SM ASCENDER FLUSH MOUNT INSTALLATION GUIDE

UNIRAC

UNIRAC Code-Compliant Installation Manual

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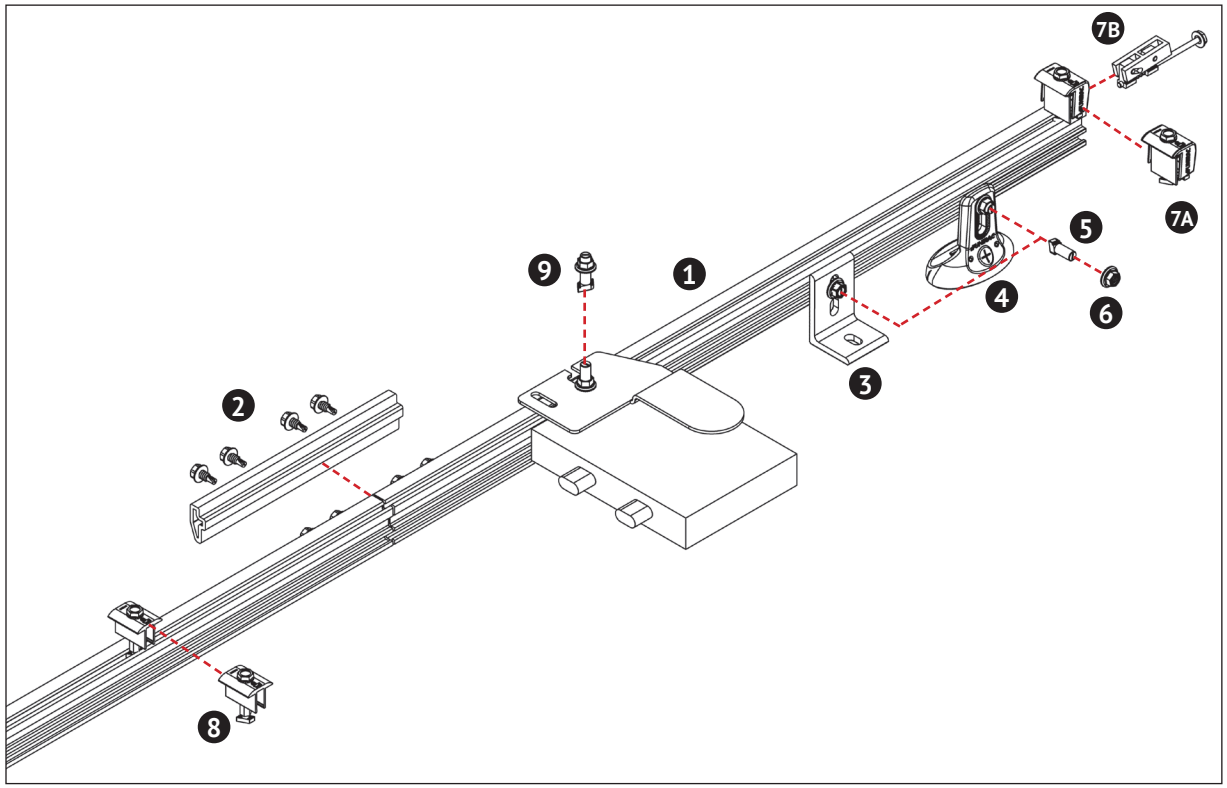


Wrenches and Torque

Description	Wrench or Socket Size	Recommended Torque (ft-lbs)
Rail Splice ❷	1/2"	20
FlashLoc Comp ❹		30
L-Foot to Rail ❻		30
UAF End Clamp ❼A		15
Pro Series End Clamp ❼B		5
UAF Mid Clamp ❽		15
Micro Inverter Mounting Bolt ❾		10

Anti-Seize ❻❾

Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:
1. Apply minimal lubricant to bolts only where indicated in installation process, preferably Anti-Seize commonly found at auto parts stores (Anti-seize has been factory applied to mid clamp bolts)
2. Shade hardware prior to installation, and
3. Avoid spinning stainless nuts onto bolts at high speed.

NOTE - POSITION INDICATOR: T-bolts have a slot in the hardware end corresponding to the direction of the T-Head.

❶ **ASCENDER RAIL (A1R181M)**
Aluminum extrusion, available in mill finish. Supports PV modules. Use at least two per row of modules.

❷ **RAIL SPLICE (A1SP02M)**
Structural splice joins, aligns, and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 10 inches long, pre-assembled with bonding hardware. Available in mill finish.

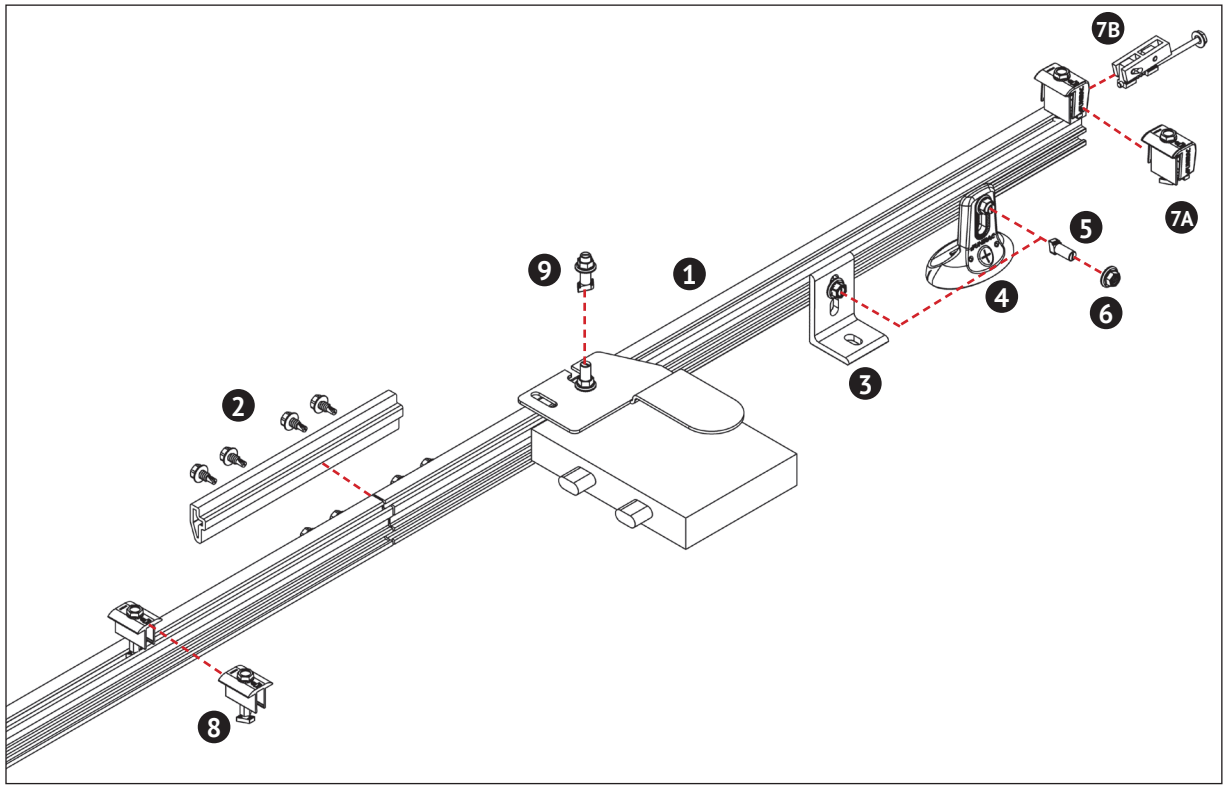
❸ **L-FOOT SERRATED WITH HARDWARE (A1LF02M)**
(1) T-bolt and (1) serrated flange nut will be shipped with L-foot. Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❹ **FLASHLOC COMP (004085)**
Use to secure rails through roofing material to building structure. Refer to loading tables or U-Builder for spacing.

❺ **L-FOOT T- BOLT (M311XX)**
(3/8" x ¾" or 1") – Use one per L-foot to secure rail to L-foot. Stainless steel. Supplied with L-foot in combination with flange nut, provides electrical bond between L-foot and rail.

❻ **SERRATED FLANGE NUT (M31184)**
Use one per L-foot to secure and bond rail to L-foot. Stainless steel. Supplied with L-foot.

❼A **MODULE UAF END CLAMP (302050M) /**
❼B **MODULE PRO-SERIES END CLAMP (302035M)**
Pre-assembled clamp that secures module to rail at module flange by tightening 1/2" hex head bolt.



8 MODULE MIDCLAMP (302045M)
Pre-assembled clamp provides module to module and module to rail bond. Aluminum clamp with stainless steel bonding pins and T-bolt. Available in clear or dark finish.

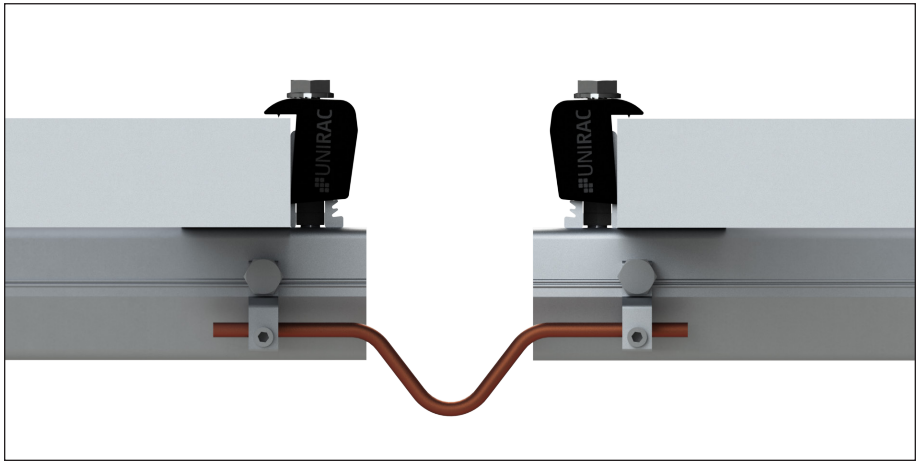
9 MICROINVERTER MOUNTING BOLT (008013S)
Pre-assembled bolt, nut, and captive star washer attaches and bonds microinverter to rail.

EXPANSION JOINT USED AS THERMAL BREAK

Expansion joints prevent buckling of rails or system failure due to thermal expansion. Determine location of expansion joints prior to installation of L-feet and rails. To create a thermal expansion joint, set gap between rails that is sufficient for proper installation of end clamps and tooling to achieve required torque. A thermal break is required when a continuous length of spliced rails exceeds the length, in feet, shown in the table to the right. For additional concerns on thermal breaks in your specific project, please consult a licensed structural engineer.

Rails in expansion joint configurations are considered cantilevered and must follow the cantilever rule, on both sides of the expansion joint, which states that the maximum amount of rail that can be cantilevered is 1/3 the respective adjacent span. An expansion joint must not be spanned by a PV module. Installing a module over an expansion joint would defeat the goal of a thermal break and could result in damage to the array.

Bonding connection for splice used as a thermal break. Option shown uses two Ilsco lugs (Model No. GBL-4DBT P/N GBL-4DBT - see product data sheet for more details) and solid copper wire.



	Maximum Continuous Length (ft.) of Spliced Rails			
	L-foot Attachment Span		Flashloc Comp Attachment Span	
ΔT (°F)	48”	72”	48”	72”
0-40	52	66	52	54
40-50	44	54	44	54
50-60	44	51	36	42
60-70	36	42	36	42
70-80	36	38	36	42
80-90	32	34	28	30
90-100	28	31	28	30
100-120	25	25	28	30
120-140	22	22	20	28

The values displayed are the maximum allowed rail length, in feet, without a thermal break.

These values apply only to the L-foot. For Flashloc Comp Mount, or if your span is less than 48”, refer to the SM Ascender Flush Mount Design & Engineering Guide for max lengths of continuous rail before a thermal break is required.

The installer is responsible for determining the maximum temperature difference (ΔT) used to establish the maximum rail length, without expansion joint, at the install location.

As spans increase, so does the maximum reaction force that the rail exerts on the L-foot. It is the responsibility of the installer to ensure that Maximum Reaction Force does not exceed the shear capacity of the roof connection. See SM Ascender Flush Mount Design and Engineering Guide for corresponding reaction forces.

ΔT refers to the maximum difference in the temperature of the rail between installation and the extreme high or low temperature. The Extreme Annual Design Conditions table at the following URL can be used as a reference when determining ΔT. ***http://ashrae-meteo.info/***

PLANNING YOUR SM ASCENDER FLUSH MOUNT INSTALLATIONS

Leave enough room to safely move around the array during installation. Some building codes and fire codes require minimum clearances around such installations, and the installer should check local building code requirements for compliance.

The length of the installation area is equal to:

UAF Series:

- the total width of the modules
- plus 1/2" inch for each space between modules (for mid- clamp)
- plus approximately 1.5" inch (3/4" inches for each End clamp)

UAF Mid Clamp and Pro Series End Clamp:

- the total width of the modules
- plus 1/2" inch for each space between modules (for mid- clamp)
- plus 0 to 1" (0 to ½ inches for each End clamp)

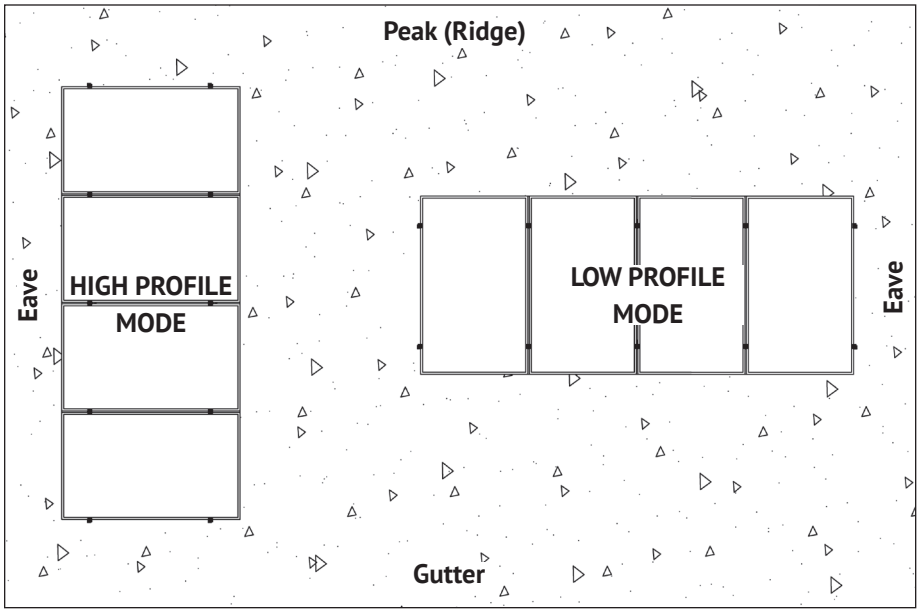
LAYING OUT L-FEET FOR TOP CLAMPS

Refer to U-Builder tool for EW span details and follow module manufacturer installation guide for rail spacing (NS spacing). Mark the locations for the L-feet within the installation area as shown in page 5

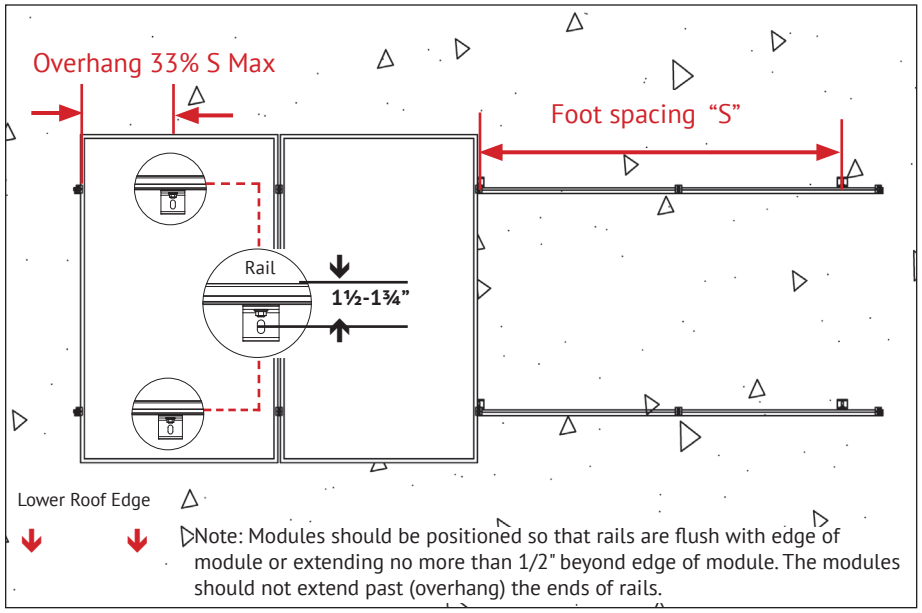
NOTE:

- **For expansion joint requirements, refer to page 3 . Rail lengths and locations of L-feet for expansion joints will need to be determined at this stage in planning system layout.**
- **Refer to U-Builder tool for allowable spans and cantilevers.**

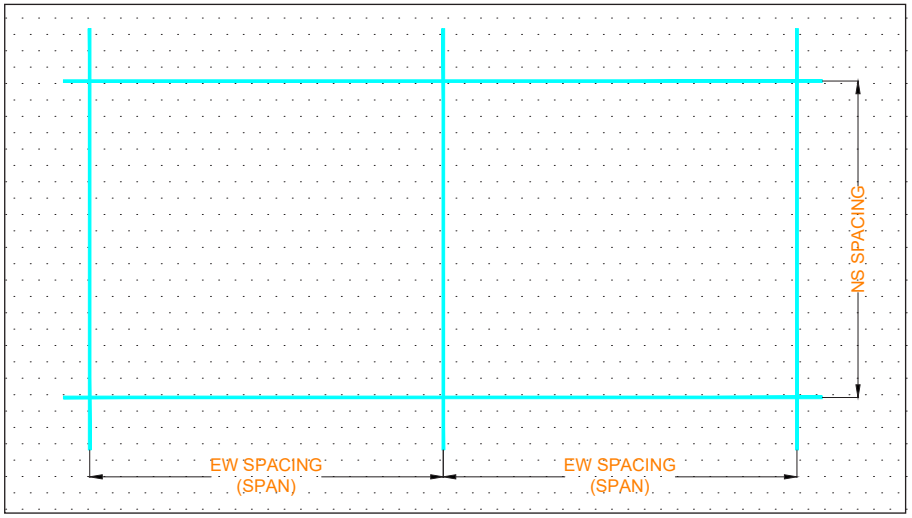
MODES OF LAYOUTS



LOW PROFILE MODE LAYOUT (RECOMMENDED)

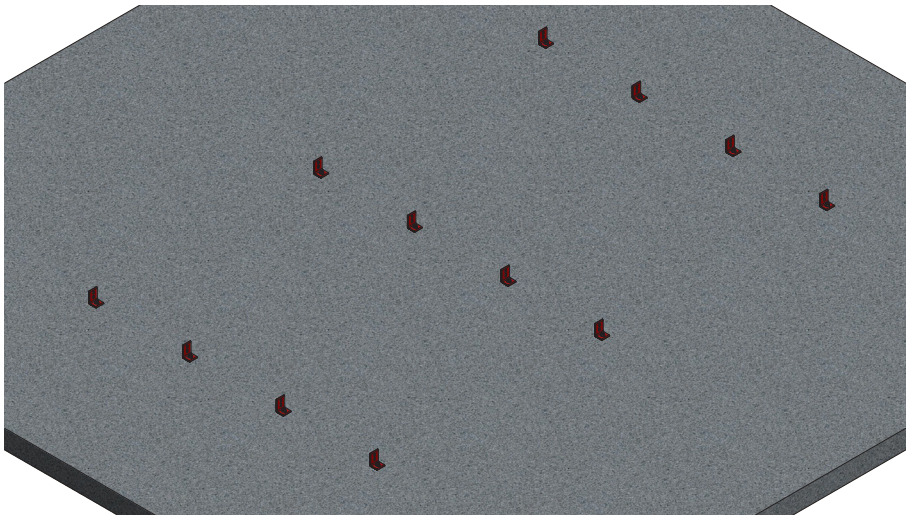


Note: Modules should be positioned so that rails are flush with edge of module or extending no more than 1/2" beyond edge of module. The modules should not extend past (overhang) the ends of rails.



STEP 1: ARRAY LAYOUT
Refer to U-Builder tool for EW span details and follow module manufacturer installation guide for rail spacing (NS spacing). Mark the location for the L-feet.

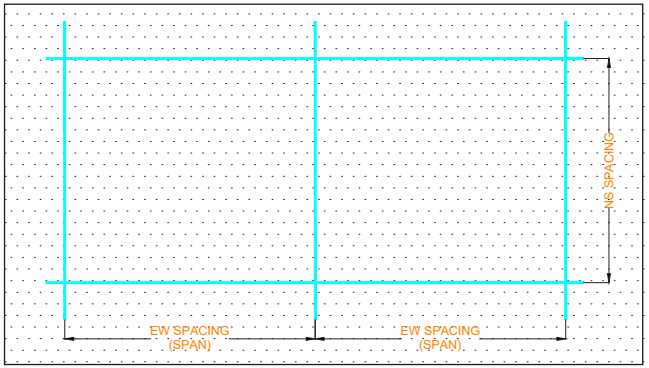
STEP 2: DRILL HOLES AND INSTALL CONCRETE ANCHORS
Follow anchor/epoxy manufacturer guidelines for hole depth and diameter. Assure all dust and debris are removed from holes prior to anchor installation. Insert anchors into holes and set per manufacturer's recommendations.



STEP 3: ATTACH L-FEET TO ANCHORS
Using a 3/8" bolt or all-thread with nut, install L-Feet and secure to concrete anchors. Ensure all L-Feet are oriented in the same direction. Follow anchor manufacturer requirements for torque specification.

⚠ CAUTION

1. **Installer need to ensure that the concrete anchor capacity is sufficient.**
2. **Weak connection may cause failure. Ensure that L-feet are securely fastened to the concrete.**
3. **Installers must ensure waterproofing for every roof penetration made while installing this racking system.**



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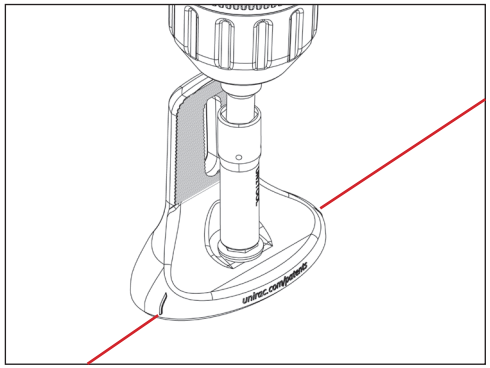
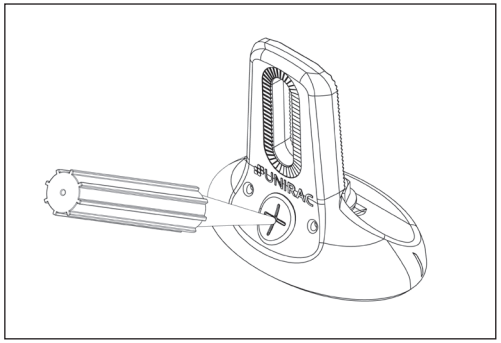
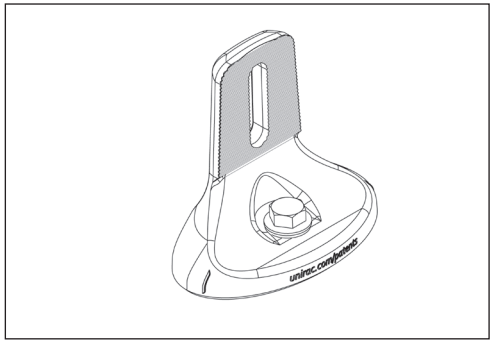


STEP 3: ATTACH FLASHLOC TO ANCHORS
Place FlasLoc over anchors with lag on down-slope side. Align indicator marks on sides of mount with chalk line. Using a 3/8" bolt or all-thread with nut, install FlashLoc and secure to concrete anchors.



STEP 4: INJECT SEALANT
Insert tip of UNIRAC provided sealant into port. Inject until sealant exits both vents.

NOTE:
- **Follow sealant manufacturer's instructions.**
- **Follow sealant manufacturer's cold weather application guidelines, if applicable.**



STEP 5: FINAL CHECK
Ensure all FlashLoc attachments are oriented in the same direction. Follow anchor manufacturer requirements for torque specification. Continue array installation, attaching rails to mounts with provided T-bolts.

⚠ CAUTION

1. **Installer need to ensure that the concrete anchor capacity is sufficient.**
2. **Weak connection may cause failure. Ensure that L-feet are securely fastened to the concrete.**
3. **Installers must ensure waterproofing for every roof penetration made while installing this racking system.**

SPLICE INSTALLATION (IF REQUIRED PER SYSTEM DESIGN)

If your installation uses splice bars, attach the rails together before mounting to the L-feet/footings. A rail must be supported by more than one footing on both sides of the splice.

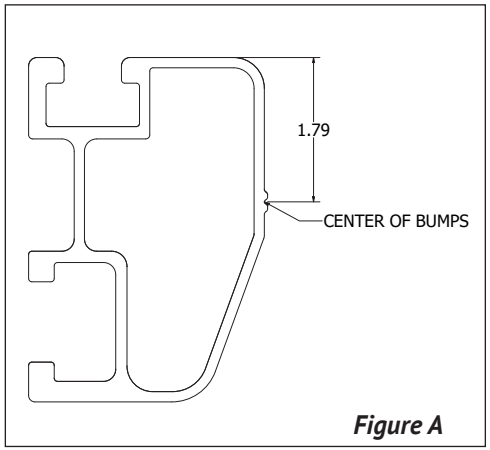


Figure A

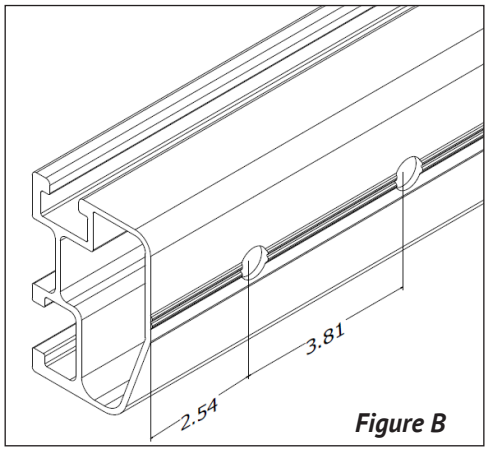
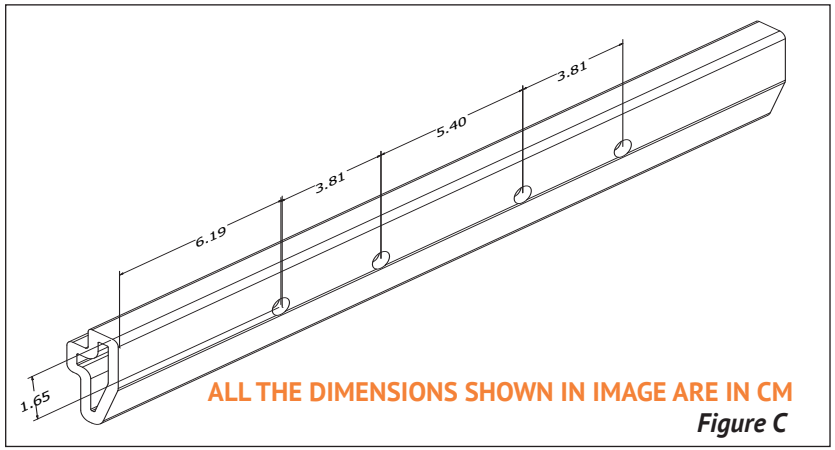


Figure B

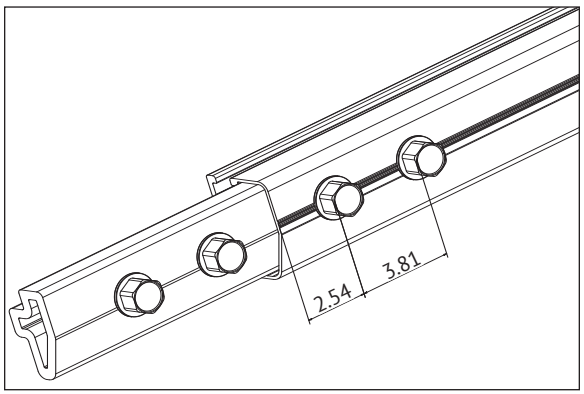


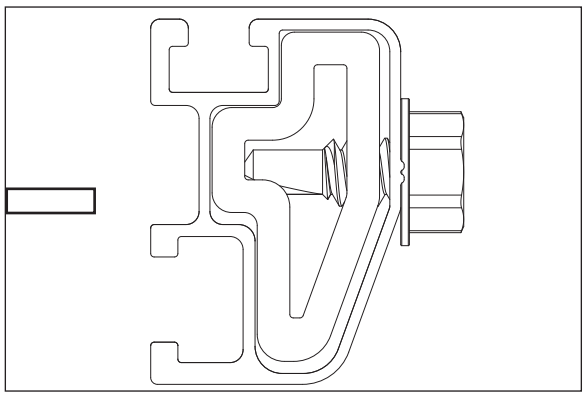
ALL THE DIMENSIONS SHOWN IN IMAGE ARE IN CM

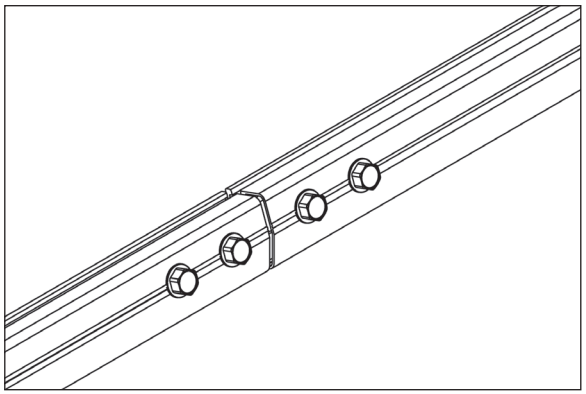
Figure C

DRILL HOLES ON RAILS& SPLICE MEMBERS

Measure the specified distances on the rails as shown on Fig A&B. Drill pilot holes of 0.238" to allow 5/16" drilling screws. Measure the specified distances on the side of the splice as shown in Fig. C. Drill pilot holes with the same size drill bits that are used for making holes on rails.





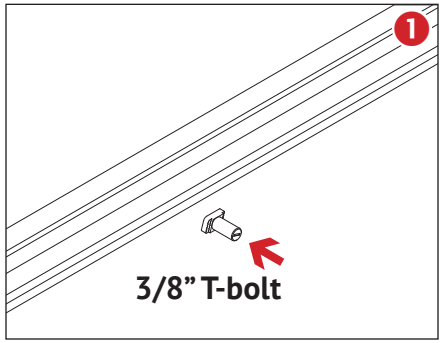


INSTALL SPLICE MEMBERS ON RAILS

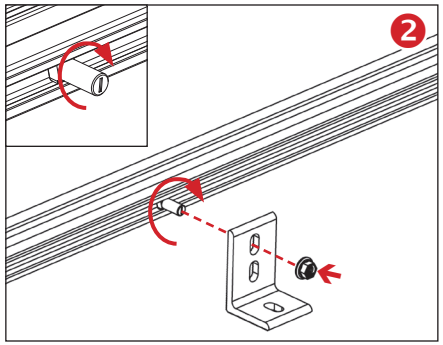
Insert the splice into the rails equally on both sides. Ensure that the splice holes and rail holes are drilled in the specified distances as mentioned in above step and the gap between the spliced rails does not exceed 0.32 cm. Failure to do so may result in lowered structural strength.

Use 4 Self-drilling screws, 2 screws on each rail. Drive the self drilling screws into the holes using impact drill until it touches the rail.

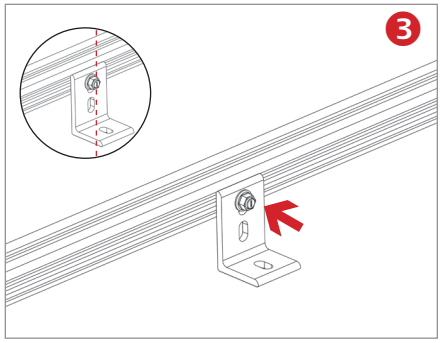
Torque 5/16" self drilling screw to 20 ft-lbs.



PLACE T-BOLT INTO RAIL: Insert 3/8" T-bolt into rail at L-foot locations.



SECURE T-BOLT: Apply Anti-Seize to bolt. Rotate T-bolt into position.



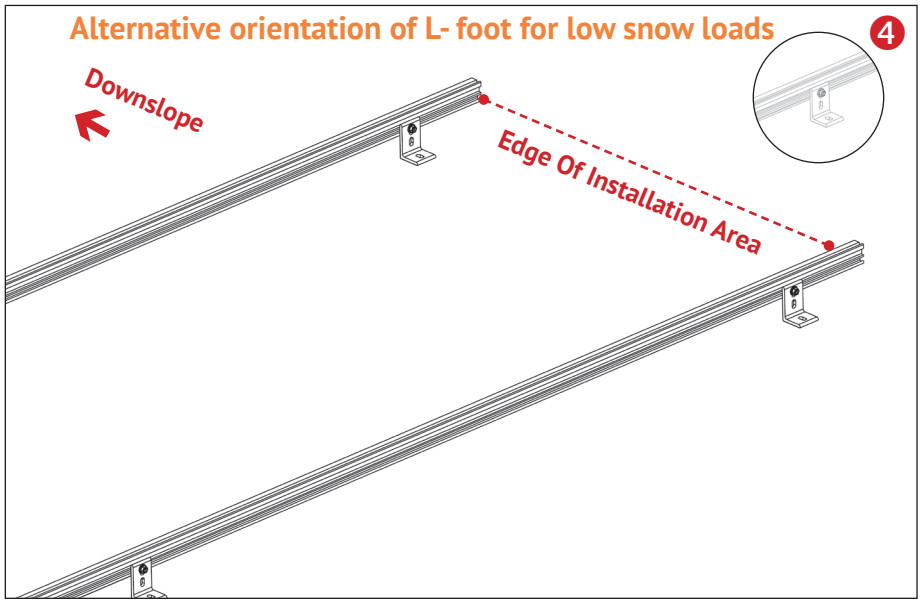
ALIGN POSITION INDICATOR: Hand tighten nut until rail alignment is complete. Verify that position indicator on bolt is vertical (perpendicular to rail)

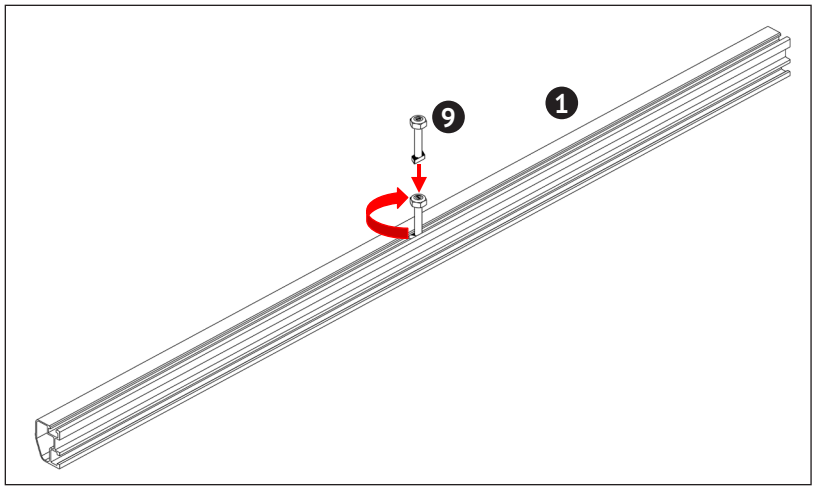
TORQUE VALUE 3/8" nut to 30 ft-lbs

ALIGN RAILS:
Align one pair of rail ends to the edge of the installation area. The opposite pair of rail ends will overhang installation area. Do not Trim them off until the installation is complete. If the rails are perpendicular to the roof inclination, either end of the rails can be aligned, but the first module must be installed at the aligned end.

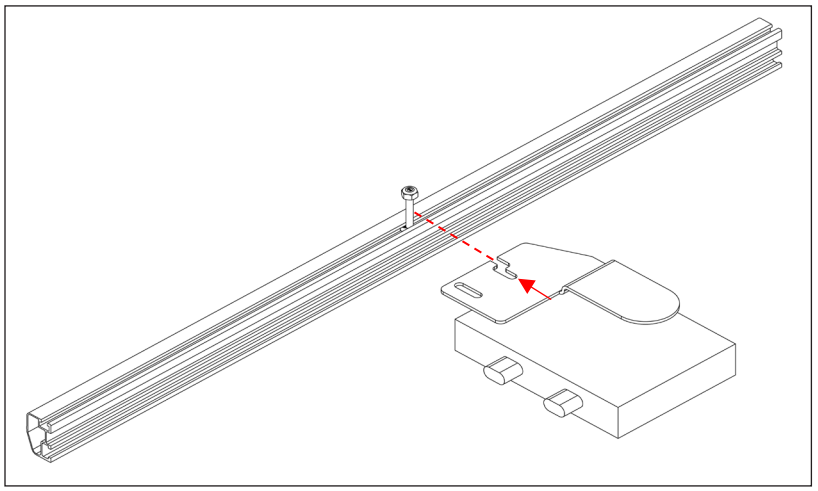
If the rails are parallel to the roof inclination, the aligned end of the rails must face the lower edge of the roof. Securely tighten all hardware after alignment is complete.

Mount modules to the rails as soon as possible. Large temperature changes may bow the rails within a few hours if module placement is delayed.

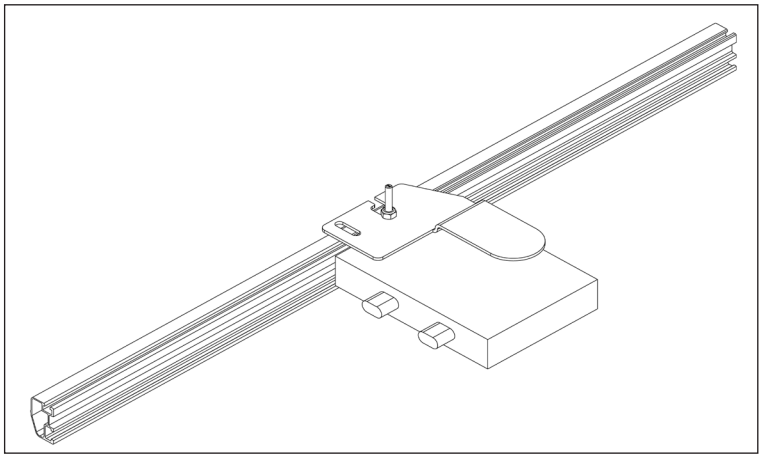




INSTALL MICROINVERTER MOUNT T-BOLT:
Apply Anti-Seize and install pre-assembled 1/4" diameter bonding T-Bolts into top 1/4" rail slot at microinverter locations. Rotate bolts into position.

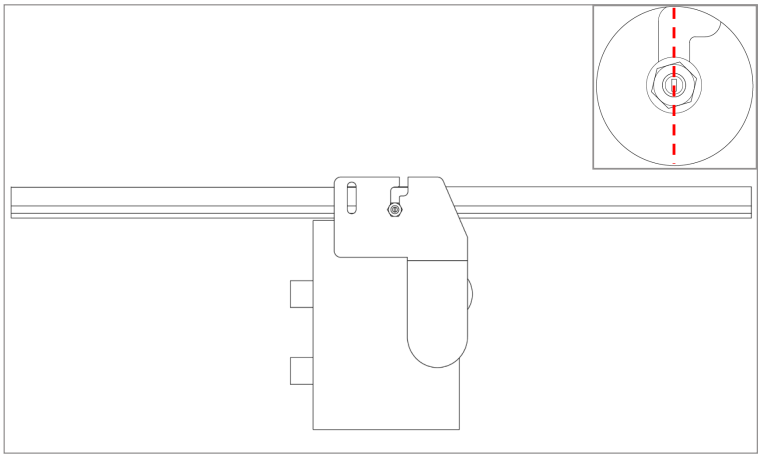


INSTALL MICROINVERTER:
Install microinverter on to the rail. Engage with bolt.



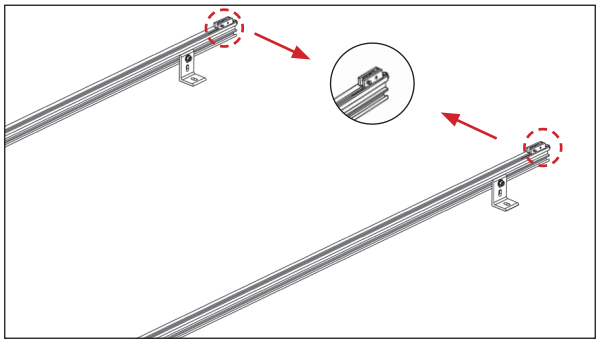
INSTALL MICROINVERTER:
Torque the 1/4" nut to 10 ft-lbs with Anti-Seize.

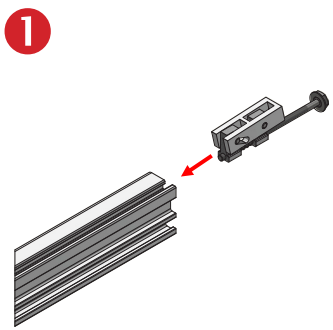
NOTES:
1. **MLPE Mount is certified for single use only.**
2. **MLPE need to be installed along with module installation.**

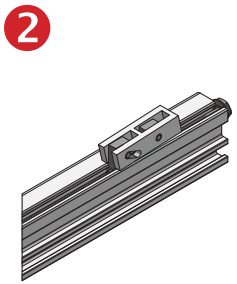


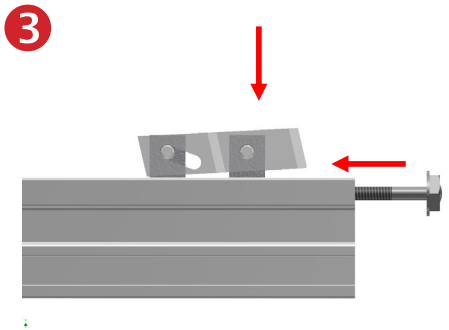
ALIGN POSITION INDICATOR:
Verify that position indicator on the T-bolt is perpendicular to rail.

ENDCLAMP, FIRST MODULE







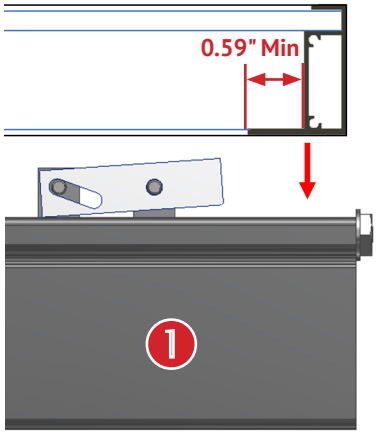


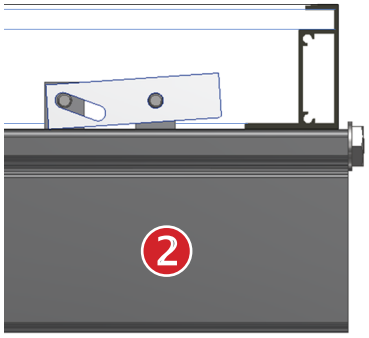
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.

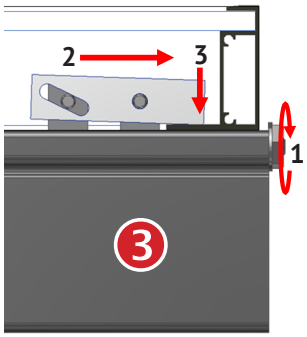
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two T-guide brackets with the top slot of the rails. Ensure bolt is extended as far as possible so that clamp is positioned at max distance from end of rail.

POSITION END CLAMPS: Slide end clamp assembly on to rail until bolt head engages with end of rail. End clamps are positioned on rails prior to the first end module and prior to the last end module.

NOTE: To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.







INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.

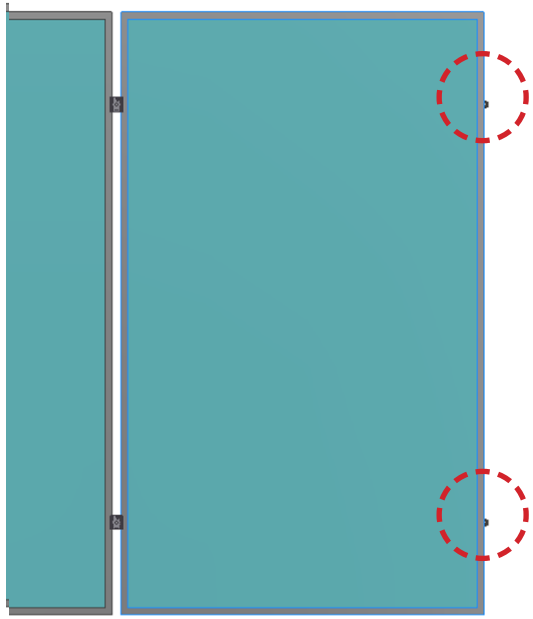
ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.

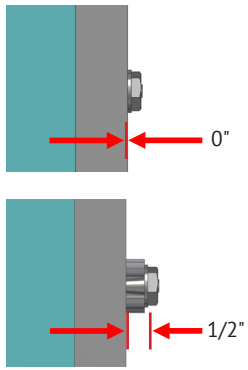
To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.

Torque End clamp bolt to 5 ft-lbs, No anti-seize

NOTE:

Requires minimum return flange length of 0.59" for Pro Series Hidden Endclamp to secure module

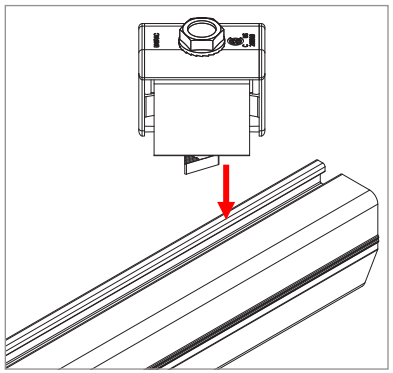




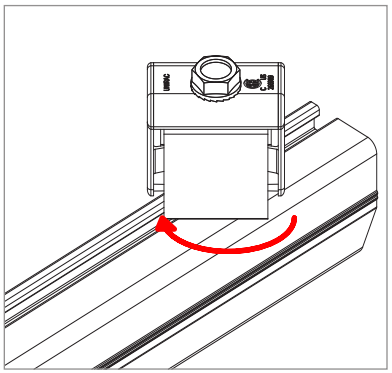
For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.

ENDCLAMP, FIRST MODULE

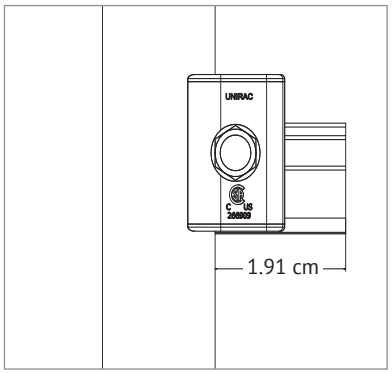
UNIVERSAL AF ENDCLAMP INSTALLATION GUIDE



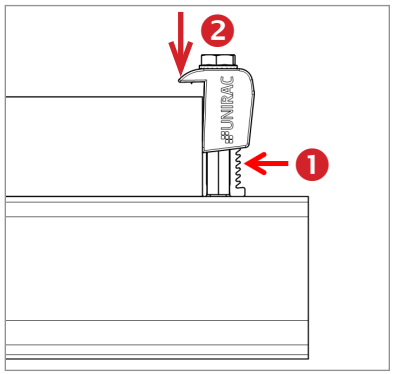
1. Position clamp to align T-bolt with rail slot. Lower clamp and Insert T-bolt into rail slot.



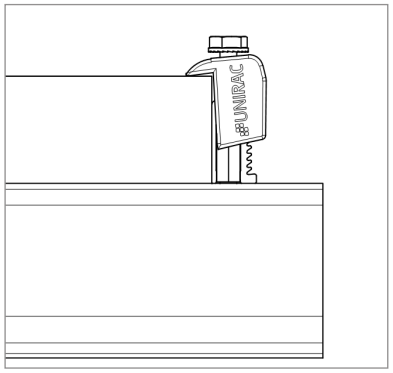
2. Rotate clamp clockwise until the T-bolt fully engages to the inside of the rail slot.



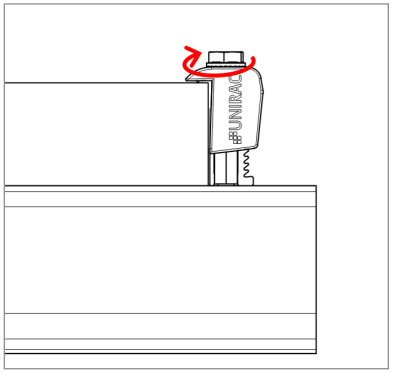
3. Place module at least 1.91 cm from end of rail and position clamp against the module frame.



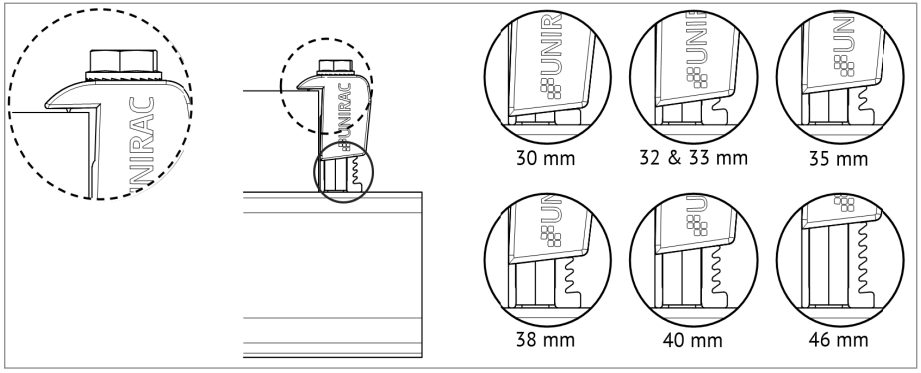
4. While applying pressure to hold the clamp against the module, push down on the module side of the clamp cap.



5. When the cap contacts the module frame, release downward pressure and it will re-engage to the clamp base.



6. Tighten bolt and torque to **15 ft-lbs.**

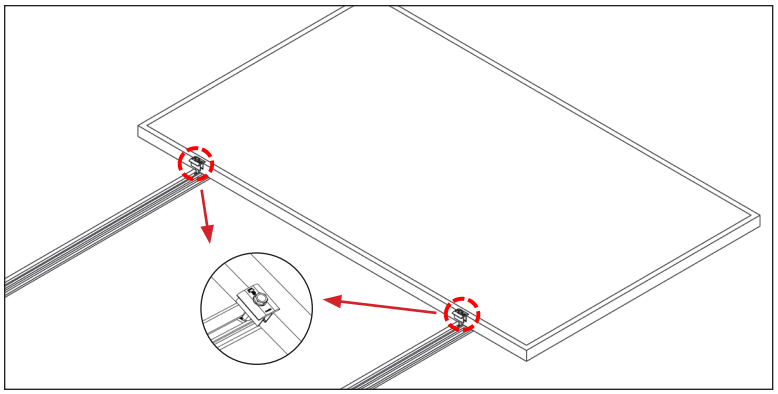


7. Confirm clamp is engaged in correct module height position and that the top of the cap is sitting level with the module frame.

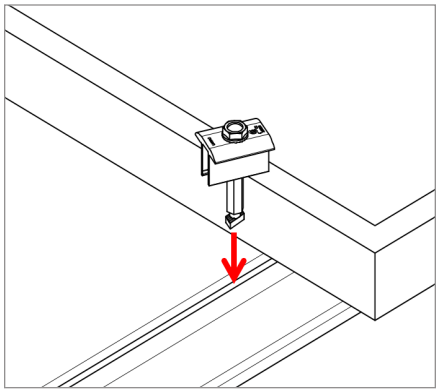
NOTE:

- **When installing 46mm modules, loosen bolt by 1 turn before positioning clamp against module frame.**
- **Do not force clamp onto module frame as this may damage the bonding pin.**

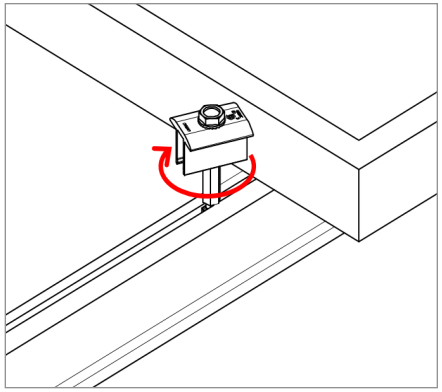
NOTE: Clamp is certified for single use only.



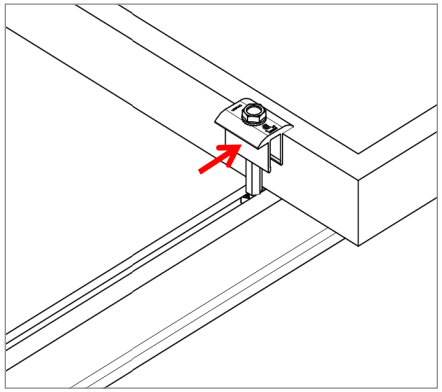
MID CLAMP INSTALLATION
Mid clamp is supplied as an assembly with a T-bolt. Clamp assemblies can be positioned in rail prior to module placement.



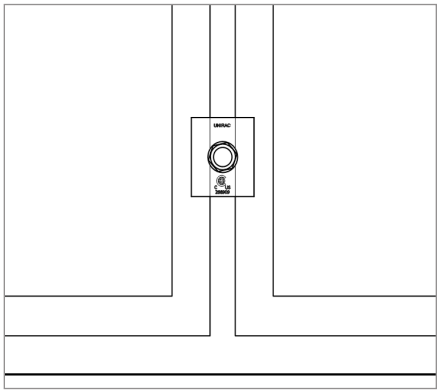
STEP 1: Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



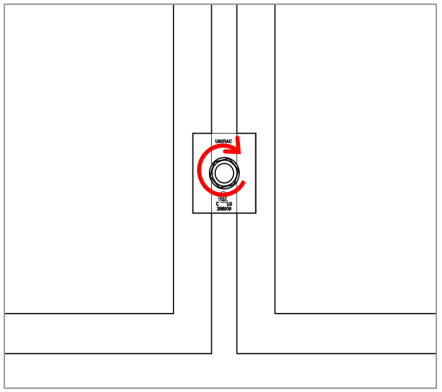
STEP 2: Rotate clamp clockwise 63° of a turn to fully engage T-bolt inside rail slot.



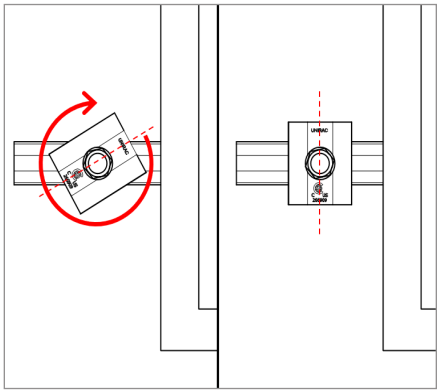
STEP 3: Slide clamp into position against module.



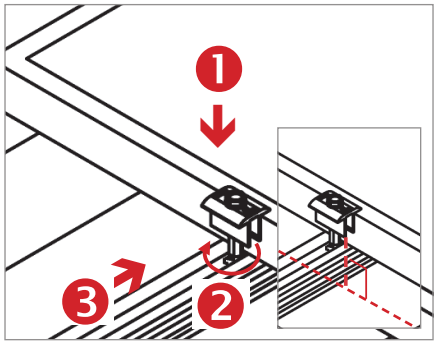
STEP 4: Place second module.



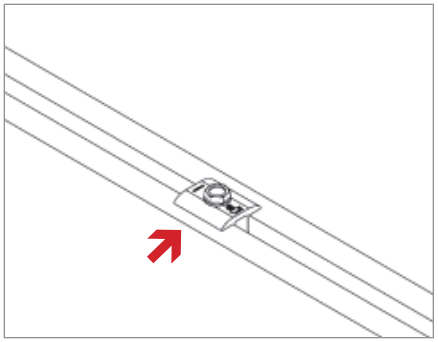
STEP 5: Tighten bolt and torque to **15 ft-lbs.**



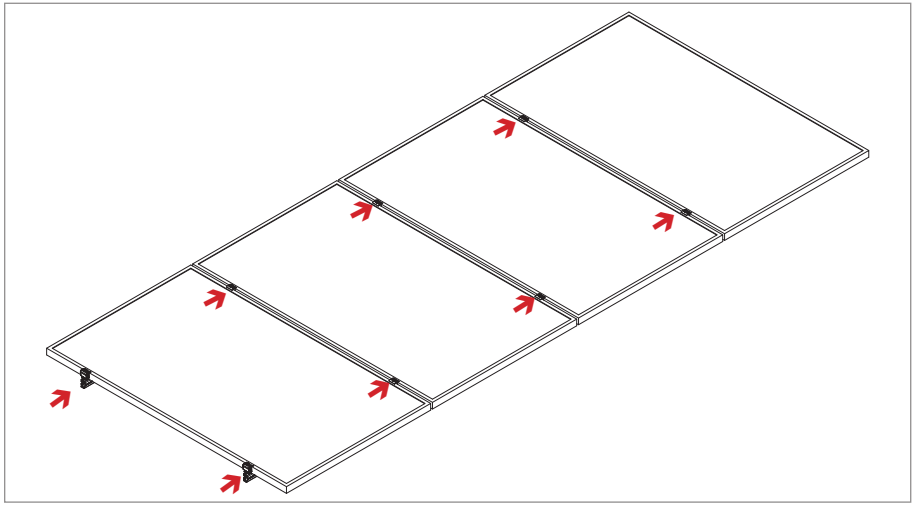
NOTE: If excessive force is applied in step 2, the cap may over-rotate causing it to be mis-aligned with the module frame. If this occurs, keep rotating the cap clockwise or counter clockwise until it returns to the original position and ensure that T-bolt is engaged in the T-slot.



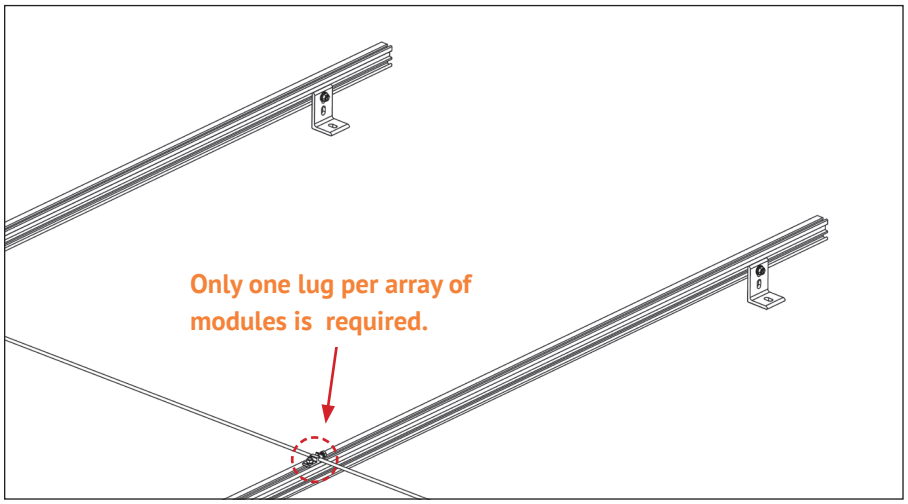
INSTALL REMAINING MID-CLAMPS:
Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.



POSITION T-BOLT ALIGNMENT MARKS:
Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Tighten to final torque.
TORQUE VALUE 15 ft-lbs. No anti-seize.



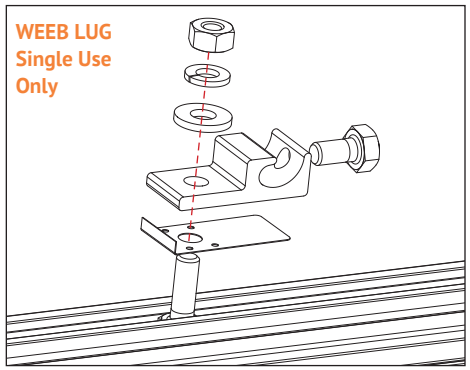
FINISH MODULE INSTALLATION: Proceed with module installation. Engage each module with the previously positioned clamp assembly:

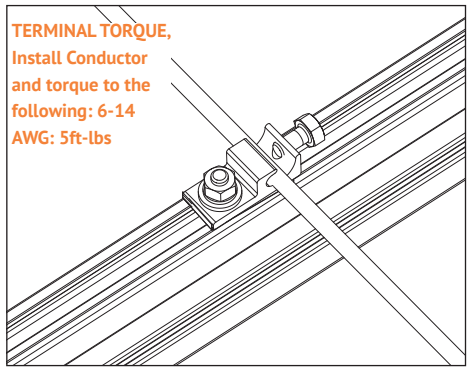


GROUNDING LUG MOUNTING DETAILS:

Below are the details provided for both the WEEB and Ilsco products. The WEEB Lug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. Installation must be in accordance with NFPA NEC 70, however the electrical designer of record should refer to the latest revision of NEC for actual grounding conductor cable size.

GROUNDING LUG-BOLT SIZE & DRILL SIZE		
GROUND LUG	**BOLT SIZE**	**DRILL SIZE**
WEEB Lug	1/4"	N/A-Place in Top SM Ascender Rail Slot
ILSCO Lug	#10-32	7/32"
•Torque value depends on conductor size. •See product data sheet for torque value.		



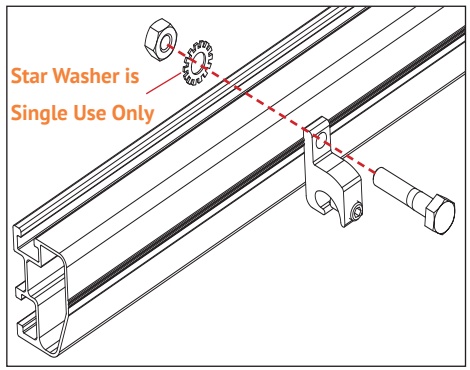


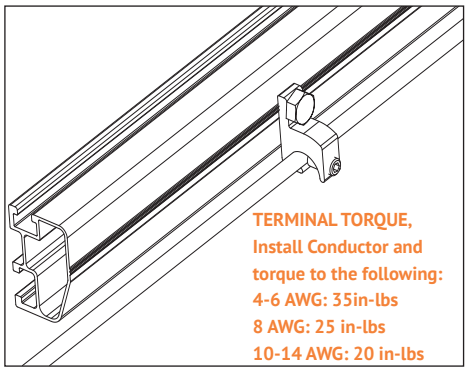
WEEB LUG CONDUCTOR - UNIRAC P/N 008002S:

Apply Anti Seize and insert a hex bolt in the aluminum rail through the T-slot. Place the stainless-steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless-steel flat washer. Install stainless steel flat washer, lock washer and nut. Tighten the nut until the dimples are completely embedded into the rail and lug.

TORQUE VALUE 10 ft lbs.

See product data sheet for more details, Model No. WEEB-LUG-6.7



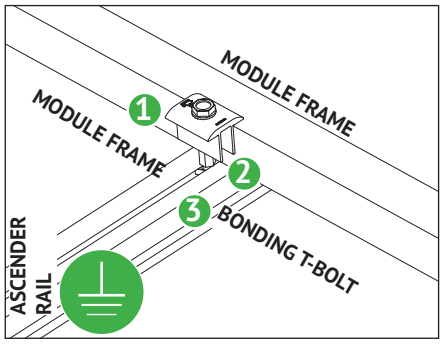


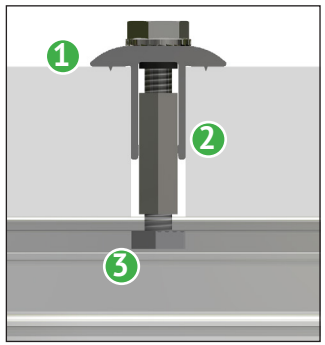
ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding Lug- Drill, deburr hole and bolt through both rail walls per table.

TORQUE VALUE 5 ft lbs.

See ILSCO product data sheet for more details, Model No. GBL-4DBT.

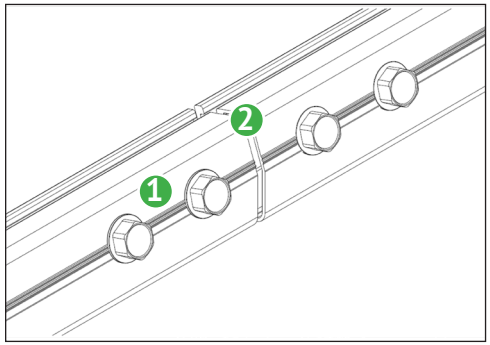
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION





BONDING MID CLAMP ASSEMBLY

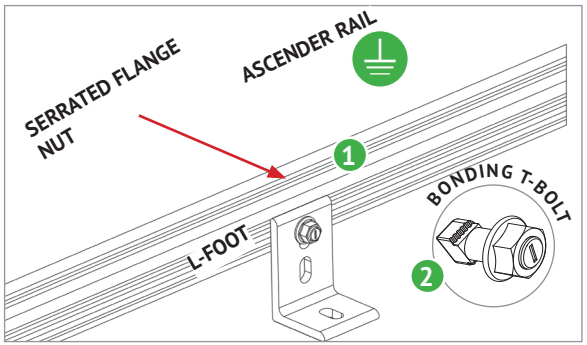
1. Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp.
2. Stainless steel nut bonds aluminum clamp to stainless steel T-bolt.
3. Serrated T-bolt head penetrates rail to bond T-bolt, nut, clamp, and modules to rail.



BONDING RAIL SPICE BAR

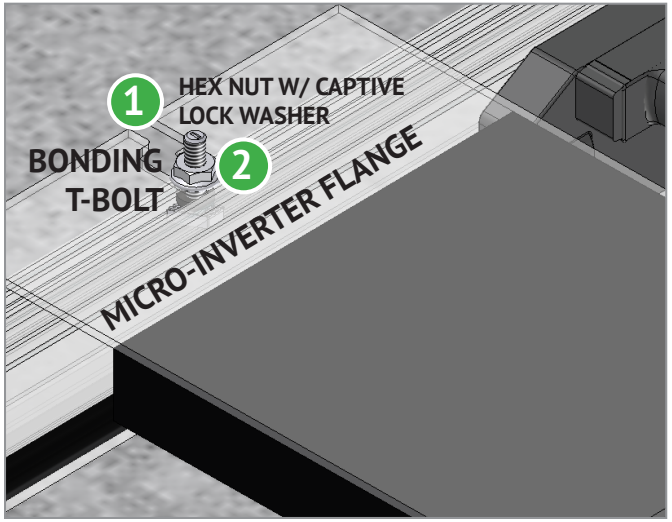
1. 5/16" self drilling screw creates bond between splice bar and rails.
2. Aluminum splice bar spans across rail gap to create rail to rail bond.

Note: Splice bar and bolted connection are structural. The splice bar function is rail alignment, strength and bonding.



RAIL TO L-FOOT w/BONDING T-BOLT

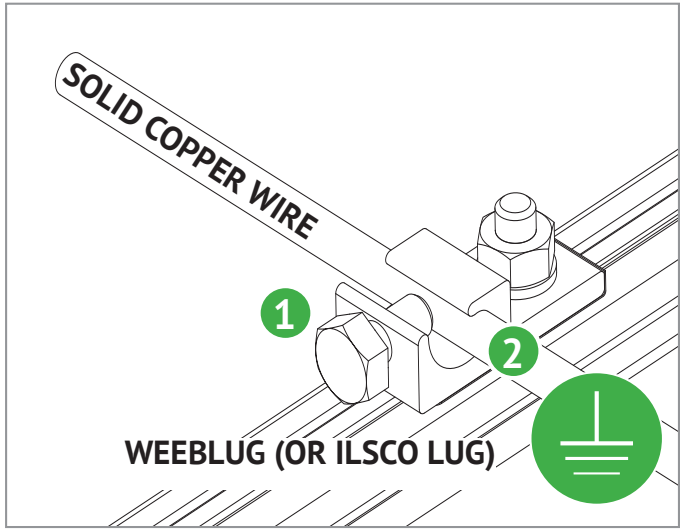
1. Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
2. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded rail



BONDING MICROINVERTER MOUNT

1. Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt.

2. Serrated T-bolt head penetrates rail to bond T-bolt and nut to grounded rail.



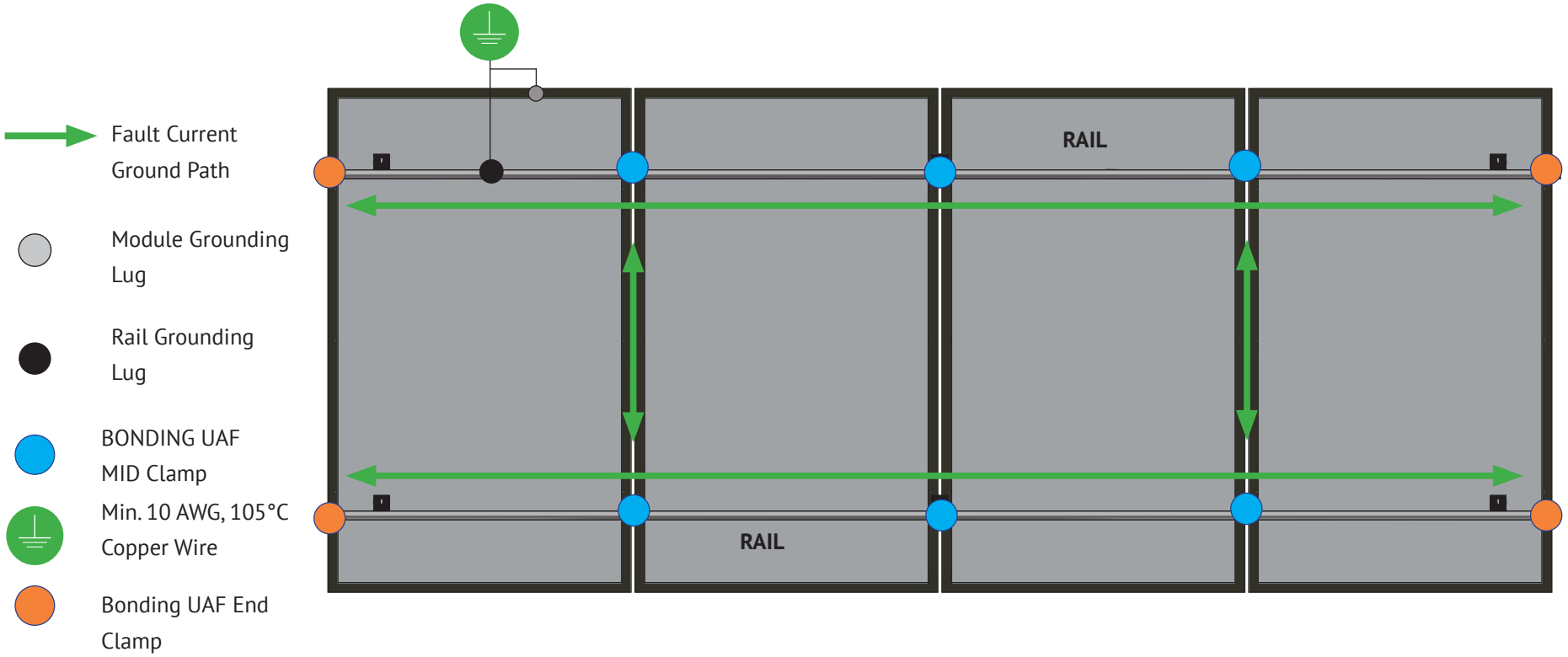
RACK SYSTEM GROUND

1. WEEB washer dimples pierce rail to create bond between rail and lug

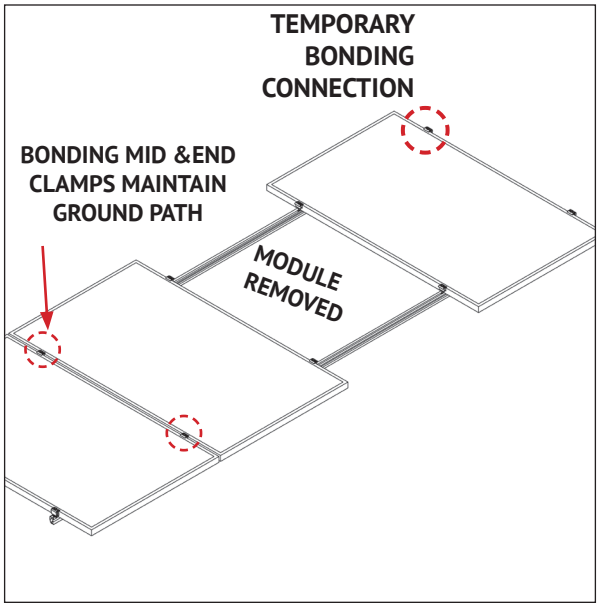
2. Solid copper wire connected to lug is routed to provide final system ground connection.

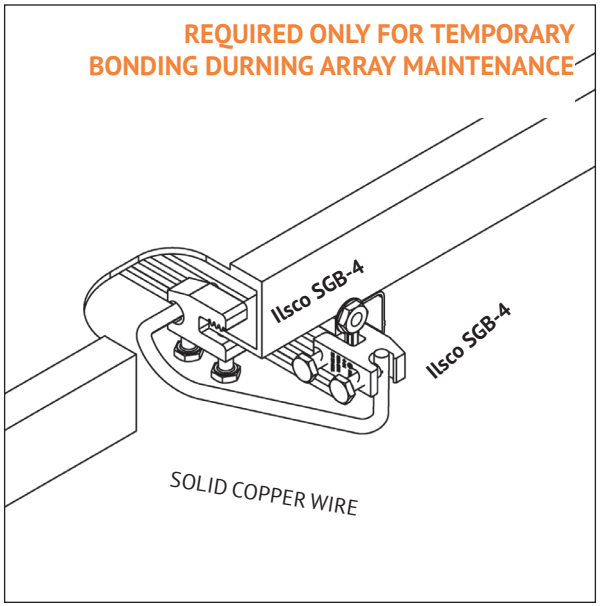
NOTE: Ilsco lug can also be used when secured to the side of the rail.

Note: Unless otherwise specified. all parts with bonding features are certified for single use only.



Note: Every array must have atleast one grounding lug; either a module grounding lug or a rail grounding lug.





TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of rail
- Attach Ilsco SGB4 to module frame
- Install solid copper wire jumper to Ilsco lugs

⚠ CAUTION

Module removal may disrupt the bonding path and could introduce the risk of electric shock. Follow above mentioned instructions to maintain the bonding path.

ELECTRICAL CONSIDERATIONS

SM Ascender Flush Mount is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary.
See below for interconnection information.

INTERCONNECTION INFORMATION

There is no size limit on how many SM Flush Mount & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

PERIODIC INSPECTION: Conduct periodic inspections for loose components, loose fasteners or any corrosion, immediately replace any affected components.

This racking system may be used to ground and/or mount a PV module complying with UL1703 or UL61730 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

UL2703 CERTIFICATION MARKING

Unirac SM Ascender is listed to UL 2703. Certification marking is embossed on all mid clamps and Universal AF end clamps as shown.

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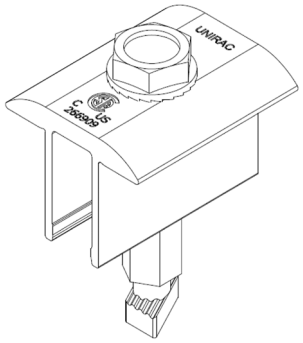

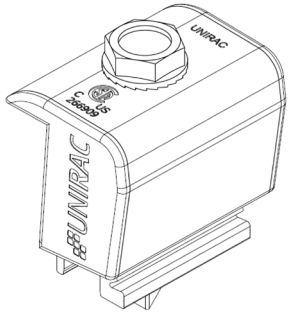

The SM Ascender Flush Mount system has been certified and listed to the UL 2703 standard (Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels). This standard includes electrical grounding, electrical bonding, mechanical load testing and and fire resistance testing.

In conducting these tests, specific modules are selected for their physical properties so that the certifications can be broadly applied. The following lists the specific modules that were tested and the applicability of those certifications to other modules that might come onto the market. PV modules may have a reduced mechanical load rating, independent of the SM Ascender load rating. Please consult the PV module manufacturer's installation guide for more information.

In addition to UL 2703 certification, Unirac performs internal testing beyond the requirements of certification tests in order to establish system functional limits, allowable loads, and factors of safety. These tests include functional system tests, and destructive load testing.

Mechanical Load Test Modules

The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed cover the following basic module parameters:

- PV module may have reduced load rating, independent of the SM Ascender Flush Mount rating. Please consult the PV module manufacturer's installation guide for more information.
- Frame thicknesses greater than or equal to 1.0 mm.
- Basic single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability).
- Clear and dark anodized aluminum frames.

Tested Modules

Module Manufacturer	Model/Series	Area [sqft]	UL2703 Certification Load Ratings
Jinko	JKM M-72HL4-V	27.76	Down: 28.5 PSF, Up: 31.9 PSF Down-Slope: 5.18 PSF

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SM Ascender Flush Mount Installation Guide. SM Ascender Flush Mount has been classified to the system level fire portion of UL2703. SM Ascender Flush Mount has achieved system level performance for steep sloped roofs and low sloped roofs. See table below for definition of steep sloped and low sloped roofs. The system is to be mounted over fire resistant roof covering rated for the application. There is no required minimum or maximum height limitation above the roof deck to maintain the system fire rating for SM Ascender Flush Mount. Module Fire Types, System Level Fire Ratings, & Rail Direction & Module Orientations are listed below:

ROOF TYPE	Module Fire Type	System Level Fire Rating	Rail Direction	Module Orientation
Steep Slope - roof pitches ≥ 2 in/ft	1, 2, 3 with metal frame, 10 with metal frame, 19, 22, 25, 29, 30 & 38	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait
Low Slope - roof pitches < 2in/ft	Type 1, 2, 29, 30 & 38	Class A	Parallel OR Perpendicular to Ridge	Landscape OR Portrait

This racking system may be used to ground and/or mount a PV module complying with UL1703 or UL61730 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SM ASCENDER system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
Aptos Solar	DNA-108-(MF/BF)10-xxxW DNA-120-(MF/BF)10-xxxW DNA-120-(MF/BF)23 DNA-120-(MF/BF)26 DNA-120-MF10 DNA-144-(MF/BF)23 DNA-144-(MF/BF)26 DNA-144-BF10-xxxW-DG
Astronergy	ASM6612P Series CHSM6612 M, M/HV CHSM6612P/HV Series CHSM6612P Series CHSM72M(DG)/F-BH CHSM72M-HC
Auxin	AXN10Mxxx AXN6M610T AXN6M612T AXN6P610T AXN6P612T AXNG1M Series
Axitec	AC-xxx(M/P)/60S AC-xxx(M/P)/72S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB) AC-xxxP/156-60S AC-xxxTGB/144TS
Bluesun Solar	HEX5 BSMxxxM10-54HPH BSMxxxM10-72HBD

Manufacture	Module Model / Series
Boviet Solar	BVM6610 BVM6610M-xxxS-H-HC BVM6610M-xxxS-H-HC-BF BVM6612 BVM6612M-xxxS-H-HC-BF-DG BVM7612M-H-HC-BF-DG
BYD	P6K & MHK-36 Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P), CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS3W-(MS/MB-AG/P/P-PB-AG) CS3Y-MB-AG, CS5A-M CS6.1-54TM-H, CS6.1-60TM-H CS6.1-72TB-H CS6.2-66TB-xxxH CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6R-MS CS6R-xxxMS-HL CS6U-(M/P/P HE) CS6W-(MS/MB-AG) CS6W-xxx-TB-AG CS6X-P, CSX-P ELPS CS6(A/P)-MM
Centrosolar America	C-Series & E-Series

Manufacture	Module Model / Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04 CTM10400HC11-08, CTM10400HC11-09 CTM10400HC11-06, CTxxxHC11-06 CTTCxxxHC12-08
Eco Solargy	Orion 1000 & Apollo 1000
EMMVEE	ExxxHCBG144-T ExxxHCBT144-T ExxxHCM120-B ExxxM72-B ExxxP72-B Titanium Clear
Energy America	ZLK-xxx
ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB ET-M772BHxxxTW/TB
First Solar	FS-6XXX(A) FS-6XXX(A)-P FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
Freedom Forever	FF-MP1-BBB-xxx FF-MP-BBB-xxx
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60

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- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
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Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the SM ASCENDER system.

Manufacture	Module Model / Series
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 132HC M10 SL Monofacial Module 144HC M10 SL Bifacial 144HC M6 156HC M10 SL Bifacial
HT-SAAE	HT60-156M-C HT60-156M(V)-C HT72-156(M/P) HT72-156P-C, HT72-156P(V)-C HT72-156M(PDV)-BF, HT72-156M(PD)-BF HT72-166M, HT72-18X
Hyperion Solar	HY-DH108N8B HY-DH108P8(B) HY-DH144P8 HY-DH156N8 HY-DH156P8
Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG HiD-SxxxRG(BK) HiN-SxxxXG(BK) HiN-TxxxNF(BK) HiN-TxxxNI HiN-TxxxNJ HiN-TxxxOJ HiS-S400PI HiS-SxxxGI HiS-SxxxOJ HiS-SxxxXG(BK) HiS-SxxxYH(BK) HIS-TxxxNF(BK) HiS-TxxxNJ

Manufacture	Module Model / Series
Illuminate USA	IL5-72HBD-xxx M IL8-66HGD-xxx M
Imperial Star	ISM7-SHDD108-400/M
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAP72S##-xxx/** JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM6(k)-60-xxx/**, JAM60S##-xxx/** i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR ** = Backsheet, ## Cell technology JAM54D41-xxx/MB JAM54S30 xxx/MR JAM54S31 xxx/MR JAM66D45 LB JAM72D10 xxx/MB JAM72D30MB JAM72D40 xxx/MB JAM72S30 /MR JAM78D10MB JAP6 60-xxx
Jinko	JKM & JKMS Series JKMxxxM-6RL3-B JKMxxxM-72HBL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HL4-TV

Manufacture	Module Model / Series
Jinko (Cont.)	JKMxxxM-72HLM-TV JKMxxxM-72HL-V JKMxxxM-7RL3-TV JKMxxxM-7RL3-V JKMxxxN-54HL4-B JKMxxxN-72HL4-BDV JKMxxxN-72HL4-BDX JKMxxxN-72HL4-TV
Kyocera	KD-F & KU Series
LA Solar	BLA Model LSxxxBF LSxxxBL LSxxxBL (410 watt) LSxxxHC LSxxxHC(166) LSxxxHC (430-450 watt range)
LG Electronics	LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6, LGxxxN2W-B3 LGxxxN2T-B5, LGxxxN1K-B6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5, LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(M1C/N1C/Q1C/Q1K)-N5 LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5 LGxxxN3K-V6

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
LONGi	LR4-60(HPB/HPH) LR4-72(HPH) LR4-72HBD xxxM LR5-54HABB-xxx M (fire type 29 only) LR5-54HPB-xxx M LR5-54HTB xxxM LR5-72HBD xxx M LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HV/PB/PE/PH) LR7-72HGD-xxx M LR8-54HGBB LR8-66HGD-xxx M RealBlack LR4-60HPB RealBlack LR6-60HPB
Maxeon	SPR-MAX3-xxx-COM SPR-MAX3-XXX-R SPR-MAX3-XXX-BLK-R SPR-MAX6-xxx SPR-MAX6-xxx-BLK
Meyer Burger	Meyer Burger Black Meyer Burger White Meyer Burger Glass
Mission Solar Energy	MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W) MSExxxHT0B MSExxxSX6Z MSExxxSX9R

Manufacture	Module Model / Series
Mission Solar Energy (Cont.)	MSH10-xxxHN4G MSH10-xxxHT4T MSI10-xxxHN4G MSI10-xxxHT4G MSI10-xxxHT4T MSN10xxxHT4T MSX10-xxxHN0B
Mitrex	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
mSolar	108BB HC Series (TXI10-xxx108BB) 144BB HC Series (TXS6-xxx144BB)
Neo Solar Power Co.	D6M Series
NE Solar	NESE xxx-72MHB-M10 NESE xxx-60MH-M6 NESE xxx 72MHT-M10 NESE xxx 72THB-M10 NESE xxx 72MHB-M10
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04 EVPVxxx EVPVxxx(H/K/PK/HK/HK2)
Peimar	SGxxxM (FB/BF) SMxxxM
Philadelphia Solar	PS-M108(HCBF)-400W (30 & 35mm frames) PS-M144(HCBF)-xxxW PS-MNB108(HCBF)-xxxW

Manufacture	Module Model / Series
Philadelphia Solar (Cont.)	PS-MNB144(HCBF)-xxxW PS-MNB156(HCBF)-xxxW
Phono Solar	PSxxxM1-20/U PSxxxM1H-20/U PSxxxM1-20UH PSxxxM1H-20UH PSxxxM4(H)-24/TH PSxxxM1-20/UH PSxxxM1H-20/UH PSxxxM-24/T PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series, P72X-xxx
Q Cells	Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+), Plus, Pro Peak L-G2, L-G4, L-G5 Peak L-G5, L-G6, L-G7, L-G8(BFF) Plus, Pro, Peak, G3, G4, Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO (BLK)-G7 Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO BLK ML-G10.B+ Q.PEAK DUO BLK ML-G10.C+ Q.PEAK DUO BLK ML-G10+ / t Q.PEAK DUO BLK ML-G10+ / TS

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
Q Cells (Cont.)	Q.PEAK DUO-G10+ Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G6.3 / BFG Q.PEAK DUO L-G8.3 (BFF/BFG/BGT) Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/ G10.d) Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-G11.3/BFG Q.PEAK DUO XL-G11S.3 / BFG Q.PEAK DUO XL-G9.3/BFG QPEAK DUO G10.C1+ AC Q.TRON BLK M-G2+ Q.TRON BLK M-G2+ AC Q.TRON BLK M-G2.C+ Q.TRON BLK M-G2.F+ Q.TRON BLK M-G2.F1+/AC Q.TRON BLK M-G2.H+ Q.TRON BLK M-G2.H1+/AC. Q.TRON BLK M-G2+ SERIES Q.TRON M-G2+ SERIES Q.TRON XL-G2.3/BFG Q.PEAK DUO BLK ML-G10.XY+/AC (where “X” = any letter between A to W, where “Y” = any number between 1 to 9.)

Manufacture	Module Model / Series
REC	RECxxxAA (BLK/Pure/Pure-R/ Pure-RX/ Pure 2/ Pro M) RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxNP3 Black RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Renesola	All 60-cell modules RS6-xxxNBG-E3
Risen	RSM Series RSM110-8-xxxBMDG
SEG Solar	SEG-xxx-BMD-HV SEG-xxx-BMD-TB SEG-xxx-BMB-TB SEG-xxx-BMA-HV SEG-xxx-BMA-TB SEG-xxx-BMB-HV SEG-xxx-BMA-BG SEG-xxx-BMB-BG SEG-xxx-BTA-BG SEG-xxx-BTB-BG SEG-xxx-BMD-BG SEG-xxx-BTD-BG
S-Energy	SN72 & SN60 Series SL45-60BGI/BHI SL45-60MBI-xxxZ

Manufacture	Module Model / Series
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/ E11) SRP-(6QA/6QB) SRP-xxx-BMB-HV SRP-xxx-BMD-HV SRP-xxx-BMA-HV SRP-xxx-6MB-HV SRP-xxx-BMC-HV SRP-xxx-BMZ-HV SRP-xxx-BTA-BG SRP-xxx-BTB-BG SRP-xxx-BTC-BG SRP-xxx-BTD-BG SRP-xxx-BTE-BG
Sharp	NU-SA & NU-SC Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SIL-xxx(BG/BK/BL/HC/HC+/HL/HM/HN/ML/ NL/NT/NX/NU/ QD/QM) SIL-xxx XL SIL-xxx XM SIL-xxx XM+
Sirius	ELNSM54M-HC-BF Series ELNSM54M-HC Series ELNSM72M-HC Series
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB S4Axxx-144MH10xxx, S4Axxx-144TH10xxx S4Axxx-144TH16xxx, S4Axxx-108MH10xxx S4Axxx-108TH10xxx

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
SolarEver USA	SE-166*83-xxxM-120N SE-182*91-xxxM-108N SE-182*105-xxxM-96-BD
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) PowerX-400R
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Sonali	SS-M-360 to 390 Series SS-M-390 to 400 Series SS-M-440 to 460 Series SS-M-430 to 460 BiFacial Series
Sun Edison	F-Series, R-Series
Suniva	MV Series & Optimus Series (35mm)
Sunmac Solar	M754SH-BB Series
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC SPR-Mxxx-H-AC SPR-Mxxx-BLK-H-AC
SunPro	SPDGxxx-120M12
SunTech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart, TD6I72M TD7G72M TM3G48M TM3G54M

Manufacture	Module Model / Series
Talesun (Cont.)	TM3G66M TM7G54M TM7G60M TM7G72M TP6F72M TP6F72M(H) TP7G54M(H)
Tesla	SC, SC B, SC B1, SC B2 TxxxS TxxxH
Thornova	TS-BBT54(xxx) TS-BG54 TS-BG72 TS-BGT72(xxx)
Trina	DE06, DE09.05, DE09C.07 DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20, TSM-NE09RC.05 PA05, PD05, DD05, DD06 PD14, PE14, DD14, DE14, DE15, DE15V(II) TSM-DE09.08, TSM-DE09C.07, TSM-DE09.05 TSM-NEG19RC.20 TSM-DE06X.05(II) TSM-NE09RH.05 TSM-NE19RC
TSMC	TS-150C2 CIGSw
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB

Manufacture	Module Model / Series
Universal Solar (Cont.)	UNIxxx-120M-BB UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) F6MxxxE7G-BB FAKxxx(C8G/E8G) FAMxxxE7G-BB FAMxxxE8G(-BB) FBKxxxM8G FBMxxxM7G-BB FBMxxxMFG-BB
Vikram Solar	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05 Paradea VSMDH.72.AAA.05
Vina	VNS-72M1-5-xxxW-1.5 VNS-72M3-5-xxxW-1.5 VNS-144M1-5-xxxW-1.5 VNS-144M3-5-xxxW-1.5 VNS-120M3-5-xxxW-1.0
VSUN	VSUN4xx-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108BMH VSUNxxx-108M-BB VSUNxxx-108MH VSUNxxx-120BMH VSUNxxx-120M-BB VSUNxxx-132BMH VSUNxxx-144M-BB

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
VSUN (Cont.)	VSUNxxx-60M-BB VSUNxxx-72MH VSUNxxxN-108BMH-BB VSUNxxxN-108BMH-BB (SoftPaw) VSUNxxxN-120BMH-BB (SoftPaw) VSUNxxxN-144BMH VSUNxxxN-144MH VSUNxxx-144BMH VSUNxxx-144MH VSUNxxx-144M-BW
Waaree	Ahnay Series Bi-33 Arka Series WSMDi
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1
ZNShine	ZXM6-72 Series, ZXM6-NH144 ZXM6-NH120 Series ZXM6-NHLDD144 ZXM7-SH108 Series ZXM7-SHDB144 ZXM7-SHLDD144 ZXM7-UHLDD144

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