TEC SOLAR
STRUCTURAL ENGINEERING
LICENSED IN 50 STATES

# Structural Letter of Approval

July 31, 2024
Beam Solar Co
1231 Shields Road Ste. 5
Kernersville, NC 27284

**Michael Doesken Residence: 810 Buchanan Rd, Lillington, NC 27546**

Dear Sir/ Madam,
Terra Engineering Consulting (TEC) has performed a structural evaluation for the roof of the structure referenced above based on its existing and proposed load conditions. The attached calculations are based on the assumption that the existing structural components are in good condition and that they meet industry standards. The existing structure information is assumed based on the site visit documentation provided by the client (Beam Solar Co). The design information and assumptions that the calculations are based on are located in the attached References page. The design of the solar panel's mounting hardware and electrical engineering are provided by others.

## Design Method

This engineering analysis was performed in accordance with ASCE 7-10 and 2018 North Carolina Residential Code (NCRC) design methods. In general, this design method is a comparison of the roof loads before and after the solar panel installation. The snow load in the area of the panels will be reduced due to the roof pitch and the solar panel's slippery surface, as justified in Section 7.4 in ASCE 7-10. Due to the reduction in snow load, the total roof loads and the stresses of the structural elements decrease after the solar panels are installed.

## Results

The total additional roof load of the solar panels system is 3 psf, and the typical 20 psf live load will not be present in the area of the panels, as defined per R324.4.1 in 2018 NCRC. The slippery surface snow load reduction allowed in Section 7.4 in ASCE 7-10 reduces the roof snow load in the area of the solar panels. The total combined vertical loads are reduced when considering the worst-case load combination (ASD). Regarding lateral wind loads, the solar panel structure is considered to be partially enclosed due to the low profile of the panels (3 to 6 inches) and airflow restrictions below the panels caused by the pv frame, wiring, conduit, and frame brackets. Because the system is considered to be 'partially enclosed' additional wind pressure on the structure is considered negligible. The addition of total PV system weight results in an increase of under 10% of the total roof weight, and meets the seismic requirements in Section 403.4 of 2018 NCEBC. See the attached calculations for further details.

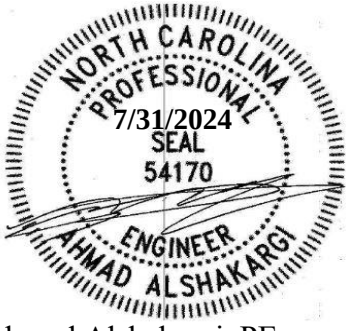
**Conclusions**

TEC concludes that the installation of solar panels on existing roof will not affect the structure and allows it to remain unaltered under the applicable design standards. The calculations performed to support these conclusions are attached to this letter.

**General Instructions**

1. The contractor shall comply with all Federal, State, County, City, local and OSHA mandated regulations and requirements. The most stringent shall govern.
2. Contractor shall keep an accurate set of As-Built plans.
3. The solar panel's racking system and mounting hardware shall be mounted in accordance with the manufacturer's most recent installation manual.
4. Connection: Sunmodo Nanomount Deck Mount (or equivalent deck mount) - (4) #14 x 1-1/2" Self drilling fasteners. Maximum anchor spacing of 48" (must embed fully into wood deck). Maximum overhang: 12".
5. Panel support connections shall be staggered to distribute load to adjacent trusses.
6. 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.
7. Structural observation or construction inspections will not be performed by TEC, Engineer-of-Record (EOR) nor their representatives.
8. TEC Solar assumes no responsibility for improper installation of the solar panels.

Best Regards,
TEC Solar, PLLC




Ahmad Alshakargi, PE
Civil (Structural) Engineer
Firm License P-3037

**References**

**Design Parameter**

Code: 2018 North Carolina Residential Code, ASCE 7-10
Risk Category: II
Ground Snow load: 15 psf
Roof Snow load: 10.4 psf
Design Wind Speed: 120 mph (3 sec gust) per ASCE 7-10
Existing roof dead load: 9.6 psf
Live Load: 20 psf (reducible where panels are located per R324.4.1 in 2018 NCRC).
Seismic Design Category: D
Wind Exposure Category: C

**Existing Roof Structure**

Roof framing: 2x2 Pre-fab Trusses at 24" O.C.
Roof material: Composite shingles
Roof slope: 30°

**Solar Panels**

Weight: 3 psf

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Date: 7/31/2024
Client: Michael Doesken
Subject: Gravity load

**Gravity load calculations**

| Snow load (S) | Existing | w/ solar panels | |
|---|---|---|---|
| Roof slope (°): | 30 | 30 | |
| Ground snow load, pg (psf): | 15 | 15 | ASCE 7-10, Section 7.2 |
| Terrain category: | C | C | ASCE 7-10, table 7-2 |
| Exposure of roof: | Fully exposed | Fully exposed | ASCE 7-10, table 7-2 |
| Exposure factor, Ce: | 0.9 | 0.9 | ASCE 7-10, table 7-2 |
| Thermal factor, Ct: | 1.1 | 1.1 | ASCE 7-10, table 7-3 |
| Risk Category: | II | II | ASCE 7-10, table 1.5-1 |

Where $p_g$ is 20 lb/ft$^2$ (0.96 kN/m$^2$) or less:

$p_m = I_s p_g$ (Importance Factor times $p_g$)

Where $p_g$ exceeds 20 lb/ft$^2$ (0.96 kN/m$^2$):

$p_m = 20\ (I_s)$ (20 lb/ft$^2$ times Importance Factor)

$$p_f = 0.7 C_e C_t I_s p_g \qquad (7.3\text{-}1)$$

| | | | |
|---|---|---|---|
| Importance Factor, Is: | 1 | 1 | ASCE 7-10, table 1.5-2 |
| Flat roof snow load, pf (psf): | 10.4 | 10.4 | ASCE 7-10, equation 7.3-1 |
| Minimum roof snow load, pm (psf): | 0 | 0 | ASCE 7-10, equation 7.3-4 |
| Roof Surface type: | Other | Unobstructed slippery surface | ASCE 7-10, Section 7.4 |
| Roof slope factor, Cs: | 1 | 0.67 | ASCE 7-10, figure 7-2b |

$$p_s = C_s p_f \qquad (7.4\text{-}1)$$

| | | | |
|---|---|---|---|
| Sloped roof snow load, ps [psf]: | 10.4 | 7.0 | ASCE 7-10, equation 7.4-1 Design Snow Load (S) |

| Roof dead load (D) | | | | | |
|---|---|---|---|---|---|
| Roof pitch/12 | 6.9 | | | | |
| Composite shingles | 2 | psf | 1/2" Gypsum clg. | 0 | psf |
| 1/2" plywood | 1.5 | psf | insulation | 0.8 | psf |
| Framing | 3 | psf | M, E & Misc | 1 | psf |
| Roof DL without PV arrays | 9.6 | psf | | | |
| PV Array DL | 3 | psf | | | |

| Roof live load (Lr) | Existing | w/ solar panels | |
|---|---|---|---|
| Roof Live Load | 20 | 0 | R324.4.1 in 2018 NCRC |

**ASD Load combination:**

| | Existing | With PV array | |
|---|---|---|---|
| D [psf] | 9.6 | 12.6 | ASCE 7-10, Section 2.4.1 |
| D+L [psf] | 9.6 | 12.6 | ASCE 7-10, Section 2.4.1 |
| D+[Lr or S or R] [psf] | 29.6 | 19.6 | ASCE 7-10, Section 2.4.1 |
| D+0.75L+0.75[Lr or S or R] [psf] | 24.6 | 17.8 | ASCE 7-10, Section 2.4.1 |
| Maximum gravity load [psf]: | 29.6 | 19.6 | |
| Ratio proposed load to existing load: | | 66.10% | |

**The stresses due to gravity load in the area of the solar panels is reduced, allowing the structure to remain unaltered.**

Date: 7/31/2024
Client: Michael Doesken
Subject: Wind load and Connection

**Wind Pressure Calculations**

$$p = q_p((GC_p) - (GC_{pi})) \qquad (30.9\text{-}1)$$

| | | |
|---|---|---|
| Basic wind speed (mph) | 120 | |
| Risk category | II | |
| Exposure category | C | |
| Roof type | Gable | |
| Figure for GCp values | ASCE 7-16 Figure 30.3-2A-I | |

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| GCp (neg) | -1 | -1.2 | -1.2 |
| GCp (pos) | 0.9 | 0.9 | 0.9 |

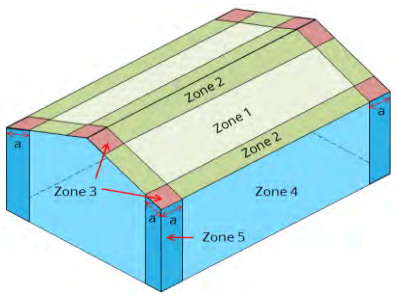
| | | | |
|---|---|---|---|
| zg (ft) | 900 | (ASCE 7-16 Table 26.11-1) | |
| α | 9.5 | (ASCE 7-16 Table 26.11-1) | |
| Kzt | 1 | (ASCE 7-16 Equation 26.8-1) | (only changes if structure located on a hill or ridge) |
| Kh | 0.94 | (ASCE 7-6 Table 26.10-1) | |
| Kd | 0.85 | (ASCE 7-16 Table 26.6-1) | |
| Velocity Pressure,qh (psf) | 28.48 | (ASCE 7-16 Equation 26.10-1) | |
| Gcpi | 0 | (ASCE 7-16 Table 26.13-1) | (0 for enclosed buildings) |

| | Zone 1 | Zone 2 | Zone 3 |
|---|---|---|---|
| W Pressure, (neg) [psf] | -28.48 | -34.18 | -34.18 |
| W Pressure, (pos) [psf] | 25.63 | 25.63 | 25.63 |
| W Pressure, (Abs. max) [psf] | 28.48 | 34.18 | 34.18 |

**Connection calculations (Self-drilling screws - for direct to deck mount)**

Capacity

| | | |
|---|---|---|
| Screw description: | 5/16 "x 1 1/12" structural wood screw | |
| Deck sheating thickness: | 5/32" | (Assumed for worse case calculations - installer to verify roof material compatibility with mounting hardware) |
| Number of fastners: | 4 | |
| Ultimate pullout load: [lbs] | 850 | |
| Factor of saftey: | 2.5 | |
| Total allowable capacity [lbs]: | 340.00 | |




Demand

| | | |
|---|---|---|
| Anchor spacing: | 48 | in |
| Anchor spacing in roof corners: | 32 | in |

| Zone | ( 0.6 W Pressure, psf), see Note 1 | Max. tributary area (ft^2) | Max Uplift force (lbs) |
|---|---|---|---|
| 1 | 17.1 | 11 | 188.0 |
| 2 | 20.5 | 11 | 225.6 |
| 3 | 20.5 | 7.3333333 | 150.4 |

Connection Meets Demand

Note: these calcuations are based on generic assumption of the deck material and thickness, using the most common fastener used by manufactuers. Conditions may vary per site and mounting hardware, and may require reduction in attachment spacing. Installer shall verify with manufacturer before installation.

## HOUSE PHOTO

## VICINITY MAP

## SHEET INDEX



GENERAL PROJECT INFO:

| | |
|---|---|
| UTILITY COMPANY | ---- |
| CITY | LILLINGTON |
| AHJ | COUNTY OF HARNETT |
| DC SYSTEM | 22.000 KWDC |
| AC SYSTEM | 15.950 KWAC |
| MODULE | Q.PEAK DUO BLK ML-G10 400W MODULES |
| INVERTER | ENPHASE IQ8PLUS-72-2-US (240V) |
| MICROINVERTER | |

GOVERNING CODES:

2018 NORTH CAROLINA BUILDING CODE
2018 NORTH CAROLINA RESIDENTIAL CODE
2018 NORTH CAROLINA EXISTING BUILDING CODE
2015 INTERNATIONAL FIRE CODE
2020 NATIONAL ELECTRIC CODE

TEC Solar, PLLC
8470 W Magna Main St Unit 311, Magna, UT 84044
North Carolina Firm License P-3037

8-22-2024
NORTH CAROLINA PROFESSIONAL SEAL 54170 ENGINEER AHMAD ALSHAKRO

**STRUCTURAL ONLY**
**The scope of professional engineer review is exclusive for structural impact on the existing roof by solar panels installation. The mounting hardware are provided by manufacturer and is out of scope of this review. Electrical engineering is out of scope of this review. Structural observation or construction inspections will not be performed by TEC, Engineer-of-Record (EOR) nor their representatives.**


BEAM SOLAR CO.
1231 SHIELDS ROAD
STE. 5
KERNERSVILLE, NC 27284


SCOPE OF WORK:

TO INSTALL OF A 55 MODULE ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 810 BUCHANAN RD THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

MICHAEL DOESKEN
RESIDENCE
810 BUCHANAN RD
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MICHAEL.DOESKEN@GMAIL.COM
TMK: #

DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

| NO. | DESCRIPTION | DATE |
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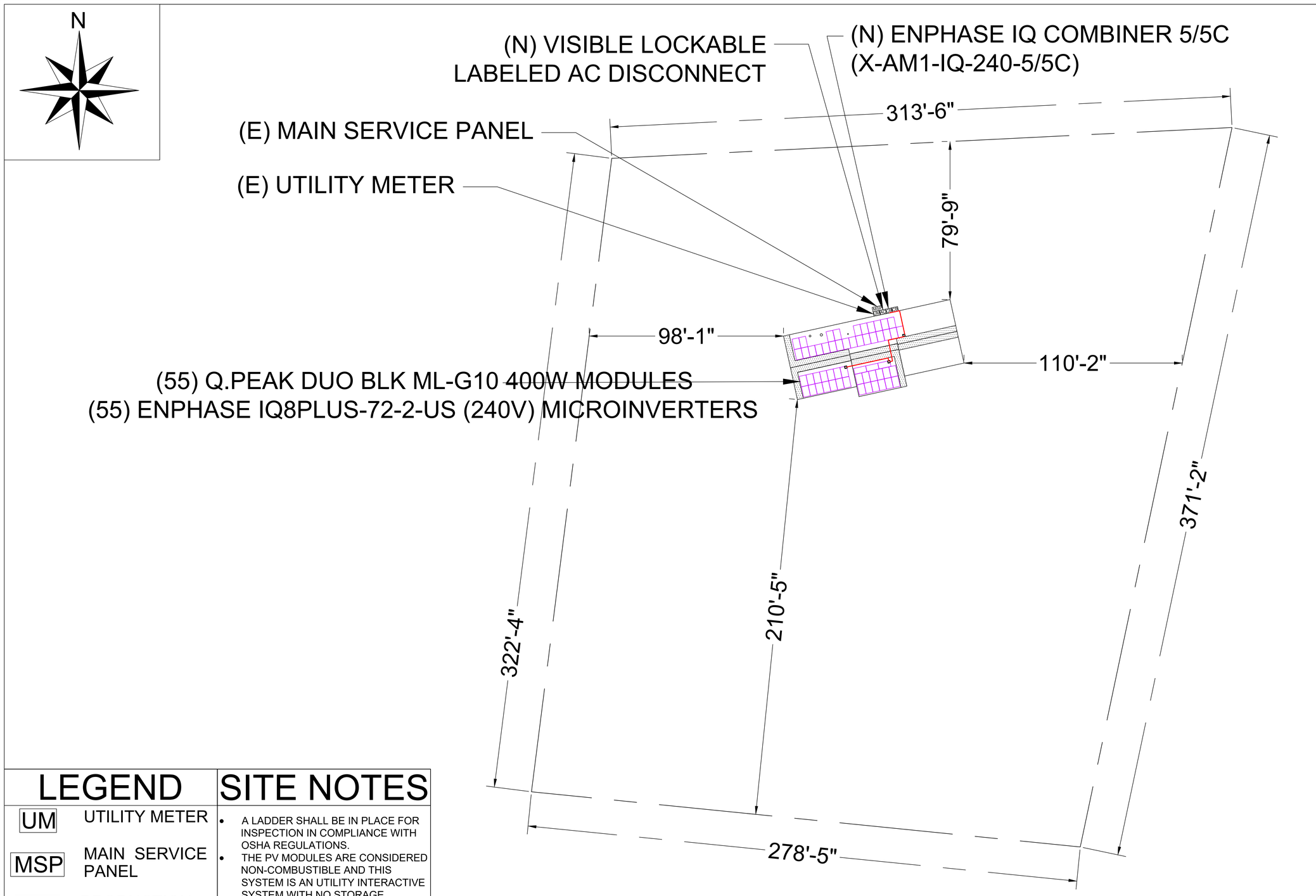
# TITLE SHEET

PV-100.00




## LEGEND

| | |
|---|---|
| UM | UTILITY METER |
| MSP | MAIN SERVICE PANEL |
| PM | PRODUCTION METER |
| AC | AC DISCONNECT |
| CB | COMBINER PANEL |

## SITE NOTES

- A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
- THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS AN UTILITY INTERACTIVE SYSTEM WITH NO STORAGE BATTERIES.
- THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
- PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BEPROVIDED AS PER SECTION [NEC 110.26]

TEC SOLAR
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8-22-2024
NORTH CAROLINA PROFESSIONAL SEAL 54170 ENGINEER HANI ALSHARARO

TEC Solar, PLLC
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0 275 549

SCALE:1" = 23'


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# SITE PLAN

PV-200.00

TEC Solar, PLLC
8470 W Magna Main St Unit 311, Magna, UT 84044
North Carolina Firm License P-3037

8-22-2024

NORTH CAROLINA PROFESSIONAL SEAL 54170 ENGINEER AHMAD ALSHAKARCHI

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GENERAL NOTES:

- THESE CONSTRUCTION DOCUMENTS HAVE BEEN BASED ON FIELD INSPECTIONS AND OTHER INFORMATION AVAILABLE AT THE TIME. ACTUAL FIELD CONDITIONS MAY REQUIRE MODIFICATIONS IN CONSTRUCTION DETAILS.
- ARCHITECT HAS NOT BEEN RETAINED TO SUPERVISE ANY CONSTRUCTION OR INSTALLATION OF ANY EQUIPMENT AT SITE.
- CONTRACTOR SHALL FURNISH ALL LABOR, MATERIAL, EQUIPMENT, TOOLS, OBTAINS ALL PERMITS, LICENSES AND PAY ALL REQUIRED FEES AND COMPLETE INSTALLATION.
- CONTRACTOR HAS THE FULL RESPONSIBILITY TO CHECK AND VERIFY ALL DIMENSIONS AND EXISTING CONDITIONS. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK. ANY WORK STARTED BEFORE CONSULTATION AND ACCEPTANCE BY THE ENGINEER SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE SUBJECT TO CORRECTION BY THEM WITHOUT ADDITIONAL COMPENSATION.
- DAMAGE CAUSED TO THE EXISTING STRUCTURE, PIPES, DUCTS, WINDOWS, WALL, FLOORS, ETC. SHALL BE REPAIRED TO THE ORIGINAL CONDITION OR REPLACED BY THE CONTRACTOR AT NO ADDITIONAL COST.
- THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR THE PROPER INSTALLATION AND COMPLETION OF THE WORK WITH APPROVED MATERIALS. · NO CHANGES ARE TO BE MADE WITHOUT THE CONSULTATION AND APPROVAL OF THE ARCHITECT. · CONTRACTOR SHALL OBTAIN BUILDING PERMIT. NO WORK TO START UNLESS BUILDING PERMIT IS PROPERLY DISPLAYED.
- ALL WORKMANSHIP AND MATERIALS SHALL BE OF FIRST QUALITY AND IN COMPLIANCE WITH THE REQUIREMENTS OF THE TX BUILDING CODE, THE DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ALL PERTINENT AGENCIES.
- IT IS ESSENTIAL THAT ALL WORK PROCEED WITH THE MAXIMUM COOPERATION OF ALL PARTIES AND WITH MINIMUM INTERFERENCE TO THE OCCUPANTS WITHIN THE BUILDING. THE OWNER'S DIRECTIONS IN THIS REGARD SHALL BE FULLY COMPLIED WITH.
- ALL EXPOSED PLUMBING, HVAC, ELECTRICAL DUCTWORK, PIPING AND CONDUITS ARE TO BE PAINTED BY GENERAL CONTRACTOR. · THE CONTRACTOR SHALL PERFORM THE WORK IN STRICT CONFORMANCE WITH THE LOCAL LAWS, REGULATIONS AND THE NATIONAL ELECTRIC CODE.
- THE CONTRACTOR SHALL OBTAIN ALL PERMITS, APPROVALS, AFFIDAVITS, CERTIFICATIONS, ETC. AND PAY ALL FEES AS REQUIRED BY THE LOCAL AUTHORITIES. CONTRACTORS SHALL OBTAIN FIRE CERTIF. UPON COMPLETION OF WORK.

ELECTRICAL NOTES:

- THE EQUIPMENT AND ALL ASSOCIATED WIRING AND INTERCONNECTION SHALL BE INSTALLED ONLY BY QUALIFIED PEOPLE. A QUALIFIED PERSON IS ONE WHO HAS SKILLS AND KNOWLEDGE RELATED TO THE CONSTRUCTION AND OPERATION OF THE ELECTRICAL EQUIPMENT AND INSTALLATIONS AND HAS RECEIVED SAFETY TRAINING TO RECOGNIZE AND AVOID THE HAZARDS INVOLVED. (NEC 690.4(E) AND 705.6)
- LOCAL UTILITY PROVIDER SHALL BE NOTIFIED PRIOR TO USE AND ACTIVATION OF ANY SOLAR PHOTOVOLTAIC INSTALLATION. FOR A LINE SIDE TAP CONNECTION, UTILITY NEEDS TO BE NOTIFIED WELL IN ADVANCE TO COORDINATE BUILDING ELECTRICAL SHUT OFF.
- NEW CONDUIT ROUTING SHOWN IS ESSENTIALLY SCHEMATIC. SUBCONTRACTOR SHALL LAY OUT RUNS TO SUIT FIELD CONDITIONS AND THE COORDINATION REQUIREMENTS OF OTHER TRADES.
- ARRAY WIRING SHOULD NOT BE READILY ACCESSIBLE EXCEPT TO QUALIFIED PERSONNEL.
- ALL EXTERIOR CONDUIT, FITTINGS, AND BOXES SHALL BE WATERTIGHT AND APPROVED FOR USE IN WET LOCATIONS. (NEC 314.15A).
- WIRING METHODS FOR PV SYSTEM CONDUCTORS AREN'T PERMITTED WITHIN 10 IN. OF THE ROOF DECKING OR SHEATHING EXCEPT WHERE LOCATED DIRECTLY BELOW THE ROOF SURFACE THAT'S COVERED BY PV MODULES AND ASSOCIATED EQUIPMENT WIRING
- BACK-FED BREAKER MUST BE AT THE OPPOSITE END OF BUS BAR FROM THE MAIN BREAKER OR MAIN LUG SUPPLYING CURRENT FROM THE UTILITIES.
- ALL CONDUCTORS AND WIRE TIES EXPOSED TO SUNLIGHT ARE LISTED AS UV RESISTANT.
- CONTRACTOR SHALL FOLLOW ALL ELECTRICAL EQUIPMENT LABELING REQUIREMENTS IN NEC 690 AND IFC 2021 · PV SOURCE, OUTPUT AND INVERTER CIRCUITS SHALL BE IDENTIFIED AT ALL POINTS OF TERMINATION, CONNECTION, AND SPLICES. THE MEANS OF ID CAN BE SEPARATE COLOR CODING, MARKING TAPE, TAGGING ETC. (NEC 690.4).
- MEASURE THE LINE-TO-LINE AND LINE-TO-NEUTRAL VOLTAGE OF ALL SERVICE ENTRANCE CONDUCTORS PRIOR TO INSTALLING ANY SOLAR EQUIPMENT. THE VOLTAGES FOR THE 240VAC RATED.

WIRING AND CONDUIT NOTES:

- ALL CONDUIT SIZES AND TYPES, SHALL BE LISTED FOR ITS PURPOSE AND APPROVED FOR THE SITE APPLICATIONS
- ALL PV CABLES AND HOMERUN WIRES BE #10AWG *USE-2, PV WIRE, OR PROPRIETARY SOLAR CABLING SPECIFIED BY MFR, OR EQUIVALENT; ROUTED TO SOURCE CIRCUIT COMBINER BOXES AS REQUIRED
- ALL CONDUCTORS AND OCPD SIZES AND TYPES SPECIFIED ACCORDING TO [NEC 690.8 (A)(1) & (B)(1)], [NEC 240] [NEC 690.7] FOR MULTIPLE CONDUCTORS
- ALL PV DC CONDUCTORS IN CONDUIT EXPOSED TO SUNLIGHT SHALL BE DERATED ACCORDING TO [NEC TABLE 310.15 (B)(2)(C)] BLACK ONLY**
- EXPOSED ROOF PV DC CONDUCTORS SHALL BE USE-2, 90°C RATED, WET AND UV RESISTANT, AND UL LISTED RATED FOR 600V, UV RATED SPIRAL WRAP SHALL BE USED TO PROTECT WIRE FROM SHARP EDGES
- PHASE AND NEUTRAL CONDUCTORS SHALL BE DUAL RATED THHN/THWN-2 INSULATED, 90°C RATED, WET AND UV RESISTANT, RATED FOR 600V PER NEC 2008 OR 1000V PER NEC 2011
- 4-WIRE DELTA CONNECTED SYSTEMS HAVE THE PHASE WITH THE HIGHER VOLTAGE TO GROUND MARKED ORANGE OR IDENTIFIED BY OTHER EFFECTIVE MEANS
- ALL SOURCE CIRCUITS SHALL HAVE INDIVIDUAL SOURCE CIRCUIT PROTECTION VOLTAGE DROP LIMITED TO 2%
- AC CONDUCTORS >4AWG COLOR CODED OR MARKED: PHASE A OR L1- BLACK, PHASE B OR L2- RED, PHASE C OR L3- BLUE, NEUTRAL- WHITE/GRAY

Beam SOLAR CO.

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SCOPE OF WORK:

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DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

| NO. | DESCRIPTION | DATE |
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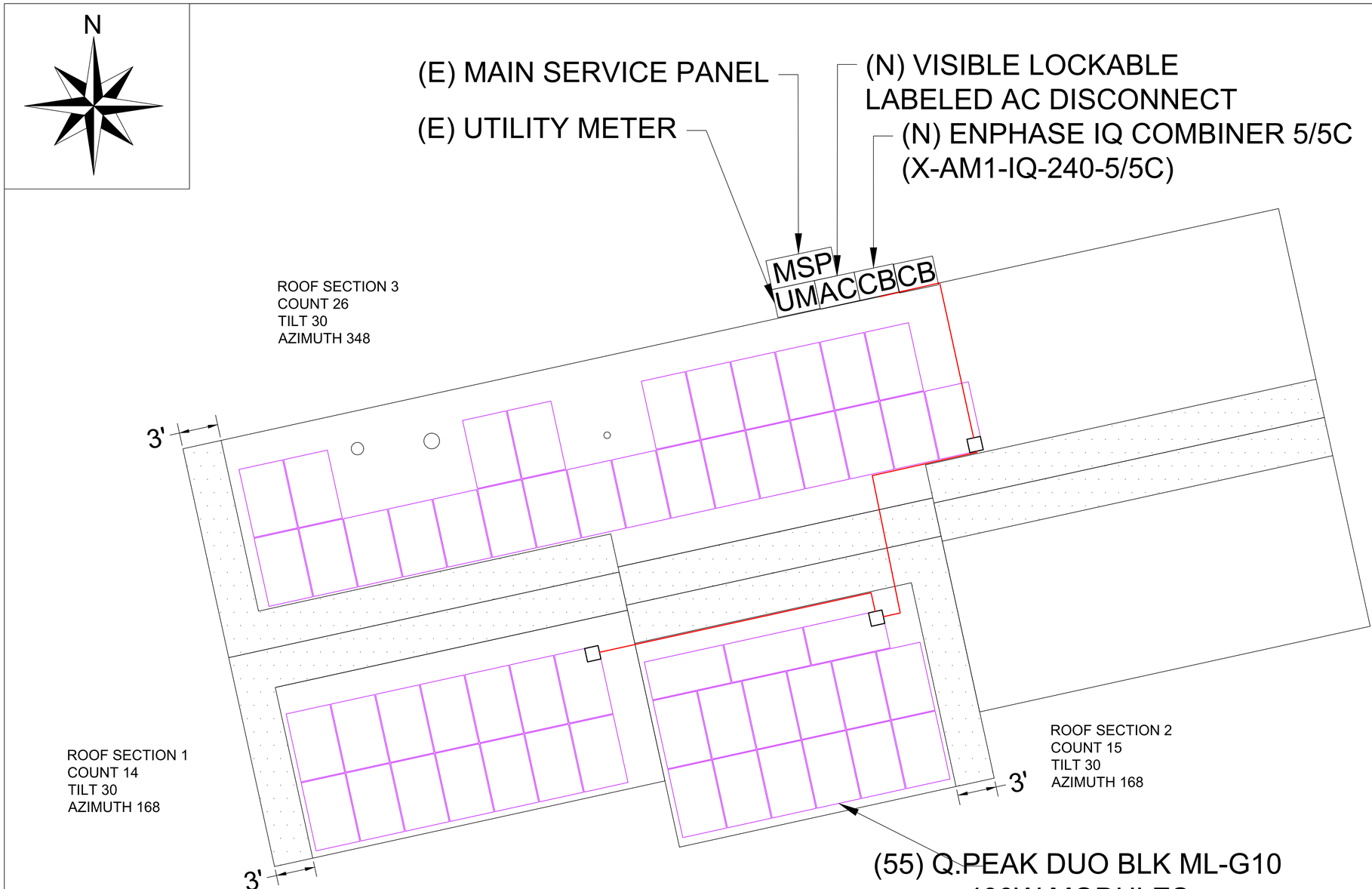
# GENERAL NOTES

PV-300.00




(55) Q.PEAK DUO BLK ML-G10
400W MODULES
(55) ENPHASE IQ8PLUS-72-2-US
(240V) MICROINVERTERS

| DESIGN SPECIFICATION | |
|---|---|
| RISK CATEGORY: | II |
| CONSTRUCTION: | SFD |
| ZONING: | RES |
| SNOW LOAD (ASCE 7-16): | 10 PSF |
| EXPOSURE CATEGORY: | B |
| WIND SPEED (ASCE 7-16): | 118 MPH |

| MOUDLE TYPE, DIMENSIONS, & WEIGHT | |
|---|---|
| NUMBER OF MODULES: | 55 MODULES |
| MODULE TYPE: | Q.PEAK DUO BLK ML-G10+ 400W MODULES |
| MODULE WEIGHT: | 48.5 LBS |
| MODULE DIMENSIONS: | 73.98" (L) x 41.14" (W) = 21.14 SF |
| UNIT WEIGHT OF AREA: | 2.29 PSF |

TEC Solar, PLLC
8470 W Magna Main St Unit 311, Magna, UT 84044
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8-22-2024

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0 50 99

SCALE: 1" = 4'

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| | | |
| | | |

# FLOOR PLAN

PV-400.00

TEC Solar, PLLC
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North Carolina Firm License P-3037

8-22-2024

NORTH CAROLINA PROFESSIONAL SEAL 54170 ENGINEER AHMAD ALSHAKARO

TEC SOLAR STRUCTURAL ENGINEERING LICENSED IN 50 STATES

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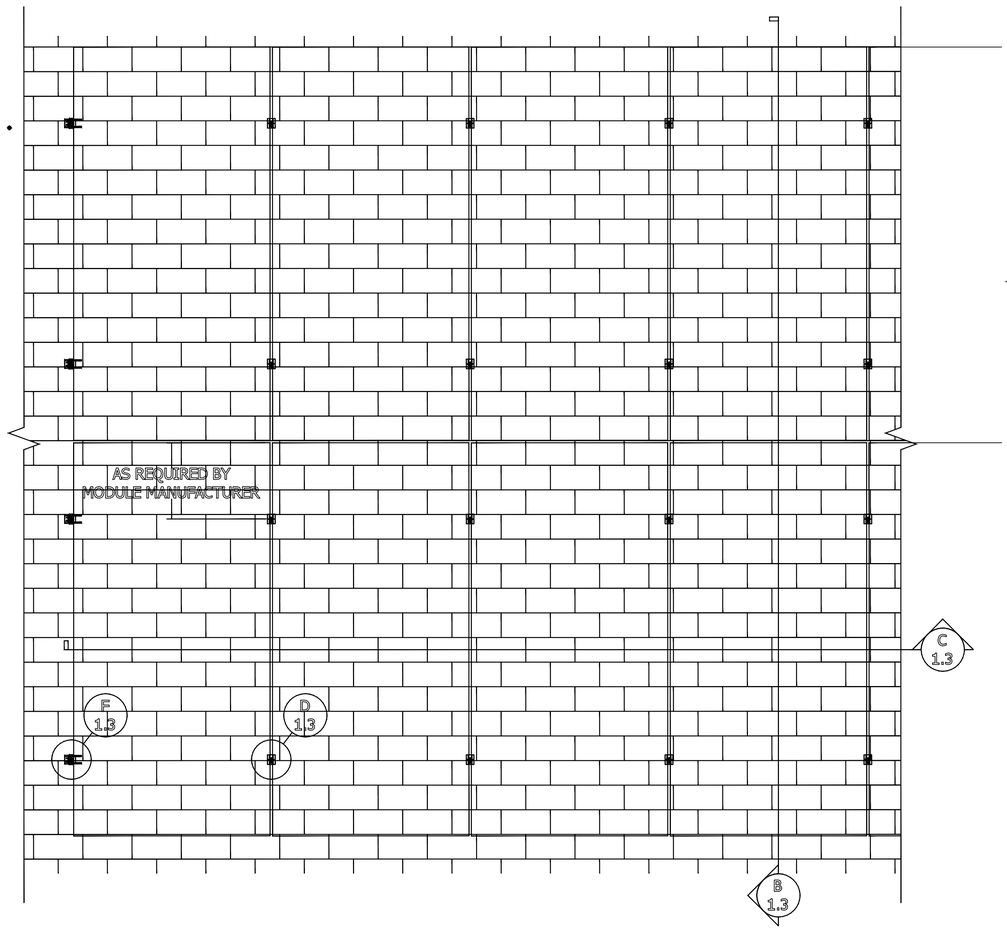
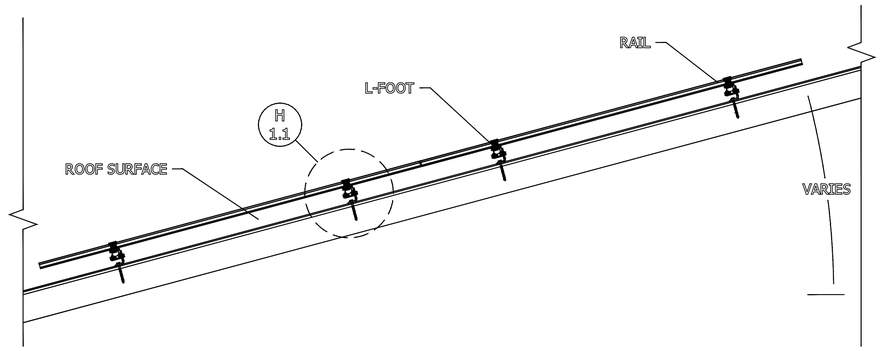
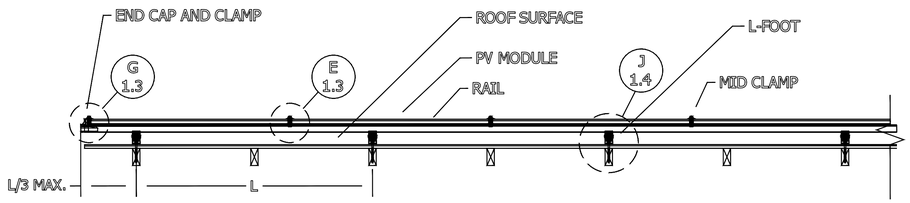


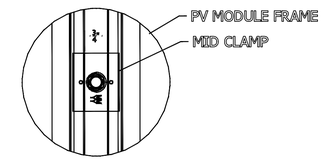

A PLAN VIEW, COMP ASSEMBLY, PORTRAIT MODULE
Scale: 1"=1'-0"



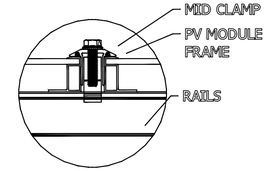

B SIDE VIEW, COMP ASSEMBLY, PORTRAIT MODULE
Scale: 1"=1'-0"



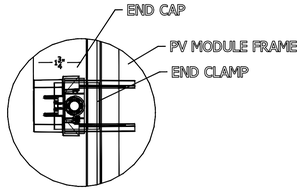

C FRONT VIEW, COMP ASSEMBLY, PORTRAIT MODULE
Scale: 1"=1'-0"



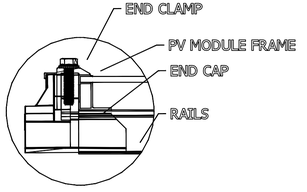

D DETAIL, MID CLAMP PLAN
Scale: 6"=1'-0"




E DETAIL, MID CLAMP FRONT
Scale: 6"=1'-0"




F DETAIL, END CAP AND CLAMP PLAN
Scale: 6"=1'-0"




G DETAIL, END CAP AND CLAMP FRONT
Scale: 6"=1'-0"

ECOFASTEN
An ESDEC Company
4141 W VAN BUREN ST. SUITE 2
PHOENIX, AZ 85009
877-859-3947 ECOFASTENSOLAR.COM

| | |
|---|---|
| CLIENT NAME | ECOFASTEN |
| PROJECT NAME | SLOPED ROOF MOUNT SYSTEM |
| PROJECT ADDRESS | |
| SYSTEM KW DC | |
| WIND SPEED, MPH | - |
| SNOW LOAD, PSF | - |
| EXPOSURE CAT | - |
| RISK CAT | - |
| MODULE TYPE | - |
| MODULE W DC | - |
| MODULE QTY | - |

APPROVAL STATUS

REVISION HISTORY

| REV | DESCRIPTION | DATE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

SHEET NAME
SLOPED ROOF PV SYSTEM DETAILS: L-FOOT COMP ASSEMBLY - PORTRAIT

| | |
|---|---|
| JOB NO. | 1.1 SR |
| ISSUE DATE | SEP 2021 |
| SHEET NO. | ECO 1.3 |
| SHEET SIZE | 24X36 |

Beam SOLAR CO.

BEAM SOLAR CO.
1231 SHIELDS ROAD
STE. 5
KERNERSVILLE, NC 27284

SCOPE OF WORK:

TO INSTALL OF A 55 MODULE ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 810 BUCHANAN RD THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

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MICHAEL.DOESKEN@GMAIL.COM
TMK: #

DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

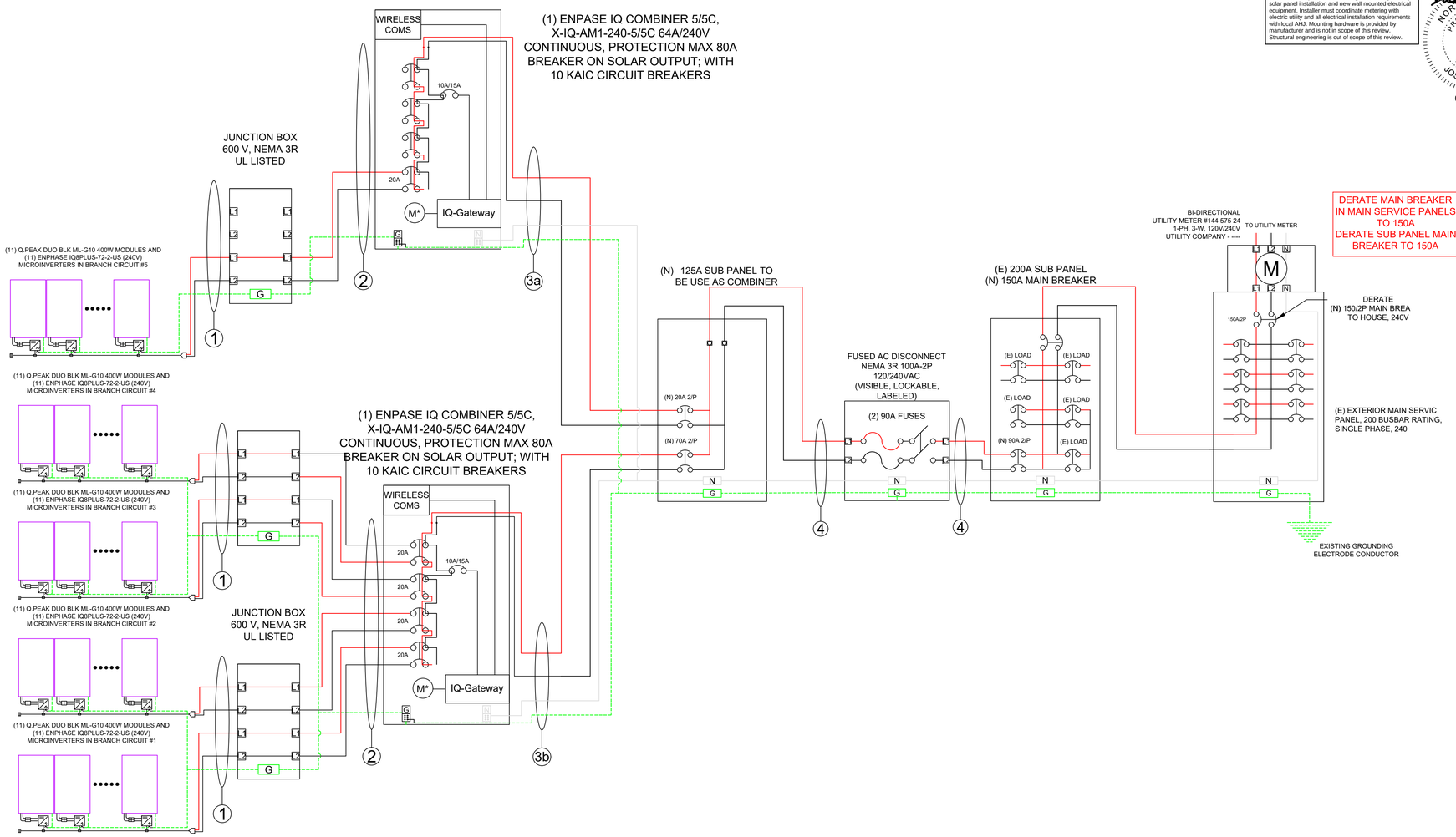
| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

# DETAIL DRAWINGS

PV-600.00

## CONDUCTOR SHCEDULE

| ID | TYPICAL | INITIAL CONDUCTOR LOCATION | FINAL CONDUCTOR LOCATION | CONDUCTOR | | | CONDUIT | # OF PARALLEL CIRCUITS | CURRENT CARRYING CONDUCTORS IN CONDUIT | CONDUIT FILL PERCENT | OCPD | EGC | | TEMP. CORR. FACTOR | | CONDUIT FILL FACTOR | CONT. CURRENT | MAX CURRENT | BASE AMP. | DERATED AMP. | TERM. TEMP. RATING | LENGTH IN FEET | VOLTAGE DROP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | STRING | JUNCTION BOX | 12 AWG | PV WIRE | COPPER | BARE | #N/A | #N/A | N/A | N/A | 6 AWG | BARE COPPER | 0.71 | (58 °C) | N/A | 15.73 A | 19.66 A | N/A | N/A | 90 °C | | 0.77% |
| 2 | 1 | JUNCTION BOX | IQ COMBINER BOX | 10 AWG | THWN-2 | COPPER | EMT | 5 | 10 | | 20A | 8 AWG | THWN-2, COPPER | 0.91 | (36 °C) | 0.5 | 15.73 A | 19.66 A | 40 A | 18.2 A | 90 °C | | 0.00% |
| 3a | 1 | IQ COMBINER BOX | LOAD CENTER | 10 AWG | THWN-2 | COPPER | EMT | 1 | 3 | | 20A | 8 AWG | THWN-2, COPPER | 0.91 | (36 °C) | 1 | 66.55 A | 83.19 A | 55 A | 50.05 A | 90 °C | | 0.00% |
| 3b | 1 | IQ COMBINER BOX | LOAD CENTER | 6 AWG | THWN-2 | COPPER | EMT | 1 | 3 | | 70A | 8 AWG | THWN-2, COPPER | 0.91 | (36 °C) | 1 | 66.55 A | 83.19 A | 75 A | 68.25 A | 90 °C | | 0.00% |
| 4 | 1 | LOAD CENTER | SUBPANEL | 4 AWG | THWN-2 | COPPER | EMT | 1 | 3 | | 90A | 8 AWG | THWN-2, COPPER | 0.91 | (36 °C) | 1 | 66.55 A | 83.19 A | 75 A | 68.25 A | 90 °C | | 0.00% |




### SERVICE INFO.

| | |
|---|---|
| UTILITY PROVIDER: | ---- |
| AHJ: | HARNETT COUNTY |
| MAIN SERVICE VOLTAGE: | 240 |
| MAIN BUSBAR: | 200 |
| MAIN BREAKER RATING: | 200 |
| MAIN SERVICE LOCATION: | NORTH EAST |
| SERVICE FEED SOURCE: | UNDERGROUND |

ELECTRICAL ONLY
The scope of professional engineer review is exclusive for electrical impact on the existing electrical system by solar panel installation and new wall mounted electrical equipment. Installer must coordinate metering with electric utility and all electrical installation requirements with local AHJ. Mounting hardware is provided by manufacturer and is not in scope of this review. Structural engineering is out of scope of this review.

NORTH CAROLINA PROFESSIONAL SEAL 057127 ENGINEER JOSHUA IBARRA
08/22/2024


BEAM SOLAR CO.
1231 SHIELDS ROAD
STE. 5
KERNERSVILLE, NC 27284


SCOPE OF WORK:

TO INSTALL OF A 55 MODULE ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 810 BUCHANAN RD THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

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TMK: #

DRAWN BY: XAM C..

DATE: 2024-08-16

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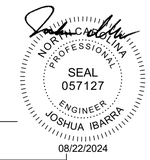
ELECTRIC
3LD

PV-700.00




| SOLAR MODULE SPECIFICATIONS | |
|---|---|
| MANFACTURER/ MODEL | Q.PEAK DUO BLK ML-G10+ 400W MODULES |
| VMP | 37.95 V |
| IMP | 10.54 A |
| VOC | 45.24 V |
| ISC | 11.05 A |
| TEMP. COEFF. VOC | -0.27 %/C° |
| MODULE DIMENSION | 73.98" (L) x 41.14" (W) |
| PANEL WATTAGE | 400 W |

| INVERTER SPECIFICATIONS | |
|---|---|
| MANUFACTURER/ MODEL | ENPHASE IQ8PLUS-72-2-US (240V) MICROINVERTER |
| MAX DC SHORT CICUIT CURRENT | 20 A |
| CONTINUOUS OUTPUT CURRENT | 1.21 A (240 VAC) |

| AMBIENT TEMPERATURE SPECS | |
|---|---|
| RECORD LOW TEMP | -10 °C |
| AMBIENT TEMP (HIGH TEMP 2%) | 36 °C |
| CONDUIT HEIGHT | 7/8" |
| ROOF TOP TEMP | 58 °C |
| CONDUCTOR TEMPERATURE RATE | 90 °C |
| MODULE TEMPERATURE COEFFIECIENT OF VOC | -0.27 %/C° |

| ARRAY WEIGHT (DEAD LOAD CALCS) | |
|---|---|
| NUMBER OF MODULES | 55 |
| MODULE WEIGHT | 48.5 LBS |
| TOTAL MODULE (ARRAY) WEIGHT | 2667.5 LBS |
| NUMBER OF ATTACHMENT POINTS | 175 |
| MOUNTING SYSTEM WEIGHT (PER MODULE) | 0 LBS |
| MOUNTING SYSTEM WEIGHT | 0 LBS |
| WEIGHT AT EACH ATTATCHMENT POINT (ARRAY WEIGHT / NUMBER OF ATTACHMENT POINT) | 14.82 LBS |
| MODULE AREA (73.98" x 41.14") | 21.14 SF |
| TOTAL ARRAY AREA | 1162.7 SF |
| DISTRIBUTED LOAD (TOTAL SYSTEM WEIGHT / TOTAL ARRAY AREA) | 2.29 PSF |
| TOTAL ROOF AREA | 3410.35 SF |
| TOTAL PERCENTAGE OF ROOF COVERED ([TOTAL ARRAY AREA / TOTAL ROOF AREA]*100) | 34.09% |

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KERNERSVILLE, NC 27284

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DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

| NO. | DESCRIPTION | DATE |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

SPECS AND CALCS

PV-800.00

1

**⚠ WARNING**

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

**LABEL LOCATION:**
POINT OF INTERCONNECTION,
(PER CODE: NEC 690.16(B))

2

**WARNING - Electric Shock Hazard**
No user serviceable parts inside
Contact authorized service provider for assistance

**LABEL LOCATION:**
INVERTER, JUNCTION BOXES (ROOF),
(PER CODE: NEC 690.13.G.3 & NEC
690.13.G.4)

3

**⚠ WARNING:** DUAL POWER SOURCE
DUAL POWER SOURCE

**LABEL LOCATION:**
POINT OF INTERCONNECTION
(PER CODE: NEC 705.15(C) & NEC 690.59)

4

**WARNING: PHOTOVOLTAIC POWER SOURCE**

**LABEL LOCATION:**
CONDUIT, COMBINER BOX
(PER CODE: NEC690.31(2))

**ADHESIVE FASTENED SIGNS:**

- THE LABEL SHALL BE SUITABLE FOR THE ENVIRONMENT WHERE IT IS INSTALLED
- WHERE REQUIRED ELSEWHERE IN THIS CODE, ALL FIELD APPLIED LABELS, WARNINGS, AND MARKINGS SHOULD COMPLY WITH ANSI Z535.4 [NEC 110.21(B) FIELD MARKING].
- ADHESIVE FASTENED SIGNS MAY BE ACCEPTABLE IF PROPERLY ADHERED. VINYL SIGNS SHALL BE WEATHER RESISTANT [IFC 605.11.1.3]

5

**PHOTOVOLTAIC SYSTEM AC DISCONNECT**
RATED AC OUTPUT CURRENT 66.55 AMPS
NOMINAL OPERATING AC VOLTAGE 240 VOLTS

**LABEL LOCATION:**
POINT OF INTERCONNECTION,
(PER CODE: NEC 690.54)

6

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

**LABEL LOCATION:**
POINT OF INTERCONNECTION,
(PER CODE: NEC 705.12(B)(3)(2))
[Not required if panelboard is rated not less than sum of ampere ratings
of all overcurrent devices supplying it]

7

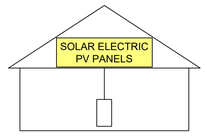
**CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED**

**LABEL LOCATION:**
POINT OF INTERCONNECTION,
(PER CODE: NEC 690.15, 690.13(B))
INVERTER

8

SOLAR PV SYSTEM EQUIPED
WITH RAPID SHUTDOWN

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




**LABEL LOCATION:**
LABEL PER NEC 690.56(C)- PROVIDE
AT AC DISCONNECT FOR RAPID
SHUTDOWN COMPLIANT SYSTEM

9

**CAUTION: SOLAR CIRCUIT**

**LABEL LOCATION:**
MARKINGS PLACED ON ALL INTERIOR AND EXTERIOR DC
CONDUIT, RACEWAYS, ENCLOSURES, AND CABLE ASSEMBLIES AT
LEAST EVERY 1O FT, AT TURNS AND ABOVE/BELOW
PENETRATIONS AND ALL COMBINER/JUCTION BOXES. (PER CODE:
IFC 605.11.1.4)

10

**CAUTION**
POWER TO THIS SERVICE IS
ALSO SUPPLIED FROM
ON-SITE SOLAR/ WIND
GENERATION

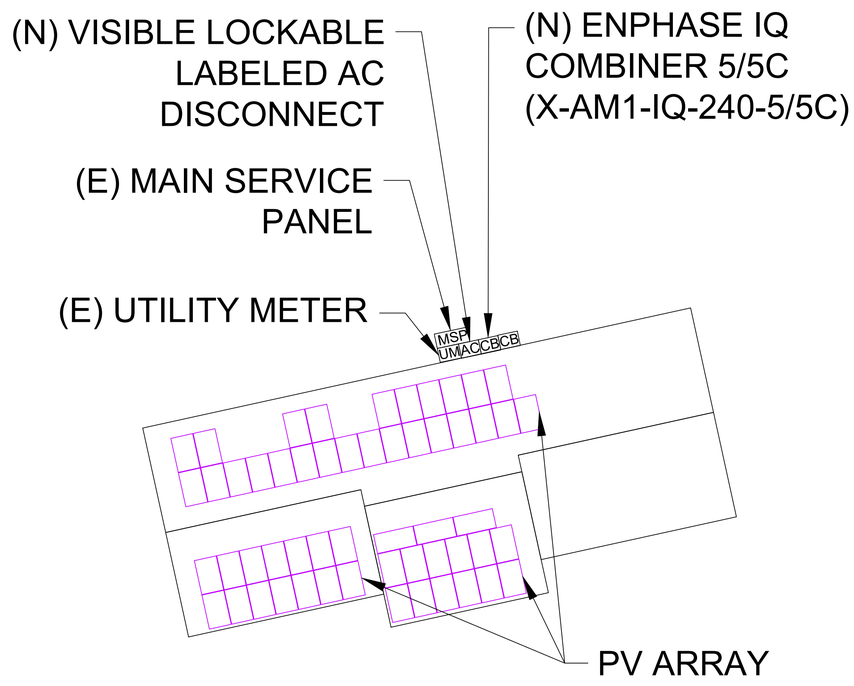
AC SYSTEM DISCONNECT

11

**CAUTION**
ALTERNATE POWER SUPPLY
AC SYSTEM DISCONNECT

N

# PV ELECTRICAL EQUIPMENT LAYOUT




NORTH CAROLINA PROFESSIONAL SEAL 057127 ENGINEER JOSHUA IBARRA
08/22/2024

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DRAWN BY: XAM C..

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|---|---|---|
| | | |
| | | |
| | | |
| | | |

LABELS

PV-900.00

# Q.PEAK DUO BLK ML-G10+ SERIES

**395 - 415 Wp | 132 Cells**
**21.1 % Maximum Module Efficiency**

**MODEL** Q.PEAK DUO BLK ML-G10.a+
Q.PEAK DUO BLK ML-G10+

### Breaking the 21% efficiency barrier

Q.ANTUM DUO Z Technology with zero gap cell layout boosts module efficiency up to 21.1%.

### A reliable investment

Inclusive 25-year product warranty and 25-year linear performance warranty[1].

### Enduring high performance

Long-term yield security with Anti LeTID Technology, Anti PID Technology[2] and Hot-Spot Protect.

### Extreme weather rating

High-tech aluminium alloy frame, certified for high snow (5400 Pa) and wind loads (4000 Pa).

### Innovative all-weather technology

Optimal yields, whatever the weather with excellent low-light and temperature behaviour.

### The most thorough testing programme in the industry

Qcells is the first solar module manufacturer to pass the most comprehensive quality programme in the industry: The new "Quality Controlled PV" of the independent certification institute TÜV Rheinland.

[1] See data sheet on rear for further information.
[2] APT test conditions according to IEC / TS 62804-1:2015, method A (−1500 V, 96 h)

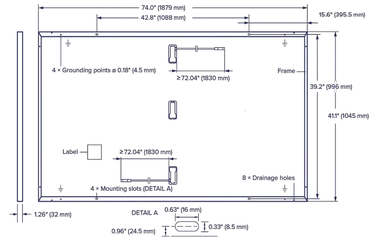
**The ideal solution for:**

Rooftop arrays on residential buildings

## Q.PEAK DUO BLK ML-G10+ SERIES

### Mechanical Specification

| | |
|---|---|
| Format | 74.0 in × 41.1 in × 1.26 in (including frame) (1879 mm × 1045 mm × 32 mm) |
| Weight | 48.5 lbs (22.0 kg) |
| Front Cover | 0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology |
| Back Cover | Composite film |
| Frame | Black anodised aluminium |
| Cell | 6 × 22 monocrystalline Q.ANTUM solar half cells |
| Junction box | 2.09-3.98 in × 1.26-2.36 in × 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), IP67, with bypass diodes |
| Cable | 4 mm² Solar cable; (+) ≥ 72.04 in (1830 mm), (−) ≥ 72.04 in (1830 mm) |
| Connector | Stäubli MC4; IP68 |

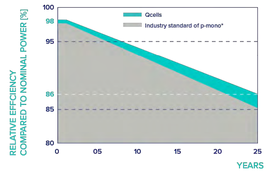



### Electrical Characteristics

| POWER CLASS | | | 395 | 400 | 405 | 410 | 415 |
|---|---|---|---|---|---|---|---|
| MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / −0 W) | | | | | | | |
| Minimum | Power at MPP[1] | $P_{MPP}$ [W] | 395 | 400 | 405 | 410 | 415 |
| | Short Circuit Current[1] | $I_{SC}$ [A] | 11.02 | 11.05 | 11.08 | 11.11 | 11.14 |
| | Open Circuit Voltage[1] | $V_{OC}$ [V] | 45.20 | 45.24 | 45.27 | 45.31 | 45.34 |
| | Current at MPP | $I_{MPP}$ [A] | 10.48 | 10.54 | 10.60 | 10.65 | 10.71 |
| | Voltage at MPP | $V_{MPP}$ [V] | 37.68 | 37.95 | 38.22 | 38.48 | 38.74 |
| | Efficiency[1] | η [%] | ≥ 20.1 | ≥ 20.4 | ≥ 20.6 | ≥ 20.9 | ≥ 21.1 |
| MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2] | | | | | | | |
| Minimum | Power at MPP | $P_{MPP}$ [W] | 296.4 | 300.1 | 303.9 | 307.6 | 311.4 |
| | Short Circuit Current | $I_{SC}$ [A] | 8.88 | 8.91 | 8.93 | 8.95 | 8.98 |
| | Open Circuit Voltage | $V_{OC}$ [V] | 42.63 | 42.66 | 42.69 | 42.73 | 42.76 |
| | Current at MPP | $I_{MPP}$ [A] | 8.25 | 8.30 | 8.35 | 8.40 | 8.45 |
| | Voltage at MPP | $V_{MPP}$ [V] | 35.93 | 36.16 | 36.39 | 36.61 | 36.84 |

[1] Measurement tolerances $P_{MPP}$ ±3%; $I_{SC}$; $V_{OC}$ ±5% at STC: 1000 W/m², 25 ± 2 °C, AM 1.5 according to IEC 60904-3 • [2] 800 W/m², NMOT, spectrum AM 1.5

### Qcells PERFORMANCE WARRANTY

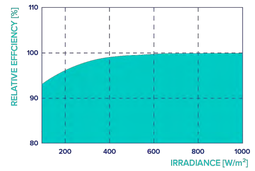



At least 98% of nominal power during first year. Thereafter max. 0.5% degradation per year. At least 93.5% of nominal power up to 10 years. At least 86% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Qcells sales organisation of your respective country.

*Standard terms of guarantee for the 5 PV companies with the highest production capacity in 2021 (February 2021)

### PERFORMANCE AT LOW IRRADIANCE




Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²).

### TEMPERATURE COEFFICIENTS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Temperature Coefficient of $I_{SC}$ | α | [%/K] | +0.04 | Temperature Coefficient of $V_{OC}$ | β | [%/K] | −0.27 |
| Temperature Coefficient of $P_{MPP}$ | γ | [%/K] | −0.34 | Nominal Module Operating Temperature | NMOT | [°F] | 109 ± 5.4 (43 ± 3 °C) |

### Properties for System Design

| | | | | | |
|---|---|---|---|---|---|
| Maximum System Voltage | $V_{SYS}$ | [V] | 1000 (IEC) / 1000 (UL) | PV module classification | Class II |
| Maximum Series Fuse Rating | | [A DC] | 20 | Fire Rating based on ANSI / UL 61730 | TYPE 2 |
| Max. Design Load, Push / Pull[3] | | [lbs / ft²] | 75 (3600 Pa) / 55 (2660 Pa) | Permitted Module Temperature on Continuous Duty | −40 °F up to +185 °F (−40 °C up to +85 °C) |
| Max. Test Load, Push / Pull[3] | | [lbs / ft²] | 113 (5400 Pa) / 84 (4000 Pa) | | |

[3] See Installation Manual

### Qualifications and Certificates

UL61730-1 & UL61730-2, CE-compliant, Quality Controlled PV - TÜV Rheinland, IEC 61215:2016, IEC 61730:2016, U.S. Patent No. 9,893,215 (solar cells),

*Contact your Qcells Sales Representative for details regarding the module's eligibility to be Buy American Act (BAA) compliant.

**Qcells pursues minimizing paper output in consideration of the global environment.**


Note: Installation instructions must be followed. Contact our technical service for further information on approved installation of this product.
Hanwha Q CELLS America Inc. 400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA | TEL +1 949 748 59 96 | EMAIL hqc-inquiry@qcells.com | WEB www.qcells.com

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KERNERSVILLE, NC 27284

SCOPE OF WORK:

TO INSTALL OF A 55 MODULE ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 810 BUCHANAN RD THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

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TMK: #

DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

| NO. | DESCRIPTION | DATE |
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DATA SHEETS

MSD

ENPHASE.

DATA SHEET


# IQ8 and IQ8+ Microinverters

Our newest IQ8 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 55nm 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.

Enphase 25 year limited warranty

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 IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.

UL CERTIFIED SAFETY

IQ8 Series Microinverters are UL listed as PV Rapid Shutdown Equipment and conform with various regulations, when installed according to manufacturer's instructions.

*Only when installed with IQ System Controller 2, meets UL 1741.
**IQ8 and IQ8Plus support split-phase, 240V installations only.



**Easy to install**

- Lightweight and compact with plug-n-play connectors
- Power Line Communication (PLC) between components
- Faster installation with simple two-wire cabling

**High productivity and reliability**

- Produce power even when the grid is down*
- More than one million cumulative hours of testing
- Class II double-insulated enclosure
- Optimized for the latest high-powered PV modules

**Microgrid-forming**

- Complies with the latest advanced grid support**
- Remote automatic updates for the latest grid requirements
- Configurable to support a wide range of grid profiles
- Meets CA Rule 21 (UL 1741-SA) and IEEE 1547:2018 (UL 1741-SB)

**Note:**

IQ8 Microinverters cannot be mixed together with previous generations of Enphase microinverters (IQ7 Series, IQ6 Series, etc) in the same system.



## IQ8 and IQ8+ Microinverters

| INPUT DATA (DC) | | IQ8-60-2-US | IQ8PLUS-72-2-US |
|---|---|---|---|
| Commonly used module pairings[1] | W | 235 – 350 | 235 – 440 |
| Module compatibility | | 60-cell / 120 half-cell | 54-cell / 108 half-cell, 60-cell / 120 half-cell, 66-cell / 132 half-cell and 72-cell / 144 half-cell |
| MPPT voltage range | V | 27 – 37 | 27 – 45 |
| Operating range | V | 16 – 48 | 16 – 58 |
| Min. / Max. start voltage | V | 22 / 48 | 22 / 58 |
| Max. input DC voltage | V | 50 | 60 |
| Max. continuous input DC current | A | 10 | 12 |
| Max. input DC short-circuit current | A | 25 | |
| Max. module $I_{sc}$ | A | 20 | |
| Overvoltage class DC port | | II | |
| DC port backfeed current | mA | 0 | |
| PV array configuration | | 1 x 1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit | |
| **OUTPUT DATA (AC)** | | **IQ8-60-2-US** | **IQ8PLUS-72-2-US** |
| Peak output power | VA | 245 | 300 |
| Max. continuous output power | VA | 240 | 290 |
| Nominal (L-L) voltage / range[2] | V | 240 / 211 – 264 | |
| Max. continuous output current | A | 1.0 | 1.21 |
| Nominal frequency | Hz | 60 | |
| Extended frequency range | Hz | 47 – 68 | |
| AC short circuit fault current over 3 cycles | Arms | 2 | |
| Max. units per 20 A (L-L) branch circuit[3] | | 16 | 13 |
| Total harmonic distortion | | <5% | |
| Overvoltage class AC port | | III | |
| AC port backfeed current | mA | 30 | |
| Power factor setting | | 1.0 | |
| Grid-tied power factor (adjustable) | | 0.85 leading – 0.85 lagging | |
| Peak efficiency | % | 97.7 | |
| CEC weighted efficiency | % | 97 | |
| Night-time power consumption | mW | 60 | |
| **MECHANICAL DATA** | | | |
| Ambient temperature range | | -40°C to +60°C (-40°F to +140°F) | |
| Relative humidity range | | 4% to 100% (condensing) | |
| DC Connector type | | MC4 | |
| Dimensions (H x W x D) | | 212 mm (8.3") x 175 mm (6.9") x 30.2 mm (1.2") | |
| Weight | | 1.08 kg (2.38 lbs) | |
| Cooling | | Natural convection – no fans | |
| Approved for wet locations | | Yes | |
| Pollution degree | | PD3 | |
| Enclosure | | Class II double-insulated, corrosion resistant polymeric enclosure | |
| 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<br>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) Pairing PV modules with wattage above the limit may result in additional clipping losses. See the compatibility calculator at https://link.enphase.com/module-compatibility. (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.

IQ8SP-12A-DS-0067-02-EN-US-2022-12-02

Beam SOLAR CO.

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DATASHEET

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, along with IQ Series Microinverters, IQ System Controller 3/3G, and IQ Battery 5P provides you with a complete grid-agnostic Enphase Energy System.

**IQ Series Microinverters**
The high-powered smart grid-ready IQ Series Microinverters (IQ6, IQ7, and IQ8 Series) dramatically 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

**Smart**
- Includes IQ Gateway for communication and control
- Includes Enphase Mobile Connect (CELLMODEM-M1-06-SP-05), only with IQ Combiner 5C
- Supports flexible networking: Wi-Fi, Ethernet, or cellular
- Provides production metering (revenue grade) and consumption monitoring

**Easy to install**
- Mounts to one stud with centered brackets
- Supports bottom, back, and side conduit entry
- Supports up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV branch circuits
- Bluetooth based Wi-Fi provisioning for easy Wi-Fi setup

**Reliable**
- Durable NRTL-certified NEMA type 3R enclosure
- 5-year limited warranty
- Two years labor reimbursement program coverage included for both the IQ Combiner SKUs
- UL1741 listed

Enphase 5 year limited warranty
5-year limited warranty

UL LISTED





| MECHANICAL DATA | |
|---|---|
| Dimensions (WxHxD) | 37.5 cm x 49.5 cm x 16.8 cm (14.75" x 19.5" x 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 | • 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors<br>• 60 A breaker branch input: 4 to 1/0 AWG copper conductors<br>• Main lug combined output: 10 to 2/0 AWG copper conductors<br>• Neutral and ground: 14 to 1/0 copper conductors<br>• Always follow local code requirements for conductor sizing |
| 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 via the internet |
| Wi-Fi range (recommended) | 10 m |
| 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 via the internet |
| 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 | For Mobile Connect |
| 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 | Refer to https://developer-v4.enphase.com |
| Local API | Refer to guide for local API |
| **COMPLIANCE** | |
| IQ Combiner | UL 1741, CAN/CSA C22.2 No. 107.1, Title 47 CFR, Part 15, Class B, ICES 003 |
| IQ Gateway | UL 60601-1/CAN/CSA 22.2 No. 61010-1, IEEE 1547: 2018 (UL 1741-SB, 3rd Ed.)<br>IEEE 2030.5/CSIP Compliant<br>Production metering: ANSI C12.20 accuracy class 0.5 (PV production) |
| **COMPATIBILITY** | |
| IQ System Controller 3/3G | SC200D111C240US01, SC200D111C240US01 |
| IQ Battery 5P | IQBATTERY-5P-1P-NA |
| Microinverter | IQ6, IQ7, and IQ8 Series Microinverters |



## 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 (ANSIC12.20 ±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 C12.20 ±0.5%), consumption monitoring (±2.5%) and IQ Battery monitoring (±2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05)[1]. 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 IQ System |
| Busbar | 125A busbar with support for 1 x IQ Gateway breaker and 4 x 20A breaker for installing IQ Series Microinverters and IQ Battery 5P |
| IQ Gateway breaker | Circuit breaker, 2-pole, 10 A/15 A |
| Production CT | Prewired 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-M1 cellular modem (CELLMODEM-M1-06-SP-05) with a 5-year T-Mobile data plan |
| Accessories kit | Spare control headers for CTRL board |
| **ACCESSORIES AND REPLACEMENT PARTS (NOT INCLUDED, ORDER SEPARATELY)** | |
| CELLMODEM-M1-06-SP-05 | 4G-based LTE-M1 cellular modem with a 5-year T-Mobile data plan |
| CELLMODEM-M1-06-AT-05 | 4G-based LTE-M1 cellular modem with a 5-year AT&T data plan |
| Circuit breakers (off-the-shelf) | Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers<br>Supports Eaton BR2206, BR2306, and BR2406 circuit breakers compatible with 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 "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 Combiner 5/5C |
| X-IQ-NA-HD-125A | Hold-down kit compatible with Eaton BR-B series circuit breakers (with screws) |
| **ELECTRICAL SPECIFICATIONS** | |
| Rating | 80 A |
| System voltage | 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 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 up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)



## Revision history

| REVISION | DATE | DESCRIPTION |
|---|---|---|
| DSH-00007-2.0 | September 2023 | Included Bluetooth specifications |
| DSH-00007-1.0 | May 2023 | Initial release |





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DATA SHEETS

MSD

EcoFasten
For Installers. By Installers.

# GF-1®

**COMPLETE MOUNT & FLASHING ASSEMBLY**

GF-1 is our most versatile solution for composition shingle roofs. The flashing installs with a single fastener for a quick and easy installation. When the GF-1 Flashing with Grommet is paired withan EcoFasten compression bracket, a watertight seal is created, maintaining the integrity of the roof.

Composition Shingle

Rail-Based, Rail-Less

Structural-Attached

## FEATURES & BENEFITS

- Patented watertight technology
- Installs without removing shingles
- One lag bolt for a single-penetration attachment point
- Compatible with a variety of EcoFasten compression brackets
- Florida Product Approved for any combination of 8"x12" GF-1 flashing with the ClickFit L-foot & Lag Screw

WATER TIGHT

25 YEAR WARRANTY

## VERSATILE WATERTIGHT MOUNT THAT INSTALLS IN SECONDS

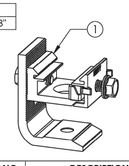
ECOFASTENSOLAR.COM

PRODUCT CUT SHEET

EcoFasten For Installers. By Installers.

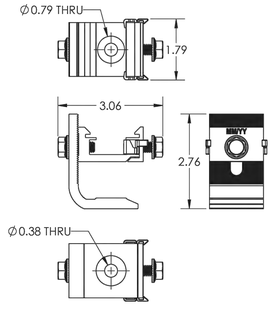
## CF UNIV L-FOOT MLL 3"

| PART NUMBER | DESCRIPTION |
|---|---|
| 2012022 | CF UNIV L-FOOT MLL 3" |




| ITEM NO. | DESCRIPTION |
|---|---|
| 1 | CLICKFIT L FOOT ASSEMBLY |

1) CLICKFIT L FOOT ASSEMBLY




| Material | Aluminum/Stainless Steel |
|---|---|
| Finish | Mill |

REV.- CS1


# CONFIGURATION OPTIONS

**1. CHOOSE YOUR FLASHING:**

GF-1 Flashing, Galvalume
8"x10", Black Finish
8"x12", Black Finish

**2. CHOOSE YOUR BRACKET:**

ClickFit Universal L-Foot
3", Mill Finish

Open Slot L-Foot
3", Black Anodized

Conduit Bracket
Comp

Rockit Smart Slide
4", Anodized Black

VIEW THE COMPLETE PARTS LIST

EcoFasten
AN ENSTALL COMPANY

LEARN HOW TO USE OUR PRODUCTS
CLICK HERE: ELEVATELEARNING.SOLAR

4141 W. VAN BUREN ST, SUITE 2, PHOENIX AZ 85009
1-877-859-3947 | INFO@ECOFASTENSOLAR.COM

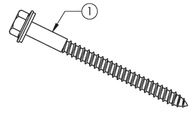
VERSION 2.1

PRODUCT CUT SHEET

EcoFasten For Installers. By Installers.

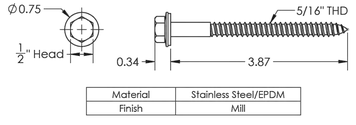
## LAG SCREW SS .313X4" W/BW (50)

| PART NUMBER | DESCRIPTION |
|---|---|
| 3016017 | LAG SCREW SS .313X4" W/BW (50) |




| ITEM NO. | DESCRIPTION |
|---|---|
| 1 | LAG SCREW, 5/16-4", THREAD 3", EPDM BACKED WASHER |

1) LAG SCREW, 5/16-4", THREAD 3", EPDM BACKED WASHER




| Material | Stainless Steel/EPDM |
|---|---|
| Finish | Mill |

REV.- CS1

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EcoFasten®
For Installers. By Installers.

CLICKFIT®

## COMPLETE RAIL-BASED RACKING SYSTEM

ClickFit is one of the fastest installing rail-based systems in the industry. Thanks to its Click-In rail assembly, the rails can be connected to any of EcoFasten's composition shingle, tile, and standing seam metal roof mounts in seconds without the need for fasteners or tools. The ClickFit system is made of robust materials and coated steel, to ensure corrosion-resistance and longevity. ClickFit conforms to UL 2703 and has been tested in extreme weather conditions including wind, fire, and snow.

## FEATURES & BENEFITS

- Pre-installed rail fastening bolt
- Fully integrated bonding
- Click-On Mid & End Clamps
- Compatible with a variety of EcoFasten roof attachments
- Florida Product Approved for composition shingle roofs

**FAST INSTALLING SYSTEM FEATURING CLICK-IN RAIL ASSEMBLY**

ROOF TYPE — **Composition Shingle, Tile & Standing Seam Metal**

RACKING — **Rail-Based**

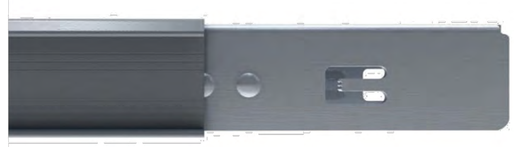
ATTACHMENT — **Structural-Attach Direct-Attach**

WATER TIGHT TECHNOLOGY

25 YEAR WARRANTY

**ECOFASTENSOLAR.COM**

CLICKFIT



### INTERNAL SPLICE

Tool-free bonded Internal Splice installs in seconds.

### EBOS ACCESSORIES

Secure Module Level Power Electronics to the top of the rail using the ClickFit MLPE Mount. PV wires can be managed using the ClickFit Wire Clip and the ClickFit Wire Management Clamp.

Additional eBoS accessories are available.

### MID CLAMP

Click-on Mid Clamp features integrated bonding pins and fits module frames from 30-50 mm in height.

### END CLAMP

One Click-on End Clamp fits modules from 30-40mm in height.

### END CAP

Slide-on End Cap provide an aesthetic finish and allow for End Clamps to be accurately positioned on the rail in seconds.

### RAIL

The ClickFit rail clicks into our proprietary composition shingle & tile L-foot and is tightened in place with a pre-installed bolt.

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| MICHAEL DOESKEN'S SUNCO BILL OF MATERIALS | | |
|---|---|---|
| ELECTRICAL | | |
| ITEM | MANUFACTURER MODEL NO. | QTY |
| MODULE | Q.PEAK DUO BLK ML-G10+ 400W MODULES | 55 |
| INVERTER | ENPHASE IQ8PLUS-72-2-US (240V) MICROINVERTER | 55 |
| JUNCTION BOX | 600VDC NEMA 3R UL LISTED JUNCTION BOX | 3 |
| COMBINER | ENPHASE COMBINER X-IQ-AM1-240-5C | 2 |
| COMBINER BREAKER | 20A | 5 |
| BATTERY | N/A | N/A |
| CONTROLLER | N/A | N/A |
| SMART SWITCH | N/A | N/A |
| AC DISCONNECT | EATON DG223NRB FUSED DISCONNECT | 2 |
| AC DISCONNECT FUSES | 90A | 2 |
| TAP CONNECTORS | POLARIS ITC-3/0 | 3 |
| Q-CABLE | ENPHASE CABLE Q-12-20-200 | 72 |
| SEALING CAP | ENPHASE Q-SEAL-10 | 14 |
| TERM CAPS | ENPHASE Q-TERM-10 | 5 |
| RACKING | | |
| ITEM | MANUFACTURER MODEL NO. | QTY |
| FLASHING | ECOFASTEN CF SMART MNT W/ CLKR AL MLL (RAFTER) 2012028 | 118 |
| RAILING | ECOFASTEN CLICKFIT STD RAIL 2012025 | 28 |
| RAIL SPLICE | ECOFASTEN CF RAIL SPLICE 2012013 | 18 |
| T BOLT | N/A | N/A |
| ENDS | ECOFASTEN CF END CLAMP 30-40MM BLK 2099022 | 36 |
| MIDS | ECOFASTEN CF MID CLAMP SHORT BLK 2099039 | 92 |
| MICROINVERTER BOLT | ECOFASTEN CF MLPE MOUNT 2012019 | 55 |
| DECK SCREWS | N/A | N/A |
| GROUND LUGS | ECOFASTEN MODULE JUMPER 4011011 / GROUND LUG (NON ECOFASTEN) | 19 |
| MISC | | |
| ITEM | MANUFACTURER MODEL NO. | QTY |
| OTHER | N/A | N/A |
| MISC | N/A | N/A |


BEAM SOLAR CO.
1231 SHIELDS ROAD
STE. 5
KERNERSVILLE, NC 27284


SCOPE OF WORK:

TO INSTALL OF A 55 MODULE ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 810 BUCHANAN RD THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

MICHAEL DOESKEN
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TMK: #

DRAWN BY: XAM C..

DATE: 2024-08-16

REVISION:

| NO. | DESCRIPTION | DATE |
|---|---|---|
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# BILL OF MATERIALS

# BOM