

N 89°53'54" E 1327.42'(M)  
N 89°53'54" E 1328.45'(D)

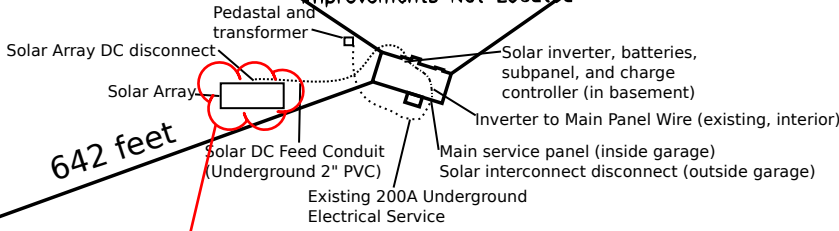
N 00°40'07" E 660.59'(M)  
N 00°46'24" E 661.10'(D)

NW Corner N 1/2 SE 1/4  
Found Monument LS 25955  
Fence Corner Is 0.57' South  
& 1.20' West of Property Corner.



N 1/2 NW 1/4 SE 1/4

Improvements Not Located



642 feet

743 feet

779 feet

NE Corner  
Set Monur  
Found Bol  
0.08' West  
Fence Cor  
of Propert

Released for Permit  
10/11/2019 8:11:17 AM  
Regional Building Department  
shelley  
CONSTRUCTION

SE Corner N 1  
Set Pin & Cap  
Found 3/4" p  
& 1.43' West

S 89°55'47" W 1329.85'(D) DEPICT DRIVEWAY FROM  
S 89°53'26" W 1329.30'(M) FLAG PORTION OF PARCEL

SW Corner N 1/2 SE 1/4  
Set Pln & Cap LS 25629  
Found 3/4" pipe 0.39' South &  
& 0.61' West of Property Corner.  
Fence Corner Is 3.20' North  
& 1.77' West of Property Corner.

DISAPPROVED  
Plan Review

10/11/2019 4:33:48 PM  
dsdespinoza

EPC Planning & Community  
Development Department

PROVIDE DIMENSIONS (WxLxH) OF  
GROUND MOUNT PV SOLAR ARRAY AND  
SETBACK MEASUREMENTS TO FRONT,  
WEST SIDE, AND REAR LOT LINES.

East Line of 1  
West 1/2 Sou

Found #5 Rebar

Found Square Sp  
Fence Post Encl

R121563  
ADD19685

TSN: 5208000031

OWNER: MOORE, JOSHUA  
LOCATION: 7480 SHOUP RD  
ZONING: RR-5 AREA: 21.67 Acres

Set Pln & Cap LS 25629

LEGAL: TRACT IN N2NW4SE4 SEC 8-12-65 AS FOLS, BEG AT  
CEN OF SEC 8, TH ELY ALG E-W C/L OF SD SEC 1328.45 FT,  
ANG R 90<45'10" SLY 661.79 FT, ANG R 89<16'43" WLY 1329.85 FT  
TO PT ON N-S C/L OF SD SEC, TH ANG R 90<50'37" NLY ALG SD  
LN 661.1 FT TO POB, TRACT IN W2SE4 SEC 8-12-65 AS FOLS, BEG  
AT S4 COR OF SEC 8, TH ELY ON S LN OF SD SEC 1102.17 FT, ANG  
L 89<22'15" 30 FT FOR POB, TH CONT ON SAME COURSE NLY  
417.4 FT, ANG R 89<22'15" ELY 201.8 FT, ANG L 89<22'15" NLY  
1537.98 FT, ANG R 89<16'43" ELY 30 FT, ANG R 90<43'17" SLY  
ALG E LN OF W2SE4 1567.98 FT, ANG R 89<22'15" WLY 201.8 FT,  
ANG L 89<22'15" SLY 387.4 FT TO PT 30 FT NLY OF S LN OF SEC 8,  
TH ANG R 89<22'15" WLY 30 FT TO POB, TOG WITH R/WS FOR RD  
AS DES BY BK 2825-639, BK 2825-320

Set Pln & Cap LS 25629  
Found 3/4" pipe 0.47' South &  
0.82' West of Property Corner.

Set Monument  
Found Square  
Fence Corner

Fence Corner is

Set Pin & Cap I  
Found 1" Angle  
0.73' West of P

Set Pln & Cap LS 25629  
Found Williams P & C 0.75' North &  
0.92' West of Property Corner.

201.80'(D)(M)  
N 89°51'10" E (D)(M)

S 89°51'10" W 201.80'(D)  
S 89°51'28" W 202.55'(M)

Set Pln & Cap LS 25629  
Fence Corner is 1.95' North &  
3.81' East of Property Corner.

Set Pln & Cap LS 25629  
Found Williams P & C 3.34' West  
of Property Corner.

East Line of  
West 1/2 Sou

N 00°28'55" W 30.00'(D)(M)

N 89°51'10" E 1102.17'(D)(M)

417.40'(D)(M)  
N 00°28'55" E (D)(M)

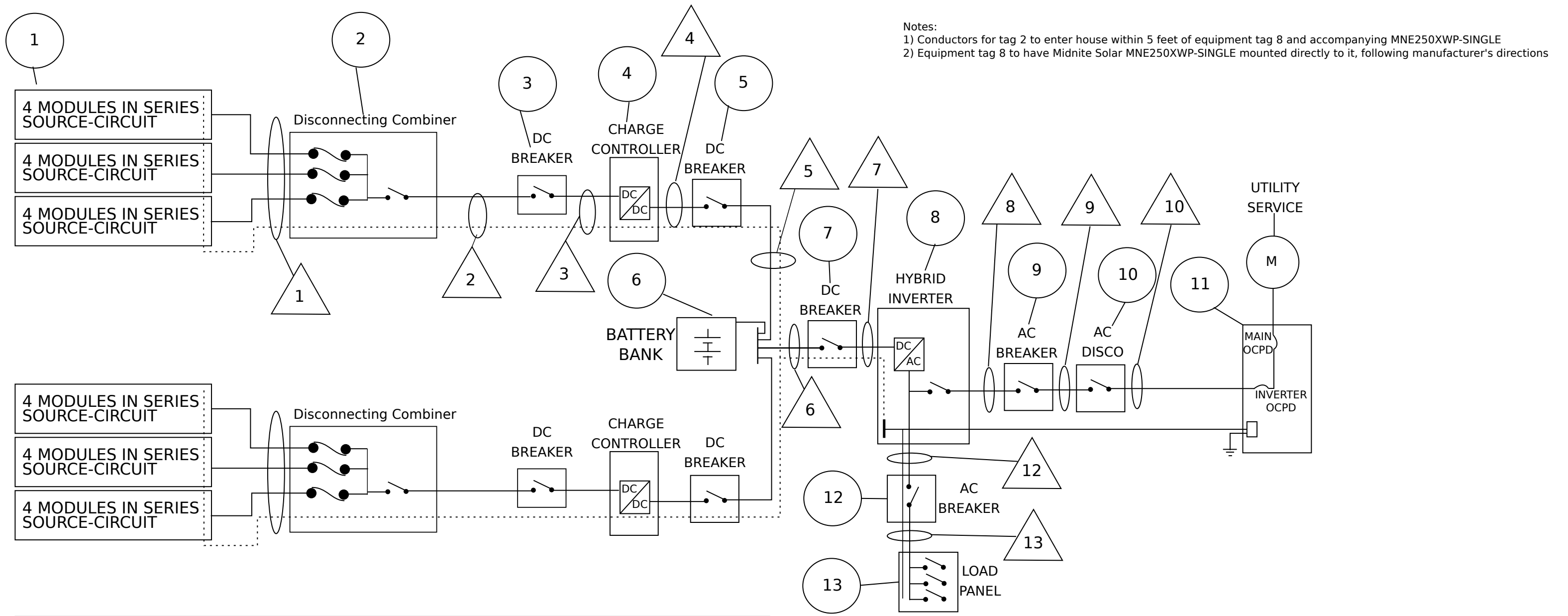
S 00°28'55" W 387.40'(D)  
S 00°29'02" W 387.39'(M)

S 89°40'59" W 30.00'

SHOUP ROAD

South 1/4 Corner Section 8  
T 12 S, R 65 W, 6th P.M.,  
El Paso County, Co. Found  
Monument LS 22095 per records  
on file.

Set Pin & Cap LS 25629  
Found #5 Rebar 3.58' West of Pr  
Fence Corner is 0.62' South &  
2.12 West of Property Corner.



Notes:  
 1) Conductors for tag 2 to enter house within 5 feet of equipment tag 8 and accompanying MNE250XWP-SINGLE  
 2) Equipment tag 8 to have Midnite Solar MNE250XWP-SINGLE mounted directly to it, following manufacturer's directions

Conduit and Conductor Schedule						
Tag	Description or Conductor Type	Cond Gauge	No. of Cond.	Conduit Type	Conduit Size	Max Circuit Voltage
1	PV Wire Bare Copper EQ Grd. Cond.	12 12	2 1	NA NA	NA NA	250 VDC
2	THWN-2 Note: Conduit shared between arrays)	8	2	Sched. 40 PVC	2"	250 VDC
3	THWN-2	8	2	NA	NA	250 VDC
4	THWN-2	4	2	NA	NA	48 VDC
5	THWN-2	4	2	NA	NA	48 VDC
6	THHN-2	4/0	2	NA	NA	48 VDC
7	Part of Midnite Solar MNE250XWP-SINGLE		2	NA	NA	48 VDC
8	Part of Midnite Solar MNE250XWP-SINGLE		2	NA	NA	120/240 VAC
9	2-2-2-4 Al Ser (existing)	2	3	NA	NA	120/240 VAC
10	THHN-3	6	3	NA	NA	120/240 VAC
11	THHN-3	6	3	NA	NA	120/240 VAC
12	Part of Midnite Solar MNE250XWP-SINGLE		3	NA	NA	120/240 VAC
13	THHN-3	6	3	NA	NA	120/240 VAC

Equipment Schedule		
Tag	Part Number	Notes
1	REC REC310PE72	
2	Midnite Solar MNPV6-DISCO, 3x MNEPV15-300	
3	Midnite Solar MNEPV50-300 In MNE250XWP-SINGLE	
4	Midnite Solar Classic 250	
5	Midnite Solar MNEDC70 In MNE250XWP-SINGLE	
6	4x 12V 200Ah SLA Batteries	Batteries in series to form 48V pack
7	Midnite Solar MNEDC250 In MNE250XWP-SINGLE	
8	Schneider Electric XW+ 6848 NA	
9	Midnite Solar MNEAC50-2P In MNE250XWP-SINGLE	
10	Square D DU221RB	
11	Cutler Hammer CHSUR42B200L2	Existing Equipment, 220VAC, 200A Main, 200A Bus, 60A Inverter OCPD
12	Midnite Solar MNEAC50-2P In MNE250XWP-SINGLE	
13	Cutler Hammer CH32L225D	Existing Equipment, 220VAC, 60A

# Conext XW+ series (120/240 V)

Device short name	XW+ 5548 NA	XW+ 6848 NA
<b>Inverter AC output (standalone)</b>		
Output power (continuous) at 25°C	5500 W	6800 W
Overload 30 min/60 sec at 25°C	7000 W/9500 W	8500 W/12000 W
Output power (continuous) at 40°C	4500 W	6000 W
Maximum output current 60 seconds (rms)	82 A (120 V); 41 A (240 V)	102 A (120 V); 52 A (240 V)
Output frequency (selectable)	50/60 Hz	50/60 Hz
Output voltage	L-N: 120 V +/- 3%; L-L: 240 V +/- 3%	L-N: 120 V +/- 3%; L-L: 240 V +/- 3%
Total harmonic distortion at rated power	< 5 %	< 5 %
Idle consumption search mode	< 8 W	< 8 W
Input DC voltage range	42 to 60 V (48 V nominal)	42 to 60 V (48 V nominal)
Maximum input DC current	150 A	180 A
<b>Charger DC output</b>		
Maximum output charge current	110 A	140 A
Output charge voltage range	40 – 64 V (48 V nominal)	40 – 64 V (48 V nominal)
Charge control	Three stage, two stage, boost, custom	Three stage, two stage, boost, custom
Charge temperature compensation	Battery temperature sensor included	Battery temperature sensor included
Power factor corrected charging	0.98	0.98
Compatible battery types	Flooded (default), Gel, AGM, Lithium ion, custom*	Flooded (default), Gel, AGM, Lithium ion, custom*
Battery bank range (scaled to PV array size)	440 – 10000 Ah	440 – 10000 Ah
<b>AC input</b>		
AC 1 (grid) input current (selectable limit)	3 – 60 A (60 A default)	3 – 60 A (60 A default)
AC 2 (generator) input current (selectable limit)	3 – 60 A (60 A default)	3 – 60 A (60 A default)
Automatic transfer relay rating/typical transfer time	60 A/8 ms	60 A/8 ms
AC input voltage limits (bypass/charge mode)	L-N: 78 - 140 V (120 V nominal); L-L: 160 - 270 V (240 V nominal)	L-N: 78 - 140 V (120 V nominal); L-L: 160 - 270 V (240 V nominal)
AC input frequency range (bypass/charge mode)	55 – 65 Hz (default) 52 – 68 Hz (allowable)	55 – 65 Hz (default) 52 – 68 Hz (allowable)
<b>AC grid-tie output</b>		
Grid sell current range on AC1(selectable limit)	0 to 40 A (120 V) / 0 to 20 A (240 V)	0 to 48 A (120 V) / 0 to 27 A (240 V)
Grid sell voltage range on AC1 (auto adjusts entering sell mode)	L-N: 105.5 to 132 +/- 1.5 V; L-L: 211 to 264 +/- 3.0 V	L-N: 105.5 to 132 +/- 1.5 V; L-L: 211 to 264 +/- 3.0 V
Grid sell frequency range on AC1 (auto adjust entering sell mode)	59.4 to 60.4 +/- 0.05 Hz	59.4 to 60.4 +/- 0.05 Hz
<b>Efficiency</b>		
Peak	95.7%	95.7%
CEC weighted efficiency	93.0%	92.5%
<b>General specifications</b>		
Part number	865-5548-01	865-6848-01
Product/shipping weight	53.5 kg (118.0 lb)/75.0 kg (165.0 lb)	55.2 kg (121.7 lb)/76.7 kg (169.0 lb)
Product dimensions (H x W x D)	58 x 41 x 23 cm (23 x 16 x 9 in)	58 x 41 x 23 cm (23 x 16 x 9 in)
Shipping dimensions (H x W x D)	71.1 x 57.2 x 39.4 cm (28.0 x 22.5 x 15.5 in)	71.1 x 57.2 x 39.4 cm (28.0 x 22.5 x 15.5 in)
IP degree of protection	NEMA Type 1 Indoor	
Operating air temperature range	-25°C to 70°C (-13°F to 158°F) (power derated above 25°C (77°F))	
Warranty (depending on the country of installation)	2 or 5 years	2 or 5 years
<b>Features</b>		
System monitoring and network communications	Available	
Intelligent features	Grid sell, peak load shave, generator support, prioritized consumption of battery or external DC energy	
Auxiliary port	0 to 12 V, maximum 250 mA DC output, selectable triggers	
Off-grid AC coupling	Frequency control	
<b>Regulatory approval</b>		
Safety	UL1741, CSA 107.1	
EMC directive	FCC and Industry Canada Class B	
Interconnect	IEEE 1547 and CSA 107.1	
<b>Compatible products</b>		
Conext XW+ Mini Power Distribution Panel	865-1013-01	
Conext XW + Power Distribution Panel	865-1015-01	
Conext MPPT 60 150	865-1030-1	
Conext MPPT 80 600	865-1032	
Conext Gateway	865-0329	
Conext ComBox	865-1058	
Conext System Control Panel	865-1050	
Conext Automatic Generator Start	865-1060	
Conext Battery Monitor	865-1080-01	
Conext Battery Fuse Combiner Box	865-1031-01	
Conext Configuration Tool	865-1155-01	
Conext Quick Fit for North America	XW+ H: 865-6848-01HPS / XW+ L: 865-6848-01LPS	

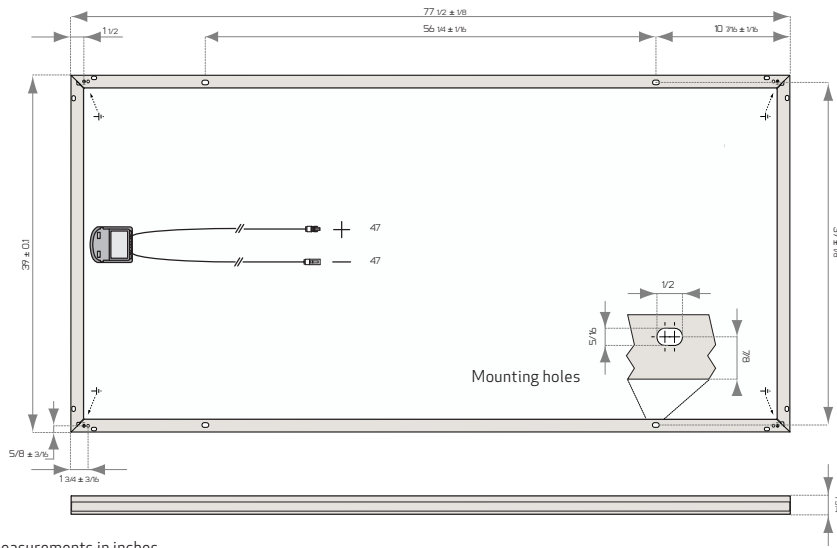
Specifications are subject to change without notice.

**Schneider Electric**  
35 rue Joseph Monier  
92500 Rueil-Malmaison, France  
Tel: +33 (0)1 41 29 70 00

Life Is On



# REC PEAK ENERGY 72 SERIES



All measurements in inches

ELECTRICAL DATA @ STC	REC295PE72	REC300PE72	REC305PE72	REC310PE72	REC315PE72
Nominal Power - $P_{MPP}$ (Wp)	295	300	305	310	315
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - $V_{MPP}$ (V)	36.1	36.4	36.6	36.7	36.8
Nominal Power Current - $I_{MPP}$ (A)	8.23	8.33	8.42	8.53	8.62
Open Circuit Voltage - $V_{OC}$ (V)	44.5	44.9	45.1	45.3	45.5
Short Circuit Current - $I_{SC}$ (A)	8.80	8.86	8.95	9.02	9.09
Panel Efficiency (%)	15.1	15.4	15.6	15.9	16.1

Analysed data demonstrates that 99.7% of modules produced have current and voltage tolerance of  $\pm 3\%$  from nominal values. Values at standard test conditions STC (airmass AM 1.5, irradiance 1000 W/m<sup>2</sup>, cell temperature 25°C). At low irradiance of 200 W/m<sup>2</sup> (AM 1.5 and cell temperature 25°C) at least 96% of the STC module efficiency will be achieved.

ELECTRICAL DATA @ NOCT	REC295PE72	REC300PE72	REC305PE72	REC310PE72	REC315PE72
Nominal Power - $P_{MPP}$ (Wp)	225	229	232	235	238
Nominal Power Voltage - $V_{MPP}$ (V)	33.9	34.2	34.4	34.6	34.7
Nominal Power Current - $I_{MPP}$ (A)	6.63	6.68	6.75	6.80	6.86
Open Circuit Voltage - $V_{OC}$ (V)	41.9	42.3	42.5	42.7	42.9
Short Circuit Current - $I_{SC}$ (A)	7.08	7.12	7.20	7.25	7.31

Nominal cell operating temperature NOCT (800 W/m<sup>2</sup>, AM 1.5, windspeed 1 m/s, ambient temperature 20°C).

## CERTIFICATION



Certified according to UL 1703  
CEC listed

## WARRANTY

10 year product warranty.  
25 year linear power output warranty  
(max. degradation in performance of 0.7% p.a.).

16.1% EFFICIENCY  
10 YEAR PRODUCT WARRANTY  
25 YEAR LINEAR POWER OUTPUT WARRANTY  
**DUTY-FREE** US IMPORT DUTY FREE

## TEMPERATURE RATINGS

Nominal Operating Cell Temperature (NOCT)	46.6°C ( $\pm 2^\circ\text{C}$ )
Temperature Coefficient of $P_{MPP}$	-0.38 %/°C
Temperature Coefficient of $V_{OC}$	-0.27 %/°C
Temperature Coefficient of $I_{SC}$	0.013 %/°C

## GENERAL DATA

Cell Type:	72 REC PE multicrystalline 3 strings of 24 cells with bypass diodes
Glass:	5/32" solar glass with anti-reflection surface treatment
Back Sheet:	Double layer highly resistant polyester
Frame:	Anodized aluminum (silver)
Junction Box:	IP67 rated 4 mm <sup>2</sup> solar cable, 47" + 47"
Connectors:	MC4 connectable (4 mm <sup>2</sup> )
Origin:	Made in Singapore

## MAXIMUM RATINGS

Operational Temperature:	-40 ... +85°C
Maximum System Voltage:	1000 V
Design Load:	75.2 lbs/ft <sup>2</sup> (3600 Pa)* 33.4 lbs/ft <sup>2</sup> (1600 Pa)* *Refer to installation manual
Max Series Fuse Rating:	20 A
Max Reverse Current:	20 A

## MECHANICAL DATA

Dimensions:	77 1/2 x 39 x 1 3/4 in
Area:	21 ft <sup>2</sup>
Weight:	59 1/2 lbs

**Note!** All specifications are subject to change without notice at any time.

REC is a leading global provider of solar energy solutions. With more than 15 years of experience, we offer sustainable, high performing products, services and investments for the solar industry. Together with our partners, we create value by providing solutions that better meet the world's growing energy needs. REC is headquartered in Norway and listed on the Oslo Stock Exchange (ticker: RECSOL). Our 1,600 employees worldwide generated revenues of USD 647 million in 2013.



www.recgroup.com

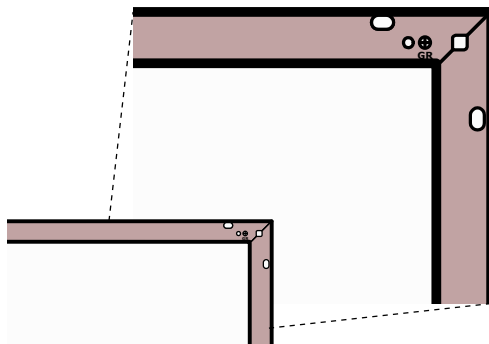
**v) Slide-in Systems**

For installations using a slide-in mounting structure, specifications must match those of the clamps noted above regarding grip length and depth. If you have any questions regarding a mounting system and its suitability for REC Peak Energy 72 Series panels, please contact your local office for technical support.

**vi) Drainage holes**

There are eight drainage holes, 3/8 x 1/4 in (12 x 7.5 mm) in the panel frame, each spaced 2 1/8 in (55 mm) from the corner of the panel frame (fig. 9). This allows water caused by rain or snow melt to exit the frame easily and minimizes any damage caused by freezing and thawing.

Fig. 8 Drainage holes



**!** Ensure the drainage holes are not covered by any part of the mounting structure.

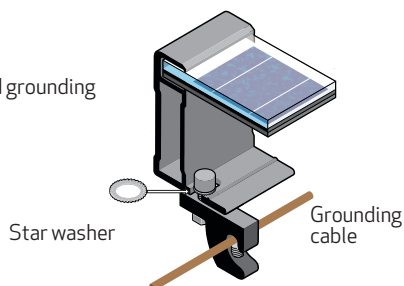
**GROUNDING**

A solar panel with exposed conductive parts is considered to be in compliance with UL 1703 only when the it is electrically grounded in accordance with the instructions presented below and the requirements of the NEC. Grounding is achieved through securement to the panel frame of the following UL Listed grounding Clips/Lugs in combination with the REC Peak Energy 72 panels.

- Suitable grounding lugs must be used: Listed (KDER) ILSCO, GBL-4DBT (tin plated) (E34440).
- Grounding cable size should be between 4 - 14 AWG (2.1 mm<sup>2</sup> - 21.2mm<sup>2</sup>).
- Attach grounds to the grounding holes in the panel frames.
- Fix lug to the frame using a star washer (#10) and lock nut (#10), ensuring a conductive connection (fig. 9). Tighten according to manufacturer's instructions.

**!** Where common grounding hardware (nuts, bolts, star washers, split-ring lock washers, flat washers and the like) are used to attach a listed grounding device, the attachment must be made in conformance with the grounding device manufacturer's instructions.

Fig. 9: Recommended grounding



Cross section [AWG]	Type	Torque [in-lbs]
4 - 6	Stranded	35
8	Stranded	25
10 - 14	Stranded / Solid	2.8

Grounding lug dimensions and wire fastening torque for GBL-4DBT

**★** To avoid galvanic corrosion, stainless steel fastening materials are preferred, however galvanized or hot dipped zinc plated fasteners are equally suitable.



**Classic 150, 200 or 250 MPPT Charge Controllers**

Nominal Battery Voltage	12 Through 72 volts on Classic's
Maximum Output Current	Classic 150 = 96A on 12V, 94A on 24V and 86A on 48V battery Classic 200 = 79A on 12V, 78A on 24+48V and 65A on 72V battery Classic 250 = 61A on 12V, 62A on 24V, 55A on 48V and 43A on 72V battery
PV Open Circuit Voltage VOC <i>(NOTE: See HyperVOC at bottom)</i>	Classic150 = 150V + HyperVOC (battery voltage up to 48V) <i>Example 150V + 48V = 198VOC</i> Classic200 = 200V + HyperVOC (battery voltage up to 48V) Classic250 = 250V + HyperVOC (battery voltage up to 48V) <i>(NOTE: See HyperVOC at bottom)</i>
Power Conversion Efficiency	98% (Typical system)
Maximum Stand-By Self-Consumption (12V)	2.8W - 4W
Reverse Current At Night	Zero - Internal relay for reverse current
Low Battery Voltage	Low Battery voltage disconnect and re-connect of loads fully programmable with 2 Auxiliary outputs to control external load disconnect /re-connect switches
Hyper VOC <i>(NOTE: See HyperVOC at bottom)</i>	Standard all models - Extended VOC range for cold climates
Arc Fault Protection	Standard on Classic, 0.25 second detect and trip speed
Ground Fault Protection	Standard all models - resettable, no fuse to blow
Charging Regulation	Bulk, Absorb, Float as well as Equalization
Battery Voltage Regulation Set Points	10-100VDC
Equalization Charging	Adjustable Voltage and Duration, Manual or Auto
PV Reverse Polarity	Protected to Max VOC ( Classic MPPT Charger Controllers are fully protected from reverse current on both input and output)
Battery Reverse Polarity	Fully protected ( Classic MPPT Charger Controllers are fully protected from reverse current on both input and output)
Battery Over Voltage	Fully protected (Classic MPPT Charger Controllers are fully protected from over current on both input and output)
Battery Short Circuit	Fully protected
Battery Temp Compensation	Automatic when BTS is installed, Adjustable mV per degree C per 2V cell
Programmable Auxiliary Control Output	2 Auxiliary outputs, Aux1 can be 12V out or dry contact, Aux2 is 12V out or Logic IN
Graphic Display	Graphical display
Networking Cabling	Standard 4 conductor phone cable, no hub needed
Communications	ModBus openly published over Ethernet and RS232
Remote Display	Display (MNGP) can be relocated and a second display can be added
Remote Monitoring And Control	Local Application software included allows viewing and control from the network or over the Internet. MyMidNite.com - online status monitoring
Terminal Rating	75 C
Internet Ready	All models
Data Logging	380 days of daily history, 24 hours of data at 5 minute intervals
Wind And Hydro Applications	Standard on all models
Positive Ground Applications	Requires 2 pole input and output breakers
Operating Temperature	Minimum of -40C to 50C - Controller will auto derate as temperature rises above 25C
Environmental Rating	Indoor type IP30 (The Classic is IP22 Rated to 60529 when used with Classic Drip Shield)
Conduit knock Outs	Single 1" conduit (35.05mm) on left and right sides. Two 1" conduit (35.05mm) on bottom. Two 3/4" conduit (27.76mm) on back.
Warranty	5 Year
Weight & Dimensions	12 Lbs. (5.45 kgs) - 14.9" x 6" x 4" (378mm x 152mm x 102mm)
Shipping Dimensions HxWxD	19" x 8.5" x 5.7" (482.6mm x 215.9mm x 144.78mm)
Options	MNGP graphical display, 3ft networking cable
Certifications	Listed by ETL for US & Canada, CE Certified, FCC Class B

**HyperVOC:** A non-operative VOC safety zone over and above the maximum input voltage for cold climates. **NOTE:** Turbine short circuit protection is provided by the additional MidNite Clipper Turbine voltage and speed protection provided when used with MidNite Clipper

Sheet1

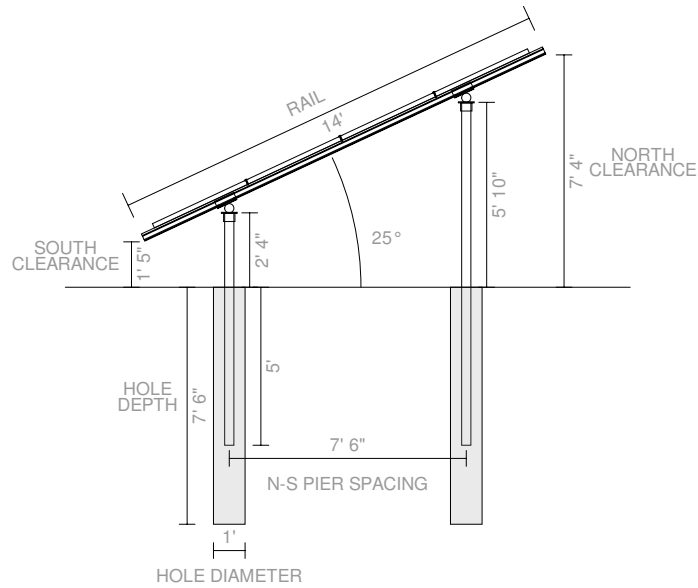
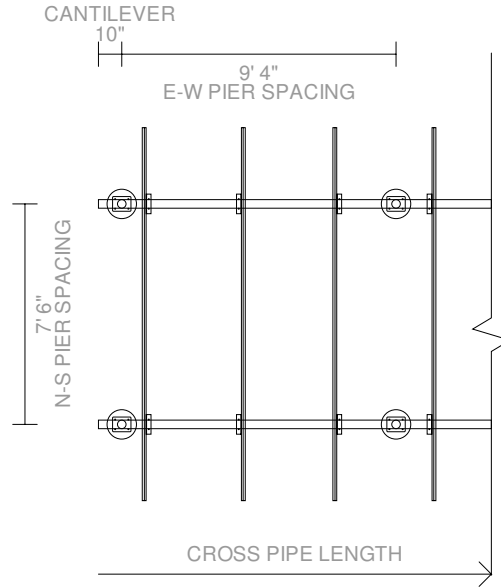
Series modules per string	4	
ISC of string	9.02 A	
ISC @ 91F	9.0293808	
NEC 690.8B Solar Derating	11.286726	
Derating for continuous current	14.1084075	
Type RHH 12 Gauge Wire	25 A	
Derating for 33C ambient	24.00 A	
Breaker	15.00 A	
ISC of combined string @ 91F	27.0881424 A	
NEC 690.8B Solar Derating	33.860178 A	
Derating for continuous current	42.3252225 A	
Type THHN 6 Gauge Wire	75 A	
Derating for 33C ambient	72 A	
Derating for 4 conductors in conduit	57.6 A	
Breaker	50 A	
Charge controller max output current	55 A	
Derating for continuous current	68.75 A	
Type THWN 4 Gauge Wire	85 A	
Derating for 33C ambient	79.9 A	
Breaker	70 A	
Inverter max input current	180 A	
Derating for continuous current	225 A	
Type THHN 2/0 Gauge Wire	260 A	
Derating for 33C ambient	249.6 A	
Breaker	250 A	
Battery Assembly Voltage	48 V	4x 12V

Project Details			
<b>Name</b>	Colorado Springs	<b>Date</b>	10/11/2019
<b>Location</b>	Colorado Springs, CO, 80908	<b>Total modules</b>	24
<b>Module</b>	REC Solar: REC310PE72 (45mm)	<b>Piers</b>	10
<b>Dimensions</b>	77.5" x 39.0" x 1.77" (1968.5mm x 990.6mm x 45.0mm)	<b>Concrete</b>	2.18 yd <sup>3</sup>
<b>Total watts</b>	7,440 kW	<b>Wind exposure</b>	C
<b>Snow load</b>	40 psf	<b>Wind speed</b>	130 mph

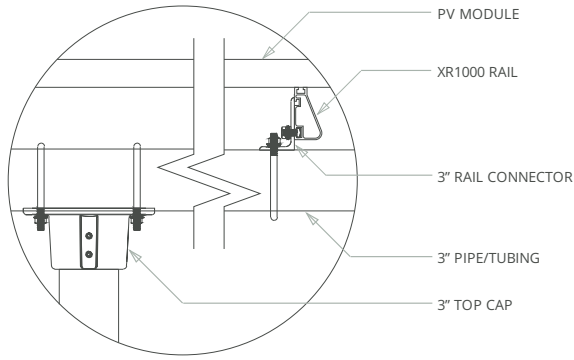
Substructure & Foundation			
<b>Tilt</b>	25°	<b>Pipe/tubing diameter</b>	3"
<b>Soil class</b>	4	<b>Hole diameter</b>	12"



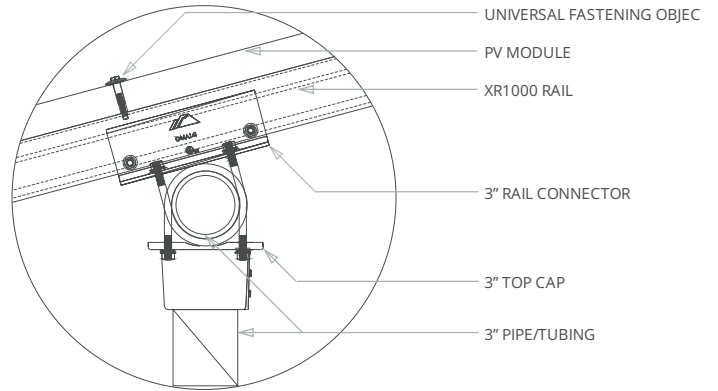
Sub array #1					
Rows	4	Columns	6	Repeats	1
Area	38' 11" (EW) × 13' 2" (NS)	Diagonal bracing	no	E/W spacing	9' 4"
Rail cantilever	2' 10"	Piers/repeat	10	Total south piers	5 (7' 4")
Total north piers	5 (10' 10")	Total cross pipes	2 (38' 11")	Pipe cantilever	10"
Total pipe length	168' 10"	Shear	1,532 lbs	Moment	3,830 ft-lbs
Uplift	-2,027 lbs				



**Pipe Fitting Detail**

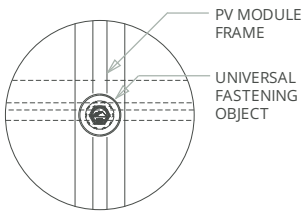


Front View

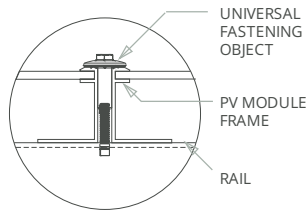


Side View

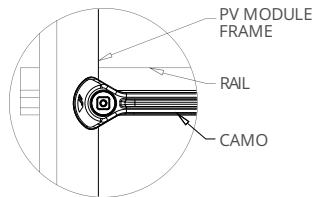
**Clamp Detail**



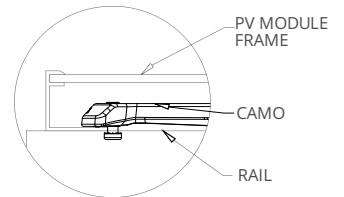
Mid Clamp, Plan



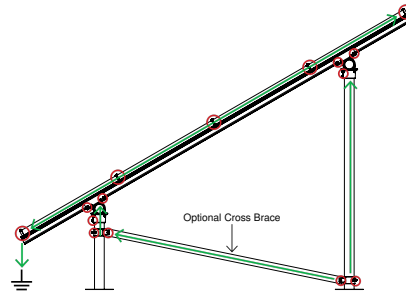
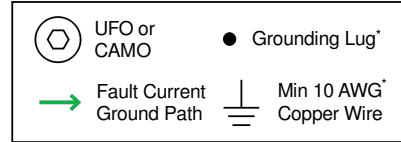
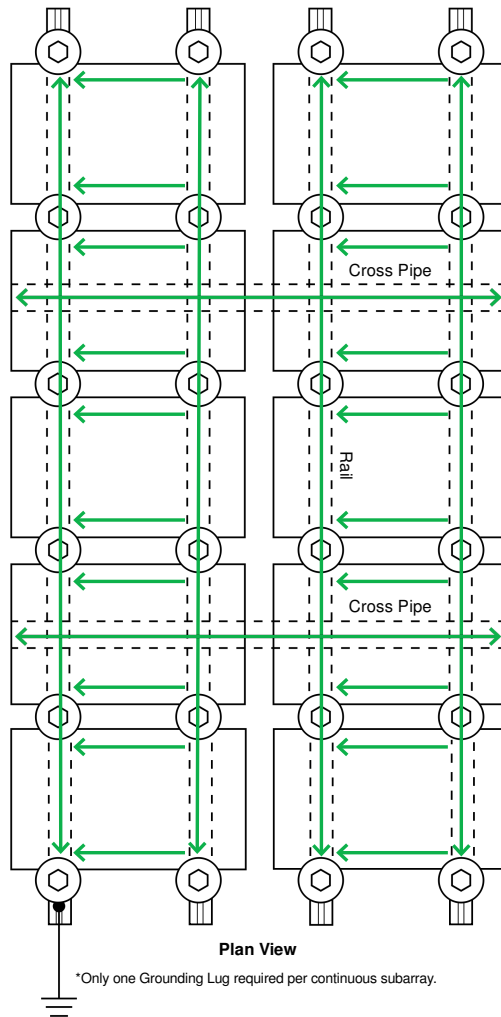
Mid Clamp, Front



CAMO End Clamp, Plan



CAMO End Clamp, Front



○ Bonding Points ← Fault Current Ground Path

\*Grounding Lugs and wire are not required in systems using certain Enphase microinverters or certain Sunpower modules. Equipment grounding is achieved with the Engage cable for Enphase or the AC module cable system for Sunpower via their integrated EGC.

**Bill of Materials**

Part	Spares	Total Qty
<b>Rails</b>		
XR-1000-168A XR1000, Rail 168" (14 Feet) Clear	0	12
<b>Clamps &amp; Grounding</b>		
UFO-CL-01-A1 Universal Module Clamp, Clear	0	36
CAMO-01-M1 Hidden End Cam (universal clamp)	0	24
XR-LUG-03-A1 Grounding Lug, Low Profile	0	1
<b>Substructure</b>		
70-0300-SGA SGA Top Cap at 3"	0	10
GM-BRC-003 Ground Mount Bonded Rail Connector - 3"	0	24



Starling Madison Lofquist, Inc.  
*Consulting Structural and Forensic Engineers*

5224 South 39<sup>th</sup> Street, Phoenix, Arizona 85040  
tel: (602) 438-2500 fax: (602) 438-2505 ROC#291316 www.smleng.com

IronRidge  
28357 Industrial Boulevard  
Hayward, CA 94545

October 15, 2018  
Page 1 of 52

Attn: Mr. Corey Geiger, VP New Markets, IronRidge Inc.

Subject: Ground Mounting System – Structural Analysis – 4 Module

Dear Sir:

We have analyzed the subject ground mounted structure and determined that it is in compliance with the applicable sections of the following Reference Documents:

Codes: ASCE/SEI 7-10 Min. Design Loads for Buildings & Other Structures  
International Building Code, 2015 Edition

Other: AC428, Acceptance Criteria for Modular Framing Systems Used to Support PV  
Modules, dated Effective November 1, 2012 by ICC-ES  
Aluminum Design Manual, 2015 Edition  
IronRidge Exhibit EX-0001

The structure is a simple column (pier) and beam (cross pipe) system. The piers & cross pipes are ASTM A53 Grade B standard weight (schedule 40) steel pipes or Allied Mechanical Tubing. Please refer to Exhibit EX-0001 for approved pipe geometry and material properties. The tops of the piers are connected in the E-W direction by the cross pipes which cantilever over and extend past the end piers. The cross pipes are connected by proprietary IronRidge XR1000 Rails spanning up and down the slope which cantilever over and extend past the top and bottom cross pipes. There are typically two rails per column of modules. The modules are clamped to the rails by the IronRidge Module Mounting Clamps as shown in the attached Exhibit.

Gravity loads are transferred to the piers and foundations by the rails and cross pipes acting as simple beams. For lateral loads the system is either a cantilever structure or, when diagonal braces are provided, a braced frame. The effect of seismic loads (for all design categories A-F) have been determined to be less than the effect due to wind loads in all load conditions and combinations.

The pier spacing in the N-S direction is 7'-6". The pier spacing in the E-W direction is selected from load tables determined by the structural design for the specified slope, wind load, and snow load. The governing criteria for the pier spacing is either the spanning capacity of the cross pipes or the cantilever capacity of the pier. Simplified Load Tables 1A-F & 2A-F are included herein for reference.

More comprehensive information covering all load combinations is available at the IronRidge website, IronRidge.com.

**Table 2B - MAXIMUM PIER SPACING (in)**

3" Unbraced Pipe Frame	Snow	Slope (deg)									
		0	5	10	15	20	25	30	35	40	45
Wind Speed & Exposure Category	psf										
100 mph Exposure C	0	212	217	186	181	171	163	139	117	100	85
	10	191	194	176	174	170	163	139	117	100	85
	20	165	167	155	154	153	153	139	117	100	85
	30	155	156	147	146	146	147	139	117	100	85
	40	142	143	136	135	137	139	139	117	100	85
	50	131	131	127	127	129	131	134	117	100	85
105 mph Exposure C	0	204	178	162	148	137	134	126	107	91	77
	10	186	178	162	148	137	134	126	107	91	77
	20	162	164	152	148	137	134	126	107	91	77
	30	152	154	144	143	137	134	126	107	91	77
	40	140	141	134	133	134	134	126	107	91	77
	50	130	131	125	125	126	129	126	107	91	77
110 mph Exposure C	0	196	202	171	166	157	150	115	97	83	70
	10	182	185	167	164	157	150	115	97	83	70
	20	159	161	149	147	145	145	115	97	83	70
	30	150	152	141	140	139	140	115	97	83	70
	40	138	139	131	130	131	132	115	97	83	70
	50	128	130	123	123	124	126	115	97	83	70
120 mph Exposure C	0	183	188	159	154	145	132	97	82	69	59
	10	174	177	158	154	145	132	97	82	69	59
	20	153	155	142	140	138	132	97	82	69	59
	30	145	147	136	134	133	132	97	82	69	59
	40	134	136	127	126	126	126	97	82	69	59
	50	125	127	119	119	120	121	97	82	69	59
130 mph Exposure C	0	171	175	148	143	135	112	82	70	59	50
	10	166	169	148	143	135	112	82	70	59	50
	20	147	150	136	134	131	112	82	70	59	50
	30	140	142	130	129	127	112	82	70	59	50
	40	130	132	122	121	121	112	82	70	59	50
	50	122	124	116	115	115	112	82	70	59	50
140 mph Exposure C	0	160	165	138	134	126	97	71	60	51	43
	10	158	162	138	134	126	97	71	60	51	43
	20	142	145	130	128	125	97	71	60	51	43
	30	135	138	125	123	121	97	71	60	51	43
	40	127	128	118	117	116	97	71	60	51	43
	50	119	121	112	111	111	97	71	60	51	43
150 mph Exposure C	0	150	155	130	126	118	84	62	52	44	38
	10	150	154	130	126	118	84	62	52	44	38
	20	137	140	125	123	118	84	62	52	44	38
	30	131	133	120	118	116	84	62	52	44	38
	40	123	125	114	113	111	84	62	52	44	38
160 mph Exposure C	0	142	146	122	118	107	74	54	46	39	33
	10	142	146	122	118	107	74	54	46	39	33
	20	132	135	120	117	107	74	54	46	39	33
	30	127	129	116	114	107	74	54	46	39	33
	40	119	121	110	108	107	74	54	46	39	33

Notes: see page 14



Notes for Tables 1 & 2:

1. Shaded region denotes special requirements for XR1000 rails – contact IronRidge
2. Cross pipe splices not permitted in outer 2/3 of end spans, or the middle 1/3 of interior spans based on the installed attachment spacing ( $L_{install}$ ). See Figure A
3. End cantilever span of pipe rails (max) =  $0.40 \times$  maximum span ( $L_{max}$ ) from above tables. See Figure A
4. When installations occur on a N-S grade, the design slope of the array shall be determined as the slope relative to level ground. Code required topographic effects have not been considered. Topographic (Wind) Factor = 1.0 (no topographic effects)
5. Dead Load (Weight) = 3 psf
6. Maximum PV Module Dimension = 80”

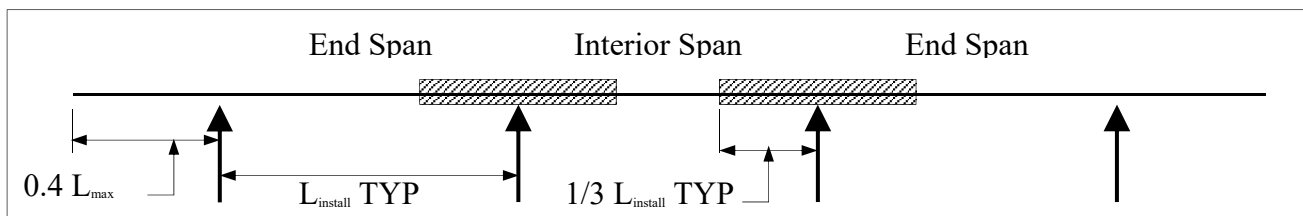



Figure A

$L_{max}$  = Maximum pier spacing provided in the tables above for the project design criteria

$L_{install}$  = Actual installed pier spacing

 = Indicates region of the pipe rail where splice may be installed

To avoid potential problems from the effects of thermal expansion, a maximum total continuous cross pipe length of 100 ft is recommended.

Notes for CAMO module clamp installation:

1. Single module installation (“orphan modules”) shall not be permitted with the ground mount system when CAMO clamp is used. Reference Figure 1 on following page for “Orphan Module” installation.
2. CAMO clamps will function within a module’s design load ratings. Be sure the specific module being used with the CAMO clamp meets the dimensional requirements shown in Figure 2 on the following page, is a module listed in IronRidge’s installation manual, and that the module selected is suitable for the environmental conditions of a particular project.

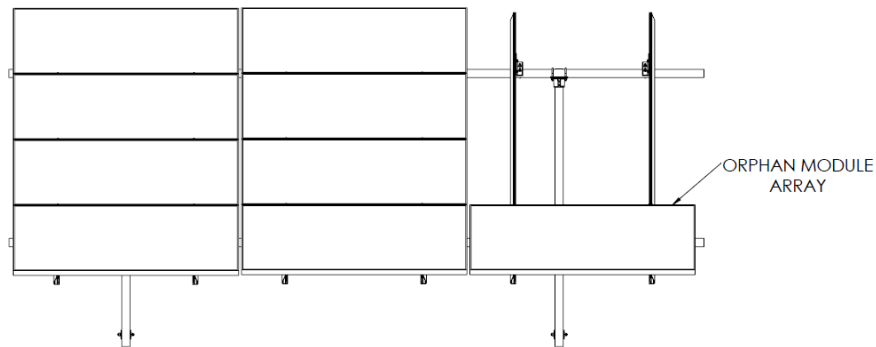


Figure 1: Orphan Module Installation

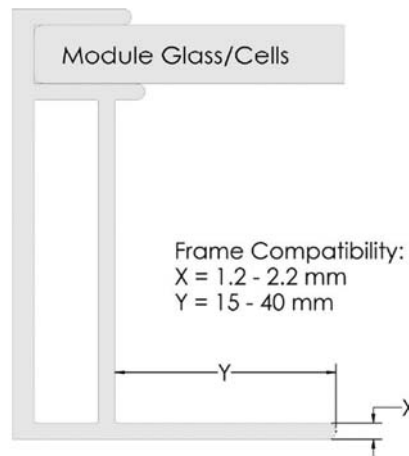


Figure 2: CAMO Clamp Module Frame Dimensional Requirements

Foundation Requirements

The foundation requirements for a cast-in-place drilled concrete pier system and for each soil class 2, 3, & 4 may be obtained from the tables below. The soil class is noted at the top of the tables. For each soil class Tables 3A-3F and 4A-4F are provided for the 2in and 3in systems respectively. These tables are based on the piers being installed at their maximum allowable spacing. For spacing values less than maximum and for loads cases with snow > 0 psf, the requirements can be determined by using the online Design Assistant at IronRidge.com.

Soil Class 4											
Table 4B - MINIMUM FOUNDATION DEPTHS (in)											
3" Pipe Frame Unbraced	Wind Speed & Exposure Category	Pier Dia (in)	Slope (deg)								
			0	5	10	15	20	25	30	35	40
100 mph Exposure C	12	42	48	54	60	72	84	90	90	90	90
	16	36	36	42	54	66	72	78	78	78	78
	20	36	36	42	48	60	66	72	72	72	72
	24	36	36	36	48	54	60	66	66	66	66
105 mph Exposure C	12	42	48	48	60	66	78	90	90	90	90
	16	36	36	42	54	60	72	78	78	78	78
	20	36	36	42	48	54	66	72	72	72	72
	24	36	36	36	42	54	60	66	66	66	66
110 mph Exposure C	12	48	54	54	66	78	84	90	90	90	90
	16	36	42	48	54	66	78	78	78	78	78
	20	36	36	42	54	60	72	72	72	72	72
	24	36	36	36	48	54	66	66	66	66	66
120 mph Exposure C	12	54	60	60	72	78	90	90	90	90	90
	16	42	48	48	60	72	78	78	78	78	78
	20	36	36	42	54	66	72	72	72	72	72
	24	36	36	42	48	60	66	66	66	66	66
130 mph Exposure C	12	54	66	66	78	84	90	90	90	90	90
	16	42	48	54	60	72	78	78	78	78	78
	20	36	42	42	54	66	72	72	72	72	72
	24	36	36	42	54	60	66	66	66	66	66
140 mph Exposure C	12	60	72	72	84	84	90	90	90	90	90
	16	48	54	54	66	72	78	78	78	78	78
	20	36	42	48	60	66	72	72	72	72	72
	24	36	36	42	54	66	66	66	66	66	*
150 mph Exposure C	12	66	78	78	90	90	90	90	90	90	90
	16	48	60	60	66	78	78	78	78	78	78
	20	42	48	48	60	72	72	72	72	72	*
	24	36	42	42	54	66	66	66	66	*	*
160 mph Exposure C	12	72	84	84	96	96	90	90	90	90	90
	16	54	60	60	72	78	78	78	78	78	78
	20	42	48	48	60	72	72	72	72	*	*
	24	36	42	48	54	66	66	66	*	*	*

Notes: see page 52

Notes for Tables 3 & 4:

1. Concrete Weight = 145 pcf /  $f'c = 2500$  psi
2. Skin Friction per 2015 IBC 1810.3.3.1.4 & 5
3. Top 1'-0" of soil neglected for Skin Friction
4. Snow Load = 0 psf – tabulated values are conservative for Snow Loads > 0 psf
5. \* indicates special foundation required. Contact IronRidge
6. Resistance to corrosion and/or sulfate attack, along with possible adverse effects due to expansive soils has not been considered in these foundation recommendations. SML Engineers assumes no liability with regard to these items.
7. Soil classification is to be determined and verified by the end user of this certification letter.

The analysis assumes that the array, including the connections and associated hardware, are installed in a workmanlike manner in accordance with the IronRidge Ground Mount Installation Manual and generally accepted standards of construction practice. Verification of PV Module capacity to support the loads associated with the given array shall be the responsibility of the Contractor or Owner and not IronRidge or Starling Madison Lofquist.

Please feel free to contact me at your convenience if you have any questions.

Respectfully yours,

Tres Warner, P.E.  
Design Division Manager

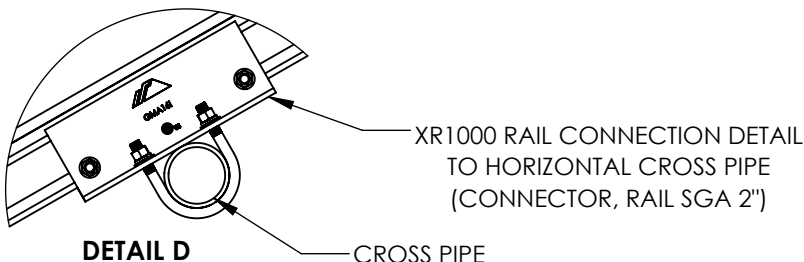
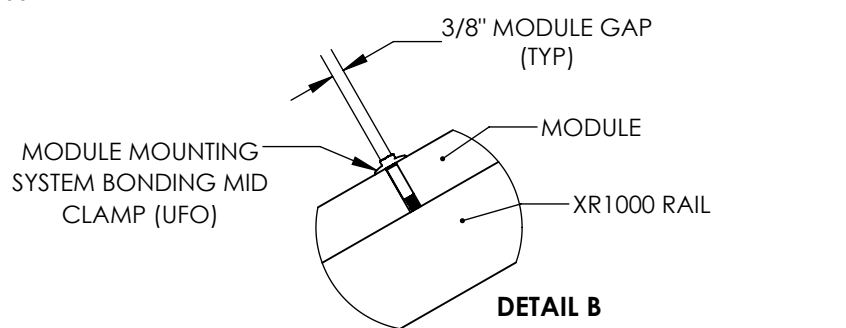
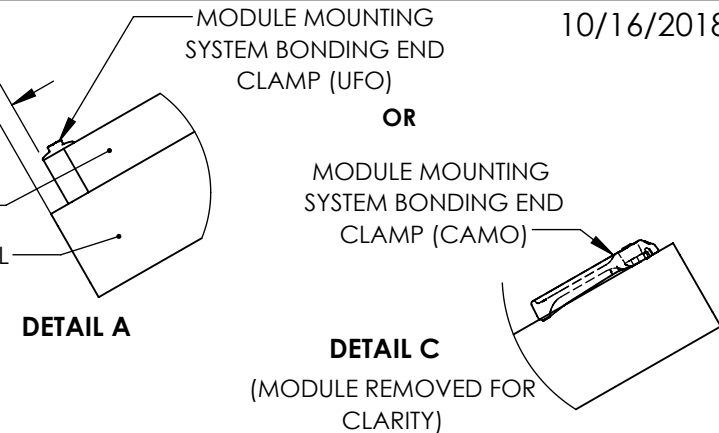
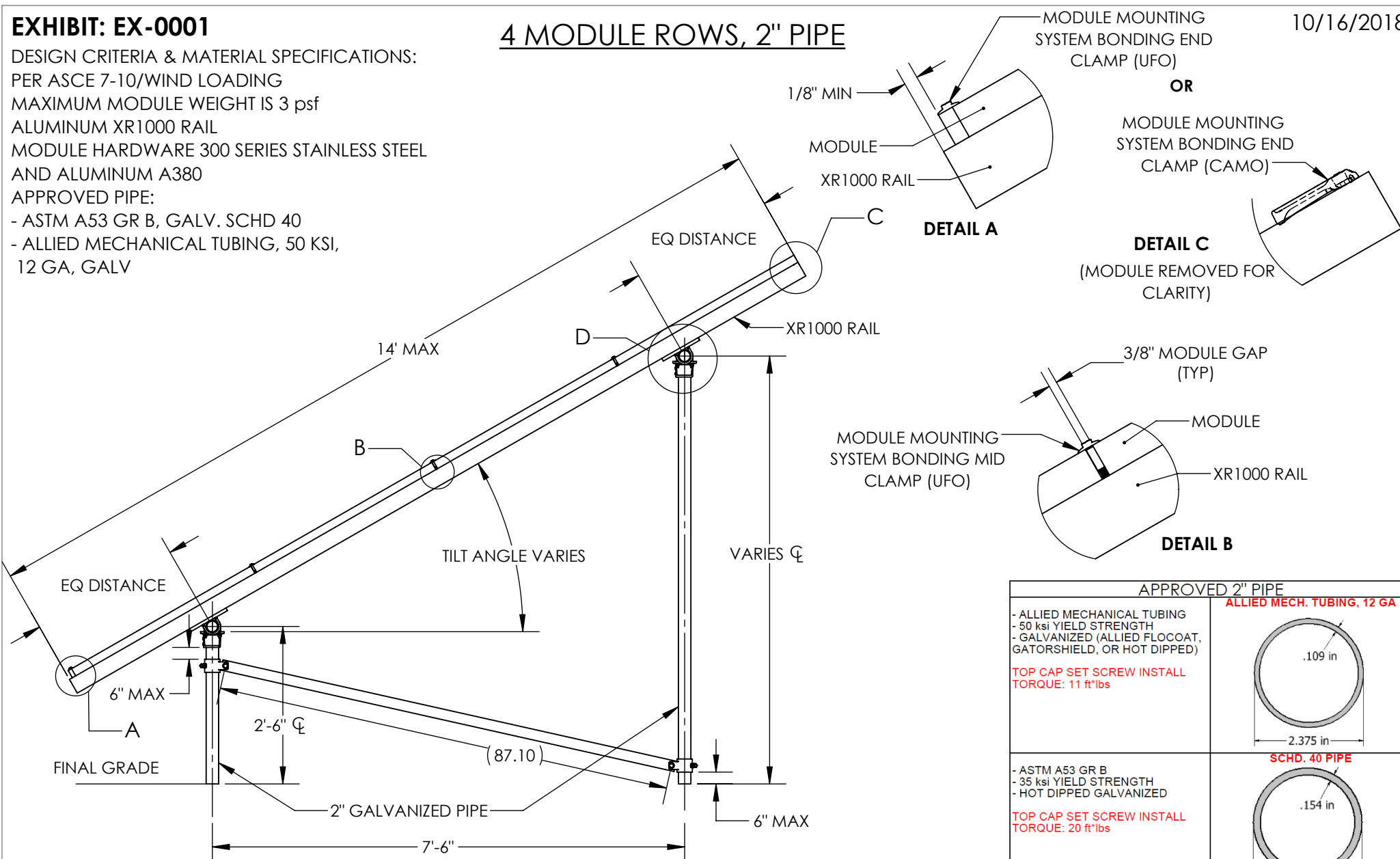


**EXHIBIT: EX-0001**

DESIGN CRITERIA & MATERIAL SPECIFICATIONS:  
 PER ASCE 7-10/WIND LOADING  
 MAXIMUM MODULE WEIGHT IS 3 psf  
 ALUMINUM XR1000 RAIL  
 MODULE HARDWARE 300 SERIES STAINLESS STEEL  
 AND ALUMINUM A380  
 APPROVED PIPE:  
 - ASTM A53 GR B, GALV. SCHD 40  
 - ALLIED MECHANICAL TUBING, 50 KSI,  
 12 GA, GALV

**4 MODULE ROWS, 2" PIPE**

10/16/2018



APPROVED 2" PIPE	
- ALLIED MECHANICAL TUBING - 50 ksi YIELD STRENGTH - GALVANIZED (ALLIED FLOCOAT, GATORSHIELD, OR HOT DIPPED)  TOP CAP SET SCREW INSTALL TORQUE: 11 ft*lbs	<b>ALLIED MECH. TUBING, 12 GA</b> 
- ASTM A53 GR B - 35 ksi YIELD STRENGTH - HOT DIPPED GALVANIZED  TOP CAP SET SCREW INSTALL TORQUE: 20 ft*lbs	<b>SCHD. 40 PIPE</b> 

DRAWN	TC	10/16/2018
CHECKED	--	--
ENG APPR.	--	--
MFG APPR.	--	--
Q.A.	--	--



**GROUND MOUNT SYSTEM 2" PIER, 4 SOLAR MODULE ROWS**

DIMENSIONS ARE IN INCHES.  
 TOLERANCES:  
 .XX: +/- .030  
 XXX: +/- .010  
 ANGLES: +/- 1°

SIZE	DWG. NO.	REV.
<b>A</b>	<b>EX-0001</b>	<b>B</b>
SCALE: 1:25	WEIGHT:	SHEET 1 OF 5

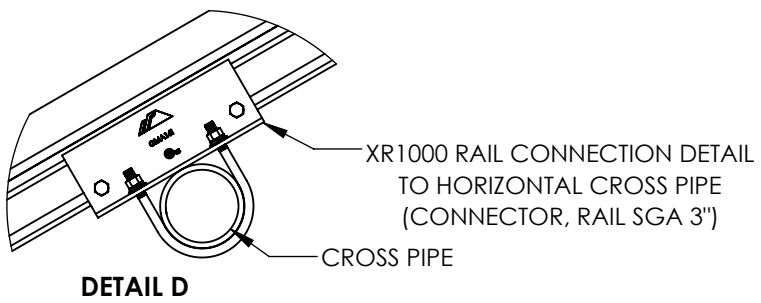
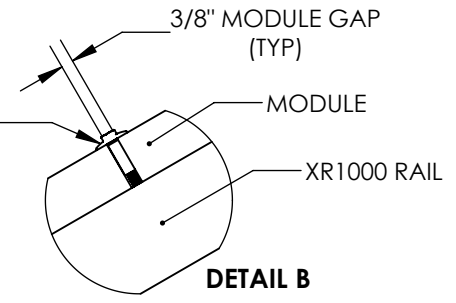
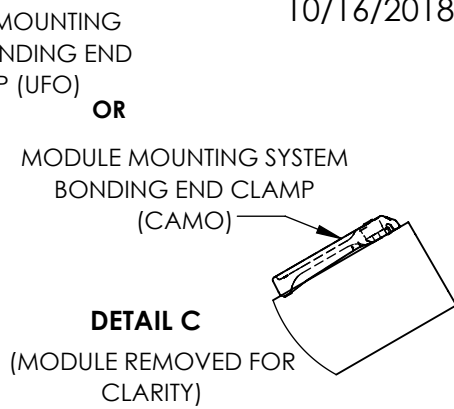
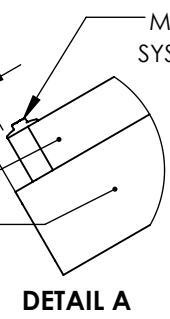
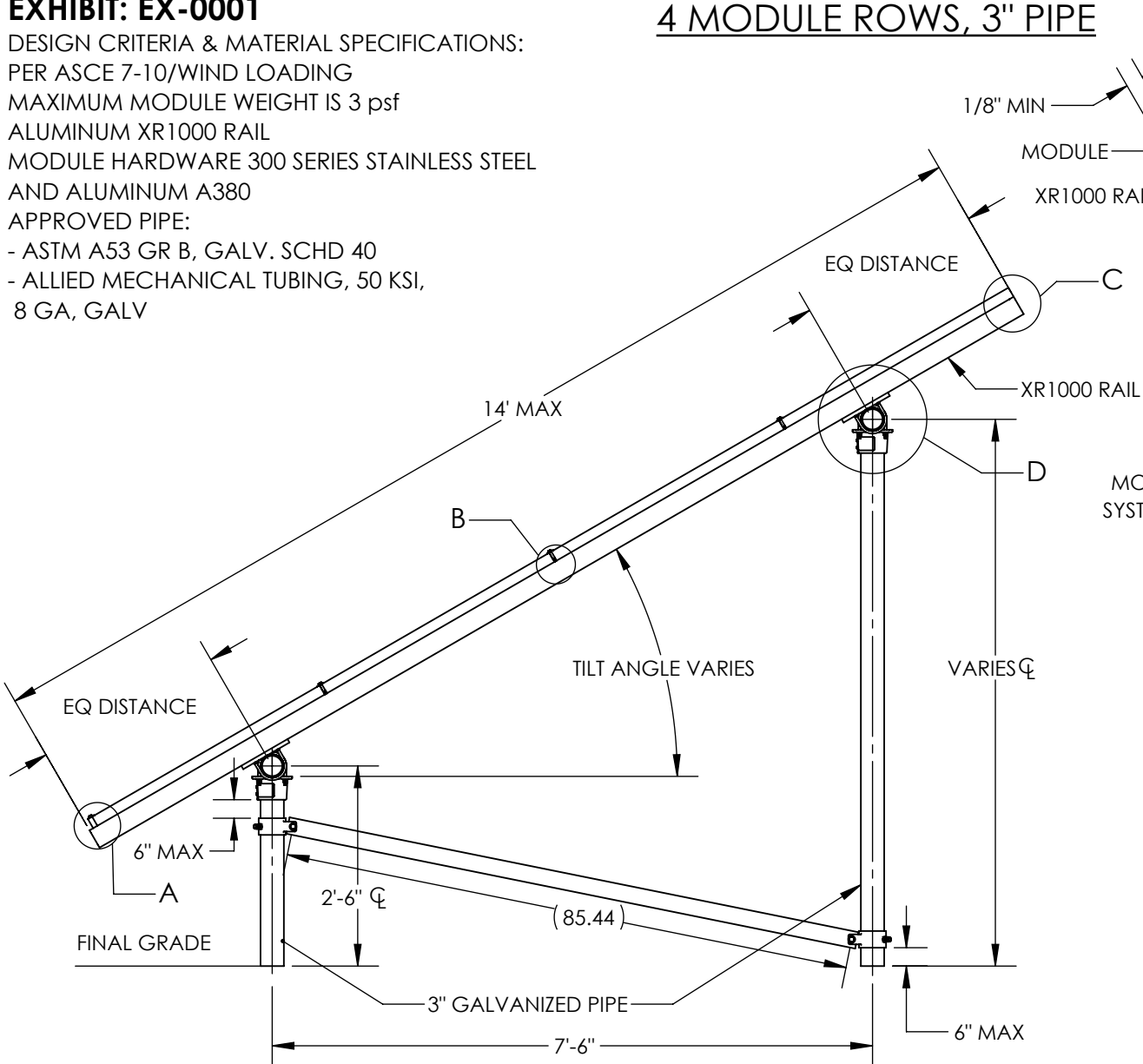
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# EXHIBIT: EX-0001

DESIGN CRITERIA & MATERIAL SPECIFICATIONS:  
 PER ASCE 7-10/WIND LOADING  
 MAXIMUM MODULE WEIGHT IS 3 psf  
 ALUMINUM XR1000 RAIL  
 MODULE HARDWARE 300 SERIES STAINLESS STEEL  
 AND ALUMINUM A380  
 APPROVED PIPE:  
 - ASTM A53 GR B, GALV. SCHD 40  
 - ALLIED MECHANICAL TUBING, 50 KSI,  
 8 GA, GALV

## 4 MODULE ROWS, 3" PIPE

10/16/2018



APPROVED 3" PIPE	
<ul style="list-style-type: none"> <li>- ALLIED MECHANICAL TUBING</li> <li>- 45 ksi YIELD STRENGTH</li> <li>- GALVANIZED (ALLIED FLOCOAT, GATORSHIELD, OR HOT DIPPED)</li> </ul> <p><b>TOP CAP SET SCREW INSTALL TORQUE: 16 ft*lbs</b></p>	<p><b>ALLIED MECH. TUBING, 8 GA</b></p>
<ul style="list-style-type: none"> <li>- ASTM A53 GR B</li> <li>- 35 ksi YIELD STRENGTH</li> <li>- HOT DIPPED GALVANIZED</li> </ul> <p><b>TOP CAP SET SCREW INSTALL TORQUE: 20 ft*lbs</b></p>	<p><b>SCHD. 40 PIPE</b></p>

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 shellee  
 CONSTRUCTION

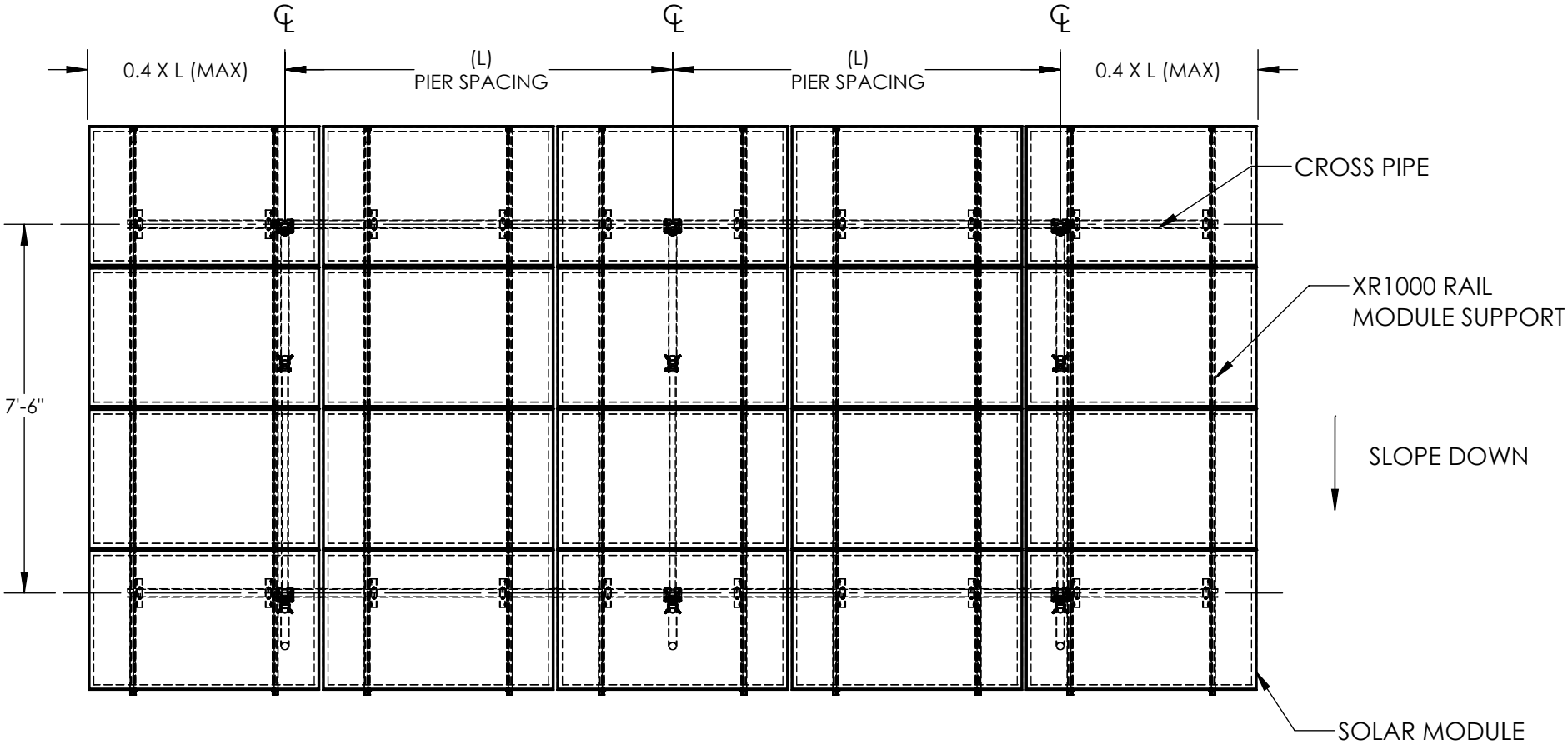


GROUND MOUNT SYSTEM 3" PIER,  
 4 SOLAR MODULE ROWS

SIZE <b>A</b>	DWG. NO. <b>EX-0001</b>	REV. <b>B</b>
SCALE: 1:25	WEIGHT:	SHEET 2 OF 5



PLAN VIEW (6 PIER LAYOUT SHOWN)

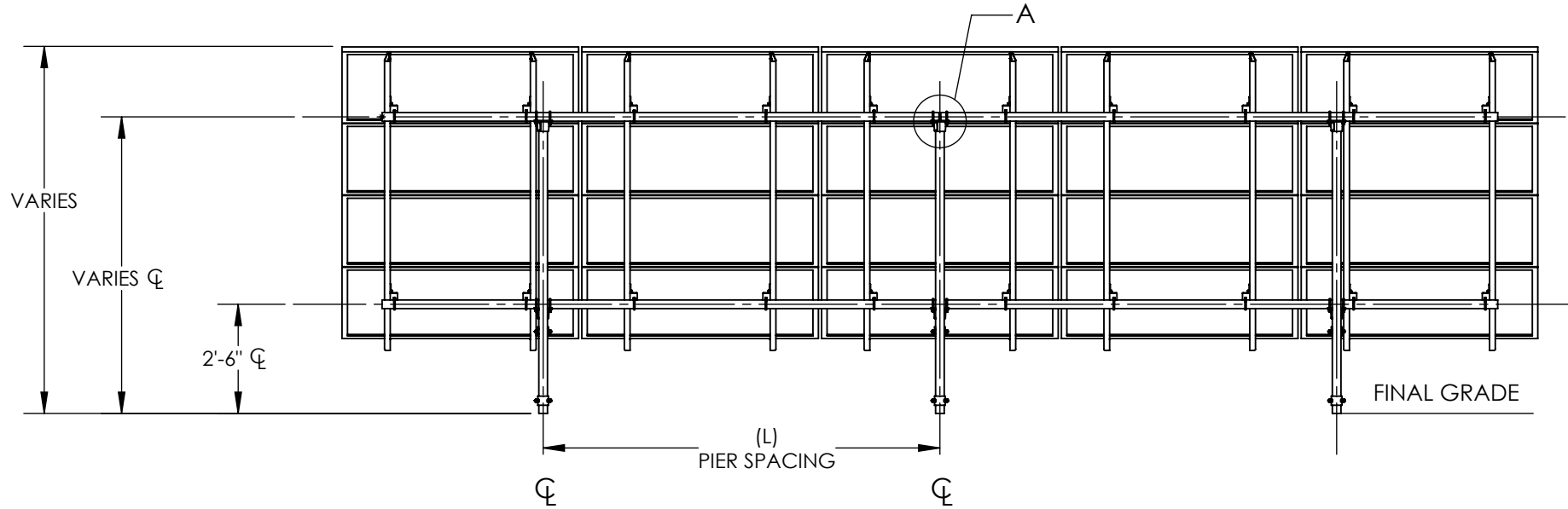


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 REGIONAL  
 CONSTRUCTION



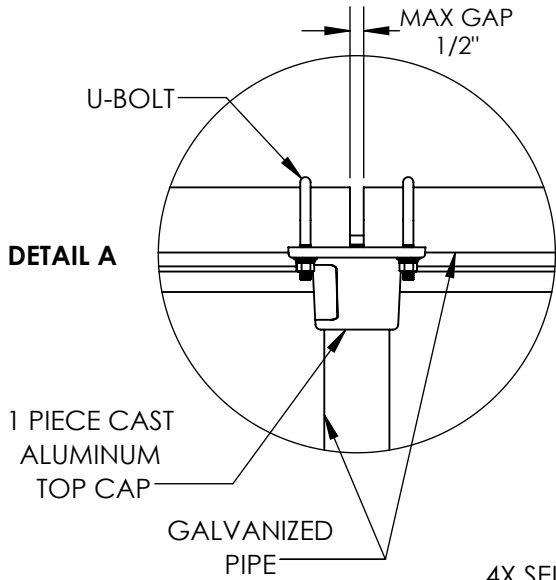
GROUND MOUNT SYSTEM, 4  
 SOLAR MODULE ROWS

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SCALE: 1:25	WEIGHT:	SHEET 3 OF 5



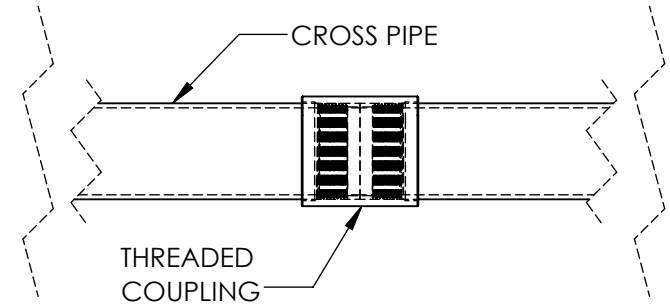
SPLICING CROSS PIPE

ALLIED MECHANICAL TUBE OR SCH. 40 PIPE SPLICE

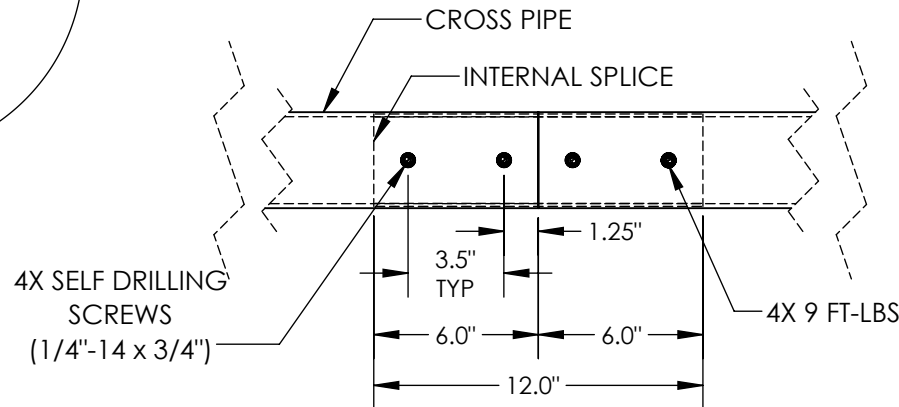


Mechanical Tube Size of the Structure	Splice Tube Size
2.375" OD, 12 Gauge	2.000" OD, 9 Gauge, Minimum 12" Long
3.500" OD, 8 Gauge	3.000" OD, 12 Gauge, Minimum 12" Long

SCH. 40 PIPE SPLICE



ALLIED MECHANICAL TUBE SPLICE

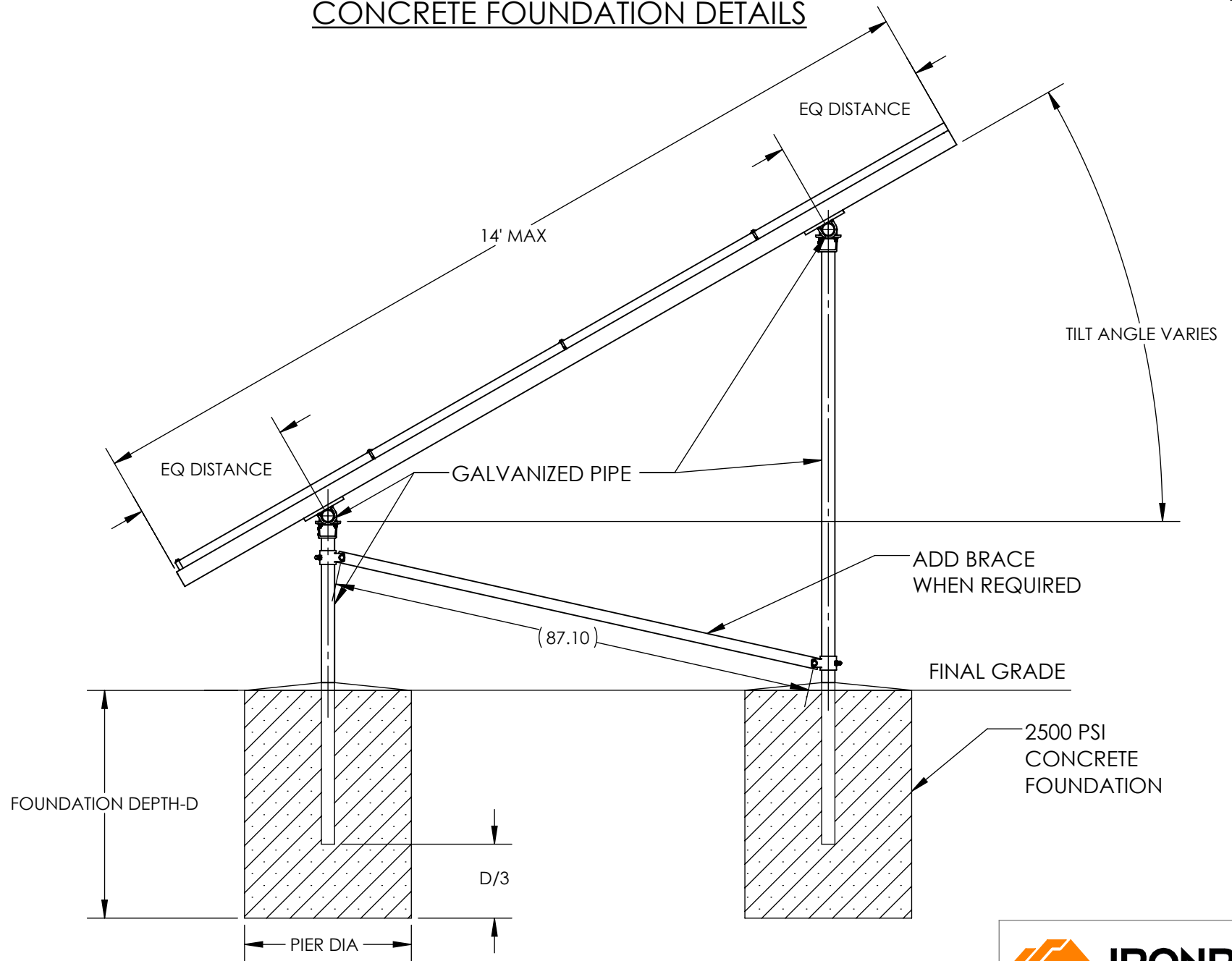


GROUND MOUNT SYSTEM, 4 SOLAR MODULE ROWS

SIZE <b>A</b>	DWG. NO. <b>EX-0001</b>	REV. <b>B</b>
SCALE: 1:25	WEIGHT:	SHEET 4 OF 5

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SHELLEY CONSTRUCTION

CONCRETE FOUNDATION DETAILS



NOTE:  
 THE ATTACHED SPAN TABLES ARE BASED ON USING DRILLED CAST-IN-PLACE CONCRETE PIER FOUNDATION SYSTEM. OTHER FOUNDATION SYSTEMS (EG. SCREW ANCHORS, DRIVEN PIERS) ARE PERMISSIBLE BUT MAY REQUIRE ADDITIONAL BRACING AND/OR REDUCED SPAN. PLEASE CONTACT IRONRIDGE FOR MORE INFORMATION.



GROUND MOUNT SYSTEM, 4 SOLAR MODULE ROWS		
SIZE <b>A</b>	DWG. NO. EX-0001	REV. B
SCALE: 1:25	WEIGHT:	SHEET 5 OF 5