



# ELECTRICAL RESIDENTIAL

910-893-7525

[www.harnett.org](http://www.harnett.org)

PERMIT NUMBER

ERES2508-0025

<b>JOB ADDRESS:</b> 580 NEW CASTLE LN	<b>PERMIT SUBTYPE:</b> RESIDENTIAL SOLAR PANELS	<b>PARCEL NO:</b> 0504-50-6250.000
<b>DESCRIPTION:</b> 4 roof mounted solar panels	<b>DATE ISSUED:</b> 9/5/2025	<b>DATE EXPIRED:</b>
<b>PLAN NAME:</b>	<b>ZONING DISTRICT:</b> RA-20M - 0.29 acres (100.0%)	

<b>APPLICANT:</b> Top Tier Solar Solutions, LLC 1530 Center Park Dr. Charlotte, NC 28217	<b>PHONE:</b> (855)997-1213 <b>EMAIL:</b> nc@toptiersolarsolutions.com
<b>CONTRACTOR:</b> Top Tier Solar Solutions, LLC 1530 Center Park Dr. Charlotte, NC 28217	<b>PHONE:</b> (855)997-1213 <b>EMAIL:</b> nc@toptiersolarsolutions.com
<b>OWNER:</b> SPRAGUE JOSHUA ALLAN 580 NEW CASTLE LN SPRING LAKE, NC 28390 SPRING LAKE, NC 28390-6018	<b>PHONE:</b> <b>EMAIL:</b>

## REQUIRED INSPECTIONS

INSPECTION TYPE	APPROVAL	DATE	COMMENTS
FINAL**			
ROUGH IN			



## STRUCTURAL ANALYSIS for the ROOFTOP PV SOLAR INSTALLATION

Project: Joshua Sprague, 580 New Castle Ln, Spring Lake, NC 28390

Prepared for:



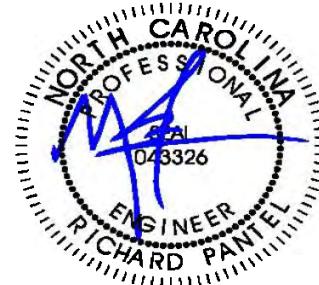
Top Tier  
1530 Center Park Dr - Charlotte, NC 28217

<u>Calculation Report Index</u>	
<u>Pages</u>	<u>Description</u>
1	Cover
	<i>Roof Structural Calculations for PV Solar Installation</i>
7-10	Location: MP 1
15-15	Snow Loading Calculations
16-19	Truss FEA Calculations
<u>Pages</u>	<u>Description</u>
2-6	Loading Summary
	<i>Roof Structural Calculations for PV Solar Installation</i>
11-14	Location: MP 2

Project No: 66.420108, Rev. 0

Report Date: 07/30/2025

Report Prepared by:



Richard Pantel, P.E.  
NC License No. 43326  
Sealed 07/30/2025

## Loading Summary

Exposure and Occupancy Categories		
C		Exposure Category (ASCE 7-16 Table 26.7.3, Page 274)
I		Building Use Occupancy / Risk Category (ASCE 7-16 Table 1.5-1, Page 5)

Wind Loading:			
v	120	mph	Over-ridden per client request. Original data from Municipality provided wind / snow loadings.
qz	27.21	psf	Velocity qz, calculated at height z [ASD]

Snow Loading			
pg	15.00	psf	Ground Snow Load pg (Over-ridden per client request. Original data from Municipality provided wind / snow loadings.)
Total Snow Load			
ps	15.00	psf	Effective snow load on roof and modules

Module Data			
JA Solar: JAM54S31-405/MR			
Dimensions	mm	ft	in
Length	1,722	5.65	67.80
Width	1,134	3.72	44.65
Area (m^2, ft^2)	2.0	21.02	
Weight	kg	lb	
Module	21.50	47.40	

Roof Panel (Cladding) Loading Summary		Module Loading Summary			
Support Point Loads		Upward	Upward	Upward	Downward
Roof Zones		1,2e,2r	2n,3r	3e	All
Net load per module	lb	-326	-417	-555	339

Positive values indicate net downward force

### Primary Stanchion: IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1)

StanchionFastener Pull-out and Spacing Calculations		
Framing spacing	ft	2.00
Rails / Module	ea	2
Max proposed stanchion span	ft	6.00
# fasteners per stanchion		2
Bolt thread embedment depth	in	1.75
Safety Factor		1.10
Pull-out for #14 threaded fasteners	lb/in	134
Factored max fastener uplift capacity	lb	425
Fastener details	Material	Stainless
Max stanchion uplift capacity	lb	1100
Max support point uplift capacity	lb	425

*lb per inch of embedment*

*Predrill hole 0.12" dia or use self tapping*

Roof Zones		1,2e,2r	2n,3r	3e
Net lift per module	lb	326	417	555
Min tot bolt thread embedment depth rq'd	in	1.34	1.72	2.29
Net uplift pressure	7. 0.60D - 0.6W	psf	-9.61	-12.31
Allowable lift area / support point	sf	44.22	34.50	25.93
Max rail span per support spacing	ft	6.00	6.00	6.00

### Landscape Modules

Length along rafter	ft	3.72		
Lift calc'ed max stanchion EW spacing	ft	> 6	> 6	> 6
Max stanchion EW spacing	ft	6.00	6.00	6.00
Maximum module area / support point	sf	11.16	11.16	11.16
Factored lift per support point	lb	-107	-137	-183

### Portrait Modules

Length along rafter	ft	5.65		
Lift calc'ed max stanchion EW spacing	ft	> 6	> 6	> 6
Max stanchion EW spacing	ft	6.00	6.00	6.00
Maximum module area / support point	sf	16.95	16.95	16.95
Factored lift per support point	lb	-163	-209	-278

### Alternate Stanchion Fastener Pull-out and Spacing Calculations

#### IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) - 6 screws

Framing spacing	ft	2.00		
Rails / Module	ea	2		
Max proposed stanchion span	ft	6.00		
# fasteners per stanchion		6		
Bolt thread embedment depth	in	0.50		
Safety Factor		1.10		
Pull-out for 1/4 threaded fasteners	lb/in	134		
Factored max fastener uplift capacity	lb	364		
Fastener details	Material	Stainless	Size	1/4
Max stanchion uplift capacity	lb	1100		
Max support point uplift capacity	lb	364		

*Predrill hole 0.12" dia or use self tapping*

Roof Zones		1,2e,2r	2n,3r	3e
Net lift per module	lb	326	417	555
Min tot bolt thread embedment depth rq'd	in	0.45	0.57	0.76
Net uplift pressure	7. 0.60D - 0.6W	psf	-9.61	-12.31
Allowable lift area / support point	sf	37.90	29.57	22.22
Max rail span per framing spacing	ft	6.00	6.00	6.00

### Landscape Modules

Length along rafter	ft	3.72		
Lift calc'ed max stanchion EW spacing	ft	> 6	> 6	> 6
Max stanchion EW spacing	ft	6.00	6.00	6.00

Maximum module area / support point	<i>sf</i>	11.16	11.16	11.16
Factored lift per support point	<i>lb</i>	-107	-137	-183
<b>Portrait Modules</b>				
Length along rafter	<i>ft</i>	5.65		
Lift calc'ed max stanchion EW spacing	<i>ft</i>	> 6	> 6	6.00
Max stanchion EW spacing	<i>ft</i>	6.00	6.00	6.00
Maximum module area / support point	<i>sf</i>	16.95	16.95	16.95
Factored lift per support point	<i>lb</i>	-163	-209	-278

Stanchion support threaded fastener sizes are indicated in the Module Loading Summary table above. Lift forces were determined from GCp and other coefficients contained in the ASCE nomographs

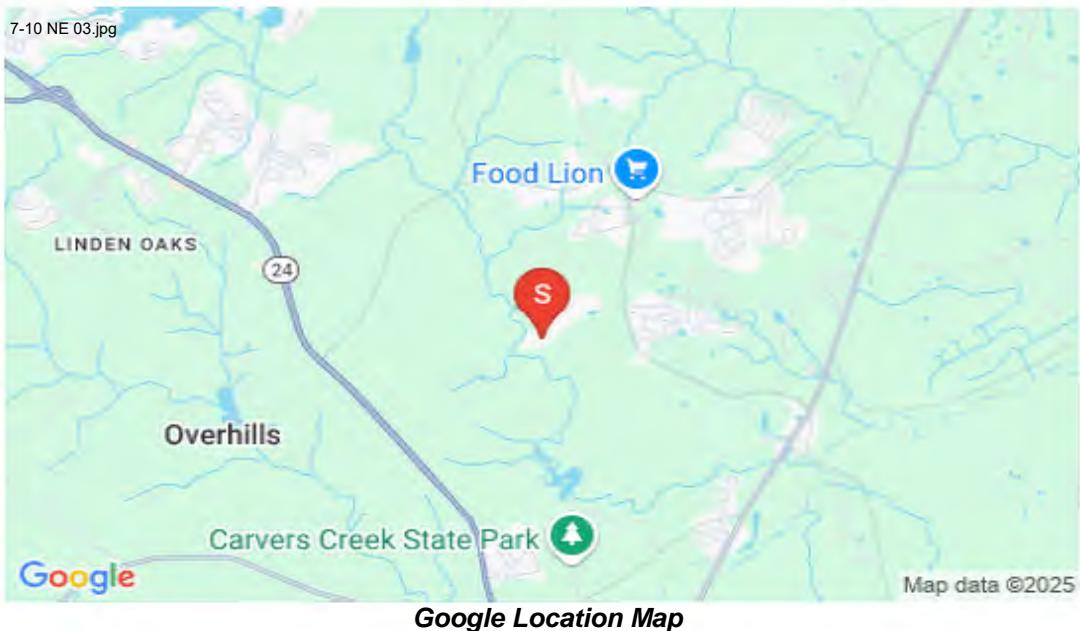
## Conclusions

We were asked to review the roof of Joshua Sprague, located at 580 New Castle Ln, Spring Lake, NC, by Top Tier, to determine its suitability to support a PV solar system installation.

The referenced building's roof structure was field measured by Top Tier. The attached framing analyses reflect the results of those field measurements combined with the PV solar module locations shown on the PV solar roof layout design prepared by Top Tier. Loads are calculated to combine the existing building and environmental loads with the proposed new PV array loads.

The IronRidge XR10 Rail racking and IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) along with the alternate IronRidge HALO ULTRAGRIP - (QM-HUG-01-B1) - 6 screws stanchions were selected for this project by Top Tier.

The racking and support stanchions shall be placed as shown on their plans, dated 07/30/2025, and shall be fastened to the roof framing using fastener sizes indicated in this report. Rack support spacing shall be no more than that shown above. Note that support points for alternating rows shall share the same truss. Intermediate rows shall move the support points laterally to the next truss.



### Framing Summary

MP 1: Truss @ 24" OC  
 MP 2: Truss @ 24" OC

\* Wood species used in these calculations assumes spruce, pine or fir, #2 grade.

Based upon the attached calculations, the existing roofs' framing systems are capable of supporting the additional loading for the proposed PV solar system along with the existing building and environmental loads. No supplemental roof framing structural supports are required. No further structural alterations or modifications are needed to support the system. Minimum required anchorage fastening is described above.

*Wood fastener notes: 1) Fastener threads must be embedded in the side grain of a roof support structural member or other structural member integrated into the building's structure. 2) Fastener must be located in the middle third of the structural member. 3) Install fasteners with head and where required, washer, flush to material surface (no gap). Do not over-torque.*

### References and Codes:

- 1) ASCE 7-16 Minimum Design Loads for Buildings and Other Structures
- 2) 2018 IBC
- 3) 2018 NC Building Code
- 4) American Wood Council, NDS 2018, Table 12.2A, 12.3.3A.
- 5) American Wood Council, Wood Structural Design, 1992, Figure 6.

# Roof Structural Calculations for PV Solar Installation

Location: MP 1

Member: Truss - Total Length 21.17 ft, Unsupported 21.17 ft

Array AR-1

Roof shape: Gable

Geometric Data			
$\Theta$	deg.	36.0	Angle of roof plane from horizontal, in degrees
$\omega$	deg.	0.0	Angle the solar panel makes with the roof surface
L	ft.	48.00	Length of roof plane, in feet (meters)
W	ft.	18.00	Plan view width of roof plane, in feet (meters)
h	ft.	16.84	Average height of roof above grade, in feet (meters)

Roof Wind Zone Width		
	use, a =	3.00 ft

Wind Velocity Pressure, $q_z$ evaluated at the height z					
$q_z =$	27.21	psf	$V_{asd} q_z =$	16.34	psf
V =	120				mph

Framing Data		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support	1	
Rafter / Truss OC	in	24.00
Member Total Length	ft	21.17

3	# Rafters / Rack Support Width
6.00	Rack Support Spacing (ft)
72.00	Max. Rack Support Spacing (in)
4	Max # of mod's / Truss top chord

Member Properties		Member
Name		(1) 2x4
Repetitive Member Factor (Cr)		1.15

\* Mem properties based upon field measurements

Truss top chord

Module Data			
Weight	kg	lb	psf load
Module	21.50	47.40	2.26
4 Stanchions	0.91	2.0	0.10

Existing Dead Loads	Units	Value	Description
Roof Deck & Surface Material*	psf	5.15	Truss members' self weight added to FEA analysis

\* Roof surface: Shingles, Asphalt, Architectural (Typical)

Rack Support Spacing and Loading			
Across rafters	ft	6.0	
Along rafter slope	ft	5.6	
Area / support point	sf	16.9	
Uphill gap between modules	in	1.0	0.08 ft

Member Total Length	ft	21.17	
Maximum member free span	ft	21.17	Truss top chord span

## Notation

Lp = Panel chord length.

p = uplift wind pressure

 $\gamma_a$  = Solar panel pressure equalization factor, defined in Fig. 29.4-8. $\gamma_E$  = Array edge factor as defined in Section 29.4.4. $\theta$  = Angle of plane of roof from horizontal, in degrees.

## 29.4.4 Rooftop Solar Panels Parallel to the Roof Surface on Buildings of All Heights and Roof Slopes.

$$\theta \geq 7 \text{ deg} \quad \text{TRUE}$$

Min.d1: Exposed **FALSE**Max.d1: Exposed **TRUE***Use EXPOSED for uplift calculations*

$$1.5(L_p) = 5.58$$

$$\gamma_E = 1.5$$

$$\gamma_a = 0.67$$

$$p = qh(GCp)(\gamma_E)(\gamma_a) \text{ (lb/ft}^2\text{)} \quad (29.4-7)$$

Zones	1,2e,2r	2n,3r	3e
GCp	-1.48	-1.75	-2.16
p, Windload (psf)	-24.30	-28.81	-35.60

Downward, Zones All Zones

$$GCp \quad 0.77$$

ASCE 7-16 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e,2r	2n,3r	3e	All Zones
2.2 SYMBOLS AND NOTATION	Module Upward	Module Upward	Module Upward	Downward
D = dead load of PV Module + Stanchion	2.35	2.35	2.35	2.35
S = snow load	15.00	15.00	15.00	15.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-24.30	-28.81	-35.60	12.60

#### 2.4 Combining Nominal Loads Using Allowable Stress Design (in psf)

2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member being considered. Effects of one or more loads not acting shall be considered.

Combination Formulae	Upward	Upward	Upward	Downward
<b>Use this loading combination for DOWNWARD for Proposed PV Dead Load</b>				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	17.35	17.35	17.35	23.02
Module Support point load (lb)	294	294	294	390
Cr Factored Module Support point load (lb)	256	256	256	339

#### Use this loading combination for UPWARD for Proposed PV Dead Load

7. 0.60D - 0.6W	-9.61	-12.31	-16.39	8.29
Module Support point load (lb)	-163	-209	-278	140

#### DOWNTWARD

Presume loading directly over member.

#### Combined Dead and Wind Pressure Downward Loading

PV Module Row	Truss top chord span		Comment	Module Orientation
	Point load loc's from Left support	Point Load #'s		
	ft from left	lb		
1	0.67		Support placed on adjoining truss	Portrait
1	6.32	339		Portrait
2	6.40	339		Portrait
2	12.05		Support placed on adjoining truss	Portrait
3	12.14		Support placed on adjoining truss	Portrait
3	17.79	339		Portrait
4	17.87	339		Landscape
4	21.59		Support outside of max stressed section	Landscape

### Truss Data and Loading for MP 1

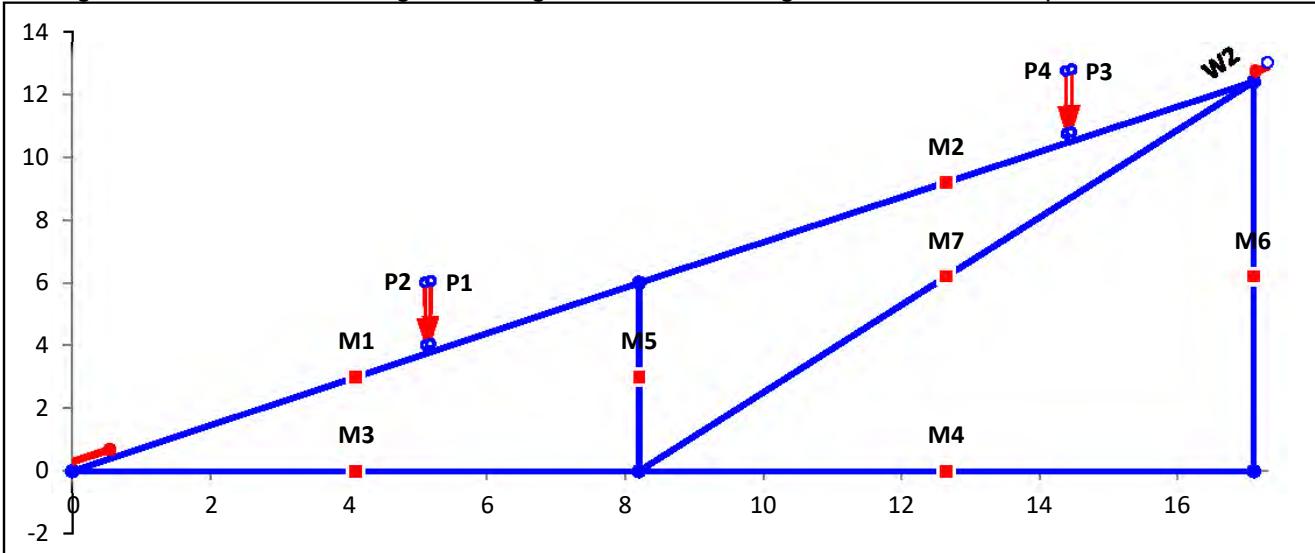
Roof slope (degrees)	36.00
Top ridge height above floor plane	12.44

Length of roof plane	21.17
Length of floor plane	17.17

### Truss Segments

Roof Plane		Floor Plane			Diagonals		Diagonals	
Mem #	Mem Type	Mem #	Mem Type		Mem #	Mem Type	Mem #	Mem Type
1	2x4	3	2x4		5	2x4	7	2x4
2	2x4	4	2x4		6	2x4		2x4

\* Loading includes member self weight & roofing materials. w loading = wind & snow on exposed areas



# Roof Structural Calculations for PV Solar Installation

Location: MP 2

Member: Truss - Total Length 12.67 ft, Unsupported 12.67 ft

Array AR-2

Roof shape: Gable

Geometric Data			
$\Theta$	deg.	36.0	Angle of roof plane from horizontal, in degrees
$\omega$	deg.	0.0	Angle the solar panel makes with the roof surface
L	ft.	26.67	Length of roof plane, in feet (meters)
W	ft.	11.08	Plan view width of roof plane, in feet (meters)
h	ft.	14.33	Average height of roof above grade, in feet (meters)

Roof Wind Zone Width		
	use, a =	3.00 ft

Wind Velocity Pressure, $q_z$ evaluated at the height z					
$q_z =$	26.63	psf	$V_{asd} q_z =$	16.00	psf
V =	120				mph

Framing Data		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support	1	
Rafter / Truss OC	in	24.00
Member Total Length	ft	12.67

3	# Rafters / Rack Support Width
6.00	Rack Support Spacing (ft)
72.00	Max. Rack Support Spacing (in)
1	Max # of mod's / Truss top chord

Member Properties		Member
Name		(1) 2x4
Repetitive Member Factor (Cr)		1.15

\* Mem properties based upon field measurements

Truss top chord

Module Data			
Weight	kg	lb	psf load
Module	21.50	47.40	2.26
4 Stanchions	0.91	2.0	0.10

Existing Dead Loads	Units	Value	Description
Roof Deck & Surface Material*	psf	5.15	Truss members' self weight added to FEA analysis

\* Roof surface: Shingles, Asphalt, Architectural (Typical)

Rack Support Spacing and Loading				
Across rafters	ft	6.0		
Along rafter slope	ft	5.6		
Area / support point	sf	16.9		
Uphill gap between modules	in	1.0	0.08	ft

Member Total Length	ft	12.67	
Maximum member free span	ft	12.67	Truss top chord span

## Notation

Lp = Panel chord length.

p = uplift wind pressure

 $\gamma_a$  = Solar panel pressure equalization factor, defined in Fig. 29.4-8. $\gamma_E$  = Array edge factor as defined in Section 29.4.4. $\theta$  = Angle of plane of roof from horizontal, in degrees.

## 29.4.4 Rooftop Solar Panels Parallel to the Roof Surface on Buildings of All Heights and Roof Slopes.

 $\Theta \geq 7 \text{ deg}$  TRUE

Min.d1: Exposed FALSE

Max.d1: Exposed TRUE

Use EXPOSED for uplift calculations

$$1.5(L_p) = 5.58$$

$$\gamma_E = 1.5$$

$$\gamma_a = 0.67$$

$$p = qh(GCp)(\gamma_E)(\gamma_a) \text{ (lb/ft}^2\text{)} \quad (29.4-7)$$

Zones	1,2e,2r	2n,3r	3e
GCp	-1.48	-1.75	-2.16
p, Windload (psf)	-23.79	-28.20	-34.84

Downward, Zones All Zones

$$GCp \quad 0.77$$

ASCE 7-16 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)				
Zones	1,2e,2r	2n,3r	3e	All Zones
2.2 SYMBOLS AND NOTATION	Module Upward	Module Upward	Module Upward	Downward
D = dead load of PV Module + Stanchion	2.35	2.35	2.35	2.35
S = snow load	15.00	15.00	15.00	15.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-23.79	-28.20	-34.84	12.33

#### 2.4 Combining Nominal Loads Using Allowable Stress Design (in psf)

2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member being considered. Effects of one or more loads not acting shall be considered.

Combination Formulae	Upward	Upward	Upward	Downward
<b>Use this loading combination for DOWNWARD for Proposed PV Dead Load</b>				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	17.35	17.35	17.35	22.90
Module Support point load (lb)	294	294	294	388
Cr Factored Module Support point load (lb)	256	256	256	338

#### Use this loading combination for UPWARD for Proposed PV Dead Load

7. 0.60D - 0.6W	-9.30	-11.95	-15.93	8.29
Module Support point load (lb)	-158	-203	-270	140

#### DOWNTWARD

Presume loading directly over member.

#### Combined Dead and Wind Pressure Downward Loading

PV Module Row	Truss top chord span			Comment	Module Orientation
	Point load loc's from Left support	Point Load #'s	Module Support Point Load		
	<i>ft from left</i>		<i>lb</i>		
1	7.67		338		Portrait
1	13.32			Support outside of max stressed section	Portrait

## Truss Data and Loading for MP 2

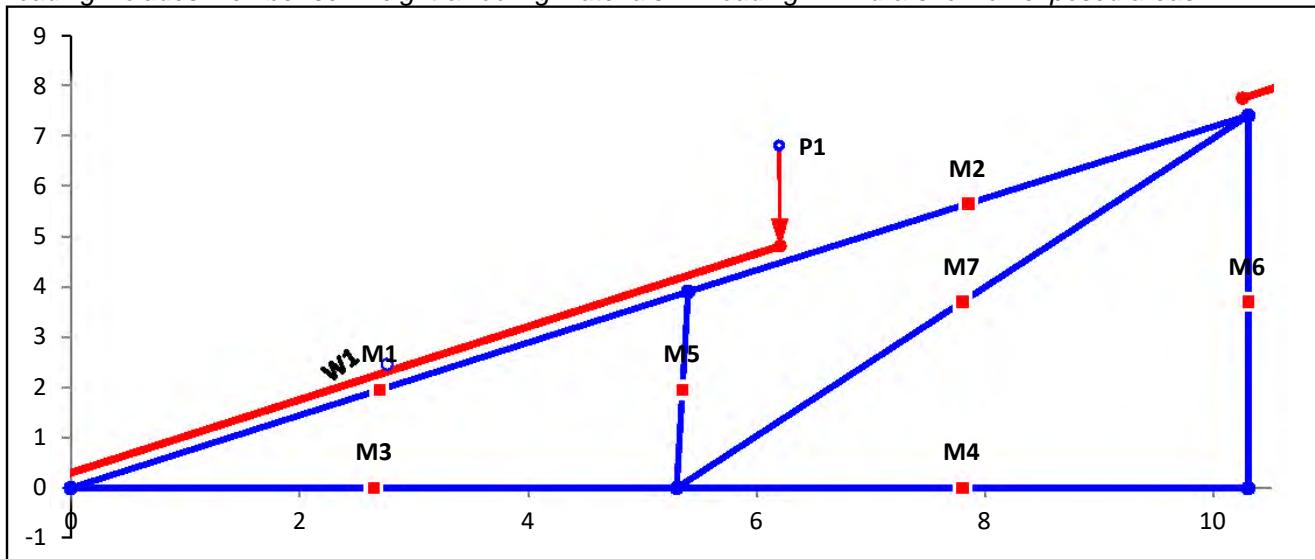
Roof slope (degrees)	36.00
Top ridge height above floor plane	7.45

	Length of roof plane	12.67
	Length of floor plane	10.25

## Truss Segments

Roof Plane		Floor Plane		Diagram	Diagonals		Diagonals	
Mem #	Mem Type	Mem #	Mem Type		Mem #	Mem Type	Mem #	Mem Type
1	2x4	3	2x4		5	2x4	7	2x4
2	2x4	4	2x4		6	2x4		2x4

\* Loading includes member self weight & roofing materials. w loading = wind & snow on exposed areas



## Snow Loading Analysis

where:

	Fully Exposed	Exposure category
<b>C<sub>e</sub></b>	= 0.9	Exposure Factor, Ce (ASCE 7-16 Table 7.3-1, Page 61)
<b>C<sub>t</sub></b>	= 1.0	Thermal Factor, Ct (ASCE 7-16 Table 7.3-2, Page 61)
<b>I<sub>s</sub></b>	= 1.0	Snow Importance Factor, Is (ASCE 7-16 Table 1.5-2, Page 5)
<b>p<sub>g</sub></b>	= 15.00	Ground Snow Load pg (Over-ridden per client request. Original data from Municipality
<b>p<sub>f</sub></b>	= <b>0.7C<sub>e</sub>C<sub>t</sub>I<sub>s</sub>P<sub>g</sub></b>	Flat Roof Snow Load, pf (ASCE 7-16 Table 7.3-1, Page 61)
<b>p<sub>f</sub></b>	= <b>9.45</b> psf	but where Pf is not less than the following: Minimum Snow Load pm (ASCE 7-16 Table 7.3.4, Page 62)
<b>p<sub>m</sub></b>	= <b>15.00</b>	When Pg <=20 psf, then use Pf = Pg x Is
<b>p<sub>f</sub></b>	= <b>15.00</b>	psf. Resultant Snow pressure to be used with Roof slope factor below
<b>p<sub>s</sub></b>	= <b>C<sub>s</sub>p<sub>f</sub></b>	Sloped Roof Snow Load ps (ASCE 7-16 Table 7.4, Page 61) Roof Type Warm Roofs

*Roof slope factor Cs for Warm Roofs, where Ct = 1.0*

Roof surface condition = Slippery Roof

**C<sub>s</sub>** = 1.00 Roof Slope Factor, Cs (ASCE 7-16 Table 7.4-1a, Page 62)

## Total Snow Load

**p<sub>s</sub>** = **15.00 psf** Roof snow load

# FEA Calculation Results for Roof Plane MP 1 for Top Tier Client JOSHUA SPRAGUE

*IDSPL - 2D Frame Analysis of a 2D frame subject to distributed loads, point loads and moments*

Equilibrium check	FX	FY	0.00031
Total applied forces	0.00	2079	
Total output reactions	0.00	-2079	
Output error	5.01E-13	1.82E-12	

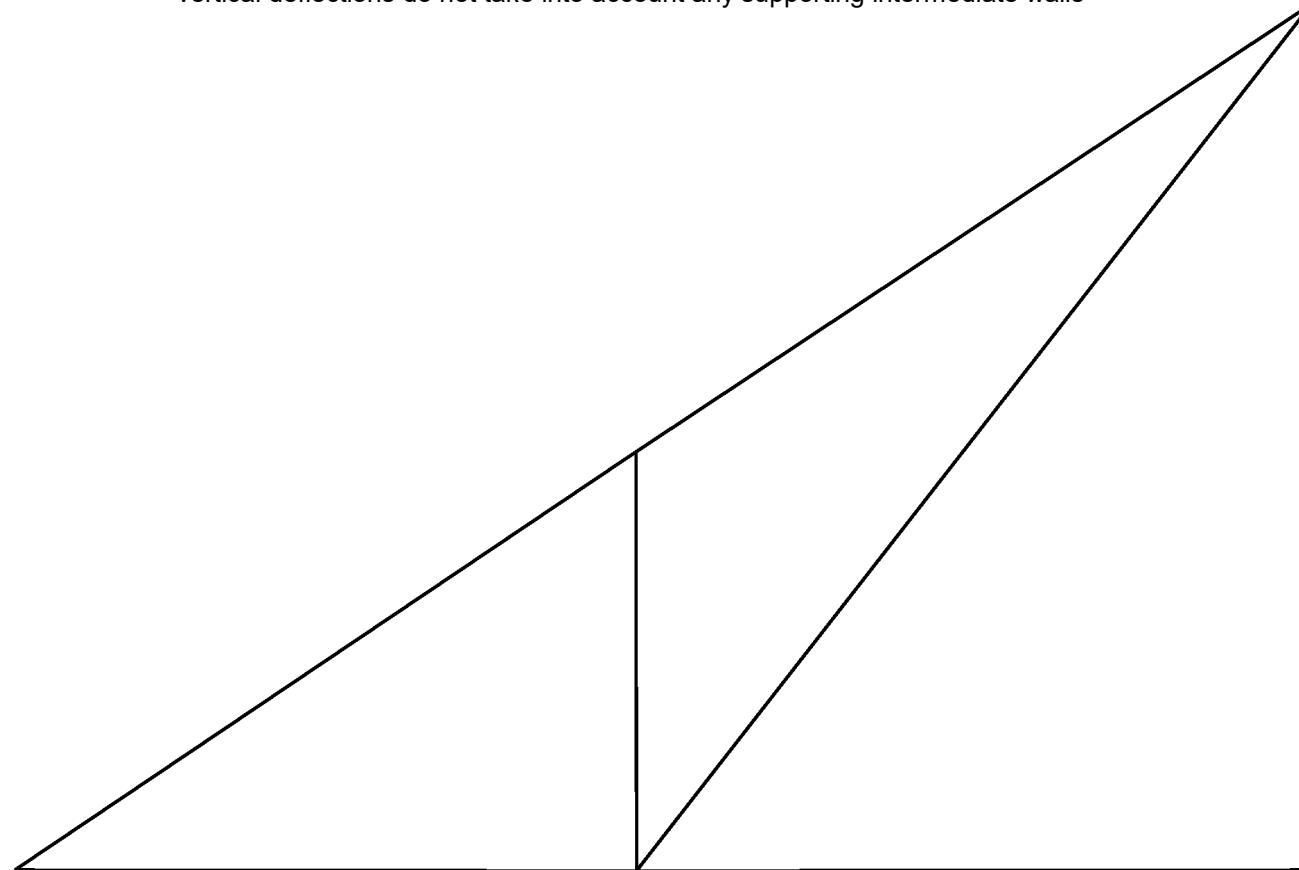
	Shear	Ax
Max (psi)	7	330
Allowable (psi)	115	5,610
# of segments/beam		1

Maximum Deflections
-3.81E-03      -7.38E-03

\* vertical deflections do not take into account any supporting intermediate walls

Node Results			Beam End Results			
Direction	Deflection	Reaction	Beam	Shear	Axial	BM
DX1	0.00E+00	0	1-1	-98	1280	0
DY1	0.00E+00	-1298		310	981	0
RZ1	0.00E+00	0		-369	1465	0
DX2	-3.78E-03	0	2-2	56	1160	0
DY2	7.38E-03	0		-463	-974	0
RZ2	0.00E+00	0		2	-974	0
DX3	2.42E-03	0	4-1	-465	0	0
DY3	1.16E-03	0		-126	0	0
RZ3	0.00E+00	0		0	849	0
DX4	-8.50E-04	0	5-2	0	825	0
DY4	6.84E-03	0		0	906	0
RZ4	0.00E+00	0		0	817	0
DX5	-8.50E-04	0	6-1	-24	-1638	0
DY5	0.00E+00	-780		53	-1745	0
RZ5	0.00E+00	0				
Rel1-3	9.66E-04	0				
Rel1-6	1.06E-03	0				

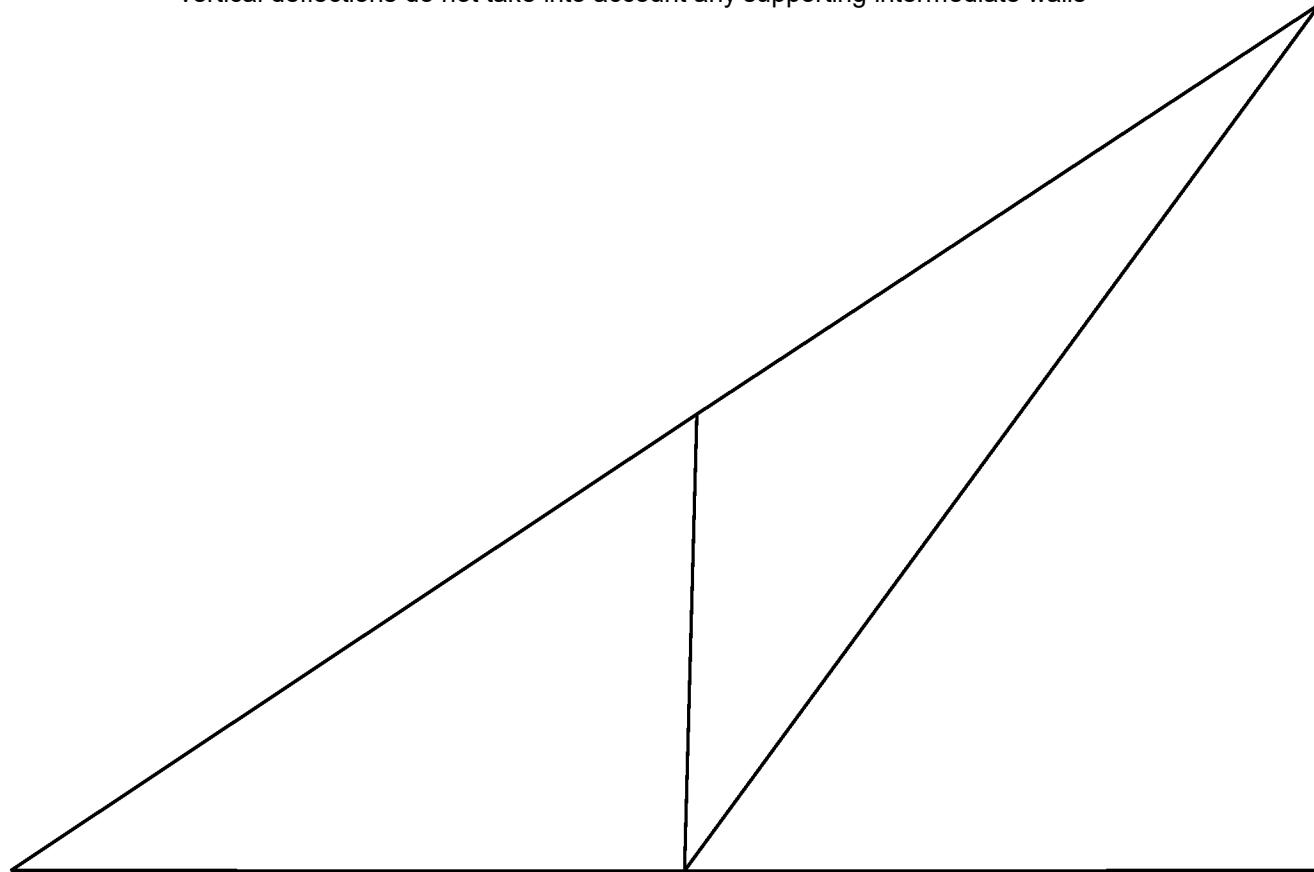
\* vertical deflections do not take into account any supporting intermediate walls



**Scaled 2X Deflected Truss Plot**  
**Roof Plane MP 1 for Top Tier Client JOSHUA SPRAGUE**



\* vertical deflections do not take into account any supporting intermediate walls



**Scaled 2X Deflected Truss Plot**  
**Roof Plane MP 2 for Top Tier Client JOSHUA SPRAGUE**





# Photovoltaic Combiner Box X-IQ-AM1-240-4

## Electrical ratings

Voltage	240VAC, 60Hz
DG Breakers	80A MAX (combined)
DG Inputs	64A MAX (combined)
Output	65A MAX, 90A MAX feeder OCPD
Temperature	46°C MAX ambient

For DG breaker, use only Eaton BR series.

202304119824

S/N:

202304119824

P/N:

883

Dedicated solar and DG Combiner Box - do not add  
10 AMP or 15 AMP IQ Gateway Breaker not used for

Connection	Wire sizes
DG Breaker (1, 2, 3, 4)	14-10 AWG 8 AWG 6-4 AWG
60A Circuit Breaker only	4-1/0 AWG
IQ Gateway Breaker	14-10 AWG
Neutral and ground	Large screw 2-1/0 AWG 14-3 AWG
	Small screw 6 AWG 8 AWG

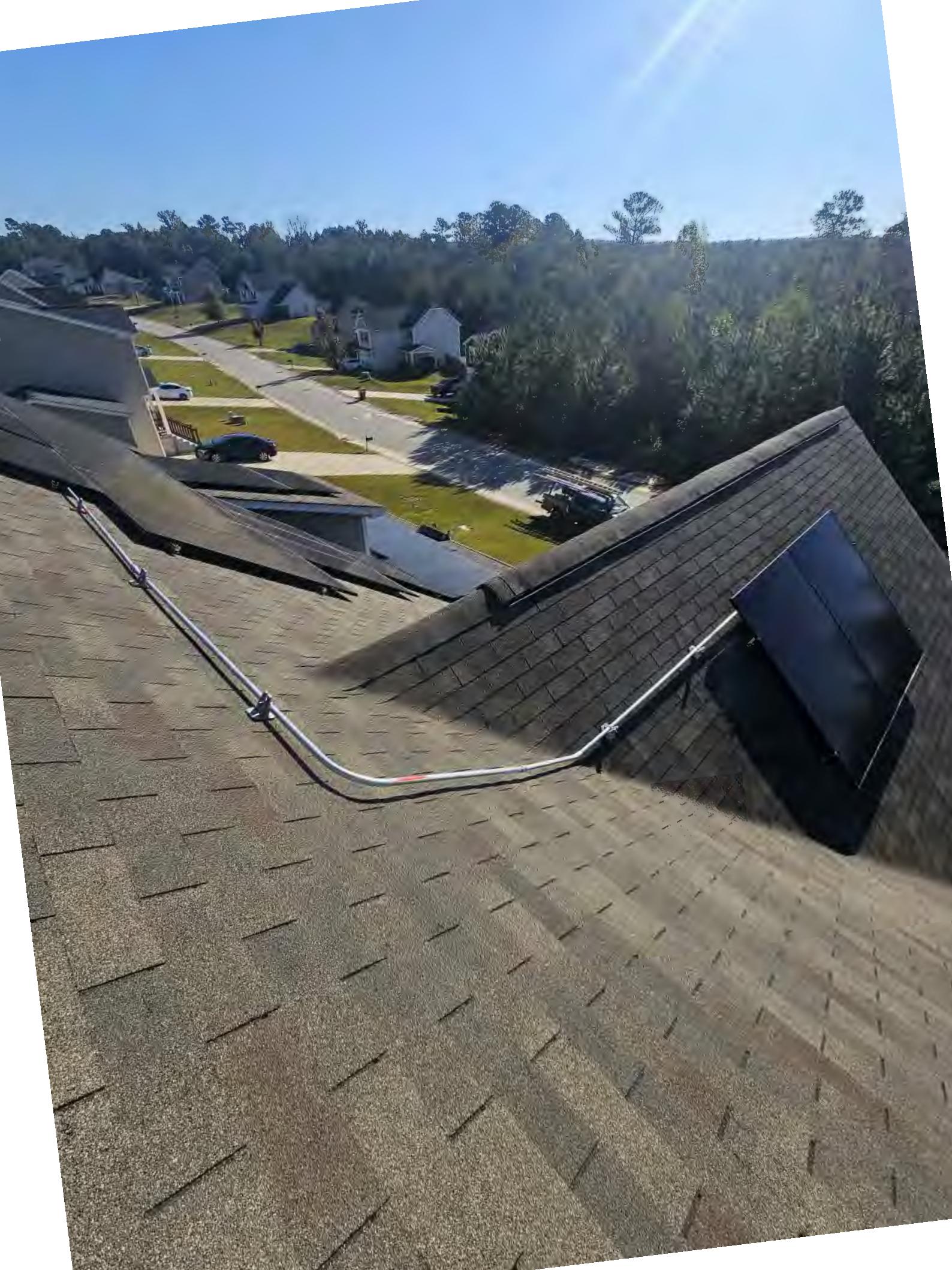


DE-ENERGIZE  
BEFORE  
CLEANING

































15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49



26 27 28 29 30 31

33 34 35

36

37 38 39

40 41

42 43

44 45

46 47

48 49

50











IQ8PLUS-72-M-US  
882-01374 08

532518009557



108PLUS-72-M-US  
108-01374 08

532518010071



IQ8PLUS-72-M-US  
882-0137A 07

E500984-B (UL) TYPE 10 800M F1

100PLUS-72-M-US

082-01074 07

532444049893

JA SOLAR 晶澳

TYPE	JAM64S1-405MR
Peak power (Pmax)	405W±3%
Open circuit voltage (Voc)	37.23V±3%
Max. power voltage (Vmp)	31.21V
Short circuit current (Isc)	13.87A±3%
Max. power current (Imp)	12.98A
Power Selection	±2%

PV connector manufacturer & Type: Stäubli,  
PV-KST4-EVO2/8II-UR, PV-KBT4-EVO2/8II-UR



2550105DK0063519

#### Customer Care - M

• Made in Laos



Please refer to the Installation Manual for the designated routing connection. Scan QR to download Installation Manual. Web: <http://www.jaeelac.com>

Safety Class based on IEC 61140: Class II  
Module fire performance: Type 1  
PV module 80th percentile operating temperature: 70°C  
Fluid: Multicell, Glycerine and EG  
Cell: Monocrystalline, 500Wp, 12Vdc, 1000°C

Field Wiring: Copper only 12AWG min insulated for 90°C

Maximum overcurrent protection rating: 25A  
 Maximum system voltage: 1600 V  
 Min. design load: -1600 Pa / +3800 Pa  
 Protection class: II

See insert for instructions  
STC Condition AME-1.5 Test STC 8-1

Solarmax Technology (Lever) Sales Co.

**NANO VILLAGE, SADYSETTHA  
DEVELOPMENT ZONE, SADYSETTHA**

THE VELLOM VIENTIEN ZONE, SAYSETTHA  
DISTRICT, VIENTIANE CAPITAL, LAO PDR

**JA SOLAR** 昌澳

**WARNING Avertissement**  
Electrical Hazard Risque électrique  
This unit produces electricity if exposed to light.  
Do not disconnect under load.  
Cette unité produit de l'électricité si elle est  
exposée à la lumière.  
Ne débranchez pas en charge.



**TYPE** JAM54S31-405/MR  
Peak power(Pmax) 405W±3%  
Open circuit voltage (Voc) 37.23V±3%  
Max. power voltage (Vmp) 31.21V  
Short circuit current (Isc) 13.87A±4%  
Max. power current (Imp) 12.98A  
Power Selection ±2%

PV connector manufacturer & Type: Stäubli,  
PV-KST4-EVO2/6II-UR, PV-KBT4-EVO2/6II-UR



2550105DK0063519

Current Class- M

Made in Laos

Int  
503  
Contr  
61730-1  
61215-1  
Certified  
C22.2 No

# PHOTOVOLTAIC ROOF MOUNT SYSTEM

(E) 26 + (N) 4 MODULES-ROOF MOUNTED - 12.020 kW DC, 8.700 kW AC

580 NEW CASTLE LN, SPRING LAKE, NC 28390



TOP TIER  
SOLAR SOLUTIONS  
1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

PROJECT DATA		GENERAL NOTES	VICINITY MAP	REVISIONS												
PROJECT ADDRESS	580 NEW CASTLE LN, SPRING LAKE, NC 28390	1. ALL COMPONENTS ARE UL LISTED AND CEC CERTIFIED, WHERE WARRANTED. 2. THE SOLAR PV SYSTEM WILL BE INSTALLED IN ACCORDANCE WITH ARTICLE 690 OF THE NEC 2017. 3. THE UTILITY INTERCONNECTION APPLICATION MUST BE APPROVED AND PV SYSTEM INSPECTED PRIOR TO PARALLEL OPERATION. 4. ALL CONDUCTORS OF A CIRCUIT, INCLUDING THE EGC, MUST BE INSTALLED IN THE SAME RACEWAY, OR CABLE, OR OTHERWISE RUN WITH THE PV ARRAY CIRCUIT CONDUCTORS WHEN THEY LEAVE THE VICINITY OF THE PV ARRAY. 5. WHERE METALLIC CONDUIT CONTAINING DC CONDUCTORS IS USED INSIDE THE BUILDING, IT SHALL BE IDENTIFIED AS "CAUTION: SOLAR CIRCUIT" EVERY 10FT. 6. HEIGHT OF THE AC DISCONNECT SHALL NOT EXCEED 6'-7" PER NEC CODE 240.24. 7. A GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH CEC 690.47 AND 250.50 THROUGH 60 AND 250-166 SHALL BE PROVIDED. PER NEC GROUNDING ELECTRODE SYSTEM OF EXISTING BUILDING MAY BE USED AND BONDED TO THE SERVICE ENTRANCE. IF EXISTING SYSTEM IS INACCESSIBLE OR INADEQUATE A SUPPLEMENTAL GROUNDING ELECTRODE WILL BE USED AT THE INVERTER LOCATION CONSISTING OF A UL LISTED 8 FT. GROUND ROD WITH ACORN CLAMP. GROUNDING ELECTRODE CONDUCTORS SHALL BE NO LESS THAN #8 AWG AND NO LARGER THAN #6 AWG COPPER AND BONDED TO THE EXISTING GROUNDING ELECTRODE TO PROVIDE FOR A COMPLETE SYSTEM. 8. PHOTOVOLTAIC MODULES ARE TO BE CONSIDERED NON-COMBUSTIBLE. 9. PHOTOVOLTAIC INSTALLATION WILL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS. 10. ALL WIRING MUST BE PROPERLY SUPPORTED BY DEVICES OR MECHANICAL MEANS DESIGNED AND LISTED FOR SUCH USE. WIRING MUST BE PERMANENTLY AND COMPLETELY HELD OFF THE ROOF SURFACE. 11. ALL SINAGE TO BE PLACED IN ACCORDANCE WITH THE LOCAL BUILDING CODE. IF EXPOSED TO SUNLIGHT, IT SHALL BE UV RESISTANT. ALL PLAQUES AND SINAGE WILL BE INSTALLED AS REQUIRED BY THE NEC AND AHJ. 12. INVERTER(S) USED IN UNGROUNDED SYSTEM SHALL BE UL 1741 LISTED. 13. THE INSTALLATION OF EQUIPMENT AND ALL ASSOCIATED WIRING AND INTERCONNECTION SHALL BE PERFORMED ONLY BY QUALIFIED PERSONS [NEC 690.4(C)] 14. ALL OUTDOOR EQUIPMENT SHALL BE NEMA 3R RATED (OR BETTER), INCLUDING ALL ROOF MOUNTED TRANSITION BOXES AND SWITCHES. 15. ALL EQUIPMENT SHALL BE PROPERLY GROUNDED AND BONDED IN ACCORDANCE WITH NEC ARTICLE 250. 16. SYSTEM GROUNDING SHALL BE IN ACCORDANCE WITH NEC 690.41. 17. PV SYSTEM CIRCUITS INSTALLED ON OR IN BUILDINGS SHALL INCLUDE A RAPID SHUTDOWN FUNCTION IN ACCORDANCE WITH NEC 690.12 18. DISCONNECTING MEANS SHALL BE LOCATED IN A VISIBLE, READILY ACCESSIBLE LOCATION WITHIN THE PV SYSTEM EQUIPMENT OR A MAXIMUM OF 10 FEET AWAY FROM THE SYSTEM [NEC 690.13(A)] 19. ALL WIRING METHODS SHALL BE IN ACCORDANCE WITH NEC 690.31 20. WORK CLEARANCES AROUND ELECTRICAL EQUIPMENT WILL BE MAINTAINED PER NEC 110.26(A)(1), 110.26(A)(2) AND 110.26(A)(3). 21. ROOFTOP MOUNTED PHOTOVOLTAIC PANELS AND MODULES SHALL BE TESTED, LISTED & IDENTIFIED IN ACCORDANCE WITH UL1703 22. ELECTRICAL CONTRACTOR TO PROVIDE CONDUIT EXPANSION JOINTS AND ANCHOR CONDUIT RUNS AS REQUIRED PER NEC.	<p>580 New Castle Ln, Spring Lake, NC 28390, United States</p>	<table border="1"> <tr> <td>DESCRIPTION</td><td>DATE</td><td>REV</td></tr> <tr> <td>INITIAL DESIGN</td><td>07/30/2025</td><td></td></tr> <tr> <td></td><td></td><td></td></tr> <tr> <td></td><td></td><td></td></tr> </table>	DESCRIPTION	DATE	REV	INITIAL DESIGN	07/30/2025							
DESCRIPTION	DATE	REV														
INITIAL DESIGN	07/30/2025															
OWNER:	JOSHUA SPRAGUE		<p>HOUSE PHOTO</p>	<p>Reviewed and approved Richard Pantel, P.E. NC Lic. No. 043326 07/30/2025</p>												
DESIGNER:	ESR															
SCOPE:	(N)1.620 kW DC ROOF MOUNT SOLAR PV SYSTEM WITH 4 JA SOLAR: JAM54S31-405/MR 405W PV MODULES WITH (N)4 ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN															
EXISTING:	(E) 7.540 kW DC ROOF MOUNT SOLAR PV SYSTEM WITH (E) (26) HANWHA SOLAR : Q.PEAK DUO BLK ML-G10+ 400W PV MODULES WITH (E) (26) ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN															
AUTHORITIES HAVING JURISDICTION:	BUILDING: HARNETT COUNTY ZONING: HARNETT COUNTY UTILITY: SOUTH RIVER EMC															
SHEET INDEX				PROJECT NAME & ADDRESS												
PV-1	COVER SHEET			JOSHUA SPRAGUE RESIDENCE 580 NEW CASTLE LN, SPRING LAKE, NC 28390												
PV-2	SITE PLAN															
PV-3	ROOF PLAN & MODULES															
PV-4	ELECTRICAL PLAN															
PV-5	STRUCTURAL DETAIL															
PV-6	ELECTRICAL LINE DIAGRAM															
PV-7	WIRING CALCULATIONS															
PV-8	LABELS															
PV-9+	EQUIPMENT SPECIFICATIONS															
SIGNATURE																
CODE REFERENCES																
<p>2018 NORTH CAROLINA BUILDING CODE 2018 NORTH CAROLINA RESIDENTIAL CODE 2018 NORTH CAROLINA FIRE CODE 2017 NATIONAL ELECTRICAL CODE</p>																
DRAWN BY																
ESR																
SHEET NAME																
COVER SHEET																
SHEET SIZE																
ANSI B																
11" X 17"																
SHEET NUMBER																
PV-1																

# PROJECT DESCRIPTION:

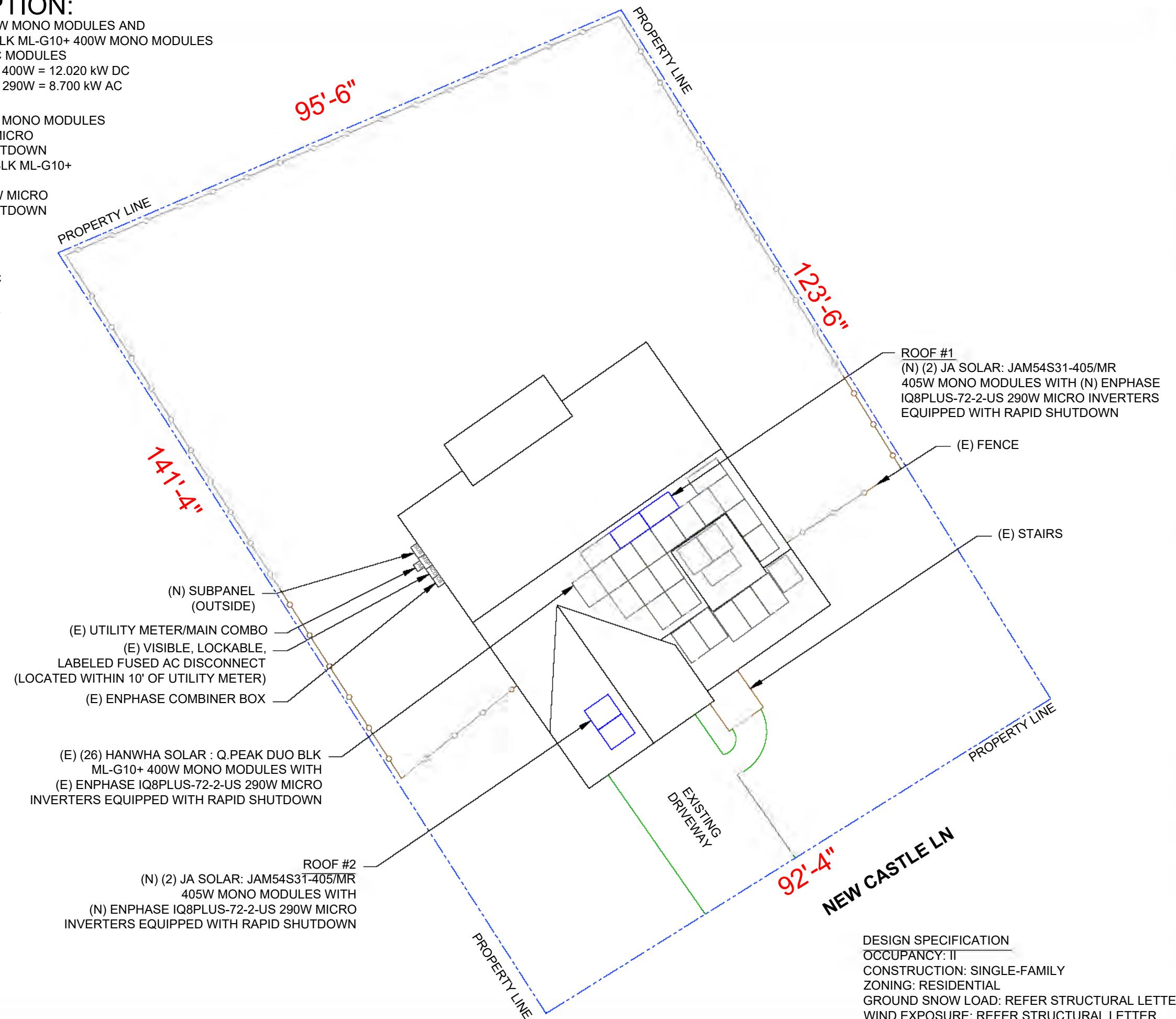
(N) 4 X JA SOLAR: JAM54S31-405/MR 405W MONO MODULES AND  
 (E) (26) HANWHA SOLAR : Q.PEAK DUO BLK ML-G10+ 400W MONO MODULES  
 ROOF MOUNTED SOLAR PHOTOVOLTAIC MODULES  
 DC SYSTEM SIZE: (N) 4 X 405W + (E) 26 X 400W = 12.020 kW DC  
 AC SYSTEM SIZE: (N) 4 X 290W + (E) 26 X 290W = 8.700 kW AC

## EQUIPMENT SUMMARY

(N) 4 JA SOLAR: JAM54S31-405/MR 405W MONO MODULES  
 (N) 4 ENPHASE IQ8PLUS-72-2-US 290W MICRO  
 INVERTERS EQUIPPED WITH RAPID SHUTDOWN  
 (E) (26) HANWHA SOLAR : Q.PEAK DUO BLK ML-G10+  
 400W MONO MODULES  
 (E) (26) ENPHASE IQ8PLUS-72-2-US 290W MICRO  
 INVERTERS EQUIPPED WITH RAPID SHUTDOWN

(N) ROOF ARRAY AREA #1: 42.02 SQ FT.  
 (N) ROOF ARRAY AREA #2: 42.02 SQ FT.

NOTE: VISIBLE, LOCKABLE, LABELED AC  
 DISCONNECT  
 LOCATED WITHIN 10' OF UTILITY METER



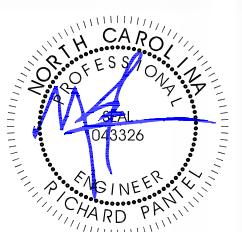
**TOP TIER**  
 SOLAR SOLUTIONS

TOP TIER SOLAR SOLUTIONS

1530 CENTER PARK DR #2911,  
 CHARLOTTE, NC 28217,  
 UNITED STATES

## REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



Reviewed and approved  
 Richard Pantel, P.E.  
 NC Lic. No. 043326  
 07/30/2025

PROJECT NAME & ADDRESS  
**JOSHUA SPRAGUE RESIDENCE**  
 580 NEW CASTLE LN,  
 SPRING LAKE, NC 28390

DRAWN BY  
**ESR**

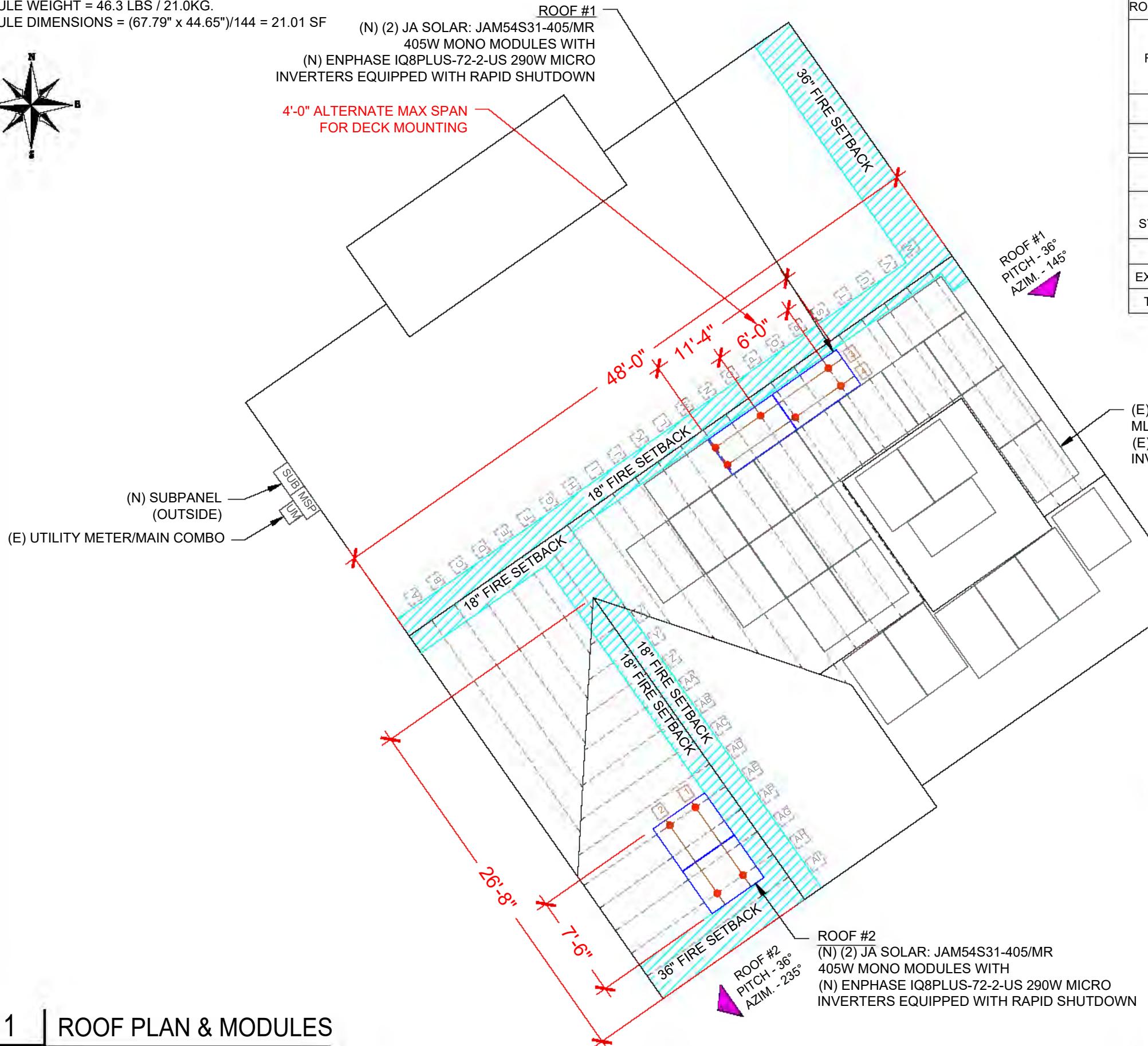
SHEET NAME  
**SITE PLAN**

SHEET SIZE  
**ANSI B  
 11" X 17"**

SHEET NUMBER  
**PV-2**

## MODULE TYPE, DIMENSIONS & WEIGHT

NUMBER OF MODULES = 4 MODULES  
 MODULE TYPE = JA SOLAR: JAM54S31-405/MR 405W MONO MODULES  
 MODULE WEIGHT = 46.3 LBS / 21.0KG.  
 MODULE DIMENSIONS = (67.79" x 44.65")/144 = 21.01 SF



ROOF DESCRIPTION					
ROOF TYPE			ASPHALT SHINGLE		
ROOF LAYER			1 LAYER		
ROOF	# OF MODULES	ROOF PITCH	AZIMUTH	TRUSS SIZE	TRUSS SPACING
#1	2	36°	145°	2"X4"	24"
#2	2	36°	235°	2"X4"	24"

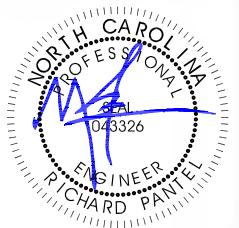
  

ARRAY AREA & ROOF AREA CALC'S			
PV SYSTEM	TOTAL PV ARRAY AREA (SQ. FT.)	TOTAL ROOF AREA (Sq. Ft.)	ROOF AREA COVERED BY ARRAY (%)
NEW	69.68	2581.60	3
EXISTING	554.58	2581.60	21
TOTAL	615.94	2581.60	24

**TOP TIER**  
SOLAR SOLUTIONS

TOP TIER SOLAR SOLUTIONS  
1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

REVISIONS		
DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



Reviewed and approved  
Richard Pantel, P.E.  
NC Lic. No. 043326  
07/30/2025

PROJECT NAME & ADDRESS  
JOSHUA SPRAGUE RESIDENCE  
580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

## LEGEND

- [JB] - JUNCTION BOX
- [CB] - COMBINER BOX
- [ACD] - AC DISCONNECT
- [UM] - UTILITY METER
- [MSP] - MAIN SERVICE PANEL
- [SUB] - SUBPANEL
- [VENT] - VENT, ATTIC FAN (ROOF OBSTRUCTION)
- - ROOF ATTACHMENT
- - TRUSS
- - CONDUIT

DRAWN BY  
ESR  
SHEET NAME  
ROOF PLAN & MODULES

SHEET SIZE  
ANSI B  
11" X 17"

SHEET NUMBER  
PV-3

DC SYSTEM SIZE: (N) 4 X 405W + (E) 26 X 400W = 12.020 kW DC  
 AC SYSTEM SIZE: (N) 4 X 290W + (E) 26 X 290W = 8.700 kW AC  
 (N) (4) JA SOLAR: JAM54S31-405/MR 405W MONO MODULES  
 WITH (N) (4) ENPHASE IQ8PLUS-72-2-US 290W MICRO  
 INVERTERS EQUIPPED WITH RAPID SHUTDOWN  
 (E) (26) HANWHA SOLAR : Q.PEAK DUO BLK ML-G10+  
 400 W MONO MODULES  
 (E) (26) ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS  
 EQUIPPED WITH RAPID SHUTDOWN

**CIRCUIT LEGENDS**

- (N)+(E) CIRCUIT #1
- (N)+(E) CIRCUIT #2
- CIRCUIT #3



**BILL OF MATERIALS**

EQUIPMENT DESCRIPTION	QTY
SOLAR PV MODULES: JA SOLAR: JAM54S31-405/MR 405W MODULE	4
MICRO INVERTERS: ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN	4
JUNCTION BOX: JUNCTION BOX UL 1741, NEMA 3R CSA C22.2 NO.290	2
20A BREAKERS	1
FUSES: 50A FUSES 240V NEMA 3R, UL LISTED	2
IRONRIDGE XR10 RAIL (RAIL 168" (14 FEET) CLEAR) (XR-10-168A)	4
UNIVERSAL MODULE CLAMP, CLEAR (UFO-CL-01-A1)	4
STOPPER SLEEVE, 40MM, MILL (UFO-STP-40MM-M1)	8
GROUNDING LUG (XR-LUG-03-A1)	2
IRONRIDGE HALO ULTRAGRIP ATTACHMENTS (QM-HUG-01-M1)	10
RD STRUCTURAL SCREW,3.0L (HW-RD1430-01-M1)	20
T-BOLT BONDING HARDWARE (BHW-SQ-02-A1)	10
MICRO INVERTER BONDING HARDWARE T-BOLT (BHW-MI-01-A1) (PRODUCT CODE 270-0152)	4

**TOP TIER**  
SOLAR SOLUTIONS

**TOP TIER SOLAR SOLUTIONS**

1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

**REVISIONS**

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

**PROJECT NAME & ADDRESS**  
**JOSHUA SPRAGUE RESIDENCE**  
 580 NEW CASTLE LN,  
 SPRING LAKE, NC 28390

**LEGEND**

- [JB] - JUNCTION BOX
- [CB] - COMBINER BOX
- [ACD] - AC DISCONNECT
- [UM] - UTILITY METER
- [MSP] - MAIN SERVICE PANEL
- [SUB] - SUBPANEL
- [VENT] - VENT, ATTIC FAN (ROOF OBSTRUCTION)
- - ROOF ATTACHMENT
- TRUSS
- CONDUIT

DRAWN BY  
ESR

SHEET NAME

**ELECTRICAL PLAN**

SHEET SIZE

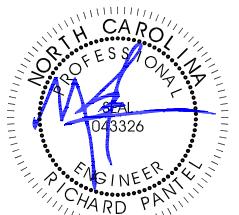
ANSI B  
11" X 17"

SHEET NUMBER

PV-4

REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



Reviewed and approved  
Richard Pantel, P.E.  
NC Lic. No. 043326  
07/30/2025

PROJECT NAME & ADDRESS

**JOSHUA SPRAGUE  
RESIDENCE**

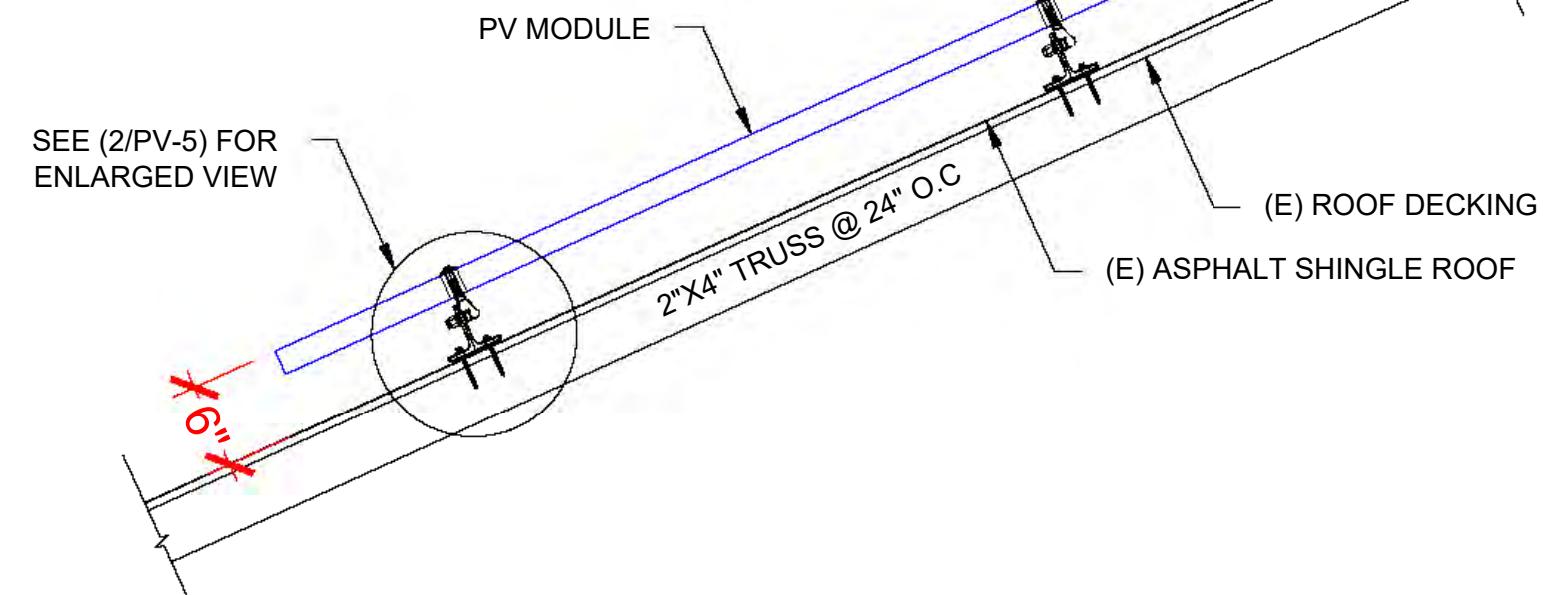
580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
ESR

SHEET NAME  
**STRUCTURAL DETAIL**

SHEET SIZE  
**ANSI B**  
**11" X 17"**

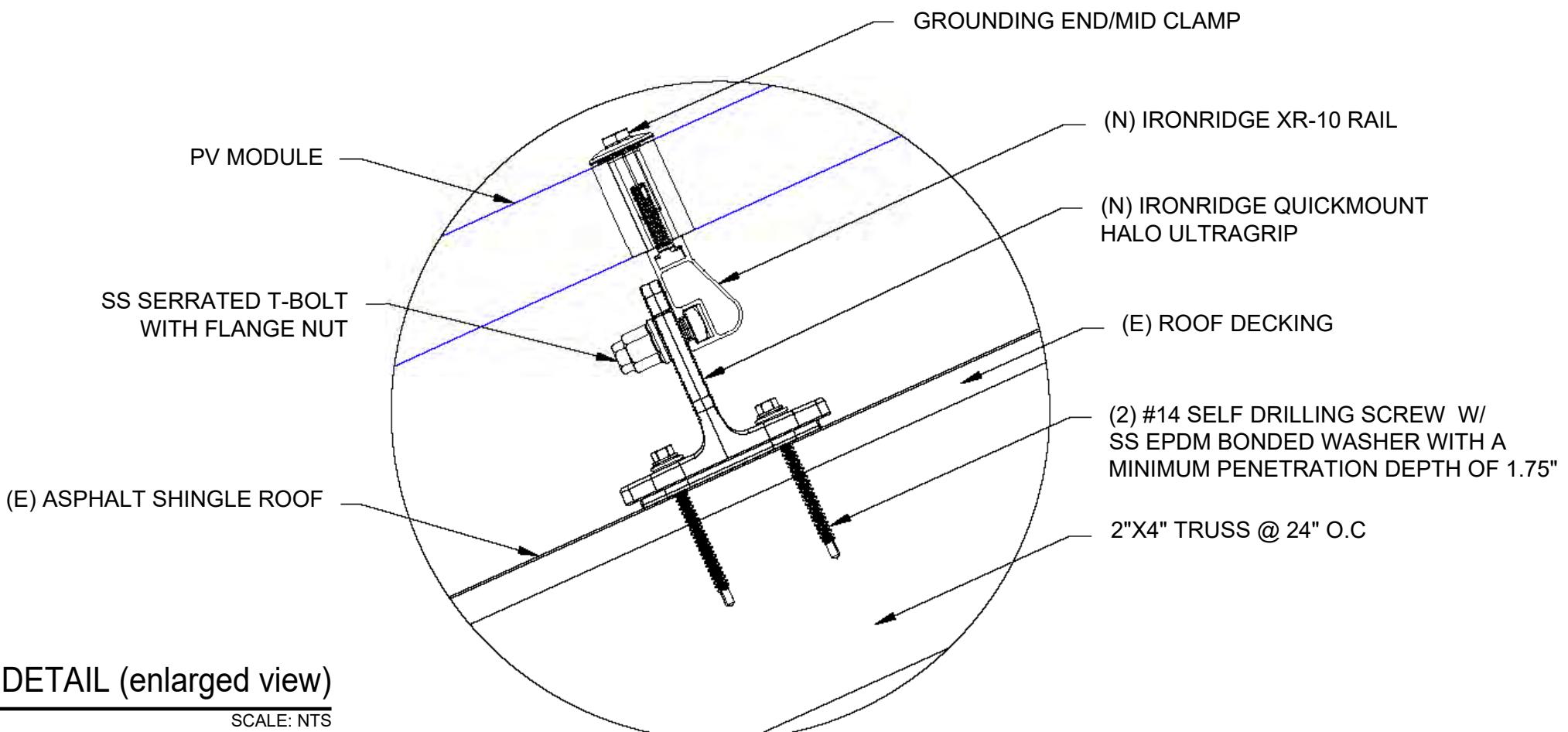
SHEET NUMBER  
**PV-5**



**1 STRUCTURAL ATTACHMENT (Side view)**

SCALE: N.T.S

PV-5



**2 ATTACHMENT DETAIL (enlarged view)**

SCALE: N.T.S

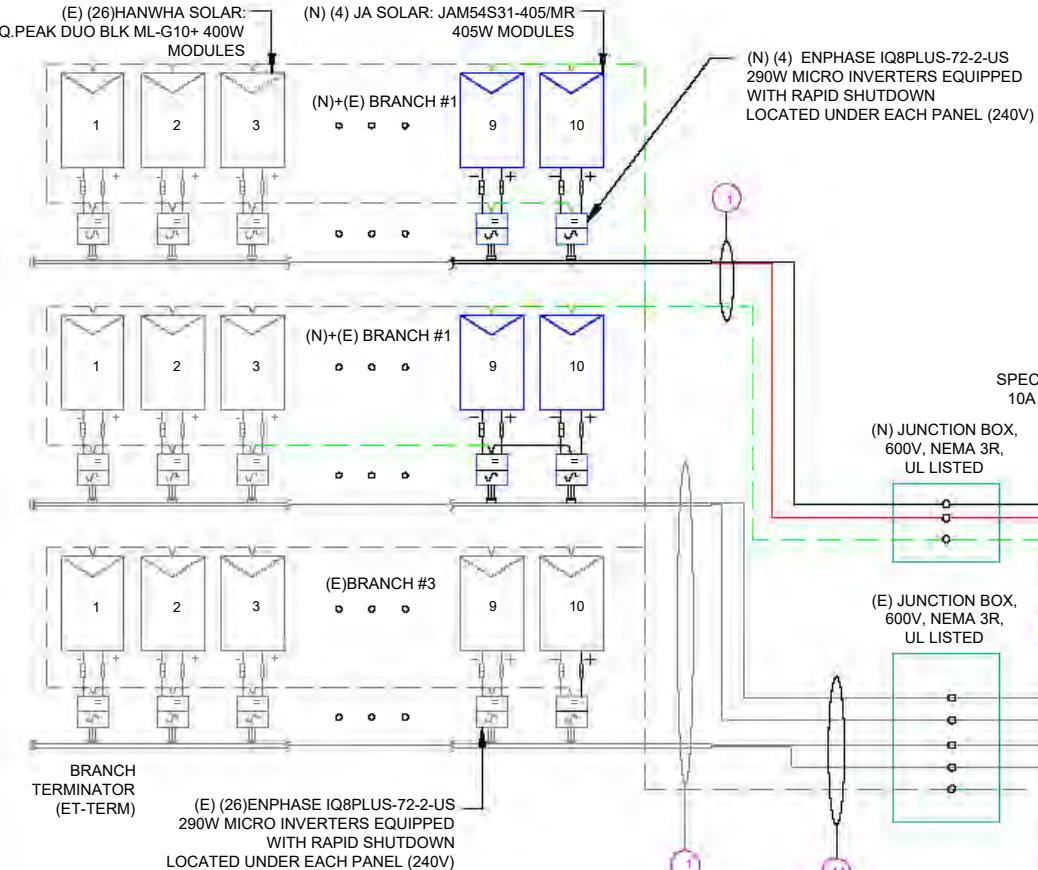
PV-5

DC SYSTEM SIZE: (N) 4 X 405W + (E) 26 X 400W = 12.020 kW DC  
AC SYSTEM SIZE: (N) 4 X 290W + (E) 26 X 290W = 8.700 kW AC

(N) (4) JA SOLAR: JAM54S31-405/MR 405W MONO MODULES  
WITH (N) (4) ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN  
(E) (26) HANWHA SOLAR : Q.PEAK DUO BLK ML-G10+ 400W MONO MODULES  
(E) (26) ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN  
(02) BRANCH CIRCUITS OF (N) 2 + (E) 8 MODULES AND  
(01) BRANCH CIRCUIT OF (E) 10 MODULES ARE CONNECTED IN PARALLEL

#### BACKFEED BREAKER CALCULATION (120% RULE):

(MAIN BUS X 1.2 - MAIN BREAKER) >= (PV BREAKER)  
(100A X 1.2 - 60A) >= (50A)  
(60A) >= (50A) HENCE OK



#### INTERCONNECTION NOTES:

1. INTERCONNECTION SIZING, LIMITATIONS AND COMPLIANCE DETERMINED IN ACCORDANCE WITH [NEC 705.12], AND [NEC 690.59].
2. GROUND FAULT PROTECTION IN ACCORDANCE WITH [NEC 215.9], [NEC 230.95].
3. ALL EQUIPMENT TO BE RATED FOR BACKFEEDING.
4. PV BREAKER TO BE POSITIONED AT THE OPPOSITE END OF THE BUSBAR RELATIVE TO THE MAIN BREAKER.

#### DISCONNECT NOTES:

1. DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING LIVE ARE CONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS)
2. AC DISCONNECT MUST BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH
3. DISCONNECT MEANS AND THEIR LOCATION SHALL BE IN ACCORDANCE WITH [NEC 225.31] AND [NEC 225.32].

#### GROUNDING & GENERAL NOTES:

1. PV GROUNDING ELECTRODE SYSTEM NEEDS TO BE INSTALLED IN ACCORDANCE WITH [NEC 690.43]
2. PV INVERTER IS UNGROUNDED, TRANSFORMER-LESS TYPE.
3. DC GEC AND AC EGC TO REMAIN UNSPLICED, OR SPLICED TO EXISTING ELECTRODE
4. ANY EXISTING WIRING INVOLVED WITH PV SYSTEM CONNECTION THAT IS FOUND TO BE INADEQUATE PER CODE SHALL BE CORRECTED PRIOR TO FINAL INSPECTION.
5. JUNCTION BOX QUANTITIES, AND PLACEMENT SUBJECT TO CHANGE IN THE FIELD - JUNCTION BOX DEPICTED ON ELECTRICAL DIAGRAM REPRESENT WIRE TYPE TRANSITIONS.
6. AC DISCONNECT NOTED IN EQUIPMENT SCHEDULE OPTIONAL IF OTHER AC DISCONNECTING MEANS IS LOCATED WITHIN 10' OF SERVICE DISCONNECT.
7. RACEWAYS AND CABLES EXPOSED TO SUNLIGHT ON ROOFTOPS SHOULD BE INSTALLED MORE THAN 7/8" ABOVE THE ROOF USING CONDUIT SUPPORTS.

#### RACKING NOTE:

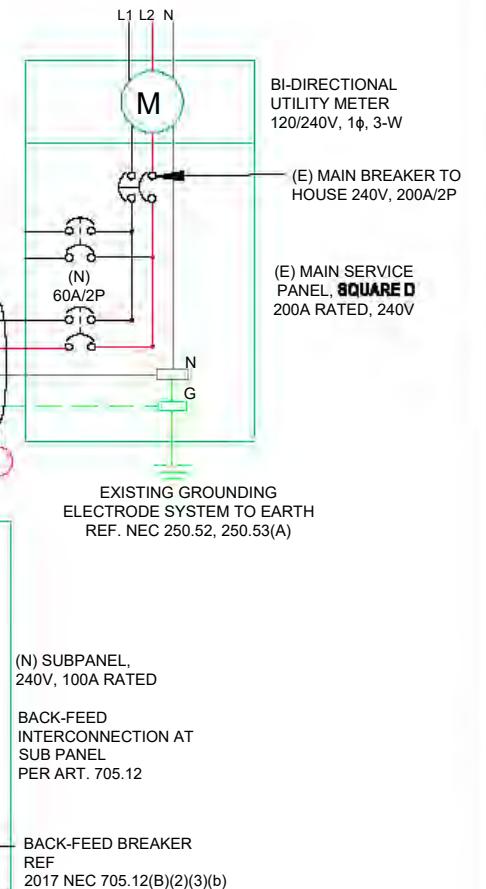
1. BOND EVERY OTHER RAIL WITH #6 BARE COPPER

NOTE: CONDUIT TO BE UL LISTED FOR WET LOCATIONS AND UV PROTECTED

NOTE: WIRE SCHEDULE CALLOUT "1A & 2A" ARE EXISTING SYSTEMS

#### REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



JOSHUA SPRAGUE  
RESIDENCE

580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
ESR

SHEET NAME

ELECTRICAL LINE DIAGRAM

SHEET SIZE

ANSI B  
11" X 17"

SHEET NUMBER

PV-6

QTY	CONDUCTOR INFORMATION	CONDUIT TYPE	CONDUIT SIZE
(2)	#12AWG - ENPHASE ENGAGE CABLE (L1 & L2 NO NEUTRAL)	N/A	N/A
(1)	#6AWG - BARE COPPER IN FREE AIR		
(4)	#12AWG - ENPHASE ENGAGE CABLE (L1 & L2 NO NEUTRAL)	N/A	N/A
(1)	#6AWG - BARE COPPER IN FREE AIR		
(2)	#10AWG - CU,THWN-2	EMT OR LFMC IN ATTIC	3/4"
(1)	#10AWG - CU,THWN-2 GND		
(2)	#10AWG - CU,THWN-2	EMT OR LFMC IN ATTIC	3/4"
(1)	#10AWG - CU,THWN-2 GND		
(2)	#8AWG - CU,THWN-2	EMT, LFMC OR PVC	3/4"
(1)	#8AWG - CU,THWN-2 N		
(1)	#10AWG - CU,THWN-2 GND		
(2)	#8AWG - CU,THWN-2	EMT, LFMC OR PVC	3/4"
(1)	#8AWG - CU,THWN-2 N		
(1)	#10AWG - CU,THWN-2 GND		
(2)	#6AWG - CU,THWN-2	EMT, LFMC OR PVC	3/4"
(1)	#6AWG - CU,THWN-2 N		
(1)	#10AWG - CU,THWN-2 GND		

INVERTER SPECIFICATIONS	
MANUFACTURER / MODEL #	ENPHASE IQ8PLUS-72-2-US 290W MICRO INVERTERS EQUIPPED WITH RAPID SHUTDOWN
MIN/MAX DC VOLT RATING	30V MIN/ 58V MAX
MAX INPUT POWER	235W-440W
NOMINAL AC VOLTAGE RATING	240V/ 211-264V
MAX AC CURRENT	1.21A
MAX MODULES PER CIRCUIT	13 (SINGLE PHASE)
MAX OUTPUT POWER	290 VA

SOLAR MODULE SPECIFICATIONS	
MANUFACTURER / MODEL #	JA SOLAR: JAM54S31-405/MR 405 W MODULE
VMP	32.37V
IMP	13.13A
VOC	38.95V
ISC	13.58A
TEMP. COEFF. VOC	-0.275%/°C
MODULE DIMENSION	67.79" L x 44.65" W x 1.18" D (In Inch)

AMBIENT TEMPERATURE SPECS	
AMBIENT TEMP (HIGH TEMP 2%)	38°
RECORD LOW TEMP	-11°
MODULE TEMPERATURE COEFFICIENT OF Voc	-0.275%/°C
PERCENT OF VALUES	NUMBER OF CURRENT CARRYING CONDUCTORS IN EMT
.80	4-6
.70	7-9
.50	10-20



REVISIONS		
DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

AC CALCULATIONS																						
CIRCUIT ORIGIN	CIRCUIT DESTINATION	VOLTAGE (V)	FULL LOAD AMPS "FLA" (A)	FLA*1.25 (A)	OCPD SIZE (A)	NEUTRAL SIZE	GROUND SIZE	CONDUCTOR SIZE	75°C AMPACITY (A)	AMPACITY CHECK #1	AMBIENT TEMP. (°C)	TOTAL CC CONDUCTORS IN RACEWAY	90°C AMPACITY (A)	DERATION FACTOR FOR AMBIENT TEMPERATURE NEC 310.15(B)(2)(a)	DERATION FACTOR FOR CONDUCTORS PER RACEWAY NEC 310.15(B)(3)(a)	90°C AMPACITY DERATED (A)	AMPACITY CHECK #2	FEEDER LENGTH (FEET)	CONDUCTOR RESISTANCE (OHM/KFT)	VOLTAGE DROP AT FLA (%)	CONDUIT SIZE	CONDUIT FILL (%)
CIRCUIT 1	(N) JUNCTION BOX	240	12.1	15.125	20	N/A	BARE COPPER #6 AWG	CU #12 AWG	25	PASS	38	2	30	0.91	1	27.3	PASS			0.31	N/A	#N/A
CIRCUIT 1	(E) JUNCTION BOX	240	12.1	15.125	20	N/A	BARE COPPER #6 AWG	CU #12 AWG	25	PASS	38	2	30	0.91	1	27.3	PASS			0.39	N/A	#N/A
CIRCUIT 3	(E) JUNCTION BOX	240	12.1	15.125	20	N/A	BARE COPPER #6 AWG	CU #12 AWG	25	PASS	38	2	30	0.91	1	27.3	PASS			0.39	N/A	#N/A
(N) JUNCTION BOX	COMBINER BOX	240	12.1	15.125	20	N/A	CU #10 AWG	CU #10 AWG	35	PASS	38	2	40	0.91	1	36.4	PASS	20	1.24	0.250	3/4" EMT	11.87617
(E) JUNCTION BOX	COMBINER BOX	240	12.1	15.125	20	N/A	CU #10 AWG	CU #10 AWG	35	PASS	38	4	40	0.91	0.8	29.12	PASS	20	1.24	0.250	3/4" EMT	19.79362
COMBINER BOX	AC DISCONNECT	240	36.3	45.375	50	CU #8 AWG	CU #10 AWG	CU #8 AWG	50	PASS	38	2	55	0.91	1	50.05	PASS	5	0.778	0.118	3/4" EMT	24.5591
AC DISCONNECT	SUB PANEL	240	36.3	45.375	50	CU #8 AWG	CU #10 AWG	CU #8 AWG	50	PASS	38	2	55	0.91	1	50.05	PASS	5	0.778	0.118	3/4" EMT	24.5591
SUB PANEL	MMC	240	60	60	60	CU #6 AWG	CU #10 AWG	CU #6 AWG	65	PASS	38	2	75	0.91	1	68.25	PASS	5	0.491	0.123	3/4" EMT	32.49531

Circuit 1 Voltage Drop	0.795
Circuit 2 Voltage Drop	0.875
Circuit 3 Voltage Drop	0.875

PROJECT NAME & ADDRESS	
JOSHUA SPRAGUE RESIDENCE	
580 NEW CASTLE LN, SPRING LAKE, NC 28390	
DRAWN BY ESR	
SHEET NAME WIRING CALCULATIONS	
SHEET SIZE ANSI B 11" X 17"	
SHEET NUMBER PV-7	

#### ELECTRICAL NOTES

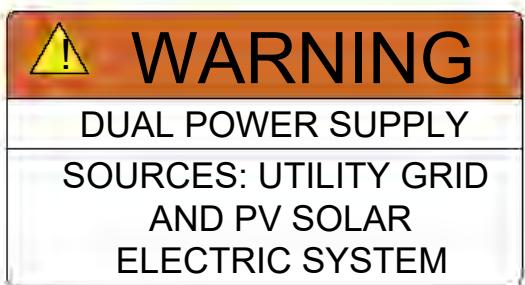
- ALL EQUIPMENT TO BE LISTED BY UL OR OTHER NRTL, AND LABELED FOR ITS APPLICATION.
- ALL CONDUCTORS SHALL BE RATED UPTO 600V FOR RESIDENTIAL AND 1000V FOR COMMERCIAL AND 90 DEGREE C WET ENVIRONMENT.
- WIRING, CONDUIT, AND RACEWAYS MOUNTED ON ROOFTOPS SHALL BE ROUTED DIRECTLY TO, AND LOCATED AS CLOSE AS POSSIBLE TO THE NEAREST RIDGE, HIP, OR VALLEY.
- WORKING CLEARANCES AROUND ALL NEW AND EXISTING ELECTRICAL EQUIPMENT SHALL COMPLY WITH NEC 110.26.
- DRAWINGS INDICATE THE GENERAL ARRANGEMENT OF SYSTEMS. CONTRACTOR SHALL FURNISH ALL NECESSARY OUTLETS, SUPPORTS, FITTINGS AND ACCESSORIES TO FULFILL APPLICABLE CODES AND STANDARDS.
- WHERE SIZES OF JUNCTION BOX, RACEWAYS, AND CONDUITS ARE NOT SPECIFIED, THE CONTRACTOR SHALL SIZE THEM ACCORDINGLY.
- ALL WIRE TERMINATIONS SHALL BE APPROPRIATELY LABELED AND READILY VISIBLE.
- MODULE GROUNDING CLIPS TO BE INSTALLED BETWEEN MODULE FRAME AND MODULE SUPPORT RAIL, PER THE GROUNDING CLIP MANUFACTURER'S INSTRUCTION.
- MODULE SUPPORT RAIL TO BE BONDED TO CONTINUOUS COPPER G.E.C. VIA WEEB LUG OR ILSCO GBL-4DBT LAY-IN LUG.
- TEMPERATURE RATINGS OF ALL CONDUCTORS, TERMINATIONS, BREAKERS, OR OTHER DEVICES ASSOCIATED WITH THE SOLAR PV SYSTEM SHALL BE RATED FOR AT LEAST 75 DEGREE C.

**TOP TIER SOLAR SOLUTIONS**

1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



LABEL- 1:  
LABEL LOCATION:  
MAIN SERVICE PANEL & SUBPANEL  
CODE REF: NEC 705.12(B) & NEC 690.59

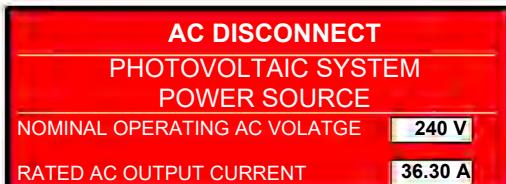
**SOLAR POINT OF INTERCONNECTION**

LABEL- 2:  
LABEL LOCATION:  
MAIN SERVICE PANEL & SUB PANEL  
CODE REF: NEC 690.13 (F), NEC 705.12(B) (3-4) & NEC 690.59

**SOLAR PV BREAKER**

**BREAKER IS BACKFED  
DO NOT RELOCATE**

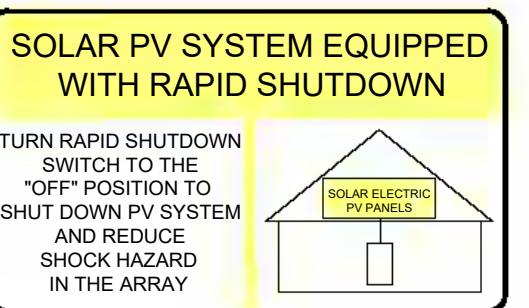
LABEL- 3:  
LABEL LOCATION:  
MAIN SERVICE PANEL & SUB PANEL  
(ONLY IF SOLAR IS BACK-FED)  
CODE REF: NEC 705.12(D) & 690.59



LABEL- 4:  
LABEL LOCATION:  
AC DISCONNECT  
CODE REF: NEC 690.54



LABEL- 5:  
LABEL LOCATION:  
AC DISCONNECT  
CODE REF: NEC 706.15(C)(4) & NEC 690.13(B)



LABEL- 6:  
LABEL LOCATION:  
COMBINER BOX  
CODE REF: IFC 605.11.3.1(1) & NEC 690.56(C)



LABEL- 7:  
LABEL LOCATION:  
COMBINER PANEL  
CODE REF: 705.12 (B) (3) (3)

**PHOTOVOLTAIC POWER SOURCE**

LABEL- 8:  
LABEL LOCATION:  
EMT/CONDUIT RACEWAY  
SOLADECk / JUNCTION BOX  
CODE REF: NEC 690.31 (D) (2)

**PHOTOVOLTAIC  
SYSTEM kWh METER**

LABEL- 9:  
LABEL LOCATION:  
PRODUCTION METER (ONLY IF PRODUCTION METER IS USED)

PROJECT NAME & ADDRESS  
**JOSHUA SPRAGUE  
RESIDENCE**  
580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
**ESR**

SHEET NAME

**LABELS**

SHEET SIZE

**ANSI B**  
11" X 17"

SHEET NUMBER

**PV-8**

REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

PROJECT NAME & ADDRESS

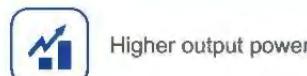
JOSHUA SPRAGUE  
RESIDENCE

580 NEW CASTLE LN,  
SPRING LAKE, NC 28390



Introduction

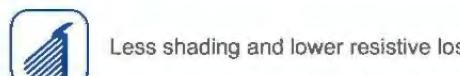
Assembled with 11BB PERC cells, the half-cell configuration of the modules offers the advantages of higher power output, better temperature-dependent performance, reduced shading effect on the energy generation, lower risk of hot spot, as well as enhanced tolerance for mechanical loading.



Higher output power



Lower LCOE



Less shading and lower resistive loss



Better mechanical loading tolerance

Superior Warranty

- 25-year product warranty
- 25-year linear power output warranty

0.55% Annual Degradation  
Over 25 years



Comprehensive Certificates

- IEC 61215, IEC 61730, UL 61215, UL 61730
- ISO 9001: 2015 Quality management systems
- ISO 14001: 2015 Environmental management systems
- ISO 45001: 2018 Occupational health and safety management systems
- IEC TS 62941: 2016 Terrestrial photovoltaic (PV) modules – Guidelines for increased confidence in PV module design qualification and type approval



**JA SOLAR**

[www.jasolar.com](http://www.jasolar.com)

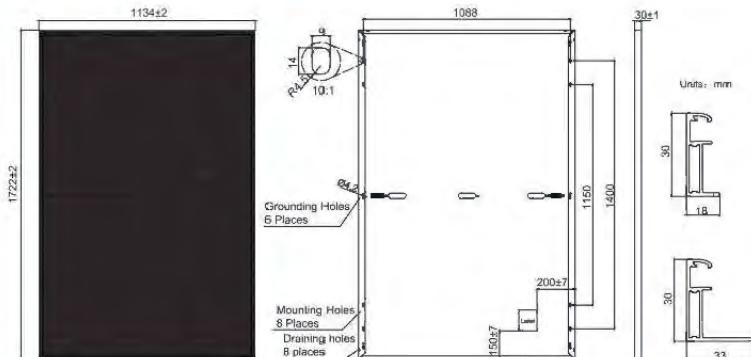
Specifications subject to technical changes and tests.  
JA Solar reserves the right of final interpretation.



**JA SOLAR**

**JAM54S31 380-405/MR Series**

MECHANICAL DIAGRAMS



Remark: customized frame color and cable length available upon request!

SPECIFICATIONS

Cell	Mono
Weight	21.5kg±3%
Dimensions	1722±2mm×1134±2mm×30±1mm
Cable Cross Section Size	4mm <sup>2</sup> (IEC), 12 AWG(UL)
No. of cells	108(6x18)
Junction Box	IP68, 3 diodes
Connector	MC4-EVO2(1500V)
Cable Length (Including Connector)	Portrait: 300mm(+)/400mm(-); Landscape: 1200mm(+)/1200mm(-)
Packaging Configuration	36pcs/Pallet, 864pcs/40ft Container

ELECTRICAL PARAMETERS AT STC

TYPE	JAM54S31 -380/MR	JAM54S31 -385/MR	JAM54S31 -390/MR	JAM54S31 -395/MR	JAM54S31 -400/MR	JAM54S31 -405/MR
Rated Maximum Power(Pmax) [W]	380	385	390	395	400	405
Open Circuit Voltage(Voc) [V]	36.58	36.71	36.85	36.98	37.07	37.23
Maximum Power Voltage(Vmp) [V]	30.28	30.46	30.64	30.84	31.01	31.21
Short Circuit Current(Isc) [A]	13.44	13.52	13.61	13.70	13.79	13.87
Maximum Power Current(Imp) [A]	12.55	12.64	12.73	12.81	12.90	12.98
Module Efficiency [%]	19.5	19.7	20.0	20.2	20.5	20.7
Power Tolerance	±2%					
Temperature Coefficient of Isc(α_Isc)	+0.045%°C					
Temperature Coefficient of Voc(β_Voc)	-0.275%°C					
Temperature Coefficient of Pmax(γ_Pmp)	-0.350%°C					
STC	Irradiance 1000W/m <sup>2</sup> , cell temperature 25°C, AM1.5G					

Remark: Electrical data in this catalog do not refer to a single module and they are not part of the offer. They only serve for comparison among different module types.

ELECTRICAL PARAMETERS AT NOCT

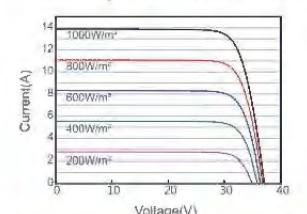
TYPE	JAM54S31 -380/MR	JAM54S31 -385/MR	JAM54S31 -390/MR	JAM54S31 -395/MR	JAM54S31 -400/MR	JAM54S31 -405/MR
Rated Max Power(Pmax) [W]	286	290	294	298	302	306
Open Circuit Voltage(Voc) [V]	34.36	34.49	34.62	34.75	34.88	35.12
Max Power Voltage(Vmp) [V]	28.51	28.68	28.87	29.08	29.26	29.47
Short Circuit Current(Isc) [A]	10.75	10.82	10.89	10.96	11.03	11.10
Max Power Current(Imp) [A]	10.03	10.11	10.18	10.25	10.32	10.38
NOCT	Irradiance 800W/m <sup>2</sup> , ambient temperature 20°C, wind speed 1m/s, AM1.5G					

OPERATING CONDITIONS

Maximum System Voltage	1000V/1500V DC
Operating Temperature	-40°C ~ +85°C
Maximum Series Fuse Rating	25A
Maximum Static Load,Front*	5400Pa(112lb/ft <sup>2</sup> )
Maximum Static Load,Back*	2400Pa(50lb/ft <sup>2</sup> )
NOCT	45±2°C
Safety Class	Class II
Fire Performance	UL Type 1

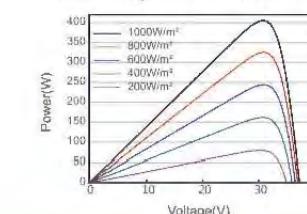
CHARACTERISTICS

Current-Voltage Curve JAM54S31-405/MR

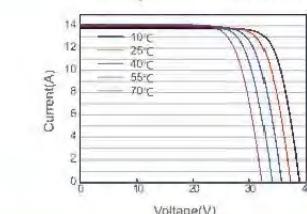


Premium Cells, Premium Modules

Power-Voltage Curve JAM54S31-405/MR



Current-Voltage Curve JAM54S31-405/MR



Version No.: Global\_EN\_20231130A

DRAWN BY  
ESR

SHEET NAME

SPECIFICATION

SHEET SIZE

ANSI B  
11" X 17"

SHEET NUMBER

PV-9

**AUTHORIZATION TO MARK**

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

**Applicant:** Shanghai JA Solar Technology Co., Ltd. **Manufacturer:** JA SOLAR VIET NAM COMPANY LIMITED.

**Address:** No. 118, Lane 3111, West Huancheng Road, Fengxian District, 201401 Shanghai **Address:** Lot G, Quang Chau industrial park, Quang Chau Ward, Viet Yen Town, Bac Giang Province, 236110

**Country:** P. R. China **Country:** Vietnam

**Party Authorized To Apply Mark:** Same as Manufacturer  
**Report Issuing Office:** Intertek Testing Services Shanghai Limited

**Control Number:** 5020189 **Authorized by:**  for L. Matthew Snyder, Certification Manager



This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.  
545 East Algonquin Road, Arlington Heights, IL 60005  
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Terrestrial Photovoltaic (PV) Modules - Design Qualification And Type Approval - Part 1: Test Requirements [UL 61215-1:2017 Ed.1]

Terrestrial Photovoltaic (PV) Modules - Design Qualification And Type Approval - Part 1-1: Special Requirements For Testing Of Crystalline Silicon Photovoltaic (PV) Modules [UL 61215-1-1:2017 Ed.1]

Terrestrial Photovoltaic (PV) Modules - Design Qualification And Type Approval - Part 2: Test Procedures [UL 61215-2:2017 Ed.1]

**Standard(s):** Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements For Construction [UL 61730-1:2017 Ed.1]

Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements For Testing [UL 61730-2:2017 Ed.1]

Photovoltaic (PV) Module Safety Qualification - Part 1: Requirements for Construction [CSA C22.2#61730-1:2019 Ed.2]

Photovoltaic (PV) Module Safety Qualification - Part 2: Requirements for Testing [CSA C22.2#61730-2:2019 Ed.2]

**AUTHORIZATION TO MARK**

**Product:** Crystalline Silicon Photovoltaic modules

**Brand Name:** JA SOLAR 晶澳

JAM72S03-385/PR,  
JAP72S03-340/SC,  
JAM72S10- followed by 395, 400, 405, 410 or 415 followed by /MB,  
JAM60S10- followed by 330, 335, 340 or 345 followed by /MB,  
JAM72S10- followed by 395, 400, 405, 410 or 415 followed by /MR,  
JAM66S10- followed by 365, 365, 370, 375 or 380 followed by /MR,  
JAM60S10- followed by 330, 335, 340 or 345 followed by /MR,  
JAM72S09- followed by 370, 375, 380, 385, 390, 395 or 400 followed by /PR,  
JAM60S09- followed by 310, 315, 320 or 325 followed by /PR,  
JAM72S09- followed by 375, 380 or 385 followed by /BP,  
JAM60S09- followed by 315 or 320 followed by /BP,  
JAM72S10- followed by 385, 390, 395 or 400 followed by /BP,  
JAM60S10- followed by 320, 325 or 330 followed by /BP,  
JAM72S10- followed by 380, 385, 390, 395, 400 or 405 followed by /PR,  
JAM60S10- followed by 320, 325, 330 or 335 followed by /PR,  
JAM72S12- followed by 365, 370, 375, 380 or 385 followed by /PR,  
JAM60S12- followed by 305, 310, 315 or 320 followed by /PR,  
1JAM78S10- followed by 435, 440, 445, 450 or 455 followed by /MR,  
1JAM6(K)-72-335/4BB/1500V,  
JAM60S17- followed by 320, 325, or 330 followed by /MR,  
JAM72S20- followed by 430, 435, 440, 445, 450, 455, 460, 465 or 470 followed by /MR,  
JAM60S20- followed by 355, 360, 365, 370, 375, 380, 385 or 390 followed by /MR,  
JAM72S30- followed by 530, 535, 540, 545, 550 or 555 followed by /MR,  
JAM66S30- followed by 490, 495 or 500 followed by /MR,  
JAM68S11- followed by 355, 360 or 365 followed by /PR,  
JAM68S11- followed by 345, 350, 355, 360 or 365 followed by /PR(B),  
JAM76S11- followed by 395, 400, 405, 410 or 415 followed by /PR(B),  
JAM76S11- followed by 395, 400, 405, 410 or 415 followed by /PR(B)/1000V,  
JAM78S30- followed by 575, 580, 585, 590, 595, 600, 605 or 610 followed by /GR,  
JAM72S30- followed by 535, 540, 545, 550, 555 or 560 followed by /GR,  
JAM66S30- followed by 490, 495, 500 or 505 followed by /GR,  
JAM60S30- followed by 445, 450, 455 or 460 followed by /GR,  
JAM54S30- followed by 400, 405, 410, 415 or 420 followed by /GR,  
JAM78S31- followed by 570, 575, 580, 585 or 590 followed by /GR,  
JAM72S31- followed by 530, 535 or 540 followed by /GR,  
JAM66S31- followed by 485, 490 or 495 followed by /GR,  
JAM60S31- followed by 440, 445 or 450 followed by /GR,  
JAM54S31- followed by 395, 400, 405, 410 or 415 followed by /GR,  
JAM60S31- followed by 430, 435, 440, 445 or 450 followed by /GR/1000V,  
JAM54S31- followed by 390, 395, 400, 405, 410 or 415 followed by /GR/1000V,  
JAM54S30- followed by 400, 405, 410, 415, 420 or 425 followed by /MR,  
JAM72S31- followed by 510, 515, 520, 525, 530, 535, 540 or 545 followed by /MR,  
JAM54S31- followed by 385, 390, 395, 400 or 405 followed by /MR,  
JAM54S30- followed by 400, 405, 410, 415, 420 or 425 followed by /MR/1000V,  
JAM72S31- followed by 510, 515, 520, 525, 530, 535, 540 or 545 followed by /MR/1000V,  
JAM54S31- followed by 385, 390, 395, 400 or 405 followed by /MR/1000V,  
JAM72S17- followed by 390, 395, 400 or 405 followed by /MR,  
JAM72S17- followed by 390, 395, 400 or 405 followed by /MR/1000V,  
JAM78S30- followed by 580, 585, 590, 595, 600 or 605 followed by /MR,JAM72S30- followed by 555, 560, 565, 570, 575, 580 followed by /LR,  
JAM54S30- followed by 415, 420, 425, 430, 435 followed by /LR,  
JAM54S31- followed by 415, 420 followed by /LR,  
JAM54S30- followed by 385, 390, 395, 400, 405, 410 followed by /MB,  
JAM54S31- followed by 385, 390, 395, 400, 405 followed by /MB,  
JAM54S30- followed by 410, 415, 420, 425 followed by /LB,  
JAM54S31- followed by 410, 415 followed by /LB,  
JAM72S30- followed by 535, 540, 545, 550 followed by /MB,  
JAM72S31- followed by 525, 530, 535, 540 followed by /MB.

**REVISIONS**

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

**PROJECT NAME & ADDRESS**
**JOSHUA SPRAGUE  
RESIDENCE**
**580 NEW CASTLE LN,  
SPRING LAKE, NC 28390**
**DRAWN BY  
ESR**
**SHEET NAME  
EQUIPMENT  
SPECIFICATION**
**SHEET SIZE**
**ANSI B  
11" X 17"**
**SHEET NUMBER  
PV-10**



## IQ8 and IQ8+ Microinverters

Our newest IQ8 Microinverters are the industry's first microgrid-forming, software-defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently. The brain of the semiconductor-based microinverter is our proprietary application-specific integrated circuit (ASIC) which enables the microinverter to operate in grid-tied or off-grid modes. This chip is built in advanced 55nm technology with high speed digital logic and has super-fast response times to changing loads and grid events, alleviating constraints on battery sizing for home energy systems.



Part of the Enphase Energy System, IQ8 Series Microinverters integrate with the Enphase IQ Battery, Enphase IQ Gateway, and the Enphase App monitoring and analysis software.



IQ8 Series Microinverters redefine reliability standards with more than one million cumulative hours of power-on testing, enabling an industry-leading limited warranty of up to 25 years.



Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.



IQ8 Series Microinverters are UL Listed as PV Rapid Shut Down Equipment and conform with various regulations, when installed according to manufacturer's instructions.

© 2022 Enphase Energy. All rights reserved. Enphase, the Enphase logo, IQ8 Microinverters, and other names are trademarks of Enphase Energy, Inc. Data subject to change.

IQ8SP-DS-0002-01-EN-US-2022-03-17

## IQ8 and IQ8+ Microinverters

		IQ8-60-2-US	IQ8PLUS-72-2-US
Commonly used module pairings <sup>1</sup>	W	235 – 350	235 – 440
Module compatibility		60-cell/120 half-cell	60-cell/120 half-cell, 66-cell/132 half-cell and 72-cell/144 half-cell
MPPT voltage range	V	27 – 37	29 – 45
Operating range	V	25 – 48	25 – 58
Min/max start voltage	V	30 / 48	30 / 58
Max input DC voltage	V	50	60
Max DC current <sup>2</sup> [module Isc]	A	15	
Oversupply class DC port		II	
DC port backfeed current	mA	0	
PV array configuration		1x1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit	
		IQ8-60-2-US	IQ8PLUS-72-2-US
Peak output power	VA	245	300
Max continuous output power	VA	240	290
Nominal (L-L) voltage/range <sup>3</sup>	V	240 / 211 – 264	
Max continuous output current	A	1.0	1.21
Nominal frequency	Hz	60	
Extended frequency range	Hz	50 – 68	
AC short circuit fault current over 3 cycles	Arms	2	
Max units per 20 A (L-L) branch circuit <sup>4</sup>		16	13
Total harmonic distortion		<5%	
Oversupply class AC port		III	
AC port backfeed current	mA	30	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging	
Peak efficiency	%	97.5	97.6
CEC weighted efficiency	%	97	97
Night-time power consumption	mW	60	
		MECHANICAL DATA	
Ambient temperature range		-40°C to +60°C (-40°F to +140°F)	
Relative humidity range		4% to 100% (condensing)	
DC Connector type		MC4	
Dimensions (HxWxD)		212 mm (8.3") x 175 mm (6.9") x 30.2 mm (1.2")	
Weight		1.08 kg (2.38 lbs)	
Cooling		Natural convection – no fans	
Approved for wet locations		Yes	
Pollution degree		PD3	
Enclosure		Class II double-insulated, corrosion resistant polymeric enclosure	
Environ. category / UV exposure rating		NEMA Type 6 / outdoor	
		COMPLIANCE	
Certifications		CA Rule 21 (UL 1741-SA), UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO.107.1-01	
		This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer's instructions.	
(1)		No enforced DC/AC ratio. See the compatibility calculator at <a href="https://link.enphase.com/module-compatibility">https://link.enphase.com/module-compatibility</a>	
(2)		(2) Maximum continuous input DC current is 10.6A (3) Nominal voltage range can be extended beyond nominal if required by the utility. (4) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.	

IQ8SP-DS-0002-01-EN-US-2022-03-17

REVISIONS		
DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

PROJECT NAME & ADDRESS		
JOSHUA SPRAGUE RESIDENCE	580 NEW CASTLE LN, SPRING LAKE, NC 28390	

DRAWN BY	ESR
SHEET NAME	EQUIPMENT SPECIFICATION

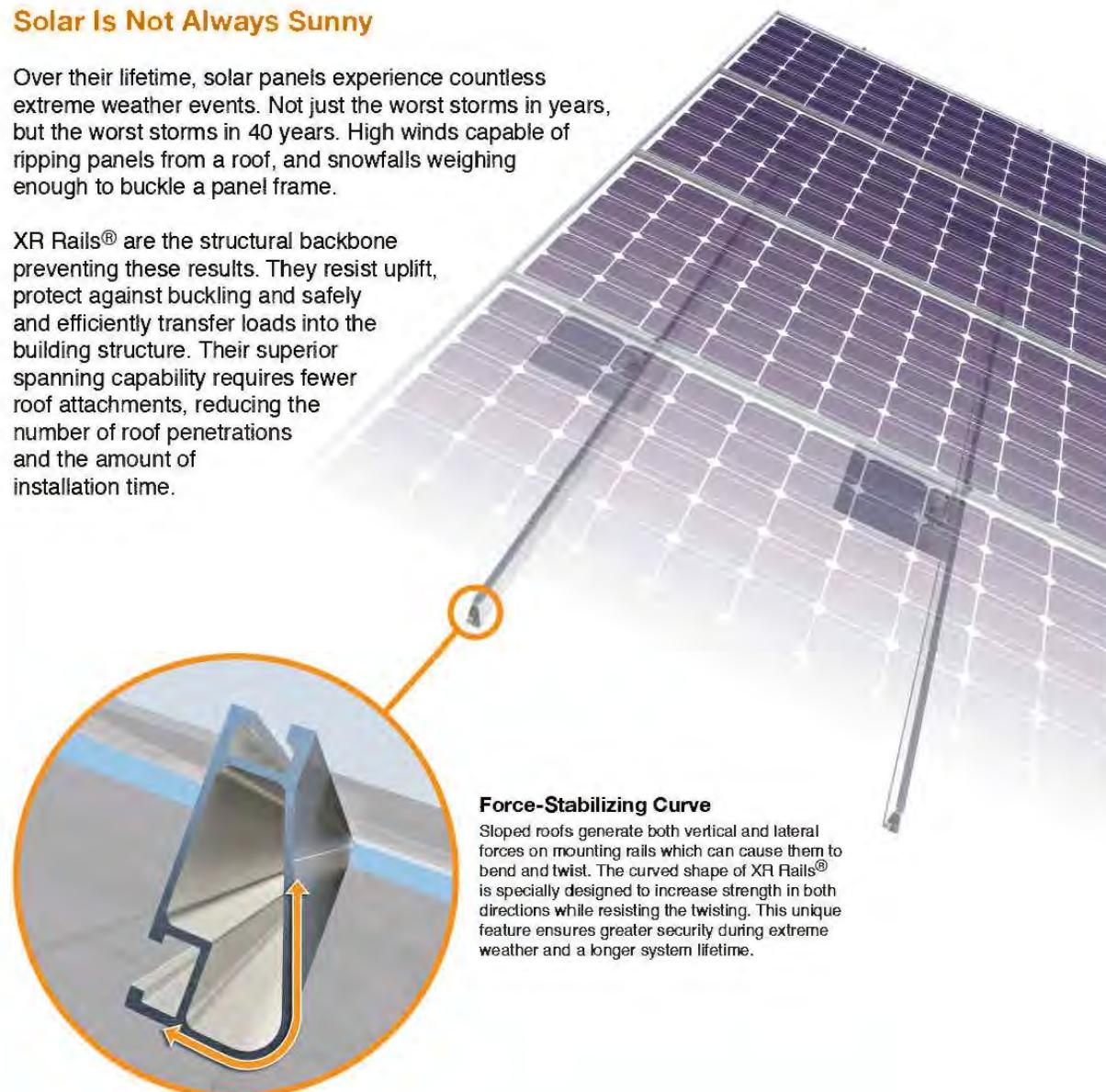
SHEET SIZE	ANSI B 11" X 17"
SHEET NUMBER	PV-11



## Solar Is Not Always Sunny

Over their lifetime, solar panels experience countless extreme weather events. Not just the worst storms in years, but the worst storms in 40 years. High winds capable of ripping panels from a roof, and snowfalls weighing enough to buckle a panel frame.

XR Rails® are the structural backbone preventing these results. They resist uplift, protect against buckling and safely and efficiently transfer loads into the building structure. Their superior spanning capability requires fewer roof attachments, reducing the number of roof penetrations and the amount of installation time.



### Compatible with Flat & Pitched Roofs



XR Rails® are compatible with FlashFoot® and other pitched roof attachments.



IronRidge® offers a range of tilt leg options for flat roof mounting applications.

### Corrosion-Resistant Materials



All XR Rails® are made of 6000-series aluminum alloy, then protected with an anodized finish. Anodizing prevents surface and structural corrosion, while also providing a more attractive appearance.

## Tech Brief

## XR Rail® Family

## XR Rail® Family

## Tech Brief

The XR Rail® Family offers the strength of a curved rail in three targeted sizes. Each size supports specific design loads, while minimizing material costs. Depending on your location, there is an XR Rail® to match.



**XR10**

XR10 is a sleek, low-profile mounting rail, designed for regions with light or no snow. It achieves spans up to 6 feet, while remaining light and economical.

- 6' spanning capability
- Moderate load capability
- Clear & black anodized finish
- Internal splices available



**XR100**

XR100 is a residential and commercial mounting rail. It supports a range of wind and snow conditions, while also maximizing spans up to 10 feet.

- 10' spanning capability
- Heavy load capability
- Clear & black anodized finish
- Internal splices available



**XR1000**

XR1000 is a heavyweight among solar mounting rails. It's built to handle extreme climates and spans up to 12 feet for commercial applications.

- 12' spanning capability
- Extreme load capability
- Clear anodized finish
- Internal splices available

## Rail Selection

The table below was prepared in compliance with applicable engineering codes and standards.\* Values are based on the following criteria: ASCE 7-16, Gable Roof Flush Mount, Roof Zones 1 & 2e, Exposure B, Roof Slope of 8 to 20 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed certification letters.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	90						
	120						
	140						
	160						
20	90						
	120						
	140						
	160						
30	90						
	160						
40	90						
	160						
80	160						
120	160						

\*Table is meant to be a simplified span chart for conveying general rail capabilities. Use approved certification letters for actual design guidance.

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

PROJECT NAME & ADDRESS  
**JOSHUA SPRAGUE RESIDENCE**  
580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
**ESR**

SHEET NAME  
**EQUIPMENT SPECIFICATION**

SHEET SIZE  
**ANSI B  
11" X 17"**

SHEET NUMBER  
**PV-13**



Tech Brief

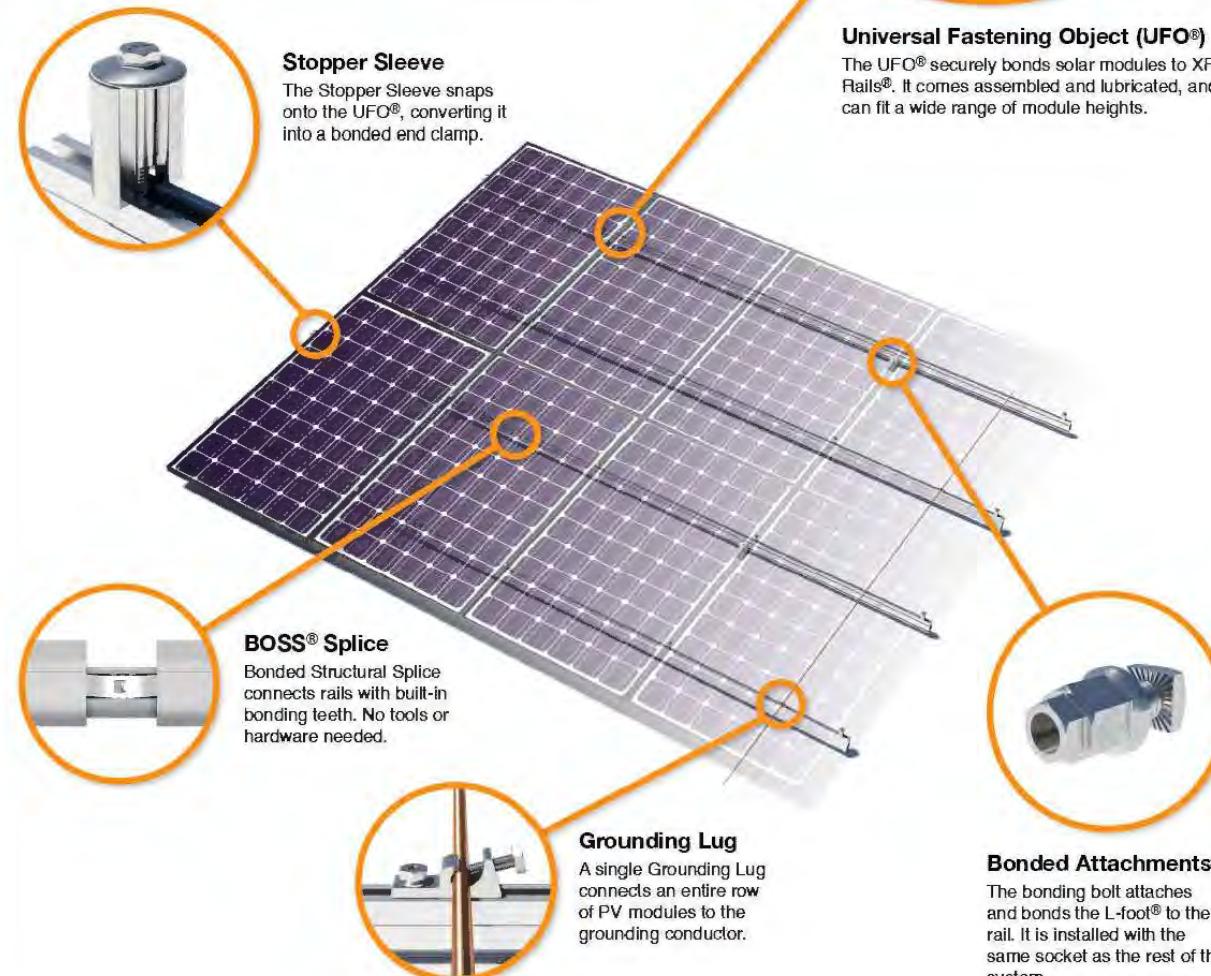
## UFO® Family of Components

## Simplified Grounding for Every Application

The UFO® family of components eliminates the need for separate grounding hardware by bonding solar modules directly to IronRidge® XR Rails®. All system types that feature the UFO® family—Flush Mount®, Tilt Mount® and Ground Mount®—are fully listed to the UL 2703 standard.

UFO® hardware forms secure electrical bonds with both the module and the rail, resulting in many parallel grounding paths throughout the system. This leads to safer and more reliable installations.

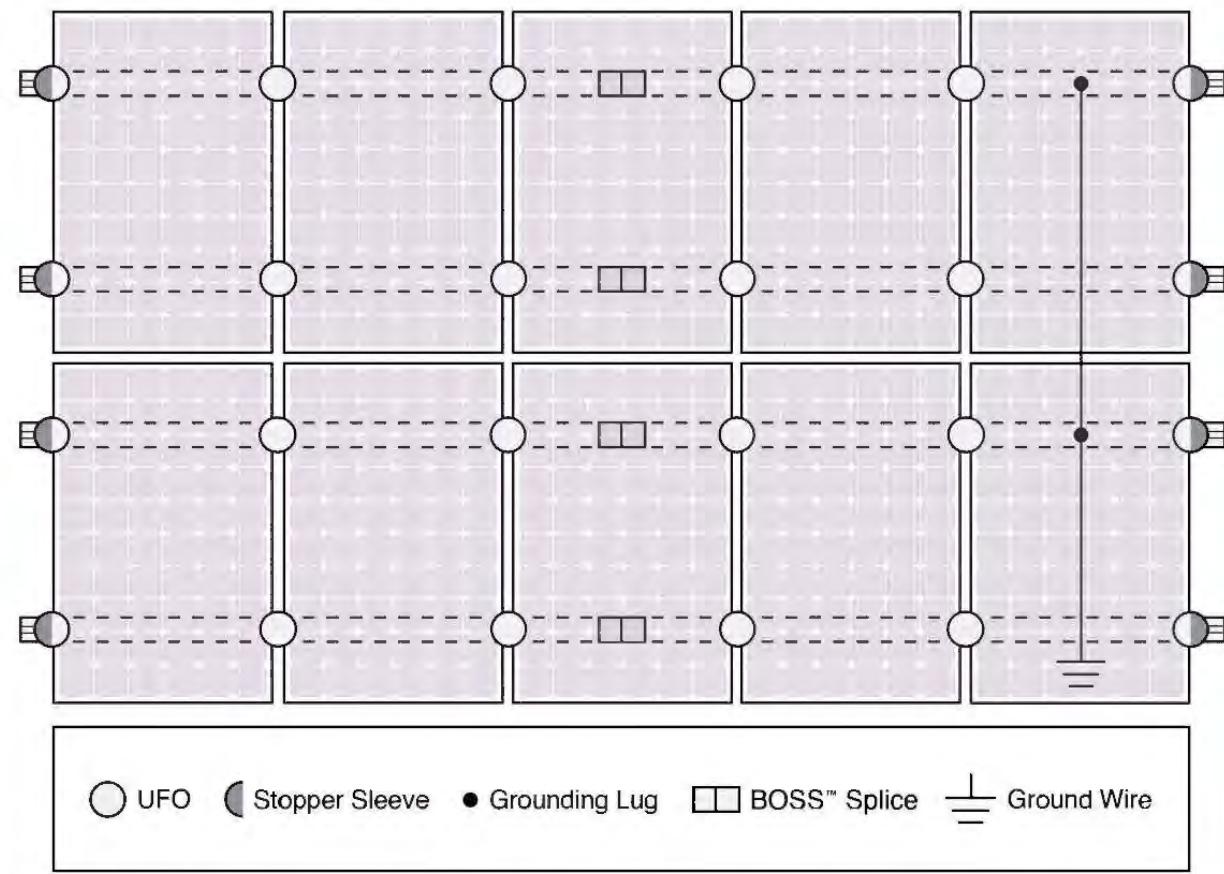
Only for installation and use with IronRidge products in accord with written instructions. See IronRidge.com/UFO



Bonded Attachments

The bonding bolt attaches and bonds the L-foot® to the rail. It is installed with the same socket as the rest of the system.

## System Diagram



Approved Enphase microinverters can provide equipment grounding of IronRidge systems, eliminating the need for grounding lugs and field installed equipment ground conductors (EGC). A minimum of two microinverters mounted to the same rail and connected to the same Engage cable is required. Refer to installation manuals for additional details.

## UL Certification

The IronRidge® Flush Mount®, Tilt Mount®, and Ground Mount Systems have been listed to UL 2703 by Intertek Group plc.

UL 2703 is the standard for evaluating solar mounting systems. It ensures these devices will maintain strong electrical and mechanical connections over an extended period of time in extreme outdoor environments.

Go to IronRidge.com/UFO

## Cross-System Compatibility

Feature	Flush Mount	Tilt Mount	Ground Mount
XR Rails®	✓	✓	XR100 & XR1000
UFO®/Stopper	✓	✓	✓
BOSS® Splice	✓	✓	N/A
Grounding Lugs	1 per Row	1 per Row	1 per Array
Microinverters & Power Optimizers	Compatible with most MLPE manufacturers. Refer to system installation manual.		
Fire Rating	Class A	Class A	N/A
Modules	Tested or Evaluated with over 400 Framed Modules. Refer to installation manuals for a detailed list.		

**TOP TIER**  
SOLAR SOLUTIONS

TOP TIER SOLAR SOLUTIONS

1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

## REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

## PROJECT NAME &amp; ADDRESS

JOSHUA SPRAGUE  
RESIDENCE

580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
ESR

SHEET NAME  
EQUIPMENT  
SPECIFICATION

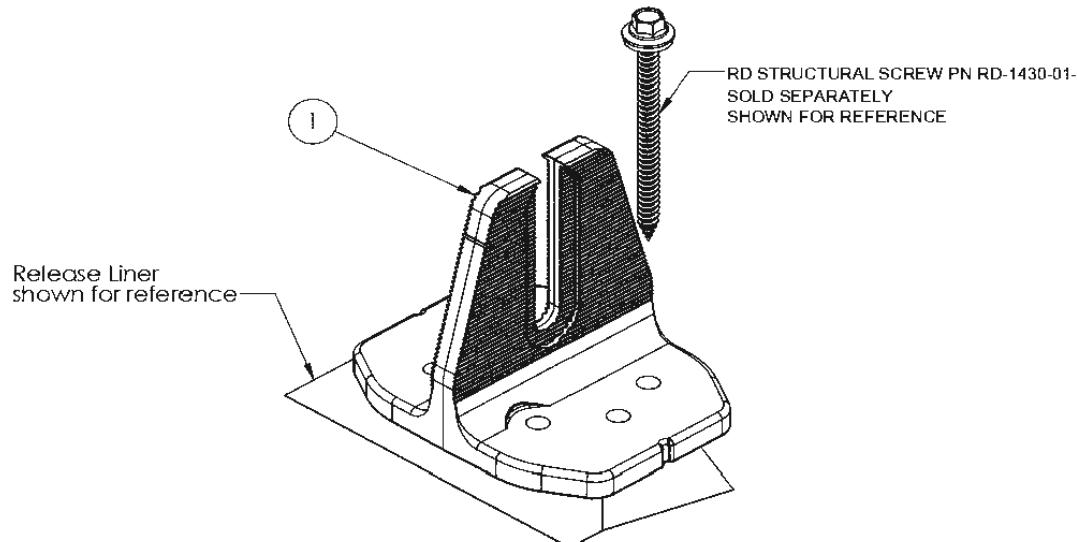
SHEET SIZE  
ANSI B  
11" X 17"

SHEET NUMBER  
PV-14



## QuickMount® Halo UltraGrip

Cut Sheet



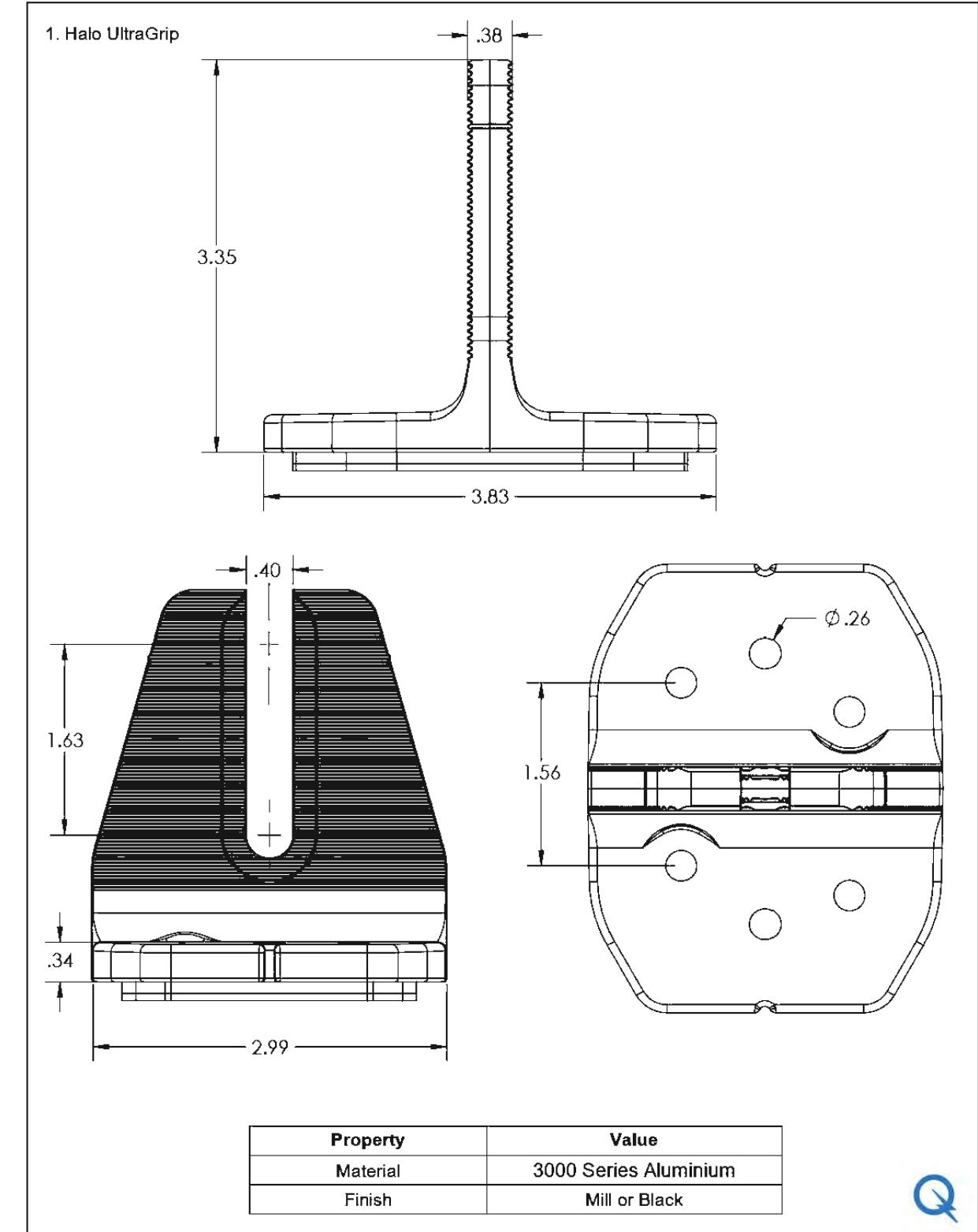
ITEM NO	DESCRIPTION	QTY IN KIT
1	QM Halo UltraGrip(Mill or Black)	1

PART NUMBER	DESCRIPTION
QM-HUG-01-M1	Halo UltraGrip - Mill
QM-HUG-01-B1	Halo UltraGrip - Black



© 2022 IronRidge, Inc. All rights reserved. Visit [www.ir-patents.com](http://www.ir-patents.com) for patent information.

QM-HUG-01-B1 or QM-HUG-01-M1 Cut Sheet Rev 1.0



© 2022 IronRidge, Inc. All rights reserved. Visit [www.ir-patents.com](http://www.ir-patents.com) for patent information.

QM-HUG-01-B1 or QM-HUG-01-M1 Cut Sheet Rev 1.0

**JOSHUA SPRAGUE  
RESIDENCE**

580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
ESR

SHEET NAME  
**EQUIPMENT  
SPECIFICATION**

SHEET SIZE  
**ANSI B  
11" X 17"**

SHEET NUMBER  
**PV-15**

**TOP TIER  
SOLAR SOLUTIONS**

**TOP TIER SOLAR SOLUTIONS**  
1530 CENTER PARK DR #2911,  
CHARLOTTE, NC 28217,  
UNITED STATES

REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	

PROJECT NAME & ADDRESS

**JOSHUA SPRAGUE  
RESIDENCE**

580 NEW CASTLE LN,  
SPRING LAKE, NC 28390

DRAWN BY  
ESR

SHEET NAME  
**EQUIPMENT  
SPECIFICATION**

SHEET SIZE  
**ANSI B  
11" X 17"**

SHEET NUMBER  
**PV-15**

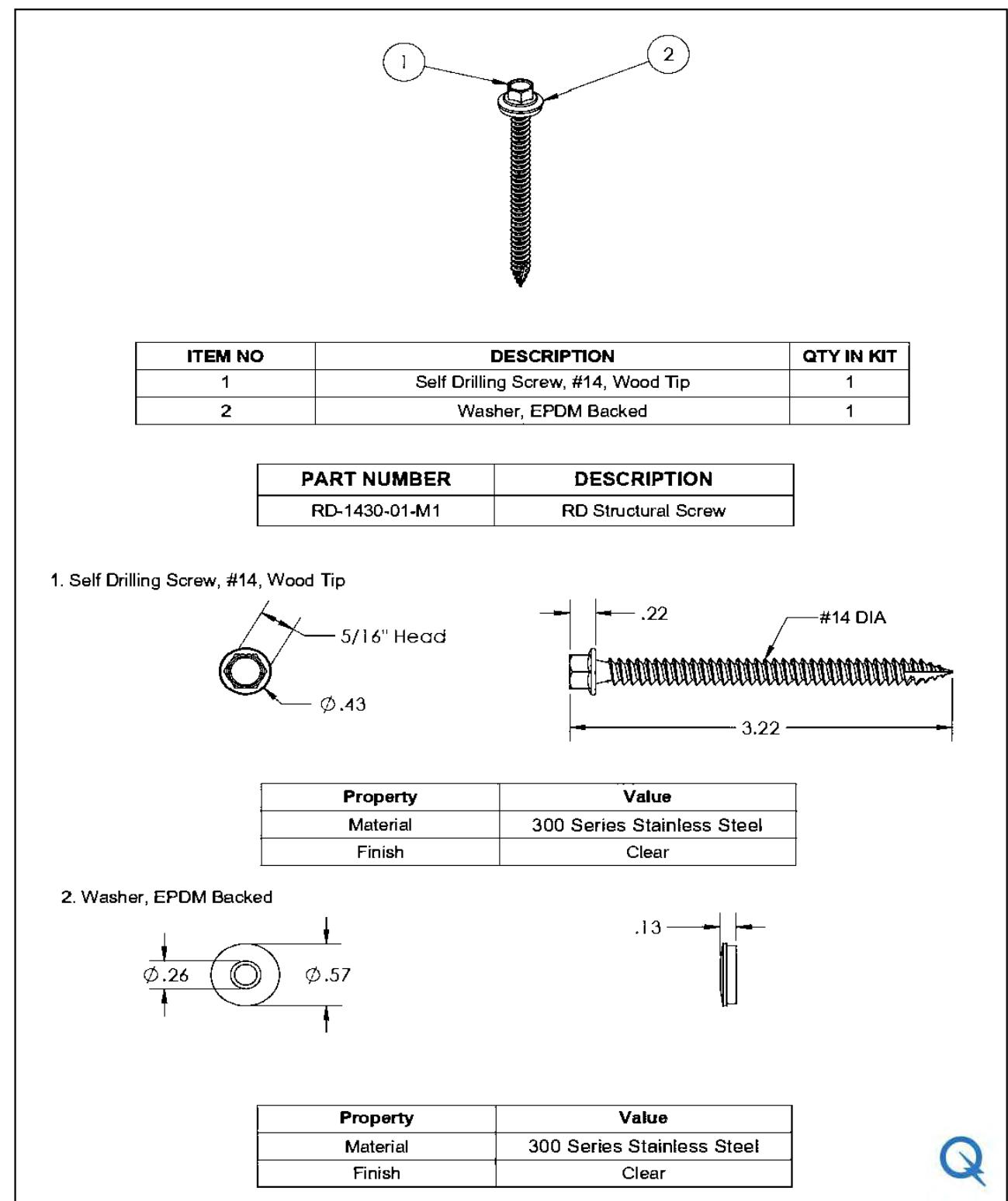


## QuickMount® RD Structural Screw

**TOP TIER**  
 SOLAR SOLUTIONS
TOP TIER SOLAR SOLUTIONS
 1530 CENTER PARK DR #2911,  
 CHARLOTTE, NC 28217,  
 UNITED STATES

## REVISIONS

DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	



Q

 PROJECT NAME & ADDRESS  
**JOSHUA SPRAGUE**  
**RESIDENCE**  
 580 NEW CASTLE LN,  
 SPRING LAKE, NC 28390

 DRAWN BY  
**ESR**

 SHEET NAME  
**EQUIPMENT**  
**SPECIFICATION**

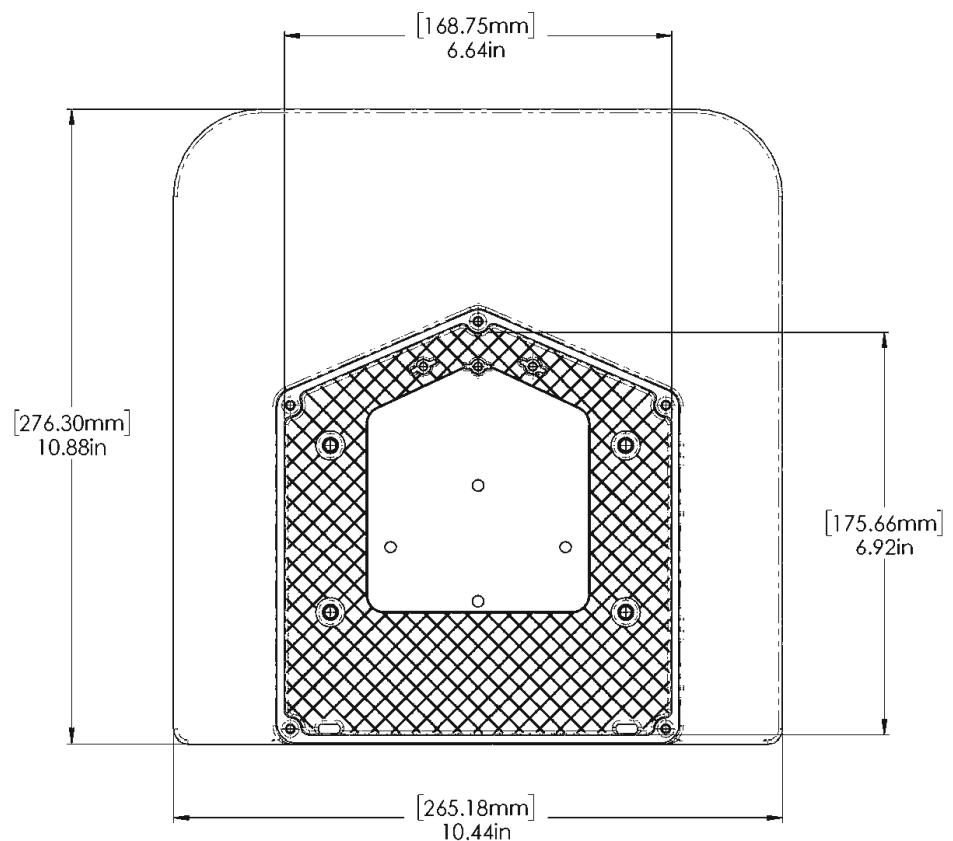
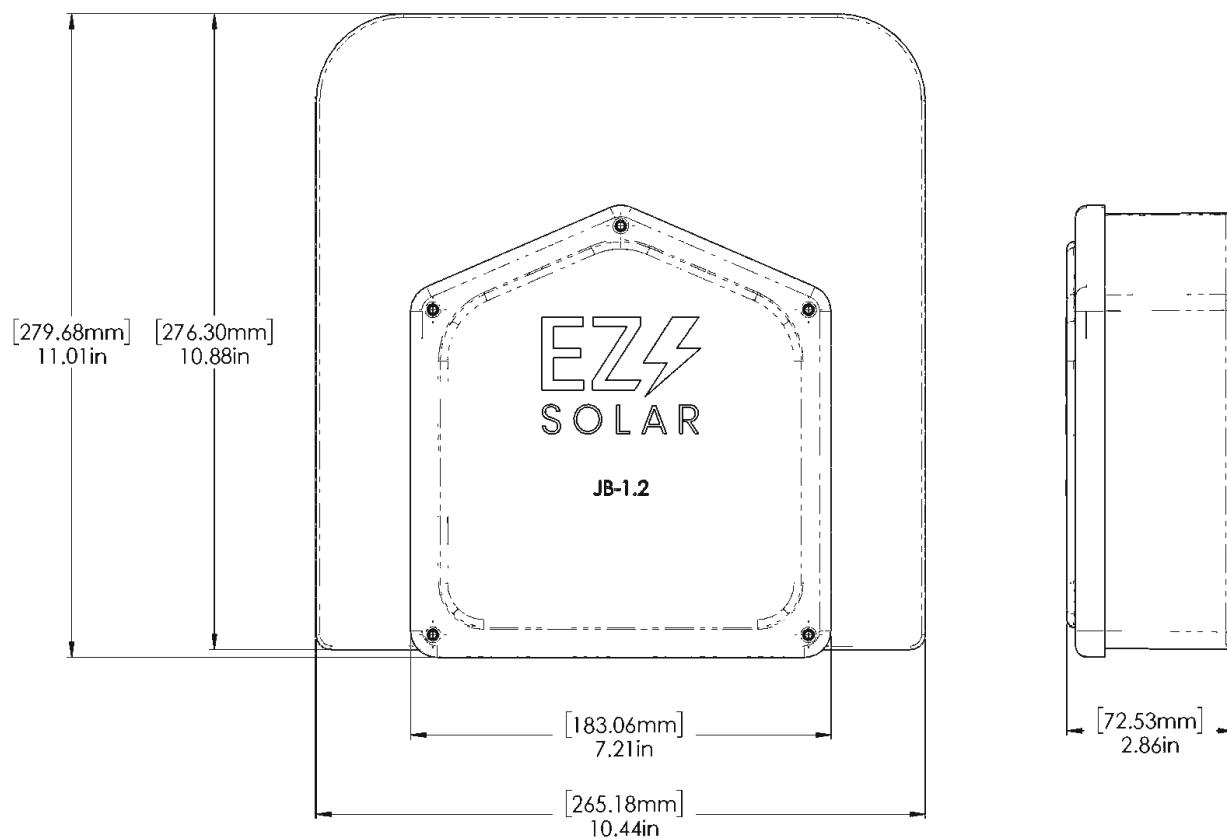
 SHEET SIZE  
**ANSI B**  
**11" X 17"**

 SHEET NUMBER  
**PV-16**

ITEM NO.	PART NUMBER	DESCRIPTION	QTY
1	JB-1.2 BODY	POLYCARBONATE WITH UV INHIBITORS	1
2	JB-1.2 LID	POLYCARBONATE WITH UV INHIBITORS	1
3	#10 X 1-1/4" PHILLIPS PAN HEAD SCREW		6
4	#8 X 3/4" PHILLIPS PAN HEAD SCREW		6

SIZE	DWG. NO.	REV
<b>B</b>	<b>JB-1.2</b>	
SCALE: 1:2	WEIGHT: 1.45 LBS	SHEET 1 OF 3
TORQUE SPECIFICATION:	<b>15-20 LBS</b>	
CERTIFICATION:	<b>UL 1741, NEMA 3R CSA C22.2 NO. 290</b>	
WEIGHT:	<b>1.45 LBS</b>	

SIZE	DWG. NO.	REV
<b>B</b>	<b>JB-1.2</b>	
SCALE: 1:2	WEIGHT: 1.45 LBS	SHEET 2 OF 3



REVISIONS		
DESCRIPTION	DATE	REV
INITIAL DESIGN	07/30/2025	