SOLARMOUNT ASCENDER 1-ROW ELEVATED INSTALLATION GUIDE



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UNIRAC Code-Compliant Installation Manual

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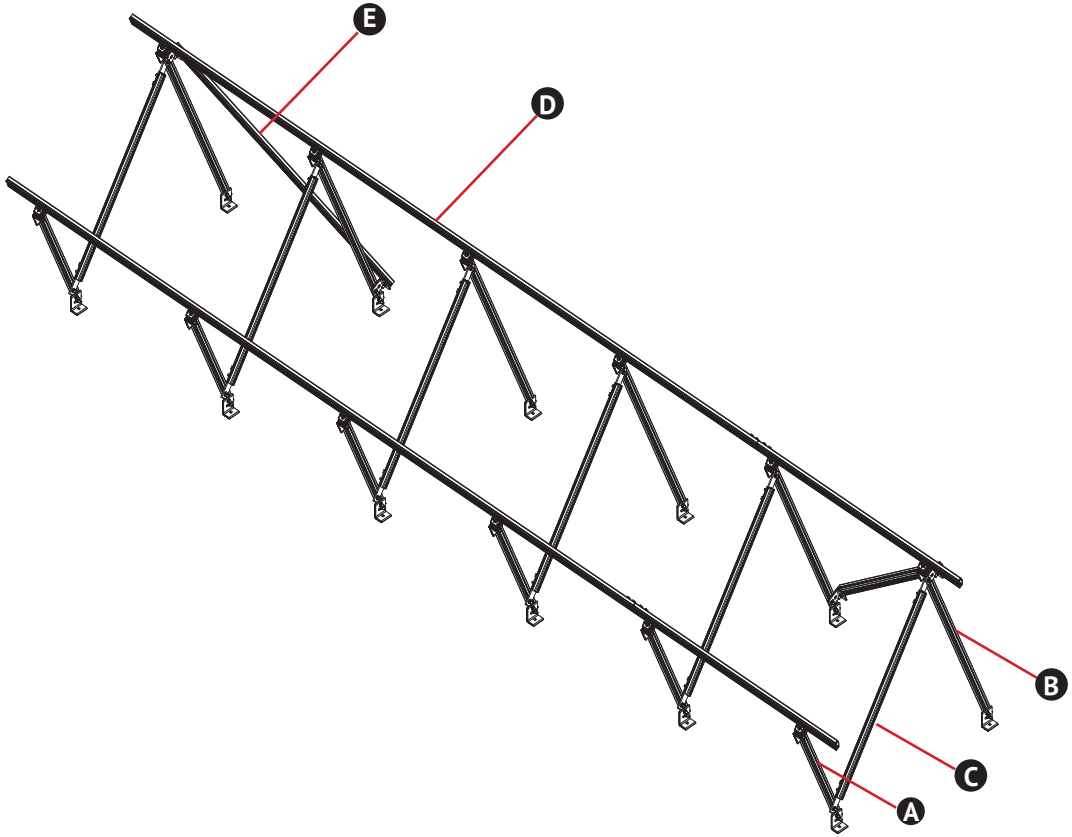
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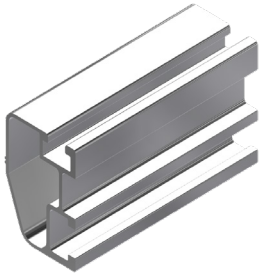
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SYSTEM COMPONENTS





1 ASCENDER RAIL (A1R181M)
Functions as A to E. Aluminum extrusion, available in mill finish.

- **A FRONT TILT LEG** - Supports front EW beam. Use one Front Tilt leg per frame/bay.
- **B REAR TILT LEG** - Supports rear EW beam. Use one Rear Tilt leg per frame/bay.
- **C NS BRACING** - NS Bracing is connected between the Front Tilt Leg and Rear Tilt Leg.
- **D EW BEAM** - Supports PV module. Use two rails per row of modules. EW Beam runs in East-West direction.
- **E 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.



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

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

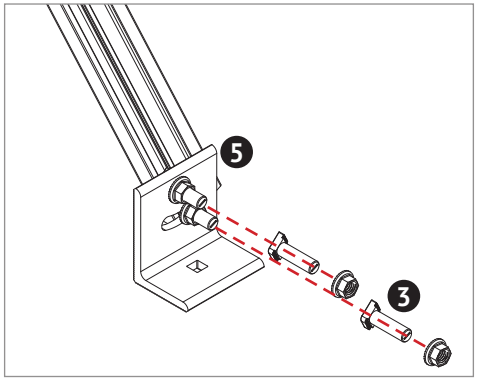
❷ **ASCENDER TILT PLATE ASSEMBLY (A1TP001)**
Connects NS bracing with Tilt legs.

❸ **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 Swivel L-plate connection. Provides electrical bonding from Tilt plate to rail and L-foot to rail.

❹ **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 EW Bracing to the tilt leg.

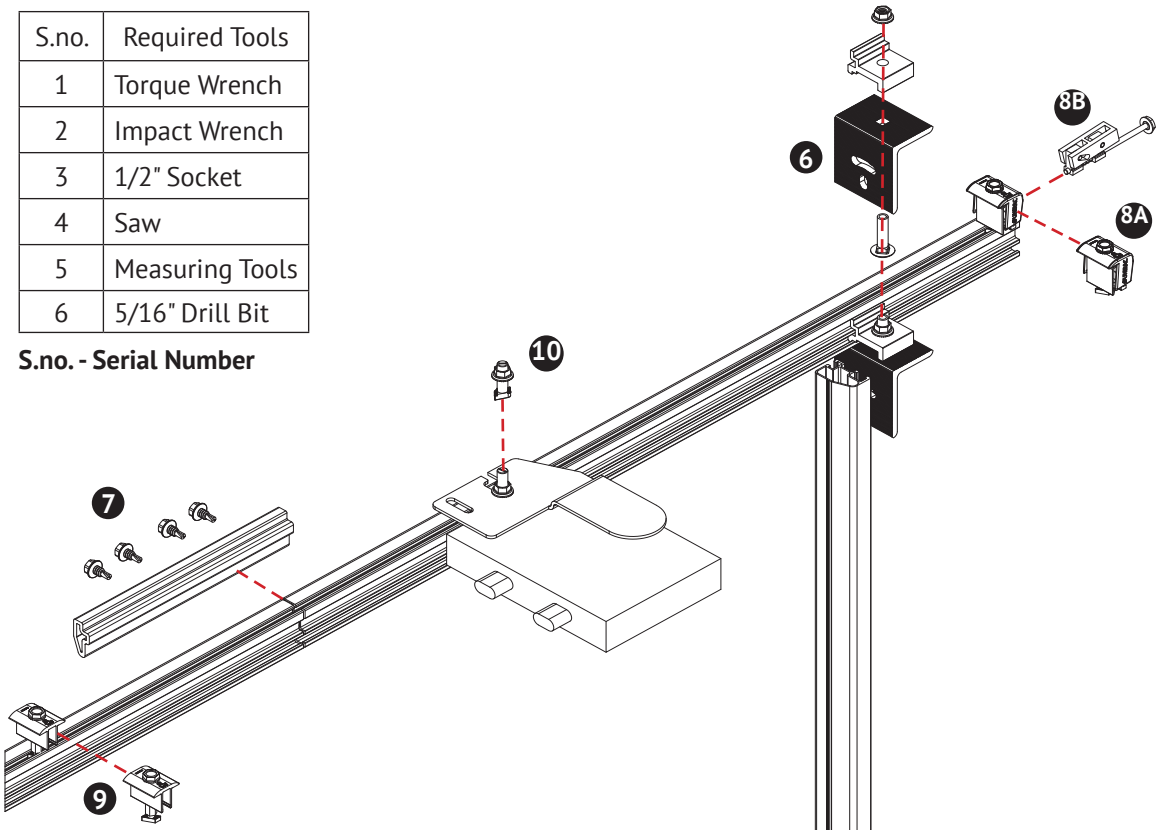
❺ **SWIVEL L-PLATE SERRATED WITH HARDWARE (A1LF01M)**
(1) T-bolt and (1) serrated flange nut will be shipped with Swivel L-Plate. Use Swivel L-Plate to secure the Tilt legs.

Note: Depending upon the load, two T-Bolts will be required in some cases. Please refer Ascender Design tool for the T-bolt requirements— the same Swivel L-Feet will be used regardless of the number of T-bolts required for the connection.



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 ALT BEAM CLIP ASSEMBLY (A1BC102)
Pre-assembled alternate beam clip assembly contains Carriage bolt, serrated flange nut, Beam clip, Swivel L-Plate. Connects the EW beam to the tilt legs.

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 ½" 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
Pre-assembled 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 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)

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 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 10.

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.**

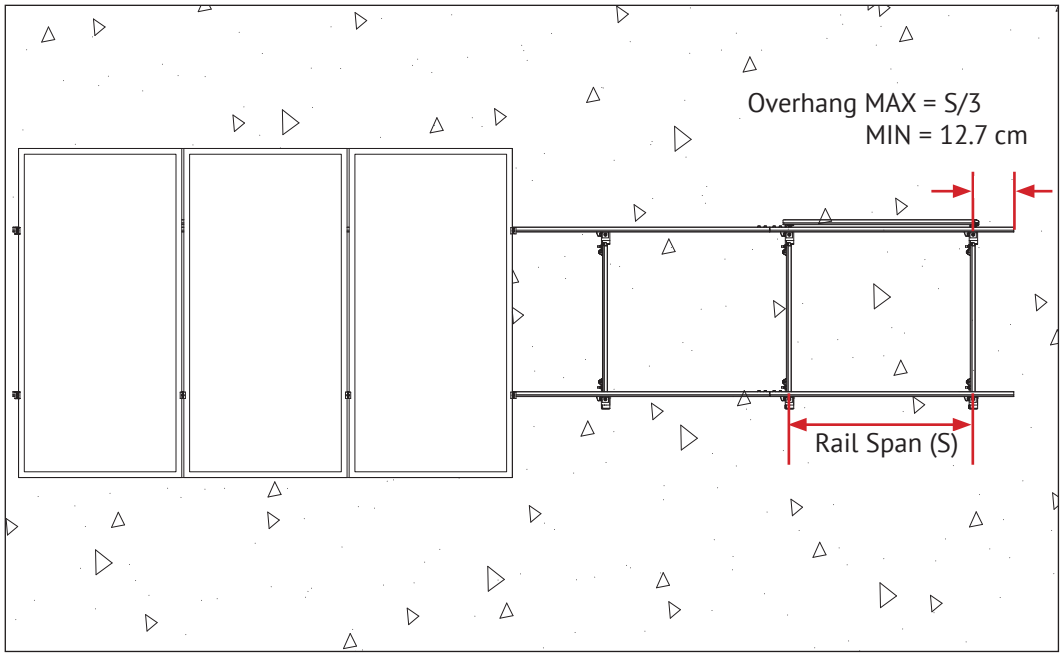


Figure shows Maximum and Minimum Overhang Limits

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.

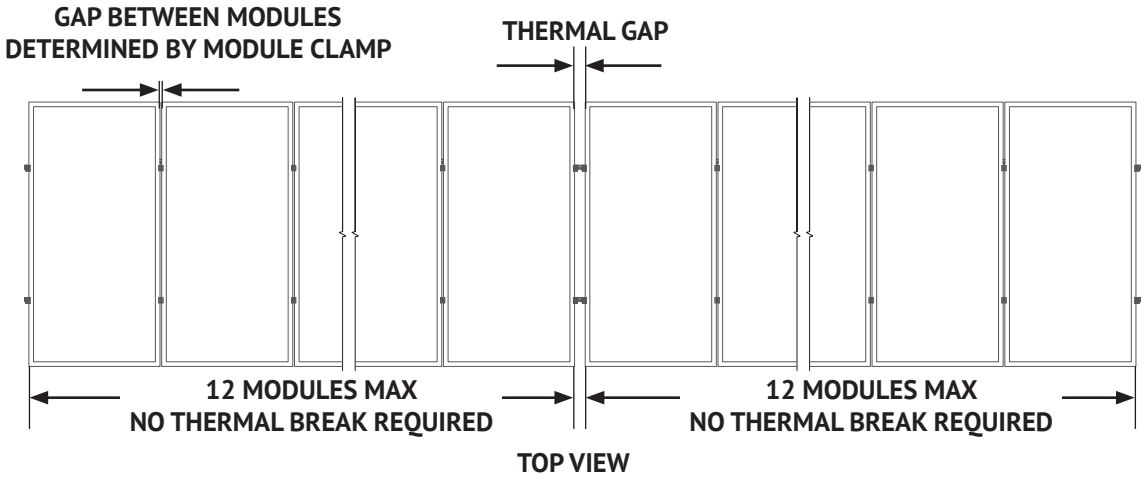
Rails in expansion joint configurations are considered cantilevered and must follow the cantilever rule on both sides of the expansion joint. An expansion joint must not be spanned by a PV module. Installing a module over an expansion joint would defeat the goal of a thermal break and could result in damage to the array.

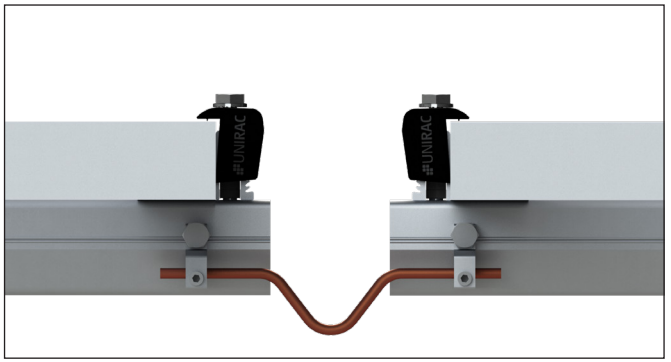
For temperature variations less than or equal to 140 °F (60 °C), thermal break is not required for up to 12 modules installed in a row.

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.

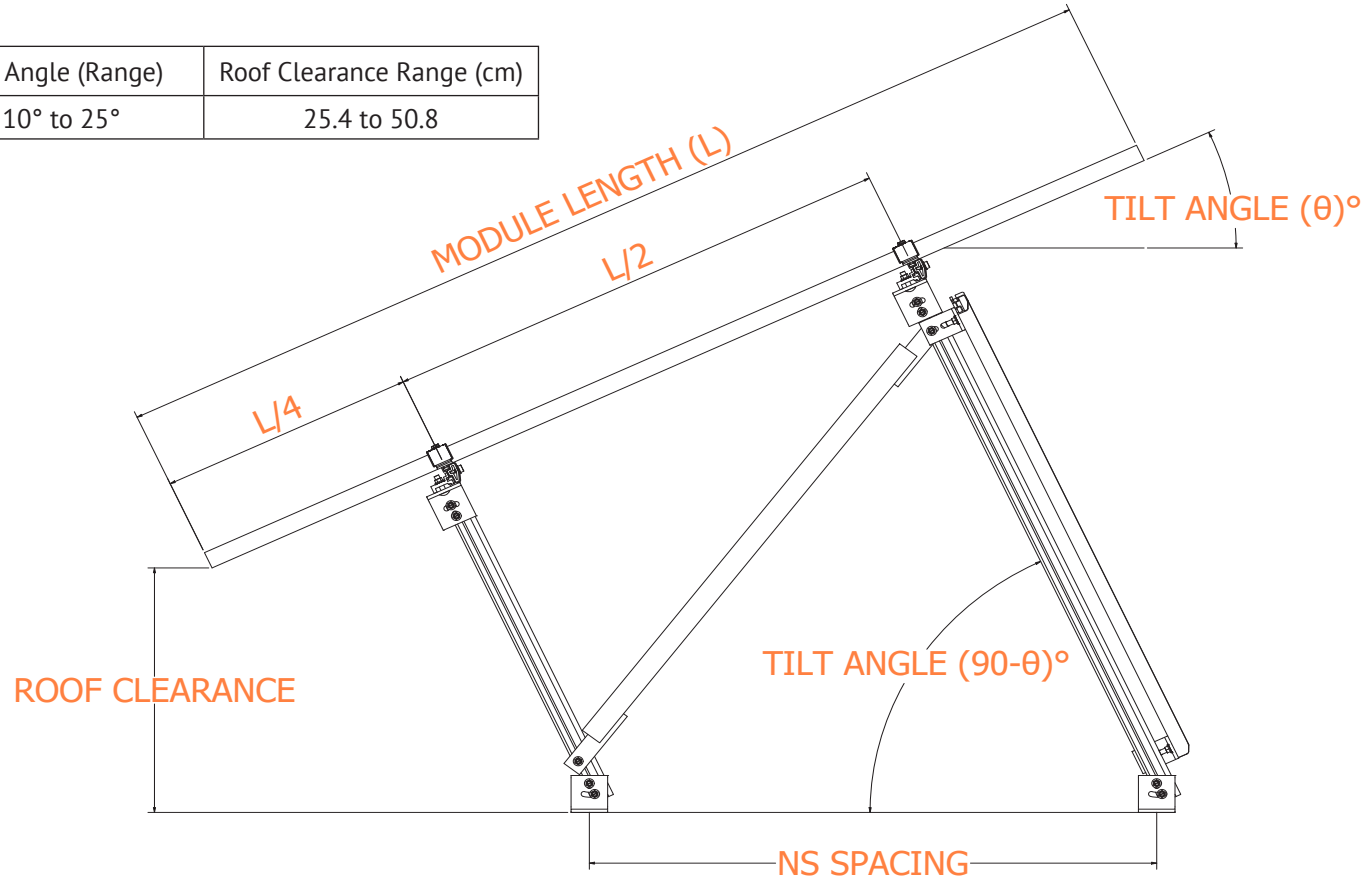
As spans increase, so does the maximum reaction force that the rail exerts on the L-foot. See Ascender Design tool for corresponding reaction forces to ensure that the Maximum Reaction Forces do not exceed the shear capacity of the roof connection.





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

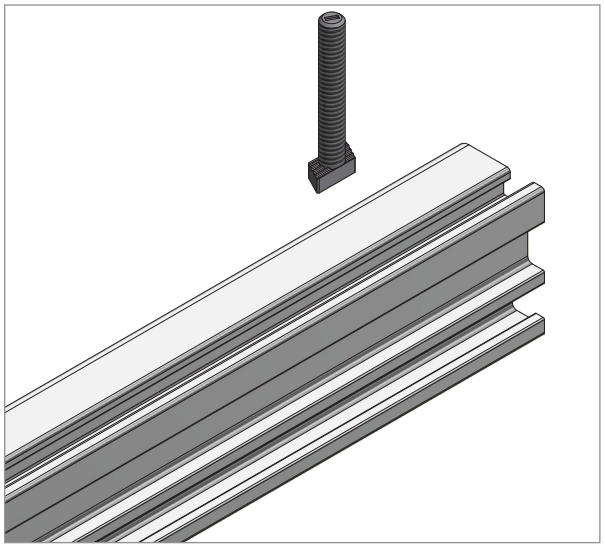
Tilt Angle (Range)	Roof Clearance Range (cm)
10° to 25°	25.4 to 50.8



- Note down the NS spacing from tool for STEP 4. See Page 10.
- Note down EW beams spacing for STEP4 and STEP 13. See Page 10 and 14.
- Note down the Module overhang distance to position the module.

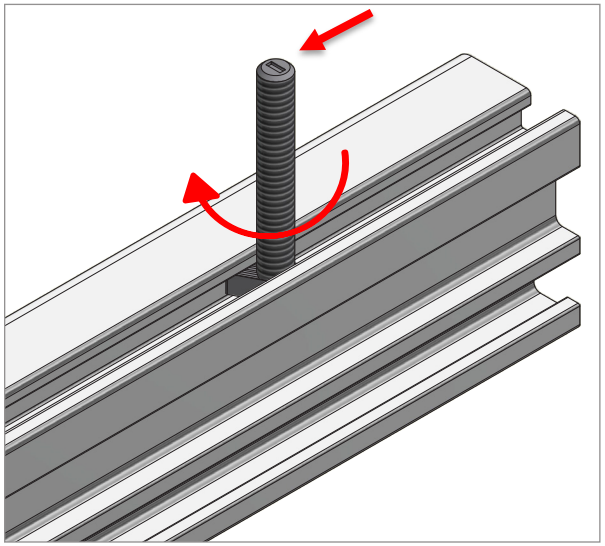
NOTE: All dimensions in the above figure are in centimeters. Module dimensions to be taken in centimeters for calculating other dimensions as mentioned in the above figure.

COMMON STEPS FOR ALL T-BOLT INSTALLATIONS:-



STEP A. INSERT T-BOLT

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



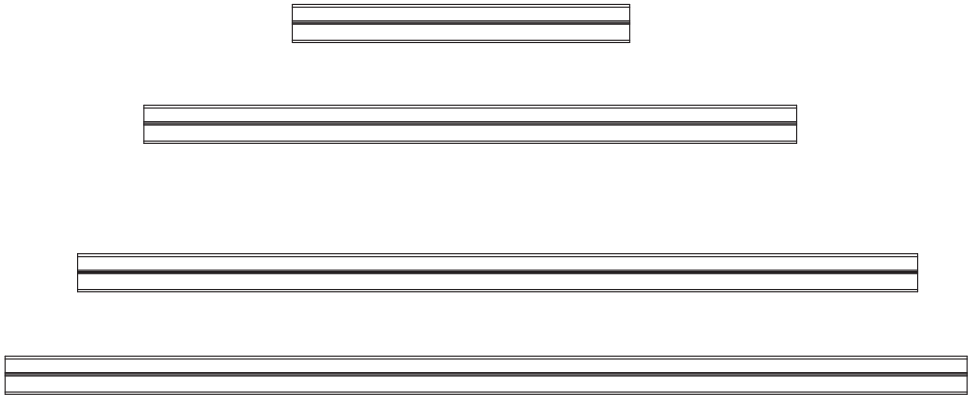
STEP B. ROTATE THE T-BOLT

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:

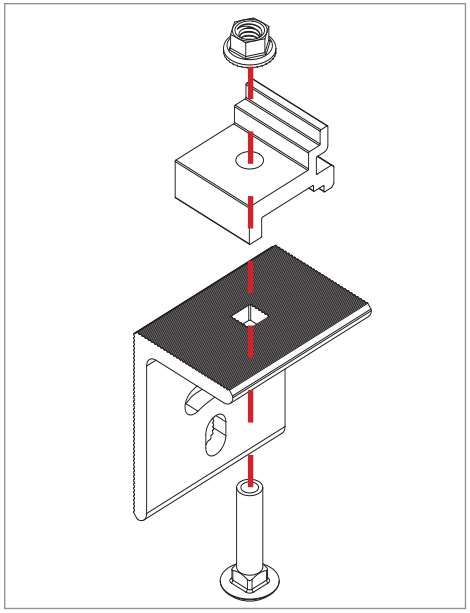
Length & Quantities	1 : Tilt Post - Front	XXX cm
		XX c/u
	2 : Tilt Post - Rear	XXX cm
		XX c/u
	3 : NS Bracing	XXX cm
		XX c/u
	4 : Overall EW Beam	XXX cm
		XX c/u
	5 : EW Bracing - Rear	XXX cm
		XX c/u

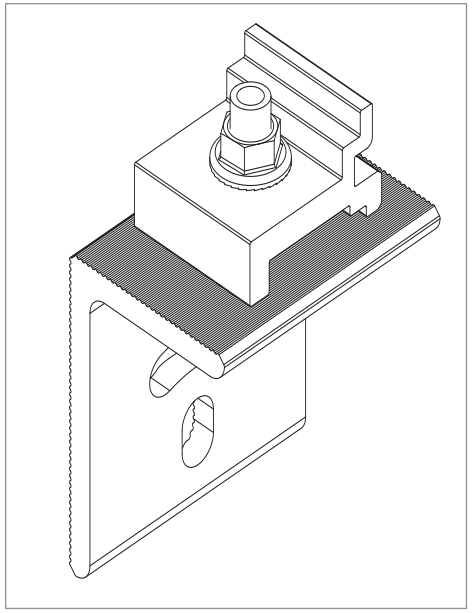


C/U : Count per Unit.

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.

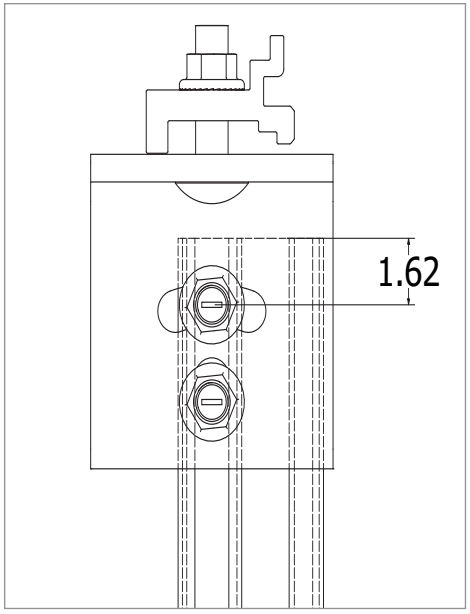




STEP 2. ASSEMBLE SWIVEL L-PLATE TO BEAM CLIP:

Assemble the part using the carriage bolt and nut included in the kit.

Do not tighten nut in this step.

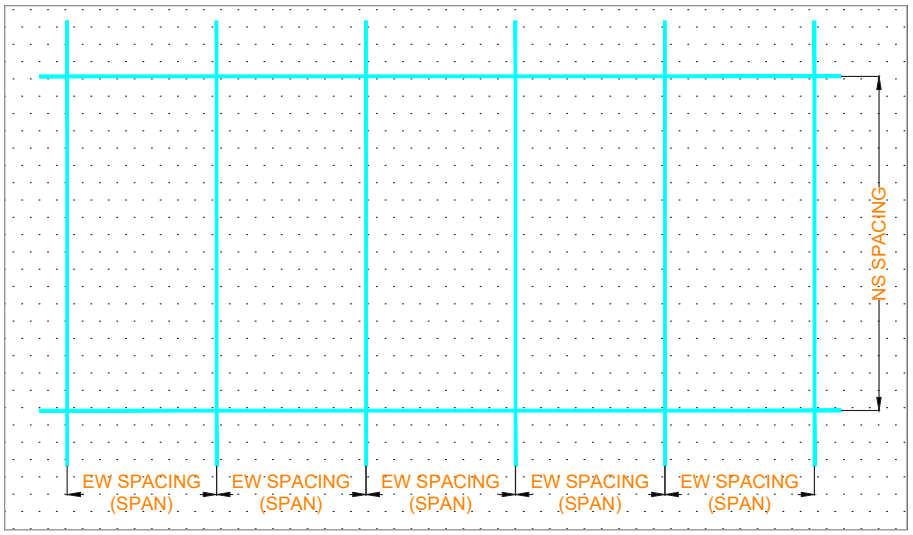


STEP 3. ATTACH ALT BEAM CLIP ASSEMBLY TO TILT LEGS

a. Attach Alt Beam Clip assembly to Tilt legs using two T-bolts.
b. Install assembly parallel to the tilt legs.
c. Install T-Bolt at a distance of 1.62 cm from the face of the rail as shown in the figure.

Note: Above installation has to be done while keeping the tilt legs on the ground.

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



STEP 4. ARRAY LAYOUT

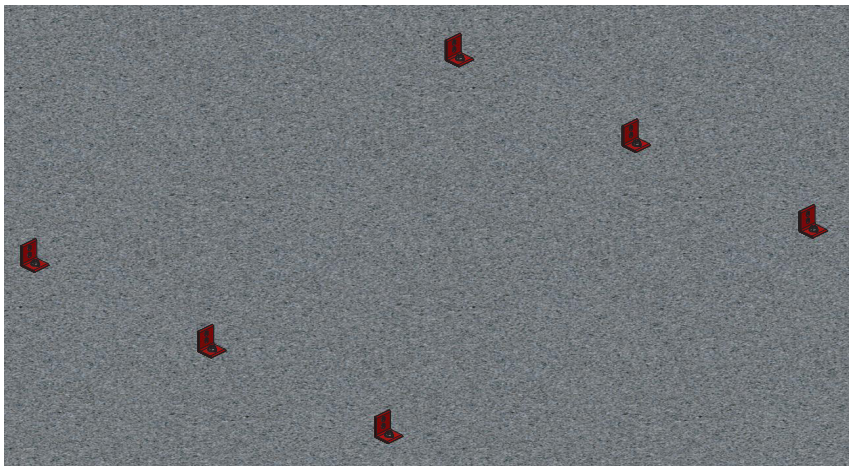
Refer to the calculator tool for details of EW span and NS Spacing. Mark the location for the L-feet.

Span/ Bay: EW distance between two frames. Refer to figure C in page 13 for frame.



STEP 5. 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.

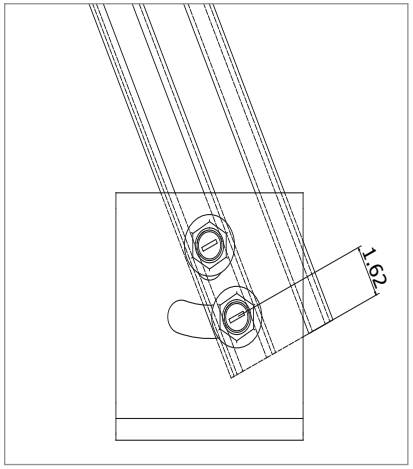


STEP 6. ATTACH SWIVEL L-PLATES TO ANCHORS

Use 3/8" bolt or all-thread with nut, install Swivel L-Plates and secure to concrete anchors. Ensure all Swivel L-Plates are oriented in the same direction. Follow anchor manufacturer requirements for torque specification.

⚠ CAUTION

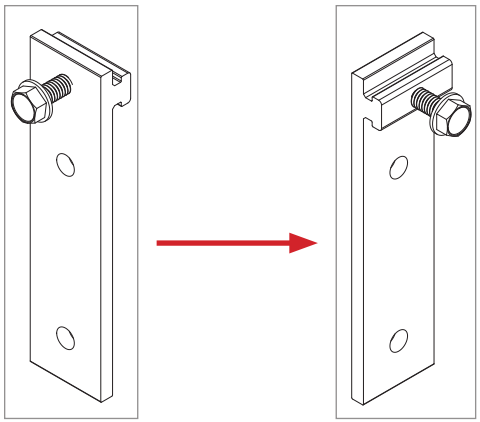
1. **Installer need to ensure that the concrete anchor capacity is sufficient.**
2. **Weak connection may cause failure. Ensure that Swivel L-Plates are securely fastened to the concrete.**



STEP 7. SECURE TILT LEGS TO SWIVEL L-PLATE

Secure tilt legs with two T-bolts by keeping Tilt legs at the required tilt leg angle, see page 6.
Install the first T-Bolt at a distance of 1.62 cm from the face of the rail.

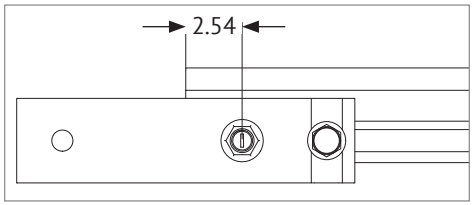
Torque 3/8" nut to 30 ft-lbs.

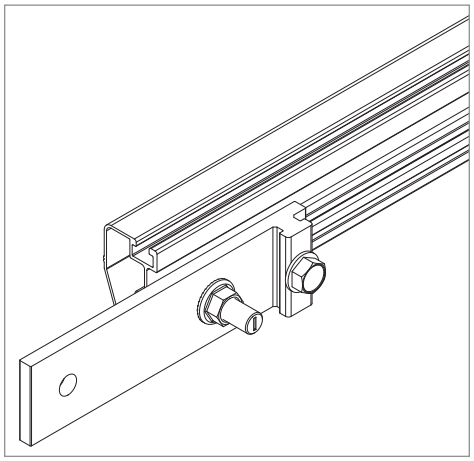


STEP 8. MOVE 5/16 THREAD CUTTING BOLT FROM ONE SIDE OF TILT PLATE TO THE OTHER

Move 5/16" bolt from the existing side of the tilt plate to the opposite end for installing the N/S Bracing.

Note:-Do not tighten the bolt now—tightening the bolt now would prevent tilt plate entry to the rail slot.





STEP 9. ATTACH TILT PLATE TO NORTH-SOUTH (N/S) BRACING

a. Install the T-Bolt connecting the Tilt plate and N/S Bracing at 2.54 cm from the face of the rail.
b. Once the T-bolt is in the rail, drive the 5/16" thread cutting bolt until it touches the tilt plate.
c. Install the tilt plate to the N/S Bracing on the opposite end in the same manner.
d. A gap will be formed between the tilt plate and the N/S Bracing as shown on figure A on the right.

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

⚠ CAUTION

Doing step 10 before step 9 might cause incorrect orientation of the N-S bracing.

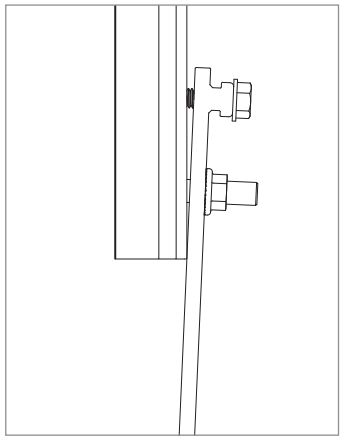
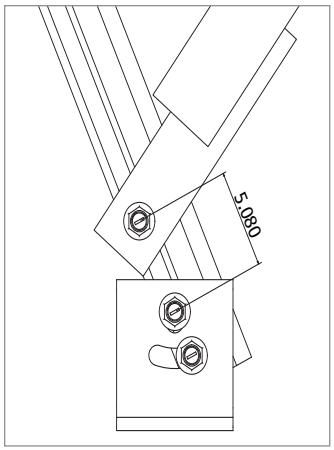
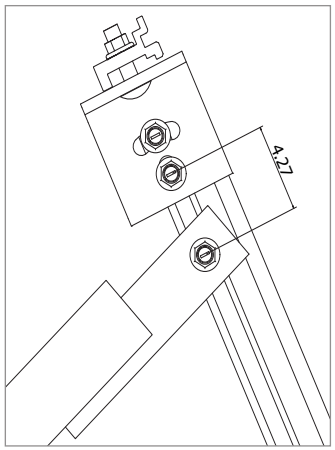


Figure A : GAP FORMED BETWEEN TILT PLATE AND THE N/S BRACING



Front Tilt Leg



Rear Tilt Leg

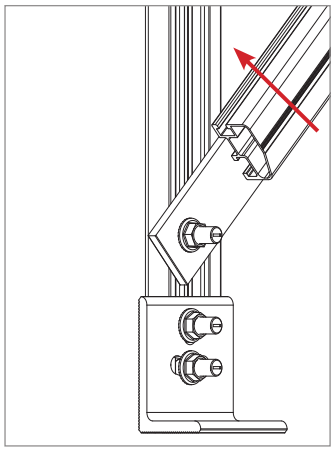


Figure B

STEP 10. SECURE ASSEMBLY OF N/S BRACE AND TILT PLATE TO TILT LEGS
Attach assembly of NS brace and Tilt plate to the Tilt leg using one T-Bolt at a distance of 5.08 cm and 4.27 cm at Front and Rear Tilt leg respectively.

Note: The NS Brace should be facing towards the tilt plate as shown on Figure B.

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

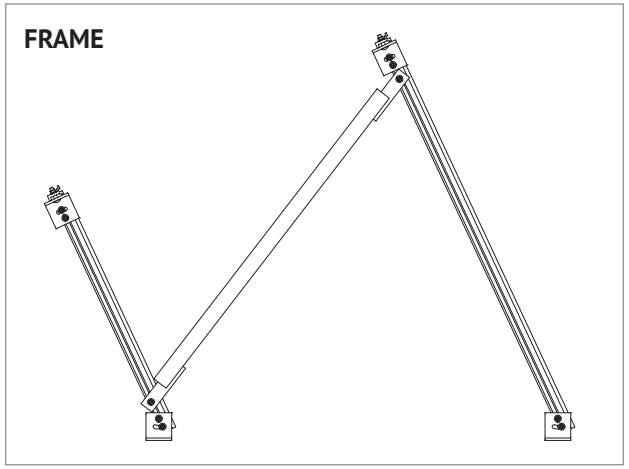
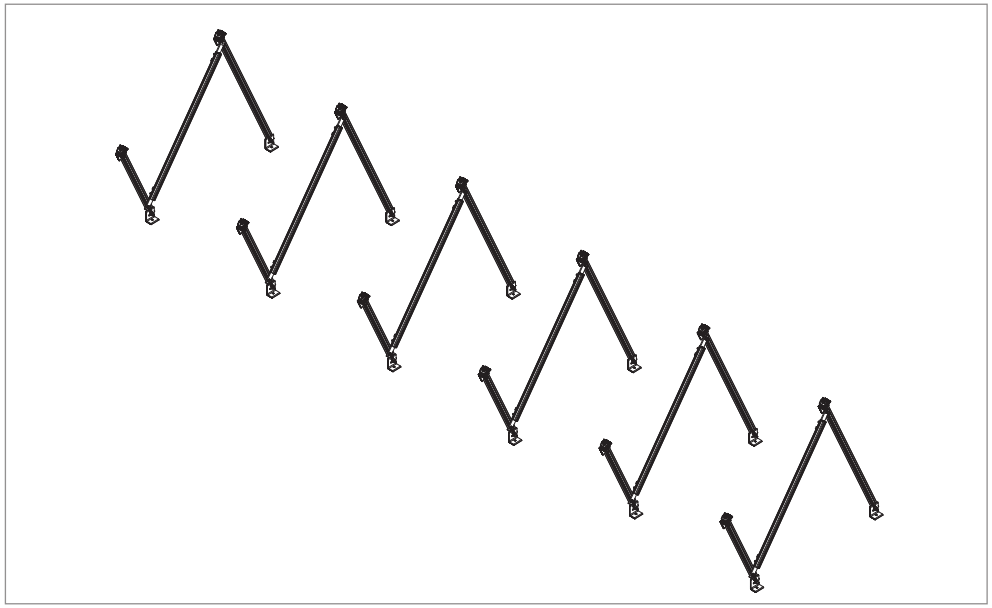


Figure C: Frame *- Two-dimensional structural connectivity in the NS* direction.



STEP 11. INSTALL ALL THE FRAMES
Install the rest of the frames at specified locations in step 4.

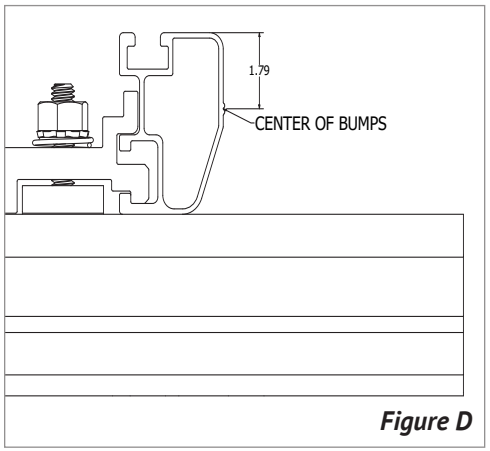


Figure D

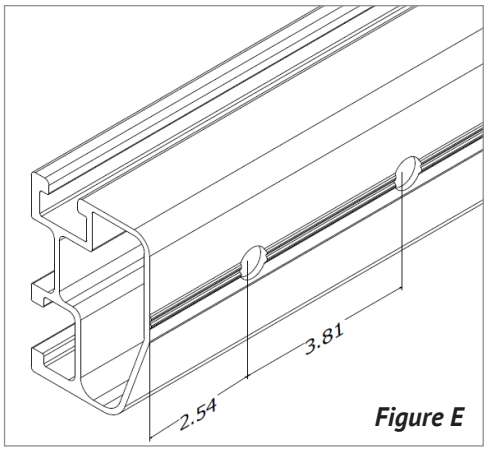
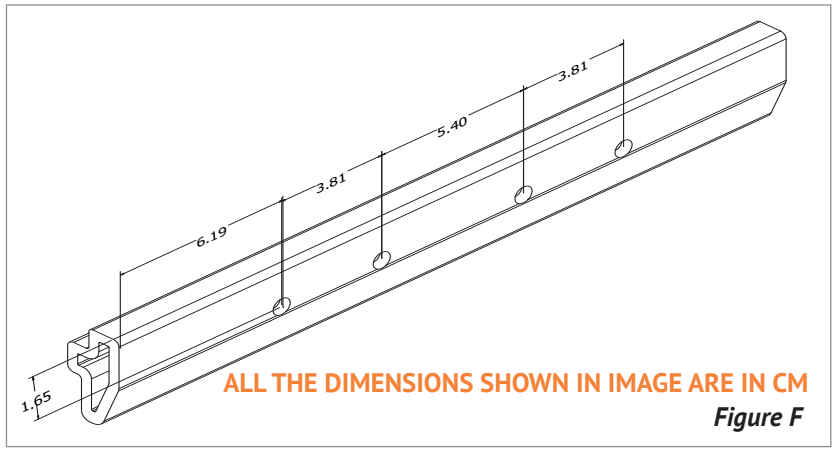


Figure E

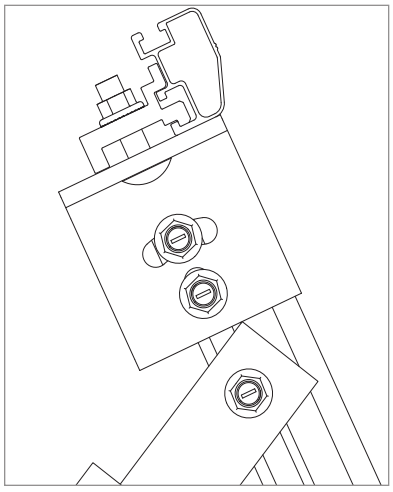


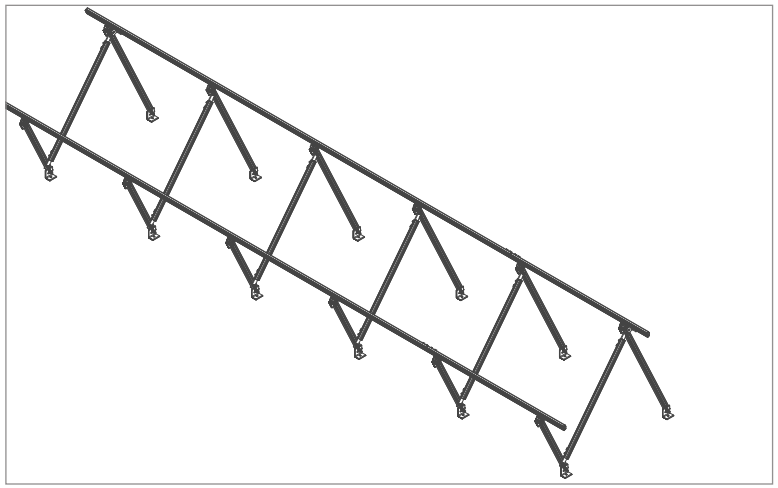
ALL THE DIMENSIONS SHOWN IN IMAGE ARE IN CM
Figure F

STEP 12. DRILL HOLES ON EAST-WEST (EW) BEAMS & SPLICE MEMBERS

Measure the specified distances on the rail used EW beams as shown on Figure D&E. Drill pilot holes to allow 5/16" drilling screws.

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

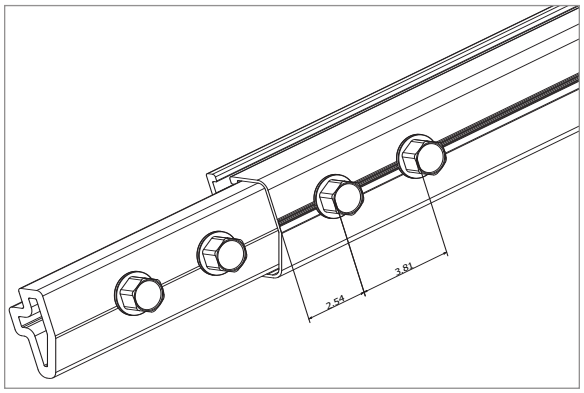


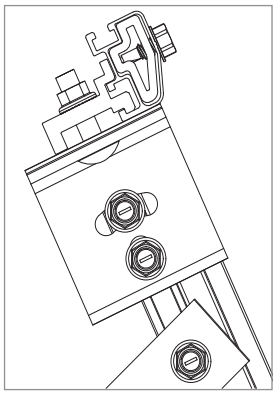


STEP 13. INSTALL EW BEAMS:

Assemble EW beams to the beam clips. Ensure that the desired tilt angle is met. Now torque the alt beam clip assembly nut which was left loosened in step 2 (See page 9).

TORQUE VALUE - 3/8" nut to 15 ft-lbs





STEP 14. 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 12 (See page 14) 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.

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.

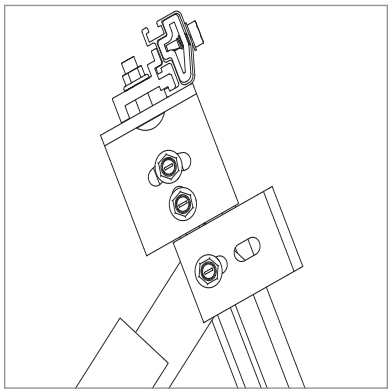


Figure G

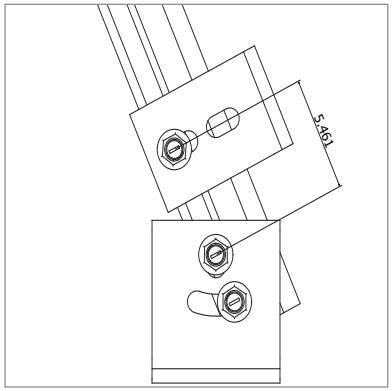


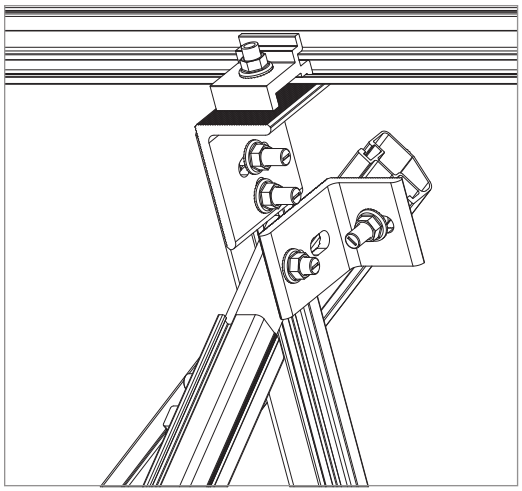
Figure H

STEP 15. SECURE L-FOOT ON REAR TILT LEGS FOR EAST-WEST (EW) Bracing

Top L - Foot: Loosen the nut on Tilt plate and position the L-Foot as shown in Figure G. Tighten the nut to the recommended torque value.

Bottom L Foot at Rear tilt leg: To connect the bottom L-Foot, place the T-Bolt at a distance of 5.46 cm from the bottom T-Bolt and place the L-Foot as shown on Figure H. Tighten the nut to the recommended torque value.

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



STEP 16. SECURE L-FOOT TO EW BRACE

Once the L-Feet are fixed, position the EW Bracing as shown. Install T-bolt at a distance of 2.54 cm from the face of the rail

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

⚠ CAUTION

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

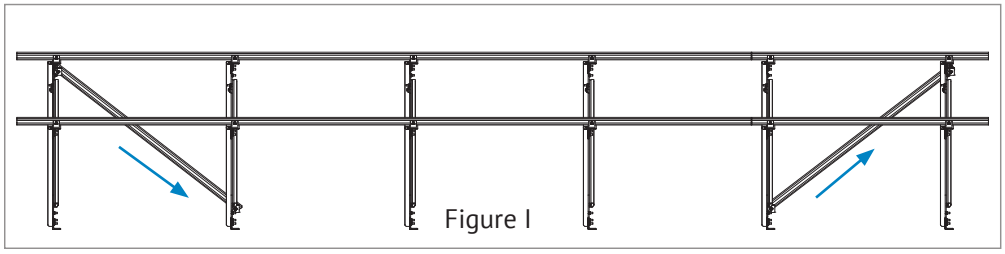


Figure I

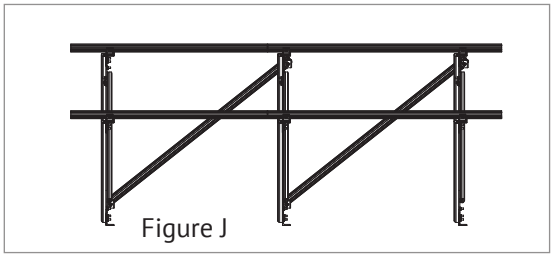


Figure J

STEP 17. INSTALL EW BRACINGS WITH EQUAL OR UNEQUAL SPAN DISRIBUTION

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 figure I. 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. J. Check the Ascender Design tool 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.

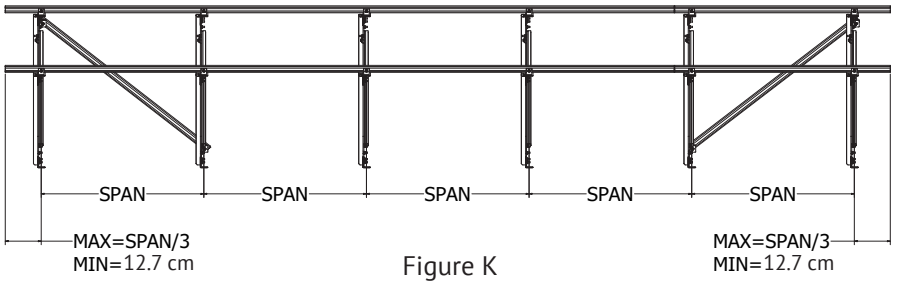
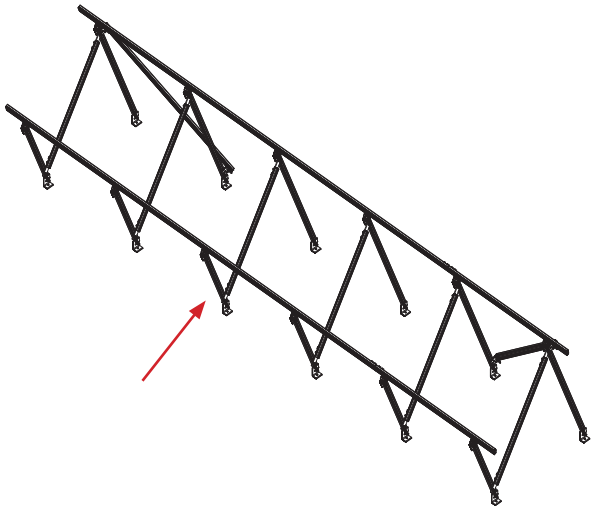


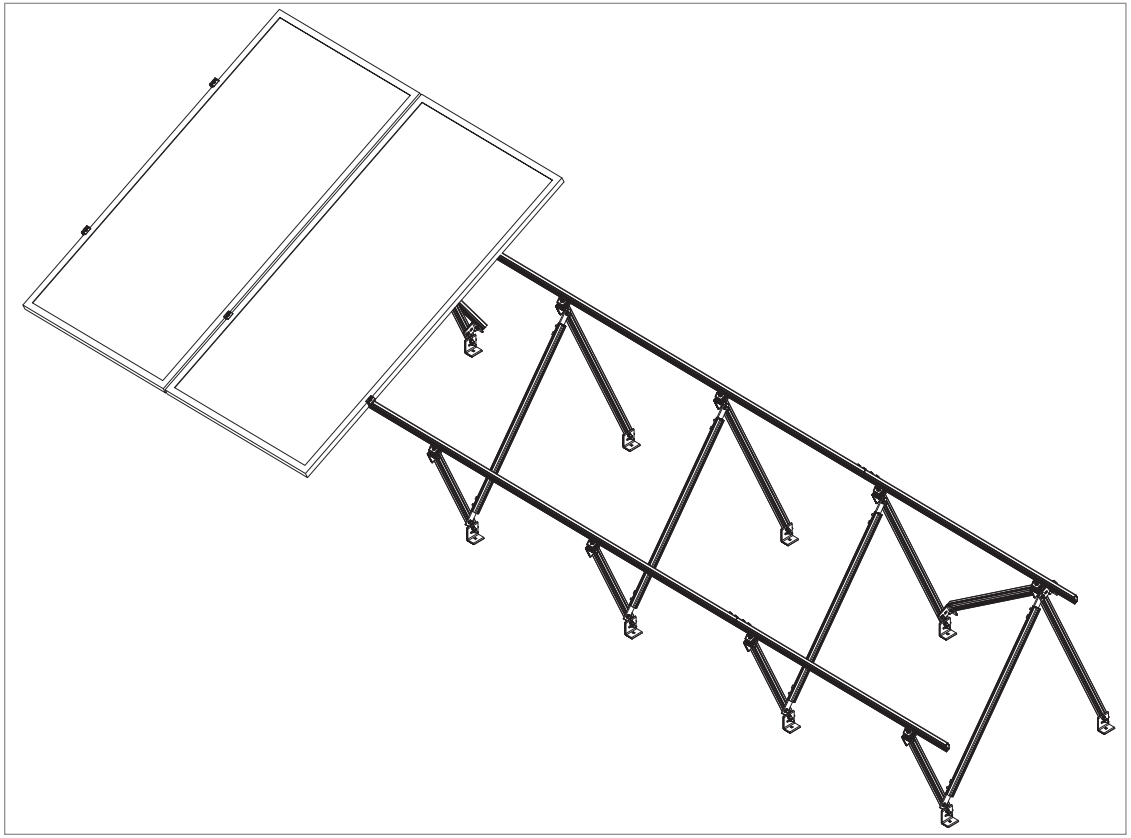
Figure K

STEP 18. CANTILEVER LENGTH LIMIT CHECK

See Figure K. 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 for span chart details.



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



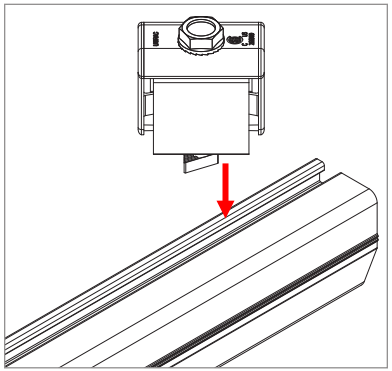
STEP 19. INSTALL PV MODULES

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.

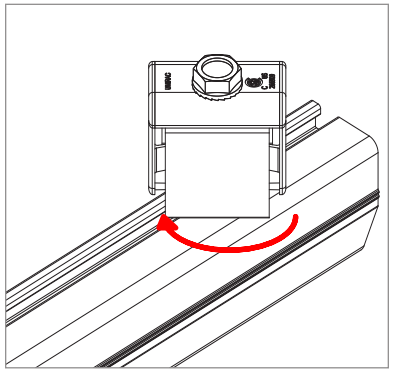
Notes:

1. **Ensure roof clearance is not more than 50.8 cm . See page 6.**
2. **See page 22, Micro Inverter Mounting section for installing MLPEs.**

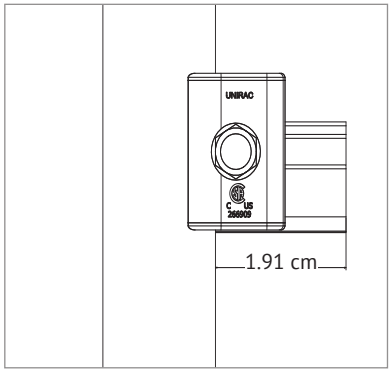
UNIVERSAL AF END CLAMP INSTALLATION :



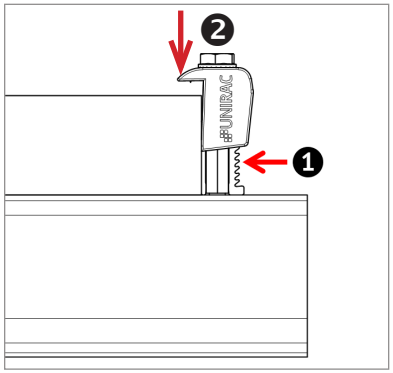
1. Position clamp to align T-bolt with rail slot. Lower clamp and Insert T-bolt into rail slot.



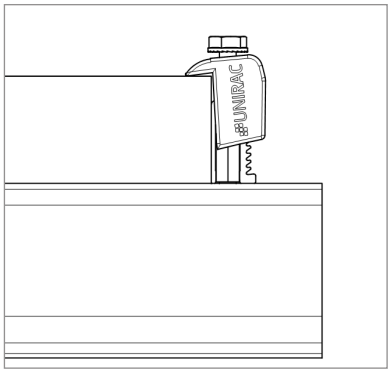
2. Rotate clamp clockwise until the T-bolt fully engages to the inside of the rail slot.



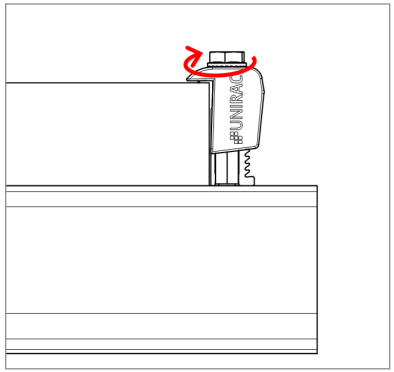
3. Place module at least 1.91 cm from end of rail and position clamp against the module frame.



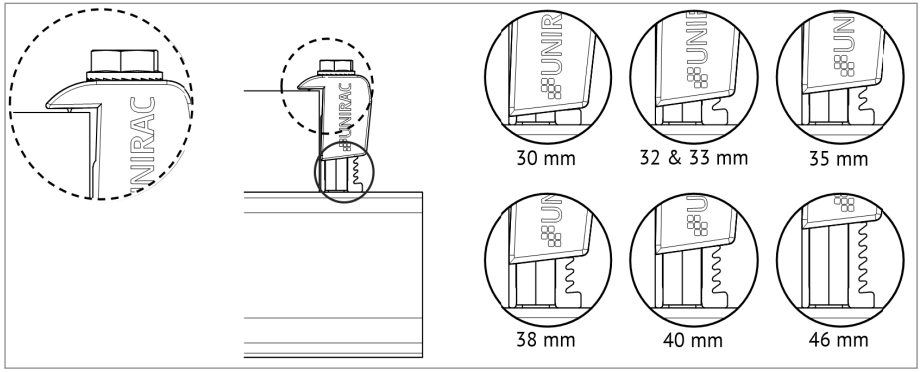
4. While applying pressure to hold the clamp against the module, push down on the module side of the clamp cap.



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.



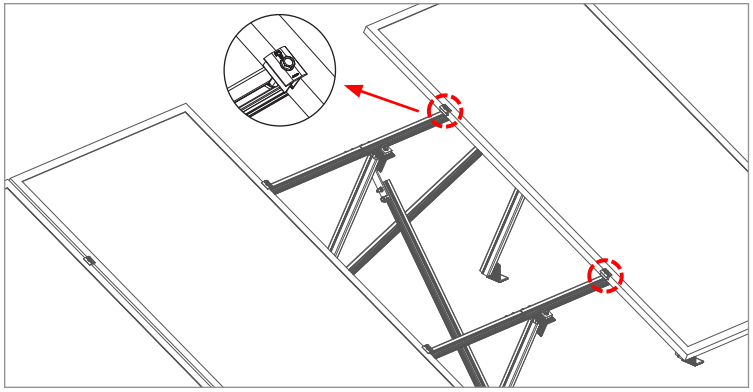
7. Confirm clamp is engaged in correct module height position and that the top of the cap is sitting level with the module frame.

NOTE: Clamp is certified for single use only.

NOTE:

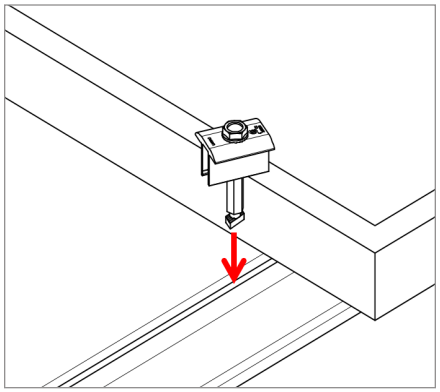
1. **When installing 46mm modules, loosen bolt by 1 turn before positioning clamp against module frame.**
2. **Do not force clamp onto module frame as this may damage the bonding pin.**

UNIVERSAL AF MID CLAMP INSTALLATION :

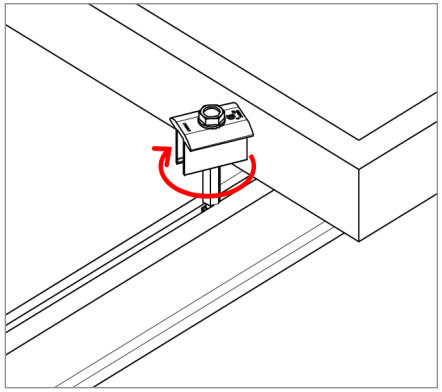


MID CLAMP INSTALLATION

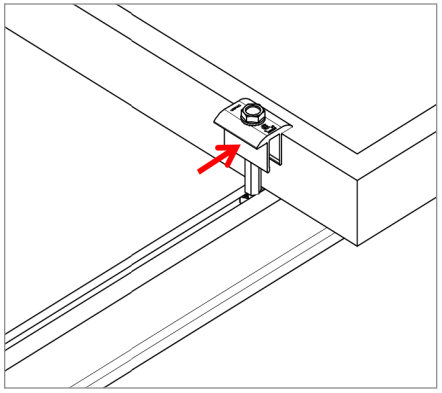
Mid clamp is supplied as an assembly with a T-bolt. Clamp assemblies can be positioned in rail prior to module placement.



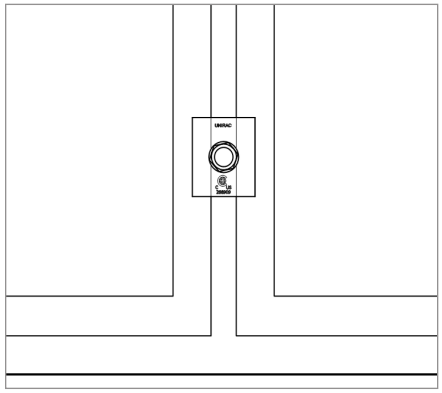
1. Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



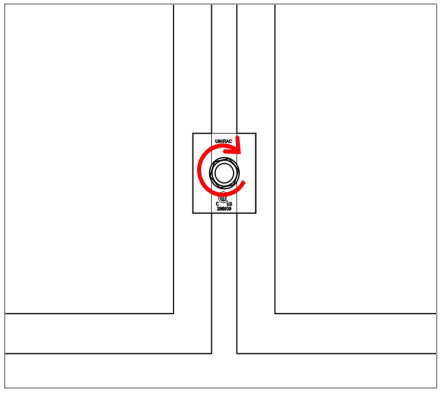
2. Rotate clamp clockwise 63° of a turn to fully engage T-bolt inside rail slot.



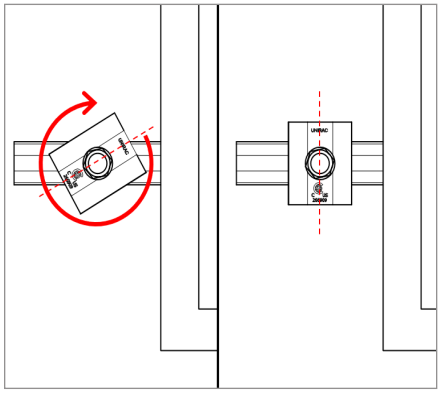
3. Slide clamp into position against module.



4. Place second module.



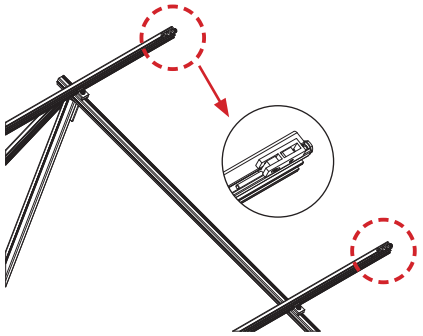
5. Tighten bolt and torque to 15 ft-lbs.



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.

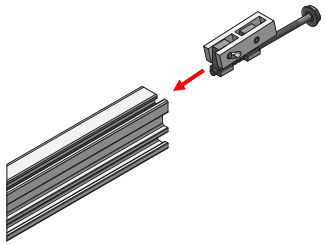
SYSTEM INSTALLATION STEPS

PRO SERIES ENDCLAMP INSTALLATION GUIDE



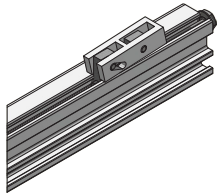
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.

❶



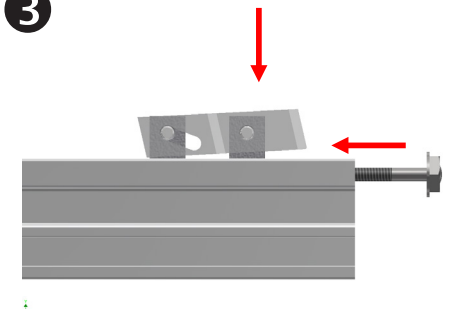
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.

❷

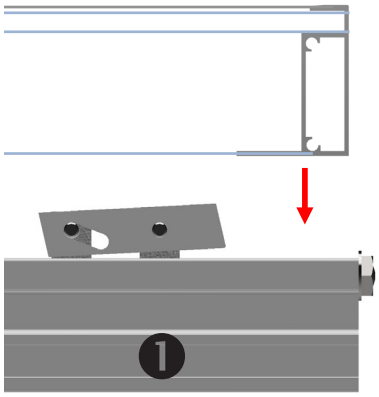


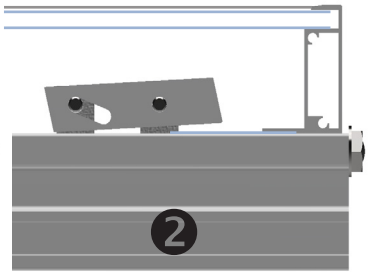
POSITION END CLAMPS: Slide end clamp assembly on to rail until bolt head engages with end of rail. End clamps are positioned on rails prior to the first end module and prior to the last end module.

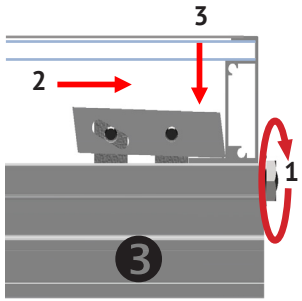
❸



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.

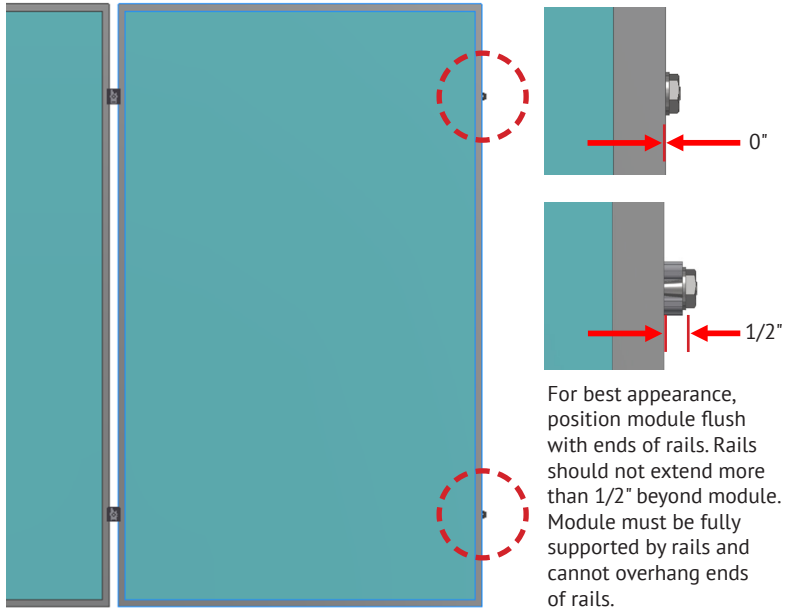




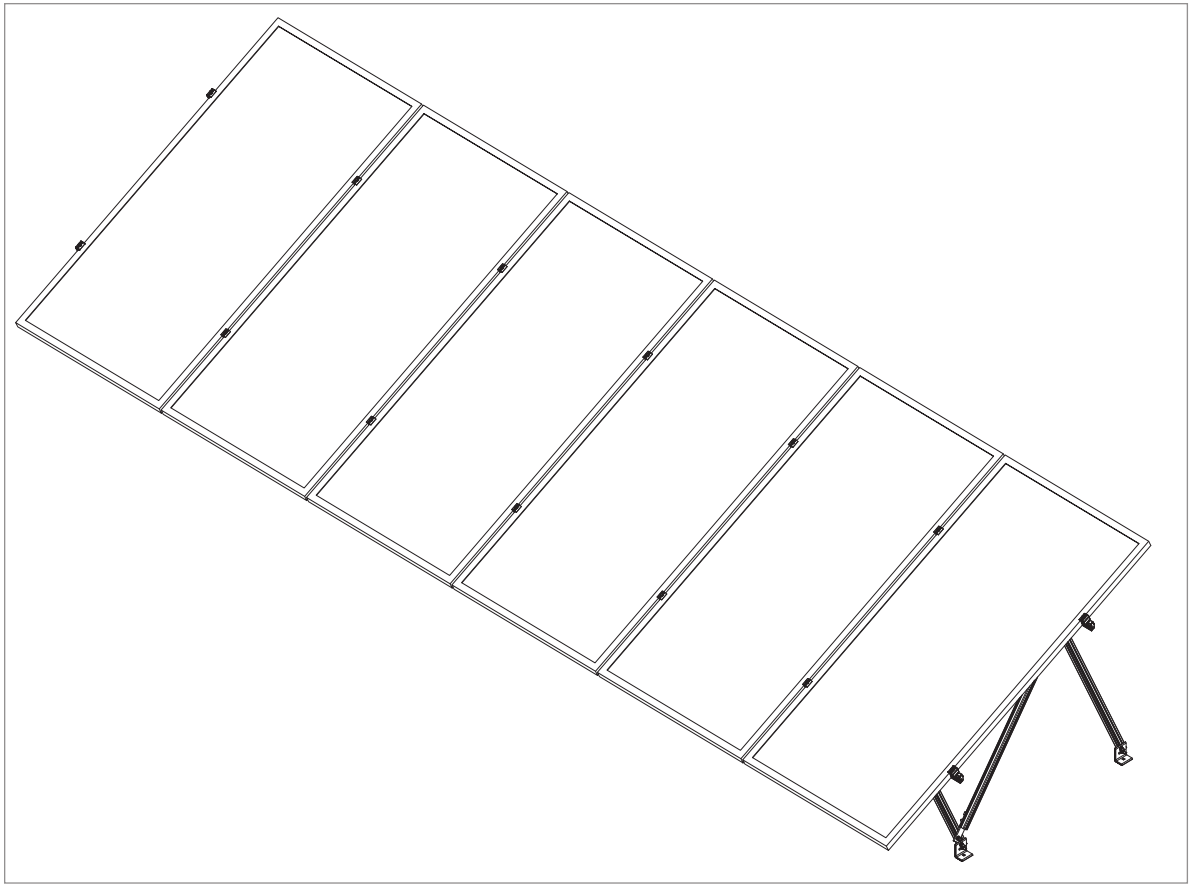


INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.

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

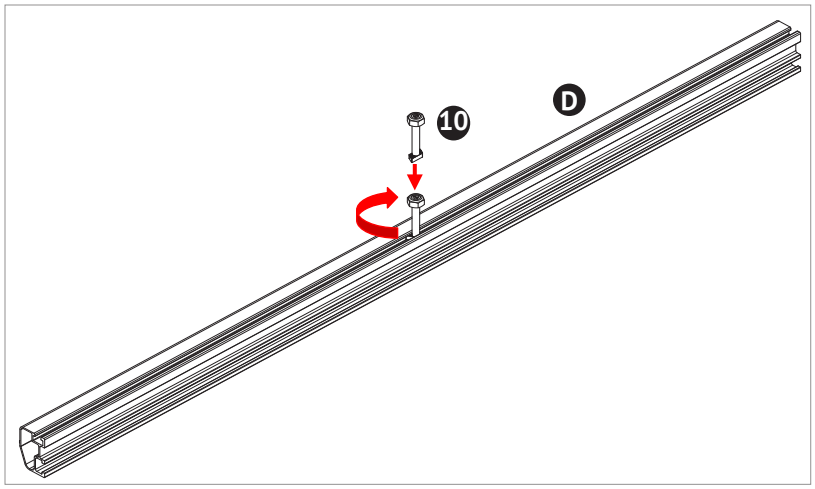


For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.

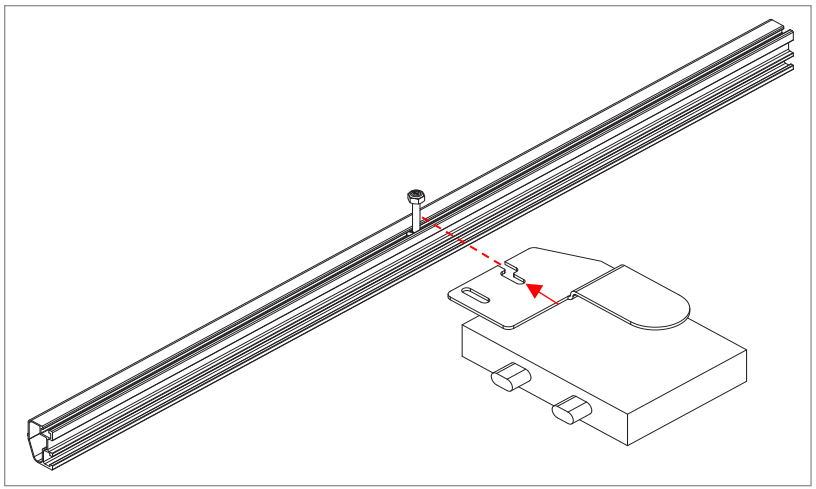


STEP 20. FINAL CHECK

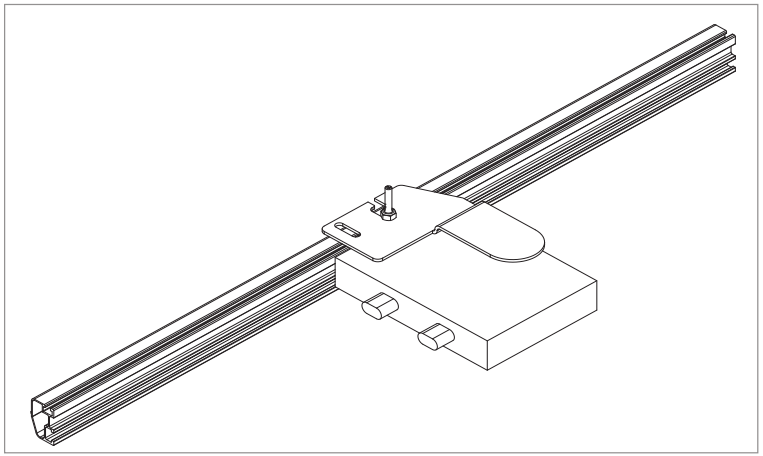
Check all fasteners to verify correct torque values and proper T-bolt engagement with rail.



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.

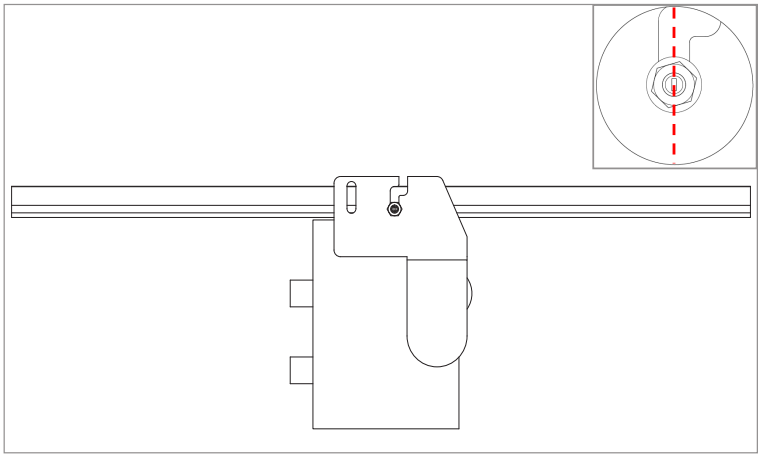


INSTALL MICROINVERTER:
Install microinverter on to the rail. Engage with bolt.

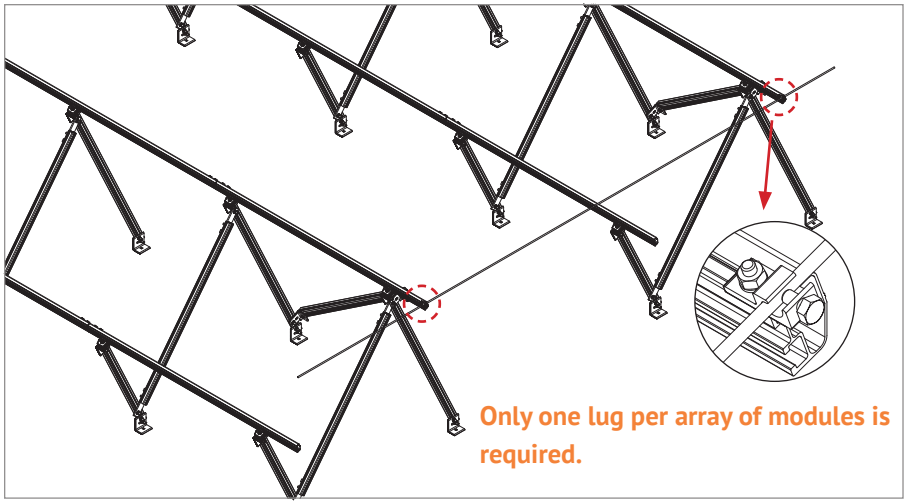


INSTALL MICROINVERTER:
Torque the 1/4" nut to 10 ft-lbs with Anti-Seize.

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



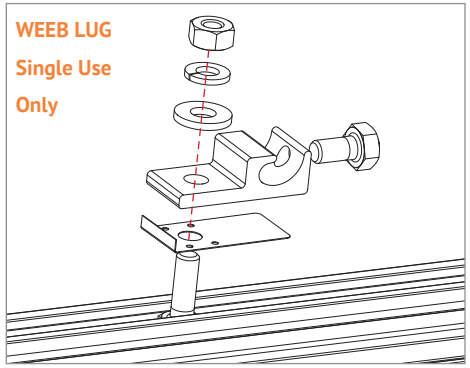
ALIGN POSITION INDICATOR:
Verify that position indicator on the T-bolt is perpendicular to rail.

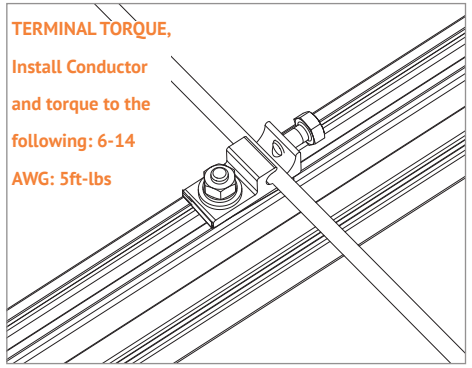


GROUNDING LUG MOUNTING DETAILS:

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.		



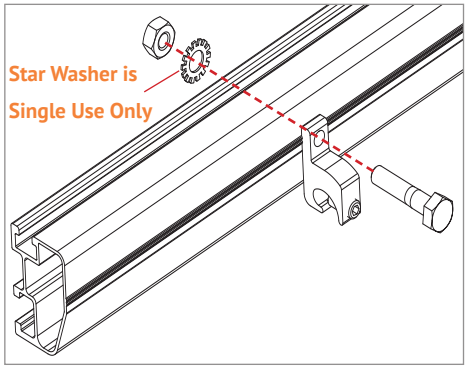


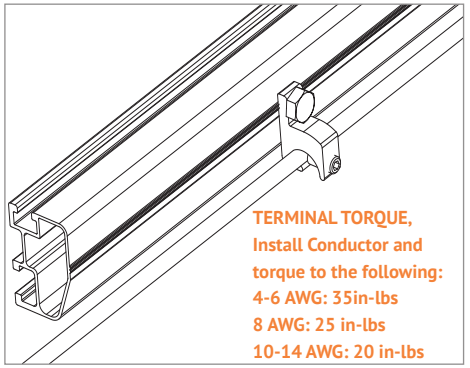
WEEB LUG CONDUCTOR - UNIRAC P/N 008002S:

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



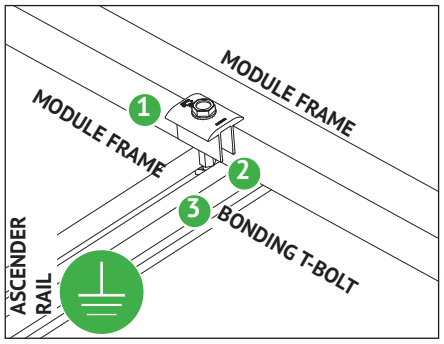


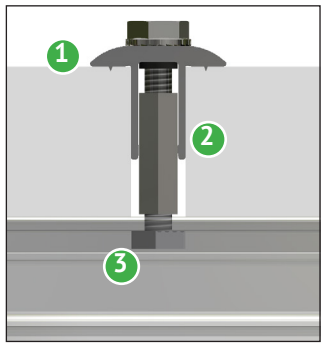
ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding Lug- Drill, deburr hole and bolt through both rail walls per table.

TORQUE VALUE 5 ft lbs.

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

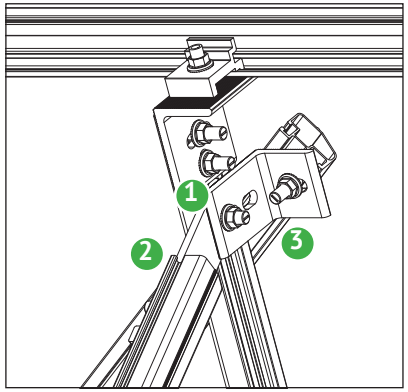
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION





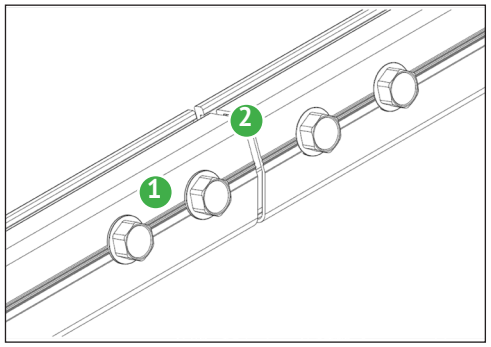
BONDING MID-CLAMP ASSEMBLY

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 SM Ascender rail



BONDING TILT PLATE AND L-FOOT

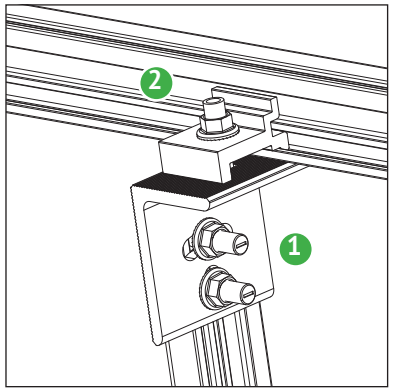
1. 3/8" T-bolt and 3/8" serrated flange nut creates bond between Tilt plate, Tilt leg and L-Foot.
2. Aluminum Tilt Plate creates bonding between North-South Bracing and Tilt Legs.
3. Aluminum L-Foot creates bonding between Tilt Legs and East-West Bracing.



BONDING RAIL SPICE BAR

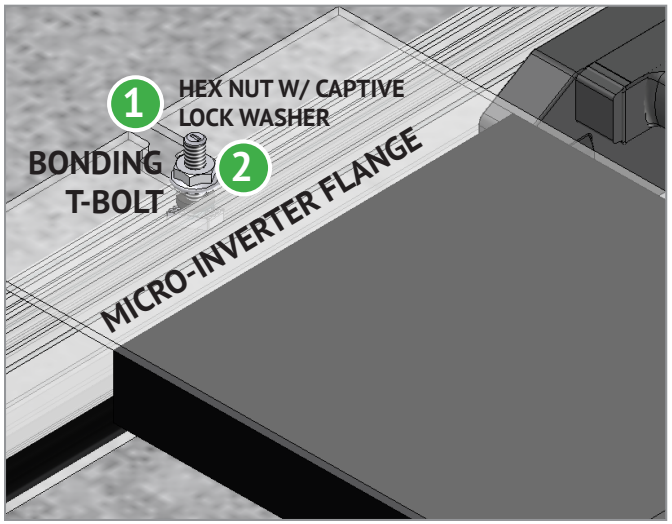
1. 5/16" self drilling screw creates bond between splice bar and EW beams.
2. Aluminum splice bar spans across rail gap to create rail to rail bond.

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



BONDING FRONT TILT LEG AND E-W BEAM

1. 3/8" T-bolt and 3/8" serrated flange nut with washer creates bond between front tilt leg and alternate beam clip assembly.
2. Carriage bolt with 3/8" serrated flange nut creates bond between Swivel L-Plate, Beam clip and E-W beam.



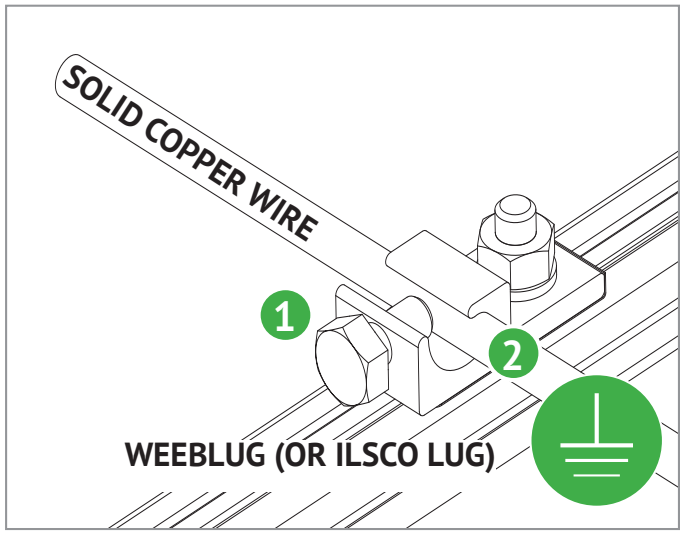
BONDING MICROINVERTER MOUNT

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.**

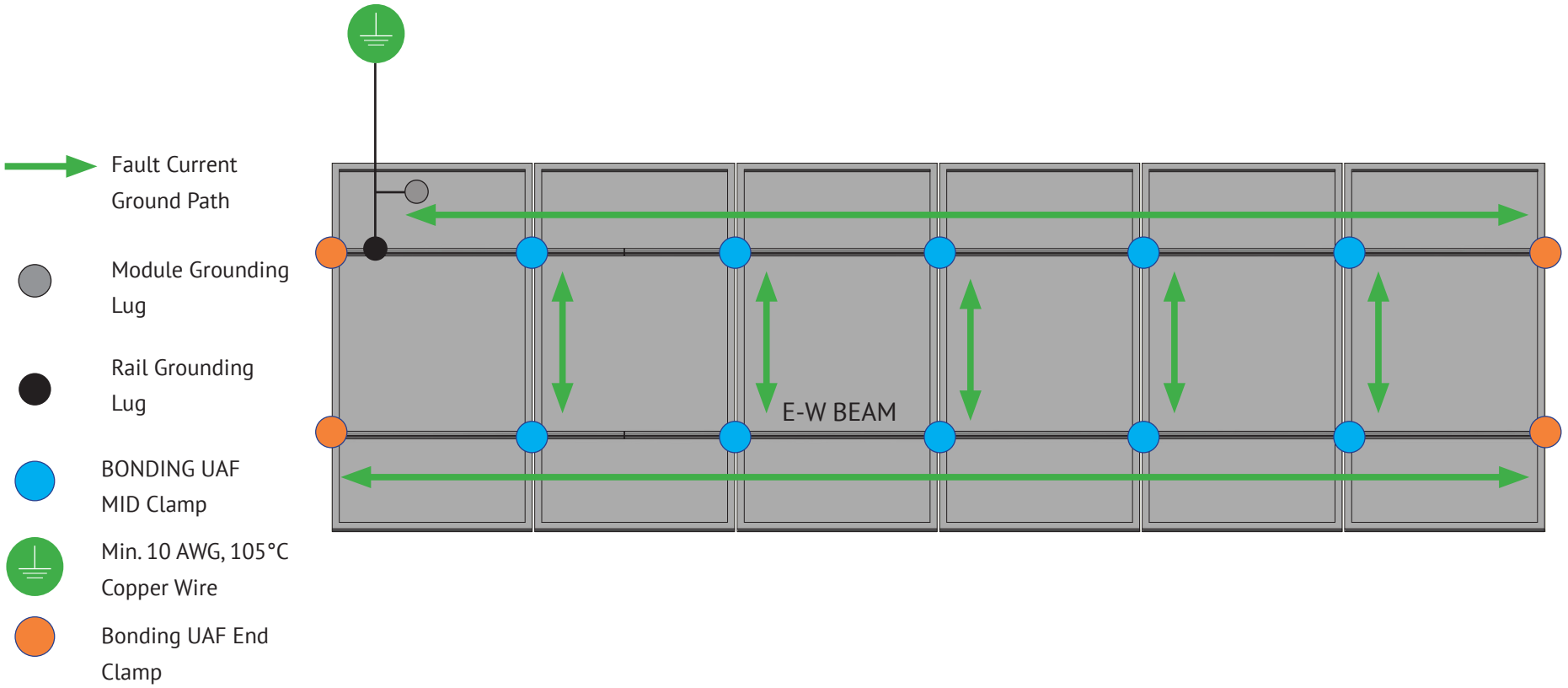


RACK SYSTEM GROUND

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

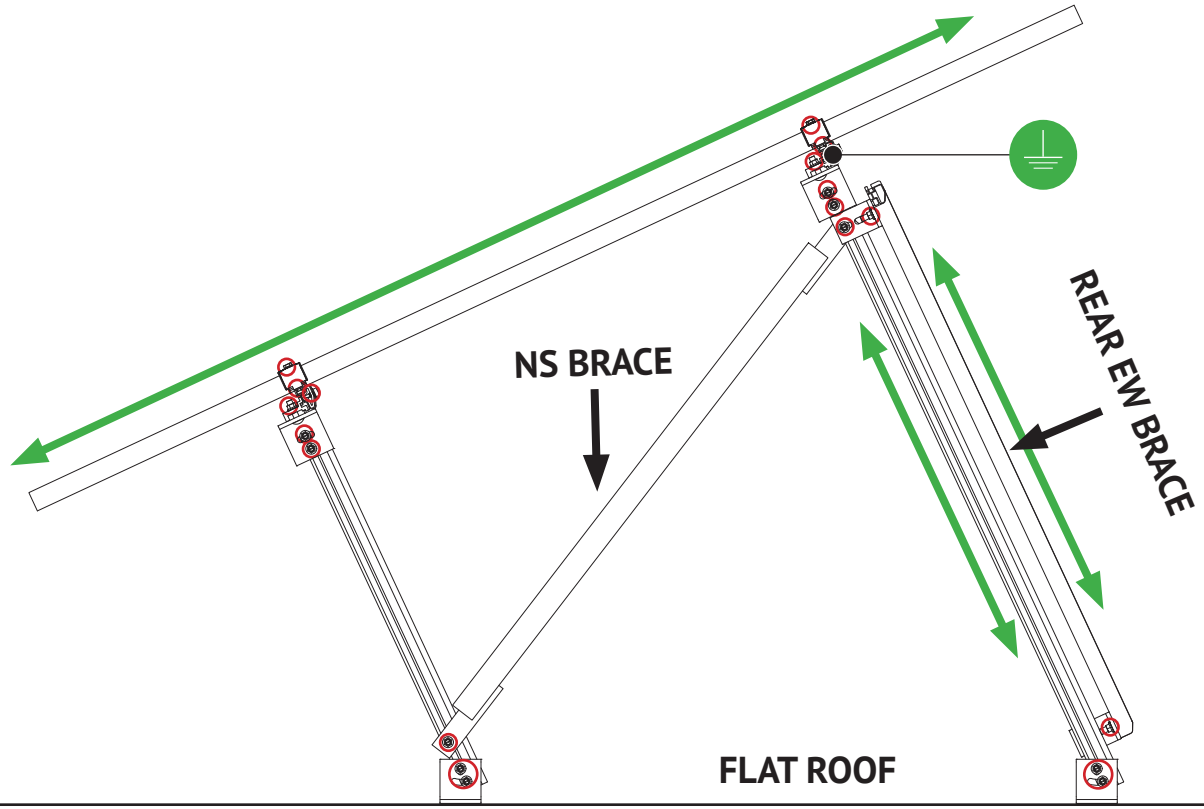
2. Solid copper wire connected to lug is routed to provide final system ground connection.

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



Note: Every array must have atleast 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

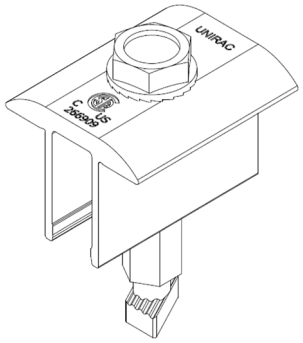
Min. 10 AWG, 105°C Copper Wire

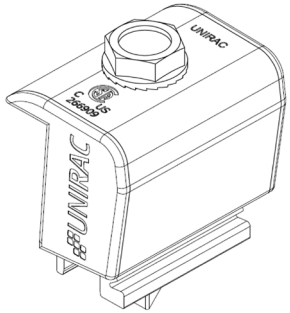
Rail Grounding Lug

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.

UNIRAC
C US
266909





MECHANICAL LOAD TEST

SYSTEM CERTIFICATION

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
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
AMPS	AMPS-xxxN-108BB AMPS-xxxP-54BB
Aptos Solar	DNA-108-(MF/BF)10-xxxW DNA-108-MFN10-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 CHSM66M(DG)/F-BH CHSM72M(DG)/F-BH CHSM72M-HC CHSM72N(DG)/F-BH
Auxin	AXN10Mxxx AXN6M610T AXN6M612T AXN6P610T AXN6P612T AXNG1M Series
Axitec	AC-xxx(M/P)/60S AC-xxx(M/P)/72S AC-xxxMBT/144V AC-xxxMH/120(S/V/SB/VB)

Manufacture	Module Model / Series
Axitec (Cont.)	AC-xxxMH/144(S/V/SB/VB) AC-xxxP/156-60S AC-xxxTGB/108BB AC-xxxTGB/144TS AC-xxxTGB/144WS-US AC-xxxTGB/96BB
Bila Solar	AA550US-6x24GG
Bluesun Solar	HEX5 BSMxxxM10-54HPH BSMxxxM10-72HBD
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 CS6.2-48TM-xxxH CS6.2-66TB-xxxH CS6.2-66TB-xxxHR CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6R-MS CS6R-xxxMS-HL

Manufacture	Module Model / Series
Canadian Solar (Cont.)	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
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, CT54M10XXX-N07 CT72M10XXX-N07
Eco Solargy	Orion 1000 & Apollo 1000
EMMVEE	ExxxHCBG144-T ExxxHCBT144-T ExxxHCM120-B ExxxM72-B ExxxP72-B Titanium Clear
Energy America	ZLK-xxx
Es Foundry	ES-DN8-H54B-xxx ES-DN8-H72-xxx ES-DP8-H54B-xxx ES-DP8-H72-xxx
ET Solar	ET AC Module, ET Module ET-M772BH520-550WW/WB ET-M772BHxxxTW/TB ET-N772TBHxxxGL
Fellow Energy	FE72-18X(ND)

- 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
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
Gstar Solar	GSD7S54T-xxxBT GSP7G54M(H)
Hansol	TD-AN3, TD-AN4 UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60
Heliene	36M, 36P 60M, 60P, 72M & 72P Series 132HC M10 SL Monofacial Module 144HC M10 SL Bifacial 144HC M6 156HC M10 SL Bifacial 144HC M10 NTYP SL Bifacial 156HC M10 NTYP 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 HT72-18X(ND)-F
Hyperion Solar	HY-DH108N8B HY-DH108P8(B) HY-DH144P8

Manufacture	Module Model / Series
Hyperion Solar (Cont.)	HY-DH156N8 HY-DH156P8
Hyundai	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 KG, MG, RW, TG, RI, RG, TI, KI, HI Series HiA-SxxxHG HiD-SxxxRG(BK)
Illuminate USA	IL5-72HBD-xxx M IL8-66HGD-xxx M
Imperial Star	ISM7-SHDD108-400/M
INDEPWR Solar	iPWR-M10-54BX2S-xxxW iPWR-M10-60BX2S-xxxW
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAM54D41-xxx/MB JAM54S30 xxx/MR JAM54S31 xxx/MR JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB JAM66D45 LB JAM72D10 xxx/MB JAM72D30MB

Manufacture	Module Model / Series
JA Solar (Cont.)	JAM72D40 xxx/MB JAM72S30 /MR JAM78D10MB JAP6 60-xxx 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
Jinko	JKM & JKMS Series JKMxxxM-6RL3-B JKMxxxM-72HBL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HL4-TV JKMxxxM-72HLM-TV JKMxxxM-72HL-V JKMxxxM-7RL3-TV JKMxxxM-7RL3-V JKMxxxN-54HL4-B JKMxxxN-72HL4-BDV (30mm & 35mm Frame Height) 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)

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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- 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
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
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

Manufacture	Module Model / Series
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 MSExxxSX5K MSExxxSX5T MSExxxSX6Z MSExxxSX9R MSExxxSX9Z MSH10-xxxHN4G MSH10-xxxHN4G-DC11 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-66THB-G12R NESE xxx-72MHB-M10 NESE xxx-60MH-M6 NESE xxx 72MHT-M10 NESE xxx 72THB-M10

Manufacture	Module Model / Series
NE Solar (Cont.)	NESE xxx 72MHB-M10
Optivolt	OPT10MxxxB
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 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 PSxxxM8GFH-24TNH PSxxxMH-24/T PSxxxM-24/TH PSxxxMH-24/TH
Prism Solar	P72 Series, P72X-xxx

- 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
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 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 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+/AC Q.PEAK DUO BLK ML-G10.B+ Q.PEAK DUO BLK ML-G10.C+ Q.PEAK DUO BLK ML-G10.C1+/AC Q.PEAK DUO BLK ML-G10+ / t Q.PEAK DUO BLK ML-G10+ / TS Q.PEAK DUO ML-G12S.3/BFG Q.PEAK DUO ML-G12S.7/BFG 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)

Manufacture	Module Model / Series
Q Cells (Cont.)	Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G10.3/BFG QPEAK DUO G10.C1+ AC Q.TRON BLK M-G2+ Q.TRON BLK M-G2(.H1)(.F1)(.C1)+/AC 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 ML-G3.3/BFG 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.) Q.PEAK DUO BLK ML-G10.C+ Q.PEAK DUO BLK ML-G10.D+ Q.PEAK DUO BLK ML-G10.D1+/AC Q.PEAK DUO ML-G12S.P3 / BFG Q.PEAK DUO XL-G11S.3 / BFG Q.PEAK DUO XL-G11S.B3 / BFG Q.PEAK DUO XL-G11S.L3 / BFG Q.TRON BLK M-G2+/AC Q.TRON BLK M-G2.C+ Q.TRON BLK M-G2.C1+/AC Q.TRON BLK M-G2.C3+/AC Q.TRON BLK M-G2.C4+/AC Q.TRON BLK M-G2.D+ Q.TRON BLK M-G2.D1+/AC Q.TRON BLK M-G2.D2+/AC

Manufacture	Module Model / Series
Q Cells (Cont.)	Q.TRON BLK M-G2.Y+ Q.TRON ML-G3.3/BFG
REC	RECxxxAA (BLK/Pure/Pure-R/ Pure-RX/ Pure 2/ Pro M) RECxxxAA Pure-RX RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxNP3 Black RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black) RECxxxAA PURE-RX-DC
Regitec Solar	RMHT54/xxxAB2
Renesola	All 60-cell modules RS6-xxxNBG-E3
Risen	RSM Series RSM110-8-xxxBMDG
Runergy	HY-DH132N11 HY-DH96N11B
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

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- 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
S-Energy	SN72 & SN60 Series SL45-60BGI/BHI SL45-60MBI-xxxZ SL40-60MAI/MBI/MCI-xxxV
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/E11) SRP-(6QA/6QB) SRP-xxx-6MB-HV SRP-xxx-BMA-HV SRP-xxx-BMB-HV SRP-xxx-BMC-HV SRP-xxx-BMD-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-N ELNSM54M-HC Series ELNSM72M-HC Series
Solar4America	S4Axxx-108MH10BB, S4Axxx-72MH5BB

Manufacture	Module Model / Series
Solar4America (Cont.)	S4Axxx-144MH10xxx, S4Axxx-144TH10xxx S4Axxx-144TH16xxx, S4Axxx-108MH10xxx S4Axxx-108TH10xxx
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
Solar Space	SS8-54HDB-xxx-N SS8-54HD-xxx-N SS8-72HD-xxx-M SS8-72HD-xxx-N SS8-78HD-xxx-M SS9-66HD-xxx-N SSA-48HDB-xxx-N SSA-48HD-xxx-N SSA-54HDB-xxx-N SSA-54HD-xxx-N SSA-66HD-xxx-N
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
SunGold Power	SG415WM
Suniva	MV Series & Optimus Series (35mm)

Manufacture	Module Model / Series
Sunket Solar	SKT580M10-144S2
Sunmac Solar	M754SH-BB Series
SunPlus Optimum	SR4-54HTB-xxxM
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 Power	SPDGxxx-120M12 SPDGxxx-N108M10 SPDGxxx-N144M10
SunTech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, Hipor M, Smart, TD6I72M TD7G72M TM3G48M TM3G54M TM3G66M TM7G54M TM7G60M TM7G72M TP6F72M TP6F72M(H) TP7G54M(H)
Tesla	SC, SC B, SC B1, SC B2 TxxxS TxxxH Tesla Solar Panel TSP-415/TSP-420

- 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
Thornova	TS-BBT54(xxx) TS-BG54 TS-BG72 TS-BGT72(xxx)
TP Solar	TPxxxVG12R16NB
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-DE06X.05(II) TSM-DE09.05 TSM-DE09.08 TSM-DE09C.07 TSM-DE15H(II) TSM-NE09RH.05 TSM-NE19RC TSM-NEG19RC.20 TSM-NEG9RH.25
TSMC	TS-150C2 CIGSw
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB 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

Manufacture	Module Model / Series
URECO (Cont.)	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 VSUNxxx-60M-BB VSUNxxx-72MH VSUNxxxN-108BMH-BB VSUNxxxN-108BMH-BB (SoftPaw) VSUNxxxN-108BMH-DG-BB VSUNxxxN-120BMH-BB (SoftPaw) VSUNxxxN-132BMHR VSUNxxxN-144BMH-DG

Manufacture	Module Model / Series
VSUN (Cont.)	VSUNxxxN-144BMH VSUNxxxN-144MH VSUNxxx-144BMH VSUNxxx-144MH VSUNxxx-144M-BW
Waaree	Ahnay Series Bi-33 Arka Series WSMDi Bi-55-xxx BiN-08-xxx
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1
ZNShine	ZXM6-72 Series ZXM6-NH120 Series ZXM6-NH144 ZXM6-NHLDD144 ZXM7-SH108 Series ZXM7-SHDB144 ZXM7-SHLDD144 ZXM7-UHLDD108 ZXM7-UHLDD144

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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- 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