SIDE	
TORQUE SPECIFICATION:	10+ LB-FT	
CERTIFICATION:	UL 2703, FILE E359313	
WEIGHT (LBS):	0.43	

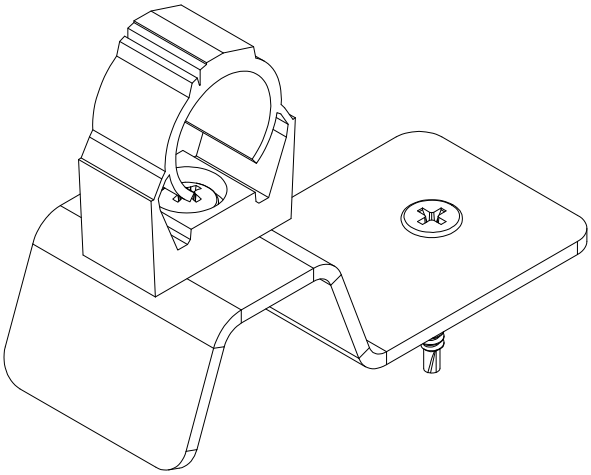
DESCRIPTION:	DRAWN BY:	
SNAPNRACK, METAL ROOF BASE	D.Ryan	SnapNrack™ Solar Mounting Solutions
PART NUMBER(S):	REVISION:	
242-02037	B	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902

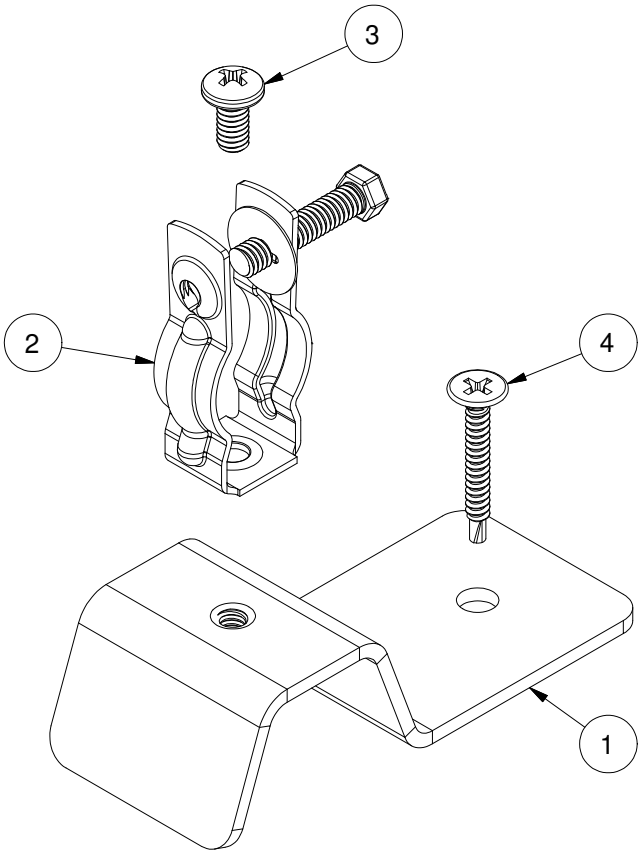


ALL DIMENSIONS IN INCHES

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, CONDUIT SUPPORT ASSEMBLY	mwatkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
242-02730, 242-02731, 242-02732, 242-02733	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.







CONDUIT SUPPORT DETAILS		
SKU	MATERIAL	SIZE
242-02730	EMT	3/4"
242-02731	EMT	1"
242-02732	PVC	3/4"
242-02733	PVC	1"

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, CONDUIT MOUNT PRC, 1/4IN-20 TAPPED, 1060 AL, MILL
2	1	CONDUIT SUPPORT, SIZE / MATERIAL VARIES, 1/4IN HOLE, ZINC PLATED STEEL / PVC
3	1	SCREW, MACHINE, 1/4IN-20 X 1/2IN, PAN HEAD PHILLIPS, ZINC
4	1	SCREW, SELF-DRILLING, #10 x 1-1/2IN, FLAT HEAD PHILLIPS, SS

MATERIALS:	1000 SERIES ALUMINUM, STAINLESS STEEL, ZINC PLATED STEEL, PVC	
DESIGN LOAD (LBS):	N/A	OPTIONS:
ULTIMATE LOAD (LBS):	N/A	3/4" & 1" EMT
TORQUE SPECIFICATION:	N/A LB-FT	3/4" & 1" PVC
CERTIFICATION:	N/A	
WEIGHT (LBS):	0.22 - 0.27	

DESCRIPTION:

SNAPNRACK, CONDUIT SUPPORT ASSEMBLY

PART NUMBER(S):

242-02730, 242-02731, 242-02732, 242-02733

DRAWN BY:

mwatkins

REVISION:

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Solar Mounting Solutions

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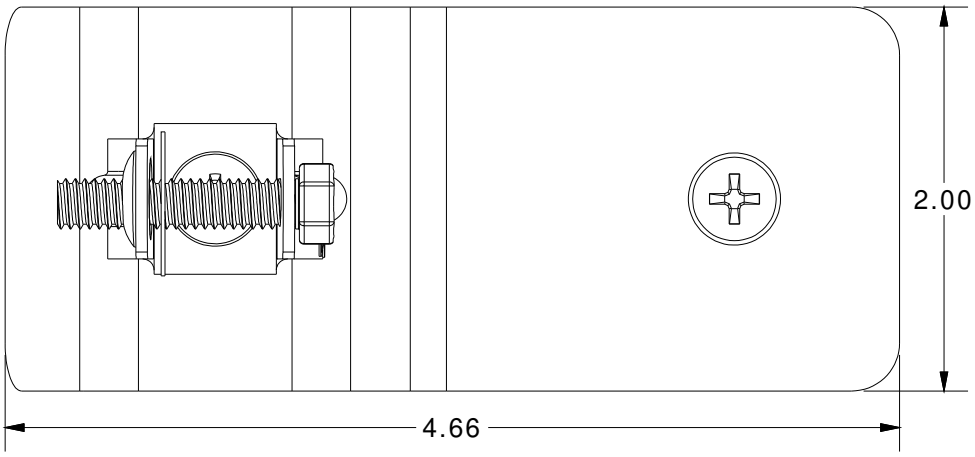

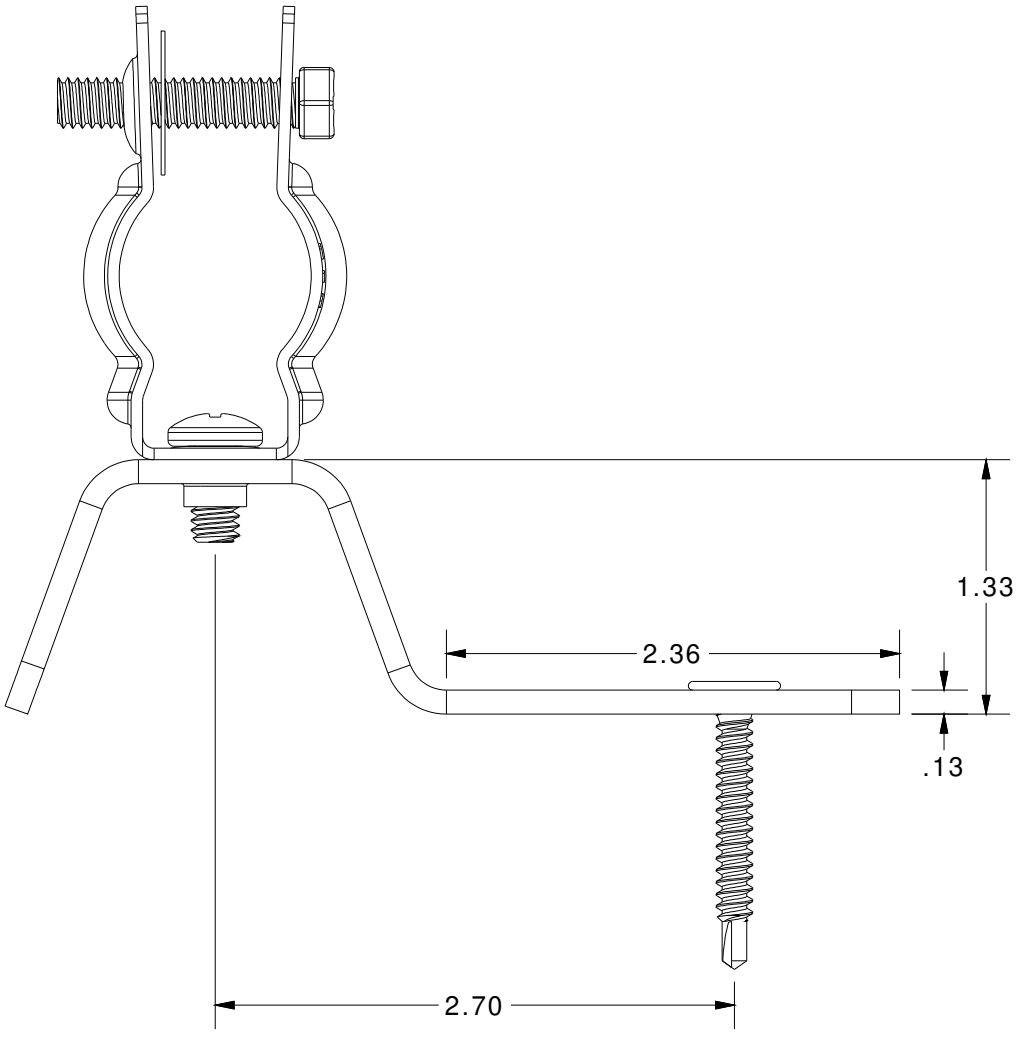

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DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, ULTRA RAIL END CLAMP	mwatkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
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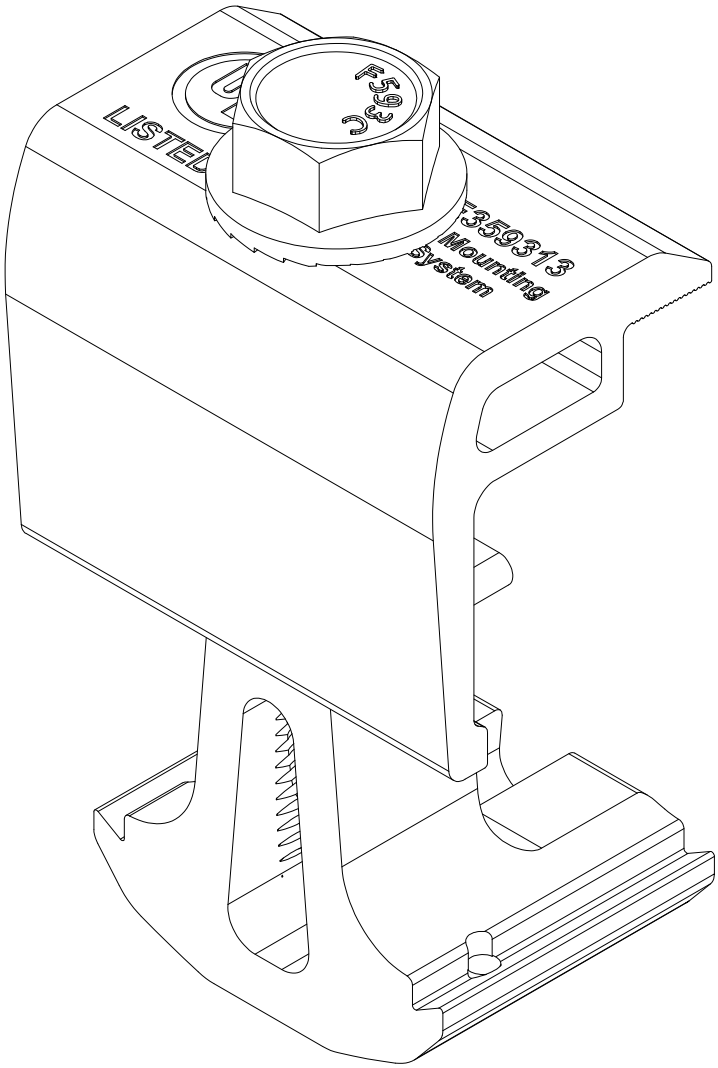

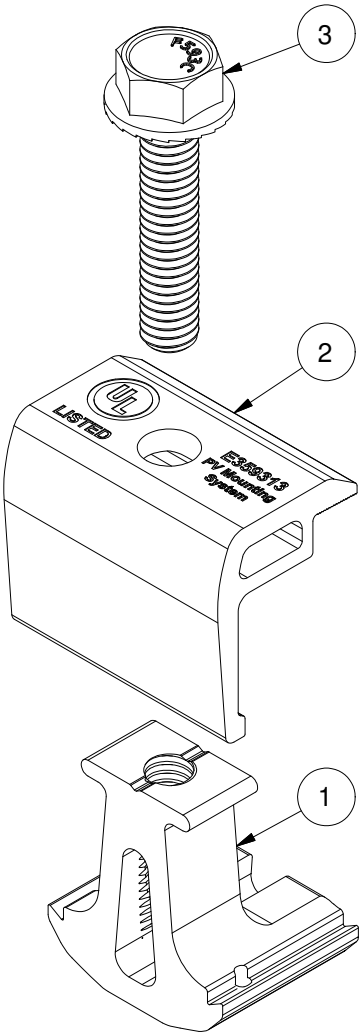

NOTE:
CLAMPS FIT 30-46MM THICK MODULE FRAMES

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, ULTRA RAIL END CLAMP, BASE
2	1	SNAPNRACK, ULTRA RAIL END CLAMP, TOP
3	1	BOLT, FLANGE SERRATED, 5/16IN-18 X 1-1/2IN, SS

MATERIALS:	6000 SERIES ALUMINUM, STAINLESS STEEL	OPTIONS:
DESIGN LOAD (LBS):	520	CLEAR / BLACK ANODIZED
ULTIMATE LOAD (LBS):	2000	
TORQUE SPECIFICATION:	16 LB-FT	
CERTIFICATION:	UL 2703, FILE E359313	
WEIGHT (LBS):	0.16	

DESCRIPTION:

SNAPNRACK, ULTRA RAIL END CLAMP

PART NUMBER(S):

242-02072, 242-02073

DRAWN BY:

mwatkins

REVISION:

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Solar Mounting Solutions

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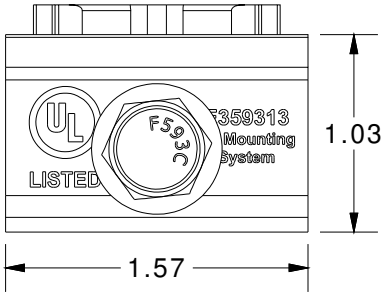
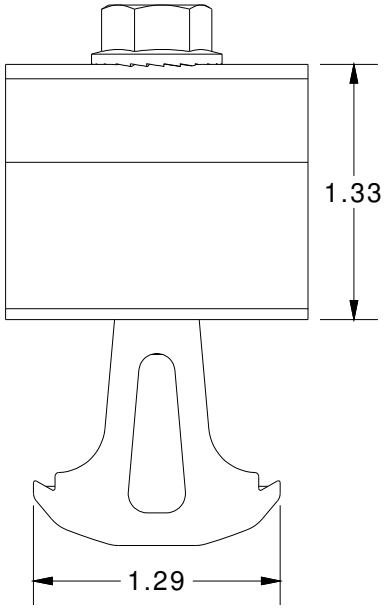
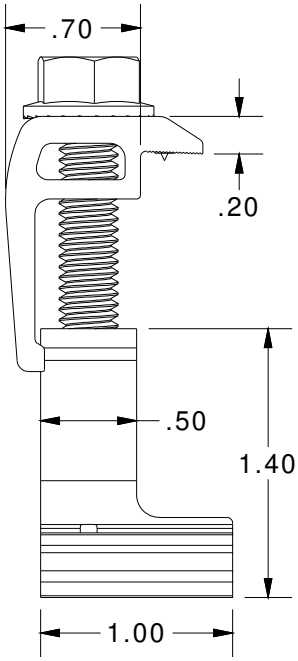
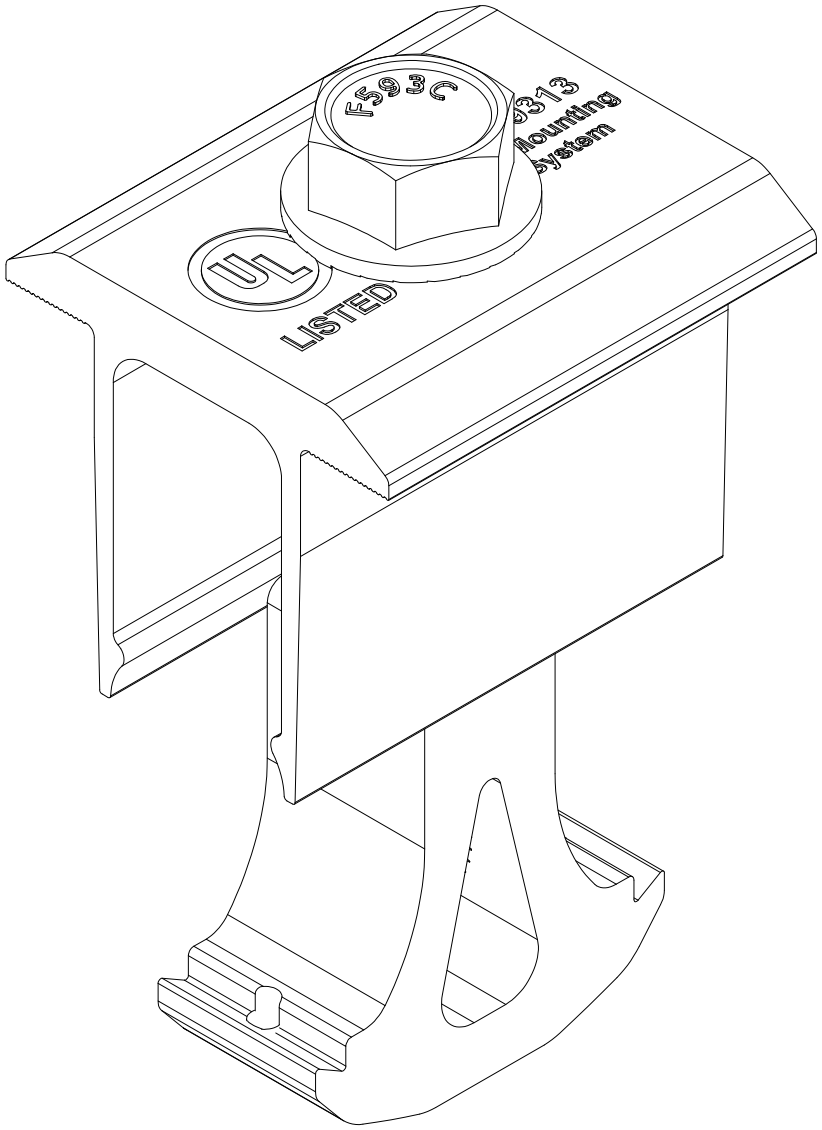


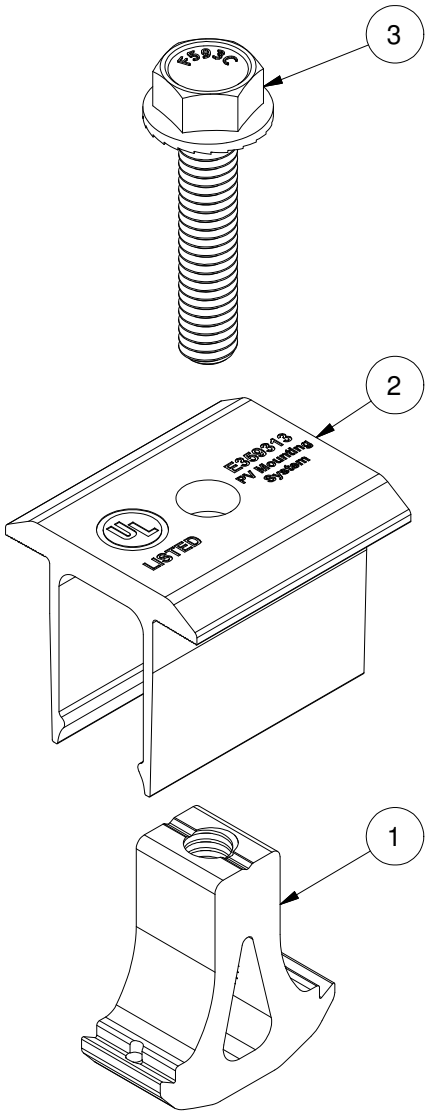




ALL DIMENSIONS IN INCHES

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, ULTRA RAIL MID CLAMP	mwatkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
242-02070, 242-02071	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.





NOTE:
CLAMPS FIT 30-46MM THICK MODULE FRAMES

PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, ULTRA RAIL MID CLAMP, BASE
2	1	SNAPNRACK, ULTRA RAIL MID CLAMP, TOP
3	1	BOLT, FLANGE SERRATED, 5/16IN-18 X 1-1/2IN, SS

MATERIALS:	6000 SERIES ALUMINUM, STAINLESS STEEL	OPTIONS:
DESIGN LOAD (LBS):	855	CLEAR / BLACK ANODIZED
ULTIMATE LOAD (LBS):	2823	
TORQUE SPECIFICATION:	16 LB-FT	
CERTIFICATION:	UL 2703, FILE E359313	
WEIGHT (LBS):	0.15	

DESCRIPTION:

SNAPNRACK, ULTRA RAIL MID CLAMP

PART NUMBER(S):

242-02070, 242-02071

DRAWN BY:

mwatkins

REVISION:

A

SnapNrack™
Solar Mounting Solutions

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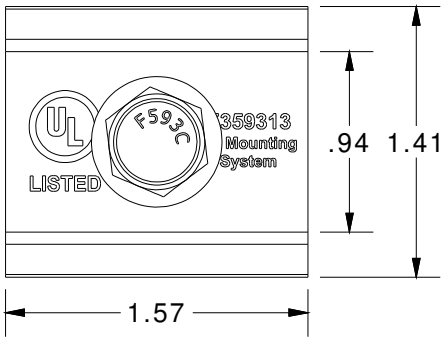

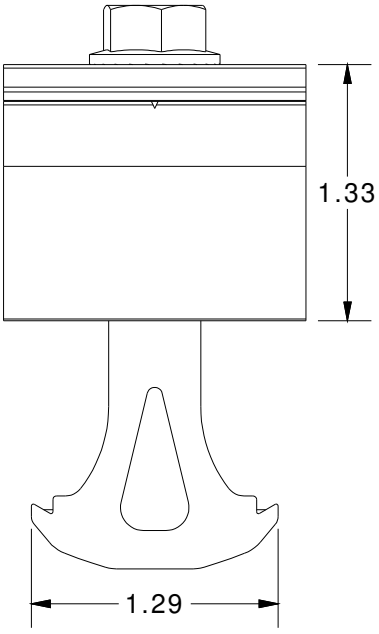

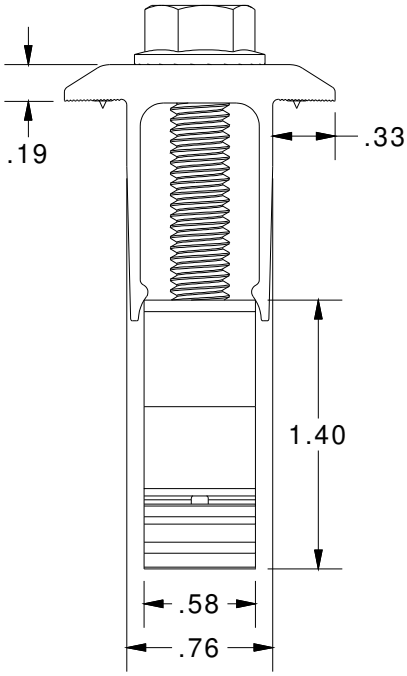

ALL DIMENSIONS IN INCHES

DESCRIPTION:

SNAPNRACK, UR-40 RAIL

DRAWN BY:

mwatkins

REVISION:

C

PART NUMBER(S):

232-02449, 232-02450, 232-02451, 232-02536, 232-02537, 232-02538

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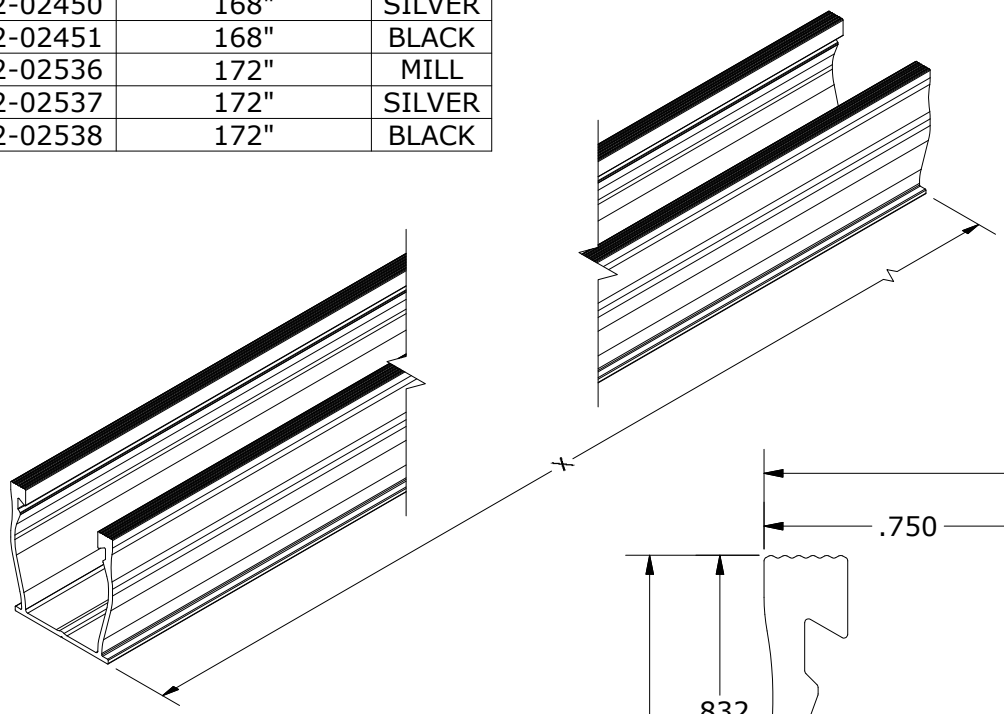
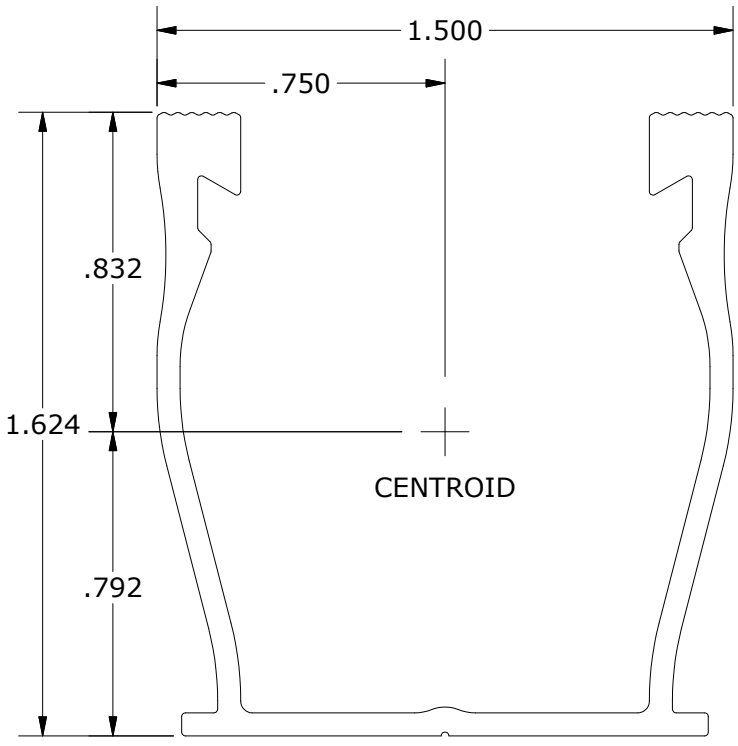
PHONE (415) 580-6900 • FAX (415) 580-6902

UR-40 RAIL PROPERTIES		
SKU	RAIL LENGTH (X)	FINISH
232-02449	168"	MILL
232-02450	168"	SILVER
232-02451	168"	BLACK
232-02536	172"	MILL
232-02537	172"	SILVER
232-02538	172"	BLACK



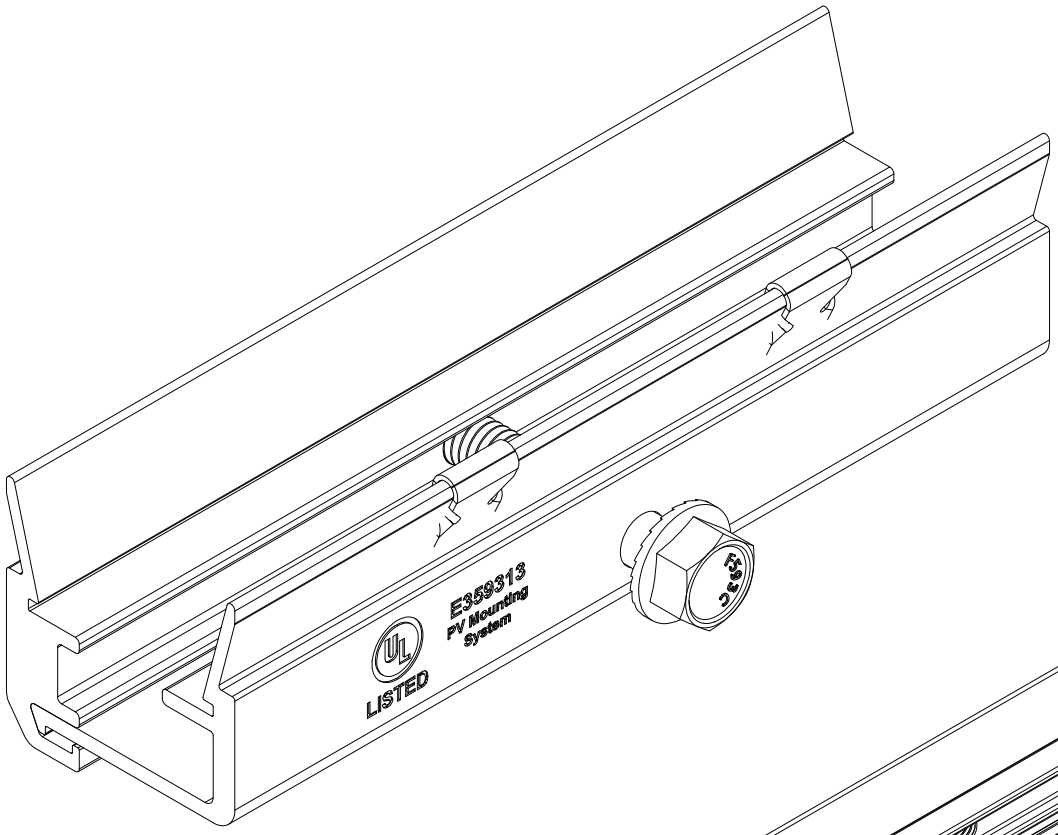


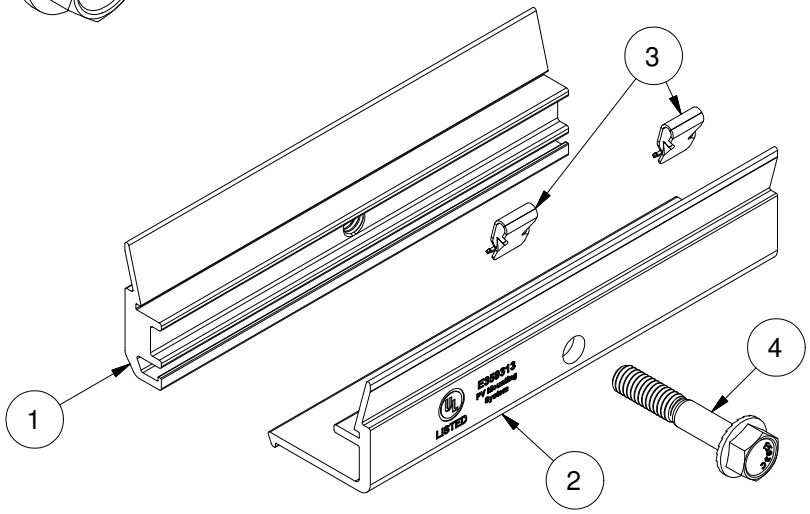
SECTION PROPERTIES	
A	0.357 in²
Ixx	0.125 in⁴
Iyy	0.132 in⁴
Sx (TOP)	0.150 in³
Sx (BOT)	0.158 in³
Sy (LEFT)	0.175 in³
Sy (RIGHT)	0.175 in³

ALL DIMENSIONS IN INCHES

MATERIALS:	6000 SERIES ALUMINUM	OPTIONS:
DESIGN LOAD (LBS):	N/A	SILVER / BLACK ANODIZED
ULTIMATE LOAD (LBS):	N/A	MILL FINISH
TORQUE SPECIFICATION:	N/A LB-FT	BUNDLES OF 144
CERTIFICATION:	UL 2703, FILE E359313	BOXES OF 8
WEIGHT (LBS):	5.85 - 5.99	

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, UR-40 SPLICE	mwatkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
242-01213, 242-01214	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.





PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, UR-40 SPLICE TAPPED PRC, CLEAR
2	1	SNAPNRACK, UR-40 SPLICE THRU PRC, CLEAR
3	2	SNAPNRACK, SNAPLINK BONDING CLIP, TYPE 2, STEEL
4	1	BOLT, FLANGE, SERRATED, 5/16IN-18 X 1-3/4IN, SS

MATERIALS:	6000 SERIES ALUMINUM, STAINLESS STEEL	OPTIONS:
DESIGN LOAD (LBS):	N/A	CLEAR / BLACK ANODIZED
ULTIMATE LOAD (LBS):	N/A	
TORQUE SPECIFICATION:	12 LB-FT	
CERTIFICATION:	UL 2703, FILE E359313	
WEIGHT (LBS):	0.52	

DESCRIPTION:

SNAPNRACK, UR-40 SPLICE

PART NUMBER(S):

242-01213, 242-01214

DRAWN BY:

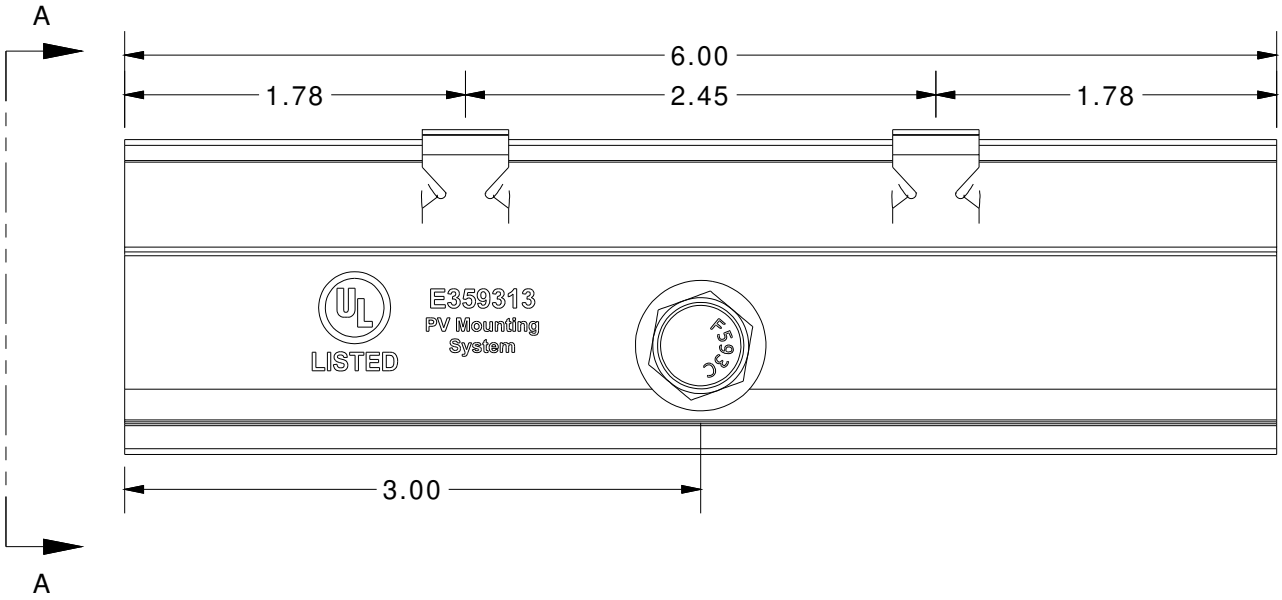
mwatkins

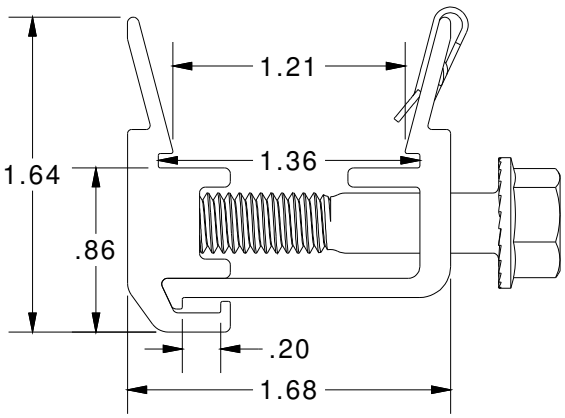
REVISION:

A

SnapNrack™
Solar Mounting Solutions

595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902

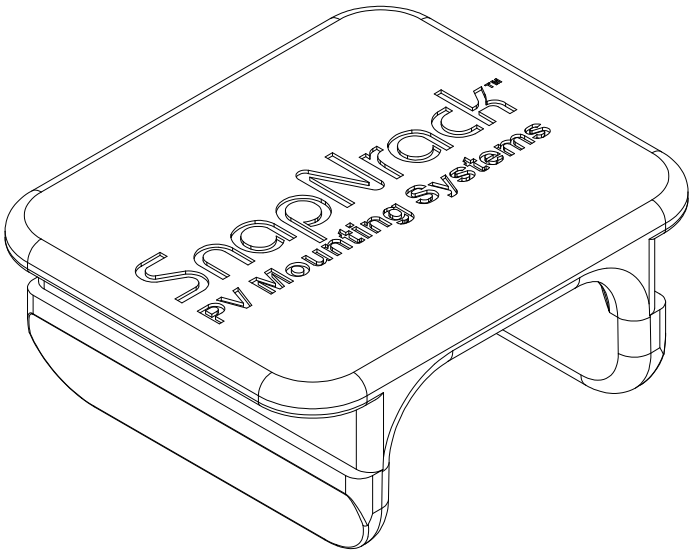


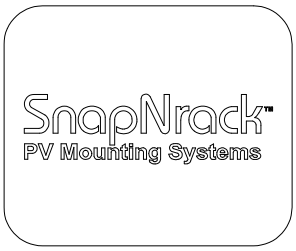


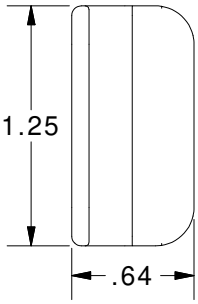
VIEW A-A
SCALE 1 : 1

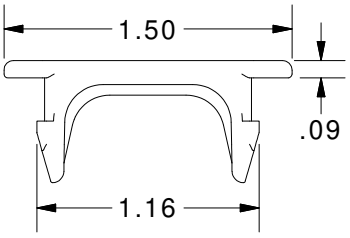
ALL DIMENSIONS IN INCHES

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, WIRE RETENTION CLIP	D.Ryan	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
232-01106	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.



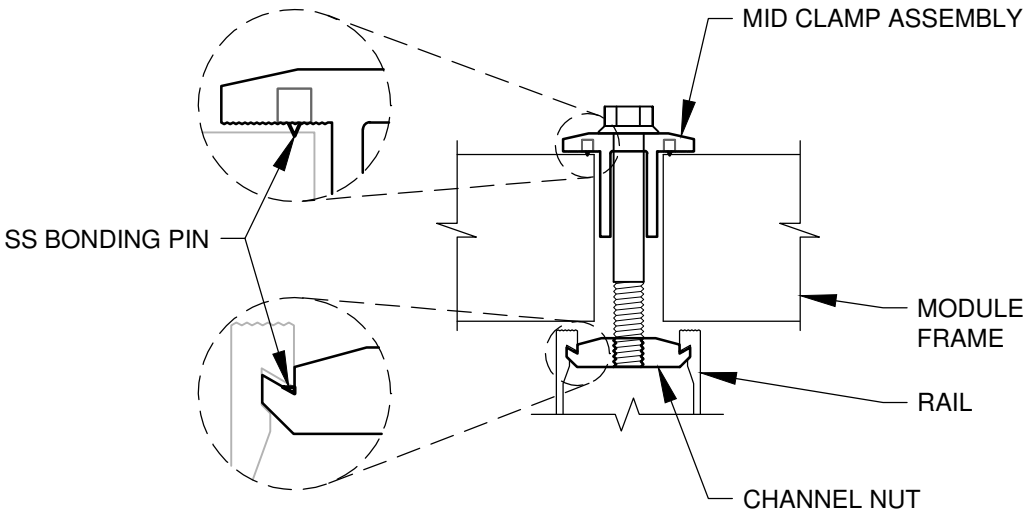




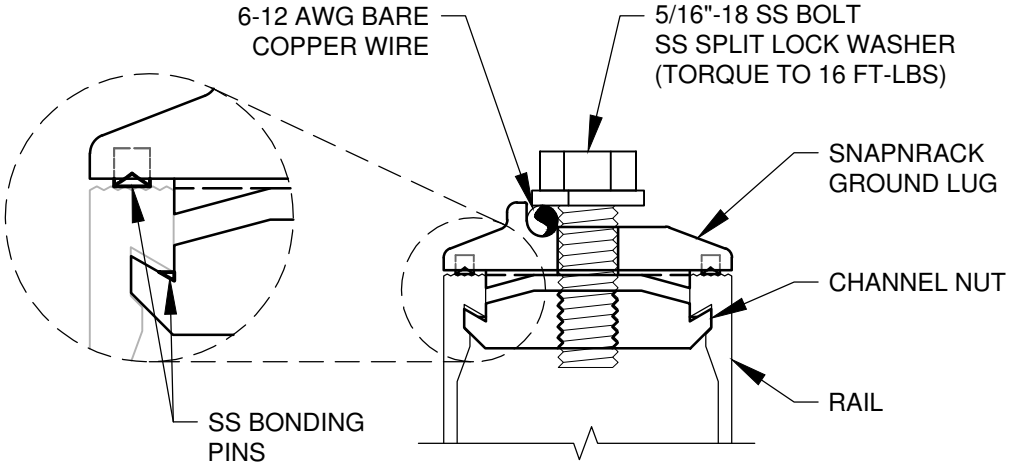


ALL DIMENSIONS IN INCHES

MATERIALS:	UV-RESISTANT POLYMER	OPTIONS:
DESIGN LOAD (LBS):	N/A	
ULTIMATE LOAD (LBS):	N/A	
TORQUE SPECIFICATION:	N/A LB-FT	
CERTIFICATION:	N/A	
WEIGHT (LBS):	0.014	



NOTE:
1. ADJUSTABLE END CLAMPS USE SAME BONDING PIN DESIGN TO BOND MODULES TO RAIL



NOTE:
1. ALL HARDWARE IS INCLUDED FROM MANUFACTURER
2. A MINIMUM OF ONE GROUND LUG IS TO BE INSTALLED ON EVERY CONTINUOUS ROW OF MODULES
3. GROUND LUG MAY BE INSTALLED IN EITHER RAIL CHANNEL
4. GROUND LUG MAY BE INSTALLED SO GROUND WIRE IS PARALLEL OR PERPENDICULAR TO RAIL
5. ENSURE SPLIT LOCK WASHER IS INSTALLED ON TOP OF COPPER WIRE

ASSEMBLER:	
INSPECTOR:	

DESCRIPTION:

SNAPNRACK MOUNTING SYSTEM
GROUNDING DETAILS

PART NUMBER:	SCALE:
	DNS

DRAWN BY: MIKE WATKINS

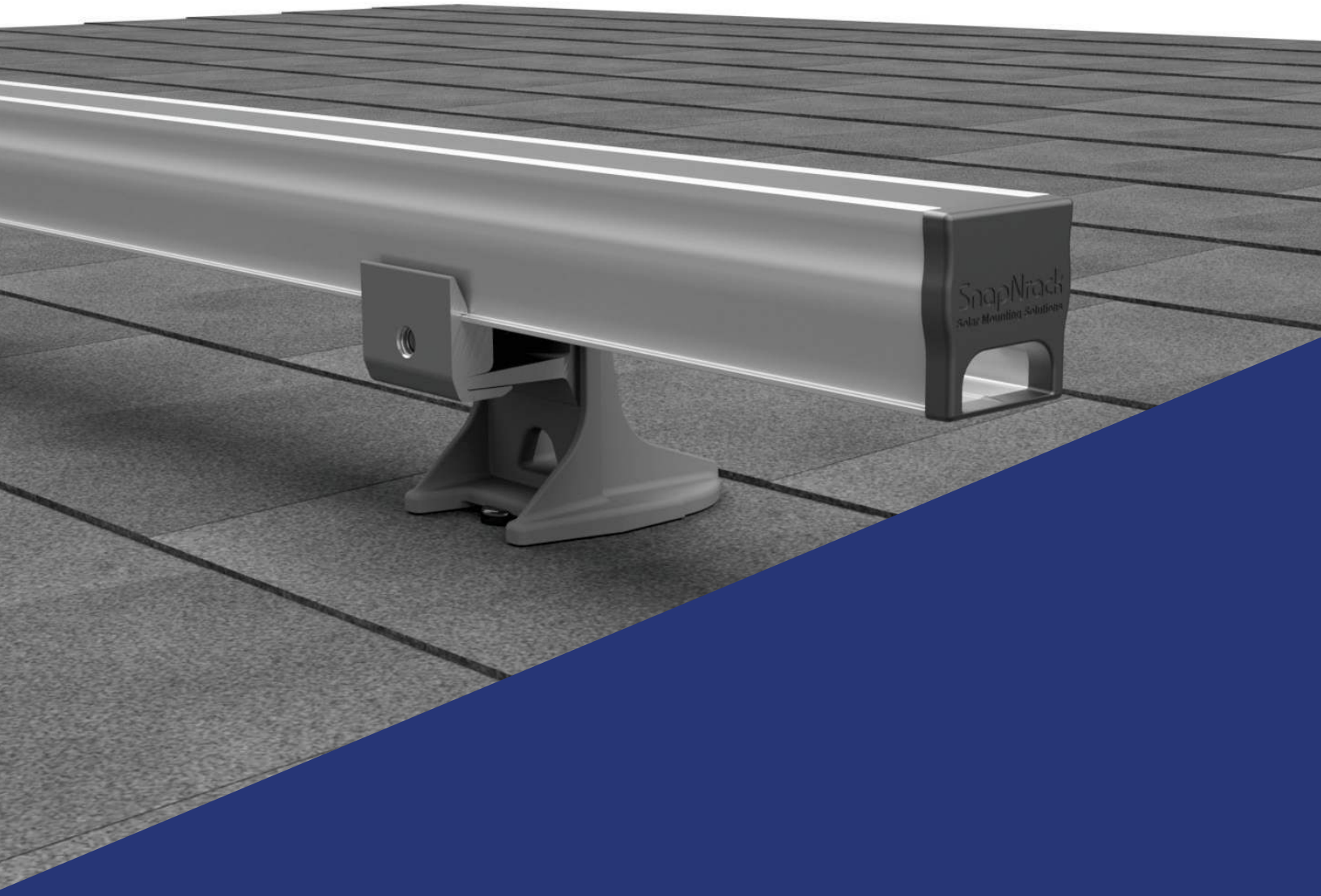
APPROVED BY: CODY NORMAN

REVISION:

G	1/11/2016	NEW ITEM

SnapNrack™
Solar Mounting Solutions

Sunrun South LLC
595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902



SnapNrack™

Solar Mounting Solutions

Ultra Rail

Residential Roof Mount System
Installation Manual

snapnrack.com

2703 Listed — PV Mounting System

An Intro to SnapNrack Ultra Rail

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

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

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

Benefits of Installing the SnapNrack Ultra Rail System

Install With Existing Roof Attachments

Compatible with existing SnapNrack roof attachments

Install With Very Few Tools

All Ultra Rail hardware is attached using a standard 1/2" socket

Built in Wire Management and Aesthetics

Extensive wire management solutions have been designed specifically for the system that adapts to multiple possible mounting positions.

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

Table of Contents

Certification Details

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

Grounding/Bonding

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

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

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

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

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

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

Mechanical Loading

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

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

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

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

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

Fire

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

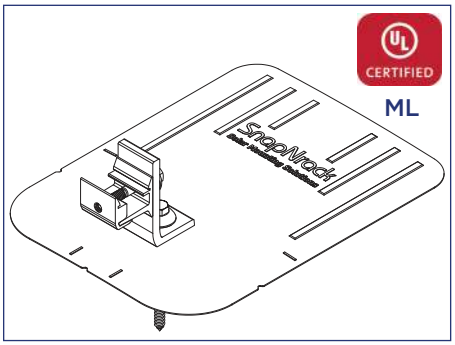
The Ultra Rail system has been evaluated for a Class A System Fire Classification for a Low-Sloped Roof (< 2:12 pitch) using Type 1 and Type 2 modules. In order to maintain the System Classification, modules are clamped to the mounting rails between 0 and 16.3 inches from the top and bottom edges of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

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

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

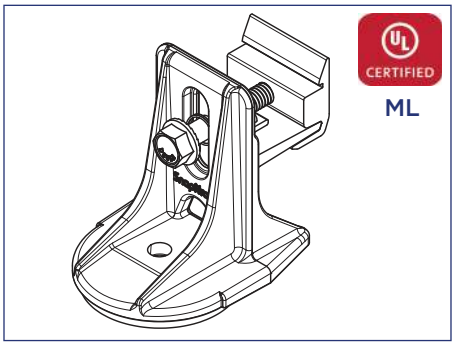
Component Details

Structural Components



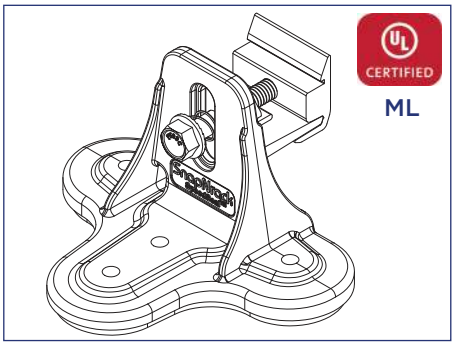
Composition Roof Attachment

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



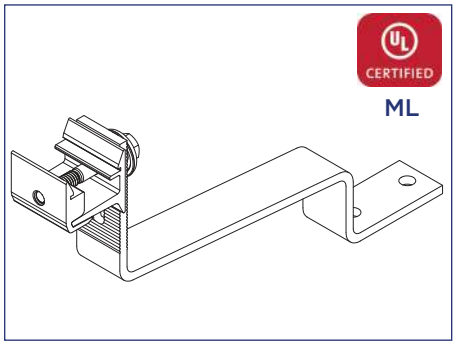
Composition Roof Attachment

Roof attachment kit for composition shingle roofs including chemically flashed L foot, lag screw, and hardware



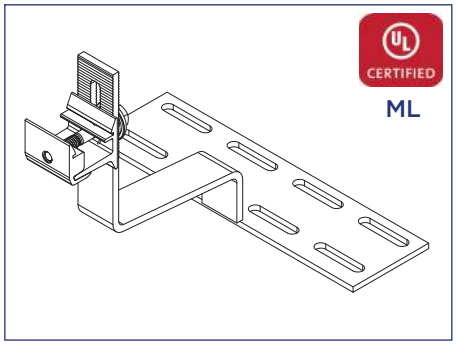
Composition Roof Attachment

Roof attachment kit for composition shingle roofs including chemically flashed L foot, self-drilling deck screws, and hardware



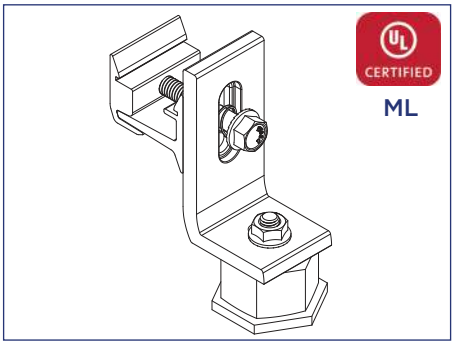
Flat Tile Roof Attachment

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



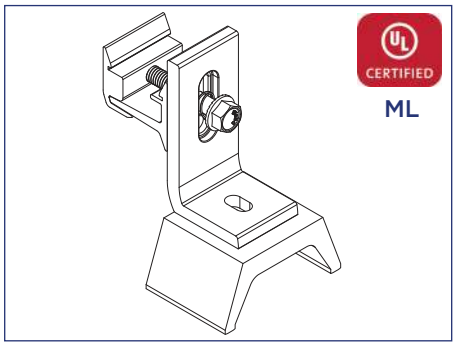
W & S Tile Roof Attachment

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



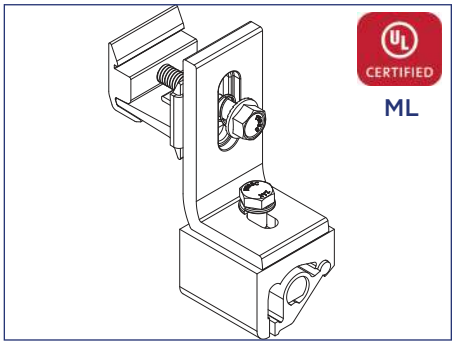
Metal Roof Base Attachment

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



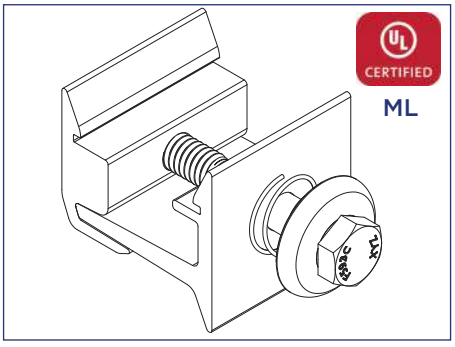
Corrugated Roof Block Attachment

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



Seam Clamp Roof Attachment

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



Ultra Rail Mounting Hardware

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

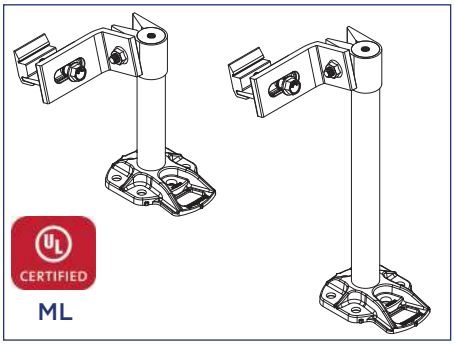
UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding

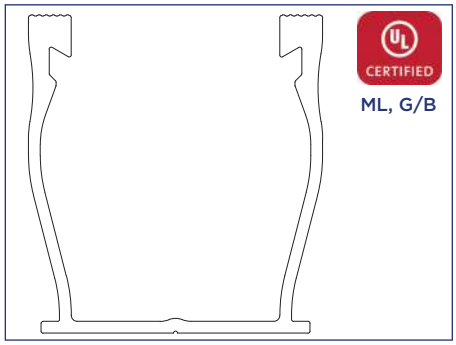
Component Details

Structural Components



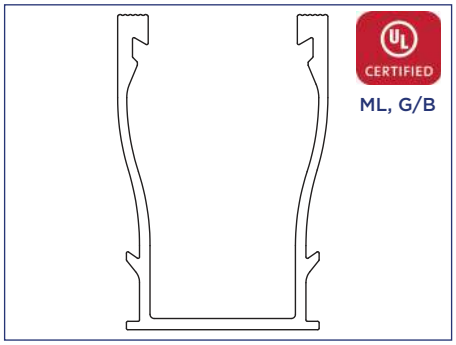
OmniBase with Fixed Tilt Standoff Roof Attachments

Roof attachment kits providing additional tilt off roof surface including standoffs, bases, and hardware



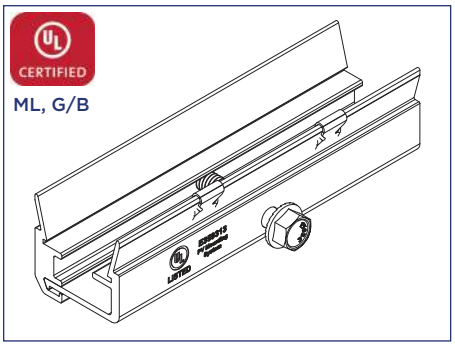
UR-40 Rail

UR-40 rail for Ultra Rail roof mount racking system



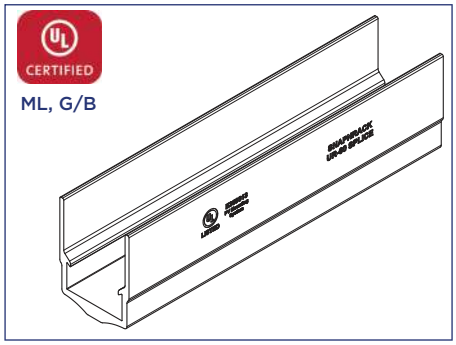
UR-60 Rail

UR-60 rail for Ultra Rail roof mount racking system



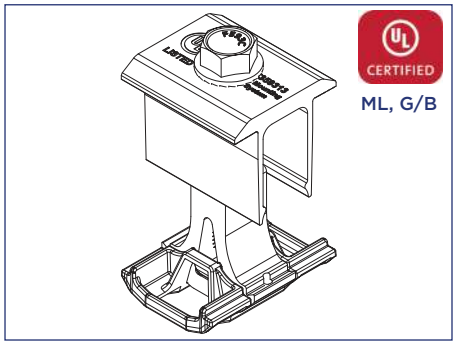
UR-40 Rail Splice

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



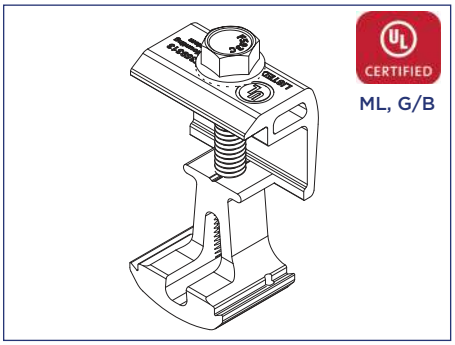
UR-60 Rail Splice

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



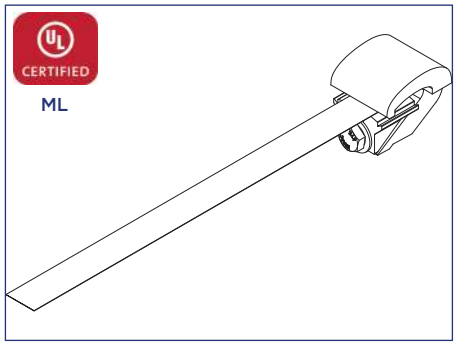
Ultra Rail Mid Clamp

Universal top-down module mid clamp including clamp and hardware



Ultra Rail End Clamp

Universal top-down module end clamp including clamp and hardware



Universal End Clamp

Bottom-mount module end clamp including clamp and hardware

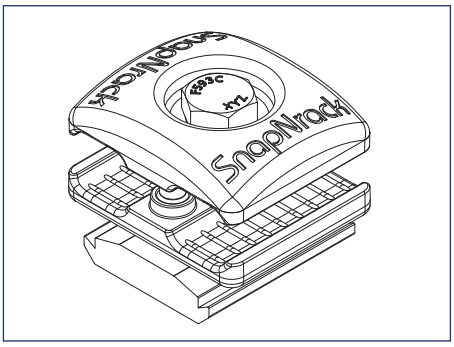
UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding

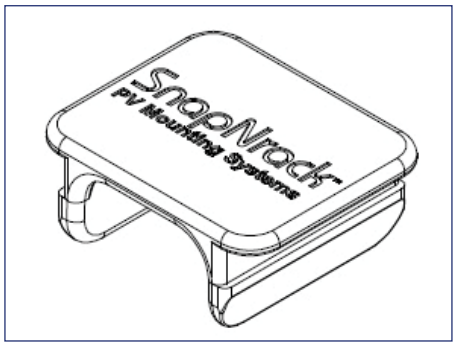
Component Details

Wire Management/Grounding Component



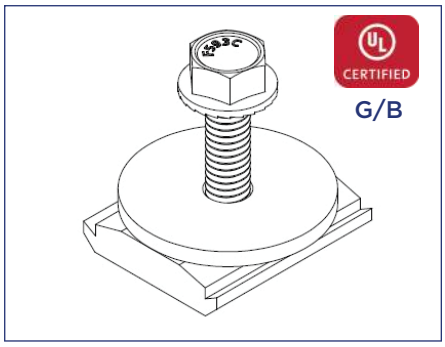
Universal Wire Clamp

Wire management component used to secure conductors between rails



Wire Retention Clip

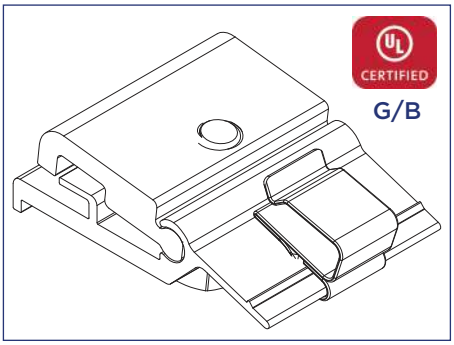
Wire management component used to secure conductors in rails



G/B

MLPE Rail Attachment Kit

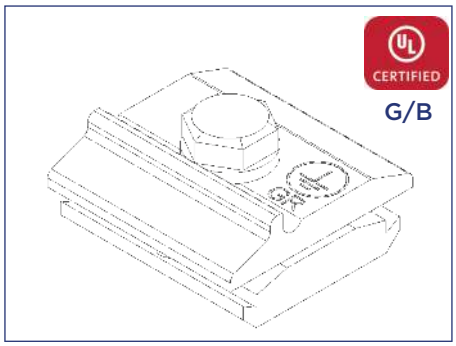
Rail attachment for module level power electronics like microinverters and optimizers



G/B

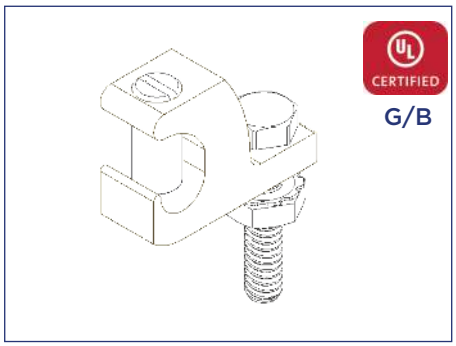
MLPE Frame Attachment Kit

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



G/B

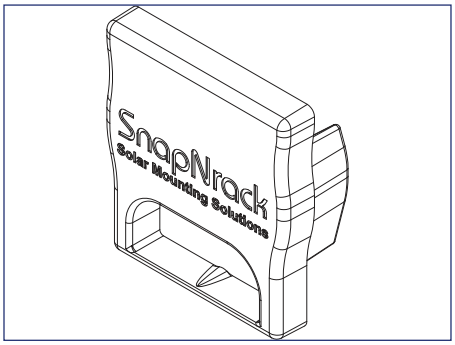
SnapNrack Ground Lug



G/B

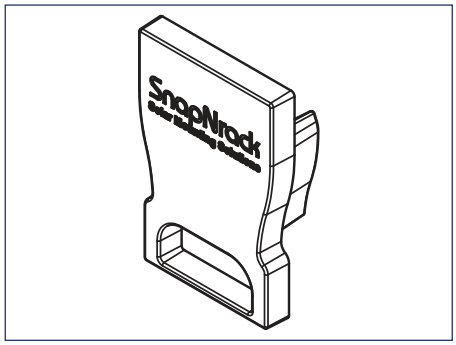
Ilsco Lay-In Lug – GBL-4DBT

Aesthetic Components



UR-40 Rail End Cap

Plastic end cap for UR-40 Rail



UR-60 Rail End Cap

Plastic end cap for UR-60 Rail

UL Listing Legend:

ML – Evaluated for Mechanical Loading

G/B – Evaluated for Grounding/Bonding

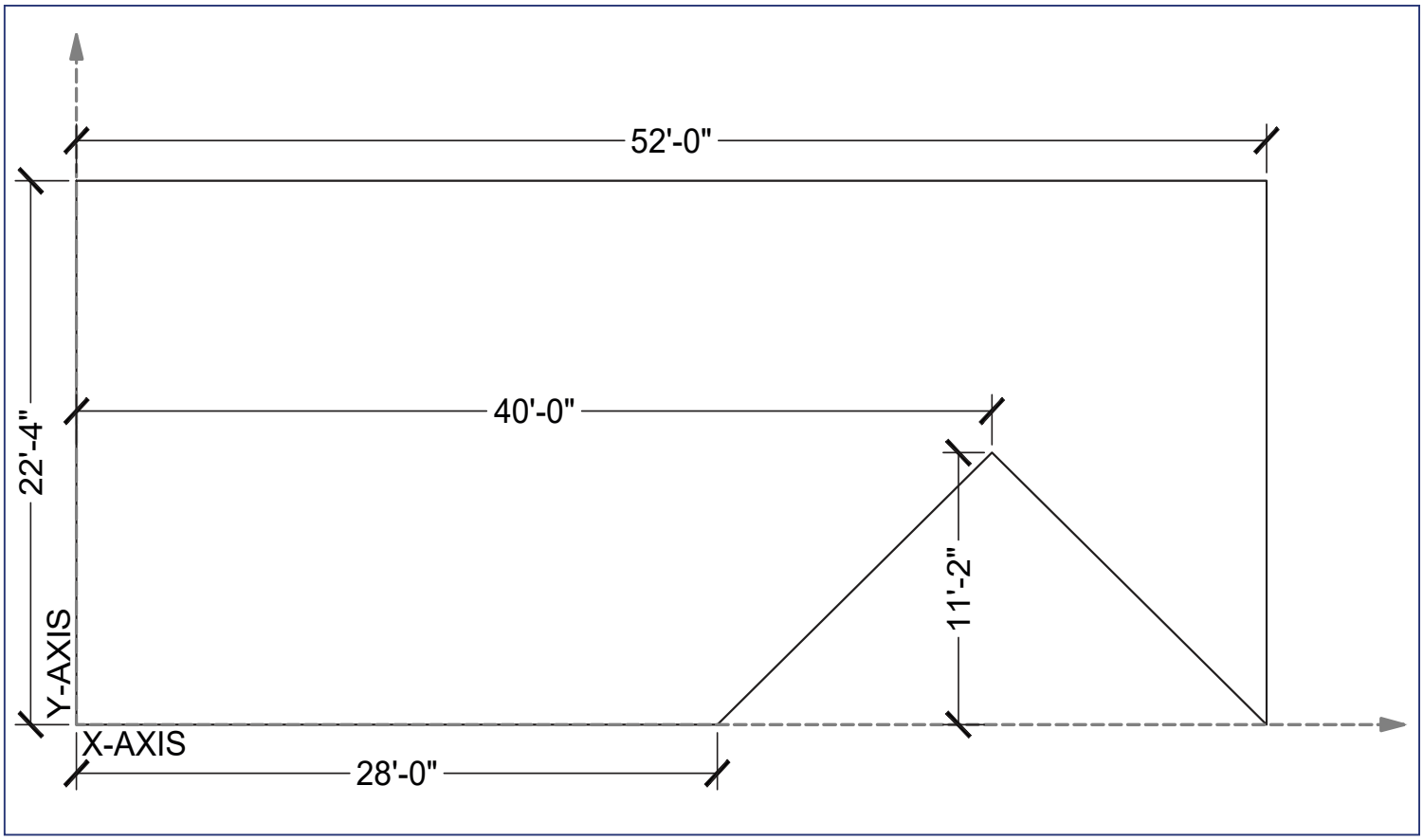
Hardware Torque Specifications

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, Flange Nut for MRB	10 ft-lbs (120 in-lbs)
Rail Splice, Flashed L Foot to Rail, Tile Hook F to Rail, Tile Hook WS to Rail, MRB to Rail, Seam Clamp to Rail	12 ft-lbs (144 in-lbs)
Ultra Rail End Clamp, Ultra Rail Mid Clamp	16 ft-lbs (192 in-lbs)
Standard Base Seam Clamp, Wide Base Seam Clamp	15-16 ft-lbs (180-192 in-lbs)
SolarEdge Frame Mounted Bracket to Module Frame	7 ft-lbs (84 in-lbs)
MLPE Rail Attachment Kit, MLPE Frame Attachment Kit	10 ft-lbs (120 in-lbs)
Enphase Frame Mounted Bracket to Module Frame	13 ft-lbs (156 in-lbs)

Pre-Installation Requirements

Site Survey

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



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 or 3/4” apart by Ultra Rail 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 (3/4” is recommended for improved rail spans).

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

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

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

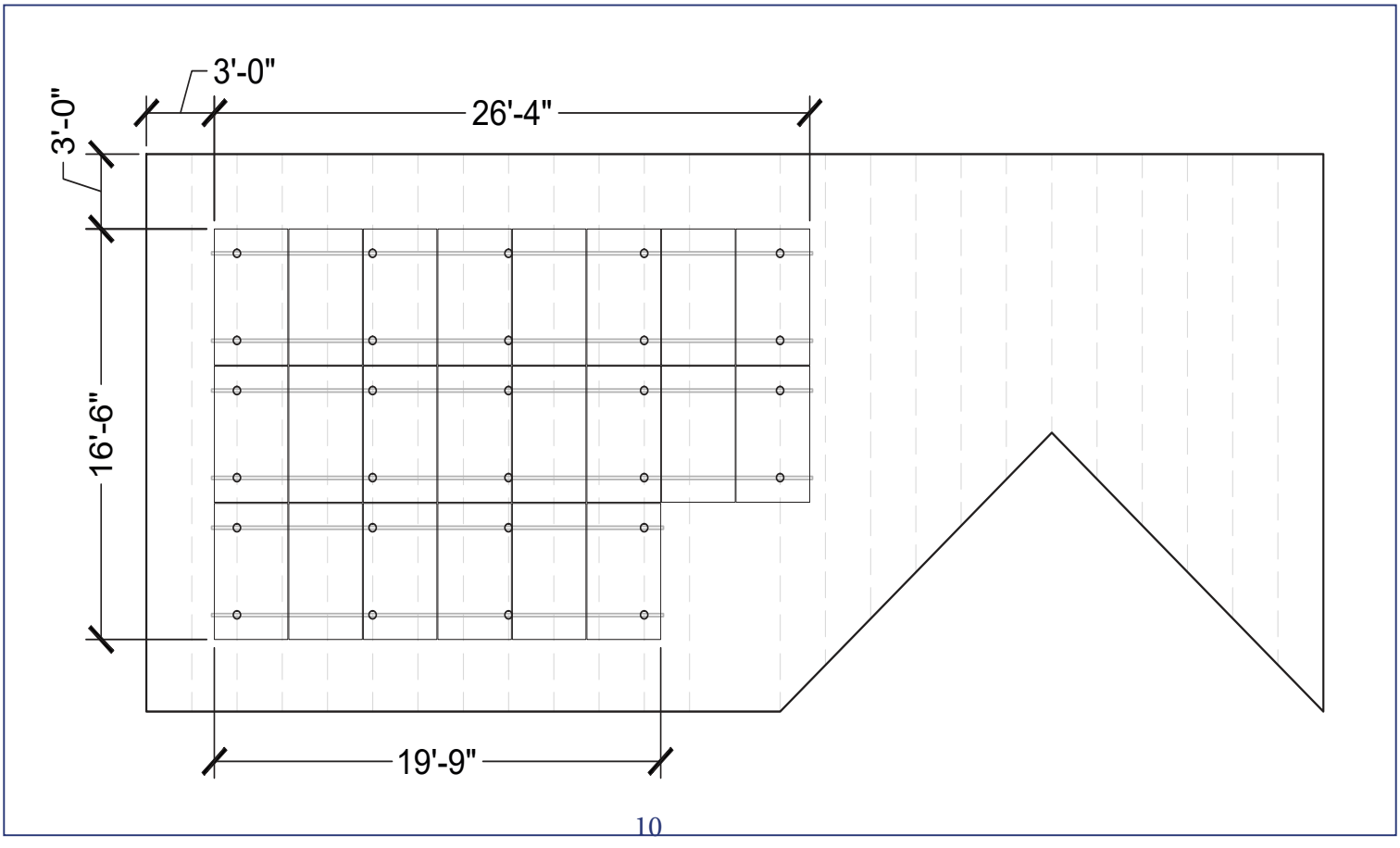
5) Draw roof attachment locations on layout based on maximum attachment spacing and cantilever values.

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

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

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

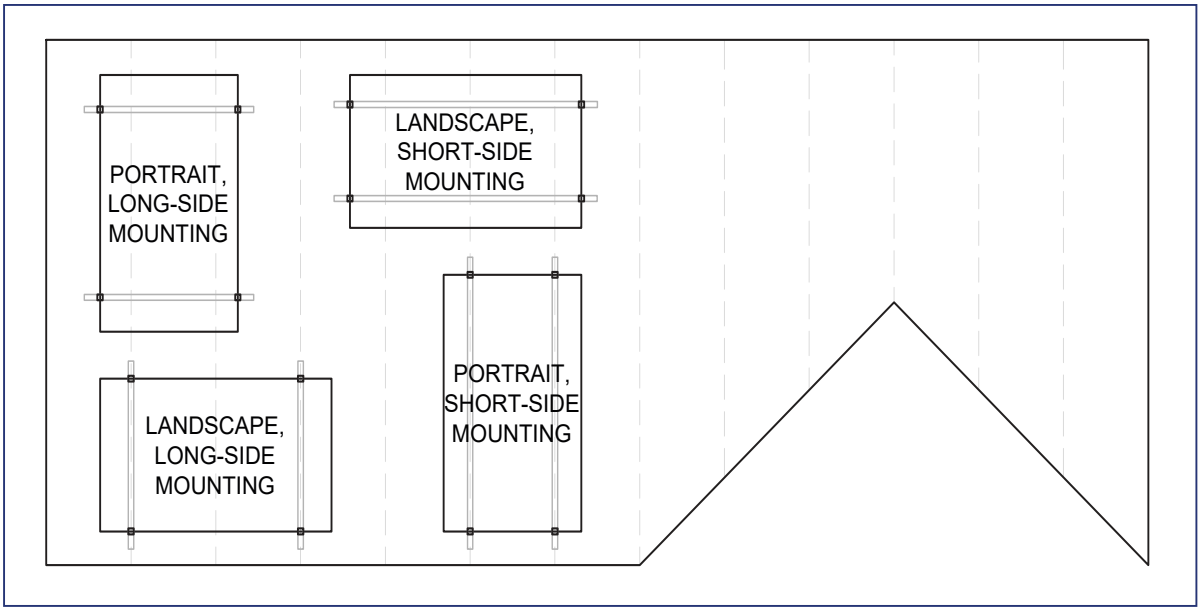
9) Insert SnapNrack installation details in to design set specific to the project requirements.



Pre-Installation Requirements

Design Note:

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



Installation Note:

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

Safety Guidance

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

Pre-Installation Requirements

System Layout

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

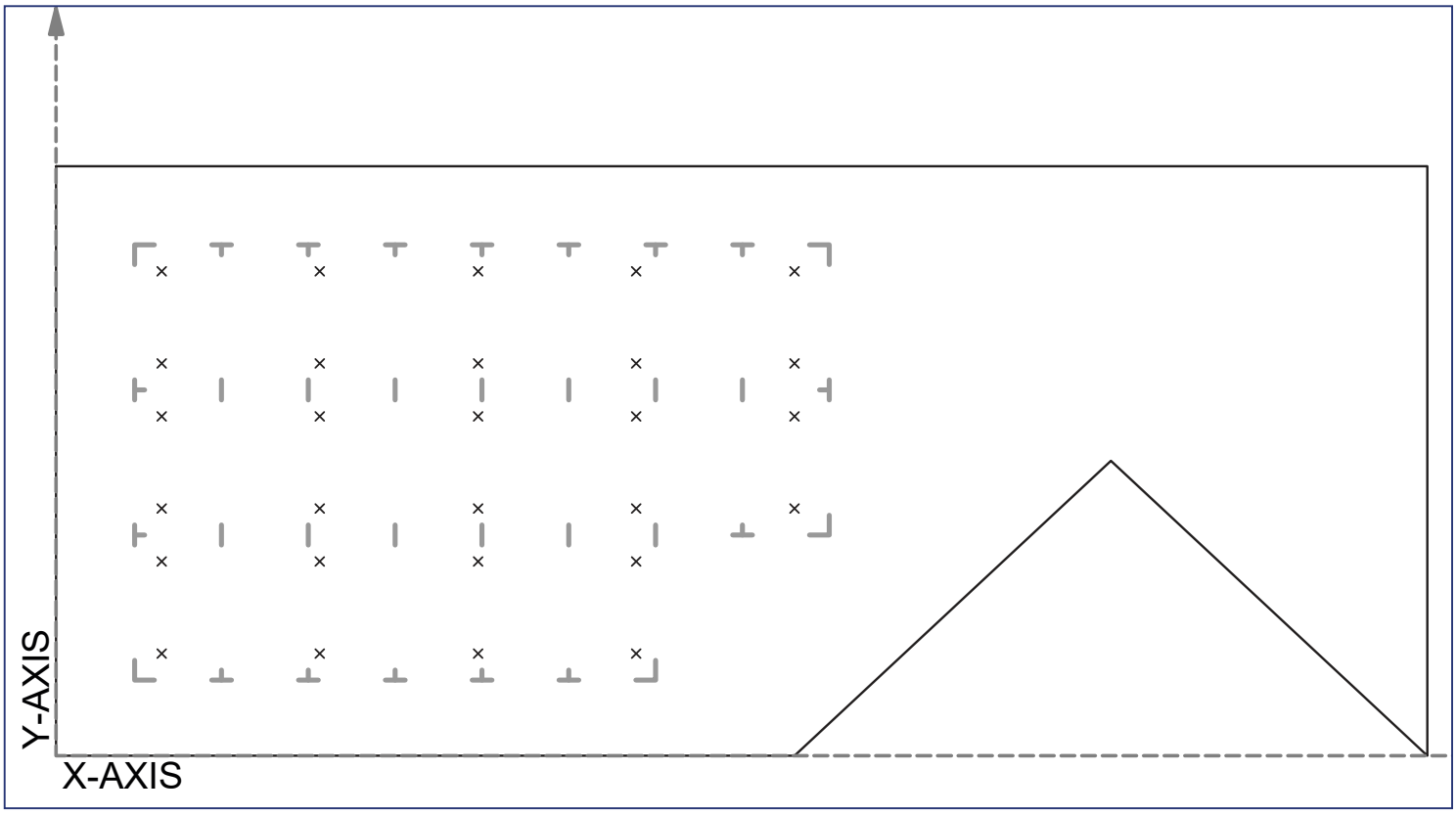
2) Locate the estimated roof framing member positions and mark them in the array area with a roof marking crayon.

3) Transfer rail locations using a chalk line.

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

Layout Note:

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



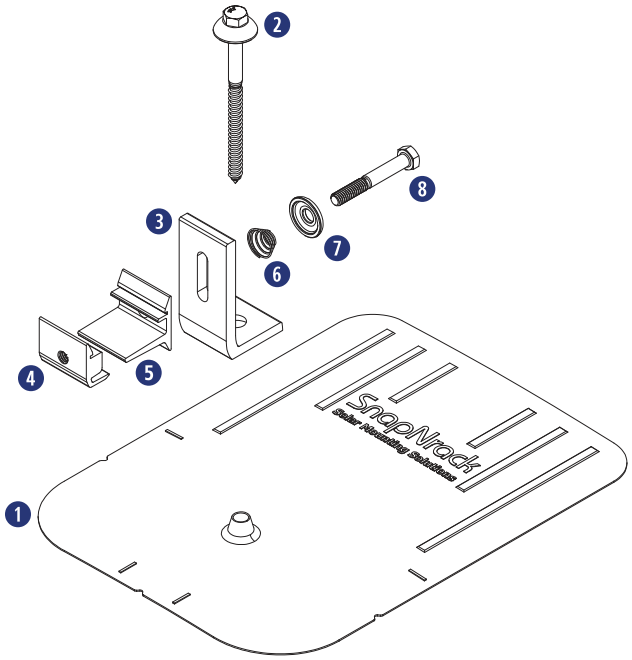
L Foot Mount

Required Tools

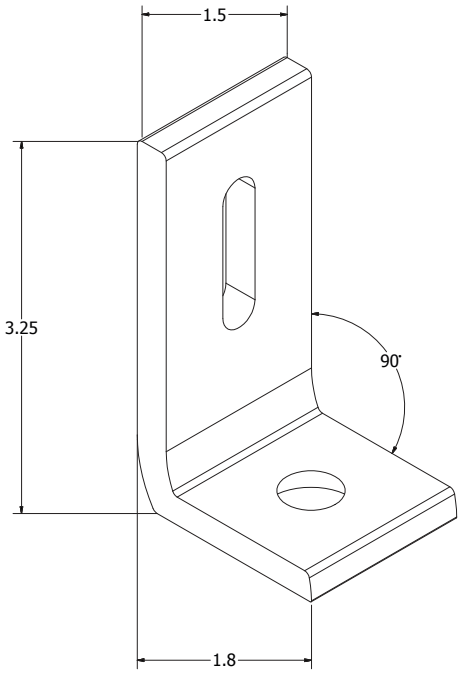
- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16” Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2” Socket

Materials Included - L Foot Mount

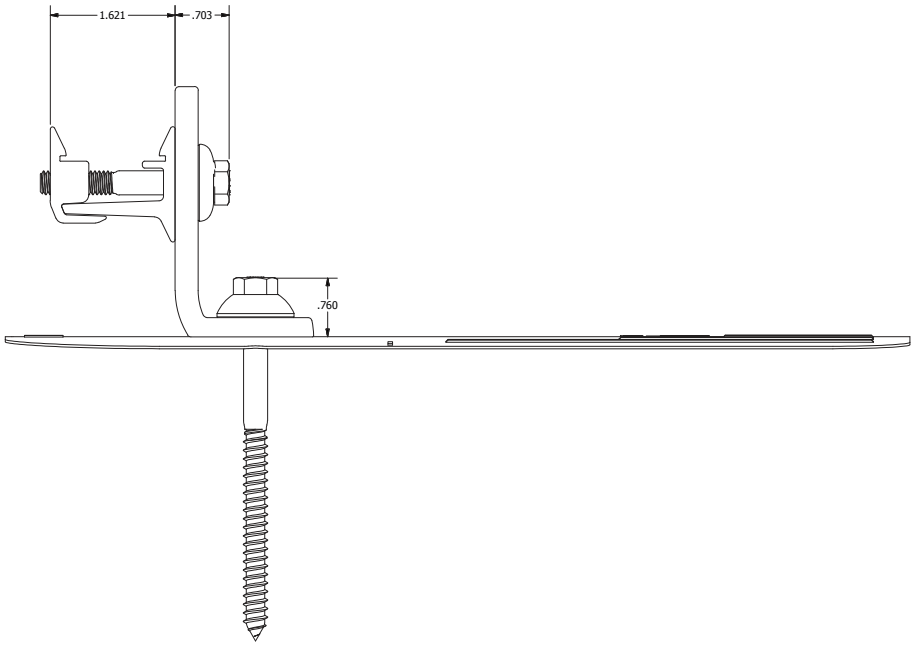
1. (1) SnapNrack Comp Umbrella Flashing
2. (1) SnapNrack Umbrella Lag Screw
3. (1) SnapNrack Umbrella L Foot
4. (1) SnapNrack Ultra Mount (Tapped)
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount Spring
7. (1) SnapNrack Ultra Mount Spring Cage
8. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



Application Note:
Install on composition shingle roofs.



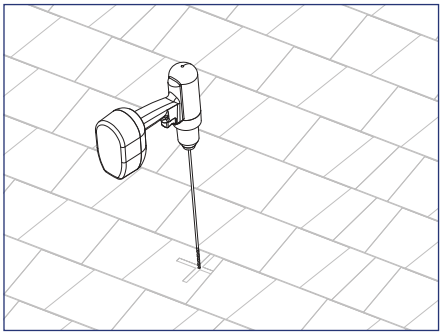
Dimensioned L Foot



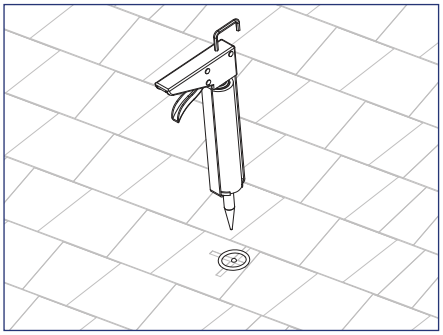
Dimensioned L Foot Assembly

L Foot Mount

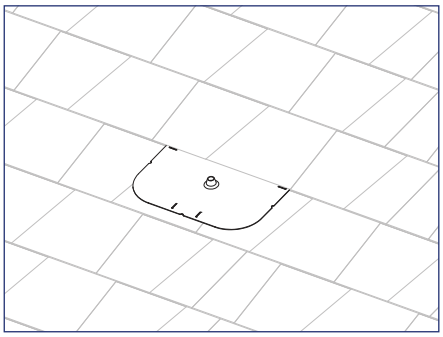
INSTALLATION INSTRUCTIONS



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



2) Apply roofing sealant in and around the pilot hole, and directly onto the lag screw to ensure a water tight seal.

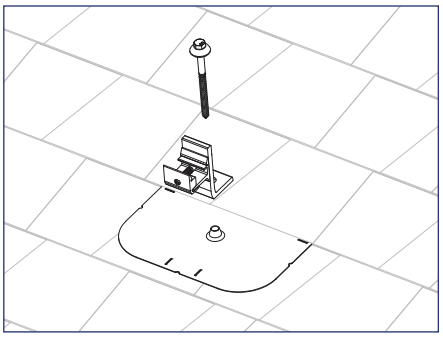


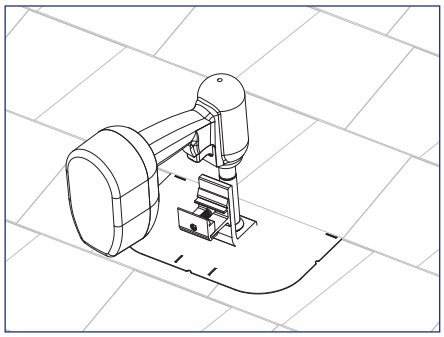
3) Pry up shingles with a breaker bar and install flashing underneath shingle course above pilot hole, and position flashing so cone is in line with pilot hole.

Install Note:

Ensure flashing extends minimum (2) courses above pilot hole, and does not overhang bottom edge of shingle course.

Apply a horseshoe of sealant under flashing to direct water away from penetration.





4) Insert Umbrella Lag Screw through Umbrella L Foot and cone in flashing, then drive lag screw for minimum 2.5” embedment into the roof framing member.

Install Note:

The L Foot can be attached in any orientation.

Best Practice:

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

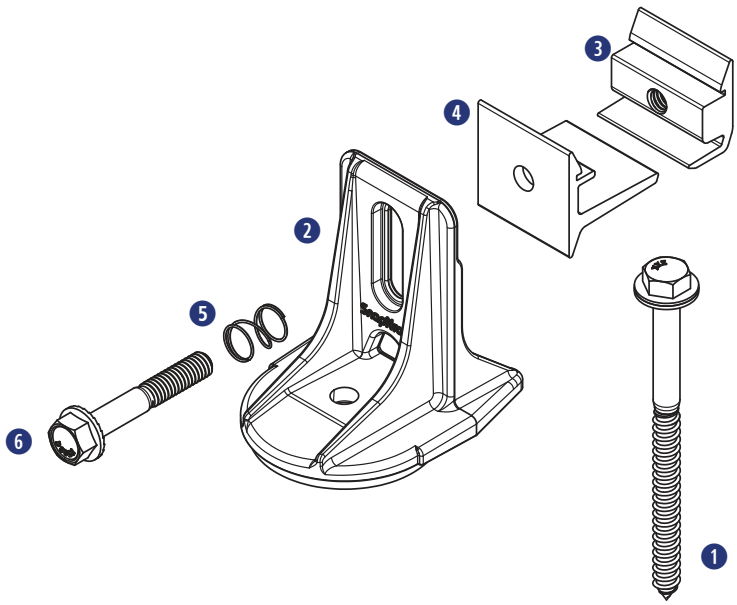
SpeedSeal™ Foot

Required Tools

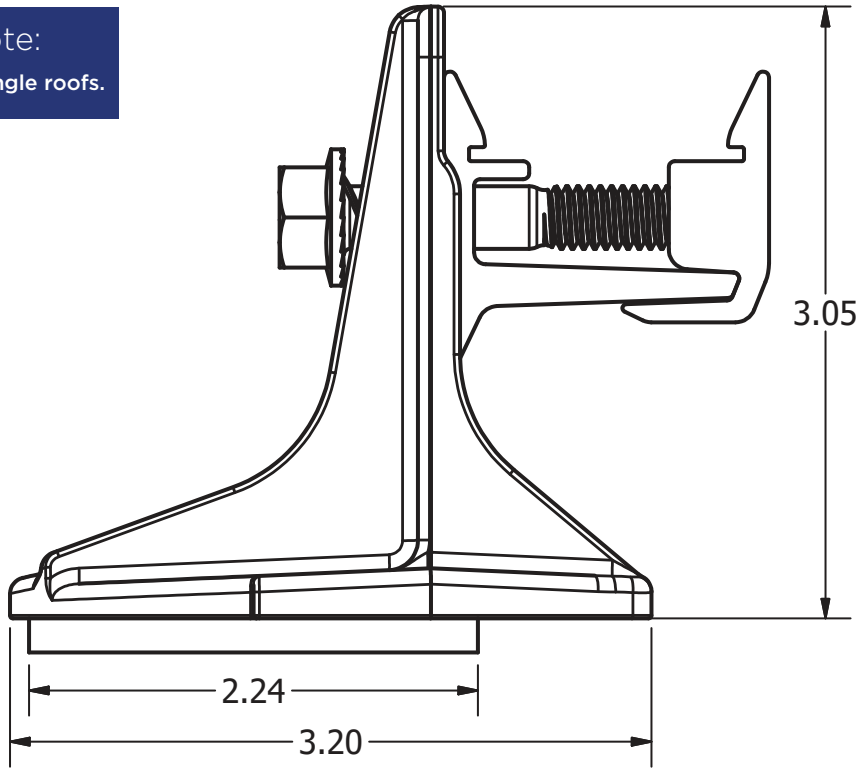
- Hammer or Stud Finder
- Roof Marking Crayon
- Drill with 3/16” Pilot Drill Bit
- Roof Sealant
- Torque Wrench
- Socket Wrench
- 1/2” Socket

Materials Included - SpeedSeal™ Foot

1. (1) SnapNrack Sealing Lag Screw
2. (1) SnapNrack SpeedSeal™ Foot
3. (1) SnapNrack Ultra Mount (Tapped)
4. (1) SnapNrack Ultra Mount (Thru-Hole)
5. (1) SnapNrack Utra Mount Spring
6. (1) 5/16”-18 X 2” SS Flange Bolt

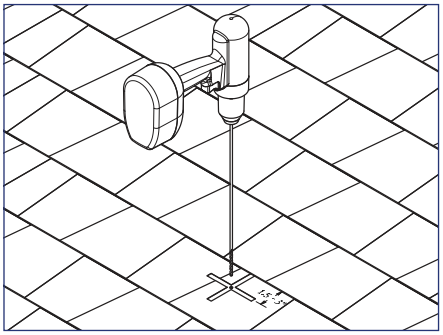


Application Note:
Install on composition shingle roofs.



Dimensioned SpeedSeal™ Foot

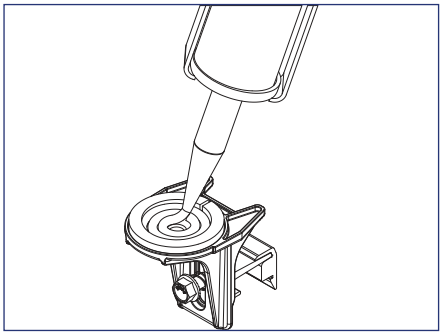
INSTALLATION INSTRUCTIONS



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

Best Practice:

Pilot hole should be located 1.5" - 3" from edge of shingle course above, and SpeedSeal™ Foot should never be installed across two shingle courses.

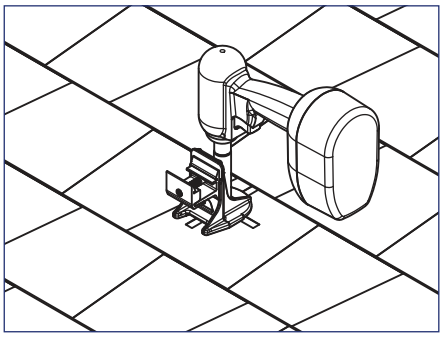


2) Fill cavity on bottom of SpeedSeal™ Foot created by sealant ring with roof sealant, as well as the pilot hole to ensure a water tight seal.

Best Practice:

Remove any dirt or debris from roof surface before SpeedSeal™ Foot is installed.

All missed pilot holes should be properly sealed before SpeedSeal™ Foot is installed.



3) Insert sealing lag screw through SpeedSeal™ Foot, then drive lag screw for minimum 2.5" embedment into the roof framing member.

Install Note:

Roof sealant should seep out from the cavity located underneath the Ultra Rail Mount, which ensures that a sufficient amount of roof sealant has been applied. If no sealant is seen, remove SpeedSeal™ Foot and add more sealant before reinstalling.

Best Practice:

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

SpeedSeal™ DeckFoot

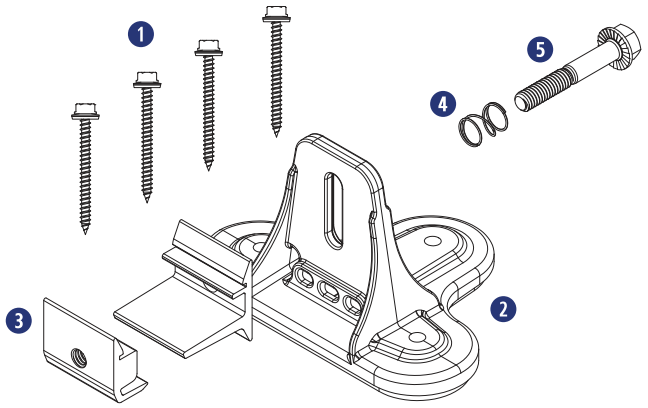
Required Tools

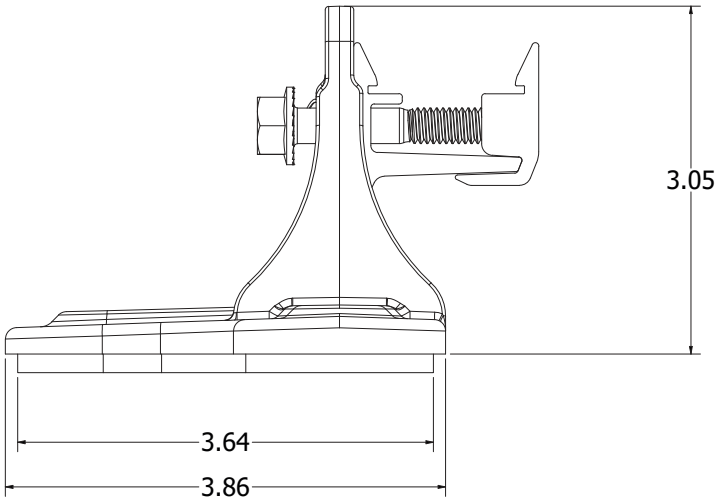
- Roof Marking Crayon
- Socket Wrench or Impact Driver
- Roof Sealant & Caulking Gun
- 3/8” Socket

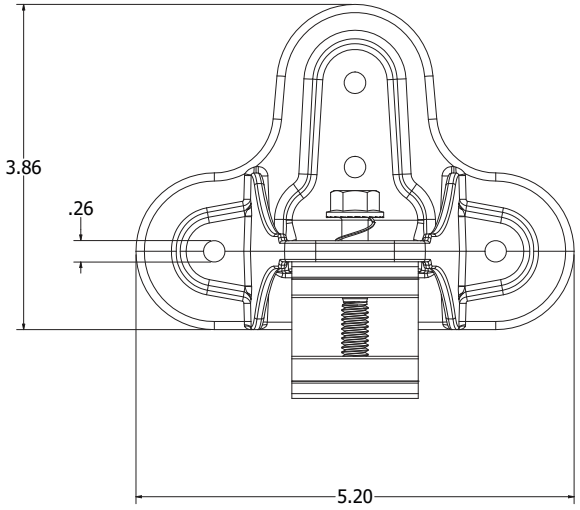
Materials Included - SpeedSeal™ DeckFoot

1. (4) SnapNrack #14 Self-Drilling Deck Screw with 3/8” Hex Head & EPDM-Backed Washer
2. (1) SnapNrack SpeedSeal™ DeckFoot
3. (1) SnapNrack Ultra Mount Live Hinge
4. (1) SnapNrack Ultra Mount Spring
5. (1) 5/16”-18 X 1-3/4” SS Flange Bolt

Application Note:
Install on composition shingle roofs

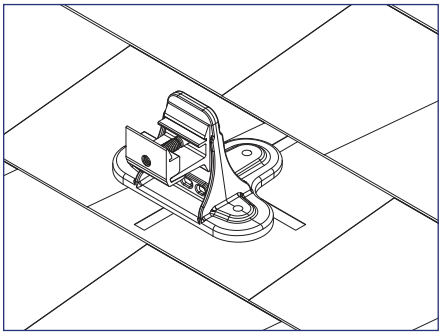






Dimensioned SpeedSeal™ DeckFoot

INSTALLATION INSTRUCTIONS



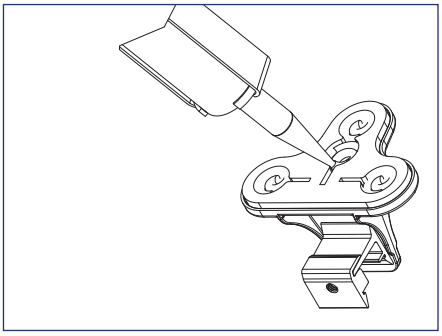
1) Using roof attachment locations drawn during system layout, check positioning of SpeedSeal™ DeckFoot for proper alignment on shingle course.

Best Practice:

SpeedSeal™ DeckFoot should never be installed across two shingle courses.

Install Note:

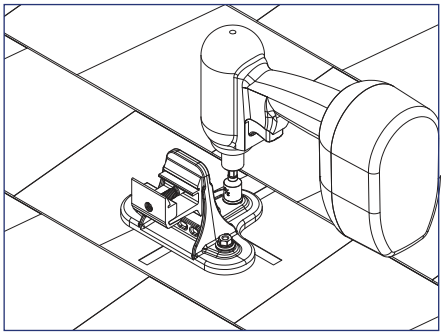
Fill any seam in shingles within 4" of a deck screw with sealant prior to installing SpeedSeal™ DeckFoot.



2) Fill all four cavities on bottom of SpeedSeal™ DeckFoot created by sealant ring with roof sealant to ensure a water tight seal.

Best Practice:

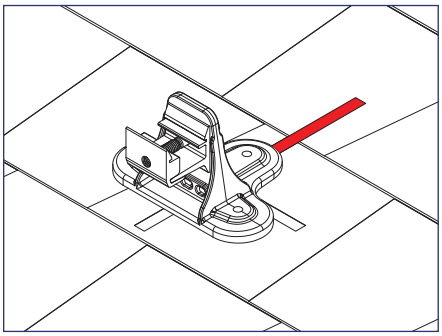
Remove any dirt or debris from roof surface before SpeedSeal™ DeckFoot is installed.



3) Insert first self-drilling deck screw through SpeedSeal™ DeckFoot mounting hole and drive into roof, then repeat for the remaining three screws.

Install Note:

Roof sealant should seep out from all three sealant vents located underneath the Ultra Rail Mount, which ensures that a sufficient amount of roof sealant has been applied. If sealant is not seen from all three vents, remove SpeedSeal™ DeckFoot and add more sealant before reinstalling.



4) Optional rafter attachment step: After locating and marking rafters on the roof use four (4) ¼" x 2½" SS lag screws and washers to attach the DeckFoot to rafters and decking by following steps 1-3 above. The two lag screws in the center of the DeckFoot must be embedded into the rafter.

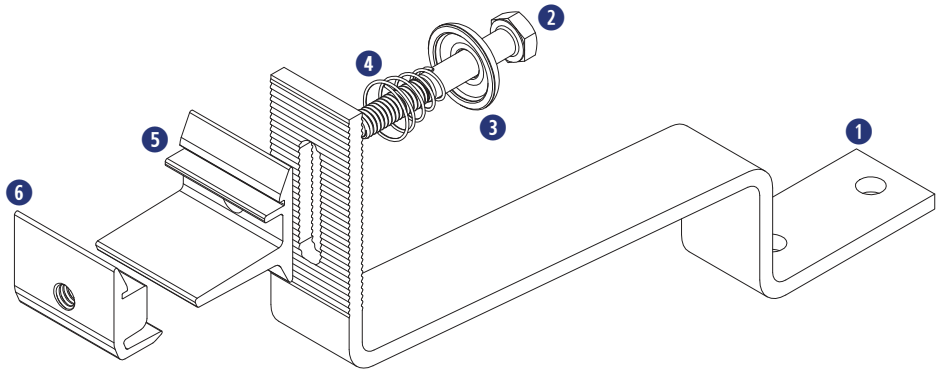
Tile Hook F

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

Materials Included - Ultra Rail Tile Hook F

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



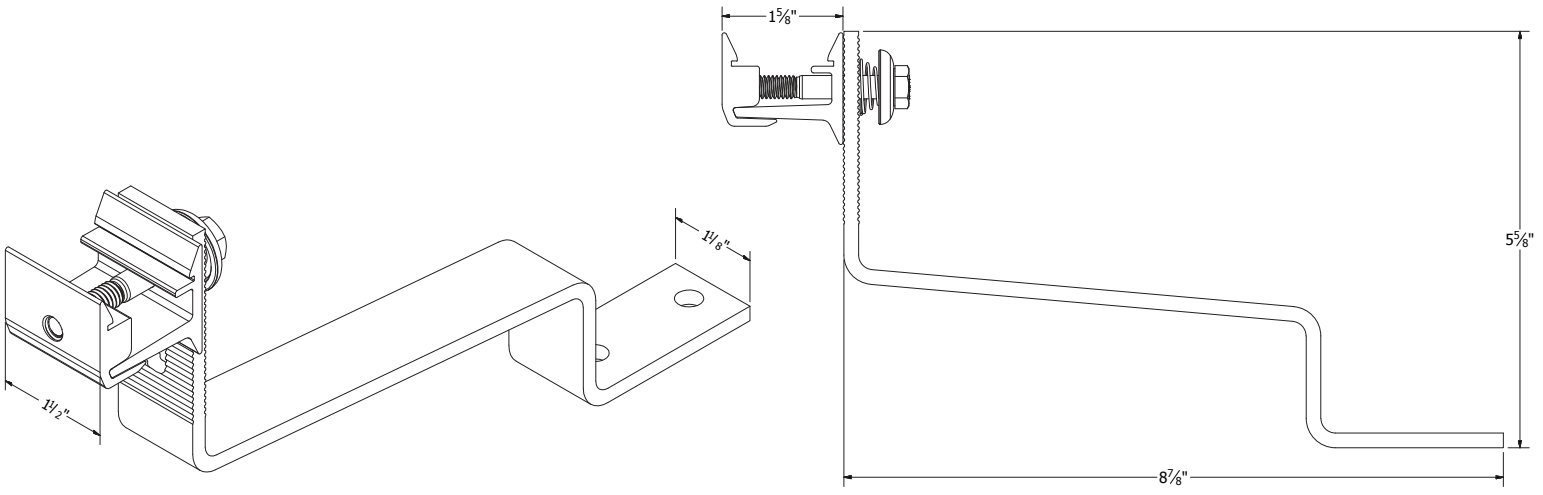
Other Materials Required (Not Shown)

① (2) 5/16” Lag Screw

② (2) 5/16” Washer

③ Flexible Flashing (when required for deck level flashing)

Application Note:
Install on flat concrete tile roofs.

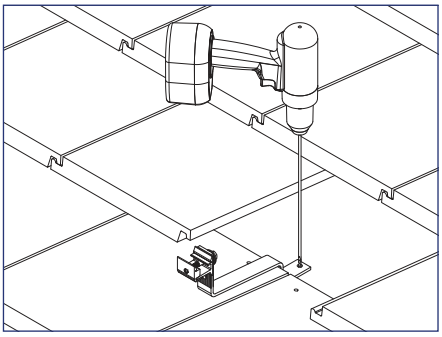


Dimensioned Ultra Rail Tile Hook F Assembly

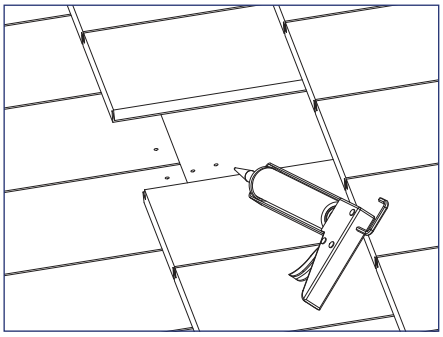
Tile Hook F

INSTALLATION INSTRUCTIONS

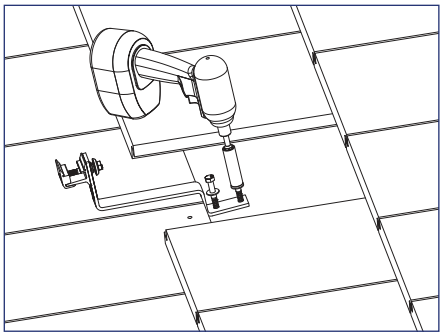
1) Using roof attachment locations drawn during system layout, remove roof tile where the roof attachment will be installed.



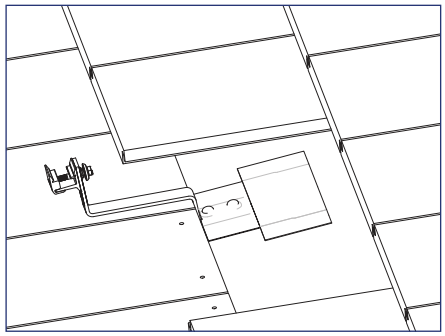
2) Align the hook over the rafter and drill two pilot holes through the roofing material into the roof framing member.



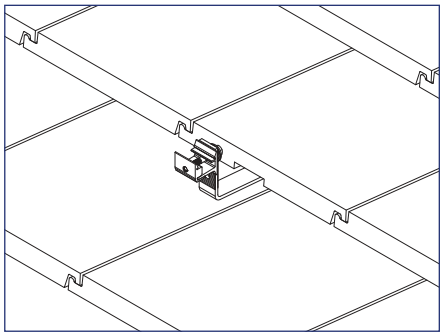
3) Apply roofing sealant to pilot holes and Tile Hook.



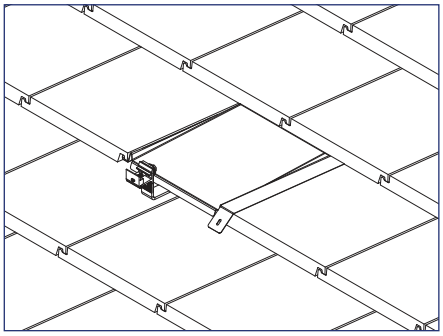
4) Attach the base with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.



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



6) Replace tile



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

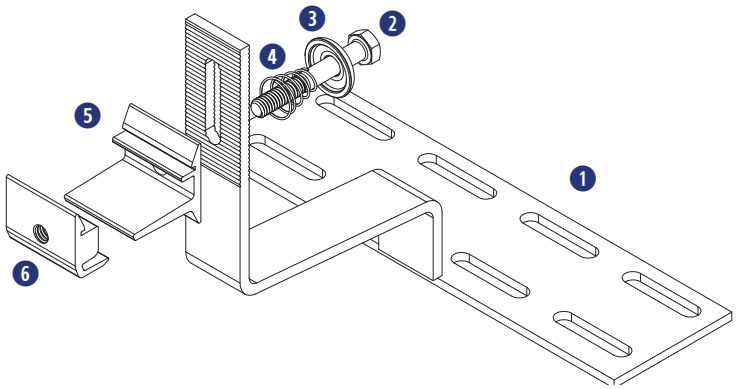
Best Practice:
Mold or slightly trim flashing around hook to achieve desired fitment.

Tile Hook WS

Required Tools

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

Materials Included - Ultra Rail Tile Hook WS



1. (1) SnapNrack Ultra Rail Tile Hook WS
2. (1) 5/16”-18 x 1-3/4” SS Flange Bolt
3. SnapNrack Ultra Mount Spring Cage
4. (1) SnapNrack Ultra Mount Spring
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount (Tapped)

Other Materials Required (Not Shown)

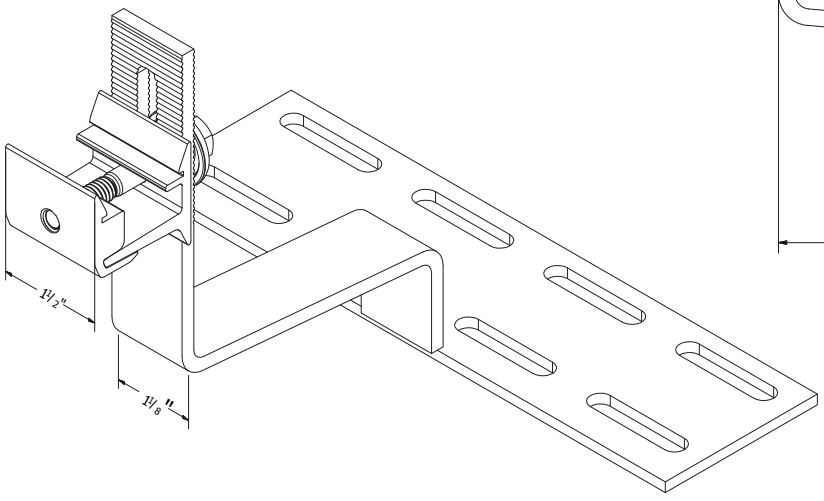
① (2) 5/16” Lag Screw

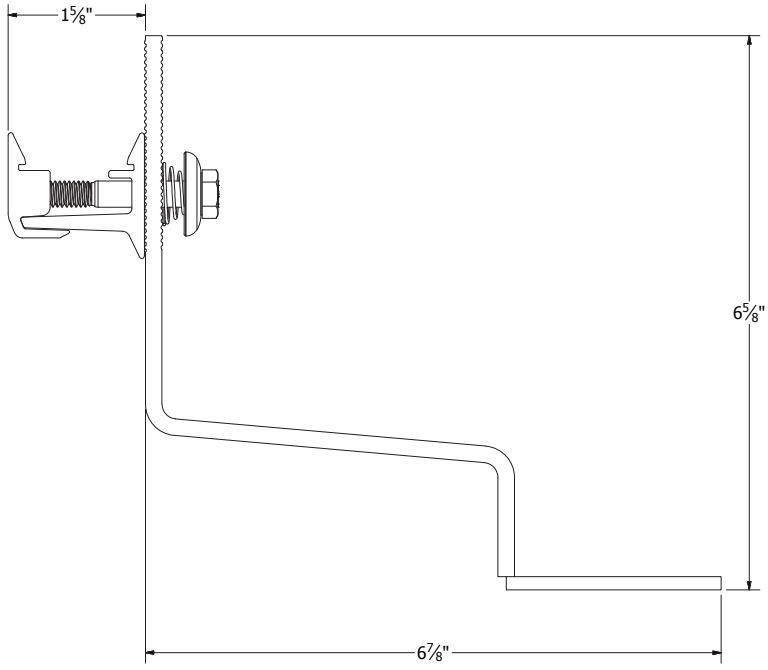
② (2) 5/16” Washer

③ Flexible Flashing (when required for deck level flashing)

Application Note:

Install on W and S style concrete tile roofs.



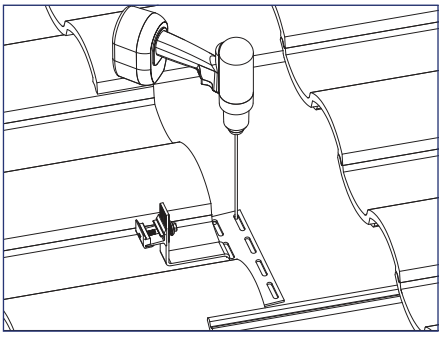


Dimensioned Ultra Rail Tile Hook WS Assembly

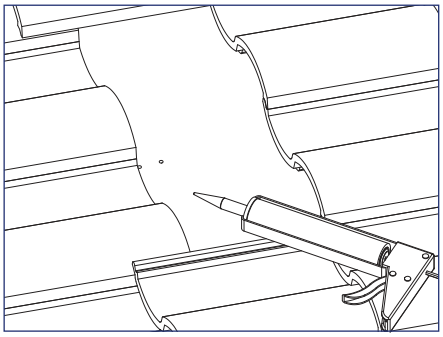
INSTALLATION INSTRUCTIONS

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

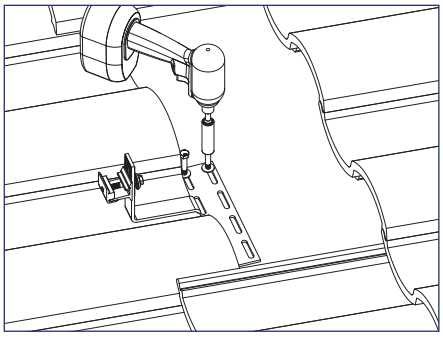
Install Note:
A neighboring tile may need to be removed to attach to the roof framing member and line up hook with the tile.



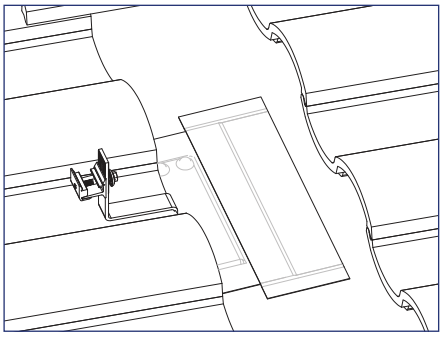
2) Align the base over the rafter so the hook can enter at the valley of a tile (W and S Tile). Drill two pilot holes through the roofing material into the roof framing member.



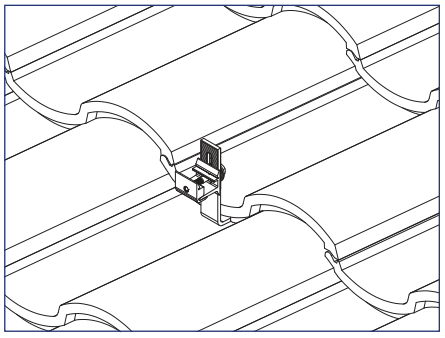
3) Apply roofing sealant to pilot holes and Tile Hook base.



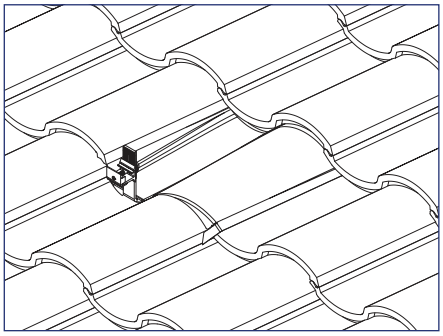
4) Attach the base with (2) 5/16" lag screws, drive lag screws for minimum 2.5" embedment into the roof framing member.



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



6) Replace tile



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

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

Metal Roof Base

Required Tools

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

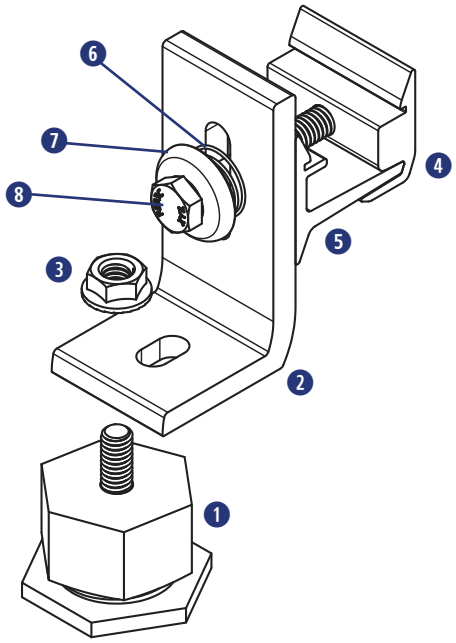
Materials Included - Metal Roof Base

1. (1) SnapNrack Metal Roof Base
2. (1) SnapNrack All Purpose L Foot
3. (1) 5/16”-18 SS Flange Nut
4. (1) SnapNrack Ultra Mount (Tapped)
5. (1) SnapNrack Ultra Mount (Thru-Hole)
6. (1) SnapNrack Ultra Mount Spring
7. (1) SnapNrack Ultra Mount Spring Cage
8. (1) 5/16”-18 X 2-1/4” SS HCS Bolt

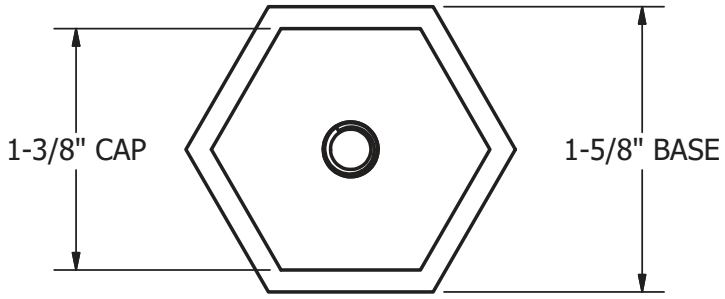
Other Materials Required - *Not Shown*

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

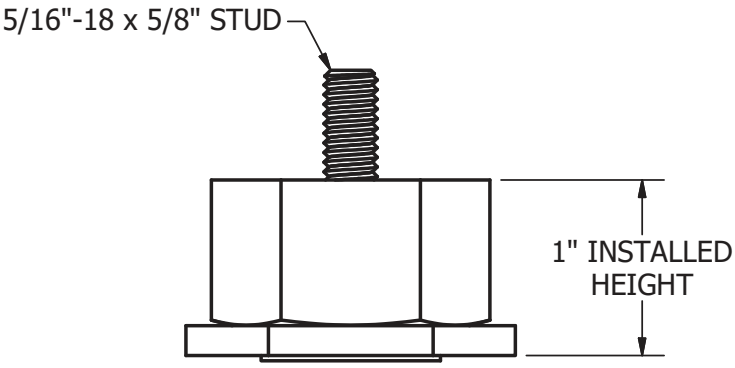
② (1) 5/16” or 1/4” Washer (3/4” max O.D.)



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



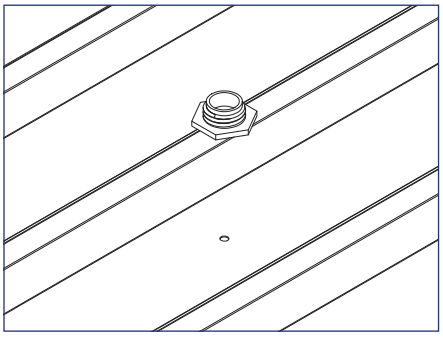
Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.



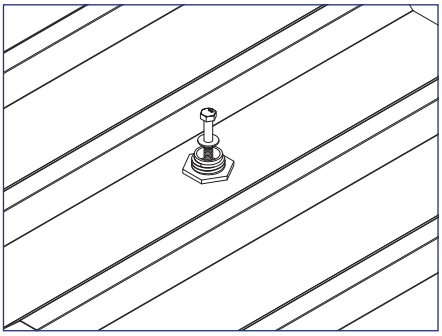
Dimensioned Metal Roof Base Assembly

Metal Roof Base

INSTALLATION INSTRUCTIONS



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

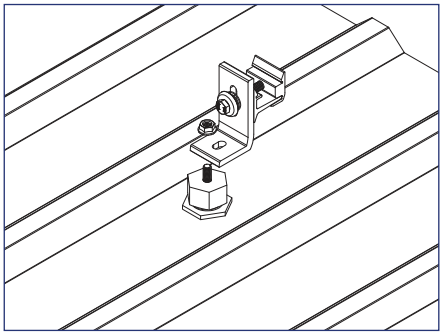


2) Attach the base with 5/16" lag screw (or 1/4" self-drilling screw for metal structures), drive screw for minimum 2.5" embedment into the roof framing member.

Install Note:

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

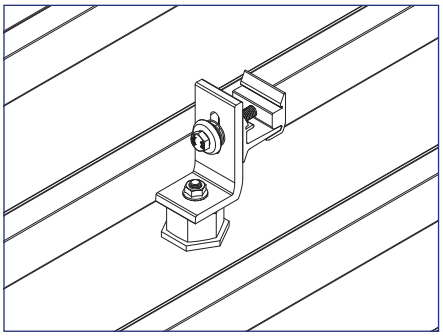
Additional roof sealant not required but can be applied after tightening the Metal Roof Base to roof, if desired.



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

Install Note:

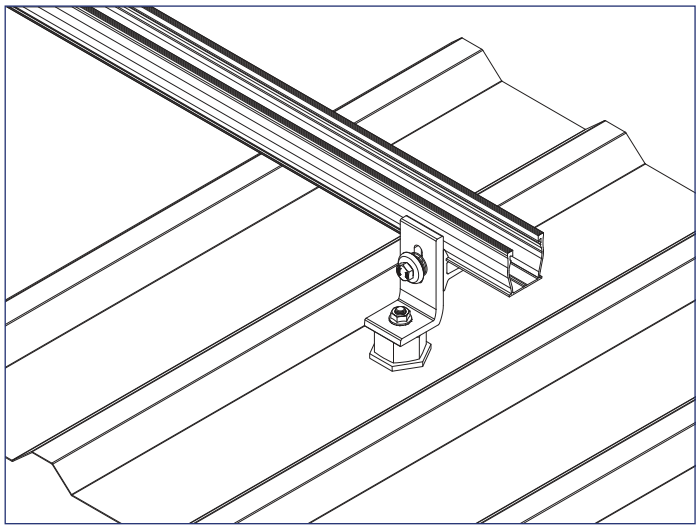
Take care to ensure the base does not twist when cap is tightened.



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

Best Practice:

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



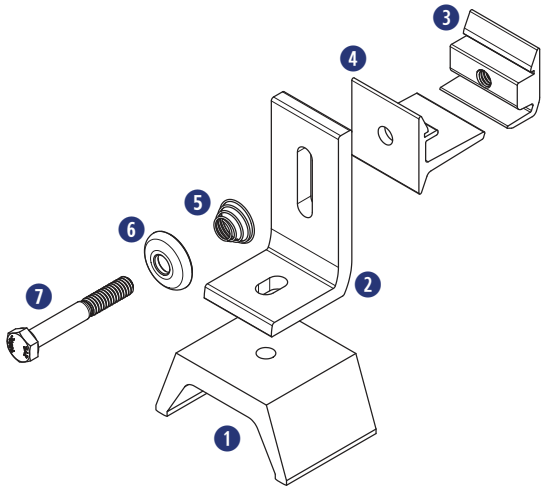
Corrugated Straddle Block

Required Tools

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

Materials Included - Corrugated Straddle Block

1. (1) SnapNrack Corrugated Straddle Block
2. (1) SnapNrack All Purpose L Foot
3. (1) SnapNrack Ultra Mount (Tapped)
4. (1) SnapNrack Ultra Mount (Thru-Hole)
5. (1) SnapNrack Ultra Mount Spring
6. (1) SnapNrack Ultra Mount Spring Cage
7. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



Other Materials Required - *Not Shown*

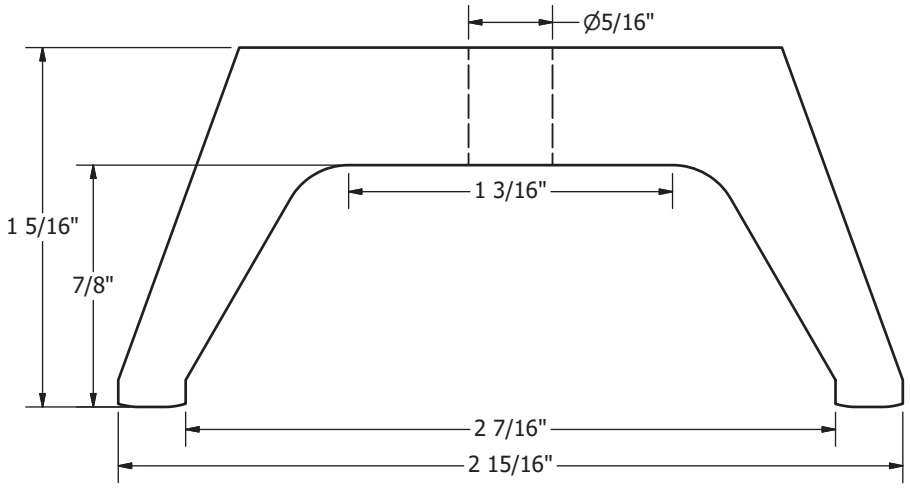
① (1) 5/16” Lag Screw or 1/4” Self-Drilling Screw

② (1) Washer

Application Note:
Use self-drilling screw for steel roofing members, lag screw for wooden roof framing members

Application Note:
Install on sinusoidal style corrugated metal roofs

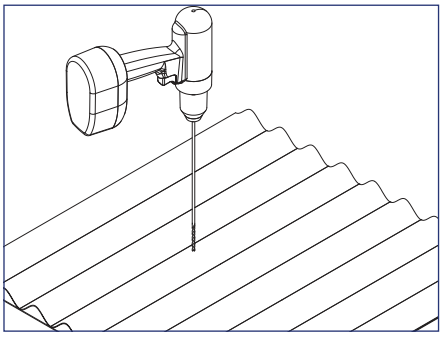
Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.



Dimensioned Corrugated Straddle Block

Corrugated Straddle Block

INSTALLATION INSTRUCTIONS

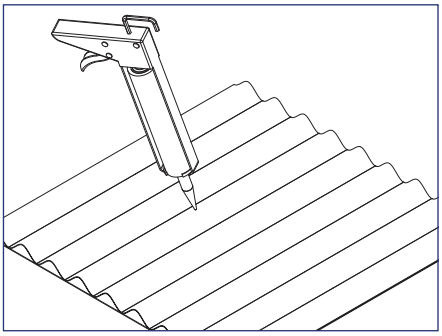


1) Using roof attachment locations drawn during system layout, drill a pilot hole through the high point of the roofing material into the roof framing member.

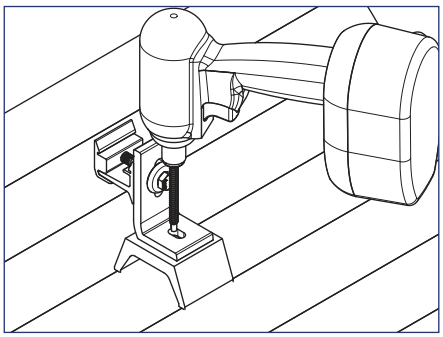
Install Note:

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

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



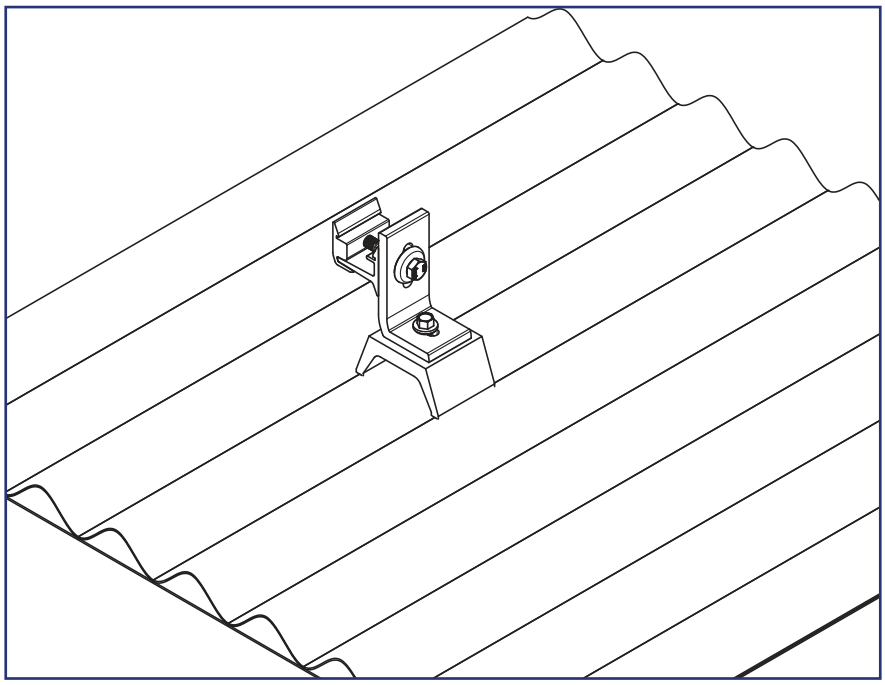
2) Apply roofing sealant directly onto the pilot hole and the lag to ensure a water tight seal.



3) Attach the Straddle Block and L Foot with 5/16” lag screw (or 1/4” self-drilling screw for metal structures), drive screw for minimum 2.5” embedment into the roof framing member.

Best Practice:

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



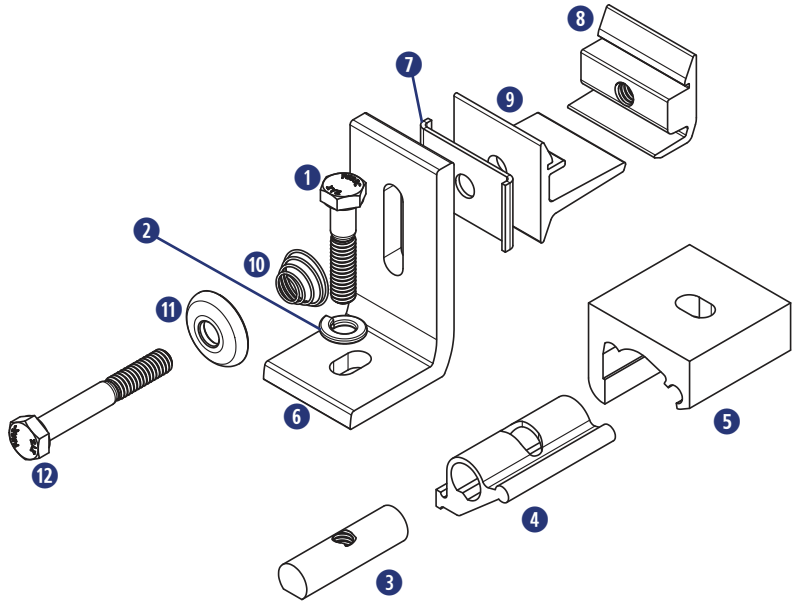
Seam Clamp

Required Tools

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

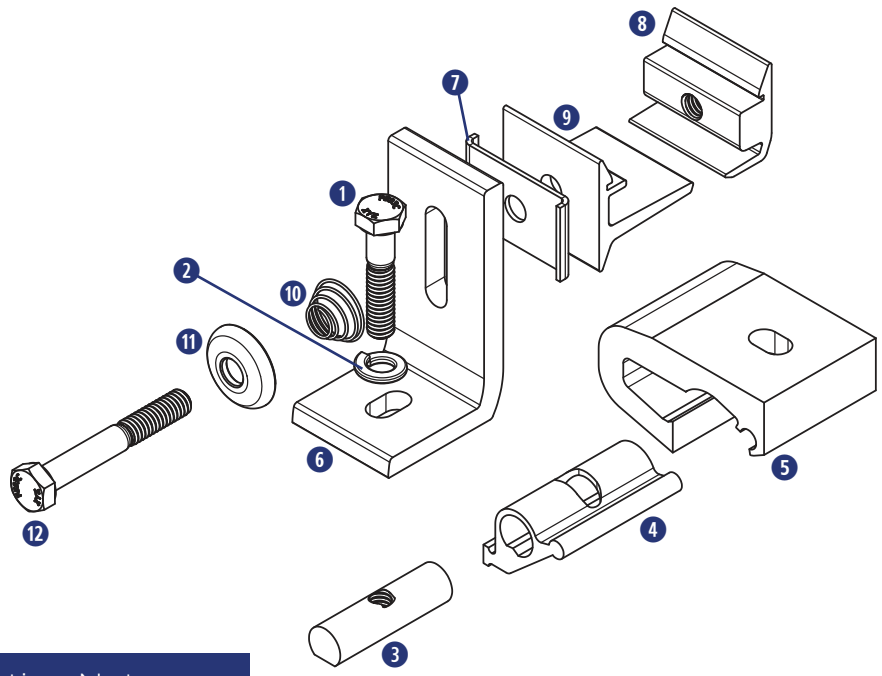
Materials Included - Standard Base Seam Clamp Kit

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



Materials Included - Wide Base Seam Clamp Kit

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

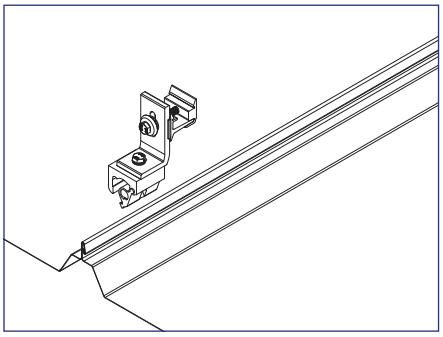


Application Note:
Install on standing metal seam roofs

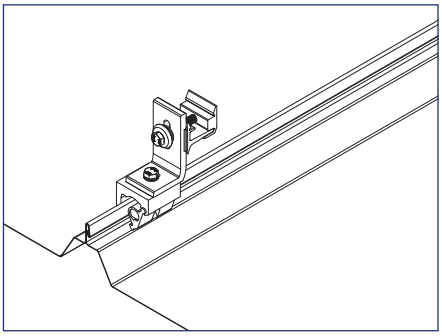
Installation Note:
Grounding and bonding of mounting system to metal roof panels shall meet local AHJ requirements.

Seam Clamp

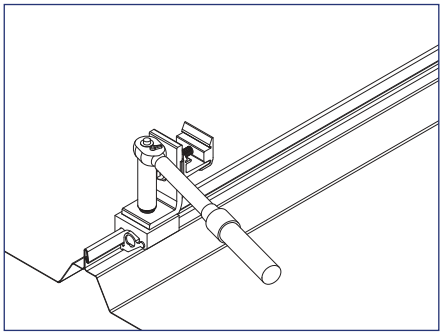
INSTALLATION INSTRUCTIONS



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

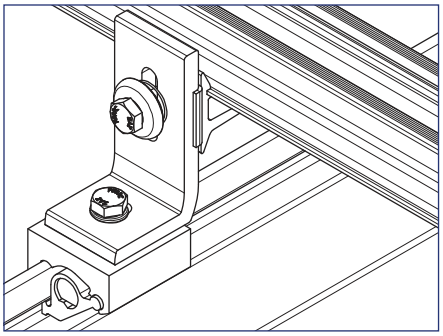


2) Attach the seam clamp to the standing metal seam by opening the seam clamp cam and placing the clamp over the top of the standing metal seam.



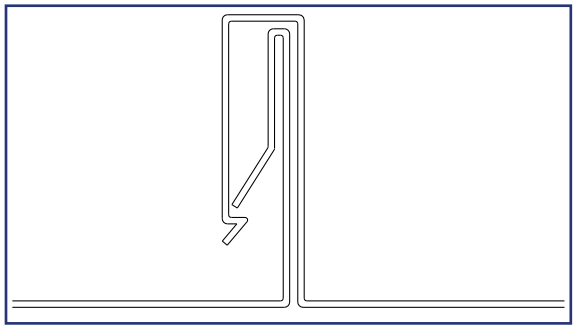
3) Torque black seam clamp bolt to 15-16 ft-lbs.

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

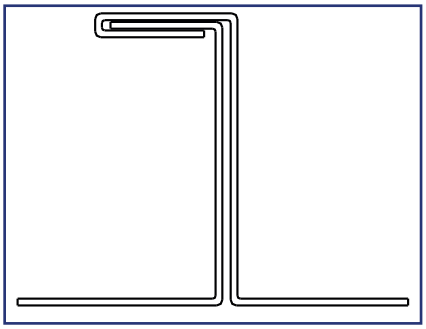


4) Ensure rotation lock is properly aligned with Ultra Mount and L foot during rail installation.

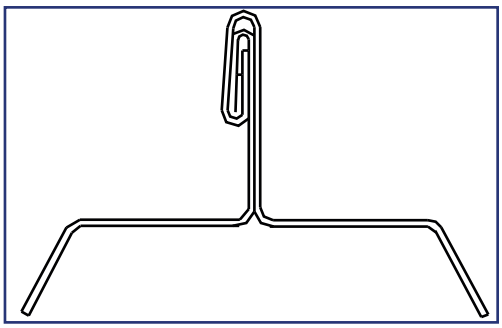
SnapNrack Seam Clamps have been designed to work with a variety of standing seam metal roofs, the most common seam types are:



Snap Lock



Single Lock



Double Lock

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

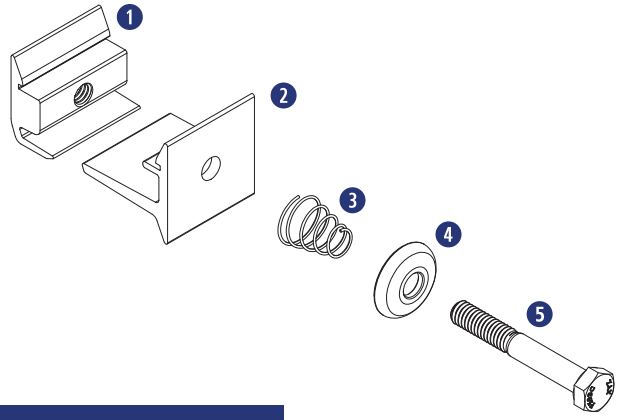
Ultra Rail Mounting Hardware

Required Tools

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

Materials Included - Ultra Rail Mounting Hardware

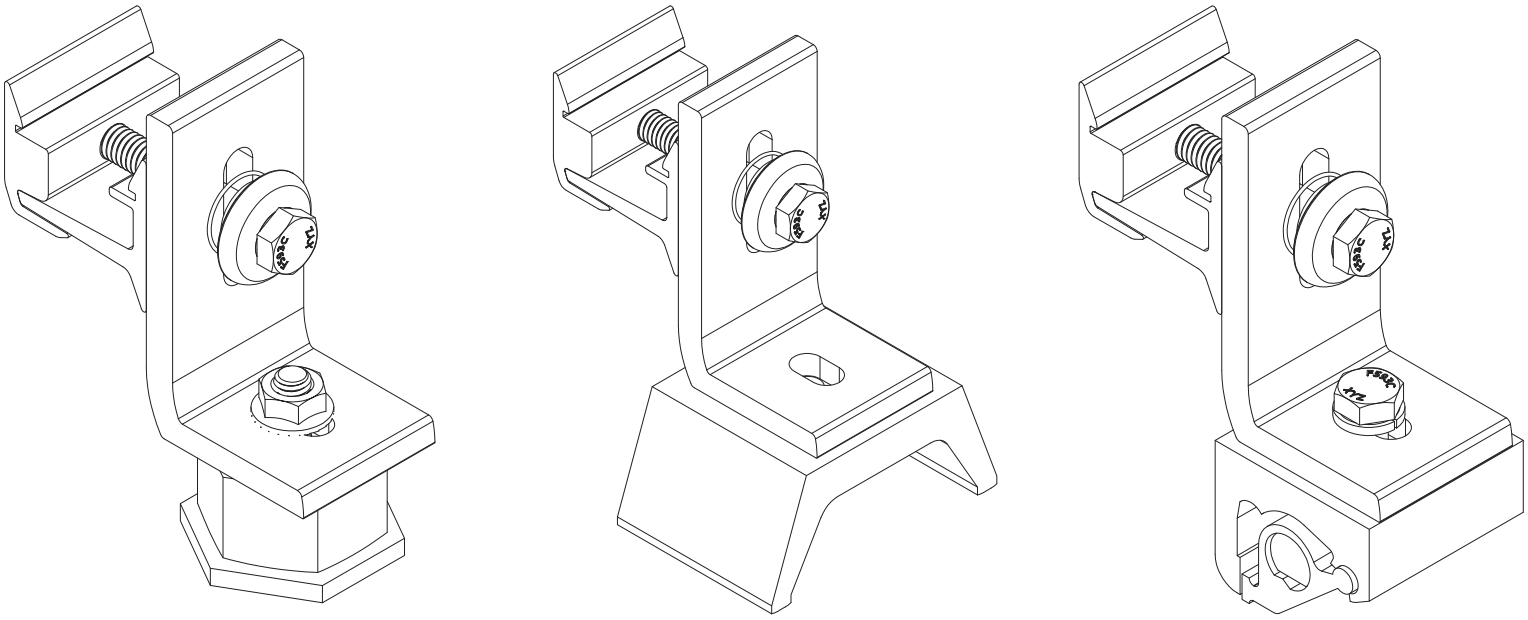
1. (1) SnapNrack Ultra Mount (Tapped)
2. (1) SnapNrack Ultra Mount (Thru-Hole)
3. (1) SnapNrack Ultra Mount Spring
4. (1) SnapNrack Ultra Mount Spring Cage
5. (1) 5/16”-18 X 2-1/4” SS HCS Bolt



Other Materials Required - *Not Shown*

① Roof Attachment

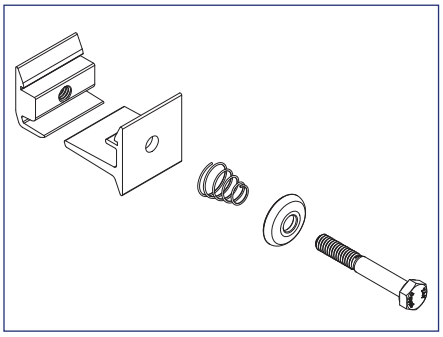
Application Note:
Install Ultra Rail onto any roof attachment that uses an L foot or other slotted mount that accepts 5/16” hardware.



Ultra Rail Mounting Hardware Installed on Different Roof Attachments

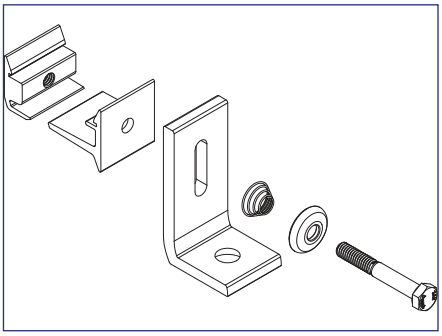
Install Note:
Roof attachments used must always meet minimum structural requirements. Consult licensed structural engineer if necessary.

INSTALLATION INSTRUCTIONS



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

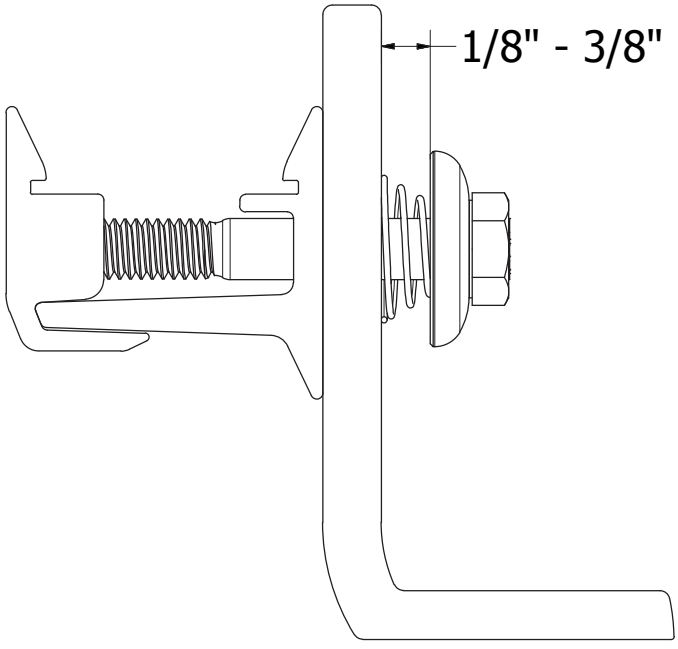
Install Note:
See exploded view on previous page for clarification.



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

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

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



Recommended Ultra Rail Mounting Hardware Installation

Fixed Tilt Mounts (5° - 30° Tilt Up)

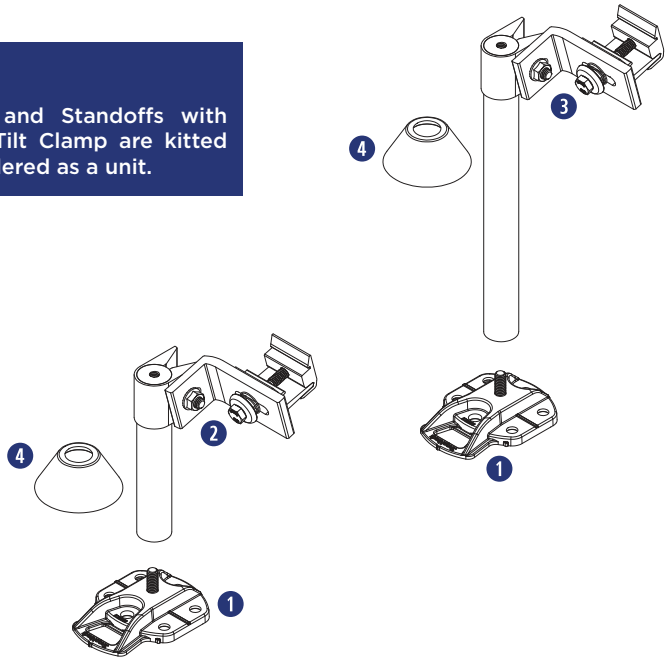
Required Tools

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

Materials Included - Ultra Rail Standoff Tilt Kits

1. (2) SnapNrack OmniBase
2. (1) Standoff with Ultra Rail Tilt Clamp, 5 ½" or 10"
3. (1) Standoff with Ultra Rail Tilt Clamp, 10", 14" or 23"
4. (2) Rubber Rain Collar (not required when sealing roof attachment with pourable roof sealant)

Note:
OmniBase and Standoffs with Ultra Rail Tilt Clamp are kitted and are ordered as a unit.



Other Materials Required - *Not Shown*

OmniBase

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

② (2) 5/16" or 1/4" SS Washers

① (2) Conical flashings to match roof type or a pourable type roof penetration seal system

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

Tilt Angle (nominal)

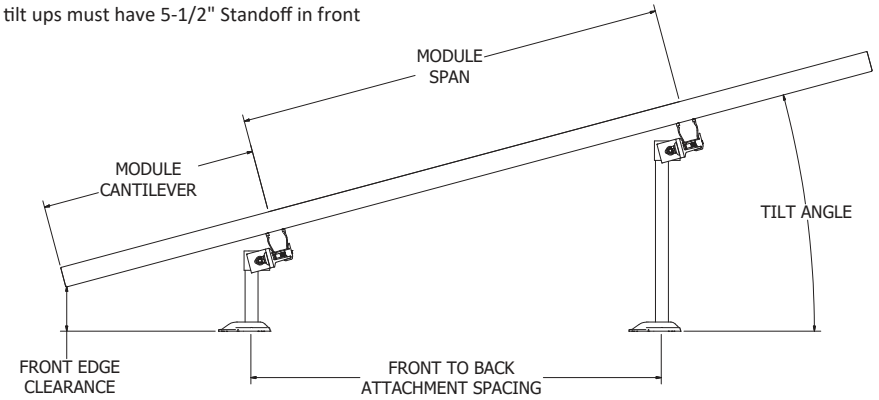
Front to back attachment	Landscape			Portrait		
	5-1/2" & 10" Standoffs	5-1/2" & 14" Standoffs	5-1/2" & 23" Standoffs	5-1/2" & 10" Standoffs	5-1/2" & 14" Standoffs	5-1/2" & 23" Standoffs
16	16°	28°	N/A	N/A	N/A	N/A
24	10°	20°	N/A	N/A	N/A	N/A
32	8°	15°	28°	8°	15°	28°
48	N/A	N/A	N/A	5°	10°	20°

Notes:
1. Table is based on 60 cell modules
2. Table assumes mounting zone on portrait modules not exceeding 25% of module length
3. Maximum tilt angle allowed = 30° relative to horizontal
4. All tilt ups must have 5-1/2" Standoff in front

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

Installation Parameters:

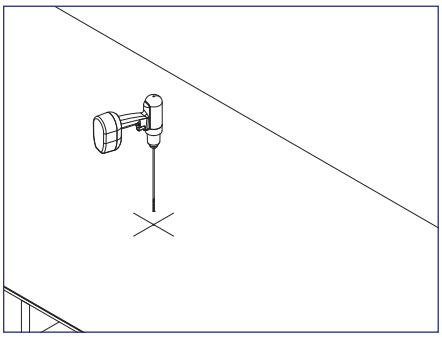
- Maximum tilt angle relative to horizontal =30° (+/- 2°)
- Module tilt to be in the same azimuth direction as roof they are to be mounted on *Exception: Flat roofs (defined as having a slope of less than 7°)*
- Maximum roof slope = 23°



Fixed Tilt Mounts (5° - 30° Tilt Up)

INSTALLATION INSTRUCTIONS

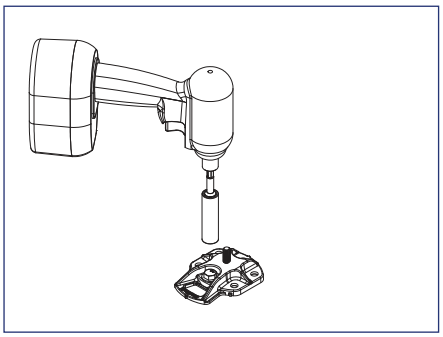
Installation Sequence #'s 3 through 5 pertain to installations with cone type flashings at roof. See Installation Sequence #'s 6 through 7 for installations with pourable type roof penetration seal systems.



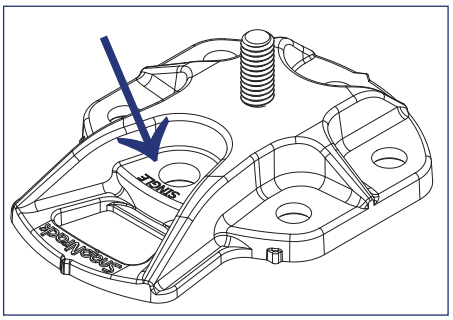
1) If required for rafter/truss applications; using roof attachment locations drawn on roof during system layout, drill pilot hole(s) into roof framing member.

Install Note:

Ensure the lag or self-drilling screws are installed in a solid portion of the roof framing member. If roof framing member is not found, seal the pilot hole immediately with proper roof sealant.



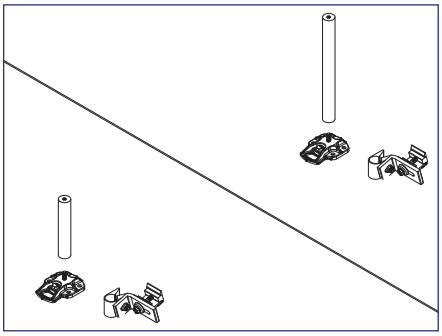
2) 2. Apply roofing sealant to underside of OmniBase and in pilot hole(s). Attach Base to roof with the appropriate fastener/s based on application from the list below:



Install Note:

When attaching OmniBase with a single fastener, use hole labeled "Single".

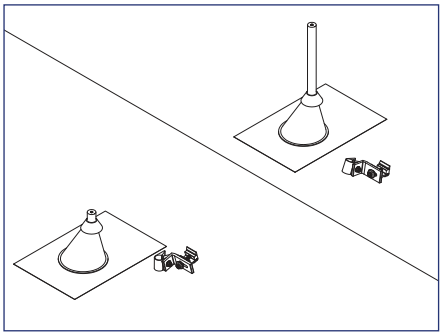
- **Standard wood rafter:** (1) 5/16" S.S. lag screw with minimum 2.5" embedment (Attachment Detail SNR-DC-01249)
- **Flat wood rafter or purlin:** (2) S.S. 5/16" lag screws with minimum 1.5" embedment (Attachment Detail SNR-DC-01250)
- **Wood I-Joist:** (2) S.S. 1/4" lag screws, choose length for proper embedment (Attachment Detail SNR-DC-01251)
- **Steel Purlin:** (2) #14 S.S. self-tapping steel fasteners, choose length for proper embedment (Attachment Detail SNR-DC-01252)
- **Concrete:** (1) 3/8" Wedge Anchor or equivalent, (2) 1/4" Wedge Anchor or equivalent, choose length for proper embedment
- (Attachment Detail SNR-DC-01253)
- **Standard 1/2" Roof Sheathing:** (6) #14 S.S. wood screws, choose length for proper embedment (Attachment Detail SNR-DC-01254)



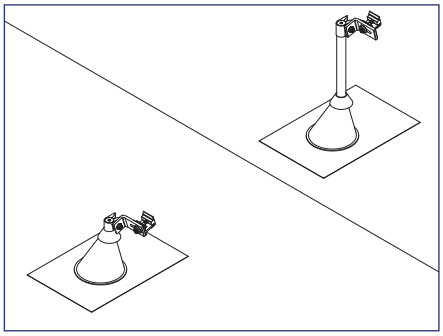
3) **Cone Type Flashings:** Install Standoff shaft onto base.

Install Note:

Standoff shafts need to be tightened to base using channel lock pliers.



4) **Cone Type Flashings:** Install appropriate roof flashing over Standoff Shaft and seal to roof surface per roofing standards and best practices. Install Rubber Rain Collar over the Standoff Shaft.



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

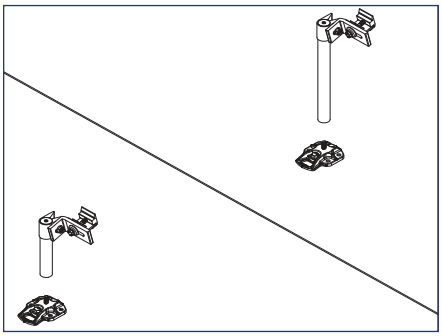
Best Practice:

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

Skip to installation sequence #8.

Fixed Tilt Mounts (5° - 30° Tilt Up)

INSTALLATION INSTRUCTIONS



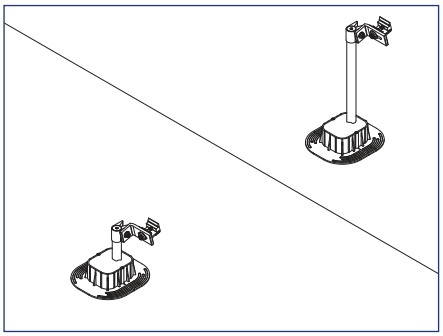
6) **Pourable Type Roof Penetration Seal System:** With Ultra Rail Tilt Clamp assembly on the Standoff Shaft, install Standoff shaft onto base.

Install Note:

Standoff shafts need to be tightened to base using channel lock pliers.

Best Practice:

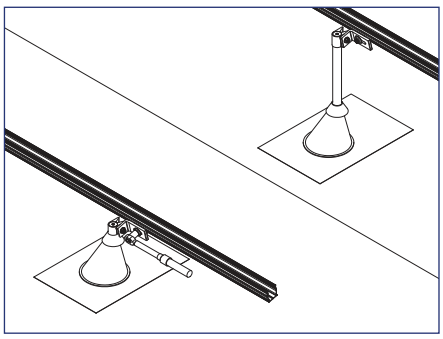
Set the Standoff Clamp assemblies approximately 1/2" below top of Standoff Shaft to accommodate final leveling adjustments.



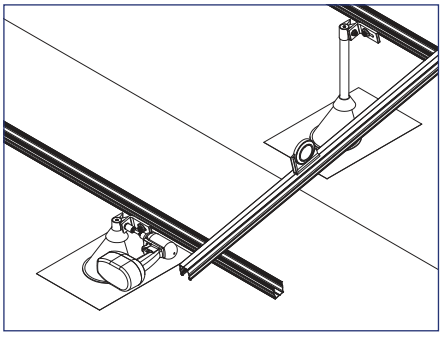
7) **Pourable Type Roof Penetration Seal System:** Seal roof penetrations at bases by placing curb around Base then applying pourable sealant material.

Install Note:

Follow manufacturer's instructions closely when applying this type of roof sealing system.



8) Set rails into the Ultra Rail Mounting Hardware on front and rear mounts then tighten the Ultra Rail Mounting Hardware to 12 ft-lbs. Connect multiple lengths of rail using the Ultra Rail Splice *(see "UR-40 or UR-60 Rail Splice" sections of manual)*



9) Set all Ultra Rail Mount angles to desired tilt angle usingan Inclinometer tool or other pitch measuring device. Tighten bolts to 10+ ft-lbs.

Best Practice:

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

Installing and Leveling Rails

snapnrack.com

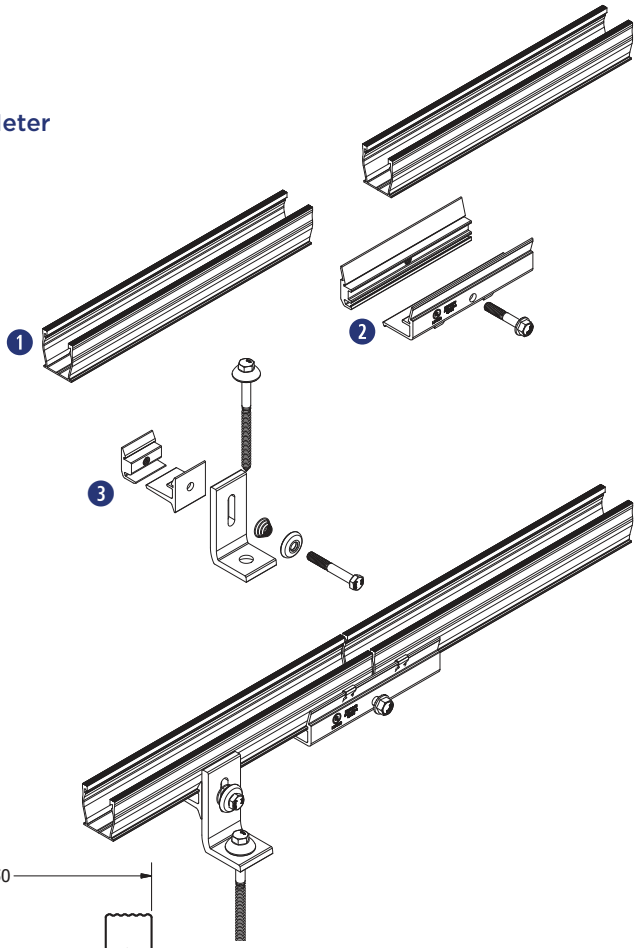
Required Tools

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

Materials Included - Installing and Leveling Rails

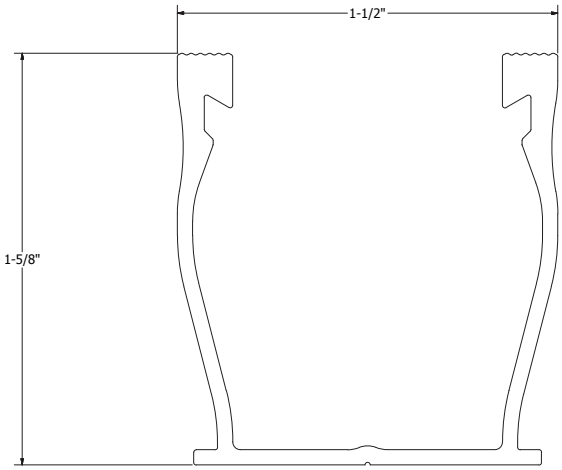
1. SnapNrack Ultra Rail (UR-40 or UR-60)
2. SnapNrack Ultra Rail Splice (UR-40 or UR-60)
3. Pre-Installed SnapNrack Roof Attachments

   (L Foot Mount, Tile Replacement, etc.)

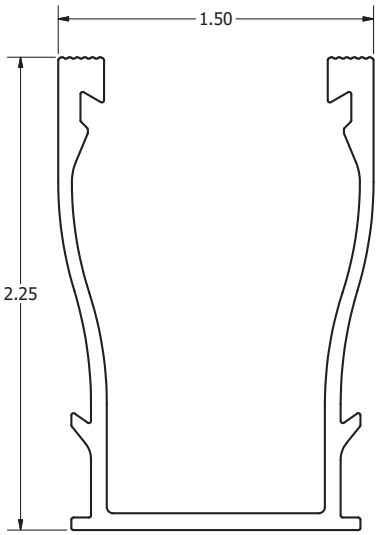


Other Materials Required - *Not Shown*

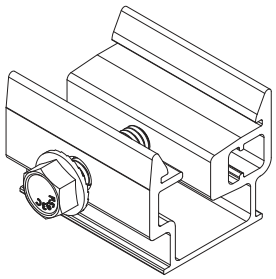
① SnapNrack Ultra Rail Leveling Spacer



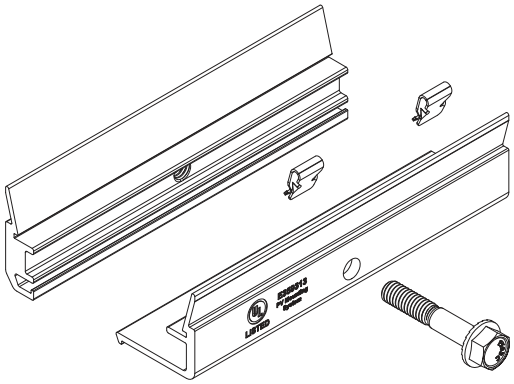
UR-40 Rail Profile



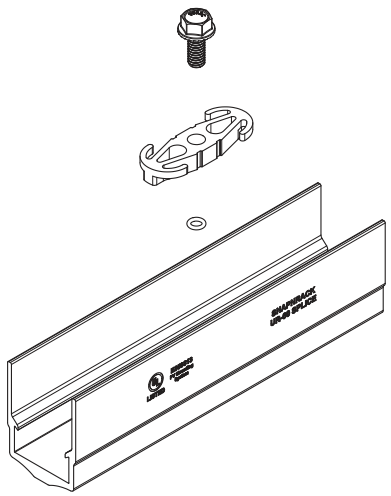
UR-60 Rail Profile



Ultra Rail Leveling Spacer



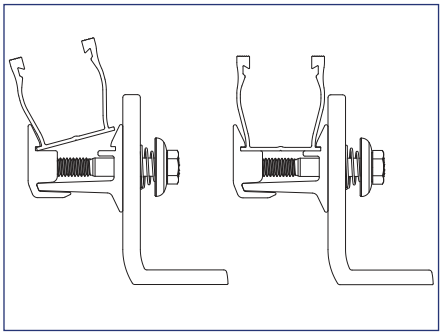
UR-40 Rail Splice



UR-60 Rail Splice

Installing and Leveling Rails

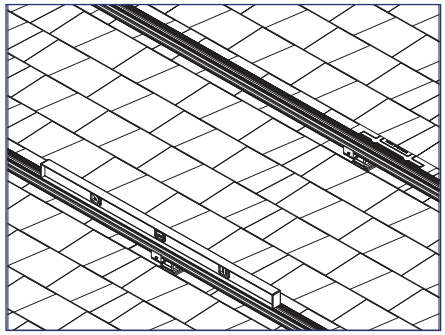
INSTALLATION INSTRUCTIONS



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

Install Note:

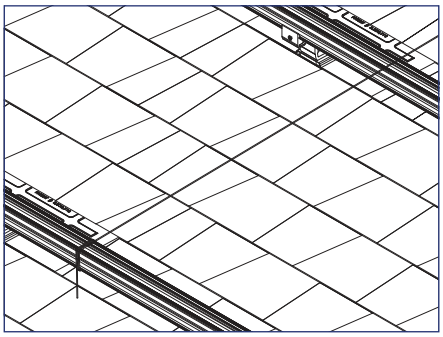
Slightly rocking rail into mounts can ease installation, leading first with side of rail furthest from mount.



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

Best Practice:

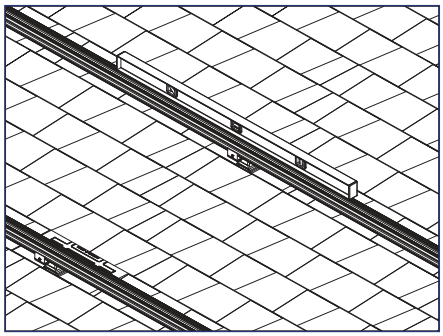
Set attachments in the middle of available leveling range to start.



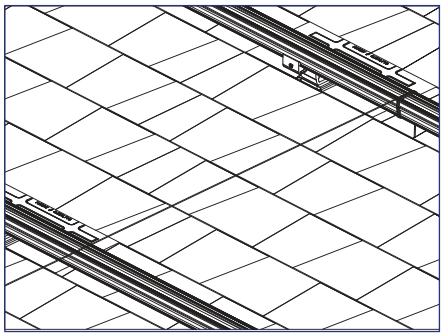
3) Run a string line or spare rail from the bottom rail to the top rail and set desired pitch of the array by adjusting the top rail, add L Foot Extension if needed.

Install Note:

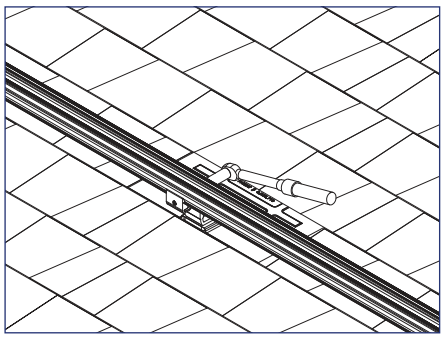
See "Leveling Components" section for installation instruction and restrictions.



4) Level the top rail by moving the string line down the length of the rail, matching pitch over the entire length of the array.



5) Level the remaining rails to the string line by working out from the middle rail, add L Foot Extensions or spacers if needed.



6) Tighten all racking hardware to 12 ft-lbs.

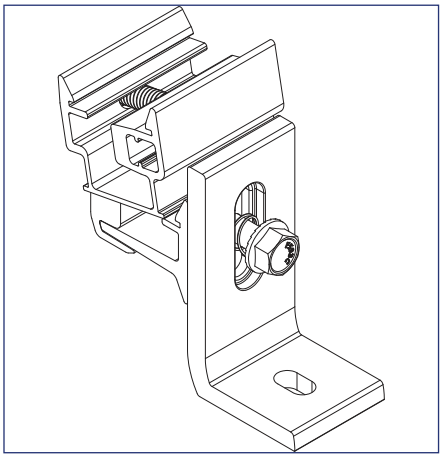
Note:

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

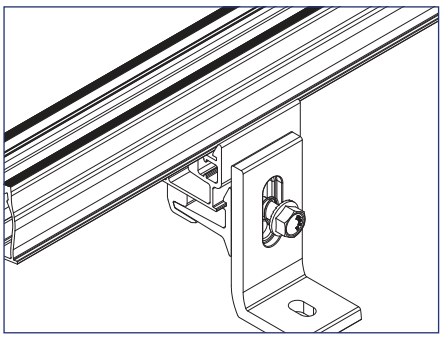
- REC Solar, Yingli, and Suniva modules: 4.00"
- ReneSola modules: 3.93" (100 mm)
- Trina Solar modules: 4.53" (115 mm)

INSTALLATION INSTRUCTIONS

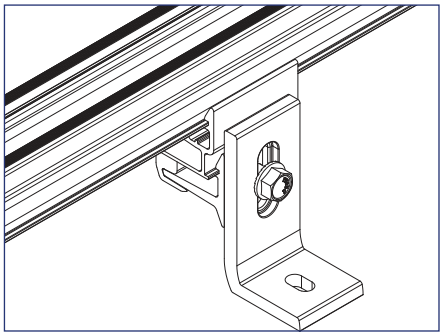
SnapNrack Ultra Rail Leveling Spacer

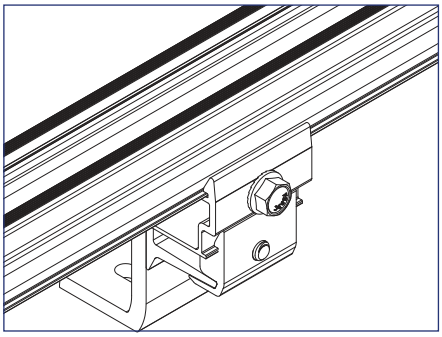


1) Snap leveling spacer into Ultra Rail mount.



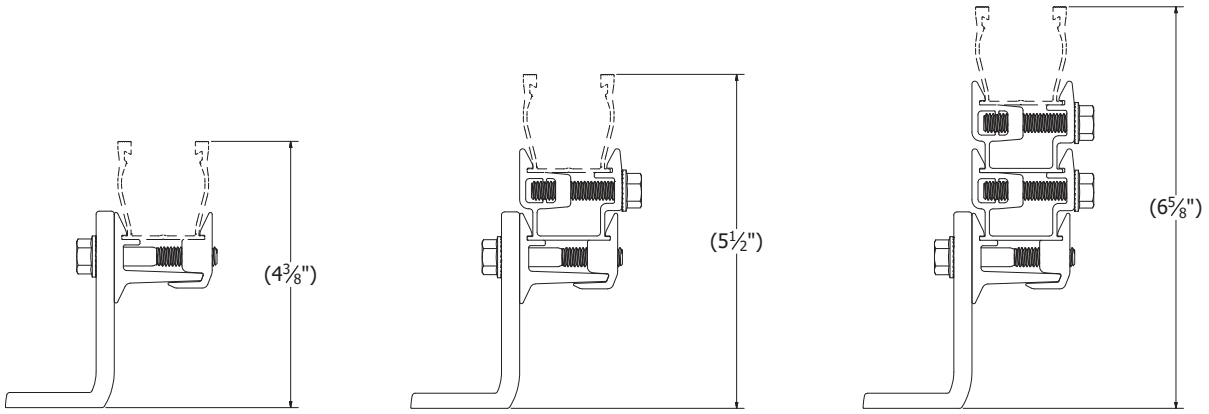
2) Snap Ultra Rail into leveling spacer.





3) Finalize rail position and tighten all hardware to 12 ft-lbs.

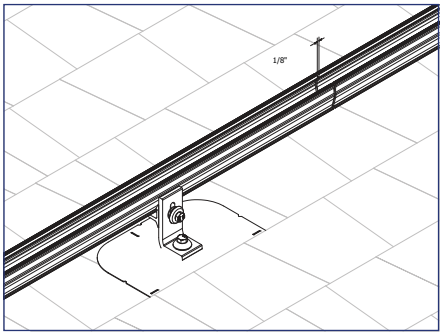
Use a single leveling spacer on no more than 30% of attachment points, and no more than two leveling spacers on more than 10%.



Leveling Spacer Provides Up To 2.25" of Additional Height Adjustment
(UR-60 Rail Adds 5/8" To Overall Height)

UR-40 Rail Splice

INSTALLATION INSTRUCTIONS

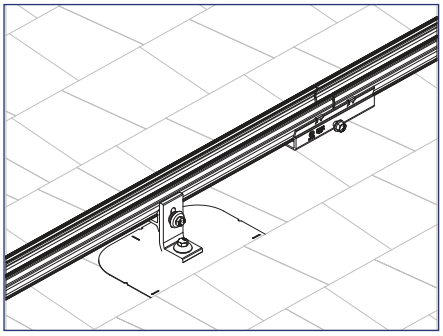


1) Align sections of rail and leave a 1/8” - 1/4” gap.

Install Note:

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

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



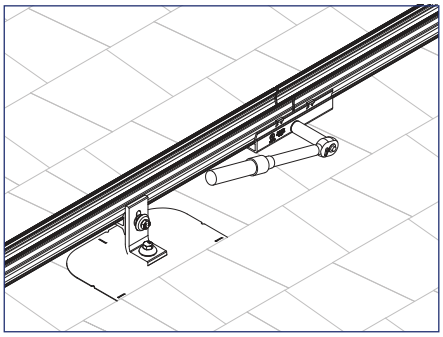
2) Install rail splice assembly onto bottom of rail, making sure both rails are seated in grooves of splice and that the splice is centered.

Install Note:

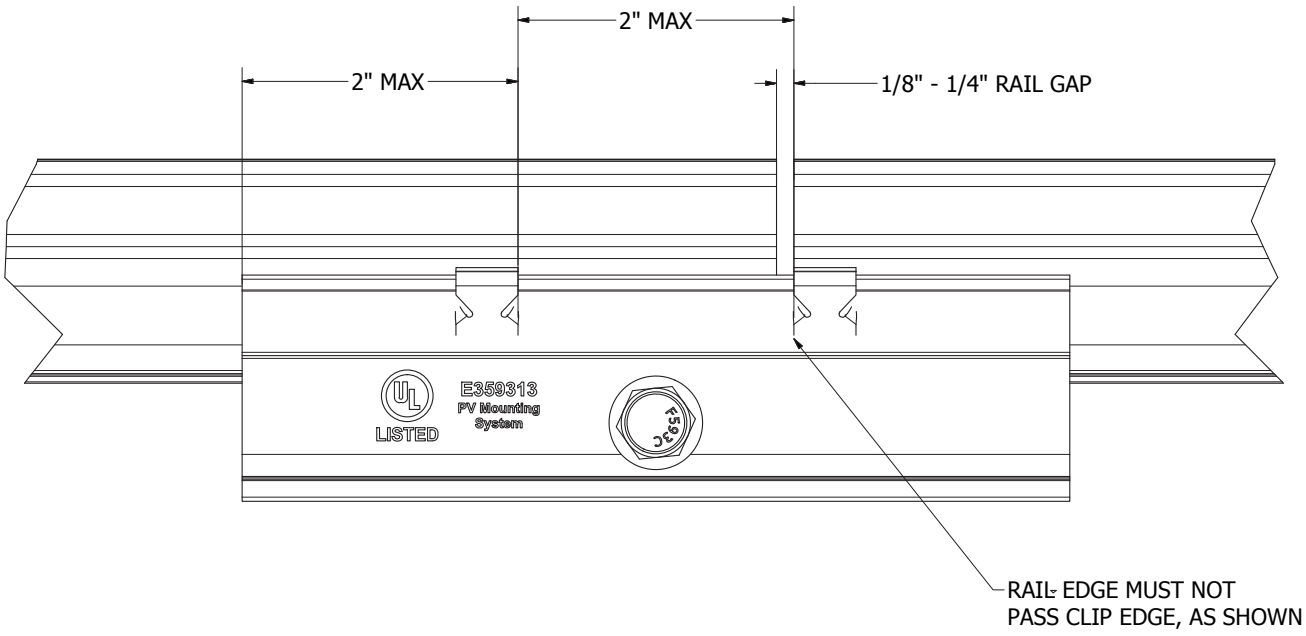
Gap between rails must land between bonding clips on splice.

Best Practice:

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

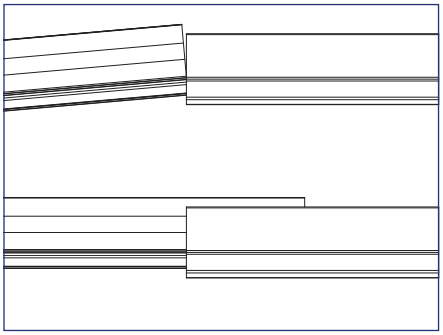


3) Tighten splice hardware to 12 ft-lbs.



UR-40 Splice Installation Limitations

INSTALLATION INSTRUCTIONS



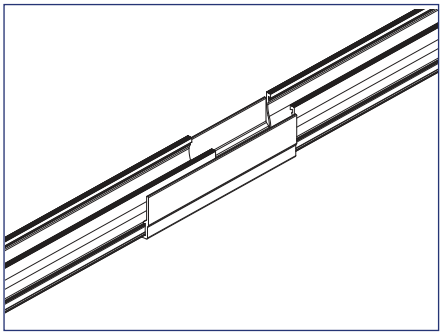
1) Slide first rail into splice, ensuring that BOTH rail flanges are engaged into lower section of splice.

Best Practice:

Rocking rail in slightly from the bottom can ease install.

Install Note:

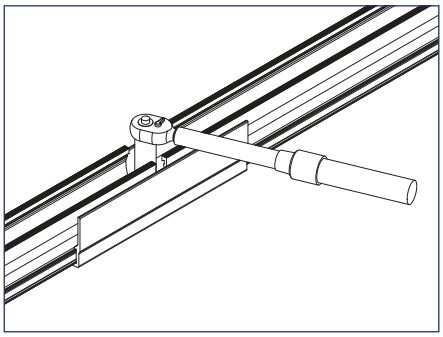
Any section of rail that is spliced will need to be supported by a roof attachment on both sides. Splices are not allowed to be installed on rail cantilevers.



2) Slide second rail into splice, ensuring that BOTH rail flanges are engaged into lower section of splice.

Best Practice:

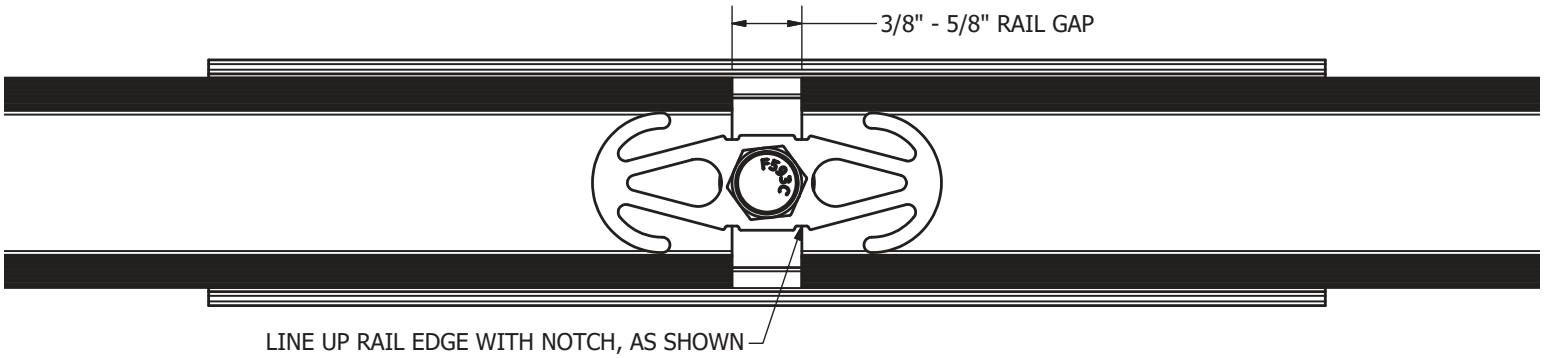
Rocking rail in slightly from the bottom can ease install.



3) Tighten splice hardware to 12 ft-lbs

Install Note:

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

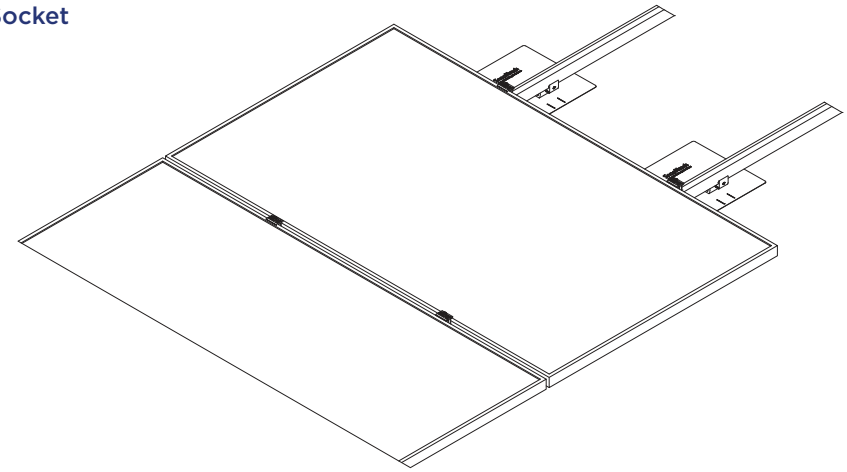


UR-60 Splice Installation Limitations

Module Installation

Required Tools

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

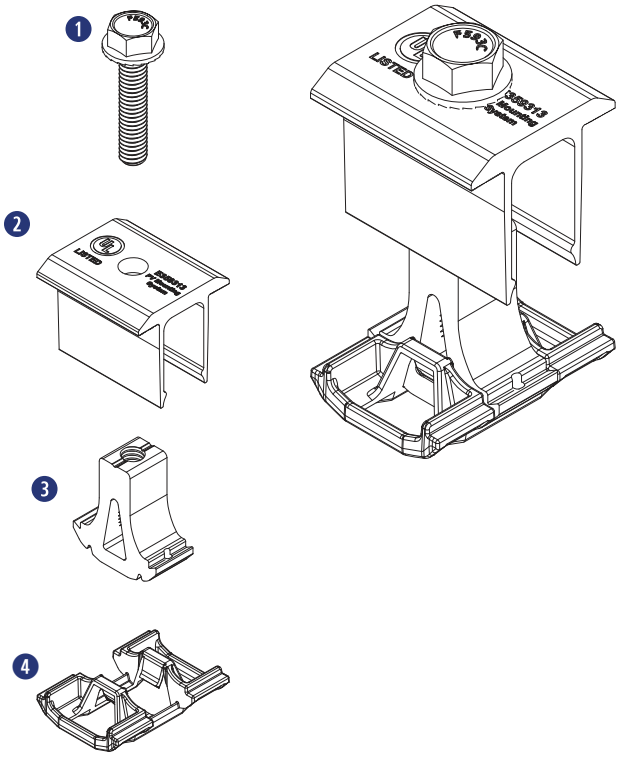


Materials Needed - Module Installation

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

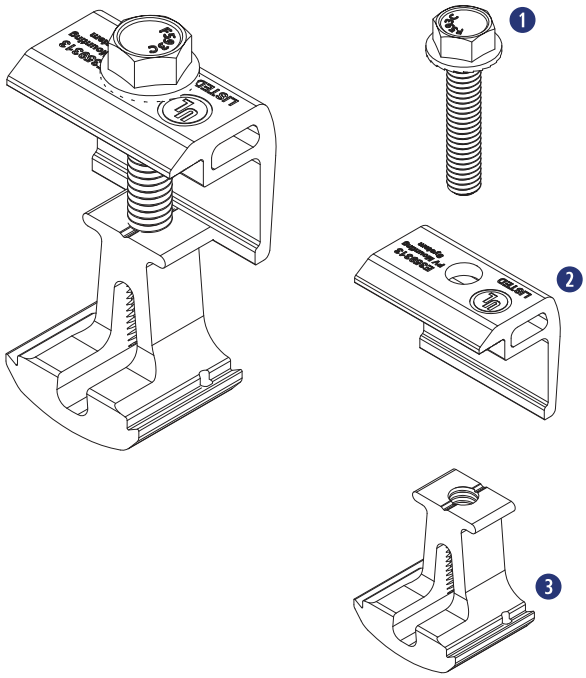
Ultra Rail Mid Clamp Assembly

1. (1) 5/16”-18 X 1-1/2” SS Flange Bolt
2. (1) SnapNrack Ultra Rail Mid Clamp Top
3. (1) SnapNrack Ultra Rail Mid Clamp Base
4. (1) SnapNrack Ultra Rail Mid Clamp Extension



Ultra Rail End Clamp Assembly

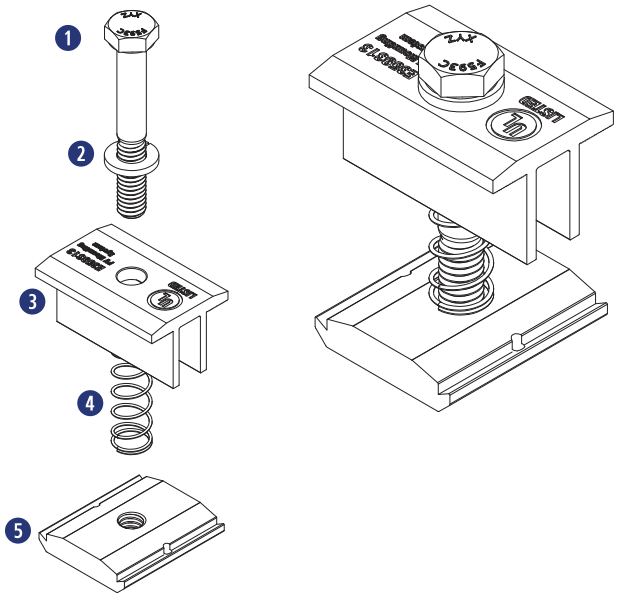
1. (1) 5/16”-18 X 1-1/2” SS Flange Bolt
2. (1) SnapNrack Ultra Rail End Clamp Top
3. (1) SnapNrack Ultra Rail End Clamp Base



Module Installation

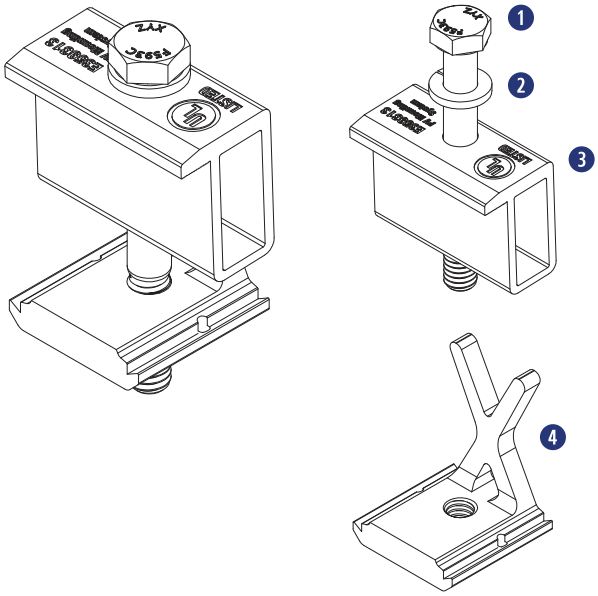
Mid Clamp Assembly

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



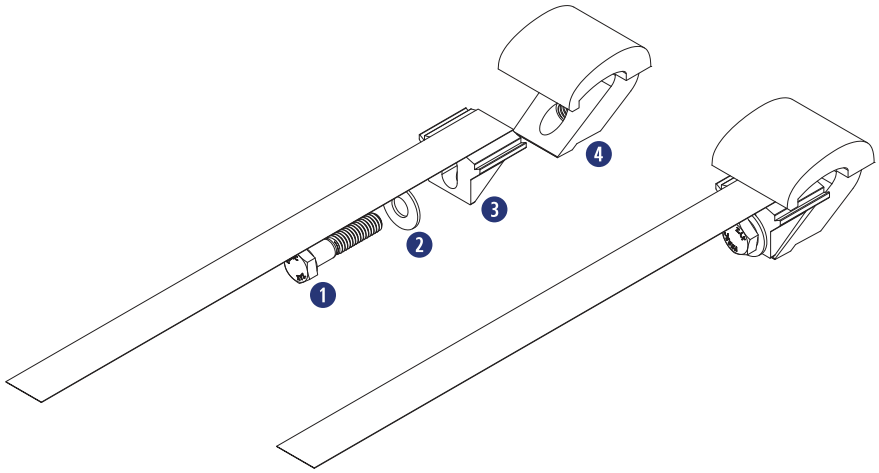
Adjustable End Clamp Assembly

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



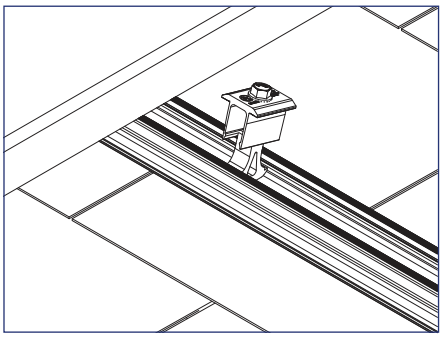
Universal End Clamp Assembly

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 Ultra Rail Mid Clamp



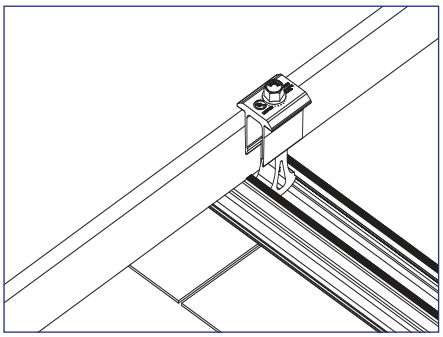
1) Snap the base into the top channel of the rail.

Best Practice:

Backing off bolt will ease installation into rail channel.

Install Note:

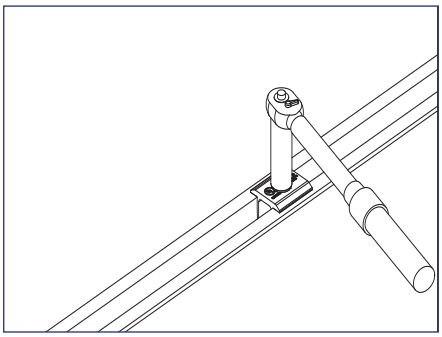
Module clamps cannot be installed anywhere there is a gap between rails (i.e. splice locations). Modules should be shifted slightly when this occurs.



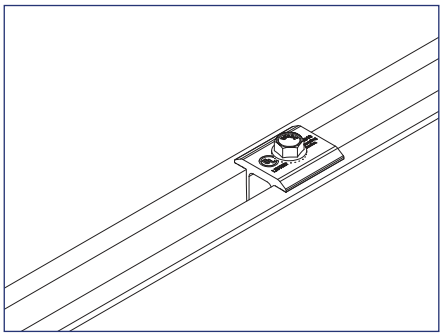
2) Slide the clamp flush to the module with the top lip of the mid clamp over the top edge of the module frame.

Install Note:

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



4) Tighten hardware to 16 ft-lbs.



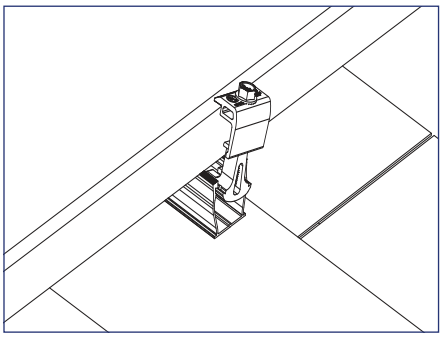
3) Place the next module flush to the other side of the mid clamp.

Install Note:

Ultra Rail Mid Clamps create 3/4" gap between modules.

INSTALLATION INSTRUCTIONS

SnapNrack Ultra Rail End Clamp

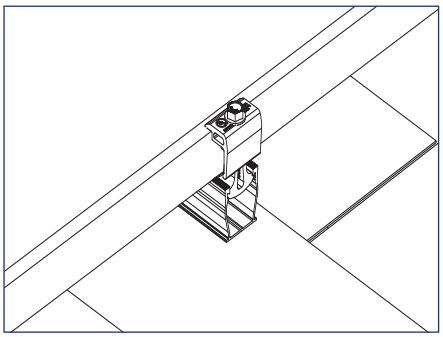


1) Snap the end clamp base into the top channel of the rail.

Install Note:

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

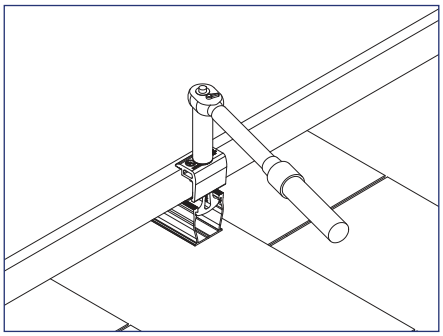
Module clamps cannot be installed anywhere there is a gap between rails (i.e. splice locations). Modules should be shifted slightly when this occurs.



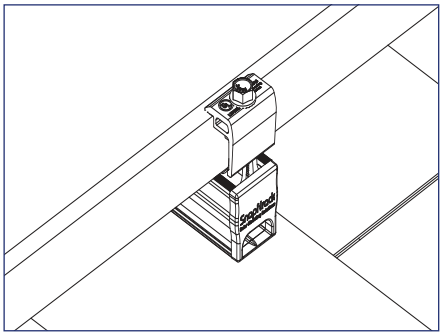
2) Slide the clamp flush to the module with the top lip of the end clamp over the top edge of the module frame.

Install Note:

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



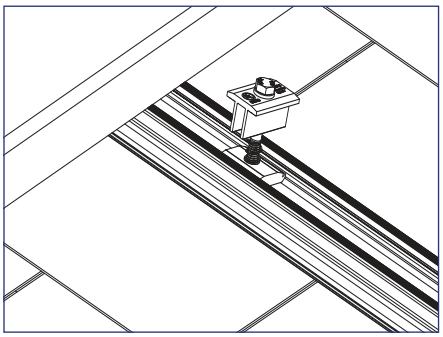
3) Tighten hardware to 16 ft-lbs.



4) Install end cap to finish.

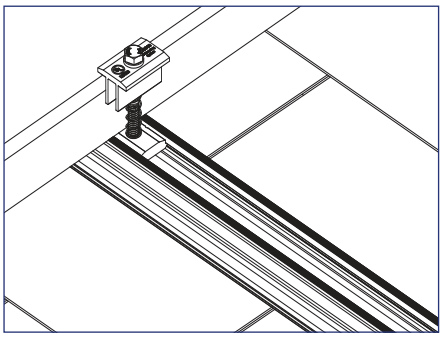
INSTALLATION INSTRUCTIONS

SnapNrack Mid Clamp



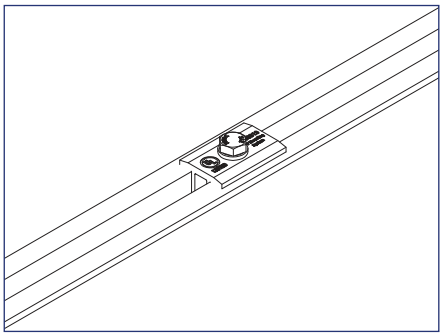
1) Snap the channel nut into the top channel of the rail.

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



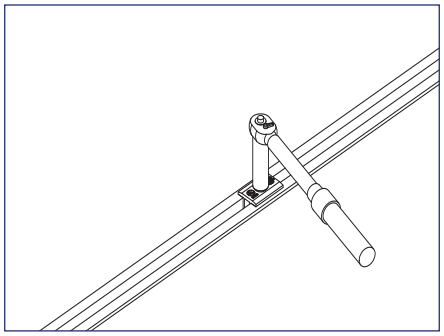
2) Slide the clamp flush to the module with the top lip of the mid clamp over the top edge of the module frame.

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



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

Install Note:
Mid clamps create 1/2" gap between modules.

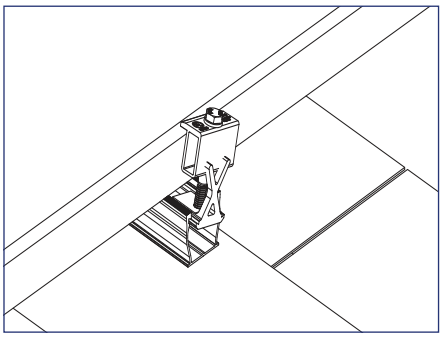


4) Tighten hardware to 10 ft-lbs.

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

INSTALLATION INSTRUCTIONS

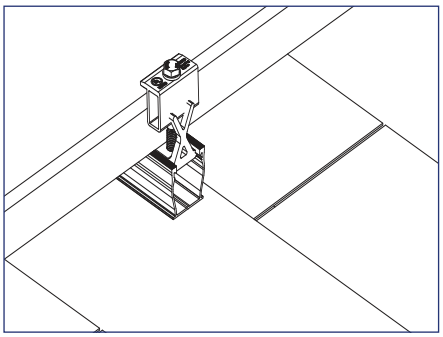
SnapNrack Adjustable End Clamp



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

Install Note:

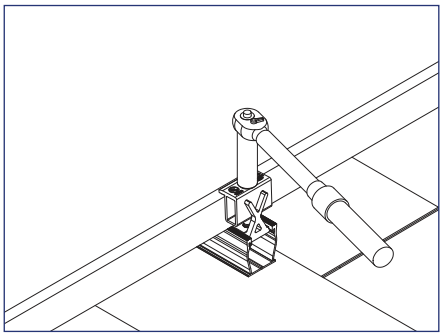
Adjustable End Clamps require extra rail to ensure that channel nut is fully engaged.



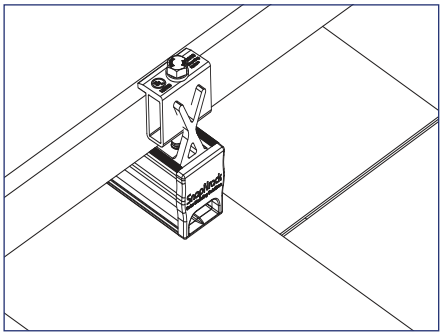
2) Slide the clamp flush to the module with the top lip of the end clamp over the top edge of the module frame.

Install Note:

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



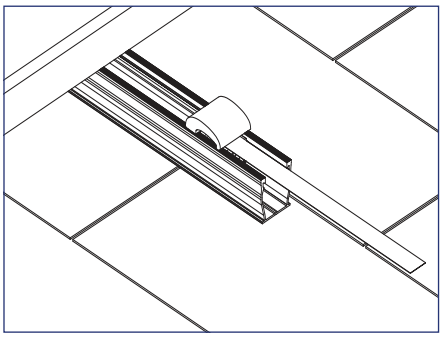
3) Tighten hardware to 10 ft-lbs.



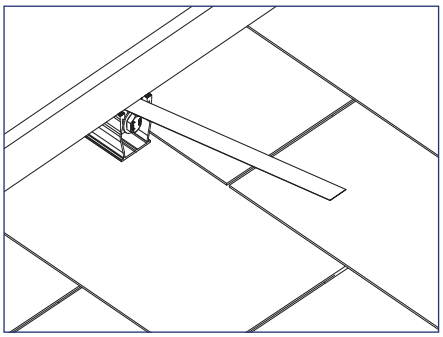
4) Install end cap to finish.

INSTALLATION INSTRUCTIONS

SnapNrack Universal End Clamp

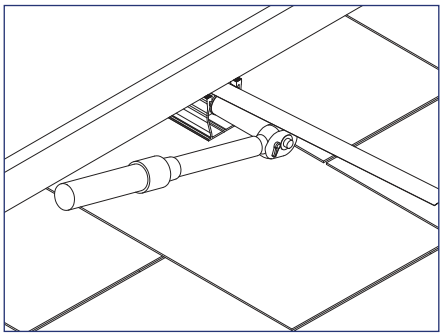


1) Slide the preassembled Universal End Clamp (UEC) into the end of the rail.



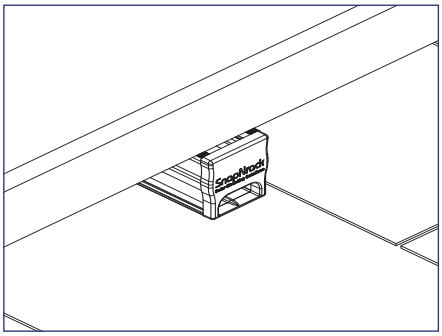
2) Lift the module and slide the clamp far enough under the module to pass the lip of the bottom edge of the module frame.

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



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

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



4) Install end cap to finish.

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

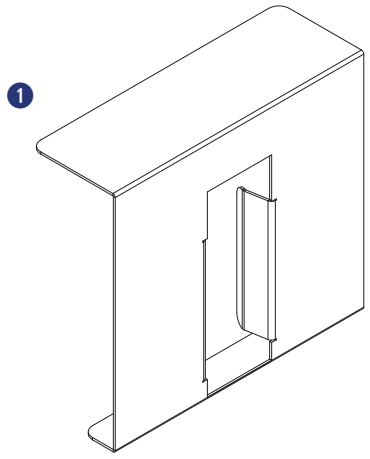
Rail Finishing

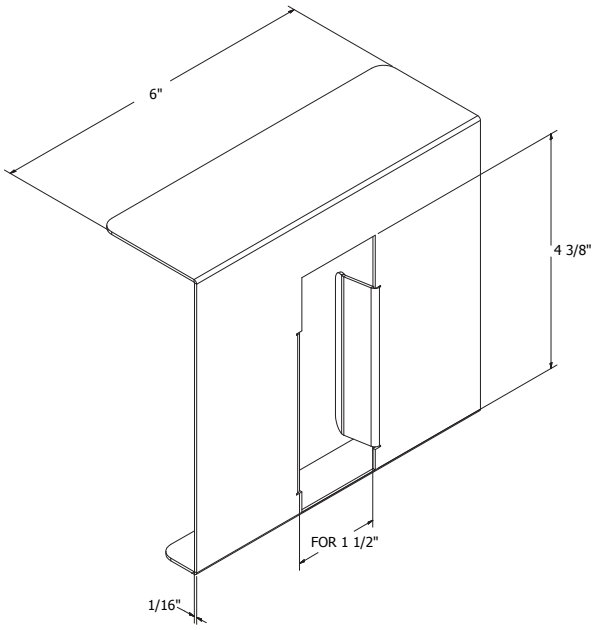
Required Tools

- Reciprocating Saw or Portable Band Saw

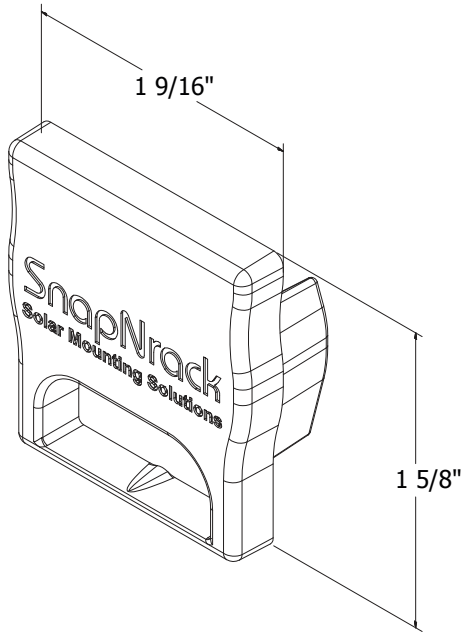
Materials Included - Rail Cutting Tool and Rail End Cap

1. (1) SnapNrack Rail Cutting Tool
2. (1) SnapNrack Ultra Rail End Cap (UR-40 or UR-60)

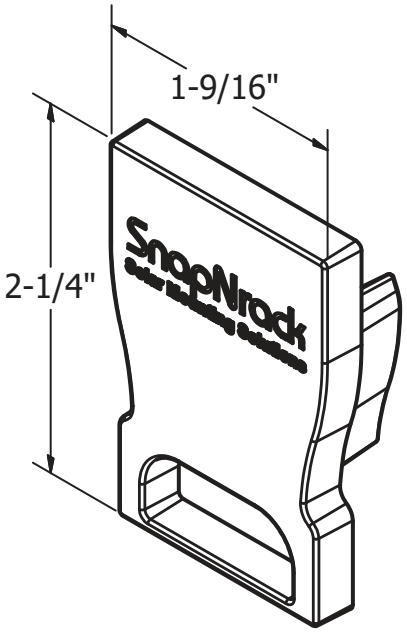




Dimensioned Rail Cutting Tool



Dimensioned UR-40 Rail End Cap

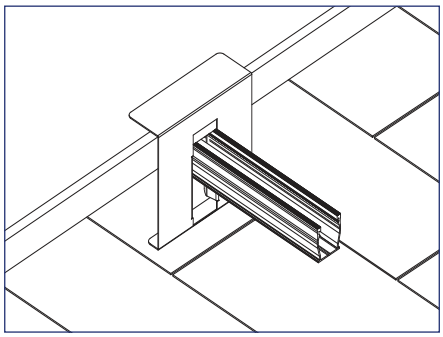


Dimensioned U-60 Rail End Cap

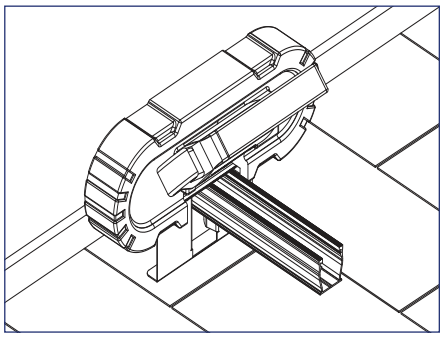
Application Note:

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

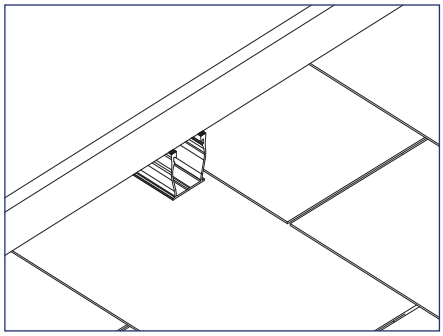
INSTALLATION INSTRUCTIONS



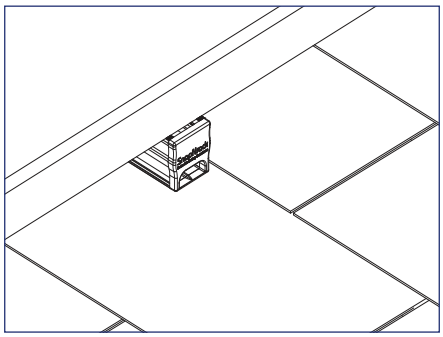
1) Slide the Rail Cutting Tool over the end of the rail and place it so that the upper lip is safely covering the edge of the module *(optional)*.



2) Use the reciprocating saw or band saw to cut off the end of the rail, then remove any sharp edges.



3) Remove the Cutting Tool from the rail, then remove any sharp edges.



4) Insert SnapNrack Ultra Rail End Cap into the cut end of the rail to create a flush finish to the array.

Wire Management

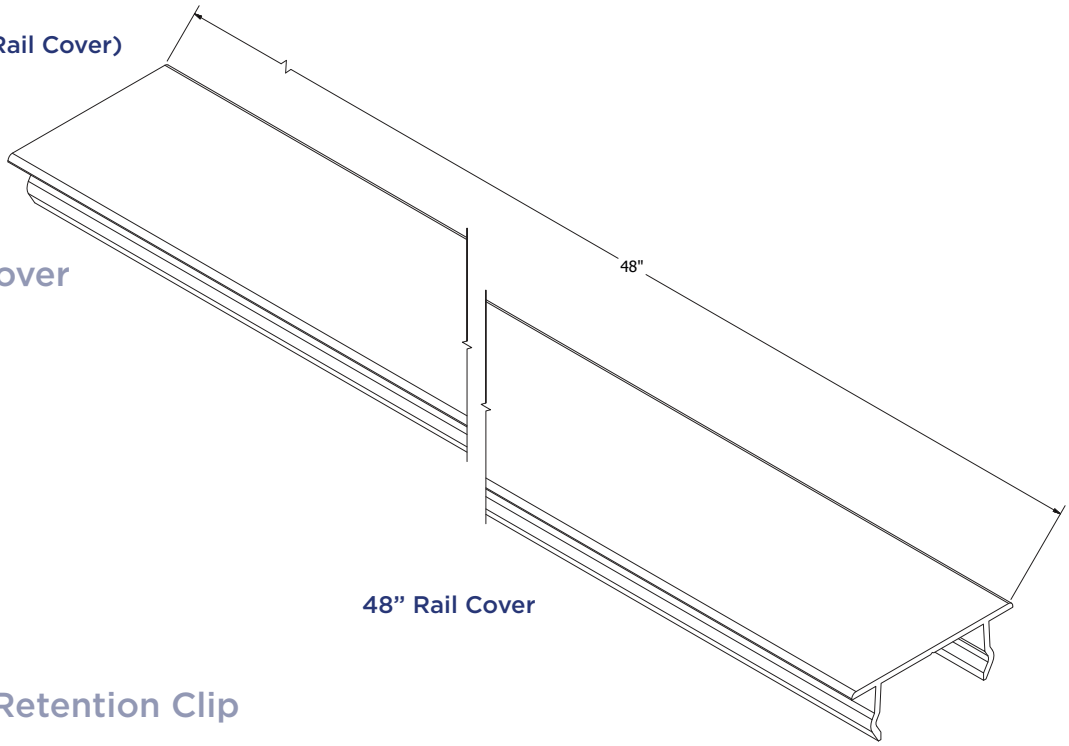
Required Tools

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

Materials Included - Rail Cover

1. (1) SnapNrack 48” Rail Cover

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



48” Rail Cover

Materials Included - Wire Retention Clip

1. SnapNrack Wire Retention Clip

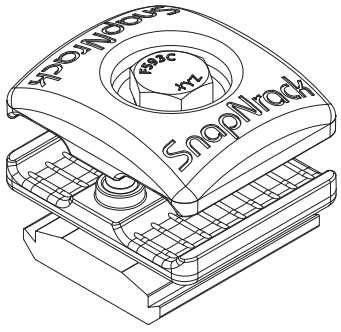
Wire Retention Clip

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

Materials Included - Wire Clamp

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

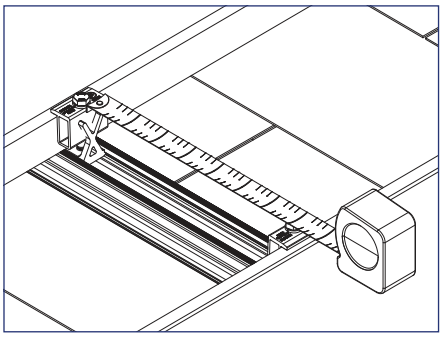
Application Note:
Install as necessary to secure cables and conductors running from rail to rail, or transitioning out/in from a rail channel



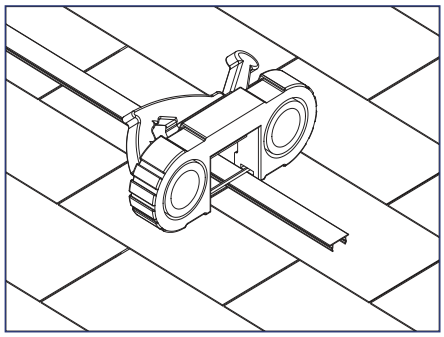
Universal Wire Clamp Assembly

INSTALLATION INSTRUCTIONS

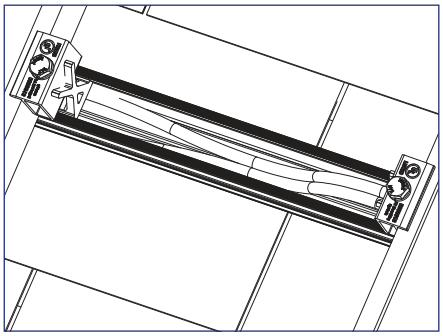
SnapNrack 48” Rail Cover



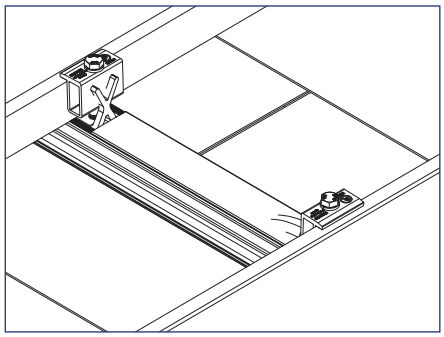
1) Measure the length of the SnapNrack 48” Rail Cover that is needed.



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



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



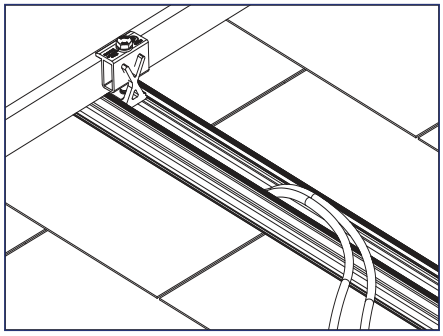
4) Snap Rail Cover into place, enclosing all conductors inside of rail channel.

Install Note:

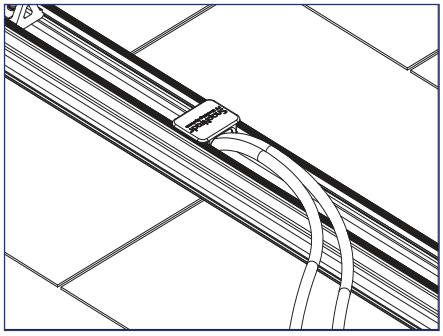
SnapNrack Rail Cover is designed to stay in place once installed, use a flat blade screw driver if it needs to be relocated or removed.

INSTALLATION INSTRUCTIONS

SnapNrack Wire Retention Clip

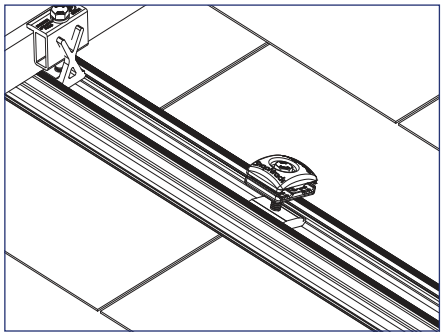


1) Place all electrical conductors in the bottom of the rail channel.

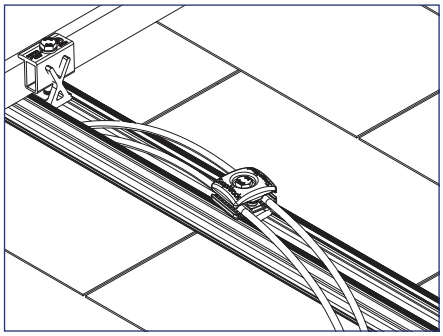


2) Install the Wire Retention Clip by snapping it into place on the rail.

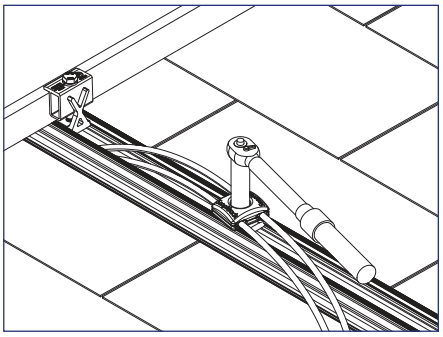
SnapNrack 4-Wire, Trunk Cable, or Universal Wire Clamp



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

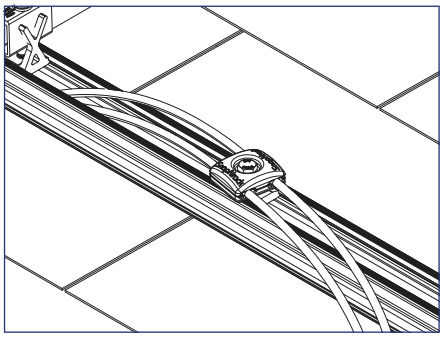


2) With Wire Clamp loose, place conductors or cables in slots.



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

Install Note:
Wire Clamps can be rotated and oriented in any direction.



4) 4-Wire Clamp intended for PV Wire conductors, Trunk Cable Clamp intended for trunk cables, Universal Wire Clamp intended for both PV Wire conductors and AC trunk cables.

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

MLPE Installation

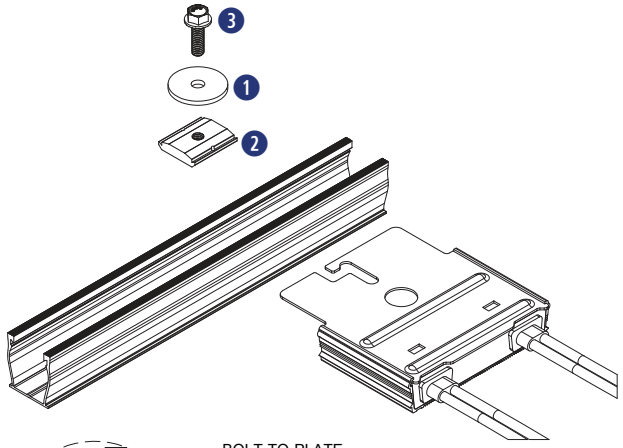
snapnrack.com

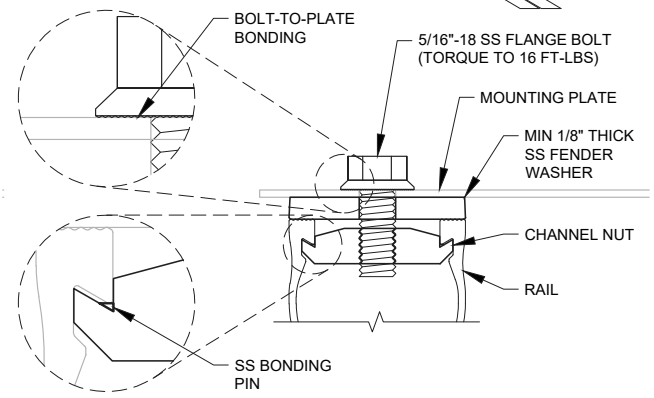
Required Tools

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

Materials Included - MLPE Rail Attachment Kit

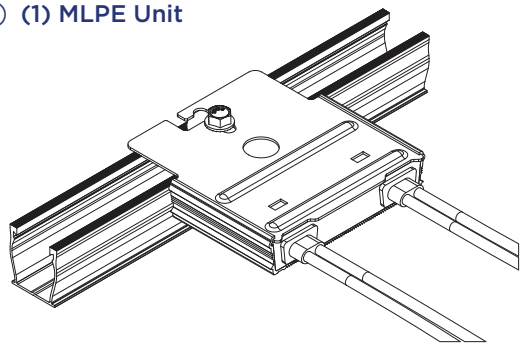
1. (1) 5/16" X 1-1/2" X 0.125" SS Fender Washer
2. (1) SnapNrack Channel Nut
3. (1) 5/16"-18 X 1-1/4" SS Flange Bolt





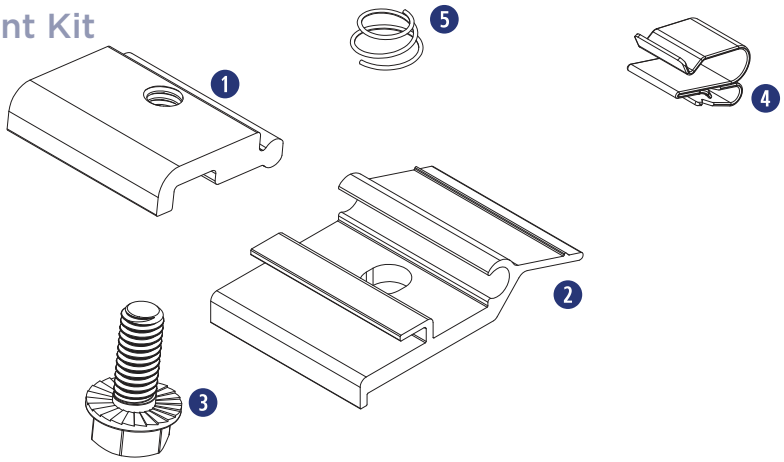
Other Materials Required

① (1) MLPE Unit



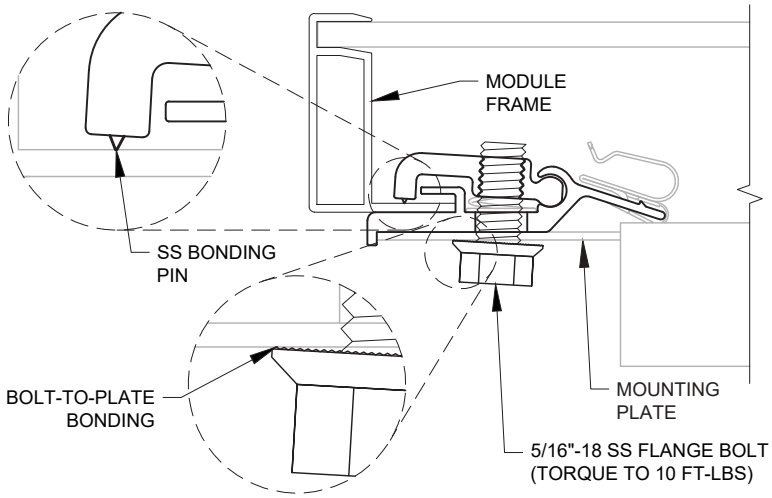
Materials Included - MLPE Frame Attachment Kit

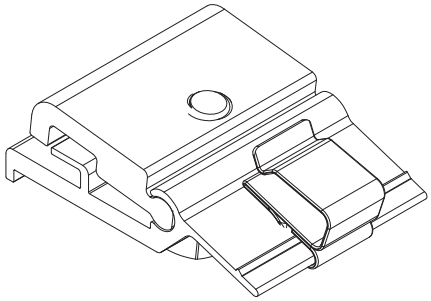
1. (1) SnapNrack MLPE Frame Attachment Top
2. (1) SnapNrack MLPE Frame Attachment Bottom
3. (1) 5/16"-18 X 3/4" SS Flange Bolt
4. (1) SnapNrack Smart Clip II
5. (1) SnapNrack MLPE Frame Attachment SS Coil Spring



Other Materials Required

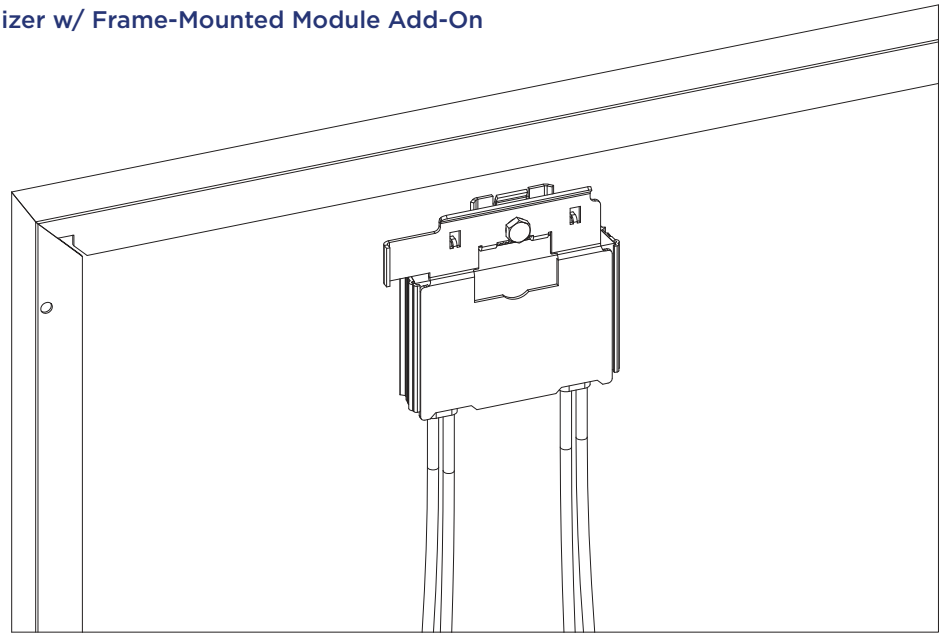
① (1) MLPE Unit





Materials Needed – SolarEdge Frame Mount

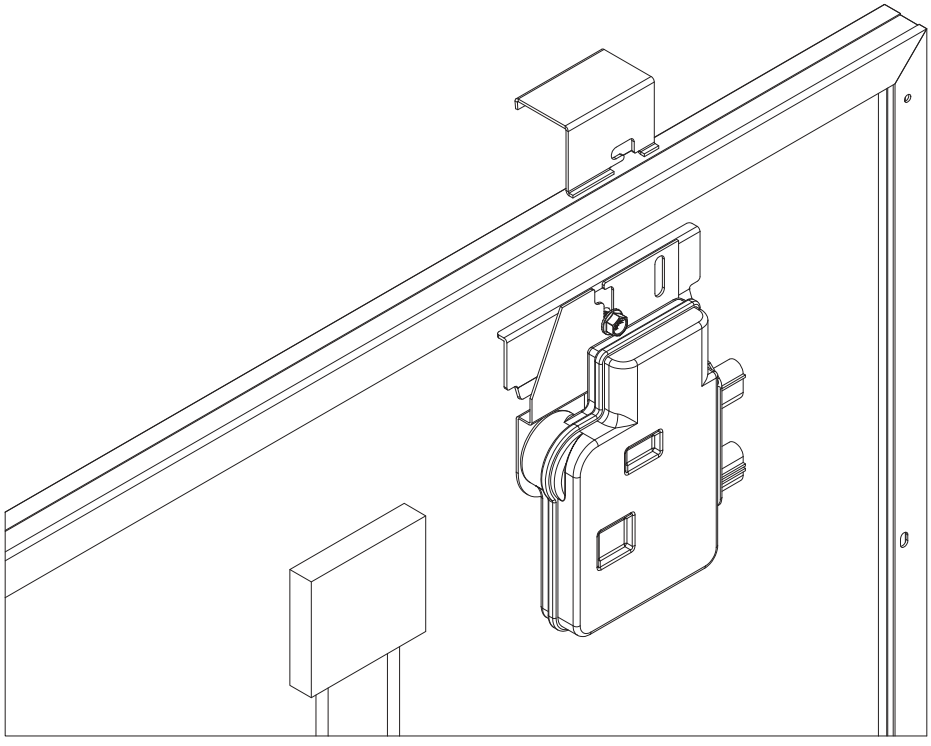
① (1) SolarEdge Optimizer w/ Frame-Mounted Module Add-On



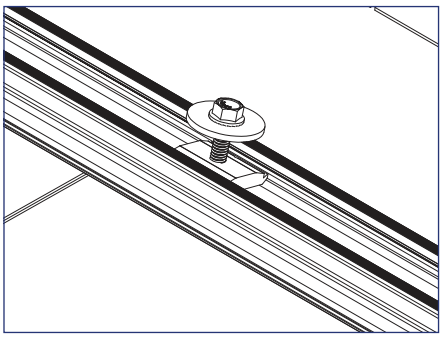
Materials Needed – Enphase Frame Mount

① (1) Enphase Microinverter

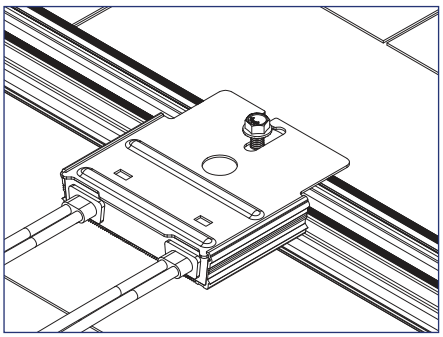
② (1) Enphase Frame Mount



INSTALLATION INSTRUCTIONS - MLPE RAIL ATTACHMENT



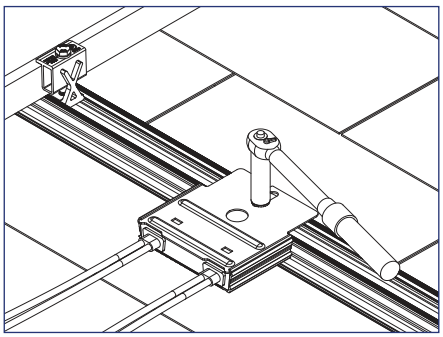
1) Snap the SnapNrack MLPE Rail Attachment Kit channel nut into the desired location on the rail where the microinverter will be installed.



2) Install the microinverter mounting plate onto the bolt of the MLPE Rail Attachment Kit, ensuring that the large fender washer is between the rail and mounting plate.

Install Note:

Bolt and washers may need to be removed and then replaced.

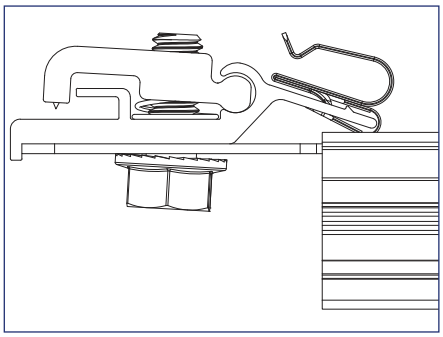


3) Tighten hardware to 10 ft-lbs.

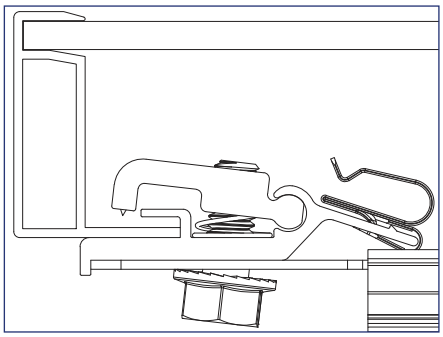
Install Note:

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

INSTALLATION INSTRUCTIONS - MLPE FRAME ATTACHMENT



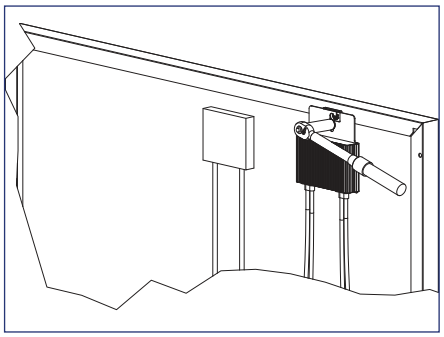
1) Slide the backplate channel of the MLPE device under the MLPE Frame Attachment Kit bolt. The MLPE mounting plate should rest against the MLPE mounting plate backstop on the MLPE Frame Attachment Kit.



2) Position the MLPE Frame Attachment Kit on the module frame flange in a location that will not interfere with mounting system components. The module frame flange should rest against the module flange backstop on the MLPE Frame Attachment Kit.

Install Note:

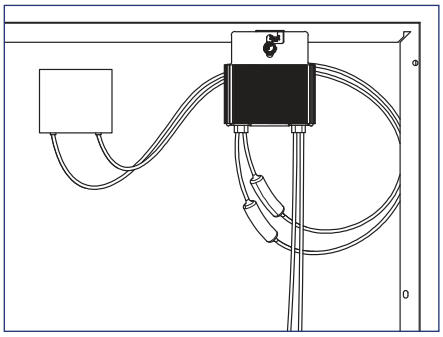
Avoid blocking module frame drainage holes when installing the MLPE Frame Attachment Kit.



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

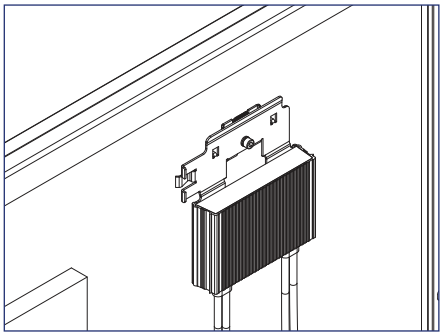
Install Note:

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

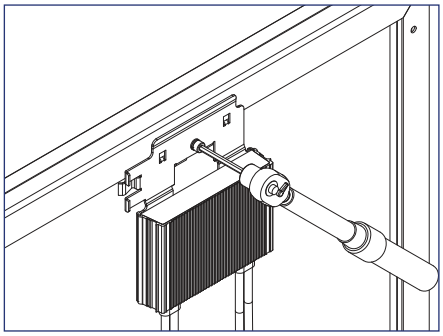


4) Connect the module leads to the input con-nectors on the MLPE device and manage con-ductors with the integrated Smart Clip.

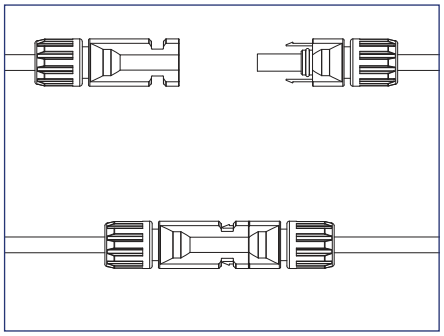
INSTALLATION INSTRUCTIONS - SOLAREDGE FRAME MOUNT



1) Locate the SolarEdge optimizer with Frame-Mounted Module Add-On at a location on the module frame that will not interfere with the SnapNrack rail.



2) Install the optimizer mounting plate onto the module frame and tighten hardware to 7 ft-lbs.

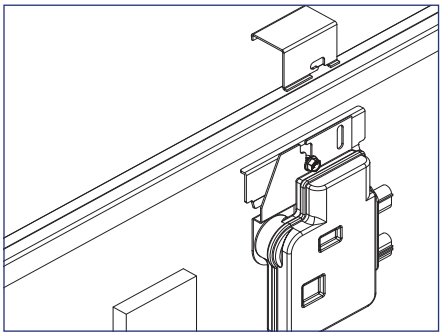


3) Connect the module leads to the input connectors on the optimizer.

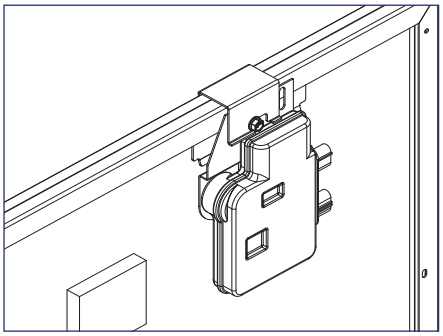
Install Note:

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

INSTALLATION INSTRUCTIONS - ENPHASE FRAME MOUNT



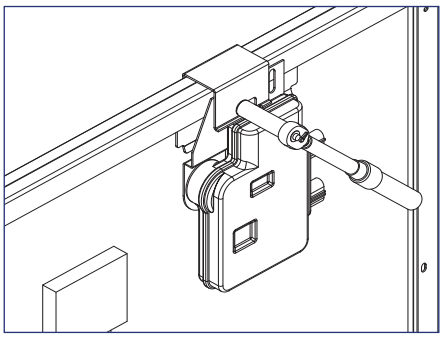
1) Locate the Enphase Frame Mount bracket clamp at a location on the module frame that will not interfere with the SnapNrack rail.



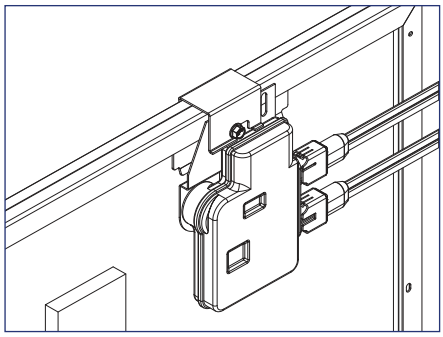
2) Slide the microinverter unit onto the bracket clamp, then move it slightly to the left.

Install Note:

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



3) Tighten hardware to 13 ft-lbs



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

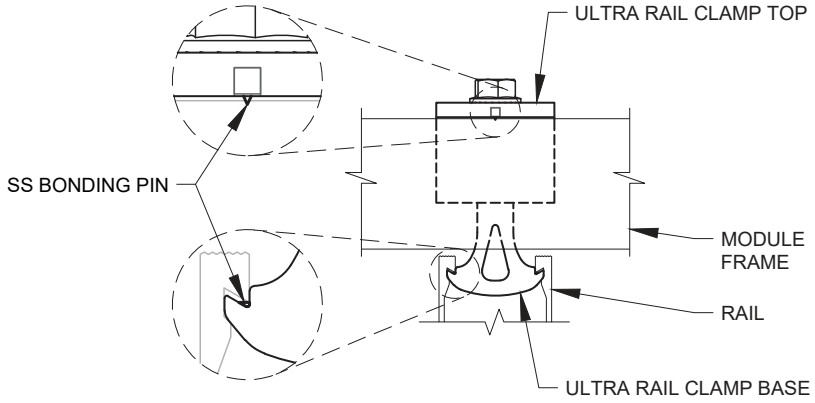
Install Note:

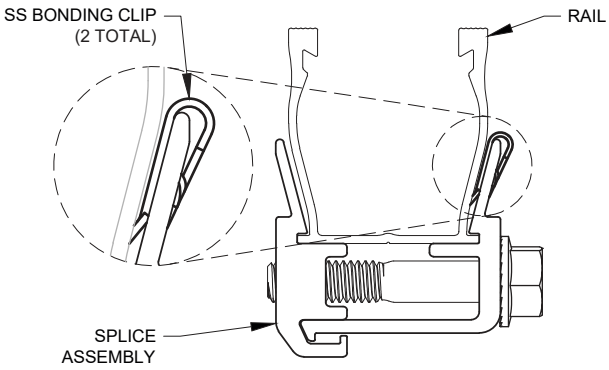
Refer to the Enphase Frame Mount installation guide for additional instructions.

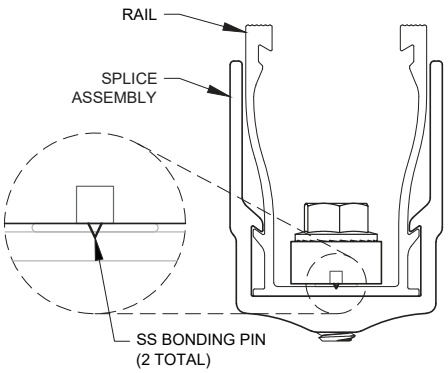
Grounding Specifications

System Bonding Methods

1. SnapNrack Ultra Rail Mid Clamp
2. SnapNrack Ultra Rail End Clamp
3. SnapNrack Mid Clamp
4. SnapNrack Adjustable End Clamp
5. SnapNrack UR-40 Rail Splice
6. SnapNrack UR-60 Rail Splice







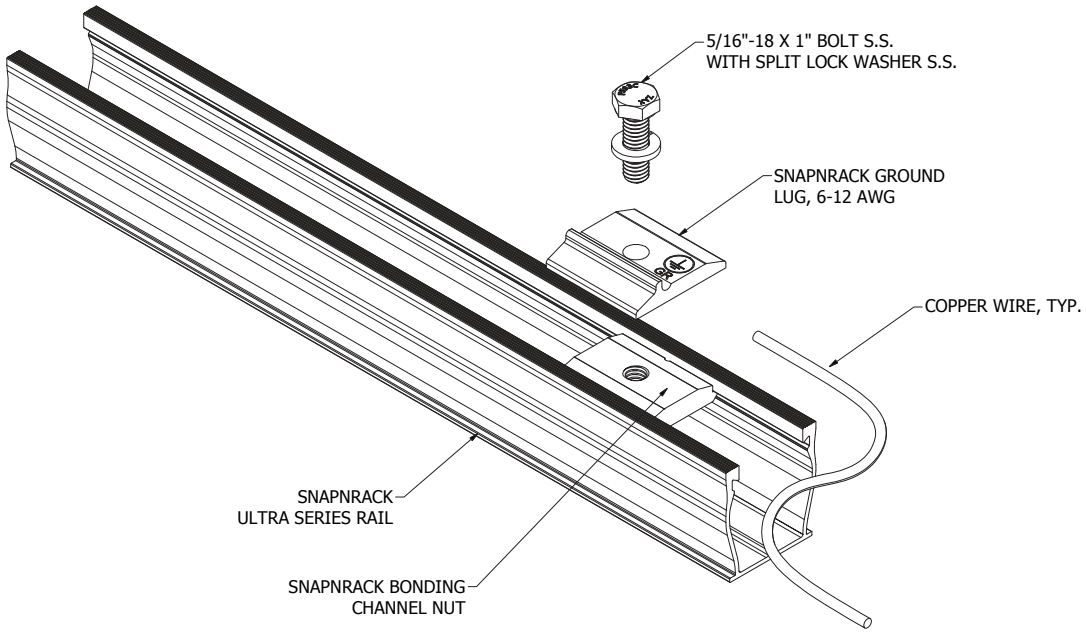
Note:

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

Note:

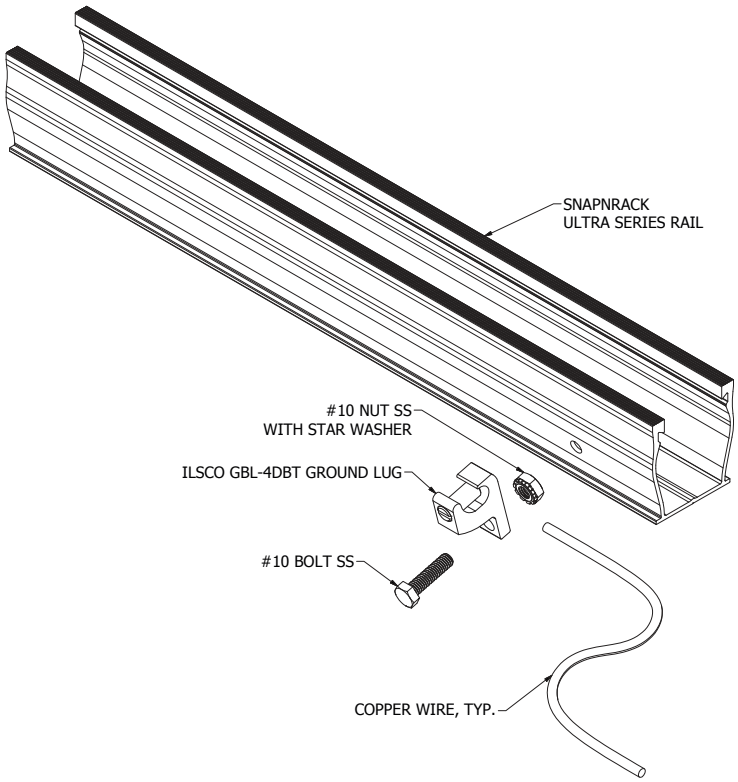
SnapNrack Ultra Rail Splices contain integral bonding clips in assembly to properly bond the system.

SnapNrack Ground Lug Assembly

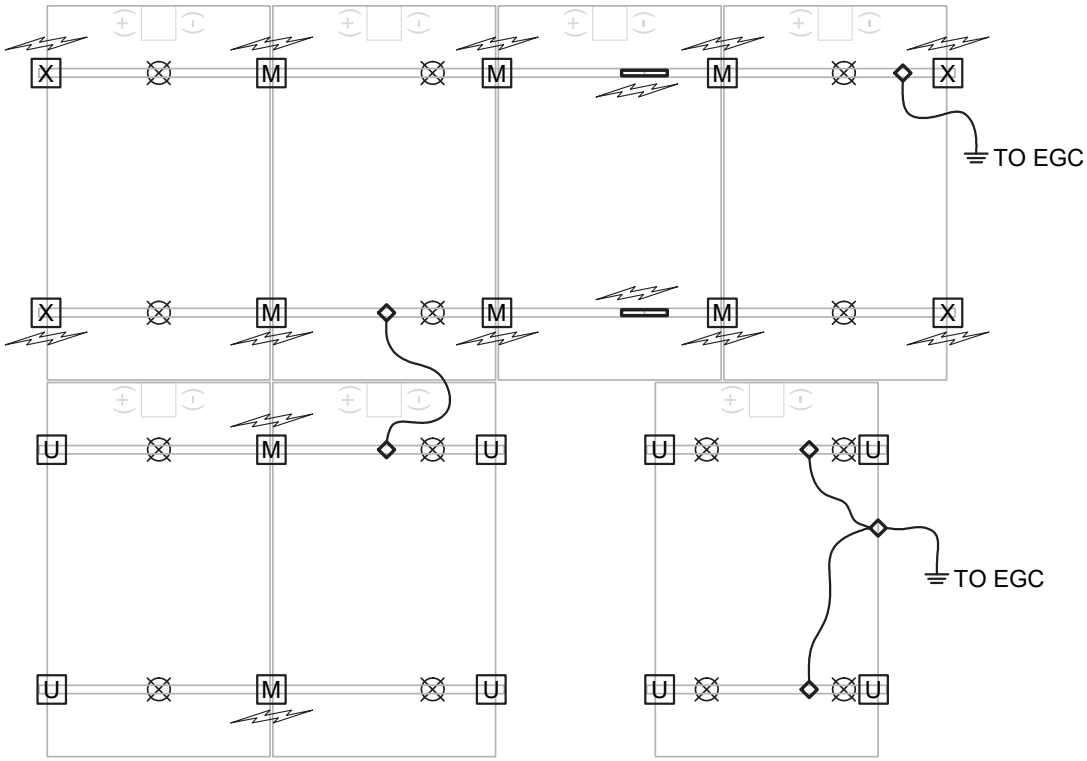


Grounding Specifications

Ilsco Lay-in Lug Assembly



Ground Path Details



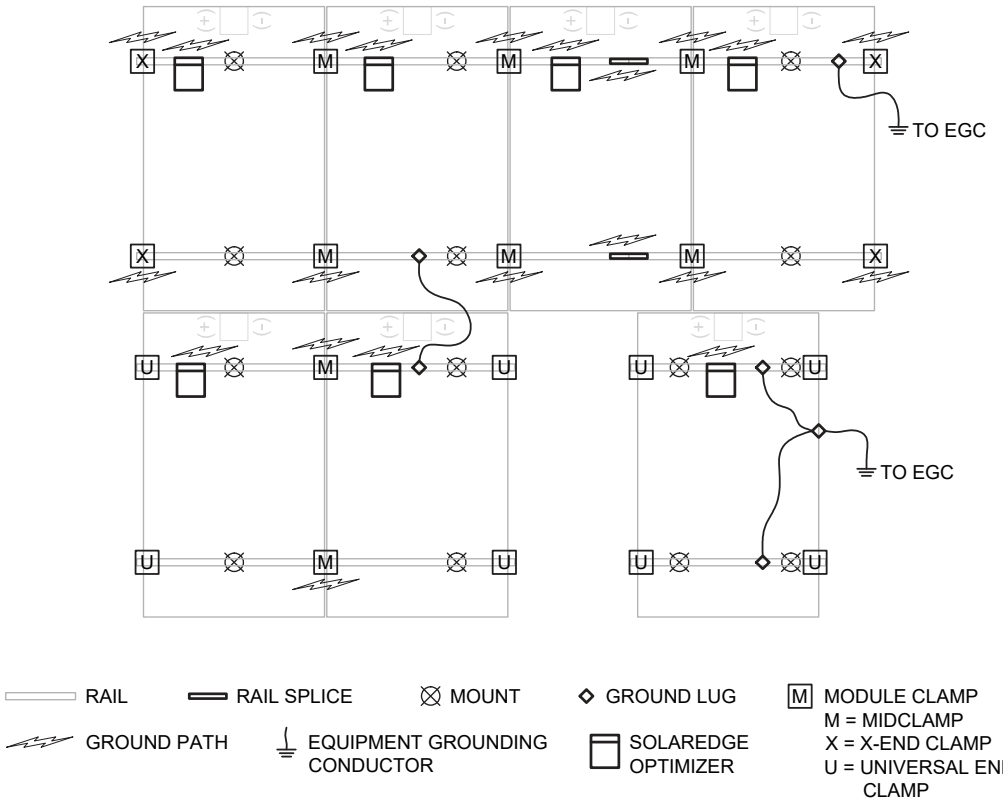
RAIL — RAIL SPLICE — MOUNT — GROUND LUG — M MODULE CLAMP

GROUND PATH — EQUIPMENT GROUNDING CONDUCTOR

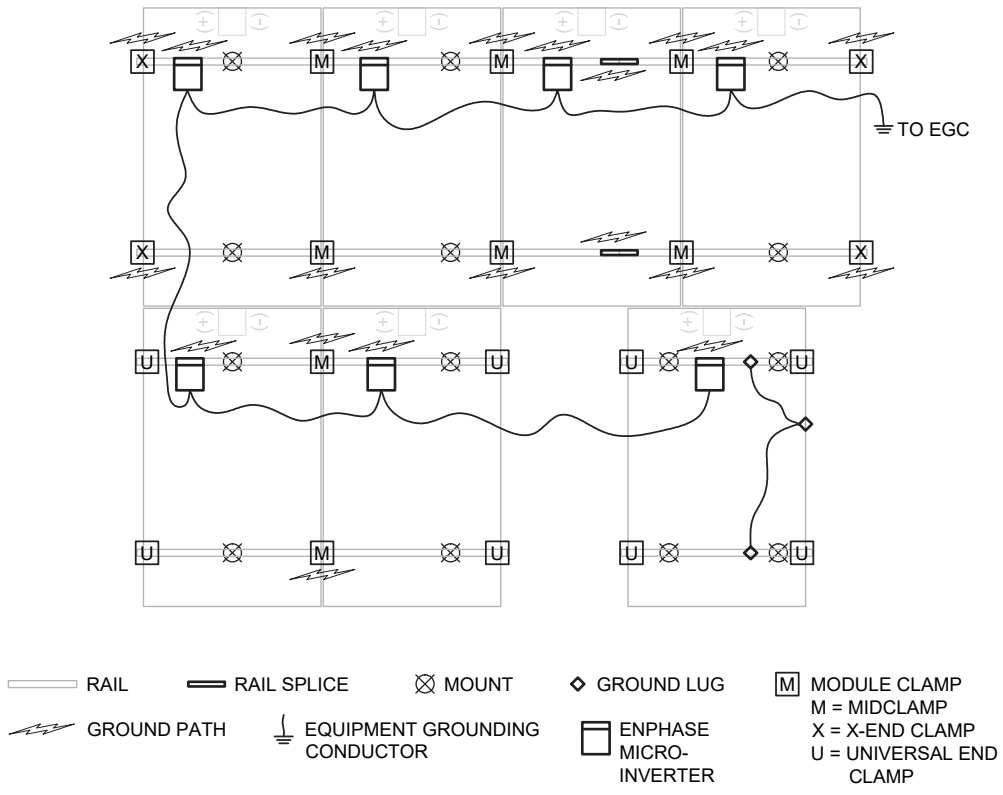
M = MIDCLAMP
X = X-END CLAMP
U = UNIVERSAL END CLAMP

Grounding Specifications

Ground Path Details - SolarEdge



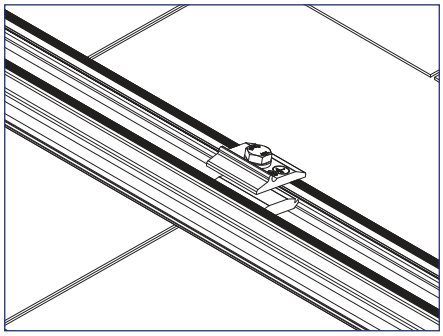
Ground Path Details - Enphase



Grounding Specifications

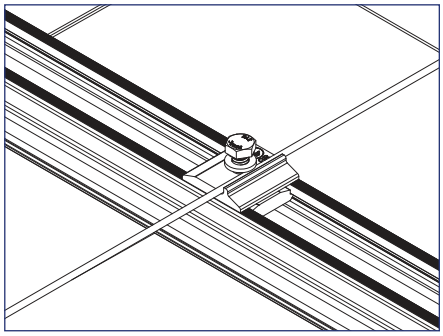
snapnrack.com

INSTALLATION INSTRUCTIONS - SNAPNRACK GROUND LUG



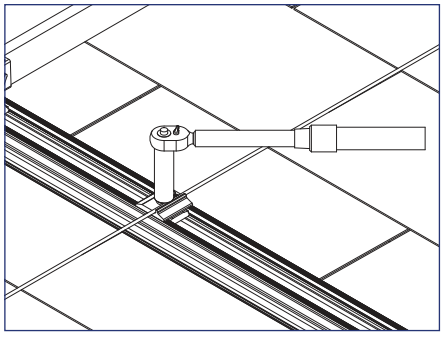
1) Snap the SnapNrack Ground Lug into the rail channel on **one rail per module row.**

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



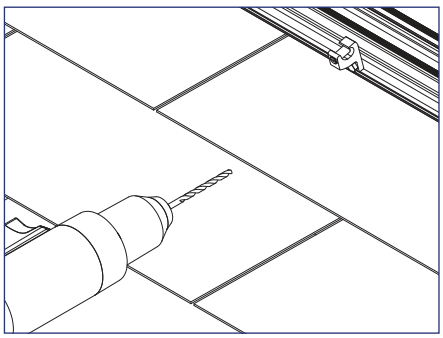
2) Place grounding conductor into slot underneath split ring washer.

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



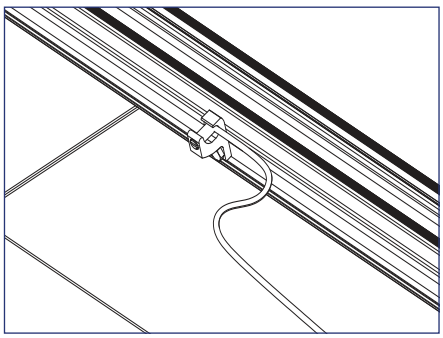
3) Tighten hardware to 16 ft-lbs.

INSTALLATION INSTRUCTIONS - ILSCO LAY-IN LUG

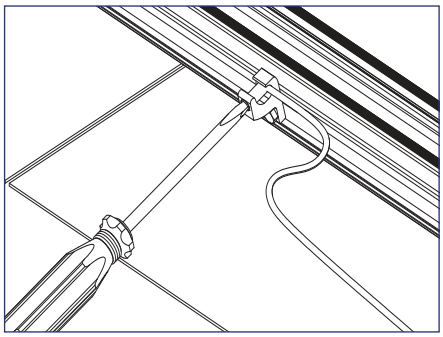


1) Drill and deburr a 1/4" hole in the back side of the rail for the Ilsco lug to attach to, place the bolt through the hole, and attach the lug assembly on **one rail per module row.**

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



2) Place grounding conductor into slot.



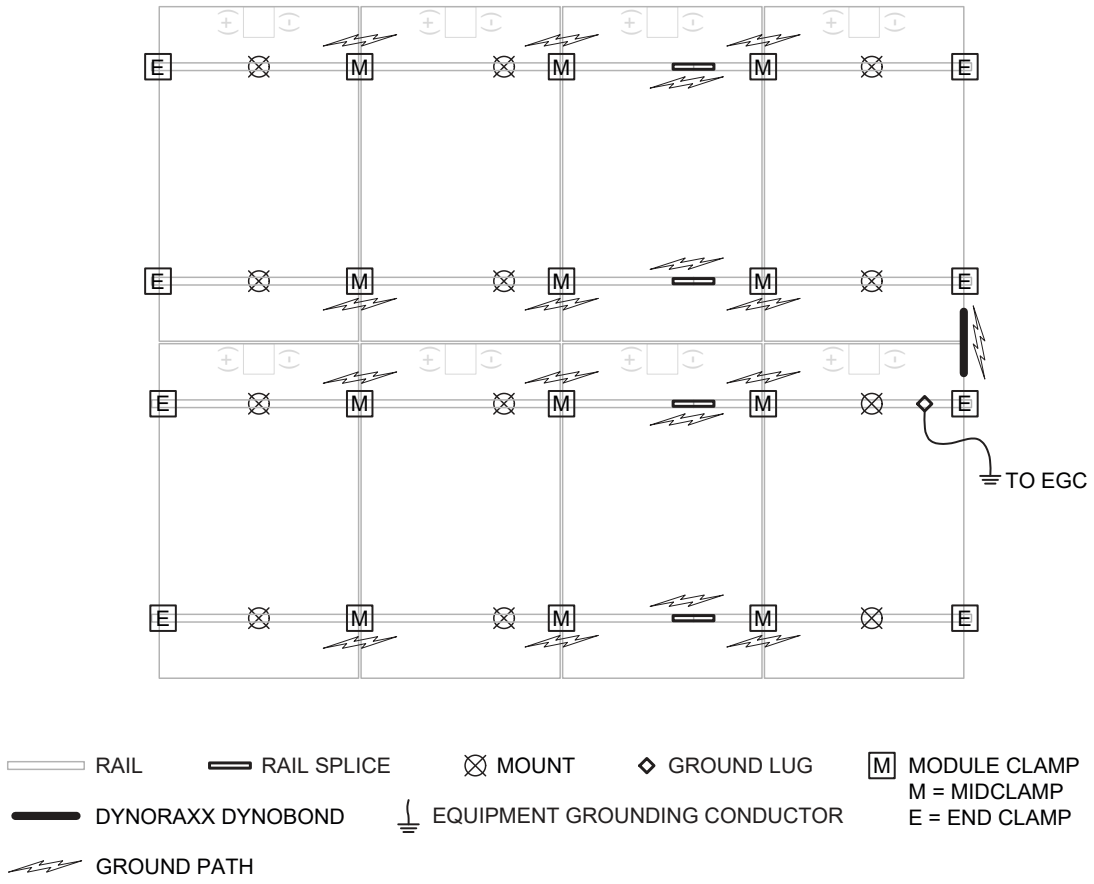
3) Tighten set screw per Ilsco's recommendation (see below).

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

Note:

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

Ground Path Details - DynoBond



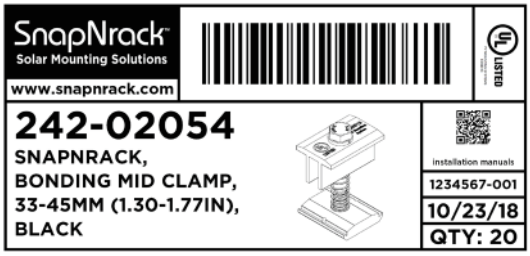
R/C (QIMS2), DynoRaxx (E357716) photovoltaic bonding jumper cat. no. DynoBond is an optional component that may be used with this system. The DynoBond jumper has been evaluated to provide module to module bonding. The DynoBond device attaches to the frame flange of adjacent modules.

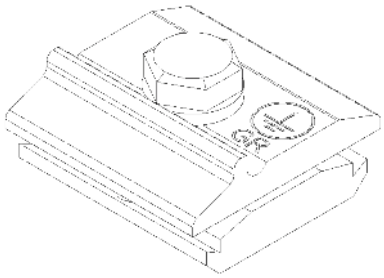
Grounding Specifications

GROUNDING MARKING DETAILS

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

The SnapNrack Ground Lug is marked with the ground symbol
Ilsco Ground Lugs have green colored set screws or bolts to indicate connection to the grounding electrode conductor





INSTRUCTION FOR MAINTAINING THE GROUNDING BONDING WHEN REMOVING A MODULE FOR SERVICING

CAUTION: Module removal may disrupt the bonding path and could introduce the risk of electric shock. Additional steps may be required to maintain the bonding path. Modules should only be removed by qualified persons in compliance with the instructions in this manual.

Module removal is not presented as a frequently expected occurrence and will not be required as part of routine maintenance.

Scenarios that could result in a disruption of the bonding path are, for example irregularly-shaped arrays, arrays consisting of individual rows, and any other scenario where module removal could disrupt the bonding path.

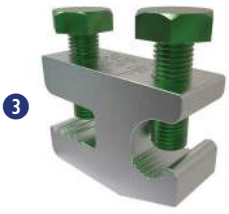
In most cases, the removal of a module for servicing will not disturb or break grounding continuity because SnapNrack Ultra Rail systems are bonded through the rail. If a module is to be removed that will break continuity, these are the steps that must be taken to maintain a continuously bonded SnapNrack Ultra Rail system.

Required Tools

- Socket Wrench
- Torque Wrench
- 1/2" Socket
- 7/16" Socket

Required Materials

1. #10 Or Larger Bare Copper Conductor
2. SnapNrack SKU 242-02101
3. Ilsco Part No. SGB-4
4. DnoRaxx Dynobond™

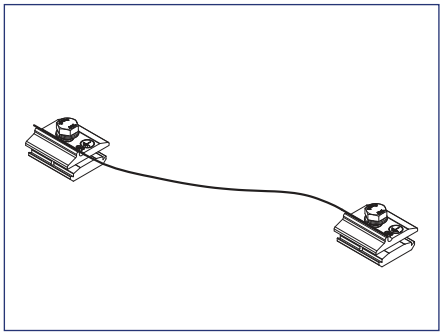


Maintaining the Grounding Bonding When Removing a Module

JUMPER ASSEMBLY INSTRUCTION & INSTALLATION

CAUTION: Do Not Remove the Module until the Jumper is installed

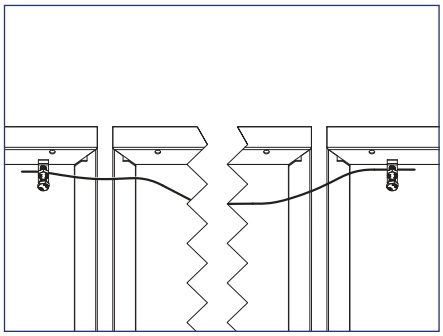
1) Identify the existing ground path at the location of module removal and choose an appropriate length of #10 bare copper to bridge the soon to be broken ground path.



Example of assembled bonding jumper using (2) SnapNrack Ground Lugs

2) Attach one ground lug to each end of #10 bare copper wire. See recommended options below:

1. (2) SnapNrack SKU: 242-02101
2. (2) Ilsco part no. SGB-4
3. (1) SnapNrack part no. 242-02101 & (1) Ilsco part no. SGB-4
4. (1) DroRaxx DynoBond™



3) Before the module is removed, attach the assembled bonding jumper. Depending on where the module will be removed and choice of ground lug, jumper attachment locations will vary.

- Ilsco SGB-4 lugs can be attached to SnapNrack Ultra Rail, or module frames
- SnapNrack Ground Lug can only be attached to SnapNrack Ulra Rail
- DynoRaxx DynoBond™ is approved and appropriate when a short bonding jumper is needed from module to module, or module to rail

4) Service the array. With the bonding jumper installed, it is now safe to remove the module for service or maintenance.

5) After Servicing the array reinstall the module and original ground path. Only then remove the bonding jumper.

Caution: Do not remove the bonding jumper until original ground path is established.

Grounding Specifications

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.

Ultra Rail has been tested with the following UL Listed module series: 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 module series listed below. All wattage values are covered.

Manufacturer	Model	
Aptos Solar	DNA-120-MF23-XXX	DNA-120-MF26-XXXW
	DNA-120-BF23-XXX	DNA-144-MF26-XXXW
	DNA-144-MF23-XXX	DNA-120-BF26-XXXW
	DNA-144-BF23-XXX	DNA-144-BF26-XXXW
Boviet Solar	BVM6610P-XXX	BVM6612P-XXX
	BVM6610M-XXX	BVM6612M-XXX
Canadian Solar	CS6K-XXX-M	CS3K-XXX-P
	CS6K-XXX-M-SD	CS3K-XXX-MS
	CS6K-XXX-P	CS3U-XXX-MS
	CS6K-XXX-P-SD	CS3U-XXX-P
	CS6K-XXX-MS	CS1K-XXX-MS
	CS6P-XXX-M	CS1H-XXX-MS
	CS6P-XXX-P	CS1H-XXX-MS-AB
	CS6P-XXX-P-SD	CS3W-XXX-P
	CS6V-XXX-M	CS3N-XXX-MS
	CS6V-XXX-P	CS1Y-XXX-MS
	CS6X-XXX-P	
CertainTeed	CTXXXHC11-06	
Chint Solar	CHSM6612M-XXX	CHSM72M-HC-XXX* (Astro 4)
	CHSM6612M(BL)-XXX	CHSM72M-HC-XXX* (Astro 5)
	CHSM6612M/HV-XXX	
Dehui Solar	DH-M760B-XXXW	DH-M760F-XXXW*
	DH-M760W-XXXW	DH-M772F-XXXW*
	DH-M772W-XXXW	
ET Solar	ET-P660XXXBB	P660XXXWB/WW
	ET-P660XXXWB	P660XXXWWG
	ET-P660XXXWW	M660XXXBB
	ET-P660XXXWWG	M660XXXWW
Hanwha Q Cells	Q.PEAK BLK-G3.1-XXX	Q.PEAK BLK-G4.1-XXX
	Q.PEAK G3.1-XXX	Q.PEAK BLK-G4.1/TAA-XXX
	Q.PLUS BFR-G3.1-XXX	Q.PEAK G4-XXX
	B.LINE PLUS BFR-G4.1-XXX	Q.PEAK G4.1-XXX
	B.LINE PRO BFR-G4.1-XXX	Q.PEAK G4.1/MAX-XXX
	Q.BASE GY-XXX	Q.PEAK G4.1/TAA-XXX
	Q.PEAK BFR-G4-XXX	Q.PLUS BFR-G4-XXX
	Q.PEAK BFR-G4.1-XXX	Q.PLUS BFR-G4.1-XXX

Grounding Specifications

Manufacturer	Model	
Hanwha Q Cells	Q.PLUS BFR-G4.1/TAA-XXX	Q.PEAK DUO-L-G7.3-XXX
	Q.PLUS G4-XXX	Q.PEAK DUO-L-G6-XXX
	Q.PLUS GY-XXX	Q.PEAK DUO-L-G6.2-XXX
	Q.PLUS BFR-GY-XXX	Q.PEAK DUO-L-G6.3-XXX
	Q.PRO BFR-G4-XXX	Q.PEAK DUO-L-G8-XXX
	Q.PRO BFR-G4.1-XXX	Q.PEAK DUO-L-G8.1-XXX
	Q.PRO BFR-G4.3-XXX	Q.PEAK DUO-L-G8.2-XXX
	Q.PRO BFR-GY-XXX	Q.PEAK DUO-L-G8.3-XXX
	Q.PRO BLK-GY-XXX	Q.PEAK DUO-G5/SC-XXX
	Q.PRO G4-XXX	Q.PEAK DUO-BLK-G5/SC-XXX
	Q.PRO GY-XXX	Q.PEAK DUO-G6+/SC-XXX
	Q.PRO GY/SC-XXX	Q.PEAK DUO-BLK-G6+/SC-XXX
	Q.PEAK DUO-G5-XXX	Q.PEAK DUO BLK-G6+/AC-XXX
	Q.PEAK DUO-BLK-G5-XXX	Q.PEAK DUO-ML-G9-XXX
	Q.PLUS DUO-G5-XXX	Q.PEAK DUO-BLK-ML-G9-XXX
	Q.PEAK DUO-G7-XXX	Q.PEAK DUO-G5/TS-XXX
	Q.PEAK DUO-BLK-G7-XXX	Q.PEAK DUO BLK-G5/TS-XXX
	Q.PEAK DUO-G7.2-XXX	Q.PEAK DUO-G6/TS-XXX
	Q.PEAK DUO-G6+-XXX	Q.PEAK DUO BLK-G6/TS-XXX
	Q.PEAK DUO-BLK-G6+-XXX	Q.PEAK DUO-G6+/TS-XXX
	Q.PEAK DUO-G6-XXX	Q.PEAK DUO BLK-G6+/TS-XXX
	Q.PEAK DUO-BLK-G6-XXX	Q.PEAK DUO XL-G9.2-XXX
	Q.PEAK DUO-G8+-XXX	Q.PEAK DUO XL-G9.3-XXX
	Q.PEAK DUO-BLK-G8+-XXX	Q.PEAK DUO XL-G9.3/BFG-XXX*
	Q.PEAK DUO-G8-XXX	Q.PEAK DUO XL-G10.2-XXX
	Q.PEAK DUO-BLK-G8-XXX	Q.PEAK DUO XL-G10.3/BFG-XXX*
	Q.PLUS L-G4-XXX	Q.PEAK DUO XL-G10.3-XXX
	Q.PLUS L-G4.1-XXX	Q.PEAK DUO XL-G10.c-XXX
	Q.PLUS L-G4.2-XXX	Q.PEAK DUO XL-G10.d-XXX
	Q.PEAK L-G4.1-XXX	Q.PEAK DUO L-G8.3/BFG-XXX*
	Q.PEAK L-G4.2-XXX	Q.PEAK DUO L-G8.3/BGT-XXX*
	Q.PLUS DUO-L-G5-XXX	Q.PEAK DUO ML-G10-XXX
	Q.PLUS DUO-L-G5.1-XXX	Q.PEAK DUO BLK ML-G10+-XXX
	Q.PLUS DUO-L-G5.2-XXX	Q.PEAK DUO ML-G10+-XXX
	Q.PLUS DUO-L-G5.3-XXX	Q.PEAK DUO BLK ML-G10-XXX
	Q.PEAK DUO-L-G5.2-XXX	Q.PEAK DUO ML-G10.a+-XXX
	Q.PEAK DUO-L-G5.3-XXX	Q.PEAK DUO BLK ML-G10.a+-XXX
	Q.PEAK DUO-L-G7-XXX	Q.PEAK DUO ML-G10.a-XXX
	Q.PEAK DUO-L-G7.1-XXX	Q.PEAK DUO BLK ML-G10.a-XXX
	Q.PEAK DUO-L-G7.2-XXX	
Hanwha SolarOne	HSL60P6-PB-2-XXXQ	HSL60P6-PB-4-XXXQ
Heliene	60M-XXX	72M-XXX
	60P-XXX	72P-XXX

Grounding Specifications

Manufacturer	Model	
Hyundai	HiS-MXXXRG	HiD-SXXXRG
	HiS-SXXXRG	HiA-SXXXMS
	HiS-SXXXRW	HiS-SXXXXY
	HiS-MXXXMG	HiS-SXXXYI
	HiS-SXXXMG	
JA Solar	JAM6-60-XXX/SI	JAM72S09-XXX/PR
	JAP6-60-XXX/3BB	JAM72S10-XXX/MR
	JAM60S09-XXX/PR	JAM72S10-XXX/PR
	JAM60S10-XXX/MR	JAM72S12-XXX/PR
	JAM60S10-XXX/PR	JAP6(k)-72-XXX/4BB
	JAM60S12-XXX/PR	JAM60S17-XXX/MR
	JAP72S01-XXX/SC	
Jinko Solar	JKMXXXM-60	JKMXXXP-72
	JKMXXXM-60L	JKMXXXP-72-V
	JKMXXXM-60HL	JKMXXXPP-72
	JKMXXXM-60HBL	JKMXXXPP-72-V
	JKMXXXP-60	JKMSXXXP-72
	JKMXXXP-60-J4	JKMXXXM-72HL-V
	JKMXXXP-60-V	JKMXXXM-72HL-TV
	JKMXXXP-60B-J4	JKMXXXM-72HBL
	JKMXXXPP-60	JKMXXXM-6TL3-B
	JKMXXXPP-60-V	JKMXXXM-6RL3-B
	JKMXXXM-72	JKMXXXM-7RL3-V
	JKMXXXM-72L-V	JKMXXXM-7RL3-TV
Kyocera	KUXXX-6YYY	KUXXX-8YYY
LG	LGXXXN1C-A5	LGXXXA1C-V5
	LGXXXN1K-A5	LGXXXM1C-L5
	LGXXXQ1C-A5	LGXXXM1K-L5
	LGXXXQ1K-A5	LGXXXN1C-N5
	LGXXXS1C-A5	LGXXXN1K-L5
	LGXXXN2C-B3	LGXXXN1K-A6
	LGXXXN2W-B3	LGXXXN1C-A6
	LGXXXN1C-G4	LGXXXN1W-A6
	LGXXXN1K-G4	LGXXXQ1C-A6
	LGXXXS1C-G4	LGXXXQ1K-A6
	LGXXXN2C-G4	LGXXXM1K-A6
	LGXXXN2K-G4	LGXXXM1C-A6
	LGXXXN2W-G4	LGXXXA1C-A6
	LGXXXS2C-G4	LGXXXQAC-A6
	LGXXXS2W-G4	LGXXXQAK-A6

Grounding Specifications

Manufacturer	Model	
LG	LGXXXN1C-V5	LGXXXN1K-B6
	LGXXXN1W-V5	LGXXXN2W-E6
	LGXXXN2T-V5	LGXXXN2T-E6
	LGXXXN2T-J5	LGXXXN1K-E6
	LGXXXN1T-V5	
Longi	LR6-60-XXXM	LR4-60HPB-XXXM
	LR6-60BK-XXXM	LR4-60HIB-XXXM
	LR6-60HV-XXXM	LR4-60HPH-XXXM
	LR6-60PB-XXXM	LR4-60HIH-XXXM
	LR6-60PE-XXXM	LR6-60HIH-XXXM
	LR6-60PH-XXXM	LR6-60HIB-XXXM
	LR6-60HPB-XXXM	LR4-72HPH-XXXM
	LR6-60HPH-XXXM	
Mission Solar	MSEXXXSO5T	MSEXXXSQ4S
	MSEXXXSO5K	MSEXXXSR8K
	MSEXXXSQ5T	MSEXXXSR8T
	MSEXXXSQ5K	MSEXXXSR9S
	MSEXXXMM4J	MSE60AXXX
	MSEXXXMM6J	MSEXXXTS60
	MSEXXXSO6W	MSEXXXSX5K
	MSEXXXSO4J	MSEXXXSX5T
	MSEXXXSO6J	MSEXXXSX6S
	MSEXXXSQ6S	MSEXXXSX6W
Next Energy Alliance	USNEA-XXXM3-60	USNEA-XXXM3-72
	USNEA-XXXM3B-60	USNEA-XXXM3B-72
Panasonic	VBHNXXXKA01	VBHNXXXSA18
	VBHNXXXKA02	VBHN325SA17E
	VBHNXXXSA16	VBHXXXRA18N
	VBHNXXXKA03	VBHXXXRA03K
	VBHNXXXKA04	EVPVXXX(K)
	VBHNXXXSA17	
Phono Solar	PSXXXM-20/U	PSXXXMH-20/U
REC	RECXXXPE	RECXXXPE72XV
	RECXXXPE-BLK	RECXXXTP2M 72
	RECXXXTP	RECXXXTP2M 72 BLK
	RECXXXTP-BLK	RECXXXTP2M 72 BLK2
	RECXXXTP IQ	RECXXXTP2SM 72
	RECXXXTP2	RECXXXTP2SM 72 BLK
	RECXXXTP2-BLK	RECXXXTP2SM 72 BLK2
	RECXXXNP	RECXXXAA
	RECXXXTP2M	RECXXXTP3M
	RECXXXTP72	RECXXXNP2
	RECXXXPE72	

Grounding Specifications

Manufacturer	Model	
Renesola	JCXXXM-24/Bb	JCXXXM-24/BBh
Silfab	SLAXXX-M	SSGXXX-M
	SLAXXX-P	SSGXXX-P
	SSAXXX-M	SILXXXNT
	SSAXXX-P	SILXXXHL
	SILXXXBL	SILXXXBK
	SILXXXML	SILXXXHC
	SILXXXNL	SILXXXNU
	SLGXXX-M	SILXXXNX
	SLGXXX-P	
Solaria	Solaria PowerXT-XXXR-PX	Solaria PowerXT-XXXR-PM
	Solaria PowerXT-XXXR-BX	Solaria PowerXT-XXXR-PM-AC
	Solaria PowerXT-XXXR-AC	
SolarWorld	SWXXX-Mono	SWXXX-Mono XL
Suniva	MVX-XXX-60-5-701	OPT-XXX-60-4-1B0
	MVX-XXX-60-5-7B1	OPT-XXX-60-4-800
	OPT-XXX-60-4-100	OPT-XXX-60-4-8B0
Sunpower	SPR-EYY-XXX	SPR-XYY-XXX
	SPR-XYY-XXX	SPR-P17-XXX-COM
	SPR-EYY-XXX	SPR-P19-XXX-COM
SunSpark	SST-XXXM3-60	SST-XXXM3-72
	SST-XXXM3B-60	SST-XXXM3B-72
Talesun	TP660M-XXX	TP672M-XXX
	TP660P-XXX	TP672P-XXX
Tesla	TXXXS	TXXXH
Trina	TSM-XXXDD05(II)	TSM-XXXPD05.05S
	TSM-XXXDD05A.05(II)	TSM-XXXPD05.08
	TSM-XXXDD05A.08(II)	TSM-XXXPD05.082
	TSM-XXXDD05A.082(II)	TSM-XXXPD05.08D
	TSM-XXXPA05	TSM-XXXPD05.08S
	TSM-XXXPA05.05	TSM-XXXDD06M.05(II)
	TSM-XXXPA05.08	TSM-XXXDE15H(II)
	TSM-XXXPD05	TSM-XXXDE15M(II)
	TSM-XXXPD05.002	TSMXXXDD05H.05(II)
	TSM-XXXPD05.05	TSMXXXDE06X.05(II)
Yingli	YLXXXA-29b	YLXXXP-29b
ZNShine	ZM6-60-XXX/M	ZXM6-NH144-XXXM
	ZXM6-NH120-XXXM	

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

The UR-40 and UR-60 mounting systems have been tested with the following UL/NRTL Listed Module Level Power Electronic (MLPE) Devices. The back plates of the MLPEs have been evaluated for bonding to UR-40 and UR-60 rail through the MLPE Attachment Kit.

AP Smart	RSD-S-PLC	
Celestica International	DG-006-F001201x	DG-006-F001401x
Delta Electronics	GPI00010105	
Enphase	C250	IQ7-60-2-US
	M215	IQ7-60-B-US
	M250	IQ7PLUS-72-2-US
	IQ6-60-2-US	IQ7PLUS-72-B-US
	IQ6PLUS-72-2-US	
Ginlong Technologies	Solis-RSD-1G	Solis-MLRSD-R2-1G
	Solis-MLRSD-R1-1G	
SolarEdge	P300-5NC4ARS	P405
	P320-5NC4ARS	P485
	P370-5NC4AFS	P505
	P400-5NC4AFS	P730
	P320	P800p
	P340	P850
	P370	P860
	P400	P950
	P401	
SMA	RSB-2S-US-10	
Tigo	TS4-R-F	TS4-R-S-DUO
	TS4-R-M	TS4-A-F
	TS4-R-O	TS4-A-2F
	TS4-R-S	TS4-A-O
	TS4-R-M-DUO	TS4-A-S
	TS4-R-O-DUO	
Vikram	SOMERA VSMHBB.60.XXX.05	

Notes:

AP Smart RSD-S-PLC, Ginlong Solis-MLRSD-R1-1G and Solis-MLRSD-R2-1G, and all Tigo models have not been investigated for bonding since the enclosures are constructed entirely of polymeric materials.
The SolarEdge P320 and P370 models are both frame mount and rail mount. All other PXXX series models are rail mount.

Mechanical Loading Specifications

Functionality of these devices was not evaluated.

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

UR-40 Rail, UR-60 Rail, UR-40/UR-60, Ultra Rail Mid Clamp, Ultra Rail End Clamp, Mid Clamp, X End Clamp, Universal End Clamp, UR-40 and UR-60 Splice, SpeedSeal™ Foot for UR40/UR60, UR-40/UR-60 Composition Mount Kits, Standard Standoff for UR-40/UR-60, Four Hole Standoff for UR-40/UR-60, Heavy Duty Standoff for UR-40/UR-60, Metal Roof Base Standoff for UR-40/UR-60, UR-40/UR-60 Corrugated Block, Standard Base Seam Clamp for UR-40/UR-60, Wide Base Seam Clamp for UR-40/UR-60, UR-40/UR-60 Universal Tile Hook, UR-40/UR-60 Flat Tile Hook, Flat Tile Replacement Kit for UR-40/UR-60, S Tile Replacement Kit for UR-40/UR-60, W Tile Replacement Kit for UR-40/UR-60, UR-40/UR-60 Tile Hook F, UR-40/UR-60 Tile Hook WS, UR-40/UR-60 Hanger Bolt Clamp, UR-40/UR-60 Tilt Kits.

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

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

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

Span	Orientation	Direction	Load Rating (lb/ft²)
4 or 6 feet	Long Side or Short Side Mounting	Downforce	10
		Uplift	5
		Down-Slope	5

UR-40 and UR-60 have been evaluated for Mechanical Loading with all UL/NRTL Listed Photovoltaic modules listed in this manual for the minimum mechanical load ratings per UL 2703.

OVERVIEW OF THE SNAPNRACK ULTRA RAIL SYSTEM INSTALLED ON A TYPICAL ROOF

REFER TO SPECIFIC "ATTACHMENT DETAIL" FOR DETAILS ON ATTACHING AND WATERPROOFING THE VARIOUS SNAPNRACK ROOF ATTACHMENT PRODUCTS

REFER TO SPECIFIC "COMPONENT DETAIL" FOR DETAILS ON VARIOUS SNAPNRACK ACCESSARY AND COMPONENT PRODUCTS

BOTH THE SNAPNRACK, UNIVERSAL END CLAMP AND SNAPNRACK, ULTRA RAIL END CLAMP CAN BE USED ON END MODULES

MODULES MAY BE CLAMPED ON SHORT OR LONG SIDE PER MODULE MANUFACTURER REQUIREMENTS

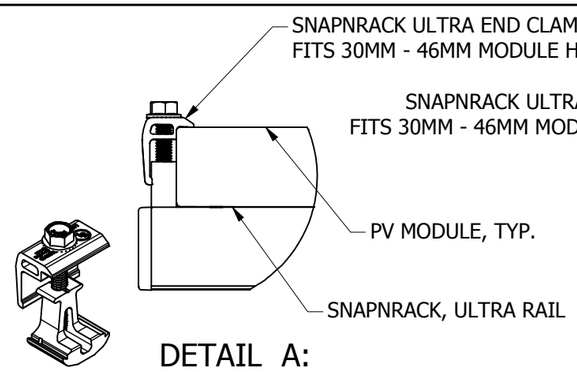
RAILS MAY BE MOUNTED UP/DOWN OR ACROSS THE SLOPE OF THE ROOF

REFER TO SNAPNRACK INSTALLATION MANUAL FOR 5/16"Ø HARDWARE TORQUE SPECIFICATIONS

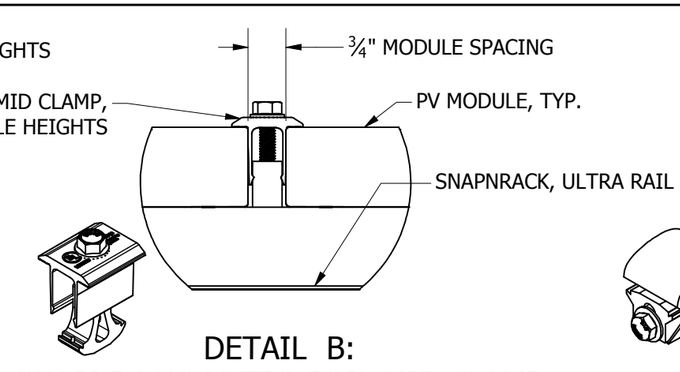
BIN: ALL

REVISION:

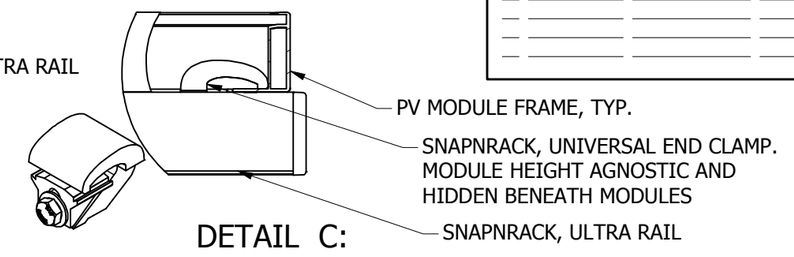
1	5/7/2019	NEW DETAIL	MJA
2	1/3/2020	ULTRA CLAMPS	MJA



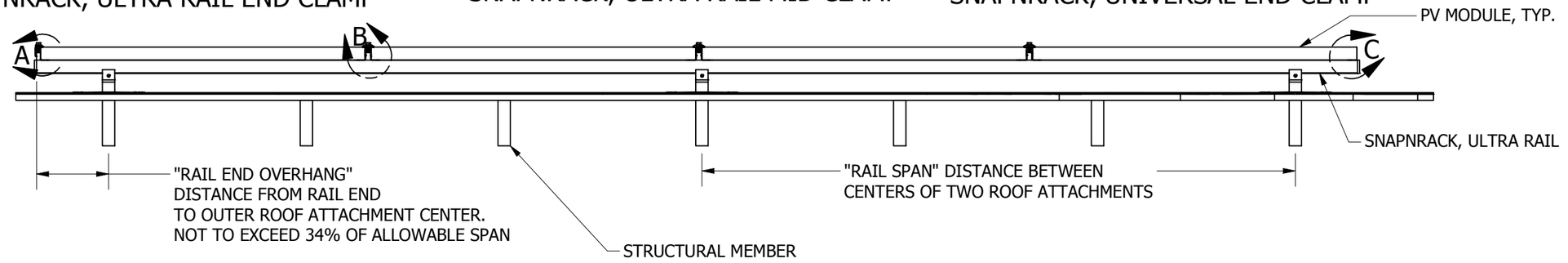
DETAIL A:
SNAPNRACK, ULTRA RAIL END CLAMP

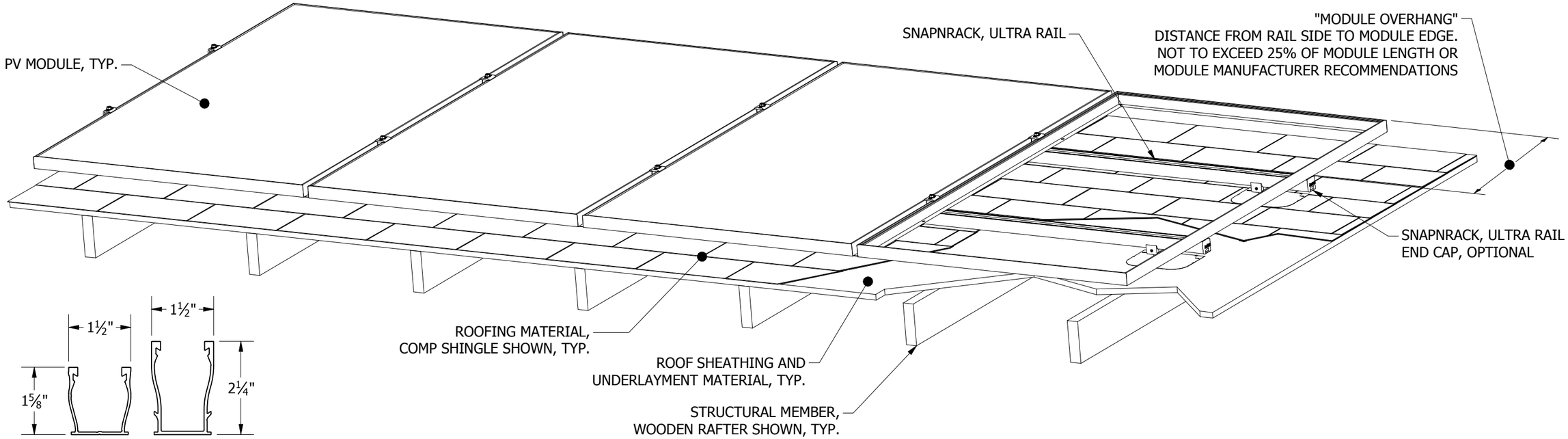


DETAIL B:
SNAPNRACK, ULTRA RAIL MID CLAMP



DETAIL C:
SNAPNRACK, UNIVERSAL END CLAMP





UR-40 RAIL | UR-60 RAIL
FOR USE WITH SNAPNRACK ULTRA SERIES RAILS

SnapNrack™
Solar Mounting Solutions

Sunrun South LLC
595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902

DESIGNER: M.AFFENTRANGER DRAFTER: M.AFFENTRANGER APPROVED BY: B.PETERSON	SCALE: DNS DATE: 1/3/2020	DRAWING NUMBER: SNR-DC-00329	DESCRIPTION: ULTRA RAIL, SYSTEM OVERVIEW, TYPICAL	REV 2

SNAPNRACK UR-40 RAIL, SPLICE, AND MOUNTING HARDWARE DETAILS

TORQUE ALL FASTENERS TO THE SPECIFIED VALUES PRIOR TO INSTALLING PV MODULES. REFER TO SNAPNRACK INSTALLATION MANUAL FOR 5/16"Ø HARDWARE TORQUE SPECIFICATIONS

SPLICE POSITIONING:

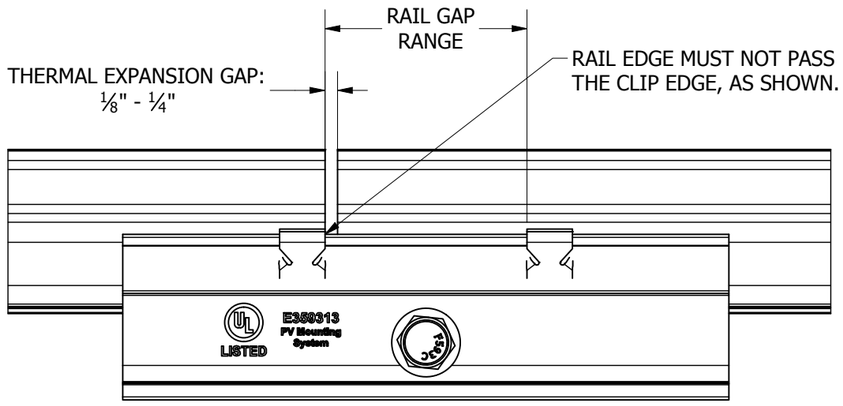
- APPROVED - ANYWHERE ALONG RAIL SPAN BETWEEN **TWO** ROOF ATTACHMENTS
- NOT APPROVED - RAIL OVERHANGS / CANTILEVERS

USE OF THE UR-40 SPLICE WITH THE UR-60 RAIL IS **PROHIBITED**

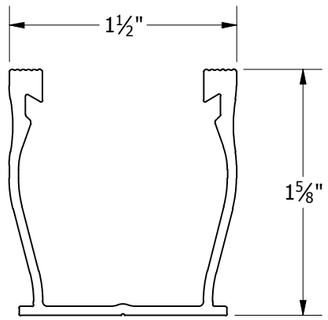
BIN: N/A

REVISION:

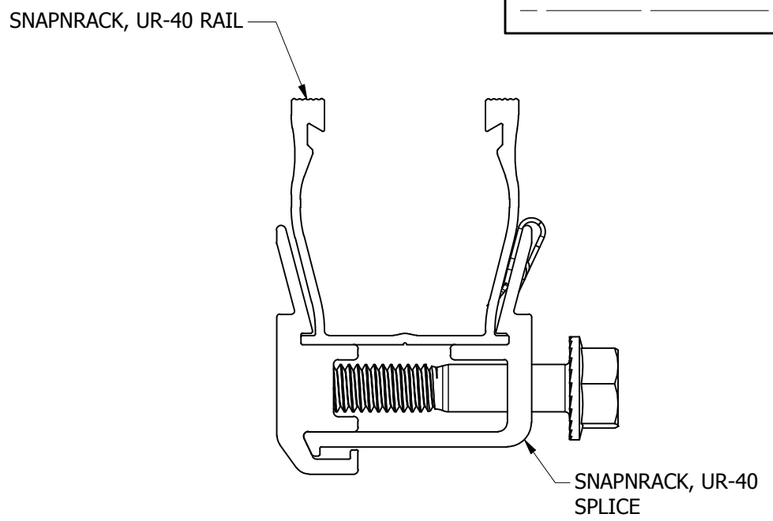
1	5/7/2019	NEW DETAIL	MJA
2	7/8/2020	CONFIGS	MJA



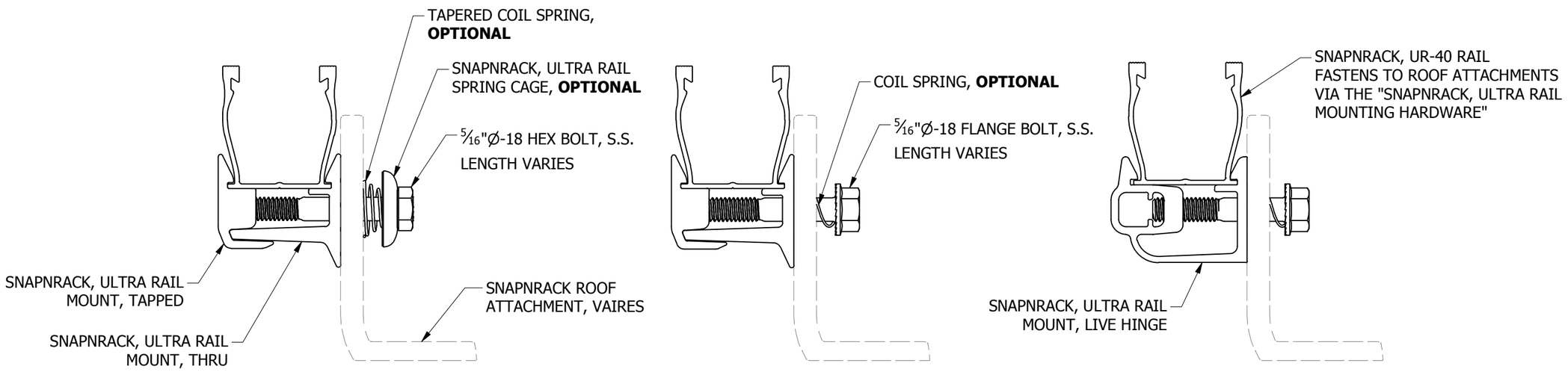
SPLICE ALIGNMENT LIMITS



SNAPNRACK, UR-40 RAIL



SNAPNRACK, UR-40 SPLICE INSTALLED



INTERCHANGEABLE CONFIGURATIONS: SNAPNRACK ULTRA RAIL MOUNTING HARDWARE

SnapNrack™ Solar Mounting Solutions

Sunrun South LLC
595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902

DESIGNER: M.AFFENTRANGER	SCALE: DNS	DRAWING NUMBER: SNR-DC-00330	DESCRIPTION: ULTRA RAIL, COMPONENT DETAIL, UR-40 RAIL, SPLICE, AND MOUNTING HARDWARE	REV: 2
DRAFTER: M.AFFENTRANGER				
APPROVED BY: W.ARBUCKLE	DATE: 7/8/2020			

SNAPNRACK METAL ROOF BASE WITH SNAPNRACK ULTRA RAIL ALL PURPOSE L-FOOT (90°) FOR METAL ROOF MOUNTING

REFER TO SNAPNRACK ENGINEERING CHARTS FOR APPLICABLE RAIL SPANS. "BIN" NUMBER ON CHART SHOULD MATCH "BIN" NUMBER ON THIS DRAWING

MIN. 3 FULL THREADS PROJECTING THROUGH PURLIN WHEN FASTENING WITH ¼"Ø TEK SCREW OR EQUIVALENT. USE TEK SCREW MANUFACTURER TORQUE SPECIFICATION

REFER TO SNAPNRACK INSTALLATION MANUAL FOR 5⁄16"Ø HARDWARE TORQUE SPECIFICATIONS

RAIL CAN BE MOUNTED ON EITHER SIDE OF THE L-FOOT

FOR LEVELING DETAILS, REFER TO SNAPNRACK DETAIL DRAWING "SNR-DC-00332 ULTRA RAIL, COMPONENT DETAIL, LEVELING EXTENSION KIT"

INSTALLATION STEPS:

STEP 1:

ATTACH METAL ROOF BASE TO PURLIN WITH ¼"Ø TEK OR EQUIVALENT SELF DRILLING SCREW. TORQUE TO MANUFACTURER'S SPECIFICATIONS

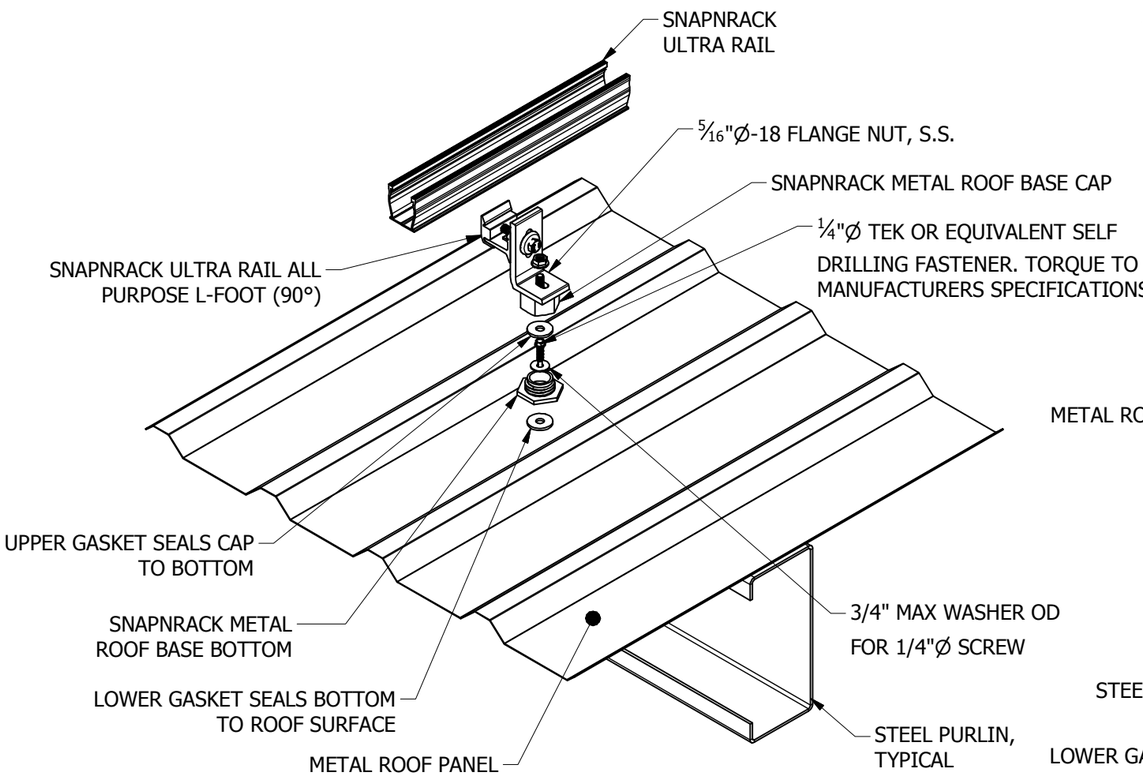
STEP 2:
THREAD METAL ROOF BASE CAP ONTO METAL ROOF BASE BOTTOM. TAKE CARE TO ENSURE THE BASE DOES NOT TWIST WHEN CAP IS TIGHTENED. ENSURE CAP IS FULLY SEATED TO BASE.

STEP 3:
ATTACH L-FOOT TO STUD IN METAL ROOF BASE CAP WITH FLANGE NUT.

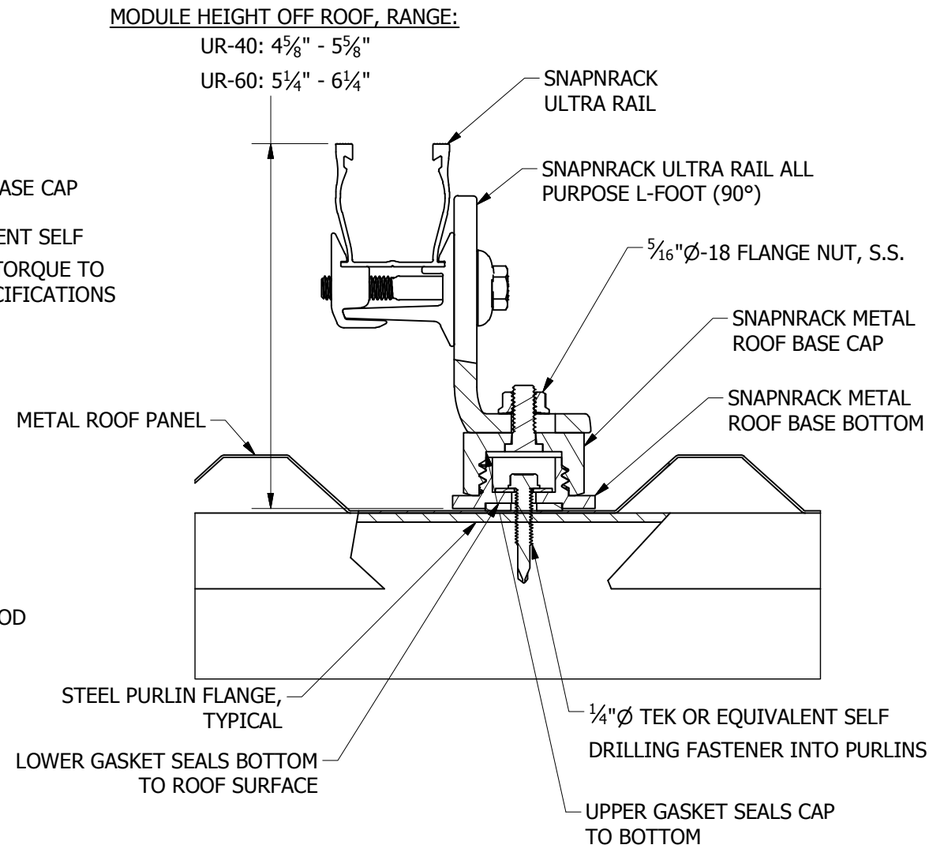
BIN: 5

REVISION:

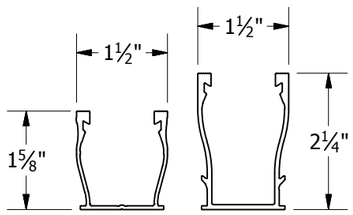
1	5/7/2019	NEW DETAIL	MJA



MRB SYSTEM INSTALLED, EXPLODED



PENETRATION DETAIL



UR-40 RAIL | UR-60 RAIL
FOR USE WITH SNAPNRACK ULTRA SERIES RAILS

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PHONE (415) 580-6900 • FAX (415) 580-6902

DESIGNER: G.MCPHEETERS DRAFTER: M.AFFENTRANGER APPROVED BY: B.PETERSON	SCALE: DNS DATE: 5/7/2019	DRAWING NUMBER: SNR-DC-00345	DESCRIPTION: ULTRA RAIL, ATTACHMENT DETAIL, METAL ROOF BASE WITH L FOOT TO PURLIN	REV: 1

Solar Install Structural

Don Muddiman
551 SW Hammock Hill Cir.
Lake City, FL 32024

The solar panels will be installed on an existing metal building, 28ft. x 56ft. x 10ft. with a 12" roof eve and a 3/12 pitch. The building is constructed of 2"x3" 12 gauge steel framing on four foot centers with B-Lap steel siding, 29 gauge steel roofing. The structure is bolted to a rebar reinforced concrete pad with a Florida certified wind rating of 170MPH as stated per the purchase invoice.

The Phono 450 watt solar panels will be installed in portrait orientation, two rows of fifteen panels for a total of thirty panels. The panels will be mounted on a SnapNrack roof rail system designed to meet the structural requirements of the solar panels weight, wind and snow loads. The SnapNrack metal roof mounts will be attached using Teks 2 ½" x 1/4" External Hex Washer Head Drill Point screws attaching into the twelve gauge metal roof truss. There will be fifty six points of attachment on the metal roof with four parallel rails fifty two feet and six inches in length. The rails are fourteen feet in length requiring three and one half rails per run. The rails will be joined with the SnapNrack splice joints. There will be fourteen attachment points spaced at an interval of four feet per rail matching the roof truss spacing. The SnapNrack rail system is designed as a connected ground system requiring only a wire bridging each rail to a single ground wire.