

**PROJECT TITLE**

ULA

**PROJECT ID**

E9A15CEF

**CREATED**

Oct. 22, 2020, 12:03 p.m.

**NAME**

Designed by Uri.Lieber

**ADDRESS**

26 Neal Dr, Chester, NY 10918, USA

ULA

**CITY, STATE**

Chester, NY

LG

**MODULE**

LG LG360N1C-N5

36 - LG360N1C-N5

 669.20 ft<sup>2</sup>

12.96 KW

## BILL OF MATERIALS

 LEGEND: ■ Base System Part ■ Accessory

PART NUMBER	PART TYPE	DESCRIPTION	QUANTITY	SUGGESTED QUANTITY	UNIT PRICE (USD)	TOTAL LIST PRICE (USD)
320208M	Rail	SM RAIL 208" MILL	24	24	49.06	1177.44
302030M	Mid Clamp	SM MIDCLAMP PRO MILL	48	48	2.10	100.80
302035M	End Clamp	SM ENDCLAMP PRO W/END CAP	48	48	2.52	120.96
403213C	Structure	ULA RAIL BRACKET, 2"	48	48	9.97	478.56
403200C	Structure	ULA BRACE, 2"@ 7 FT	1	1	35.70	35.70
403201C	Structure	ULA BRACE, 2"@ 10.5 FT	8	8	51.98	415.84
403215C	Structure	ULA SLIDER, 2", AL	10	10	10.75	107.50
403211C	Structure	ULA FRONT CAP, 2", AL	7	7	22.58	158.06
403214C	Structure	ULA REAR CAP, 2", AL	7	7	22.58	158.06
UserSupplied	Structure	2" SCHEDULE 40 PIPE	227	227	0.00	0.00
008002S	Grounding Lug (Weeb)	GROUND WEEBLUG #1	12	12	6.44	77.28

BASE SYSTEM PRICE	<b>\$2752.92</b>	ACCESSORIES PRICE	<b>\$77.28</b>	TOTAL PRICE	<b>\$2830.20</b>
\$0.212 PER WATT		\$0.006 PER WATT		\$0.218 PER WATT	

This design is to be evaluated to the product appropriate Unirac Code Compliant Installation Manual which references International Building Code 2009, 2012, 2015, 2018 and ASCE 7-05, ASCE 7-10, ASCE 7-16 and California Building Code 2010, 2016. The installation of products related to this design is subject to requirements in the above mentioned installation manual.

## DETAILED PARTS DESCRIPTION

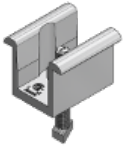
QTY



**Rail** 320208M SM RAIL 208" MILL

24

Structural aluminum extrusion containing slots that accept module and roof attachment hardware, electrical bonding accessories, and splice bars.



**Mid Clamp** 302030M SM MIDCLAMP PRO MILL

48

SOLARMOUNT Pro Series universal height mid clamps: Installed between modules and provide top-down clamping to secure module frame to SM rail. These pre-assembled, self-standing clamps will accommodate module frame heights from 30mm to 51mm. Mill finished (bare) aluminum.



**End Clamp** 302035M SM ENDCLAMP PRO W/END CAP

48

SOLARMOUNT Pro Series universal end clamps: Installed at the beginning and end of a row of modules. These clamps slide into the top rail channel and secure the module frame bottom-side return flange. Rail should be cut flush with the module frame for a clean look. End cap included for each clamp; end cap works on both SM standard and light rail profiles.



**Structure** 403213C ULA RAIL BRACKET, 2"

48

Rail bracket connects SOLARMOUNT and SOLARMOUNT HD rail to 2" horizontal pipe structure.



**Structure** 403200C ULA BRACE, 2"@ 7 FT

1

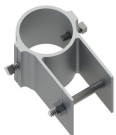
7' Square aluminum tube for ULA seismic bracing. Used to create diagonal bracing between upright foundations. Cut to length and drill for installation.



**Structure** 403201C ULA BRACE, 2"@ 10.5 FT

8

10.5' Square aluminum tube for ULA seismic bracing. Used to create diagonal bracing between upright foundations. Cut to length and drill for installation.



**Structure** 403215C ULA SLIDER, 2", AL

10

Slider connects the lower end of diagonal seismic bracing. Mounts on 2" vertical pipe.



**Structure** 403211C ULA FRONT CAP, 2", AL

7

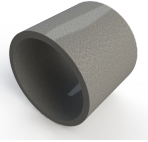
Aluminum front cap. Connects short (front of array) upright post with 2" horizontal pipe structure.



**Structure** 403214C ULA REAR CAP, 2", AL

7

Aluminum rear cap. Connects tall (rear of array) upright post with 2" horizontal pipe structure.



**Structure** UserSupplied 2" SCHEDULE 40 PIPE

227

2" SCHEDULE 40 GALVANIZED PIPE SERVES AS THE STRUCTURE TO MOUNT RACKING. SOURCE THIS PIPE LOCALLY.



**Grounding Lug (Weeb)** 008002S GROUND WEEBLUG #1

12

For electrical bonding of PV modules and rails. Accepts one 14AWG to 6AWG or two 12 AWG to 10 AWG copper wires. Tin plated copper body, 1/4" stainless steel fasteners.



# ENGINEERING REPORT

## Plan review

TOTAL NUMBER OF MODULES	36
TOTAL NUMBER OF TABLES	1
TOTAL KW	12.96 KW

## Loads Used for Design

BUILDING CODE	ASCE 7-10
BASIC WIND SPEED	105.00 mph
GROUND SNOW LOAD	0.00 psf
RISK CATEGORY	I
SEISMIC (SS)	0.21
SEISMIC (S1)	0.06
ELEVATION	653.00 ft
WIND EXPOSURE	C

## Loads Determined by Zip10918

CITY, STATE	Chester, NY
BASIC WIND SPEED	115.00 mph
GROUND SNOW LOAD	0.00 psf

## Inspection

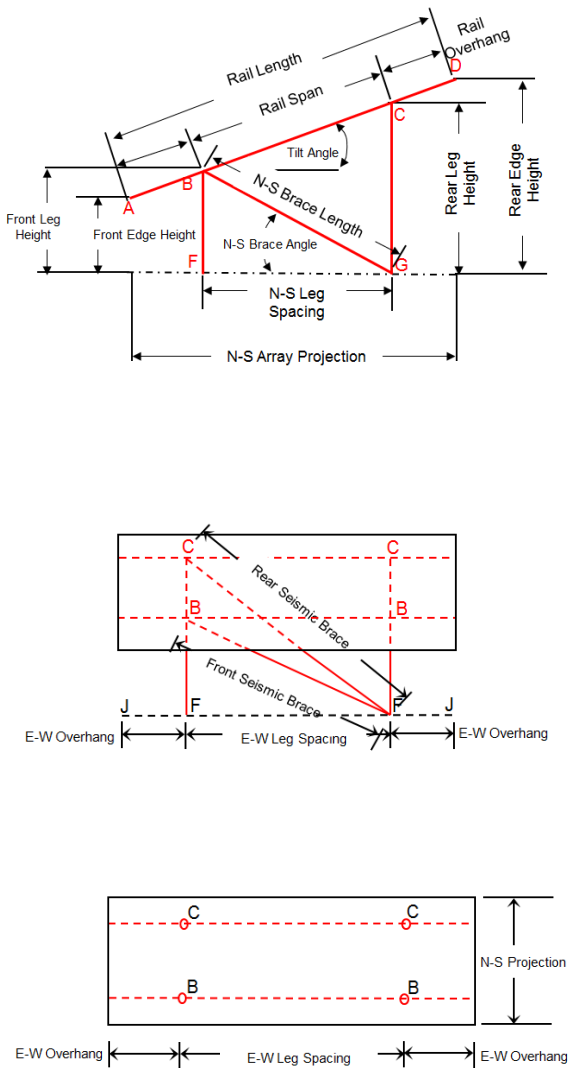
PRODUCT	ULA
MODULE MANUFACTURER	LG
MODEL	36 - LG360N1C-N5
MODULE WATTS	360 watts
MODULE LENGTH	66.92"
MODULE WIDTH	40.00"
MODULE THICKNESS	1.57"
MODULE WEIGHT	39.70 lbs
TILT	25 degrees
CLAMP TYPE	Pro Series Top Clamps
FOUNDATION TYPE	CONCRETE
FRONT EDGE HEIGHT	2.00 ft

Site Area 1 / Table Size 1 (count:1)

NUMBER OF MODULES:	36
TOTAL KW:	12.96 KW
TABLE SIZE:	3 X 12
RAIL USED:	SM
ORIENTATION:	PORTRAIT
SUGGESTED ROW SPACING	182.16"

(Not required for design. Calculated based on latitude, tilt, and no module shading between 10am and 2pm on Dec. 21st. Customer is responsible for final row spacing and energy production.)

GEOMETRY



Member Description

N-S RAIL LENGTH: AD	205.76"
N-S RAIL SPAN: BC	114.31"
N-S RAIL OVERHANG: AB, CD	45.72"
FRONT EDGE HEIGHT	24.00 "
REAR EDGE HEIGHT	109.69 "
FRONT LEG LENGTH: BF	35.54"
REAR LEG LENGTH: CG	83.85"
N-S BRACE LENGTH: BG	104.50"
N-S BRACE ANGLE	18.42 degrees
N-S LEG SPACING: FG	103.60"
E-W ARRAY LENGTH	491.00"
E-W BRACE LENGTH(FRONT)	74.12"
E-W BRACE LENGTH(REAR)	103.78"
E-W BRACE ANGLE(FRONT)	24.0 degrees
E-W BRACE ANGLE(REAR)	49.56 degrees
E-W SPAN/LEG SPACING	72.21"
E-W OVERHANG: JF, FJ	28.88"
NUMBER OF POSTS	14

LOAD VARIABLES

Dead Loadspsf

VERTICAL	1.94
HORIZONTAL	0.90

Wind Loads on table (Front Post)psf

LC 0, A	-28.89
LC 0, B	-6.36
LC 180, A	31.78
LC 180, B	40.44

Wind Loads on table (Rear Post)psf

LC 0, A	-27.73
LC 0, B	-42.18
LC 180, A	32.93
LC 180, B	13.87

Seismic Loadpsf

VERTICAL	0.30
HORIZONTAL	0.49

Snow Loadpsf

VERTICAL	0.00
HORIZONTAL	0.00

NORTH-SOUTH(N-S) RAIL DESIGN

Maximum LoadsSM

MAXIMUM VERTICAL LOAD	36.16 plf
MINIMUM VERTICAL LOAD	-40.24 plf
MAXIMUM EAST-WEST LOAD	1.93 plf
MINIMUM EAST-WEST LOAD	2.08 plf
MAXIMUM MOMENT VERTICAL	317.02 ft-lbs
MAXIMUM MOMENT EAST-WEST	15.08 ft-lbs
MAXIMUM SHEAR	170.35 lbs
MAXIMUM AXIAL (NORTH-SOUTH)	35.62 lbs
MAXIMUM DEFLECTION	0.08"

FOUNDATION

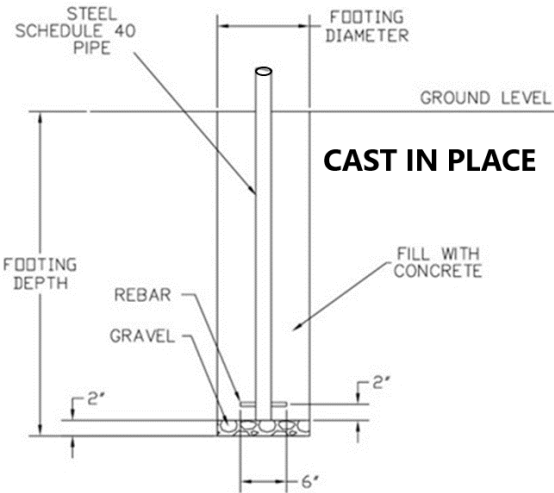
Design Inputs

pcf

CONCRETE DENSITY	140.00
SOIL DENSITY	110.00

Concrete Design

FOOTING DIAMETER	18.00"
FOOTING DEPTH	5.35 ft

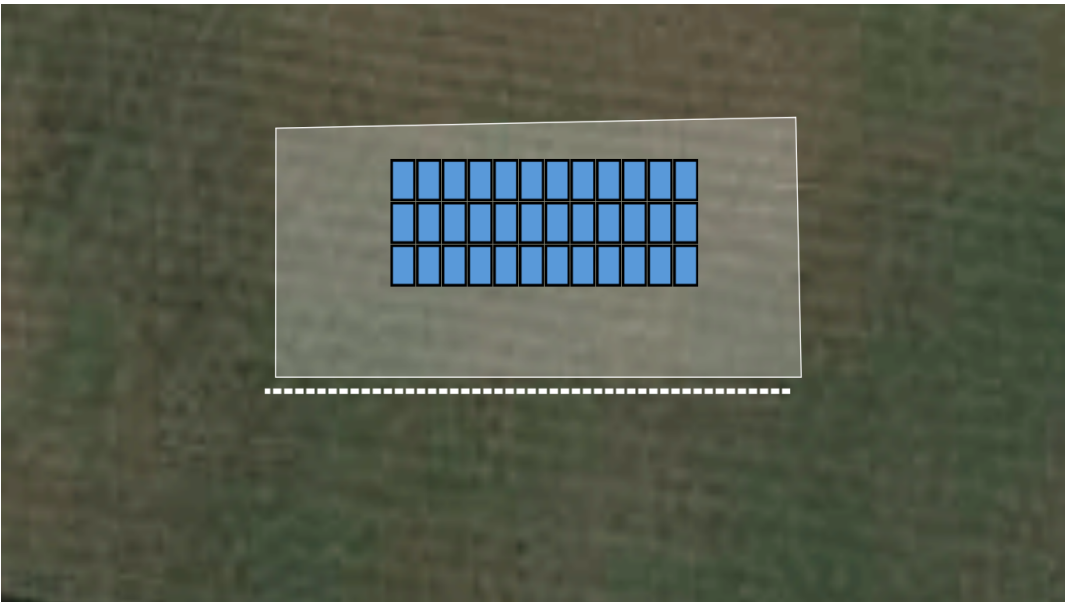


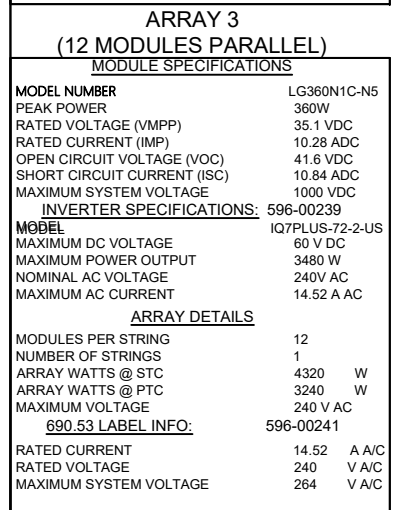
INSTALLATION AND DESIGN PLAN

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Site Area 1

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1. EQUIPMENT SHALL BE NEW UNLESS OTHERWISE NOTED
2. EQUIPMENT SHALL BE UL LISTED UNLESS OTHERWISE NOTED
3. EQUIPMENT SHALL BE INSTALLED PROVIDING ADEQUATE WORKING SPACE AROUND THE EQUIPMENT AND WILL ADHERE TO THE N.E.C. 2017
4. MODULES SHALL BE POSITIVELY GROUNDED, GROUNDED POSITIVE CONDUCTORS SHALL BE UN-FUSED AND UNBROKEN TO THE ARRAY TO THE INVERTER DC TERMINAL. UNGROUNDED NEGATIVE CONDUCTORS SHALL BE FUSED AND/OR SWITCHED
5. COPPER CONDUCTORS SHALL BE USED ON ROOF AND SHALL HAVE INSULATION RATING OF 600V 90°C UNLESS OTHERWISE NOTED
6. CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH N.E.C. AMPACITY SHALL BE DE-RATED TO COMPENSATE FOR THERMAL LOAD, CONDUIT FILL AND VOLTAGE DROP
7. CONDUITS SHALL BE ADEQUATELY SUPPORTED AS PER N.E.C. 2017
8. AC DISCONNECT SHOWN IS REQUIRED IF THE UTILITY REQUIRES VISIBLE VISIBLE BLADE SWITCH
9. EXPOSED NON CURRENT CARRYING METAL PARTS SHALL BE GROUNDED AS PER N.E.C. 2017
10. LOAD SIDE INTERCONNECTION SHALL COMPLY WITH N.E.C.
11. THIS DESIGN IS BASED UPON COLDEST AMBIENT TEMPERATURE -14°F AND AVERAGE HOTTEST TEMP 85°F
12. BREAKERS SHALL BE INSTALLED IN ACCORDANCE WITH N.E.C. 2017 690.13.
13. I.C.P.D. SHALL BE DESIGNED AS PER (ISC)(1.25)(1.25)=WIRE AMPACITY OR N.E.C. 2017 TABLE 690.8
14. ANY DC CONDUCTORS INSIDE OF THE STRUCTURE SHALL BE IN METAL CONDUIT
15. IT IS CONTRACTORS RESPONSIBILITY TO COMPLY WITH N.E.C. 2017 690.11 ARC FAULT PROTECTION REQUIREMENTS.
16. ALL INSTALLATIONS MUST BE APPROVED BY LOCAL BUILDING DEPARTMENT



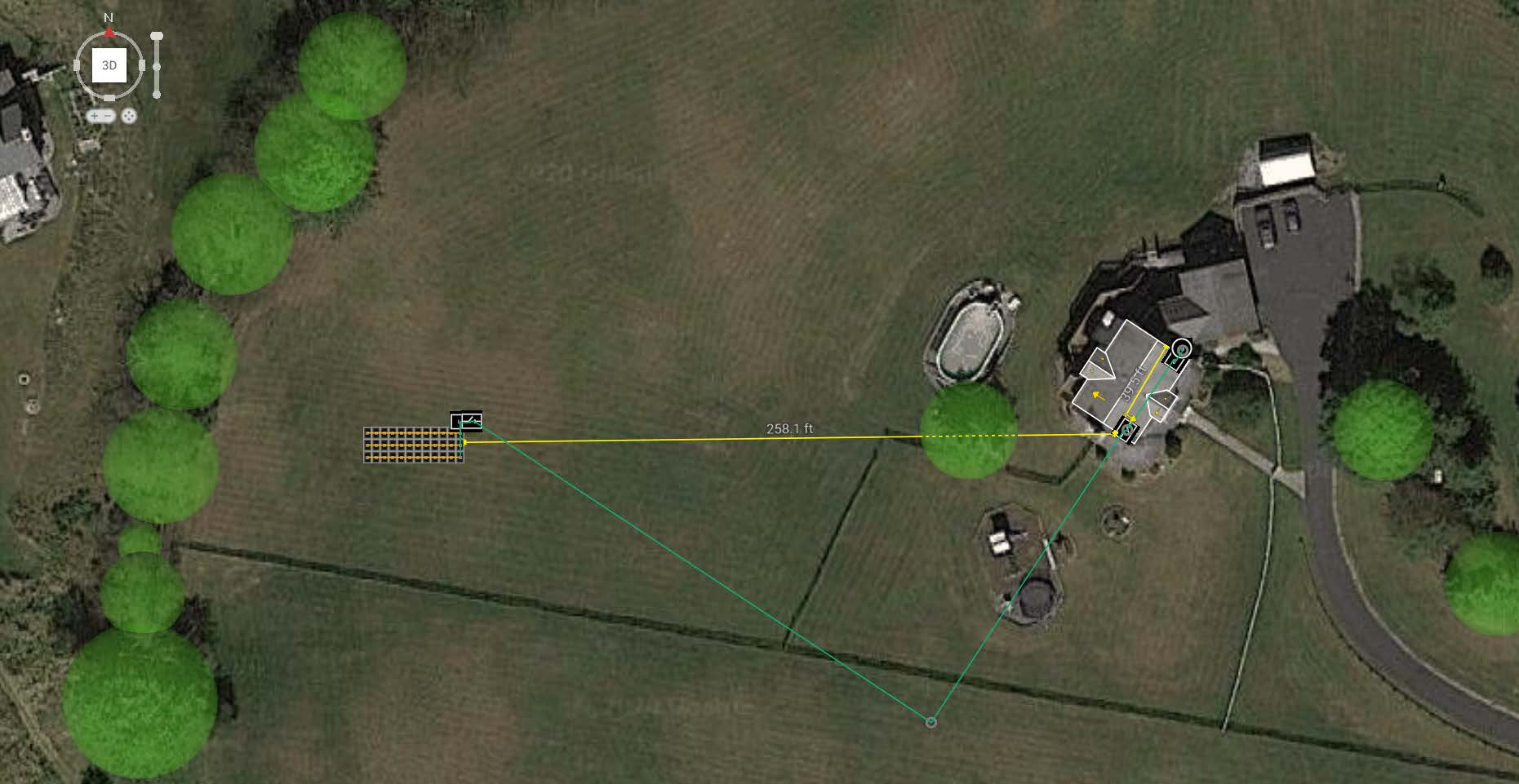




258.1 ft



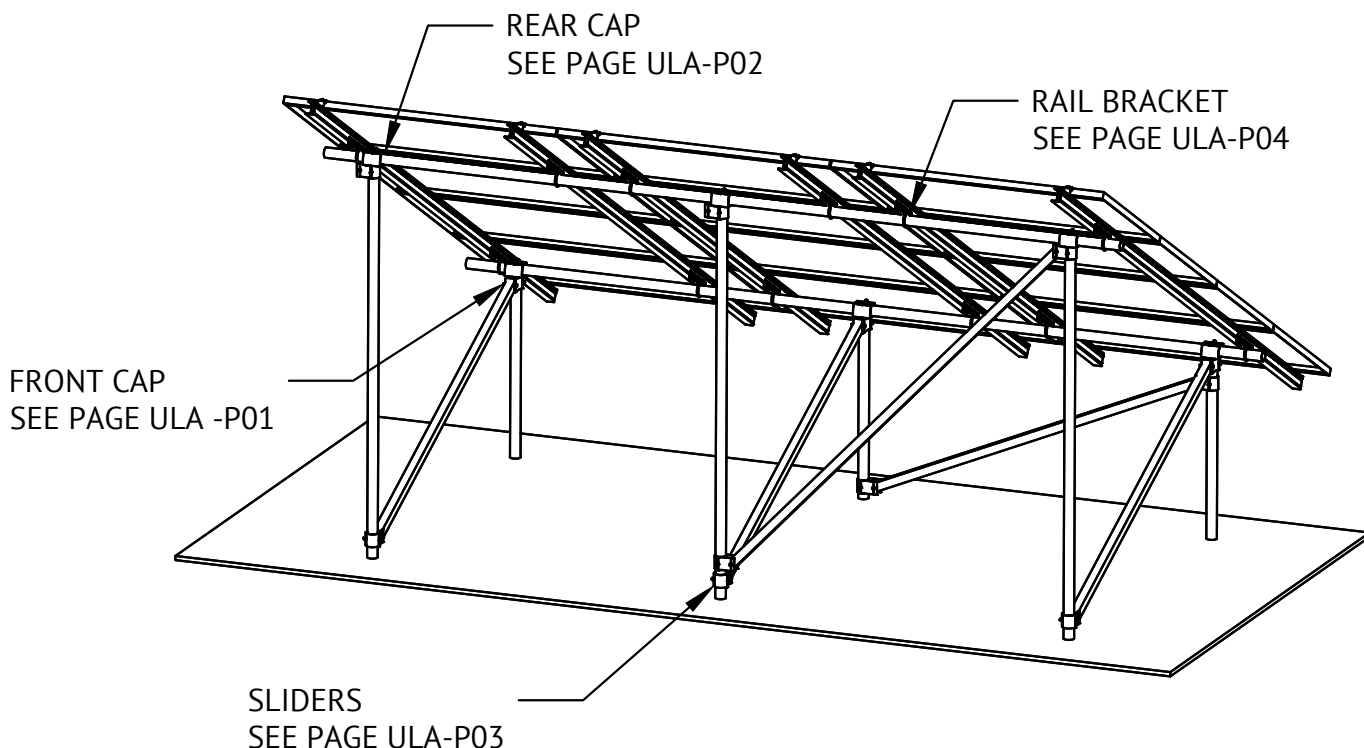
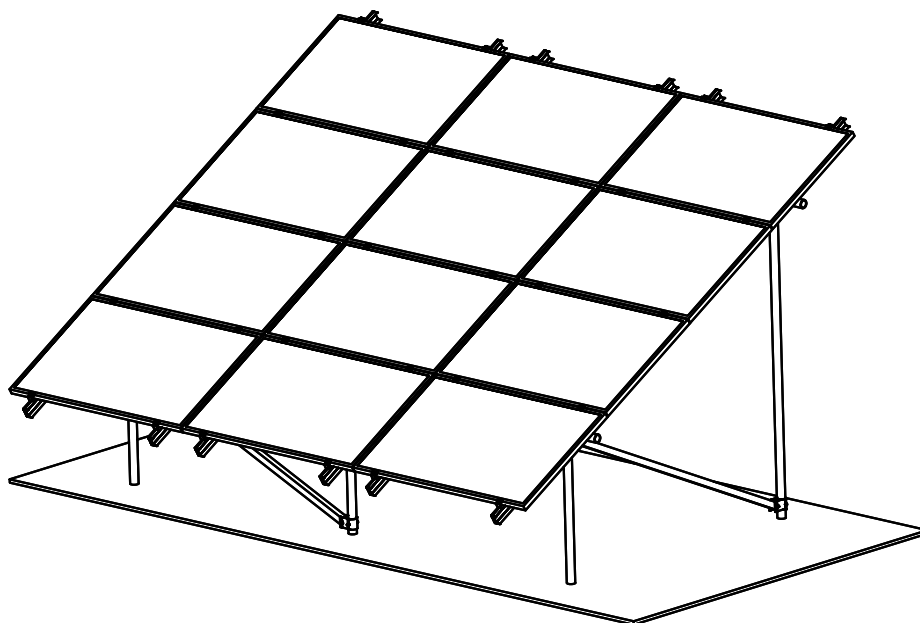




258.1 ft

39.5 ft





1411 BROADWAY BLVD NE  
ALBUQUERQUE, NM 87102 USA

WWW.UNIRAC.COM

**PRODUCT LINE:** ULA

**DRAWING TYPE:** ASSEMBLY

**DESCRIPTION:** ASSEMBLY EXAMPLE

**REVISION DATE:** APRIL 2016

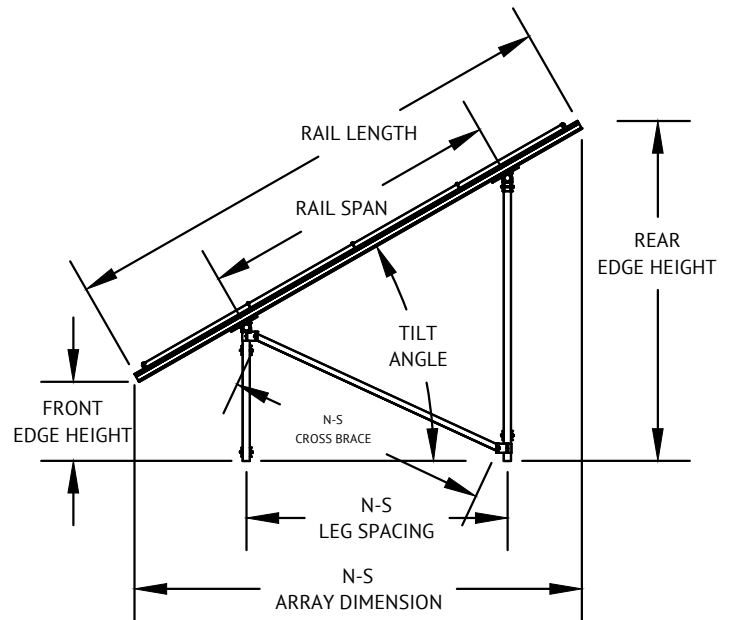
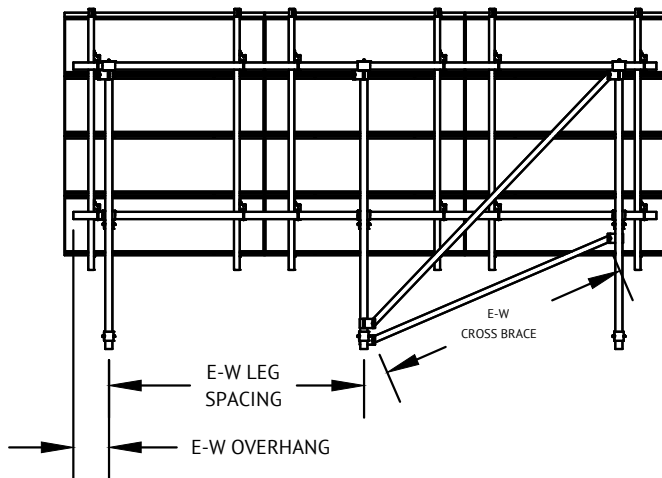
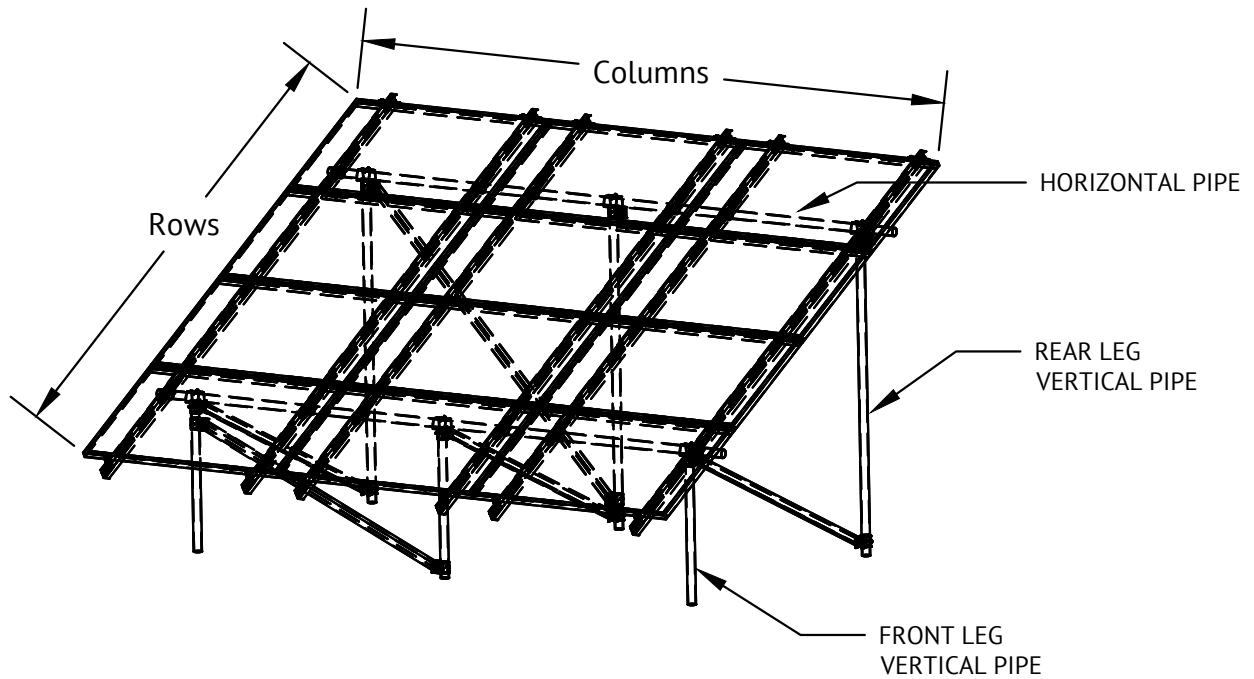
DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE  
OR MORE US PATENTS

**LEGAL NOTICE**

**ULA-A01**

**SHEET**



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**PRODUCT LINE:** ULA

**DRAWING TYPE:** ASSEMBLY

**DESCRIPTION:** ASSEMBLY EXAMPLE

**REVISION DATE:** APRIL 2016

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE NOMINAL

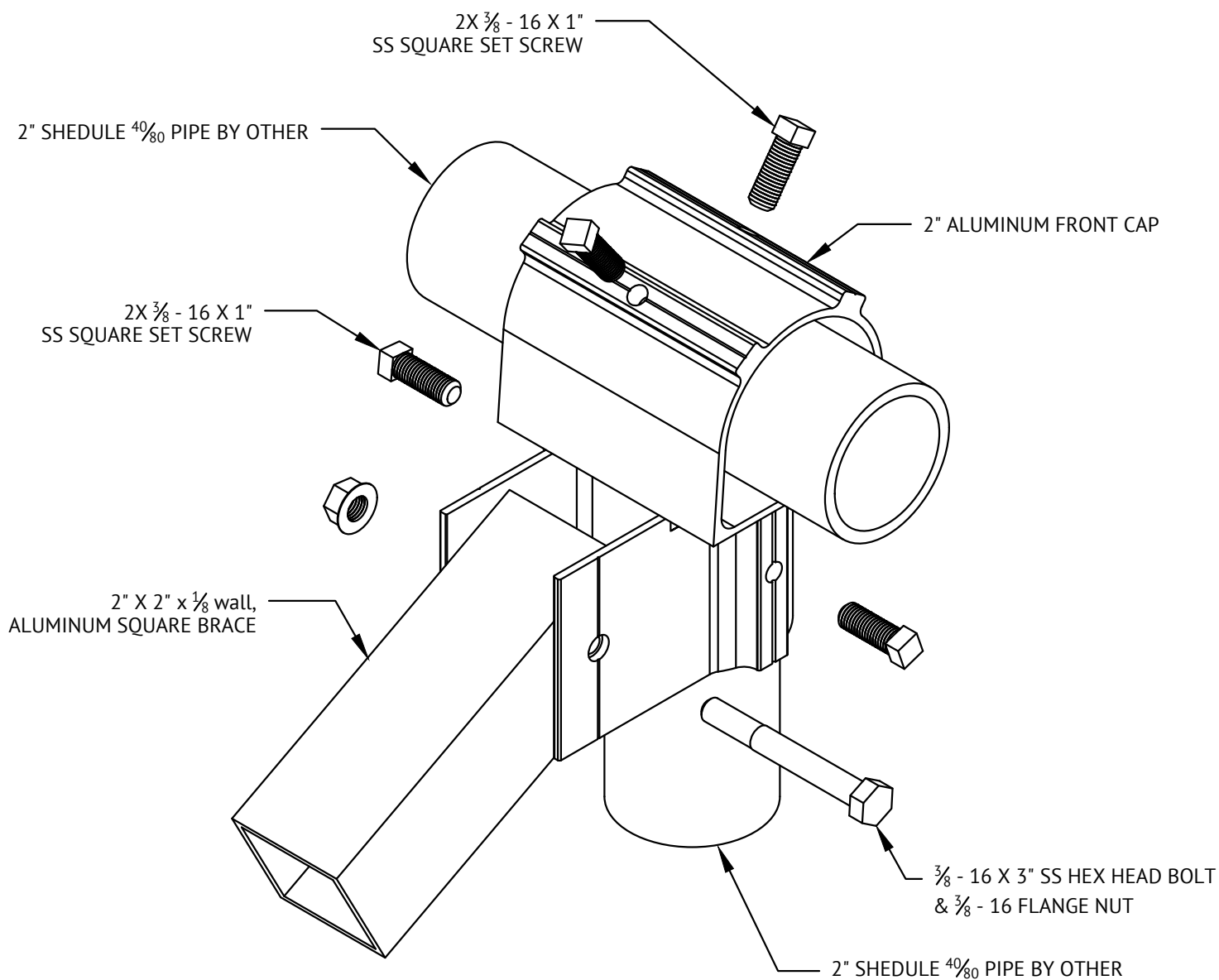
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**LEGAL NOTICE**

**ULA-A02**

**SHEET**

**SHEET**



1411 BROADWAY BLVD NE  
ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:** ULA

**DRAWING TYPE:** PART

**DESCRIPTION:** ALUM FRONT CAP

**REVISION DATE:** APRIL 2016

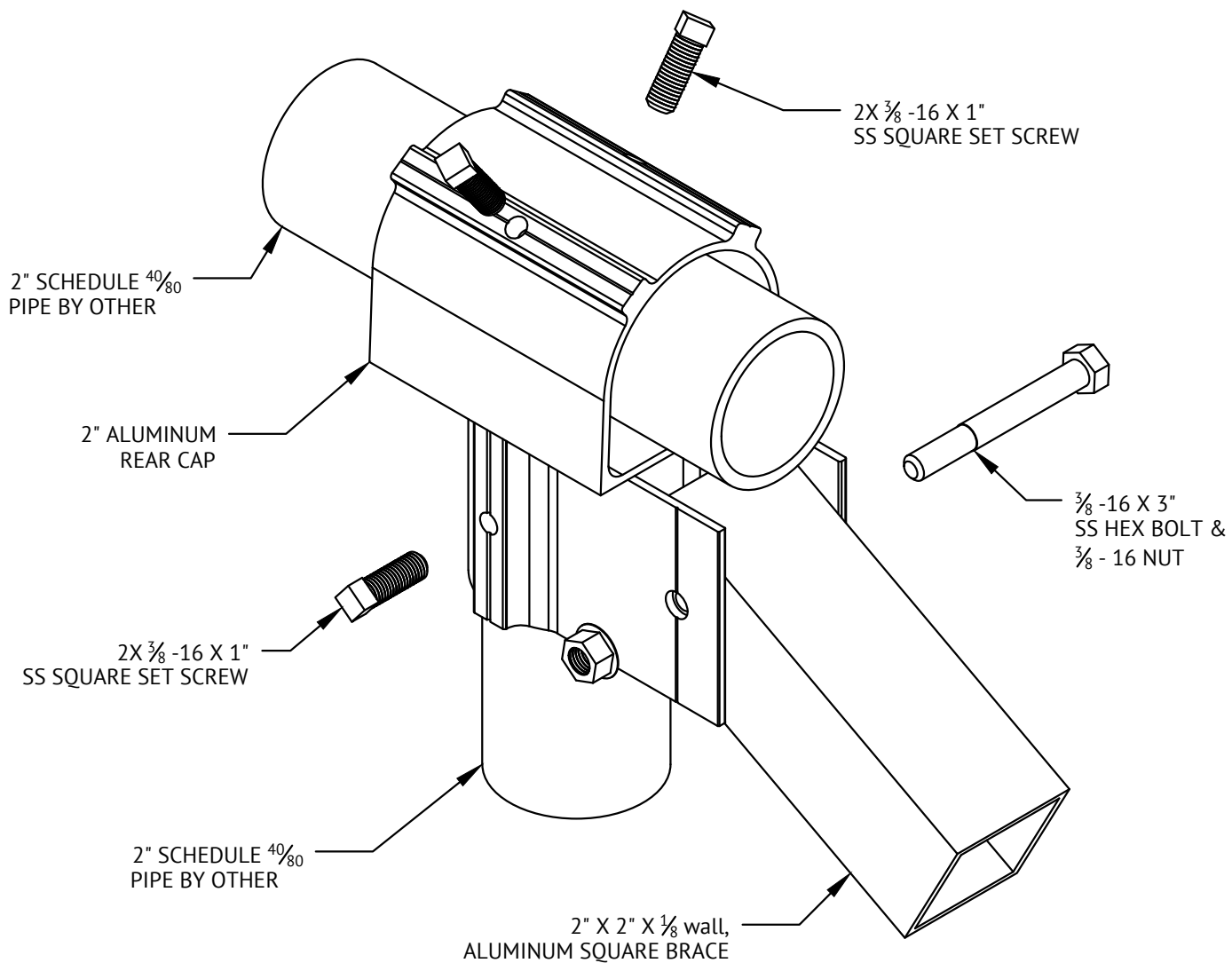
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PRODUCT PROTECTED BY ONE  
OR MORE US PATENTS

**LEGAL NOTICE**

**ULA-A04**

**SHEET**



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ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:** ULA

**DRAWING TYPE:** PART

**DESCRIPTION:** ALUMINUM REAR CAP

**REVISION DATE:** APRIL 2016

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE NOMINAL

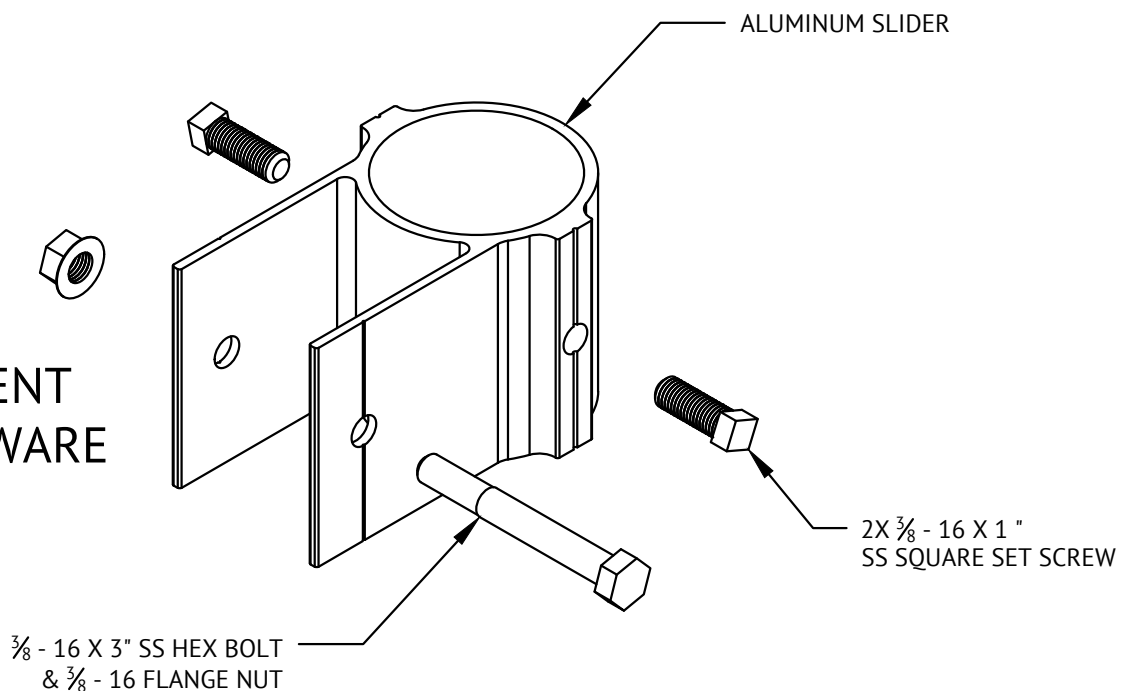
PRODUCT PROTECTED BY ONE  
OR MORE US PATENTS

**LEGAL NOTICE**

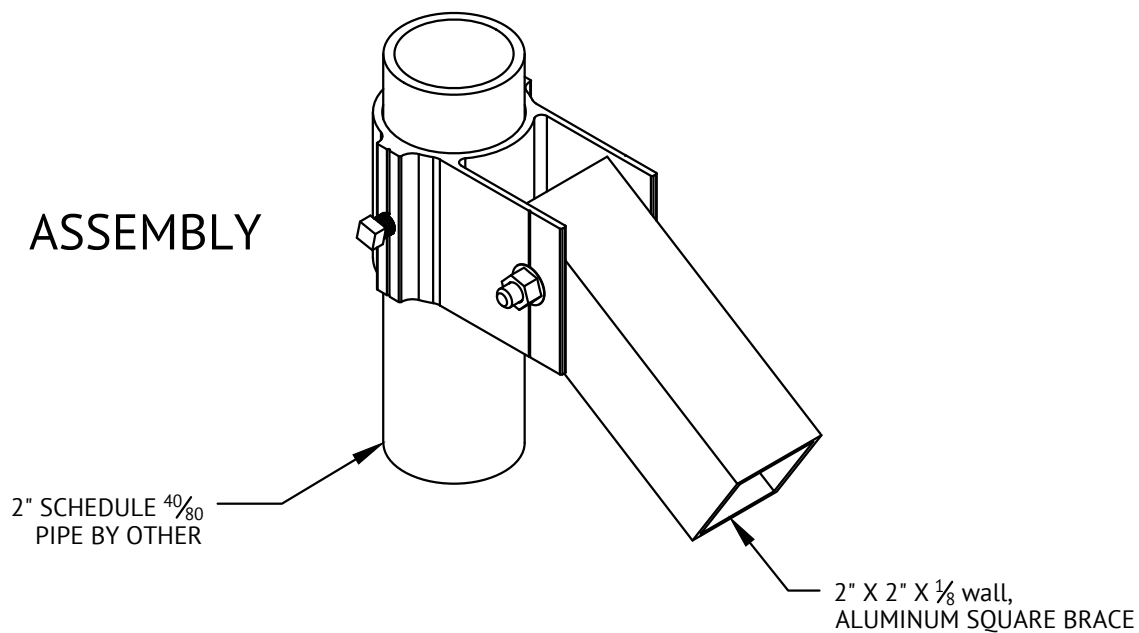
**ULA-A05**

**SHEET**

## COMPONENT & HARDWARE



## ASSEMBLY



1411 BROADWAY BLVD NE  
ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:** ULA

**DRAWING TYPE:** PART

**DESCRIPTION:** ALUM SLIDER

**REVISION DATE:** APRIL 2016

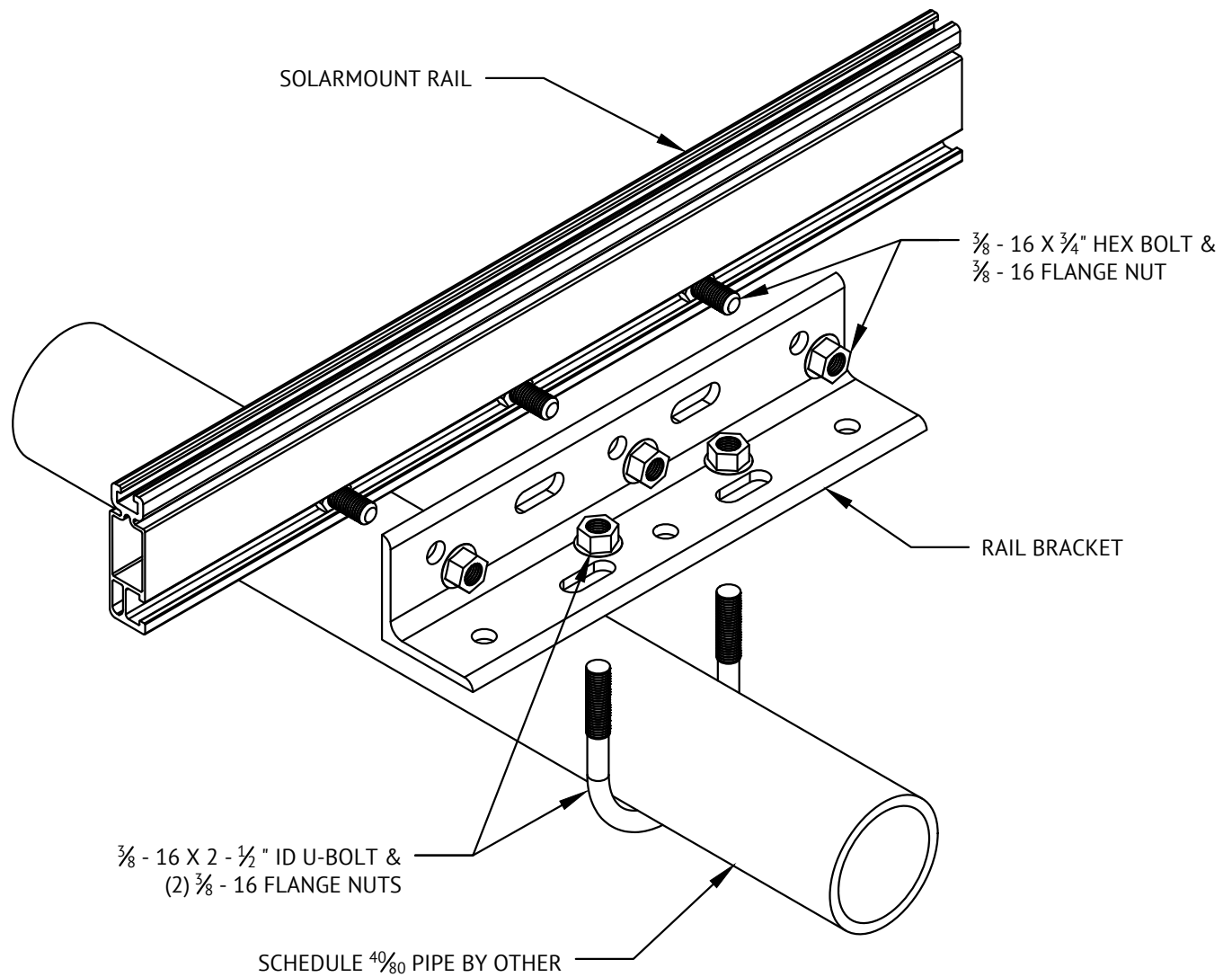
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**LEGAL NOTICE**

**ULA-A06**

**SHEET**



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ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:**

ULA

**DRAWING TYPE:**

PART

**DESCRIPTION:**

UNIVERSAL RAIL BRACKET

**REVISION DATE:**

APRIL 2016

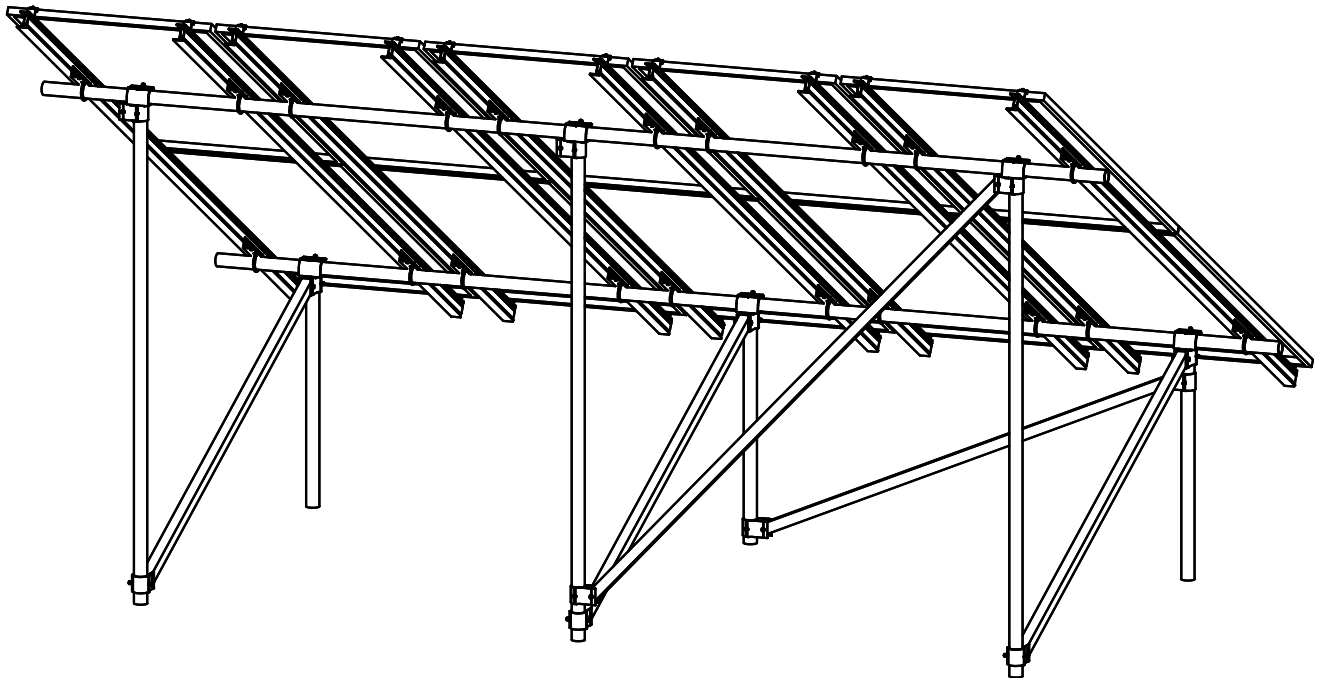
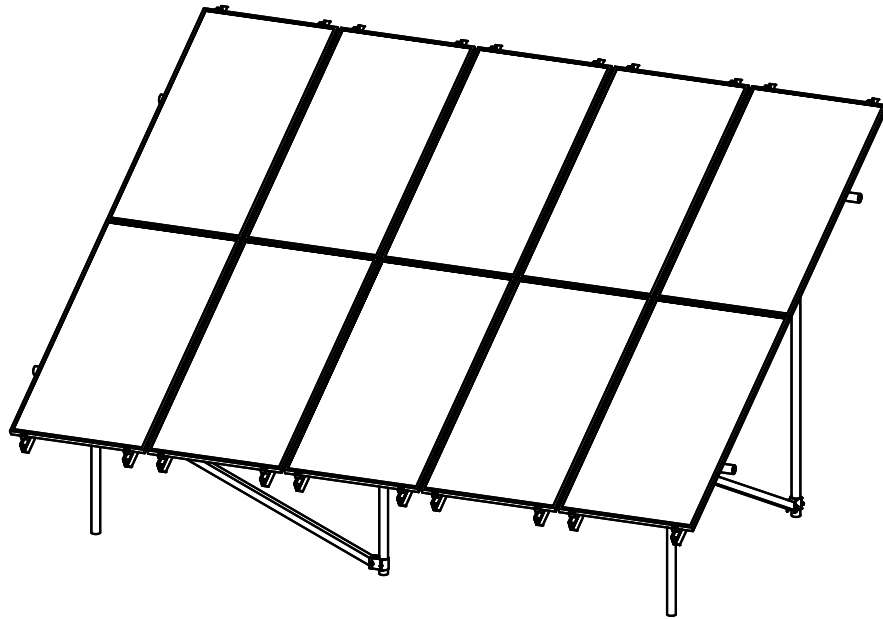
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OR MORE US PATENTS

**LEGAL NOTICE**

**ULA-A07**

**SHEET**



1411 BROADWAY BLVD NE  
ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:**

ULA

**DRAWING TYPE:**

ASSEMBLY

**DESCRIPTION:**

PORTRAIT ORIENTATION

**REVISION DATE:**

APRIL 2016

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE  
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**LEGAL NOTICE**

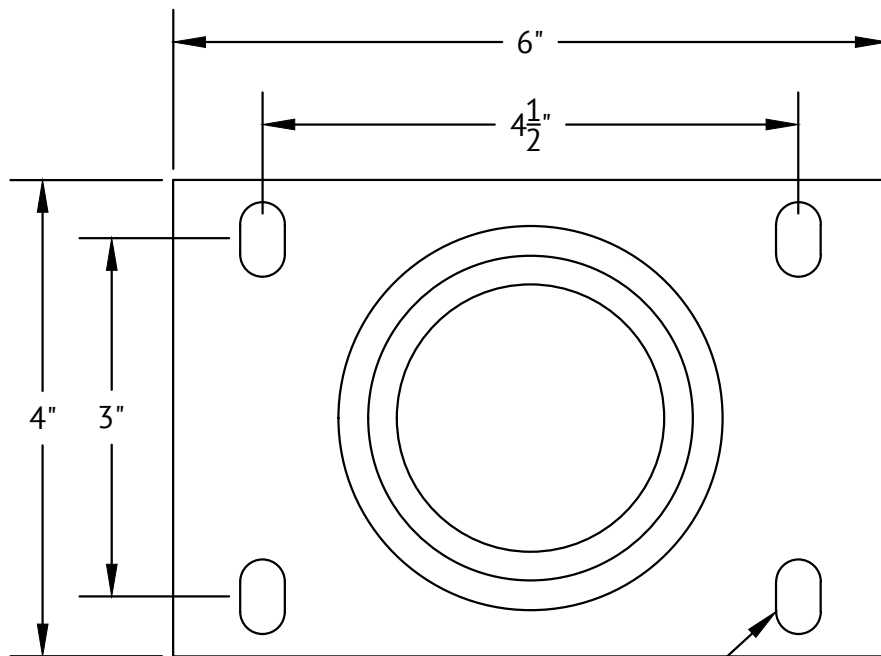
**ULA-A08**

**SHEET**



2  $\frac{3}{8}$  INCH DIAMETER PIPE THREAD  
(11.5 THREADS PER INCH)

$\frac{3}{16}$ "



$\frac{3}{8}$  x  $\frac{5}{8}$  SLOT



1411 BROADWAY BLVD NE  
ALBUQUERQUE, NM 87102 USA

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**PRODUCT LINE:**

ULA

**DRAWING TYPE:**

PART

**DESCRIPTION:**

STEEL THREADED FOOT

**REVISION DATE:**

APRIL 2016

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE  
OR MORE US PATENTS

**LEGAL NOTICE**

**ULA-P01**

**SHEET**

# ULA

## Planning and Assembly Installation Manual 304



# UNIRAC Code-Compliant Installation Manual

### Installer responsibility

The installer is solely responsible for:

- Complying with all local or national building codes, including any that may supercede this manual.
- Ensuring that UNIRAC and other products are appropriate for the particular installations and installation environment.
- Ensuring safe installation of all electrical aspects of the PV array.




UNIRAC welcomes input concerning the accuracy and user-friendliness of this publication.

REV2018OCT01

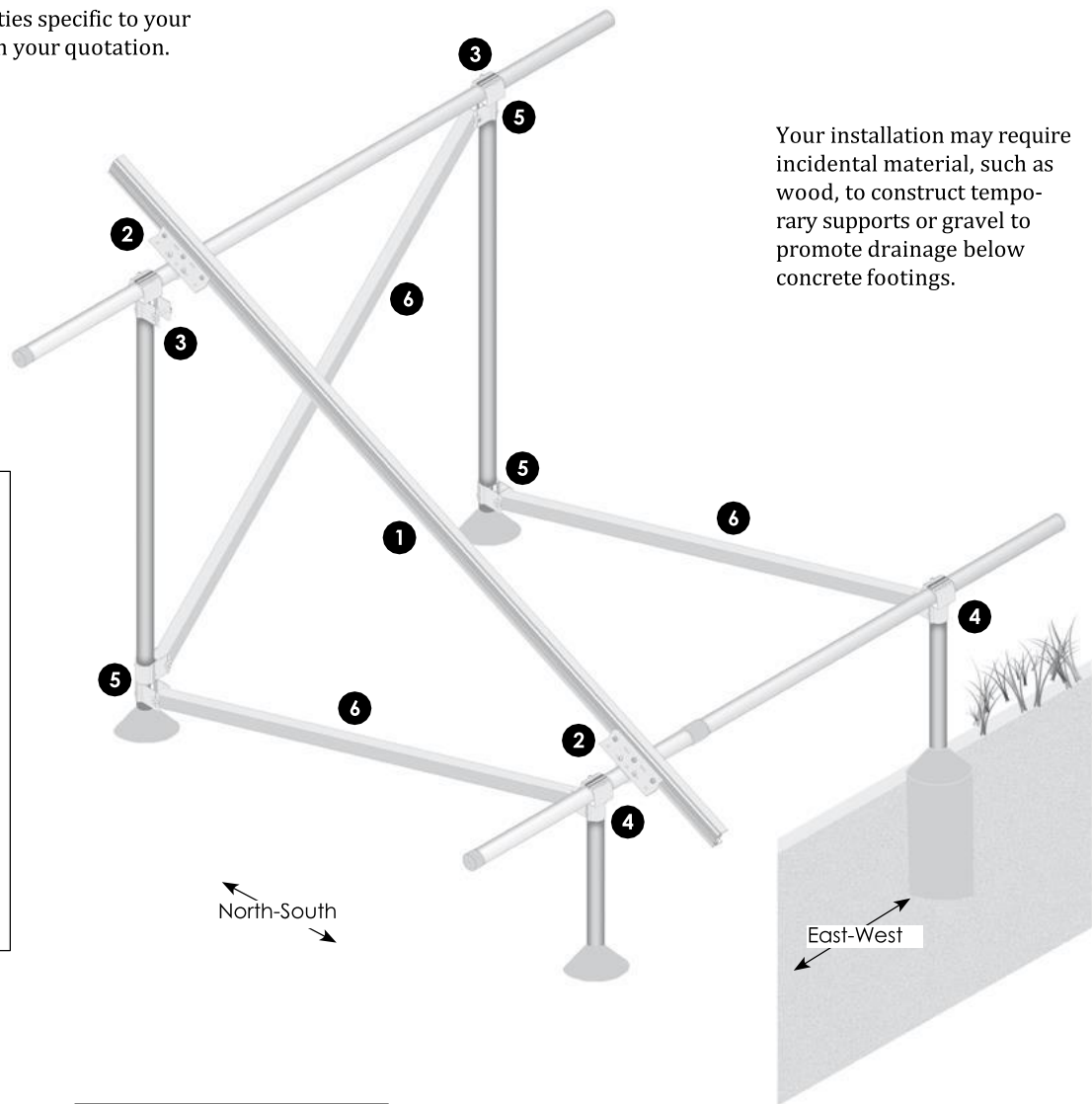
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## Figure 1. U-LA components

Components and quantities specific to your installations are listed on your quotation.



Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood, (1) apply lubricant to bolts, preferably an anti-seize lubricant, available at auto parts stores, (2) shade hardware prior to installation, and (3) avoid spinning on nuts at high speed.

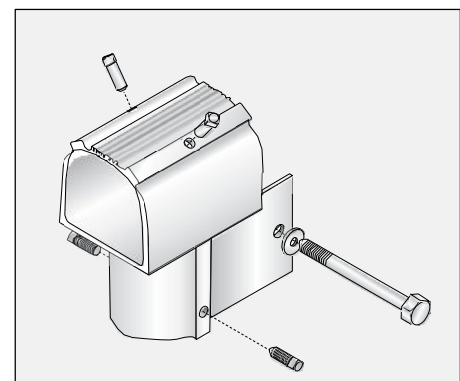
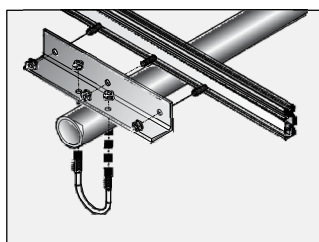


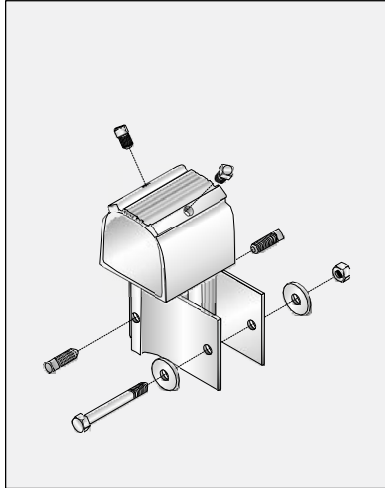
- 1. SOLARMOUNT rail**—Standard or HD (heavy duty) rails support PV modules.



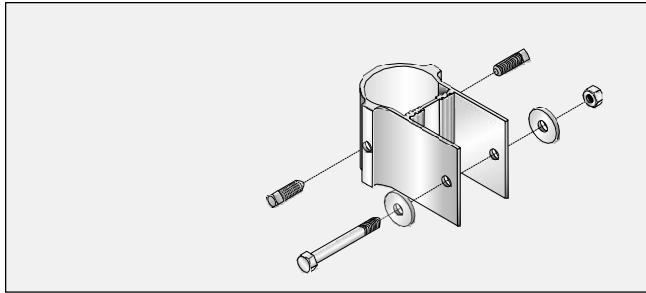
- 3. Rear cap**—Attaches back horizontal pipe to vertical pipes. Includes  $\frac{3}{8}$ -inch hardware: 2 U-bolts sized for pipe and 4 flange nuts, and 2 or 4 set screws.

- 2. Rail bracket**—Attaches rail to horizontal pipes. Includes  $\frac{3}{8}$ -inch hardware: 1 U-bolt, 3 hexhead bolts, and 5 flange nuts.

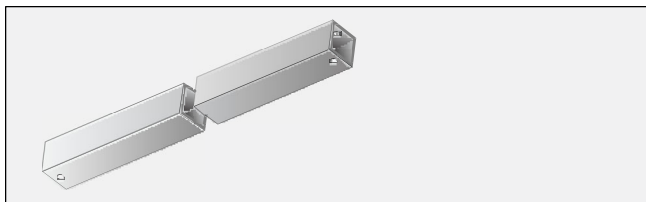




4. **Front cap**—Attaches front horizontal pipe to vertical pipes and anchors upper end of north-south braces. Includes  $\frac{3}{8}$ -inch hardware: 2 U-bolts and cross-brace bolt sized for pipe, 5 flange nuts, and 2 or 4 set screws.



5. **Slider**—Attaches lower end of north-south cross braces to rear legs. Anchors both ends of east-west braces (if employed in your installation). Includes  $\frac{3}{8}$ -inch hardware: 1 cross-brace bolt sized for pipe, 1 flange nut, and 2 or 4 set screws.



6. **Cross Brace**—Provides north-south and east-west diagonal bracing. Extrusion size matches other 2- or 3-inch components.

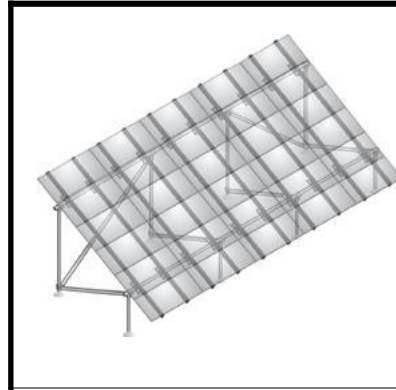
*Be prepared to cut and drill braces on the jobsite. Hole location is 1" from the end of brace along the center line.*

## Material specifications

**Rails, caps, sliders, rail brackets, cross braces, pro series end and mid clamps, and top mounting clamps**—6105-T5 aluminum extrusion; caps are welded.

**Fasteners**—304 stainless steel.

**Horizontal and vertical pipe** (installer supplied)—Minimum



**Figure 2: Module mounting systems**

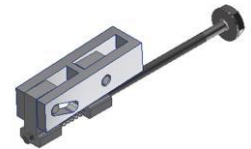
**Top mounting End and Mid clamp and Pro Series End and Mid clamp**—Mounts modules in landscape mode.

End Clamp

Legacy



Pro Series



Mid Clamp

Legacy



Pro Series



requirement of ASTM A53B Schedule 40 galvanized steel pipe in 2" or 3" diameter.

**Concrete** (installer supplied)—Rated for a minimum of 2,500 pounds per square inch.

## Planning the array prior to installation

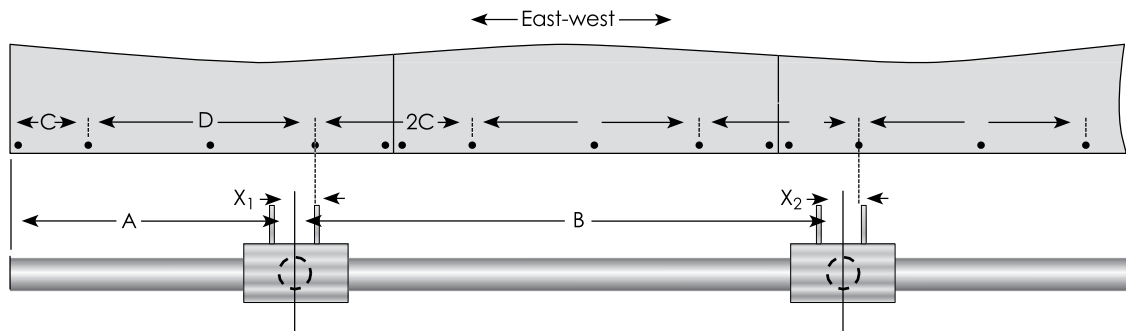
On a U-LA truss structure, leg caps, rail brackets, and cross pipe couplers must be offset from one another in the east-west direction. If you are using top mounting clamps, any conflicts among these components can be dealt with easily on site, so there is never the need to deviate from the average east/west leg spacing listed on your Specs Sheet. Go on to “Lay out and excavate leg positions,” below.

Make a scale drawing to identify potential component conflicts (see Fig. 3 or Fig. 4). If one occurs, use one or more of these solutions:

- Shift the position of conflicting pair of legs without exceeding maximum leg spacing listed on your Specs Sheet.
- Shift all cross pipes and rails relative to the legs without exceeding maximum cross pipe overhang listed on your Specs Sheet.

Cross pipe coupler conflicts and minor conflicts between leg caps and rail brackets, where offsets are near but not below the minimums listed in Figure 3 or 4, can be dealt with easily on site.

**Figure 3.**  
**Planning**  
**installs**  
**with bot-**  
**tom mount-**  
**ing clips**



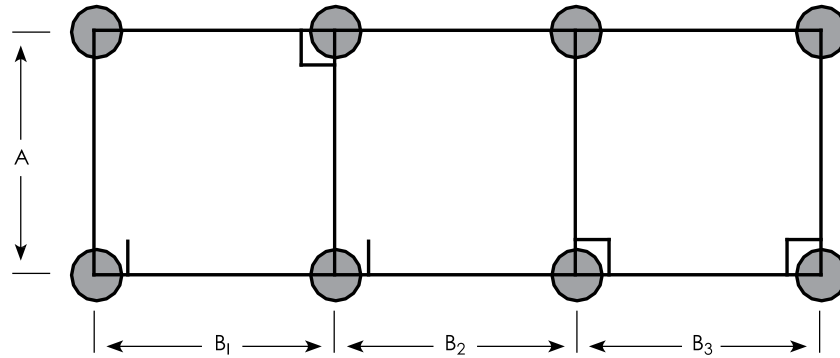
Create a dimensional drawing that lists overhang (A) and average leg spacing (B), which are listed under “Design Parameters” on page 2 of your Specs Sheet. Determine east-west offsets between vertical legs (dotted circles) to the module mounting holes you

intend to use. C and D depend on your specific modules. Determine your offsets ( $X_1$ ,  $X_2$ , etc.). If the offsets are less than the applicable minimum offset below, you will need to slightly shift leg positions. Be sure to keep within maximum allowable spacing.

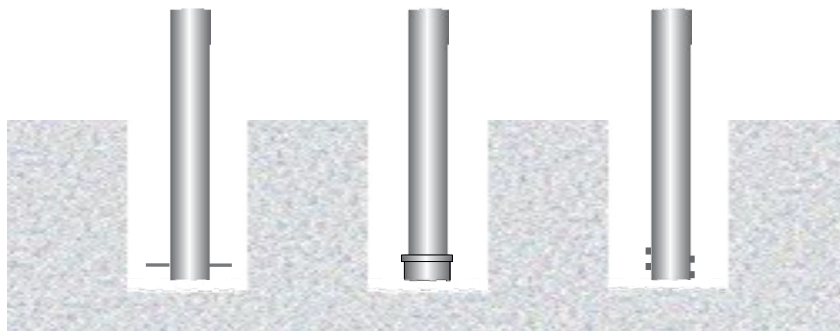
## Lay out and excavate leg positions

Once the grid of leg positions has been established, verify that all angles are square.

Dig leg holes to the "Footing diameter" and "Footing depth" listed on page 2 of your Specs Sheet. If you need to promote drainage, go a few inches deeper and fill the difference with gravel.



**Figure 5.** North-south leg spacing is fixed. East-west spacing ( $B_1$ ,  $B_2$ , etc.) is identical in most installations; see "Average leg spacing e-w" (Nominal Values under "Design Parameters") on page 2 of your Specs Sheet. However, if you needed to shift leg positions, follow the east-west spacing you set during your planning session.



**Figure 6.** A length of rebar, a threaded cap, or bolts must be installed at the foot of the vertical pipes to prevent withdrawal of the footing.

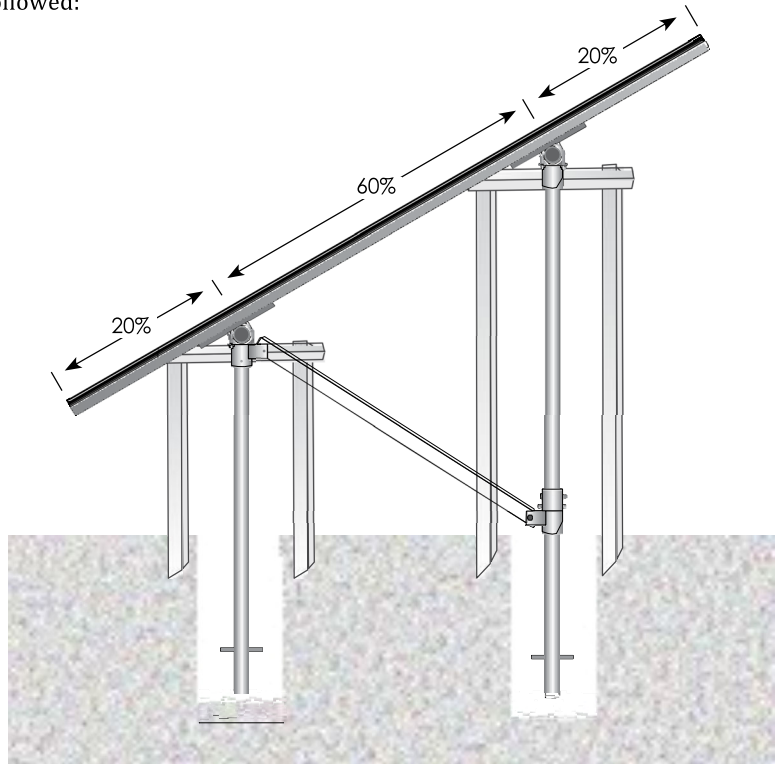


## Select an assembly sequence

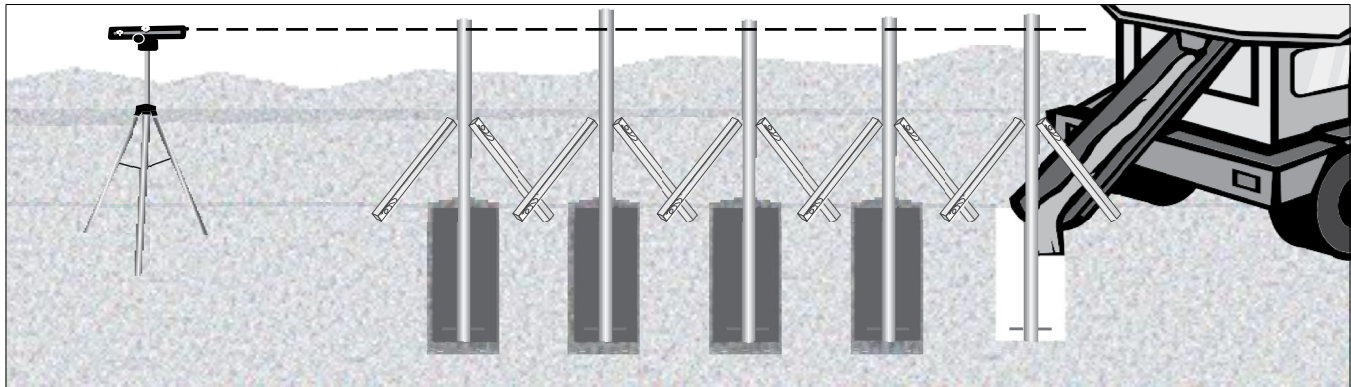
The assembly sequence depends on installer preference and the size of the installation. Either of these options may be followed:

- If a U-LA has just a few pairs of legs, installers may prefer to assemble the full truss structure prior to pouring concrete. Figure 7 details this approach.
- On the larger U-LA structures with many pairs of legs, installers may prefer to place the vertical leg pipes, pour the concrete, and let it cure overnight before proceeding. Figure 8 details this approach.

In either case, when mounting rails be sure to center them on the horizontal pipes, which will leave about 20 percent overhang on north and south sides.



**Figure 7. FULL-TRUSS OPTION.** Footing holes should extend below the frost line. You may elect to use a few inches of gravel at the base of the holes to promote drainage. Loosely assemble the full truss structure, using wood supports to stabilize vertical and horizontal pipes. When cross braces and rails are in place, square up the array and tighten fasteners. Pour concrete after array is fully assembled, save for the modules themselves. See page 8 of this manual for installation notes.



**Figure 8. LEGS-FIRST OPTION.** Footing holes should extend below the frost line. You may elect to use a few inches of gravel at the base of the holes to promote drainage. Using wood supports, level and square vertical leg pipes. Be certain that legs are precisely

aligned and that the front and back rows are parallel. Pour cement and allow to cure overnight before proceeding. Sighting with a laser level, transit, or string line, even the tops of the poles. See page 8 of this manual for installation notes.

## Installation notes

Regardless of your assembly procedure, review these notes prior to installation and keep them handy for reference on site.

### ***Shape concrete pillars for drainage***

Slope concrete away from the legs to promote drainage. This can be done above ground or slightly below the surface. ***Be sure footings extend below the frost line.***

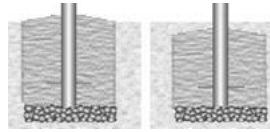


Figure 9. Drainage options.

### ***Don't forget your sliders!***

A forgotten or misplaced sliding truss anchor can result in extensive disassembly. To avoid this needless labor, be sure that all sliders are in place and correctly oriented.

### ***Rail assembly options for landscape mode***

All Unirac specified module mounting systems facilitate assembly of rails to the truss structure prior to mounting the PV modules.

### ***Recommended torques for fasteners***

- Set screws for leg caps and sliders: 15 foot-pounds.
- $\frac{3}{8}$ -inch serrated flange nuts for U-bolts and rail brackets: 8 foot-pounds.
- $\frac{1}{4}$ -inch module mounting hardware: 10 foot-pounds

### ***Pipe coupler positions***

Remember that cross pipe couplers need to be offset from both leg caps and rail brackets. As a general guideline, place pipe couplers one-quarter to one-third of the way between leg caps and roughly midway between rail brackets.

### ***Minor conflicts between leg caps and rail brackets***

Rail brackets, rails, and module mounts can go together in several ways. If a pair of rail brackets conflicts with leg cap positions, consult the table below. For top mounting clips, Figures 3 and 4 (pp. 4–5) illustrates the arrangements allowing the least offset between module mounting holes and leg pipe centers.

This racking system may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

#### Solutions to minor conflicts between leg caps and rail brackets

Module mounting style	Solutions (employ one or more as needed)
Top mounting clamps (landscape)	Shift rail toward the end of the module, reversing (if necessary) rail bracket and rail and moving them to the other side of the leg cap.

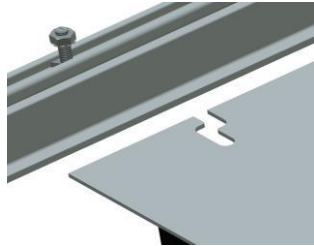
\*Rail brackets, rails, and module mounts can be configured in several ways. Figures 3 and 4 (pp. 4–5) illustrates the arrangement that permits the least offset between rail brackets and leg caps.



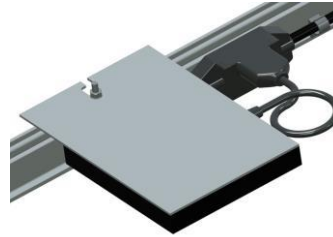
## Microinverter Mounting



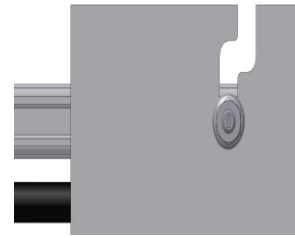
**INSTALL MICROINVERTER MOUNT T-BOLT:** Apply Anti-Seize and install pre-assembled 1/4" dia. bonding T-bolts into top 1/4" rail slot at microinverter locations. Rotate bolts into position.



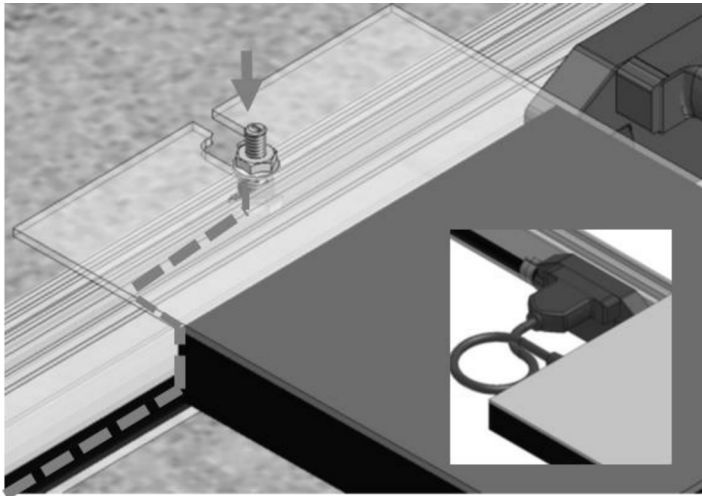
**INSTALL MICROINVERTER:** Install microinverter on to rail. Engage with bolt.



**INSTALL MICROINVERTER: TORQUE VALUE (See Note on PG. A)**  
1/4" nut to 10 ft-lbs w/Anti-Seize



**ALIGN POSITION INDICATOR:** Verify that position indicator on bolt is perpendicular to rail.



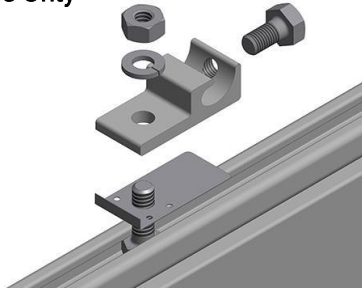
### SM EQUIPMENT GROUNDING THROUGH ENPHASE MICROINVERTERS

The Enphase M215 and M250 microinverters have integrated grounding capabilities built in. In this case, the DC circuit is isolated from the AC circuit, and the AC equipment grounding conductor (EGC) is built into the Enphase Engage integrated grounding (IG) cabling.

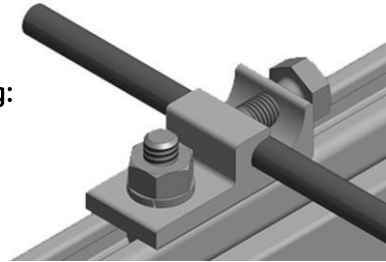
In order to ground the SOLARMOUNT racking system through the Enphase microinverter and Engage cable assembly, there must be a minimum of three PV modules connected to the same trunk cable within a continuous row. Continuous row is defined as a grouping of modules installed and bonded per the requirements of this installation guide sharing the same two rails. The microinverters are bonded to the SOLARMOUNT rail via the mounting hardware. Complete equipment grounding is achieved through the Enphase Engage cabling with integrated grounding (IG). No additional EGC grounding cables are required, as all fault current is carried to ground through the Engage cable.

## Standard System Grounding

### WEEBLUG Single Use Only



**TERMINAL TORQUE,  
Install Conductor and  
torque to the following:  
6-14 AWG: 5ft-lbs**



### WEEBLUG CONDUCTOR - UNIRAC P/N 008002S:

Apply Anti Seize and insert a bolt in the aluminum rail and through the clearance hole in the stainless steel flat washer. 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.

### ONLY ONE LUG PER ROW OF MODULES:

Only one lug per row of modules is required. See Page F for additional lugs required for expansion joint

**TORQUE VALUE 10 ft lbs. (See Note on PG. A)**

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

### GROUNDING LUG MOUNTING DETAILS:

Details are provided for both the WEEB and IlSCO products. The WEEBLug 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.

**Required if not using approved integrated grounding microinverters**

GROUNDING LUG - BOLT SIZE & DRILL SIZE		
GROUND LUG	BOLT SIZE	DRILL SIZE
WEEBLug	1/4"	N/A - Place in Top SM Rail Slot
ILSCO Lug	#10-32	7/32"
<ul style="list-style-type: none"> <li>Torque value depends on conductor size.</li> <li>See product data sheet for torque value.</li> </ul>		

### Star Washer is Single Use Only



**TERMINAL TORQUE,  
Install Conductor and  
torque to the following:  
4-6 AWG: 35in-lbs  
8 AWG: 25 in-lbs  
10-14 AWG: 20 in-lbs**

**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 Note on PG. A)**

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

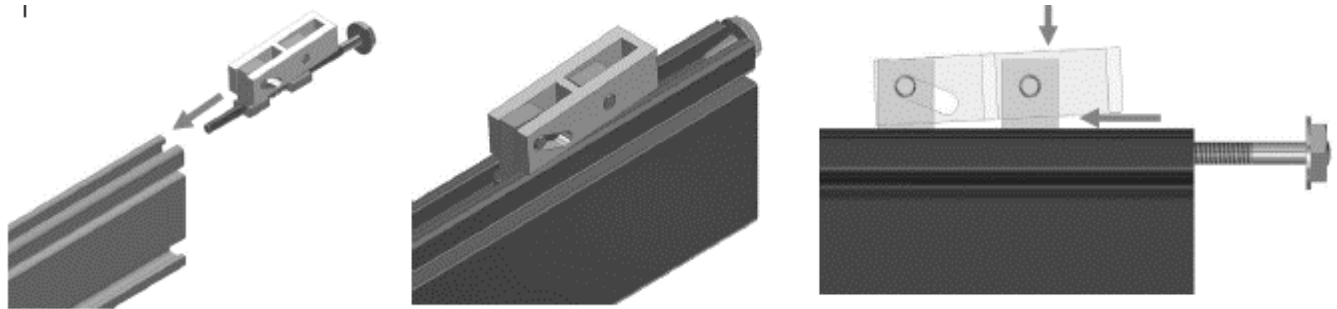
### GROUNDING NOTES

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

### ELECTRICAL CONSIDERATIONS

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

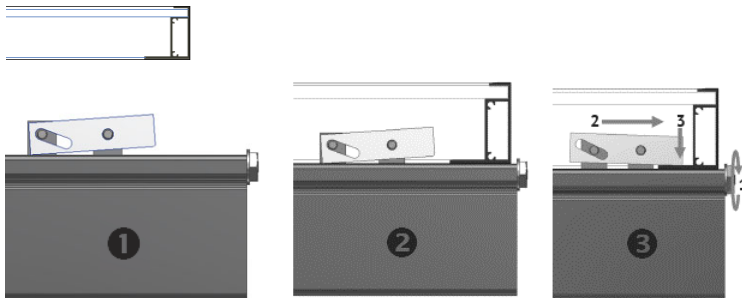
## Pro Series: Endclamp, First Module & Trim



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

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

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



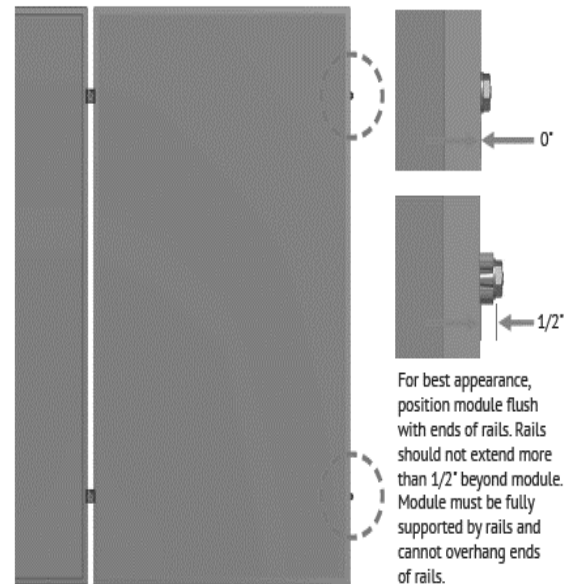
**INSTALL FIRST MODULE:** Install the first module onto rails with the flange of the module frame positioned between end clamps an ends of rails.

**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.

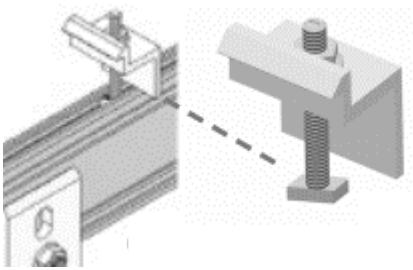
**To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.**

**TORQUE VALUE** (See table and notes on PG. 1)

**End clamp bolt to 3 ft-lbs, No anti-seize**

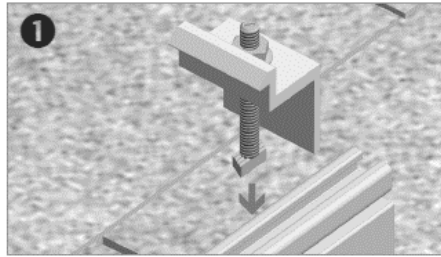


## Legacy: Endclamp, First Module & Trim

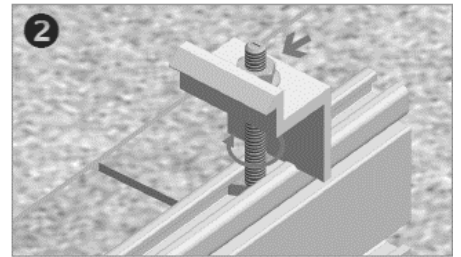


### INSTALL MODULE ENDCLAMPS:

The Endclamp is supplied as an assembly with a T-bolt, serrated flange nut, and washer. The washer retains the clamp at the top of the assembly. This will enable the clamp to remain upright for module installation.

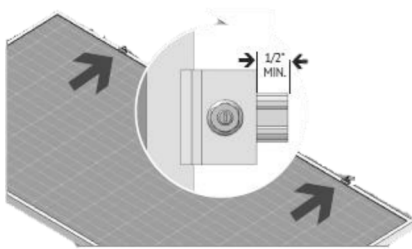


**INSERT ENDCLAMP T-BOLT:** Insert 1/4" T-bolt into rail.



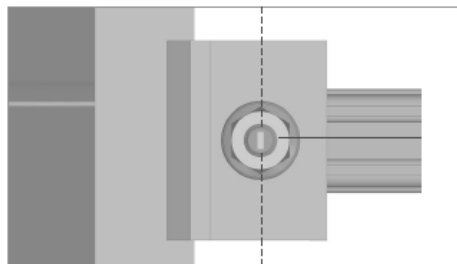
**ROTATE ENDCLAMP T-BOLT:** Rotate T-bolt into position. Verify that the position indicator & T-bolt shaft are angled in the correct position.

**End clamps are positioned on rails prior to the first end module and installed after the last end module.**

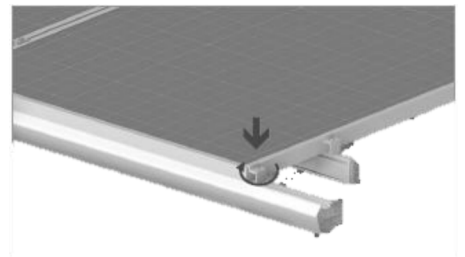


**INSTALL FIRST MODULE:** Install the first end module onto rails. Engage module frame with Endclamps. Verify that the position indicator & T-bolt shaft are angled in the correct position.

**TORQUE VALUE (See Note on PG. A) 1/4" nuts to 10 ft-lbs. w/Anti Seize**



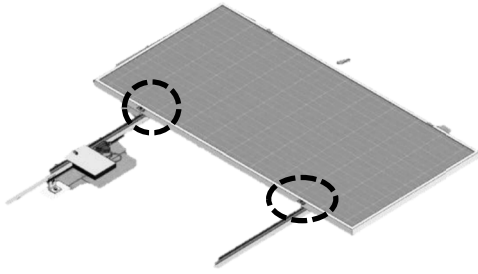
**POSITION INDICATOR - SERRATED T-BOLT:** Verify the T-bolt position indicator is perpendicular to the rail.



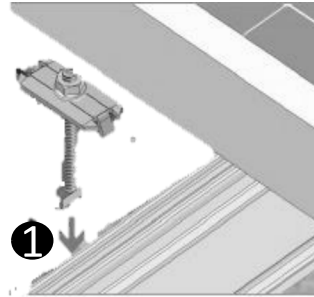
### TRIM INSTALLATION INSTRUCTIONS

**TRIM ENDCLAMPS:** Install Endclamps on Trim in like manner to module endclamps per install instructions above.  
**TORQUE VALUE (See Note on PG. 1) 1/4" nuts to 10 ft-lbs w/ Anti Seize**

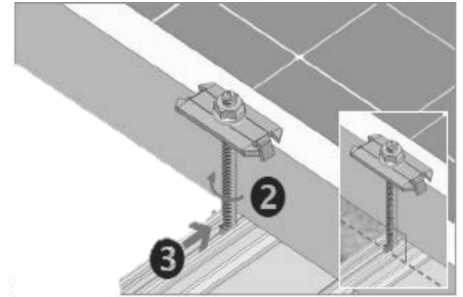
## Legacy: Bonding Midclamp & Trim



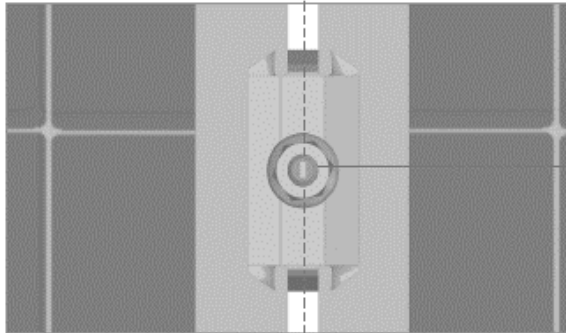
**INSTALL MIDCLAMPS:** Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



**INSERT MIDCLAMP T-BOLT:** Apply Anti-Seize and insert 1/4" T-bolt into rail.

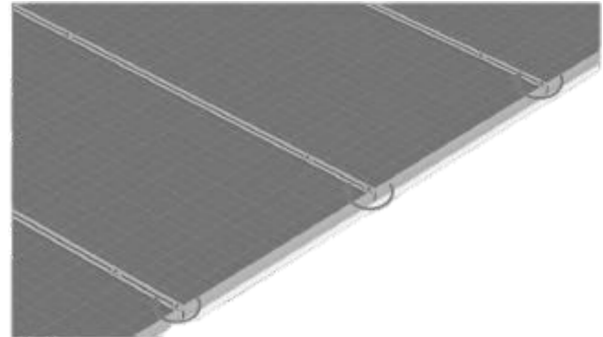


**ROTATE MIDCLAMP T-BOLT:** Rotate bolt into position and slide until bolt and clamp are against module frame. Do not tighten nut until next module is in position. Verify that the position indicator & T-bolt shaft are angled in the correct position.



**POSITION INDICATOR - SERRATED T-BOLT:** Verify the T-bolt position indicator is perpendicular to the rail.

### TRIM INSTALLATION INSTRUCTIONS

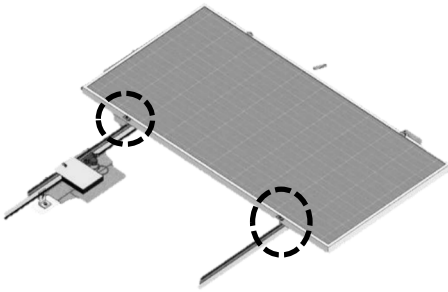


**TRIM MIDCLAMPS:** Ensure Trim lip is in contact with module face and verify alignment marks on T-bolts are in proper position, tighten midclamp on Trim, repeat at each gap between modules.

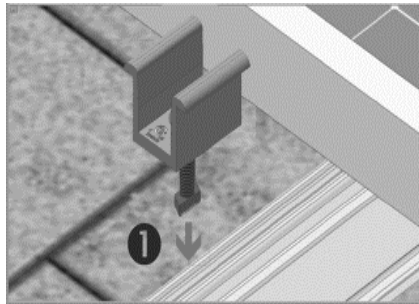
**TORQUE VALUE (See Note on PG. 1)**  
1/4" nuts to 10 ft-lbs w/ Anti Seize



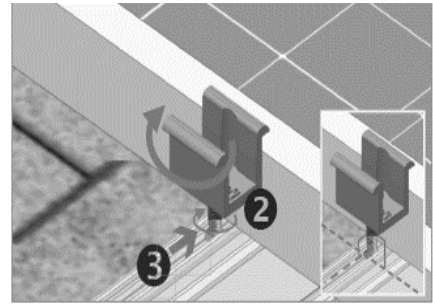
## Pro Series: Bonding Midclamp & Trim



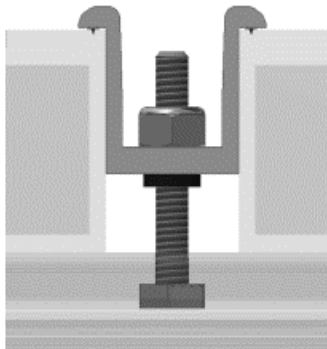
**INSTALL MIDCLAMPS:** Midclamp is supplied as an assembly with a T-bolt for module installation. Clamp assemblies may be positioned in rail near point of use prior to module placement.



**INSERT MIDCLAMP ASSEMBLY:** Insert 1/4" T-Bolt into top slot of rail



**MIDCLAMP:** Rotate midclamp assembly and slide until clamp is against module frame. Do not tighten nut until next module is in position. Ensure bolt is perpendicular to rail.

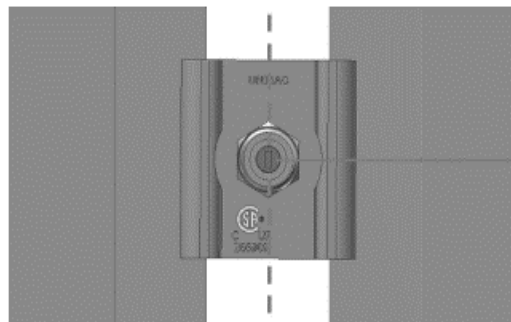


### PLACE ADJACENT MODULE AGAINST CLAMPS:

Modules must be tight against clamps with no gaps.  
Tighten nut to required torque.

**TORQUE VALUE** (See table and notes on PG. A)

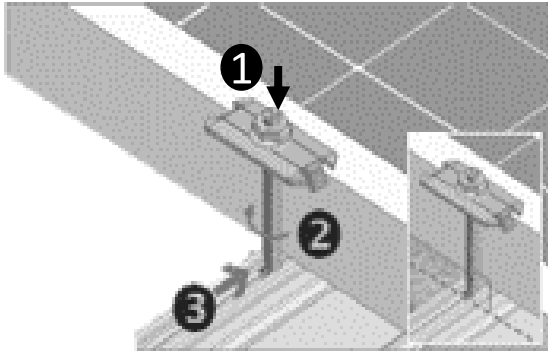
**11 ft-lbs. No anti-seize.**



### POSITION INDICATOR - SERRATED T-BOLT:

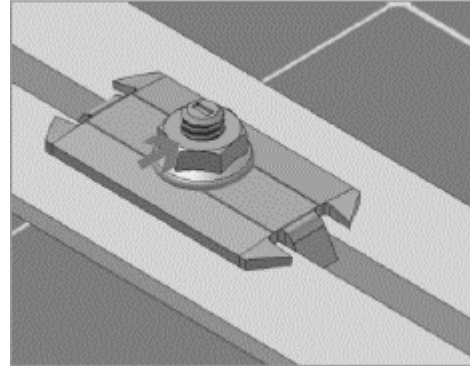
Verify the T-bolt position indicator is perpendicular to the rail.

## Legacy: Remaining Modules



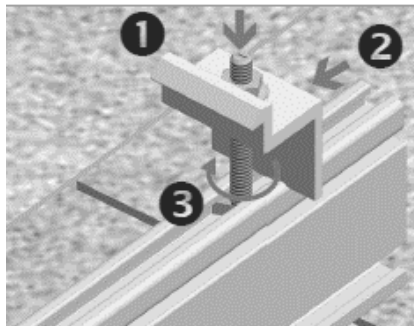
**INSTALL REMAINING MID-CLAMPS:** Proceed with module installation. Engage each module with previously positioned Midclamp assemblies.

**NOTE:** Apply Anti-Seize to each Mid Clamp prior to installation.



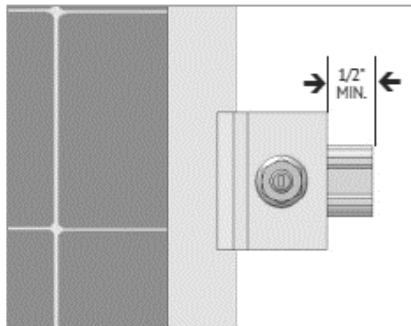
**POSITION T-BOLT ALIGNMENT MARKS:** Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position.

**TORQUE VALUE (See Note on PG. A)**  
1/4" nuts to 10 ft-lbs. w/Anti Seize



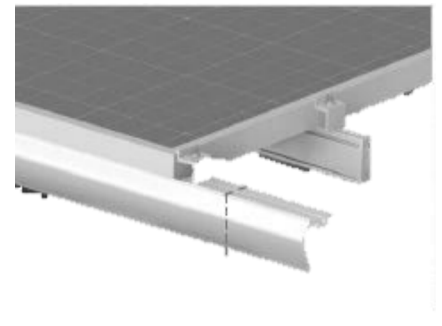
**INSTALL ENDCLAMPS:** Apply Anti-Seize and install final Endclamps in same manner as first Endclamps. Slide clamps against module.

**TORQUE VALUE (See Note on PG. A)**  
1/4" nuts to 10 ft-lbs. w/Anti Seize



**POSITION T-BOLT ALIGNMENT MARKS & CUT RAIL:** Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Trim off any excess rail, being careful not to cut into the roof. Allow 1/2" between the Endclamp and the end of the rail.

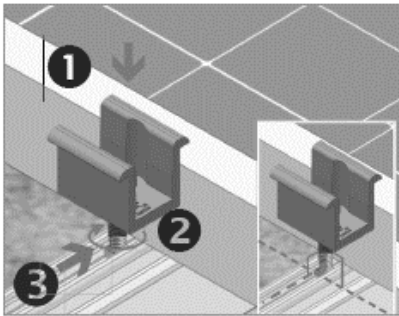
### TRIM INSTALLATION INSTRUCTIONS



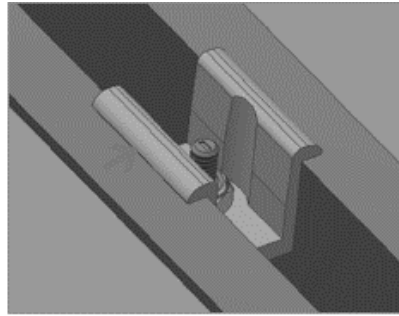
**FINISH TRIM INSTALLATION, INSTALL ENDCLAMP & CUT EXCESS RAIL:** Install final endclamp & Cut away excess Trim at end of array or where required for proper cantilevers. See D&E Guide or U-Builder for allowable cantilevers.

**TORQUE VALUE (See Note on PG. 1)**  
1/4" nuts to 10 ft-lbs w/ Anti Seize

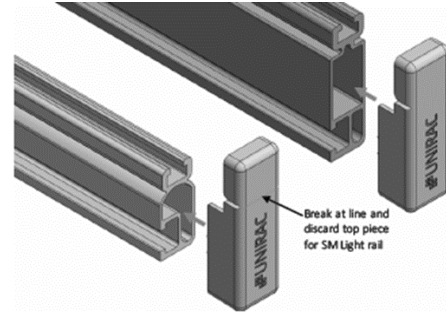
## Pro Series: Remaining Modules



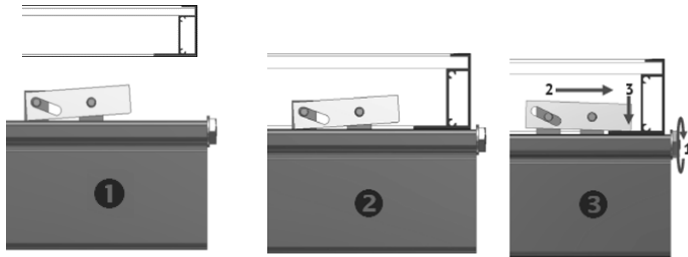
**INSTALL REMAINING MID-CLAMPS:**  
Proceed with module installation.  
Engage each module with previously positioned Midclamp assemblies.



**POSITION T-BOLT ALIGNMENT MARKS:**  
Verify that the position indicator(s) & T-bolt shaft(s) are angled in the correct position. Tighten to final torque.  
**TORQUE VALUE** (See table and notes on PG. A) 11 ft-lbs. No anti-seize.



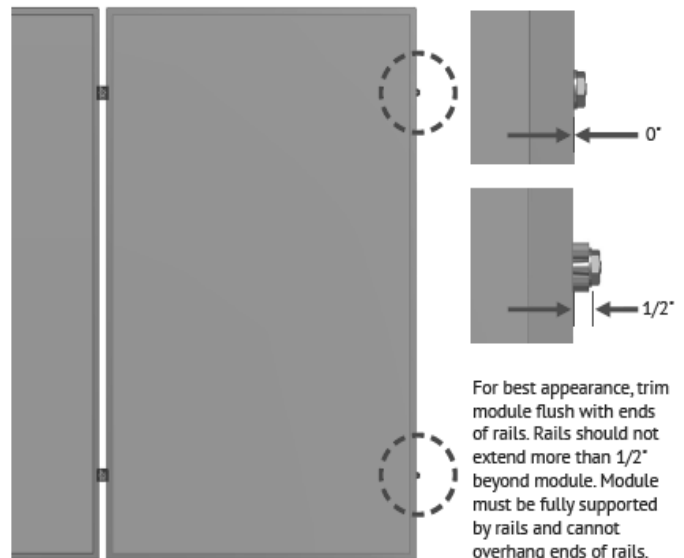
**INSTALL END CAPS:** End caps install as supplied on SM standard rail and SM light rail. If desired for SM light rail, the end cap may be modified as shown by hand, or by using a cutting tool.



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

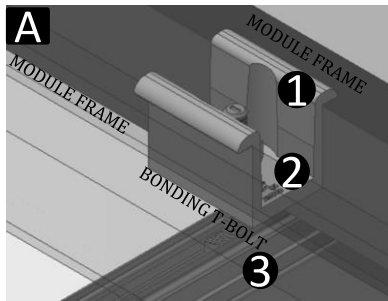
**ENGAGE CLAMP:** While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.  
**To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact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

**TORQUE VALUE** (See table and notes on PG. 1)  
End clamp bolt to 3 ft-lbs, No anti-seize



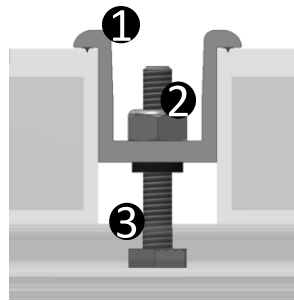


## Pro Series: Bonding Connection Ground Paths



**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 anodization to bond T-bolt, nut, clamp, and modules to SM rail

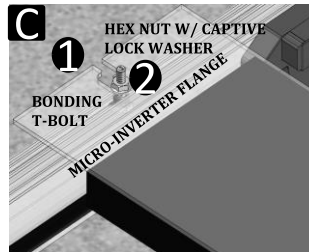
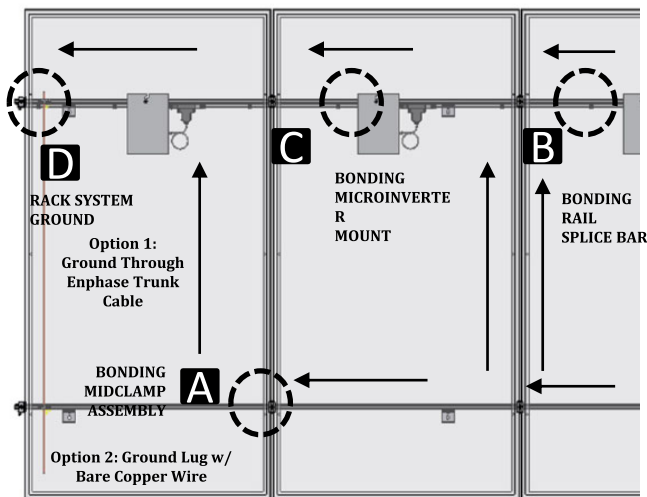


**BONDING RAIL SPLICE BAR**

- 1** Stainless steel self drilling screws drill and tap into splice bar and rail creating bond between splice bar and each rail section
- 2** Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

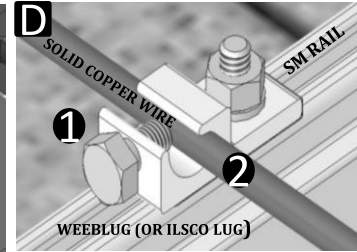
**Note:** Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.

**Note:**  
Only one lug per module row required



**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 anodization to bond T-bolt, nut, and L-foot to grounded SM rail. **System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page I for details**



**RACK SYSTEM GROUND**

- 1** WEEB washer dimples pierce anodized 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. See page I-3 for details**

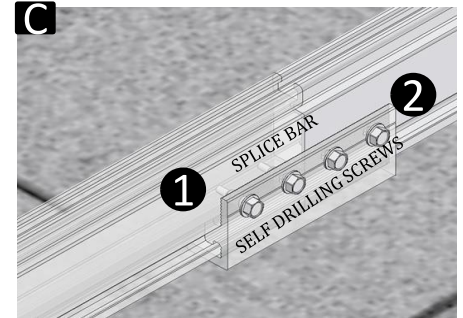
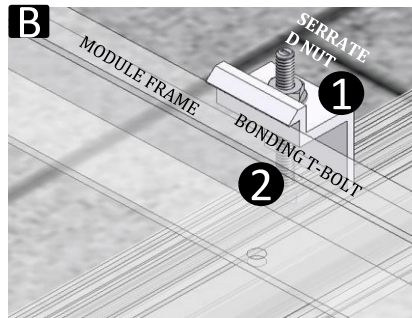
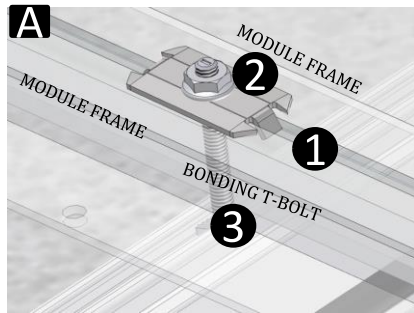
### GROUNDING NOTES

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

### ELECTRICAL CONSIDERATIONS

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

## Legacy: Bonding Connection Ground Paths



- 1 Stainless steel Midclamp points, 2 per module, pierce module frame anodization to bond module to module through clamp.
- 2 Serrated flange nut bonds stainless steel clamp to stainless steel T-bolt
- 3 Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to grounded SM rail.

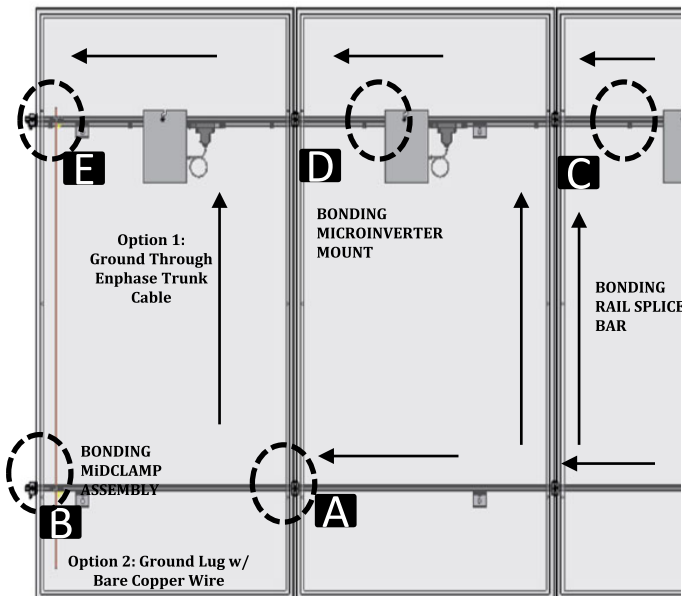
- 1 Serrated flange nut bonds aluminum Endclamp to stainless steel T-bolt
- 2 Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and Endclamp to grounded SM rail

**Note: End clamp does not bond to module frame.**

- 1 Stainless steel self drilling screws drill and tap into splice bar and rail creating bond between splice bar and each rail section
- 2 Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

**Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.**

**Note:**  
Only one lug per module row required

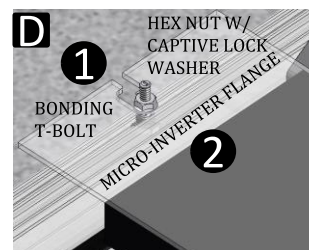


### GROUNDING NOTES

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

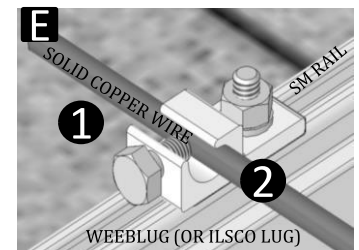
### ELECTRICAL CONSIDERATIONS

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



### 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 anodization to bond T-bolt, nut, and L-foot to grounded SM rail
- System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page I for details**



### RACK SYSTEM GROUND

- 1 WEEB washer dimples pierce anodized 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. See page I-3 for details**

## Appendix A

The SOLARMOUNT 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 included 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.

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:

- 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
- UL2703 Certification Load Ratings:
  - Down – 113.4 PSF , Up – 50.4 PSF , Down-Slope – 14.7 PSF
- Tested Loads:
  - Down – 170.10 PSF , Up – 75.60 PSF, Down-Slope – 22.05 PSF
- Maximum Area of Module = 21.06 sqft

Tested Modules	
Module Manufacturer	Model/Series
Hyundai	HiS-S325TI

Manufacturer	Series/Model		
Aleo	P18, P19, S18, S59, S79	LG Electronics	*Mono Neon, Mono X, NeON 2 LGxxxN2W-G4, NeON LGxxxN2W-B3, NeON LGxxxS1C-G4, Mono X LGxxxS2W-G4, Mono X Plus LGxxxS1C-A5, NeON 2 LGxxxN1C-A5 NeON R LGxxxQ1C(Q1K)-A5 NeON 2 LGxxxN1C(N1K)-A5 NeON 2 Bifacial LGxxxN2T-A5 NeON 2 LGxxxN2W-A5 Mono X Plus LGxxxS2W-A5 NeON 2 ACe LGxxxE1C-A5 NeON 2 LGxxxN1C(N1K)-G4 *
AU Optronics (BenQ Solar)	PM Series	Mission Solar	MSE Mono 60, MSE Mono 72 MSE PERC 60, MSE PERC 72
Canadian Solar	CS5A-M, CS6P-M, CS6P-P, CS6X-P, CSX-P, ELPS CS6P-MM, ELPS CS6A-MM, CS6U-P, CS6U-M, CS6K-MS, CS6K-M, CS6K-P, CS3U-P, CS3U-MS, CS3K-P, CS3K-MS, CS1K-MS	Mitsubishi	MJE, MLE, NSP
Centrosolar America	C-Series, E-Series	Panasonic	VBHNxxxSA06, VBHNxxxSA06B, VBHNxxxSA11, VBHNxxxSA11B, VBHNxxxSA15, VBHNxxxSA15B, VBHNxxxSA16, VBHNxxxSA16B, VBHNxxxKA, VBHNxxx SA17/18/ KA03/04
CertainTeed	CTxxxMxx-01, CTxxxP01, CTxxxMxx02	Phono Solar Technology	All Standard Modules
Eco Solargy	Orion 1000, Apollo 1000	Q-Cells	Q.PEAK-G3.1 XXX, Q.PEAK BLK-G3.1 XXX, Q.PLUS BFR G3.1 XXX, Q.PLUS-G3 XXX, Q.PRO G3 XXX, Q.PRO BFR-G3 XXX, Q.PEAK-G3 XXX, Q.PEAK BLK-G3 XXX, Q.PLUS BFR G4.1 XXX, Q.PRO BFR G4 XXX, Q.PRO BFR G4.1 XXX, Q.PRO BFR G4.3 XXX, Q.PEAK-G4.1 XXX, Q.PEAK-G4.1/MAX XXX, Q.PEAK BLK G4.1 XXX, Q.PRO G4 XXX, Q.PLUS G4 XXX, Q.PEAK-G4.1/TAA XXX, Q.PEAK BLK G4.1/TAA XXX, Q.PLUS BFR G4.1/TAA XXX, Q.PLUS BFR G4.1/MAX XXX, B.LINE PLUS BFR G4.1 XXX, B.LINE PRO BFR G4.1 XXX, Q.PRO EC-G4.4 XXX, Q.PRO L-G2 XXX, Q.PEAK L G4.2 XXX, Q.PLUS L G4.2 XXX, Q.PLUS L G4.1 XXX, Q.PLUS L G4 XXX, Q.PRO L G4 XXX, Q.PRO L G4.1 XXX, Q.PRO L G4.2 XXX, B.LINE PLUS L G4.2 XXX, B.LINE PRO L G4.1 XXX, B.LINE PRO L G4.2 XXX, Q.PLUS L-G4.2/TAA
ET Solar	ET AC Module, ET Module		
Flextronics	FXS		
Hanwha SolarOne	HSL 60		
Heliene	72M, 72P, 72M-BLK, 60M, 60P, 60M-BLK, 36M, 36P		
Hyundai Heavy Industries	MG, RW, RG, KG, TG Series		
Hyundai Heavy Industries	KI, TI, RI Series		
ITEK	IT HE and IT SE		
JA Solar	*JAP6(k)-72-xxx/4BB; JAP725YY-xxx/ZZ; JAP6(k)-60-xxx/4BB; JAP605YY-xxx/ZZ JAM6(k)-72-xxx/ZZ; JAM725YY-xxx/ZZ; JAM6(k)-60-xxx/ZZ; JAM605YY-xxx/ZZ YY = Backsheet, ZZ Cell technology*		
Jinko 60 Cell	Jinko 60: JKMxxxP-60, Jinko Eagle 60: JKMxxxPP-60, Jinko Eagle MX60: JKMSxxxPP-60, Jinko MX60: JKMSxxxP-60, Jinko Black 60: JKMxxxPP-60B Jinko 60: JKMxxxPP-60		
Jinko 72 Cell	Jinko 72: JKMxxxP-72, Jinko Eagle 72: JKMxxxPP-72, Jinko Eagle MX72: JKMxxxPP-72		
Kyocera	KD-F Series, KU-60 Series, KU2XX-6MCA		

Manufacturer	Series/Model
REC	TwinPeak 72 45mm Peak Energy 72 45mm Peak Energy 38mm TwinPeak (2) (BLK2) - 38mm TwinPeak2S 72 Series - RECxxxTP2S 72 30mm
Renesola	All 60-cell modules
Seraphim	SEG-6PA, SEG-6PB, SEG-6MA, SEG-E01, SEG-E11, SRP-6QA, SRP-6QB (40mm only)
Sharp	ND240QCJ, ND240QCS, NDQ235F4
Silfab	SLAXXXM, SLAXXXP, SLGXXXP, SLGXXXM
Solartech	STU-XXX HIT, b. STU-XXX PERC, Quantum PERC
SolarWorld	SunModule Protect, SunModule Plus, SunModule Pro
Sun Edison / MEMC	F-Series, R-Series
Suniva	MV Series, OPTIMUS Series
SunPower	AC, E-Series, Sig Black, X-Series P-Series
Suntech	STP *XXX*
Talesun	TP672, TP660, TP654, TP572, TP596, Hipor M350, Smart
Trina	PD05, PA05, DD05, DD14, PE14, PD14, DE14
TSMC Solar	TS-150C2 CIGS
Winaico	WST, WSP
Yingli	Panda 60, YGE 60, YGE-Z 60 YGE-U72

## System Markings



UL2703 CERTIFICATION MARKING LABEL Unirac ULA is listed to UL 2703. Marking Labels are shipped with the Midclamps. After the racking system is fully assembled, a single Marking Label should be applied to the rail at the edge of the array. Before applying the label, the corners of the label that do not pertain to the system being installed must be removed so that only the installed system type is showing. Note: The sticker label should be placed such that it is visible, but not outward facing.

## Periodic Inspection

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

## UL 2703 Mechanical Load Test Ratings

### Pro-Series Clamps

Downward Design Load (lb/ft <sup>2</sup> )	113.4
Upward Design Load (lb/ft <sup>2</sup> )	50.4
Down-Slope Design Load (lb/ft <sup>2</sup> )	14.7

### Legacy Top-Down Clamps

Downward Design Load (lb/ft <sup>2</sup> )	112
Upward Design Load (lb/ft <sup>2</sup> )	50
Down-Slope Design Load (lb/ft <sup>2</sup> )	10