| Address:       | 26001 Frederick R., Clarksburg                   | Meeting Date:  | 12/21/2022    |
|----------------|--|----------------|---------------|
| Resource:      | Primary Resource<br>Hyattstown Historic District | Report Date:   | 12/14/2022    |
| Applicant:     | Brendan Brammer<br>Beth Vallandingham, Agent     | Public Notice: | 12/7/2022     |
| <b>Review:</b> | HAWP   | Tax Credit:    | n/a           |
| Case No.:      | 1014103  | Staff:         | Dan Bruechert |
| Proposal:      | Roof Mounted Solar Panels                        |                |               |

# MONTGOMERY COUNTY HISTORIC PRESERVATION COMMISSION STAFF REPORT

# **STAFF RECOMMENDATION**

Staff recommends the HPC **approve with one** (1) **condition** the HAWP application:

1. The approval does not extend to the four street-facing solar panels. A roof plan that satisfies this condition needs to be submitted to Staff for final review and approval prior to permit submission.

# **ARCHITECTURAL DESCRIPTION**

| SIGNIFICANCE: | Primary Resource to the Hyattstown Historic District |
|---------------|--|
| STYLE:        | Vernacular   |
| DATE:         | c.1890   |



Figure 1: The subject property is on the east side of Frederick Rd.

# **PROPOSAL**

The applicant proposes to install twenty-five (25) roof-mounted solar panels.

### APPLICABLE GUIDELINES

When reviewing alterations and new construction within the Clarksburg Historic District several documents are to be utilized as guidelines to assist the Commission in developing their decision. These documents include the historic preservation review guidelines in the approved and adopted amendment for the *Montgomery County Code Chapter 24A* (*Chapter 24A*), and *the Secretary of the Interior's Standards for Rehabilitation (Standards)* and *Historic Preservation Commission Policy No. 20-01: ADDRESSING EMERGENCY CLIMATE MOBILIZATION THROUGH THE INSTALLATION OF ROOF-MOUNTED SOLAR PANELS.* The pertinent information in these documents is outlined below.

#### Montgomery County Code; Chapter 24A-8

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

#### Secretary of the Interior's Standards for Rehabilitation:

- 2. The historic character of a property shall be retained and preserved. The removal of historic materials or alteration of features and spaces that characterize a property shall be avoided.
- 9. New additions, exterior alterations, or related new construction will not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and will be compatible with the historic materials, features, size, scale and proportions, and massing to protect the integrity of the property and its environment.
- 10. New additions and adjacent or related new construction will 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

On December 5, 2017, the Montgomery Council adopted an Emergency Climate Mobilization resolution (Resolution No.: 18-974) which declared a climate emergency and charged the County Executive, Montgomery County Public Schools, and the Maryland-National Capital Park and Planning Commission to advise the Council on methods to reduce greenhouse gas emissions.

As a body established by the County Executive, it is incumbent on the Historic Preservation Commission (HPC) to undertake steps to achieve the goals of the Emergency Climate Mobilization resolution.

One method for reducing greenhouse gas emissions is to replace carbon-heavy methods of energy production, like coal and natural gas power plants, with renewable sources like wind and solar power. Current historic preservation best practice is to limit the locations solar panels may be installed to preserve the character of the building above all other considerations. Chapter 24A-8 (b) (6) of County Code establishes a balancing test for approval of a HAWP where there is an apparent conflict between the desired impact on the historic resource compared to the public benefit of the proposal. Because the widespread use of solar panels, both for hot water and for electricity production, will reduce greenhouse gases in the county, it is the position of the HPC that solar panels may be installed on all roof elevations of historic sites or historic resources located within a historic district provided:

- 1. The identified preferred location (on the rear of the property, building additions, accessory structures, or ground-mounted arrays) is not feasible due to resource orientation or other site limitations and;
- 2. The roof is not either architecturally significant or a slate or tile roof unless it can be demonstrated that the solar array will be installed without damaging the historic character of the resource or historic fabric; and
- 3. A Historic Area Work Permit (HAWP) is required for all work referenced in this policy.

### 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**

The subject property is a c.1890 side gable house with clapboard siding and a large non-historic rear addition. The house is only setback from Frederick Rd. by approximately 15' (fifteen feet). The applicant proposes to install 25 (twenty-five) roof-mounted solar panels:

- Four panels on the front-facing roof;
- Two panels on the rear addition's north roof slope; and,
- Nineteen panels on the rear addition's south roof slope.

Staff finds 21 (twenty-one) of the panels are proposed for one of the preferred locations identified in the solar panel policy statement—on a non-historic rear addition. This placement limits their visibility from the right-of-way and does not impact any historic fabric. Staff finds these panels should be approved based on the reasoning in the solar panel policy and 24A-8(b)(2) and Standard 2.

The remaining four panels require additional analysis. Staff finds the front roof slope is not one of the identified preferred locations. Staff additionally finds that the resource orientation does not limit the ability to install solar panels on the resource. Staff finds the simply detailed side-gable vernacular structure is the primary defining feature of the house, as its porch, windows, trim, and shutters are all non-historic alterations; and – aside from the chimney - is the only visible historic characteristic remaining. While installing the solar panels on the front of the house would not damage any historic fabric, Staff finds the form of the house would be negatively impacted by the proposal. The bar to justify street-facing solar panels is high, and rightly so, but Staff finds that this proposal fails to clear that bar and Staff recommends the HPC not extend its approval to include the four-front facing solar panels.

# **STAFF RECOMMENDATION**

Staff recommends that the Commission **approve with one condition** the HAWP application:

1. The approval does not extend to the four street-facing solar panels. A roof plan that satisfies this condition needs to be submitted to Staff for final review and approval prior to permit submission;

under the Criteria for Issuance in Chapter 24A-8(b)(1), (2), and (d) and the *Historic Preservation Commission Policy No. 20-01: ADDRESSING EMERGENCY CLIMATE MOBILIZATION THROUGH THE INSTALLATION OF ROOF-MOUNTED SOLAR PANELS* having found that the proposal will not substantially alter the exterior features of the historic resource and is compatible in character with the district and the purposes of Chapter 24A;

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

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

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

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





DP5 - #8

HISTORIC PRESERVATION COMMISSION 301/563-3400

# APPLICATION FOR HISTORIC AREA WORK PERMIT

|   |   |  | Beth Vallandingha  | h     |
|---|---|--|--|-------|
| Contact Email:  | lvallandingham  | n@tesla.com  | Contact Person: Detri Vallari un gila  |       |
|   |   |  | Daytime Phone No.: 240-917-9885  |       |
| Tax Account No.: 02-  | - 00020975  | ······   |  |       |
| Name of Property Owner:   | Brendan Barmr   | ner  | Daytime Phone No.: (571) 352-8652  |       |
| Address: 26001  | Frederick Rd, Cl  | <u>arksburg, M[</u>  | 0 20871  |       |
|   |   |  | 51887 240-917-9885   |       |
|   |   | <u>0, IINO</u>   | Fridmi No 240 011 0000   |       |
|   | th Vallandingha   | <i>и</i>   |  |       |
|   | an valianangna  |  |  |       |
| COCATION OF BUILDI  | NG/PREMISE  |  |  |       |
| House Number: 260   | 01  | Street   |  |       |
| Town/City: CLAR   | (SBURG  | Nearest Cross Street:  |  |       |
| Lot: <u>P14</u>   | Block: Subdivi  | ision: <u>0001</u>   |  |       |
| Liber: <u>66002</u>   | Folio:P   | harcal: <u>0000</u>  |  |       |
| PUTIONE TYPEOL  |   |  |  |       |
| 1A. CHECK ALL APPLICA   | VBLE:   | CHECK ALI  | APPLICABLE   |       |
| Construct   | 3 Extend 3 Alter/Renovate   | □ <b>A/C</b>   | 🗆 Slab 🛛 Room Addition 🔲 Porch 💭 Deck  |       |
| G Move 🛇  | 🖌 install 🛛 Wreck/Raze  | 🐼 Solar  | 🗆 Fireplace 🔲 Woodburning Stove 🛄 Single   | e Far |
| C Revision  | ) Repair 🔲 Revocable.   | C Fence/   | Vall (complete Section 4) 🛛 🖾 Other:   |       |
| 1B. Construction cost es  | timate: \$ <u>23100</u>   |  |  |       |
| 1C. If this is a revision of  | a previously approved active per  | mit, see Permit #  |  |       |
|   |   |  |  |       |
| PART TWO: COMPLE  | TE FOR NEW CONSTRUCTION   | N AND EXTEND/ADDIT   | ONS  | -     |
| PART TWO: COMPLE<br>2A. Type of sewage dis  | POSAL: 01 . WSSC  | N AND EXTEND/ADDIT<br>02 🗔 Septic  | 0115<br>03 🗀 Other:  |       |
| PART TWO: COMPLE<br>2A. Type of sewage dis<br>2B. Type of water suppl   | posal: 01 🗆 WSSC<br>y: 01 🗆 WSSC  | NANDEXTEND/ADDIT<br>02 Septic<br>02 Well   | 03 🖸 Other:03 🗍 Other:   |       |
| PART TWO: COMPLE<br>2A. Type of sewage dis<br>2B. Type of water suppl   | THE FOR NEW CONSTRUCTION<br>posal: 01 D WSSC<br>IV: 01 D WSSC   | N AND EXTEND/ADDIT<br>02 🖸 Septic<br>02 🗍 Well<br>NIGLA LEADE  | 03 C Other:03 C Other:03 C Other:  |       |
| PART TWO: COMPLE<br>2A. Type of sewage dis<br>2B. Type of water suppl<br>PART THREE: COMPL<br>2A. Haide   | TTE FOR NEW CONSTRUCTIO<br>posel: 01 D WSSC<br>ly: 01 D WSSC<br>TTE OU V FOR FENCE AND<br>fort  | N AND EXTEND/ADDIT<br>02 🖸 Septic<br>02 🗋 Well   | 03 [] Other:<br>03 [] Other:   |       |
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# P#1014103

#### THE FOLLOWING ITEMS MUST BE COMPLETED AND THE REQUIRED DOCUMENTS MUST ACCOMPANY THIS APPLICATION.

#### 1. WRITTEN DESCRIPTION OF PROJECT

 a. Description of existing structure(s) and environmental setting, including their historical features and significance: <u>1,675 SF 2 STORY RESIDENTIAL HOME BUILT IN 1890</u> <u>PROPERTY AREA IS 39,279 SF</u>

#### b. General description of project and its effect on the historic resource(s), the environmental setting, and, where applicable, the historic district: <u>INSTALL 25 ROOF MOUNTED SOLAR PANELS</u>

#### 2. SITE PLAN

Site and environmental setting, drawn to scale. You may use your plat. Your site plan must include;

- a. the scale, north arrow, and date;
- b. dimensions of all existing and proposed structures; and
- c. site features such as walkways, driveways, fences, ponds, streams, trash dumpsters, mechanical equipment, and landscaping.

#### 3. PLANS AND ELEVATIONS

You must submit 2 copies of plans and elevations in a format no larger than 11" x 17". Plans on 8 1/2" x 11" paper are preferred.

- a. Schemetic construction plans, with marked dimensions, indicating location, size and general type of walls, window and door openings, and other fixed features of both the existing resource(s) and the proposed work.
- b. Elevations (facades), with marked dimensions, clearly indicating proposed work in relation to existing construction and, when appropriate, context. All materials and fixtures proposed for the exterior must be noted on the elevations drawings. An existing and a proposed elevation drawing of each facade affected by the proposed work is required.

#### 4. MATERIALS SPECIFICATIONS

General description of materials and manufactured items proposed for incorporation in the work of the project. This information may be included on your design drawings.

#### 5. PHOTOGRAPHS

- a. Clearly labeled photographic prints of each facade of existing resource, including details of the affected portions. All labels should be placed on the front of photographs.
- b. Clearly label photographic prints of the resource as viewed from the public right-of-way and of the adjoining properties. All labels should be placed on the front of photographs.

#### 6. TREE SURVEY

If you are proposing construction adjacent to or within the dripline of any tree 6" or larger in diameter (at approximately 4 feet above the ground), you must file an accurate tree survey identifying the size, location, and species of each tree of at least that dimension.

#### 7. ADDRESSES OF ADJACENT AND CONFRONTING PROPERTY OWNERS

For <u>ALL</u> projects, provide an accurate list of adjacent and confronting property owners (not tenants), including names, addresses, and zip codes. This list should include the owners of all lots or parcels which adjoin the parcel in question, as well as the owner(s) of lot(s) or parcel(s) which lie directly across the street/highway from the parcel in question.

PLEASE PRINT (IN BLUE OR BLACK INK) OR TYPE THIS INFORMATION ON THE FOLLOWING PAGE. PLEASE STAY WITHIN THE GUIDES OF THE TEMPLATE, AS THIS WILL BE PHOTOCOPIED DIRECTLY ONTO MAILING LABE<del>LS</del>.

| HAWP APPLICATION: MAILING ADDRESSES FOR NOTIFING<br>[Owner, Owner's Agent, Adjacent and Confronting Property Owners] |                                  |  |  |  |
|--|----------------------------------|--|--|--|
| Owner's mailing address  | Owner's Agent's mailing address  |  |  |  |
| Brendan Barmmer  | TESLA ENERGY OPS, INC            |  |  |  |
| 26001 FREDERICK RD,  | 9000 VIRGINIA MANOR RD, STE 250, |  |  |  |
| CLARKSBURG MD, 20871   | BELTSVILLE MD, 20705             |  |  |  |
| Adjacent and confronting Property Owners mailing addresses   |                                  |  |  |  |
| JOSEPH & NANCY LONGO   | SUNG HEE LEE                     |  |  |  |
| 26000 FREDERICK RD,  | 26005 FREDERICK RD,              |  |  |  |
| CLARKSBURG MD, 20871   | HYATTSTOWN MD, 20871             |  |  |  |
| 25929 Frederick Road   | 26002 Frederick Road             |  |  |  |
| Clarksburg, MD 20871   | Clarksburg, MD 20871             |  |  |  |
| 26008 Frederick Road   | 15021 Hyattstown Mill Road       |  |  |  |
| Clarksburg, MD 20871   | Clarksburg, MD 20871             |  |  |  |

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# Existing Property Condition Photographs (duplicate as needed)



Detail: FRONT OF HOUSE



# Detail: BACK OF HOUSE

Applicant: BETH VALLANDINGHAM

Existing Property Condition Photographs (duplicate as needed)



Detail: SOUTH SIDE OF HOUSE



# Detail:\_\_NORTH SIDE OF HOUSE

Applicant: BETH VALLANDINGHAM



November 3, 2022

#### **Certification Letter**

Project/Job # 20812111 Project Address:

Barmmer Residence 26001 Frederick Rd Clarksburg, MD 20871

AHJ SC Office Montgomery County Beltsville

#### **Design Criteria:**

- Total Number of Modules = 25
- Applicable Codes = 2018 IEBC/IBC, 2018 IRC, ASCE 7-16, and 2018 NDS
- Risk Category = II
- Wind Speed = 115 mph (3-s Gust Vult), Exposure Category C, Partially/Fully Enclosed Method
- Ground Snow Load = 30 psf
- MP2: 2x4 Stick Frame @ 24" OC, Comp Roof, Roof DL = 9 psf, Roof LL/SL = 20.8 psf (Non-PV), Roof LL/SL = 11.5 psf (PV)
- MP4: 2x4 Stick Frame @ 24" OC, Comp Roof, Roof DL = 9 psf, Roof LL/SL = 20.8 psf (Non-PV), Roof LL/SL = 12.5 psf (PV)
- MP5: 2x6 Stick Frame @ 16" OC, Comp Roof, Roof DL = 10 psf, Roof LL/SL = 20.8 psf (Non-PV), Roof LL/SL = 20.8 psf (PV)

Note: Per IBC 1613.1; Seismic check is not required because Ss = 0.135 < 0.4g and Seismic Design Category (SDC) = B < D

To Whom It May Concern,

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

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

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

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

 $[\sqrt{]}$  I prepared or approved the construction documents for the mounting equipment, rack system, roof structure for this project.

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. 49463, EXPIRATION DATE: 5-26-2024



1 Tesla Road, Austin, TX 78725 P 650 681 5100 F 650 681 5101



Version #95.5 - 3 PIL

# HARDWARE DESIGN AND STRUCTURAL ANALYSIS RESULTS SUMMARY TABLES

| Landscape |             | Hardware       | Hardware - Landscape Modules' Standoff Specifications |                |               |            |
|-----------|-------------|----------------|---|----------------|---------------|------------|
| Hardware  | X-X Spacing | X-X Cantilever | Y-Y Spacing   | Y-Y Cantilever | Configuration | Uplift DCR |
| MP2       | 72"         | 24"            | 41"   | NA             | Staggered     | 68.6%      |
| MP4       | 72"         | 24"            | 41"   | NA             | Staggered     | 68.4%      |
| MP5       | 64"         | 24"            | 41"   | NA             | Staggered     | 80.9%      |
|           |             |                |   |                |               |            |
|           |             |                |   |                |               |            |
|           |             |                |   |                |               |            |
|           |             |                |   |                |               |            |

| Portrait |             | Hardwa         | ware - Portrait Modules' Standoff Specifications |                |               |            |
|----------|-------------|----------------|--|----------------|---------------|------------|
| Hardware | X-X Spacing | X-X Cantilever | Y-Y Spacing                                      | Y-Y Cantilever | Configuration | Uplift DCR |
| MP2      | 48"         | 19"            | 74"  | NA             | Staggered     | 82.6%      |
| MP4      | 48"         | 19"            | 74"  | NA             | Staggered     | 82.3%      |
| MP5      | 32"         | 15"            | 74"  | NA             | Staggered     | 73.1%      |
|          |             |                |  |                |               |            |
|          |             |                |  |                |               |            |
|          |             |                |  |                |               |            |
|          |             |                |  |                |               |            |

| Mounting Plane | St          | ructure Informatio | on       | Qualification Results     |
|----------------|-------------|--------------------|----------|---------------------------|
|                | Туре        | Pitch              | Spacing  | Member Evaluation Results |
| MP2            | Stick Frame | 37°                | 24" O.C. | Member Impact Check OK    |
| MP4            | Stick Frame | 34°                | 24" O.C. | Member Impact Check OK    |
| MP5            | Stick Frame | 9°                 | 16" O.C. | Member Analysis OK        |
|                |             |                    |          |                           |
|                |             |                    |          |                           |
|                |             |                    |          |                           |
|                |             |                    |          |                           |

# STRUCTURE ANALYSIS - LOADING SUMMARY AND MEMBER CHECK - MP2

| Member Properties Summary      |                         |                 |                   |                 |           |  |
|--------------------------------|-------------------------|-----------------|-------------------|-----------------|-----------|--|
| MD2                            | Horizontal Member Spans |                 | Rafter Properties |                 |           |  |
| IVIF2                          |                         | Overhang        | 1.20 ft           | Actual W        | 1.50''    |  |
| Roof System Properties         |                         | Span 1          | 2.13 ft           | Actual D        | 3.50"     |  |
| Number of Spans (w/o Overhang) | 2                       | Span 2          | 7.24 ft           | Nominal         | Yes       |  |
| Roofing Material               | Comp Roof               | Span 3          |                   | A (in^2)        | 5.25      |  |
| Re-Roof                        | No                      | Span 4          |                   | Sx (in.^3)      | 3.06      |  |
| Plywood Sheathing              | Yes                     | Span 5          |                   | lx (in^4)       | 5.36      |  |
| Board Sheathing                | None                    | Total Rake Span | 13.23 ft          | TL Defl'n Limit | 120       |  |
| Vaulted Ceiling                | No                      | PV 1 Start      | 0.50 ft           | Wood Species    | SPF       |  |
| Ceiling Finish                 | 1/2" Gypsum Board       | PV 1 End        | 10.57 ft          | Wood Grade      | #2        |  |
| Rafter Slope                   | 37°                     | PV 2 Start      |                   | Fb (psi)        | 875       |  |
| Rafter Spacing                 | 24" O.C.                | PV 2 End        |                   | Fv (psi)        | 135       |  |
| Top Lat Bracing                | Full                    | PV 3 Start      |                   | E (psi)         | 1,400,000 |  |
| Bot Lat Bracing                | At Supports             | PV 3 End        |                   | E-min (psi)     | 510,000   |  |

| Member Loading Summary                                     |                   |          |                 |          |          |  |  |
|--|-------------------|----------|-----------------|----------|----------|--|--|
| Roof Pitch 9/12 Initial Pitch Adjust Non-PV Areas PV Areas |                   |          |                 |          |          |  |  |
| Roof Dead Load   | DL                | 9.0 psf  | x 1.25          | 11.3 psf | 11.3 psf |  |  |
| PV Dead Load   | PV-DL             | 3.0 psf  | x 1.25          |          | 3.8 psf  |  |  |
| Roof Live Load   | RLL               | 20.0 psf | x 0.75          | 15.0 psf |          |  |  |
| Snow Load  | SL <sup>1,2</sup> | 30.0 psf | x 0.69   x 0.38 | 20.8 psf | 11.5 psf |  |  |
| Total Load (Governing LC)                                  | TL                |          |                 | 32.1 psf | 26.5 psf |  |  |

Notes: 1. ps = Cs\*pf; Cs -roof, Cs -pv per ASCE 7 [Figure 7.4-1]; 2. pf = 0.7 (Ce) (Ct) (Is) pg; Ce=0.9, Ct=1.1, Is=1.0;

| Member Analysis Results Summary |        |            |         |            |        |
|---------------------------------|--------|------------|---------|------------|--------|
| Governing Analysis              | Pre-PV | Load (psf) | Post-PV | Net Impact | Result |
| Gravity Loading Check           | 32.1   |            | 26.5    | -17%       | Pass   |

# ZEP HARDWARE DESIGN CALCULATIONS - MP2

| Nounting Plane Information     |  |                                 |  |  |  |
|--------------------------------|--|---------------------------------|--|--|--|
| Roofing Material               |  | Comp Roof                       |  |  |  |
| Roof Slope                     |  | 37°                             |  |  |  |
| Framing Type / Direction       |  | Y-Y Rafters                     |  |  |  |
| PV System Type                 |  | SolarCity SleekMount™           |  |  |  |
| Zep System Type                |  | ZS Comp                         |  |  |  |
| Standoff (Attachment Hardware) |  | ZS Comp V4 with Flashing Insert |  |  |  |
| Spanning Vents                 |  | No                              |  |  |  |
|                                |  |                                 |  |  |  |
|                                |  |                                 |  |  |  |
|                                |  |                                 |  |  |  |

| Wind Design Criteria          |                 |   |                               |
|-------------------------------|-----------------|---|-------------------------------|
| Design Standard               |                 | ASCE 7-16   |                               |
| Wind Design Method            |                 | Partially/Fully Enclosed Method                     |                               |
| Ultimate Wind Speed           | V-Ult           | 115 mph   | Fig. 26.5-1B                  |
| Exposure Category             |                 | С   | Section 26.7                  |
| Roof Style                    |                 | Gable Roof  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Mean Roof Height              | h               | 25 ft   | Section 26.2                  |
| Notes: 1. Risk Category = II  |                 |   |                               |
| Wind Pressure Calculation Coe | efficients      |   |                               |
| Wind Pressure Exposure        | Kz              | 0.95  | Table 26.10-1                 |
| Topographic Factor            | K <sub>zt</sub> | 1.00  | Section 26.8                  |
| Wind Directionality Factor    | K <sub>d</sub>  | 0.85  | Section 26.6-1                |
| Ground Elevation Factor       | Ke              | 1.00  | Table 26.9-1                  |
| Velocity Pressure             | q <sub>h</sub>  | qh = 0.00256 (Kz) (Kzt) (Kd) (Ke) (V^2)<br>27.2 psf | Equation 26.10-1              |

|                                   |                     | Wind Pressure                                |                               |
|-----------------------------------|---------------------|--|-------------------------------|
| Ext. Pressure Coefficient (Up)    | GCp (Up)            | -1.47  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Ext. Pressure Coefficient (Down)  | GCp (Down)          | 0.77   | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Design Wind Pressure              | р                   | p = qh (yE) (ya) (GCp); yE = 1.15, yA = 0.60 | Equation 29.4-7               |
| Wind Pressure Up (Design   Ult)   | p <sub>(up)</sub>   | -16.6   -27.7 psf                            |                               |
| Wind Pressure Down (Design   Ult) | p <sub>(down)</sub> | 9.6   16 psf                                 |                               |

Notes: 1. Wind Zone Perimeter Width (a) = 3.8 ft.; Effective Wind Area (A) = 21.3 sf

2. yE = Array Edge Factor and yA = Solar Panel Pressure Equalization Factor per SEAoC PV2-2017

### ALLOWABLE STANDOFF SPACINGS

|  |           | X-Direction | Y-Direction |
|--|-----------|-------------|-------------|
| Max Allowable Standoff Spacing         | Landscape | 72"         | /1"         |
| Max Allowable Standon Spacing          | Lanuscape | 12          | 41          |
| Max Allowable Cantilever               | Landscape | 24"         | NA          |
| Standoff Configuration                 | Landscape | Staggered   |             |
| Max Standoff Tributary Area (Interior) | Trib      | 21 sf       |             |
| PV Assembly Dead Load                  | W-PV      | 3.0 psf     |             |
| Net Wind Uplift at Standoff (Interior) | T-actual  | -313 lbs    |             |
| Uplift Capacity of Standoff            | T-allow   | 456 lbs     |             |
| Standoff Demand/Capacity (Interior)    | DCR       | 68.6%       |             |

|  |          | X-Direction | Y-Direction |
|--|----------|-------------|-------------|
| Max Allowable Standoff Spacing         | Portrait | 48''        | 74''        |
| Max Allowable Cantilever               | Portrait | 19"         | NA          |
| Standoff Configuration                 | Portrait | Staggered   |             |
| Max Standoff Tributary Area (Interior) | Trib     | 25 sf       |             |
| PV Assembly Dead Load                  | W-PV     | 3.0 psf     |             |
| Net Wind Uplift at Standoff (Interior) | T-actual | -377 lbs    |             |
| Uplift Capacity of Standoff            | T-allow  | 456 lbs     |             |
| Standoff Demand/Capacity (Interior)    | DCR      | 82.6%       |             |

# STRUCTURE ANALYSIS - LOADING SUMMARY AND MEMBER CHECK - MP4

| Member Properties Summary      |                   |                 |             |                   |           |  |
|--------------------------------|-------------------|-----------------|-------------|-------------------|-----------|--|
| MD4                            |                   | Horizontal Mo   | ember Spans | Rafter Properties |           |  |
| IVI F4                         |                   | Overhang        | 1.20 ft     | Actual W          | 1.50''    |  |
| Roof System Propert            | ties              | Span 1          | 6.34 ft     | Actual D          | 3.50"     |  |
| Number of Spans (w/o Overhang) | 1                 | Span 2          |             | Nominal           | Yes       |  |
| Roofing Material               | Comp Roof         | Span 3          |             | A (in^2)          | 5.25      |  |
| Re-Roof                        | No                | Span 4          |             | Sx (in.^3)        | 3.06      |  |
| Plywood Sheathing              | Yes               | Span 5          |             | lx (in^4)         | 5.36      |  |
| Board Sheathing                | None              | Total Rake Span | 9.09 ft     | TL Defl'n Limit   | 120       |  |
| Vaulted Ceiling                | No                | PV 1 Start      | 2.67 ft     | Wood Species      | SPF       |  |
| Ceiling Finish                 | 1/2" Gypsum Board | PV 1 End        | 5.67 ft     | Wood Grade        | #2        |  |
| Rafter Slope                   | 34°               | PV 2 Start      |             | Fb (psi)          | 875       |  |
| Rafter Spacing                 | 24" O.C.          | PV 2 End        |             | Fv (psi)          | 135       |  |
| Top Lat Bracing                | Full              | PV 3 Start      |             | E (psi)           | 1,400,000 |  |
| Bot Lat Bracing                | At Supports       | PV 3 End        |             | E-min (psi)       | 510,000   |  |

| Member Loading Summary    |                          |          |                 |              |          |  |
|---------------------------|--------------------------|----------|-----------------|--------------|----------|--|
| Roof Pitch                | 8/12                     | Initial  | Pitch Adjust    | Non-PV Areas | PV Areas |  |
| Roof Dead Load            | DL                       | 9.0 psf  | x 1.21          | 10.9 psf     | 10.9 psf |  |
| PV Dead Load              | PV-DL                    | 3.0 psf  | x 1.21          |              | 3.6 psf  |  |
| Roof Live Load            | RLL                      | 20.0 psf | x 0.80          | 16.0 psf     |          |  |
| Snow Load                 | <b>SL</b> <sup>1,2</sup> | 30.0 psf | x 0.69   x 0.42 | 20.8 psf     | 12.5 psf |  |
| Total Load (Governing LC) | TL                       |          |                 | 31.7 psf     | 27.0 psf |  |

Notes: 1. ps = Cs\*pf; Cs -roof, Cs -pv per ASCE 7 [Figure 7.4-1]; 2. pf = 0.7 (Ce) (Ct) (Is) pg; Ce=0.9, Ct=1.1, Is=1.0;

| Member Analysis Results Summary |        |            |         |            |        |
|---------------------------------|--------|------------|---------|------------|--------|
| Governing Analysis              | Pre-PV | Load (psf) | Post-PV | Net Impact | Result |
| Gravity Loading Check           | 31.7   |            | 27.0    | -15%       | Pass   |

# **ZEP HARDWARE DESIGN CALCULATIONS - MP4**

| Iounting Plane Information     |  |                                 |  |
|--------------------------------|--|---------------------------------|--|
| Roofing Material               |  | Comp Roof                       |  |
| Roof Slope                     |  | 34°                             |  |
| Framing Type / Direction       |  | Y-Y Rafters                     |  |
| PV System Type                 |  | SolarCity SleekMount™           |  |
| Zep System Type                |  | ZS Comp                         |  |
| Standoff (Attachment Hardware) |  | ZS Comp V4 with Flashing Insert |  |
| Spanning Vents                 |  | No                              |  |
|                                |  |                                 |  |
|                                |  |                                 |  |
|                                |  |                                 |  |

| Wind Design Criteria          |                 |   |                               |  |  |  |
|-------------------------------|-----------------|---|-------------------------------|--|--|--|
| Design Standard               |                 | ASCE 7-16   |                               |  |  |  |
| Wind Design Method            |                 | Partially/Fully Enclosed Method                     |                               |  |  |  |
| Ultimate Wind Speed           | V-Ult           | 115 mph   | Fig. 26.5-1B                  |  |  |  |
| Exposure Category             |                 | C Section 2   |                               |  |  |  |
| Roof Style                    |                 | Gable Roof  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |  |  |  |
| Mean Roof Height              | h               | 25 ft   | Section 26.2                  |  |  |  |
| Notes: 1. Risk Category = II  |                 |   |                               |  |  |  |
| Wind Pressure Calculation Coe | efficients      |   |                               |  |  |  |
| Wind Pressure Exposure        | Kz              | 0.95  | Table 26.10-1                 |  |  |  |
| Topographic Factor            | K <sub>zt</sub> | 1.00  | Section 26.8                  |  |  |  |
| Wind Directionality Factor    | K <sub>d</sub>  | 0.85  | Section 26.6-1                |  |  |  |
| Ground Elevation Factor       | Ke              | 1.00  | Table 26.9-1                  |  |  |  |
| Velocity Pressure             | q <sub>h</sub>  | qh = 0.00256 (Kz) (Kzt) (Kd) (Ke) (V^2)<br>27.2 psf | Equation 26.10-1              |  |  |  |

|                                   |                     | Wind Pressure                                |                               |
|-----------------------------------|---------------------|--|-------------------------------|
| Ext. Pressure Coefficient (Up)    | GCp (Up)            | -1.47  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Ext. Pressure Coefficient (Down)  | GCp (Down)          | 0.77   | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Design Wind Pressure              | р                   | p = qh (yE) (ya) (GCp); yE = 1.15, yA = 0.60 | Equation 29.4-7               |
| Wind Pressure Up (Design   Ult)   | p <sub>(up)</sub>   | -16.6   -27.7 psf                            |                               |
| Wind Pressure Down (Design   Ult) | p <sub>(down)</sub> | 9.6   16 psf                                 |                               |

Notes: 1. Wind Zone Perimeter Width (a) = 3.8 ft.; Effective Wind Area (A) = 21.3 sf

2. yE = Array Edge Factor and yA = Solar Panel Pressure Equalization Factor per SEAoC PV2-2017

# ALLOWABLE STANDOFF SPACINGS

|  |           | X-Direction | Y-Direction  |
|--|-----------|-------------|--------------|
| Max Allowable Standoff Spacing         | Landscape | 72''        | <i>4</i> 1'' |
| Max Allowable Cantilever               | Landscape | 24"         | NA           |
| Standoff Configuration                 | Landscape | Staggered   |              |
| Max Standoff Tributary Area (Interior) | Trib      | 21 sf       |              |
| PV Assembly Dead Load                  | W-PV      | 3.0 psf     |              |
| Net Wind Uplift at Standoff (Interior) | T-actual  | -312 lbs    |              |
| Uplift Capacity of Standoff            | T-allow   | 456 lbs     |              |
| Standoff Demand/Capacity (Interior)    | DCR       | 68.4%       |              |

|  |          | X-Direction | Y-Direction |
|--|----------|-------------|-------------|
| Max Allowable Standoff Spacing         | Portrait | 48''        | 74''        |
| Max Allowable Cantilever               | Portrait | 19"         | NA          |
| Standoff Configuration                 | Portrait | Staggered   |             |
| Max Standoff Tributary Area (Interior) | Trib     | 25 sf       |             |
| PV Assembly Dead Load                  | W-PV     | 3.0 psf     |             |
| Net Wind Uplift at Standoff (Interior) | T-actual | -375 lbs    |             |
| Uplift Capacity of Standoff            | T-allow  | 456 lbs     |             |
| Standoff Demand/Capacity (Interior)    | DCR      | 82.3%       |             |

# STRUCTURE ANALYSIS - LOADING SUMMARY AND MEMBER CHECK - MP5

| Member Properties Summary      |                   |                 |             |                 |           |
|--------------------------------|-------------------|-----------------|-------------|-----------------|-----------|
| MP5                            |                   | Horizontal M    | ember Spans | Rafter Pi       | roperties |
|                                |                   | Overhang        | 1.20 ft     | Actual W        | 1.50''    |
| Roof System Propert            | ies               | Span 1          | 7.98 ft     | Actual D        | 5.50"     |
| Number of Spans (w/o Overhang) | 3                 | Span 2          | 8.88 ft     | Nominal         | Yes       |
| Roofing Material               | Comp Roof         | Span 3          | 8.98 ft     | A (in^2)        | 8.25      |
| Re-Roof                        | No                | Span 4          |             | Sx (in.^3)      | 7.56      |
| Plywood Sheathing              | Yes               | Span 5          |             | lx (in^4)       | 20.80     |
| Board Sheathing                | None              | Total Rake Span | 27.37 ft    | TL Defl'n Limit | 120       |
| Vaulted Ceiling                | No                | PV 1 Start      | 1.25 ft     | Wood Species    | SPF       |
| Ceiling Finish                 | 1/2" Gypsum Board | PV 1 End        | 25.33 ft    | Wood Grade      | #2        |
| Rafter Slope                   | 9°                | PV 2 Start      |             | Fb (psi)        | 875       |
| Rafter Spacing                 | 16" O.C.          | PV 2 End        |             | Fv (psi)        | 135       |
| Top Lat Bracing                | Full              | PV 3 Start      |             | E (psi)         | 1,400,000 |
| Bot Lat Bracing                | At Supports       | PV 3 End        |             | E-min (psi)     | 510,000   |

| Member Loading Summary    |                          |          |                 |              |          |
|---------------------------|--------------------------|----------|-----------------|--------------|----------|
| Roof Pitch                | 2/12                     | Initial  | Pitch Adjust    | Non-PV Areas | PV Areas |
| Roof Dead Load            | DL                       | 10.0 psf | x 1.01          | 10.1 psf     | 10.1 psf |
| PV Dead Load              | PV-DL                    | 3.0 psf  | x 1.01          |              | 3.0 psf  |
| Roof Live Load            | RLL                      | 20.0 psf | x 1.00          | 20.0 psf     |          |
| Snow Load                 | <b>SL</b> <sup>1,2</sup> | 30.0 psf | x 0.69   x 0.69 | 20.8 psf     | 20.8 psf |
| Total Load (Governing LC) | TL                       |          |                 | 30.9 psf     | 34.0 psf |

Notes: 1. ps = Cs\*pf; Cs -roof, Cs -pv per ASCE 7 [Figure 7.4-1]; 2. pf = 0.7 (Ce) (Ct) (Is) pg; Ce=0.9, Ct=1.1, Is=1.0;

| Member Analysis Results Summary |            |            |          |     |        |
|---------------------------------|------------|------------|----------|-----|--------|
| Governing Analysis              | Max Moment | @ Location | Capacity | DCR | Result |
| (-) Bending Stress (psi)        | -595.7     | 18.0 ft    | -1,202.6 | 50% | Pass   |

# **ZEP HARDWARE DESIGN CALCULATIONS - MP5**

| Mounting Plane Information     |  |                                 |  |  |  |
|--------------------------------|--|---------------------------------|--|--|--|
| Roofing Material               |  | Comp Roof                       |  |  |  |
| Roof Slope                     |  | 9°                              |  |  |  |
| Framing Type / Direction       |  | Y-Y Rafters                     |  |  |  |
| PV System Type                 |  | SolarCity SleekMount™           |  |  |  |
| Zep System Type                |  | ZS Comp                         |  |  |  |
| Standoff (Attachment Hardware) |  | ZS Comp V4 with Flashing Insert |  |  |  |
| Spanning Vents                 |  | No                              |  |  |  |
|                                |  |                                 |  |  |  |
|                                |  |                                 |  |  |  |
|                                |  |                                 |  |  |  |

| Wind Design Criteria          |                 |   |                               |
|-------------------------------|-----------------|---|-------------------------------|
| Design Standard               |                 | ASCE 7-16   |                               |
| Wind Design Method            |                 | Partially/Fully Enclosed Method                     |                               |
| Ultimate Wind Speed           | V-Ult           | 115 mph   | Fig. 26.5-1B                  |
| Exposure Category             |                 | С   | Section 26.7                  |
| Roof Style                    |                 | Gable Roof  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Mean Roof Height              | h               | 25 ft   | Section 26.2                  |
| Notes: 1. Risk Category = II  |                 |   |                               |
| Wind Pressure Calculation Coe | efficients      |   |                               |
| Wind Pressure Exposure        | Kz              | 0.95  | Table 26.10-1                 |
| Topographic Factor            | K <sub>zt</sub> | 1.00  | Section 26.8                  |
| Wind Directionality Factor    | K <sub>d</sub>  | 0.85  | Section 26.6-1                |
| Ground Elevation Factor       | Ke              | 1.00  | Table 26.9-1                  |
| Velocity Pressure             | q <sub>h</sub>  | qh = 0.00256 (Kz) (Kzt) (Kd) (Ke) (V^2)<br>27.2 psf | Equation 26.10-1              |

|                                   |                     | Wind Pressure                                |                               |
|-----------------------------------|---------------------|--|-------------------------------|
| Ext. Pressure Coefficient (Up)    | GCp (Up)            | -1.94  | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Ext. Pressure Coefficient (Down)  | GCp (Down)          | 0.46   | Fig. 30.3-2A/B/C/D/E/G/H-5A/B |
| Design Wind Pressure              | р                   | p = qh (yE) (ya) (GCp); yE = 1.15, yA = 0.60 | Equation 29.4-7               |
| Wind Pressure Up (Design   Ult)   | p <sub>(up)</sub>   | -21.9   -36.6 psf                            |                               |
| Wind Pressure Down (Design   Ult) | p <sub>(down)</sub> | 9.6   16 psf                                 |                               |

Notes: 1. Wind Zone Perimeter Width (a) = 3.8 ft.; Effective Wind Area (A) = 21.3 sf

2. yE = Array Edge Factor and yA = Solar Panel Pressure Equalization Factor per SEAoC PV2-2017

### ALLOWABLE STANDOFF SPACINGS

|  |           | X-Direction | Y-Direction |
|--|-----------|-------------|-------------|
| Max Allowable Standoff Spacing         | Landscape | 64''        | /1"         |
|  | Lanuscape | 04          | 41          |
| Max Allowable Cantilever               | Landscape | 24          | NA          |
| Standoff Configuration                 | Landscape | Staggered   |             |
| Max Standoff Tributary Area (Interior) | Trib      | 18 sf       |             |
| PV Assembly Dead Load                  | W-PV      | 3.0 psf     |             |
| Net Wind Uplift at Standoff (Interior) | T-actual  | -369 lbs    |             |
| Uplift Capacity of Standoff            | T-allow   | 456 lbs     |             |
| Standoff Demand/Capacity (Interior)    | DCR       | 80.9%       |             |

|  |          | X-Direction | Y-Direction |
|--|----------|-------------|-------------|
| Max Allowable Standoff Spacing         | Portrait | 32"         | 74''        |
| Max Allowable Cantilever               | Portrait | 15"         | NA          |
| Standoff Configuration                 | Portrait | Staggered   |             |
| Max Standoff Tributary Area (Interior) | Trib     | 17 sf       |             |
| PV Assembly Dead Load                  | W-PV     | 3.0 psf     |             |
| Net Wind Uplift at Standoff (Interior) | T-actual | -333 lbs    |             |
| Uplift Capacity of Standoff            | T-allow  | 456 lbs     |             |
| Standoff Demand/Capacity (Interior)    | DCR      | 73.1%       |             |

| ABBREVIATIONS   | ELECTRICAL NOTES  | JURISDICTION NOTES  |   |
|---|---|---|---|
| A AMPERE AC ALTERNATING CURRENT BLDG<br>BUILDING CONC CONCRETE DC DIRECT CURRENT<br>EGC EQUIPMENT GROUNDING CONDUCTOR (E)<br>EXISTING EMT ELECTRICAL METALLIC TUBING FSB<br>FIRE SET-BACK GALV GALVANIZED GEC GROUNDING<br>ELECTRODE CONDUCTOR GND GROUND HDG HOT<br>DIPPED GALVANIZED I CURRENT Imp CURRENT AT<br>MAX POWER Isc SHORT CIRCUIT CURRENT kVA<br>KILOVOLT AMPERE kW KILOWATT LBW LOAD<br>BEARING WALL MIN MINIMUM (N) NEW NEUT<br>NEUTRAL NTS NOT TO SCALE OC ON CENTER PL<br>PROPERTY LINE POI POINT OF INTERCONNECTION<br>PV PHOTOVOLTAIC SCH SCHEDULE S STAINLESS<br>STEEL STC STANDARD TESTING CONDITIONS TYP<br>TYPICAL UPS UNINTERRUPTIBLE POWER SUPPLY V<br>VOLT Vmp VOLTAGE AT MAX POWER Voc VOLTAGE<br>AT OPEN CIRCUIT W WATT 3R NEMA 3R, RAINTIGHT | <ol> <li>THIS SYSTEM IS GRID-INTERTIED VIA A UL-LISTED<br/>POWER-CONDITIONING INVERTER.</li> <li>THIS SYSTEM HAS NO BATTERIES, NO UPS.</li> <li>A NATIONALLY-RECOGNIZED TESTING LABORATORY<br/>SHALL LIST ALL EQUIPMENT IN COMPLIANCE WITH<br/>ART. 110.3.</li> <li>WHERE ALL TERMINALS OF THE DISCONNECTING<br/>MEANS MAY BE ENERGIZED IN THE OPEN POSITION,<br/>A SIGN WILL BE PROVIDED WARNING OF THE<br/>HAZARDS PER ART. 690.17.</li> <li>EACH UNGROUNDED CONDUCTOR OF THE<br/>MULTIWRE BRANCH CIRCUIT WILL BE IDENTIFIED BY<br/>PHASE AND SYSTEM PER ART. 210.5.</li> <li>CIRCUITS OVER 250V TO GROUND SHALL COMPLY<br/>WITH ART. 250.97, 250.92(B).</li> <li>DC CONDUCTORS EITHER DO NOT ENTER BUILDING<br/>OR ARE RUN IN METALLIC RACEWAYS OR<br/>ENCLOSURES TO THE FIRST ACCESSIBLE DC<br/>DISCONNECTING MEANS PER ART. 690.31(E).</li> <li>ALL WIRES SHALL BE PROVIDED WITH STRAIN<br/>RELIEF AT ALL ENTRY INTO BOXES AS REQUIRED BY<br/>UL LISTING.</li> <li>MODULE FRAMES SHALL BE GROUNDED AT THE<br/>UL-LISTED LOCATION PROVIDED BY THE<br/>MANUFACTURER USING UL LISTED GROUNDING<br/>HARDWARE.</li> <li>MODULE FRAMES, RAIL, AND POSTS SHALL BE<br/>BONDED WITH EQUIPMENT GROUND CONDUCTORS.</li> </ol> | STRUCTURAL DESIGN FOR THE SUPPORTING<br>STRUCTURE OF THE HOUSE WAS PERFORMED IN<br>ACCORDANCE WITH IRC/IBC 2018 - STRUCTURAL<br>DESIGN FOR THE RACK SYSTEM AND MOUNTING<br>HARDWARE WAS PERFORMED IN ACCORDANCE WITH<br>IRC/IBC 2018. |   |
|   |   | VICINITY MAP  | INDEX   |
|   |   |   | Sheet 1 COVER SHEET<br>Sheet 2 SITE PLAN<br>Sheet 3 STRUCTURAL VIEWS<br>Sheet 4 UPLIFT CALCULATIONS |
| LICENSE   | GENERAL NOTES   |   | Sheet 5 THREE LINE DIAGRAM<br>Cutsheets Attached  |
| #11805 MASTER ELECTRICIAN<br>Nicholaus Meyers   | 1. ALL WORK SHALL COMPLY WITH THE 2018 IBC<br>AND 2018 IRC. 2. ALL ELECTRICAL WORK SHALL<br>COMPLY WITH THE 2017 NATIONAL ELECTRIC CODE.  | Hyatistown  |   |
| MODULE GROUNDING METHOD: ZEP SOLAR  |   |   |   |
| AHJ: Montgomery County  |   |   | REV BY DATE COMMENTS  |
|   |   | 109   | * * * *   |
| UIILIIY: POTOMAC Edison (MD)  |   | , Maxar Technologies, U.S. Geological Survey, USDA/FPA  | C/GEO * * * *   |
| confidential – the information herein job number: $JB-2($   | )812111 00 CUSTOMER:<br>Branda  | DESCRIPTION:  | DESIGN:<br>Blake Parkison   |
| BENEFIT OF ANYONE EXCEPT TESLA INC., NOR<br>SHALL IT BE DISCLOSED IN WHOLE OR IN<br>ZS Comp V4 w Flat   | shing-Insert 26001  | Frederick Rd  |   |
| ORGANIZATION, EXCEPT IN CONNECTION WITH<br>THE SALE AND USE OF THE RESPECTIVE (25) Tesla # T400H  | Clarkst   | urg, MD 20871   |   |
| TESLA EQUIPMENT, WITHOUT THE WRITTEN<br>PERMISSION OF TESLA INC.<br>7.6 kW Tesla Inc 15   | 538000-00-F (240V) 571352   | 28652 COVER SHEET   | 1 A 11/8/2022 <b>19</b>   |



| Y THAT THESE              |   |
|---------------------------|---|
| INEER UNDER               | MP2 AZIMUTH: 268 ARRAY AZIMUTH: 268<br>MATERIAL: Comp Shingle STORY: 2 Stories  |
| 26-2024                   |   |
|                           | MP4 PITCH: 34° (8:12) ARRAY PITCH: 34° (8:12)<br>AZIMUTH: 358 ARRAY AZIMUTH: 358<br>MATERIAL: Comp Shingle STORY: 2 Stories |
|                           | PITCH: 9° (2:12)ARRAY PITCH: 9° (2:12)MP5AZIMUTH: 178ARRAY AZIMUTH: 178MATERIAL: Comp ShingleSTORY: 2 Stories               |
|                           |   |
|                           | LEGEND  |
| ILY                       | (E) UTILITY METER & WARNING LABEL   |
|                           | INVERTER W/ INTEGRATED DC DISCO<br>& WARNING LABELS   |
|                           | DC DISCONNECT & WARNING LABELS  |
|                           | AC DISCONNECT & WARNING LABELS  |
|                           | DC JUNCTION/COMBINER BOX & LABELS   |
|                           | DISTRIBUTION PANEL & LABELS   |
|                           | LOAD CENTER & WARNING LABELS  |
|                           | DEDICATED PV SYSTEM METER   |
|                           | RESO RAPID SHUTDOWN   |
|                           | STANDOFF LOCATIONS     CONDUIT RUN ON EXTERIOR     CONDUIT RUN ON INTERIOR     ONDUIT RUN ON INTERIOR                       |
|                           | HEAT PRODUCING VENTS ARE RED  |
|                           | interior equipment is dashed  |
|                           |   |
|                           | SITE PLAN   |
| \ (SF): 542<br>(SF): 1965 | Scale: $1/8'' = 1'$   |
| NIS ≈ 27.59<br>ROOF AREA  |   |
| DESIGN:<br>Blake          | <sup>arkison</sup> TESLA  |
| SHEET:                    | rev: date:<br>A 11/8/2022   |
|                           | 20  |









| WARNING: PHOTOVOLTAIC POWER SOURCE   | Label Location:<br>(C)(CB)(JB)<br>Per Code:<br>NEC 690.31.G.3<br>Label Location:<br>(DC) (INV)<br>Per Code:<br>NEC 690.13.B | WARNING<br>ELECTRIC SHOCK HAZARD<br>DO NOT TOUCH TERMINALS<br>TERMINALS ON BOTH LINE AND<br>LOAD SIDES MAY BE ENERGIZED<br>IN THE OPEN POSITION   | Label Location:<br>(AC)(POI)<br>Per Code:<br>NEC 690.13.B   | WARNING<br>ELECTRIC SHOCK HAZARD<br>THE DC CONDUCTORS OF THIS<br>PHOTOVOLTAIC SYSTEM ARE<br>UNGROUNDED AND<br>MAY BE ENERGIZED | Label Location:<br>(DC) (INV) |
|--|---|---|---|--|-------------------------------|
| MAXIMUM POWER-<br>POINT CURRENT (Imp)<br>MAXIMUM POWER-<br>POINT VOLTAGE (Vmp)<br>MAXIMUM SYSTEM<br>VOLTAGE (Voc)  | Label Location:<br>(DC) (INV)<br>Per Code:<br>NEC 690.53  | PHOTOVOLTAIC SYSTEM<br>EQUIPPED WITH RAPID<br>SHUTDOWN  | Label Location:<br>(INV)<br>Per Code:<br>NEC 690.56.C.3     |  |                               |
| SHORT-CIRCUIT<br>CURRENT (Isc)<br>A<br>WARNING<br>ELECTRIC SHOCK HAZARD<br>IF A GROUND FAULT IS INDICATED  | Label Location:<br>(DC) (INV)<br>Per Code:<br>690.41.B  | WARNING<br>INVERTER OUTPUT<br>CONNECTION<br>DO NOT RELOCATE<br>THIS OVERCURRENT<br>DEVICE   | Label Location:<br>(POI)<br>Per Code:<br>NEC 705.12.B.2.3.b |  |                               |
|  | Label Location:<br>(DC) (CB)  | CAUTION<br>PHOTOVOLTAIC SYSTEM<br>CIRCUIT IS BACKFED  | Label Location:<br>(D) (POI)<br>Per Code:<br>NEC 690.64.B.4 |  |                               |
| ELECTRICAL SHOCK HAZARD<br>DO NOT TOUCH TERMINALS<br>TERMINALS ON BOTH LINE AND<br>LOAD SIDES MAY BE ENERGIZED<br>IN THE OPEN POSITION<br>DC VOLTAGE IS<br>ALWAYS PRESENT WHEN<br>SOLAR MODULES ARE<br>EXPOSED TO SUNLIGHT | Per Code:<br>CEC 690.13.B   | CAUTION<br>DUAL POWER SOURCE<br>SECOND SOURCE IS<br>PHOTOVOLTAIC SYSTEM   | Label Location:<br>(POI)<br>Per Code:<br>NEC 705.12.B.3     |  |                               |
| PHOTOVOLTAIC AC<br>DISCONNECT  | Label Location:<br>(AC) (POI)<br>Per Code:<br>NEC 690.13.B  | PHOTOVOLTAIC POINT OF<br>INTERCONNECTION<br>WARNING: ELECTRIC SHOCK<br>HAZARD. DO NOT TOUCH<br>TERMINALS. TERMINALS ON<br>BOTH THE LINE AND LOAD SIDE<br>MAY BE ENERGIZED IN THE OPEN<br>POSITION. FOR SERVICE<br>DE-ENERGIZE BOTH SOURCE | Label Location:<br>(POI)<br>Per Code:<br>CEC 690.13.B       |  |                               |
| MAXIMUM AC<br>OPERATING CURRENT<br>MAXIMUM AC<br>OPERATING VOLTAGE   | Label Location:<br>(AC) (POI)<br>Per Code:<br>NEC 690.54  | AND MAIN BREAKER.<br>PV POWER SOURCE<br>MAXIMUM AC<br>OPERATING CURRENT<br>MAXIMUM AC<br>OPERATING VOLTAGE  |   |  |                               |

(AC): AC Disconnect
(C): Conduit
(CB): Combiner Box
(D): Distribution Panel
(DC): DC Disconnect
(IC): Interior Run Conduit
(INV): Inverter With Integrated DC Disconnect
(LC): Load Center
(M): Utility Meter
(POI): Point of Interconnection

# MCI WIRING DETAIL

# GENERAL NOTES

- DRAWING OF STANDARD MCI WIRING DETAIL FOR ANY GIVEN STRING LENGTH
- IF INITIATED, RAPID SHUTDOWN OCCURS WITHIN 30 SECONDS OF ACTIVATION AND LIMITS VOLTAGE ON THE ROOF TO NO GREATER THAN 165V (690.12.B.2.1)
- MID CIRCUIT INTERRUPTER (MCI) IS A UL 1741 PVRSE CERTIFIED RAPID SHUTDOWN DEVICE (RSD)

# RETROFIT PV MODULES

- MCIS ARE LOCATED AT ROOF LEVEL, JUST UNDER THE PV MODULES IN ACCORDANCE WITH 690.12 REQUIREMENTS
- THE QUANTITY OF MCIS PER STRING IS DETERMINED BY STRING LENGTH
  - NUMBER OF MODULES BETWEEN MCI UNITS = 0-3
  - MAXIMUM NUMBER OF MODULES PER MCI UNIT = 3
  - MINIMUM NUMBER MCI UNITS = MODULE COUNT/3

GD J-BOX DC+ J-BOX J-BOX MCI DC-J-BOX J-BOX

\*Exception: Tesla (Longi) modules installed in locations where the max Voc for 3 modules at low design temperature exceeds 165V shall be limited to 2 modules between MCIs.

PLEASE REFER TO MCI CUTSHEET AND PVRSA INSERT FOR MORE INFORMATION



TESLA



# Tesla Solar Inverter with Solar Shutdown Device

Tesla Solar Inverter completes the Tesla home solar system, converting DC power from solar to AC power for home consumption. Tesla's renowned expertise in power electronics has been combined with robust safety features and a simple installation process to produce an outstanding solar inverter that is compatible with both Solar Roof and traditional solar panels. Once installed, homeowners use the Tesla mobile app to manage their solar system and monitor energy consumption, resulting in a truly unique ecosystem experience.

**KEY FEATURES** 

- Built on Powerwall technology for exceptional efficiency and reliability
- Wi-Fi, Ethernet, and cellular connectivity with easy over-the-air updates
- Designed to integrate with Tesla Powerwall and Tesla App
- 0.5% revenue-grade metering for Solar Renewable Energy Credit (SREC) programs included
- 3.8 kW and 7.6 kW models available

# **Tesla Solar Inverter Technical Specifications**

Electrical Specifications: Output (AC)

**Electrical Specifications:** 

Input (DC)

Performance

Specifications

Model Number Output (AC) Nominal Power Maximum Apparent Pow

Maximum Continuous Cu Breaker (Overcurrent Pro Nominal Power Factor THD (at Nominal Power)

MPPT

Input Connectors per MI Maximum Input Voltage DC Input Voltage Range DC MPPT Voltage Range Maximum Current per M Maximum Short Circuit ( MPPT (I<sub>sr</sub>)

<sup>1</sup> Maximum current.

 $^2$  Where the DC input current exceeds an MPPT rating, jumpers can be used to allow a single MPPT to intake additional DC current up to 26 A  $\rm I_{MP}$  / 34 A  $\rm I_{SC}$ .

Peak Efficiency

CEC Efficiency

Allowable DC/AC Ratio Customer Interface Internet Connectivity

Factory-Installed Reven AC Remote Metering Su Protections

Supported Grid Types

<sup>3</sup> Applicable to Tesla Solar Inverter with Site Controller (1538000-45-y) only.
 <sup>4</sup> Cellular connectivity subject to network operator service coverage and signal strength.



|           | 1534000-xx-y                           | 1538000-xx-y                           |
|-----------|--|--|
|           | 3.8 kW                                 | 7.6 kW                                 |
|           | 3,800 W                                | 7,600 W                                |
| ver       | 3,328 VA at 208 V<br>3,840 VA at 240 V | 6,656 VA at 208 V<br>7,680 VA at 240 V |
| urrent    | 16 A                                   | 32 A                                   |
| otection) | 20 A                                   | 40 A                                   |
|           | 1 - 0.9 (lead                          | ing / lagging                          |
| )         | <                                      | 5%                                     |

|                        | 2   |                           | 4       |
|------------------------|-----|---------------------------|---------|
| РРТ                    | 1-2 |                           | 1-2-1-2 |
|                        |     | 600 VDC                   |         |
| 2                      |     | 60 - 550 VDC              |         |
| e                      |     | 60 - 480 VDC <sup>1</sup> |         |
| PPT (I <sub>MP</sub> ) |     | 13 A <sup>2</sup>         |         |
| Current per            |     | 17 A <sup>2</sup>         |         |
|                        |     |                           |         |

|                | 98% at 208 V<br>98.1% at 240 V                               | 98.4% at 208 V<br>98.6% at 240 V |
|----------------|--|----------------------------------|
|                | 07.5% at 200 V   | 07.5% at 200 V                   |
|                | 97.5% at 208 V   | 97.5% at 208 V                   |
|                | 97.5% at 240 V   | 98.0% at 240 v                   |
|                | 1.7  |                                  |
|                | Tesla Mobile App   |                                  |
|                | Wi-Fi (2.4 GHz, 802.11 b/g/r<br>Ethernet ³, Cellular (LTE/4G | 1),<br>) <sup>4</sup>            |
| ue Grade Meter | Revenue Accurate (+/- 0.5%                                   | 6) <sup>3</sup>                  |
| pport          | Wi-Fi (2.4 GHz, 802.11 b/g/r                                 | ו), RS-485                       |
|                | Integrated arc fault circuit<br>interrupter (AFCI), Rapid SI | nutdown                          |
|                | 60 Hz, 240 V Split Phase<br>60 Hz, 208 V Wye                 |                                  |
|                |  |                                  |

# **Tesla Solar Inverter Technical Specifications**

| Mechanical Specifications    | Dimensions   | 660 mm x 411 mm x 158 mm (26 in x 16 in x 6 in)  | accordance with Art<br>loss of AC power.                             | icle 690 of the applicable NEC  | C. When paire  |  |
|------------------------------|--|--|--|---|--|--|
|                              |  |  | Electrical   | Nominal Input DC Curre  | ent Rating (I <sub>M</sub>                                 |  |
|                              |  |  | Specifications   | Maximum Input Short C   | Maximum Input Short Circuit Curren                         |  |
|                              |  |  |  | Maximum System Volta  | ge (PVHCS)   |  |
|                              |  | 660 mm   | RSD Module   | Maximum Number of D   | evices per Str   |  |
|                              |  |  | Performance  | Control   |  |  |
|                              |  |  |  | Passive State   |  |  |
|                              |  |  |  | Maximum Power Consu   | mption   |  |
|                              |  |  |  | Warranty  |  |  |
|                              |  |  |  |   |  |  |
|                              |  | ← 411 mm → ← 150 →<br>mm   | Environmental  | Ambient Temperature   |  |  |
|                              | Weight   | 52 lb <sup>5</sup>   | Specifications   | Storage Temperature   |  |  |
|                              | Mounting Options   | Wall mount (bracket)   |  | Enclosure Rating  |  |  |
|                              | <sup>5</sup> Door and bracket can be rem                                 | noved for a mounting weight of 37 lb.  | Compliance   | Certifications  |  |  |
|                              |  |  | mornation  | RSD Initiation Method   |  |  |
|                              |  |  |  | Compatible Equipment  |  |  |
| Environmental Specifications | Operating Temperature  | -30°C to 45°C (-22°F to 113°F) <sup>6</sup>  |  |   |  |  |
|                              | Operating Humidity (RH)  | Up to 100%, condensing $70\%$ to $70\%$ ( $23\%$ to $158\%$ C)   | Mechanical   | Model Number  | MCI-1  |  |
|                              | Maximum Elevation  | -3000  m (9843  ft)  | Specifications   | Electrical Connections  | MC4 Conr   |  |
|                              | Environment  | Indoor and outdoor rated   |  | Housing   | Plastic  |  |
|                              | Enclosure Rating   | Type 3R  |  | Dimensions  | 12E mm v   |  |
|                              | Ingress Rating   | IP55 (Wiring compartment)  |  | Dimensions  | 22 mm  |  |
|                              | Pollution Rating   | PD2 for power electronics and terminal wiring  |  |   | (5 in x 6 ir   |  |
|                              |  | compartment, PD3 for all other components  |  | Weight  | 350 g (0.7   |  |
|                              | Operating Noise @ 1 m  | < 40 db(A) nominal, < 50 db(A) maximum   |  | Mounting Options  | ZEP Home   |  |
|                              | <sup>6</sup> For the 7.6 kW Tesla Solar In<br>5.37 kW at 208 V when oper | verter, performance may be de-rated to 6.2 kW at 240 V or<br>rating at temperatures greater than 45°C. |  |   | M8 Bolt (5<br>Nail / Wo                                    |  |
|                              |  |  | UL 3741 PV Ha  | zard Control (and PVR   | SA) Com  |  |
| Compliance Information       | Grid Certifications  | UL 1741, UL 1741 SA, UL 1741 SB, IEEE 1547,<br>IEEE 1547.1   | Tesla Solar Roof and<br>with Tesla Solar Inve<br>Hazard Control Syst | Tesla/Zep ZS Arrays using the<br>rter and Solar Shutdown Devic<br>em Listing for guidance on inst | e following mo<br>ces. See <u>Tesla</u><br>talling Tesla S |  |
|                              | Safety Certifications  | UL 1741 PVRSS, UL 1699B, UL 1998 (US), UL 3741   | Brand Model  |   |  |  |
|                              | Emissions  | EN 61000-6-3 (Residential), FCC 47CFR15.109 (a)  | Tesla Solar Re   | oof V3  |  |  |
|                              |  |  | Tesla Tesla Tx   | xxS (where xxx = 405 to 450   | W, increments  |  |
|                              |  |  | Tesla Tesla Tx   | xxH (where xxx = 395 to 415 V   | V, increments  |  |

limited to two modules between Solar Shutdown Devices. Tesla Solar Inverter and Solar Shutdown Device Datasheet

Q.PEAK DUO BLK-G5 or Q.PEAK DUO BLK-G6+

Hanwha

# Solar Shutdown Device 1 Technical Specifications

The Solar Shutdown Device is a Mid-Circuit Interrupter (MCI) and is part of the PV system rapid shutdown (RSD) function in accordance with Article 690 of the applicable NEC. When paired with Tesla Solar Inverter, solar array shutdown is initiated by any

| ting (I <sub>MP</sub> )  | 12 A   |
|--|--|
| Current (I <sub>sc</sub> )   | 15 A   |
| /HCS)  | 600 V DC   |
| per String   | 5  |
|  | Power Line Excitation  |
|  | Normally Open  |
| n  | 7 W  |
|  | 25 years   |
|  | -40°C to 50°C (-40°F to 122°F)                                       |
|  | -30°C to 70°C (-22°F to 158°F)                                       |
|  | NEMA 4X / IP65   |
|  | UL 1741 PVRSE, UL 3741,<br>PVRSA (Photovoltaic Rapid Shutdown Array) |
|  | PV System AC Breaker or Switch                                       |
|  | See Compatibility Table below  |
| CI-1<br>C4 Connector   | 250 mm   |
| astic  |  |
| 5 mm x 150 mm x<br>mm<br>in x 6 in x 1 in)                             | 650 mm 150 mm M4 Screw   |
| 0 g (0.77 lb)  | Nail /   |
| P Home Run Clip<br>4 Screw (#10)<br>3 Bolt (5/16")<br>iil / Wood screw |  |
| Compatibility  | 22 mm ←125 mm→   |

# Compatibility

wing modules are certified to UL 3741 and UL 1741 PVRSA when installed ee <u>Tesla Solar Inverter Rapid Shutdown: Module Selection Based on PV</u> I Tesla Solar Inverter and Solar Shutdown Devices with other modules.

|         | Required Solar Shutdown Devices                    |
|---------|--|
|         | 1 Solar Shutdown Device per 10 modules             |
| s of 5) | 1 Solar Shutdown Device per 3 modules <sup>7</sup> |
| s of 5) | 1 Solar Shutdown Device per 3 modules              |
|         | 1 Solar Shutdown Device per 3 modules              |

<sup>7</sup> Exception: Tesla solar modules installed in locations where the max Voc for three modules at low design temperatures exceeds 165 V shall be

# Tesla Photovoltaic Module

T395H, T400H, and T405H

The Tesla module is one of the most powerful residential photovoltaic modules available and exceeds industry engineering and quality standards. Featuring our proprietary Zep Groove design, the all-black module mounts close to your roof for a minimalist aesthetic. Modules are certified to IEC / UL 61730 - 1, IEC / UL 61730 - 2 and IEC 61215.



# **Module Specifications**

# **Electrical Characteristics** Power Class Test Method Max Power, P<sub>MAX</sub> (W) Open Circuit Voltage, V<sub>oc</sub> (V) Short Circuit Current, I<sub>sc</sub> (A) Max Power Voltage, $V_{_{MP}}(V)$ 35 mm / 1.378 ir Max Power Current, $I_{_{MP}}(A)$ Module Efficiency (%) STC NOCT 6120 Pa | 128 lb/ ft² Refer to module and system installation manuals for 6120 Pa | 128 lb/ ft² allowable design loads, foot 4080 Pa | 85 lb/ft² spacings, and cantilever 4080 Pa | 85 lb/ft<sup>2</sup> specifications. 35 mm at 27.2 m/s 132 (6 x 22) IP68, 3 diodes 4 mm² | 12 AWG, 1325 mm | 47.2 in. Length Staubli MC4 0.13 in (3.2 mm) thermally pre-stressed glass Black Anodized Aluminum Alloy 23.5 kg | 51.8 lb 1890 mm x 1046 mm x 40 mm 74.4 in x 41.2 in x 1.57 in -40°C up to +85°C -0 /+5 W +/-5% DC 1000 V (IEC/UL) 20 A 45.7 +/- 3 °C Class II UL 61730 Type 2 25 years



Tesla Module Datasheet (TEPV-DS-0011-21)

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# **ROOFING SYSTEM SPECIFICATIONS**







| Wire & Conduit Size Equivalence Table: Copper & Aluminum |                             |                   |              |                             |              |
|--|-----------------------------|-------------------|--------------|-----------------------------|--------------|
|  | Copper Aluminum             |                   |              | Aluminum                    |              |
| Rating (A)   | Conductor<br>(AWG or kcmil) | Min. EGC<br>(AWG) | Conduit      | Conductor<br>(AWG or kcmil) | Conduit      |
| 100  | 3                           | 8                 | 1" - EMT     | 1                           | 1-1/4" - EMT |
| 115  | 2                           | 6                 | 1-1/4" - EMT | 1/0                         | 2" - PVC     |
| 130  | 1                           | 6                 | 1-1/4" - EMT | 2/0                         | 2" - PVC     |
| 150  | 1/0                         | 6                 | 2" - PVC     | 3/0                         | 2" - PVC     |
| 175  | 2/0                         | 6                 | 2" - PVC     | 4/0                         | 2" - PVC     |
| 200  | 3/0                         | 6                 | 2" - PVC     | 250                         | 2" - PVC     |

# **NEC Code references**

NEC Table 310.15(B)(16) (formerly Table 310.16) NEC Table 250.122 Table 310.104(A)

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WIRE & CONDUIT SIZE EQUIVALENCE TABLE



# **PV HAZARD CONTROL SYSTEM** | ZS PVHCS

UL 3741 REPORT DATE 10-20-21 (APPLICABLE TO ZS COMP. ZS SPAN, ZS RAMP, AND ZS SEAM) PV RAPID SHUTDOWN ARRAY. UL 1741 CATEGORY QIJR

WARNING: To reduce the risk of injury, read all instructions.

# PV HAZARD CONTROL EQUIPMENT AND COMPONENTS

| Function                               | Manufacturer  | Model No.   | Firmware Versions and Checksums              | Certification Standard                     |
|--|---|---|--|--|
| PVRSE Mid Circuit<br>Interrupter (MCI) | Tesla   | MCI-1   | N/A  | UL 1741 PVRSE                              |
| Inverter or Powerwall+                 | Tesla   | 7.6 kW: 1538000 <sup>1</sup><br>3.8 kW: 1534000 <sup>1</sup><br>7.6 kW: 1850000 <sup>1</sup>                                    | V4, CEA4F802<br>V4, FF7BE4E1<br>V4, CEA4F802 | UL 1741, 1998<br>PVRSS/PVRSE               |
| PV Module                              | Hanwha/ Q-CELLS<br>Tesla  | Q.PEAK DUO BLK-G5/SC310-320<br>Q.PEAK DUO BLK G6+/SC330-345<br>Tesla TxxxS (xxx = 405 to 450)<br>Tesla TxxxH (xxx = 395 to 415) | N/A  | UL 1703<br>UL 61730                        |
| PVHCS Initiator<br>(PV Inverter)       | Dedicated PV system AC circuit breaker or AC disconnect switch, labeled per NEC 690.12 requirements.              |   |  | N/A  |
| PVHCS Initiator<br>(Powerwall+)        | Emergency stop device (NISD)- Listed "Emergency Stop Button" or "Emergency Stop Device" or "Emergency Stop Unit". |   |  | UL 508 or UL 60947 Parts<br>1, 5-1 and 5-5 |

<sup>1</sup> Applies to variations of this part number with suffix of two numbers and one letter.

Note: PVHCS installation requirements may reduce the effective equipment and component ratings below the individual equipment and component PVRSE ratings in order to achieve PVHCS shock hazard reduction requirements.

#### **PVHCS INSTALLATION REQUIREMENTS**

| Max System Voltage  | 600 VDC                             |
|---|-------------------------------------|
| PVHCS Maximum Circuit Voltage (Array Internal Voltage After Actuation)  | 165 VDC (cold weather open circuit) |
| Max Series-Connected Modules Between MCIs:<br>*Exception: Tesla S-Series (TxxxS) modules installed in locations where the max VOC for 3<br>modules at low design temperature exceeds 165V shall be limited to 2 modules between MCIs. | 3*                                  |

# OTHER INSTALLATION INSTRUCTIONS

1. An MCI must be connected to one end of each series string or mounting plane sub-array string.

2. Verification that MCIs are installed with 3 or fewer modules between MCIs shall be documented for inspection, by voltage measurement logs and/or as-built string layout diagrams.

3. For PV Inverter: The PVHCS initiator (AC breaker or switch) shall be sized and installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings.

4. For Powerwall+: The PVHCS emergency stop initiator shall have the following minimum ratings: Outdoor (Type 3R or higher), 12V, 1A, and shall be installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings. Refer to the Powerwall+ installation manual for further details.



Certification Mark of UL on the installation instructions is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The Certification Mark for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY," the geographic identifier(s), and a file number.

# **PV HAZARD CONTROL SYSTEM PVHCS** | CERTIFICATION

UL 3741 REPORT DATE 8-12-21 PV RAPID SHUTDOWN ARRAY, UL 1741 CATEGORY QIJR, REPORT DATE: 2021-06-11 (REV 8-10-21)

WARNING: To reduce the risk of injury, read all instructions.

#### PV HAZARD CONTROL EQUIPMENT AND COMPONENTS

| Function                                    | Manufacturer  | Model No.  | Firmware Versions<br>and Checksums           | Certification Standard                     |
|---|---|--|--|--|
| PVRSE Mid Circuit<br>Interrupter (MCI)      | Tesla   | MCI-1<br>15503791  | N/A  | UL 1741 PVRSE                              |
| Inverter or Powerwall+                      | Tesla   | 7.6 kW: 1538000 <sup>1</sup><br>3.8 kW: 1534000 <sup>1</sup><br>7.6 kW: 1850000 <sup>1</sup> | V4, CEA4F802<br>V4, FF7BE4E1<br>V4, CEA4F802 | UL 1741, 1998<br>PVRSS/PVRSE               |
| PV Module                                   | Tesla   | SR60T1, SR72T1<br>SR72T2   | N/A  | UL 61730                                   |
| Diode Harness<br>(Not applicable to SR72T2) | Tesla   | SRDTH  | N/A  | UL 9703                                    |
| PV Wire Jumper(s)                           | Tesla   | SR-BJ2X, SR-BJ3X,<br>SR-BJ4X, SR-BJMini  | N/A  | UL 9703                                    |
| Pass-Through Box                            | Tesla   | SRPTB-4  | N/A  | UL 1741                                    |
| PVHCS Initiator :<br>(PV Inverter)          | Dedicated PV system AC circuit breaker or AC disconnect switch, labeled per NEC 690.12 requirements.  |  |  | N/A  |
| PVHCS Initiator<br>(Powerwall+)             | Emergency stop device (NISD)- Listed "Emergency Stop Button" or "Emergency StopUL 508 or UL 60947Device" or "Emergency Stop Unit"Parts 1, 5-1 and 5-5 |  |  | UL 508 or UL 60947<br>Parts 1, 5-1 and 5-5 |

<sup>1</sup> Applies to variations of this part number with suffix of two numbers and one letter.

Note: PVHCS installation requirements may reduce the effective equipment and component ratings below the individual equipment and component PVRSE ratings in order to achieve PVHCS shock hazard reduction requirements.

# **PVHCS INSTALLATION REQUIREMENTS**

Max System Voltage

PVHCS Maximum Circuit Voltage (Array Internal Voltage After A

Max Series-Connected Panels between MCIs

#### OTHER INSTALLATION INSTRUCTIONS

1. An MCI must be connected to one end of each series string or mounting plane sub-array string.

2. Verification that MCIs are installed with 10 or fewer modules between MCIs shall be documented for inspection, by voltage measurement logs and/or as-built string layout diagrams.

3. For PV Inverter: The PVHCS initiator (AC breaker or switch) shall be sized and installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings.

4. For Powerwall+: The PVHCS emergency stop initiator shall have the following minimum ratings: Outdoor (Type 3R or higher), 12V, 1A, and shall be installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings. Refer to the Powerwall+ installation manual for further details.



Certification Mark of UL on the installation instructions is the only method provided by UL to identify products manufactured under its Certification and Follow-Up Service. The Certification Mark for these products includes the UL symbol, the words "CERTIFIED" and "SAFETY," the geographic identifier(s), and a file number.

|           | 600 VDC                             |
|-----------|-------------------------------------|
| ctuation) | 165 VDC (cold weather open circuit) |
|           | 10                                  |