



THE RACKING SYSTEM DESIGNED BY
INSTALLERS FOR INSTALLERS

PV Stealth Roof System Installation Instructions



Key Benefits:

- Available in Black or Mill finish.
- Modules can be seated without any bolts, clamps or clips.
- Module “Hold Down Area” is more than 10x that of conventional clamps.
- PV Racking Rails will hold modules securely through the expansion/contraction changes due to seasonal temperature fluctuations.
- Module placement is seamless. No gaps between the modules resulting in a clean, sleek finish.

This manual provides recommendations. Local and National codes govern the requirements for solar installation and must be followed.



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PV Racking Roof System Installation Instructions

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Important: Please Read Before Starting

PV Racking components carry a 15 Year Limited Warranty. (See PV Racking 15 Year Limited Warranty for terms and conditions.) Installer shall install and operate all PV Racking components in accordance with the specifications and instructions from PV Racking and shall comply with all applicable rules, laws and regulations from local, state and federal governments and agencies, including the latest NEC Guidelines in connection with the installation of solar systems. FAILURE TO DO SO SHALL VOID ALL WARRANTIES FROM PV RACKING.

PLEASE REVIEW THIS MANUAL THOROUGHLY BEFORE INSTALLING YOUR PV RACKING SYSTEM.

Getting Started

This Installation Guide will provide you with the information needed for a professional installation. Please note the following items are the sole responsibility of the Installer and must be completed prior to installation:

PV RACKING'S BILL OF MATERIALS ORDER SHEET IS USED SOLELY FOR CREATING A BILL OF MATERIALS FOR A SOLAR ARRAY AND DOES NOT INCLUDE ANY ENGINEERING ANALYSIS. PV RACKING STRONGLY RECOMMENDS THAT ALL SOLAR INSTALLERS USE THE SERVICES OF THEIR OWN PROFESSIONAL ENGINEERS IN DESIGNING A SOLAR ARRAY TO ENSURE IT SATISFIES ALL SITE SPECIFIC STRUCTURAL REQUIREMENTS.

Comply with all applicable local, state or national building codes, including the current NEC Guidelines, and any that may supersede this manual.

Verify that correct and appropriate design parameters are used in determining the loading used for design of the specific installation. Parameters such as snow loading, wind speed, exposure and topographic factor should be confirmed with the local building official or a licensed professional engineer.

Verify that the roof is structurally sound and can support the array under all code level loading conditions that are appropriate. Verify that the ground structure supporting the array is structurally sound and can support the array under all code level loading conditions that are appropriate.

Only PV Racking parts used in conjunction with installer provided parts that are specified in the Installation Guide may be used. The substitution of other non-approved parts may void the Limited Warranty.

ALWAYS PROVIDE A WORK ENVIRONMENT THAT IS GEARED TOWARDS PERSONAL SAFETY!

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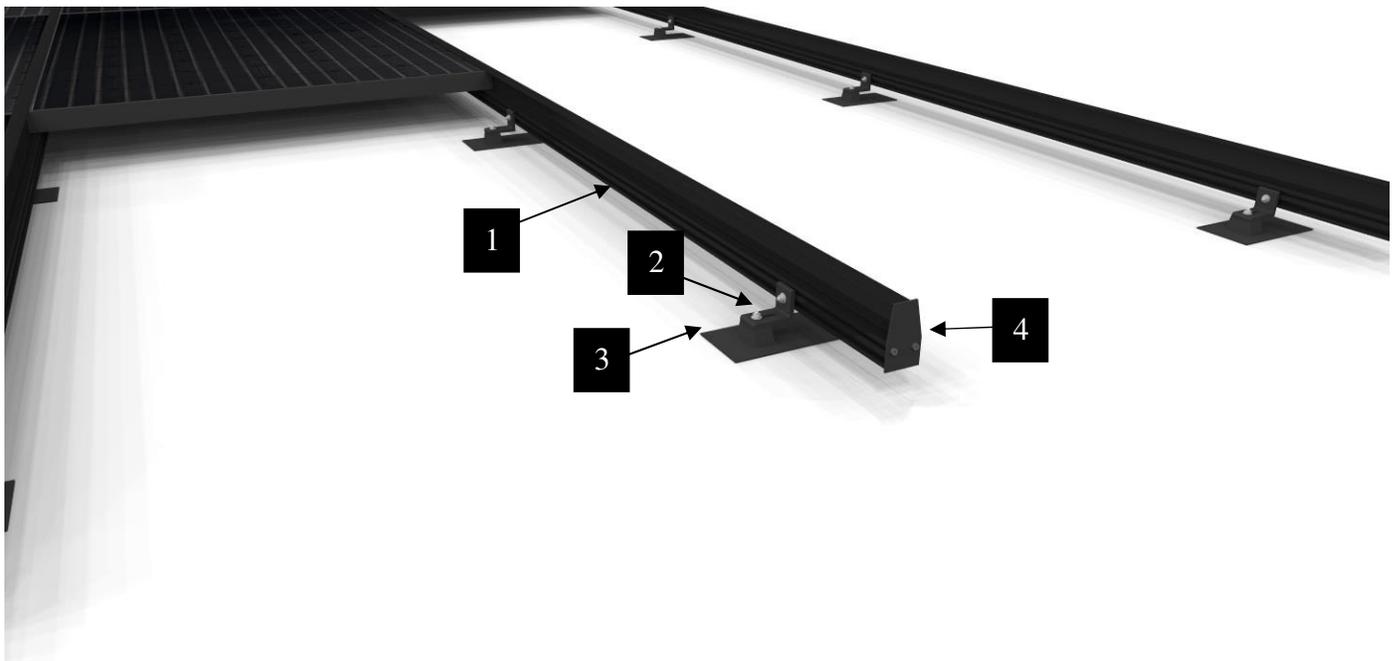
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The PV Stealth Roof System

Conventions:

- Horizontal: direction parallel with the gutter
- Vertical: direction parallel with the eaves
- North: toward the ridge of the roof
- South: toward the gutters of the roof
- East: the right side of the roof
- West: the left side of the roof

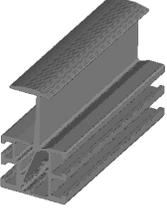
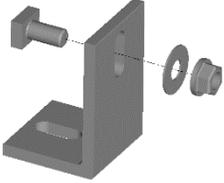
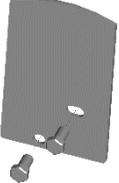
Components



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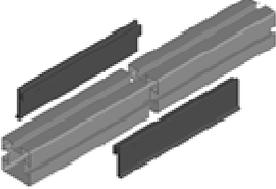
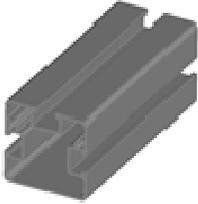
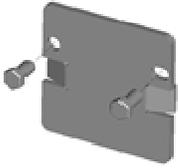
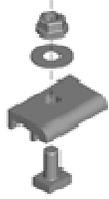
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<p>1 PV Stealth Horizontal Rail <i>RHxxx - 204</i></p> <p>where: xxx depends on the thickness of the module frame [see below] and 204 is the length of the rail in inches</p> <p>Selecting Rails depends on the thickness of the module frame. There are five ranges available for modules. Please check the thickness of the module frame planned for the installation and select the proper Rail: (Module frame thicknesses that fall in between two rail sizes should default to the larger rail size)</p> <p>RH135 - 204 Thickness of the module frame 1.16"-1.22" (29.4mm-31mm) RH153 - 204 Thickness of the module frame 1.34"-1.40" (32mm-35.56mm) RH178 - 204 Thickness of the module frame 1.57"-1.65" (36mm-41.91mm) RH194 - 204 Thickness of the module frame 1.77"-1.81" (42mm-45.97mm) RH213 - 204 Thickness of the module frame 1.97"-2.00" (46mm-50.80mm)</p>	
<p>2 L-Foot, <i>RLFoot</i></p>	
<p>3 Standard flashed roof mount for composite roofs. (Note that PV Stealth L-Foot can be attached to most commercially available composite flashing, metal, and tile roof attachments)</p>	
<p>4 Horizontal Rail Ends, used to cap the ends of the Horizontal Rails. Match it to the Horizontal Rails used.</p> <p><i>RH135End</i> <i>RH153End</i> <i>RH175End</i> <i>RH194End</i> <i>RH213End</i></p>	

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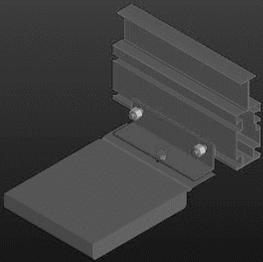
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<p>Splicing kit, used to extend Horizontal and Vertical Rails as necessary</p> <p><i>RSplice</i></p>	
<p>Roofing Vertical Rail,</p> <p><i>RV***-A8</i></p> <p>where: ***= Rail length in inches (85, 124, 131, 164, 204)</p>	
<p>Vertical Rail Ends, used to cap the ends of the Vertical Rails.</p> <p><i>RVEnd</i></p>	
<p>Roof Clamp, used to mount Horizontal and Vertical Rails to each other.</p> <p><i>RClamp</i></p>	
<p>Wire Clip holds wires securely to the Rails.</p> <p><i>WireClip-A300</i></p> <p>Sold in quantities of 300.</p>	
<p>Wire Loop holds thicker wires to the Rails</p> <p><i>WireLoops-A300</i></p> <p>Sold in quantities of 300.</p>	

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<p>Horizontal Rail Spacing Fixture makes installation quicker and more precise. (Much faster than using tape measure.)</p> <p>RSpacer-A3</p> <p>Sold in quantities of 3.</p>	
<p>SabreTooth. (For roofs with an equal or less than 2:12 pitch.)</p> <p><i>RSabreTooth-A300</i></p> <p>Sold in quantities of 300.</p>	
<p>Micro-inverter / Maximize Mount</p> <p>Used to attach micro-inverters or maximizers to rail</p>	

Torque Specifications:

3/8" nuts and bolts	15 Ft LBS
Ilco SGB-4	75 In LBS
#12 Self Drilling Screws	24 In Lbs

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Overview

The PV Stealth Roof System is unmatched in its simplicity and quality. Superior module retention is provided without any clamps, anti-galling lubricants, and without the tedious tasks associated with securing modules to rails utilizing the traditional clamping method. PV Stealth's strength and non-clamped retention is a perfect match for solar systems warranted for 25 years.

It is imperative that the roof penetrations are placed accurately in order to ensure that the horizontal rails can be spaced properly to accommodate the module. There is a slot on the bottom of the L Foot to allow adjustability. The orientation of the L Foot can also be switched.

PV Stealth provides continuous edge support for the modules. PV Stealth does not put undue stress on the modules as it is designed to deflect minimally under full load. Design has been analyzed with advanced FEA methods and actual field testing. Please note that it is the installers' responsibility to check with the module manufacturer that this support method is acceptable.

PV Stealth Roof Installation

General installation notes

If the roof has a pitch equal to or less than 9 degrees (2:12) SabreTooth EPDM retainer must be installed.

Plan the layout of the modules on the roof. Landscape orientation is favored because it provides the most power on most pitched roofs and supports modules along their long edge.

Make sure that the roof can take designed load. A structural engineer should calculate the loads and review and approve the roof structure. IT IS THE INSTALLER'S RESPONSIBILITY TO ENSURE THAT THE ROOF CAN SUPPORT THE ADDED LOAD.

Once the plan is approved, follow the installation steps outlined in this manual.

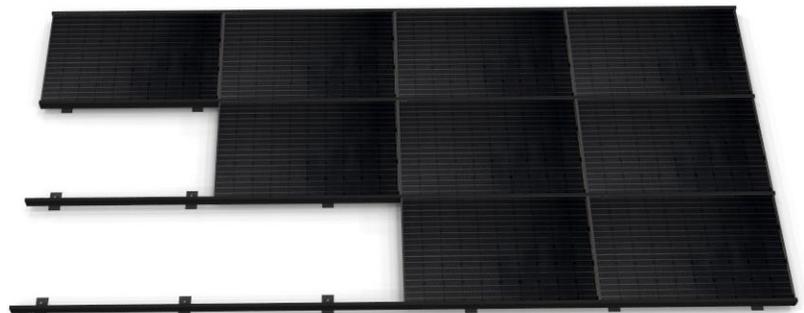
A typical residential roof will accommodate more modules in landscape mode than in portrait; therefore, landscape is the preferred orientation.

Flashed roof penetrations are located along rafters where load carrying capacity of the roof is the highest. The distance between flashed roof penetrations along the rafters is flexible and depends on the dimensions of the module being placed, as well as the orientation of the modules.

PV Stealth is compatible with most standard roof flashing hardware.

The following steps are required to successfully install a solar system using PV Racking components:

- Install flashed roof attachments
- Install Horizontal Rails
- Install modules



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Flashed Roof Attachments

Determine the location of the flashed roof attachments

The following steps are required to determine the location of the flashed roof attachments:

1. **Measure the roof rafter spacing.**
2. **Obtain the Design Pressure, P_{design} (psf).** (The Design Pressure is given by a structural engineer or obtained from the procedure described in the “*PVRacking Roof Loading Calculations Guide*” and approved by a structural engineer.)
3. **Based on the Design Pressure, look up the spacing in Table 1. (Page 10).** (If the exact Design Pressure is not show in the table, select the next **larger** Design Pressure column. Once the Design pressure column is found, read down until the last green block is reached. Select the horizontal rows where the green blocks are located. At the left-most column of these rows are the acceptable spacing (span) distances for the penetration points.
4. **Select the span that would land all penetration points over roof rafters.** This selected span is the Horizontal Installation Distance (center to center distance measured parallel with the peak of the roof) between flashed roof penetration points.

For example: The existing roof rafters measure 16” on centers and the Design Pressure, (P_{design} or Total Design Load) is calculated to be 26.7 psf. Round up the Total Design Load to the nearest (higher) whole value found in the columns header of Table 1. This would be 30 psf. Panels would be installed in Landscape format. Read down on the 30 psf column and locate the green blocks. The corresponding vertical spans are shown in the left-most column. These are 24”, 32”, and 48”.

Please note that 24” is not a multiple of the existing rafter spacing in this example and using 24” spacing penetrations would miss rafters. Therefore 24” is not an acceptable selection in this example.

Install the flashed roof attachments

The most common way to attach a flashed roof penetration is using a lag bolt. The length of the lag bolt is determined by the load it has to withstand. The further apart the penetration points are, the longer the bolts have to be to withstand the higher loads per penetration point. The location of the lag bolts in relation to the rafters is critical. *It must be located in the center of the rafter.* If the lag bolt is not in the center of the rafter, the rafter may split which would diminish the holding capacity of the mounting and severely compromise the safety of the whole system. For installing the flashed roof penetrations, follow the manufacturer’s instructions.

Selecting the best spacing distance, from 16” to 96”, depends on whether the roof rafter can safely hold the bolt and the transferred load. A structural engineer should carefully evaluate the strength of the rafter and make sure that the installation is safe and within the allowed structural limits.

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Roof angle 9 to 45 degrees										
<i>Allowable Rail Spans for nominal 40" x 65" Panels in Landscape Orientation (Span is measured horizontally between penetrations)</i>										
Span (in)	Design Pressure, P _{design} (psf)									
	5	10	15	20	25	30	35	40	50	60
16	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green
24	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green
32	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green
48	Yellow	Green	Green	Green	Green	Green	Green	Green	Red	Red
64	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red
72	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red
80	Green	Green	Red	Red	Red	Red	Red	Red	Red	Red
96	Green	Red	Red	Red	Red	Red	Red	Red	Red	Red
Roof angle 9 to 45 degrees										
<i>Allowable Rail Spans for nominal 40" x 65" Panels in Portrait* Orientation (Span is measured horizontally between penetrations)</i>										
<small>*Portrait orientation is allowed for modules that can be supported on their short sides</small>										
Span (in)	Design Pressure, P _{design} (psf)									
	5	10	15	20	25	30	35	40	50	60
20	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green
20	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green
20	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green
29	Yellow	Green	Green	Green	Green	Green	Green	Green	Red	Red
38	Green	Green	Green	Green	Red	Red	Red	Red	Red	Red
44	Green	Green	Green	Red	Red	Red	Red	Red	Red	Red
48	Green	Green	Red	Red	Red	Red	Red	Red	Red	Red
58	Green	Red	Red	Red	Red	Red	Red	Red	Red	Red
Legend										
	Red Block indicates that a span is too long to be used at the corresponding Design Pressure									
	Green Block indicates that a span is in an optimal range for the corresponding Design Pressure									
	Yellow Block indicates that a span is usable, but may not be economically optimal									

Table 1.

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PV Stealth Horizontal Rail installation (RSxxx)

The formula for calculating the length of the Horizontal Rails is:

$$RS_L = (NMH \times (MD + 1/8)) + 3/4$$

Where

RS_L = Horizontal Rail Length

NMH = Number of columns of modules horizontally

MD = Module Dimension (in landscape mode this is the long side of the module)

For example:

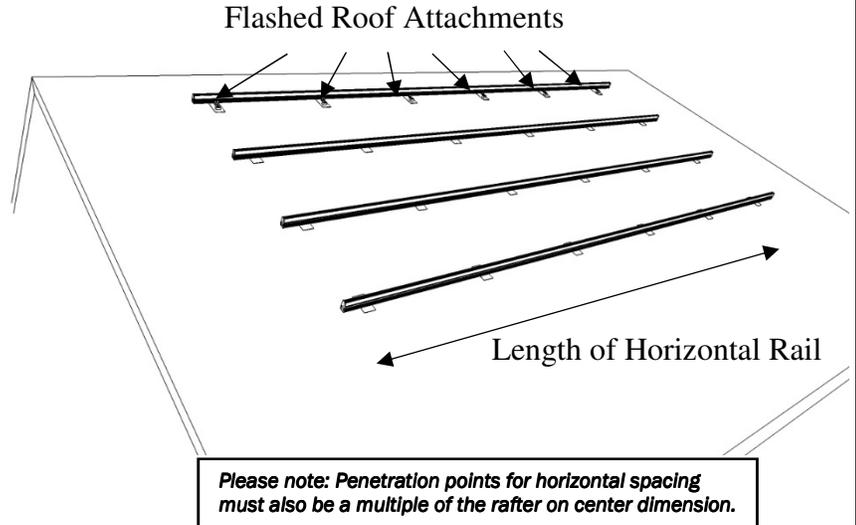
The installation depicted to right has modules with dimensions 40"x60".

$$RS_L = (2 \times (60 + 0.125)) + 3/4$$

Apply the actual values to the formula:

$$RS_L = (2 \times (60 + 0.125)) + 3/4 = 121"$$

Note: If the calculated length exceeds the standard Rail length you will need to install a Rail Splice per instructions provided in the "2.4.7 Rail Splices Installation" section.



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The formula for calculating the spacing between Horizontal Rails is:

$$CTCD = MD + .55$$

Where CTCD- Center to Center Dimension to install the Horizontal Rails. Establishes the point where the Horizontal Rail meets the rafter.

MD= Module Dimension. For modules installed in the landscape format, this dimension would be the length of the short side of the module.

For example:

The installation has modules with dimensions 40"x60".

$$CTCD = MD + .55$$

Apply the actual values to the formula:

$$CTCD = 40 + .55 = 40.55"$$

Calculate the inside edge to inside edge dimension (to set spacing fixtures)

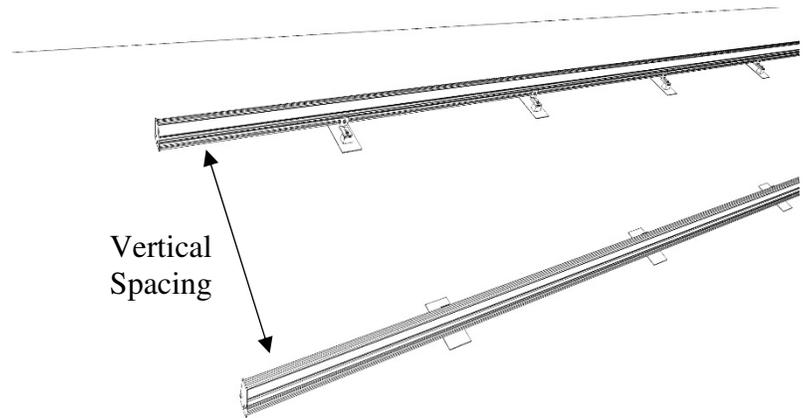
The formula for calculating the spacing between the inside edges of the Horizontal Rails.

$$IED = CTCD - 1.80$$

Where

CTCD= Center to Center Dimension to install the Horizontal Rails.

IED = Inside edge to inside edge dimension



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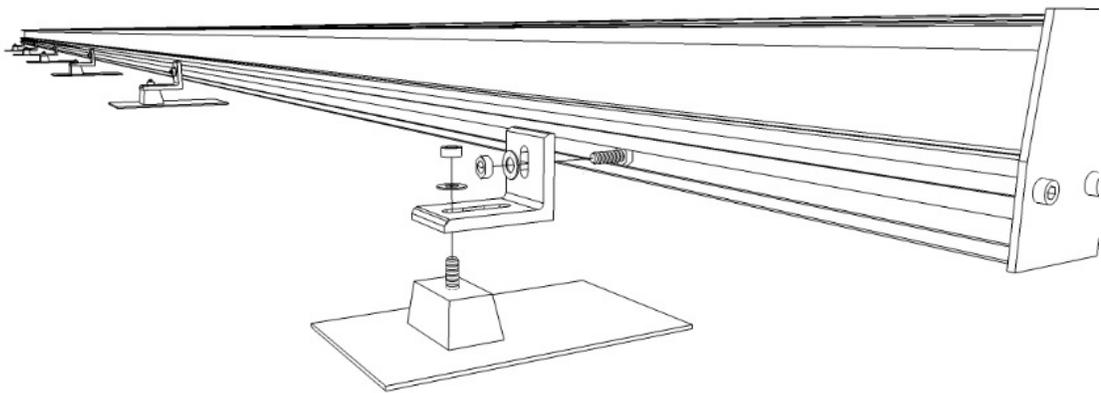
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Mounting the Stealth Rails

Stealth horizontal rails (RS) are attached directly to roof penetrations via the L foot. The vertical part of the L Foot must attach to the lower (southern) side of the horizontal rail. The open side of the angle may face north or south. Attention must be focused on squaring and securing the bottom rail in a manner such that the rail is parallel with the edge of the roof. Do not tighten the penetration lag bolts to the L Feet until the rail is positioned and aligned. Position the next horizontal rails at the correct CTCD distance (in the above example it is 40.55") away from the previously installed rail. You can also use the rail spacing fixtures to determine subsequent rail locations. Use the "inside edge to inside edge" dimension calculation above to determine the dimension to set the fixtures at. Affix the hardware to the horizontal rail, and secure the horizontal rail to the L feet. Obtain a diagonal measurement of rails to ensure square alignment of the system.

Installation steps

1. Secure the southernmost horizontal rail by sliding the provided 3/8-16 bolts along the rail to all intersections where the rail meets the L feet. Secure the bottom edge of the horizontal rail to the L feet with flat washers and flange nuts. Tighten the flange nuts to a maximum of 15 lb-ft.
2. Use a tape measure or the rail spacing fixtures to locate the next horizontal rail.
3. Secure the horizontal rail to the L feet following the same procedure as above. Obtain a cross measurement between rails to ensure congruency. Repeat for all horizontal rails.
4. Check the maximum allowed unsupported overhang distance for the horizontal rails in table 2 below.
5. The east and west edges of the rails must follow a straight line.
6. Install end caps (RSEnd) at both ends of the horizontal rails.



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Horizontal Overhang Table

Horizontal overhang
(Optional Vertical Rails
Shown in Picture)



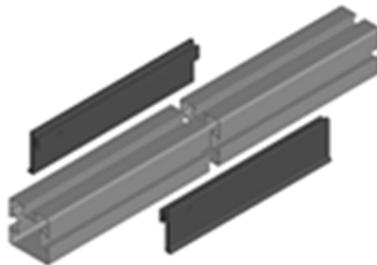
Based on the maximum design pressure P_{design} and the pitch of the roof, look up the allowable overhang (cantilever) dimensions from Table 2 below.

Roof angle 9 to 45 degrees										
<i>Allowable Overhang for nominal 40" x 65" Panels in Landscape Orientation</i>										
	Design Pressure P_{design} (psf)									
	5	10	15	20	25	30	35	40	50	60
<i>Horizontal</i>	24	24	24	24	24	24	22	20	16	12

Table 2.

PV Stealth Rail Splice installation

PV Stealth Rail Splices (RSplice) are required when Horizontal Rails need extension. The splice kit includes two equally sized plates. The plates key into the 3/8" T-slots on both sides of the rails to be. Leave a 1/8" gap between Rail ends for heat expansion. Center the splice kit so each Rail is engaged evenly. Fasten the Rail Splices using the #12 stainless steel self-drilling screw (It is suggested that lubricant is placed on the tip of the self-drilling screw prior to installing). Orient the splices so that one of each of the two rails being spliced has a self-drilling screw. Use one IlSCO SGB-4 grounding lug on each side of the splices (one on each of the rails) and connect them with a short jumper wire to maintain rail grounding as necessary.



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Optional - PV Racking Vertical Rail installation

For installing the L Feet to the flashed roof penetrations, follow the manufacturer's instructions.

Calculate the length of the Vertical Rails

The formula for calculating the length of the Vertical Rails is:

$$RVL = (NMV \cdot (MD + 1/2)) + 5$$

Where

RVL= Vertical Rails' Length

NMV= Number of Module Rows Vertically

MD= Module Dimension in the vertical direction (in landscape mode this is the short side of the module).

For example:

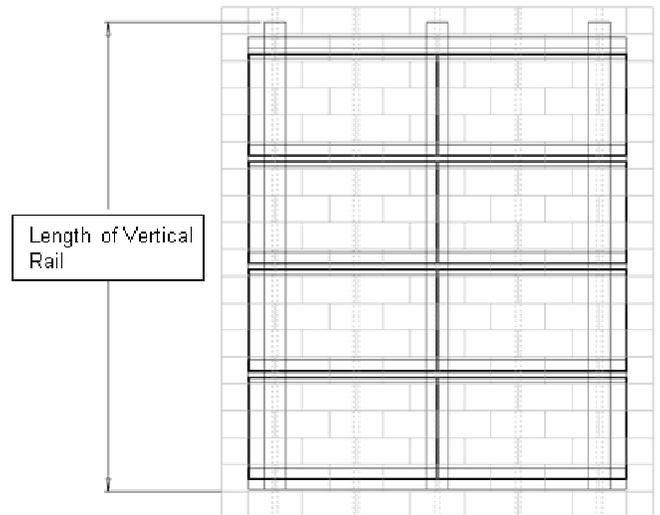
The installation depicted to right has modules with dimensions 40"x60".

$$RVL = (NMV \cdot (MD + 1/2)) + 5$$

Apply the actual values to the formula:

$$RVL = (4 \cdot (40 + 1/2)) + 5 = 167"$$

Note: If the calculated length exceeds the standard Rail length you will need to install a Rail Splice per instructions provided in the "Rail Splices Installation" section.



Mounting the Vertical Rails

1. Mount the Vertical Rails (RV) to the L feet (LFoot) using 3/8-16 x 1 1/4" hex head cap screw (stainless steel) and flange nut with flat washer. Max torque is 15 ft-lb.
2. Check the maximum allowed unsupported overhang distance for the Vertical Rails in Table 2. below.
3. The south edges of the Rails must follow a straight line.
4. Install End Caps (RVEnd) at both ends of the Vertical Rails

Optional – Micro-inverter/Optimizer Mounting Bracket

Installing Mounting Bracket – Mounting bracket includes one WEEB Washer, two 3/8" x 3/4" stainless steel bolts with serrated nuts, and the bracket.

Slide two bolts into lower slot of rail, slide WEEB Washer onto one bolt and mount bracket onto rail using serrated nuts. Torque each nut to 15 lbs. /ft. Mount micro-inverter or optimizer using center hole in bracket per manufacturer's instructions.

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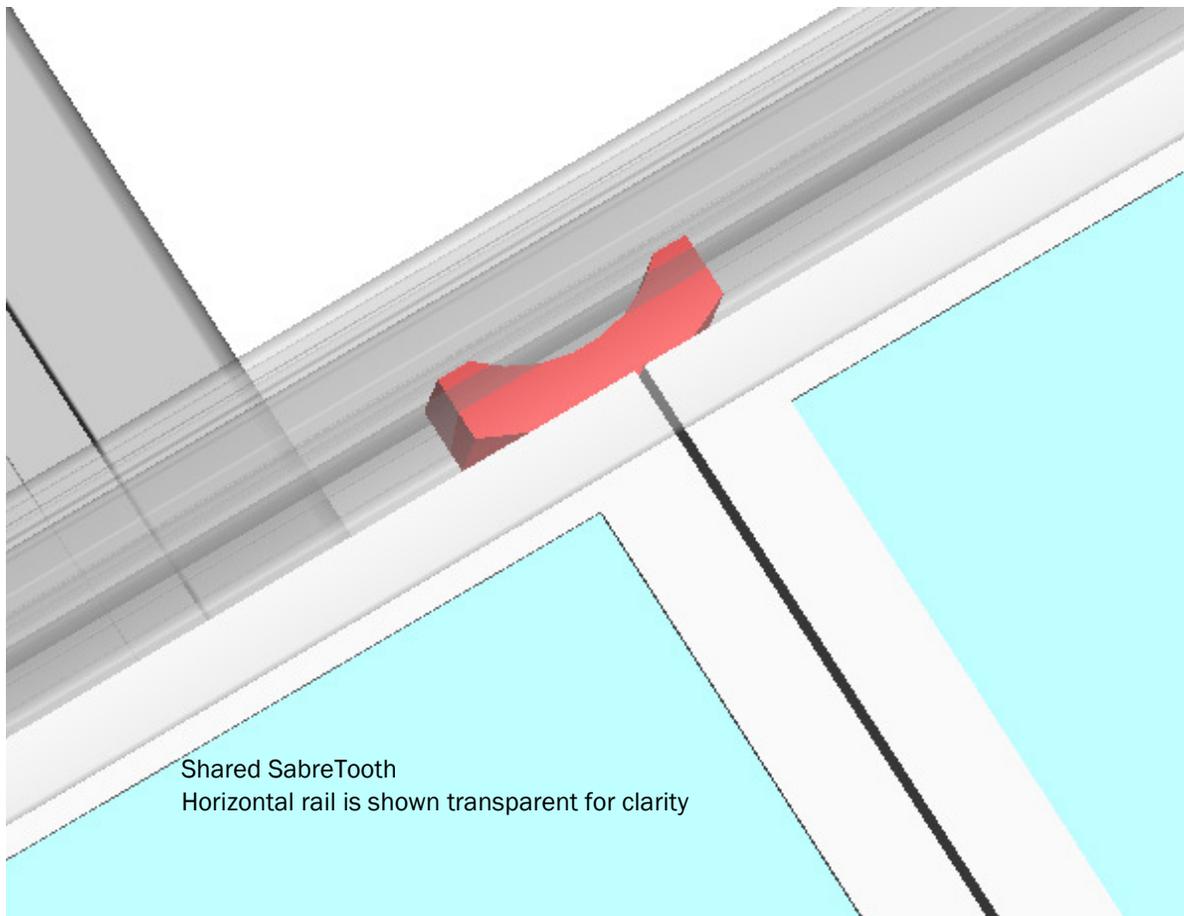


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Installation of SabreTooth EPDM Blocks

For roofs having 2:12 or less pitch the PV Racking SabreTooth must be installed in the gap between the north edge of the installed modules and the vertical rail wall. Wedge half of a SabreTooth between an already installed module and the rail. Install the next module as usual close to the shared SabreTooth and slide it sideways against the previous installed module to close the gap. The SabreTooth is now shared at the joint edges of the two modules.

The first and last modules in a row will get a dedicated SabreTooth at their outside edges before the horizontal end plates are installed.



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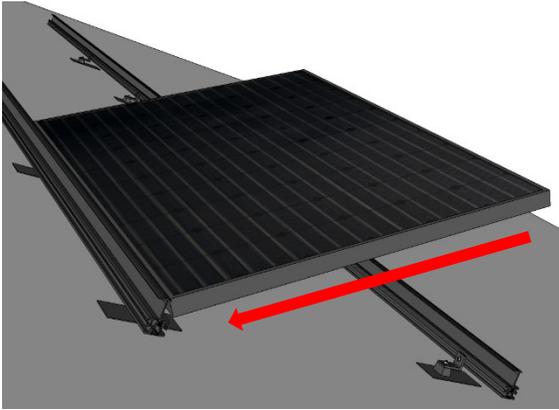
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Installation of Modules

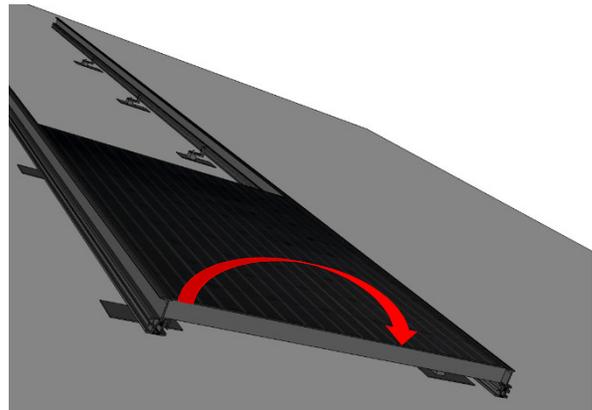
First install grounding lugs, grounding and extension wires on the modules and rails as necessary. Use the Wire Clip or Wire Loop to secure wire runs to railing. (See *Notes on Wire Management*).

Module installation into the PV Stealth's system is a quick, three step process.

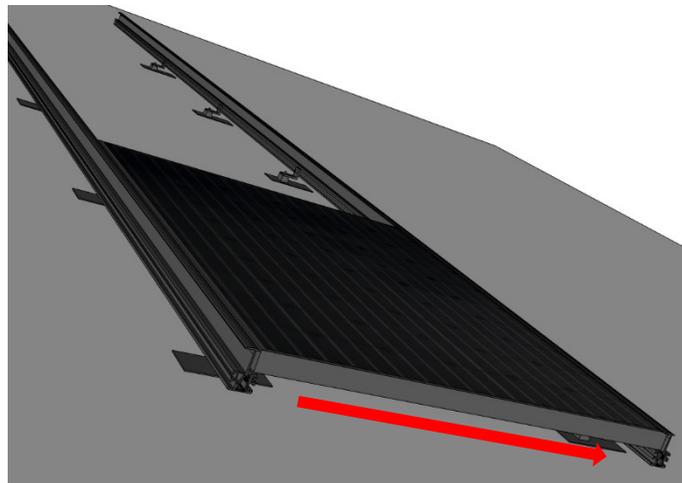
- 1) Insert the module into the upper (northern) Horizontal Rail by slipping the top edge under upper lip of the Horizontal Rail.



- 2) Slide the module upwards as far as it will go under the top lip and rest the bottom edge on the bottom (southern) Horizontal Rail.



- 3) Slide the module down and rest it on the bottom (southern) Horizontal Rail. Install End Caps (RHEnd) at both ends of the Horizontal Rails. Module retention is completed without any clamps.



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General Notes

Notes on Grounding the PV Stealth System

Grounding must follow current coding requirements if different from instructions below.

All modules and rails should be bonded with grounding lugs or bonding jumpers (we recommend the IlSCO SGB-4 or Dynobond™ Bonding Jumper). Bonding jumpers or SGB-4 lugs (with a bare copper grounding wire sized per local and/or national codes) are attached to the backside of each panel frame in the row or array and connecting each module to the next in series. DynoBond is used as a jumper between modules and is installed on the rear frame of the modules to connect them East to West across each individual row. DynoBond will also be connected onto the last panel in each row to the next to row from North to South to bridge each row together. An SGB-4 grounding lug can be attached into the lower channel of the horizontal rail near the end cap and to the last panel frame in the array. Connect a bare copper grounding wire per local and or national codes to module and rail. Grounding wire should be run from rail to rail and is attached using SGB-4 lug into bottom channel of each rail in the array.

Install a thermal jumper at splice points where applicable (SGB-4 on both sides of the splice connected with grounding wire). When the installation is complete, ensure that there is a continuous grounding path between all modules and rails.

Notes on Wire Management

PVRacking offers advanced wire management that provides a reliable, long lasting solution to the challenges of routing home run wires.

The stainless steel PVRacking WireClip can safely hold up to three wires.

The weather proof plastic WireLoop fits into 3/8" T-slots. Can hold a half dozen or more regular wires or up to two thicker cable wires.



**Wire
Loop**



**Wire
Clip**

Installation instruction updates

PV Racking continuously improves the product line. The latest installation information is available at www.PVRacking.com. Contact PV Racking should you have any questions or require additional information (855) PV RACKS or (855) 787-2257.

This manual provides recommendations. Local and National codes govern the requirements for solar installation and must be followed.



THE RACKING SYSTEM DESIGNED BY INSTALLERS FOR INSTALLERS

PV Racking 15 year Limited Warranty

PV Racking ("PV Racking") warrants to the original consumer purchaser ("Customer" or "Purchaser") that the PV Racking aluminum frame housing (the "Product") will be free from defects in materials or workmanship as described below under normal installation, application, use and service conditions, for a period of fifteen (15) years from the date of original purchase. If, within the specified warranty period, the Product shall be reasonably proven to be defective, then PV Racking will, at its option, either repair the defect or replace the defective Product or part thereof with a new or remanufactured equivalent at no charge to the Purchaser for parts or labor. PV Racking's total liability hereunder for such repair or replacement shall not exceed the original purchase price of the Product. This Limited Warranty does not cover failure to function caused by damage to the Product while in the Customer's possession, improper installation, unreasonable use or abuse of the Product, failure to provide or use of improper maintenance, failure to follow the written installation and use instructions, cosmetic damage, damage from accident, negligence, misuse, normal wear and tear, or acts of God, and is voided by failure to have the Product installed according to PV Racking's written Installation Manual, by an authorized installer or failure to operate or use the Product in accordance with instructions and warnings contained in the Installation Manual, or if the Product has been modified, repaired or reworked in a manner NOT PREVIOUSLY AUTHORIZED BY PV Racking IN WRITING. This Limited Warranty does not apply to any foreign residue deposited on the finish. All installations in corrosive atmospheric conditions are excluded. This Limited Warranty does not cover damage to the Product that occurs during its shipment, storage or installation. Manufacturers of related items such as PV modules and flashings may provide written warranties of their own. PV Racking's Limited Warranty covers only its Product, and not any related items. PV Racking makes no warranty against defects in materials and workmanship by component parts from other manufacturers including but not limited to batteries, PV modules, inverters, transformers, disconnects, and data acquisition components. Warranties, if any, for these products may be available through Customer's authorized installer or contractor. This Limited Warranty is voided if the Product is modified, moved or relocated after the original installation.

Neither the sales personnel of PV Racking nor any other person is authorized to make any warranties other than those described herein, or to extend the duration of any warranties beyond the time period described above on behalf of PV Racking.

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To obtain warranty services, the Purchaser must contact PV Racking by telephone or mail, and PV Racking will establish and initiate a review of the claim. The Purchaser must maintain proof of purchase of the Product to prove date of purchase in the unlikely event of a claim under this Limited Warranty.

Warranty service contacts:

PV Racking
505 Keystone Road
Southampton, PA 18966
Phone (855)787-2257
Email info@pv racking.com

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