



KINETIC SOLAR K-RACK™ INSTALLATION GUIDE

Kinetic Solar Racking and Mounting

UL 2703 and LTR-AE-001-2012 Listed



1. Disclaimer

Limitation of Liability/Precautionary Measures

Kinetic Solar Racking and Mounting Inc. (Kinetic Solar) does not install any components of its Racking and Mounting systems. Kinetic Solar Racking and Mounting does not have any duty or responsibility for safe and proper installation and/or maintenance of its Racking and Mounting systems; including job site safety standards and procedures.

All installation work must comply with the applicable regional and local regulations or other national or international electrical standards and are the sole responsibility of the installer, contractor and/or developer.

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Before attempting to install, operate or service a Kinetic Solar system, all instructions should be read and understood. Failure to follow these instructions/guidelines may result in death, injury or property damage.

Space rails according to module manufacturer's specifications

Solar module width and/or length will determine the exact rail spacing. (Please refer to the module manufacturer's specifications)

Please retain this manual for future reference. Kinetic Solar reserves the right to make additions, deletions and modifications to the content of this document without prior notice.

Geocel 4500 Roof Bonding Sealant, BES 925 Roof Bonding Sealant or equivalent is required for wind speeds above 40km/h when installing on pitched roofs.

This manual is only valid for the following Kinetic Solar Racking Systems: K-Rack

The instructions contained in this manual are exclusive to the products referenced. Use of any other products in conjunction with the listed products is done at one's own risk.

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4. Certification Details

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. The system has been evaluated to UL 2703 for Grounding/Bonding and Mechanical Loading. The largest module tested with this system was 2024 mm x 1024 mm in size. Please see Kinetic Solar's List of Compatible Modules Revision 6 for more details.

5. Common System Features

5.1. Torque Specifications

Product	Fastener Size	Torque ft-lbs (N-m)
Lay-In Ground Lug (Nut and Bolt)	#8	N/A
L-Bracket	5/16"	12 (16.27)
Flashing Kit (Excluding Lag Screws)		
Mid-Clamp / End Clamp		
Joiner		
Micro-Inverter Mount		
Standing-L		
Hanger Bolts (Excluding Lag Screw Portion)		
Flashing Kit Base Plate		
4" Base Plate (Excluding Lag Screws)		
Hat Rail Micro Inverter Mount		
Conduit Clamp		
Conduit Attachment Bracket for Flashing Kit		
Top of Rail Accessory Clamp		
Grounding Lug (to rail)		
Kinetic Rail Jumper Kit (to rail)		
Grounding Lug (to wire)		3 (4.07)
Kinetic Rail Jumper Kit (to wire)		N/A
Rodent Guard Clamp		N/A
End Cap		N/A
Custom L	3/8"	20 (27.12)
Fall Restraint		

Figure 1 - Torque Specifications

5.2. Kinetic Product Configurations

Product Category	Components
M-Type (For use with mill finish aluminum rail <u>only</u>)	KJS2-MM KHGLUG-M KMWCxxxx-MM KECxxxx-MM
A-Type (For use with anodized rail or mill finish rail)	KJS2W-MA KJS2W-BA KJS2W-CA KHGLUG-A KMWCxxxx-BA KMWCxxxx-CA KECxxxx-BA KECxxxx-CA
G-Type (For use with galvanized steel only)	KHGLUG-G KMWCxxxx-G KECxxxx-G

5.2.1. Understanding Kinetic SKUs

The following SKU suffixes are used:

_____ -MM	Mill finished component for use with mill finish rail <u>only</u>	
_____ -M	For use with mill finish rail <u>only</u>	
_____ -MA	Mill finish component for use with anodized rail or mill finish rail	
_____ -CA	Clear anodized component for use with anodized rail or mill finish rail	
_____ -BA	Clear anodized component for use with anodized rail or mill finish rail	
_____ -A	For use with anodized rail or mill finish rail	
_____ -G	For use with galvanized rail	
KJS2W-MA	Example	Kinetic Joiner - Mill Finish for Anodized Rail or Mill Finish Rail

5.3. Components

5.3.1. Kinetic Nut (K-Nut)

The Kinetic Nut (K-Nut) [KHNTS-M or KHNTS-A] is a common component utilized in many Kinetic products.

5.3.1.1. Inserting *K-nut* into side channel

If attaching a component to the side channel of the rail such as an L-Bracket follow the steps shown in Figure 2

1. At a 30° angle insert the L-Bracket with the K-Nut at the top of the slot
2. Rotate into position so that the entirety of the K-Nut ends up inside the channel
3. Drop into place. The inserted component should sit in place and easily slide back and forth in the channel



Figure 2: Inserting K-Nut into Side Channel

5.3.1.2. Inserting *K-Nut* into top channel

If attaching a component to the top channel of the rail such as an End or Mid Clamp follow the steps shown in Figure 3

1. At a 30° angle insert the clamp assembly with the clamp held at the top of the bolt. Ensure that the K-Nut is positioned at the lowest point on the bolt so that there is clearance to pivot the clamp into an upright position.
2. Rotate into position so that the entirety of the K-Nut is inside the top channel of the rail
3. Drop into place. The inserted component should easily slide back and forth in the channel see Figure 3 B

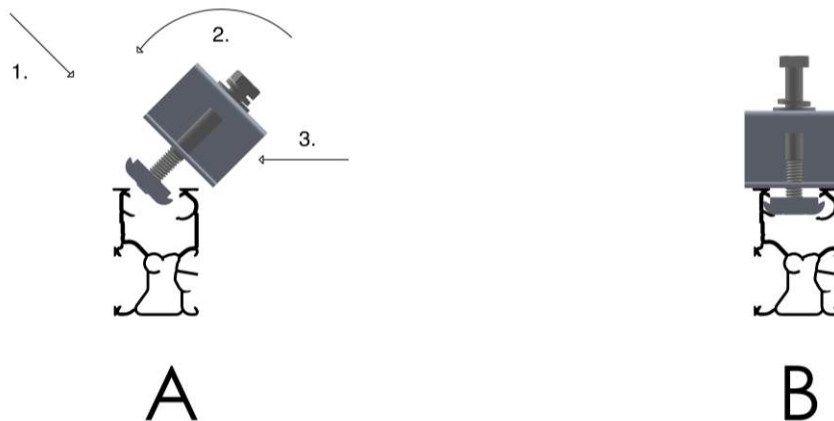


Figure 3 - Inserting K-Nut into Top Channel (End-Clamp shown)

5.3.1.3. *K-Nut* Tightening Procedure

For components utilizing the K-Nut, check to ensure that the K-Nut is properly seated in the channel and that its sides are parallel to the length of the rail.

5.3.2. Steel Nut

When installing Mid or End Clamps onto the Hat Rail, follow the steps shown below:

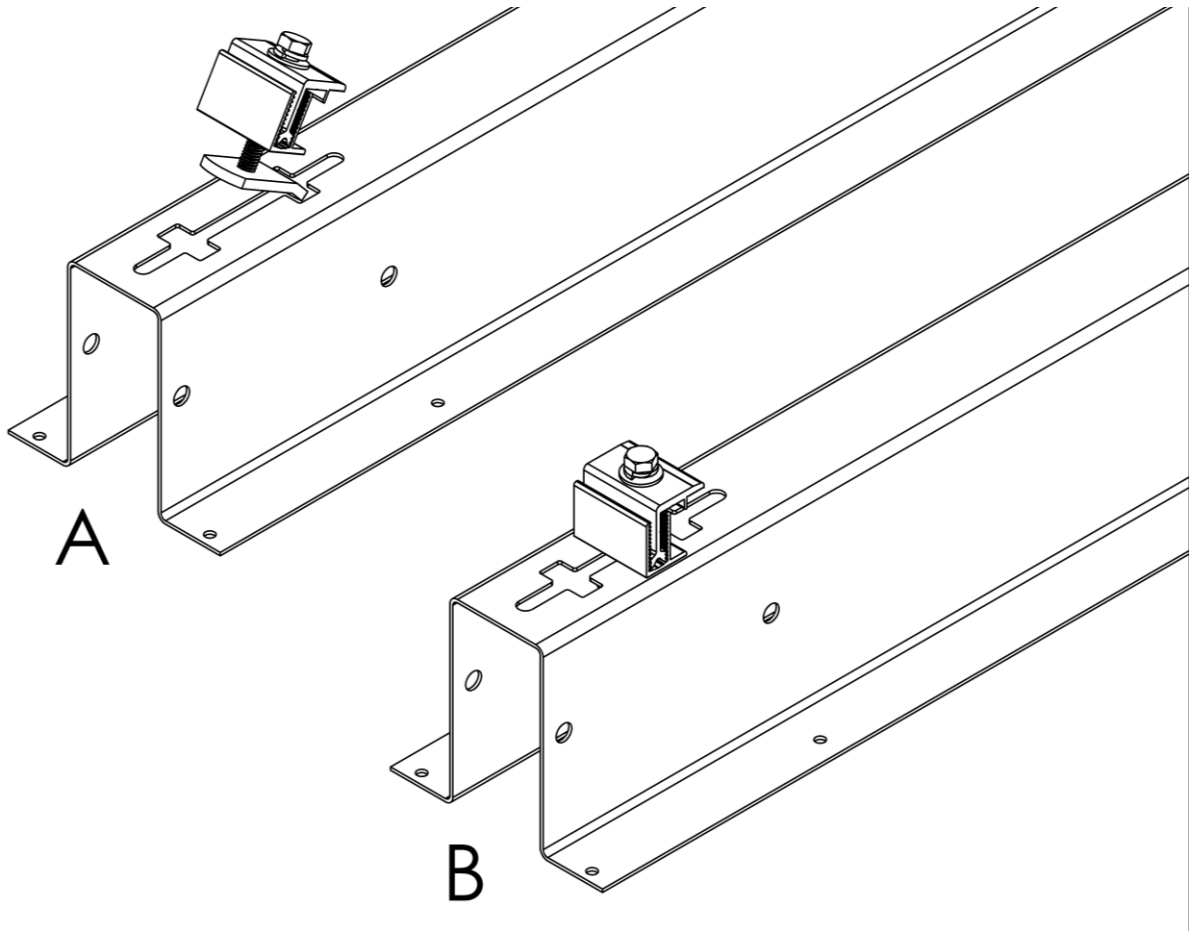


Figure 4 - Hat Rail Nut Insertion Procedure

- a) Insert bent end of Nut into wide portion of slot at a 30° angle
- b) Insert nut fully into slot
- c) Drop into place

5.3.3. Cable Management Options

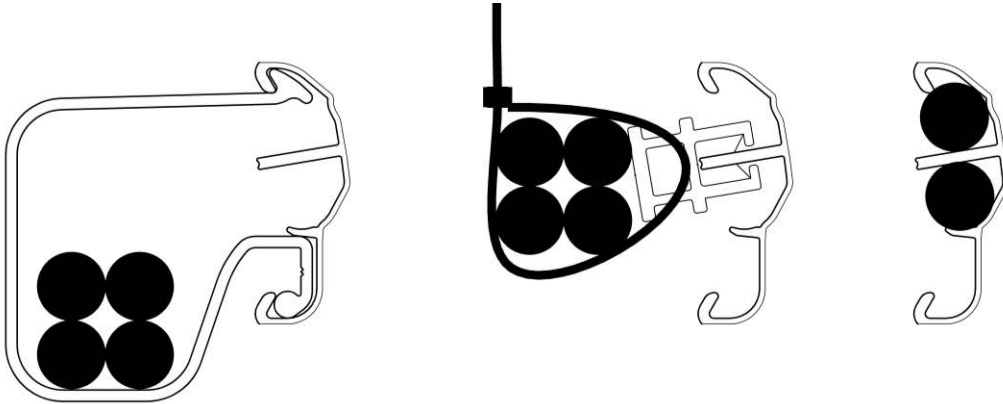


Figure 5 Cable Management Options (Left) Cable Raceway, (Middle) Lock-On Cable Tie, (Right) Integrated Cable Management

5.3.3.1. Lock-on Cable Tie

Unlike traditional cable ties, the Rail Locking Cable Tie (KCMT-1) connects directly to Rail instead of wrapping around it; extending the life of the Cable Tie by reducing stress points.



Figure 6 Lock-on Cable Tie

5.3.3.2. Integrated Cable Management

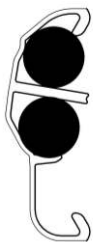


Figure 7 Integrated Cable Management

The rail itself provides a channel which may be used to secure cables in certain scenarios. Simply press the cable into the grooves at the top of the cable management channel along the length which you would like to secure. A maximum of two cables can be secured this way using the channel.

5.3.3.3. Cable Raceway

The Cable Raceway may be attached to the cable management channel or the side channel. The same method of installation can be used for both. Cable Raceway Kits include a sufficient number of segments to cover the indicated length or span between L-Brackets.

Sold in kits of 16" 24" 32" & 48"

1. Hang the Cable Raceway segment on the bottom edge of the side channel of the rail. Lay cables into Cable Raceway segment.
2. Rotate Raceway segment until it snaps into top edge of side channel of rail

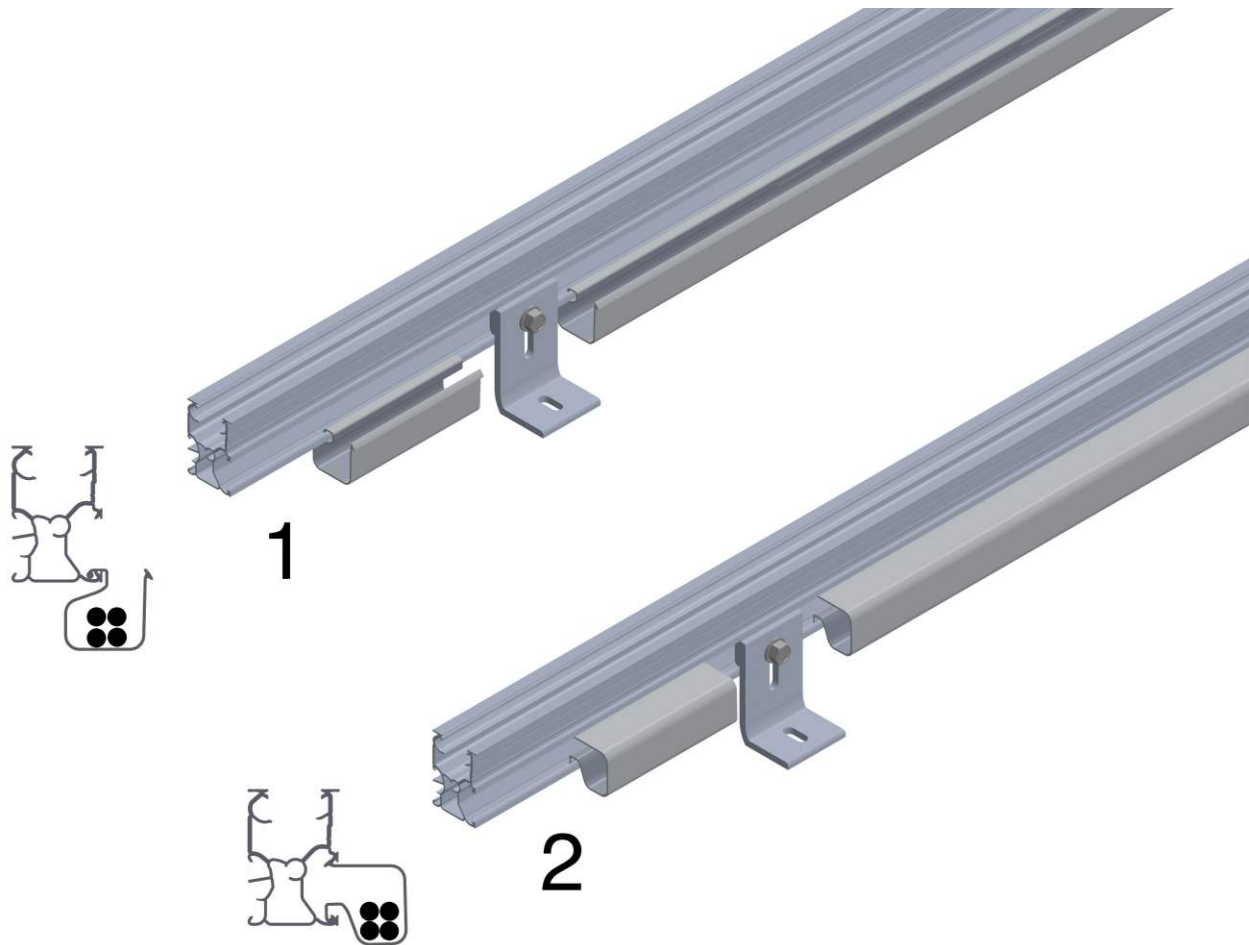


Figure 8 Cable Raceway Installation Procedure

6. Bonding Path

6.1. Traditional Grounding Path

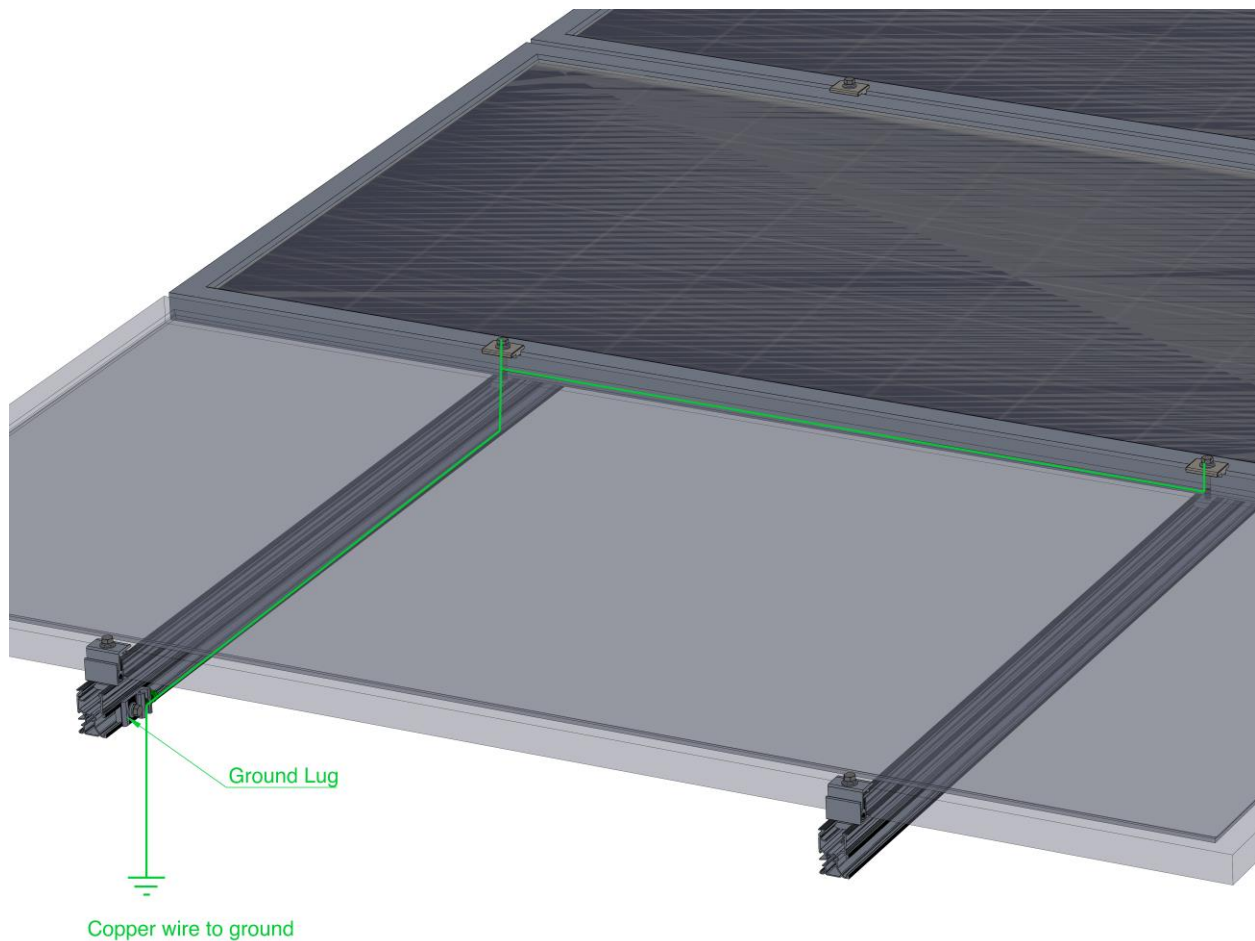


Figure 9 Grounding Path Detail

The grounding path through the main bonding components is shown above. The rail shown is the Rapid Rail, however this bonding path is consistent for the Venture Rail, Ground Hog Rail and Hat Rail. The module bonding is achieved through the Mid-Clamp. If anodized rail is to be used, then the A-Type of Kinetic Mid-Clamps and Ground Lugs must be used in order to penetrate the anodized coating of the rail and provide adequate bonding. If mill finished rail is to be used, then the M-Type of components or A-Type may be used. Similarly, if bonding is to be achieved through the rail joiner, the correct rail joiner must also be used. For anodized rail, the KJS2W must be used. For mill finish rail, either the KJS2W or KJS2 may be used.

Rail	Component
Mill Finish Aluminum Rails	M-Type or A-Type
Black Anodized Aluminum Rails	A-Type only
Clear Anodized Aluminum Rails	A-Type only
Hat Rail	G-Type only

Figure 10 Component Compatibility Chart

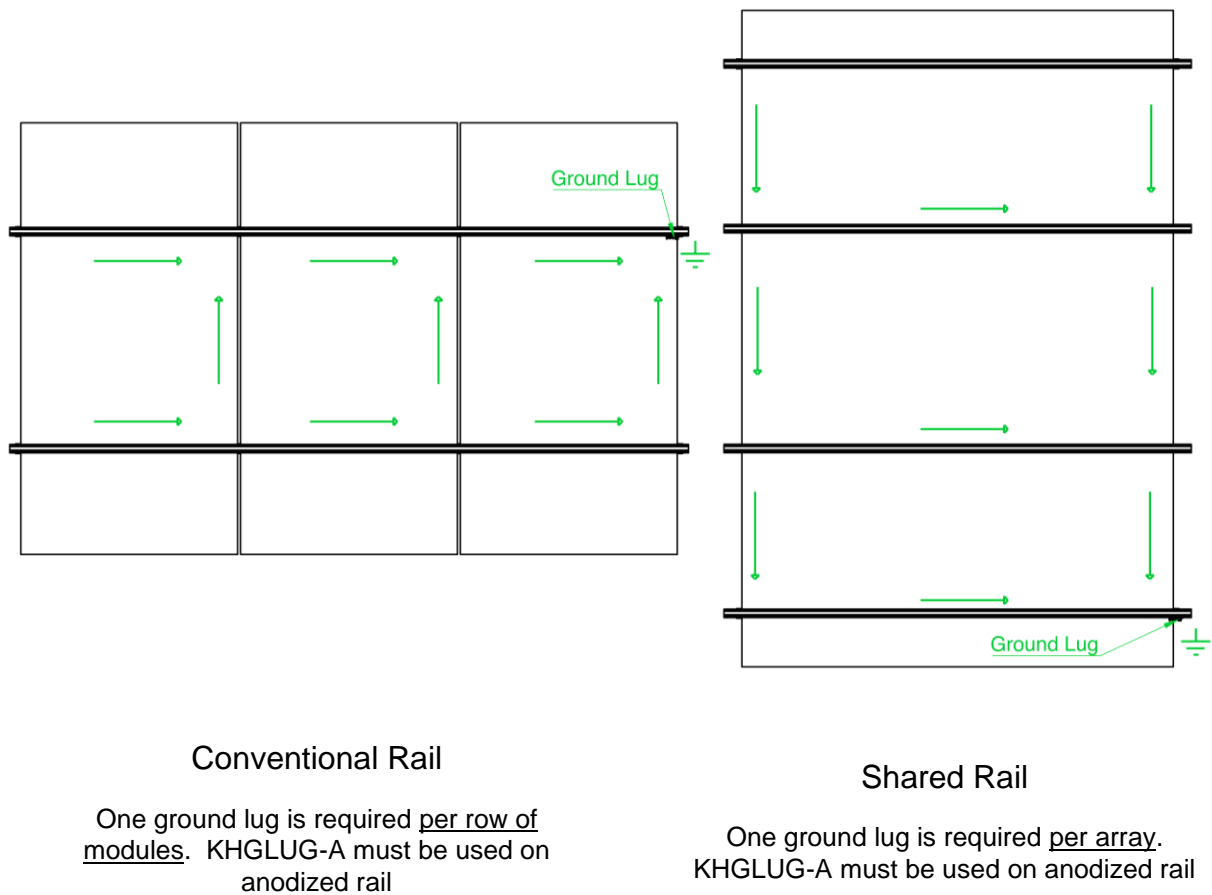


Figure 11 Grounding Path of Conventional and Shared Rail Systems

6.2. Groundhog Rail Grounding Path

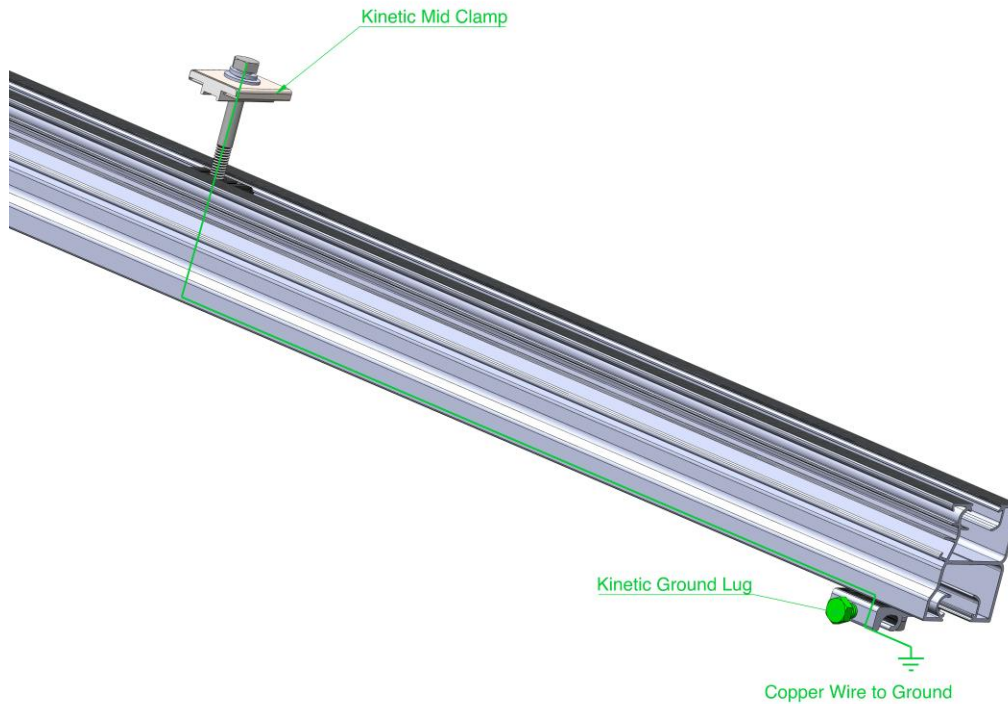


Figure 12 Fixed Angle Ground Mount Grounding Path (Bottom Ground Lug Attachment Shown)

Grounding can be achieved on the Groundhog Rail through the use of a ground lug (KHGLUG-M) for mill finish rails or (KHGLUG-A) for anodized rails. The ground lug can be positioned at either the top or the bottom of the rail.

6.3. Hat Rail Grounding Path

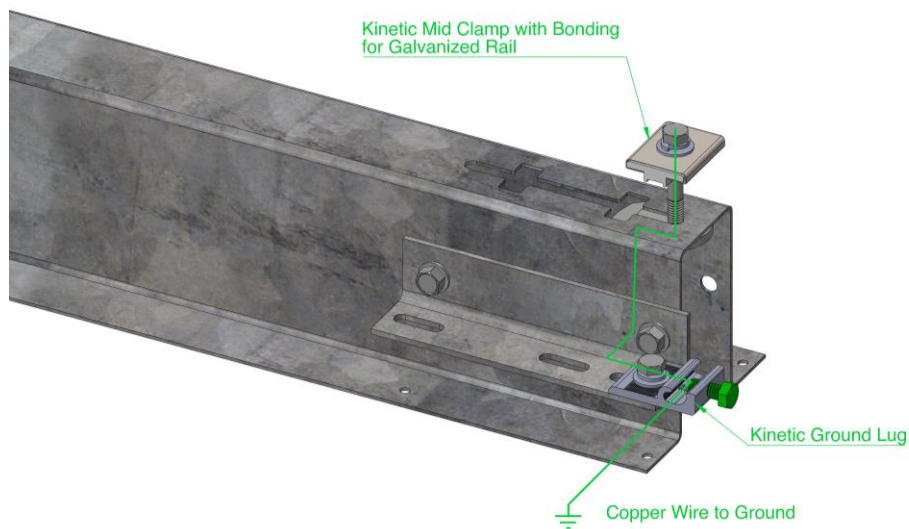


Figure 13 Adjustable Ground Mount Grounding Path

Grounding can be achieved on the Hat Rail through the use of a ground lug (KHGLUG-G) attached to the Mounting Kit or directly to the Hat Rail.

6.4. Joiners

If there are any rail joiners, adequate bonding must be used between rail sections. If an anodized rail is being used then a KJS2W joiner must be used.

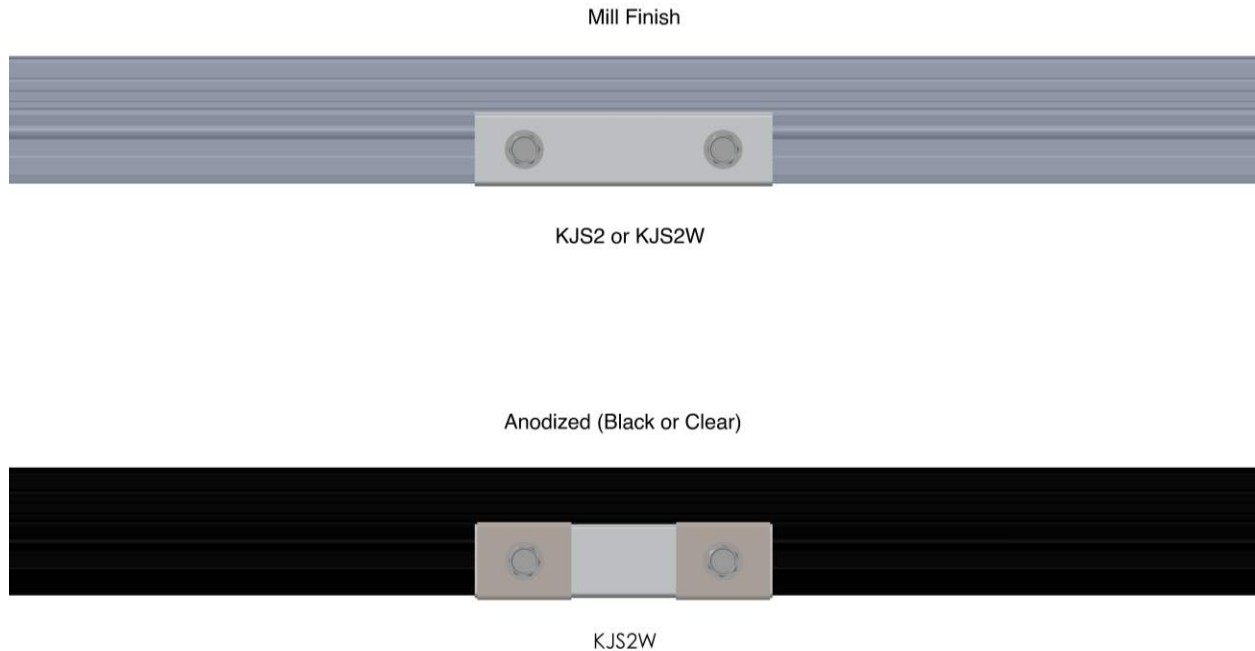


Figure 14 Joiner Compatibility

6.5. Thermal Break

If there is a thermal break, two ground lugs (KHGLUG-M, KHGLUG-A or KHGLUG-G) either side of the break, joined with a piece wire that meets the specifications in the table below is required.

6.6. Grounding

Grounding is to be achieved through the Kinetic Grounding Lug (KHGLUG-M, KHGLUG-A or KHGLUG-G) and a copper or aluminum wire that meets the specifications in the table below. Systems mounted in a conventional rail design require a minimum of one ground lug per row. Systems mounted in a shared rail design require a minimum of one ground lug per array.

Conductor Material	Minimum Cable Size	Cable Type	Temperature Rating
Aluminum	10 AWG	Solid or Braided	75 °C
Copper	8 AWG	Solid or Braided	60 °C

Figure 15 Bonding Conductor Requirements

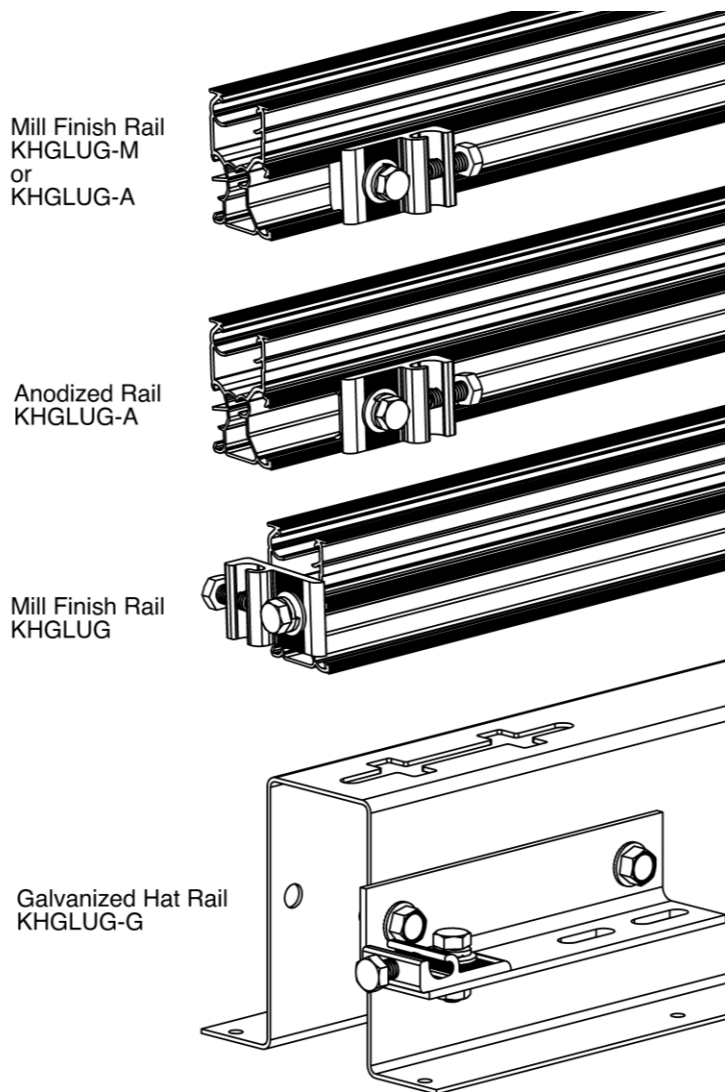


Figure 16 Ground Lug Mounting Options

6.7. Bonding and Grounding Devices

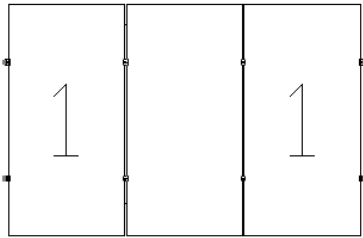
SKU	Component Description	Use With	Associated Hardware
KMWC3037 -MM	Kinetic Mid Clamp with Grounding Washer 30-37mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut - SBWK-312 or WEEB-M-KR
KMWC3037 -BA/CA	Kinetic Mid Clamp with Grounding Washer 30-37mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 2 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KMWC3037 -G	Kinetic Mid Clamp with Grounding Washer 30-37mm	-Galvanized Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Hat Rail Nut - SBWK-312 or WEEB-M-KR
KMWC3843 -MM	Kinetic Mid Clamp with Grounding Washer 38-43mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/2" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut - SBWK-312 or WEEB-M-KR
KMWC3843 -BA/CA	Kinetic Mid Clamp with Grounding Washer 38-43mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 2 1/2" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KMWC3843 -G	Kinetic Mid Clamp with Grounding Washer 38-43mm	-Galvanized Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/2" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Hat Rail Nut - SBWK-312 or WEEB-M-KR
KMWC4450 -MM	Kinetic Mid Clamp with Grounding Washer 44-50mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 3" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut - SBWK-312 or WEEB-M-KR
KMWC4450 -BA/CA	Kinetic Mid Clamp with Grounding Washer 44-50mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 3" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KMWC4450 -G	Kinetic Mid Clamp with Grounding Washer 44-50mm	-Galvanized Steel	<ul style="list-style-type: none"> - 5/16" x 3" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Hat Rail Nut - SBWK-312 or WEEB-M-KR

SKU	Component Description	Use With	Associated Hardware
KHGLUG-M	Kinetic Ground Lug for Mill Finish Systems	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 3/4" Green, Stainless, Hex Head Bolt - 5/16" x 1" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut
KHGLUG-A	Kinetic Ground Lug for Anodized Finish Systems	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 3/4" Green, Stainless, Hex Head Bolt - 5/16" x 1" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut
KHGLUG-G	Kinetic Ground Lug for Galvanized Finish Systems	-Galvanized Steel	<ul style="list-style-type: none"> - 5/16" x 3/4" Green, Stainless, Hex Head Bolt - 5/16" x 1 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - 5/16" Stainless Hex Nut
KJS2-MA/BA/CA	Kinetic Joiner for Anodized Systems (Mill Finish, Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 3/4" Stainless Serrated Flanged Hex Head Bolt (2) - SBWK-312 or WEEB-M-KR (2)
KJS2-MM	Kinetic Joiner (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 3/4" (2) Stainless Serrated Flanged Hex Head Bolt - Kinetic Joiner Clamp
KEWC3037-MA	Kinetic End Clamp with Grounding Washer 30-37mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut - SBWK-312 or WEEB-M-KR
KEWC3037-BA/CA	Kinetic End Clamp with Grounding Washer 30-37mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 2 1/4" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KEWC3843-MA	Kinetic End Clamp with Grounding Washer 38-43mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 2 1/2" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - K-Nut - SBWK-312 or WEEB-M-KR
KEWC3843-BA/CA	Kinetic End Clamp with Grounding Washer 38-43mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 2 1/2" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KEWC4450-MA	Kinetic End Clamp with Grounding Washer 44-50mm (Mill Finish)	- Mill Finish Rail	<ul style="list-style-type: none"> - 5/16" x 3" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer

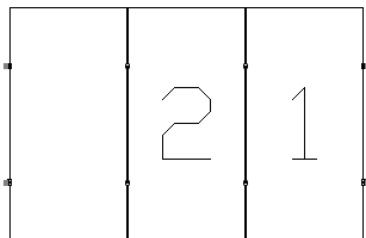
SKU	Component Description	Use With	Associated Hardware
			<ul style="list-style-type: none"> - K-Nut - SBWK-312 or WEEB-M-KR
KEWC4450-BA/CA	Kinetic End Clamp with Grounding Washer 44-50mm (Black Anodized or Clear Anodized)	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - 5/16" x 3" Stainless Hex Head Bolt - 5/16" Stainless Flat Washer - 5/16" Stainless Lock Washer - Stainless K-Nut - SBWK-312 or WEEB-M-KR
KSGMM-G	Mounting Kit for Hat Rail	-Galvanized Steel	<ul style="list-style-type: none"> - 5/16" x 3/4" Serrated Flanged Hex Head Bolt (4) - 5/16" Serrated Nut (4)
KRJK-M	Kinetic Rail Jumper Kit	-Mill Finish	<ul style="list-style-type: none"> - KHGLUG-M (2) - 8 AWG Braided Copper Wire
KRJK-A	Kinetic Rail Jumper Kit	<ul style="list-style-type: none"> - Mill Finish - Black Anodized - Clear Anodized 	<ul style="list-style-type: none"> - KHGLUG-A (2) - 8 AWG Braided Copper Wire

Figure 17 Bonding and Grounding Devices

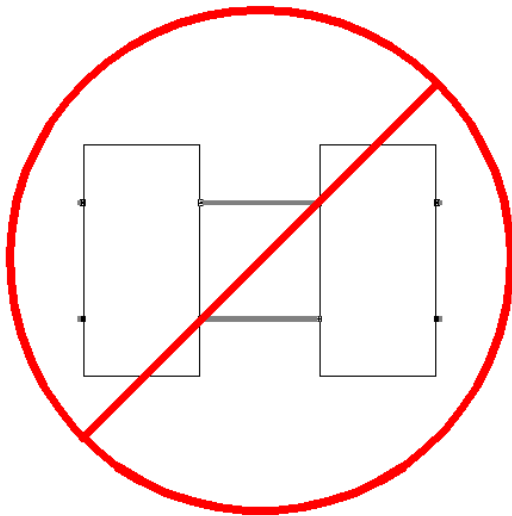
6.8. Removing Modules from an Array



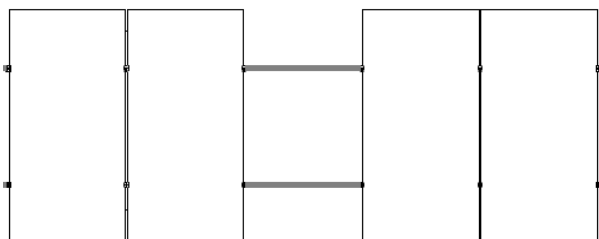
If removing the module on the end of a row, no special precautions need to be taken.



If a module (or modules) need to be removed from second from the end of a row, the modules on the end need to be removed first. This may be avoided if module 1 is grounded independently of module 2



Never remove the module second from the end of a row before removing the end module unless the end modules are grounded independently



If there are two or more modules remaining at the end of a row, there is no need to remove the modules on the end.

Figure 18 Module Removal Procedure

7. List of Compatible Modules

Please see the Kinetic Solar's List of Compatible Modules Revision 6 for a full list of modules certified for use with our system.

8. Required Maintenance

All installed systems should be checked at least annually to ensure that no components have come loose, become damaged or corroded. If any inadequacies are found, they are to be immediately remedied.

9. Pitched Roof Installation Instructions

Please note that other fasteners can be substituted for lag bolts as long as they meet or exceed the shear and pullout strength of a 5/16" lag bolt. Installation procedures may differ, follow manufacturer guidelines in place of Kinetic instructions where necessary.

9.1. Layout Considerations

Each span between L-Brackets (48") in a conventional (2 rails per run of modules) system typically supports 1.2 72 cell modules in portrait or 0.6 72 cell modules in landscape. In a shared rail system, a shared rail may support up to 1.2 72 cell modules between L-Brackets (48") in landscape.

9.1.1. Design Loads

9.1.1.1. UL 2703 Design Load

		Maximum Span
Downward Design Load	3600 Pa (75.3 lb/ft ²)	48"
Upward Design Load	1600 Pa (33.4 lb/ft ²)	48"
Down Slope Load	239 Pa (5.0 lb/ft ²)	48"

Figure 19 UL 2703 Design Loads

9.1.1.2. LTR-AE-001-2012 Design Load

		Maximum Span
Downward Design Load	5400 Pa (113 lb/ft ²)	48"
Upward Design Load	2400 Pa (50 lb/ft ²)	48"

Figure 20 LTR-AE-001-2012 Design Loads

*Please note that for loads greater than 2400 Pa (50 lb/ft²) the attachment to the L-Bracket must be positioned at the bottom of the slot.

**Ground Mount Systems have not been mechanical load tested.

9.1.2. Horizontal

Mounting the rail horizontally on a pitched roof is the most common and typically the easiest way to install solar modules.

9.1.2.1. Shared Rail

Rails are to be spaced according to manufacturer guidelines. Attachments are to be spaced at a maximum of 48" depending on local wind and snow loads.

*See design loads above.

Pro-Tip

When installing a shared rail system, the top and bottom rails can be installed in a conventional Landscape orientation in order to avoid roof edges and peaks.

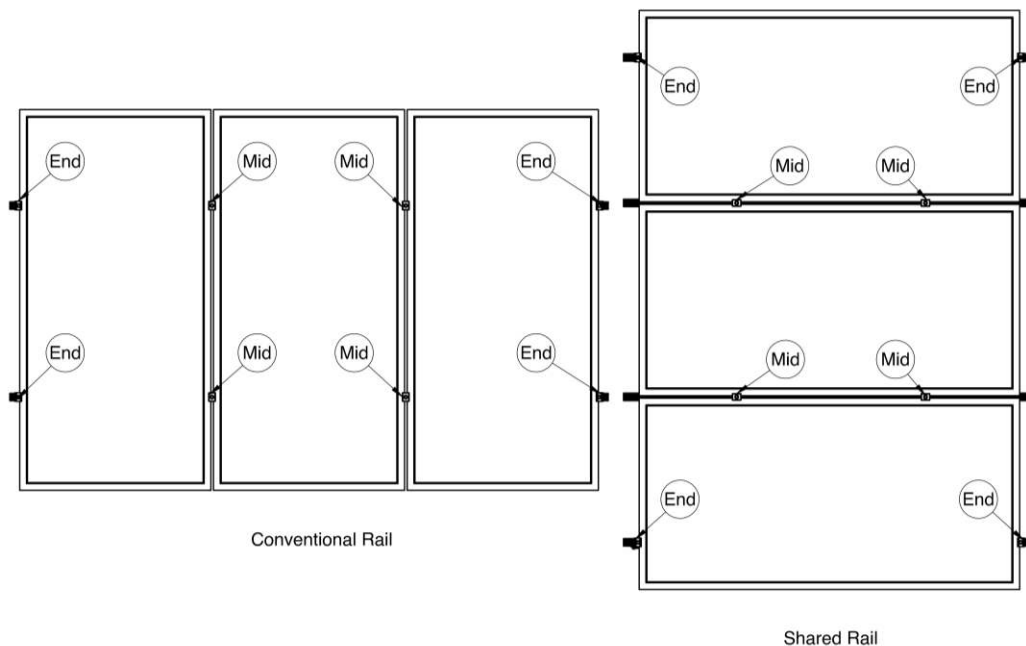


Figure 21 Conventional vs Shared Rail

The rail positions of shared and conventional. It is recommended that the upper and lowermost rails in a shared rail configuration be installed conventionally in order to make installation easier. Please note that not all panel manufacturers support this clamping configuration.

9.1.2.2. Conventional

Rails are to be spaced according to module manufacturer guidelines. Attachments are to be spaced at a maximum of 48" depending on local wind and snow loads.

*See design loads above.

9.1.3. Vertical Conventional

In some cases, the rails can be installed vertically up the roof in order to reduce the amount of rail required. The ability to do this will ultimately rely on the structural assessment of the roof and whether or not it can be supported. Other than the orientation of the rails, the installation will be identical to a conventional rail system.

9.2. Install Roof Mounts

9.2.1. Shingled Roof

9.2.1.1. Flashing & Mounting Kit

- i. Measure and mark the appropriate bracket locations. Use a measuring tape to ensure chalk lines are straight and square. When marking, take care to ensure that the top of the flashing is at least $\frac{1}{4}$ " above the top of the slit in the shingle (Figure 22 Flashing Positioning)

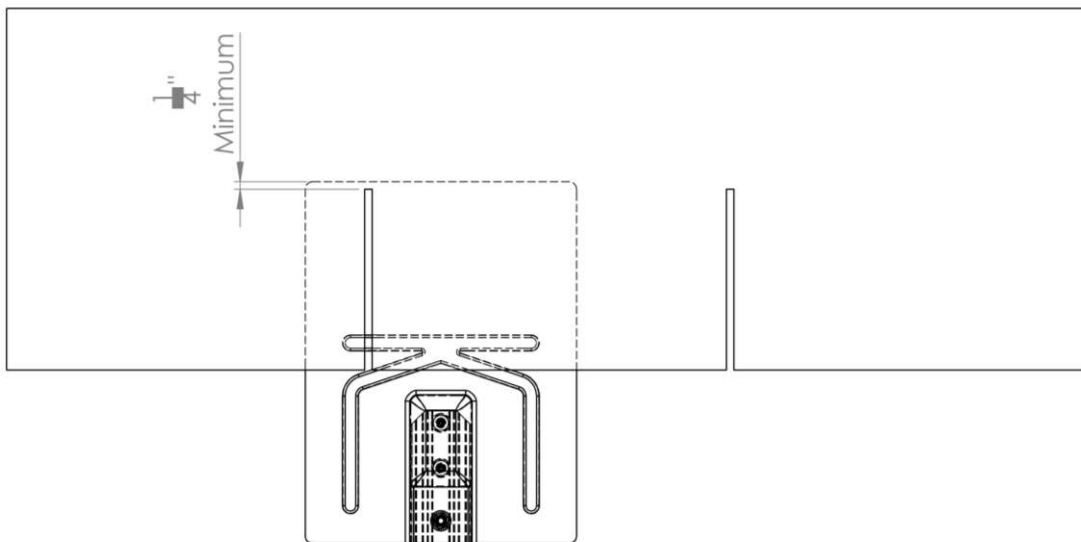


Figure 22 Flashing Positioning

- ii. Prepare roof for the installation of lag bolts by drilling two 7/32" pilot holes through the roof and into the rafter for each Base Plate that will be affixed.

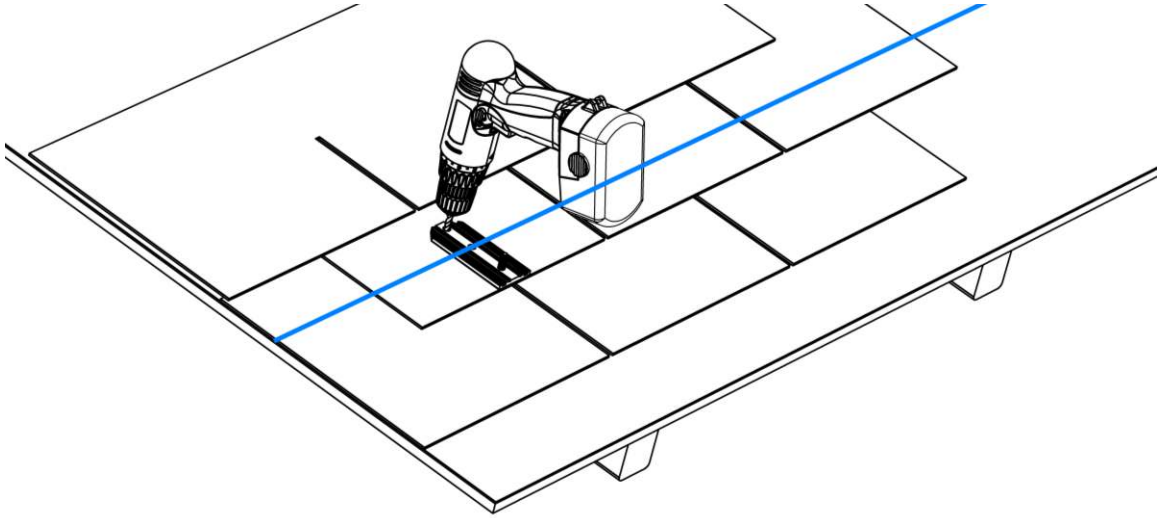


Figure 23 Measure and Pre-Drill

- iii. Screw each Base Plate into position using two lag bolts. The Base Plate should be facing downward (holes up with respect to the peak of the roof, stud facing outwards)

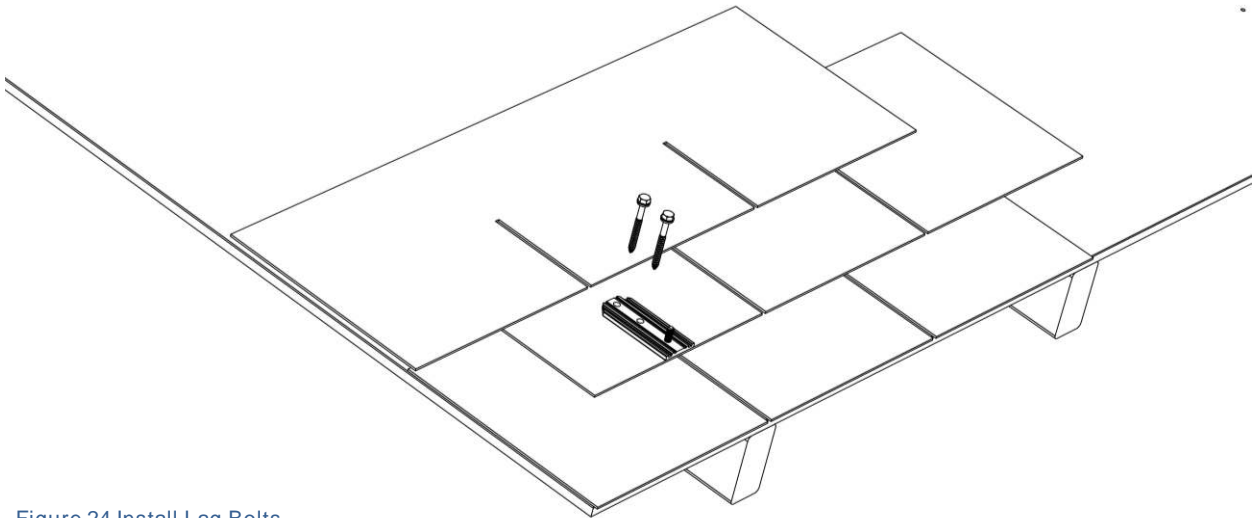


Figure 24 Install Lag Bolts

- iv. Apply Geocel 4500 Roof Bonding Sealant, BES 925 or equivalent to the underside of your K-Flash sheet



Figure 26 Geocel 4500



Figure 25 Geocel PROFLEX

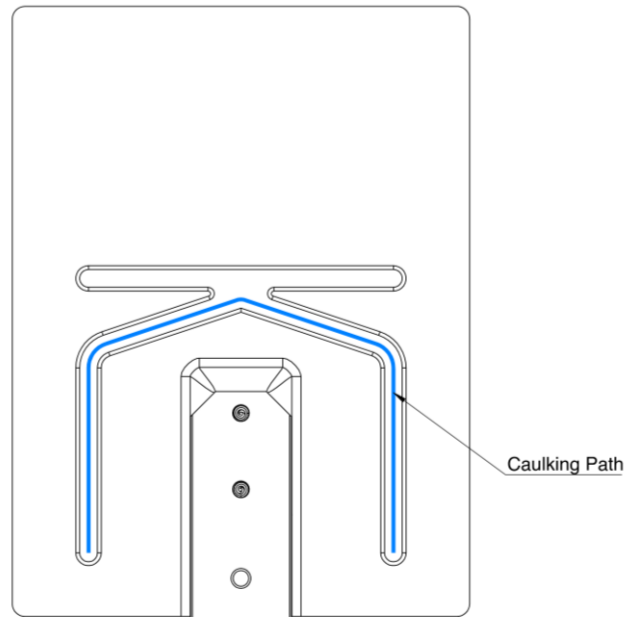


Figure 27 Caulking Path

- v. Slide the K-Flash sheet under shingles and position over the base plate stud; the K-Flash sheet should sit flush against the roof.

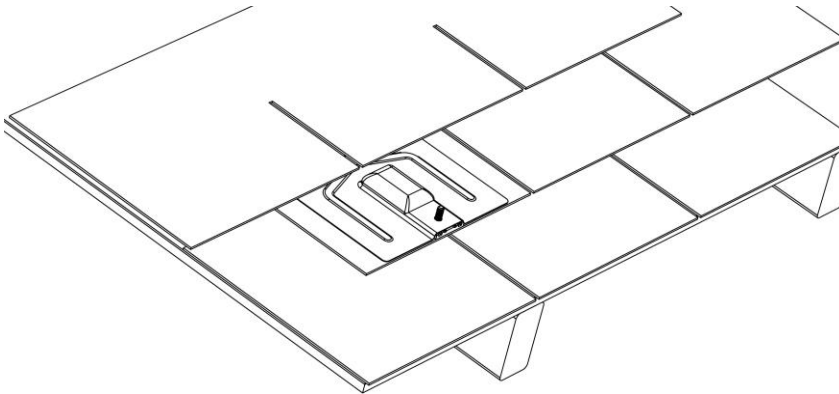


Figure 28 Installed Flashing

9.2.1.2. Universal L-Mount

Install on individual shingle surface. Surface must be flat and even (within 1/16") to ensure watertight seal – do not install over cut out or butt edge of shingle.

1. Measure and mark the appropriate mount locations. Use a measuring tape to ensure chalk lines are straight and square.
2. Prepare roof for the installation of lag bolts by drilling two 7/32" pilot holes through the roof and into the rafter for each mount that will be affixed.
3. Peel wax paper off backing of mount prior to its final placement.
4. Screw each mount into position using two lag bolts.

9.2.2. Metal Roof

9.2.2.1. Trapezoidal/Corrugated

9.2.2.1.1. Hippo Mount

- i. Drill two 7/32" pilot holes through the seam and into the rafter for each Hippo Mount.
- ii. At each location, position the Hippo Mount parallel to the seam of the roof
- iii. Insert a bead of Geocel 4500 or BES 925 into each of the pilot holes
- iv. Install Lag Bolts (with EPDM washer) through the Hippo Mount and into the pilot holes

9.2.2.1.2. Hanger Bolt

- i. When installing into the raised portion (Figure 29 Hanger Bolt Ridge Installation) of the roof drill a \varnothing 3/4" hole into the steel portion of the roof only.
 - a) If you are installing into the lower portion (Figure 30 Hanger Bolt Trough Installation) of the roof, skip Step 1 and continue to Step 2
- ii. Drill a \varnothing 7/32" pilot hole into the rafter/truss
- iii. (Optional) Insert a bead of Geocel 4500 or BES 925 into the pilot hole
- iv. (Optional) Apply a bead of Geocel 4500 or BES 925 around the outside perimeter of the hole
- v. If installing into the ridge of the roof, insert the optional spacer around the pointed end of the bolt
 - a) If mounting into the lower portion of the roof (trough), skip this step
- vi. Insert Hanger Bolt assembly into the drilled hole
- vii. Using a long series 1/2" socket drive, tighten until the EPDM Neoprene Washer is seated firmly enough to ensure a watertight seal

DO NOT OVERTIGHTEN - THIS MAY DAMAGE THE ROOF AND CAUSE LEAKAGE

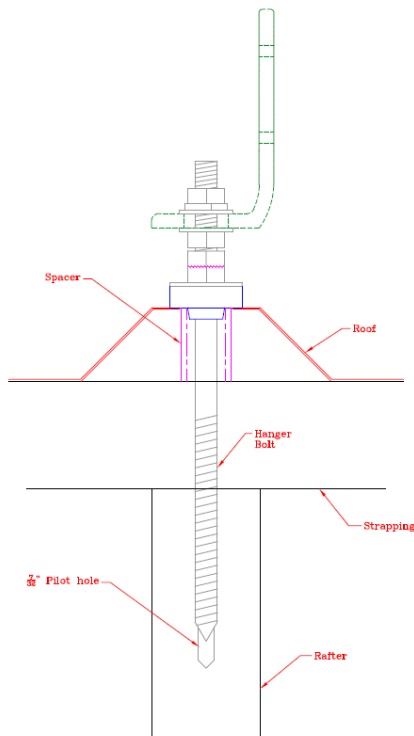


Figure 29 Hanger Bolt Ridge Installation

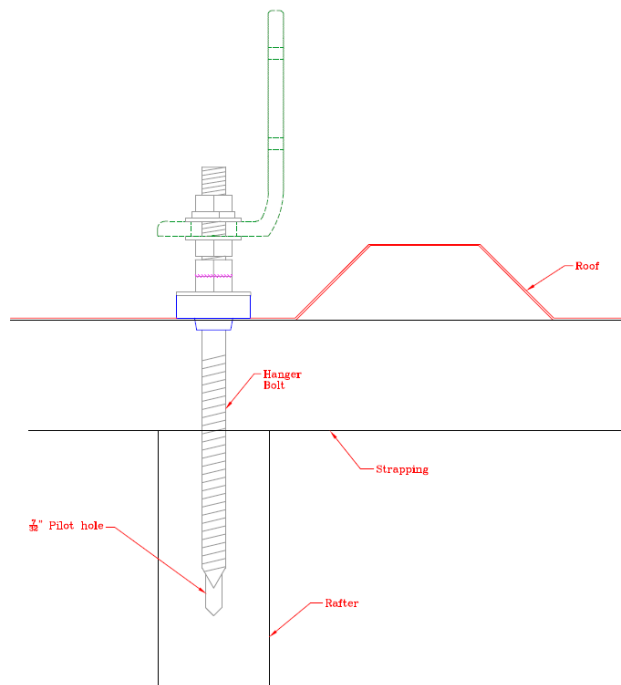


Figure 30 Hanger Bolt Trough Installation

9.2.2.1.3. Square Roof Bracket

- i. Drill two 7/32" pilot holes in line with the holes of the mounting plate at each mounting location.
- ii. Insert a bead of Geocel 4500, BES 925 or equivalent into each of the holes
- iii. At each location, install two Lag Bolts through the holes of the steel plate into the predrilled holes
- iv. Lay a bead of Geocel 4500, BES 925 or equivalent on the roof around the outside edge of the plate

9.2.2.1.4. Universal L-Mount

- i. Installation surface must be flat and even (within 1/16") to ensure watertight seal
- ii. Measure and mark the appropriate mount locations. Use a measuring tape to ensure chalk lines are straight and square.
- iii. Prepare roof for the installation of lag bolts by drilling two 7/32" pilot holes through the roof and into the rafter for each mount that will be affixed.
- iv. Peel wax paper off backing of mount prior to its final placement
- v. Screw each mount into position using two lag bolts.

9.2.2.2. Standing Seam

9.2.2.2.1. Regular Standing L & Large Standing L

- i. Measure and mark the appropriate Standing L locations. Use a measuring tape to ensure chalk lines are straight and square.
- ii. Place the Standing L so that it straddles the standing seam, ensure that the underside of the Standing L rests on top of the seam
- iii. Torque to 12 ft-lbs (16.3 N-m)

9.2.2.2.2. S-5! / A2

Please refer to the manufacturers installation instructions

9.3. L-Brackets / Rails



- a) Insert the K-Nut of the L-Bracket assembly into the side channel of the rail.

*See section 5.3.1

- b) Attach the short end of the L-Bracket to the base plate using the supplied flange nut. The long end should be upright.

9.4. Rail Joiners

*If not using Rail Joiners, continue to section 9.5.

- a) Insert the Joiner assembly into the side channel of the rail at the ends being joined. Ensure Joiner is centered between the two rail ends. Tighten the bolts of the Joiner. Torque to 12 ft-lbs (16.3 N-m).

9.5. Micro Inverters

*Install Micro Inverters according to manufacturer specifications. The following attachment methods can be used.

Figure 31 Installed Rails

9.5.1. Side Mount

- Insert K-Nut portion of micro inverter mount assembly into side channel of Rail at 30-degrees.
- Install micro inverter onto mount
- Tighten and torque to spec

9.6. Mount Solar Modules

- Position module on the rails (make sure to hold modules securely until properly fastened). Ensure the first module is square before continuing, as this will affect the squareness of the array.
- Insert the K-Nut of the End-Clamp assembly into the top channel of the rail. Insert K-Nut of the Mid-Clamp assembly into the top channel of the rail. Slide Mid and End-Clamps into place against edge of panel
- Tighten Mid and End-Clamps to hold module in place - do not fully torque

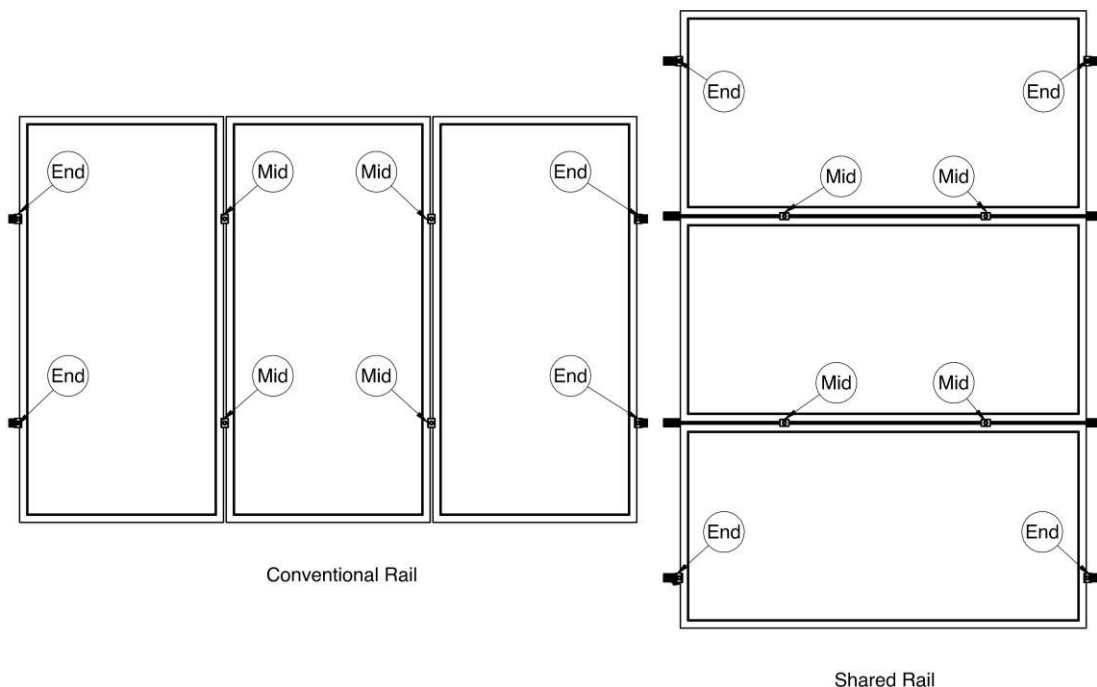


Figure 32 End and Mid Clamp Positions in Conventional and Shared Rail Layouts

- Repeat steps 1-4 as required for remaining modules
- Torque clamps to 12 ft-lbs (16.3 N-m)

9.7. Wire Management

Various Wire Management methods can be combined

9.7.1. Cable Raceway

- i. Hang the Cable Raceway segment on the bottom edge of the side channel of the rail
- ii. Lay cables into Cable Raceway segment. Rotate Raceway segment until it snaps into top edge of side channel of rail

9.7.2. Lock-On Cable Tie

- i. Place on rail where needed; approximately 1 x Cable Tie for every 1 foot of rail
- ii. Wrap Cable Tie around cables and fasten tightly

9.7.3. Integrated Cable Management

The rail itself provides a channel which may be used to secure cables in certain scenarios. Simply press the cable into the grooves at the top of the cable management channel along the length which you would like to secure. A maximum of two cables can be secured this way using the channel.



Figure 33 Integrated Cable Management

10. Venture Rail System

10.1. O-Ring Cord Sealing Channel

- a) Without stretching, press the O-Ring cord into the O-Ring Cord Sealing Channel along its top edge
- b) Repeat for the other side and other rails as necessary

10.2. Install Rails

10.2.1. L-Brackets

- a) Position the rail in the desired location, place the L-Bracket in the side channel of the rail in the appropriate position
- b) Install your desired fasteners along with the L-Brackets in the appropriate locations according to the manufacturer's guidelines
- c) Repeat steps 1-2 as necessary for the remaining rails

10.2.2. K-Nut & Bolt

- a) Drill holes at the desired locations and insert the bolts from the underside and attach the K-Nuts
 - b) Starting from either end, slide the rail onto the K-Nuts
 - c) Position the rail and tighten the bolts
- *Ensure bolt does not come into contact with top edge of bottom channel

10.3. Mounting Modules

- a) Position the module on the rails (make sure to hold modules securely until properly fastened)
- b) Ensure the first module is square before continuing, as this will affect the squareness of the array.
- c) Insert the K-Nut of the End-Clamp assembly into the top channel of the rail. Insert K-Nut of the Mid-Clamp assembly into the top channel of the rail.
- d) Slide clamps into place against the edge of the panel
- e) Tighten the clamps to hold the module in place (do not fully torque)
- f) Repeat steps 1-4 as required for remaining modules
- g) Torque clamps to 12 ft-lbs (16.3 N-m)

10.4. Wire Management

Various Wire Management methods can be combined

10.4.1. Cable Raceway

- a) Hang the Cable Raceway segment on the bottom edge of the side channel of the rail
- b) Lay cables into Cable Raceway segment. Rotate Raceway segment until it snaps into top edge of side channel of rail

10.4.2. Lock-On Cable Tie

- a) Place on rail where needed; approximately 1 x Cable Tie for every 1 foot of rail
- b) Wrap Cable Tie around cables and fasten tightly

10.4.3. Integrated Cable Management



The rail itself provides a channel which may be used to secure cables in certain scenarios. Simply press the cable into the grooves at the top of the cable management channel along the length which you would like to secure. A maximum of two cables can be secured this way using the channel.

Figure 34 Integrated Cable Management

10.5. Micro-Inverter Mounts

*Install Micro Inverters according to manufacturer specifications. The following attachment methods can be used.

10.5.1. Side Mount

- a) Insert K-Nut portion of micro inverter mount assembly into side channel of Rail at 30-degrees.
- b) Install micro inverter onto mount
- c) Tighten and torque to spec



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