



Historic Preservation Services
Community Development & Neighborhood Services
281 North College Avenue
P.O. Box 580
Fort Collins, CO 80522.0580
970.224.6078
preservation@fcgov.com
fcgov.com/historicpreservation

REPORT OF ALTERATIONS TO DESIGNATED RESOURCE

Site Number/Address: 821 Mathews St.

Laurel School National Register Historic District

ISSUED: December 28, 2023

Kathy Watkinson
c/o Adrian Buck, Freedom Solar Power, LLC
2300 E. 76th Ave., Ste. D400
Denver, CO 80229

Dear Kathy:

This report is to inform you of the results of this office's review of proposed alterations to the Emma Woods Residence at 821 Mathews St., pursuant to Fort Collins Municipal Code, Chapter 14, [Article IV](#). A copy of this report may be forwarded to the Colorado Office of Archaeology and Historic Preservation as well.

The alterations reviewed include:

- Rooftop solar panel installation

Our staff review of the proposed work finds the alterations do not meet the SOI Standards for Rehabilitation because the panels will likely be visible from the street. However, please note that this evaluation does not prevent your project from moving forward.

Notice of this application review has been provided to building and zoning staff to facilitate the processing of any permits that are needed for the work. Please note that work beyond that indicated in your permit application/correspondence requires additional approval.

If you have any questions regarding this report, or if I may be of any assistance, please do not hesitate to contact me. I can be reached at yjones@fcgov.com or at 970-224-6045.

Sincerely,

Yani Jones
Historic Preservation Planner



BUILDING PERMIT APPLICATION:

Solar

All information on the application must be filled out (as applicable).

USE / TYPE OF BUILDING *(check the correct uses below):*

Residential Commercial
Single family detached Duplex/Two-Family Single Family Attached (Townhome) Multi-Family (Apartment/Condo)
Garage Bank Bar Church Hotel/Motel Medical Office Retail Other : _____

JOB SITE ADDRESS: _____ UNIT#: _____

PROPERTY OWNER INFO: (All owner information is required – NOT optional)

Last Name _____ First Name _____ Middle _____
Street Address _____ City _____ State _____ Zip _____
Phone # _____ Email _____

CONTRACTOR INFO:

Company Name _____
License Holder Name _____ LIC # _____ CERT # _____

CONSTRUCTON INFO *(check any that apply):*

PV (photovoltaic) Thermal Hydronic System
Mounting: Ground Roof

UTILITES INFO:

Electric Service Upgrade? Yes No Existing Amps _____ New Amps _____
Electric Meter Relocation? Yes No
Meter change out? Yes No
Panel change out? Yes No

VALUE OF CONSTRUCTION *(materials and labor):* \$ _____


DESCRIPTION OF WORK *(Include KWh and number of solar panels):*

JOBSITE SUPERVISOR CONTACT INFO: Name _____ Phone _____

SUBCONTRACTOR INFO:

Electrical _____ Plumbing _____

Applicant: I hereby acknowledge that I have read this application and state that the above information is correct and agree to comply with all requirements contained herein and City of Fort Collins ordinances and state laws regulating building construction.

Applicant Signature  _____ Type or Print Name _____

Phone # _____ Email _____

THIS APPLICATION EXPIRES 180 DAYS FROM APPLICATION DATE


iRooFA™
Instant Roof Framing Analysis
www.iroofa.solar
 tel: 540.313.5317 - email: info@iRooFA.solar

STRUCTURAL ANALYSIS
 for the
ROOFTOP PV SOLAR INSTALLATION

Project: Gene Kathy Watkinson, 821 Mathews Street, Ft Collins, CO 80524

Prepared for:



Freedom Solar, LLC
 4801 Freidrich Ln, Ste 100 - Austin, TX 78744

<u>Calculation Report Index</u>			
<u>Pages</u>	<u>Description</u>		
1	Cover	2-4	Loading Summary
	<i>Roof Structural Calculations for PV Solar Installation</i>		
5-8	Location: MP 1		
9-9	Snow Loading Calculations		

Project Number: 36.113427, Rev. 0

Report Date: 12/21/2023

Report Prepared by:



Richard Pantel, P.E.
 CO License No. PE-42396
 Sealed 12/21/2023

Loading Summary

Exposure and Occupancy Categories	
B	<i>Exposure Category (ASCE 7-16 Table 26.7.3, Page 246)</i>
II	<i>Building Use Occupancy / Risk Category (ASCE 7-16 Table 1.5-1, Page 2)</i>

Wind Loading:			
v	140	mph	<i>Over-ridden per client request. Original data from Municipality provided wind / snow loadings.</i>
qz	29.85	psf	<i>Velocity qz, calculated at height z [ASD]</i>

Snow Loading			
pg	30	psf	<i>Ground Snow Load pg (Over-ridden per client request. Original data from Municipality provided wind / snow loadings.)</i>
<i>Total Snow Load</i>			
ps	30.00	psf	<i>Effective snow load on roof and modules</i>

Module Data			
REC Solar: REC420AA Pure-R			
Dimensions	<i>mm</i>	<i>ft</i>	<i>in</i>
<i>Length</i>	1,730	5.68	68.11
<i>Width</i>	1,118	3.67	44.02
<i>Area (m², ft²)</i>	1.9	20.82	
Weight	kg	lb	
<i>Module</i>	21.50	47.40	

Roof Panel (Cladding) Loading Summary		Module Loading Summary			
<i>Support Point Loads</i>		<i>Upward</i>	<i>Upward</i>	<i>Upward</i>	<i>Downward</i>
Roof Zones		1,2e,2r	2n,3r	3e	All
Net load per module	<i>lb</i>	-247	-315	-417	384

Positive values indicate net downward force

Stanchion Fastener Pull-out and Spacing Calculations				
Framing spacing	<i>ft</i>		1.33	
Rails / Module	<i>ea</i>		2	
Max proposed stanchion span	<i>ft</i>		4.00	
# fasteners per stanchion			5	
Screw thread embedment depth	<i>in</i>		0.5	
Safety Factor			1.10	
Pull-out for M5 threaded fasteners	<i>lb/in</i>		103	
Factored max fastener uplift capacity	<i>lb</i>		235	
Fastener details	<i>Material</i>	Stainless	<i>Size</i>	M5
Max stanchion uplift capacity	<i>lb</i>		400	
Max support point uplift capacity	<i>lb</i>		235	

Roof Zones			1,2e,2r	2n,3r	3e
Net lift per module	<i>lb</i>		247	315	417
Min tot screw thread embedment depth req'd	<i>in</i>		0.52	0.67	0.89
Net uplift pressure	7. 0.60D - 0.6W	<i>psf</i>	-10.86	-13.85	-18.39
Allowable lift area / support point		<i>sf</i>	21.65	16.97	12.79
Max rail span per framing spacing		<i>ft</i>	4.00	4.00	4.00

Landscape Modules					
Length along rafter	<i>ft</i>		3.67		
Lift calc'ed max stanchion EW spacing	<i>ft</i>		> 6	> 6	> 6
Max stanchion EW spacing	<i>ft</i>		4.00	4.00	4.00
Maximum module area / support point		<i>sf</i>	11.00	11.00	11.00
Factored lift per support point		<i>lb</i>	-120	-152	-202

Portrait Modules					
Length along rafter	<i>ft</i>		5.68		
Lift calc'ed max stanchion EW spacing	<i>ft</i>		> 6	5.33	4.00
Max stanchion EW spacing	<i>ft</i>		4.00	4.00	4.00
Maximum module area / support point		<i>sf</i>	11.35	11.35	11.35
Factored lift per support point		<i>lb</i>	-123	-157	-209

Plywood Nailing Calculations					
Nail Size	<i>Gauge</i>	<i>Shank Dia</i>	<i>Length</i>	<i>W</i>	
8D	10	0.134	2.5	54	
10D	9	0.148	3	59	
Load Duration Factor - Wind	1.6				
AWC 11.3.1 $W' = W * Cd * Cm * Ct * Ceg * LD$					
8D withdrawal force @ 2" penetration (lb)	138				
10D withdrawal force @ 2.5" penetration (lb)	189				

		1,2e,2r	2n,3r	3e
# 8D's Req'd / stanchion in Landscape	<i>ea</i>	0.86	1.10	1.46
# 10D's Req'd / stanchion in Landscape	<i>ea</i>	0.63	0.81	1.07
# 8D's Req'd / stanchion in Portrait	<i>ea</i>	0.89	1.14	1.51
# 10D's Req'd / stanchion in Portrait	<i>ea</i>	0.65	0.83	1.11

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 Gene Kathy Watkinson, located at 821 Mathews Street, Ft Collins, CO, by Freedom Solar, LLC, to determine its suitability to support a PV solar system installation.

The referenced building's roof structure was field measured by Freedom Solar, LLC on 12/13/2023. 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 Freedom Solar, LLC. Loads are calculated to combine the existing building and environmental loads with the proposed new PV array loads.

The SunPower InvisiMount 6000 series racking and Roof Tech RT Mini w 5 M5 screws stanchions were selected for this project by Freedom Solar, LLC. The racking and support stanchions shall be placed as shown on their plans, dated 12/15/2023, 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 rafter. Intermediate rows shall move the support points laterally to the next rafter. The support rail can be cantilevered up to 1/3 of the maximum span between modules. 1/3 maximum span = 16.00 inches.



Google Location Map

Framing Summary

Based upon the attached calculations, the existing roof's framing system is 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. Minimum required anchorage fastening is described above.

Fastener notes: 1) 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) IBC 2021
- 3) 2021 *International Residential Code, CO Edition*
- 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

Array AR-1

Location: MP 1

Member: Rafter - Total Length 23.5 ft, Unsupported 17.9 ft

Geometric Data			
Θ	deg.	39.98	Angle of roof plane from horizontal, in degrees
ω	deg.	0.00	Angle the solar panel makes with the roof surface
L	ft.	27.00	Length of roof plane, in feet (meters)
W	ft.	19.00	Plan view width of roof plane, in feet (meters)
h	ft.	24.33	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 =	29.85	psf	$V_{asd} q_z$ =	18.10 psf
V=	140			mph
				Basic wind pressure

Framing Data		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support	1	
Rafter / Truss OC	in	16.00
Member Total Length	ft	23.50

3	# Rafters / Rack Support Width
4.00	Rack Support Spacing (ft)
48	Max. Rack Support Spacing (in)
4	Max # of mod's / Rafter

Member Properties		Member
Name		(1)1.5x9.25
Repetitive Member Factor (Cr)		1.15
Max Shear perp. to grain	psi	530
Max Shear parallel to grain	psi	1,100

* Mem properties based upon field measurements

Rafter

16.00	Collar tie OC spacing, in.
-------	----------------------------

Module Physical Data			
Weight	kg	lb	psf load
Module	21.50	47.40	2.28
4 Stanchions	2.72	6.0	0.29

Existing Dead Loads	Units	Value	Description
Framing Member	psf	1.98	
Roof Deck & Surface	psf	4.40	0.50 in. Plywood w/ Standard Asphalt Shingles

Rack Support Spacing and Loading			
Across rafters	ft	4.0	
Along rafter slope	ft	5.7	
Area / support point	sf	11.4	
Uphill gap between modules	in	1.0	0.08 ft

Member Total Length	ft	23.50	
Maximum member free span	ft	17.90	Rafter below Collar tie
Rafter segment to calc	ft	17.90	Free span
Deflection Ratio		180	Use max delta 1/x for deflection

* Collar tie height @ 11.50' AFF max height. Adjust to match lowest adjoining roof's collar tie as needed

Eave Overhang Length past Rafter Plate	0.83	ft
Uphill Distance from Eave to Lowest Support	2.92	ft

ASCE 7-16 Method for Calculating Uplift on PV Modules

Notation

Lp = Panel chord length.

p = uplift wind pressure

ya = Solar panel pressure equalization factor, defined in Fig. 29.4-8.

γE = Array edge factor as defined in Section 29.4.4.

θ = 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.

θ >= 7 deg TRUE

Min.d1: Exposed **FALSE**

Max.d1: Exposed **TRUE**

Use EXPOSED for uplift calculations

1.5(Lp) =	5.50
γE =	1.5
ya =	0.67

p = qh(GCp) (γE) (Ya) (lb/ft2) (29.4-7)

Zones	1,2e,2r	2n,3r	3e
p, Windload (psf)	-27.05	-32.04	-39.59

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	<i>Module Upward</i>	<i>Module Upward</i>	<i>Module Upward</i>	<i>Downward</i>
D = dead load of PV Module + Stanchion	2.56	2.56	2.56	2.56
S = snow load	30.00	30.00	30.00	30.00
W = wind load	-27.05	-32.04	-39.59	13.98

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.				
<i>Combination Formulae</i>	<i>Upward</i>	<i>Upward</i>	<i>Upward</i>	<i>Downward</i>
Use this loading combination for DOWNWARD for Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	32.56	32.56	32.56	38.86
Module Support point load (lb)	370	370	370	441
Cr Factored Module Support point load (lb)	321	321	321	384

Use this loading combination for UPWARD for Proposed PV Dead Load				
7. 0.60D - 0.6W	-10.86	-13.85	-18.39	8.95
Module Support point load (lb)	-123	-157	-209	102

DOWNWARD

Presume loading directly over member.

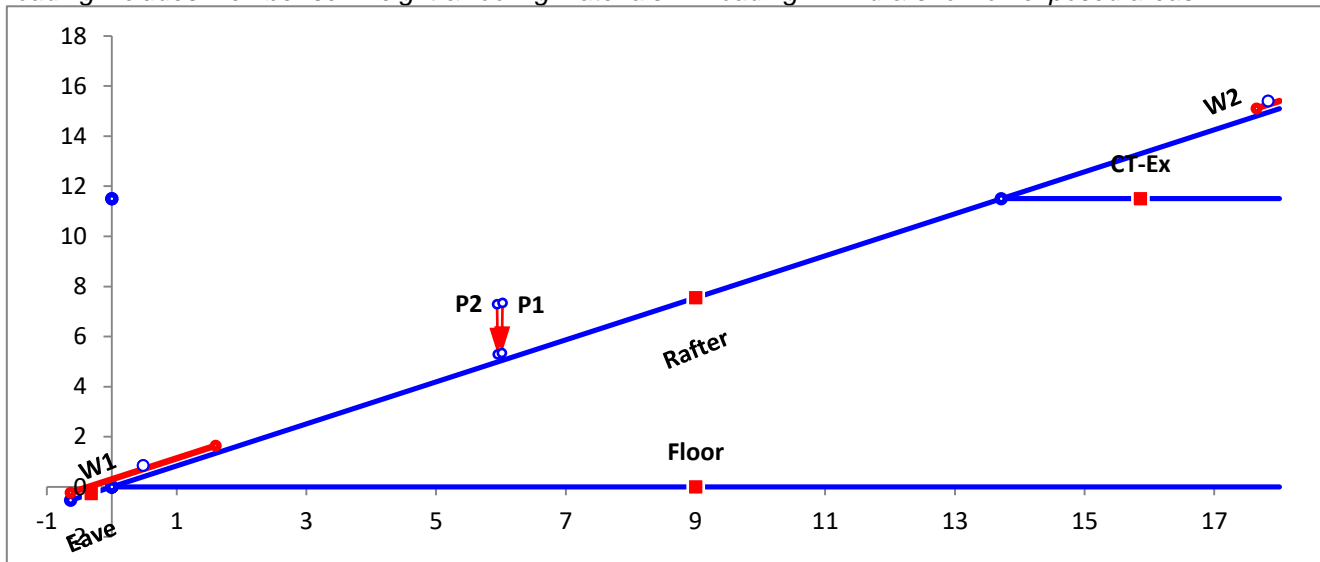
Combined Dead and Wind Pressure Downward Loading					
Rafter below Collar tie					
PV Module Row	Point load loc's from Left support		Module Support Point Load	Comment	Module Orientation
	<i>ft from left</i>		<i>lb</i>		
1	2.09			Support placed on adjoining rafter	Portrait
1	7.77		384		Portrait
2	7.85		384		Portrait
2	13.53			Support placed on adjoining rafter	Portrait
3	13.61			Support placed on adjoining rafter	Portrait
3	19.28			Support outside of max stressed section	Portrait
4	19.37			Support outside of max stressed section	Landscape
4	23.04			Support outside of max stressed section	Landscape

Analysis for PV impacted areas

5. Simple Beam - Exposed Roof Snow Load - Above and Below PV				
<i>Parameter</i>	<i>Units</i>	<i>Total</i>	<i>Allowed</i>	<i>Check</i>
Delta @ mid span	<i>in</i>	0.02	1.19	OK
M at mid span	<i>lb-ft</i>	46	11,646	OK

Sum Downward Loading Conditions: PV; Beam DL; Exposed Roof Environmental Load				
<i>Parameter</i>	<i>Units</i>	<i>Total</i>	<i>Allowed</i>	<i>Check</i>
Delta	<i>in</i>	1.16	1.19	OK
Percent Max Delta	<i>%</i>	97%	100%	OK
Moment	<i>lb-ft</i>	3,296	11,646	OK
fs	<i>psi</i>	1,849	6,533	OK

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



Framing section with max stress: Rafter below Collar tie

Snow Loading Analysis

where:

- | | | |
|------------------------|--|---|
| | Fully Exposed | Exposure category |
| C_e = | 0.9 | Exposure Factor, C _e (ASCE 7-16 Table 7-2, Page 30) |
| C_t = | 1.0 | Thermal Factor, C _t (ASCE 7-16 Table 7-3, Page 30) |
| I_s = | 1.0 | Snow Importance Factor, I _s (ASCE 7-16 Table 1.5-2, Page 5) |
| p_g = | 30 | Ground Snow Load p _g (Over-ridden per client request. Original data from Municipality) |
| p_f = | 0.7C_eC_tI_sP_g | Flat Roof Snow Load, p _f (ASCE 7-16 Table 7-2, Page 30) |
| p_f = | 18.9 | psf |
| | | but where P _f is not less than the following: |
| | | Minimum Snow Load p _m (ASCE 7-16 Table 7.3.4, Page 29) |
| p_m = | 20 | psf. When P _g > 20 psf, then use P _f = 20 psf x I _s |
| p_f = | 30 | psf. Override min roof snow load for Lynn, CO |
| p_f = | 30 | psf. Resultant Snow pressure to be used with Roof slope factor below |
| p_s = | C_sp_f | Sloped Roof Snow Load p _s (ASCE 7-16 Table 7.4, Page 31) |
| | | Roof Type Warm Roofs |

Roof slope factor C_s for Warm Roofs, where C_t = 1.0

Roof surface condition = Slippery Roof

- | | | |
|------------------------|------|---|
| C_s = | 1.00 | Roof Slope Factor, C _s (ASCE 7-16 Table 7-2a, Page 36) |
|------------------------|------|---|

Total Snow Load

p_s =	30.00 psf	Roof snow load
------------------------	------------------	----------------

SCOPE OF WORK

TO INSTALL A SOLAR PHOTOVOLTAIC (PV) SYSTEM AT THE WATKINSON RESIDENCE, LOCATED AT 821 MATHEWS STREET, FORT COLLINS, COLORADO. THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

SYSTEM RATING

9.240 kW DC STC
6.930 kW AC

EQUIPMENT SUMMARY

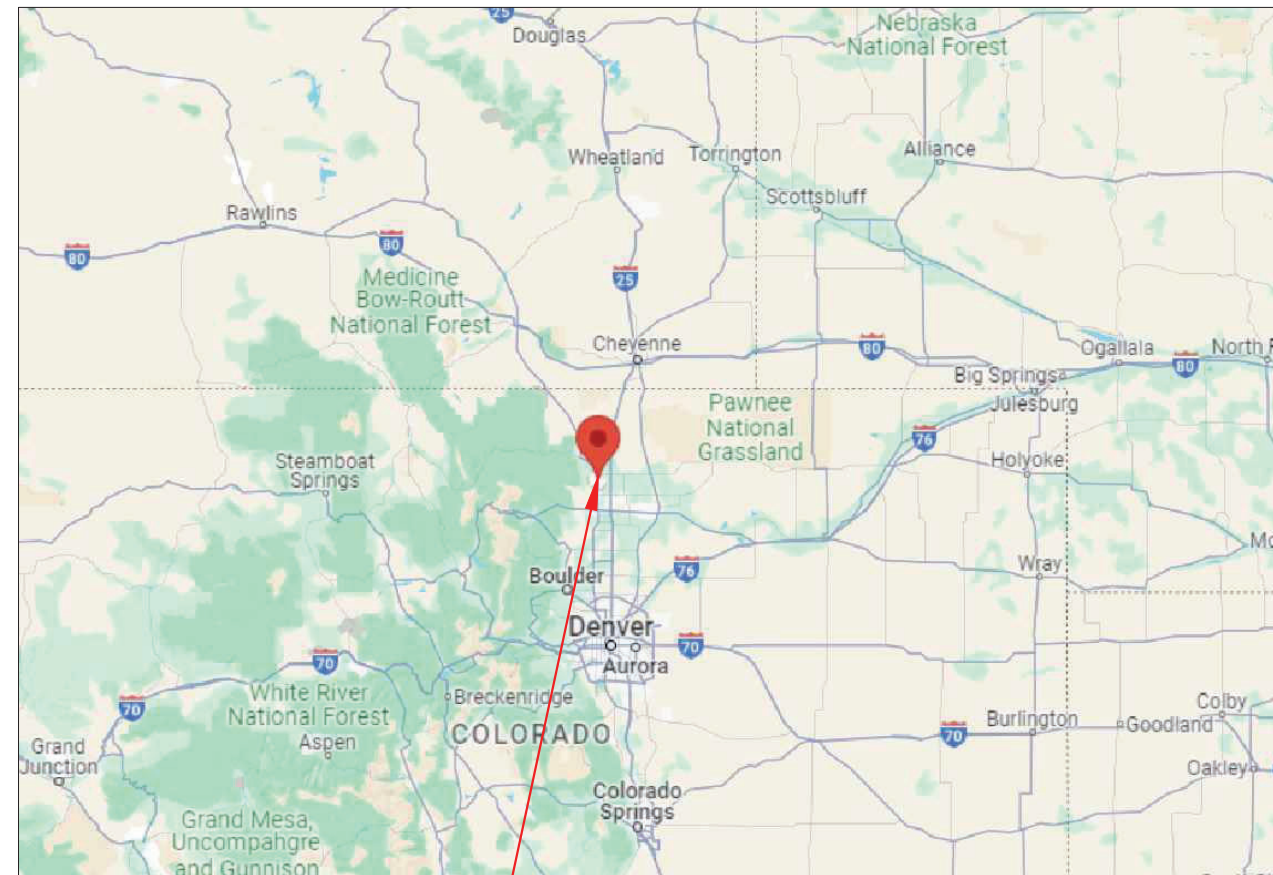
- (22) REC SOLAR REC420AA PURE-R (420W) PV MODULES
- (22) ENPHASE IQ7XS-96-2-US [240V] PV INVERTERS
- (215) (20 X 10.75') LINEAR FEET SUNPOWER UNIVERSAL INVISIMOUNT

SHEET INDEX

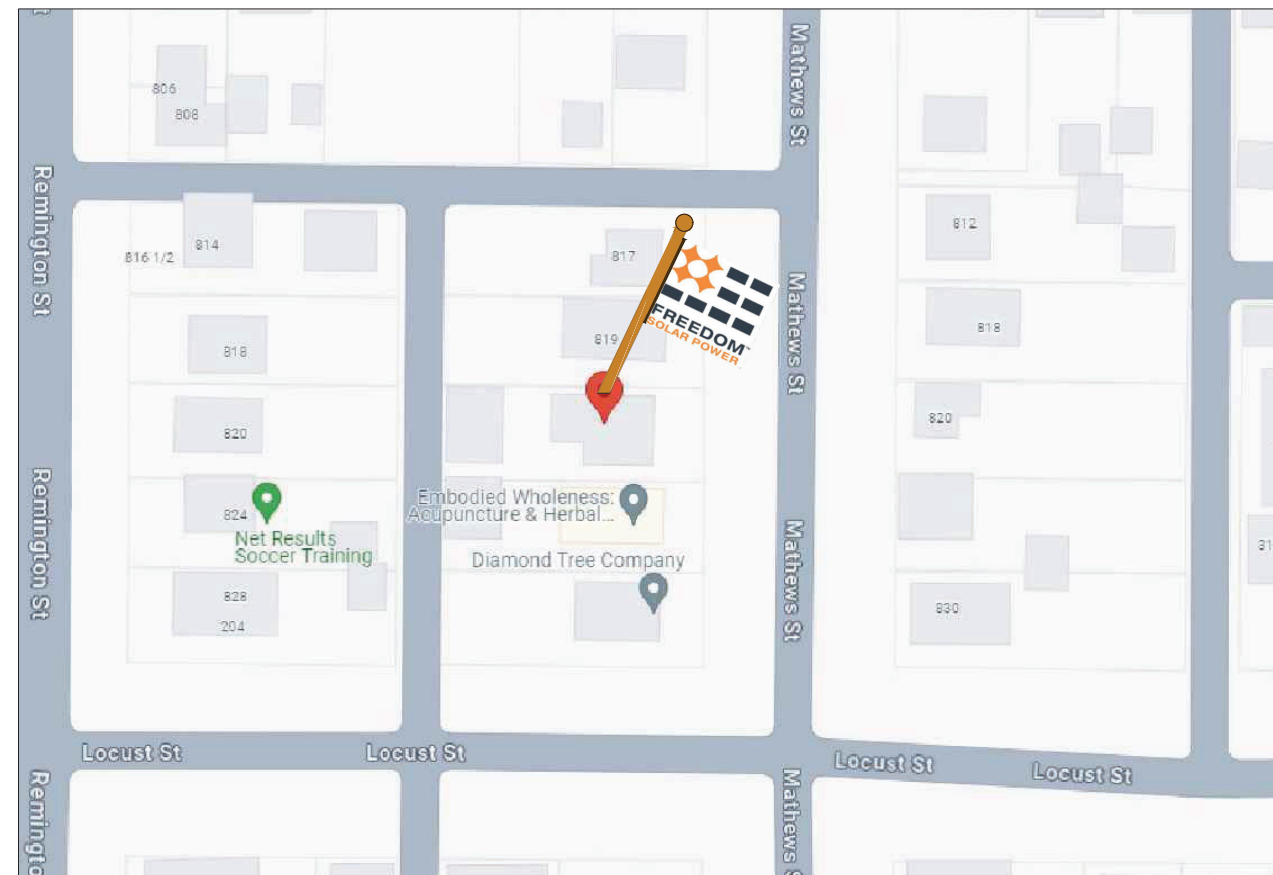
- PV-0 COVER
- PV-1 SITE MAP AND PV LAYOUT
- PV1A RACKING PLAN
- PV-2 STRING MAP AND MONITORING LAYOUT
- PV-3 ELECTRICAL DIAGRAM
- PV-4 EQ WALL & MOUNTING DETAIL
- PV-5 SYSTEM LABELING DETAIL
- PV-6 SITE DIRECTORY PLACARD
- PV-7 SAFETY PLAN

GOVERNING CODES

- 2023 NATIONAL ELECTRICAL CODE
- 2021 INTERNATIONAL RESIDENTIAL CODE
- 2021 INTERNATIONAL FIRE CODE
- UNDERWRITERS LABORATORIES (UL) STANDARDS
- OSHA 29 CFR 1910.269



PROJECT LOCATION



VICINITY MAP

CONTRACTOR

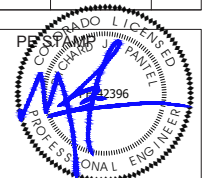


FREEDOM
SOLAR POWER

FREEDOM SOLAR LLC
4801 FREIDRICH LN, STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

REVISIONS

DESCRIPTION	DATE	REV
DESIGN PACKET	12/15/2023	



Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396

PROJECT NAME
12/21/2023

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789

SHEET NAME

COVER

SHEET SIZE

ANSI B
11" x 17"

SHEET NUMBER

PV-0

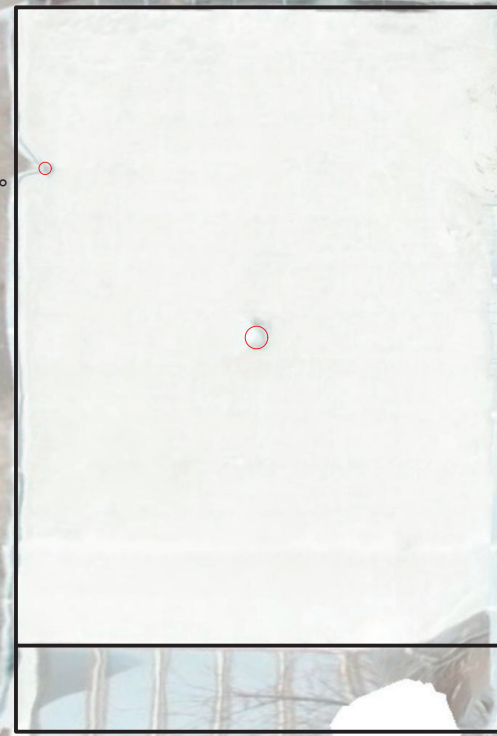
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CONSTRUCTION SUMMARY

- (22) (REC SOLAR REC420AA PURE-R (420W)) SOLAR MODULES, 9.240 kW DC STC
MODULE DIMENSIONS = 44.0" X 68.1" X 1.2"
- (22) ENPHASE IQ7XS-96-2-US [240V] PV INVERTERS
COMBINED INVERTER OUTPUT = 6.930 kW AC.
- (215) (20 X 10.75') LINEAR FEET SUNPOWER UNIVERSAL INVISIMOUNT
- (72) RT-MINI ROOF ATTACHMENTS
- (01) SUNPOWER MONITORING

SITE DETAILS

ROOF TYPE: ASPHALT SHINGLE
ARRAY #1 - TILT = 40°, AZIMUTH = 180°



DETACHED STRUCTURE

MAIN HOUSE

FIRE CODE SETBACK
PER 2021 IRC 324.6

STREET/DRIVEWAY
SIDE PATHWAY

FORT COLLINS UTILITIES
REVENUE METER
#15 603 364
GROUNDING ELECTRODE
MAIN DISTRIBUTION PANEL
(OUTSIDE HOUSE WALL)

SOLAR LOAD CENTER
MONITORING
PV AC DISCONNECT
- VISIBLE
- LOCKABLE
- LABELED
(OUTSIDE HOUSE WALL)

PV ARRAY #1
9.240 kW
(22) MODULES

ROOF AREA = 1689.2 SQFT
ARRAY AREA = 457.8 SQFT
AREA COVERED BY ARRAY = 27.1%

FALL PROTECTION REQUIRED

CONSTRUCTION NOTES

- 1.) ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- 2.) ALL OUTDOOR EQUIPMENT SHALL BE RAINTIGHT WITH MINIMUM NEMA 3R RATING.
- 3.) ALL LOCATIONS ARE APPROXIMATE AND REQUIRE FIELD VERIFICATION.

DESIGN CRITERIA:-
SNOW LOAD: LIVE LOAD: 30 PSF / GROUND SNOW LOAD 35 PSF
FROST DEPTH: 30 INCHES
SEISMIC DESIGN CATEGORY: B

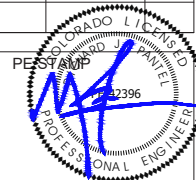
BASIC WIND SPEED:
RISK CATEGORY II (MOST STRUCTURES):
140MPH (ULTIMATE) EXPOSURE B
RISK CATEGORY I: 130MPH (ULTIMATE) EXPOSURE B
RISK CATEGORY III & IV: 150MPH (ULTIMATE) EXPOSURE B

CONTRACTOR

FREEDOM SOLAR POWER
FREEDOM SOLAR LLC
4801 FREDRICH LN, STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

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PROJECT NAME

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789

SHEET NAME

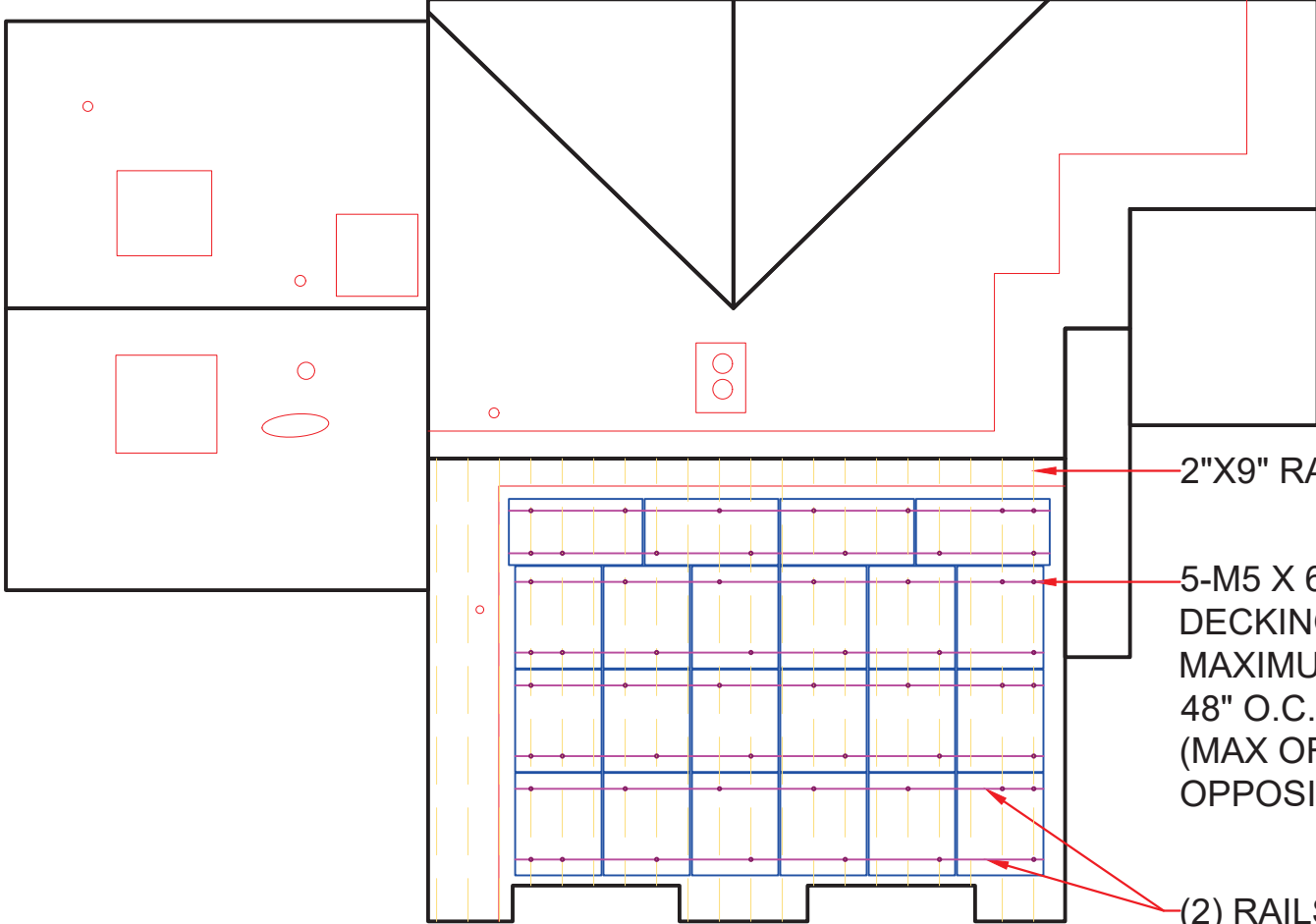
SITE MAP & PV LAYOUT

SHEET SIZE

**ANSI B
11" x 17"**

SHEET NUMBER

PV-1



2"X9" RAFTERS AT 16" O.C. TYP.

5-M5 X 60MM SCREWS INTO DECKING PER ATTACHMENT
MAXIMUM ATTACHMENT SPAN IS 48" O.C. STAGGERED ALONG RAILS
(MAX OFFSET SPAN IS 36" FROM OPPOSITE RAIL ATTACHMENT)

(2) RAILS PER ROW OF MODULES
EVENLY SPACED

CONTRACTOR

FREEDOM SOLAR POWER
 FREEDOM SOLAR LLC
 4801 FREIDRICH LN, STE 100
 AUSTIN, TX 78744
 512-759-8313
 TECL # 28621

REVISIONS

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GENE & KATHY WATKINSON
 821 MATHEWS STREET
 FORT COLLINS, COLORADO,
 80524
 (970) 689-9789

SHEET NAME

RACKING PLAN

SHEET SIZE

**ANSI B
 11" x 17"**

SHEET NUMBER

PV-1A

CONSTRUCTION NOTES

- 1.) ALL EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- 2.) ALL OUTDOOR EQUIPMENT SHALL BE RAINTIGHT WITH MINIMUM NEMA 3R RATING.
- 3.) ALL LOCATIONS ARE APPROXIMATE AND REQUIRE FIELD VERIFICATION.

SUNPOWER SUPERVISOR S/N _____

CONTRACTOR

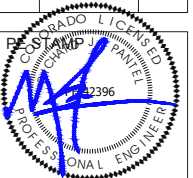


**FREEDOMTM
SOLAR POWER**

FREEDOM SOLAR LLC
4801 FREIDRICH LN. STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

REVISIONS

DESCRIPTION	DATE	REV
DESIGN PACKET	12/15/2023	



Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396

PROJECT NAME
12/21/2023

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789

SHEET NAME
STRING MAP &
MONITORING
LAYOUT

SHEET SIZE
ANSI B
11" x 17"

SHEET NUMBER
PV-2

**SOLAR ARRAY - 9.240 kW DC STC, 6.930 KW AC
(22) REC SOLAR REC420AA PURE-R (420W) MODULES**

NEW ROOFTOP JUNCTION BOXES:
TRANSITION FROM DG CABLE
TO AWG #10 THWN-2
NEMA 3R, UL LISTED

BRANCH #1



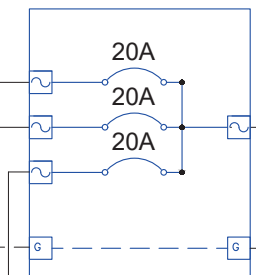
BRANCH #2



(22) (ENPHASE IQ7XS-96-2-US [240V])
INVERTERS 240VAC, 1.31A MAX,
CEC WEIGHTED EFFICIENCY 97.5%
NEMA 4R, UL LISTED, INTERNAL GFDI

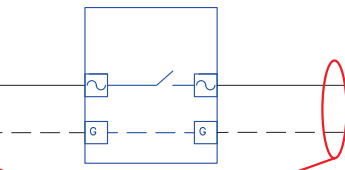
(4) AWG #10 THWN-2
(1) AWG #8 THWN-2 GND
IN 3/4" CONDUIT

NEW SOLAR LOAD CENTER
240VAC, 125A
NEMA 3R, UL LISTED
(3) 2P-20A BREAKERS



NEW SUNPOWER MONITORING

NEW PV AC DISCONNECT
240VAC, 60A
NON-FUSIBLE,
NEMA 3R, UL LISTED
VISIBLE, LOCKABLE, LABELED



(3) AWG #8 THWN-2
(1) AWG #8 THWN-2 GND
IN 1" CONDUIT

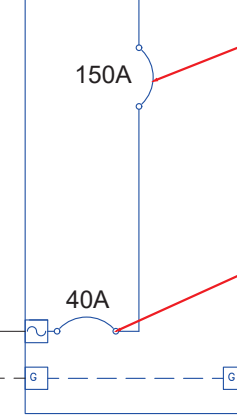


FORT COLLINS UTILITY
REVENUE METER
#15 603 364
1-PHASE, 240V

MAIN SERVICE DISCONNECT
240V, 150A

MAIN DISTRIBUTION PANEL
SQD QO, 1P3W
240V, 200A BUS

POINT OF INTERCONNECTION
(1) 2P-40A CIRCUIT BREAKER
INSTALLED AT OPPOSITE END OF
BUS FROM MAIN DISCONNECT



EXISTING GROUNDING
ELECTRODE SYSTEM

**REMOVE UNUSED 2P-20A BREAKER IN MDP
TO MAKE ROOM FOR INTERCONNECTION.**

ELECTRICAL NOTES

- 1.) ALL EQUIPMENT TO BE LISTED BY UL OR OTHER NRTL, AND LABELED FOR ITS APPLICATION.
- 2.) ALL CONDUCTORS SHALL BE COPPER. ALUMINUM CONDUCTORS MAY BE USED IF CORRECTLY UPSIZED FOR AMPACITY RATING PER NEC 310.12 OR 310.16. ALL CONDUCTORS SHALL BE RATED FOR 600V AND 90°C WET ENVIRONMENT UNLESS OTHERWISE NOTED.
- 3.) WORKING CLEARANCES AROUND ALL NEW AND EXISTING ELECTRICAL EQUIPMENT SHALL COMPLY WITH NEC 110.26.
- 4.) DRAWINGS INDICATE THE GENERAL ARRANGEMENT OF SYSTEMS. CONTRACTOR SHALL FURNISH ALL NECESSARY OUTLETS, SUPPORTS, FITTINGS AND ACCESSORIES TO FULFILL APPLICABLE CODES AND STANDARDS.
- 5.) WHERE SIZES OF JUNCTION BOXES, RACEWAYS AND CONDUITS ARE NOT SPECIFIED, THE CONTRACTOR SHALL SIZE THEM ACCORDINGLY. SPECIFIED CONDUIT AND WIRE SIZES ARE MINIMUM REQUIREMENTS AND LARGER DIAMETER SHALL BE PERMITTED.
- 6.) ALL WIRE TERMINATIONS SHALL BE APPROPRIATELY LABELED AND READILY VISIBLE.
- 7.) MAXIMUM MOUNTING HEIGHT FROM GRADE TO CENTER OF METER SOCKET SHALL BE 72" FOR RESIDENTIAL SINGLE PHASE METER SOCKETS 0-320 AMPS. MINIMUM MOUNTING HEIGHT IS 30" FROM FOR AUSTIN ENERGY, AND 48" FOR ALL OTHER JURISDICTIONS
- 8.) MINIMUM HORIZONTAL CLEARANCE FROM GAS REGULATOR TO ANY ELECTRICAL ENCLOSURE IS 36", EXCEPT AUSTIN ENERGY WHICH REQUIRES 48" CLEARANCE FROM GAS TO METER SOCKET
- 9.) PV DISCONNECT SHALL BE VISIBLE, LOCKABLE AND LABELED AND THE DOOR CANNOT BE OPENED WHEN HANDLE IS IN ON POSITION
- 10.) BY DEFAULT THE MONITORING DEVICE IS SHOWN CONNECTED TO A 20-AMP BREAKER IN THE SOLAR LOAD CENTER. ALTERNATIVELY, THE MONITORING DEVICE MAY BE CONNECTED TO A 20 AMP BREAKER AT THE MAIN DISTRIBUTION PANEL.
- 11.) ALL EQUIPMENT TERMINATIONS SHALL BE RATED FOR 75 DEGREES OR GREATER
- 12.) ALL CT WIRES SHALL BE CONSIDERED CLASS 1 PER NEC ARTICLE 725, AND BE MARKED AS RATED FOR 600V. PER 725.48(A) CLASS 1 CIRCUITS SHALL BE PERMITTED TO OCCUPY THE SAME RACEWAY AS OTHER CIRCUITS PROVIDED ALL CONDUCTORS ARE INSULATED FOR THE MAXIMUM VOLTAGE OF ANY CONDUCTOR IN THE RACEWAY.
- 13.) AWG #10 COPPER CONDUCTORS ARE SPECIFIED AS THE DEFAULT WIRE REQUIRE FROM THE PV ARRAY TO THE SOLAR LOAD CENTER, HOWEVER, AWG #12 COPPER CONDUCTORS MAY BE UTILIZED IF BOTH OF THE FOLLOWING CONDITIONS ARE MET: THE LENGTH OF THE CONDUCTOR IS LESS THAN 75 FT AND THERE ARE LESS THAN 8 CURRENT-CARRYING CONDUCTORS WITHIN THE RACEWAY.

CALCULATIONS FOR CURRENT CARRYING CONDUCTORS	CALCULATIONS FOR OVERCURRENT DEVICES
INVERTER OUTPUT WIRE AMPACITY CALCULATION [NEC 690.8(A)(1)(c)]: 1.31A PER INVERTER (ENPHASE IQ7XS-96-2-US [240V]) MAXIMUM INVERTER BRANCH CURRENT = (12)(1.31A) = 15.7A CONTINUOUS USE: #10 WIRE 75°C DERATED AMPACITY = (0.80)(35.0A) = 28.0A 28.0A > 15.7A CONDITIONS OF USE: #10 WIRE 90°C DERATED AMPACITY = (0.91)(0.80)(40.0A) = 29.1A 29.1A > 15.7A SOLAR LOAD CENTER OUTPUT WIRE AMPACITY CALCULATION [NEC 690.8(A)(1)(c)]: 1.31A PER INVERTER (ENPHASE IQ7XS-96-2-US [240V]) COMBINED CURRENT = (22)(1.31A) = 28.8A CONTINUOUS USE: #6 WIRE 75°C DERATED AMPACITY = (0.80)(65A) = 52.0A 52.0A > 28.8A CONDITIONS OF USE: #6 WIRE 90°C DERATED AMPACITY = (0.91)(75A) = 68.3A 68.3A > 28.8A	INVERTER BRANCH AC CURRENT CALCULATION [NEC 690.8(A)(1)(c)]: 1.31A PER INVERTER (ENPHASE IQ7XS-96-2-US [240V]) MAXIMUM BRANCH INVERTER CURRENT = (12)(1.31A) = 15.7A MINIMUM OCPD = (15.7A)(1.25) = 19.7A USE 2P-20A BREAKERS IN SOLAR LOAD CENTER FOR INVERTER BRANCH OCPD SYSTEM AC CURRENT CALCULATION [NEC 690.8(A)(1)(c)]: 1.31A PER INVERTER (ENPHASE IQ7XS-96-2-US [240V]) COMBINED CURRENT = (22)(1.31A) = 28.8A MINIMUM OCPD = (28.8A)(1.25) = 36.0A USE 2P-40A BREAKER IN MAIN DISTRIBUTION PANEL FOR SYSTEM OCPD

CONTRACTOR

FREEDOM SOLAR POWER
FREEDOM SOLAR LLC
4801 FREIDRICH LN, STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

REVISIONS

DESCRIPTION	DATE	REV
DESIGN PACKET	12/15/2023	

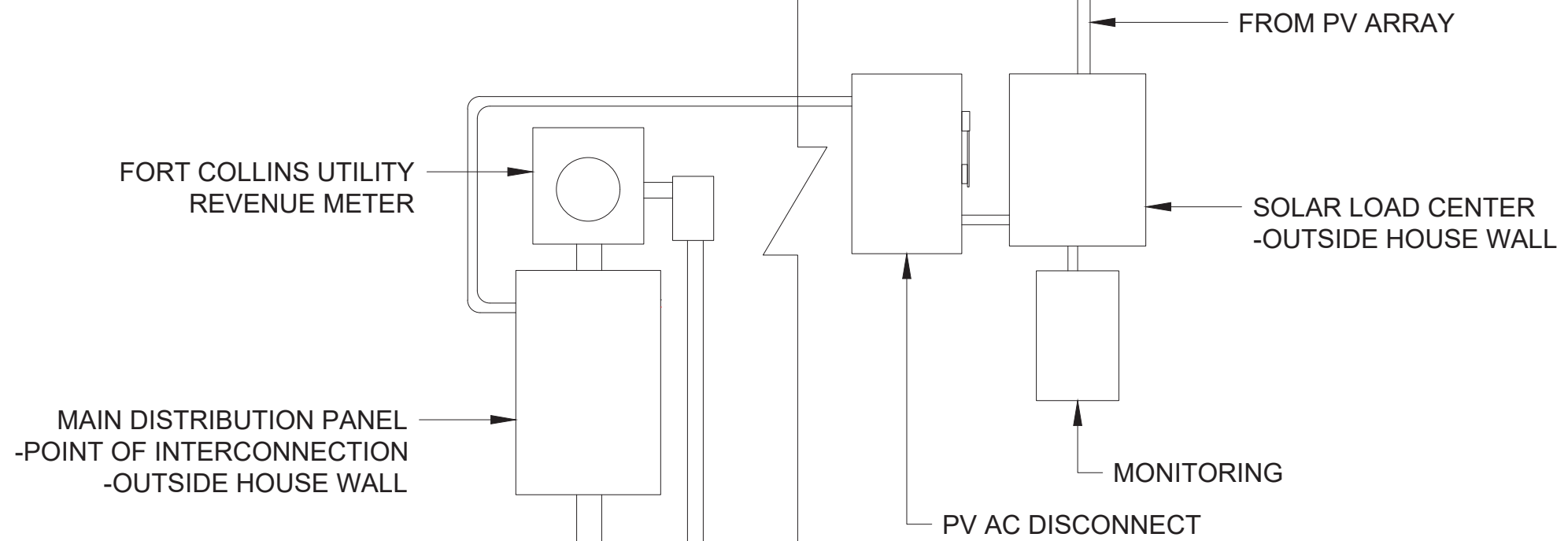
Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396
PROJECT 12/15/2023

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789

SHEET NAME
**ELECTRICAL
DIAGRAM**

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

SHEET NUMBER
PV-3



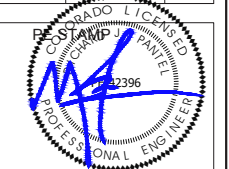
CONTRACTOR

**FREEDOM™
SOLAR POWER**

FREEDOM SOLAR LLC
4801 FREIDRICH LN, STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

REVISIONS

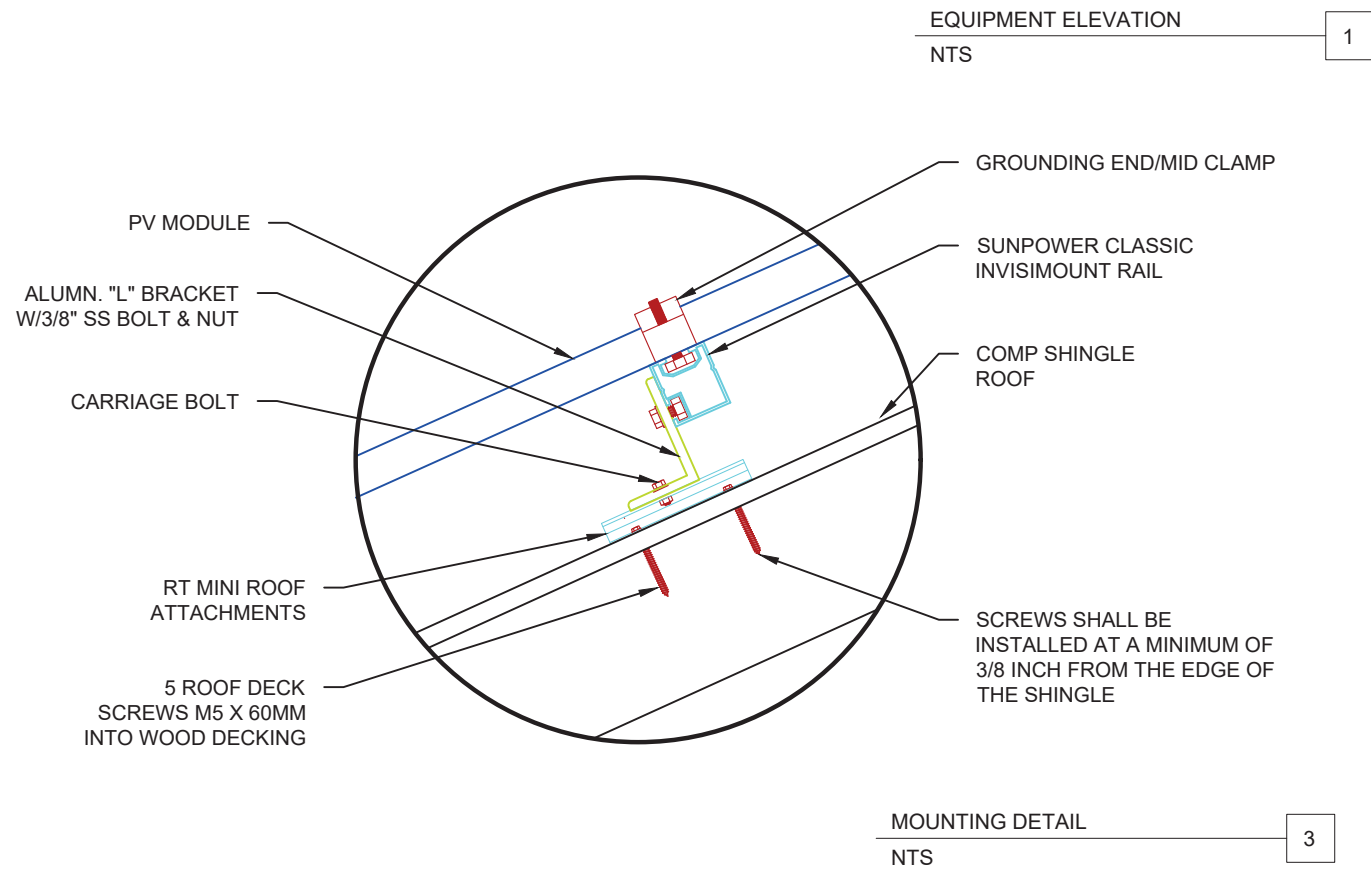
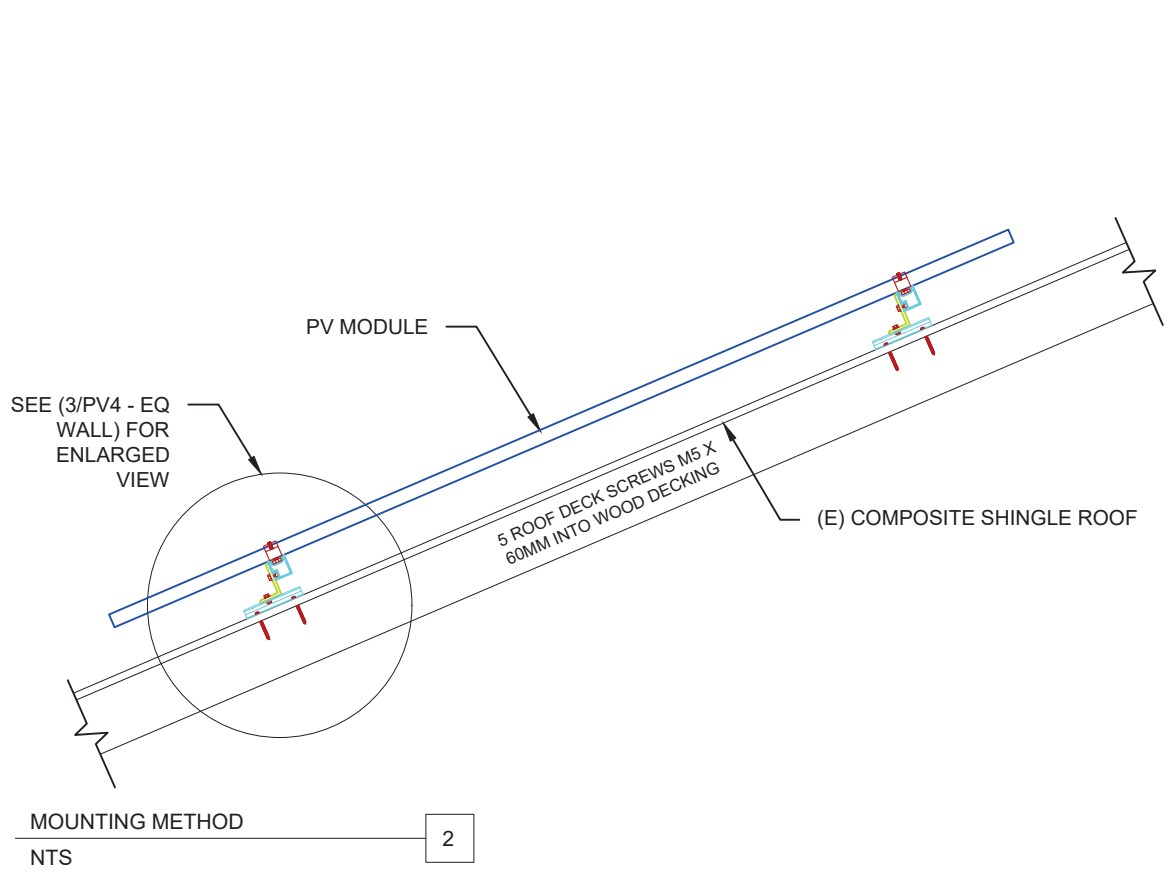
DESCRIPTION	DATE	REV
DESIGN PACKET	12/15/2023	



Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396
12/21/2023

PROJECT NAME

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789



SHEET NAME

**EQ.WALL &
MOUNTING DETAIL**

SHEET SIZE

**ANSI B
11" x 17"**

SHEET NUMBER

PV-4

NOTE: NOT ALL LABELS MAY BE APPLICABLE

WARNING
ELECTRIC SHOCK HAZARD.
DO NOT TOUCH TERMINALS.
TERMINALS ON BOTH THE
LINE AND LOAD SIDES MAY BE
ENERGIZED IN THE OPEN
POSITION.

REQ'D BY: NEC 690.13 (B)

A

APPLY TO:
PV DISCONNECT

WARNING
-SOLAR LOAD CENTER-
THIS EQUIPMENT FED BY
MULTIPLE SOURCES, TOTAL RATING
OF ALL OVERCURRENT DEVICES,
EXCLUDING MAIN SUPPLY
OVERCURRENT DEVICES, SHALL NOT
EXCEED AMPACITY OF BUSBAR.

REQ'D BY: 705.12(B)(3)

B

APPLY TO:
SOLAR LOAD CENTER

PV SYSTEM DISCONNECT

OPERATING CURRENT: 28.8A
OPERATING VOLTAGE: 240 VAC

REQ'D BY: NEC 690.13(B)&(D)

C

APPLY TO:
PV DISCONNECT

WARNING
POWER SOURCE OUTPUT
DO NOT RELOCATE THIS
OVERCURRENT DEVICE

REQ'D BY: NEC 705.12(B)(2)

D

APPLY TO:
PV SYSTEM BREAKER

CAUTION
MULTIPLE SOURCES OF POWER
EMERGENCY CONTACT:
FREEDOM SOLAR POWER
512-200-2085

REQ'D BY: NEC 705.10

E

MAIN SERVICE PANEL

**WARNING: PHOTOVOLTAIC
POWER SOURCE**

REQ' BY: NEC 690.31(D)(2)*

F

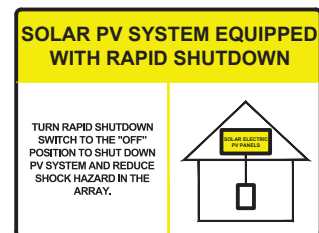
APPLY TO:
CONDUIT EVERY 10 FT
(*ONLY REQUIRED FOR RACEWAYS
WITH PV DC CIRCUITS)

**RAPID SHUTDOWN SWITCH
FOR SOLAR PV SYSTEM**

REQ'D BY: NEC 690.56(D)(2)

G

APPLY TO:
PV DISCONNECT



REQ'D BY: NEC 690.12(D)

H

APPLY TO:
MAIN DISTRIBUTION PANEL

CAUTION:
MULTIPLE SOURCES OF POWER

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM THE
FOLLOWING SOURCES WITH DISCONNECTS AS SHOWN:

UTILITY SUPPLY & CUSTOMER
SERVICE PANEL

PV AC DISCONNECT

RAPID SHUTDOWN SWITCH

FRONT

REQ'D BY: 705.10*

I

APPLY TO:
MAIN DISTRIBUTION PANEL
(*ONLY REQUIRED IF PV SYSTEM
DISCONNECT IS NOT GROUPED
WITH MAIN SERVICE DISCONNECT)
**SEE SHEET PV-6 FOR SITE
SPECIFIC LABEL**

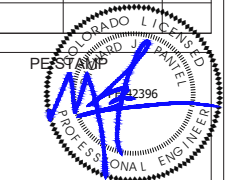
CONTRACTOR

**FREEDOM
SOLAR POWER**

FREEDOM SOLAR LLC
4801 FREIDRICH LN, STE 100
AUSTIN, TX 78744
512-759-8313
TECL # 28621

REVISIONS

DESCRIPTION	DATE	REV
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Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396
12/21/2023

PROJECT NAME

GENE & KATHY WATKINSON
821 MATHEWS STREET
FORT COLLINS, COLORADO,
80524
(970) 689-9789

SHEET NAME

SYSTEM LABELING DETAIL

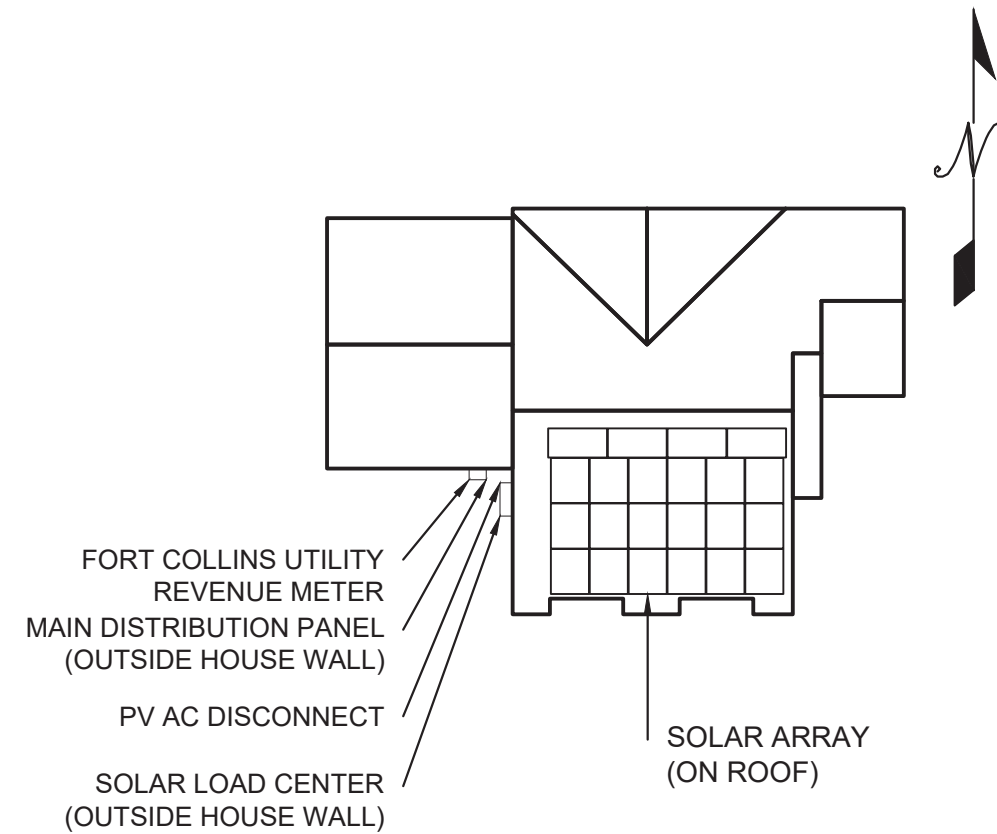
SHEET SIZE

ANSI B
11" x 17"

SHEET NUMBER

PV-5

CAUTION:
MULTIPLE SOURCES OF POWER
LOCATION OF EACH POWER SOURCE
DISCONNECTING MEANS SHOWN BELOW



QUESTIONS, CALL:
 800-504-2337
www.freedomsolarpower.com



CONTRACTOR

FREEDOM™
SOLAR POWER

FREEDOM SOLAR LLC
 4801 FREDRICH LN, STE 100
 AUSTIN, TX 78744
 512-759-8313
 TECL # 28621

REVISIONS

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Reviewed and approved
 Richard Pantel, P.E.
 CO Lic. No. PE-42396
 12/21/2023

PROJECT NAME

GENE & KATHY WATKINSON
 821 MATHEWS STREET
 FORT COLLINS, COLORADO,
 80524
 (970) 689-9789

SHEET NAME

SITE
 DIRECTORY
 PLACARD

SHEET SIZE

ANSI B
 11" x 17"

SHEET NUMBER

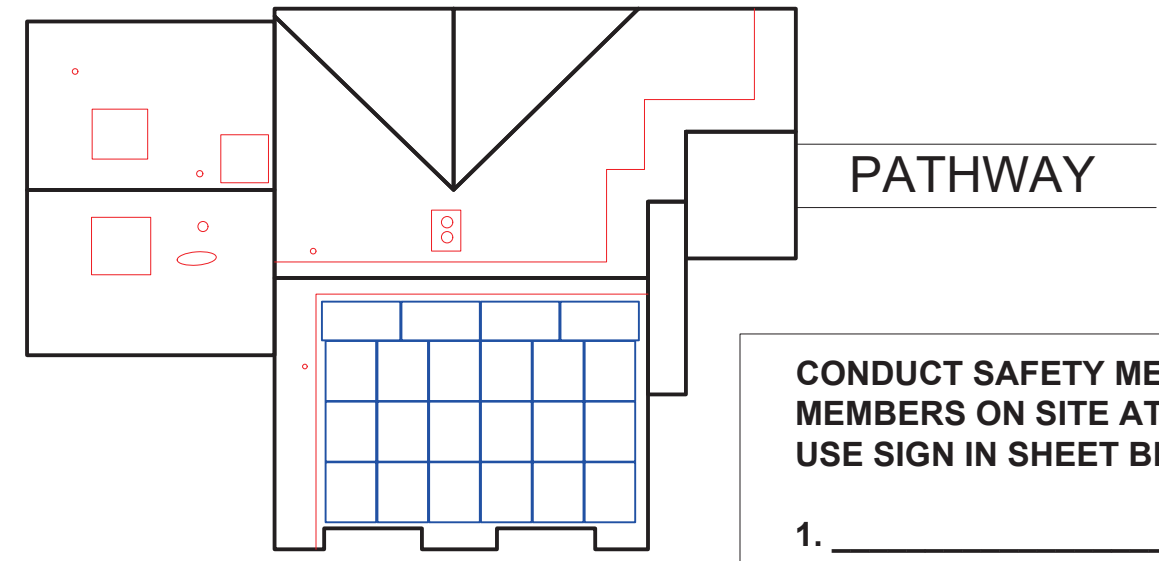
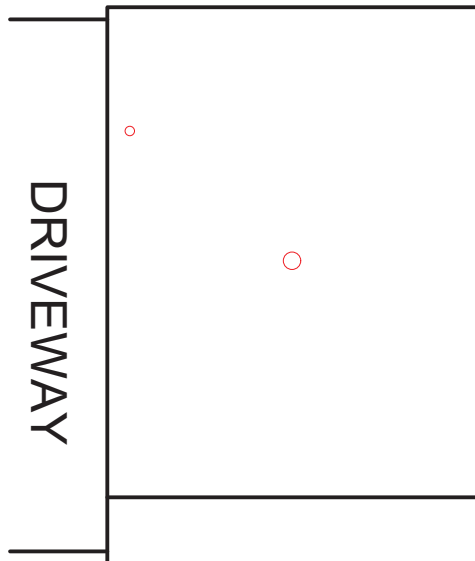
PV-6

USE THE SAFETY SYMBOL KEY TO DRAW IN THE CONTROLLED ACCESS ZONE (CAZ), LADDER PLACEMENT, METER LOCATION, FALL PROTECTION ANCHOR POINT, AND ANY OTHER HAZARD.

HARD HAT IS REQUIRED AT ALL TIMES IN CAZ

SAFETY SYMBOL KEY

- CAZ
- L LADDER
- M METER
- ==== POWER LINES
- R RESTRAINT ANCHOR
- A ARREST ANCHOR



CONDUCT SAFETY MEETING WITH ALL CREW MEMBERS ON SITE AT THE BEGINNING OF EACH JOB. USE SIGN IN SHEET BELOW.

1. _____
2. _____
3. _____
4. _____
5. _____

GUEST SIGN IN

1. _____
2. _____
3. _____

COMPETENT PERSON: _____ JOB START DATE: _____

CONTRACTOR

FREEDOM SOLAR POWER
 FREEDOM SOLAR LLC
 4801 FREIDRICH LN, STE 100
 AUSTIN, TX 78744
 512-759-8313
 TECL # 28621

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 12/21/2023

PROJECT NAME

GENE & KATHY WATKINSON
 821 MATHEWS STREET
 FORT COLLINS, COLORADO,
 80524
 (970) 689-9789

SHEET NAME

SAFETY PLAN

SHEET SIZE

**ANSI B
 11" x 17"**

SHEET NUMBER

PV-7

SOLAR'S MOST TRUSTED



REC ALPHA PURE-R SERIES PRODUCT SPECIFICATIONS

COMPACT PANEL SIZE

9 A MODULE CURRENT
COMPATIBLE WITH MLPE

430 WP
20.7 W/FT²
22.3% EFFICIENCY



LEAD-FREE
ROHS COMPLIANT

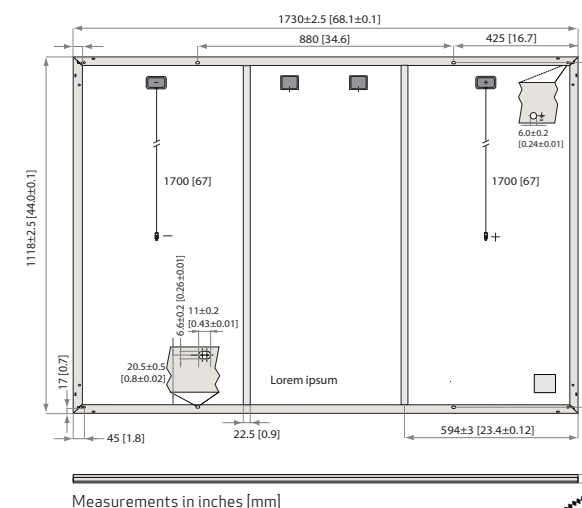
EXPERIENCE
α
PERFORMANCE

REC ALPHA PURE-R SERIES PRODUCT SPECIFICATIONS



GENERAL DATA

Cell type:	80 half-cut REC bifacial, heterojunction cells with lead-free, gapless technology
Glass:	0.13in (3.2mm) solar glass with anti-reflective surface treatment in accordance with EN 12150
Backsheet:	Highly resistant polymer (black)
Frame:	Anodized aluminum (black)
Junction box:	4-part, 4 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors:	Stäubli MC4 PV-KBT4/KST4 (12 AWG) in accordance with IEC 62852, IP68 only when connected
Cable:	12 AWG (4mm ²) PV wire, 67 + 67 in (1.7 + 1.7 m) in accordance with EN 50618
Dimensions:	68.1 x 44.0 x 1.2 in (20.77 ft ²) / 1730 x 1118 x 30 mm (1.93 m ²)
Weight:	47.4 lbs (21.5 kg)
Origin:	Made in Singapore



ELECTRICAL DATA

Product Code*: RECxxxAA PURE-R

	410	420	430
Power Output - P _{MAX} (Wp)	410	420	430
Watt Class Sorting - (W)	0/+10	0/+10	0/+10
Nominal Power Voltage - V _{MPP} (V)	48.8	49.4	50.0
Nominal Power Current - I _{MPP} (A)	8.20	8.30	8.40
Open Circuit Voltage - V _{OC} (V)	58.9	59.2	59.4
Short Circuit Current - I _{SC} (A)	8.80	8.84	8.91
Power Density (W/ft ²)	19.26	19.74	20.22
Panel Efficiency (%)	20.7	21.2	22.3
Power Output - P _{MAX} (Wp)	305	312	320
Nominal Power Voltage - V _{MPP} (V)	46.0	46.6	47.1
Nominal Power Current - I _{MPP} (A)	6.64	6.70	6.80
Open Circuit Voltage - V _{OC} (V)	55.5	55.8	56.0
Short Circuit Current - I _{SC} (A)	7.11	7.16	7.20

STC

NMOT

Values at standard test conditions (STC: air mass AM1.5, irradiance 1075 W/sq ft (1000 W/m²), temperature 77°F (25°C), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 68°F (20°C), windspeed 3.3 ft/s (1 m/s). *Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS

Operational temperature:	-40 ... +85°C
System voltage:	1000 V
Test load (front):	+ 7000 Pa (146 lbs/ft ²)*
Test load (rear):	- 4000 Pa (83.5 lbs/ft ²)*
Series fuse rating:	25 A
Reverse current:	25 A

* See installation manual for mounting instructions.
Design load = Test load / 1.5 (safety factor)

WARRANTY

	Standard	REC ProTrust
Installed by an REC Certified Solar Professional	No	Yes
System Size	All	<25 kW 25-500 kW
Product Warranty (yrs)	20	25
Power Warranty (yrs)	25	25
Labor Warranty (yrs)	0	25
Power in Year 1	98%	98%
Annual Degradation	0.25%	0.25%
Power in Year 25	92%	92%

See warranty documents for details. Conditions apply

Available from:

CERTIFICATIONS

IEC 61215:2016, IEC 61730:2016	UL 61730
IEC 62804	PID
IEC 61701	Salt Mist
IEC 62716	Reviewed and approved
IEC 62782	Richard Pantel, P.E.
IEC 61215-2:2016	CO Lic. No. PE-42396
IEC 62321	Hailstone (35112/21/2023)
ISO 14001, ISO 9001, IEC 45001, IEC 62941	Lead-free acc. to RoHS EU 863/2015



TEMPERATURE RATINGS*

Nominal Module Operating Temperature:	44°C (±2°C)
Temperature coefficient of P _{MAX} :	-0.24 %/°C
Temperature coefficient of V _{OC} :	-0.24 %/°C
Temperature coefficient of I _{SC} :	0.04 %/°C

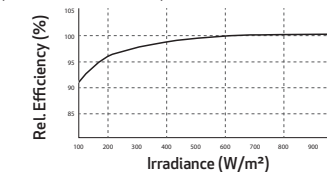
*The temperature coefficients stated are linear values

DELIVERY INFORMATION

Panels per pallet:	33
Panels per 40 ft GP/high cube container:	858 (26 pallets)
Panels per 53 ft truck:	858 (26 pallets)

LOW LIGHT BEHAVIOUR

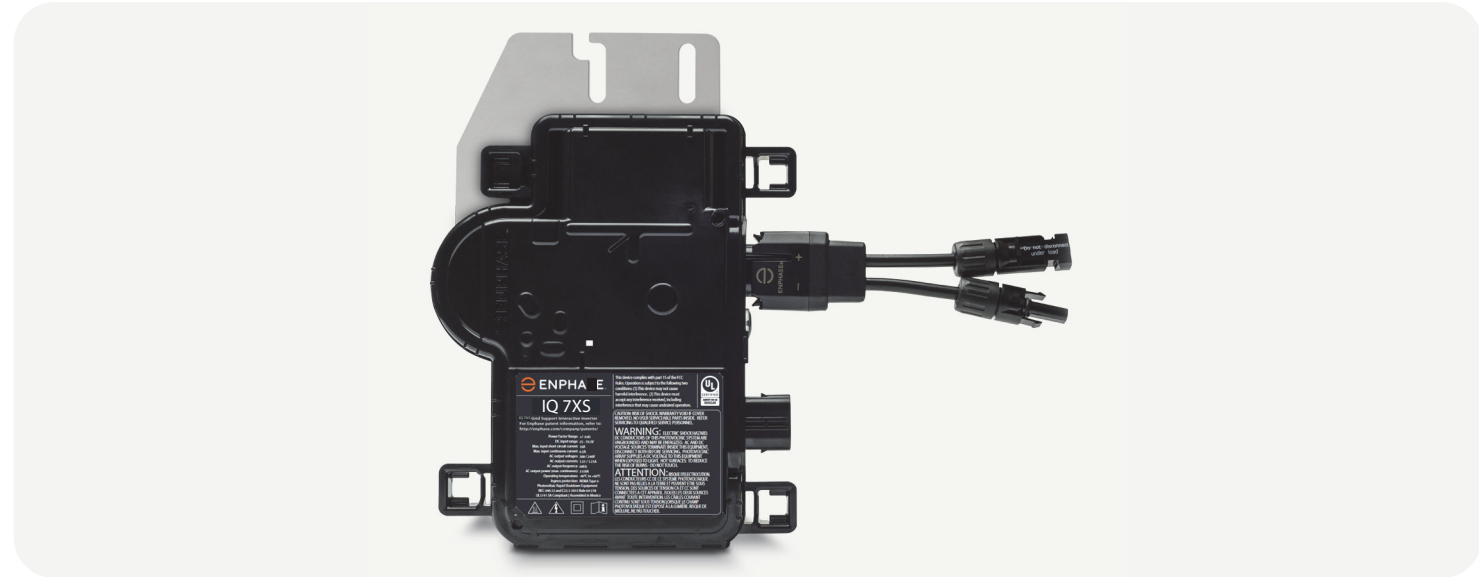
Typical low irradiance performance of module at STC:



Founded in 1996, REC Group is an international pioneering solar energy company dedicated to empowering consumers with clean, affordable solar power. As Solar's Most Trusted, REC is committed to high quality, innovation, and a low carbon footprint in the solar materials and solar panels it manufactures. Headquartered in Norway with operational headquarters in Singapore, REC also has regional hubs in North America, Europe, and Asia-Pacific.



www.recgroup.com



IQ7XS Microinverter

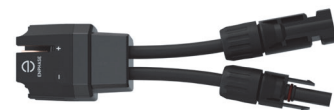
The high-powered, smart grid-ready IQ7XS Microinverter dramatically simplifies the installation process while achieving the highest system efficiency for systems with 96-cell modules.



Part of the Enphase Energy System, the IQ7XS Microinverter integrates with the IQ Gateway, IQ Battery, and the Enphase Installer App monitoring and analysis software.



The IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.



Connect PV modules quickly and easily to IQ7XS Microinverters using the included Q-DCC-2 adapter cable with plug-and-play MC4 connectors.



IQ7XS Microinverters are UL Listed as PV rapid shutdown equipment and conform with various regulations when installed according to manufacturer's instructions.

Easy to install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014, 2017, and 2020)

Efficient and reliable

- Optimized for high powered 96-cell modules
- Highest CEC efficiency of 97.5%
- More than a million hours of testing
- Class II double-insulated enclosure
- UL Listed

Smart grid-ready

- Complies with advanced grid support, voltage, and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA) and IEEE® 1547:2018 (UL 1741-SB, 3rd Ed.)

IQ7XS Microinverters

INPUT DATA (DC)		UNITS	IQ7XS-96-2-US	
Commonly used module pairings ¹		W	320-460	
Module compatibility		—	To meet compatibility, PV modules must be within maximum input DC voltage and maximum module I _{sc} listed below. Module compatibility can be checked at https://enphase.com/installers/microinverters/calculator .	
MPPT voltage range		V	53-64	
Operating range		V	25-79.5	
Minimum/Maximum start voltage		V	33/79.5	
Maximum input DC voltage		V	79.5	
Maximum continuous input DC current		A	6.5	
Maximum module I _{sc}		A	10	
Overvoltage class DC port		—	II	
DC port backfeed current		mA	0	
PV array configuration		—	1 × 1 ungrounded array; no additional DC side protection required; AC side protection requires maximum 20 A per branch circuit.	
OUTPUT DATA (AC)		UNITS	IQ7XS-96-2-US@240 VAC	IQ7XS-96-2-US @208 VAC
Peak output power		VA	320	
Maximum continuous output power		VA	315	
Nominal grid voltage (L-L)		V	240, split-phase (L-L), 180°	208, single-phase
Minimum and Maximum grid voltage ²		V	211-264	183-228
Maximum continuous output current		A	1.31	1.51
Nominal frequency		Hz	60	
Extended frequency range		Hz	49-68	
AC short circuit fault current over three cycles		Arms	5.8	
Maximum units per 20 A (L-L) branch circuit ³		—	12	10
Overvoltage class AC port		—	III	
AC port backfeed current		mA	18	
Power factor setting		—	1.0	
Grid-tied power factor (adjustable)		—	0.85 leading ... 0.85 lagging	
CEC weighted efficiency		%	97.5	97.0
MECHANICAL DATA		UNITS		
Ambient temperature range		°C (°F)	-40 to 60 (-40 to 140)	
Relative humidity range		%	4 to 100 (condensing)	
DC connector type		—	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)	
Dimensions (H × W × D)		mm (in)	212 (8.3) × 175 (6.9) × 30.2 (1.2)	
Weight		kg (lbs)	1.1 (2.4)	
Cooling		—	Natural convection—no fans	
Approved for wet locations		—	Yes	
Pollution degree		—	PD3	
Enclosure		—	Class II double-insulated, corrosion-resistant polymeric enclosure	
Environmental category/UUV exposure rating		—	NEMA Type 6/Outdoor	
COMPLIANCE				
Compliance	CA Rule 21 (UL 1741-SA), IEEE® 1547:2018 (UL 1741-SB 3 rd Ed.), HEI Rule 14H SRD 2.0, UL 62109-1, 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 shutdown equipment and conforms with NEC 2014, NEC 2017, and NEC 2020, section 690.12 and C22.1-2015. Rule 64-218 rapid shutdown of PV Systems for AC and DC conductors when installed according to manufacturer's instructions.			



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To learn more about Enphase offering, visit [Enphase.com](https://enphase.com)

(1) Pairing PV modules with wattage above the limit may result in additional clipping losses.
(2) Nominal voltage range can be extended beyond nominal if required by the utility.
(3) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

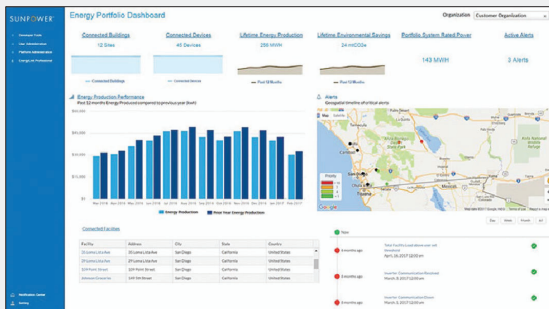


SunPower® EnergyLink™ | Residential and Commercial PVS6

Improve Support, Reduce Maintenance Costs

An intuitive monitoring website enables you to:

- See a visual map of customer sites
- Remotely manage hundreds of sites
- Receive elective system reports
- Locate system issues and remotely diagnose
- Diagnose issues online
- Drill down for the status of individual devices



Add Value for Customers

With the SunPower Monitoring System customers can:

- See what their solar system produces each day, month, or year
- Optimize their solar investment and save on energy expenses
- See their energy use and estimated bill savings
- See their solar system's performance using the SunPower monitoring website or mobile app



SunPower EnergyLink—Plug-and-Play Installation

This complete solution for residential and commercial monitoring and control includes the SunPower® PV Supervisor 6 (PVS6) which improves the installation process, overall system reliability, and customer experience.

- Compact footprint for improved aesthetics
- Robust cloud connectivity and comprehensive local connectivity
- Flexible configuration of devices during installation
- Consumption metering
- Revenue-grade production metering (pending)
- Web-based commissioning
- Remote diagnostics of PVS6 and inverters
- Durable UL Type 3R enclosure reduces maintenance costs
- Easy integration with SunPower eBOS



Robust Cloud Connectivity

Multiple options to maintain optimal connectivity:

- Hardwired Ethernet
- Wi-Fi
- Cellular backup

SunPower® EnergyLink™ | Residential and Commercial PVS6

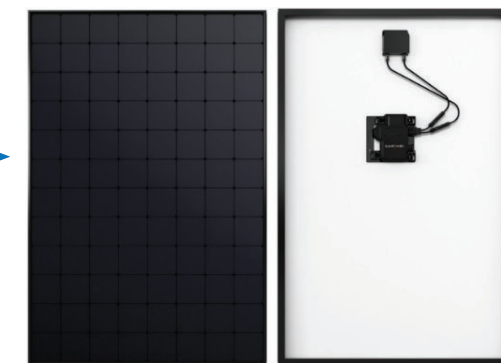
SunPower Monitoring Websites



PVS6



SunPower AC Modules



Multiple communication options include Ethernet, Wi-Fi, and cellular.

Site Requirements	
Number of SunPower AC modules supported per PVS6	85
Internet access	High-speed internet access via accessible router or switch
Power	<ul style="list-style-type: none"> • 100–240 VAC (L–N), 50 or 60 Hz • 208 VAC (L–L in 3-phase), 60 Hz

Mechanical	
Weight	5.5 lbs (2.5 kg)
Dimensions	11.8 × 8.0 × 4.2 in. (30.5 × 20.5 × 10.8 cm)
Enclosure rating	UL50E Type 3R

Web and Mobile Device Support	
Customer site	monitor.us.sunpower.com
Partner site	pvs6gmt.us.sunpower.com
Browsers	Firefox, Safari, and Chrome
Mobile devices	iPhone®, iPad®, and Android™
Customer app	<ol style="list-style-type: none"> 1. Create account online at: monitor.us.sunpower.com. 2. On a mobile device, download the SunPower Monitoring app from Apple App Store™ or Google Play™ store. 3. Sign in using account email and password.

Operating Conditions	
Temperature	–22°F to +140°F (–30°C to +60°C)
Humidity (maximum)	95%, non-condensing

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Communication	
RS-485	Inverters and meters
Integrated Metering	<ul style="list-style-type: none"> • One channel of revenue-grade production metering • Two channels of consumption metering
Ethernet	1 LAN (or optional WAN) port
PLC	PLC for SunPower AC modules
Wi-Fi	802.11b/g/n 2.4 GHz and 5 GHz
Cellular	LTE Cat-M1/3G UMTS
ZigBee	IEEE 802.15.4 MAC, 2.4GHz ISM band
Data Storage	60 days
Upgrades	Automatic firmware upgrades

Warranty and Certifications	
Warranty	10-year Limited Warranty
Certifications	UL, cUL, CE, UL 61010-1 and -2, FCC Part 15 (Class B)

FCC ID: YAW529027

UL LISTED E503346

SunPower® InvisiMount™ | Residential Mounting System

Simple and Fast Installation

- Integrated module-to-rail grounding
- Pre-assembled mid and end clamps
- Levitating mid clamp for easy placement
- Mid clamp width facilitates consistent, even module spacing
- UL 2703 Listed integrated grounding

Flexible Design

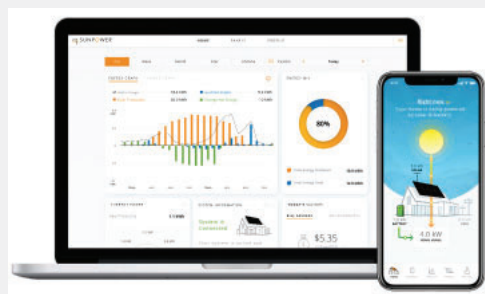
- Addresses sloped and low-sloped residential roofs
- Design in landscape and portrait with up to 8' rail span
- Pre-drilled rails and rail splice
- Rails enable easy obstacle management

Customer-Preferred Aesthetics

- Best-in-class system aesthetics
- Black anodized components
- Low-profile mid clamps and capped, flush end clamps

Part of Superior System

- Best-in-class system reliability and aesthetics
- Optional rooftop transition flashing, rail-mounted J-box, and wire management rail clips
- Combine with SunPower modules and mySunPower® monitoring app



Elegant Simplicity

SunPower® InvisiMount™ is a SunPower-designed rail-based mounting system. The InvisiMount system addresses residential sloped roofs and combines faster installation time, design flexibility, and superior aesthetics.

Classic InvisiMount is specifically envisioned and engineered to pair with SunPower modules; Universal InvisiMount is compatible with a wide range of modules. The resulting system-level approach amplifies the installation and aesthetic benefits—for homeowners and for installers.



Intertek
5024883
Conf. To UL STD 2703
Class A Fire Rating

sunpower.com

SunPower® InvisiMount™ | Residential Mounting System

InvisiMount Components



InvisiMount Component Details		
Classic mid clamp	Black oxide stainless steel 300 series	63 g (2.2 oz)
Universal mid clamp	Black anodized aluminum 6000 series	60 g (2.1 oz)
Classic end clamp	Black anodized aluminum 6000 series	110 g (3.88 oz)
Universal end clamp	Black anodized aluminum 6000 series	103 g (3.63 oz)
Rail	Black anodized aluminum 6000 series	830 g/m (9 oz/ft)
Rail splice	Aluminum alloy 6000 series	830 g/m (9 oz/ft)
Rail bolt	M10-1.5 x 25 mm; custom T-head SS304	18 g (0.63 oz)
Rail nut	M10-1.5; DIN 6923 SS304	nominal
Ground lug assembly	SS304; A2-70 bolt; tin-plated copper lug	106.5 g (3.75 oz)
Row-to-row grounding clip	SS 301 with SS 304 M6 bolts	75 g (2.6 oz)
Row-to-row grounding jumper	Stainless steel 300 series	10 g (0.35 oz)
Row-to-row spacer	Black POM-grade plastic	5 g (0.18 oz)

Roof Attachment BOM	
• InvisiMount Comp Shingle Attachment with Pegasus	
• InvisiMount Flat Tile Replacement Attachment with Pegasus	
• InvisiMount S-Tile Replacement Attachment with Pegasus	
• InvisiMount W-Tile Replacement Attachment with Pegasus	

InvisiMount Warranties And Certifications	
Warranties	<ul style="list-style-type: none"> • 25-year product warranty • 5-year finish warranty
Certifications	<ul style="list-style-type: none"> • UL 2703 Listed • Class A Fire Rated

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InvisiMount Operator
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12/21/2023

Roof Attachment Hardware Warranties	
Refer to roof attachment hardware manufacturer's documentation.	

InvisiMount Component LRF D Capacities ²		
Classic Mid clamp	Uplift	664 lbf
	Shear	540 lbf
Universal Mid clamp	Uplift	962 lb
	Shear	437 lb
Classic End clamp	Uplift	899 lbf
	Shear	220 lbf
Universal End clamp	Uplift	605 lb
	Shear	242 lb
Rail	Moment: upward	548 lbf-ft
	Moment: downward	580 lbf-ft
Rail splice	Moment: upward	548 lbf-ft
	Moment: downward	580 lbf-ft
L-foot	Uplift	1000 lbf
	Shear	390 lbf

¹ With Classic InvisiMount, a module frame that is compatible with the InvisiMount system is required for hardware interoperability; modules without this frame may be used with Universal InvisiMount.

² SunPower recommends that all Equinox™, InvisiMount™, and AC module systems always be designed using the InvisiMount Span Tables #524734. If a designer decides to instead use the component capacities listed in this document to design a system, note that the capacities shown are Load and Resistance Factor Design (LRF D) design loads, and are NOT to be used for Allowable Stress Design (ASD) calculations; and that a licensed Professional Engineer (PE) must then stamp all calculations. If you have any questions please contact SunPower Technical Support at 1-855-977-7867.

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sunpower.com
509506 RevH

RT-MINI

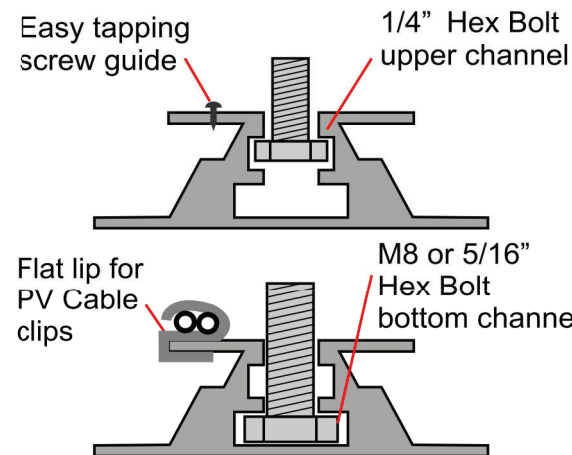
Self-flashing base for asphalt & metal roof-top PV mounting systems

RT-MINI is suitable for mounting any rail system with a conventional L-Foot.



Dual bolt design:
M8 or 5/16" for L-Foot
& 1/4" for EMC

Call Now for more detail
619-551-7029



RT-MINI

Flexible Flashing certified by the International Code Council (ICC)

Engineered to ASTM D 1761 (Standard Test Methods for Mechanical Fasteners in Wood)

Components

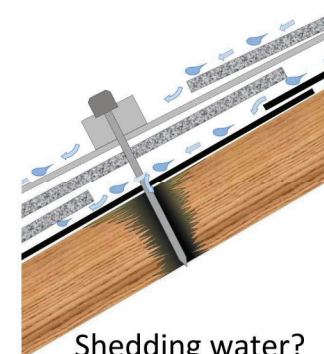
RT2-00-MINIBK
 PAT : PENDING



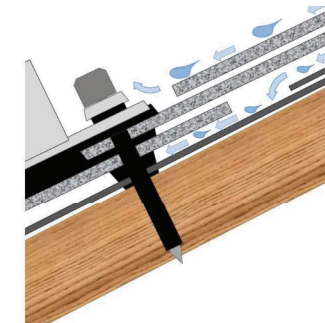
MINI base : 20 ea.
 Screw : 40 ea.
 Extra RT-Butyl : 10 ea.

RT-Butyl is Roof Tech's flexible flashing used in 550,000 residential PV systems for the last 20 years. It is the first PV mounting system with Flexible Flashing certified by the ICC.

Metal Flashing Retrofit



Flexible Flashing



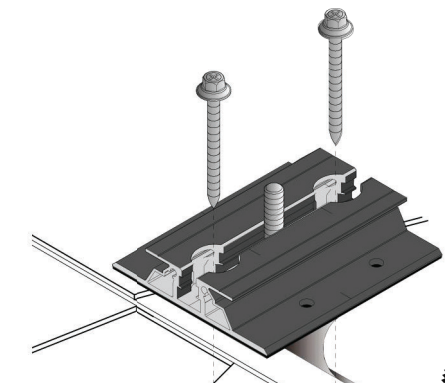
Shedding water?

100% Waterproof

ICC ESR-3575 ASTM2140 testing UV testing (7500 hrs.)

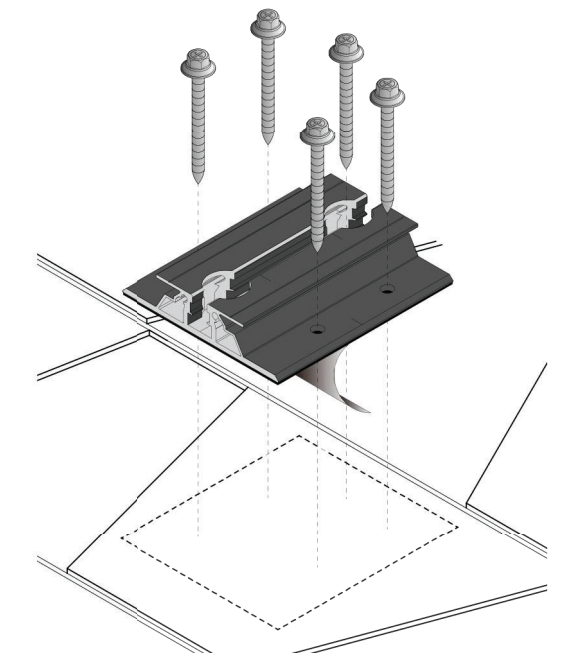


Rafter installation



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 12/21/2023

Deck installation



P.E. Stamped Letters available at www.roof-tech.us/support

Non-Fusible Switching Devices & Safety Switches

Product Selection

UL listed File No. E5239

1

DG321NRB

120/240 Vac General-Duty, Fusible, Single-Throw, continued



System	Ampere Rating	Fuse Type Provision	Maximum Horsepower Ratings ^①			DC 250V	NEMA 1 Enclosure Indoor Catalog Number	NEMA 3R Enclosure Rainproof Catalog Number
			Single-Phase AC 120V	240V	Three-Phase AC 240V			
Cartridge Type—Three-Pole, Three-Wire (Three Blades, Three Fuses)—240 Vac								
	30	—	—	—	—	—	②	②
	60	—	—	—	—	—	②	②
	100	—	—	—	—	—	②	②
	200	H	—	15	25-60	—	DG324FGK ③④	②
	400	H	—	—	50-125	—	DG325FGK ③④	DG325FRK ③④
	600	H	—	—	75-200	—	DG326FGK ③④	DG326FRK ③④
Cartridge Type—Four-Wire (Three Blades, Three Fuses, S/N)—120/240 Vac								
	30	H	—	1-1/2-3	3-7-1/2	—	DG321NGB	DG321NRB
	60	H	—	3-10	7-1/2-15	—	DG322NGB	DG322NRB
	100	H	—	7-1/2-15	15-30	—	DG323NGB	DG323NRB
	200	H	—	15	25-60	—	DG324NGK	DG324NRK
	400	H	—	—	50-125	—	DG325NGK	DG325NRK
	600	H	—	—	75-200	—	DG326NGK	DG326NRK

DG322URB

120/240 Vac General-Duty, Non-Fusible, Single-Throw



System	Ampere Rating	Maximum Horsepower Ratings			DC 250V	NEMA 1 Enclosure Indoor Catalog Number	NEMA 3R Enclosure Rainproof Catalog Number
		Single-Phase AC 120V	240V	Three-Phase AC 240V			
Two-Pole, Two-Wire (Two Blades)—240 Vac							
	30	2	3	—	—	DG221UGB ④	DG221URB ④
	60	3	10	—	—	DG222UGB ④	DG222URB ④
	100	—	15	—	—	DG223UGB ④	DG223URB ④
	200	—	15	—	—	④⑤	DG224URK ④
Three-Pole, Three-Wire (Three Blades)—240 Vac							
	30	2	3	7-1/2	—	DG321UGB ④	DG321URB ④
	60	3	10	15	—	DG322UGB ④	DG322URB ④
	100	—	15	30	—	DG323UGB ④	DG323URB ④
	200	—	15	60	—	DG324UGK ④	DG324URK ④
	400	—	—	125	—	DG325UGK ④	DG325URK ④
	600	—	—	200	—	DG326UGK ④	DG326URK ④

Notes

- ① Maximum hp ratings apply only when dual element time delay fuses are used.
 - ② Use four-wire catalog numbers below.
 - ③ Solid neutral bars are not included. Order separately from table on Page V2-T1-13.
 - ④ **WARNING!** Switch is not approved for service entrance unless a neutral kit is installed.
 - ⑤ Use three-wire catalog numbers below.
- All general-duty safety switches are individually packaged.
- Accessories are limited in scope on general-duty safety switches. See Page V2-T1-13 for availability. In addition, clear line shields are available as an accessory on 200-600A general-duty switches. Catalog Numbers: 200A = 70-7759-11, 400A = 70-8063-8, 600A = 70-8064-8.

Fusible Switching Devices & Safety Switches

Product Selection

120/240 Vac General-Duty, Fusible, Single Throw

Specifications

- 30 – 600 amperes.
- Suitable for service entrance applications unless otherwise noted.
- Horsepower rated.
- Bolt-on hub provision. Provided for general-duty switches in a NEMA 3R enclosure. See Page 8-7 for selection.
- UL listed File No. E5239. Meets UL 98 for enclosed switches and NEMA Std. KS-1.
- 200 – 600 ampere switches incorporate K-Series design.



DP221NGB



DG321NRB

2

Table 8-40. 120/240 Vac General-Duty, Fusible, Single Throw

System	Ampere Rating	Fuse Type Provision	Maximum Horsepower Ratings ^①				NEMA 1 Enclosure Indoor		NEMA 3R Enclosure Rainproof	
			Single-Phase ac		3-Phase ac	dc	Catalog Number	Price U.S. \$	Catalog Number	Price U.S. \$
			120 Volt	240 Volt	240 Volt	250 Volt				
Fusible — Plug Type ^②										
2-Wire (One Blade, One Fuse, S/N) — 120 Vac										
	30	Plug (Type S, T or W)	1/2-2	—	—	—	DP111NGB	—	—	—
3-Wire (Two Blades, Two Fuses, S/N) — 120/240 Vac										
	30	Plug (Type S, T or W)	1/2-2	1-1/2-3	—	—	DP221NGB	—	Use cartridge-type fuse catalog number DG221NRB	—
Fusible — Cartridge Type										
2-Pole 2-Wire (Two Blades, Two Fuses) — 240 Vac										
	30	—	—	1-1/2-3	3-7-1/2	—	③	—	③	—
	60	—	—	3-10	7-1/2-15	—	③	—	③	—
	100	—	—	7-1/2-15	15-30	—	③	—	③	—
	200	—	—	15	25-60	—	③	—	③	—
	400	H	—	—	50-125	—	DG225FGK ④⑤	—	DG225FRK ④⑤	—
	600	H	—	—	75-200	—	DG226FGK ④⑤	—	DG226FRK ④⑤	—
3-Wire (Two Blades, Two Fuses, S/N) — 120/240 Vac										
	30	H	—	1-1/2-3	3-7-1/2 ⑥	—	DG221NGB	—	DG221NRB	—
	60	H	—	3-10	7-1/2-15 ⑥	—	DG222NGB	—	DG222NRB	—
	100	H	—	7-1/2-15	15-30 ⑥	—	DG223NGB	—	DG223NRB	—
	200	H	—	15	25-60 ⑥	—	DG224NGK	—	DG224NRK	—
	400	H	—	—	50-125 ⑥	50	DG225NGK	—	DG225NRK	—
	600	H	—	—	75-200 ⑥	—	DG226NGK	—	DG226NRK	—

- ① Maximum hp ratings apply only when dual element time delay fuses are used.
- ② These switches do not have an interlock which prevents door from being opened when switch is in the ON position.
- ③ Use 3-wire catalog numbers below.
- ④ Solid neutral bars are not included. Order separately from Table 8-1 on Page 8-5.
- ⑤ **WARNING!** Switch is not approved for service entrance unless a neutral kit is installed.
- ⑥ Grounded B phase rating, UL listed.

Note: All general-duty safety switches are individually packaged.

Note: Accessories are limited in scope on general-duty safety switches. See Page 8-5 for availability. In addition, clear line shields are available as an accessory on 200 – 600 ampere general-duty switches. Catalog Numbers: 200 A = 70-7759-11, 400 A = 70-8063-8, 600 A = 70-8064-8.



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12/21/2023

1.1

Loadcenters and Circuit Breakers

Type CH Loadcenters and Circuit Breakers

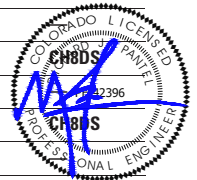
1

CH42L225G



Single-Phase Three-Wire—120/240 Vac—Insulated/Bondable Split Neutral—Factory-Installed Ground Bar

Main Ampere Rating	Maximum Number 3/4-Inch (19.1 mm) Poles	Enclosure Type	Box Size	Wire Size Range Cu/Al 60 °C or 75 °C for Main Lugs	Loadcenter Catalog Number	Loadcenter Cover Catalog Number	Combination	Surface
125	12	Indoor	B	#6–2/0	CH12L125B ①	CH8BF	CH8BS	
	12	Outdoor	B	#6–2/0	CH12L125R ①②	—	—	
	16	Indoor	B	#6–2/0	CH16L125B ①	CH8BF	CH8BS	
	16	Outdoor	B	#6–2/0	CH16L125R ①②	—	—	
	20	Indoor	C	#6–2/0	CH20L125C ①	CH8CF	CH8CS	
	20	Outdoor	C	#6–2/0	CH20L125R ①②	—	—	
	24	Indoor	C	#6–2/0	CH24L125C ①	CH8CF	CH8CS	
	24	Outdoor	C	#6–2/0	CH24L125R ①②	—	—	
150	24	Indoor	D	#4–300 kcmil	CH24L150D ①	CH8DF	CH8DS	
	24	Outdoor	D	#4–300 kcmil	CH24L150R ②③	—	—	
	32	Indoor	D	#4–300 kcmil	CH32L150D ①	CH8DF	CH8DS	
	32	Outdoor	D	#4–300 kcmil	CH32L150R ②③	—	—	
200	12	Indoor	D	#4–300 kcmil	CH12L200D ①	CH8DF	CH8DS	
	12	Outdoor	D	#4–300 kcmil	CH12L200R ②③	—	—	
	16	Indoor	D	#4–300 kcmil	CH16L200D ①	CH8DF	CH8DS	
	16	Outdoor	D	#4–300 kcmil	CH16L200R ②③	—	—	
225	24	Indoor	D	#4–300 kcmil	CH24L225D ①	CH8DF	CH8DS	
	24	Outdoor	D	#4–300 kcmil	CH24L225R ②③	—	—	
	32	Indoor	D	#4–300 kcmil	CH32L225D ①	CH8DF	CH8DS	
	32	Outdoor	D	#4–300 kcmil	CH32L225R ②③	—	—	
	42	Indoor	G	#4–300 kcmil	CH42L225G ③	CH8GF	CH8GS	
	42	Outdoor	G	#4–300 kcmil	CH42L225R ②③	—	—	
400	42	Indoor	P	(2) 1/0–300 kcmil (1) 750 kcmil	CH42PL400 ④	CH7PF ⑤	CH7PS	



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12/21/2023

Notes

- ① Suitable for use as service equipment when not more than six disconnecting means are provided and when not used as a lighting and appliance panelboard (see Article 408.34 of the NEC).
- ② Rainproof panels are furnished with hub closure plates. For rainproof hubs, refer to **Page V1-T1-25**.
- ③ Suitable for use as service equipment when a circuit breaker is used as a main breaker. The main breaker is backfed and requires hold-down bracket kit catalog number **CH125RB**.
- ④ Suitable for use as service equipment when a circuit breaker is used as a main breaker. The main breaker is backfed and must be a Type CHB.
The breaker cannot be a Type CH.
- ⑤ This cover is for flush application only (not combination).

Box sizes **Pages V1-T1-27** and **V1-T1-28**.

1.4 Listings, Compatibility, and Classification

The SunPower InvisiMount Residential Mounting System is UL 2703 Listed. The InvisiMount Listing **includes** the following modules, which have been tested for grounding and mechanical load with the InvisiMount system.

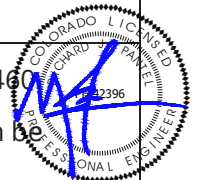
For Classic InvisiMount certification information, refer to UL at their site <https://www.ul.com> or the at the UL portal <https://www.ul.com/resources/apps/myul-client-portal> and view *File E314938* and *File E466981*. For Universal InvisiMount certification information, visit Intertek at [https://ramuk.intertekconnect.com/WebClients/ITS/DLP/products.nsf/\\$\\$Search?OpenForm](https://ramuk.intertekconnect.com/WebClients/ITS/DLP/products.nsf/$$Search?OpenForm) and search for InvisiMount.

SunPower DC Modules	SunPower AC Modules	
<ul style="list-style-type: none"> • SPR-A400-BLK-DC • SPR-A400-DC • SPR-A410-DC • SPR-E19-320 • SPR-E20-327 • SPR-X21-335-BLK • SPR-X21-350-BLK • SPR-X21-345 • SPR-X22-360 • SPR-X22-370 	<ul style="list-style-type: none"> • SPR-A400-BLK-G-AC • SPR-A390-G-AC • SPR-A400-G-AC • SPR-A410-G-AC • SPR-A415-G-AC • SPR-A425-G-AC • SPR-M415-BLK-H-AC • SPR-M425-BLK-H-AC • SPR-M420-H-AC • SPR-M425-H-AC • SPR-M435-H-AC • SPR-M440-H-AC 	<ul style="list-style-type: none"> • SPR-X22-370-E-AC • SPR-X22-360-E-AC • SPR-X21-350-BLK-E-AC • SPR-X21-335-BLK-E-AC • SPR-X20-327-BLK-E-AC • SPR-X21-345-E-AC • SPR-X21-335-E-AC • SPR-X20-327-E-AC • SPR-E20-327-E-AC • SPR-E19-320-E-AC

With Universal InvisiMount:

Manufacturer	Module Model / Series
Aptos	<ul style="list-style-type: none"> • DNA-120-MF26-xxxW, where xxx is wattage. • DNA-108-BF10-xxxW, where xxx is wattage. • DNA-120-BF26-xxxW where xxx is 350–370.
Canadian Solar	<ul style="list-style-type: none"> • Canadian Solar: CS3NxxxMS where xxx is 380–405.
Hanwha	<ul style="list-style-type: none"> • Q.PEAK DUO BLK ML-G10.a+ xxx, where xxx can be 370–425.
Jinko	<ul style="list-style-type: none"> • JKMxxxM-6RL3-B, where xxx can be 365–400.

REC	<ul style="list-style-type: none"> • RECxxxNP2, where xxx can be 350–380. • RECxxxNP2 Black, where xxx can be 350–380. • RECxxxTP4, where xxx can be 350–380. • RECxxxTP4 Black, where xxx can be 350–380. • RECxxxAA, where xxx can be 340–385. • RECxxxAA Black, where xxx can be 340–385. • RECxxxAA Pure, where xxx can be 380–415 • RECxxxAA PURE-R, where xxx can be 400, 410, 420, or 430 • RECxxxAA PURE-2, where xxx can be 400, 410, 420, or 430. • RECxxxAA PURE-RX, where xxx can be 450, 460, or 470.
spwr™	<ul style="list-style-type: none"> • SPR-U405-BLK
SunPower	<ul style="list-style-type: none"> • SPR-Axxx-COM (may be followed by -BLK), where xxx can be 380–460 • SPR-Axxx-yyy-MLSD, where xxx can be 350–460 and where yyy can be -COM and/or -300 V.
Trina	<ul style="list-style-type: none"> • TSM-xxxDE06X.05(II), where xxx can be 355–380.
Waaree	<ul style="list-style-type: none"> • WSMDi-xxx where xxx is 395–415.



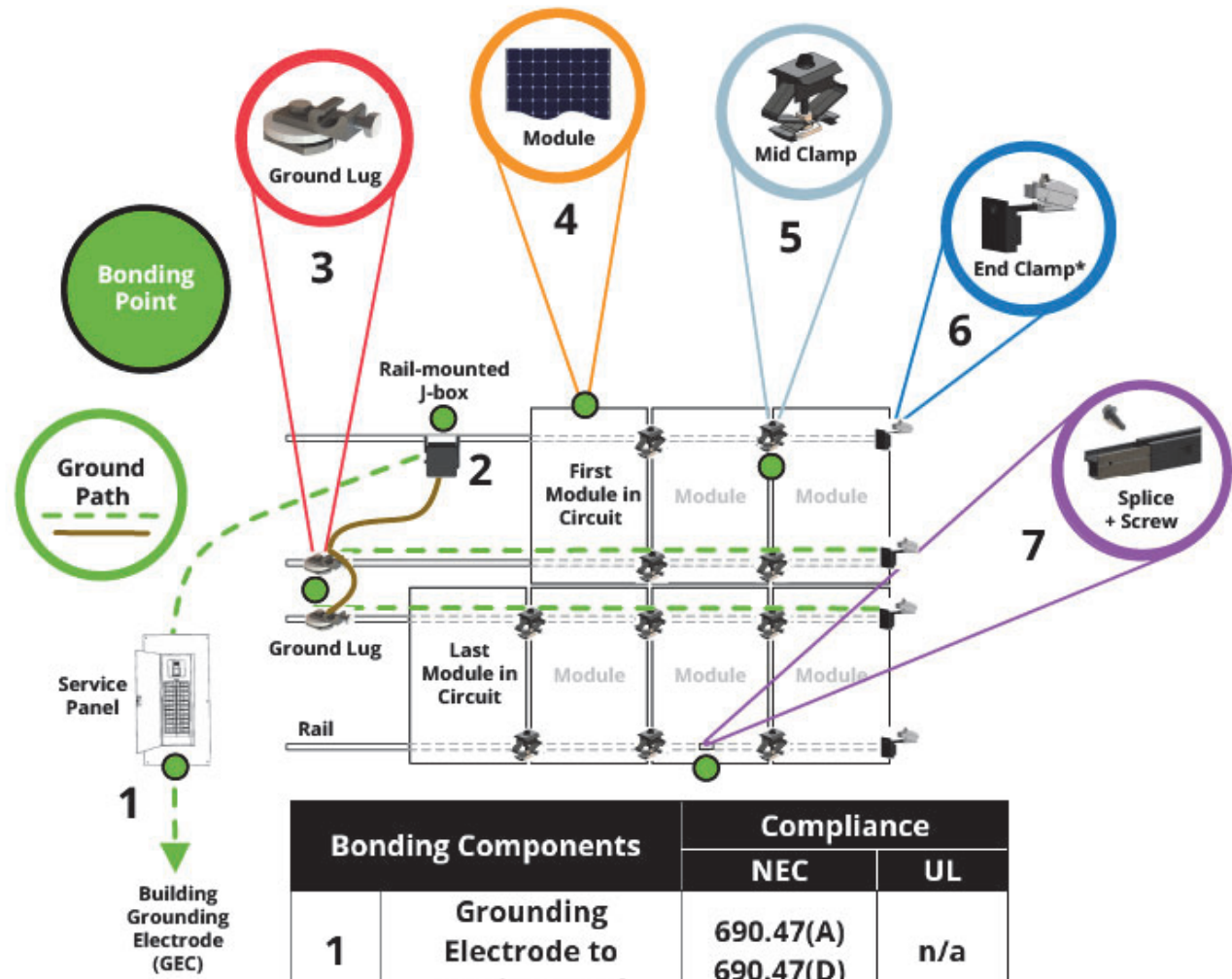
Reviewed and approved
Richard Pantel, P.E.
CO Lic. No. PE-42396
12/21/2023

System Design Load Rating: 10 PSF downward, 5 PSF upward, 5 PSF lateral. Actual system structural capacity is defined by the *InvisiMount Span Tables 524734*.

Grounding from the module to the rail is accomplished through the clamps. See Section 1.5 for more information. The Listing also includes the following components, which have been evaluated for both mounting and bonding in accordance with UL 2703:

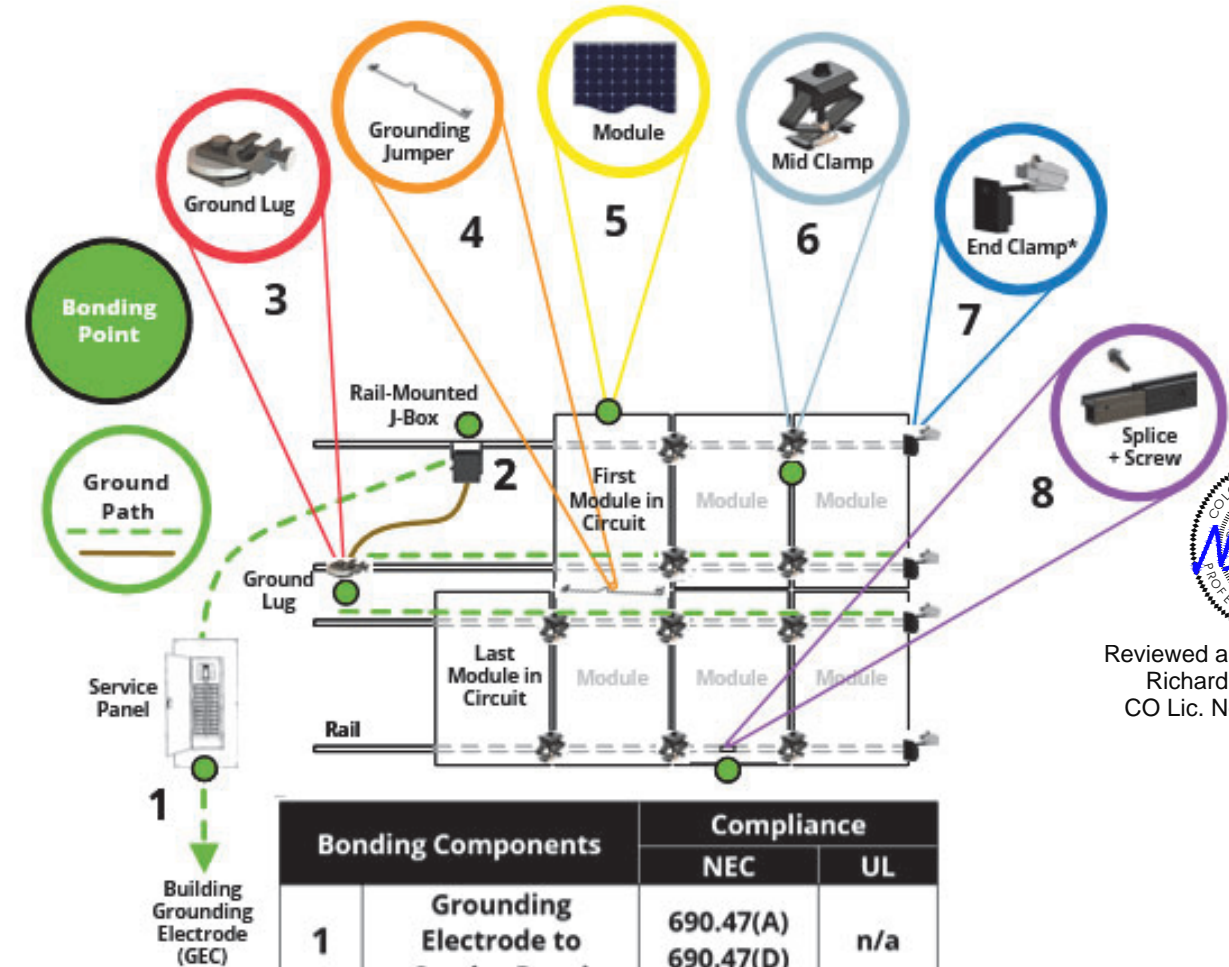
- End clamp
- Mid clamp
- Rail
- Splice and splice screw
- Ground lug assembly
- L-foot
- Row-to-row (R2R) grounding clip
- Row-to-row (R2R) grounding jumper
- Row-to-row (R2R) spacer
- Rail-mounted grounding junction box (RMJ)

SunPower Universal InvisiMount™ Ground Path and Compliance



Bonding Components	Compliance	
	NEC	UL
1 Grounding Electrode to Service Panel	690.47(A) 690.47(D)	n/a
2 Service Panel to Ground Wire	690.43(C)	1741
3 Ground Wire to Ground Lug to Rail	690.43(C)	2703
4 Module Frame	n/a	1703
5 Rail to Mid Clamp to Module Frame	690.43(A) 690.43(C) 690.43(D)	2703
6 End Clamp to Rail* *Note that end clamp does not bond module to rail; mid clamp bonds module to rail.	690.43(A) 690.43(C) 690.43(D)	2703
7 Rail to Splice	690.43(A) 690.43(C) 690.43(D)	2703

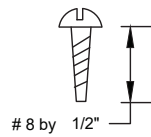
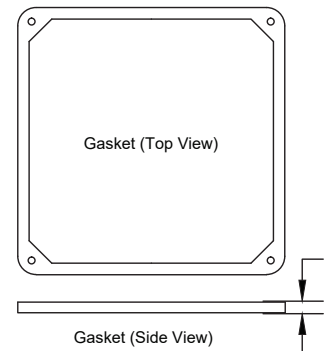
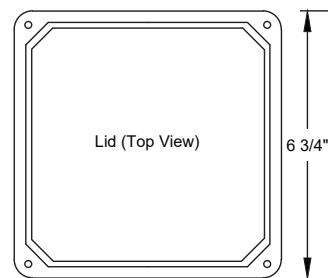
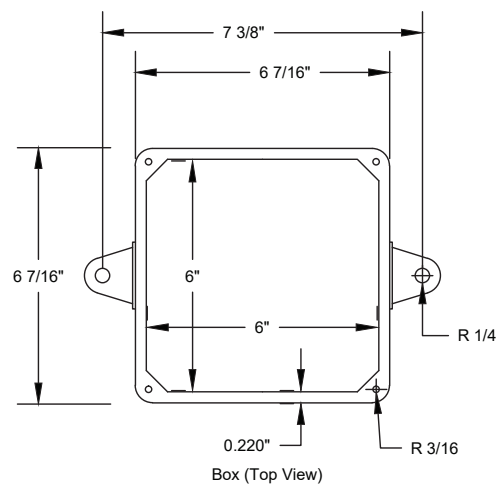
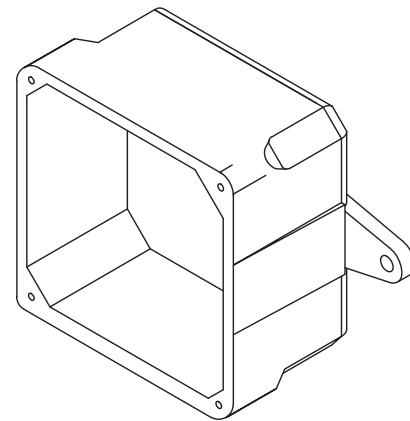
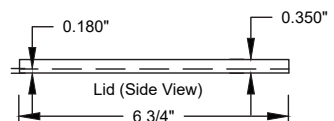
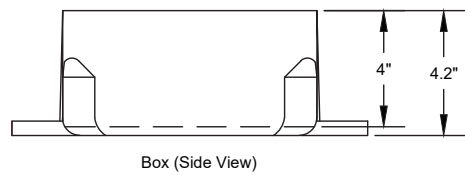
SunPower Universal InvisiMount™ with Grounding Jumper Ground Path and Compliance



Bonding Components	Compliance	
	NEC	UL
1 Grounding Electrode to Service Panel	690.47(A) 690.47(D)	n/a
2 Service Panel to Ground Wire	690.43(C)	1741
3 Ground Wire to Ground Lug to Rail	690.43(C)	2703
4 Module Frame to Module Frame	690.43(C)	2703
5 Module Frame	n/a	1703
6 Rail to Mid Clamp to Module Frame	690.43(A) 690.43(C) 690.43(D)	2703
7 End Clamp to Rail* *Note that end clamp does not bond module to rail; mid clamp bonds module to rail.	690.43(A) 690.43(C) 690.43(D)	2703
8 Rail to Splice	690.43(A) 690.43(C) 690.43(D)	2703



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UL Listed
 Marine Listed
 UL File # E205935 (QCUP)
 UL Control # 92CM
 Material is Rigid PVC
 132 cu in Volume (2163 cu cm)
 Screws are Zinc Plated Steel
 Gasket is neoprene



CANTEX INC. Fort Worth, TEXAS		
Junction Box 6 x 6 x 4		
Drawn By: O.M.	Date: 6/19/17	5133710



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 CO Lic. No. PE-42396
 12/21/2023