



SOLARMOUNT ASCENDER
2-ROW NON-ELEVATED

INSTALLATION GUIDE



UNIRAC Code-Compliant Installation Manual

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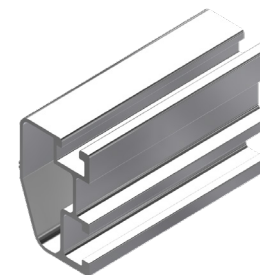
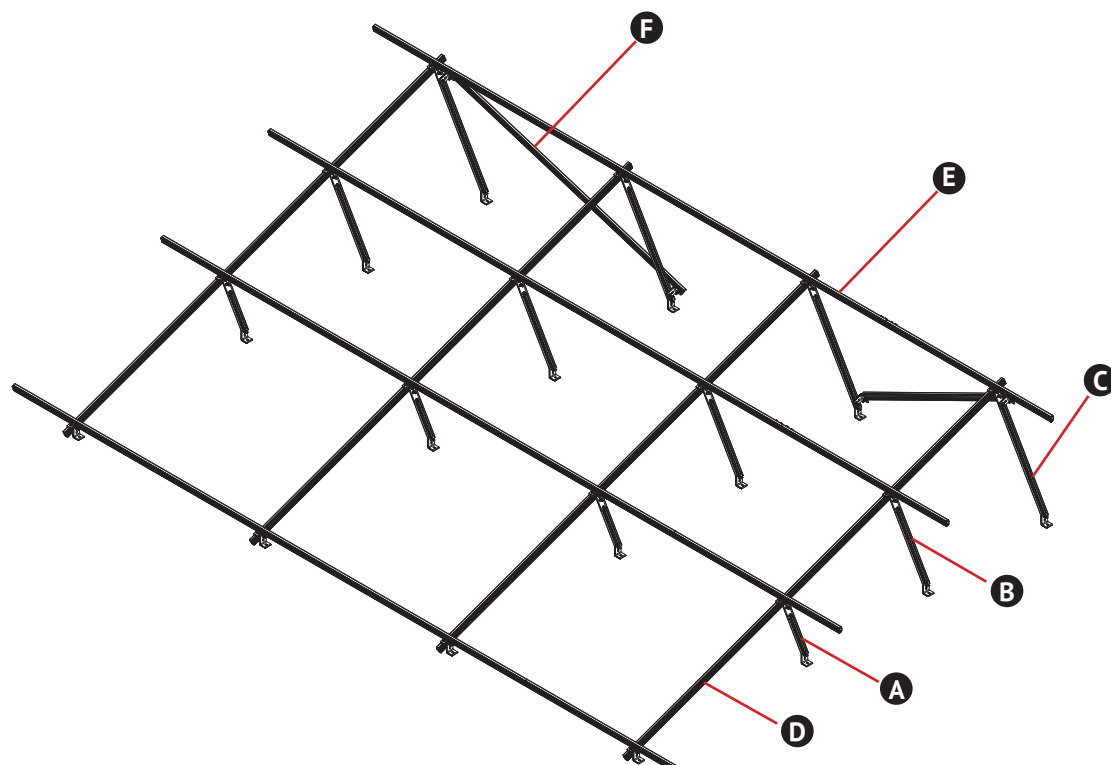
SOLARMOUNT ASCENDER 2-ROW NON-ELEVATED

INSTALLATION GUIDE

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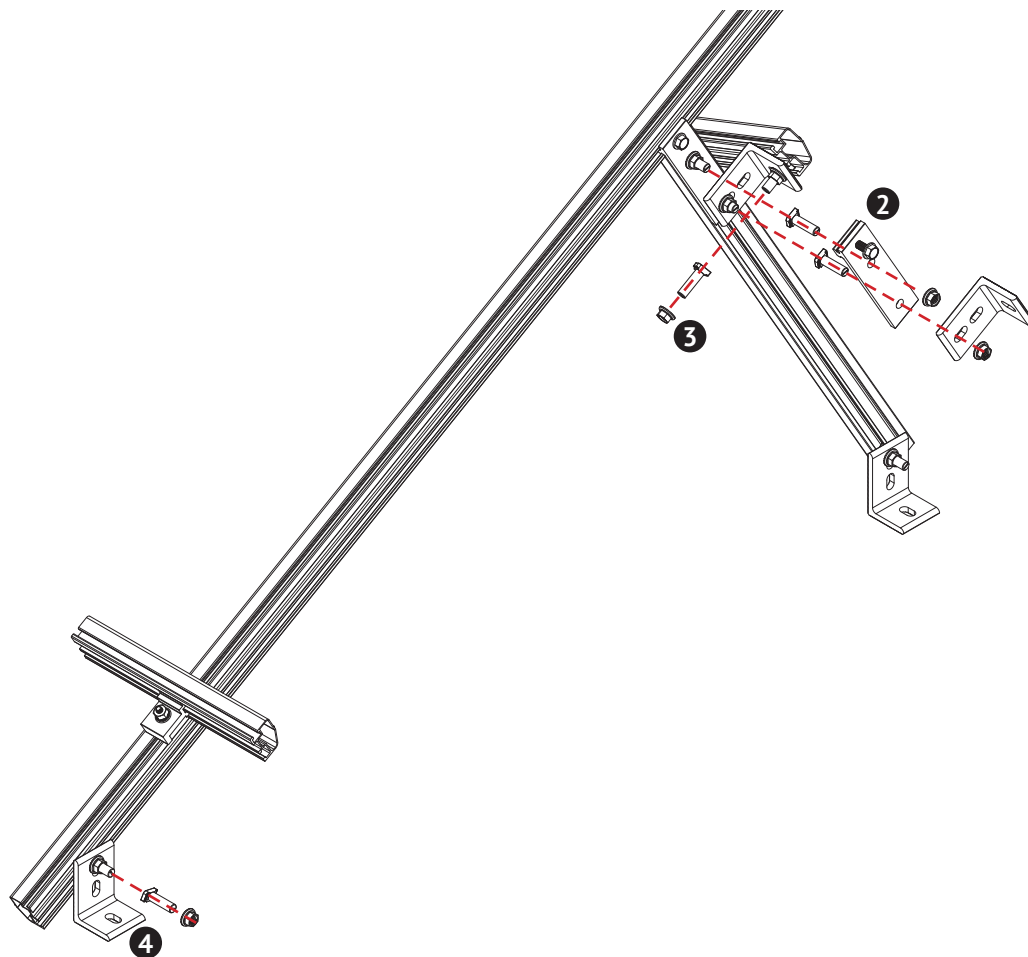
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- 1 ASCENDER RAIL (A1R181M)**
 Functions as **A** to **F**. Aluminum extrusion, available in mill finish.
- A FRONT TILT LEG** - Supports NS rail. Use one Front Tilt leg per frame/bay.
- B MID TILT LEG** - Supports NS rail. Use one Mid Tilt leg per frame/bay.
- C REAR TILT LEG** - Supports NS rail. Use one Rear Tilt leg per frame/bay.
- D NS RAIL** - Supports EW Beam. Use one NS rail per frame/bay. NS rail runs in North-South direction.
- E EW BEAM** - Supports PV module. Use two rails per row of modules. EW Beam runs in East-West direction.
- F EW REAR BRACE** - Connects the Rear Tilt legs.

SAFETY:

All applicable OSHA safety guidelines should be observed when working on a PV installation job site. The installation and handling of PV solar modules, electrical installation and PV racking systems involves handling components with potentially sharp metal edges. Rules regarding the use of gloves and other personal protective equipment should be observed.

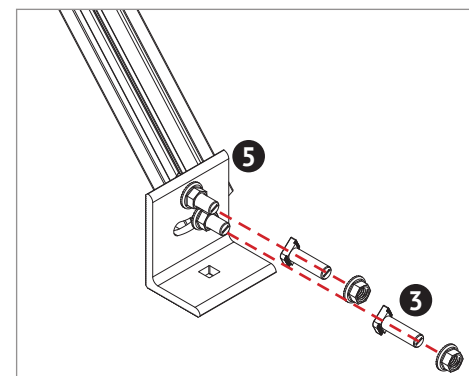


- 2 ASCENDER TILT PLATE ASSEMBLY (A1TP001)**
Connects Tilt legs with NS rail and NS bracing with Tilt legs.
- 3 T-BOLT AND SERRATED FLANGE NUT (3/8" X 1.2" SS) (009022S)**
Use at Tilt plate assembly, EW brace to L-foot and Tilt leg to L-foot connection. Provides electrical bonding from Tilt plate to rail and L-foot to rail.
- 4 L-FOOT SERRATED WITH HARDWARE (A1LF02M)**
(1) T-bolt and (1) serrated flange nut will be shipped with L-foot. Use L-Foot to secure the Tilt legs to attachment and EW Brace to the tilt leg.
- 5 SWIVEL L-PLATE SERRATED WITH HARDWARE (A1LF01M)**
(1) T-bolt and (1) serrated flange nut will be shipped with Swivel L-Plate. Use Swivel L-Plate to secure the Tilt legs to attachment and EW Brace to the tilt leg.

Note: Depending upon the load, two T-Bolts will be required in some cases. Please consult the Ascender Design tool for the T-bolt requirements—Use L-foot for single T-bolt connection and use Swivel L-plate for two T-bolts connections

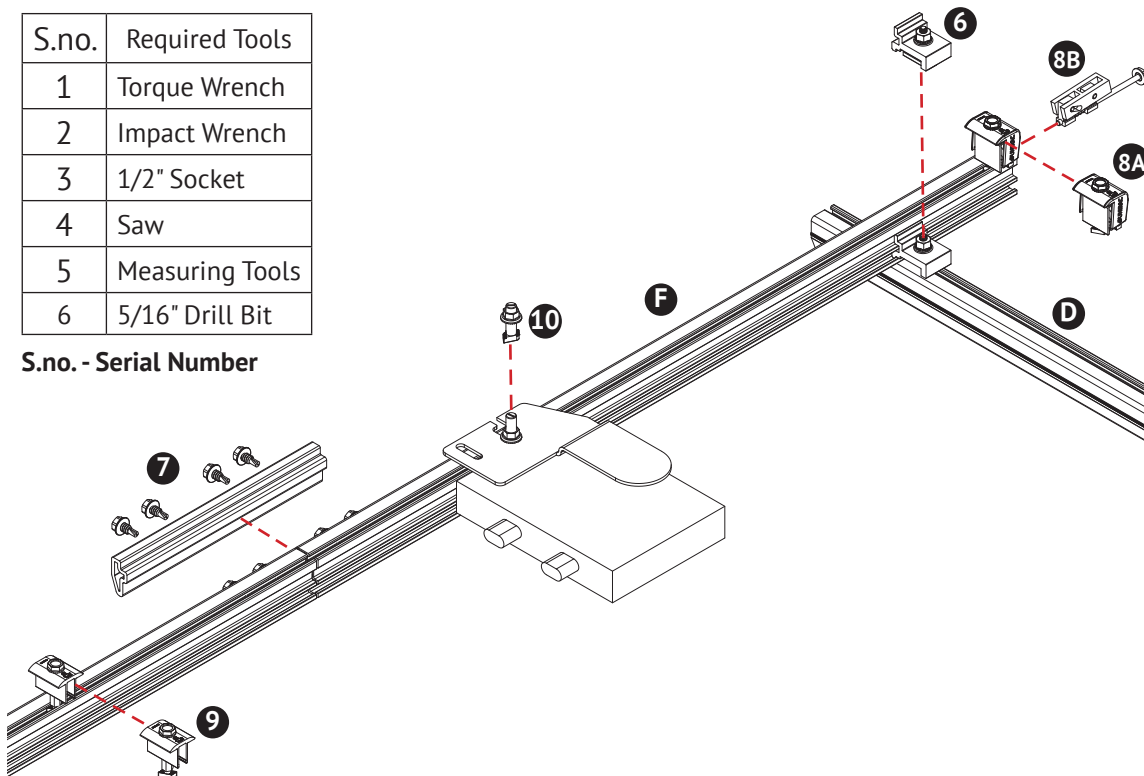
Wrenches and Torques		
Description	Wrench or Socket Size	Recommended Torque (ft-lbs)
5/16" Thread cutting Bolt - 2	1/2"	30
3/8" T-Bolt - 3, 4, 5		30

Note: Only unique connections are displayed in each detail. Same connections are not repeated.



S.no.	Required Tools
1	Torque Wrench
2	Impact Wrench
3	1/2" Socket
4	Saw
5	Measuring Tools
6	5/16" Drill Bit

S.no. - Serial Number



6 ASCENDER BEAM CLIP ASSEMBLY (A1BC102)

Pre-assembled beam clip assembly contains beam clip, beam plate, stud, keps nut, spring. Connects the EW beam to the NS rail.

7 ASCENDER SPLICE WITH HARDWARE (A1SP02M)

4 - 5/16"-18 X 0.75" SS Hex Head Drilling Screws will be shipped with splice. Connects EW beam to EW beam. Structural splice joins, aligns and electrically bonds rail sections into single length of rail. Forms a rigid splice joint, 10 inches long, assembled with bonding hardware. Use 4 screws per splice.

8A MODULE UAF END CLAMP (302050M) /

8B MODULE PRO SERIES END CLAMP (302035M)

Pre-assembled clamp that secures module to rail at module flange by tightening 1/2" Hex Bolt.

9 MODULE MID CLAMP (302045M)

Pre-assembled universal clamp provides module to module and module to rail bond. Aluminum clamp with stainless steel bonding pins and T-Bolt.

10 MICROINVERTER MOUNTING BOLT(008013S)

Preassembled bolt, nut and captive star washer attaches and bonds microinverter to rail.

Wrenches and Torques		
Description	Wrench or Socket Size	Recommended Torque (ft-lbs)
Beam Clip 6	1/2"	15
Rail Splice Bolt 7		20
UAF End Clamp 8A		15
Pro Series End Clamp 8B		5
UAF Mid Clamp 9		15
Micro Inverter Mounting Bolt 10		10

Anti-Seize

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.

PLANNING YOUR ASCENDER INSTALLATIONS

Center the installation area over the structural members as much as possible. 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.

PV modules to be installed in the Portrait orientation and modules to be installed facing true south only.

The total 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 Endclamp)

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 1/2 inches for each Endclamp)

STEPS TO AVOID SHADING LOSSES

- Please ensure the location selected for the installation of the structure is free of any objects in the close vicinity.
- For projects with multiple rows of structure, the installer need to ensure to set the pitch correctly to avoid the shadow of one structure on the other.

LAYING OUT L-FEET FOR TOP CLAMPS

Refer to the Ascender Design tool for details of EW span and NS Spacing. Mark the locations for the L-feet within the installation area as shown in page 11.

NOTE:

- For expansion joint requirements, refer to page 5. Rail lengths and locations of L-feet for expansion joints will need to be determined at this stage in planning system layout.
- Refer to Ascender Design tool for allowable spans and cantilevers.

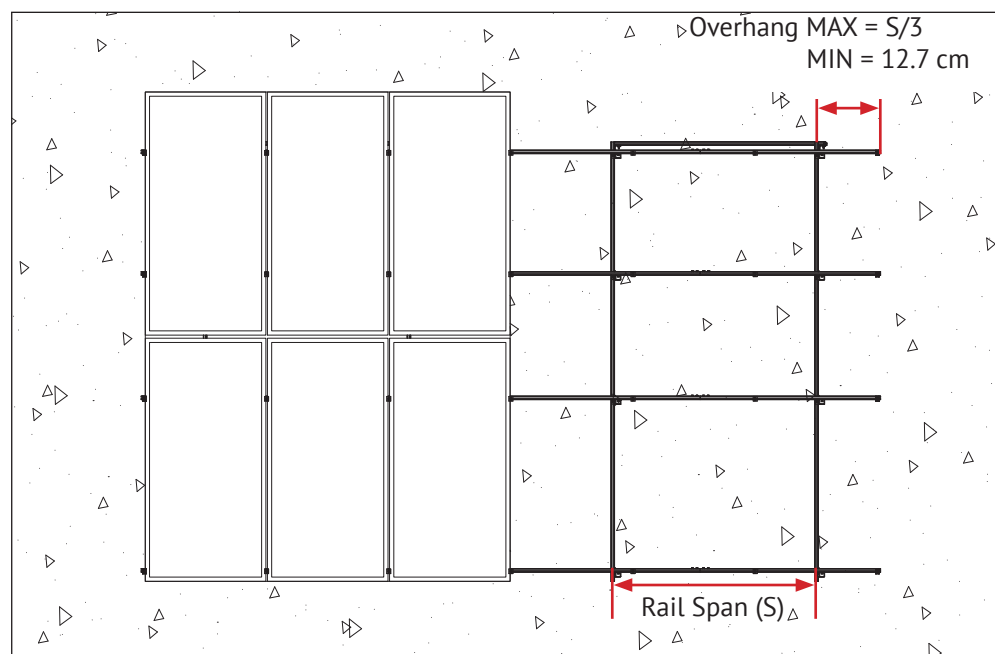


Figure shows Maximum and Minimum Overhang Limits

EXPANSION JOINT USED AS THERMAL BREAK

Expansion joints prevent buckling of rails or system connections failure due to thermal expansion. Determine location of expansion joints prior to installation of roof attachments 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 the required torque. In any case the thermal gap should never be less than 1.52cm.

Rails in expansion joint configurations are considered cantilevered and must follow the cantilever rule on both sides of the expansion joint. 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.

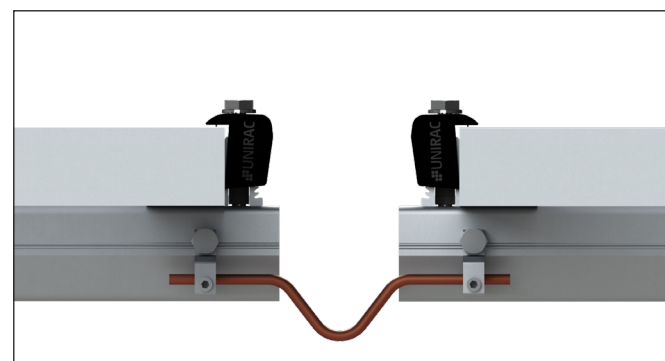
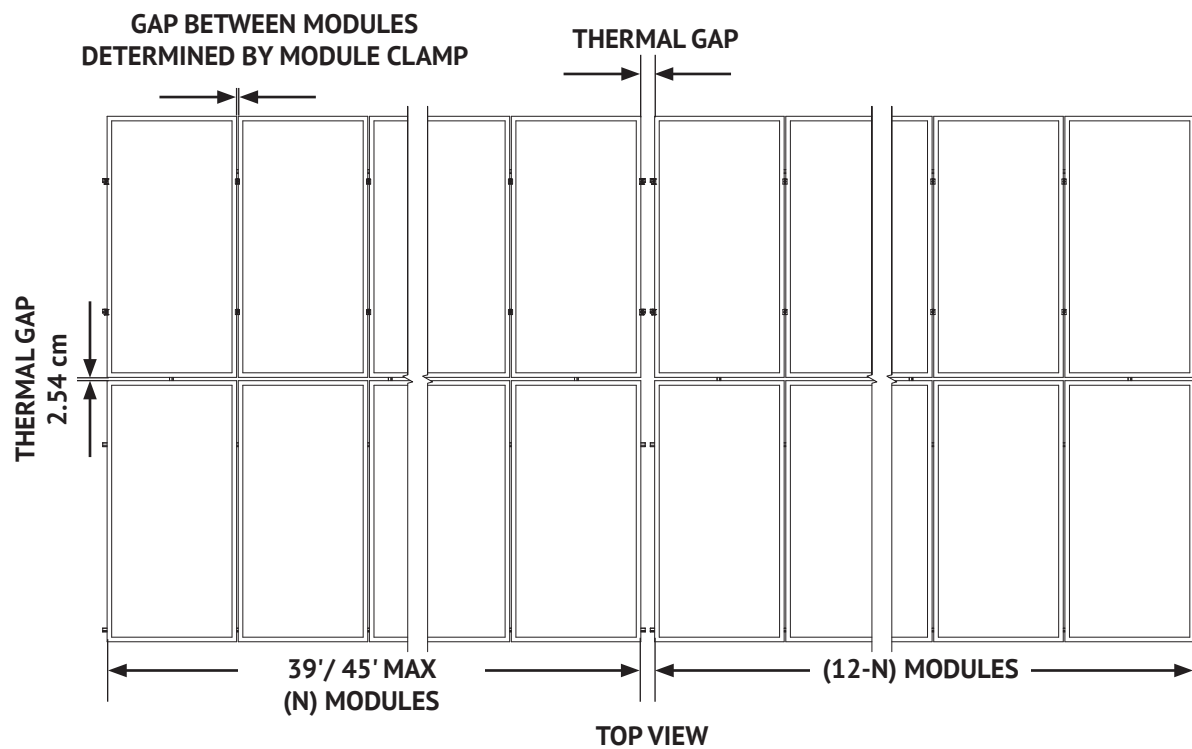
For temperature variations less than 120 °F, thermal break is not required up to 12 modules installed in a row. Thermal lengths for temperature variations greater than and equal to 120 °F are shown in table below:

Temperature variation (ΔT) in °F	Maximum continuous length (ft.) of spliced rails
120	45
140	39

For additional concerns on thermal breaks in your specific project, please consult a licensed structural engineer.

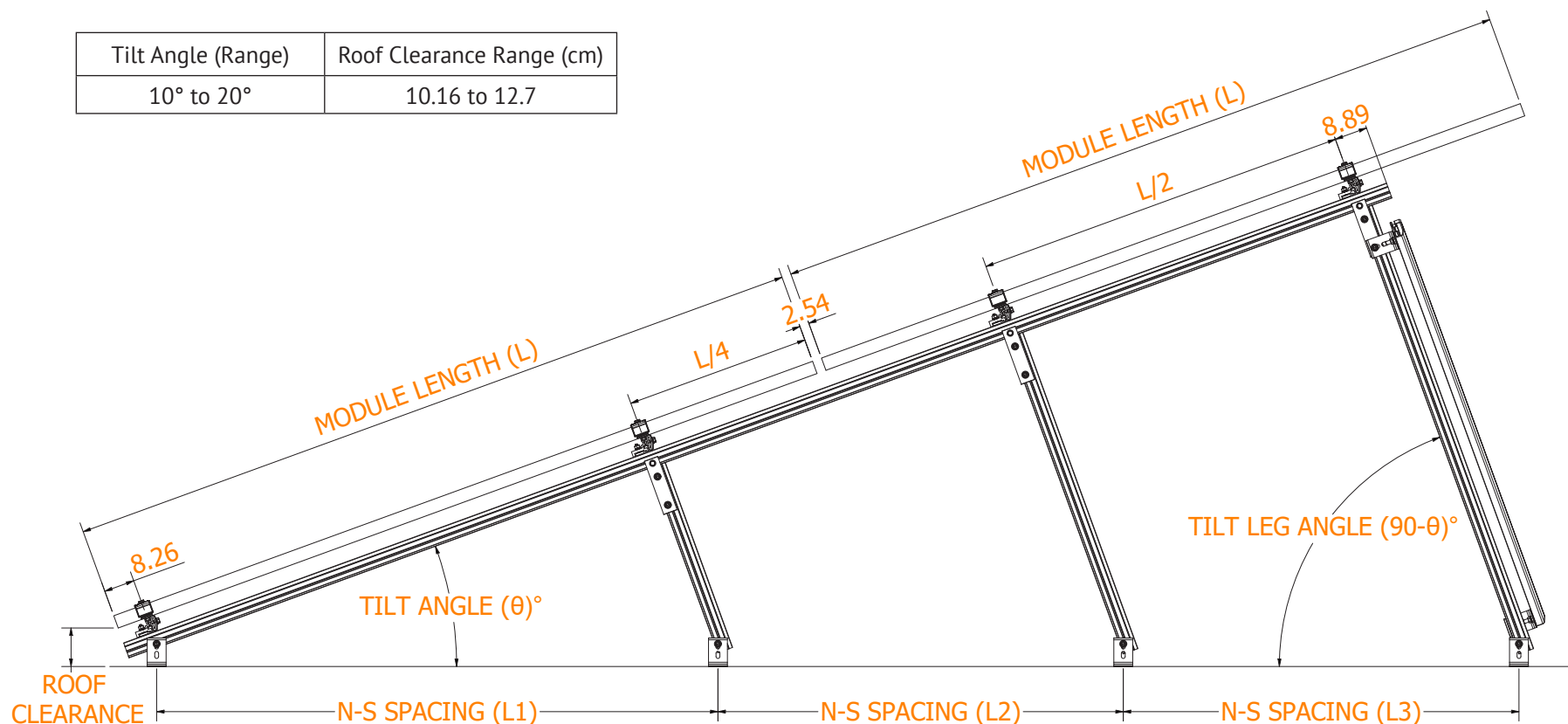
Determine the maximum rail temperature difference (ΔT) between the time of installation and the extreme high or low temperature. The Extreme Annual Design Conditions table at the following url can be used as a reference when determining ΔT . <http://ashrae-meteo.info/>. The installer is responsible for 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 Swivel L-Plate. See Ascender design tool for corresponding reaction forces to ensure that the Maximum Reaction Forces do not exceed the shear capacity of the roof connection.



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

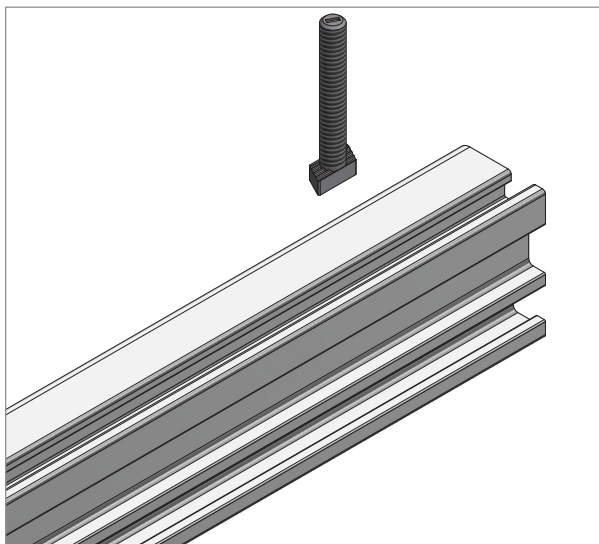
Tilt Angle (Range)	Roof Clearance Range (cm)
10° to 20°	10.16 to 12.7



- Install front tilt plate at L-8.25 cm from front edge of NS rail and rear tilt plate at 8.89 cm from rear edge of NS rail. Install mid tilt plate at L/2 distance from the rear tilt plate. Note these dimensions for Step 2. See page 10.
- Install T-bolt for south edge connection at 8.26 cm from front edge of the N-S rail. note this distance for Step 7. See page 13.
- For NS spacing, measure distance between point on NS rail at 9.68cm to bottom edge of front tilt leg (L1), bottom edge of front tilt leg to bottom edge of mid tilt leg (L2) and bottom edge of middle tilt leg to bottom edge of rear tilt leg (L3). Note these dimensions for Step 3. See page 11.
- Note down EW beams spans for Steps 3&8. See pages 11&13.

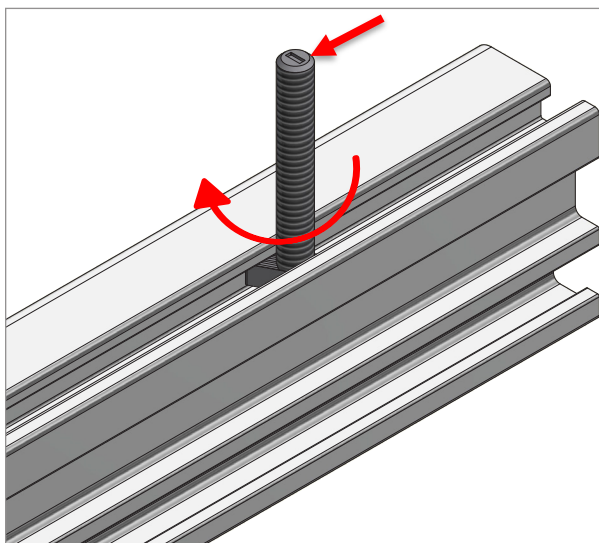
NOTE: All dimensions in the above figure are in centimeters. Module dimensions are to be taken in centimeters for calculating other dimensions as mentioned in the figure.

COMMON STEPS FOR ALL T-BOLT INSTALLATIONS:



STEP A. INSERT T-BOLT

Insert T-Bolt into the rail and position the T-Bolt.



STEP B. ROTATE THE T-BOLT

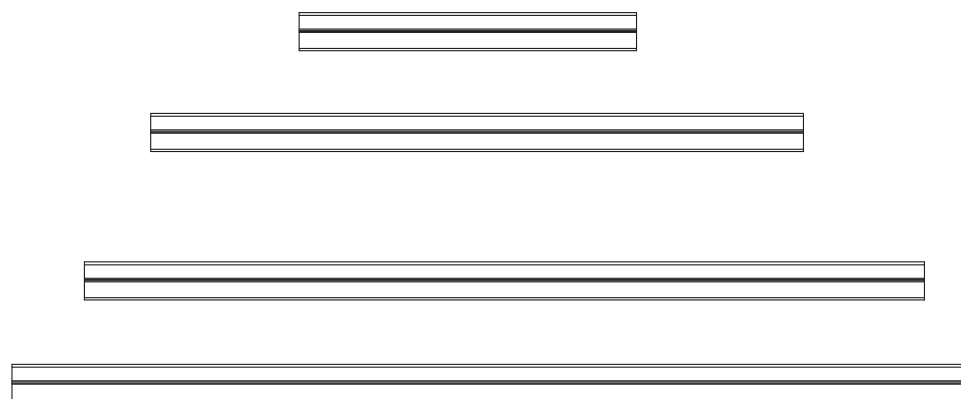
Rotate T-Bolt into position. Verify that the position indicator on the T-Bolt shaft is angled perpendicular to the rail.

STEP 1. CUT RAIL INTO SECTIONS:

Cut rails into needed lengths and verify the count of each part. Refer to the Ascender Design tool to find the length and quantities of the following parts:

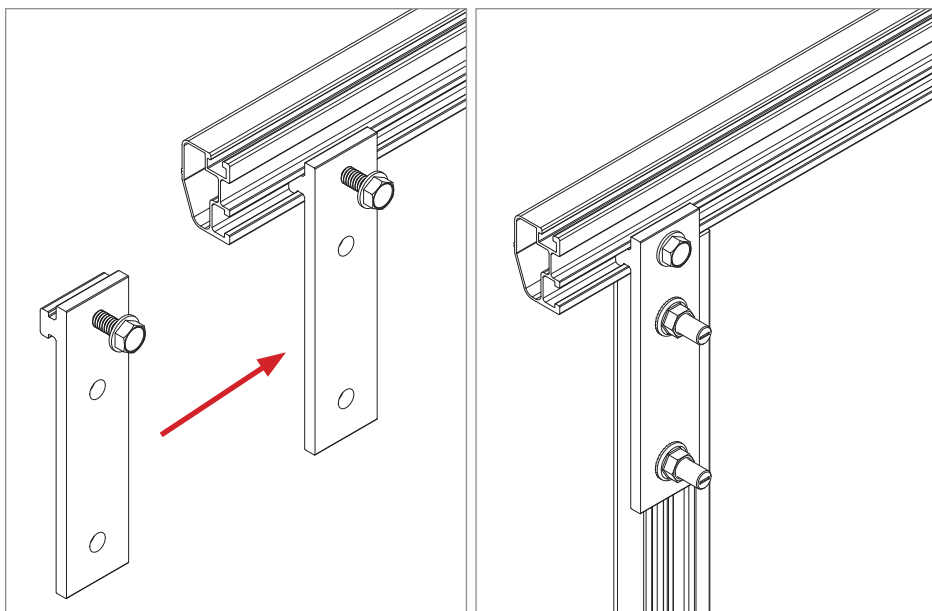
Length & Quantities	1 : Tilt Post - Front	XXX cm
		XX c/u
	2 : Tilt Post - Mid	XXX cm
		XX c/u
	3 : Tilt Post - Rear	XXX cm
		XX c/u
	4 : NS Beam	XXX cm
		XX c/u
	5 : Overall EW Beam	XXX cm
		XX c/u
	6 : EW Bracing - Rear	XXX cm
		XX c/u

C/U : Count per Unit.



CUTTING GUIDE :

1. Cut the East-West Beam into the specified length. Measure before cutting to minimize waste.
2. Utilize excess rail after cutting the EW beam before using a new rail to make other members of the structure.
3. Minimize rail waste by considering the different length of the rail necessary for each member of the structure.
4. Cutting must be accurate to next millimeter. Any discrepancy in the lengths may result in difficulties during installation of the structure.
5. For installation on uneven sites, measure length of the members from the deepest undulation for the given span and build the first frame. The rest of the tilt legs must only be adjusted by shortening. Module clearance will vary depending on depth of undulations.

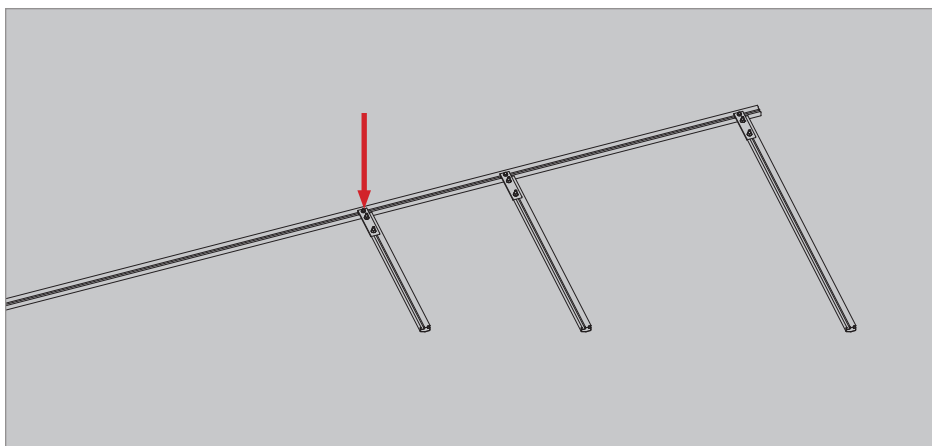


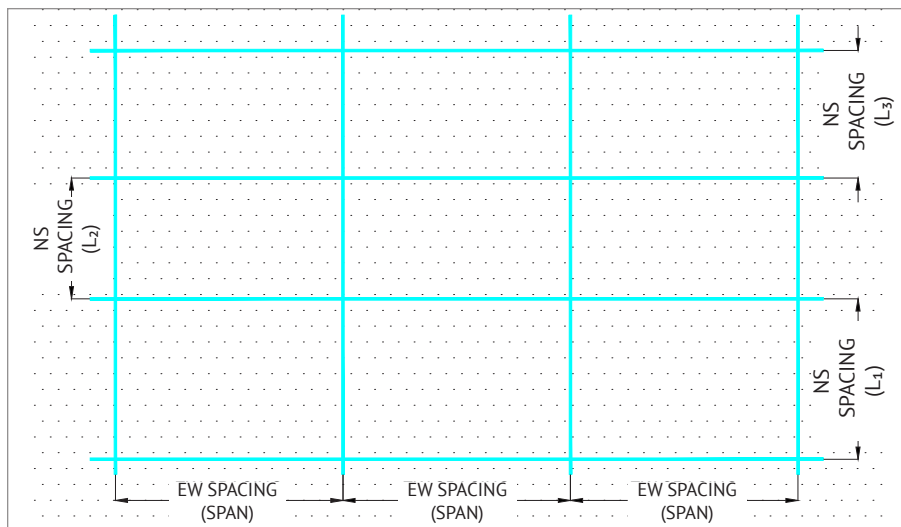
STEP 2. ASSEMBLE TILT PLATES TO TILT LEGS AND NORTH-SOUTH (NS) RAIL:

Slide the Tilt Plate into the NS rail and install the bolt loosely. Refer to page 7 for the position of Tilt plate on the NS rail.

Then, attach the tilt leg to the Tilt plate using two 3/8" T-Bolts. Similarly, engage all the tilt plates to the tilt legs and NS rail and then drive the 5/16" thread cutting bolt using rechargeable impact and drive the bolt until it touches the tilt plate. All the members should be kept on the ground while driving thread cutting bolt, to secure the Tilt legs to NS rail.

Note:-Torque 3/8" nut and 5/16" thread cutting bolt to 30 ft-lbs.





STEP 3. ARRAY LAYOUT

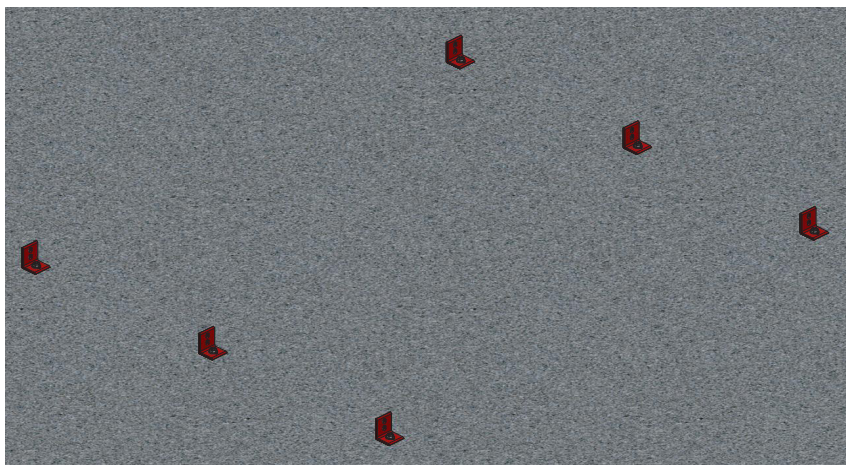
Refer to the calculator tool for details of EW span and NS Spacing. Mark the location for the L-feet.

Span/ Bay: EW distance between two frames. Refer to figure A in page 12 for frame.



STEP 4. 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 5. ATTACH L-FEET TO ANCHORS

Use 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.

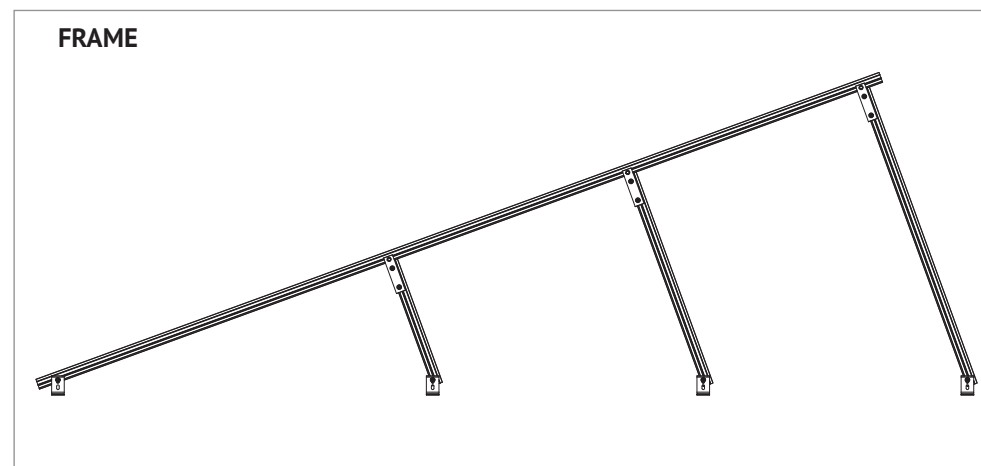
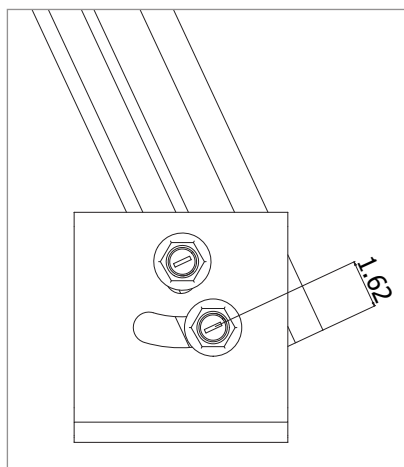
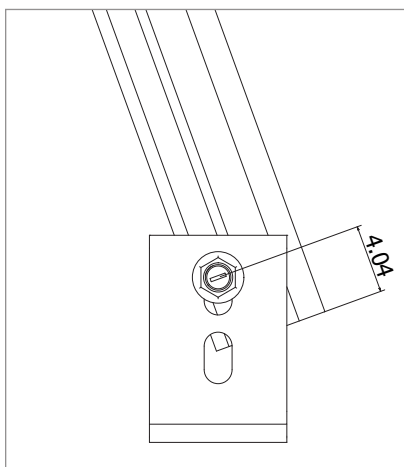
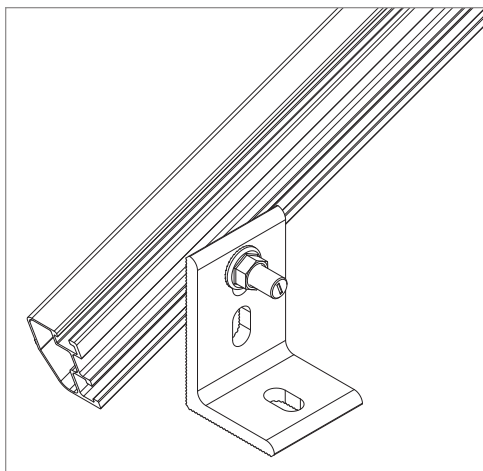


Figure A: Frame - Two-dimensional structural connectivity in the NS direction.

STEP 6. SECURE TILT LEGS TO L-FOOT

Lift the entire frame from the ground and secure the Tilt legs to the L-Feet using one or two T-Bolts as recommended by the calculator tool. For one T-Bolt connection, Use L-Foot and connect the T-Bolt at 4.04 cm from the face of the rail. For two T-Bolt connections, use Swivel L-Plate and connect the bottom T-Bolt at 1.62 cm from the face of the rail.

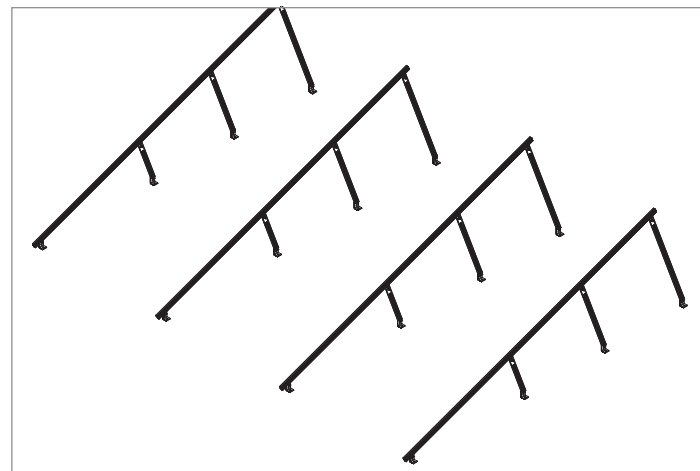
Torque 3/8" nut to 30 ft-lbs



STEP 7. SECURE L-FOOT TO NS RAIL

Secure the L-Foot to the NS Beam using one T-Bolt.

Torque 3/8" nut to 30 ft-lbs



STEP 8. INSTALL ALL THE FRAMES

Install the rest of the frames at specified locations in step 3 by repeating steps 6 and 7.

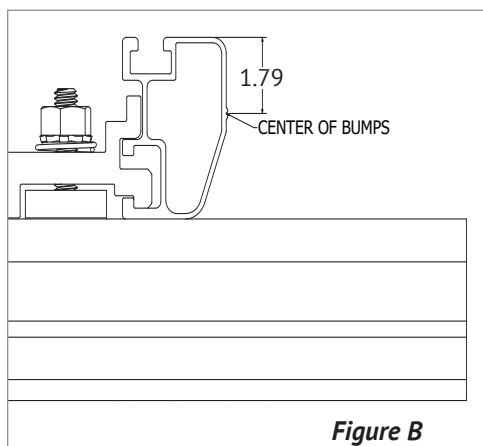


Figure B

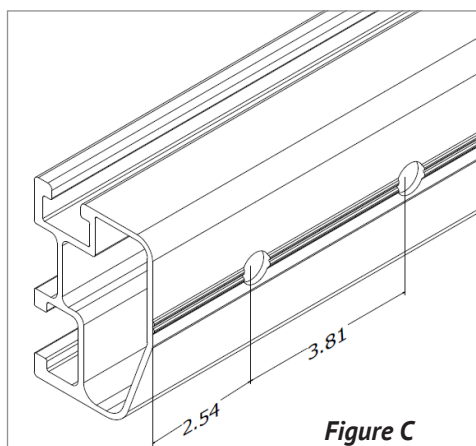


Figure C

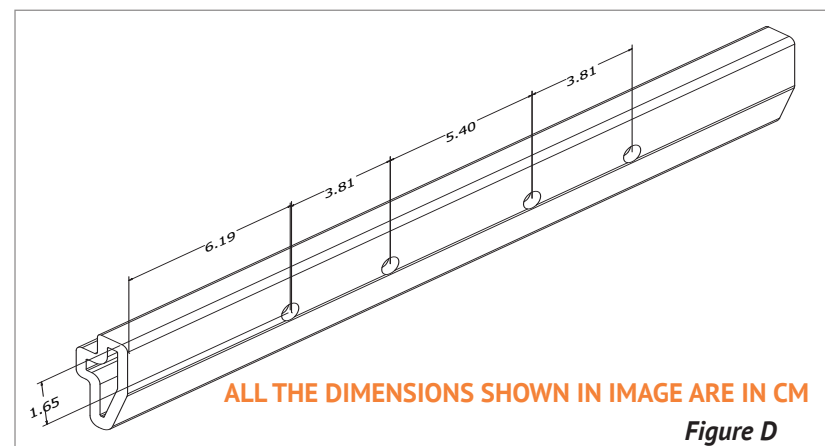


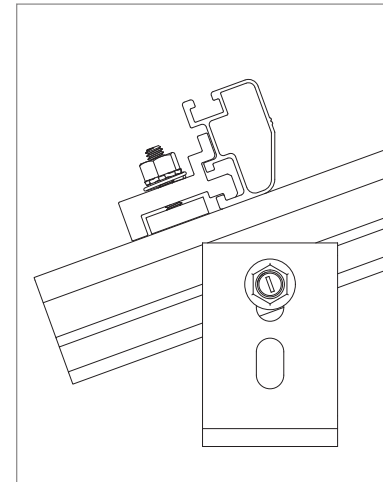
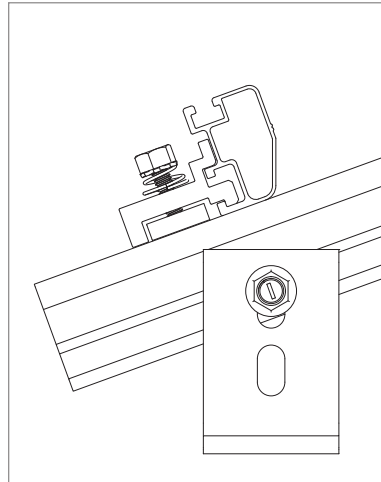
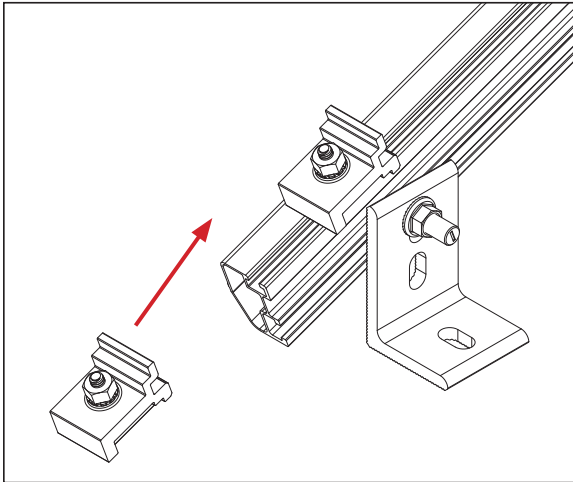
Figure D

ALL THE DIMENSIONS SHOWN IN IMAGE ARE IN CM

STEP 9. DRILL HOLES ON EAST-WEST (EW) BEAMS & SPLICE MEMBERS

Measure the specified distances on the rail used EW beams as shown on Fig B & C. Drill pilot holes of 0.238" to allow 5/16" drilling screws.

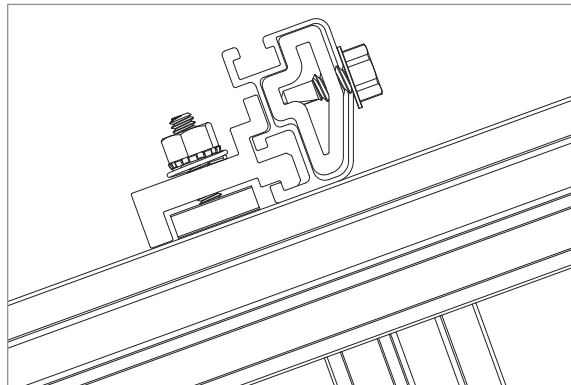
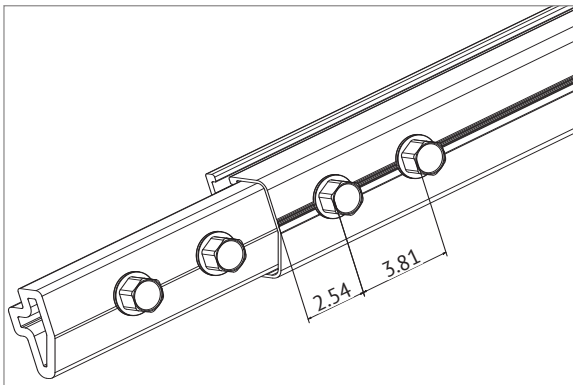
Measure the specified distances on the side of the splice as shown on Fig. D. Drill pilot holes with the same size drill bits that are used for making holes on EW beams.



STEP 10. SECURE EW BEAMS TO NS RAIL USING BEAM CLIP:

Mark on NS rail where the EW Beam are expected to go as calculated in Page 7. Slide the Beam clip into the NS rail with the rail on the upslope side of the beam clip and then bring the EW Beam to the marked position. Ensure proper fitment of the Beam clip with the EW Beam and then torque the nut.

Torque 1/4" nut to 15 ft-lbs



Note: Ensure when tightening the EW beams that EW spacing at the top of the tilt legs matches the EW spacing at the bottom of the tilt legs, such that the tilt legs will be parallel to each other and vertical.

STEP 11. INSTALL SPLICE MEMBERS ON EAST-WEST (EW) BEAMS

Insert the splice into the EW Beam equally on both sides. Ensure that the splice holes and EW beam holes are drilled in the specified distances as mentioned in step 9 and the gap between the spliced EW beams 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 EW beam on the above figure. 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.

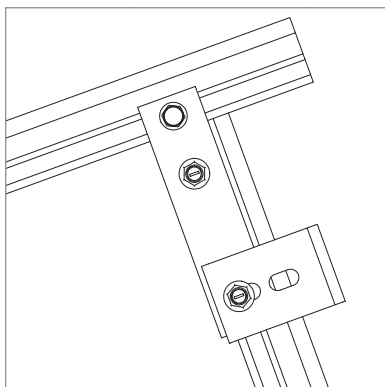


Figure E: REAR TILT LEG

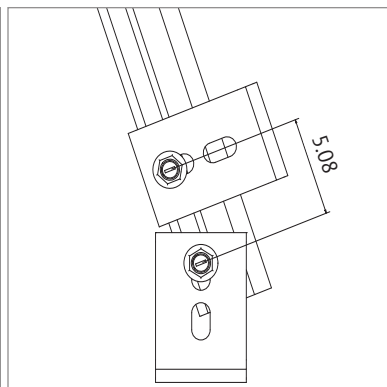


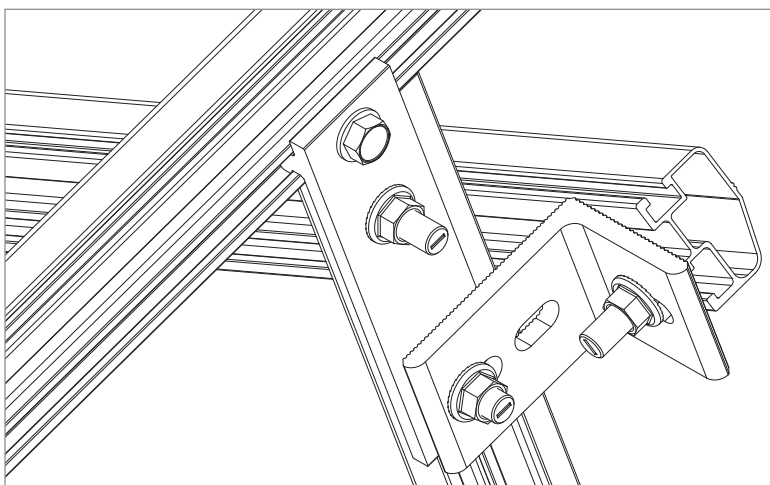
Figure F: REAR TILT LEG

STEP 12. SECURE L-FOOT ON TILT LEGS FOR EW BRACE

Top L Foot at Rear tilt leg: L-Foot to be installed on Rear tilt leg only for EW Brace connection. To connect the the high side L-Foot, loosen the 2nd nut on the Tilt plate and place the L-Foot as shown on Figure E. Then, tighten the nut to the desired torque.

Bottom L Foot at Rear tilt leg: To connect the bottom L-Foot, place the T-Bolt at a distance of 5.08 cm from the face of the T bolt as shown on Figure F. Then, tighten the nut to the desired torque.

Torque 3/8" nut to 30 ft-lbs



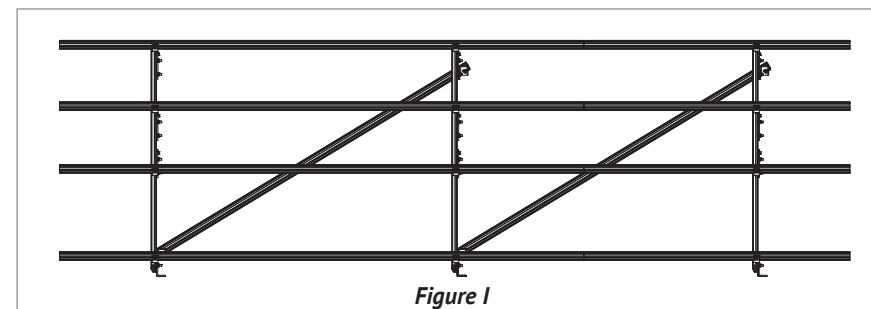
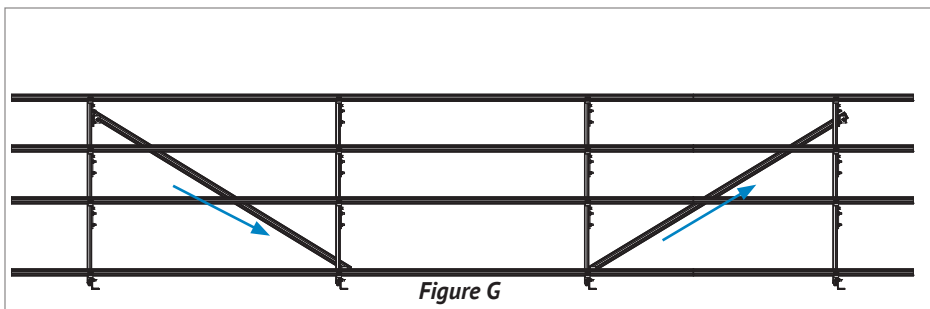
STEP 13. SECURE L-FOOT TO EW BRACE

After STEP 12, attach the other leg of L-Foot to the EW brace using one T-Bolt. Install T-bolt at a distance of 2.54 cm from the face of the rail.

Torque 3/8" nut to 30 ft-lbs.



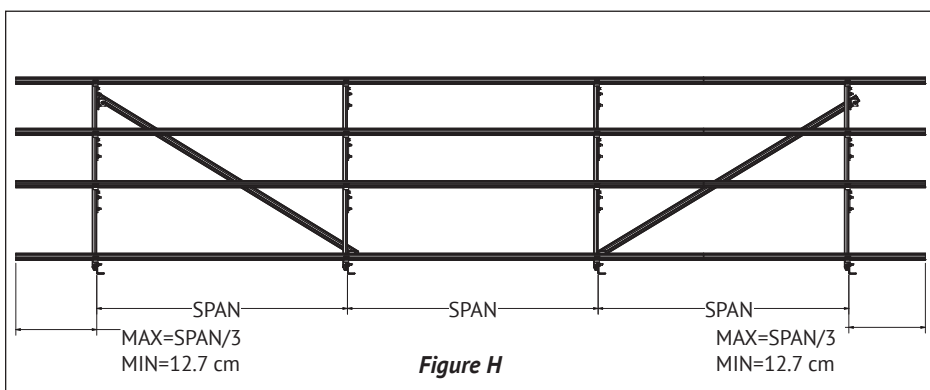
System may loose structural strength if recommended bracing connection distance is not observed.



STEP 14. INSTALL EW BRACINGS WITH EQUAL OR UNEQUAL SPAN DISTRIBUTION

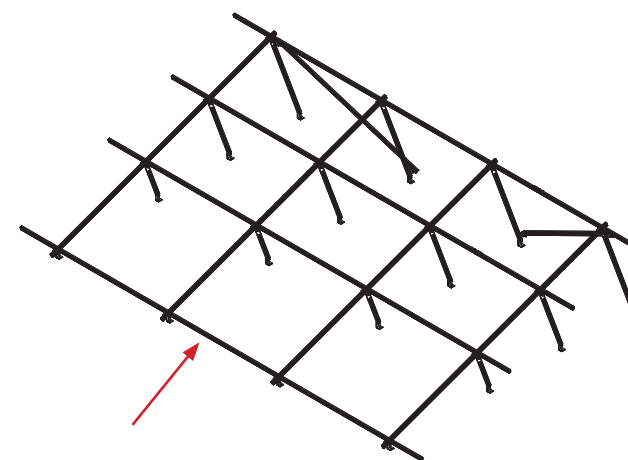
Using L-Feet and rail, attach EW Bracings at bays specified by the Ascender Design tool. The orientation of the EW Bracing at the two ends should be in accordance with the shown direction on Fig. G. Based on thermal break, the last bay either East bay or West bay (based on side you start) may have a different span. In case of an array with only two spans and two EW bracings, then mount EW bracing in same orientation as shown in Fig. I. Check the Ascender Design tool for these occurrences.

Note: Ensure that tilt legs are vertical when tightening EW bracing to L-feet.
Torque 3/8" nut to 30 ft-lbs.

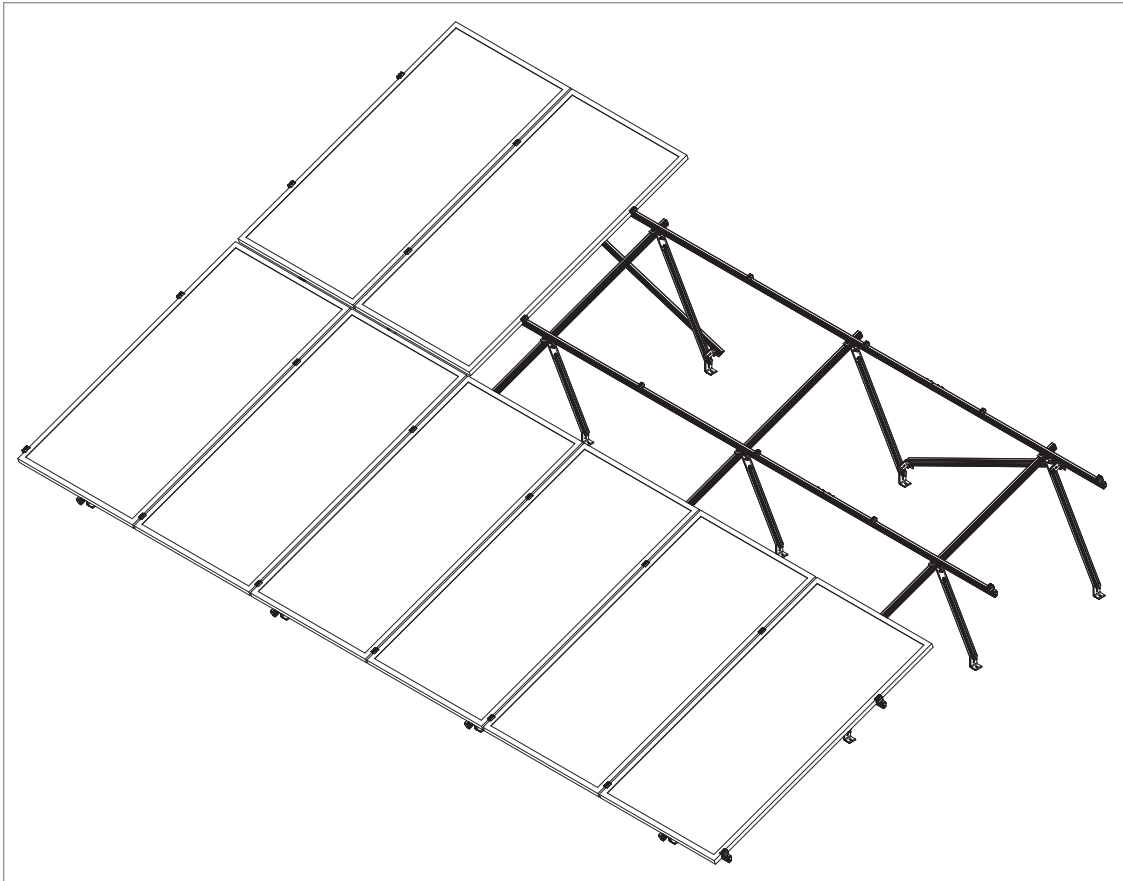


STEP 15. CANTILEVER LENGTH LIMIT CHECK

See Figure H. Maximum length of the cantilever beam should be 1/3rd of the span and minimum cantilever should be 12.7 cm. Refer to the Ascender Design tool sheet for span chart details.



The red arrow in the above figure shows the view direction of the observer for Fig. G, Fig. H, and Fig. I.

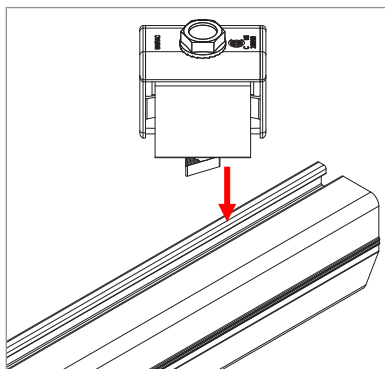


STEP 16. INSTALL PV MODULES

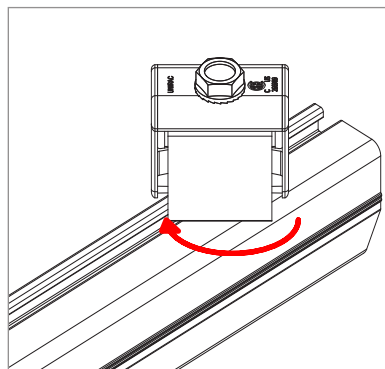
Using supplied clamps, attach modules to EW beams. Install end-clamp first then continue to use mid-clamps along the array until the final module, then use an end-clamp.

Notes:

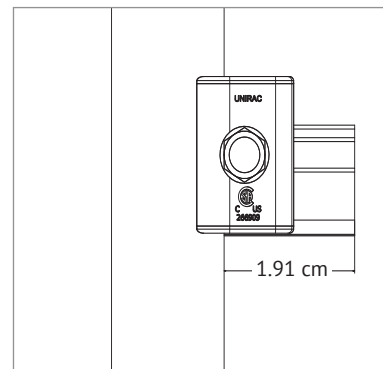
1. Ensure roof clearance is not more than 12.7 cm . See page 7.
2. See page 22, Micro Inverter Mounting section for installing MLPEs.



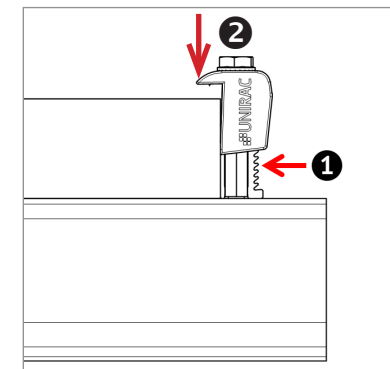
1. Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot.



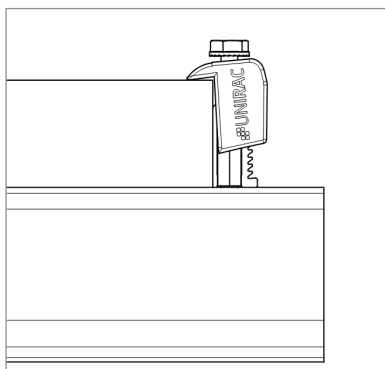
2. Rotate clamp clockwise until the T-bolt fully engages to the inside of the rail slot.



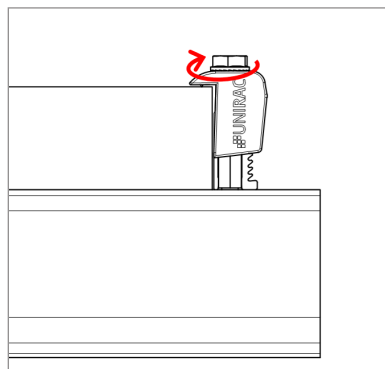
3. Place module at least 1.91 cm from end of rail and position clamp against the module frame.



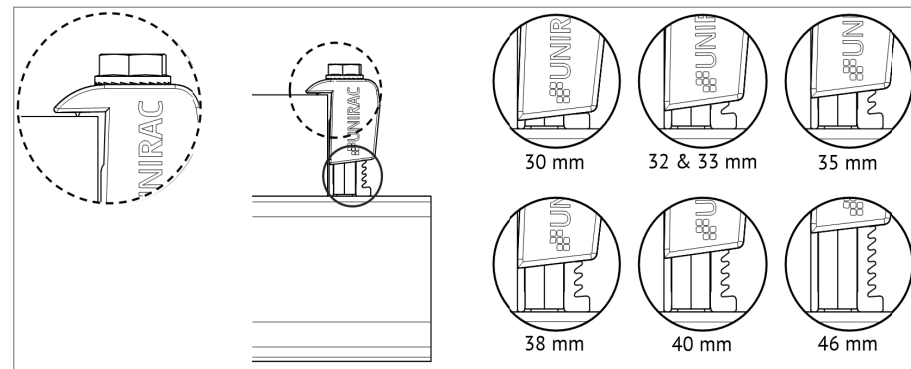
4. While applying pressure to hold the clamp against the module, push down on the module side of the clamp cap.



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.

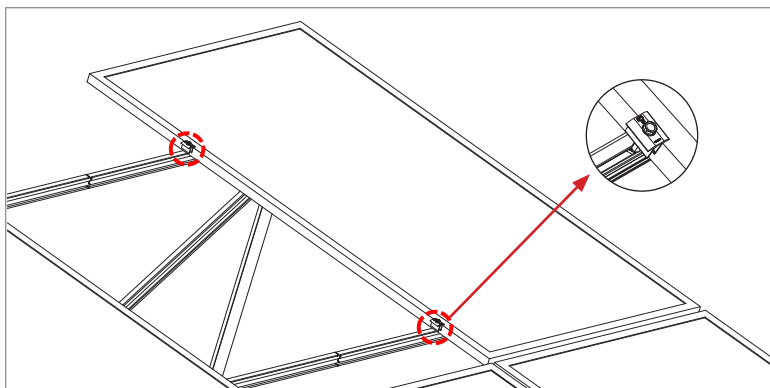


7. Confirm clamp is engaged in correct module height position and that the top of the cap is sitting level with the module frame.

NOTE:

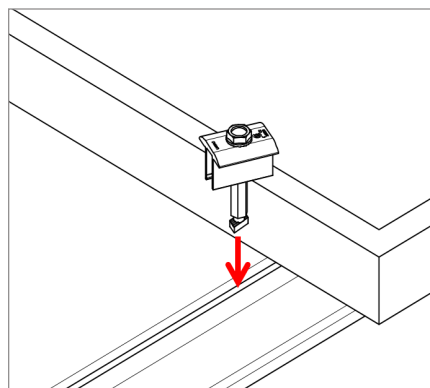
1. When installing 46mm modules, loosen bolt by 1 turn before positioning clamp against module frame.
2. Do not force clamp onto module frame as this may damage the bonding pin.

NOTE: Clamp is certified for single use only.

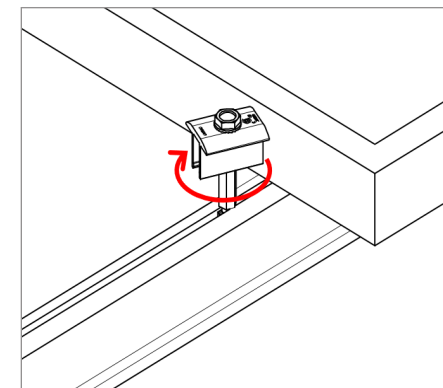


MID CLAMP INSTALLATION

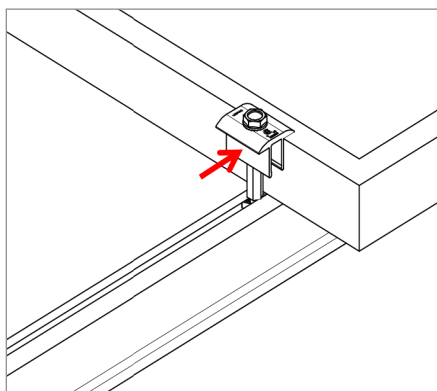
Mid clamp is supplied as an assembly with a T-bolt. Clamp assemblies can be positioned in rail prior to module placement.



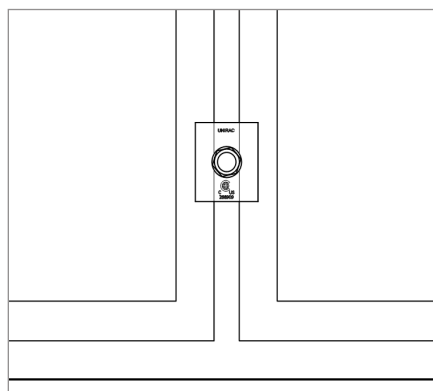
1. Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



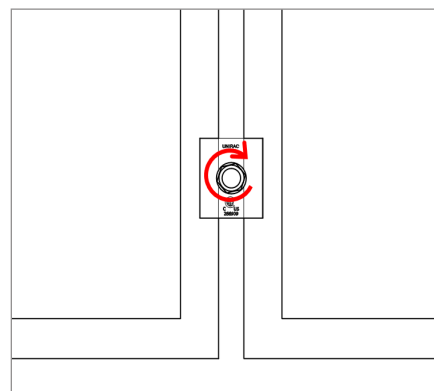
2. Rotate clamp clockwise 63° of a turn to fully engage T-bolt inside rail slot.



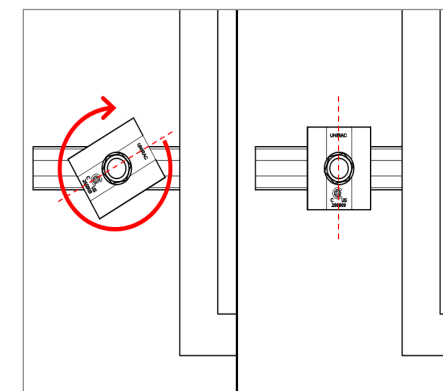
3. Slide clamp into position against module.



4. Place second module.

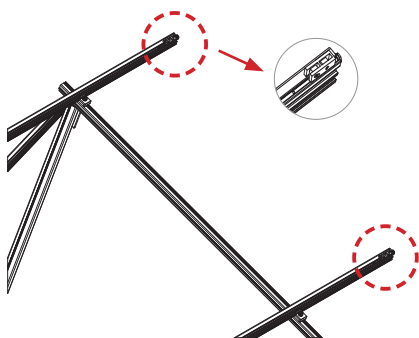


5. Tighten bolt and torque to 15 ft-lbs.



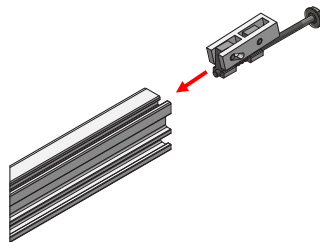
NOTE: If excessive force is applied in step 2, the cap may over-rotate causing it to be mis-aligned with the module frame.

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.



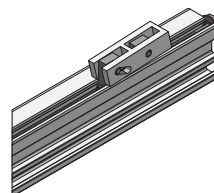
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.

1



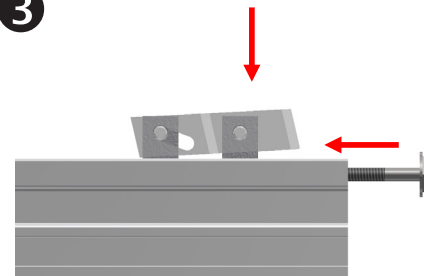
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.

2

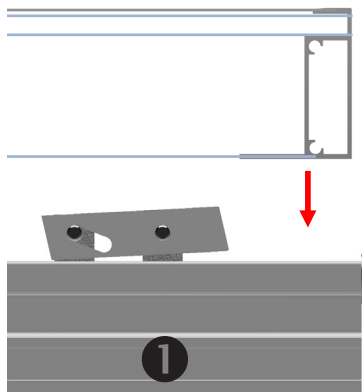


POSITION END CLAMPS: Slide end clamp assembly on to rail until bolt head engages with end of rail. End clamps are positioned on rails prior to the first end module and prior to the last end module.

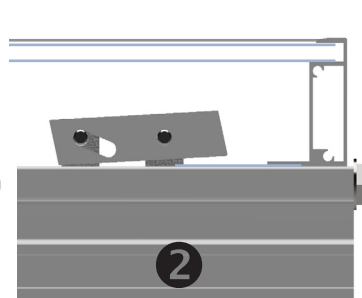
3



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.

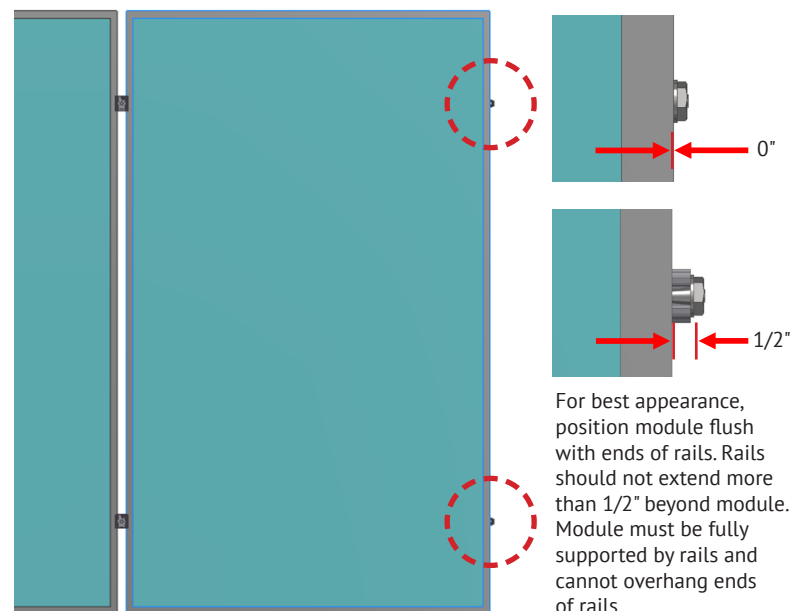
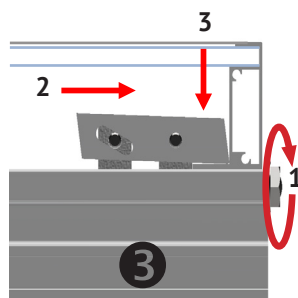


INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps at ends of rails.

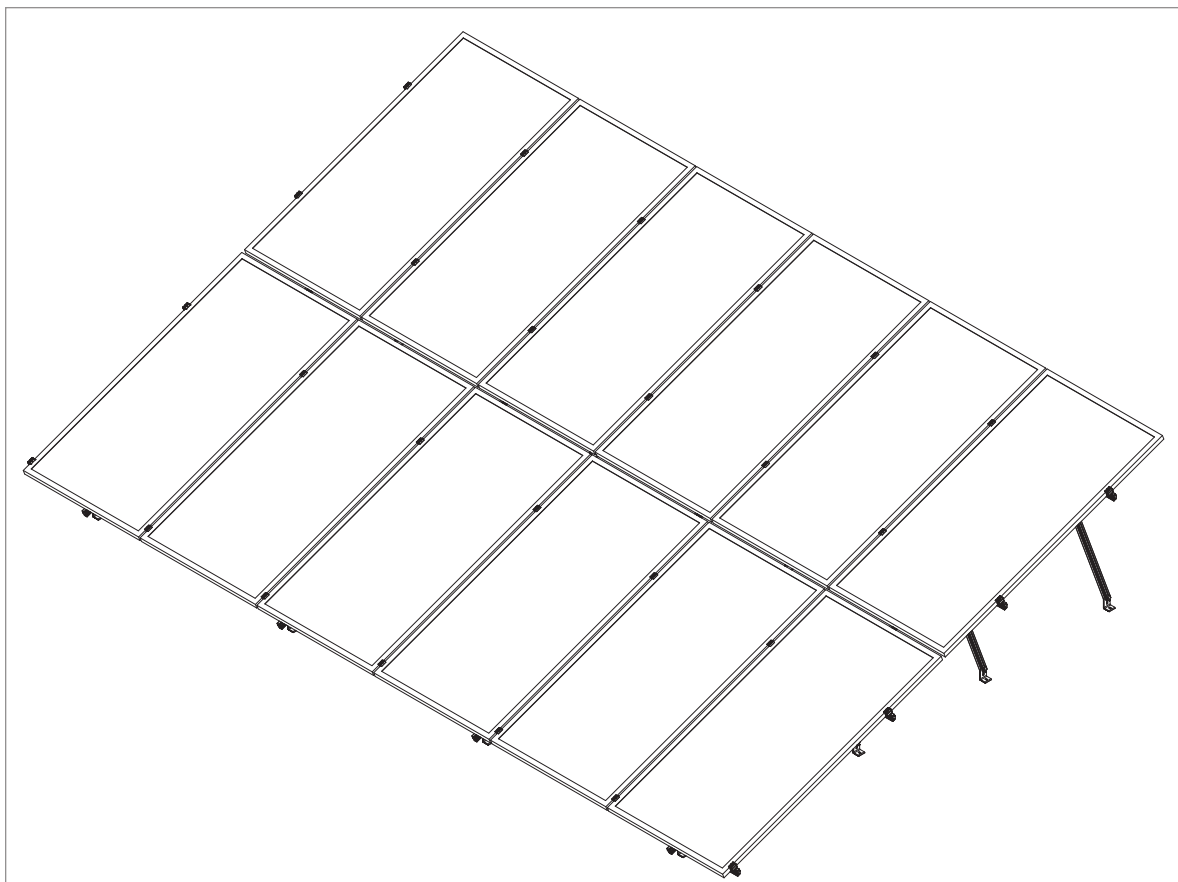


ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force. **To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.**

Torque End clamp bolt to 5 ft-lbs

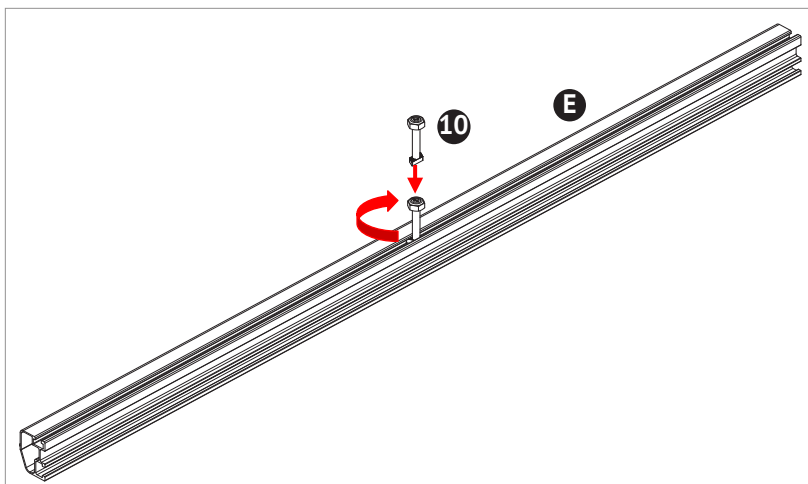


For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.



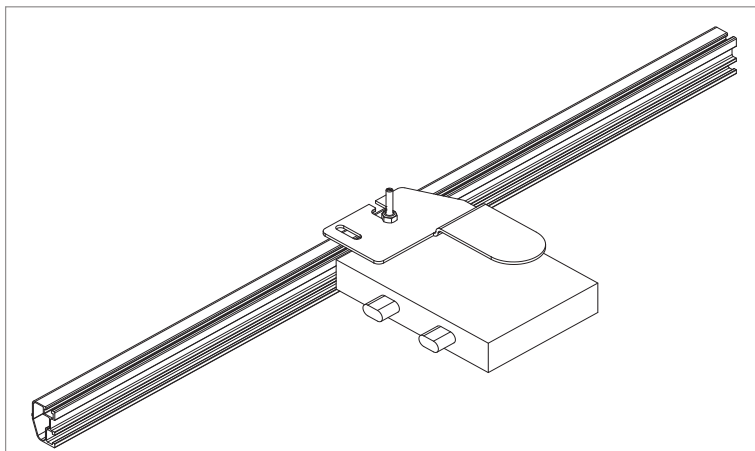
STEP 17. FINAL CHECK

Check all fasteners to verify correct torque values and proper T-bolt engagement with rail.



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.

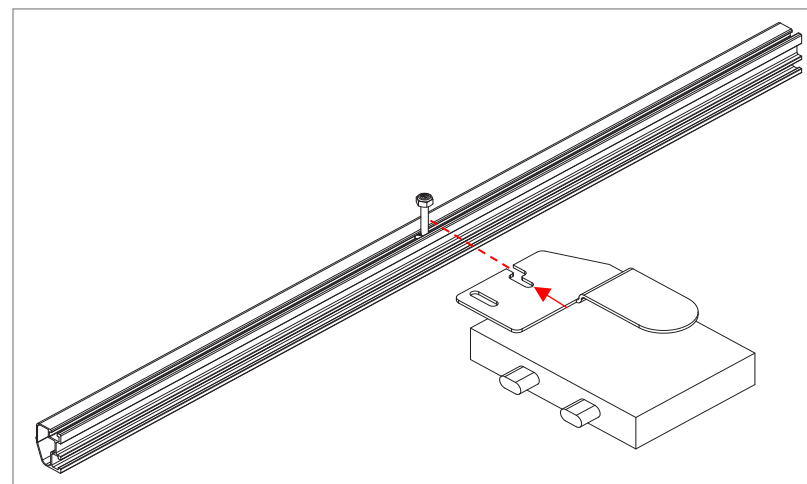


INSTALL MICROINVERTER:

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

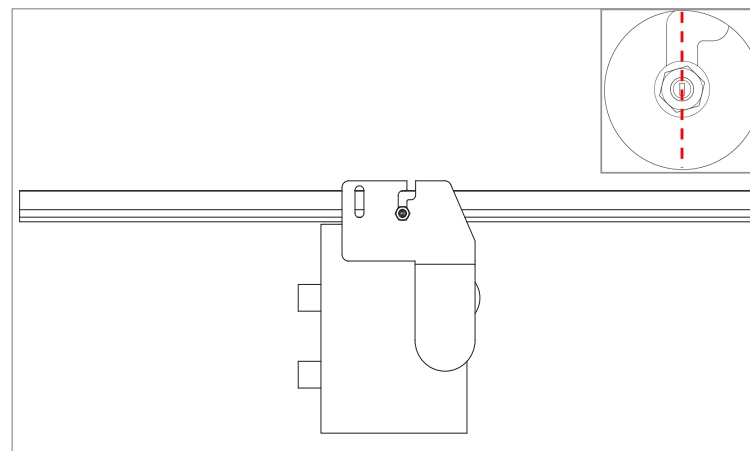
NOTES:

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



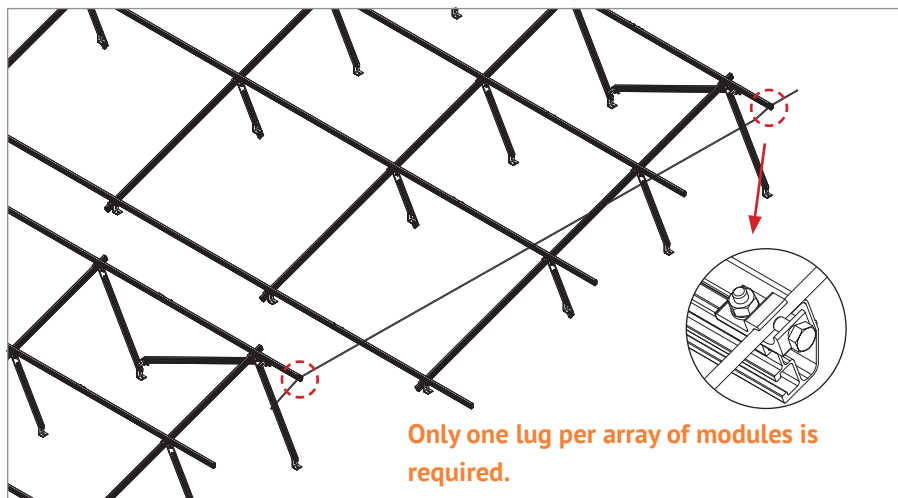
INSTALL MICROINVERTER:

Install microinverter on to the rail. Engage with bolt.



ALIGN POSITION INDICATOR:

Verify that position indicator on the T-bolt is perpendicular to rail.



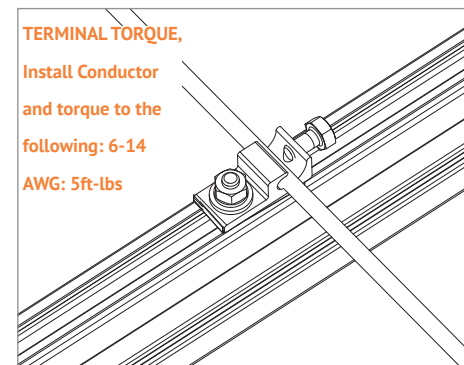
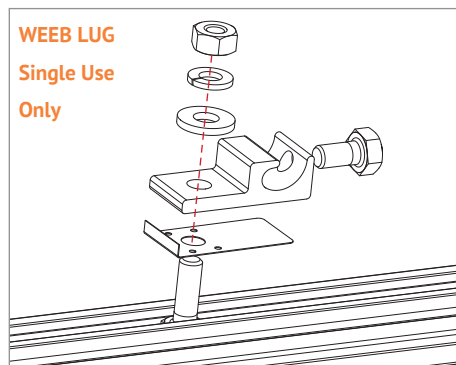
Only one lug per array of modules is required.

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.

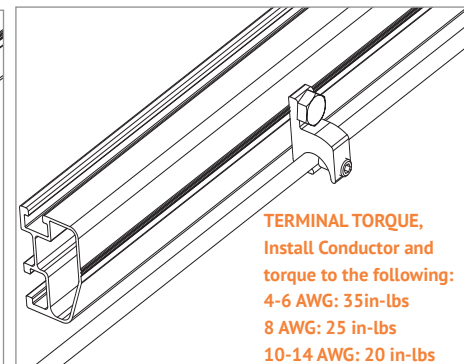
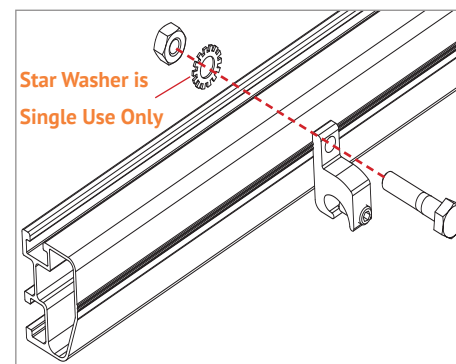


WEEB LUG CONDUCTOR - UNIRAC P/N 008002S:

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



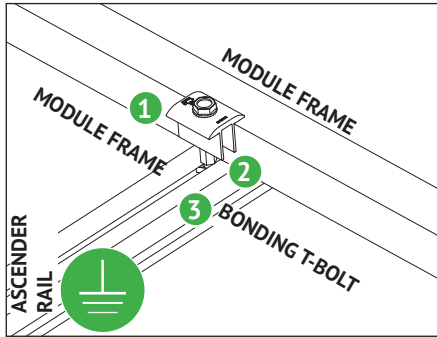
ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding

Lug- Drill, deburr hole and bolt thru both rail walls per table.

TORQUE VALUE 5 ft lbs.

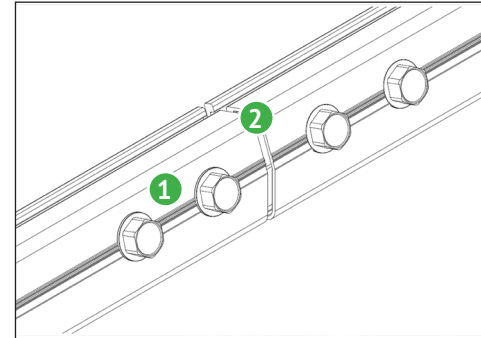
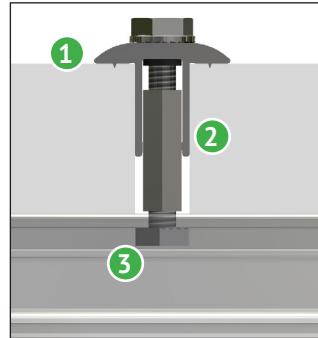
See ILSCO product data sheet for more details, Model No. GBL-4DBT.

NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION



BONDING MIDCLAMP ASSEMBLY

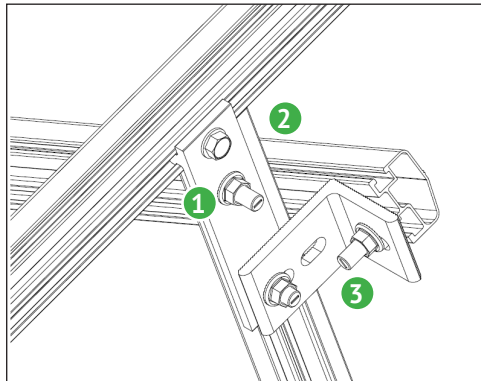
- 1 Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp
- 2 Stainless steel nut bonds aluminum clamp to stainless steel T-bolt
- 3 Serrated T-bolt head penetrates rail to bond T-bolt, nut, clamp, and modules to SM Ascender rail.



BONDING RAIL SPICE BAR

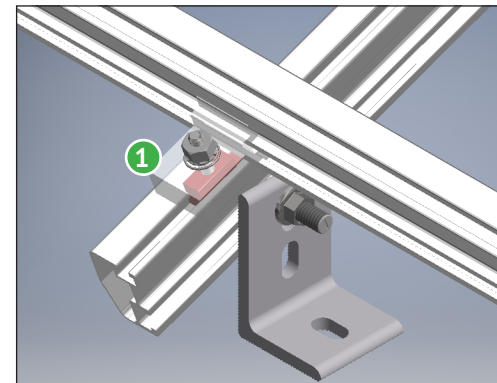
- 1 5/16" self drilling screw creates bond between splice bar and EW beams.
- 2 Aluminum splice bar spans across rail gap to create rail to rail bond.

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



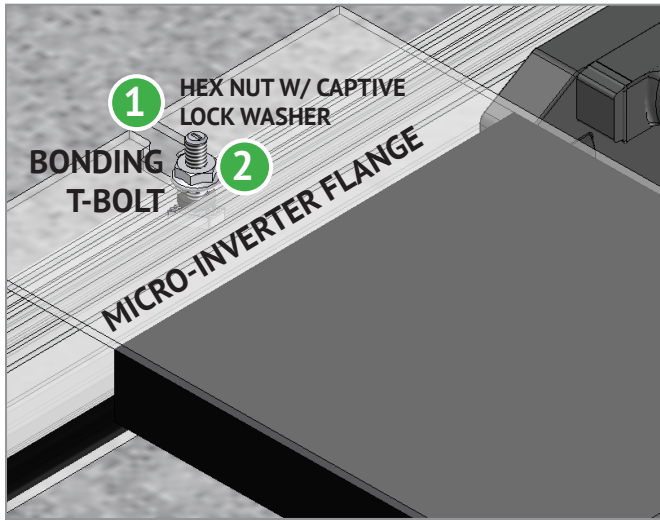
BONDING TILT PLATE AND L-FOOT

- 1 5/16" thread cutting bolt, 3/8" T-bolt and 3/8" serrated flange nut creates bond between Tilt plate and both rails.
- 2 Aluminum Tilt Plate creates bonding between North-South rail and Tilt Legs.
- 3 Aluminum Swivel L Foot creates bonding between Tilt Legs and East-West Bracing.



BONDING BEAM CLIP ASSEMBLY

- 1 1/4" stud, 1/4" keps nut, beam clip and beam plate creates bond between NS rail and EW beam.

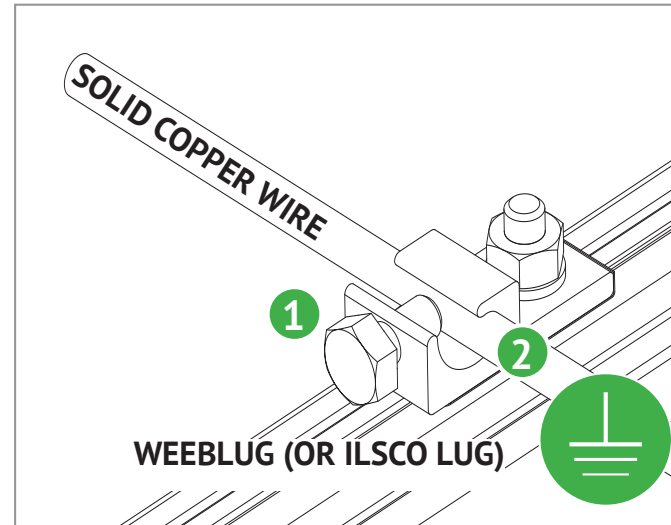


BONDING MICROINVERTER MOUNT

- 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 Ascender rail.

CAUTION

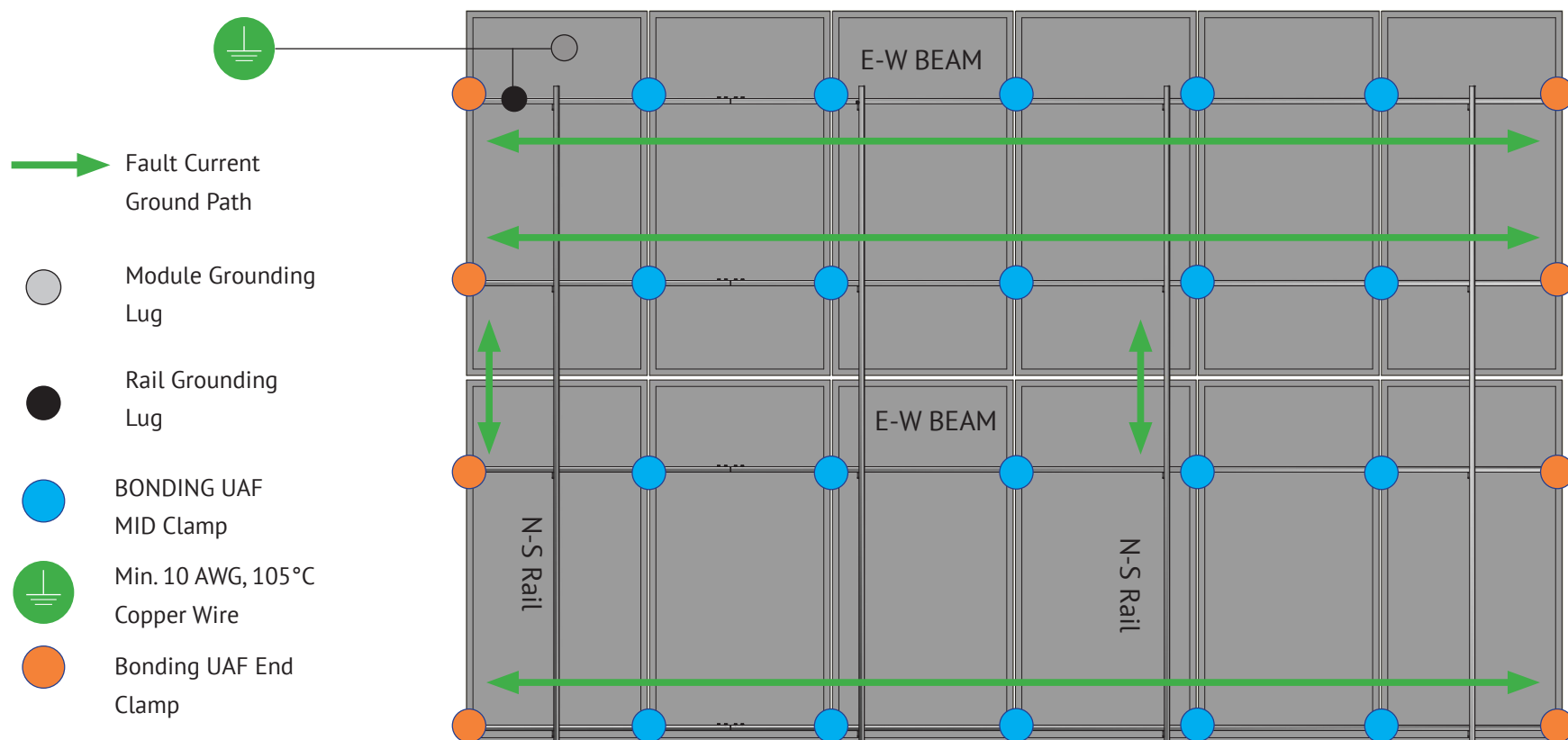
1. If loose components or loose fasteners are found during periodic inspection, re-tighten immediately.
2. Any components showing signs of corrosion or damage that compromise safety shall be replaced immediately.



RACK SYSTEM GROUND

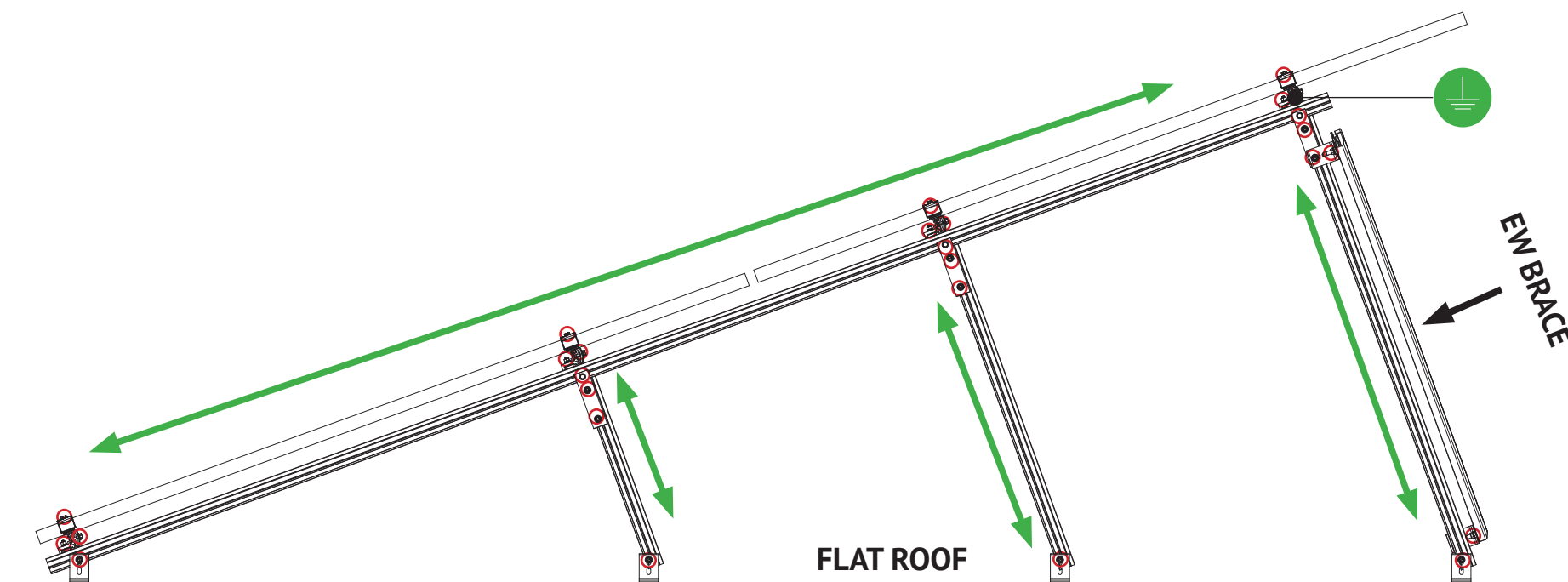
- 1 Weeb washer dimples pierce rail to create bond between rail and lug
- 2 Solid copper wire connected to lug is routed to provide final system ground connection.

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



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

Refer to page 27 for NS bonding connections.



Fault Current Ground
Path



Bonding Connection



Min. 10 AWG, 105°C
Copper Wire

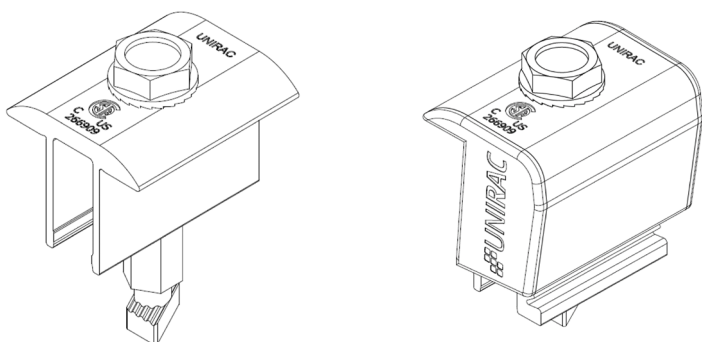


Rail Grounding
Lug

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.



The SM Ascender 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 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 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

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	Manufacture	Module Model / Series	Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1	Canadian Solar (cont.)	CS3W-(MS/MB-AG/P/P-PB-AG) CS3Y-MB-AG CS5A-M 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) CS6X-P, CSX-P ELPS CS6(A/P)-MM	Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Aleo	P-Series & S-Series			Hanwha SolarOne	HSL 60
Aptos Solar	DNA-120-(MF/BF)10-xxxW DNA-120-MF10 DNA-120-(MF/BF)23 DNA-144-(MF/BF)23 DNA-120-(MF/BF)26 DNA-144-(MF/BF)26 DNA-108-(MF/BF)10-xxxW			Heliene	36M, 36P 60M, 60P, 72M & 72P Series 144HC M6 144HC 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
Astronergy	CHSM6612 M, M/HV CHSM6612P Series CHSM6612P/HV Series CHSM72M-HC CHSM72M(DG)/F-BH	Centrosolar America	C-Series & E-Series	Hyperion Solar	HY-DH108P8(B), HY-DH108N8B HY-DH144P8
		CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-01 CTxxxPxx-01, CTxxxMxx-02, CTxxxMxx-03 CTxxxMxx-04, CTxxxHC11-04 CTM10400HC11-08, CTM10400HC11-09	Hyundai	KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG, HiD-SxxxRG(BK), HiS-S400PI HiS-SxxxYH(BK) HiS-SxxxXG(BK) HiN-SxxxXG(BK)
Auxin	AXN6M610T AXN6P610T AXN6M612T AXN6P612T	Eco Solargy	Orion 1000 & Apollo 1000		
		EMMVEE	ExxxP72-B ExxxM72-B ExxxH CM120-B		
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxP/156-60S AC-xxxMH/120(S/V/SB/VB) AC-xxxMH/144(S/V/SB/VB)	ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB	Imperial Star	ISM7-SHDD108-400/M
Bluesun Solar	HEX5 BSMxxxM10-54HPH	First Solar	FS-6XXX(A) FS-6XXX(A)-P, FS-6XXX(A)-P-I	Inxeption	mSolar 108BB HC Series (TXI10-xxx108BB) mSolar 144BB HC Series (TXS6-xxx144BB)
Boviet	BVM6610, BVM6612	Flextronics	FXS-xxxBB	ITEK	iT-SE Series
BYD	P6K & MHK-36 Series	Freedom Forever	FF-MP-BBB-xxx, FF-MP1-BBB-xxx	Japan Solar	JPS-60 & JPS-72 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)	FreeVolt	PVGraf	JA Solar	JAM54S30 xxx/MR JAM54S31 xxx/MR JAM72D30MB, JAM78D10MB JAM72S30 /MR JAP6 60-xxx JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB
		GCL	GCL-P6 & GCL-M6 Series		

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A

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	Manufacture	Module Model / Series	Manufacture	Module Model / Series
JA Solar (cont.)	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	LONGi	LR4-60(HPB/HPH) LR4-72(HPH) LR5-54-HPB-xxxM LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HV/PB/PE/PH) RealBlack LR4-60HPB RealBlack LR6-60HPB	Peimar	SGxxxM (FB/BF) SMxxxM
				Philadelphia Solar	PS-M108(HCBF)-400W (30 & 35mm frames)
Jinko	JKM & JKMS Series JKMxxxM-72HL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HLM-TV JKMxxxM-7RL3-V JKMxxxM-72HBL-V JKMxxxM-72HL4-TV JKMxxxM-6RL3-B JKMxxxN-72HL4-BDV JKMxxxN-54HL4-B JKMxxxN-72HL4-TV JKMxxxM-7RL3-TV	Maxeon	SPR-MAX3-xxx-COM SPR-MAX3-XXX-R SPR-MAX3-XXX-BLK-R	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
		Meyer Burger	Meyer Burger Black, Meyer Burger White Meyer Burger Glass		
Kyocera	KD-F & KU Series	Mission Solar Energy	MSExxxSX9R MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W)	Prism Solar	P72 Series, P72X-xxx
LA Solar	LSxxxHC(166), LSxxxBF, LSxxxBL, LSxxxHC, BLA Model	Mitrex	Mxxx-L3H, Mxxx-I3H	Q Cells	Plus, Pro, Peak, G3, G4, 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) Q.PEAK DUO(BLK)-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G7 Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G8.3 (BFF/BFG/BGT) Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G9.3/BFG Q.PEAK DUO-G10+ Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC
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	Mitsubishi	MJE & MLE Series		
		Neo Solar Power Co.	D6M Series		
		NE Solar	NESE xxx-72MHB-M10 NESE xxx-60MH-M6		
		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)		

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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
- Use with a maximum over current protection device OCPD of 30A

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
Q Cells (cont.)	Q.PEAK DUO (BLK) ML-G10(a)(+)
	Q.PEAK DUO BLK ML-G10+ / t
	Q.PEAK DUO BLK ML-G10+ / TS
	Q.TRON M-G2+ SERIES
	Q.TRON BLK M-G2+ SERIES
	Q.PEAK DUO XL-G11S.3 / BFG
	Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/ G10.d)
	Q.PEAK DUO XL-G10.3/BFG
REC	Q.PEAK DUO XL-G10.d/BFG
	Q.PEAK DUO XL-(G11.2/G11.3)
	Q.PEAK DUO XL-G11.3/BFG
	RECxxxAA (BLK/Pure/Pure-R/ Pure-RX/ Pure 2/ Pro M)
	RECxxxNP (N-PEAK)
	RECxxxNP2 (Black)
	RECxxxNP3 Black
	RECxxxPE, RECxxxPE72
Renesola	RECxxxTP, RECxxxTP72
	RECxxxTP2(M/BLK2)
	RECxxxTP2S(M)72
	RECxxxTP3M (Black)
	RECxxxTP4 (Black)
	All 60-cell modules
Risen	RSM Series, RSM110-8-xxxBMDG
SEG Solar	SEG-xxx-BMD-HV
	SEG-xxx-BMD-TB
	SEG-xxx-BMB-TB
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-6MB-HV, SRP-320-375-BMB-HV, SRP-xxx-BMC-HV, SRP-390-450-BMA-HV, SRP-xxx-BMZ-HV, SRP-390-405-BMD-HV
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)
Sirius	ELNSM72M-HC Series
	ELNSM54M-HC Series
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB
SolarEver USA	SE-166*83-xxxM-120N
	SE-182*91-xxxM-108N
Solaria	PowerXT-xxxR-(AC/PD/BD)
	PowerXT-xxxC-PD
	PowerXT-xxxR-PM (AC)
Solartech	PowerX-400R
	STU HJT, STU PERC & Quantum PERC
	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

Manufacture	Module Model / Series
SunPower	AC, X-Series, E-Series & P-Series
	SPR E20 435 COM (G4 Frame)
SunTech	Axxx-BLK-G-AC, SPR-Mxxx-H-AC
	SPR-Mxxx-H-AC
Talesun	STP, STPXXXS - B60/Wnhb
	TP572, TP596, TP654, TP660
Tesla	TP672, Hipor M, Smart,
	TD6I72M, TP7G54M(H)
Thornova	SC, SC B, SC B1, SC B2, TxxxS, TxxxH
	TS-BG54
Trina	PA05, PD05, DD05, DD06
	DE06, DE09.05, DE09C.07
	PD14, PE14, DD14, DE14, DE15, DE15V(II)
	DEG15HC.20(II), DEG15MC.20(II)
TSMC	DEG15VC.20(II), DE18M(II), DEG18MC.20(II)
	DE19, DEG19C.20
	TS-150C2 CIGSw
	UNI4xx-144BMH-DG
Universal Solar	UNI5xx-144BMH-DG
	UNIxxx-108M-BB
	UNIxxx-120M-BB
	UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A)
URECO	FAKxxx(C8G/E8G), FAMxxxE7G-BB
	FAMxxxE8G(-BB), FBKxxxM8G
	F6MxxxE7G-BB
	FBMxxxMFG-BB

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
Vikram	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.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	VSUNxxx-60M-BB, VSUNxxx-72MH VSUN4xx-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108M-BB VSUNxxx-120M-BB VSUNxxx-120BMH VSUNxxx-132BMH VSUNxxx-108BMH
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-NHLDD144 ZXM7-SH108 Series ZXM7-SHLDD144 ZXM7-SHDB144

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