

**MONTGOMERY COUNTY HISTORIC PRESERVATION COMMISSION**  
**STAFF REPORT**

<b>Address:</b>	7315 Willow Avenue, Takoma Park	<b>Meeting Date:</b>	3/25/2026
<b>Resource:</b>	Outstanding Resource <b>Takoma Park Historic District</b>	<b>Report Date:</b>	3/18/2026
<b>Applicant:</b>	Joseph McGarvey EDGE Energy (agent)	<b>Public Notice:</b>	3/11/2026
<b>Review:</b>	RETROACTIVE HAWP	<b>Tax Credit:</b>	No
<b>Case Number:</b>	1147831	<b>Staff:</b>	Devon Murtha
<b>Proposal:</b>	Retroactive solar panel installation		

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**RECOMMENDATION**

Staff recommends that the Historic Preservation Commission **approve with one (1) condition** the HAWP application, with final approval of details delegated to Staff.

1. The applicant cannot install the two (2) panels aligned with the front roof plane. The applicant must submit revised plans showing the panels removed or relocated behind the recommended setback as illustrated in *Figure 7*, with final approval delegated to Staff.

**PROPERTY DESCRIPTION**

**SIGNIFICANCE:** Outstanding Resource to the Takoma Park Historic District  
**STYLE:** Art Moderne  
**DATE:** 1914



*Figure 1: 7315 Willow Avenue is located within the Takoma Park Historic District, annotated with a yellow star.*

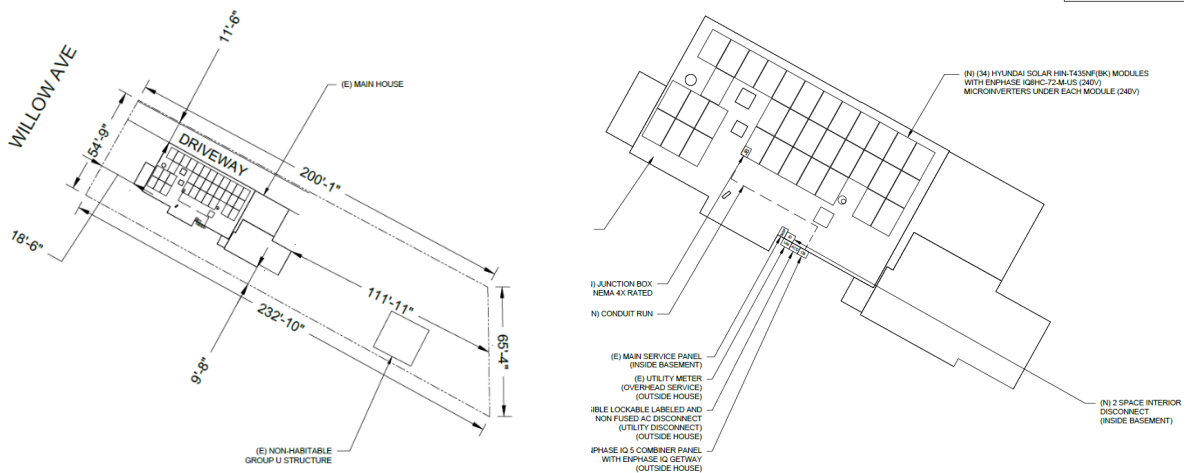
**PROPOSAL**

The subject property is located along Willow Avenue and contains a two-story house executed in the Art Moderne style. It is an Outstanding Resource within the Takoma Park Historic District. The house features a flat roof with a short parapet and stucco cladding.



*Figure 2: View of subject property along Willow Avenue.*

The applicant is seeking retroactive approval for the installation of thirty-four (34) solar panels in one (1) array on the main roof of the subject property. The HD Hundai NF(BK) series panels will be mounted to the flat roof with Ironridge rails.



*Figure 3: Site plan (left) and solar panel plan (right).*

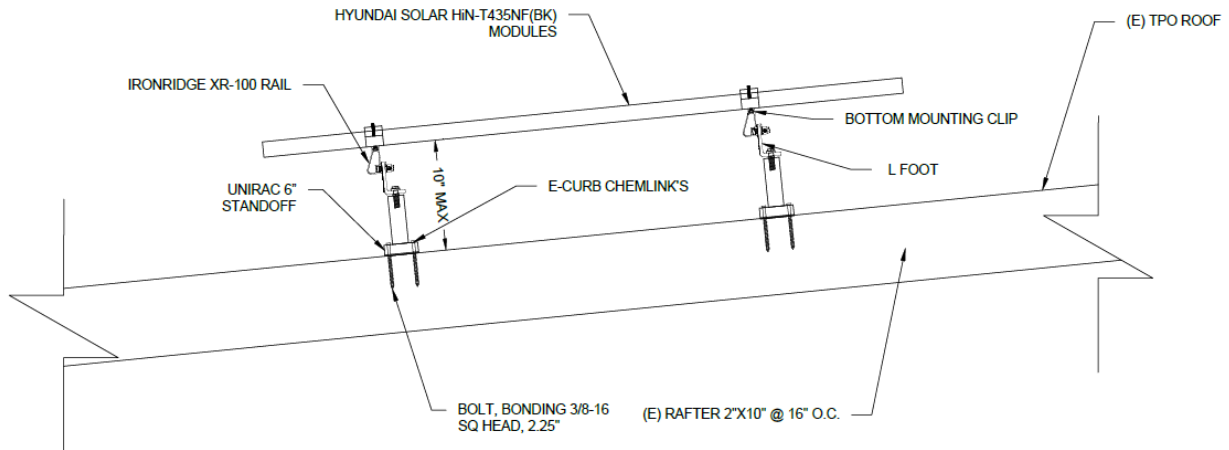


Figure 4: Installation diagram for the solar panels.

## 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)*, 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.

**Outstanding Resources – Residential:** These resources have the highest level of architectural and/or historical significance. While they will receive the most detailed level of design review, it is permissible to make sympathetic alterations, changes and additions to Outstanding Resources.

As a set of guiding principles for design review of Outstanding Resources, the Historic Preservation Commission will utilize the Secretary of the Interior's "Standards for Rehabilitation".

Specifically, some of the factors to be considered in reviewing HAWPs on Outstanding Resources:

Plans for all alterations should be compatible with the resource's original design; additions, specifically, should be sympathetic to existing architectural character, including massing, height, setback, and materials

Preservation of original and distinctive architectural features, such as porches, dormers, decorative details, shutters, etc..is encouraged

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;
  - (4) The proposal is necessary in order that unsafe conditions or health hazards be remedied;

(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.
- 5. Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.
- 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:

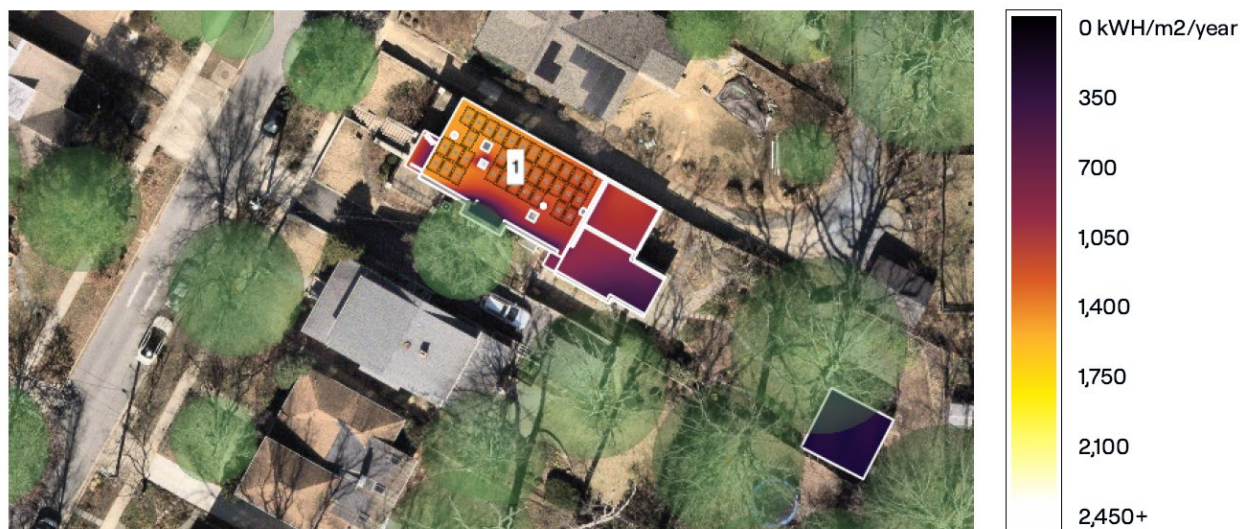
1. The preferred locations for solar panel installation(s) on a designated historic site or an historic resource located within an historic district is a) on the rear of the property, b) on non-historic building additions, c) on accessory structures, or d) in ground-mounted arrays;
2. If it is not feasible 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).
5. A Historic Area Work Permit (HAWP) is required for all work referenced in this policy.

## STAFF DISCUSSION

Staff supports the proposal and recommends approval, with the condition that the applicant cannot install the two (2) panels aligned with the front roof plane. Retroactive applications are to be reviewed as though the work has not been completed.

The subject property contains the only historic building in the *Takoma Park Design Guideline Index to Historic Properties* described as Art Moderne, and is categorized as an Outstanding Resource. Although Takoma Park is home to a handful of Art Deco buildings, mostly commercial in use, the subject property is unique for its use of stucco, rectilinear planes, streamline appearance, and horizontal emphasis, all hallmarks of the early Art Moderne style. Staff notes that the review of this proposal should be careful to safeguard the character-defining features of this rare property.

Staff evaluated the proposed placement of the solar panels on the subject property against the guidance provided by *Historic Preservation Commission Policy No. 20-01*. In determining the most appropriate placement of solar panels, the policy outlines several preferred locations, including (in order of preference), in ground-mounted arrays, on accessory structures, on non-historic building additions, and on the rear of the property. Installation of solar panels on the primary preferred location (ground-mounted array) is not possible for this project due to the lot size and canopy cover. Installation on the secondary preferred location (accessory structure) and on the rear of the main roof is not feasible for this project, as there is limited sunlight to that area due to the extensive canopy.



*Figure 5: Shade report for subject property.*

Staff acknowledge that the arrays will be installed on the historic main roof, which is a non-preferred location; however, due to the flat slope of the roof and modest parapet (approximately 2” tall at the front), Staff finds that thirty-two (32) of the thirty-four (34) panels will not be visible from the right-of-way along Willow Avenue. Staff finds that the panels that are not visible from the right-of-way are appropriate and consistent with *Policy 20-01*, as they do not detract from the character-defining features of the property.

Staff finds that two (2) of the panels, as proposed and installed, are visible from the right-of-way along Willow Avenue, and recommends that the HPC include a condition of approval that these panels be relocated, shifted back, or removed. These two panels can be seen above the existing parapet, and interrupt the singular, horizontal plane of the Moderne roof, adding visual clutter to an area characterized by its streamline nature. Staff finds that this alteration alters the exterior features of the historic resource, contra

Chapter 24A-8(b)(2), and impacts the distinctive features of a historic property, contra *Standard 5*. The parapet is notably shorter at the front of the house, and taller towards the rear, contributing to the heightened visibility of these panels in this location.



*Figure 6: View of subject property from the right-of-way. Visible solar panels are noted with a yellow arrow.*

In reviewing this application, Staff looked to the approved and adopted *Policy Guidance #20-01: Solar Technology*. The Guidance states that schemes for traditional roof-mounted arrays should setback solar panels from the edges and ridge of the roof, and that

*The HPC prefers all solar systems to be located on secondary elevations before consideration of primary elevations visible from public rights-of-way. The systems should be hidden behind existing architectural features (such as dormers, chimneys, etc.) to limit their visibility.<sup>1</sup>*

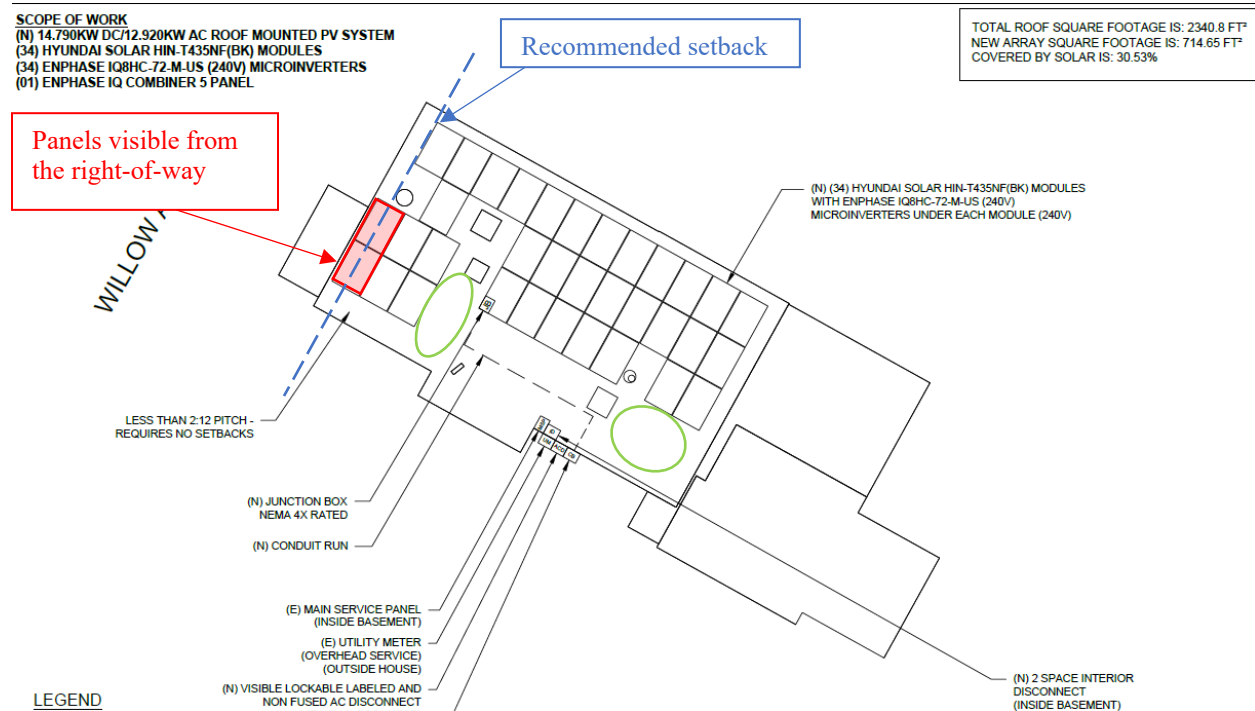
Staff finds that, contra to this guidance, the two panels are installed at the edge of the roof plane and are not hidden behind the existing architectural features (including the parapet), but rise above the roof and are visible from the right-of-way. Based on the information submitted, it appears that the panels could be pulled back one to two feet, in line with the panels installed in the north corner and the recommended setback in *Figure 7*. The applicant submitted a justification for the placement of the two panels as follow:

*In addition moving the 2 front most panels towards the back of the home will impede the ability to access the skylights for maintenance and ease to walk along the roof. If repairs are needed and the panels do not allow for adequate working space this can slow the needed work and become an additional costs [sic] to the homeowner.*

Staff finds this justification to be unpersuasive, and that the convenience of roof access and maintenance is not a compelling reason for the HPC to approve panels in a non-preferred location on an Outstanding Resource. Based on the information submitted, it appears that there are several other feasible locations to install the panels that would allow for ample maintenance access. Staff also finds that the relocation or removal of two (2) of the thirty-four (34) solar panels may have an impact on the solar production, but that the impact will be comparatively small. The subject property had an estimated annual usage of roughly 14,930 Kwh, and the proposed system will generate approximately 11,170 kWh, accounting for

<sup>1</sup> See Guidelines here: <https://montgomeryplanning.org/wp-content/uploads/2021/12/Solar-Panel-Interactive.pdf>. Quoted guidance is located on pages 7-8.

approximately seventy-five (75) percent of the annual production. Staff recommends that the HPC add a condition that all panels should be installed behind the recommended setback line (*Figure 7*).



*Figure 7: Proposed and installed solar plans. The red box shows the location of the panels that are visible from the right-of-way. The dashed blue line shows the recommended setback. The green circles denote areas that may be more appropriate for the solar panels.*

In the past, the HPC has added similar conditions to applications for solar panel installation on Outstanding Resources to ensure visual compatibility with the district.

- In 2022, the HPC approved an application for installation of solar panels at 28 Pine Avenue, but adopted a condition that five (5) of the panels closest to the front edge of the roof could not be installed, as they were too visible from the right-of-way and visually impacted the view of a character-defining chimney (*Figure 8*).<sup>2</sup>
- In 2024, the HPC approved an application for the installation of solar panels at 7209 Willow Avenue, but adopted a condition that “the three panels proposed toward the front wall plane cannot be installed” (*Figure 8*).<sup>3</sup>
- In 2024, the HPC approved an application for installation of solar panels at 316 Tulip Avenue, but adopted a condition that “The eight (8) panels proposed on the southeast (front) corner of the main roof must be eliminated unless the applicant fully demonstrates that no alternative locations are feasible, in which case the minimum number of panels is to be installed and the panels pulled back from the front wall plane and installed in a consistent pattern. The applicant has the option to instead install panels on the garage dormer and/or rear roof, but only after staff reviews and approves a revised plan.” The applicant ultimately installed the panels on the rear roofs

<sup>2</sup> See the Staff Report for HAWP No. 989988 here: <https://montgomeryplanning.org/wp-content/uploads/2022/04/I.L-28-Pine-Avenue-Takoma-Park-989988.pdf>.

<sup>3</sup> See the approval for HAWP No. 1077703 here: [https://mcatlas.org/tiles6/06\\_HistoricPreservation\\_PhotoArchives/HAWP/HPC%202024-08-14/7209%20Willow%20Ave.,%20Takoma%20Park%-201077703%20-%20Approval.pdf](https://mcatlas.org/tiles6/06_HistoricPreservation_PhotoArchives/HAWP/HPC%202024-08-14/7209%20Willow%20Ave.,%20Takoma%20Park%-201077703%20-%20Approval.pdf)

slopes and accessory structures, in accordance with the Staff condition (Figure 9).<sup>4</sup>

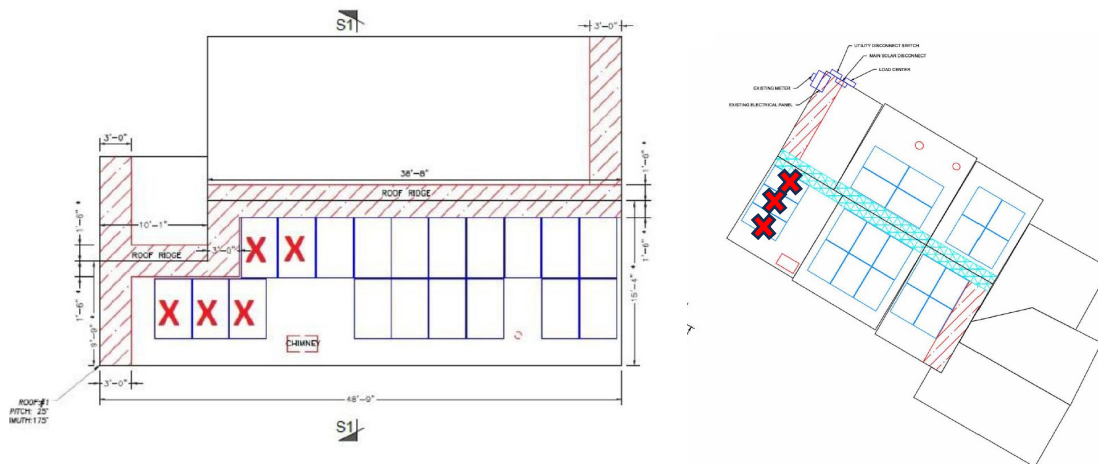


Figure 8: Plans for 28 Pine Avenue (left) and 7209 Willow Avenue (right). Panels that were not approved by the HPC and notated with red arrows.



Figure 9: Proposed (left) and approved (right) plan for 316 Tulip Avenue.

After full and fair consideration of the applicant's submission, staff finds the proposal, as modified by the conditions, consistent with the Criteria for Issuance in Chapter 24A-8(b)(1), (2), having found the proposal is consistent with the *Secretary of the Interior's Standards for Rehabilitation* #2, 9, and 10, and *Takoma Park Historic District Guidelines*, and the HPC's Policy No. 20-01 as outlined above.

### **STAFF RECOMMENDATION**

Staff recommends that the Historic Preservation Commission **approve with one (1) condition** the HAWP application, with final approval of details delegated to Staff.

1. The applicant cannot install the two (2) panels aligned with the front roof plane. The applicant must submit revised plans showing the panels removed or relocated behind the recommended

<sup>4</sup> See approval documents for HAWP No. 1085063 here:

[https://mcatlas.org/tiles6/06\\_HistoricPreservation\\_PhotoArchives/HAWP/HPC%202024-10-09/316%20Tulip%20Ave,%20Takoma%20Park%20-1085063%20-%20Approval.pdf](https://mcatlas.org/tiles6/06_HistoricPreservation_PhotoArchives/HAWP/HPC%202024-10-09/316%20Tulip%20Ave,%20Takoma%20Park%20-1085063%20-%20Approval.pdf).

setback as illustrated in *Figure 7*, with final approval delegated to Staff.

under the Criteria for Issuance in Chapter 24A-8(b)(1), (2) and (4), 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;

*The Takoma Park Historic District Guidelines;*

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

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

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 [devon.murtha@montgomeryplanning.org](mailto:devon.murtha@montgomeryplanning.org) to schedule a follow-up site visit.

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

Residential home, driveway, tree on front and rear of property

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

Residential rooftop solar panels with required electrical equipment

Work Item 1: **Solar Panels** \_\_\_\_\_

Description of Current Condition:  
No panels on roof or property

Proposed Work:  
Rooftop solar array

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/ Landscaping	*	*		*	*	*	*
Tree Removal	*	*		*	*	*	*
Siding/ Roof Changes	*	*	*	*	*		*
Window/ Door Changes	*	*	*	*	*		*
Masonry Repair/ Repoint	*	*	*	*	*		*
Signs	*	*	*	*	*		*



6854 Distribution Dr  
Beltsville, MD 20705  
Toll Free: 888-586-3343  
Fax: 888-586-2849

Hi HAWP Team,

Due to roof layout and shading constraints at 7315 Willow Ave, there is no viable space on the rear roof planes to accommodate the system. It is significant enough to where even moving one panel will drop the production and thus reduce solar savings to our homeowner. The front roof portion receives the most sunlight throughout the day. In addition moving the 2 front most panels towards the back of the home will impede the ability to access the skylights for maintenance and ease to walk along the roof. If repairs are needed and the panels do not allow for adequate working space this can slow the needed work and become an additional costs to the homeowner. Please see pictures of the panels attached along with the aurora shade report.

Currently the annual production for the solar panels at McGarvey residence is 11,170 Kwh.  
The McGarvey residence estimated annual consumption is 14,930.

Thank you for your time and consideration on this matter. Please let me know if you have any questions or any further information is needed.

Thank you,  
EDGE Energy Team

# JOE MCGARVEY

**AHJ**  
CITY OF TAKOMA PARK

**UTILITY**  
POTOMAC ELECTRIC POWER CO

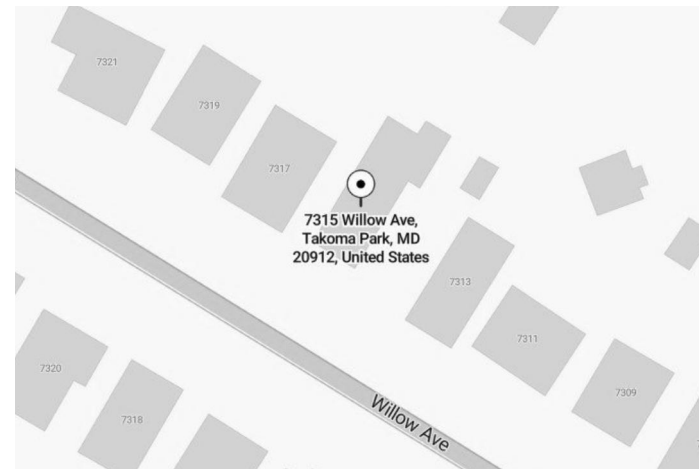
**SCOPE OF WORK**  
(N) 14.790KW DC/12.920KW AC ROOF MOUNTED PV SYSTEM  
(34) HYUNDAI SOLAR HIN-T435NF(BK) MODULES  
(34) ENPHASE IQ8HC-72-M-US (240V) MICROINVERTERS  
(01) ENPHASE IQ COMBINER 5 PANEL

**CODES AND STANDARDS WITH AMENDMENTS**

2021 IRC  
2021 IBC  
2020 NEC  
STATE OF MARYLAND FIRE PREVENTION CODE  
NFPA 1 & 101, 2018

**ENVIRONMENTAL**  
WIND SPEED: 115 MPH  
SNOW LOAD: 30 PSF  
EXPOSURE CATEGORY: C

**VICINITY MAP**



**CONTRACTOR**



EDGE ENERGY  
6854 DISTRIBUTION DRIVE,  
BELTSVILLE, MD, USA  
+1 434 568 7220  
LIC TYPE: MHIC, STATE  
ELECTRICAL LICENSE  
LIC NO.: 126720,13228

PROJECT INFO & ADDRESS

JOE MCGARVEY  
**7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA**

**SYSTEM SIZE**

DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC

**GENERAL NOTES**

**PROJECT NOTES:**  
- THIS PHOTOVOLTAIC (PV) SYSTEM SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE (NEC) ARTICLE 690, ALL MANUFACTURER'S LISTING AND INSTALLATION INSTRUCTIONS, AND THE RELEVANT CODES AS SPECIFIED BY THE AUTHORITY HAVING JURISDICTION'S (AHJ) APPLICABLE CODES.  
- THE UTILITY INTERCONNECTION APPLICATION MUST BE APPROVED AND PV SYSTEM INSPECTED PRIOR TO PARALLEL OPERATION  
- GROUND FAULT DETECTION AND INTERRUPTION (GFDI) DEVICE IS INTEGRATED WITH THE MICRO INVERTERS IN ACCORDANCE WITH NEC 690.41(B)  
- ALL PV SYSTEM COMPONENTS; MODULES, UTILITY-INTERACTIVE INVERTERS, AND SOURCE CIRCUIT COMBINER BOXES ARE IDENTIFIED AND LISTED FOR USE IN PHOTOVOLTAIC SYSTEMS AS REQUIRED BY NEC 690.4: PV MODULES: UL1703, IEC61730, AND IEC61215, AND NFPA 70 CLASS C FIRE INVERTERS: UL 1741 CERTIFIED, IEEE 1547, 929, 519 COMBINER BOX(ES): UL 1703 OR UL 1741 ACCESSORY  
- MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC. IF UNAVAILABLE, MAX DC VOLTAGE CALCULATED ACCORDING TO NEC 690.7.  
- ALL INVERTERS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AND SOURCE CIRCUIT COMBINERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER 690.4. SHALL BE INSTALLED ACCORDING TO ANY INSTRUCTIONS FROM LISTING OR LABELING [NEC 110.3].  
- ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE. IF EXPOSED TO SUNLIGHT, IT SHALL BE UV RESISTANT. ALL PLAQUES AND SIGNAGE WILL BE INSTALLED AS REQUIRED BY THE NEC AND AHJ.

METER NO: 112 127 293

**SHEET INDEX**

- PV-1 COVER SHEET
- PV-2 SITE PLAN-1
- PV-2.1 SITE PLAN-2
- PV-3 ATTACHMENT PLAN
- PV-3.1 STRUCTURAL PLAN
- PV-4 ELECTRICAL
- PV-4.1 ELECTRICAL CALCULATIONS
- PV-5 LABELS
- PV-6 RESOURCE DOCUMENT
- PV-6.1 RESOURCE DOCUMENT
- PV-6.2 RESOURCE DOCUMENT
- PV-6.3 RESOURCE DOCUMENT
- PV-6.4 RESOURCE DOCUMENT
- PV-6.5 RESOURCE DOCUMENT
- PV-6.6 RESOURCE DOCUMENT
- PV-6.7 RESOURCE DOCUMENT
- PV-6.8 RESOURCE DOCUMENT
- PV-6.9 RESOURCE DOCUMENT



**Wyssling Consulting, PLLC**  
76 N. Meadowbrook Drive, Alpine UT  
Maryland COA # 58509  
Signed 10/17/2025

**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. 43466, EXPIRATION DATE: 4/11/2027


DRAWN BY	OB
DATE	10/10/2025
REVISION	
SIGNATURE	
PV-1	

**COVER SHEET**

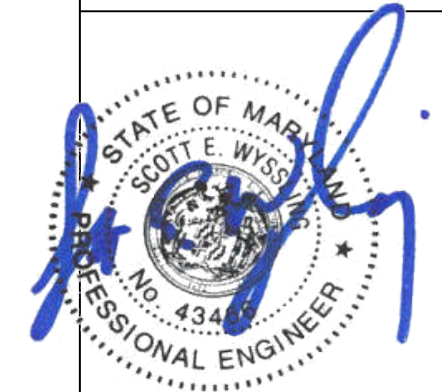
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 (34) ENPHASE IQ8HC-72-M-US (240V) MICROINVERTERS  
 (01) ENPHASE IQ COMBINER 5 PANEL

TOTAL ROOF SQUARE FOOTAGE IS: 2340.8 FT<sup>2</sup>  
 NEW ARRAY SQUARE FOOTAGE IS: 714.65 FT<sup>2</sup>  
 COVERED BY SOLAR IS: 30.53%

**CONTRACTOR**

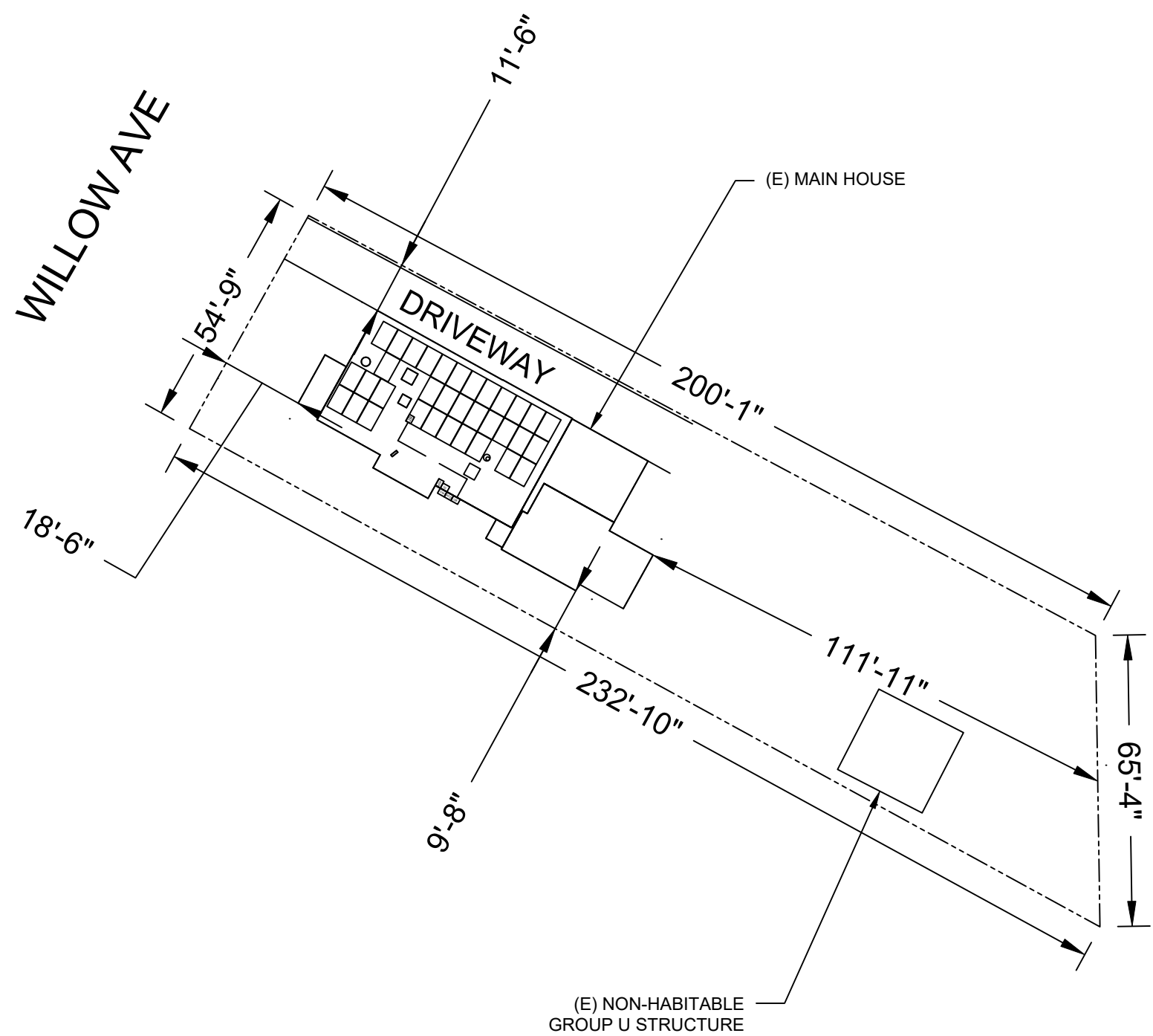
  
**EDGE ENERGY**  
 6854 DISTRIBUTION DRIVE,  
 BELTSVILLE, MD, USA  
 +1 434 568 7220  
 LIC TYPE: MHIC, STATE  
 ELECTRICAL LICENSE  
 LIC NO.: 126720,13228






PROJECT INFO & ADDRESS  
 JOE MCGARVEY  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**  
 SYSTEM SIZE  
 DC SIZE: 14.790 KW DC-(STC)  
 AC SIZE: 12.920 KW AC



**Wyssling Consulting, PLLC**  
 76 N. Meadowbrook Drive, Alpine UT  
 Maryland COA # 58509  
 Signed 10/17/2025

**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. 43466, EXPIRATION DATE: 4/11/2027



- LEGEND**
-  FIRE PATHWAYS
  -  PROPERTY LINE
  -  FENCE
  -  SKYLIGHT/CHIMNEY
  -  VENT/OBSTRUCTION

 **SITE PLAN-1**  
 SCALE: 1/32" = 1'-0"

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DATE	10/10/2025
REVISION	
SIGNATURE	
PV-2	

**SITE PLAN-1**

**SCOPE OF WORK**  
 (N) 14.790KW DC/12.920KW AC ROOF MOUNTED PV SYSTEM  
 (34) HYUNDAI SOLAR HIN-T435NF(BK) MODULES  
 (34) ENPHASE IQ8HC-72-M-US (240V) MICROINVERTERS  
 (01) ENPHASE IQ COMBINER 5 PANEL

TOTAL ROOF SQUARE FOOTAGE IS: 2340.8 FT<sup>2</sup>  
 NEW ARRAY SQUARE FOOTAGE IS: 714.65 FT<sup>2</sup>  
 COVERED BY SOLAR IS: 30.53%

**CONTRACTOR**



**EDGE ENERGY**  
 6854 DISTRIBUTION DRIVE,  
 BELTSVILLE, MD, USA  
 +1 434 568 7220  
 LIC TYPE: MHIC, STATE  
 ELECTRICAL LICENSE  
 LIC NO.: 126720,13228

**PROJECT INFO & ADDRESS**

JOE MCGARVEY  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**

**SYSTEM SIZE**

DC SIZE: 14.790 KW DC-(STC)  
 AC SIZE: 12.920 KW AC



**Wyssling Consulting, PLLC**  
 76 N. Meadowbrook Drive, Alpine UT  
 Maryland COA # 58509  
 Signed 10/17/2025

**PROFESSIONAL CERTIFICATION**

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 PREPARED OR APPROVED BY ME, AND THAT I  
 AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER  
 THE LAWS OF THE STATE OF MARYLAND, LICENSE  
 NO. 43466, EXPIRATION DATE: 4/11/2027

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 PV-2.1

**SITE PLAN-2**

WILLOW AVE

LESS THAN 2:12 PITCH -  
 REQUIRES NO SETBACKS

(N) (34) HYUNDAI SOLAR HIN-T435NF(BK) MODULES  
 WITH ENPHASE IQ8HC-72-M-US (240V)  
 MICROINVERTERS UNDER EACH MODULE (240V)

(N) JUNCTION BOX  
 NEMA 4X RATED

(N) CONDUIT RUN

(E) MAIN SERVICE PANEL  
 (INSIDE BASEMENT)

(E) UTILITY METER  
 (OVERHEAD SERVICE)  
 (OUTSIDE HOUSE)

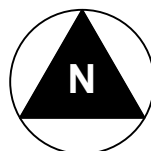
(N) VISIBLE LOCKABLE LABELED AND  
 NON FUSED AC DISCONNECT  
 (UTILITY DISCONNECT)  
 (OUTSIDE HOUSE)

(N) ENPHASE IQ 5 COMBINER PANEL  
 WITH ENPHASE IQ GETWAY  
 (OUTSIDE HOUSE)

(N) 2 SPACE INTERIOR  
 DISCONNECT  
 (INSIDE BASEMENT)

**LEGEND**

- FIRE PATHWAYS
- PROPERTY LINE
- FENCE
- SKYLIGHT/CHIMNEY
- VENT/OBSTRUCTION







**SITE PLAN-2**

SCALE: 3/32" = 1'-0"

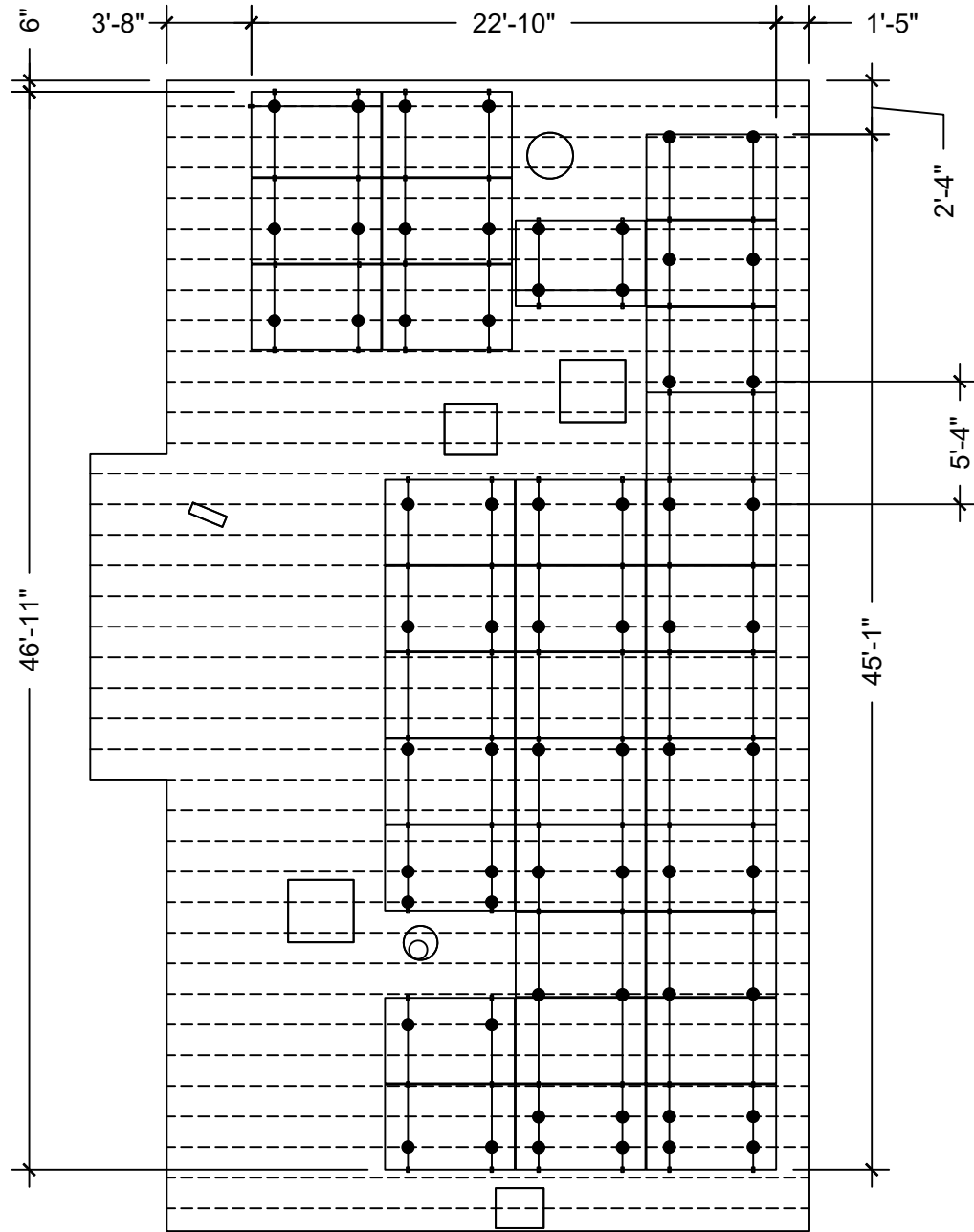
**ROOF SECTION(S)**

ROOF 1	ROOF MATERIAL - TPO ROOF RAFTER SIZE - 2"X10" O.C. SPACING - 16" MODULES - 34
--------	--

DEAD LOAD CALCULATION			
BOM	QUANTITY	LBS/UNIT	TOTAL WEIGHT(LBS)
HYUNDAI SOLAR HIN-T435NF(BK) MODULES	34	46.7	1587.80
MID-CLAMP	38	0.26	9.88
END-CLAMP	60	0.36	21.60
RAIL LENGTH	44	9.55	420.20
SPLICE BAR	10	0.5	5.00
UNIRAC STANDOFF 6" WITH CHEMLINK E-CURB WITH PITCH POCKET	64	0.8	51.20
ENPHASE IQ8HC-72-M-US (240V) MICROINVERTER	34	2.43	82.62
TOTAL WEIGHT OF THE SYSTEM (LBS)			2178.30
TOTAL ARRAY AREA ON THE ROOF (SQ.FT)			714.65
WEIGHT PER SQ.FT. (LBS)			3.05
WEIGHT PER PENETRATION (LBS)			34.04

-  - CLAMP
-  - UNIRAC STANDOFF 6" WITH CHEMLINK E-CURB WITH PITCH POCKET
-  - IRONRIDGE XR-100 RAIL
-  - RAFTER

64 - TOTAL MOUNT



ARRAY 1  
TILT- 5 DEG  
AZIMUTH - 119 DEG

1 | ATTACHMENT PLAN  
SCALE: 1/8" = 1'-0"

**CONTRACTOR**



**EDGE ENERGY**  
6854 DISTRIBUTION DRIVE,  
BELTSVILLE, MD, USA  
+1 434 568 7220  
LIC TYPE: MHIC, STATE  
ELECTRICAL LICENSE  
LIC NO.: 126720,13228

**PROJECT INFO & ADDRESS**

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**7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA**

**SYSTEM SIZE**

DC SIZE: 14.790 KW DC-(STC)  
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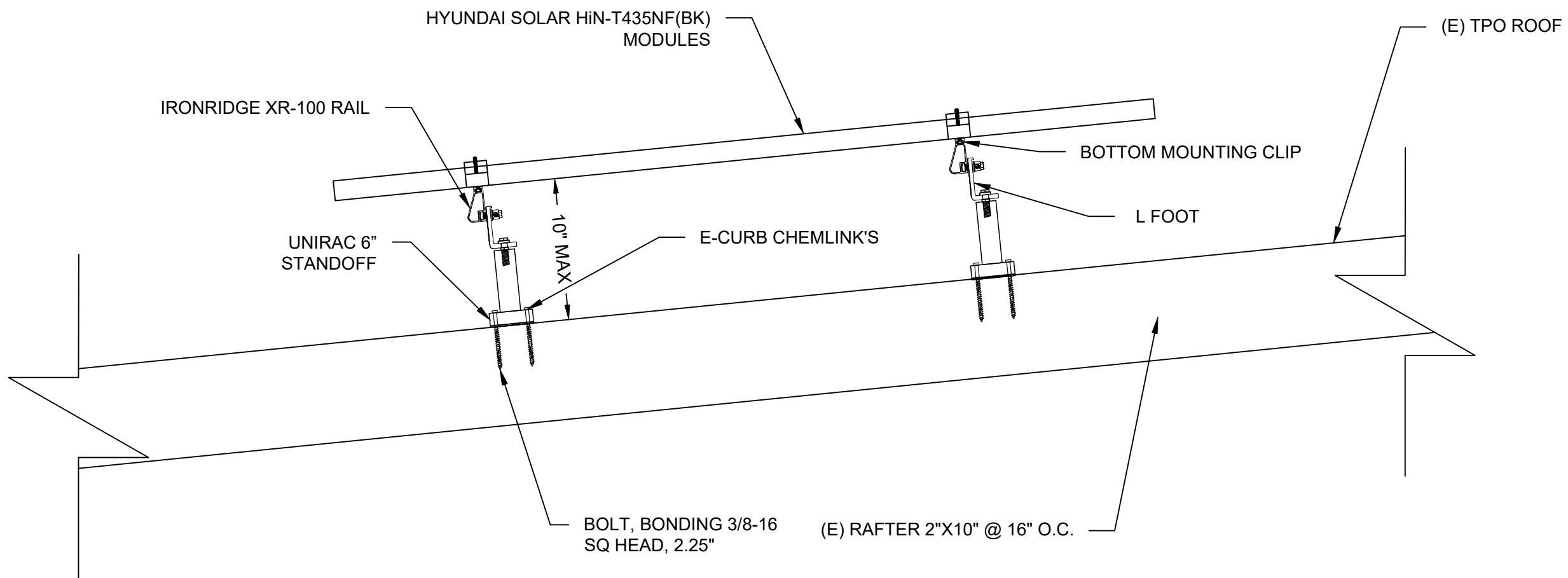


**Wyssling Consulting, PLLC**  
76 N. Meadowbrook Drive, Alpine UT  
Maryland COA # 58509  
Signed 10/17/2025

**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. 43466, EXPIRATION DATE: 4/11/2027

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	PV-3
<b>ATTACHMENT PLAN</b>	



1 | **STRUCTURAL PLAN**  
**SCALE:NTS**

**CONTRACTOR**



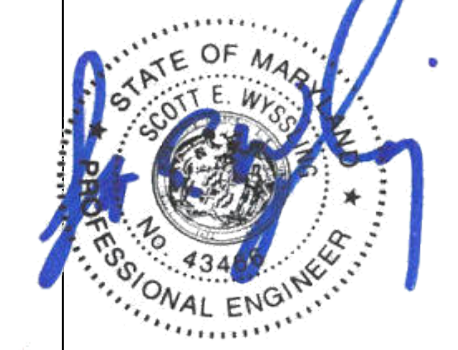
**EDGE ENERGY**  
**6854 DISTRIBUTION DRIVE,**  
**BELTSVILLE, MD, USA**  
**+1 434 568 7220**  
**LIC TYPE: MHIC, STATE**  
**ELECTRICAL LICENSE**  
**LIC NO.: 126720,13228**

**PROJECT INFO & ADDRESS**

**JOE MCGARVEY**  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**

**SYSTEM SIZE**

**DC SIZE: 14.790 KW DC-(STC)**  
**AC SIZE: 12.920 KW AC**



**Wyssling Consulting, PLLC**  
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**Signed 10/17/2025**

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DRAWN BY	OB
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DATE	10/10/2025
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REVISION	
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SIGNATURE	
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	PV-3.1
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**STRUCTURAL PLAN**







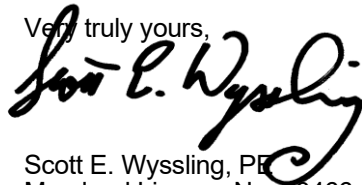
**D. Solar Panel Anchorage**

1. The solar panels shall be mounted in accordance with the most recent Ironridge installation manual. If during solar panel installation, the roof framing members appear unstable or deflect non-uniformly, our office should be notified before proceeding with the installation.
2. The maximum allowable withdrawal force for a #14 lag screw is 194 lbs per inch of penetration as identified in the National Design Standards (NDS) of timber construction specifications. Based on a minimum penetration depth of 2", the allowable capacity per connection is greater than the design withdrawal force (demand). Considering the variable factors for the existing roof framing and installation tolerances, the connection using two #14 lag screws with a minimum of 2" embedment will be adequate and will include a sufficient factor of safety.
3. Considering the wind speed, roof slopes, size and spacing of framing members, and condition of the roof, the panel supports shall be placed no greater than 64" on center.

Based on the above evaluation, this office certifies that with the racking and mounting specified, the existing roof system will adequately support the additional loading imposed by the solar system. This evaluation is in conformance with the Maryland Residential Code (2021 IRC), current industry standards, and is based on information supplied to us at the time of this report.

Should you have any questions regarding the above or if you require further information do not hesitate to contact me.

Very truly yours,



Scott E. Wyssling, PE  
Maryland License No. 43466  
Maryland COA #58509



**Wyssling Consulting, PLLC**  
76 N. Meadowbrook Drive, Alpine UT  
Maryland COA # 58509  
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## Wind Uplift

### Rooftop Solar Panels Parallel to Roof Surface

ASCE 7-16, Section 29.4.4

McGarvey Residence  
7315 Willow Avenue,  
Takoma Park, MD

V =	115	Basic Wind Speed
Exposure	C	ASCE 7-16, Section 26.7
K <sub>z</sub> =	0.85	Velocity Pressure Coefficient, ASCE 7-16, Figure 26.10-1
K <sub>zt</sub> =	1	Topographic Factor, ASCE 7-16, Section 26.8.2
K <sub>d</sub> =	0.85	Directionality Factor, ASCE 7-16, Section 26.6
K <sub>e</sub> =	1.000	Ground Elevation Factor, ASCE 7-16, Section 26.9
q <sub>h</sub> =	24.5 psf	q <sub>h</sub> = 0.00256K <sub>z</sub> K <sub>zt</sub> K <sub>d</sub> K <sub>e</sub> V <sup>2</sup> (ASCE 7-16 Eq. 26.10-1)
Roof Angle =	5	deg
Roof Type	Gable	
S <sub>anchor</sub> =	64 in	Horizontal spacing of roof anchors
A <sub>trib</sub> =	15.07 sf	Panel Area tributary to each roof anchor



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GC <sub>p</sub>	External Pressure Coefficient, ASCE 7-16, Figure 30.3-2			
Roof Zone	<b>Zone 1</b>	<b>1'</b>	<b>Zone 2</b>	<b>Zone 3</b>
	-1.69	-0.90	-2.29	-3.18
g <sub>a</sub> =	0.78	Pressure Equalization Factor, ASCE 7-16 Figure 29.4.-8		
g <sub>E</sub> =	1.00	Edge Array Factor, ASCE 29.4.3 edges < 0.5*building height, and panel spacing < 4ft.		

p<sub>net</sub> = q<sub>h</sub>GC<sub>p</sub>g<sub>a</sub>g<sub>E</sub> = Design Wind Pressure, ASCE 7-16, Equation 29.4-7

Roof Zone	<b>1</b>	<b>1'</b>	<b>Zone 2</b>	<b>Zone 3</b>
	-32 psf	-17 psf	-44 psf	-61 psf
	<b>Use 32 psf</b>	<b>Use 17 psf</b>	<b>Use 44 psf</b>	<b>Use 61 psf</b>
x 0.6 =	<b>19 psf</b>	<b>16 psf</b>	<b>26 psf</b>	<b>36 psf</b>

#### Connection to Existing Roof Framing

F.S. =	1	Additional Factor of Safety applied to withdrawal force, if desired		
A <sub>trib</sub> =	15.1	ft <sup>2</sup>		
DL <sub>panel</sub> =	3 psf			
Roof Zone	<b>1</b>	<b>1'</b>	<b>Zone 2</b>	<b>Zone 3</b>
W <sub>uplift</sub> =	32 psf	17 psf	44 psf	61 psf

P<sub>lag</sub> = F.S. x A<sub>trib</sub> x (0.6D - 0.6W) = **Withdrawal force for each roof anchor**

Roof Zone	<b>1</b>	<b>1'</b>	<b>Zone 2</b>	<b>Zone 3</b>
	<b>-266.8 lbs</b>	<b>-130.5 lbs</b>	<b>-369.6 lbs</b>	<b>-522.7 lbs</b>

#### Connection Capacity

d <sub>b</sub> =	1/4 in	Lag Screw diameter
D <sub>pen</sub> =	2 in	Lag Screw penetration into existing framing member
No. of Screws	2	Screws per Connection
	Spruce-Pine-Fir	Species of wood framing
C <sub>D</sub> =	1.6	Load Duration Factor for Wind Loading, NDS Table 2.3.2
C <sub>t</sub> =	0.7	Temperature Factor, NDS Table 10.3.4
W =	173 lb/in	Withdrawal Capacity, NDS Equation 11.2-1
W' = C <sub>D</sub> x C <sub>t</sub> x W =	194 lb/in	Adjusted withdrawal value
P <sub>allow</sub> = D <sub>pen</sub> x W' =	<b>776 lbs</b>	<b>(Using (2) screws per connection)</b>

Roof Zone	<b>1</b>	<b>1'</b>	<b>Zone 2</b>	<b>Zone 3</b>
<b>DEMAND =</b>	<b>267 lbs</b>	<b>130 lbs</b>	<b>370 lbs</b>	<b>523 lbs</b>
<b>CAPACITY =</b>	<b>776 lbs</b>	<b>776 lbs</b>	<b>776 lbs</b>	<b>776 lbs</b>
	<b>up to 72in ok</b>	<b>up to 72in ok</b>	<b>up to 72in ok</b>	<b>up to 72in ok</b>

This analysis calculates the capacity of the lag screws only. For capacity of the complete mounting system, please see manufacturer's recommendations.



Scott E. Wyssling, PE  
Heath J. Harpster, PE, P.Eng  
Gregory T. Elvestad, PE

76 North Meadowbrook Drive  
Alpine, UT 84004  
office (201) 874-3483  
swyssling@wysslingconsulting.com

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October 17, 2025

Edge Energy  
6854 Distribution Drive,  
Beltsville, MD

Re: Engineering Services  
McGarvey Residence  
7315 Willow Avenue, Takoma Park, MD  
14.790 kW System

To Whom It May Concern:

We have received information regarding solar panel installation on the roof of the above referenced structure. Our evaluation of the structure is to verify the existing capacity of the roof system and its ability to support the additional loads imposed by the proposed solar system.

**A. Site Assessment Information**

1. Site visit documentation identifying attic information including size and spacing of framing for the existing roof structure.
2. Design drawings of the proposed system including a site plan, roof plan and connection details for the solar panels. This information will be utilized for approval and construction of the proposed system.

**B. Description of Structure:**

**Roof Framing:** 2 x 10 dimensional lumber spaced at 16" on center with interior bearing wall support.  
**Roof Material:** TPO Roofing  
**Roof Slope:** 5 degrees  
**Attic Access:** Accessible  
**Foundation:** Permanent

**C. Loading Criteria Used**

- **Dead Load**
  - Existing Roofing and framing = 7 psf
  - New Solar Panels and Racking = 3 psf
  - TOTAL = 10 PSF
- **Live Load** = 20 psf (reducible) – 0 psf at locations of solar panels
- **Ground Snow Load** = 30 psf
- **Wind Load** based on ASCE 7-16
  - Ultimate Wind Speed = 115 mph (based on Risk Category II)
  - Exposure Category C

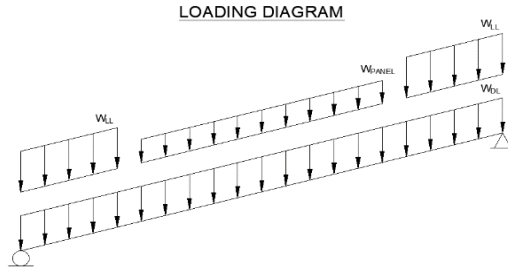
*Analysis performed of the existing roof structure utilizing the above loading criteria is in accordance with the Maryland Residential Code (2021 International Residential Code). This analysis indicates that the existing framing will support the additional panel loading without damage, if installed correctly.*



Beginning and ending locations of Panel Dead and/or Snow Load along rafter span ( $W_{\text{PANEL}}$ )

$$x_{\text{start}} = 2.33 \text{ ft}$$

$$x_{\text{end}} = 24.66 \text{ ft}$$



Results

Load Combination	V	M	D	D
DL + LL	122.60	401.5	0.049	L / 3152
DL + S (upper)	395.80	1115.38	0.049	L / 3152
DL + S (lower)	395.80	1115.38	0.049	L / 3152
0.6DL - 0.6W	41.60	135.20	0.030	L / 5253

**Wyssling Consulting, PLLC**  
76 N. Meadowbrook Drive, Alpine UT  
Maryland COA # 58509  
Signed 10/17/2025

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Capacity of Wood Rafter

Adjustment Factors

	Shear	Moment	
$C_D =$	1.15	1.15	Load Duration Factor, NDS Table 2.3.2
$C_M =$	1	1	Wet Service Factor, NDS Table 4A
$C_t =$	1	1	Temperature Factor, NDS Table 10.3.4
$C_L =$		1	Beam Stability Factor, NDS Section 3.3.3
$C_F =$		1.1	Size Factor, NDS Table 4A
$C_{fu} =$		1	Flat Use Factor, NDS Table 4A
$C_i =$	1	1	Incising Factor, NDS Section 4.3.8
$C_r =$		1.15	Repetitive Member Factor, NDS Table 4A

$$F_b = 875 \text{ psi Reference Design Allowable Bending Stress, NDS Table 4A}$$

$$F_v = 135 \text{ psi Reference Design Allowable Shear Stress, NDS Table 4A}$$

$$F'_b = F_b \times \text{Adjustment Factors} = \mathbf{1273 \text{ psi}} \text{ (allowable bending stress)}$$

$$f_{b \text{ upper}} = M/S = \mathbf{626 \text{ psi}} \text{ (actual bending stress determined from } M_{\text{max}})$$

$$f_{b \text{ lower}} = M/S = \mathbf{626 \text{ psi}} \text{ (actual bending stress determined from } M_{\text{max}})$$

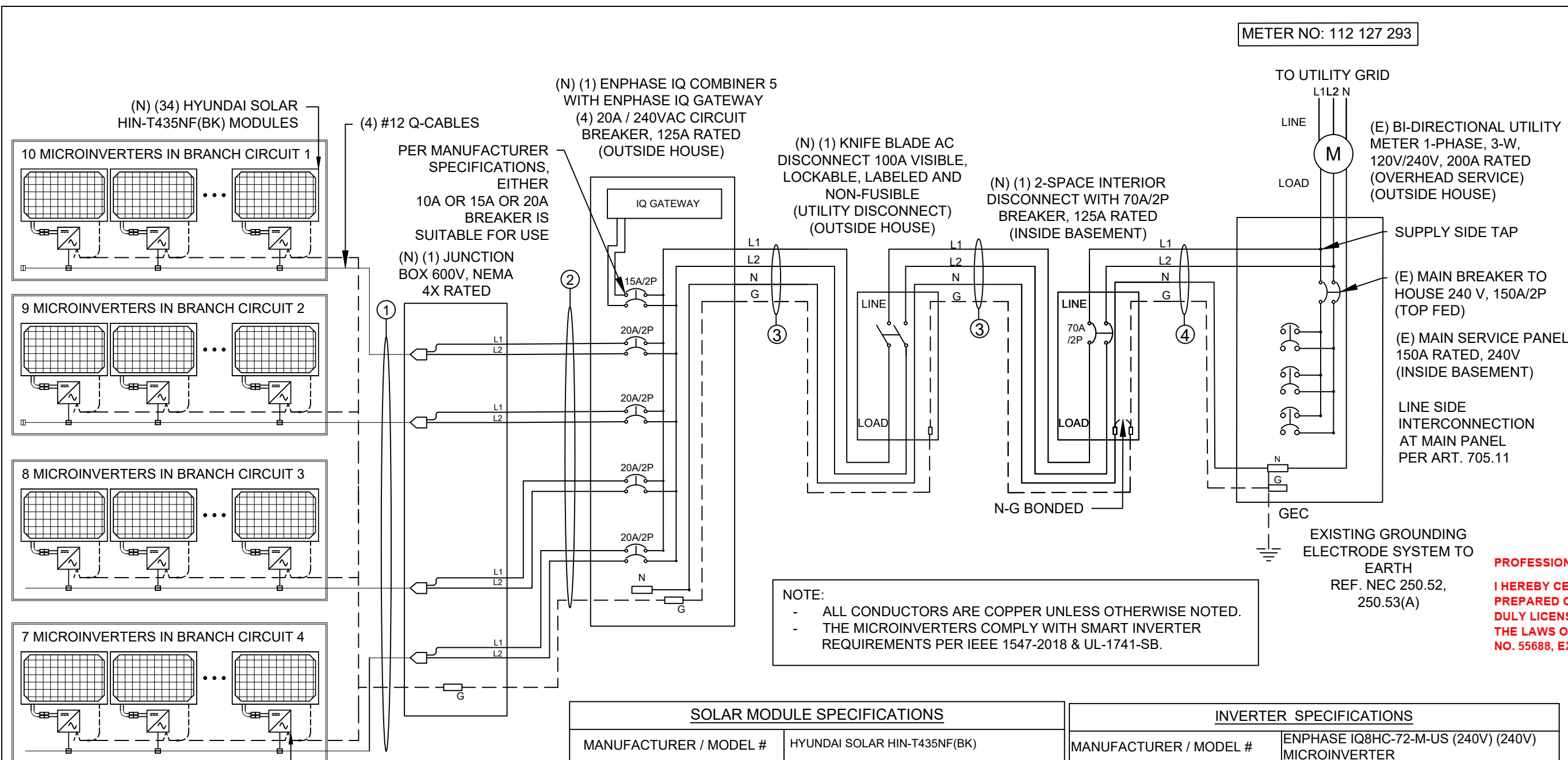
**OK IN BENDING**

$$F'_v = F_v \times \text{Adjustment Factors} = \mathbf{155 \text{ psi}} \text{ (allowable shear stress)}$$

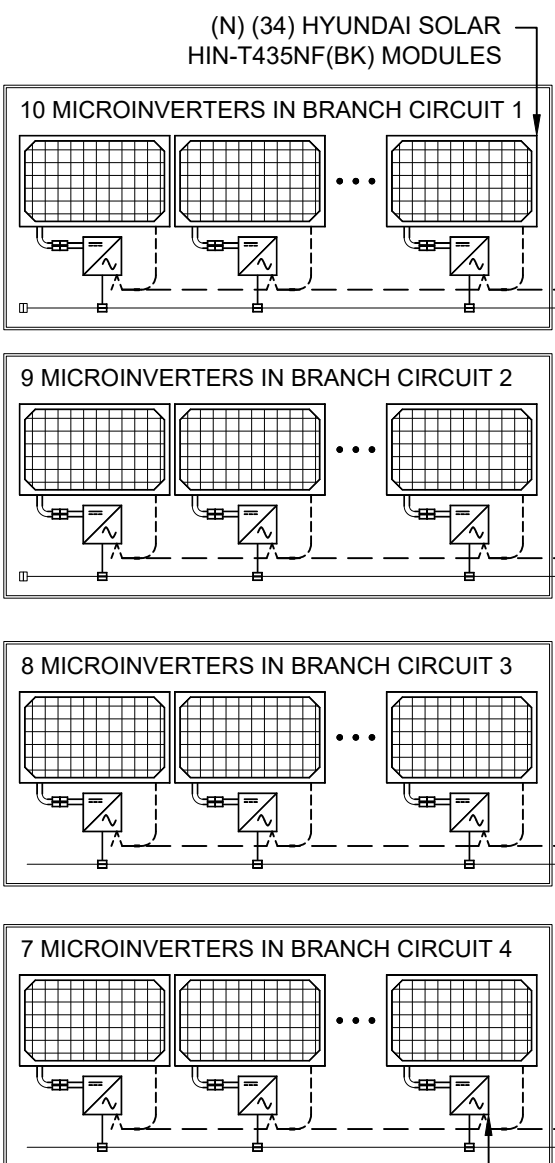
$$f_{v \text{ upper}} = 3V/2bd = \mathbf{43 \text{ psi}} \text{ (actual shear stress determined from } V_{\text{max}})$$

$$f_{v \text{ lower}} = 3V/2bd = \mathbf{43 \text{ psi}} \text{ (actual shear stress determined from } V_{\text{max}})$$

**OK IN SHEAR**



METER NO: 112 127 293



(N) (34) ENPHASE IQ8HC-72-M-US (240V) MICROINVERTERS ONE UNDER EACH MODULE (240V)

(4) #12 Q-CABLES  
PER MANUFACTURER SPECIFICATIONS, EITHER 10A OR 15A OR 20A BREAKER IS SUITABLE FOR USE  
(N) (1) JUNCTION BOX 600V, NEMA 4X RATED

(N) (1) ENPHASE IQ COMBINER 5 WITH ENPHASE IQ GATEWAY  
(4) 20A / 240VAC CIRCUIT BREAKER, 125A RATED (OUTSIDE HOUSE)

(N) (1) KNIFE BLADE AC DISCONNECT 100A VISIBLE, LOCKABLE, LABELED AND NON-FUSIBLE (UTILITY DISCONNECT) (OUTSIDE HOUSE)

(N) (1) 2-SPACE INTERIOR DISCONNECT WITH 70A/2P BREAKER, 125A RATED (INSIDE BASEMENT)

TO UTILITY GRID  
LINE L1 L2 N  
LOAD  
(E) BI-DIRECTIONAL UTILITY METER 1-PHASE, 3-W, 120V/240V, 200A RATED (OVERHEAD SERVICE) (OUTSIDE HOUSE)

SUPPLY SIDE TAP  
(E) MAIN BREAKER TO HOUSE 240 V, 150A/2P (TOP FED)  
(E) MAIN SERVICE PANEL 150A RATED, 240V (INSIDE BASEMENT)  
LINE SIDE INTERCONNECTION AT MAIN PANEL PER ART. 705.11

NOTE:  
- ALL CONDUCTORS ARE COPPER UNLESS OTHERWISE NOTED.  
- THE MICROINVERTERS COMPLY WITH SMART INVERTER REQUIREMENTS PER IEEE 1547-2018 & UL-1741-SB.

EXISTING GROUNDING ELECTRODE SYSTEM TO EARTH  
REF. NEC 250.52, 250.53(A)

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SOLAR MODULE SPECIFICATIONS	
MANUFACTURER / MODEL #	HYUNDAI SOLAR HIN-T435NF(BK)
VMP	32.1V
IMP	13.56A
VOC	38.6V
ISC	14.32A
TEMP. COEFF. VOC	-0.25%/K
MODULE DIMENSION	67.8"L x 44.6"W x 1.18"D (In Inch)

INVERTER SPECIFICATIONS	
MANUFACTURER / MODEL #	ENPHASE IQ8HC-72-M-US (240V) (240V) MICROINVERTER
MIN/MAX DC VOLT RATING	22V MIN/ 58V MAX
MAX INPUT POWER	540W
NOMINAL AC VOLTAGE RATING	240V/ 211-264V
MAX AC CURRENT	1.58A
MAX MODULES PER STRING	10 MODULES
MAX OUTPUT POWER	380 VA

ID	PHASE CONDUCTOR AND NEUTRAL QTY, SIZE AND TYPE PER CONDUIT			GROUND CONDUCTOR QTY, SIZE AND TYPE PER CONDUIT			CONDUIT SIZE	CONDUIT TYPE
	QTY	SIZE	TYPE	QTY	SIZE	TYPE		
1	4	AWG #12	Q-CABLE	1	AWG #6	BARE COPPER EGC IN FREE AIR	N/A	FREE AIR
2	8	AWG #10	THWN-2 OR NM CABLE	1	AWG #10	THWN-2 OR NM CABLE	3/4"	EMT/FMC/NM CABLE
3	3	AWG #4	THWN-2 OR NM CABLE	1	AWG #8	THWN-2 OR NM CABLE	1"	EMT/FMC/NM CABLE
4	3	AWG #4	THWN-2 OR NM CABLE	1	AWG #6	THWN-2 OR NM CABLE	1"	EMT/FMC

**CONTRACTOR**

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LIC TYPE: MHIC, STATE  
ELECTRICAL LICENSE  
LIC NO.: 126720,13228

PROJECT INFO & ADDRESS  
JOE MCGARVEY  
7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA

**SYSTEM SIZE**  
DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC

**ELECTRICAL ONLY**  
  
**Wyssling Consulting, PLLC**  
76 N Meadowbrook Drive, Alpine UT 84004  
Maryland COA #58509

Signed 10/20/2025  
DRAWN BY OB  
DATE 10/10/2025  
REVISION  
SIGNATURE  
PV-4

**ELECTRICAL**

AMBIENT TEMPERATURE SPECS	
RECORD LOW TEMP	-12°
AMBIENT TEMP (HIGH TEMP 2%)	34°
CONDUIT HEIGHT	7/8"
ROOF TOP TEMP	56°
CONDUCTOR TEMPERATURE RATE	75°
MODULE TEMPERATURE COEFFICIENT OF Voc	-0.25%/K

PERCENT OF VALUES	NUMBER OF CURRENT CARRYING CONDUCTORS IN EMT
0.80	4-6
0.70	7-9
0.50	10-20

**CALCULATIONS:**

**1. CURRENT CARRYING CONDUCTOR**

**(A) BEFORE IQ COMBINER PANEL**

AMBIENT TEMPERATURE - (34)°C ...NEC 310.15(B)(1)  
 TEMPERATURE DERATE FACTOR - 0.94 ...NEC 310.15(B)(1)  
 GROUPING FACTOR - 0.7...NEC 310.15(C)(1)

**CONDUCTOR AMPACITY**

= (INV O/P CURRENT ) x 1.25 / A.T.F / G.F ...NEC 690.8(B)  
 = [(10 x 1.58) x 1.25] / [0.94 x 0.7]  
 = 30.02A

SELECTED CONDUCTOR - #10 THWN-2 ...NEC 310.16

**(B) AFTER IQ COMBINER PANEL**

TEMPERATURE DERATE FACTOR - 0.94  
 GROUPING FACTOR - 1

**CONDUCTOR AMPACITY**

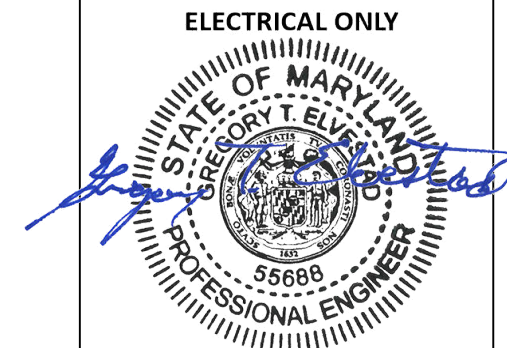
= (TOTAL INV O/P CURRENT) x 1.25 / 0.94/ 1 ...NEC 690.8(B)  
 = [(34 x 1.58) x 1.25] / [0.94 x 1]  
 = 71.44 A

SELECTED CONDUCTOR - #4 THWN-2 ...NEC 310.16

**2. PV OVER CURRENT PROTECTION ...NEC 690.9(B)**

= TOTAL INVERTER O/P CURRENT x 1.25  
 = (34 x 1.58) x 1.25 = 67.15 A

**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. 55688, EXPIRATION DATE: 2/18/2026.



Wyssling Consulting, PLLC  
 76 N Meadowbrook Drive, Alpine UT 84004  
 Maryland COA #58509

Signed 10/20/2025

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PV-4.1

**ELECTRICAL CALCULATIONS**

**CONTRACTOR**



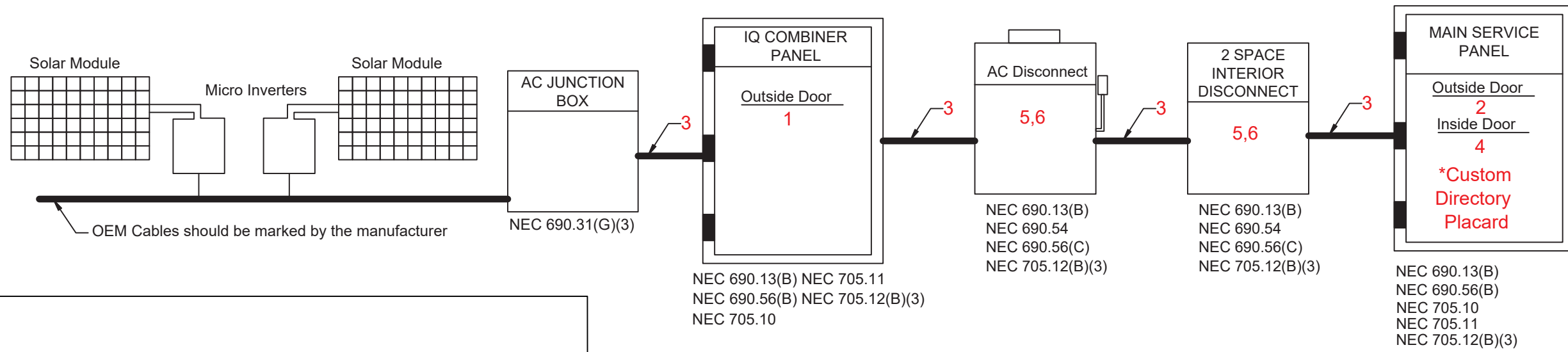
EDGE ENERGY  
 6854 DISTRIBUTION DRIVE,  
 BELTSVILLE, MD, USA  
 +1 434 568 7220  
 LIC TYPE: MHIC, STATE  
 ELECTRICAL LICENSE  
 LIC NO.: 126720,13228

PROJECT INFO & ADDRESS

JOE MCGARVEY  
 7315 WILLOW AVE,  
 TAKOMA PARK,  
 VA 20912, USA

SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
 AC SIZE: 12.920 KW AC



**1** PHOTOVOLTAIC SYSTEM COMBINER PANEL DO NOT ADD LOADS

**2** **WARNING:** DUAL POWER SOURCE SECOND SOURCE IS PHOTOVOLTAIC SYSTEM

**3** CAUTION: SOLAR CIRCUIT

**4** **WARNING** INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE

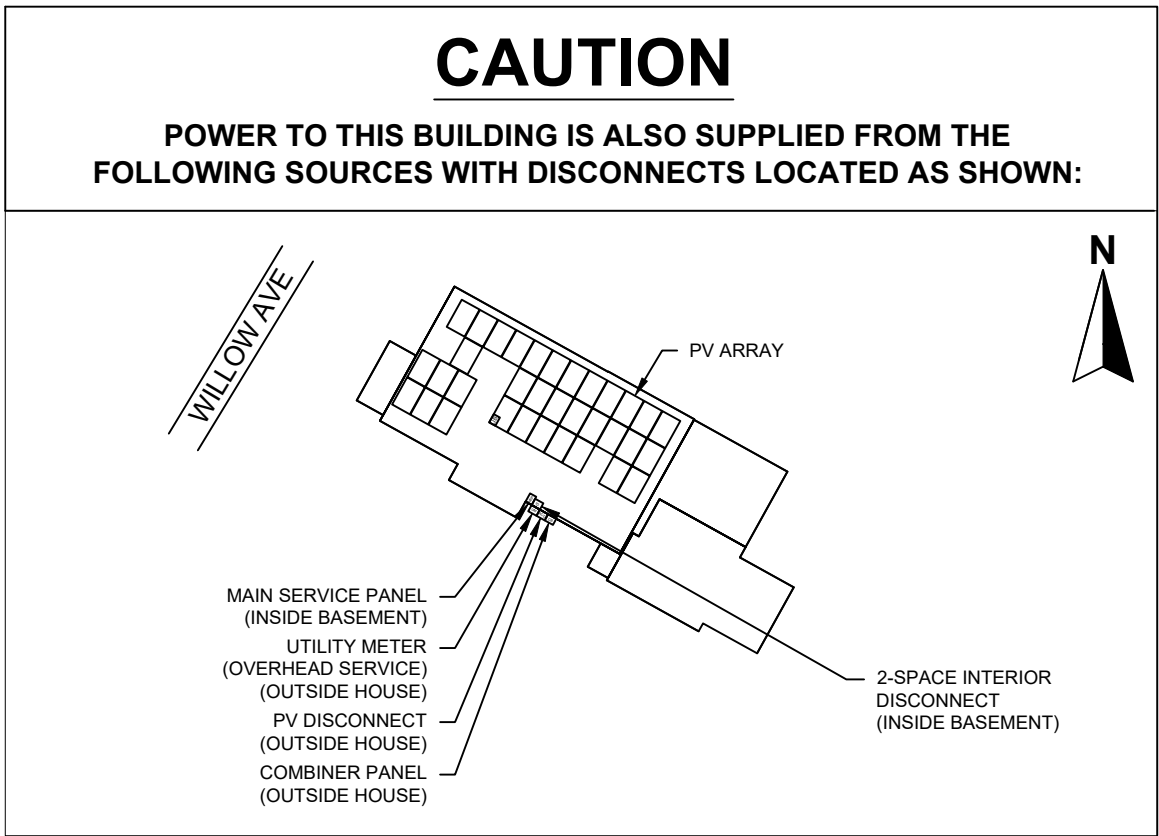
**5** SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY

**6** PHOTOVOLTAIC SYSTEM AC DISCONNECT RATED AC OUTPUT CURRENT 53.72 AMPS NOMINAL OPERATING AC VOLTAGE 240 VOLTS

**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. 55688, EXPIRATION DATE: 2/18/2026.



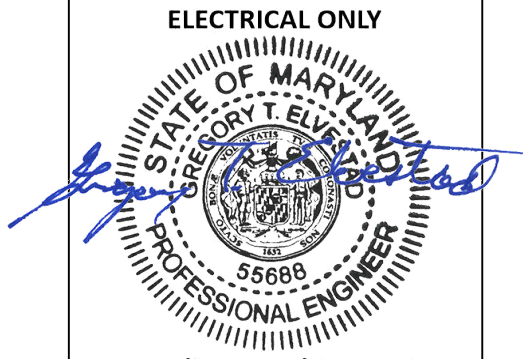
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PROJECT INFO & ADDRESS  
JOE MCGARVEY  
**7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA**

**SYSTEM SIZE**  
DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC



**Wyssling Consulting, PLLC**  
76 N Meadowbrook Drive, Alpine UT 84004  
Maryland COA #58509

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PV-5

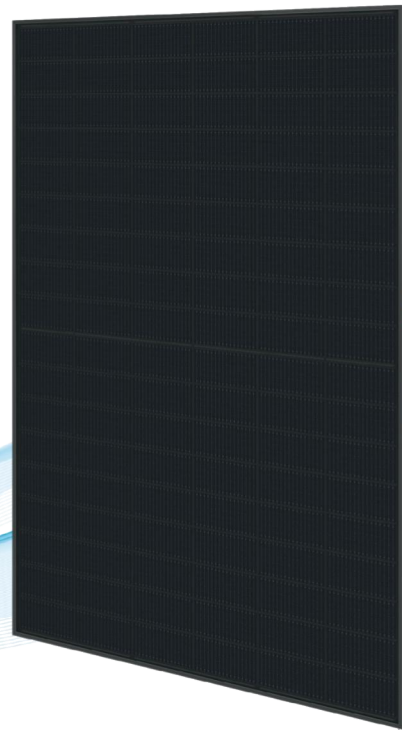
**LABELS**

# HD HYUNDAI SOLAR MODULE

## NF(BK) Series

Premium N-Type TOPCon Module

HiN-T430NF(BK) | HiN-T435NF(BK) | HiN-T440NF(BK)



22.53%  
High Efficiency



High-End  
TOPCon  
Technology



Higher  
Bifaciality



Long-Term  
Reliability



Compatible  
with Carport  
Applications



For Residential  
(Full Black Design)

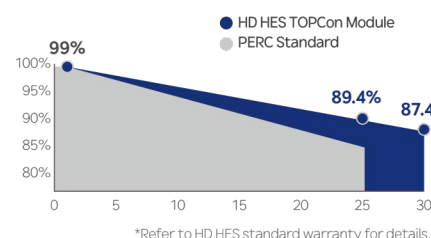
### HD Hyundai's Warranty Provisions



• 25-Year Product Warranty  
• Materials and workmanship



• 30-Year Performance Warranty  
• First year degradation: 1%  
• Linear warranty after initial year:  
with 0.4%p annual degradation,  
87.4% is guaranteed up to 30years



\*Refer to HD HES standard warranty for details.

### Certification



• ISO 9001 : Quality management systems  
• ISO 14001 : Environmental management systems  
• ISO 45001 : Occupational health and safety management systems  
• UL 61730: Photovoltaic (PV) module safety qualification (CSA)  
• IEC 61701: Salt mist corrosion testing  
• IEC 62716: Ammonia corrosion testing  
• IEC 62804: Potential Induced Degradation (PID) testing  
• IEC 60068-2-68: Sand and dust testing for environmental durability

### Electrical Characteristics

Item	Unit	HiN-T430NF(BK)		HiN-T435NF(BK)		HiN-T440NF(BK)	
		BNPI	BNPI	BNPI	BNPI	BNPI	BNPI
Nominal output (Pmax)	W	430	476	435	482	440	488
Open circuit voltage (Voc)	V	38.4	38.4	38.6	38.6	38.8	38.8
Short circuit current (Isc)	A	14.25	15.79	14.32	15.87	14.39	15.94
Voltage at Pmax (Vmpp)	V	31.9	31.9	32.1	32.1	32.3	32.3
Current at Pmax (Impp)	A	13.48	14.94	13.56	15.01	13.63	15.10
Module efficiency	%	22.02	24.40	22.28	24.68	22.53	25.00
Power Class Sorting	W	0 ~ +5					
Temperature coefficient of Pmax	%/K	-0.30					
Temperature coefficient of Voc	%/K	-0.25					
Temperature coefficient of Isc	%/K	0.046					
Bifaciality	%	80%±10%					

\*STC : Irradiance 1,000 W/m<sup>2</sup>, cell temperature 25°C, AM=1.5 / Test uncertainty for Pmax ±3%; Voc ±3%; Isc ±3%  
\*\*The electrical properties of BNPI are measured under the irradiance corresponding to 1000 W/m<sup>2</sup> on the module front and 135 W/m<sup>2</sup> on the module rear.

Additional Power Gain from rear side					
Pmpp gain	Pmpp[W]	Vmpp[V]	Impp[A]	Voc[V]	Isc[A]
5%	458	32.30	14.18	38.80	14.97
15%	493	32.30	15.27	38.80	16.12
25%	528	32.40	16.36	38.90	17.27

\*Electrical characteristics with different rear power gain (reference to 440W)

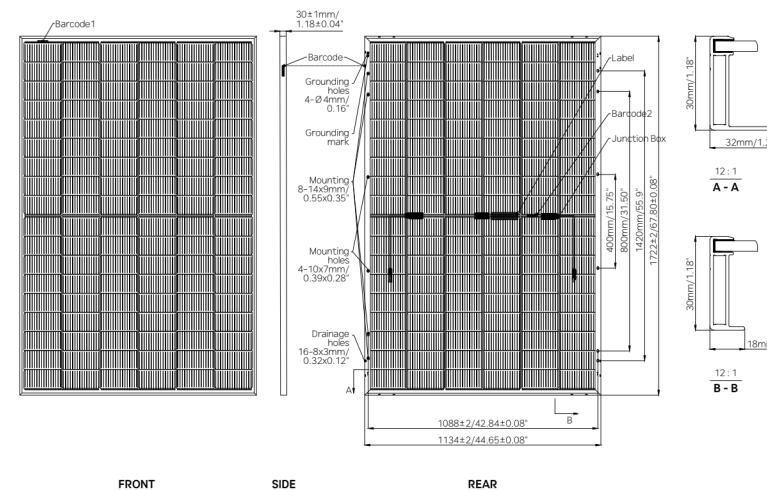
### Mechanical Characteristics

Dimensions	1,722mm (L) x 1,134mm (W) x 30mm (H) (67.8in x 44.6in x 1.2in)
Weight	24.5 kg (50.01lbs)
Solar Cells	N-Type TOPCon, 108 (6x18) monocrystalline 16BB half-cut bifacial cells
Output Cables	Cable : (+) 1,200mm(47.2in), (-) 1,200mm(47.2in) / Customized length available Connector : Staubli MC4 genuine Connector / Compatible, IP68
Junction Box	3-part, 3 bypass diodes, IP68 rated
Construction	Front : 2.0mm(0.08in) semi-tempered solar glass with high transmittance and anti-reflective coating Rear : 2.0mm(0.08in) semi-tempered solar glass
Frame	Anodized aluminum alloy

### Shipping Configurations

Packing Direction	Vertical	Packing pallet weight (kg)	912
Container Size (HC)	40'	Modules Per Pallet (pcs)	36
Pallets Per Container	26	Modules Per Container (pcs)	936

### Module Diagram (unit : mm)



Sales & Marketing  
hes.sales@hd.com

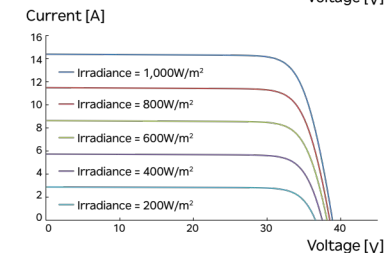
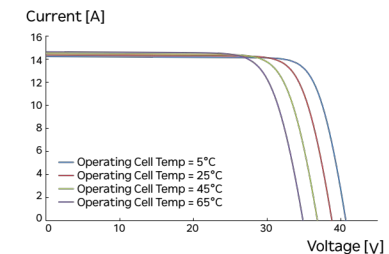
HD Hyundai Energy Solutions reserves the right to update or modify the specifications and features listed in this datasheet without prior notice. Always check the latest version of the datasheet for accurate information. Before using the product, please refer to the Installation and Operation Manual and Warranty. We retain the right of final interpretation.

### Installation Safety Guide

- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not handle or install modules when they are wet.

Nominal Module Operation Temperature	44°C ± 2°C
Operating Temperature	-40°C~+85°C
Maximum System Voltage	DC 1,500 V
Maximum Reverse Current	30A
Maximum Test Load	Front 5,400Pa *Rear 5,400Pa
Fire Performance	Type 29

### I-V Curves (HiN-T440NF(BK))



### CONTRACTOR



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ELECTRICAL LICENSE  
LIC NO.: 126720,13228

### PROJECT INFO & ADDRESS

JOE MCGARVEY  
7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA

### SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC

DRAWN BY OB

DATE 10/10/2025

REVISION

SIGNATURE

PV-6

**RESOURCE  
DOCUMENT**



DATA SHEET



## IQ8HC Microinverter

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



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



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



Connect PV modules quickly and easily to the IQ8 Series Microinverters that have integrated MC4 connectors.



IQ8 Series Microinverters are UL Listed as PV rapid shutdown equipment and conform with various regulations when installed according to the manufacturer's instructions.

\*Only when installed with IQ System Controller 2 meets UL 1741.

## IQ8HC Microinverter

INPUT DATA (DC)	UNITS	IQ8HC-72-M-US
Commonly used module pairings <sup>1</sup>	W	320-540
Module compatibility		To meet compatibility, PV modules must be within the maximum input DC voltage and maximum module I <sub>sc</sub> listed below. Module compatibility can be checked at <a href="https://enphase.com/installers/microinverters/calculator">https://enphase.com/installers/microinverters/calculator</a> .
MPPT voltage range	V	29.5-45
Operating range	V	18-58
Minimum/Maximum start voltage	V	22/58
Max. input DC voltage	V	60
Max. continuous operating DC current	A	14
Max. input DC short-circuit current	A	25
Max. module I <sub>sc</sub>	A	20
Overtoltage class DC port		II
DC port backfeed current	mA	0
PV array configuration		Ungrounded array; no additional DC side protection required; AC side protection requires max 20 A per branch circuit

OUTPUT DATA (AC)	UNITS	IQ8HC-72-M-US @240 VAC	IQ8HC-72-M-US @208 VAC
Peak output power	VA	384	366
Max. continuous output power	VA	380	360
Nominal grid voltage (L-L)	V	240, split-phase (L-L), 180°	208, single-phase (L-L), 120°
Minimum and maximum grid voltage <sup>2</sup>	V	211-264	183-229
Max. continuous output current	A	1.58	1.73
Nominal frequency	Hz	60	
Extended frequency range	Hz	47-68	
AC short circuit fault current over three cycles I <sub>arms</sub>		2.70	
Max. units per 20 A (L-L) branch circuit <sup>3</sup>		10	9
Total harmonic distortion	%	< 5	
Overtoltage class AC port		III	
AC port backfeed current	mA	18	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading...0.85 lagging	
Peak efficiency	%	97.31	97.21
CEC weighted efficiency	%	97.00	96.50
Nighttime power consumption	mW	22	29

MECHANICAL DATA	UNITS
Ambient temperature range	-40°C to 65°C (-40°F to 149°F)
Relative humidity range	4% to 100% (condensing)
DC connector type	Stäubli MC4
Dimensions (H x W x D); Weight	212 mm (8.3") x 175 mm (6.9") x 30.2 mm (1.2"); 1.1 kg (2.43 lbs)
Cooling	Natural convection - no fans
Approved for wet locations; Pollution degree	Yes; PD3
Enclosure	Class II double-insulated, corrosion-resistant polymeric enclosure
Environ. category; UV exposure rating	NEMA Type 6; outdoor

COMPLIANCE	
Certifications	CA Rule 21 (UL 1741-SA), UL 62109-1, IEEE 1547:2018 (UL 1741-SB), FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV rapid shutdown equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 rapid shutdown of PV systems for AC and DC conductors when installed according to manufacturer's instructions.

(1) No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/installers/microinverters/calculator>.  
(2) Nominal voltage range can be extended beyond nominal if required by the utility.  
(3) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

## CONTRACTOR



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LIC TYPE: MHIC, STATE  
ELECTRICAL LICENSE  
LIC NO.: 126720,13228

PROJECT INFO & ADDRESS  
JOE MCGARVEY  
7315 WILLOW AVE,  
TAKOMA PARK,  
VA 20912, USA

**SYSTEM SIZE**  
DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC

DRAWN BY	OB
DATE	10/10/2025
REVISION	

SIGNATURE

PV-6.1  
**RESOURCE DOCUMENT**



DATA SHEET



X-IQ-AM1-240-5  
X-IQ-AM1-240-5C

## IQ Combiner 5/5C

The IQ Combiner 5/5C consolidates interconnection equipment into a single enclosure and streamlines IQ Series Microinverters and IQ Gateway installation by providing a consistent, pre-wired solution for residential applications. IQ Combiner 5/5C uses wired control communication and is compatible with IQ System Controller 3/3G and IQ Battery 5P.

The IQ Combiner 5/5C, IQ Series Microinverters, IQ System Controller 3/3G, and IQ Battery 5P provide a complete grid-agnostic Enphase Energy System.



**IQ Series Microinverters**  
The high-powered smart grid-ready IQ Series Microinverters (IQ6, IQ7, and IQ8 Series) simplify the installation process.



**IQ System Controller 3/3G**  
Provides microgrid interconnection device (MID) functionality by automatically detecting grid failures and seamlessly transitioning the home energy system from grid power to backup power.



**IQ Battery 5P**  
Fully integrated AC battery system. Includes six field-replaceable IQ8D-BAT Microinverters.



**IQ Load Controller**  
Helps prioritize essential appliances during a grid outage to optimize energy consumption and prolong battery life.



5-year limited warranty



\*For country-specific warranty information, see the <https://enphase.com/installers/resources/warranty> page.  
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IQC-5-5C-DSH-00007-3.0-EN-US-2024-03-01

## IQ Combiner 5/5C

MODEL NUMBER	
IQ Combiner 5 (X-IQ-AM1-240-5)	IQ Combiner 5 with IQ Gateway printed circuit board for integrated revenue-grade PV production metering (ANSI CT2.20 ±0.5%), consumption monitoring (±2.5%), and IQ Battery monitoring (±2.5%). Includes a silver solar shield to deflect heat.
IQ Combiner 5C (X-IQ-AM1-240-5C)	IQ Combiner 5C with IQ Gateway printed circuit board for integrated revenue-grade PV production metering (ANSI CT2.20 ±0.5%), consumption monitoring (±2.5%) and IQ Battery monitoring (±2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05). Includes a silver solar shield to deflect heat.
WHAT'S IN THE BOX	
IQ Gateway printed circuit board	IQ Gateway is the platform for total energy management for comprehensive, remote maintenance, and management of the Enphase Energy System
Busbar	80 A busbar with support for 1 × IQ Gateway breaker and 4 × 20 A breaker for installing IQ Series Microinverters and IQ Battery 5P
IQ Gateway breaker	Circuit breaker, 2-pole, 10 A/15 A
Production CT	Pre-wired revenue-grade solid-core CT, accurate up to ±0.5%
Consumption CT	Two consumption metering clamp CTs, shipped with the box, accurate up to ±2.5%
IQ Battery CT	One battery metering clamp CT, shipped with the box, accurate up to ±2.5%
CTRL board	Control board for wired communication with IQ System Controller 3/3G and the IQ Battery 5P
Enphase Mobile Connect (only with IQ Combiner 5C)	4G-based LTE-M cellular modem (CELLMODEM-M1-06-SP-05) with a 5-year T-Mobile data plan
Accessories kit	Spare control headers for the COMMS-KIT-02 board
ACCESSORIES AND REPLACEMENT PARTS (NOT INCLUDED, ORDER SEPARATELY)	
CELLMODEM-M1-06-SP-05	4G-based LTE-M cellular modem with a 5-year T-Mobile data plan
CELLMODEM-M1-06-AT-05	4G-based LTE-M cellular modem with a 5-year AT&T data plan
Circuit breakers (off-the-shelf)	Supports Eaton BR2XX, Siemens Q2XX and GE/ABB THQL21XX Series circuit breakers (XX represents 10, 15, 20, 30, 40, 50, or 60). Also supports Eaton BR220B, BR230B, and BR240B circuit breakers compatible with the hold-down kit.
Circuit breakers (provided by Enphase)	BRK-10A-2-240V, BRK-15A-2-240V, BRK-20A-2P-240V, BRK-15A-2P-240V-B, and BRK-20A-2P-240V-B (more details in the "Accessories" section)
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 5/5C
XA-ENV2-PCBA-5	IQ Gateway replacement printed circuit board (PCB) for IQ Combiner 5/5C
X-IQ-NA-HD-125A	Hold-down kit compatible with Eaton BR-B Series circuit breakers (with screws)
XA-COMMS2-PCBA-5	Replacement COMMS-KIT-02 printed circuit board (PCB) for IQ Combiner 5/5C
ELECTRICAL SPECIFICATIONS	
Rating	80 A
System voltage and frequency	120/240 VAC, 60 Hz
Busbar rating	125 A
Fault current rating	10 kAIC
Maximum continuous current rating (input from PV/storage)	64 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR, Siemens Q, or GE/ABB THQL Series distributed generation (DG) breakers only (not included)
Maximum total branch circuit breaker rating (input)	80 A of distributed generation/95 A with IQ Gateway breaker included
IQ Gateway breaker	10 A or 15 A rating GE/Siemens/Eaton included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-CLAMP)	A pair of 200 A clamp-style current transformers is included with the box
IQ Battery metering CT	200 A clamp-style current transformer for IQ Battery metering, included with the box

1. A plug-and-play industrial-grade cell modem for systems of up to 60 microinverters. Available in the United States, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.

IQC-5-5C-DSH-00007-3.0-EN-US-2024-03-01

MECHANICAL DATA		
Dimensions (W × H × D)	37.5 cm × 49.5 cm × 16.8 cm (14.75" × 19.5" × 6.63"). Height is 21.06" (53.5 cm) with mounting brackets	
Weight	7.5 kg (16.5 lbs)	
Ambient temperature range	-40°C to 46°C (-40°F to 115°F)	
Cooling	Natural convection, plus heat shield	
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction	
Wire sizes	<ul style="list-style-type: none"> <li>20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors</li> <li>60 A breaker branch input: 4 to 1/0 AWG copper conductors</li> <li>Main lug combined output: 10 to 2/0 AWG copper conductors</li> <li>Neutral and ground: 14 to 1/0 copper conductors</li> <li>Always follow local code requirements for conductor sizing</li> </ul>	
Communication (in-premise connectivity)	Built-in CTRL board for wired communication with IQ Battery 5P and IQ System Controller 3/3G. Integrated power line communication for IQ Series Microinverters	
Altitude	Up to 2,600 meters (8,530 feet)	
COMMUNICATION INTERFACES		
Integrated Wi-Fi	802.11b/g/n (dual band 2.4 GHz/5 GHz), for connecting the Enphase Cloud through the internet	
Wi-Fi range (recommended)	10 m (32.8 feet)	
Bluetooth	BLE4.2, 10 m range to configure Wi-Fi SSID	
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included), for connecting to the Enphase Cloud through the internet	
Cellular/Mobile Connect	CELLMODEM-M1-06-SP-05 or CELLMODEM-M1-06-AT-05 (included with IQ Combiner 5C)	
Digital I/O	Digital input/output for grid operator control	
USB 2.0	Mobile Connect, COMMS-KIT-01 for IQ Battery 3/3T/10/10T, COMMS-KIT-02 for IQ Battery 5P	
Access point (AP) mode	For connection between the IQ Gateway and a mobile device running the Enphase Installer App	
Metering ports	Up to two Consumption CTs, one IQ Battery CT, and one Production CT	
Power line communication	90–110 kHz	
Web API	See <a href="https://developer-v4.enphase.com">https://developer-v4.enphase.com</a>	
Local API	See <a href="#">guide for local API</a>	
COMPLIANCE		
IQ Combiner with IQ Gateway	UL 1741, CAN/CSA C22.2 No. 107.1, Title 47 CFR, Part 15, Class B, ICES 003, NOM-208-SCFI-2016, UL 60601-1/CANCSA 22.2 No. 61010-1, IEEC 1547-2:018 (UL 1741-SB, 3rd Ed.), IEEC 2030.5/CSIP Compliant, Production metering: ANSI CT2.20 accuracy class 0.5 (PV production)	
COMPATIBILITY		
PV	Microinverters IQ6, IQ7, and IQ8 Series Microinverters	
COMMS-KIT-01 <sup>1</sup>	IQ System Controller	EP200G101-M240US00
	IQ System Controller 2	EP200G101-M240US01
COMMS-KIT-02 <sup>2</sup>	IQ Battery	ENCHARGE-3-1P-NA, ENCHARGE-10-1P-NA, ENCHARGE-3T-1P-NA, ENCHARGE-10T-1P-NA
	IQ System Controller 3	SC200D111C240US01, SC200G111C240US01
	IQ Battery	IQBATTERY-5P-1P-NA

2. For information about IQ Combiner 5/5C compatibility with the 2<sup>nd</sup>-generation batteries, refer to the [compatibility matrix](#).  
3. IQ Combiner 5/5C comes pre-equipped with COMMS-KIT-02.

IQC-5-5C-DSH-00007-3.0-EN-US-2024-03-01

## CONTRACTOR



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AC SIZE: 12.920 KW AC

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SIGNATURE

PV-6.2

**RESOURCE  
DOCUMENT**

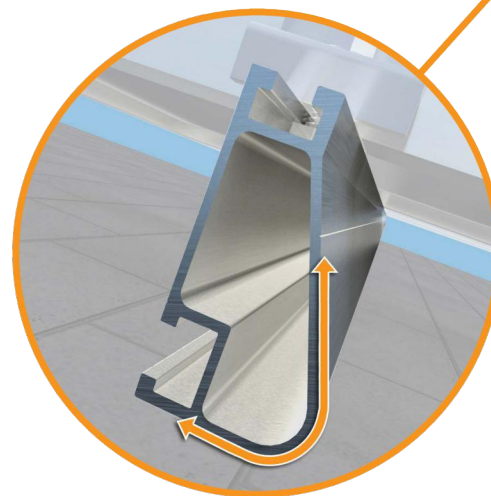
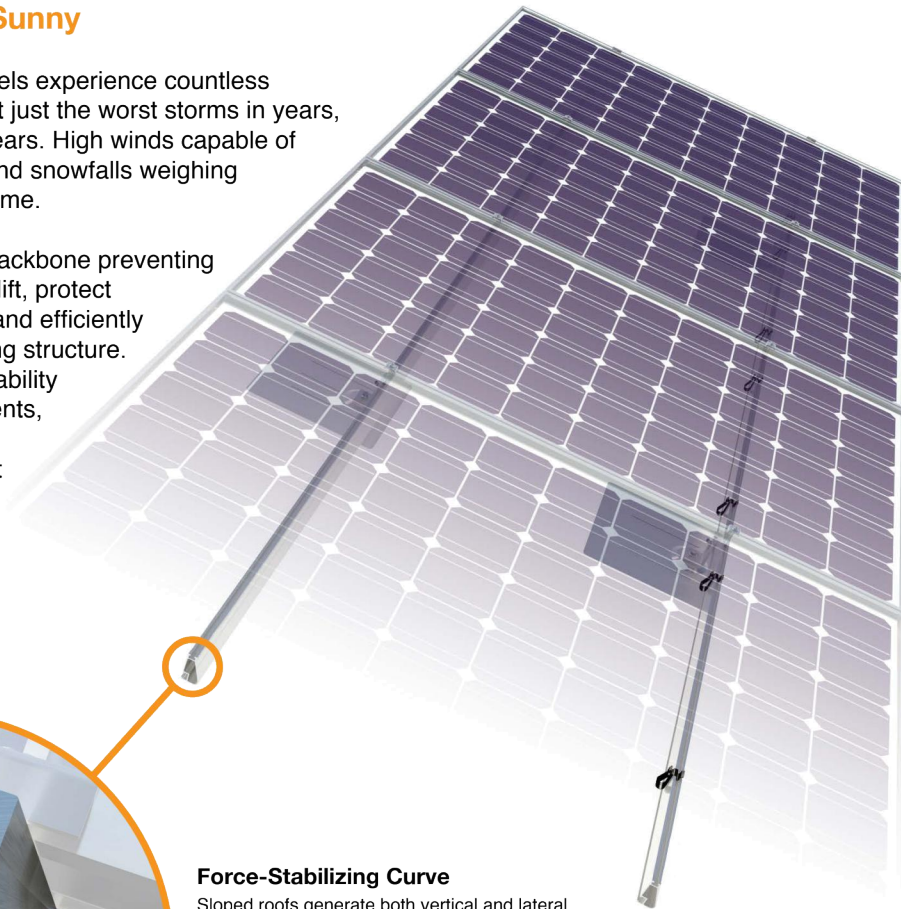


## XR Rail Family

### Solar Is Not Always Sunny

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

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



#### Force-Stabilizing Curve

Sloped roofs generate both vertical and lateral forces on mounting rails which can cause them to bend and twist. The curved shape of XR Rails is specially designed to increase strength in both directions while resisting the twisting. This unique feature ensures greater security during extreme weather and a longer system lifetime.

#### Compatible with Flat & Pitched Roofs



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



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

#### Corrosion-Resistant Materials

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



## XR100 Rail

See Description / Length

Rail Section Properties	
Property	Value
Total Cross-Sectional Area	0.582 in <sup>2</sup>
Section Modulus (X-axis)	0.297 in <sup>3</sup>
Moment of Inertia (X-axis)	0.390 in <sup>4</sup>
Moment of Inertia (Y-axis)	0.085 in <sup>4</sup>
Torsional Constant	0.214 in <sup>3</sup>
Polar Moment of Inertia	0.126 in <sup>4</sup>

APPROVED MATERIALS:  
6005-T6, 6005A-T61, 6105-T5, 6N01-T6  
(34,000 PSI YIELD STRENGTH MINIMUM)

Clear Part Number	Black Part Number	Description / Length	Material	Weight
XR-100-132A	XR-100-132B	XR100, Rail 132" (11 Feet)	6000-Series Aluminum	7.50 lbs.
XR-100-168A	XR-100-168B	XR100, Rail 168" (14 Feet)		9.55 lbs.
XR-100-204A	XR-100-204B	XR100, Rail 204" (17 Feet)		11.60 lbs.

v1.1



**EDGE ENERGY**  
6854 DISTRIBUTION DRIVE,  
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+1 434 568 7220  
**LIC TYPE: MHIC, STATE**  
**ELECTRICAL LICENSE**  
**LIC NO.: 126720,13228**

PROJECT INFO & ADDRESS

JOE MCGARVEY  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**

**SYSTEM SIZE**

DC SIZE: 14.790 KW DC-(STC)  
AC SIZE: 12.920 KW AC

DRAWN BY OB

DATE 10/10/2025

REVISION

SIGNATURE

PV-6.3

**RESOURCE DOCUMENT**

### 2-Piece Standoff Technical Datasheet

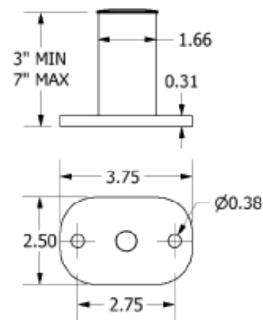
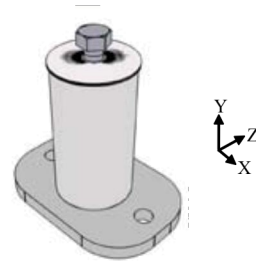
Pub 101026-1td V1.0 October 2010

2-Piece Aluminum Standoffs . . . . .	1
2-Piece Aluminum Standoff with SolarMount-I 1-flange connection . . . . .	2
2-Piece Aluminum Standoff with L-foot connection . . . . .	2

#### Standoffs

#### 2-Piece Aluminum Standoffs

Part No. 310503, 310504, 310506, 310507, 310553, 310554, 310556, 310557, 310603, 310604, 310606, 310607, 310653, 310654, 310656, 310657



Dimensions specified in inches unless noted

#### Standoff and Base Material:

- One of the following extruded aluminum alloys: 6005-T5, 6105-T5, 6061-T6
- Ultimate tensile: 38 ksi; Yield: 35 ksi
- Clear or Dark anodized

#### Weight:

- 3" Standoff (as shown): 0.522 pounds (237 g)
- Add 0.086 pounds per inch (39 g/ inch)

Allowable and design loads are valid for a Unirac 2-piece aluminum standoff

Attach with zinc plated carbon steel or stainless steel fasteners

Resistance and safety factors are determined according to Part 1A section 9 of the 2005 Aluminum Design Manual

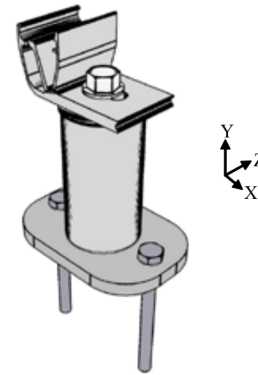
**NOTE: Loads are given for the standoff only. Check load limits for lag screw or other attachment method.**

Applied Load Direction	Average Ultimate Load lbs (N)	Allowable Load lbs (N)	Safety Factor, W	Design Load lbs (N)	Resistance Factor, F
Tension/Compression, Y±	3266 (14528)	1089 (4844)	3.00	1633 (7264)	0.500
∪Z Bending, Applied Moment*	559 ft lbs (758 Nm)	250 ft lbs (339 Nm)	2.24	378 ft lbs (512 Nm)	0.676

\*Example: If the module is mounted 6" (0.5 ft) from the base of the standoff, the allowable side load is 250 ft\*lbs/ 0.5 ft = 500 lbs

For product and purchasing inquiries contact:  
  
 CLEAN ENERGY SOLUTIONS  
 www.ecodirect.com

### 2-Piece Aluminum Standoff with SolarMount-I 1-flange connection Part No. 05013C, 05014C, 05016C, 05017C



Reference the SolarMount-I series datasheet for 1-flange connection specifications.

#### For the 1-flange connection to standoff:

- Use included 1 ¼" EPDM washer between the 1-flange connection and standoff
- Assemble with included 300 series stainless steel ¾"-16 flanged hex head screw
- Use anti-seize and tighten to 30 ft-lbs of torque

Allowable and design loads are valid when components are assembled according to authorized Unirac documents.

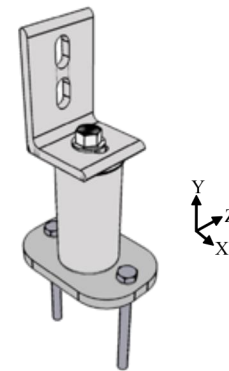
1-Flange connections are compatible with SolarMount-I series beams.

Resistance factors and allowable loads are determined according to part 1A section 9 of the 2005 Aluminum Design Manual.

**NOTE: Loads are for the connection and standoff only. Check load limits for the lag screw or other attachment method.**

Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Loads lbs (N)	Resistance Factor, ϕ
Tension, Y+	1415 (6294)	635 (2825)	2.23	960 (4270)	0.679
Compression, Y-	1949 (8670)	873 (3883)	2.23	1320 (5872)	0.677
Transverse, X-, downhill	635 (2825)	313 (1392)	2.03	473 (2104)	0.745
Transverse, X+, uphill	42 (187)	20 (89)	2.15	30 (133)	0.705
∪Z Bending, Applied Moment	559 ft lbs (758 Nm)	250 ft lbs (339 Nm)	2.24	378 ft lbs (512 Nm)	0.676

### 2-Piece Aluminum Standoff with L-foot connection



Reference the SolarMount datasheet for L-foot specifications.

#### For the L-foot to standoff connection:

- Use included 1 ¼" EPDM washer between the L-foot and standoff
- Assemble with included 300 series stainless steel ¾"-16 flanged hex head screw
- Use anti-seize and tighten to 30 ft-lbs of torque

Allowable and design loads are valid when components are assembled according to authorized Unirac documents.

L-feet are compatible with SolarMount, SolarMount Heavy Duty, and SunFrame rails.

Resistance factors and allowable loads are determined according to part 1A section 9 of the 2005 Aluminum Design Manual.

**NOTE: Loads are for the connection and standoff only. Check load limits for the lag screw or other attachment method.**

Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Loads lbs (N)	Resistance Factor, ϕ
Tension, Y+	1859 (8269)	707 (3144)	2.63	1069 (4755)	0.575
Compression, Y-	3258 (14492)	1325 (5893)	2.46	2004 (8913)	0.615
Sliding, Z±	1766 (7856)	755 (3356)	2.34	1141 (5077)	0.646
Transverse, X±	486 (2162)	213 (949)	2.28	323 (1436)	0.664
∪Z Bending, Applied Moment	559 ft lbs (758 Nm)	250 ft lbs (339 Nm)	2.24	378 ft lbs (512 Nm)	0.676



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JOE MCGARVEY  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**

#### SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
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DRAWN BY OB

DATE 10/10/2025

REVISION

SIGNATURE

PV-6.4

**RESOURCE DOCUMENT**



# E-CURB™ SYSTEM

## PENETRATION SEALS

Technical Data Sheet

Polyether Technology

CSI Section No. 07 12 13

### CHEM LINK

#### Construction & Maintenance

Telephone: 800-826-1681  
 Fax: 269-679-4448  
 353 E. Lyons Street  
 Schoolcraft, MI 49087

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

#### Product Description

**E-Curb** penetration seals replace old-style metal pitch pans with versatile, precast components and pourable sealants. CHEM LINK's **E-Curb** System can usually be installed in under 15 minutes and never requires flashing or mechanical attachment.

**E-Curbs** are designed for use on granulated modified bitumen, asphalt and coal tar B.U.R. (built up roofing). **E-Curbs** are specified for PVC, EPDM, PIB, and TPO single ply roofing membranes. **E-Curbs** are highly versatile for sealing penetrations around solar panel mounts, HVAC, Electrical, and any type of structural supports. TPO Primer is required for use with TPO single-ply roof membrane.

When installed properly, this system forms a durable, waterproof rubber seal around penetrations. An extended manufacture warranty against leaks is activated with submittal of a completed warranty card.

#### Special Characteristics

- Rapid installation - "Slip-fit" light weight curb design reduces labor significantly.
- Excellent adhesion to most roofing materials.
- No flashing or mechanical attachment required.
- Service Temperature -40°F to 200°F (-40°C to 93°C)
- **1-Part**® accommodates movement and is suggested for use on all granulated membranes and details with excessive movement.
- For sloped roof applications, substitute **DuraLink 50**™ non-slump adhesive/sealant for **1-Part** and **M-1**®

#### Restrictions

- Please contact customer service for application guidelines with temperatures below 32°F (0°C).
- Do not install if rain is anticipated within 4 hours.
- Do not use on Hypalon or smooth APP modified bitumen membrane. For smooth APP, torch down a target of granulated APP before installation.
- TPO Primer must be used for TPO applications.
- Do not prime bonding surfaces with asphalt primer!
- Do not use asphalt cement as a "night sealant." Use **M-1** for this purpose.
- **E-Curb** kits are designed to contain enough **1-Part** to fill each curb with displacement in consideration. Refer to our penetration calculator under contractor resources at [chemlink.com](http://chemlink.com) to verify volumes.



#### E-Curb System Components

- **E-Curb** exterior rings, straights, and corners.
- **M-1** Structural Adhesive/Sealant used for bonding the **E-Curb** components, sealing and priming the penetration.
- **1-Part** "moisture cure" pourable sealer, used to form a durable, water-tight seal around the roof penetration. **US Patent No. RE41,586**

**E-Curb** precast form components are composed of light weight nylon resin. The **E-Curb** is 2-inches high and is available in a variety of shapes and sizes. Standard sizes include bisected circular pieces with inside diameters of 3, 4, 5, 6 or 9 inches; corner pieces with a 2-inch radius; straight pieces in 3-inch or 8-inch lengths; and a 4.5" x 3.4" rectangle. The outer surface is impervious to ice, corrosion, UV (ultraviolet) light and ponding water.

**M-1** Structural Adhesive/Sealant is a durable, self-fixturing moisture cure mastic. Cartridges of **M-1** are supplied in each **E-Curb** Kit. Components are also sold separately.

**1-Part** is a highly flexible, self-leveling moisture cure pourable sealer that eliminates mixing. It is also 100% solid rubber, has a very low VOC content, will not melt or shrink, and is resistant to deterioration. It is supplied in 10.1-oz and 28-oz cartridges or 1/2 gallon pouches. Unused sealant can be capped and reused.



Last Revision: 03/20/17  
 Document No. DS1350

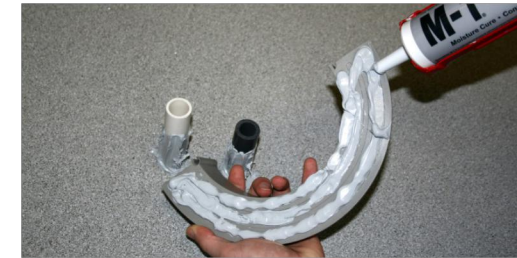
#### Step 1

Remove all previously applied caulk, mastic, cement, asphalt, and other contaminants from penetrations with a wire brush. Clean all smooth substrates with isopropyl or denatured alcohol. Brush away all gravel or loose granules. Seal the base of each penetration with **M-1**. Coat penetrations with **M-1** to 3" above the roof line.



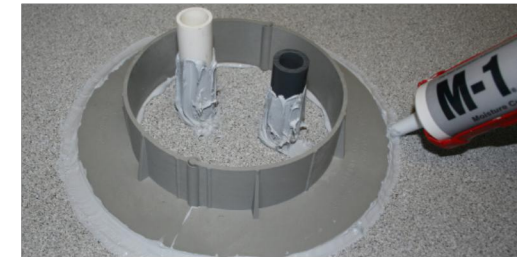
#### Step 2

Hold a section of **E-Curb**, flat side up, and apply a 1/4" bead of **M-1** to the entire bottom perimeter. Apply 1 additional 1/4" bead of **M-1** down the center of the section. Do not tool the beads flat. Place the **E-Curb** section on the roof surface to form a half circle around the penetration(s). Press down firmly until **M-1** extrudes from the outside edges.



#### Step 3

Apply **M-1** to the second section of **E-Curb** as described above. Place the second section of curb on the roof surface to form a circle with the first section. Press firmly in place until excess adhesive extrudes from the outside edges. Apply a bead of **M-1** around the outside base of the installed **E-Curb**, and tool to form a smooth fillet. For non **E-Curb** penetrations seals, add **M-1** to scarf joint surfaces and tool smooth.



#### Step 4

Cut tip off **1-Part** cartridge at widest point on plastic nozzle and pierce the foil seal. Insert into caulking gun and pump **E-Curb** full. When using a **1-Part** pouch, remove cap, pour, squeeze out excess air, and reseal. **Note:** To provide an adequate rubber seal, maintain a 1" distance between penetrations and inside edge of the **E-Curb**.



All properties described in this document are derived from testing conducted in laboratory conditions. Properties and performance will vary depending on environmental conditions and application technique. Test and evaluate to determine appropriate usage. Visit [www.chemlink.com](http://www.chemlink.com) for the Safety Data Sheet, Technical Data Guides and full warranty for this product.

**LIMITED WARRANTY:** **CHEM LINK** warrants this product's performance, provided it is properly stored and applied within 1 year. If this **CHEM LINK** material is proved to be defective, return remaining product and purchase receipt for refund or replacement of product exclusive of labor or cost of labor. This is the sole and exclusive remedy for defects or failure of this product. User must read and follow the direction of the current Technical Data Guide and SDS prior to product use. User determines suitability of product for intended use and assumes all risks. Manufacturer shall not be liable for damages (including consequential or incidental damages) in excess of the purchase price, except where such exclusion or limitation is prohibited by state law. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, WRITTEN OR ORAL, STATUTORY, EXPRESS OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE; except for the above express warranty given by manufacturer, the product is sold with all faults. **CHEM LINK** SHALL NOT BE RESPONSIBLE FOR THE USE OF THIS PRODUCT IN A MANNER TO INFRINGE ON ANY PATENT OR ANY OTHER INTELLECTUAL PROPERTY RIGHTS HELD BY OTHERS. This warranty gives you specific legal rights, and you may also have other rights in the U.S. which vary from state to state. For warranty claim information, call 800-826-1681.



### CONTRACTOR



**EDGE ENERGY**  
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 +1 434 568 7220  
 LIC TYPE: MHIC, STATE  
 ELECTRICAL LICENSE  
 LIC NO.: 126720,13228

#### PROJECT INFO & ADDRESS

JOE MCGARVEY  
 7315 WILLOW AVE,  
 TAKOMA PARK,  
 VA 20912, USA

#### SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
 AC SIZE: 12.920 KW AC

DRAWN BY	OB
DATE	10/10/2025
REVISION	

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PV-6.5  
**RESOURCE DOCUMENT**

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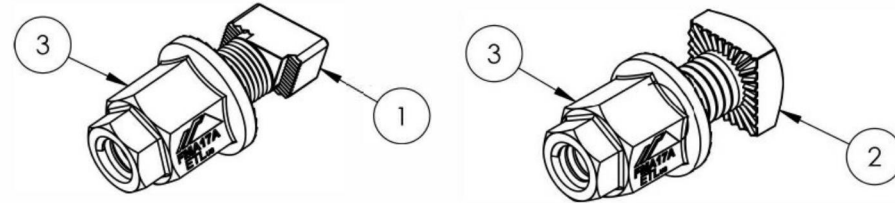
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**RESOURCE DOCUMENT**

Cut Sheet



### Bonding Hardware

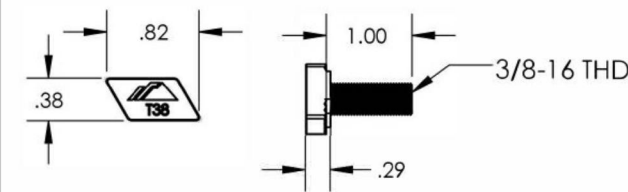


ITEM NO.	DESCRIPTION
1	BOLT, T CSTM, 3/8-16
2	BOLT, BONDING 3/8-16 SQ HEAD
3	NUT, BONDING STEP

BONDING HARDWARE

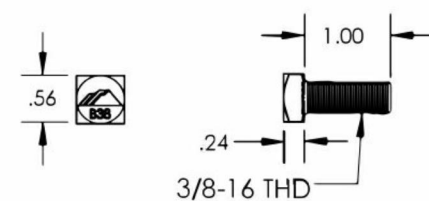
Part Number	Description
BHW-TB-02-A1	T-BOLT, BONDING HARDWARE
BHW-SQ-02-A1	SQUARE-BOLT, BONDING HARDWARE

1) BOLT, T CSTM, 3/8-16



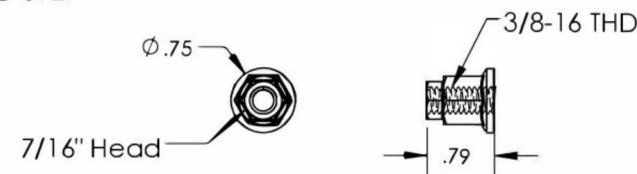
Property	Value
Material	300 Series Stainless Steel
Finish	Clear

2) BOLT, BONDING 3/8-16 SQ HEAD



Property	Value
Material	300 Series Stainless Steel
Finish	Clear

3) NUT, BONDING STEP



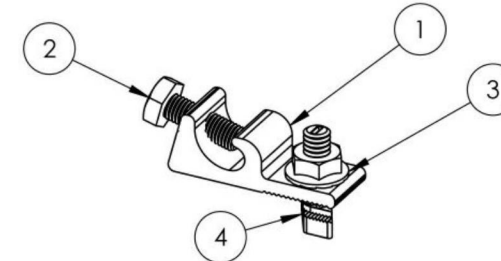
Property	Value
Material	300 Series Stainless Steel
Finish	Clear

v1.30

Cut Sheet



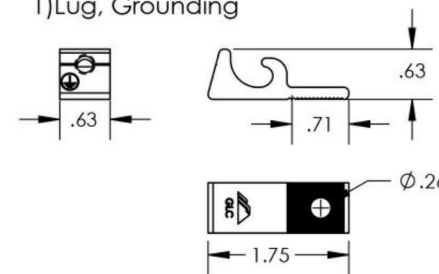
### Grounding Lug



ITEM NO.	DESCRIPTION
1	LUG, GROUNDING, LAY-IN - LOW PROFILE
2	BOLT, 1/4-28 X .750" HEX CS SST
3	NUT, FLANGE HEX 1/4-20 SST
4	BOLT, T CSTM 1/4-20 X 1.188" LOCK SS

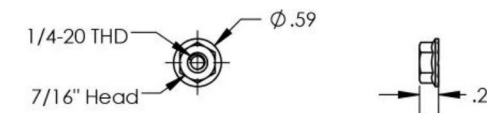
Part Number	Description	Wire Size Range (AWG)
XR-LUG-03-A1	GROUNDING LUG, LOW PROFILE	4-10

1) Lug, Grounding



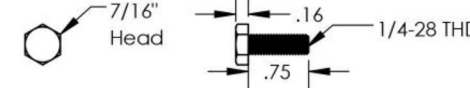
Property	Value
Material	Tin Plated Copper
Finish	Clear Matte

3) Nut, Flange Hex 1/4-20



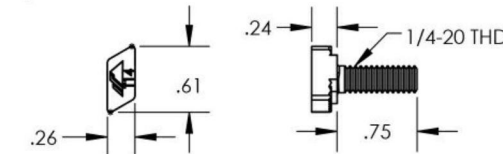
Property	Value
Material	300 Series Stainless Steel
Finish	Clear

2) Bolt, 1/4-28 x .750 Hex



Property	Value
Material	300 Series Stainless Steel
Finish	Clear

4) Bolt, T CSTM 1/4-20 x .750



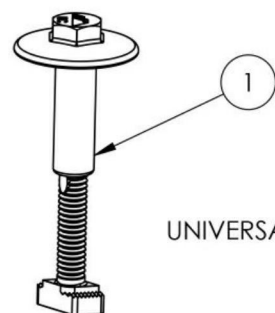
Property	Value
Material	300 Series Stainless Steel
Finish	Clear

v1.10



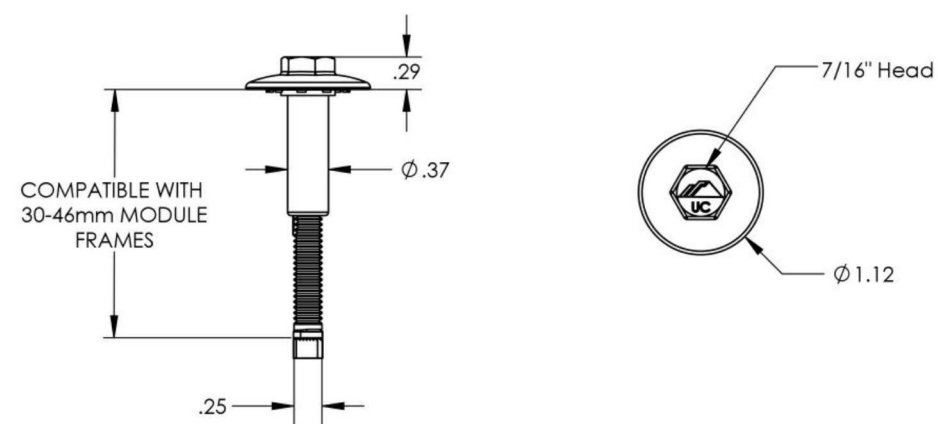
## Universal Fastening Object

Cut Sheet



UNIVERSAL FASTENING OBJECT

ITEM NO.	DESCRIPTION
UFO-CL-01-A1	UNIVERSAL MODULE CLAMP, CLEAR
UFO-CL-01-B1	UNIVERSAL MODULE CLAMP, BLACK



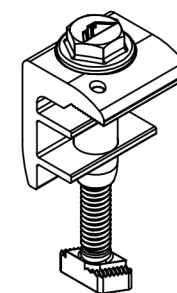
Property	Value
Material	300 Series Stainless Steel
Finish	Clear and Black

v1.30

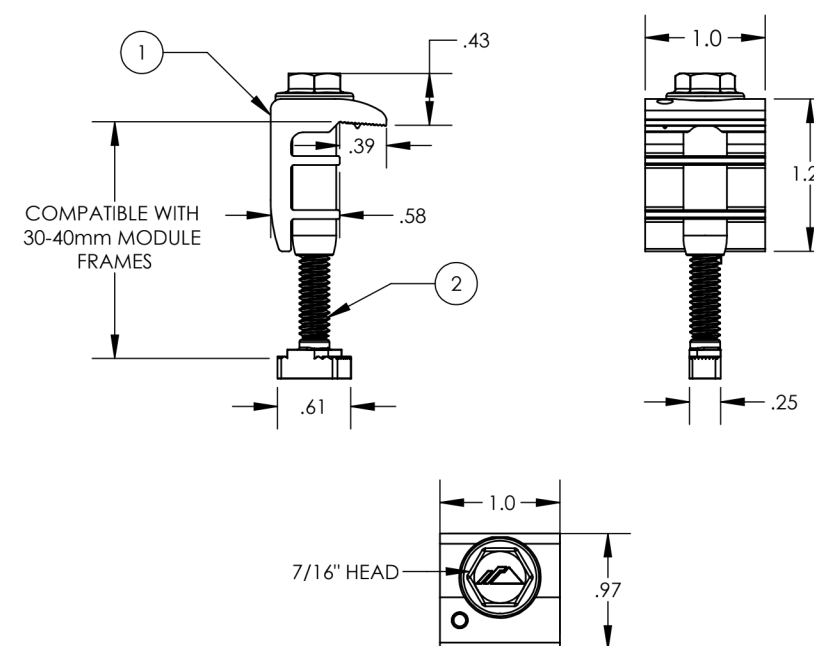


## End Fastening Object

Cut Sheet



PART NO.	DESCRIPTION
UFO-END-01-A1	END FASTENING OBJECT (END CLAMP, 30-40mm), MILL
UFO-END-01-B1	END FASTENING OBJECT (END CLAMP, 30-40mm), BLACK



ITEM NO.	MATERIAL	FINISH
1	6000 SERIES ALUMINUM	MILL OR BLACK
2	300 SERIES STAINLESS STEEL	CLEAR AND BLACK

v1.0

### CONTRACTOR



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#### SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
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REVISION

SIGNATURE

PV-6.7

**RESOURCE  
DOCUMENT**



## UFO® Family of Components

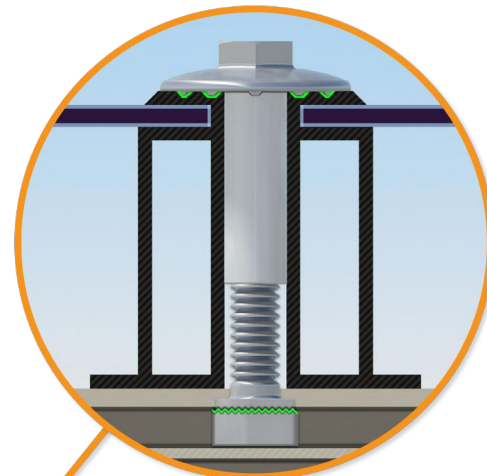
Tech Brief

### 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](http://IronRidge.com/UFO)



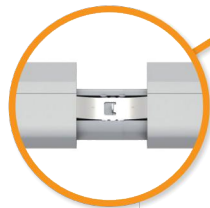
#### Universal Fastening Object (UFO®)

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



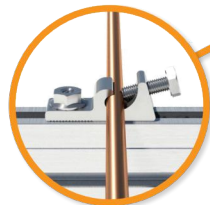
#### Stopper Sleeve

The Stopper Sleeve snaps onto the UFO®, converting it into a bonded end clamp.



#### BOSS® Splice

Bonded Structural Splice connects rails with built-in bonding teeth. No tools or hardware needed.



#### Grounding Lug

A single Grounding Lug connects an entire row of PV modules to the grounding conductor.

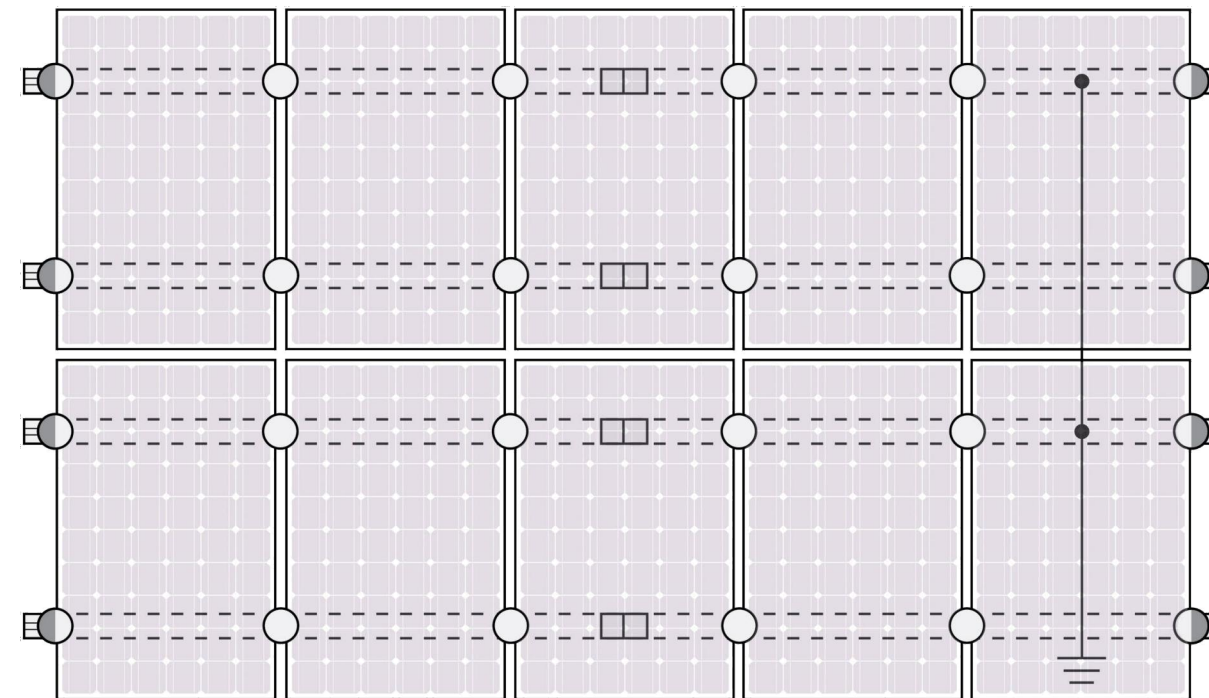


#### Bonded Attachments

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

### System Diagram

Tech Brief



○ UFO   ◐ Stopper Sleeve   ● Grounding Lug   □ BOSS™ Splice   ≡ Ground Wire

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

### UL Certification

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

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

[Go to IronRidge.com/UFO](http://Go to IronRidge.com/UFO)

### Cross-System Compatibility

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

### CONTRACTOR



**EDGE ENERGY**  
 6854 DISTRIBUTION DRIVE,  
 BELTSVILLE, MD, USA  
 +1 434 568 7220  
 LIC TYPE: MHIC, STATE  
 ELECTRICAL LICENSE  
 LIC NO.: 126720,13228

#### PROJECT INFO & ADDRESS

JOE MCGARVEY  
**7315 WILLOW AVE,**  
**TAKOMA PARK,**  
**VA 20912, USA**

#### SYSTEM SIZE

DC SIZE: 14.790 KW DC-(STC)  
 AC SIZE: 12.920 KW AC

DRAWN BY    OB

DATE            10/10/2025

REVISION

SIGNATURE

PV-6.8

**RESOURCE  
DOCUMENT**

# Specifications



Photo is representative

## Eaton DG223URB

Eaton General duty non-fusible safety switch, single-throw, 100 A, NEMA 3R, Rainproof, Painted galvanized steel, Two-pole, Two-wire, 240 V

### General specifications

<b>PRODUCT NAME</b>	Eaton general duty non-fusible safety switch
<b>CATALOG NUMBER</b>	DG223URB
<b>UPC</b>	782114731154
<b>PRODUCT LENGTH/DEPTH</b>	7.38 in
<b>PRODUCT HEIGHT</b>	19.25 in
<b>PRODUCT WIDTH</b>	9.13 in
<b>PRODUCT WEIGHT</b>	12 lb
<b>WARRANTY</b>	Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.
<b>COMPLIANCES</b>	NEC 230.62 (C) Compliant Barrier
<b>CERTIFICATIONS</b>	UL Listed
<b>CATALOG NOTES</b>	WARNING! Switch is not approved for service entrance unless a neutral kit is installed.

### Physical Attributes

<b>ENCLOSURE</b>	NEMA 3R
<b>ENCLOSURE MATERIAL</b>	Painted galvanized steel
<b>FUSE CONFIGURATION</b>	Non-fusible
<b>NUMBER OF POLES</b>	Two-pole
<b>NUMBER OF WIRES</b>	2
<b>TYPE</b>	Non-fusible, single-throw

### Miscellaneous

<b>PRODUCT CATEGORY</b>	General duty safety switch
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### Performance Ratings

<b>AMPERAGE RATING</b>	100A
<b>VOLTAGE RATING</b>	240V

### Resources

<b>CATALOGS</b>	<a href="#">Commercial Distribution, Switching Devices, Volume 2, Tab 1</a>
<b>MULTIMEDIA</b>	<a href="#">Switching Devices Flex Center</a> <a href="#">Double Up on Safety</a>
<b>SPECIFICATIONS AND DATASHEETS</b>	<a href="#">Eaton Specification Sheet - DG223URB</a>

**PROJECT NAME:**

**PROJECT NUMBER:**

**PREPARED BY:**

**DATE:**



**Eaton Corporation plc**  
Eaton House  
30 Pembroke Road  
Dublin 4, Ireland  
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**RESOURCE DOCUMENT**