



**PRINCE WILLIAM**  
COUNTY

# Residential Solar Panel Installations

[pwcva.gov/residentialsolar](http://pwcva.gov/residentialsolar)



# Residential Solar Panel Installations Agenda

- Introduction (Eric Mays)
- PWC Submittal Requirements (Jenna Goodman)
- Structural Requirements (Brian Byrne)
- Electrical Requirements (Tread Willis)
- Questions



# Residential Solar Panel Installations Current Situation

- Increase Demand for Residential Solar Installations
- Expansion of PWC Solar Contractors from 8 to 80+
- Corresponding Expansion of Consulting Designers
- Introduction of New/Unapproved Components/Technology
- Contractor/Designer Inexperience with Electronic Plan Submission & Plan Review Process

(NOTE: Most Virginia localities do not require a Plan Review or only perform a limited Quality Control Plan Review. Responsibility falls to County/City Inspectors.)



**PRINCE WILLIAM**  
COUNTY

# PWC Submittal Requirements for Residential Solar Projects

For additional information please visit  
[www.pwcva.gov/residentialsolar](http://www.pwcva.gov/residentialsolar)



## Prepare your documents for submission

- For all systems:
  - Structural calculations and/or research report by nationally recognized testing laboratory for the mounting system (and foundation if ground mounted)
  - Design snow load of 30psf and ultimate wind speed of 105mph
- For roof top mounted systems:
  - Completed Solar Energy Systems – Roof Mounted Solar Panels Structural form
  - Roof plan showing location of panels and mounting system connections
  - Setbacks from horizontal ridge
- For ground mounted systems:
  - Location of panels, details for mounting system, connection to foundation, and foundation plans/details



## Log into the ePortal

The customer ePortal is used for application of the submission of your project documents and payments.

If you are a new user, you must first sign up for the ePortal by clicking on “Login or Register” or [click here](#).

\*Please be aware registration must be approved by county staff after you submit which may not be instant. Please allow time for processing the ePortal request prior to needing to submit.\*

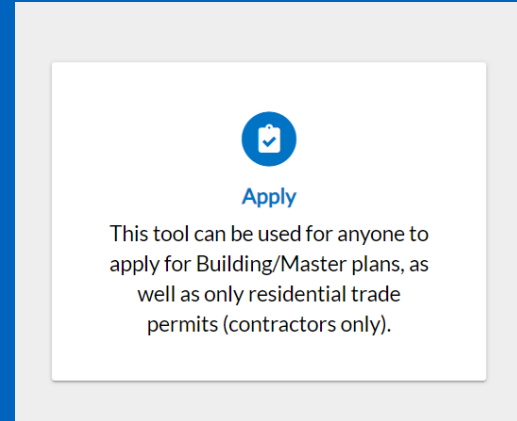


# Apply for a permit

In the ePortal, click on the “apply” card

Search and Select the “Building Residential Alternation/Repair” permit type and follow the prompts

To avoid delays in your project, please ensure all requirements listed in the [Residential Solar Energy System ePlan Checklist](#) are included in the first submission and all items meet the requirements outlined in the [ePlan Guide](#).





## Upload documents

- Zoning approval if ground mounted
- Plans meeting the requirements outlined on the [Customer ePlans Guide](#)
- Structural Calculations signed, sealed, and dated by the designer
- Manufacturer information demonstrating the UL listing

\*See the [Residential Solar Energy System Checklist](#) for a full list of requirements\*





## QC Process

The plans and documents will now be Quality Controlled by intake staff.

If there is additional information needed a QC Denial Letter will be emailed to the applicant and the letter will be available on the [ePortal](#).

Once the submission is approved, the filing fees will be invoiced and are payable through the [ePortal](#).

The submission will be routed for review after fees are paid. When plans are routed a "Plan Application Receipt" will be sent to the contacts. This is NOT a plan approval, but a QC approval. The expected due date for the plan review will be listed on this letter.



## Fees

- Review Fees (filing fee) and permit fees can be found in the fee schedule located at [pwcgov.org/BDD](http://pwcgov.org/BDD).
- Review fees (filing fee) will be invoiced after the submission has passed QC. Fees must be paid in full prior to the plans being routed for review.
- Permit fees will be invoiced to the PERMIT after approval of the drawings and prior to the permit being issued.
- All fees (permitting and review) are attached to the permit.



## Plan Review

- If the system is not per the County Typical Solar Energy System Plans, plan Review time is 10 days for residential solar panels.
- If the reviewer needs additional information a comment letter will be sent to the customer via email and the ePortal.
- Once the requested information is re-submitted in the ePortal, it will go through QC again and be re-routed for a 5 day review after resubmission fees are paid.
- Once the review is approved, the submission will be sent to permits for processing.



## Resubmissions

- All resubmissions must include the entire plan set, not just the corrected sheets.
- Resubmissions must be uploaded to the Plan Case (BPR). The plan case number will be viewable in your ePortal under “my plans” and the number will be noted on any QC Denial letters and/or Comment Letters.



**PRINCE WILLIAM**  
COUNTY

# 2018 VRC Structural Requirements for Rooftop-mounted Photovoltaic Systems




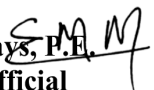
For additional information please visit  
[www.pwcva.gov/residentialsolar](http://www.pwcva.gov/residentialsolar)



# PRINCE WILLIAM COUNTY

## R301.2 Design criteria and Policy 3.1.1

- Ground snow load = 30 psf
- Ultimate wind speed = 105 mph.

	<b>BUILDING DEVELOPMENT POLICIES AND PROCEDURES RESIDENTIAL PLAN REVIEW GENERAL</b>	<b>Effective Date:</b> December 20, 2020
		<b>Supersedes Policy Dated:</b> July 1, 2009
	<b>3.1.1 Climatic and Geographic Design Criteria</b>	<b>Issued by:</b> Eric M. Mays, P.E.  <b>Building Official</b>

The International Residential Code requires the locality to fill out Table R301.2(1) for Climatic and Geographic Design Criteria. Following is the completed table for Prince William County.

Ground Snow Load (psf)	Wind Design				Seismic Design Category	Subject to Damage From			Winter Design Temp.	Ice Barrier Underlayment Required	Flood Hazards	Air Freezing Index	Mean Annual Temp.
	Speed (mph)	Topographic effects	Special wind region	Wind-borne debris zone		Weathering	Frost line depth	Termite					
30	115	No	No	No	B <sup>1</sup>	Severe	24"	Moderate to Heavy	17°F	Yes	12/01/81	≤ 1500°F	55°F

<sup>1</sup>(Seismic Design Category A may be used and supported with geotechnical report.)



# PRINCE WILLIAM COUNTY

## R324.4.1 Structural requirements – Mounting System

- Engineering report or research report for the mounting system including rail, mount, and connections.

May 28, 2021

SnapNTrack  
775 Fiero Lane, Ste. 200  
San Luis Obispo, CA 93401  
TEL: (877) 732-2990

Attn.: SnapNTrack - Engineering Department

Re: SnapNTrack pre-engineered PV racking systems:

- RL Universal System (Report # 2019-02916A.01 and B.01)
- S200 Ground Mount System (Report # 2017-00240-D.02)
- UR40 Railed System (Report # 2017-03227.11)
- UR90 Railed System (Report # 2018-11940.03)

Subject: Engineering certification for the State of Virginia.

PZSE, Inc. - Structural Engineers has provided engineering and span tables as presented in the above referenced reports. All information, data, and analysis therein are based on, and comply with, the following building codes and typical specifications:

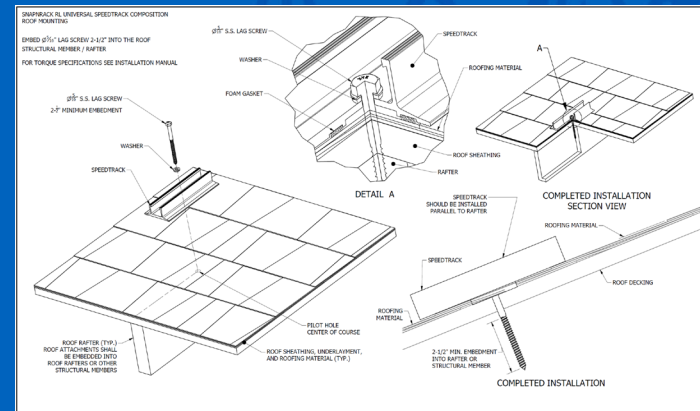
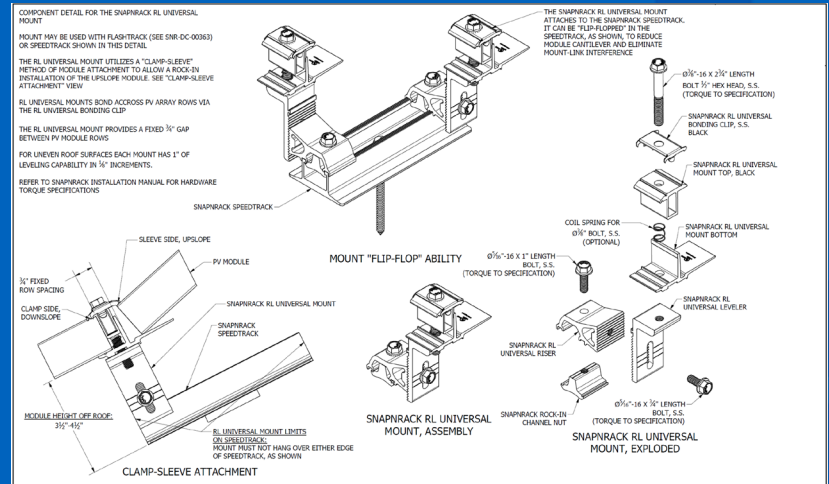
Building Codes:

1. ASCE/SEI 7-10 & 7-16, Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers
2. 2015 & 2018 International Building Code, by International Code Council, Inc.
3. AC408 Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012, by ICC-ES
5. Aluminum Design manual 2015, by The Aluminum Association, Inc.
6. ANSI/WWC NDS-2015, National Design Specification for Wood Construction, by the American Wood Council

This letter certifies that the design criteria and design methodology for the SnapNTrack product span tables are in compliance with the above codes. Please refer to the system specific Engineering Certification Reports (listed above) for system specific design criteria and limitations.

If you have any questions on the above, do not hesitate to call.


Prepared by:  
PZSE, Inc. - Structural Engineers  
Roseville, CA





## R324.4.1 Structural requirements - Calculations

- Structural calculations sealed by a Virginia engineer to show the roof is adequate to support the rooftop-mounted photovoltaic system.



**WoodWorks**  
SOFTWARE FOR WOOD DESIGN

COMPANY

PROJECT

June 21, 2022 15:29

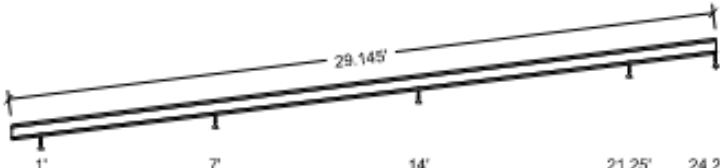
Beam1.wwb

**Design Check Calculation Sheet**  
WoodWorks Sizer 2019 (Update 4)

**Loads:**

Load	Type	Distribution	Pat-tern	Location [ft]		Magnitude		Unit
				Start	End	Start	End	
Dead	Dead	Full Area	No			7.00	(24.0*)	psf
PV1	Dead	Point	No	20.00		17		lbs
PV2	Dead	Point	No	16.00		17		lbs
PV3	Dead	Point	No	15.00		17		lbs
PV4	Dead	Point	No	11.00		17		lbs
Snow1	Snow	Point	Yes	20.00		150		lbs
Snow2	Snow	Point	Yes	16.00		150		lbs
Snow3	Snow	Point	Yes	15.00		150		lbs
Snow4	Snow	Point	Yes	11.00		150		lbs
DistSnow1	Snow	Partial Area	Yes	8.00	0.50	26.00	(24.0*)	psf
DistSnow2	Snow	Partial Area	Yes	20.50	23.25	26.00	(24.0*)	psf
PV5	Dead	Point	No	10.00		17		lbs
PV6	Dead	Point	No	6.00		17		lbs
PV7	Dead	Point	No	5.00		17		lbs
PV8	Dead	Point	No	1.00		17		lbs
Snow5	Snow	Point	Yes	10.00		150		lbs
Snow6	Snow	Point	Yes	6.00		150		lbs
Snow7	Snow	Point	Yes	5.00		150		lbs
Snow8	Snow	Point	Yes	1.00		150		lbs

**Maximum Reactions (lbs), Bearing Capacities (lbs) and Bearing Lengths (in) :**



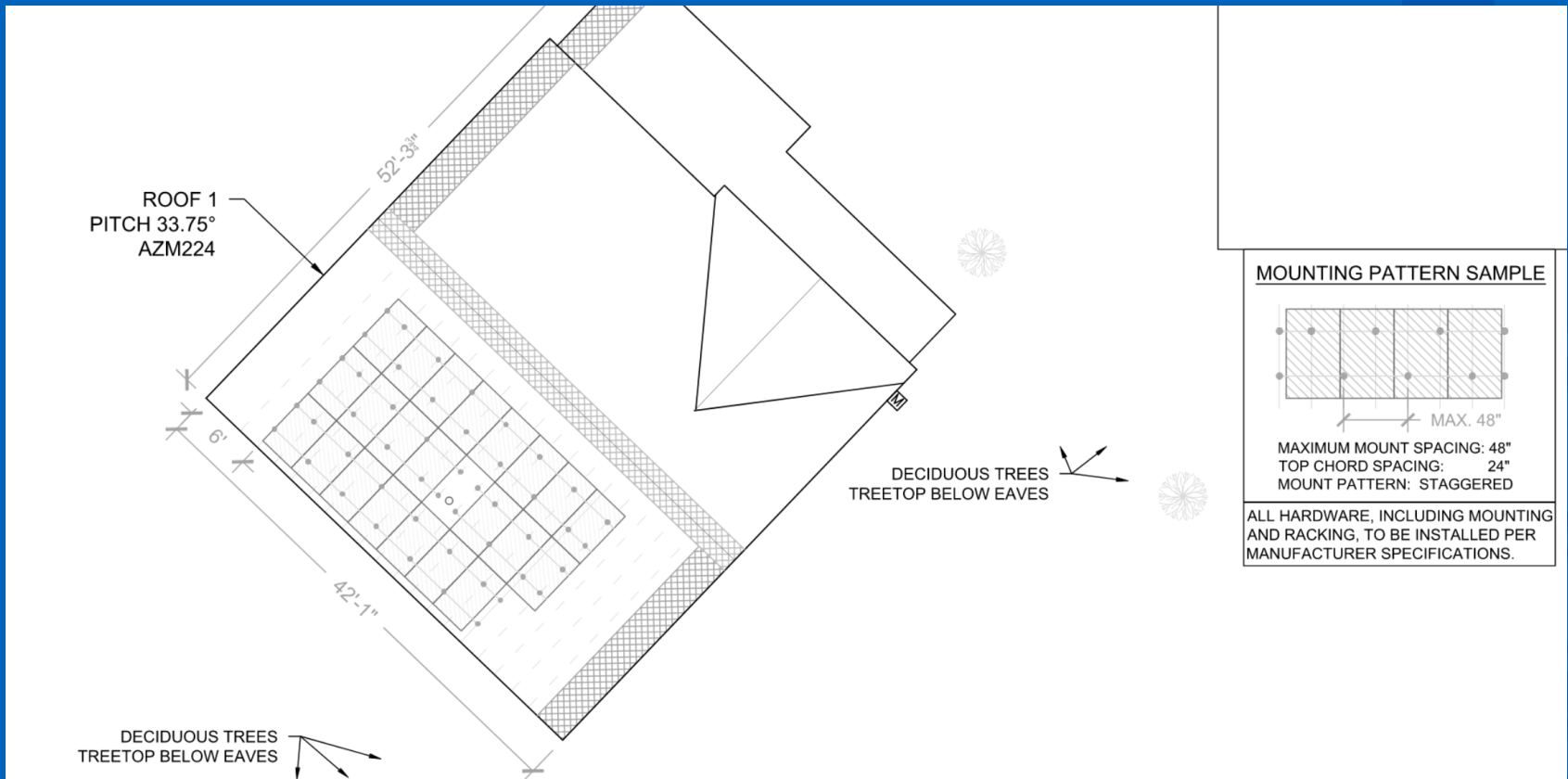
Roof Snow Load Calculations	
$p_g$ = Ground Snow Load =	30 psf
$p_f = 0.7 C_e C_t I p_g$	(ASCE7 - Eq 7-1)
$C_e$ = Exposure Factor =	1 (ASCE7 - Table 7-2)
$C_t$ = Thermal Factor =	1.2 (ASCE7 - Table 7-3)
$I$ = Importance Factor =	1
$p_f$ = Flat Roof Snow Load =	26.0 psf
$p_s = C_s p_f$	(ASCE7 - Eq 7-2)
$C_s$ = Slope Factor =	1
<b><math>p_s</math> = Sloped Roof Snow Load =</b>	<b>26.0 psf</b>
PV Dead Load = 3 psf (Per Ion Solar)	
DL Adjusted to 33 Degree Slope	3.58 psf
PV System Weight	
Weight of PV System (Per Ion Solar)	3.0 psf
X Standoff Spacing =	2.00 ft
Y Standoff Spacing =	2.88 ft
Standoff Tributary Area =	5.75 sft
<b>Point Loads of Standoffs</b>	<b>17 lb</b>





## R324.4.1 Structural requirements - Plans and Details

- Roof plan showing location and spacing of mount connections

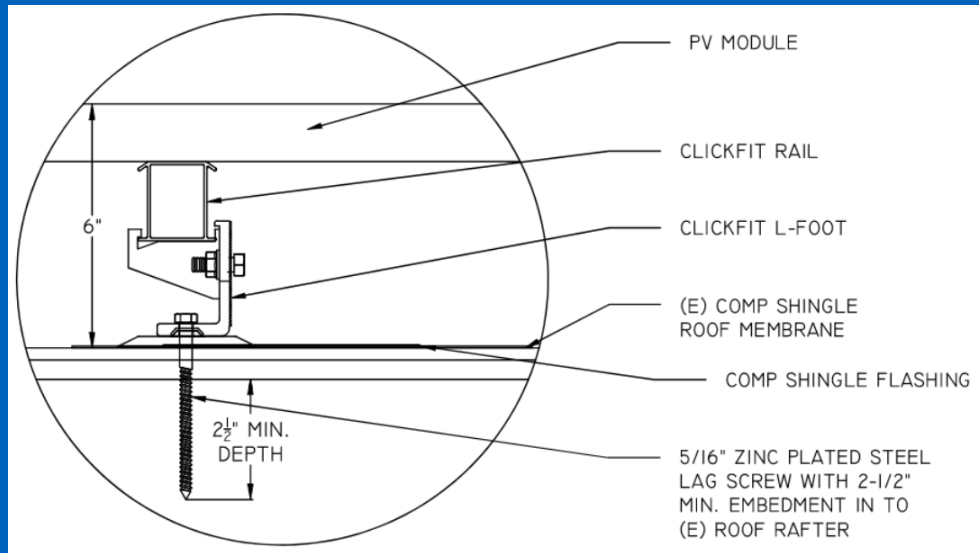




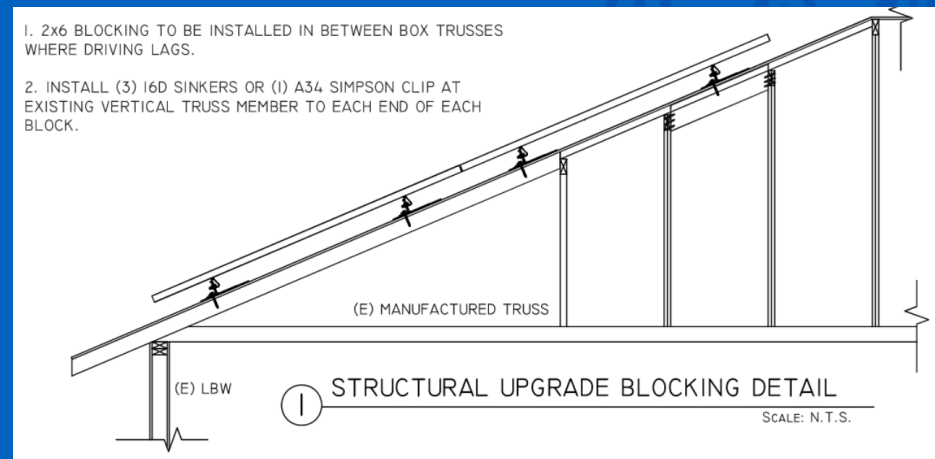
# PRINCE WILLIAM COUNTY

## R324.4.1 Structural requirements - Plans and Details

- Details for mount connections to roof framing



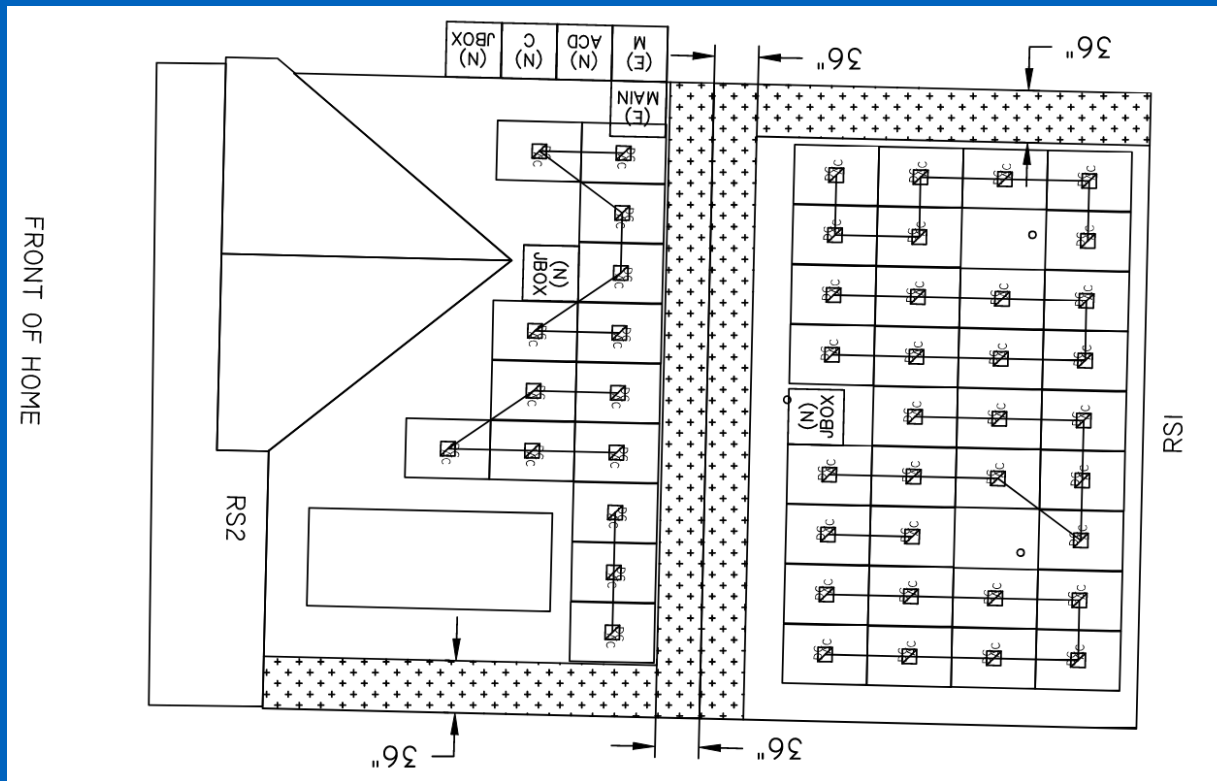
Blocking required  
for hip trusses





## R324.6.1 Pathways

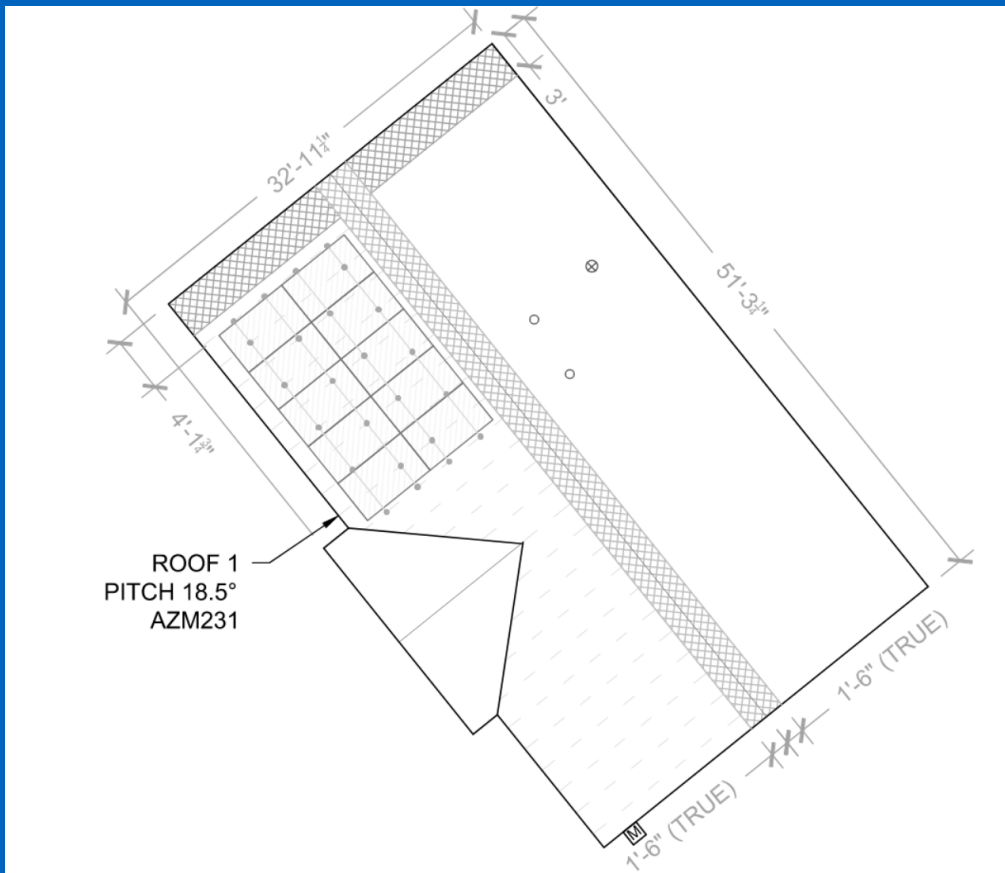
- Two 36-inch wide pathways on separate roof planes from the eave to the ridge
- One 36-inch wide pathway located on the street or driveway side of the roof
- One 36-inch wide pathway each roof plane with a photovoltaic array or an adjacent roof plane





## R324.6.2 Setback at ridge.

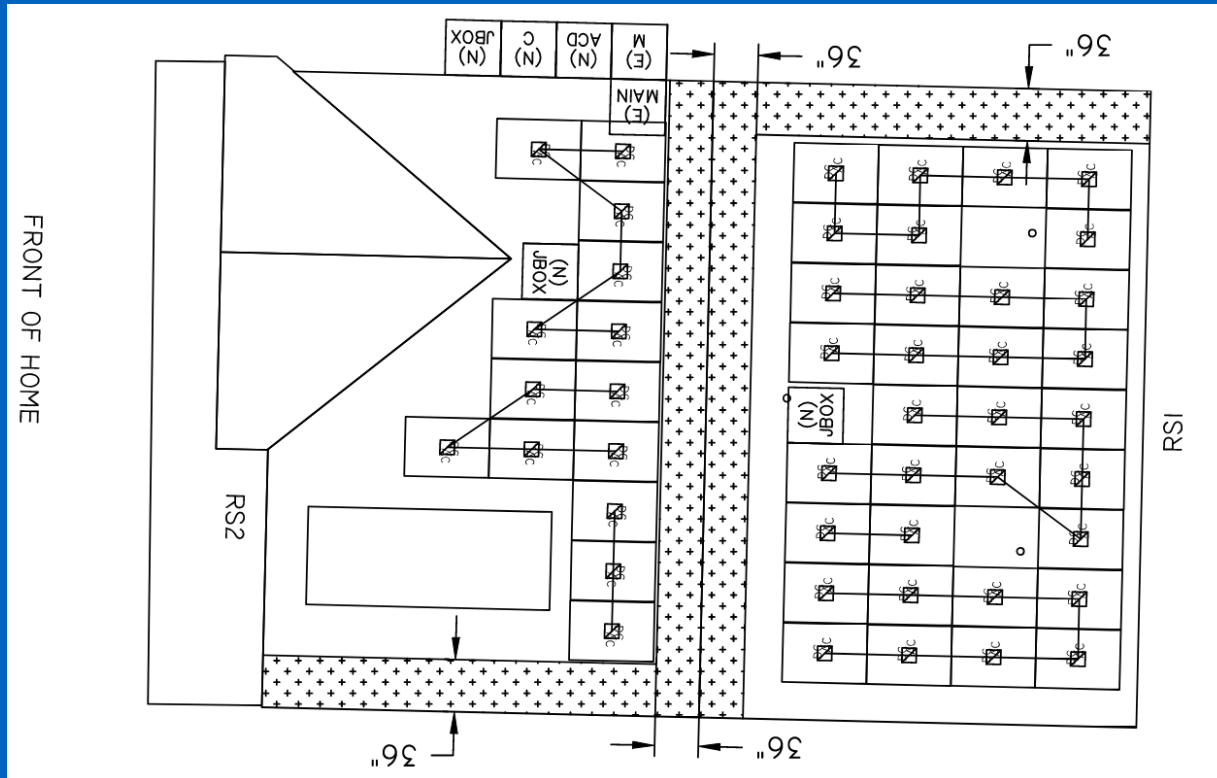
- Panels occupying less than 33 percent of plan view roof area
- 18-inch wide clear setback is required on both sides of the ridge





## R324.6.2 Setback at ridge.

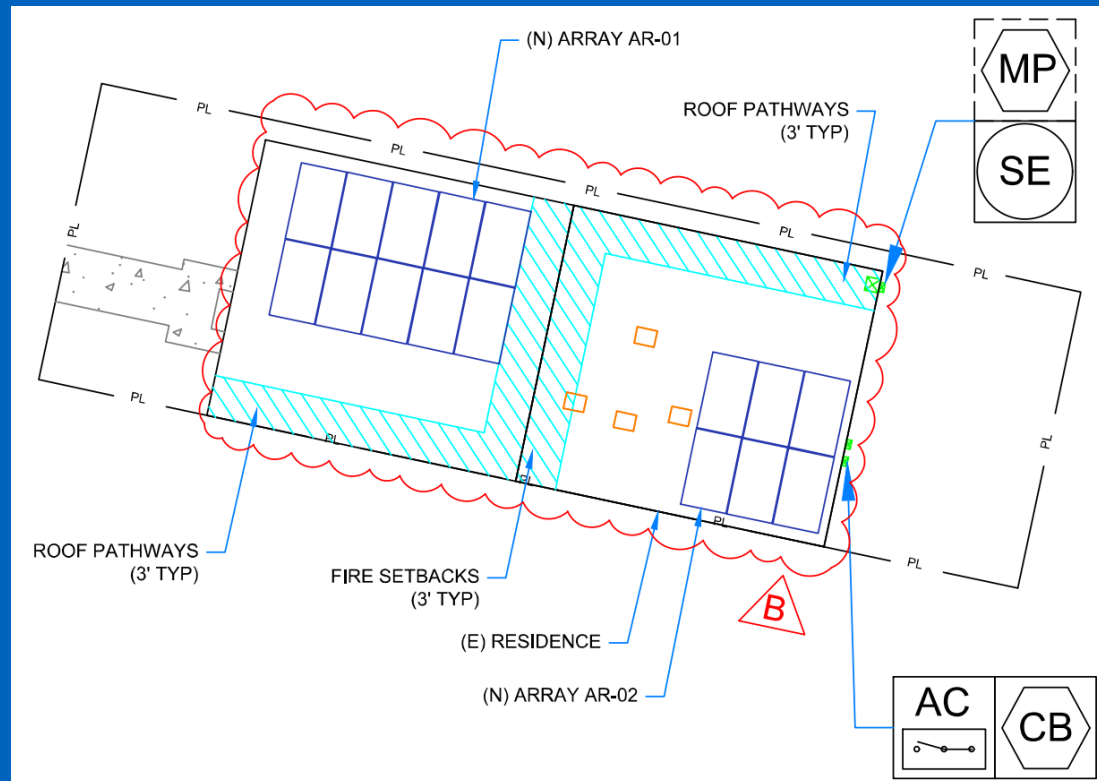
- Panel occupying more than 33 percent of plan view roof area
- 36-inch wide clear setback is required on both sides of the ridge





## R324.6.1 Pathways and R324.6.2 Setback at ridge

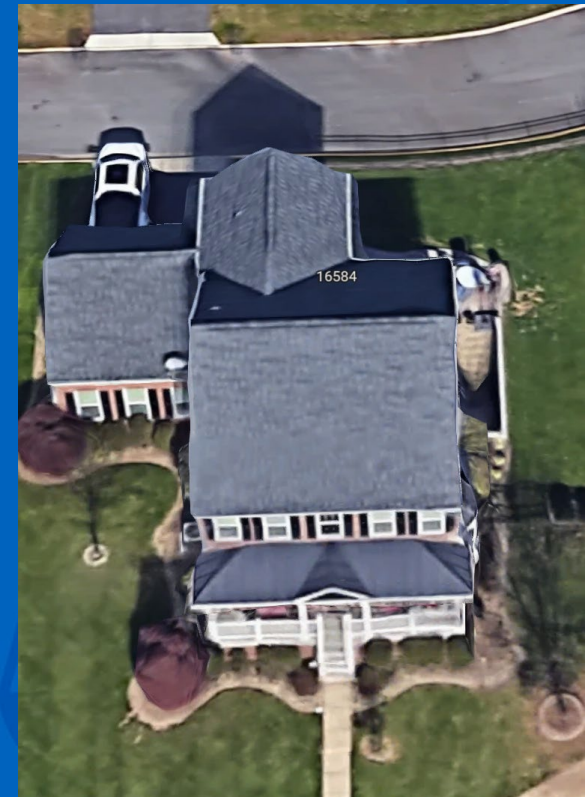
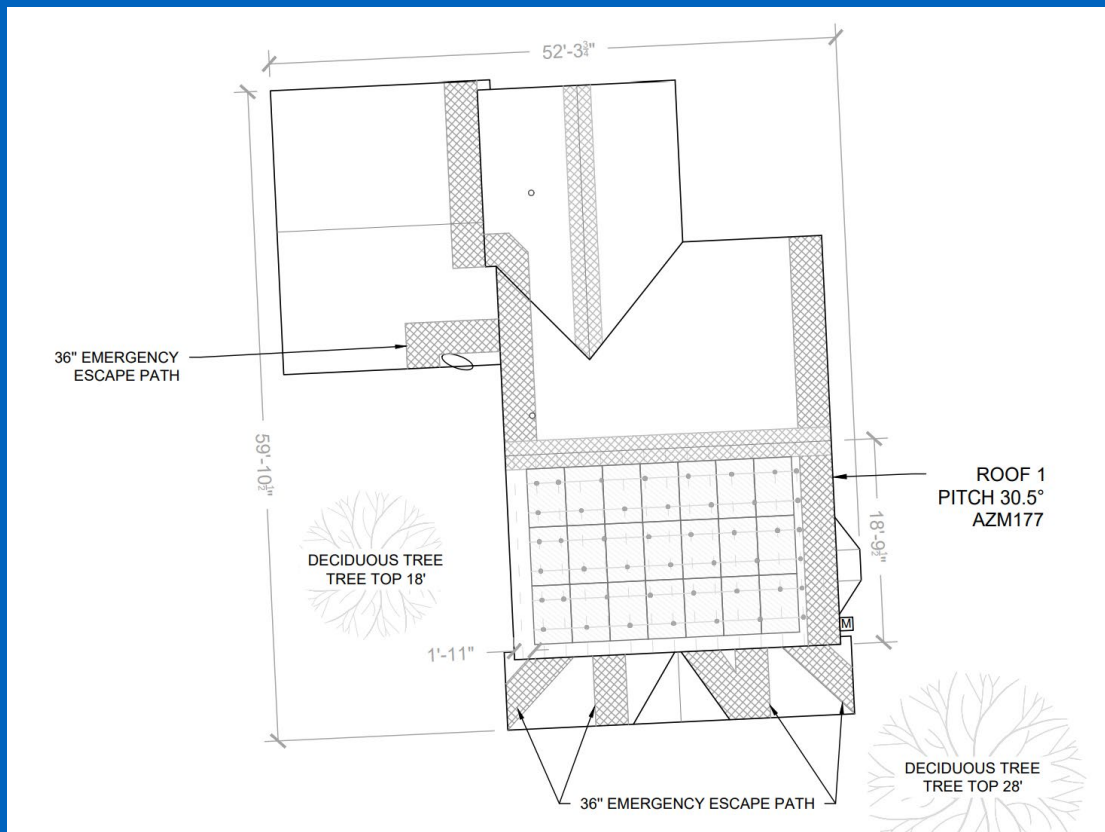
- Townhouse with photovoltaic arrays
- Two 36-inch wide pathways from the eave to the ridge
- Panels occupying more than 33 percent of plan view roof area
- 36-inch clear setback is required on both sides of the ridge





## R324.6.2.2 Emergency escape and rescue opening

- 36-inch wide pathways required to emergency escape and rescue openings





# PRINCE WILLIAM COUNTY

## R324.3.1 Equipment listings

- Submit certification for photovoltaic panels and modules listed and labeled in accordance with UL 1703.
- Submit certification for inverters listed and labeled in accordance with UL 1741.
- Systems connected to the utility grid shall use inverters listed for utility interaction.

**CERTIFICATE OF COMPLIANCE**

<b>Certificate Number</b>	20150223-E246423
<b>Report Reference</b>	E246423-20040917
<b>Issue Date</b>	2015-FEBRUARY-23

**Issued to:** SUNPOWER CORP  
77 RIO ROBLES  
SAN JOSE CA 95134

**This is to certify that representative samples of** PHOTOVOLTAIC MODULES AND PANELS  
(See addendum for additional information.)


Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.

**Standard(s) for Safety:** UL 1703, 3rd Edition, revised May 20, 2014, "Standard for Safety for Flat-Plate Photovoltaic Modules and Panels."

**Additional Information:** See the UL Online Certifications Directory at [www.ul.com/database](http://www.ul.com/database) for additional information

Only those products bearing the UL Listing Mark for the US and Canada should be considered as being covered by UL's Listing and Follow-Up Service meeting the appropriate requirements for US and Canada.  
The UL Listing Mark for the US and Canada generally includes: the UL in a circle symbol with "C" and "US" identifiers; the word "LISTED"; a control number (may be alphanumeric) assigned by UL; and the product category name (product identifier) as indicated in the appropriate UL Directory.  
Look for the UL Listing Mark on the product.

*William R. Conroy*  
William R. Conroy, Director, North American Certification Programs  
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Page 1 of 2

**CERTIFICATE OF COMPLIANCE**

<b>Certificate Number</b>	20150223-E246423
<b>Report Reference</b>	E246423-20040917
<b>Issue Date</b>	2015-FEBRUARY-23

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

**Photovoltaic Modules:**

Models XXX-440 to -410, -408, -405, -402, -400, -398, -395, -392, -390, -388, -385, -382, -380, -375, -345 to -293, -290, -285, -280, -250 to -225, followed by E or NE, may be followed by -BLK or -WHT, followed by -D, -I, or -U, where XXX represents SPR or SPV.

Models XXX-EYY-### where XXX represents SPR or SPV, YY represents 18, 19, 20 or 21 and ### is any number from 440 to 375 or 345 to 265 or 250 to 225 and may be followed by -COM and/or -BLK

Models XXX-450 to -435, XXX-345 to -311, XXX-262 to -233 followed by J, NJ, NX or X, may be followed by -BLK or -WHT, followed by -D, -I, or -U, where XXX represents SPR or SPV.

Models XXX-XY-### where XXX represents SPR or SPV, YY represents 18, 19, 20 or 21 and ### is any number from 486 to 435 or 395 to 310 or 274 to 233 and may be followed by -COM and/or -BLK

Flat-Plate Photovoltaic Modules with construction compliant to Module Fire Performance Type 2.

*William R. Conroy*  
William R. Conroy, Director, North American Certification Programs  
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Page 2 of 2





# PRINCE WILLIAM COUNTY

## R902.4 Rooftop-mounted photovoltaic panel systems

- Submit certification for rooftop-mounted photovoltaic panel systems tested, listed and identified with a fire classification in accordance with UL 1703 and UL 2703

### CERTIFICATE OF COMPLIANCE

**Certificate Number** E467724  
**Report Reference** E467724-20140829  
**Date** 2021-June-24

**Issued to:** K2 Systems LLC  
 2835 La Mirada Dr, Suite A  
 Vista CA, 92081 US

**This is to certify that representative samples of** MOUNTING SYSTEMS, MOUNTING DEVICES, CLAMPING DEVICES AND GROUND LUGS FOR USE WITH PHOTOVOLTAIC MODULES AND PANELS - COMPONENT  
 See Addendum Page for Product Designation(s).

Have been investigated by UL in accordance with the component requirements in the Standard(s) indicated on this Certificate. UL Recognized components are incomplete in certain constructional features or restricted in performance capabilities and are intended for installation in complete equipment submitted for investigation to UL LLC.

**Standard(s) for Safety:** UL 2703 Standard for Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for use with Flat-Plate Photovoltaic Modules and Panels.

**Additional Information:** See the UL Online Certifications Directory at <https://iq.ulprospector.com> for additional information

This Certificate of Compliance does not provide authorization to apply the UL Recognized Component Mark. Only the UL Follow-Up Services Procedure provides authorization to apply the UL Mark.

Only those products bearing the UL Recognized Component Mark should be considered as being UL Certified and covered under UL's Follow-Up Services.

Look for the UL Recognized Component Mark on the product.



*Brady*  
Bruce Mahrtzsch, Director North American Certification Program  
UL LLC  
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### CERTIFICATE OF COMPLIANCE

**Certificate Number** E467724  
**Report Reference** E467724-20140829  
**Date** 2021-June-24

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements

**USR – Component pieces:**  
 -CrossRail 48  
 -CrossRail 80  
 -Rail Connector CrossRail 48  
 -Rail Connector CrossRail 80  
 -L-foot  
 -Bonding T-bolt  
 -Standard T-bolt  
 -CrossRail Tuk Bracket  
 -Climber  
 -44-X Climber  
 -Rail Connector CR48  
 -Slide Bracket  
 -Stand Off  
 -Shared Rail Slide Hook  
 -CrossRail 48-S, 48, 80 Tilt Connector  
 -Single Hook  
 -Everest Ground Lug  
 -Simple Tilt Knee Connector assembly  
 -Splice Foot X  
 -Splice Foot XL  
 -Alternate MK2 Alu Slot Nut  
 -MLPE Module Frame Mount

Evaluated for Bonding Only

For use only in (or with) complete equipment where the acceptability of the combination is determined by UL LLC.



*Brady*  
Bruce Mahrtzsch, Director North American Certification Program  
UL LLC  
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**PRINCE WILLIAM**  
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# 2018 Electrical Requirements for Residential Solar Projects

For additional information please visit  
[www.pwcva.gov/residentialsolar](http://www.pwcva.gov/residentialsolar)



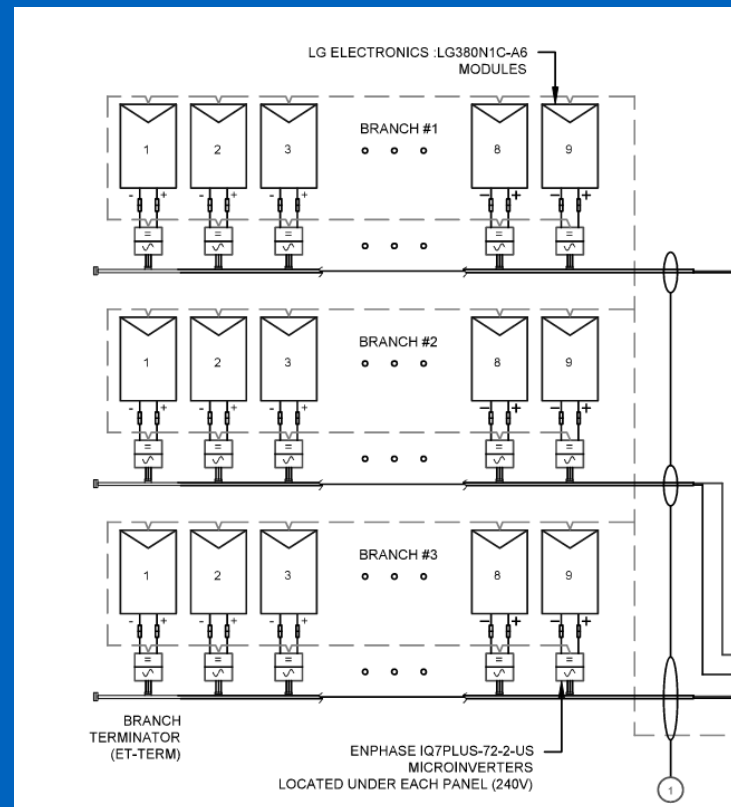
## Equipment Spec Sheets

- Provide spec sheets for all equipment being used
- This includes panels, inverters, combiners, optimizers, etc.
- These spec sheets shall provide required electrical data in order to perform necessary calculations.
- Coordinate the equipment being shown on design drawings with the spec sheets provided.
- Make sure the spec sheets provided reference a Nationally Recognized Testing Laboratory.



# Electrical Design of Photovoltaic System

- Starting at the array:
  - Identify on one line drawing/riser diagram all equipment to be used. (panels, micro-inverters, optimizers)
  - Identify string length and number of strings





# From The Array to the Combiner Panel or Single Inverter

Circuit conductors shall be sized correctly and verified by calculations using all necessary corrections factors including ambient temperature, more than 3 current carrying conductors in a raceway etc.

Choose an appropriate wiring method, raceway or cable, and size raceway appropriately for the number of conductors.

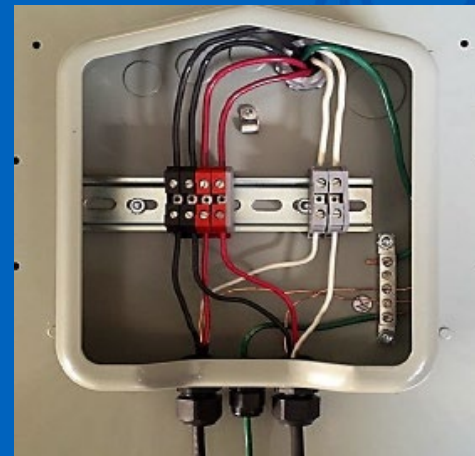
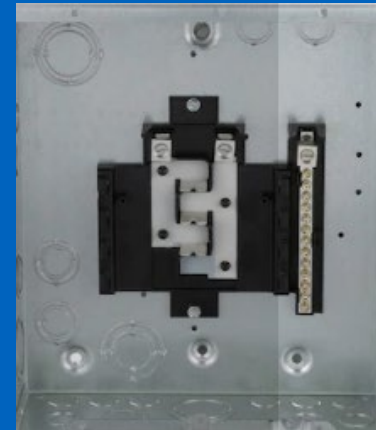
DC circuits located in the interior of a building shall be installed in a metal raceway or MC cable.

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



# Combiner Panel and Junction Boxes

- Provide all necessary documentation for the equipment being used.
- Confirm the junction box has adequate volume for the number of conductors being installed.
- The rules of 705.12(B), load side connections, apply to the connections of the power production system to a panelboard dedicated for power production.





## Rapid Shutdown Switch

Locate the Rapid Shutdown Switch with the required label at a readily accessible location outside of the building.

The Rapid Shutdown Switch shall be either the service disconnecting means, PV system disconnecting means or a readily accessible switch that plainly indicates whether it is on or off.

For most DC systems, the disconnect in the inverter also provides rapid shutdown.

For AC systems, typical rapid shutdown is provided by the AC disconnect.



## Calculations

These calculations demonstrate compliance with adjusted conductor ampacity, conduit fill, overcurrent protection, and string sizing. These calculations are verified by reviewers for compliance and accuracy. Please note the geographic design information as the high and low temperatures make a difference for these calculations and compatibility of equipment.

### PV SYSTEM ELECTRICAL SPECIFICATIONS AND CALCULATIONS

#### DESIGN LOCATION AND TEMPERATURES

TEMPERATURE DATA SOURCE	ASHRAE
STATE	VIRGINIA
JURISDICTION	PRINCE WILLIAM COUNTY VA
WEATHER STATION	MANASSAS MUNI AWOS
ASHRAE EXTREME LOW TEMP (°C)	-16
ASHRAE 2% HIGH TEMP (°C)	33
DESIGNED MAX. SYSTEM VDROP / VRISE	4.00%

#### PV MODULE SPECIFICATIONS

MODEL	SILFAB SOLAR SIL-380 HC 202(110)
RATED POWER (PMAX) (W)	380
MAXIMUM POWER VOLTAGE (VMP)	35.32
MAXIMUM POWER CURRENT (IMP)	10.77
OPEN CIRCUIT VOLTAGE (VOC)	42.77
SHORT CIRCUIT CURRENT (ISC)	11.36
PM/IMP TEMP. COEFFICIENT	-0.36
VOC TEMP. COEFFICIENT	-0.28
SERIES FUSE RATING	20
ADJ. MODULE VOC @ ASHRAE LOW TEMP	47.0
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	30.2

#### INVERTER SPECIFICATIONS

MODEL	ENPHASE 107PLUS-72-2-UG
TYPE	MICROINVERTER
MAX. OR RECOMMENDED MODULE POWER (W)	440
MAXIMUM INPUT DC OPEN-CIRCUIT VOLTAGE (VOC)	60
MINIMUM START VOLTAGE (V)	22
MAXIMUM START VOLTAGE (V)	60
MAXIMUM INPUT CURRENT (ISC) (A)	15
CEC PEAK OUTPUT POWER (W)	290
MAX. CONTINUOUS OUTPUT CURRENT (A)	1.21
NOMINAL (L-L) OUTPUT VOLTAGE	240
CEC WEIGHTED EFFICIENCY (%)	97.0%

#### SYSTEM ELECTRICAL SPECIFICATIONS

	CIR 1	CIR 2
NUMBER OF MODULES PER CIRCUIT	12	11
DC POWER RATING PER CIRCUIT (STC)(W DC)	4560	4180
TOTAL MODULE QUANTITY	23 PV MODULES	
STC DC POWER RATING OF ARRAY	8740W DC	
INVERTER OUTPUT CIRCUIT CURRENT (A AC)	14.52	13.31
125% INVERTER OUTPUT CIRCUIT CURRENT (A AC)	18.15	16.64
CIRCUIT OCPD RATING (A)	20	
COMBINED INVERTER CONTINUOUS OUTPUT CURRENT	27.83A AC	
PV POWER PRODUCTION SYSTEM OCPD RATING (X125%)	35A	
MAX. ARRAY STC-AC POWER (W)	6670W AC (STC)	
MAX. ARRAY CEC-AC POWER (W)	7795W AC (CEC)	

#### AC VOLTAGE RISE CALCULATIONS

	DIST (FT)	COND.	VRISE(V)	VEND(V)	%VRISE
VRISE SEC. 1 (MICRO TO JBOX) *	28.8	12 CU.	1.7	24.7	0.70%
VRISE SEC. 2 (JBOX TO COMBINER BOX)	90	10 CU.	3.1	24.1	1.31%
VRISE SEC. 3 (COMBINER BOX TO POI)	10	8 CU.	0.4	24.4	0.18%

TOTAL VRISE  
 \* 8 MICROINVERTER MAX SUB-BRANCH CIRCUIT SIZE TO COMPLY WITH VRISE CALCULATIONS. 5.2 24.2 2.18% OK

#### RACEWAY / CONDUCTOR CALCULATIONS

<u>MICROINVT. TO JUNCTION BOX (1)</u>	
MAX INVERTER OUTPUT CIRCUIT CURRENT =	14.5 A AC
MAX CURRENT X125% =	18.0 A AC
PER NEC 690.8(B)(1)(W/O CORRECTION FACTORS)	
CONDUCTOR SIZE / INSULATION / TYPE =	12 AWG 2C, TC-ER, CU.
CONDUCTOR AMP. RATING @ 90°C =	30 A
AMB. TEMP. AMP. CORRECTION =	NOT APPLIED
ADJUSTED AMPACITY COMPLIANCE (A) =	30 > 18.0 OK
RACEWAY SIZE / TYPE =	3/4 IN. EMT OR FREE AIR
CROSS-SECTIONAL AREA OF CONDUCTOR(S) / CABLE(S)(IN. <sup>2</sup> ) =	0.142 IN. <sup>2</sup>
CROSS-SECTIONAL AREA OF RACEWAY(IN. <sup>2</sup> ) =	0.533 IN. <sup>2</sup>
% ALLOWABLE RACEWAY FILL (NEC CHAPTER 9, TABLE 1) =	53% > 27% OK

#### JUNCTION BOX TO JUNCTION BOX (2)

MAX INVERTER OUTPUT CIRCUIT CURRENT =	14.5 A AC
MAX CURRENT X125% =	18 A AC
PER NEC 690.8(B)(1)(W/O CORRECTION FACTORS)	
CONDUCTOR SIZE / INSULATION / TYPE =	10 AWG 2C, NM-B W/G, CU.
CONDUCTOR AMP. RATING @90°C =	30 A
# OF CONDUCTORS IN RACEWAY CORRECTION =	NOT APPLIED
AMB. TEMP. AMP. CORRECTION =	NOT APPLIED
ADJUSTED AMPACITY COMPLIANCE (A) =	30 > 18.0 OK
RACEWAY SIZE / TYPE =	FREE AIR

#### JUNCTION BOX TO COMBINER BOX (3)

MAX INVERTER OUTPUT CIRCUIT CURRENT =	14.5 A AC
PER NEC 690.8(B)(2)(WITH CORRECTION FACTORS)	
CONDUCTOR SIZE / INSULATION / TYPE =	10 AWG THHN / THWN, CU.
CONDUCTOR AMP. RATING @90°C =	35 A
# OF CONDUCTORS IN RACEWAY CORRECTION =	0.8
AMB. TEMP. AMP. CORRECTION =	0.94
ADJUSTED AMPACITY COMPLIANCE (A) =	26.32 > 14.5 OK
RACEWAY SIZE / TYPE =	3/4 IN. EMT
CROSS-SECTIONAL AREA OF CONDUCTOR(S) / CABLE(S)(IN. <sup>2</sup> ) =	0.106 IN. <sup>2</sup>
CROSS-SECTIONAL AREA OF RACEWAY(IN. <sup>2</sup> ) =	0.533 IN. <sup>2</sup>
% ALLOWABLE RACEWAY FILL (NEC CHAPTER 9, TABLE 1) =	40% > 20% OK

#### COMBINER BOX TO MAIN PV OCPD (10)

COMBINED INVERTER CONTINUOUS OUTPUT CURRENT =	27.8 A AC
MAX CURRENT X125% =	35.0 A AC
PER NEC 690.8(B)(1)(W/O CORRECTION FACTORS)	
CONDUCTOR SIZE / INSULATION / TYPE =	8 AWG THHN / THWN, CU.
CONDUCTOR AMP. RATING @75°C =	50 A
# OF CONDUCTORS IN RACEWAY CORRECTION =	NOT APPLIED
AMB. TEMP. AMP. CORRECTION =	NOT APPLIED
ADJUSTED AMPACITY COMPLIANCE (A) =	50.0 > 35.0 OK
RACEWAY SIZE / TYPE =	3/4 IN. EMT
CROSS-SECTIONAL AREA OF CONDUCTOR(S) / CABLE(S)(IN. <sup>2</sup> ) =	0.146 IN. <sup>2</sup>
CROSS-SECTIONAL AREA OF RACEWAY(IN. <sup>2</sup> ) =	0.533 IN. <sup>2</sup>
% ALLOWABLE RACEWAY FILL (NEC CHAPTER 9, TABLE 1) =	40% > 27% OK



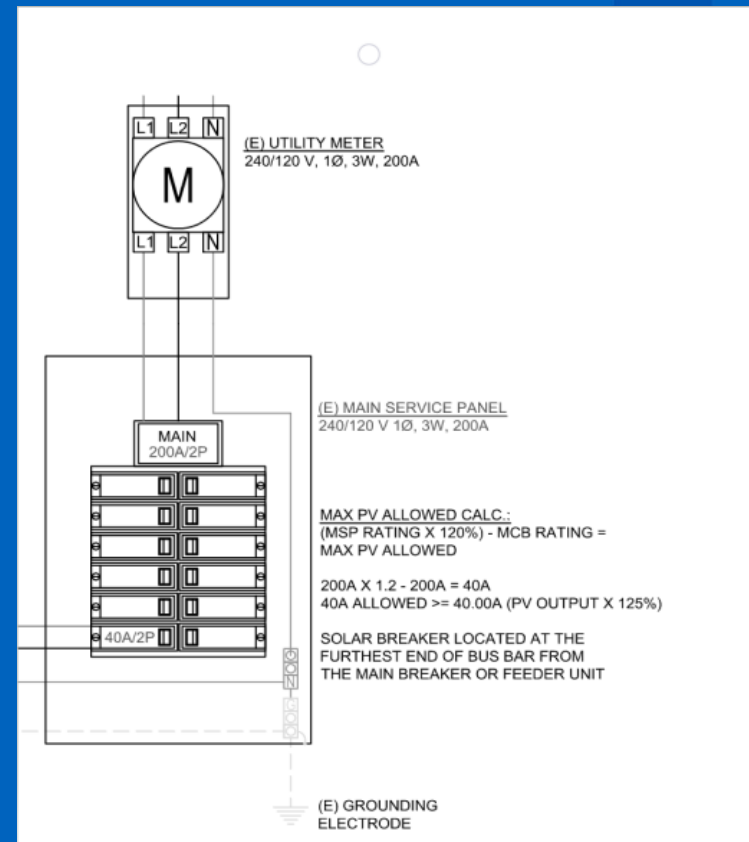


## Interconnection: Load side connection

Load side connections shall comply with 705.12(B)

Typical connection type is a connection to the main panel busbar at a dedicated circuit breaker at the opposite end of the busbar from the main overcurrent device.

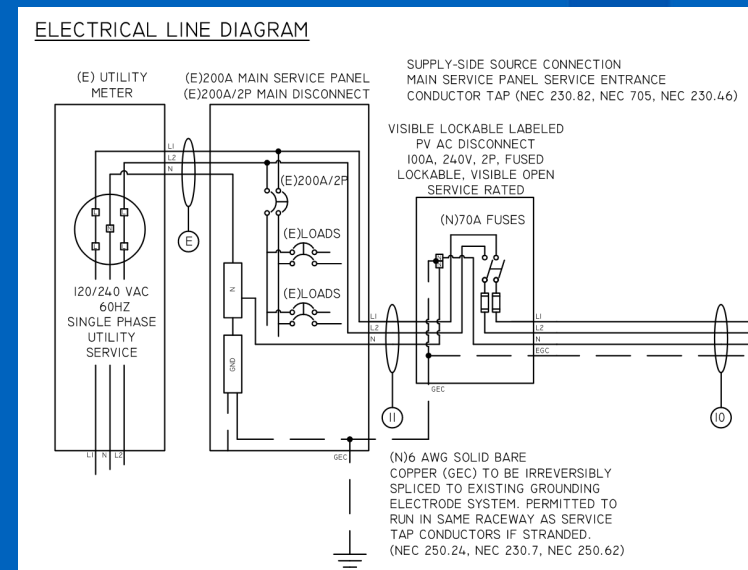
At this point, the required calculations are important to demonstrate compliance.





# Interconnection: Line Side Connection

- For line side connections, the disconnecting means shall be service rated.
- Make sure the disconnect has the appropriate labels.
- If the disconnect also serves as the rapid shutdown initiation device, provide the required label at this location as well.
- Wiring methods for service taps shall be chosen from one of the 19 approved methods from 230.43.





## Labels and Placards

- This reference sheet should include all labels and placards required for the proposed installation.
- Where required, please fill in required information such as nominal operating voltage, rated AC output current, etc.
- As shown, please provide a reference drawing stating where each label or placard is to be placed.

**ELECTRICAL FIELD-APPLIED HAZARD MARKINGS**

<b>PHOTOVOLTAIC SYSTEM AC DISCONNECT</b> RATED AC OUTPUT CURRENT: 50, 5A NOMINAL OPERATING VOLTAGE: 240 V	<b>A</b>	AT EACH PV SYSTEM DISCONNECTING MEANS. [NEC 690.54, NEC 690.15(B)]	<b>RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM</b>	<b>F</b>	SIGN LOCATED ON OR NO MORE THAN 3 FT FROM THE RAPID SHUT DOWN DISCONNECT SWITCH [NEC 690.56(C)].
<b>WARNING</b> ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION	<b>B</b>	FOR PV DISCONNECTING MEANS WHERE ALL TERMINALS OF THE DISCONNECTING MEANS MAY BE ENERGIZED IN THE OPEN POSITION. [NEC 690.15(B), NEC 705.22]	<b>SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN</b> TURN RAPID SHUTDOWN SWITCH TO OFF POSITION TO SHUT DOWN PV SYSTEM. DO NOT RELOCATE THIS LABEL.	<b>G</b>	FOR BUILDINGS WITH PV SYSTEMS, TO BE LOCATED AT EACH SERVICE EQUIPMENT LOCATION TO WHICH THE PV SYSTEM IS CONNECTED. [NEC 690.56(C)]
<b>WARNING</b> DUAL POWER SUPPLY SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM	<b>C</b>	AT EQUIPMENT CONTAINING OVERCURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO A BUSBAR OR CONDUCTOR SUPPLIED FROM MULTIPLE SOURCES. [NEC 705.10(C)]	<b>WARNING</b> MAIN SERVICE PANEL (UTILITY DISCONNECTS) POWER TO THIS SERVICE IS ALSO SUPPLIED FROM A PHOTOVOLTAIC SYSTEM. THIS SERVICE POINT AND ALL ELECTRICAL POWER SOURCE DISCONNECTING MEANS (SOLAR ARRAY RAPID SHUTDOWN SWITCH) ARE GROUNDED AND IN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 690.56(C) & NEC 705.10]	<b>H</b>	PERMANENT DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT LOCATION IF ALL ELECTRICAL POWER SOURCE DISCONNECTING MEANS (SOLAR ARRAY RAPID SHUTDOWN SWITCH) ARE GROUNDED AND IN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 690.56(C) & NEC 705.10]
<b>WARNING</b> POWER SOURCE OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE	<b>D</b>	PLACED ADJACENT TO PV SYSTEM PLUG-IN TYPE BREAKER TO A SUBBAR FOR A LOAD SIDE CONNECTION. [NEC 705.12(B)(3)(2)]			

ALL CAUTION, WARNING, OR DANGER SIGNS OR LABELS SHALL:

1. COMPLY WITH ANSI Z35.6-201 STANDARDS.
2. BE PERMANENTLY AFFIXED TO THE EQUIPMENT OR WIRING METHOD AND SHALL NOT BE HANDWRITTEN.
3. SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED.
4. UNLESS OTHERS SPECIFIED MINIMUM TEXT HEIGHT TO BE 2" (50MM).

**CAUTION:**

**MULTIPLE SOURCES OF POWER**

POWER TO THIS SERVICE IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN

[NEC 705.10 & NEC 706.11] CUSTOMER SERVICE PANEL, PV/AC DISCONNECT AND RAPID SHUTDOWN DEVICE



# Energy Storage Systems

- Energy Storage Systems shall comply with Article 706 of the National Electrical Code.
- Know your equipment. Not all ESS are equipped with integral overcurrent protection creating a potential for comments during plan review, especially when the ESS is located more than 5 feet away or circuit conductors pass through a wall.
- If an ESS has less capacity than the calculated load, please reference 710.15(A) that the ESS has enough capacity to start the largest single piece of utilization equipment connected to it.



## Common Electrical Comments

- If responsible party is a Master Tradesperson, make sure all electrical design sheets bear the name, address and license number of the individual.
- Please coordinate the equipment on the electrical design sheet with the equipment spec sheets provided.
- Required calculations from the checklist are missing. These calculations are reference in 690.8 of the NEC.
- If point of interconnection is a line side tap, the disconnecting means shall be service rated.
- For line side connections, please detail the connection to the Grounding Electrode System and properly size the Grounding Electrode Conductor per 250.66 of the NEC.
- Plans need to reference the appropriate code year. Any plans submitted from 7/1/2022 forward should reference the 2017 NEC.



**PRINCE WILLIAM**  
COUNTY

# Questions?

