MONTGOMERY COUNTY HISTORIC PRESERVATION COMMISSION
STAFF REPORT

Address:	5 Montgomery Ave., Takoma Park	**Meeting Date:**	6/26/2024
Resource:	Contributing Resource **Takoma Park Historic District**	**Report Date:**	6/18/2024
Applicant:	Margo Ricks, Agent	**Public Notice:**	6/12/2024
Review:	HAWP	**Tax Credit:**	no
Case Number:	1068720	**Staff:**	Dan Bruechert
Proposal:	Solar Panel Installation		

RECOMMENDATION

Staff recommends that the Historic Preservation Commission **approve** the HAWP application.

PROPERTY DESCRIPTION

SIGNIFICANCE: Contributing Resource to the Takoma Park Historic District
STYLE: Queen Anne
DATE: 1923

Figure 1: The subject property is located near the southern edge of the Takoma Park Historic District.

BACKGROUND

On May 24, 2023, the HPC approved a HAWP to construct an addition, restore the siding, and install a architectural shingle roof.

PROPOSAL

The applicant proposes to install 20 (twenty) roof-mounted solar panels.

APPLICABLE GUIDELINES

The Historic Preservation Office and Historic Preservation Commission (HPC) consult several documents when reviewing alterations and new construction within the Takoma Park Historic District. These documents include the historic preservation review guidelines in the approved and adopted amendment for the *Takoma Park Historic District (Guidelines)*, *Montgomery County Code Chapter 24A (Chapter 24A)*, and the *Secretary of the Interior's Standards for Rehabilitation (Standards)*, and the HPC's *Policy No. 20-01 ADDRESSING EMERGENCY CLIMATE MOBILIZATION THROUGH THE INSTALLATION OF ROOF-MOUNTED SOLAR PANELS*. The pertinent information in these four documents is outlined below.

Takoma Park Historic District Guidelines

There are two broad planning and design concepts which apply to all categories. These are:

- The design review emphasis will be restricted to changes that are all visible from the public right-of-way, irrespective of landscaping or vegetation (it is expected that the majority of new additions will be reviewed for their impact on the overall district), and

- The importance of assuring that additions and other changes to existing structures act to reinforce and continue existing streetscape, landscape, and building patterns rather than to impair the character of the historic district.

A majority of the buildings in the Takoma Park Historic District have been assessed as being "Contributing Resources." While these buildings may not have the same level of architectural or historical significance as Outstanding Resources or may have lost some degree of integrity, collectively, they are the basic building blocks of the Takoma Park district. They are important to the overall character of the district and the streetscape due to their size, scale, and architectural qualities, rather than for their particular architectural features.

Contributing Resources should receive a more lenient level of design review than those structures that have been classified as Outstanding. This design review should emphasize the importance of the resource to the overall streetscape and its compatibility with existing patterns rather than focusing on a close scrutiny of architectural detailing. In general, however, changes to Contributing Resources should respect the predominant architectural style of the resource.

The following guidance which pertains to this project are as follows:

- All exterior alterations, including those to architectural features and details, should be generally consistent with the predominant architectural style and period of the resource and should preserve

the predominant architectural features of the resource; exact replication of existing details and features is, however, not required.

- Minor alterations to areas that do not directly front on a public right-of-way -such as vents, metal stovepipes, air conditioners, fences, skylights, etc. should be allowed as a matter of course; alterations to areas that do not directly front on a public right-of-way which involve the replacement of or damage to original ornamental or architectural features are discouraged but may be considered and approved on a case-by-case basis.

- Alterations to features that are not visible at all from the public right-of-way should be allowed as a matter of course.

- All changes and additions should respect existing environmental settings, landscaping, and patterns of open space.

Montgomery County Code, Chapter 24A-8

The following guidance which pertains to this project are as follows:

(b) The commission shall instruct the director to issue a permit, or issue a permit subject to such conditions as are found to be necessary to ensure conformity with the purposes and requirements of this chapter, if it finds that:

(1) The proposal will not substantially alter the exterior features of an historic site or historic resource within an historic district; or

(2) The proposal is compatible in character and nature with the historical, archeological, architectural or cultural features of the historic site or the historic district in which an historic resource is located and would not be detrimental thereto or to the achievement of the purposes of this chapter;

(6) In balancing the interests of the public in preserving the historic site or historic resource located within an historic district, with the interests of the public from the use and benefit of the alternative proposal, the general public welfare is better served by granting the permit.

(d) In the case of an application for work on an historic resource located within an historic district, the commission shall be lenient in its judgment of plans for structures of little historical or design significance or for plans involving new construction, unless such plans would seriously impair the historic or architectural value of surrounding historic resources or would impair the character of the historic district. (Ord. No. 9-4, § 1; Ord. No. 11-59.)

Secretary of the Interior's Standards for Rehabilitation

The Secretary of the Interior defines rehabilitation as "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features, which convey its historical, cultural, or architectural values." The applicable *Standards* are as follows:

2. The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features, spaces and spatial relationships that characterize a property will be avoided.

9. New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.

10. New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

Historic Preservation Commission Policy No. 20-01: Addressing Emergency Climate Mobilization Through the Installation of Roof-Mounted Solar Panels

Now, THEREFORE:

WHEREAS, Historic Area Work Permit decisions are guided by the criteria in Section 24A, The Secretary of the Interior's Standards for Rehabilitation, and pertinent guidance from applicable master plan amendments and/or site or district-specific studies;

WHEREAS, The Secretary of the Interior's Standards for Rehabilitation as interpreted by the National Park Service limit the placement of rooftop solar panels under Standards 2, 9, and 10 to less conspicuous locations;

WHEREAS, the County Council has established a Climate Emergency;

WHEREAS, the Historic Preservation is a body established by the County Executive and County Council;

WHEREAS, Section 24-8(b)(6) states, "In balancing the interest of the public in preserving the historic site or historic resource located within an historic district, with the interests of the public from the use and benefit of the alternative proposal, the general public welfare is better served by granting the permit;"

WHEREAS, the widespread use of solar panels, both for hot water and for electricity production, will reduce greenhouse gases in the county, in accordance with the aims of the Emergency Climate Mobilization resolution (Resolution No.: 18-974), it shall be the policy of the Historic Preservation Commission that:

1. The preferred locations for solar panel installation(s) on a designated historic site or an historic resource located within an historic district is a) on the rear of the property, b) on non-historic building additions, c) on accessory structures, or d) in ground-mounted arrays;

2. If it is not feasible to install solar panels in one of the identified preferred locations due to resource orientation or other site limitations; and,

3. The roof is determined to be neither architecturally significant, nor a character-defining feature of the resource, nor is it a slate or tile roof, that unless it can be demonstrated that the solar array will be installed without damaging the historic character of the resource or historic fabric; then

4. The public welfare is better served by approving a Historic Area Work Permit for solar panels on all visible side or front roof slopes under Section 24A-8(b)(6).

A Historic Area Work Permit (HAWP) is required for all work referenced in this policy.

STAFF DISCUSSION

The subject property is a two-and-a-half-story Queen Anne house with a cross-gable roof and a wrap-around porch. A rear gable addition was constructed in late 2023. The applicant proposes to install 20 (twenty) solar panels on the house roof. The proposed solar panels are arranged in three arrays, with two other panels installed on rear-facing roof slopes. Staff finds the proposed solar installation is consistent with the HPC's guidance, the *Design Guidelines*, and Chapter 24A.

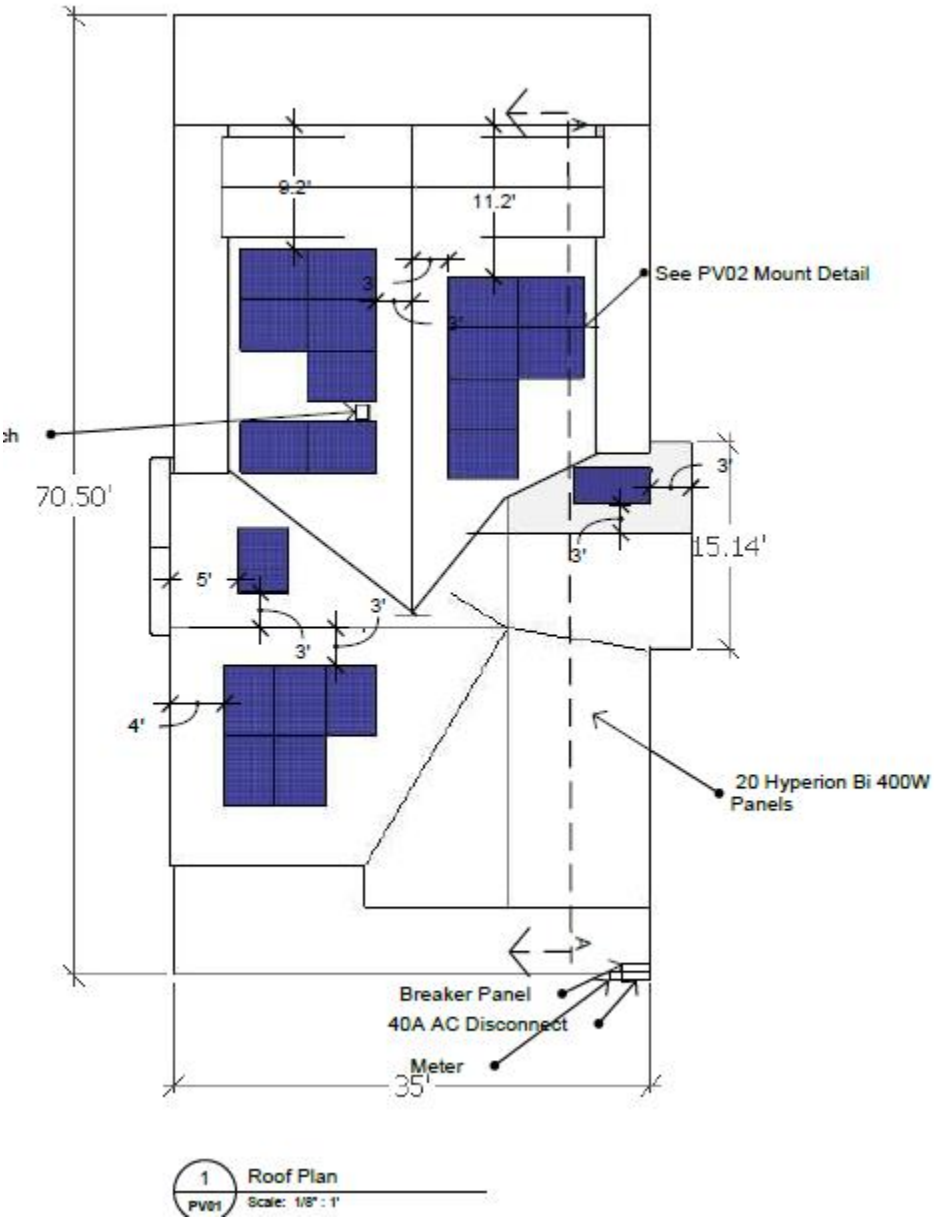


Figure 2: The proposed solar panel layout. Five panels are on the street-facing roof slope.

Rear Addition
The applicant proposes to install a majority (13 of 20) of the solar panels on the recently completed rear addition.

Staff finds these panels are located in one of the preferred locations identified in the HPC's adopted solar panel policy – non-historic rear additions – and that the panels will not be highly visible from the public right-of-way. Staff additionally finds that the *Design Guidelines* state alterations not visible from the right-of-way should be allowed as a matter of course. While the adopted Solar Panel Illustrated Design Guidelines show the HPC's preference for arranging panels in an organized configuration to avoid a disjointed opinion, Staff finds the limited visibility of these panels will not have a significant impact on the house's visual characteristics and will not impact the character of the district.

Staff finds the 13 (thirteen) solar panels on the rear addition will not have a significant impact on the character of the house or surrounding district and recommends the HPC approve them under 24A-8(b)(2) and (d); the *Design Guidelines*; Standards 2, 9, and 10; and the HPC's adopted solar policy.

Rear Roof Slopes
The applicant proposes to install two solar panels on rear-facing roof slopes. One panel will be installed on the south-facing roof slope on the east-facing gable and one on the west-facing gable. These two panels are in one of the preferred locations (on the rear of the property) in the HPC's adopted solar policy.

Staff finds that neither of these panels will be visible from the public right-of-way and that their installation will not impact the roof profile. Staff additionally finds that the *Design Guidelines* state alterations not visible from the right-of-way should be allowed as a matter of course. As with the panels on the non-historic addition, Staff does not find that the arrangement of the panels will detract from the character of the house or surrounding district because they will not be at all visible from the public right-of-way.

Staff finds the two solar panels on the rear-facing gables will not have a significant impact on the character of the house or surrounding district and recommends the HPC approve them under 24A-8(b)(2) and (d); the *Design Guidelines*; Standards 2, 9, and 10; and the HPC's adopted solar policy.

Front-Facing Roof Slope
On the left (east) side of the front-facing roof slope, the applicant proposes to install 5 (five) solar panels. These panels will be highly visible from the public right-of-way. The street-facing roof slope is not a preferred location for solar panels for Contributing and Outstanding Resources.

When solar panels are proposed for the front roof slope, the applicant needs to first, demonstrate that none of the preferred locations are feasible. In this instance, the applicant proposes to install panels in two of the preferred locations (a non-historic addition and rear roof slope); and the other two preferred locations (an accessory structure and ground-mounted array) are not feasible due to the size of the lot and the small size of the existing shed. Second, the roof needs to be found to be neither architecturally significant nor a material that will be irreparably damaged by the solar installation. Staff finds a complex roof form is typical of Queen Anne architecture, however, Staff also finds that the character of the roof will not be significantly harmed by installing the solar panels. Additionally, the recently installed architectural, asphalt shingle roof will not be irreparably damaged by installing these roof-mounted solar panels. Finally, the applicant demonstrated that the estimated solar panel will likely not exceed the house's electricity needs.

In the immediate area surrounding the subject property, there is one Outstanding Resource, at 10 Pine

Ave. The remaining houses are Non-Contributing or Contributing. Staff finds installing solar panels on the front elevation will not impact the viewshed of any significant resources.

Figure 3: The subject property (shown with a star) and the only Outstanding Resource at 10 Pine Ave. (shown with a +).

Staff finds the proposed front-facing solar panels will not seriously detract from the character of the house and surrounding district; and can be removed without damaging historic fabric. Staff finds the 5 (five) solar panels on the front-facing roof slope will not have a significant impact on the character of the house or surrounding district and recommends the HPC approve them under 24A-8(b)(2) and (d); the *Design Guidelines*; Standards 2, 9, and 10; and the HPC's adopted solar policy.

STAFF RECOMMENDATION

Staff recommends that the Commission **approve** the HAWP application; under the Criteria for Issuance in Chapter 24A-8(b)(2), (6), and (d), having found that the proposal will not substantially alter the exterior features of the historic resource and is compatible in character with the district and the purposes of Chapter 24A;

and with the *Secretary of the Interior's Standards for Rehabilitation #2, #9,* and *#10*;

and with the general condition that the applicant shall present an electronic set of drawings, if applicable, to Historic Preservation Commission (HPC) staff for review and stamping prior to submission for the Montgomery County Department of Permitting Services (DPS) building permits;

and with the general condition that final project design details, not specifically delineated by the Commission, shall be approved by HPC staff or brought back to the Commission as a revised HAWP application at staff's discretion;

and with the general condition that the applicant shall notify the Historic Preservation Staff if they propose to make **any alterations** to the approved plans. Once the work is completed the applicant will contact the staff person assigned to this application at 301-563-3400 or dan.bruechert@montgomeryplanning.org to schedule a follow-up site visit.

FOR STAFF ONLY:
HAWP# 1068720
DATE ASSIGNED_____

APPLICATION FOR HISTORIC AREA WORK PERMIT

HISTORIC PRESERVATION COMMISSION
301.563.3400

APPLICANT:

Name: Margo Ricks E-mail: mricks@solarsolutionllc.com

Address: 4700 14th st NW City: washington Zip: 20011

Daytime Phone: 2022491112 Tax Account No.: _____

AGENT/CONTACT (if applicable):

Name: _____ E-mail: _____

Address: _____ City: _____ Zip: _____

Daytime Phone: _____ Contractor Registration No.: _____

LOCATION OF BUILDING/PREMISE: MIHP # of Historic Property 37/03

Is the Property Located within an Historic District? X Yes/District Name Takoma Park
__No/Individual Site Name_____

Is there an Historic Preservation/Land Trust/Environmental Easement on the Property? If YES, include a map of the easement, and documentation from the Easement Holder supporting this application.

Are other Planning and/or Hearing Examiner Approvals /Reviews Required as part of this Application? (Conditional Use, Variance, Record Plat, etc.?) If YES, include information on these reviews as supplemental information.

Building Number: 5 Street: Montgomery Avenue

Town/City: Takoma Park Nearest Cross Street: _____

Lot: _____ Block: _____ Subdivision: _____ Parcel: _____

TYPE OF WORK PROPOSED: See the checklist on Page 4 to verify that all supporting items for proposed work are submitted with this application. Incomplete Applications will not be accepted for review. Check all that apply:

- ☐ New Construction
- ☐ Addition
- ☐ Demolition
- ☐ Grading/Excavation
- ☐ Deck/Porch
- ☐ Fence
- ☐ Hardscape/Landscape
- ☐ Roof
- ☐ Shed/Garage/Accessory Structure
- ☑ Solar
- ☐ Tree removal/planting
- ☐ Window/Door
- ☐ Other:_____

I hereby certify that I have the authority to make the foregoing application, that the application is correct and accurate and that the construction will comply with plans reviewed and approved by all necessary agencies and hereby acknowledge and accept this to be a condition for the issuance of this permit.

Margo Ricks
Signature of owner or authorized agent

4/30/24
Date

Adjacent and Confronting Properties:

Takoma Park, MD 20912

1 Montgomery Avenue

6 Montgomery Avenue

8 Montgomery Avenue

9 Montgomery Avenue

10 Montgomery Avenue

10 Pine Avenue

24 Pine Avenue

26 Pine Avenue

102 Elm Avenue

104 Elm Avenue

106 Elm Avenue

108 Elm Avenue

HAWP APPLICATION: MAILING ADDRESSES FOR NOTIFING [Owner, Owner's Agent, Adjacent and Confronting Property Owners]	
Owner's mailing address 5 Montgomery Ave Takoma Park MD	**Owner's Agent's** mailing address 4700 14th st NW Washington DC
Adjacent and confronting Property Owners mailing addresses	
9 Montgomery Ave Takoma Park MD	1 Montgomery Ave Takoma Park MD
8 Montgomery Ave Takoma Park MD	6 Montgomery Ave Takoma Park MD
10 Pine Ave Takoma Park MD	

Description of Property: Please describe the building and surrounding environment. Include information on significant structures, landscape features, or other significant features of the property:

Traditional style house with north and south facing pitches. There are surrounding houses with solar modules visible to the street.

Description of Work Proposed: Please give an overview of the work to be undertaken:

To install 8.8kW solar array (22 modules) on roof of building.

Work Item 1: Solar

Description of Current Condition:	Proposed Work:
currently shingled roof	add 22 modules to roof of building

Work Item 2: _____

Description of Current Condition:	Proposed Work:

Work Item 3: _____

Description of Current Condition:	Proposed Work:

HISTORIC AREA WORK PERMIT
CHECKLIST OF
APPLICATION REQUIREMENTS

	Required Attachments						
Proposed Work	I. Written Description	2. Site Plan	3. Plans/ Elevations	4. Material Specifications	5. Photographs	6. Tree Survey	7. Property Owner Addresses
New Construction	*	*	*	*	*	*	*
Additions/ Alterations	*	*	*	*	*	*	*
Demolition	*	*	*		*		*
Deck/Porch	*	*	*	*	*	*	*
Fence/Wall	*	*	*	*	*	*	*
Driveway/ Parking Area	*	*		*	*	*	*
Grading/Excavation/Landscaing	*	*		*	*	*	*
Tree Removal	*	*		*	*	*	*
Siding/ Roof Changes	*	*	*	*	*		*
Window/ Door Changes	*	*	*	*	*		*
Masonry Repair/ Repoint	*	*	*	*	*		*
Signs	*	*	*	*	*		*

Index

SITE PLAN

SATELLITE VIEW

Scope of Work:

To install 8.8kW size of solar panels on roof of building.

CODES:

- NFPA 70
- NEC 2017
- IBC 2018
- CC 2018

BUILDING USE - SINGLE FAMILY DWELLING UNIT

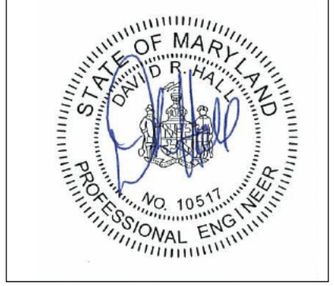
CONSTRUCTION TYPE- III

REQUIRED FIRE CODE OFFSETS - MINIMUM 3 FEET OFFSETS FROM RIDGE AND EAVES

ROOF RATING - CLASS A

ROOF ANGLE- GREATER THAN 2:12 DEGREES (PITCHED)

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25



CLIENT		PROJECT NO.	SYSTEM SIZE	ISSUE	DRAWN BY		
Justin Rood	5 Montgomery Avenue, Takoma Park, MD, USA	5920	8.8	04.04.2024	HS	SOLAR SOLUTION 4700 14th ST. NW Washington, DC 20011	00

NOTE: The IQ 7 Micro, IQ 7+ Micro and the IQ 7X Micro have integrated ground and double insulation. The inverter does not require a EGC, other EGC requirements remain unchanged. The DC circuit is isolated and insulated from ground and meets the requirements of NEC 690.35.

Notes:

Modules are clamped with mid/end clamps.
#6 bare copper Ground Wire in contact with all modules and rails/beams/trays

Mid and End Clamps with integrated Grounding

11 Hyperion Bi 400W Panels (IQ7+)

#6 Bare Copper connected to all rails/beams with Lugs. Mid and end clamps with integrated ground

String 1

Enphase Q Cable (Portrait)
Two (2) #12 AWG Wire
THWN-2
L1-Black
L2-Red

Junction Box

1/2" Conduit
(4) #12 AWG Conductors
(2) #10 Insulated EGC

11 Hyperion Bi 400W Panels (IQ7+)

#6 Bare Copper connected to all rails/beams with Lugs. Mid and end clamps with integrated ground

String 2

Enphase Q Cable (Portrait)
Two (2) #12 AWG Wire
L1-Black
L2-Red

Label 2

1/2" Conduit
(2) #12 AWG
Conductors

Label 1

Label 8 → To/From Meter & Grid

40A AC
Disconnect
housed inside
Combiner Box

Enphase IQ Combiner
40A OCPD
Rated 80A
1PH
240VAC

#10 AWG
insulated Ground
(Typical)

20A

20A

15A

Enphase
Envoy
Monitoring
Unit

Label 6

40A

Label 5

Label 4

Label 11

Existing
200A
1PH
240VAC

Line Side

Label 11

Label 1

Existing
Ground

40A

Load Side

1/2" Conduit
(3) #8 AWG
#10 Insulated EGC

"Rapid shutdown is built in enphase microinverters and meet RSS requirements nec 690.12 without any addition equipment"
IEEE-1547-2018 AND UL 1741-SB compliant

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

STATE OF MARYLAND
DAVID R. HALL
NO. 10517
PROFESSIONAL ENGINEER

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Electrical Diagram

Issue Date
04.04.2024

Revisions:

System Size:
8.8 kW

e

CODE REFERENCE:

ART 690.8 (A)
1. The maximum current shall be the sum of parallel module rated short - circuit currents multiplied by 125%.

3. The maximum current shall be the inverter continuous output current rating.

ART 690.8(B)(1)

1. CONDUCTION MUST HAVE 30 C AMPACITY > 125% OF CONTINUOUS CURRENT PER 690.8(A)

2. CONDUCTOR MUST HAVE (AFTER CORRECTIONS FOR CONDITIONS OF USE) GREATER THAN OR EQUAL TO CONTINUOUS CURRENT PER TABLE 310.15

3. EVALUATE CONDUCTOR TEMPERATURE AT TERMINATION PER ART 110.14(C). AMPACITY OF WIRE DERATED FOR CONDITIONS OF TERMINATION MUST BE > CONTINUOUS CURRENT X 1.25.

DC CALCULATIONS

SYSTEM SIZE: 22X 400 W = 8.8kW

PV SOURCE CIRCUIT
PV MODULE ISC = 13.79 A
OF MODULES IN PARALLEL PER CIRCUIT = 1
MAX ISC = 1 X 13.79 A X 1.25 = 17.23A
OCPD/Ampacity = 17.23A x 1.25 = 21.54 A, 20A OCPD

SOURCE CIRCUIT WIRING
CONDUCTOR = COPPER #10 AWG THWN-2 90°C RATED
CORRECTION FACTORE FOR 60°C AMBIENT = 0.71
CORRECTED AMPACITY: 40 A X 0.71 X 0.8 = 22.72A > 21.54A

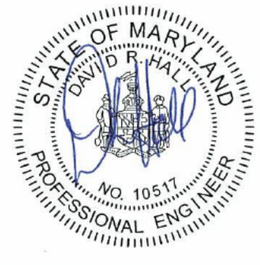
AC Current Calculations

Total Panels: 22 x 1.21A = 27.83A
String 1: 11 x 1.21A = 13.31A
String 2: 11 x 1.21A = 13.31A

Combiner Box Home Run Current: 22 x 1.21A = 27.83A
OCPD Sizing: 40A
80% of OCPD = 40A x .8 = 32A > 27.83A

Wiring for Combiner Box: 1/2" Conduit #8 AWG & #10 Ground
Conductor for #8 AWG THWN-2 90 C Rated
Correction Factor for 45 C Ambient = 0.87
Corrected Ampacity: 55Ax0.87x0.8 = 38.28A > 27.83A

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25



SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Electrical Calculations

Issue Date
04.04.2024

Revisions:

System Size:
8.8 kW

e

Solar System Warning Labels Material

Vinyl Material - Flexcon DPM FWS White Vinyl

Reflective Material - Avery Dennison T-1500-A Engineering Grade Beaded Retroreflective Film

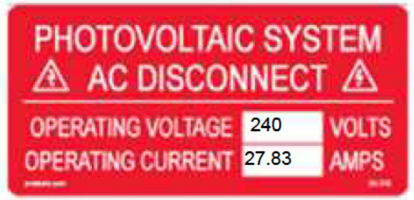
Lamination - Flexcon DPM Clear Gloss Polyester Laminate

Label 1

4" X 1"

Location: (C)(CB)
Per code:
NEC 690.31.G.3

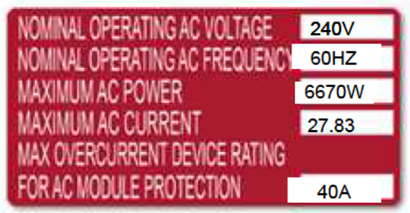
Label 4



4" X 2"

Location: (AC)(POI)
Per code:
NEC 690.14.C.2
NEC 690.54

Label 5



4" X 2"

Label 8

4" X 2"

Location: (POI)
Per code:
NEC 690.64.B.4

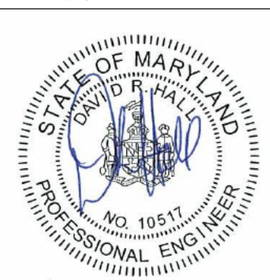
Label 11

1/2" X 2"

Label 6

4" X ¾"

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25



SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Electrical Labels

Issue Date
04.04.2024

Revisions:

System Size:
8.8 kW

e

DRH ENGINEERS PLC
CIVIL - STRUCTURAL - FORENSIC
7190 Brewster Lane, Suite 100
Warrenton, Virginia 20187
540-349-7840

Property Owners Name: JUSTIN ROOD

Property Owners Address: 5 MONTGOMERY AVE, TAKOMA PARK, MD

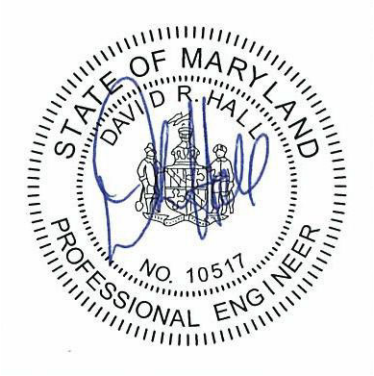
Address of installation if different than owners address:

I certify that:

■ I prepared or approved the electrical drawings and related documents for the photovoltaic (PV) system at the above location.

■ The design of the PV system, and all electrical installations and equipment, meets the standards and requirements of the National Electrical Code as adopted by Montgomery County in COMCOR 17.02.01.

10517
Maryland PE License Number



Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/23

Date 04/12/24

Signature

Montgomery County Master Electrician License Number

Date

Signature

Must Be Submitted With Plans

[Company Letterhead]

DRH ENGINEERS, PLC
CIVIL - STRUCTURAL - FORENSIC
7190 Brewster Lane, Suite 100
Warrenton, Virginia 20187
540-349-7840

Project **Residential PV Installation** Property Owner **Justin Rood**

Address **5 Montgomery Ave, Takoma Park, MD**

☑ I reviewed the design of the photovoltaic (PV) system, as designed by the manufacturer, and the design criteria utilized for the mounting equipment and panel mounting assembly (rack system) for the installation of (22) panels supported by the rack system, as shown on the drawings prepared for the above referenced address. I certify that the configurations and design criteria meet the standards and requirements of the International Residential Code (IRC) and International Existing Building Code (IEBC) adopted by Montgomery County in COMCOR 08.00.02.

☑ The attachment of the rack system to the building at the above address, including the location, number, and type of attachment points; the number of fasteners per attachment point; and the specific type of fasteners (size, diameter, length, minimum embedment into structural framing, etc.) meets the standards and requirements of the IRC and IEBC adopted by Montgomery County in COMCOR 08.00.02.

☑ I evaluated the existing roof structure of the building at the above address and analyzed its capacity to support the additional loads imposed by the PV system. I certify that no structural modifications of the existing roof structure are required. The existing roof structure meets the standards and requirements of the IRC and IEBC, adopted by Montgomery County in COMCOR 08.00.02, necessary to support the PV system.

☐ I evaluated the existing roof structure of the building at the above address and analyzed its capacity to support the additional loads imposed by the PV system. Structural modifications of the existing roof structure are required. I certify that the roof structure, as modified on the drawings for this project, will support the additional loads imposed by the PV system. I further certify that design of the modified roof structure meets the standards and requirements of the IRC and IEBC, adopted by Montgomery County in COMCOR 08.00.02.

☑ I prepared or approved the construction documents for the mounting equipment, rack system, roof structure for this project.

10517
Maryland PE License Number

Date 04/12/24

Signature

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

Must be submitted with plans

DRH ENGINEERS, PLC
CIVIL - STRUCTURAL - FORENSIC

SOLAR SOLUTION 5870		JUSTIN ROOD		
		Revision		
Job No:	2240253	Page:	C/01	
Section: Rack Mounted Units	Prepared By:	drh	Date:	04/12/24

Design Criteria: ASCE 7-10; NDS2005; Allowabe Stress Design Method Used (ASD)

Average PV array mounted height: 30 feet above ground (see plans)
Roof Framing System: PRE-ENG TRUSSES
Roof Slope from plans: Run [ft]= 13.50 Rise [ft]= 7.50 Panel Type: HYPERION 400

Existing Framing Capacity: DL= 10 psf LL= 30 psf

PHOTOVOLTAIC (PV) PANEL TYPE

PV panels mounted on or above pitched roof

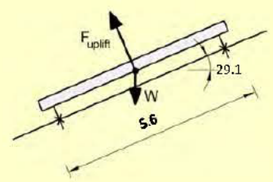
SUMMARY

Force per fixing per PV panel [lbs] = 104.4 / -111.4

BUILDING AND WIND DATA

Mean roof height above ground 'h' *[ft]* =	30.0
Parapet height 'h_{pt}' *[ft]* =	N/A
Building length 'L' *[ft]* =	70.5
Building width 'B' *[ft]* =	35.0
Roof angle from horizontal 'θ' *[deg]* =	29.1
Wind velocity 'V' *[mph]* =	115
Topographic factor 'K_{zt}' =	1.00
Wind exposure category =	B
Wind directionality factor 'K_d' =	0.85
Velocity pressure exposure coefficient 'K_z' =	0.70
Velocity pressure 'q_h' *[psf]* =	20.16
Roof shape determinant 'a_{pv}' *[ft]* =	23.0

DIAGRAM: SECTION



Roof Pitch: 7 : 12

(Not to scale)

LIVE LOADS:

Wind Speed [mph]: 115
Ground Snow Load [psf]: 30

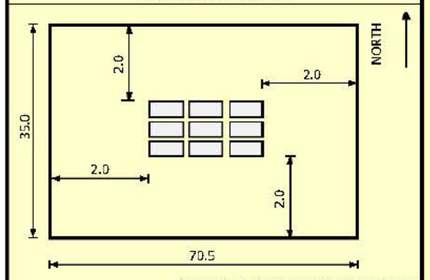
DEAD LOADS: (From ASCE 10 Table C3-1)

Roofing *[psf]*	2.0	
Sheathing *[psf]*	1.6	
PV System *[psf]*	3.7	
Misc *[psf]*	1.5	
Total *[psf]*	**8.8**	< 10psf OK

PV PANEL DATA

Panel width 'b' *[ft]* =	3.59
Panel chord lenght 'l_p' *[ft]* =	5.65
Panel height above roof at low edge 'h_1' *[ft]* =	N/A
Self weight of solar panel 'W' *[lbs]* =	49.82
Coefficient of friction 'μ' =	N/A

DIAGRAM: ROOF LAYOUT



(Not to scale. Panels and obstructions are indicative only)

PV MODULE PARAMETERS:

PV Solar Panel Weight *[lbs]* = 49.82

PV Panel area *[s.f.]* = 20.3
PV System Areal Weight *[psf]* = 3.7
Number of PV modules *[ea]* = 22
Total array Area *[s.f.]* = 446
Total Array Weight *[lbs]* = 1644.06
Total uplift on single panel *[lbs]* = **490.5**
Force per fixing *[lbs]* = **245.3**

Use 5/16" x 2-1/2" min. thread embedment depth fastener; see Table below

Lumber Species = SYP
Number of Fasteners required = **44**
Withdrawal Capacity per 1" depth = 307
Number of Fasteners/panel *[ea]* = **2.0**
Total pullout capacity *[lbs]* = **1535.0** OK **3.1**

PV ARRAY LOCATION (see layout)

Direction:	'd_{edge}' *[ft]*:	edge panel:	'$d_{adjacent}$' *[ft]*:
North	2.0	Yes	N/A
East	2.0	Yes	N/A
South	2.0	Yes	N/A
West	2.0	Yes	N/A

Calculation type: North-East panel design

d_{edge} - distance to building edge in given direction.
edge panel - panel unobstructed by other panels in given direction.
$d_{adjacent}$ - distance to adjacent panel in given direction.

PV ARRAY ANALYSIS

Corner:	Zone:	'h_{ck}' *[ft]*:	'GC_p'	'$\gamma_E * (GC_{rn})_{non}$'	'E' factor:
North-East	3	2.30	-1.2/0.9	N/A	N/A
South-East	3	0.50	-1.2/0.9	N/A	N/A
South-West	3	0.50	-1.2/0.9	N/A	N/A
North-West	3	2.30	-1.2/0.9	N/A	N/A

CALCULATIONS: WIND FORCES

Reduction for wind tunnel tests & load sharing =	0%
In-to-roof force on PV panel '$F_{in\text{-}to\text{-}roof}$' *[lbs]* =	367.9
Uplift force on PV panel 'F_{uplift}' *[lbs]* =	-490.5
Horizontal 'uplift' force on panel 'F_{horz}' *[lbs]* =	N/A
Vertical uplift force on panel 'F_{vert}' *[lbs]* =	N/A

CALCULATIONS: WIND PRESSURES

Dead load of panel over module area 'P_D' *[psf]* =	9.8
Panel chord length factor 'γ_c' =	N/A
Parapet height factor 'γ_p' =	N/A
Effective wind area 'A' *[sqft]* =	5.1
Normalized wind area 'A_n' *[sqft]* =	N/A
Tributary area 'A_t' *[sqft]* =	5.1
Net in-to-roof pressure coefficient 'GCp' =	0.90
Net uplift suction coefficient 'GCp' =	-1.20
Design in-to-roof wind pressure '$p_{in\text{-}to\text{-}roof}$' *[psf]* =	18.15
Design uplift wind suction 'p_{uplift}' *[psf]* =	-24.19

RESULTS

Building mean height less than 60ft:	OK
Building mean height less than min L, B:	OK
Required ballast for uplift 'W_{blst_uplift}' *[lbs]* =	N/A
Required ballast for sliding '$W_{blst\_sliding}$' *[lbs]* =	N/A
Required ballast per PV panel '$W_{ballast}$' *[lbs]* =	N/A
Force per fixing per PV panel 'F_{comp_fixing}' *[lbs]*:	**104.4**
Force per fixing per PV panel 'F_{tens_fixing}' *[lbs]*:	**-111.4**
Force per fixing per PV panel 'F_{shear_fixing}' *[lbs]*:	N/A

Lag reference withdrawal (pull out) design capacities *[lbs.]* in typical lumber:	5/16" Shaft per 1" thread depth	5/16" Shaft per 2-1/2" thread depth
Douglas Fir, Larch	266	665
Douglas Fir, South	235	588
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	235	588
Hem, Fir (north)	212	530
Hem, Fir	235	588
Southern Pine	307	768
Spruce, Pine, Fir	205	513
Spruce, Pine, Fir (E of 2 million psi and higher grades of MSR and MEL)	266	665

Source: American Wood Council, NDS 2005, Table 11.2A, 11.3.2 A

calculations are based on **SEAOC PV2** (2012) and **ASCE 7-10** (2010)

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

DRH ENGINEERS, PLC
CIVIL - STRUCTURAL - FORENSIC
7190 Brewster Lane, Suite 100
Warrenton, Virginia 20187
540-349-7840

PREPARED BY
DAVID R. HALL, P.E.

PROJECT NAME
JUSTIN ROOD
RESIDENTAL
SOLAR PROJECT

SHEET NUMBER
SC001

SCALE
NFS

STRUCTURAL
CALCULATIONS

GENERAL NOTES:

1. ALL ROOFTOP EQUIPMENT INSTALLATION WORK, INCLUDING FLASHED AND SEALED PENETRATIONS SHALL BE PERFORMED IN ACCORDANCE WITH CHAPTER 9 SECTION R903 WATHER PROTECTION OF THE 2018 EDITION OF THE IRC.

2. THIS PHOTOVOLTAIC INSTALLATION SHALL BE INSTALLED IN ACCORDANCE WITH THE 2018 EDITION OF THE IBC AS ADOPTED BY , THE 2017 NEC, AND ANY LOCAL BUILDING CODES CURRENTLY BEING ENFORCED BY THE AHJ

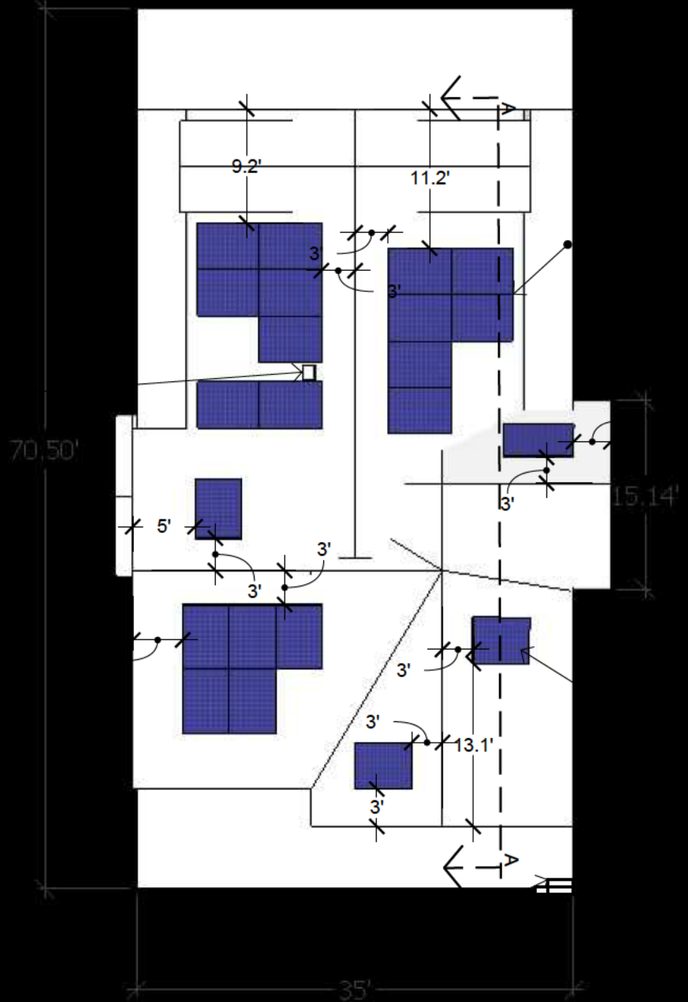
3. REQUIRED OFFSETS ARE 3' FROM THE RIDGE AND EAVES IF THE SLOPE IS GREATER THAN 2:12 DEGREES

4.IRONRIDGE QUICKMOUNT HALO ULTRAGRIPGRIP (HUG) INSTALLED ON THE FLAT PART OF THE SHINGLE, LEAVING A MINIMUM OF 2" BELOW THE DRIP EDGE OF THE UPSLOPE SHINGLE. QUICKMOUNT HUG IS ONLY INSTALLED ON ASPHALFT AND COMPOSITIOION SHINGLE TYPE ROOFS WITH SLOPES BETWEEN 2:12 TO 2:12.

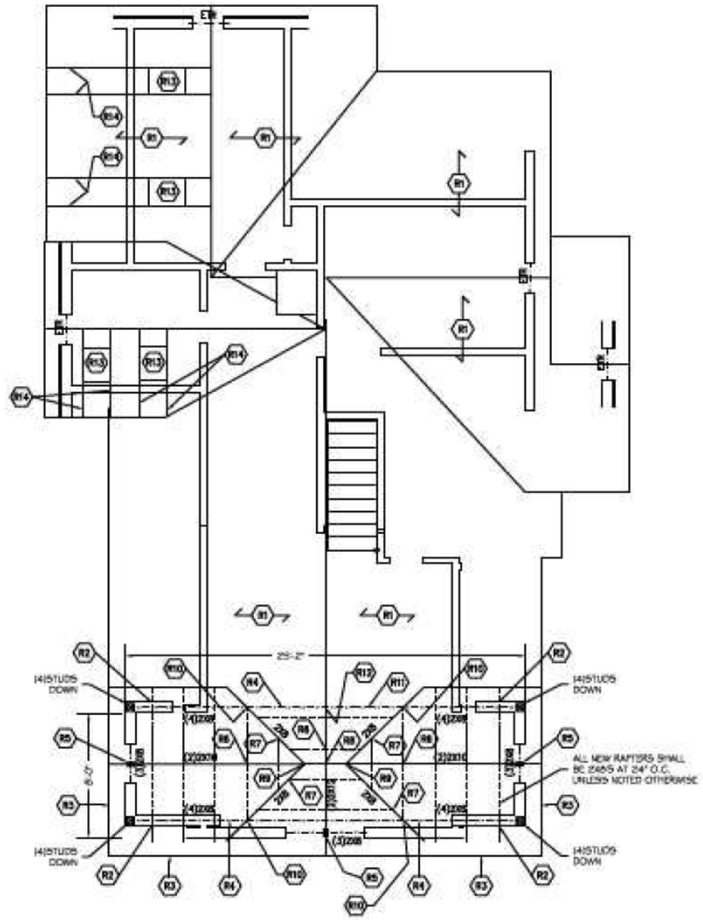
5. ALL RAFTER ATTACHED INSTALLATIONS REQUIRE A MINIMUM OF TWO RD STRUCTURAL SCREWS. FOR DECK ATTACHED INSTALLATION, SIX RD STRUCTURAL SCREWS ARE REQUIRED.

6.IRONRIDGE QUICKMOUNT HUG IS INSTALLED IN ALTERNATING RAFTERS (SEE PV02) WITH A MAX XR10 RAIL SPAN OF 4'.

BUILDING HEIGHT: 30
ROOF SLOPE: 29 degrees



1 PV01 Roof Plan
Scale: 1/8" : 1'



1 PV02 Roof Framing Plan View of A-A
Scale: 3/8" : 1'

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

STATE OF MARYLAND
DAVID R. HALL
NO. 10517
PROFESSIONAL ENGINEER

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

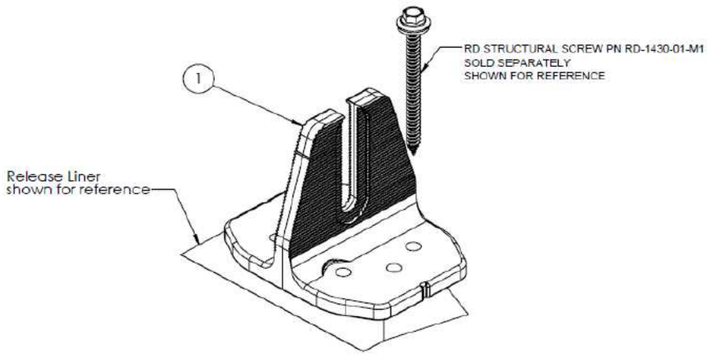
Roof Layout

Issue Date
04.04.2024

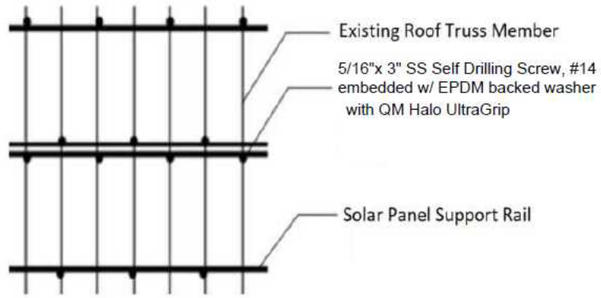
Revisions:

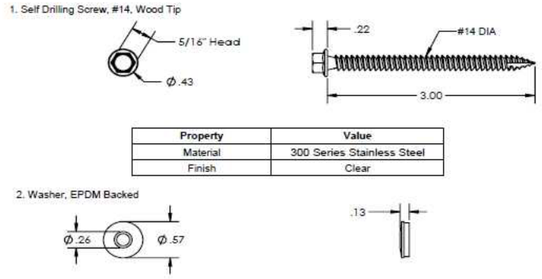
System Size:
8.8 kW

pv



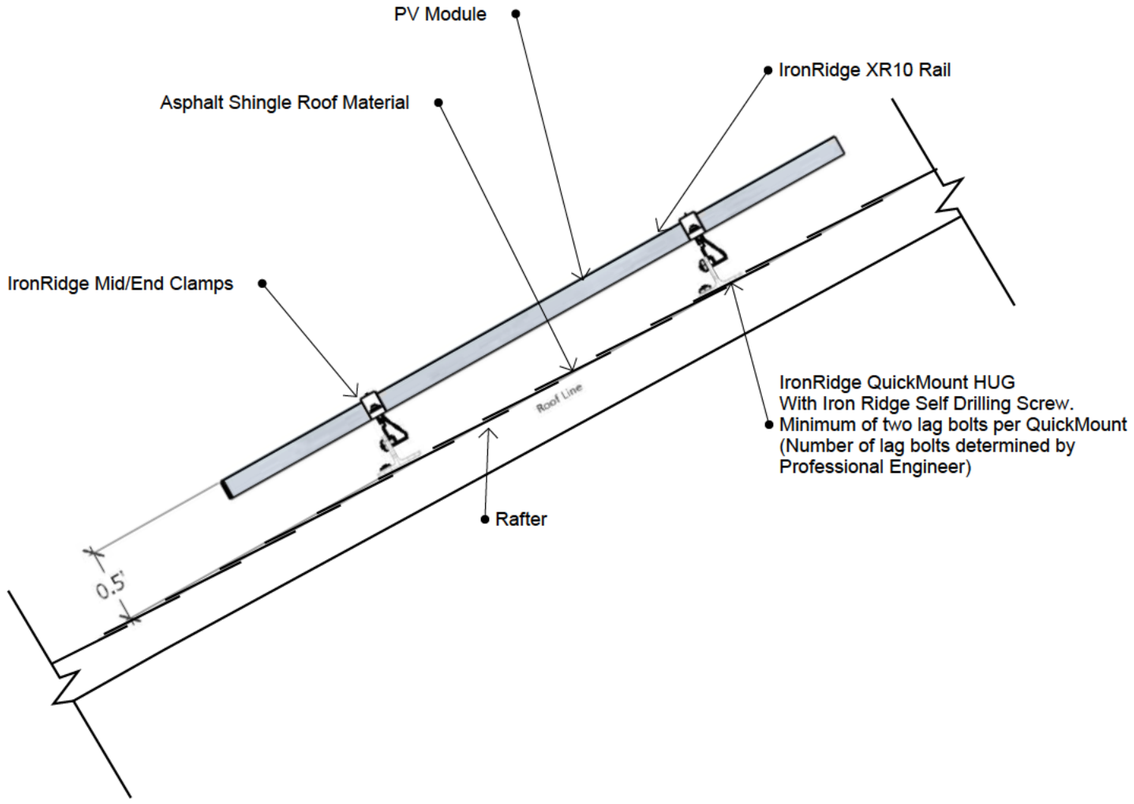
IronRidge QuickMount HUG





Property	Value
Material	300 Series Stainless Steel
Finish	Clear

IronRidge QuickMount RD structural screw



Rail Selection

The following table was prepared in compliance with applicable engineering codes and standards. Values are based on the following criteria: ASCE 7-10, Roof Zone 1, Exposure B, Roof Slope of 7 to 27 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed span tables and certifications.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	100	XR10		XR100		XR1000	
	120						
	140						
	160						
10-20	100						
	120						
	140						
	160						
30	100						
	160						
40	100						
	160						
50-70	160						
80-90	160						

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Mount Detail

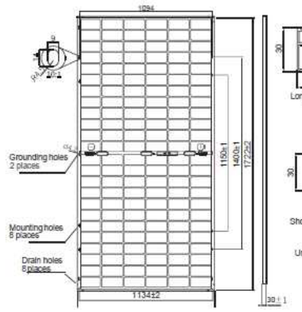
Issue Date
04.04.2024

Revisions:

System Size:
8.8 kW

pv

HY-DH108P8 390-410W(B)



Mechanical Characteristics

Solar Cell	Mono PERC 182 mm
No. of Cells	108 (6 × 18)
Dimensions	1722±2 × 1134±2 × 30±1 mm
Weight	22.6kg (±5%)
Cable Cross Section Size	4mm²(IEC),12 AWG(UL)
Junction Box	IP68 rated (3 bypass diodes)
Output Cables	Portrait: (-)350 mm and (+)160 mm in length or customized length
Front/Back Glass	2.0mm AR Tempered glass 2.0mm Semi-tempered glass
Container	36 pcs/Pallet, 936 pcs/ 40'HQ

Operating Parameters

Max. System Voltage	DC 1500V
Operating Temperature	-40℃ ~ +85℃
Max. Fuse Rated Current	30A
Front Static Load(snow,wind)	5400Pa(112lb/ft²)
Back Static Load(wind)	2400Pa(50lb/ft²)
Bifaciality	70%±10%
Fire Resistance	UL Type 1

Electrical Characteristics

Maximum Power at STC (Pmax)	410W	405W	400W	395W	390W
Optimum Operating Voltage (Vmp)	31.45V	31.21V	31.01V	30.84V	30.64V
Optimum Operating Current (Imp)	13.04A	12.98A	12.90A	12.81A	12.73A
Open Circuit Voltage (Voc)	37.32V	37.23V	37.07V	36.98V	36.85V
Short Circuit Current (Isc)	13.95A	13.87A	13.79A	13.70A	13.61A
Module Efficiency	21.0%	20.7%	20.5%	20.2%	20.0%
Operating Module Temperature	-40 °C to +85 °C		Maximum Series Fuse Rating		25A
Maximum System Voltage	1500 V DC (IEC)		Power Tolerance		0/+5 W

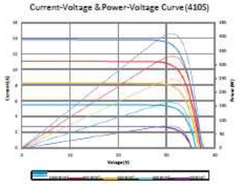
NMOT

Maximum Power at NMOT (Pmax)	309.4W	305.6W	302.2W	298.5W	294.8W
Optimum Operating Voltage (Vmp)	29.2V	29.0V	28.8V	28.6V	28.4V
Optimum Operating Current (Imp)	10.67A	10.63A	10.58A	10.53A	10.47A
Open Circuit Voltage (Voc)	35.21V	35.00V	34.77V	34.61V	34.43V
Short Circuit Current (Isc)	11.22A	11.18A	11.13A	11.08A	11.02A

Irradiance 800 W/m², ambient temperature 20 °C, AM=1.5, wind speed 1 m/s.

Electrical Characteristics with Different Rearside Power Gain (Reference to 405W Front)

Rearside Power Gain	5%	15%	25%
Maximum Power at STC (Pmax)	425W	466W	506W
Optimum Operating Voltage (Vmp)	31.41V	31.41V	31.40V
Optimum Operating Current (Imp)	13.59A	14.88A	16.18A
Open Circuit Voltage (Voc)	37.22V	37.23V	37.23V
Short Circuit Current (Isc)	14.48A	15.86A	17.24A
Module Efficiency	21.68%	23.74%	25.81%

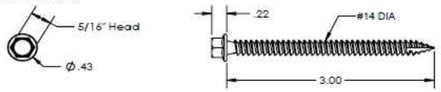


Temperature Characteristics

Nominal Module Operating Temperature (NMOT)	42 ± 2°C
Nominal Cell Operating Temperature	45 ± 2°C
Temperature Coefficient of Pmax	-0.36%/°C
Temperature Coefficient of Voc	-0.304%/°C
Temperature Coefficient of Isc	0.050%/°C

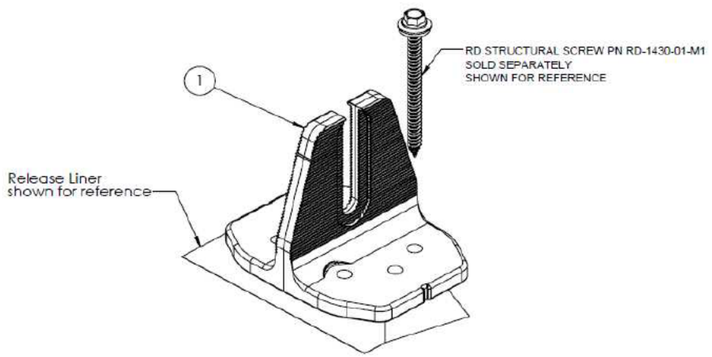
IronRidge QuickMount HUG + RD Structural Screw with EPDM washer:

1. Self Drilling Screw, #14, Wood Tip

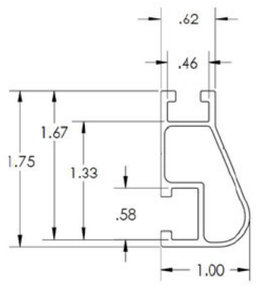


Property	Value
Material	300 Series Stainless Steel
Finish	Clear

2. Washer, EPDM Backed



IRON RIDGE XR10 RAIL



Rail Section Properties	
Property	Value
Total Cross-Sectional Area	0.363 in^2
Section Modulus (X-axis)	0.136 in^3
Moment of Inertia (X-axis)	0.124 in^4
Moment of Inertia (Y-axis)	0.032 in^4
Torsional Constant	0.076 in^3
Polar Moment of Inertia	0.033 in^4

IRONRIDGE

Simplified Grounding for Every Application

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

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

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

Universal Fastening Object (UFO®)
The UFO® securely bonds solar modules to XR Rails®. It comes assembled and lubricated, and can fit a wide range of module heights.

Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)	IQ7-60-2-US / IQ7-60-B-US		IQ7PLUS-72-2-US / IQ7PLUS-72-B-US	
Commonly used module pairings[1]	235 W - 350 W +		235 W - 440 W +	
Module compatibility	60-cell PV modules only		60-cell and 72-cell PV modules	
Maximum input DC voltage	48 V		60 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V	
Operating range	16 V - 48 V		16 V - 60 V	
Min/Max start voltage	22 V / 48 V		22 V / 60 V	
Max DC short circuit current (module Isc)	15 A		15 A	
Overvoltage class DC port	II		II	
DC port backfeed current	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	**IQ 7 Microinverter**		**IQ 7+ Microinverter**	
Peak output power	250 VA		295 VA	
Maximum continuous output power	240 VA		290 VA	
Nominal (L-L) voltage/range[2]	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)
Nominal frequency	60 Hz		60 Hz	
Extended frequency range	47 - 68 Hz		47 - 68 Hz	
AC short circuit fault current over 3 cycles	5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit[3]	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Overvoltage class AC port	III		III	
AC port backfeed current	0 A		0 A	
Power factor setting	1.0		1.0	
Power factor (adjustable)	0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY	**@240 V**	**@208 V**	**@240 V**	**@208 V**
Peak efficiency	97.6 %	97.6 %	97.5 %	97.3 %
CEC weighted efficiency	97.0 %	97.0 %	97.0 %	97.0 %
MECHANICAL DATA				
Ambient temperature range	-40°C to +65°C			
Relative humidity range	4% to 100% (condensing)			
Connector type (IQ7-60-2-US & IQ7PLUS-72-2-US)	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)			
Connector type (IQ7-60-B-US & IQ7PLUS-72-B-US)	Friends PV2 (MC4 intermateable). Adaptors for modules with MC4 or UTX connectors: - PV2 to MC4: order ECA-S20-S22 - PV2 to UTX: order ECA-S20-S25			
Dimensions (WxHxD)	212 mm x 175 mm x 30.2 mm (without bracket)			
Weight	1.08 kg (2.38 lbs)			
Cooling	Natural convection - No fans			
Approved for wet locations	Yes			
Pollution degree	PD3			
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure			
Environmental category / UV exposure rating	NEMA Type 6 / outdoor			
FEATURES				
Communication	Power Line Communication (PLC)			
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.			
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.			
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC-2014 and NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.			

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 10517 , Expiration Date: 07/31/25

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Hardware Specifications

Issue Date
04.04.2024

Revisions:

System Size:
8.8 kW

pv

Subject: Solar System Justification
Property: 5 Montgomery Ave Takoma Park MD 20912
Client: Justin Rood

To Whom It May Concern:

I am writing to provide a comprehensive justification for the installation of solar panels at Justin Rood's property. The proposed solar system has been carefully designed to cover the energy needs of the client, while adhering to all relevant guidelines and considerations.

Please see the attached usage analysis that outlines the client's 2022 and 2023 consumption. The proposed system of 20 panels does not cover the client's annual usage. We would like you to consider the client's renovation in 2023 that resulted in lower-than-average electricity consumption. Despite the reduced energy usage during this period, that proposed solar system only covers 95% of 2023's annual usage. The proposed system covered 70% of the client's consumption in 2022.This client's future energy usage is expected to return to or exceed 2022's levels, making the proposed system's capacity essential.

Solar is a clean and renewable energy source that will reduce our client's carbon footprint and green house gas emissions. Allowing a full installation aligns with broader environmental goals and initiatives.

Given the significant benefits of the proposed solar system, and the client's usage justification, we strongly advocate for the approval of the full solar panel installation. We appreciate your consideration and are available to address further questions or concerns.

Sincerely,

Kathleen dePorter
COO
KdePorter@SolarSolutionDC.com
202-340-2880

Index

SITE PLAN

SATELLITE VIEW

Scope of Work:

To install 8kW size of solar panels on roof of building.

CODES:

- NFPA 70
- NEC 2017
- IBC 2018
- CC 2018

BUILDING USE - SINGLE FAMILY DWELLING UNIT

CONSTRUCTION TYPE- III

REQUIRED FIRE CODE OFFSETS - MINIMUM 3 FEET OFFSETS FROM RIDGE AND EAVES

ROOF RATING - CLASS A

ROOF ANGLE- GREATER THAN 2:12 DEGREES (PITCHED)

CLIENT		PROJECT NO.	SYSTEM SIZE	ISSUE	DRAWN BY		
Justin Rood	5 Montgomery Avenue, Takoma Park, MD, USA	5920	8	06.03.2024	HS	SOLAR SOLUTION 4700 14th ST. NW Washington, DC 20011	00

GENERAL NOTES:

1. ALL ROOFTOP EQUIPMENT INSTALLATION WORK, INCLUDING FLASHED AND SEALED PENETRATIONS SHALL BE PERFORMED IN ACCORDANCE WITH CHAPTER 9 SECTION R903 WATHER PROTECTION OF THE 2017 EDITION OF THE IRC.

2. THIS PHOTOVOLTAIC INSTALLATION SHALL BE INSTALLED IN ACCORDANCE WITH THE 2017 EDITION OF THE IBC AS ADOPTED BY , THE 2017 NEC, AND ANY LOCAL BUILDING CODES CURRENTLY BEING ENFORCED BY THE AHJ

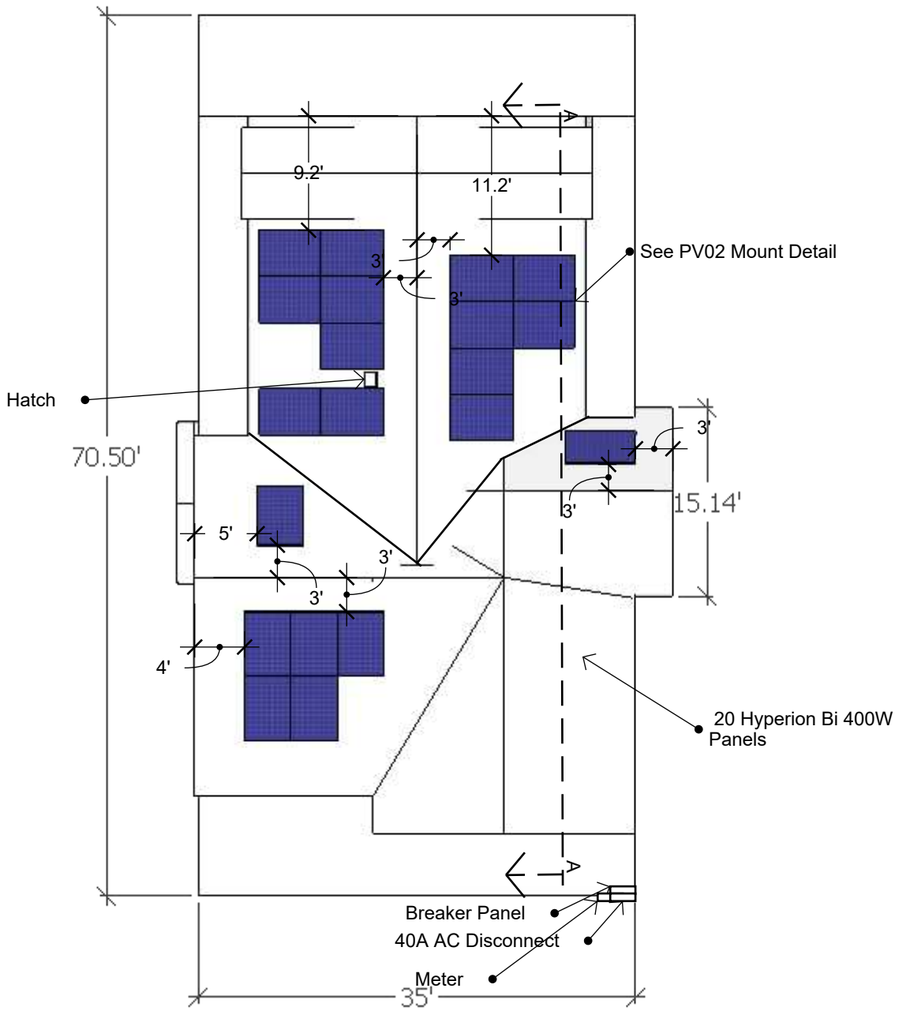
3. REQUIRED OFFSETS ARE 3' FROM THE RIDGE AND EAVES IF THE SLOPE IS GREATER THAN 2:12 DEGREES AND SOLAR COVERAGE IS GREATER THAN 66%. EXCEPTIONS APPLY FOR RIDGE OFFSETS WHEN THE SOLAR COVERAGE IS LESS THAN 66%.

4.IRONRIDGE QUICKMOUNT HALO ULTRAGRIPGRIP (HUG) INSTALLED ON THE FLAT PART OF THE SHINGLE, LEAVING A MINIMUM OF 2" BELOW THE DRIP EDGE OF THE UPSLOPE SHINGLE. QUICKMOUNT HUG IS ONLY INSTALLED ON ASPHALFT AND COMPOSITIOION SHINGLE TYPE ROOFS WITH SLOPES BETWEEN 2:12 TO 2:12.

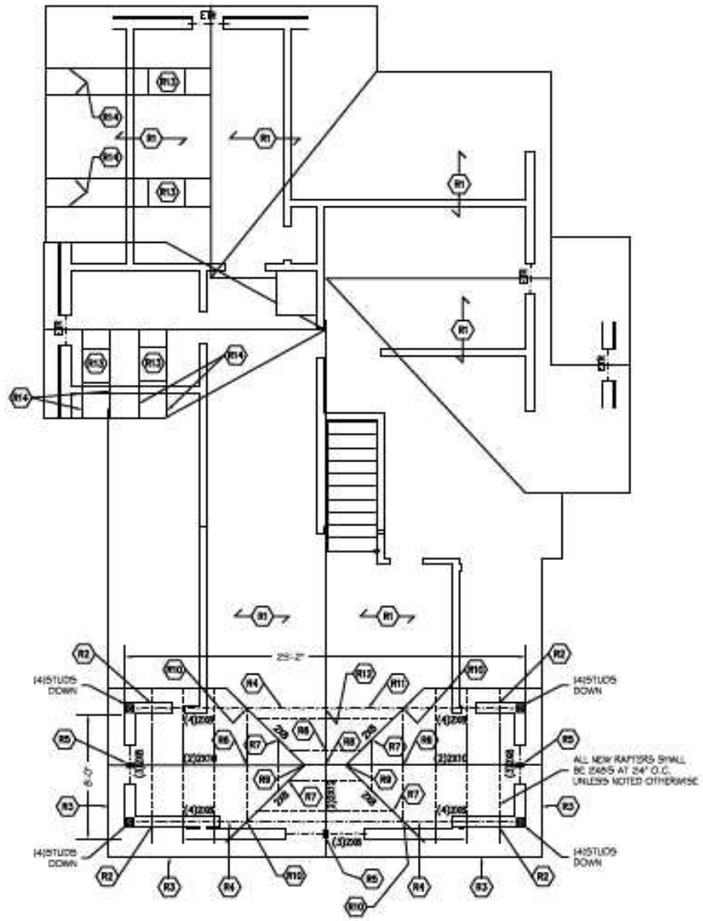
5. ALL RAFTER ATTACHED INSTALLATIONS REQUIRE A MINIMUM OF TWO RD STRUCTURAL SCREWS. FOR DECK ATTACHED INSTALLATION, SIX RD STRUCTURAL SCREWS ARE REQUIRED.

6.IRONRIDGE QUICKMOUNT HUG IS INSTALLED IN ALTERNATING RAFTERS (SEE PVO2) WITH A MAX XR10 RAIL SPAN OF 4'.

BUILDING HEIGHT: 30
ROOF SLOPE: 29 degrees



1 PV01 Roof Plan
Scale: 1/8" : 1'



1 PV02 Roof Framing Plan View of A-A
Scale: 3/8" : 1'

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

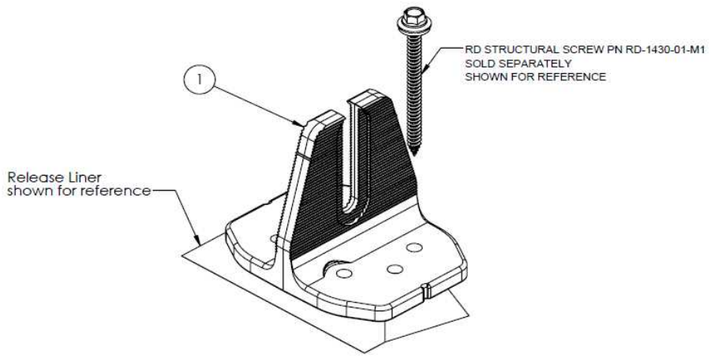
Roof Layout

Issue Date
06.03.2024

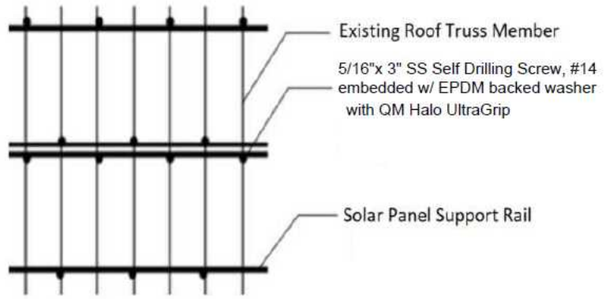
Revisions:

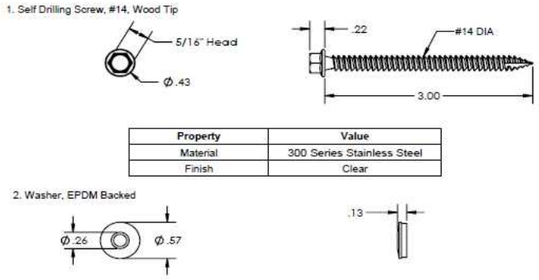
System Size:
8 kW

pv

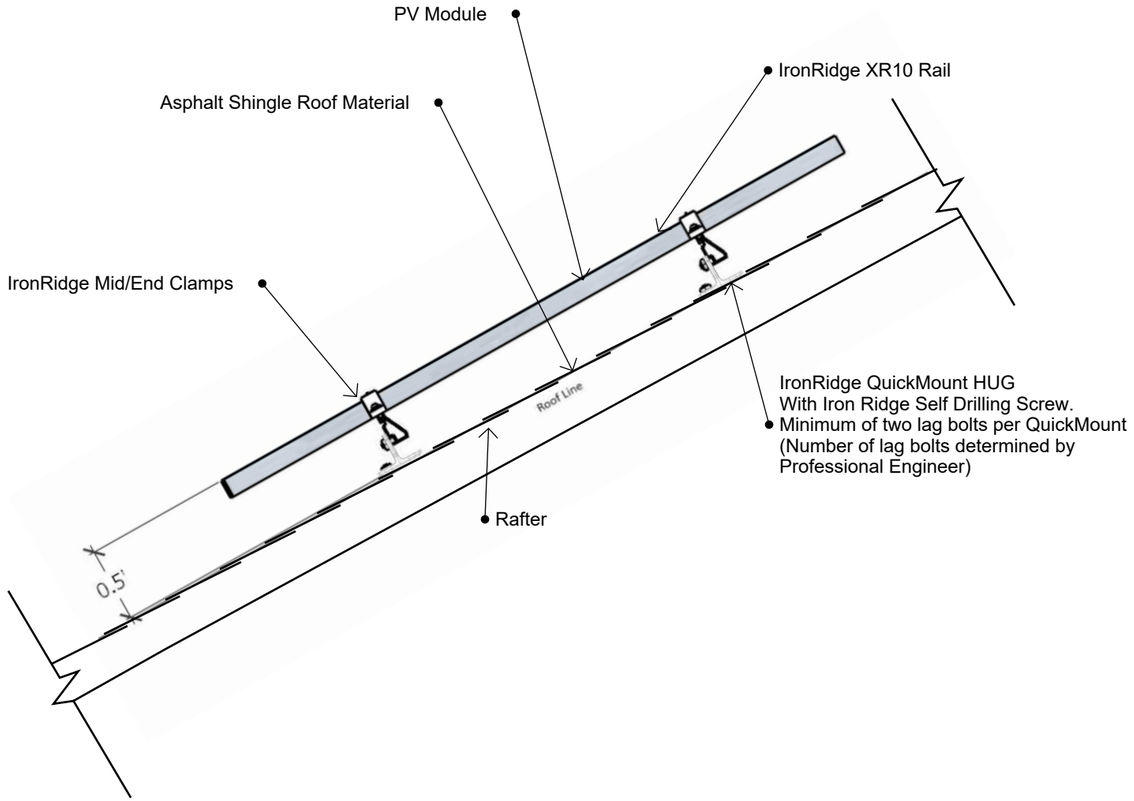


IronRidge QuickMount HUG





IronRidge QuickMount RD structural screw



Rail Selection

The following table was prepared in compliance with applicable engineering codes and standards. Values are based on the following criteria: ASCE 7-10, Roof Zone 1, Exposure B, Roof Slope of 7 to 27 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed span tables and certifications.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	100	XR10		XR100		XR1000	
	120						
	140						
	160						
10-20	100						
	120						
	140						
	160						
30	100						
	160						
40	100						
	160						
50-70	160						
80-90	160						

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Project #5920
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Mount Detail

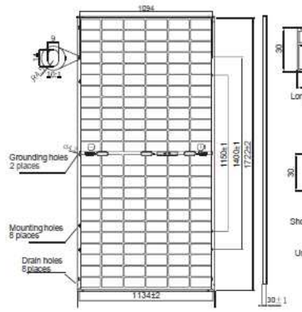
Issue Date
06.03.2024

Revisions:

System Size:
8 kW

pv

HY-DH108P8 390-410W(B)



Mechanical Characteristics

Solar Cell	Mono PERC 182 mm
No. of Cells	108 (6 × 18)
Dimensions	1722±2 × 1134±2 × 30±1 mm
Weight	22.6kg (±5%)
Cable Cross Section Size	4mm²(IEC),12 AWG(UL)
Junction Box	IP68 rated (3 bypass diodes)
Output Cables	Portrait: (-)350 mm and (+)160 mm in length or customized length
Front/Back Glass	2.0mm AR Tempered glass 2.0mm Semi-tempered glass
Container	36 pcs/Pallet, 936 pcs/ 40'HQ

Operating Parameters

Max. System Voltage	DC 1500V
Operating Temperature	-40℃ ~ +85℃
Max. Fuse Rated Current	30A
Front Static Load(snow,wind)	5400Pa(112lb/ft²)
Back Static Load(wind)	2400Pa(50lb/ft²)
Bifaciality	70%±10%
Fire Resistance	UL Type 1

Electrical Characteristics

Maximum Power at STC (Pmax)	410W	405W	400W	395W	390W
Optimum Operating Voltage (Vmp)	31.45V	31.21V	31.01V	30.84V	30.64V
Optimum Operating Current (Imp)	13.04A	12.98A	12.90A	12.81A	12.73A
Open Circuit Voltage (Voc)	37.32V	37.23V	37.07V	36.98V	36.85V
Short Circuit Current (Isc)	13.95A	13.87A	13.79A	13.70A	13.61A
Module Efficiency	21.0%	20.7%	20.5%	20.2%	20.0%
Operating Module Temperature	-40 ℃ to +85 ℃		Maximum Series Fuse Rating		25A
Maximum System Voltage	1500 V DC (IEC)		Power Tolerance		0/+5 W

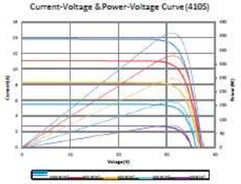
NMOT

Maximum Power at NMOT (Pmax)	309.4W	305.6W	302.2W	298.5W	294.8W
Optimum Operating Voltage (Vmp)	29.2V	29.0V	28.8V	28.6V	28.4V
Optimum Operating Current (Imp)	10.67A	10.63A	10.58A	10.53A	10.47A
Open Circuit Voltage (Voc)	35.21V	35.00V	34.77V	34.61V	34.43V
Short Circuit Current (Isc)	11.22A	11.18A	11.13A	11.08A	11.02A

Irradiance 800 W/m², ambient temperature 20 °C, AM=1.5, wind speed 1 m/s.

Electrical Characteristics with Different Rearside Power Gain (Reference to 405W Front)

Rearside Power Gain	5%	15%	25%
Maximum Power at STC (Pmax)	425W	466W	508W
Optimum Operating Voltage (Vmp)	31.41V	31.41V	31.40V
Optimum Operating Current (Imp)	13.59A	14.88A	16.18A
Open Circuit Voltage (Voc)	37.22V	37.23V	37.23V
Short Circuit Current (Isc)	14.48A	15.86A	17.24A
Module Efficiency	21.68%	23.74%	25.81%

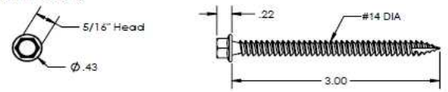


Temperature Characteristics

Nominal Module Operating Temperature (NMOT)	42 ± 2°C
Nominal Cell Operating Temperature	45 ± 2°C
Temperature Coefficient of Pmax	-0.36%/°C
Temperature Coefficient of Voc	-0.304%/°C
Temperature Coefficient of Isc	0.050%/°C

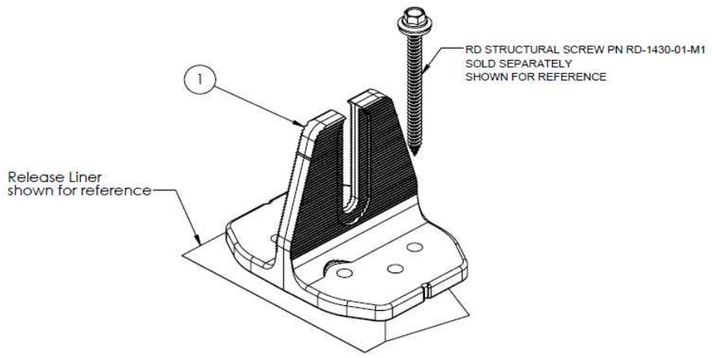
IronRidge QuickMount HUG + RD Structural Screw with EPDM washer:

1. Self Drilling Screw, #14, Wood Tip

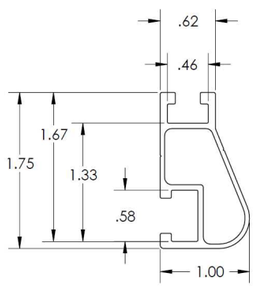


Property	Value
Material	300 Series Stainless Steel
Finish	Clear

2. Washer, EPDM Backed



IRON RIDGE XR10 RAIL



Rail Section Properties	
Property	Value
Total Cross-Sectional Area	0.363 in²
Section Modulus (X-axis)	0.136 in³
Moment of Inertia (X-axis)	0.124 in⁴
Moment of Inertia (Y-axis)	0.032 in⁴
Torsional Constant	0.076 in³
Polar Moment of Inertia	0.033 in⁴

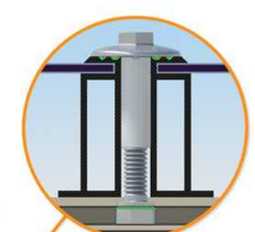
IRONRIDGE

Simplified Grounding for Every Application

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

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

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



Universal Fastening Object (UFO®)
The UFO® securely bonds solar modules to XR Rails®. It comes assembled and lubricated, and can fit a wide range of module heights.

Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)	IQ7-60-2-US / IQ7-60-B-US		IQ7PLUS-72-2-US / IQ7PLUS-72-B-US	
Commonly used module pairings¹	235 W - 350 W +		235 W - 440 W +	
Module compatibility	60-cell PV modules only		60-cell and 72-cell PV modules	
Maximum input DC voltage	48 V		60 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V	
Operating range	16 V - 48 V		16 V - 60 V	
Min/Max start voltage	22 V / 48 V		22 V / 60 V	
Max DC short circuit current (module Isc)	15 A		15 A	
Overvoltage class DC port	II		II	
DC port backfeed current	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	**IQ 7 Microinverter**		**IQ 7+ Microinverter**	
Peak output power	250 VA		295 VA	
Maximum continuous output power	240 VA		290 VA	
Nominal (L-L) voltage/range²	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)
Nominal frequency	60 Hz		60 Hz	
Extended frequency range	47 - 68 Hz		47 - 68 Hz	
AC short circuit fault current over 3 cycles	5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit³	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Overvoltage class AC port	III		III	
AC port backfeed current	0 A		0 A	
Power factor setting	1.0		1.0	
Power factor (adjustable)	0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY	**@240 V**	**@208 V**	**@240 V**	**@208 V**
Peak efficiency	97.6 %	97.6 %	97.5 %	97.3 %
CEC weighted efficiency	97.0 %	97.0 %	97.0 %	97.0 %
MECHANICAL DATA				
Ambient temperature range	-40°C to +65°C			
Relative humidity range	4% to 100% (condensing)			
Connector type (IQ7-60-2-US & IQ7PLUS-72-2-US)	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)			
Connector type (IQ7-60-B-US & IQ7PLUS-72-B-US)	Friends PV2 (MC4 intermateable). Adaptors for modules with MC4 or UTX connectors: - PV2 to MC4: order ECA-S20-S22 - PV2 to UTX: order ECA-S20-S25			
Dimensions (WxHxD)	212 mm x 175 mm x 30.2 mm (without bracket)			
Weight	1.08 kg (2.38 lbs)			
Cooling	Natural convection - No fans			
Approved for wet locations	Yes			
Pollution degree	PD3			
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure			
Environmental category / UV exposure rating	NEMA Type 6 / outdoor			
FEATURES				
Communication	Power Line Communication (PLC)			
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.			
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.			
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 1071-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC-2014 and NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.			

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Hardware Specifications

Issue Date
06.03.2024

Revisions:

System Size:
8 kW

pv

NOTE: The IQ 7 Micro, IQ 7+ Micro and the IQ 7X Micro have integrated ground and double insulation. The inverter does not require a EGC, other EGC requirements remain unchanged. The DC circuit is isolated and insulated from ground and meets the requirements of NEC 690.35.

Notes:

Modules are clamped with mid/end clamps.
#6 bare copper Ground Wire in contact with all modules and rails/beams/trays

Mid and End Clamps with integrated Grounding

10 Hyperion Bi 400W Panels (IQ7+)

#6 Bare Copper connected to all rails/beams with Lugs. Mid and end clamps with integrated ground

String 1

Enphase Q Cable (Portrait)
Two (2) #12 AWG Wire
THWN-2
L1-Black
L2-Red

Junction Box

1/2" Conduit
(4) #12 AWG Conductors
(2) #10 Insulated EGC

10 Hyperion Bi 400W Panels (IQ7+)

#6 Bare Copper connected to all rails/beams with Lugs. Mid and end clamps with integrated ground

String 2

Enphase Q Cable (Portrait)
Two (2) #12 AWG Wire
L1-Black
L2-Red

Label 2

1/2" Conduit
(2) #12 AWG
Conductors

Label 1

Label 8 → To/From Meter & Grid

40A AC Disconnect housed inside Combiner Box

Enphase IQ Combiner
40A OCPD
Rated 80A
1PH
240VAC

#10 AWG insulated Ground (Typical)

20A

20A

15A

Enphase Envoy Monitoring Unit

Label 6

40A

Label 5

Label 4

Label 11

Existing 200A 1PH 240VAC

Line Side

Label 11

Label 1

Existing Ground

40A

Load Side

1/2" Conduit
(3) #8 AWG
#10 Insulated EGC

"Rapid shutdown is built in enphase microinverters and meet RSS requirements nec 690.12 without any addition equipment"
IEEE-1547-2018 AND UL 1741-SB compliant

SOLAR SOLUTION
4700 14th ST. NW
Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Electrical Diagram

Issue Date
06.03.2024

Revisions:

System Size:
8 kW

e

CODE REFERENCE:

ART 690.8 (A)
1. The maximum current shall be the sum of parallel module rated short - circuit currents multiplied by 125%.

3. The maximum current shall be the inverter continuous output current rating.

ART 690.8(B)(1)

1. CONDUCTION MUST HAVE 30 C AMPACITY > 125% OF CONTINUOUS CURRENT PER 690.8(A)

2. CONDUCTOR MUST HAVE (AFTER CORRECTIONS FOR CONDITIONS OF USE) GREATER THAN OR EQUAL TO CONTINUOUS CURRENT PER TABLE 310.15

3. EVALUATE CONDUCTOR TEMPERATURE AT TERMINATION PER ART 110.14(C). AMPACITY OF WIRE DERATED FOR CONDITIONS OF TERMINATION MUST BE > CONTINUOUS CURRENT X 1.25.

DC CALCULATIONS

SYSTEM SIZE: 20X 400 W = 8kW

PV SOURCE CIRCUIT
PV MODULE ISC = 13.79 A
OF MODULES IN PARALLEL PER CIRCUIT = 1
MAX ISC = 1 X 13.79 A X 1.25 = 17.23A
OCPD/Ampacity = 17.23A x 1.25 = 21.54 A, 20A OCPD

SOURCE CIRCUIT WIRING
CONDUCTOR = COPPER #10 AWG THWN-2 90°C RATED
CORRECTION FACTORE FOR 60°C AMBIENT = 0.71
CORRECTED AMPACITY: 40 A X 0.71 X 0.8 = 22.72A > 21.54A

AC Current Calculations

Total Panels: 20 x 1.21A = 24.2A
String 1: 10 x 1.21A = 12.1A
String 2: 10 x 1.21A = 12.1A

Combiner Box Home Run Current: 20 x 1.21A = 24.2A
OCPD Sizing: 40A
80% of OCPD = 40A x .8 = 32A > 24.2A

Wiring for Combiner Box: 1/2" Conduit #8 AWG & #10 Ground
Conductor for #8 AWG THWN-2 90 C Rated
Correction Factor for 45 C Ambient = 0.87
Corrected Ampacity: 55Ax0.87x0.8 = 38.28A > 24.2A

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Project #5920
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Electrical Calculations

Issue Date
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Revisions:

System Size:
8 kW

e

Solar System Warning Labels Material

Vinyl Material - Flexcon DPM FWS White Vinyl

Reflective Material - Avery Dennison T-1500-A Engineering Grade Beaded Retroreflective Film

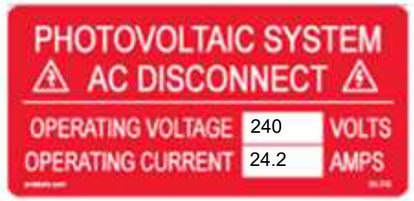
Lamination - Flexcon DPM Clear Gloss Polyester Laminate

Label 1

4" X 1"

Location: (C)(CB)
Per code:
NEC 690.31.G.3

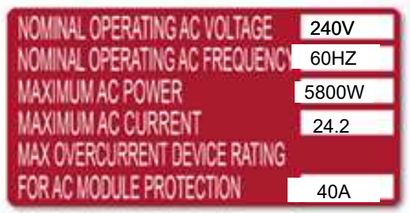
Label 4



4" X 2"

Location: (AC)(POI)
Per code:
NEC 690.14.C.2
NEC 690.54

Label 5



4" X 2"

Label 8

4" X 2"

Location: (POI)
Per code:
NEC 690.64.B.4

Label 11

1/2" X 2"

Label 6

4” X ¾”

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Washington, DC 20011

Project #5920
Justin Rood
5 Montgomery Avenue,
Takoma Park, MD, USA

Electrical Labels

Issue Date
06.03.2024

Revisions:

System Size:
8 kW

e

Customer	Justin Rood
Address	5 Montgomery Ave MD

	2022 Usage (kWH)	2023 Usage (kWh)	Solar Production (kWh)
January	1120	360	311
February	640	900	369
March	635	910	619
April	640	1140	887
May	610	940	837
June	1100	1380	958
July	1400	1420	944
August	1560	400	895
September	1440	200	705
October	600	180	633
November	610	180	335
December	760	200	289
Sum	11115	8210	7782

	2022	2023
Solar Offset	70%	95%