

GENERAL NOTES

CODE AND STANDARDS

1. ALL WORK SHALL COMPLY WITH 2017 NATIONAL ELECTRIC CODE (NEC), 2018 NORTH CAROLINA BUILDING CODE (NCBC), 2018 NORTH CAROLINA RESIDENTIAL CODE (NCR), PLUMBING CODE (NPC), AND ALL STATE AND LOCAL BUILDING, ELECTRICAL, AND PLUMBING CODES.
2. DRAWINGS HAVE BEEN DETAILED ACCORDING TO UL LISTING REQUIREMENTS.

SITE NOTES / OSHA REGULATION

1. A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
2. THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS A UTILITY INTERACTIVE SYSTEM.
3. THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
4. ROOF COVERINGS SHALL BE DESIGNED, INSTALLED, AND MAINTAINED IN ACCORDANCE WITH THIS CODE AND THE APPROVED MANUFACTURER'S INSTRUCTIONS SUCH THAT THE ROOF COVERING SHALL SERVE TO PROTECT THE BUILDING OR STRUCTURE.

SOLAR CONTRACTOR

1. MODULE CERTIFICATIONS WILL INCLUDE UL1703, IEC61646, IEC61730.
2. IF APPLICABLE, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE MARKED GROUNDING LUG HOLES PER THE MANUFACTURER'S INSTALLATION REQUIREMENTS.
3. AS INDICATED BY DESIGN, OTHER NRTL LISTED MODULE GROUNDING DEVICES MAY BE USED IN PLACE OF STANDARD GROUNDING LUGS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ.
4. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS.
5. CONDUIT POINT OF PENETRATION FROM EXTERIOR TO INTERIOR TO BE INSTALLED AND SEALED WITH A SUITABLE SEALING COMPOUND.
6. DC WIRING LIMITED TO MODULE FOOTPRINT W/ ENPHASE AC SYSTEM.
7. ENPHASE WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY W/ SUITABLE WIRING CLIPS.
8. MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC UNLESS NOT AVAILABLE.
9. ALL INVERTERS, MOTOR GENERATORS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AC PHOTOVOLTAIC MODULES, DC COMBINERS, DC-TO-DC CONVERTERS, SOURCE CIRCUIT COMBINERS, AND CHARGE CONTROLLERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER NEC 690.4(B).
10. ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE.
11. TERMINALS AND LUGS WILL BE TIGHTENED TO MANUFACTURER TORQUE SPECIFICATIONS (WHEN PROVIDED) IN ACCORDANCE WITH NEC CODE 110.14(D) ON ALL ELECTRICAL CONNECTIONS.

EQUIPMENT LOCATIONS

1. PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION NEC 110.26.
2. EQUIPMENT INSTALLED IN DIRECT SUNLIGHT MUST BE RATED FOR EXPECTED OPERATING TEMPERATURE AS SPECIFIED BY NEC 690.31(A) AND NEC TABLE 310.15(B).
3. ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.
4. ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

PROJECT INFORMATION:

NUMBER OF STORIES: 2
CONDUIT RUN: Interior
ECOBEE QTY: 2
LIGHT BULB QTY: 0
PV METER: Not Required

ROOF TYPE (1) INFORMATION:

ROOF TYPE: Comp Shingle
FRAMING TYPE: Manufactured Truss
SHEATHING TYPE: OSB
ATTACHMENT: SFM Infinity Switchblade Flashkit
RACKING: Unirac SFM Infinity @ 48" OC Portrait / 72" OC Landscape
NUMBER OF ATTACHMENTS: 26

ROOF TYPE (2) INFORMATION (IF APPLICABLE):

***SEE PV4.2**

SYSTEM TO BE INSTALLED INFORMATION:

SYSTEM SIZE: 6.4 kW DC
MODULE TYPE: (16) REC Solar REC400AA Pure
INVERTER TYPE: Enphase IQ7PLUS-72-2-US
MONITORING: Enphase IQ Combiner 3 X-IQ-AM1-240-3

AERIAL VIEW



DESIGN CRITERIA

WIND SPEED: 115 MPH
GROUND SNOW LOAD: 15 lb/ft²
WIND EXPOSURE FACTOR: C
SEISMIC DESIGN CATEGORY: B

SITE SPECIFICATIONS

CONSTRUCTION - V-B
 ZONING: RESIDENTIAL

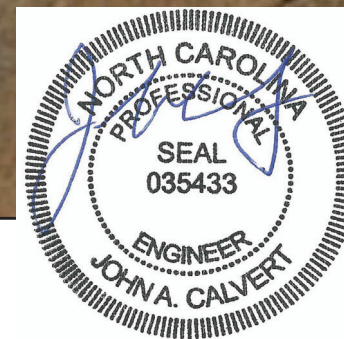
SCOPE OF WORK

INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM AND ANY NECESSARY ADDITIONAL WORK NEEDED FOR INSTALLATION.

SHEET INDEX

PV1 - COVER SHEET
PV2 - SITE PLAN
PV3 - ROOF PLAN
PV4 - STRUCTURAL
PV5 - ELECTRICAL 3-LINE DIAGRAM
PV6 - ELECTRICAL CALCULATIONS 6/15/2022
PV7 - WARNING LABELS AND LOCATIONS
(ALL OTHER SHEETS AS REQUIRED)
SS - PRODUCT SPEC. SHEETS Firm No. : D-0449

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PV INSTALLATION PROFESSIONAL

Scott Gurney
 #PV-011719-015866

CONTRACTOR:
 BRS FIELD OPS
 800-377-4480

CUSTOMER INFORMATION:

Lawrence Shang
 84 red cedar way
 FUQUAY VARINA, North Carolina
 27526

DC SYSTEM SIZE: 6.4 kW DC

DRAWING BY:

Jacob Pixton

PLOT DATE:

June 14, 2022

PROJECT NUMBER:

536095

SHEET NAME:

COVER SHEET

REVISION:

0

PAGE NUMBER:

PV1

UTILITY COMPANY:

Duke Energy NC

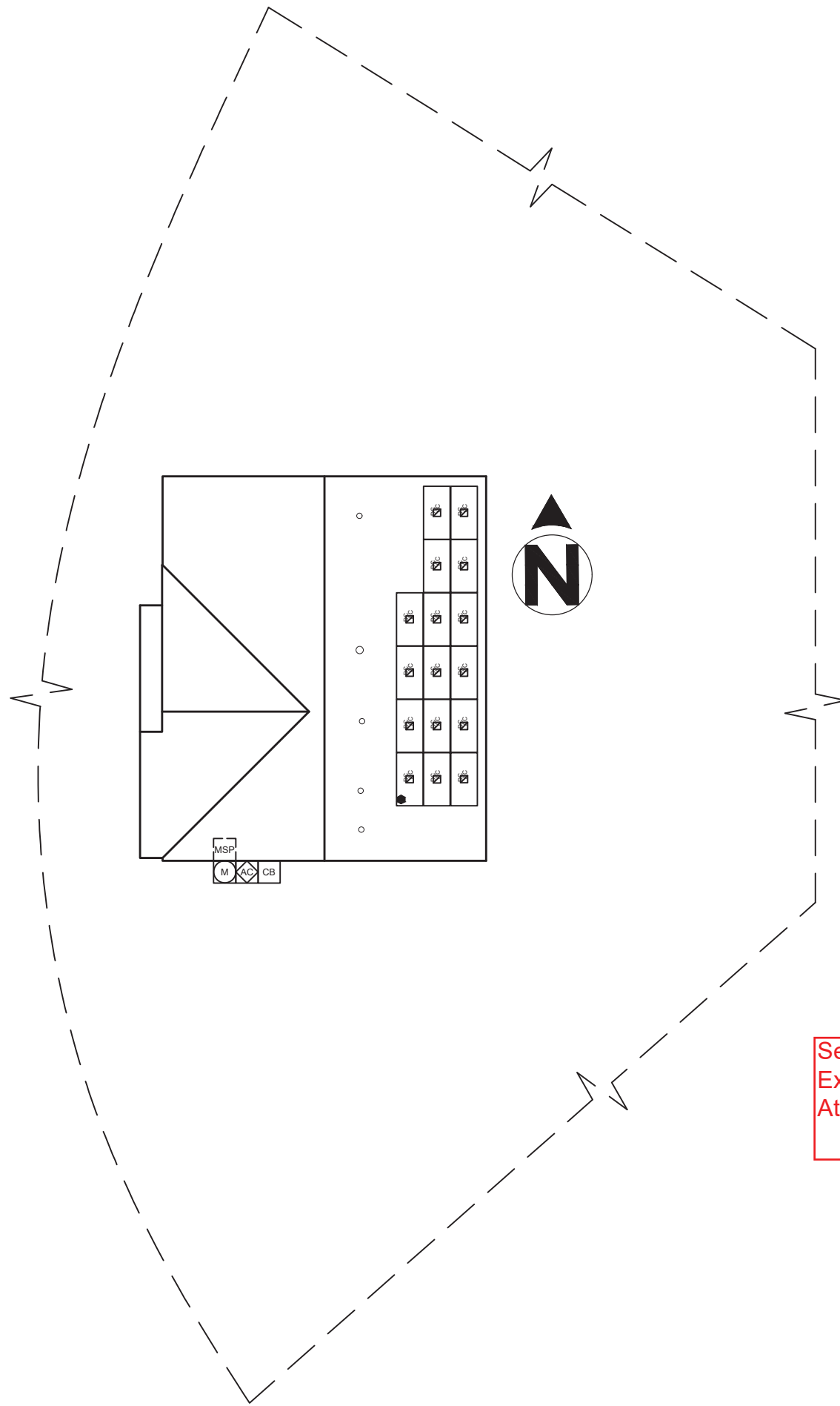
Digitally signed by John A. Calvert

PERMIT ISSUER:

Town of Fuquay Varina

Date: 2022.06.15
 09:28:35 -06'00'

FRONT OF HOME
84 red cedar way


















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6/15/2022

Firm No. : D-0449

LEGEND

-  JUNCTION BOX
-  UTILITY METER
-  MAIN SERVICE PANEL
-  AC DISCONNECT
-  COMBINER BOX
-  LOAD CENTER
-  SUBPANEL
-  PV METER
-  TRANSFER SWITCH
-  SUNPOWER ESS
-  SUNPOWER HUB+
-  REMOTE POWER OFF
-  FIRE SETBACK
-  TRENCHING
-  PROPERTY LINE

SCALE: 1/16" = 1'-0"



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PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
800-377-4480

CUSTOMER INFORMATION:

Lawrence Shang
84 red cedar way
FUQUAY VARINA, North Carolina
27526
DC SYSTEM SIZE: 6.4 kW DC

DRAWING BY:

Jacob Pixton

PLOT DATE:

June 14, 2022

PROJECT NUMBER:

536095

SHEET NAME:

SITE PLAN

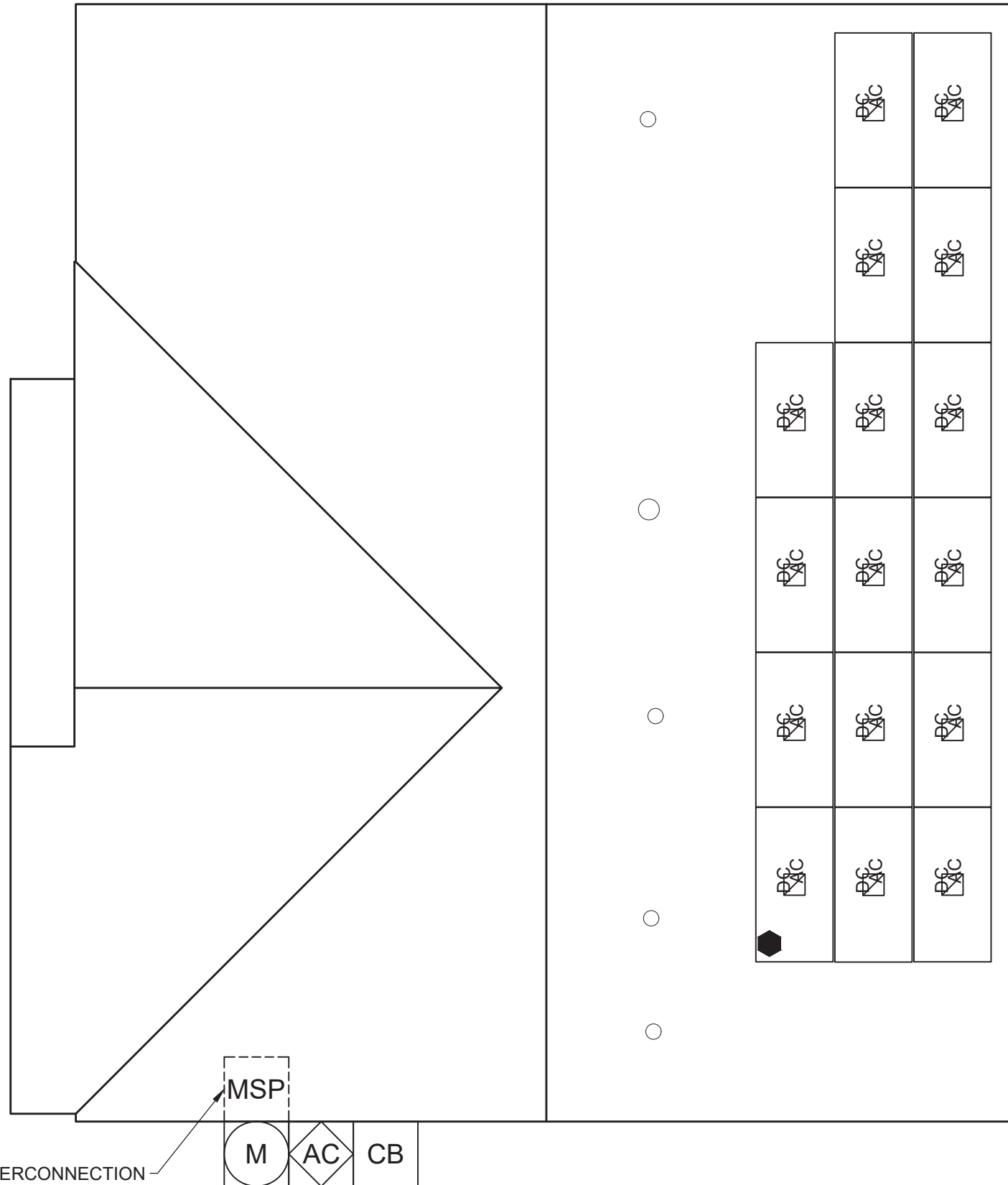
REVISION:

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PAGE NUMBER:

PV2

FRONT OF HOME



MP1
 # OF MODULES: 16
 AZIMUTH: 91
 PITCH: 27
 TSRF: 85%
 AREA: 879 ft.²

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LEGEND

- JUNCTION BOX
- UTILITY METER
- MAIN SERVICE PANEL
- AC DISCONNECT
- COMBINER BOX
- LOAD CENTER
- SUBPANEL
- PV METER
- TRANSFER SWITCH
- SUNPOWER ESS
- SUNPOWER HUB+
- REMOTE POWER OFF
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

SCALE: 3/16" = 1'-0"



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DC SYSTEM SIZE: 6.4 kW DC

DRAWING BY:
Jacob Pixton

PLOT DATE:
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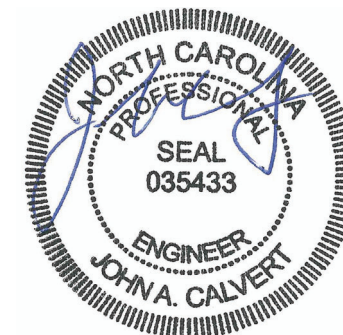
SHEET NAME:
ROOF PLAN

| | |
|----------------|---------------------|
| REVISION: 0 | PAGE NUMBER: PV3 |
|----------------|---------------------|

DC SYSTEM SIZE: 6.4 kW DC
 MODULE: (REC Solar REC400AA Pure)
 INVERTER(S): Enphase IQ7PLUS-72-2-US

6/15/2022

Firm No. : D-0449



STRUCTURAL INFORMATION:

ROOF TYPE (1):

ROOF TYPE: Comp Shingle
SHEATHING TYPE: OSB
FRAMING TYPE: Manufactured Truss
FRAMING SIZE: 2x4 @ 24" OC
CEILING JOIST SIZE: 2x4 @ 24" OC

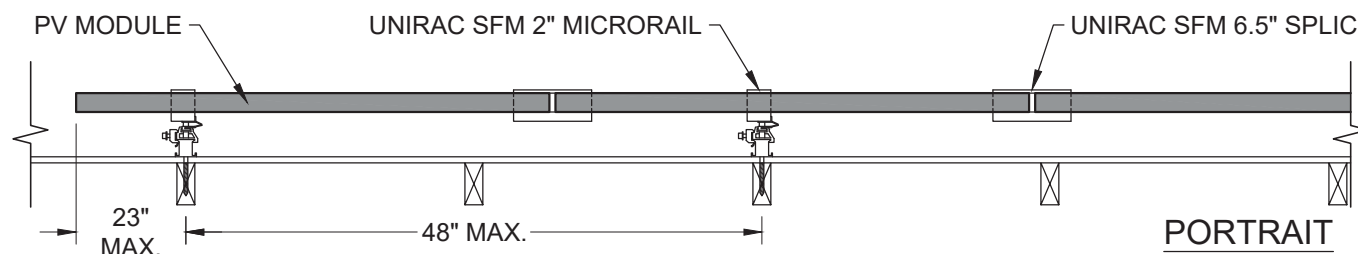
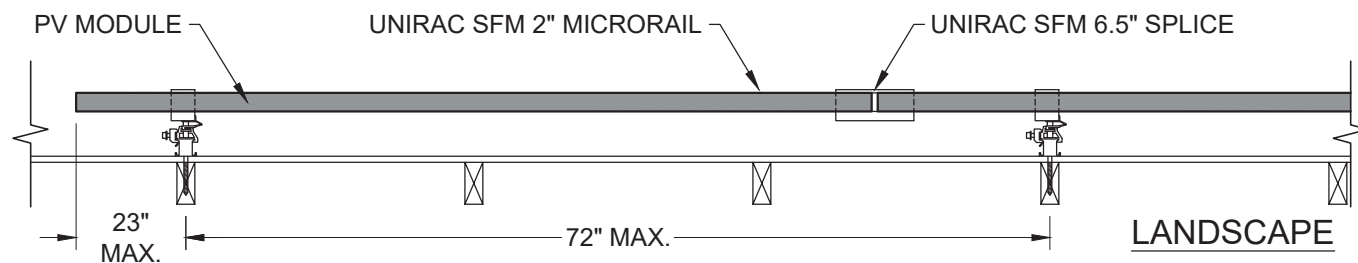
ATTACHMENT: SFM Infinity Switchblade Flashkit
RACKING: Unirac SFM Infinity
 @ 48" OC Portrait / 72" OC Landscape
NUMBER OF ATTACHMENTS: 26

PV MODULE COUNT: 16 Modules
TOTAL ARRAY AREA: 280.2 ft² (17.51ft²/panel)
TOTAL ROOF AREA: 1838 ft²
ARRAY/ROOF AREA: 15.2%
ARRAY WEIGHT: 800 lbs (50 lbs/panel)
DISTRIBUTED LOAD: 2.86 lbs/ft²
POINT LOAD: 30.77 lbs/attachment

STRUCTURAL NOTES:

None

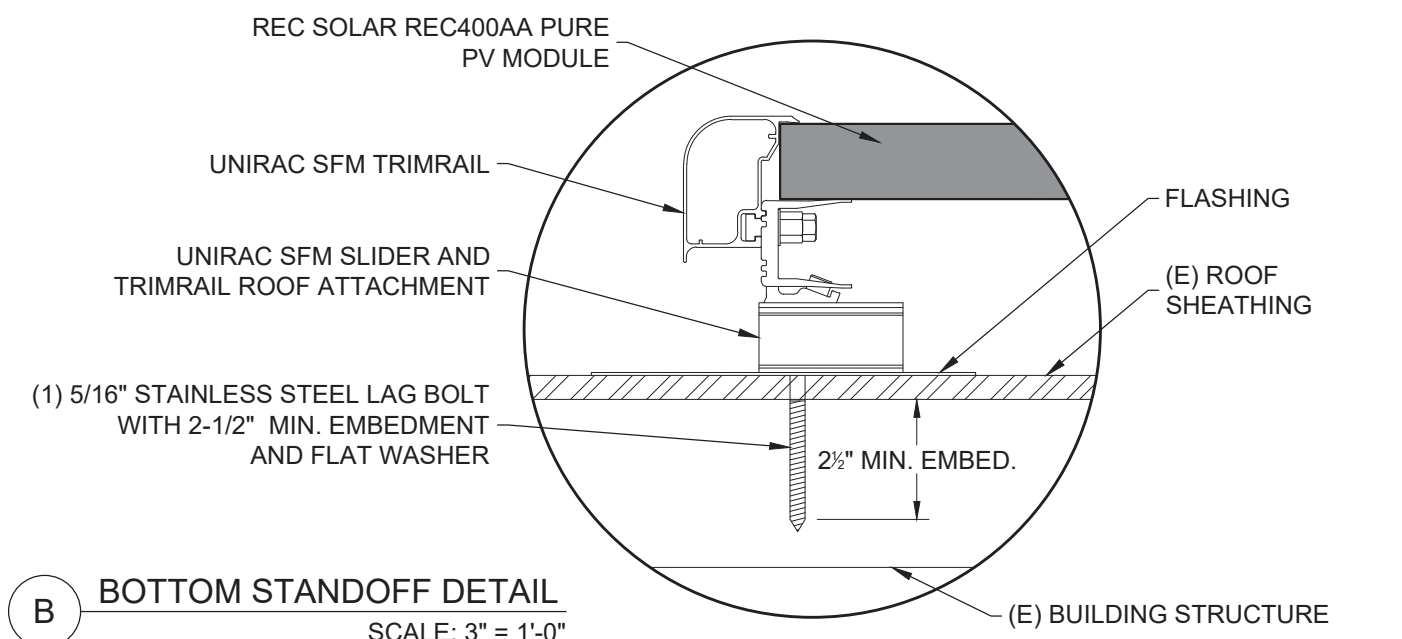
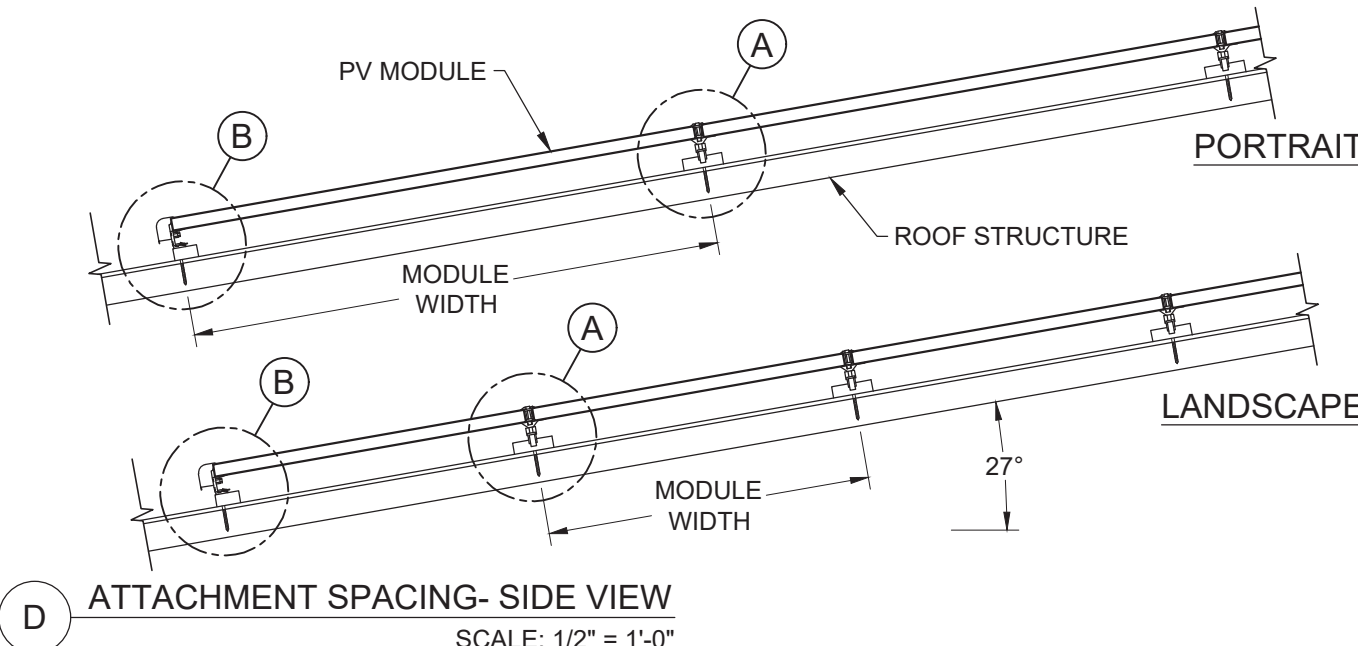
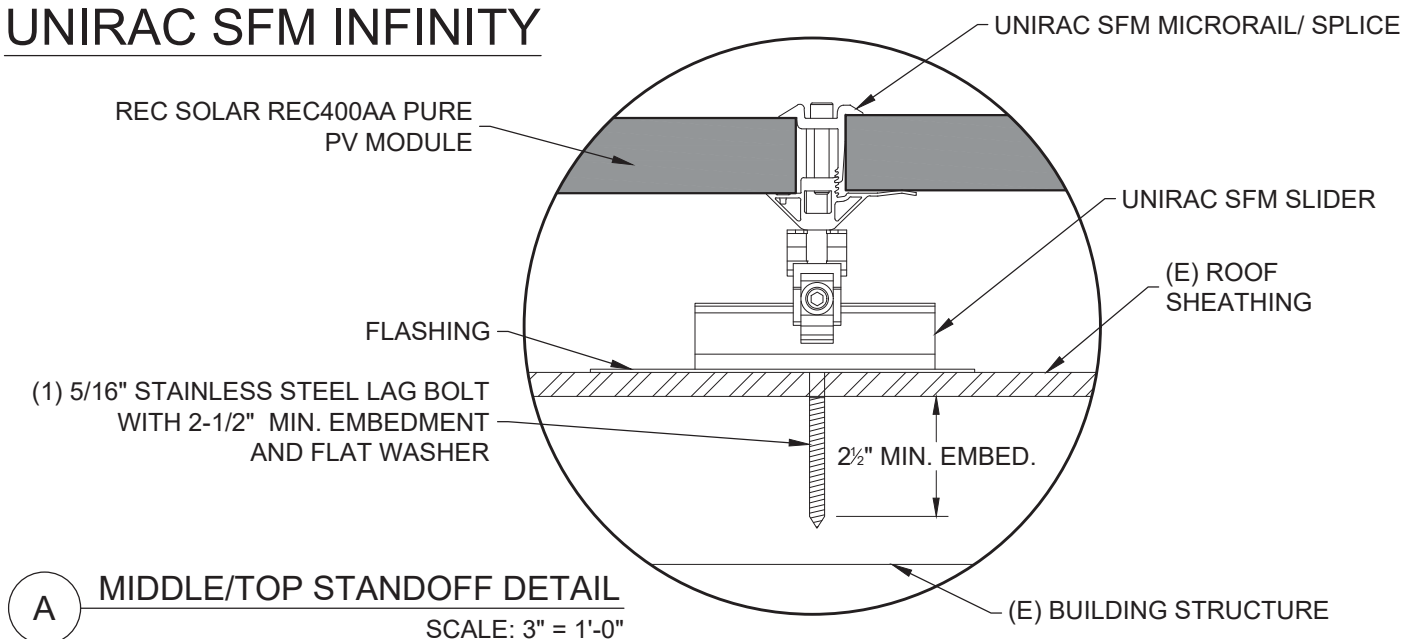
*NOTE: LISTED NUMBER OF ATTACHMENT POINTS ARE AN ESTIMATE ONLY AND MAY VARY BASED ON FIELD CONDITIONS. MAXIMUM ATTACHMENT SPACING TO BE FOLLOWED PER ENGINEER OF RECORD SPECIFICATIONS.



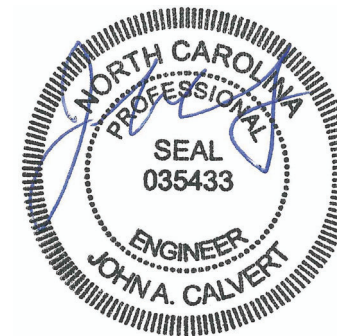
C ATTACHMENT SPACING- FRONT VIEW
SCALE: 3/4" = 1'-0"

-RACKING ATTACHMENTS TO BE STAGGERED BY SHIFTING EACH SUBSEQUENT ROW OF ATTACHMENTS OVER ONE RAFTER.

UNIRAC SFM INFINITY



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PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
800-377-4480

CUSTOMER INFORMATION:

Lawrence Shang
84 red cedar way
FUQUAY VARINA, North Carolina
27526
DC SYSTEM SIZE: 6.4 kW DC

DRAWING BY:
Jacob Pixton

PLOT DATE:
June 14, 2022

PROJECT NUMBER:
536095

SHEET NAME:
STRUCTURAL

REVISION: 0
PAGE NUMBER: PV4

| | | | | | | | | | | | | |
|----|--|-----------|---|--|--------------|---|--|--------------|---|----------------------------------|--------------|----------|
| 15 | (1) 10 AWG THHN/THWN-2, CU., BLACK (L1) | 19.4 A AC | 3 | (2) 10 AWG THHN/THWN-2, CU., BLACK (L1) | MAX 9.7 A AC | 2 | (1) 10 - 2 UF-B (or NM) W/G, THHN/THWN-2, SO | MAX 9.7 A AC | 1 | (1) 12-2 TC-ER, THHN/THWN-2, CU. | MAX 9.7 A AC | EXTERIOR |
| | (1) 10 AWG THHN/THWN-2, CU., RED (L2) | 240 V AC | | (2) 10 AWG THHN/THWN-2, CU., RED (L2) | 240 V AC | | (1) 6 AWG BARE, CU (EGC) | 240 V AC | | | | |
| | (1) 10 AWG THHN/THWN-2, CU., WHITE (N) | | | (1) 10 AWG THHN/THWN-2, CU., GREEN (EGC) | | | | | | | | |
| | (1) 10 AWG THHN/THWN-2, CU., GREEN (EGC) | | | | | | | | | | | |
| | (1) 3/4 INCH EMT | EXTERIOR | | (1) 3/4 INCH EMT | EXTERIOR | | | INTERIOR | | | EXTERIOR | |

DESIGNER NOTES:

LOAD SIDE BREAKER IN MSP, INTERIOR POI.

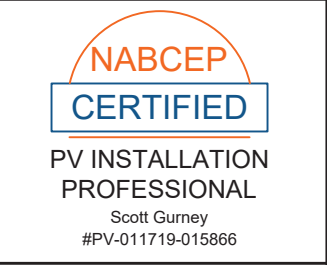
ELECTRICAL NOTES:

16 INVERTERS x 290 W AC = 4.64 kW AC
 PANEL WATTAGE = 400 W DC

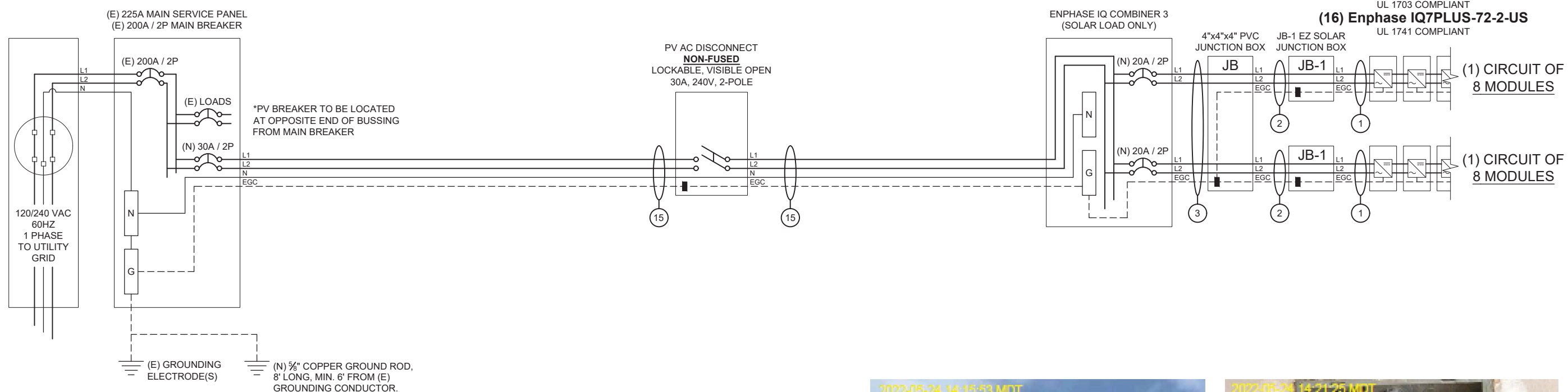


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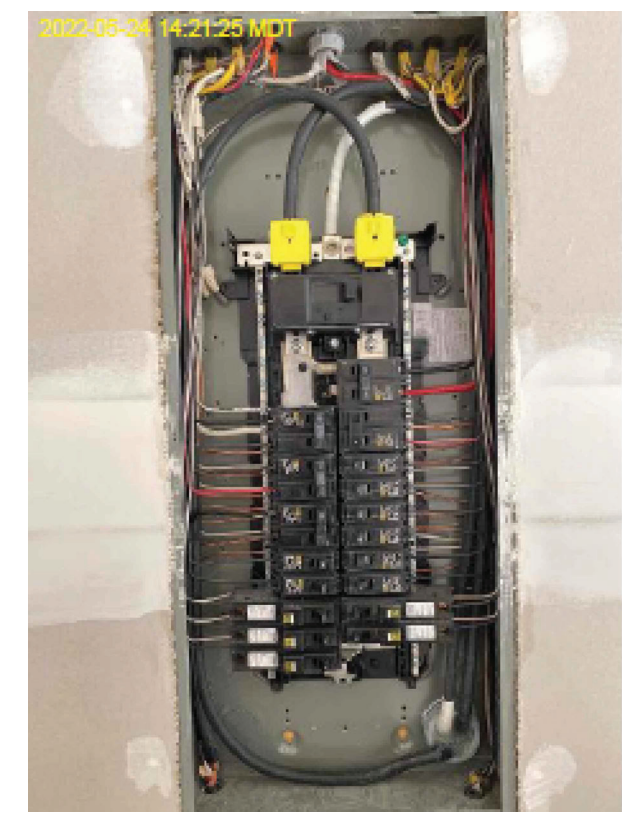
VERIFICATION WILL BE DONE TO ENSURE THE GROUNDING ELECTRODE SYSTEM IS CONGRUENT WITH CURRENT REQUIREMENTS. (NEC 250 PART III) IF NOT, A NEW GROUND ROD WILL BE INSTALLED.

GEC INSTALLED PER NEC 250.64: 6 OR 4 AWG SOLID COPPER GEC.

INTERCONNECTION NOTES
 705.12(B)(3) THE FOLLOWING METHOD(S) SHALL BE USED TO DETERMINE THE RATINGS OF BUSBARS: (2) WHERE TWO SOURCES, ONE A PRIMARY POWER SOURCE AND THE OTHER ANOTHER POWER SOURCE, ARE LOCATED AT OPPOSITE ENDS OF A BUSBAR THAT CONTAINS LOADS, THE SUM OF 125 PERCENT OF THE POWER-SOURCE(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUS BAR SHALL NOT EXCEED 120 PERCENT OF THE AMPACITY OF THE BUSBAR.



UTILITY COMPANY: Duke Energy NC



PERMIT ISSUER: Town of Fuquay Varina

CUSTOMER INFORMATION:
 Lawrence Shang
 84 red cedar way
 FUQUAY VARINA, North Carolina
 27526
DC SYSTEM SIZE: 6.4 kW DC

| | |
|-----------------------------|---------------------|
| DRAWING BY: Jacob Pixton | |
| PLOT DATE: June 14, 2022 | |
| PROJECT NUMBER: 536095 | |
| SHEET NAME: ELECTRICAL | |
| REVISION: 0 | PAGE NUMBER: PV5 |

| MODULE SPECIFICATIONS | | REC Solar REC400AA Pure |
|--|--|-------------------------|
| RATED POWER (STC) | | 400 W |
| MODULE VOC | | 48.8 V DC |
| MODULE VMP | | 42.1 V DC |
| MODULE IMP | | 9.51 A DC |
| MODULE ISC | | 10.25 A DC |
| VOC CORRECTION | | -0.24 %/°C |
| VMP CORRECTION | | -0.26 %/°C |
| SERIES FUSE RATING | | 25 A DC |
| ADJ. MODULE VOC @ ASHRAE LOW TEMP | | 53.1 V DC |
| ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP | | 37.6 V DC |

| MICROINVERTER SPECIFICATIONS | | Enphase IQ7+ Microinverters |
|-------------------------------------|---------|-----------------------------|
| POWER POINT TRACKING (MPPT) MIN/MAX | 22 - 60 | V DC |
| MAXIMUM INPUT VOLTAGE | 60 | V DC |
| MAXIMUM DC SHORT CIRCUIT CURRENT | 15 | A DC |
| MAXIMUM USABLE DC INPUT POWER | 440 | W |
| MAXIMUM OUTPUT CURRENT | 1.21 | A AC |
| AC OVERCURRENT PROTECTION | 20 | A |
| MAXIMUM OUTPUT POWER | 290 | W |
| CEC WEIGHTED EFFICIENCY | 97 | % |

| AC PHOTOVOLTAIC MODULE MARKING (NEC 690.52) | |
|---|---------------|
| NOMINAL OPERATING AC VOLTAGE | 240 V AC |
| NOMINAL OPERATING AC FREQUENCY | 47 - 68 HZ AC |
| MAXIMUM AC POWER | 240 VA AC |
| MAXIMUM AC CURRENT | 1.0 A AC |
| MAXIMUM OCPD RATING FOR AC MODULE | 20 A AC |

| DESIGN LOCATION AND TEMPERATURES | |
|----------------------------------|------------------------------|
| TEMPERATURE DATA SOURCE | ASHRAE 2% AVG. HIGH TEMP |
| STATE | North Carolina |
| CITY | FUQUAY VARINA |
| WEATHER STATION | RALEIGH DURHAM INTERNATIONAL |
| ASHRAE EXTREME LOW TEMP (°C) | -12 |
| ASHRAE 2% AVG. HIGH TEMP (°C) | 34 |

| SYSTEM ELECTRICAL SPECIFICATIONS | CIR 1 | CIR 2 | CIR 3 | CIR 4 | CIR 5 | CIR 6 |
|------------------------------------|------------|-------|-------|-------|-------|-------|
| NUMBER OF MODULES PER MPPT | 8 | 8 | | | | |
| DC POWER RATING PER CIRCUIT (STC) | 3200 | 3200 | | | | |
| TOTAL MODULE NUMBER | 16 MODULES | | | | | |
| STC RATING OF ARRAY | 6400W DC | | | | | |
| AC CURRENT @ MAX POWER POINT (IMP) | 9.7 | 9.7 | | | | |
| MAX. CURRENT (IMP X 1.25) | 12.1 | 12.1 | | | | |
| OCPD CURRENT RATING PER CIRCUIT | 20 | 20 | | | | |
| MAX. COMB. ARRAY AC CURRENT (IMP) | 19.4 | | | | | |
| MAX. ARRAY AC POWER | 4640W AC | | | | | |

| AC VOLTAGE RISE CALCULATIONS | DIST (FT) | COND. | √RISE(V) | VEND(V) | %VRISE |
|-------------------------------------|-----------|--------|----------|---------|--------|
| VRISE SEC. 1 (MICRO TO JBOX) | 28.8 | 12 Cu. | 0.93 | 240.93 | 0.39% |
| VRISE SEC. 2 (JBOX TO COMBINER BOX) | 35 | 10 Cu. | 0.86 | 240.86 | 0.36% |
| VRISE SEC. 3 (COMBINER BOX TO POI) | 5 | 10 Cu. | 0.25 | 240.25 | 0.10% |
| TOTAL VRISE | | | 2.04 | 242.04 | |

| PHOTOVOLTAIC AC DISCONNECT OUTPUT LABEL (NEC 690.54) | |
|--|-----------|
| AC OUTPUT CURRENT | 19.4 A AC |
| NOMINAL AC VOLTAGE | 240 V AC |

| CONDUCTOR SIZE CALCULATIONS | | | |
|-----------------------------------|---|-----------|--------|
| MICROINVERTER TO JUNCTION BOX (1) | MAX. SHORT CIRCUIT CURRENT (ISC) = | 9.7 A AC | |
| | MAX. CURRENT (ISC X1.25) = | 12.1 A AC | |
| | CONDUCTOR (TC-ER, COPPER (90°C)) = | 12 AWG | |
| | CONDUCTOR RATING = | 30 A | |
| | AMB. TEMP. AMP. CORRECTION = | 0.96 | |
| | ADJUSTED AMP. = | 28.8 | > 12.1 |
| JUNCTION BOX TO JUNCTION BOX (2) | MAX. SHORT CIRCUIT CURRENT (ISC) = | 9.7 A AC | |
| | MAX. CURRENT (ISC X1.25) = | 12.1 A AC | |
| | CONDUCTOR (UF-B, COPPER (60°C)) = | 10 AWG | |
| | CONDUCTOR RATING = | 30 A | |
| | CONDUIT FILL DERATE = | 1 | |
| | AMB. TEMP. AMP. CORRECTION = | 0.96 | |
| | ADJUSTED AMP. = | 28.8 | > 12.1 |
| JUNCTION BOX TO COMBINER BOX (3) | MAX. SHORT CIRCUIT CURRENT (ISC) = | 9.7 A AC | |
| | MAX. CURRENT (ISC X1.25) = | 12.1 A AC | |
| | CONDUCTOR (UF-B, COPPER (60°C)) = | 10 AWG | |
| | CONDUCTOR RATING = | 30 A | |
| | CONDUIT FILL DERATE = | 0.8 | |
| | AMB. TEMP. AMP. CORRECTION = | 0.96 | |
| | ADJUSTED AMP. = | 23.04 | > 12.1 |
| COMBINER BOX TO MAIN PV OCPD (15) | INVERTER RATED AMPS = | 19.4 A AC | |
| | MAX. CURRENT (RATED AMPS X1.25) = | 24.2 A AC | |
| | CONDUCTOR (THWN-2, COPPER (75°C TERM.)) = | 10 AWG | |
| | CONDUCTOR RATING = | 35 A | |
| | CONDUIT FILL DERATE = | 1 | |
| | AMB. TEMP. AMP. CORRECTION = | 0.96 | |
| | ADJUSTED AMP. = | 33.6 | > 24.2 |

GROUNDING NOTES

1. A GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH [NEC 690.47] AND [NEC 250.50-60] SHALL BE PROVIDED. PER [NEC 690.47], THE GROUNDING ELECTRODE SYSTEM OF AN EXISTING BUILDING MAY BE USED AND BE BONDED AT THE SERVICE ENTRANCE. IF EXISTING SYSTEM IS INACCESSIBLE, OR INADEQUATE, OR IS ONLY METALLIC WATER PIPING, A SUPPLEMENTAL GROUNDING ELECTRODE WILL BE USED AT THE INVERTER LOCATION CONSISTING OF A UL LISTED 8 FT GROUND ROD WITH ACORN CLAMP.
2. THE GROUNDING ELECTRODE CONDUCTOR SHALL BE PROTECTED FROM PHYSICAL DAMAGE BETWEEN THE GROUNDING ELECTRODE AND THE PANEL (OR INVERTER) IF SMALLER THAN #6 AWG COPPER WIRE PER [NEC 250.64(B)]. THE GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AT BUSBARS WITHIN LISTED EQUIPMENT PER [NEC 250.64(C)].
3. GROUNDING ELECTRODE CONDUCTORS SHALL BE NO LESS THAN 8 AWG AND NO GREATER THAN 6 AWG COPPER AND BONDED TO THE EXISTING GROUNDING ELECTRODE TO PROVIDE FOR A COMPLETE SYSTEM.
4. PV SYSTEM SHALL BE GROUNDED IN ACCORDANCE TO [NEC 250.21], [NEC TABLE 250.122], AND ALL METAL PARTS OR MODULE FRAMES ACCORDING TO [NEC 690.46].
5. MODULE SOURCE CIRCUITS SHALL BE GROUNDED IN ACCORDANCE TO [NEC 690.42].
6. THE GROUNDING CONNECTION TO A MODULE SHALL BE ARRANGED SUCH THAT THE REMOVAL OF A MODULE DOES NOT INTERRUPT A GROUNDED CONDUCTOR TO ANOTHER MODULE.
7. EACH MODULE WILL BE GROUNDED USING THE SUPPLIED CONNECTION POINTS IDENTIFIED IN THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
8. ENCLOSURES SHALL BE PROPERLY PREPARED WITH REMOVAL OF PAINT/FINISH AS APPROPRIATE WHEN GROUNDING EQUIPMENT WITH TERMINATION GROUNDING LUGS.
9. GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVICES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR DIRECT BURIAL.
10. GROUNDING AND BONDING CONDUCTORS SHALL BE COPPER, SOLID OR STRANDED, AND BARE WHEN EXPOSED.
11. EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO [NEC 690.45] AND BE A MINIMUM OF 10 AWG WHEN NOT EXPOSED TO DAMAGE (6 AWG SHALL BE USED WHEN EXPOSED TO DAMAGE).
12. GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN (OR MARKED GREEN IF 4 AWG OR LARGER).
13. ALL CONDUIT BETWEEN THE UTILITY AC DISCONNECT AND THE POINT OF CONNECTION SHALL HAVE GROUNDED BUSHINGS AT BOTH ENDS.
14. SYSTEM GEC SIZED ACCORDING TO [NEC 690.47], [NEC TABLE 250.66], DC SYSTEM GEC SIZED ACCORDING TO [NEC 250.166], MINIMUM 8 AWG WHEN INSULATED, 6 AWG WHEN EXPOSED TO DAMAGE.
15. EXPOSED NON-CURRENT CARRYING METAL PARTS OF MODULE FRAMES, EQUIPMENTS, AND CONDUCTOR ENCLOSURES SHALL BE GROUNDED IN ACCORDANCE WITH [NEC 250.134] OR [NEC 250.136(A)] REGARDLESS OF VOLTAGE.

WIRING & CONDUIT NOTES

1. ALL CONDUIT SIZES AND TYPES, SHALL BE LISTED FOR ITS PURPOSE AND APPROVED FOR THE SITE APPLICATIONS.
2. BOLTED CONNECTION REQUIRED IN DC DISCONNECTS ON THE WHITE GROUNDED CONDUCTOR (USE POLARIS BLOCK OR NEUTRAL BAR).
3. ANY CONNECTION ABOVE LIVE PARTS MUST BE WATERTIGHT. REDUCING WASHERS DISALLOWED ABOVE LIVE PARTS, MEYERS HUBS RECOMMENDED
4. UV RESISTANT CABLE TIES (NOT ZIP TIES) USED FOR PERMANENT WIRE MANAGEMENT OFF THE ROOF SURFACE IN ACCORDANCE WITH [NEC 110.2.110.3(A-B)].
5. SOLADECK JUNCTION BOXES MOUNTED FLUSH WITH ROOF SURFACE TO BE USED FOR WIRE MANAGEMENT AND AS FLASHED ROOF PENETRATIONS FOR INTERIOR CONDUIT RUNS.
6. ALL PV CABLES AND HOMERUN WIRES BE TYPE USE-2, AND SINGLE-CONDUCTOR CABLE LISTED AND IDENTIFIED AS PV WIRE, TYPE TC-ER, OR EQUIVALENT; ROUTED TO SOURCE CIRCUIT COMBINER BOXES AS REQUIRED.
7. ALL CONDUCTORS AND OCPD SIZES AND TYPES SPECIFIED ACCORDING TO [NEC 690.8] FOR MULTIPLE CONDUCTORS.
8. ALL PV DC CONDUCTORS IN CONDUIT EXPOSED TO SUNLIGHT SHALL BE INSTALLED AT LEAST 7/8" ABOVE THE ROOF SURFACE AND DERATED ACCORDING TO [NEC TABLE 310.15 (B)(2)(A)], [NEC TABLE 310.15(B)(3)(A)], & [NEC 310.15(B)(3)(C)].
9. 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.
10. PHASE AND NEUTRAL CONDUCTORS SHALL BE DUAL RATED THHN/THWN-2 INSULATED, 90°C RATED, WET AND UV RESISTANT, RATED FOR 600V
11. 4-WIRE DELTA CONNECTED SYSTEMS HAVE THE PHASE WITH THE HIGHER VOLTAGE TO GROUND MARKED ORANGE OR IDENTIFIED BY OTHER EFFECTIVE MEANS.
12. ALL SOURCE CIRCUITS SHALL HAVE INDIVIDUAL SOURCE CIRCUIT PROTECTION
13. VOLTAGE DROP LIMITED TO 2% FOR DC CIRCUITS AND 3% FOR AC CIRCUITS
14. NEGATIVE GROUNDED SYSTEMS DC CONDUCTORS SHALL BE COLOR CODED AS FOLLOWS: DC POSITIVE- RED (OR MARKED RED), DC NEGATIVE- GREY (OR MARKED GREY)
15. POSITIVE GROUNDED SYSTEMS DC CONDUCTORS COLOR CODED: DC POSITIVE- GREY (OR MARKED GREY), DC NEGATIVE- BLACK (OR MARKED BLACK)
16. 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
- * USE-2 IS NOT INDOOR RATED BUT PV CABLE IS RATED THWN/THWN-2 AND MAY BE USED INSIDE
- ** USE-2 IS AVAILABLE AS UV WHITE
17. RIGID CONDUIT, IF INSTALLED, (AND/OR NIPPLES) MUST HAVE A PULL BUSHING TO PROTECT WIRES.
18. IF CONDUIT DETERMINED TO BE RAN THROUGH ATTIC IN FIELD THEN CONDUIT WILL BE EITHER EMT, FMC, OR MC CABLE IF DC CURRENT COMPLYING WITH [NEC 690.31], [NEC 250.118(10)]. DISCONNECTING MEANS SHALL COMPLY WITH [NEC 690.13] AND [NEC 690.15].
19. CONDUIT RAN THROUGH ATTIC WILL BE AT LEAST 18" BELOW ROOF SURFACE COMPLYING WITH [NEC 230.6(4)] AND SECURED NO GREATER THAN 6' APART PER [NEC 330.30(B)].



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PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
800-377-4480

CUSTOMER INFORMATION:

Lawrence Shang
84 red cedar way
FUQUAY VARINA, North Carolina
27526
DC SYSTEM SIZE: 6.4 kW DC

DRAWING BY:
Jacob Pixton

PLOT DATE:
June 14, 2022

PROJECT NUMBER:
536095

SHEET NAME:
ELEC CALCS

REVISION: 0
PAGE NUMBER: PV6

STANDARD LABELS

WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

LABEL 1
FOR PV SYSTEM DISCONNECTING MEANS WHERE THE LINE AND LOAD TERMINALS MAY BE ENERGIZED IN THE OPEN POSITION. [NEC 690.13(B)]

PHOTOVOLTAIC SYSTEM AC DISCONNECT
RATED AC OUTPUT CURRENT 19.36 A
NOMINAL OPERATING AC VOLTAGE 240 V

LABEL 2
SHALL BE MARKED AT AN ACCESSIBLE LOCATION AT THE DISCONNECTING MEANS AS A POWER SOURCE AND WITH THE RATED AC OUTPUT CURRENT AND THE NOMINAL OPERATING AC VOLTAGE. [NEC 690.54]

WARNING
DUAL POWER SUPPLY
SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

LABEL 3
IF INTERCONNECTING LOAD SIDE, INSTALL THIS LABEL ANYWHERE THAT IS POWERED BY BOTH THE UTILITY AND THE SOLAR PV SYSTEM, IE. MAIN SERVICE PANEL AND SUBPANELS. [NEC 705.12(B)(3)]

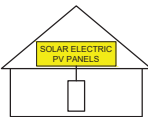
WARNING
POWER SOURCE OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL 4
APPLY TO THE DISTRIBUTION EQUIPMENT ADJACENT TO THE BACK-FED BREAKER FROM THE POWER SOURCE. [NEC 705.12(B)(2)]

WARNING
THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE, SHALL NOT EXCEED AMPACITY OF BUSBAR.

LABEL 5
APPLY TO THE PV COMBINER BOX [NEC 705.12 (3)(3)]

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



LABEL 6
BUILDINGS WITH PV SYSTEMS SHALL HAVE A PERMANENT LABEL LOCATED AT EACH SERVICE EQUIPMENT LOCATION TO WHICH THE PV SYSTEMS ARE CONNECTED OR AT AN APPROVED READILY VISIBLE LOCATION AND SHALL INDICATE THE LOCATION OF RAPID SHUTDOWN INITIATION DEVICES. [NEC 690.56(C)]

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 7
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH [NEC 690.56(C)(2)]

ADDITIONAL LABELS

WARNING
MAIN DISTRIBUTION UTILITY DISCONNECT(S)
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM A ROOF MOUNTED SOLAR ARRAY WITH A RAPID SHUTDOWN DISCONNECTING MEANS GROUPED AND LABELED WITHIN LINE OF SIGHT AND 10 FT OF THIS LOCATION

LABEL 8
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. [2017 NEC 705.10]

WARNING
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM MAIN DISTRIBUTION UTILITY DISCONNECT LOCATED

LABEL 9
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. [2017 NEC 705.10]

WARNING
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM A ROOF MOUNTED SOLAR ARRAY. SOLAR ARRAY RAPID SHUTDOWN DISCONNECT IS LOCATED OUTSIDE NEXT TO THE UTILITY METER.

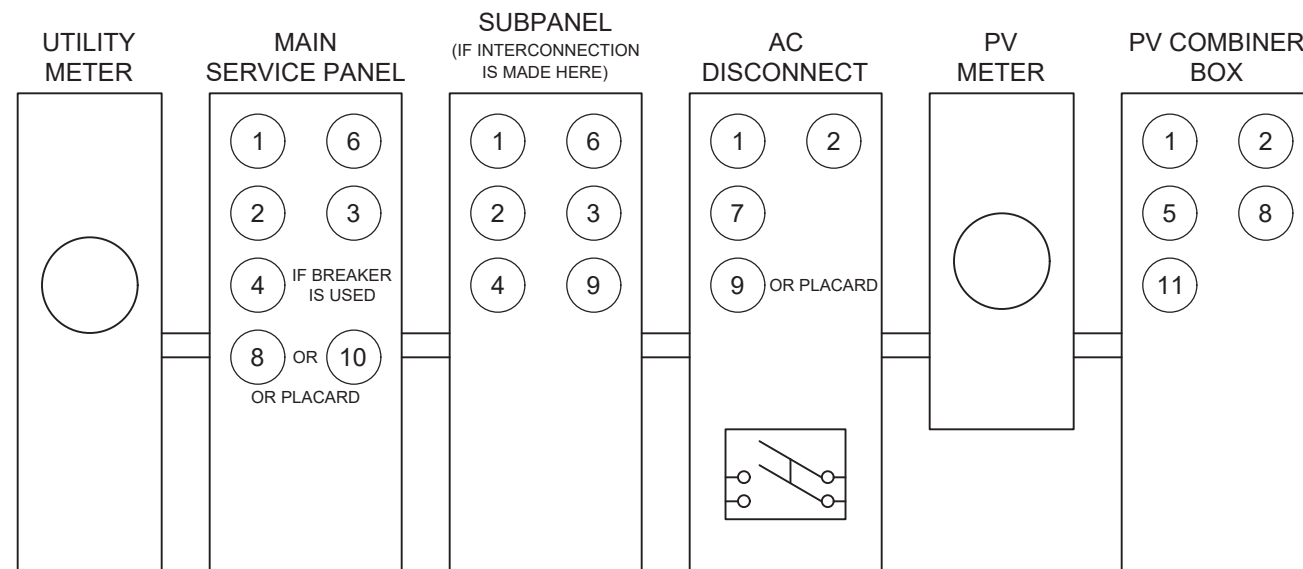
LABEL 10
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT DENOTING THE LOCATION OF THE RAPID SHUTDOWN SYSTEM DISCONNECTING MEANS IF SOLAR ARRAY RAPID SHUTDOWN DISCONNECTING SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [2017 NEC 705.10 AND 690.56(C)(1)]

WARNING
PHOTOVOLTAIC SYSTEM COMBINER PANEL
DO NOT ADD LOADS

LABEL 11
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT AC COMBINER PANEL. [NEC 110.21(B)]

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL 12
AT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS. [NEC 690.31(G)(3&4)]



LABELING NOTES

- 1) LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
- 2) LABELING REQUIREMENTS BASED ON THE 2017 & 2020 NEC CODE, OSHA STANDARD 19010.145, ANSIZ535.
- 3) MATERIAL BASED ON THE REQUIREMENTS OF THE AHJ.
- 4) LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AND SHALL NOT BE HANDWRITTEN [NEC 110.21]

*ELECTRICAL DIAGRAM SHOWN ABOVE IS FOR LABELING PURPOSES ONLY. NOT AN ACTUAL REPRESENTATION OF EQUIPMENT AND CONNECTIONS TO BE INSTALLED. LABEL LOCATIONS PRESENTED MAY VARY DEPENDING ON TYPE OF INTERCONNECTION METHOD AND LOCATION PRESENTED ON 3 LINE DIAGRAM. 3 LINE DIAGRAM ON PV5 TO REFLECT ACTUAL REPRESENTATION OF PROPOSED SCOPE OF WORK.



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LABELS

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PV7

Enphase IQ 7 and IQ 7+ Microinverters

The high-powered smart grid-ready **Enphase IQ 7 Micro™** and **Enphase IQ 7+ Micro™** dramatically simplify the installation process while achieving the highest system efficiency.

Part of the Enphase IQ System, the IQ 7 and IQ 7+ Microinverters integrate with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.

Easy to Install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014 & 2017)

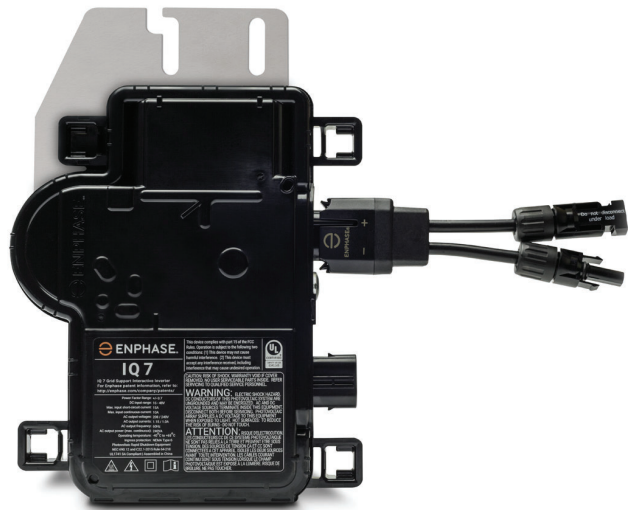
Productive and Reliable

- Optimized for high powered 60-cell/120 half-cell and 72-cell/144 half-cell* modules
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

Smart Grid Ready

- Complies with advanced grid support, voltage and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA)

* The IQ 7+ Micro is required to support 72-cell/144 half-cell modules.



Enphase IQ 7 and IQ 7+ Microinverters

| INPUT DATA (DC) | IQ7-60-2-US | | IQ7PLUS-72-2-US | |
|--|--|----------------------|--|----------------------|
| Commonly used module pairings ¹ | 235 W - 350 W + | | 235 W - 440 W + | |
| Module compatibility | 60-cell/120 half-cell PV modules only | | 60-cell/120 half-cell and 72-cell/144 half-cell PV modules | |
| Maximum input DC voltage | 48 V | | 60 V | |
| Peak power tracking voltage | 27 V - 37 V | | 27 V - 45 V | |
| Operating range | 16 V - 48 V | | 16 V - 60 V | |
| Min/Max start voltage | 22 V / 48 V | | 22 V / 60 V | |
| Max DC short circuit current (module Isc) | 15 A | | 15 A | |
| Overvoltage class DC port | II | | II | |
| DC port backfeed current | 0 A | | 0 A | |
| PV array configuration | 1 x 1 ungrounded array; No additional DC side protection required; | | AC side protection requires max 20 A per branch circuit | |
| OUTPUT DATA (AC) | IQ 7 Microinverter | | IQ 7+ Microinverter | |
| Peak output power | 250 VA | | 295 VA | |
| Maximum continuous output power | 240 VA | | 290 VA | |
| Nominal (L-L) voltage/range ² | 240 V / 211-264 V | 208 V / 183-229 V | 240 V / 211-264 V | 208 V / 183-229 V |
| Maximum continuous output current | 1.0 A (240 V) | 1.15 A (208 V) | 1.21 A (240 V) | 1.39 A (208 V) |
| Nominal frequency | 60 Hz | | 60 Hz | |
| Extended frequency range | 47 - 68 Hz | | 47 - 68 Hz | |
| AC short circuit fault current over 3 cycles | 5.8 Arms | | 5.8 Arms | |
| Maximum units per 20 A (L-L) branch circuit ³ | 16 (240 VAC) | 13 (208 VAC) | 13 (240 VAC) | 11 (208 VAC) |
| Overvoltage class AC port | III | | III | |
| AC port backfeed current | 18 mA | | 18 mA | |
| Power factor setting | 1.0 | | 1.0 | |
| Power factor (adjustable) | 0.85 leading ... 0.85 lagging | | 0.85 leading ... 0.85 lagging | |
| EFFICIENCY | @240 V | | @208 V | |
| Peak efficiency | 97.6 % | | 97.6 % | |
| CEC weighted efficiency | 97.0 % | | 97.0 % | |
| MECHANICAL DATA | | | | |
| Ambient temperature range | -40°C to +65°C | | | |
| Relative humidity range | 4% to 100% (condensing) | | | |
| Connector type | MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter) | | | |
| Dimensions (HxWxD) | 212 mm x 175 mm x 30.2 mm (without bracket) | | | |
| Weight | 1.08 kg (2.38 lbs) | | | |
| Cooling | Natural convection - No fans | | | |
| Approved for wet locations | Yes | | | |
| Pollution degree | PD3 | | | |
| Enclosure | Class II double-insulated, corrosion resistant polymeric enclosure | | | |
| Environmental category / UV exposure rating | NEMA Type 6 / outdoor | | | |
| FEATURES | | | | |
| Communication | Power Line Communication (PLC) | | | |
| Monitoring | Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy. | | | |
| Disconnecting means | The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690. | | | |
| Compliance | CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions. | | | |

1. No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/en-us/support/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.



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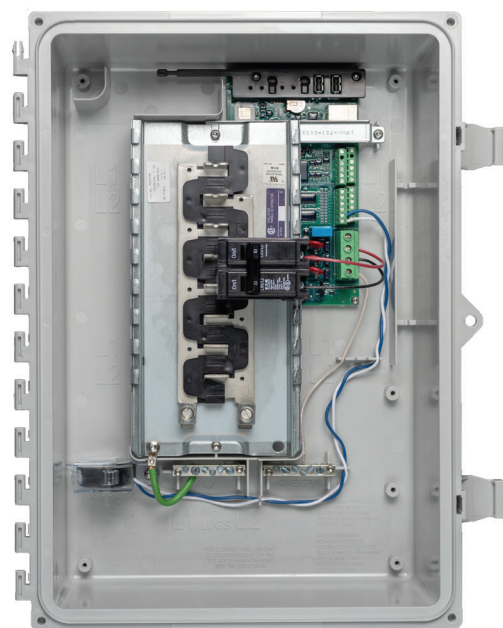
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REVISION

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Enphase IQ Combiner 3 (X-IQ-AM1-240-3)

The **Enphase IQ Combiner 3™** with Enphase IQ Envoy™ consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and Eaton BR series busbar assembly.



Smart

- Includes IQ Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and optional consumption monitoring

Simple

- Reduced size from previous combiner
- Centered mounting brackets support single stud mounting
- Supports back and side conduit entry
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- UL listed

Enphase IQ Combiner 3

| MODEL NUMBER | |
|--|---|
| IQ Combiner 3 X-IQ-AM1-240-3 | IQ Combiner 3 with Enphase IQ Envoy™ printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional* consumption monitoring (+/- 2.5%). |
| ACCESSORIES and REPLACEMENT PARTS (not included, order separately) | |
| Enphase Mobile Connect™ CELLMODEM-03 (4G/12-year data plan) CELLMODEM-01 (3G/5-year data plan) CELLMODEM-M1 (4G based LTE-M/5-year data plan) | Plug and play industrial grade cellular modem with data plan 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.) |
| Consumption Monitoring* CT CT-200-SPLIT | Split core current transformers enable whole home consumption metering (+/- 2.5%). |
| * Consumption monitoring is required for Enphase Storage Systems | |
| Wireless USB adapter COMMS-KIT-01 | Installed at the IQ Envoy. For communications with Enphase Encharge™ storage and Enphase Enpower™ smart switch. Includes USB cable for connection to IQ Envoy or Enphase IQ Combiner™ and allows redundant wireless communication with Encharge and Enpower. |
| Circuit Breakers BRK-10A-2-240 BRK-15A-2-240 BRK-20A-2P-240 | Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220 |
| EPLC-01 | Power line carrier (communication bridge pair), quantity - one pair |
| XA-PLUG-120-3 | Accessory receptacle for Power Line Carrier in IQ Combiner 3 (required for EPLC-01) |
| XA-ENV-PCBA-3 | Replacement IQ Envoy printed circuit board (PCB) for Combiner 3 |
| ELECTRICAL SPECIFICATIONS | |
| Rating | Continuous duty |
| System voltage | 120/240 VAC, 60 Hz |
| Eaton BR series busbar rating | 125 A |
| Max. continuous current rating (output to grid) | 65 A |
| Max. fuse/circuit rating (output) | 90 A |
| Branch circuits (solar and/or storage) | Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included) |
| Max. continuous current rating (input from PV) | 64 A |
| Max. total branch circuit breaker rating (input) | 80A of distributed generation / 90A with IQ Envoy breaker included |
| Production Metering CT | 200 A solid core pre-installed and wired to IQ Envoy |
| MECHANICAL DATA | |
| Dimensions (WxHxD) | 49.5 x 37.5 x 16.8 cm (19.5" x 14.75" 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° to 115° F) |
| Cooling | Natural convection, plus heat shield |
| Enclosure environmental rating | Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction |
| Wire sizes | <ul style="list-style-type: none"> • 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing. |
| Altitude | To 2000 meters (6,560 feet) |
| INTERNET CONNECTION OPTIONS | |
| Integrated Wi-Fi | 802.11b/g/n |
| Ethernet | Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included) |
| Cellular | Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G) or CELLMODEM-M1 (4G based LTE-M) (not included) |
| COMPLIANCE | |
| Compliance, Combiner | UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production) |
| Compliance, IQ Envoy | UL 60601-1/CANCSA 22.2 No. 61010-1 |

To learn more about Enphase offerings, visit enphase.com

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2019-11-04



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SHEET NAME
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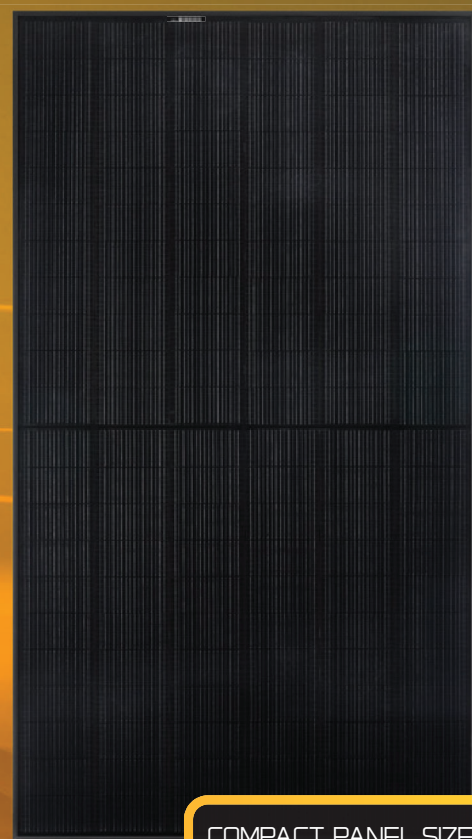
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SOLAR'S MOST TRUSTED



REC ALPHA[®] PURE SERIES PRODUCT SPECIFICATIONS



COMPACT PANEL SIZE

410 WP
222 W/M²

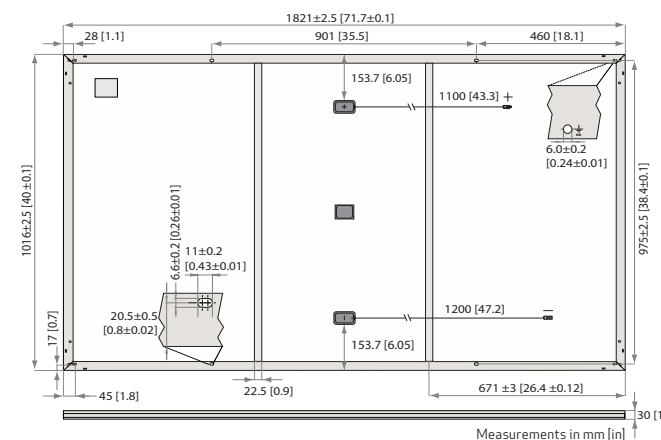


REC ALPHA PURE SERIES PRODUCT SPECIFICATIONS



GENERAL DATA

| | |
|---------------|---|
| Cell type: | 132 half-cut REC heterojunction cells with lead-free, gapless technology, 6 strings of 22 cells in series |
| Glass: | 3.2 mm solar glass with anti-reflective surface treatment in accordance with EN12150 |
| Backsheet: | Highly resistant polymer (black) |
| Frame: | Anodized aluminum (black) |
| Junction box: | 3-part, 3 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790 |
| Connectors: | Stäubli MC4 PV-KBT4/KST4 (4 mm ²) in accordance with IEC 62852, IP68 only when connected |
| Cable: | 4 mm ² solar cable, 1.1 m + 1.2 m in accordance with EN50618 |
| Dimensions: | 1821 x 1016 x 30 mm (1.85 m ²) |
| Weight: | 20.5 kg |
| Origin: | Made in Singapore |



ELECTRICAL DATA

Product Code: RECxxxAA Pure

STC

NMOT

| | 385 | 390 | 395 | 400 | 405 | 410 |
|--|-------|-------|-------|-------|-------|-------|
| Power Output - P _{MAX} (Wp) | 385 | 390 | 395 | 400 | 405 | 410 |
| Watt Class Sorting - (W) | 0/+5 | 0/+5 | 0/+5 | 0/+5 | 0/+5 | 0/+5 |
| Nominal Power Voltage - V _{MPP} (V) | 41.2 | 41.5 | 41.8 | 42.1 | 42.4 | 42.7 |
| Nominal Power Current - I _{MPP} (A) | 9.35 | 9.40 | 9.45 | 9.51 | 9.56 | 9.61 |
| Open Circuit Voltage - V _{OC} (V) | 48.5 | 48.6 | 48.7 | 48.8 | 48.9 | 49.0 |
| Short Circuit Current - I _{SC} (A) | 10.18 | 10.19 | 10.20 | 10.25 | 10.30 | 10.35 |
| Power Density (W/m ²) | 208 | 211 | 214 | 216 | 219 | 222 |
| Panel Efficiency (%) | 20.8 | 21.1 | 21.4 | 21.6 | 21.9 | 22.2 |
| Power Output - P _{MAX} (Wp) | 293 | 297 | 301 | 305 | 309 | 312 |
| Nominal Power Voltage - V _{MPP} (V) | 38.8 | 39.1 | 39.4 | 39.7 | 40.0 | 40.2 |
| Nominal Power Current - I _{MPP} (A) | 7.55 | 7.59 | 7.63 | 7.68 | 7.72 | 7.76 |
| Open Circuit Voltage - V _{OC} (V) | 45.7 | 45.8 | 45.9 | 46.0 | 46.1 | 46.2 |
| Short Circuit Current - I _{SC} (A) | 8.16 | 8.20 | 8.24 | 8.28 | 8.32 | 8.36 |

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 25°C) based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 20°C, windspeed 1 m/s). *Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS

| | |
|----------------------------|------------------------------------|
| Operational temperature: | -40 ... +85°C |
| Maximum system voltage: | 1000 V |
| Maximum test load (front): | +7000 Pa (713 kg/m ²)* |
| Maximum test load (rear): | -4000 Pa (407 kg/m ²)* |
| Max series fuse rating: | 25 A |
| Max reverse current: | 25 A |

*See installation manual for mounting instructions. Design load = Test load / 1.5 (safety factor)

WARRANTY

| | Standard | REC ProTrust |
|--|----------|------------------|
| Installed by an REC Certified Solar Professional | No | Yes |
| System Size | All | ≤25 kW 25-500 kW |
| Product Warranty (yrs) | 20 | 25 |
| Power Warranty (yrs) | 25 | 25 |
| Labor Warranty (yrs) | 0 | 25 |
| Power in Year 1 | 98% | 98% |
| Annual Degradation | 0.25% | 0.25% |
| Power in Year 25 | 92% | 92% |

See warranty documents for details. Conditions apply

CERTIFICATIONS

| |
|--|
| IEC 61215:2016, IEC 61730:2016, UL 61730 |
| IEC 62804 PID |
| IEC 61701 Salt Mist |
| IEC 62716 Ammonia Resistance |
| ISO 11925-2 Ignitability (Class E) |
| IEC 62782 Dynamic Mechanical Load |
| IEC 61215-2:2016 Hailstone (35mm) |
| IEC 62321 Lead-free acc. to RoHS EU 863/2015 |
| ISO 14001, ISO 9001, IEC 45001, IEC 62941 |



TEMPERATURE RATINGS*

| | |
|---|-------------|
| Nominal Module Operating Temperature: | 44°C (±2°C) |
| Temperature coefficient of P _{MAX} : | -0.26%/°C |
| Temperature coefficient of V _{OC} : | -0.24%/°C |
| Temperature coefficient of I _{SC} : | 0.04%/°C |

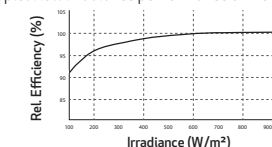
*The temperature coefficients stated are linear values

DELIVERY INFORMATION

| | |
|--|------------------|
| Panels per pallet: | 33 |
| Panels per 40 ft GP/high cube container: | 792 (24 pallets) |
| Panels per 13.6 m truck: | 924 (28 pallets) |
| Panels per 53 ft truck: | 891 (27 pallets) |

LOW LIGHT BEHAVIOUR

Typical low irradiance performance of module at STC:



Specifications subject to change without notice.

Ref: PM4-DS-12-06-Rev-E 11/21



www.recgroup.com



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PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

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Product data sheet
Characteristics

DU221RB
Safety switch, general duty, non fusible, 30A,
2 poles, 3 hp, 240 VAC, NEMA 3R, bolt-on
provision

Product availability : Stock - Normally stocked in distribution facility



Price* : 177.00 USD



Main

| | |
|---------------------------|---|
| Product | Single Throw Safety Switch |
| Current Rating | 30 A |
| Certifications | UL listed file E2875 |
| Enclosure Rating | NEMA 3R |
| Disconnect Type | Non-fusible disconnect switch |
| Factory Installed Neutral | None |
| Mounting Type | Surface |
| Number of Poles | 2 |
| Electrical Connection | Lugs |
| Duty Rating | General duty |
| Voltage Rating | 240 V AC |
| Wire Size | AWG 14...AWG 6 copper AWG 12...AWG 6 aluminium |

Complementary

| | |
|----------------------------|---|
| Short-circuit withstand | 200 kA |
| Maximum Horse Power Rating | 3 hp 240 V AC 60 Hz 1 phase NEC 430.52 |
| Tightening torque | 30 lbf.in (3.39 N.m) 0.00...0.02 in ² (2.08...13.3 mm ²) AWG 14...AWG 6) |
| Height | 9.63 in (244.60 mm) |
| Width | 7.75 in (196.85 mm) |
| Depth | 3.75 in (95.25 mm) |

Ordering and shipping details

| | |
|-----------------------|-----------------------------------|
| Category | 00106 - D & DU SW,NEMA3R, 30-200A |
| Discount Schedule | DE1A |
| GTIN | 00785901490340 |
| Nbr. of units in pkg. | 1 |
| Package weight(Lbs) | 4.65 lb(US) (2.11 kg) |
| Returnability | Yes |
| Country of origin | MX |

Packing Units

| | |
|------------------------------|----------------------------|
| Unit Type of Package 1 | PCE |
| Package 1 Height | 5.40 in (13.716 cm) |
| Package 1 width | 7.80 in (19.812 cm) |
| Package 1 Length | 9.90 in (25.146 cm) |
| Unit Type of Package 2 | CAR |
| Number of Units in Package 2 | 5 |
| Package 2 Weight | 24.60 lb(US) (11.158 kg) |
| Package 2 Height | 10.80 in (27.432 cm) |
| Package 2 width | 10.50 in (26.67 cm) |
| Package 2 Length | 23.80 in (60.452 cm) |
| Unit Type of Package 3 | PAL |
| Number of Units in Package 3 | 160 |
| Package 3 Weight | 814.00 lb(US) (369.224 kg) |
| Package 3 Height | 46.50 in (118.11 cm) |
| Package 3 width | 40.00 in (101.6 cm) |
| Package 3 Length | 48.00 in (121.92 cm) |

Offer Sustainability

| | |
|----------------------------|---|
| Sustainable offer status | Green Premium product |
| California proposition 65 | WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov |
| REACH Regulation | REACH Declaration |
| REACH free of SVHC | Yes |
| EU RoHS Directive | Compliant EU RoHS Declaration |
| Toxic heavy metal free | Yes |
| Mercury free | Yes |
| RoHS exemption information | Yes |
| China RoHS Regulation | China RoHS declaration Pro-active China RoHS declaration (out of China RoHS legal scope) |
| Environmental Disclosure | Product Environmental Profile |
| PVC free | Yes |

Contractual warranty

| | |
|----------|-----------|
| Warranty | 18 months |
|----------|-----------|

* Price is "List Price" and may be subject to a trade discount – check with your local distributor or retailer for actual price.

Disclaimer: This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications



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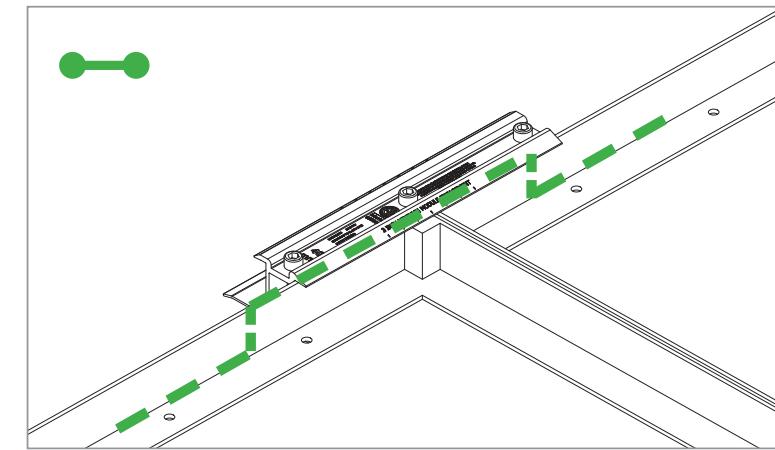
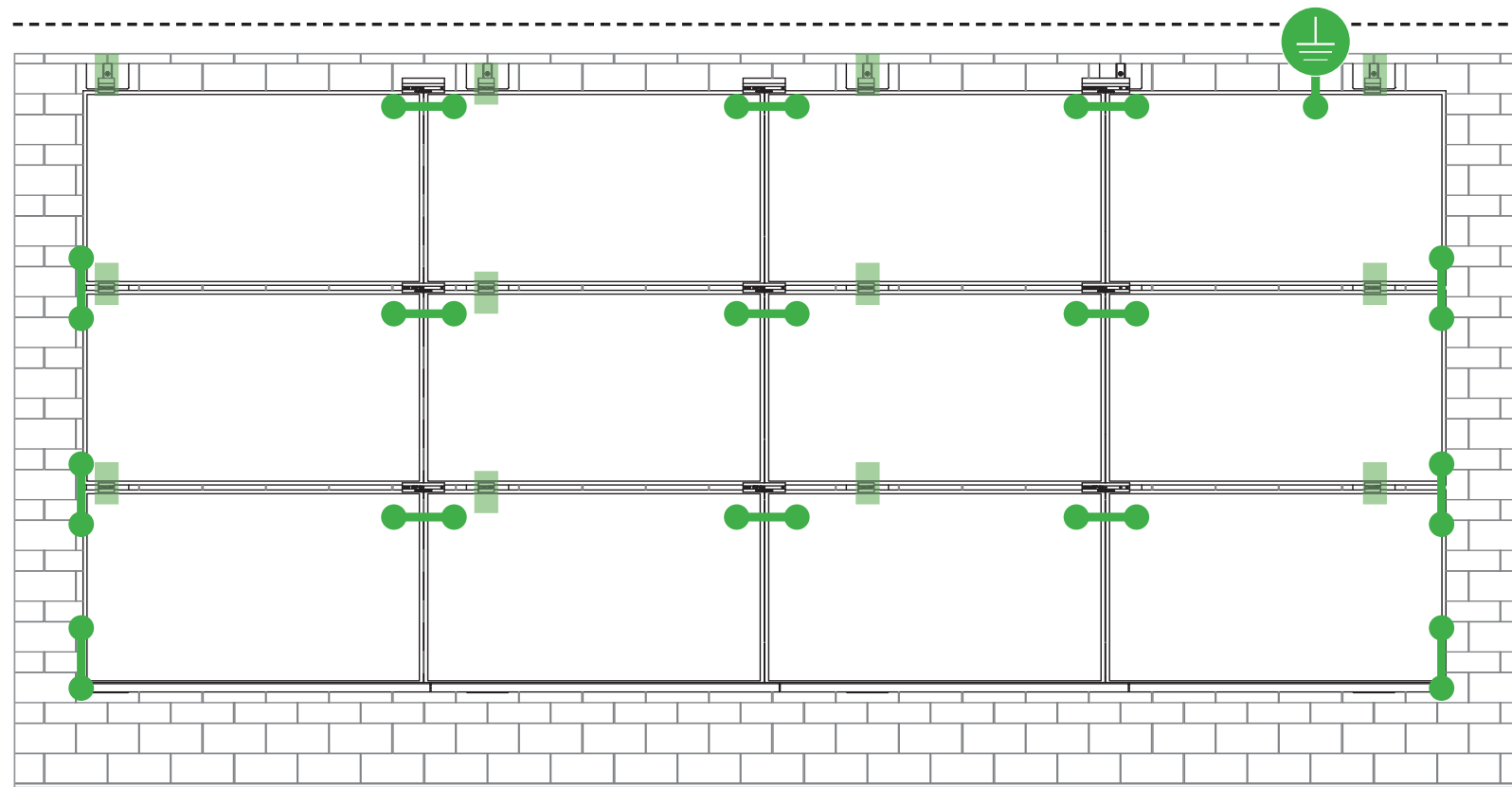
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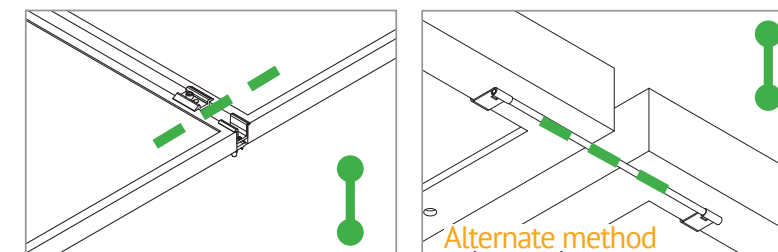
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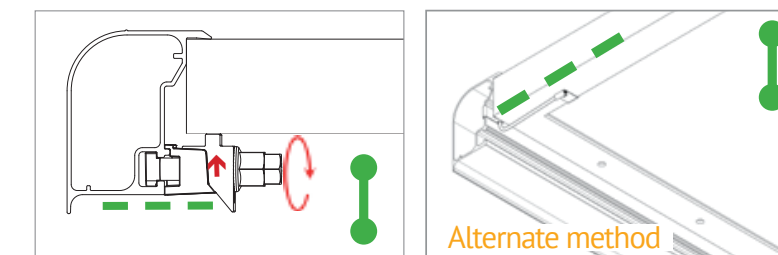
E-W BONDING PATH:

E-W module to module bonding is accomplished with 2 pre-installed bonding pins which engage on the secure side of the Microrail™ and splice.



N-S BONDING PATH:

N-S module to module bonding is accomplished with bonding clamp with 2 integral bonding pins. (refer also to alternate method)



TRIMRAIL BONDING PATH:

Trimrail to module bonding is accomplished with bonding clamp with integral bonding pin and bonding T-bolt. (refer also to alternate method)

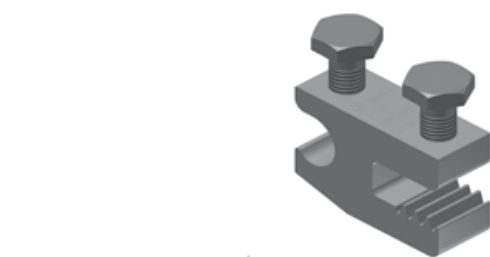
Star Washer is Single Use Only



TERMINAL TORQUE,
Install Conductor and torque to the following:
4-6 AWG: 35in-lbs
8 AWG: 25 in-lbs
10-14 AWG: 20 in-lbs

LUG DETAIL & TORQUE INFO IlSCO Lay-In Lug (GBL-4DBT)

- 10-32 mounting hardware
- Torque = 5 ft-lb
- AWG 4-14- Solid or Stranded

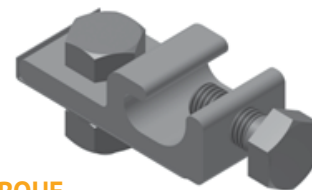


TERMINAL TORQUE,
Install Conductor and torque to the following:
4-14 AWG: 35in-lbs

LUG DETAIL & TORQUE INFO IlSCO Flange Lug(SGB-4)

- 1/4" mounting hardware
- Torque = 75 in-lb
- AWG 4-14- Solid or Stranded

WEEBLUG Single Use Only



TERMINAL TORQUE,
Install Conductor and torque to the following:
6-14 AWG: 7ft-lbs

LUG DETAIL & TORQUE INFO Wiley WEEBLug (6.7)

- 1/4" mounting hardware
- Torque = 10 ft-lb
- AWG 6-14- Solid or Stranded

NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

System bonding is accomplished through modules. System grounding accomplished by attaching a ground lug to any module at a location on the module specified by the module manufacturer.

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UL CODE COMPLIANCE NOTES

INSTALLATION GUIDE

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SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SUNFRAME MICRORAIL (SFM) Installation Guide. SFM has been classified to the system level fire portion of UL 1703. This UL 1703 classification has been incorporated into the UL 2703 product certification. SFM has achieved Class A, B & C system level performance for low slope & steep sloped roofs when used in conjunction with type 1 and type 2 modules. Class A, B & C system level fire

performance is inherent in the SFM design, and no additional mitigation measures are required. The fire classification rating is valid for any roof pitch. There is no required minimum or maximum height limitation above the roof deck to maintain the Class A, B & C fire rating for SFM. SUNFRAME MICRORAIL™ components shall be mounted over a fire resistant roof covering rated for the application.

| Module Type | Roof Slope | System Level Fire Rating | Microrail Direction | Module Orientation | Mitigation Required |
|-------------------|-------------------------|--------------------------|---------------------|-----------------------|---------------------|
| Type 1 and Type 2 | Steep Slope & Low Slope | Class A, B & C | East-West | Landscape OR Portrait | None Required |

UL2703 TEST MODULES

See pages V and W for a list of modules that were electrically and mechanically tested or qualified with the SUNFRAME MICRORAIL (SFM) components outlined within this Installation Guide.

- Maximum Area of Module = 27.76 sqft
- UL2703 Design Load Ratings:
 - a) Downward Pressure – 113 PSF / 5400 Pa
 - b) Upward Pressure – 50 PSF / 2400 Pa
 - c) Down-Slope Load – 21.6 PSF / 1034 Pa
- Tested Loads:
 - a) Downward Pressure – 170 PSF / 8000 Pa
 - b) Upward Pressure – 75 PSF / 3500 Pa
 - c) Down-Slope Load – 32.4 PSF / 1550 Pa
- Maximum Span = 6ft
- Use with a maximum over current protection device OCPD of 30A
- System conforms to UL Std 2703, certified to LTR AE-001-2012
- Rated for a design load of 2400 Pa / 5400 Pa with 24 inch span
- PV modules may have a reduced load rating, independent of the SFM load rating. Please consult the PV module manufacturer's installation guide for more information
- Down-Slope design load rating of 30 PSF/ 1400 Pa for module areas of 22.3 sq ft or less



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PV INSTALLATION PROFESSIONAL
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| Manufacture | Module Model / Series |
|---------------------|---|
| Aleo | P-Series |
| Astronergy | CHSM6612P, CHSM6612P/HV, CHSM6612M, CHSM6612M/HV, CHSM6610M (BL)(BF)/(HF), CHSM72M-HC |
| Auxin | AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T |
| Axitec | AXIblackpremium 60 (35mm), AXIpower 60 (35mm), AXIpower 72 (40mm), AXIpremium 60 (35mm), AXIpremium 72 (40mm). |
| Aptos | DNA-120-(BF/MF)26 DNA-144-(BF/MF)26 |
| Boviet | BVM6610, BVM6612 |
| BYD | P6K & MHK-36 Series |
| Canadian Solar | CS1(H/K/U/Y)-MS CS3(K/L/U), CS3K-MB-AG, CS3K-(MS/P) CS3N-MS, CS3U-MB-AG, CS3U-(MS/P), CS3W CS5A-M, CS6(K/U), CS6K-(M/P), CS6K-MS CS6P-(M/P), CS6U-(M/P), CS6V-M, CS6X-P |
| Centrosolar America | C-Series & E-Series |
| CertainTeed | CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04 |
| Dehui | DH-60M |

| Manufacture | Module Model / Series |
|-------------|---|
| Eco Solargy | Orion 1000 & Apollo 1000 |
| ET Solar | ET-M672BHxxxTW |
| FreeVolt | Mono PERC |
| GCL | GCL-P6 & GCL-M6 Series |
| Hansol | TD-AN3, TD-AN4, UB-AN1, UD-AN1 |
| Heliene | 36M, 60M, 60P, 72M & 72P Series |
| HT Solar | HT60-156(M) (NDV) (-F), HT 72-156(M/P) |
| Hyundai | KG, MG, TG, RI, RG, TI, MI, HI & KI Series HiA-SxxxHG |
| ITEK | iT, iT-HE & iT-SE Series |
| Japan Solar | JPS-60 & JPS-72 Series |
| JA Solar | JAP6 60-xxx, JAM6-60-xxx/SI, JAM6(K)-60/ xxx, JAP6(k)-72-xxx/4BB, JAP72SY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP60SY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM72SY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM60SY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HiT, IB, MW, MR |
| Jinko | JKM & JKMS Series Eagle JKMxxxM JKMxxxM-72HL-V |
| Kyocera | KU Series |

| Manufacture | Module Model / Series |
|----------------|--|
| LG Electronics | LGxxxN2T-A4 LGxxx(A1C/E1C/E1K/N1C/N1K/N2T/N2W/ Q1C/Q1K/S1C/S2W)-A5 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/ QAC/QAK)-A6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(N1C/Q1C/Q1K)-N5 LGxxx (N1C/N1K/N2W/Q1C/Q1K)-V5 |
| | LR4-60(HIB/HIH/HPB/HPH)-xxxM LR4-72(HIH/HPH)-xxxM LR6-60(BP/HBD/HIBD)-xxxM (30mm) LR6-60(BK)(PE)(HPB)(HPH)-xxxM (35mm) LR6-60(BK)(PE)(PB)(PH)-xxxM (40mm) LR6-72(BP)(HBD)(HIBD)-xxxM (30mm) LR6-72(HV)(BK)(PE)(PH)(PB)(HPH)-xxxM (35mm) LR6-72(BK)(HV)(PE)(PB)(PH)-xxxM (40mm) |
| | Mission Solar Energy MSE Series |
| | Mitsubishi MJE & MLE Series |
| | Neo Solar Power Co. D6M & D6P Series |

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- Please see the SFM UL2703Construction Data Report at Unirac.com to ensure the exact solar module selected is approved for use with SFM
- SFM Infinity is not compatible with module frame height of less than 30mm and more than 40mm. See Module Mounting section, page L for further information

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| Manufacture | Module Model / Series |
|-------------|---|
| Panasonic | VBHNxxxSA15 & SA16, VBHNxxxSA17 & SA18, VBHNxxxSA17(E/G) & SA18E, VBHNxxxKA01 & KA03 & KA04, VBHNxxxZA01, VBHNxxxZA02, VBHNxxxZA03, VBHNxxxZA04 |
| Peimar | SGxxxM (FB/BF) |
| Phono Solar | PS-60, PS-72 |
| Prism Solar | P72 Series |
| Q.Cells | Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7 Q.PEAK DUO BLK-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G8(+) Q.PEAK DUO L-G8.3/BFF Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-G9/G9.2/G9.3 Q.PEAK DUO (BLK) ML-G10(+) Q.PEAK DUO XL-G(10/10.2/10.3/10.c/10.d) |
| REC | Alpha (72) (Black) (Pure) N-Peak (Black) N-Peak 2 (Black) PEAK Energy Series PEAK Energy BLK2 Series PEAK Energy 72 Series |

| Manufacture | Module Model / Series |
|------------------------|---|
| REC (cont.) | TwinPeak Series TwinPeak 2 Series TwinPeak 2 BLK2 Series TwinPeak 2S(M)72(XV) TwinPeak 3 Series (38mm) TP4 (Black) |
| Rezosola | Vitrus2 Series & 156 Series |
| Risen | RSM72-6 (MDG) (M), RSM60-6 |
| S-Energy | SN72 & SN60 Series (40mm) |
| Seraphim | SEG-6 & SRP-6 Series |
| Sharp | NU-SA & NU-SC Series |
| Silfab | SLA, SLG, BC Series & SILxxx(BL/NL/NT/HL/ML/BK/NX/NU/HC) |
| Solaria | PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) |
| SolarWorld | Sunmodule Protect, Sunmodule Plus |
| Sonali | SS 230 - 265 |
| Suntech | STP |
| Suniva | MV Series & Optimus Series |
| Sun Edison/Flextronics | F-Series, R-Series & FLEX FXS Series |
| SunPower | X-Series, E-Series & P-Series |
| Talesun | TP572, TP596, TP654, TP660, TP672, Hipor M, Smart |

| Manufacture | Module Model / Series |
|-------------|--|
| Tesla | SC, SC B, SC B1, SC B2 TxxxS |
| Trina | PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE09.05, DE14, DE15, PE15H |
| Upsolar | UP-MxxxP(-B), UP-MxxxM(-B) |
| URE | D7MxxxH7A, D7(M/K)xxxH8A FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB) |
| Vikram | Eldora, Solivo, Somera |
| Waaree | AC & Adiya Series |
| Winaico | WST & WSP Series |
| Yingli | YGE & YLM Series |
| ZN Shine | ZXM6-72 |

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AUTHORIZATION TO MARK

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Country: USA
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Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

| | |
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| Standard(s): | Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019] PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020] |
| Product: | Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29 |
| Brand Name: | Unirac |
| Models: | Unirac SFM |

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| Product: | Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29 |
| Brand Name: | Unirac |
| Models: | Unirac SFM |

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Scott Gurney
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| Product: | Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29 |
| Brand Name: | Unirac |
| Models: | Unirac SFM |

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Country: USA
Party Authorized To Apply Mark: Same as Manufacturer
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| Product: | Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29 |
| Brand Name: | Unirac |
| Models: | Unirac SFM |

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| 1.0 Reference and Address | | |
|---------------------------|--|--|
| Report Number | 102393982LAX-002 | Original 11-Apr-2016 Revised: 2-Jan-2022 |
| Standard(s) | Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019] PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020] | |
| Applicant | Unirac, Inc | Manufacturer 2 |
| Address | 1411 Broadway Blvd NE Albuquerque, NM 87102 | Address |
| Country | USA | Country |
| Contact | Klaus Nicolaedis Todd Ganshaw | Contact |
| Phone | 505-462-2190 505-843-1418 | Phone |
| FAX | NA | FAX |
| Email | klaus.nicolaedis@unirac.com toddg@unirac.com | Email |
| Manufacturer 3 | Manufacturer 4 | |
| Address | Address | |
| Country | Country | |
| Contact | Contact | |
| Phone | Phone | |
| FAX | FAX | |
| Email | Email | |
| Manufacturer 5 | | |
| Address | | |
| Country | | |
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| 1.0 Reference and Address | | | |
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| Report Number | 102393982LAX-002 | Original 11-Apr-2016 | Revised: 2-Jan-2022 |
| Email | | | |

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| 2.0 Product Description | |
|-------------------------|--|
| Product | Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29 |
| Brand name | Unirac |
| Description | <p>The product covered by this report is the Sun Frame Micro Rail roof mounted Photovoltaic Rack Mounting System. This system is designed to provide bonding and grounding to photovoltaic modules. The mounting system employs anodized or mill finish aluminum brackets that are roof mounted using the slider, outlined in section 4 of this report. There are no rails within this product, whereas the 3" Micro Rail, Floating Splice, and 9" Attached Splice electrically bond the modules together forming the path to ground.</p> |
| | <p>The Micro Rails are installed onto the module frame by using a stainless steel bolt anodized with black oxide with a stainless type 300 bonding pin, torqued to 20 ft-lbs, retaining the modules to the bracket. The bonding pin of the Micro Rail when bolted and torqued, penetrate the anodized coating of the photovoltaic module frame (at bottom flange) to contact the metal, creating a bonded connection from module to module.</p> |
| | <p>The grounding of the entire system is intended to be in accordance with the latest edition of the National Electrical Code, including NEC 250: Grounding and Bonding, and NEC 690: Solar Photovoltaic Systems or the Canadian Electrical Code, CSA C22.1 Part 1 in accordance to the revision in effect in the jurisdiction in which the project resides. Any local electrical codes must be adhered in addition to the national electrical codes. The Grounding Lug is secured to the photovoltaic module, torqued in accordance with the installation manual provided in this document.</p> <p>Other optional grounding includes the use of the Enphase UL2703 certified grounding system, which requires a minimum of 2 micro-inverters mounted to the same rail, and using the same engage cable.</p> |

| 2.0 Product Description | |
|-------------------------|---|
| Models | Unirac SFM |
| Model Similarity | NA |
| Ratings | <p>Fuse Rating: 30A</p> <p>Module Orientation: Portrait or Landscape Maximum Module Size: 17.98 ft² UL2703 Design Load Rating: 33 PSF Downward, 33 PSF Upward, 10 PSF Down-Slope Tested Loads - 50 psf/2400Pa Downward, 50psf/2400Pa Uplift, 15psf/720Pa Down Slope Trina TSM-255PD05.08 and Sunpower SPR-E20-327 used for Mechanical Loading</p> <p>Increased size ML test: Maximum Module Size: 22.3 ft² UL2703 Design Load Rating: 113 PSF Downward, 50 PSF Upward, 30 PSF Down-Slope LG355S2W-A5 used for Mechanical Loading test. Mounting configuration: Four mountings on each long side of panel with the longest span of 24" UL2703 Design Load Rating: 46.9 PSF Downward, 40 PSF Upward, 10 PSF Down-Slope LG395N2W-A5, LG360S2W-A5 and LG355S2W-A5 used for used for Mechanical Loading test. Mounting configuration: Six mountings for two modules used with the maximum span of 74.5" IEC 61646 Test Loads - 112.78 psf/5400Pa Downward, 50psf/2400Pa Uplift</p> |
| | <p>Mechanical Load test to add FlashLoc Slider and Trim Assemblies to UL2703 and IEC 61646 Certifications, & Increase SFM System UL2703 Module Size: Maximum Module Size: 27.76 ft² UL2703 Design Load Rating: 113 PSF Downward, 50 PSF Upward, 21.6 PSF Down-Slope Jinko Eagle 72HM G5 used for Mechanical Loading test. Mounting configuration: Four mountings on each long side of panel with the longest span of 24" Maximum module size: 21.86 ft² IEC 61646 Test Loads - 112.78 psf/5400Pa Downward, 75psf/3600Pa Uplift SunPower model SPR-A430-COM-MLSD used for Mechanical Loading</p> |
| | <p>Fire Class Resistance Rating: - Class A for Steep Slope Applications when using Type 1 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A for Steep Slope Applications when using Type 2 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A Fire Rated for Low Slope applications with Type 1 or 2 listed photovoltaic modules. This system was evaluated with a 5" gap between the bottom of the module and the roof's surface</p> <p>See section 7.0 illustrations # 1, 1a, 1b, and 1c for a complete list of PV modules evaluated with these racking systems</p> |
| Other Ratings | NA |



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7.0 Illustrations

Illustration 1 - Approved PV Modules

| Manufacture | Module Model / Series | Manufacture | Module Model / Series |
|---------------------|---|-------------|--|
| Aleo | P-Series | Eco Solargy | Orion 1000 & Apollo 1000 |
| Astronergy | CH5M6612P, CH5M6612P/HV, CH5M6612M, CH5M6612M/HV, CH5M6610M (BL)(BF)/(HF), CH5M72M-HC | ET Solar | ET-M672BHxxxTW |
| Auxin | AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T | FreeVolt | Mono PERC |
| Axitec | AXIblackpremium 60 (35mm), AXIpower 60 (35mm), AXIpower 72 (40mm), AXIpremium 60 (35mm), AXIpremium 72 (40mm). | GCL | GCL-P6 & GCL-M6 Series |
| Aptos | DNA-120-(BF/MF)26 DNA-144-(BF/MF)26 | Hansol | TD-AN3, TD-AN4, UB-AN1, UD-AN1 |
| Boviet | BVM6610, BVM6612 | Heliene | 36M, 60M, 60P, 72M & 72P Series |
| BYD | P6K & MHK-36 Series | HT Solar | HT60-156(M) (NDV) (-F), HT 72-156(M/P) |
| Canadian Solar | CS1(H/K/U/Y)-MS CS3(K/L/U), CS3K-MB-AG, CS3K-(MS/P) CS3N-MS, CS3U-MB-AG, CS3U-(MS/P), CS3W CS5A-M, CS6(K/U), CS6K-(M/P), CS6K-MS CS6P-(M/P), CS6U-(M/P), CS6V-M, CS6X-P | Hyundai | KG, MG, TG, RI, RG, TI, MI, HI & KI Series HiA-SxxxHG |
| Centrosolar America | C-Series & E-Series | ITEK | IT, IT-HE & IT-SE Series |
| CertainTeed | CT2xxMxx-01, CT2xxPxx-01, CTxxMxx-02, CTxxM-03, CTxxMxx-04, CTxxHC11-04 | Japan Solar | JPS-60 & JPS-72 Series |
| Dehui | DH-60M | JA Solar | JAP6 60-xxx, JAM6-60-xxx/5I, JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB, JAP725YY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP605YY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM725YY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM605YY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HIT, IB, MW, MR |
| | | Jinko | JKM & JKMS Series Eagle JKMxxxM JKMxxxM-72HL-V |
| | | Kyocera | KU Series |

7.0 Illustrations

Illustration 1a - Approved PV Modules Continue

| Manufacture | Module Model / Series | Manufacture | Module Model / Series |
|----------------------|--|-------------|---|
| LG Electronics | LGxxxN2T-A4 LGxxx(A1C/E1C/E1K/N1C/N1K/N2T/N2W/Q1C/Q1K/S1C/S2W)-A5 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(N1C/Q1C/Q1K)-N5 LGxxx (N1C/N1K/N2W/Q1C/Q1K)-V5 | Panasonic | VBHNxxxSA15 & SA16, VBHNxxxSA17 & SA18, VBHNxxxSA17(E/G) & SA18E, VBHNxxxKA01 & KA03 & KA04, VBHNxxxZA01, VBHNxxxZA02, VBHNxxxZA03, VBHNxxxZA04 |
| | | Peimar | SGxxxM (FB/BF) |
| | | Phono Solar | PS-60, PS-72 |
| | | Prism Solar | P72 Series |
| LONGi | LR4-60(HIB/HIH/HPB/HPH)-xxxM LR4-72(HIH/HPH)-xxxM LR6-60(BP/HBD/HIBD)-xxxM (30mm) LR6-60(BK)(PE)(HPB)(HPH)-xxxM (35mm) LR6-60(BK)(PE)(PB)(PH)-xxxM (40mm) LR6-72(BP)(HBD)(HIBD)-xxxM (30mm) LR6-72(HV)(BK)(PE)(PH)(HPH)-xxxM (35mm) LR6-72(BK)(HV)(PE)(PB)(PH)-xxxM (40mm) | Q.Cells | Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7 Q.PEAK DUO BLK-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G8(+) Q.PEAK DUO L-G8.3/BFF Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-G9/G9.2/G9.3 Q.PEAK DUO (BLK) ML-G10(+) Q.PEAK DUO XL-G(10/10.2/10.3/10.c/10.d) |
| Mission Solar Energy | MSE Series | REC | Alpha (72) (Black) (Pure) N-Peak (Black) N-Peak 2 (Black) PEAK Energy Series PEAK Energy BLK2 Series PEAK Energy 72 Series |
| Mitsubishi | MJE & MLE Series | | |
| Neo Solar Power Co. | D6M & D6P Series | | |



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7.0 Illustrations

Illustration 1b - Approved PV Modules Continue

| Manufacture | Module Model / Series | Manufacture | Module Model / Series |
|------------------------|---|-------------|--|
| REC (cont.) | TwinPeak Series TwinPeak 2 Series TwinPeak 2 BLK2 Series TwinPeak 2S(M)72(XV) TwinPeak 3 Series (38mm) TP4 (Black) | Tesla | SC, SC B, SC B1, SC B2 Txxx5 |
| Renesola | Vitrus2 Series & 156 Series | Trina | PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE09.05, DE14, DE15, PE15H |
| Risen | RSM72-6 (MDG) (M), RSM60-6 | Upsolar | UP-MxxxP(-B), UP-MxxxM(-B) |
| S-Energy | SN72 & SN60 Series (40mm) | URE | D7MxxxH7A, D7(M/K)xxxH8A FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB) |
| Seraphim | SEG-6 & SRP-6 Series | Vikram | Eldora, Solivo, Somera |
| Sharp | NU-SA & NU-SC Series | Waaree | AC & Adiya Series |
| Silfab | SLA, SLG, BC Series & SILxxx(BL/NL/NT/HL/ ML/BK/NX/NU/HC) | Winaico | WST & WSP Series |
| Solaria | PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) | Yingli | YGE & YLM Series |
| SolarWorld | Sunmodule Protect, Sunmodule Plus | ZN Shine | ZXM6-72 |
| Sonali | SS 230 - 265 | | |
| Suntech | STP | | |
| Suniva | MV Series & Optimus Series | | |
| Sun Edison/Flextronics | F-Series, R-Series & FLEX FX5 Series | | |
| SunPower | X-Series, E-Series & P-Series | | |
| Talesun | TP572, TP596, TP654, TP660, TP672, Hipor M, Smart | | |



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IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



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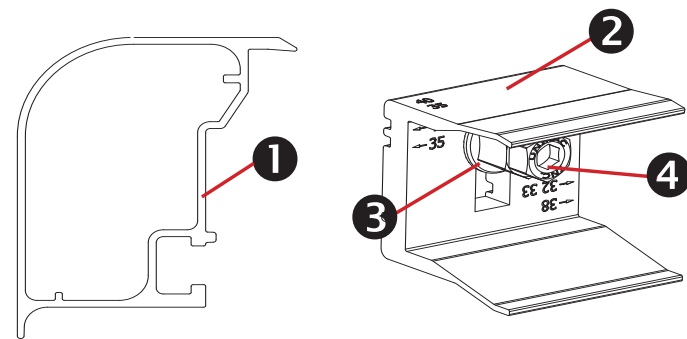
DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:
SPEC SHEET

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Trimrail™ and Module Clips

Sub-Components:

1. Trim Rail
2. Module Clip
3. T-Bolt
4. Tri-Drive Nut

Trimrail™

Functions:

- Required front row structural support (with module clips)
- Module mounting
- Installation aid
- Aesthetic trim

Features:

- Mounts directly to L-feet
- Aligns and captures module leading edge
 - Supports discrete module thicknesses from 32, 33, 35, 38, and 40mm

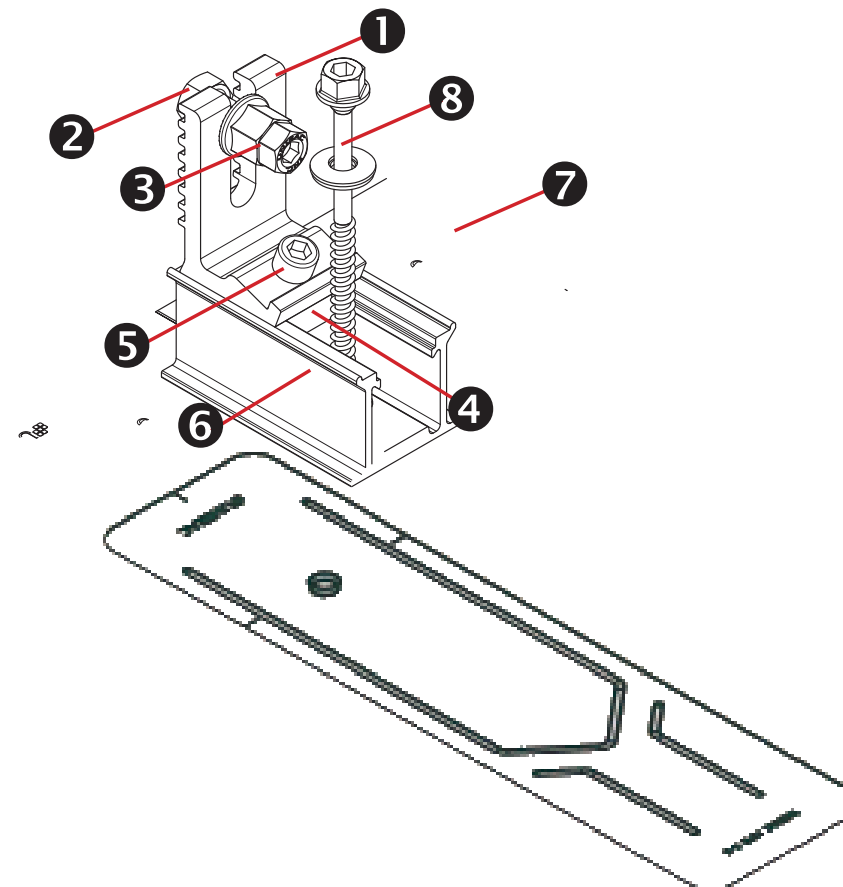
Module Clips

Functions:

- Required front row structural support (with trimrail)
- Module mounting

Features:

- Mounts to Trimrail™ with T-bolt and tri-drive nut
- Manually adjustable to fit module thicknesses 32, 33, 35, 38, and 40mm.



Trimrail™ Flashkit

Sub-Components:

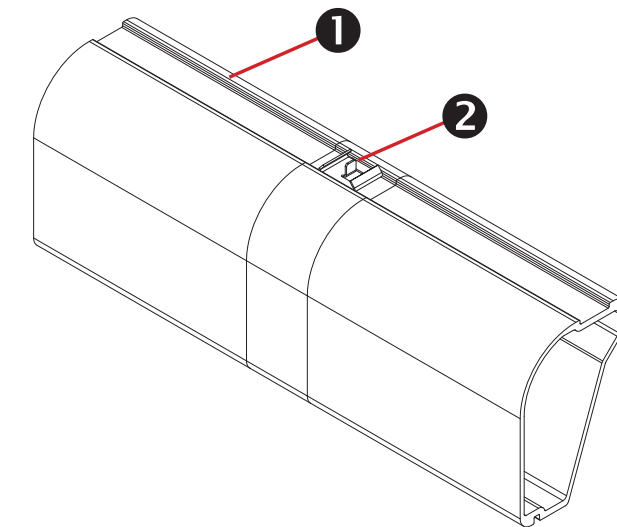
- L-Foot
- Hex bolt
- Tri-drive nut
- Channel Nut
- Socket Head Cap Screw
- 3\"Channel/Slider w/grommet
- 3\" Wide Flashing
- Structural Screw & SS EPDM Washer

Functions:

- Attach Trimrail™ to roof attachment / flashing
- Patented roof sealing technology at roof attachment point

Features:

- Slot provides vertical adjustments to level array
- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



Trimrail™ Splice

Sub-Components:

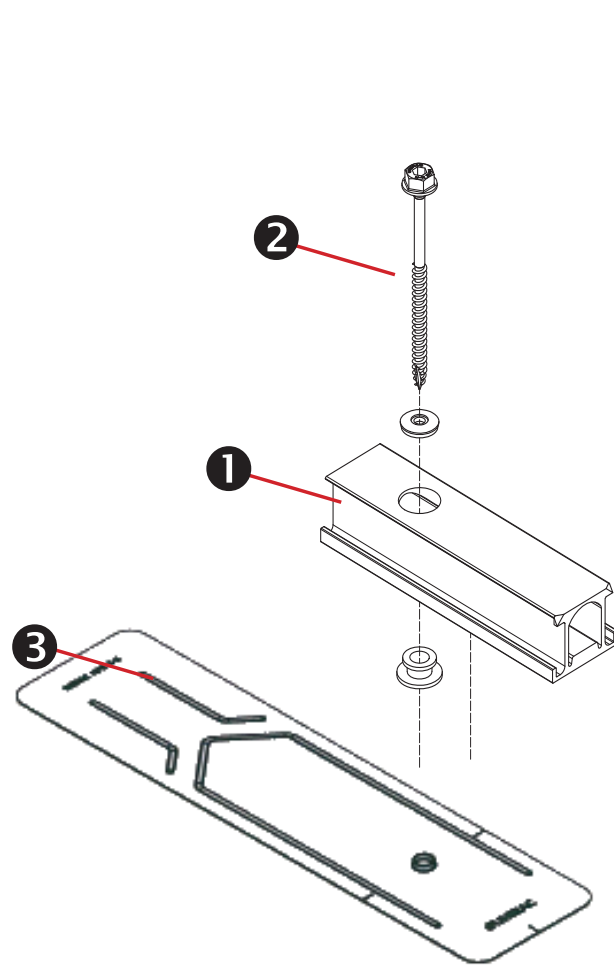
1. Structural Splice Extrusion
2. Bonding Clip

Functions:

- Front row structural support
- Installation aid
- Structurally connects 2 pieces of Trimrail™
- Electrically bonds 2 pieces of Trimrail™

Features:

- Aligns and connects Trimrail™ pieces
- Tool-less installation



SFM Slider Flashkit

Sub-Components:

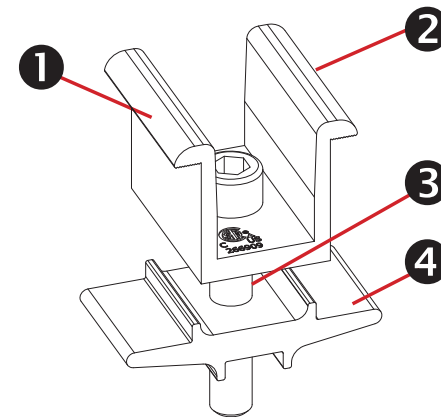
1. Slider w/grommet
2. Structural Screw & SS EPDM washer
3. 3" Wide Flashing

Functions:

- Patented Shed & Seal roof sealing technology at roof attachment point
- For use with compatible 2" Microrail or 8" Attached Splices

Features:

- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



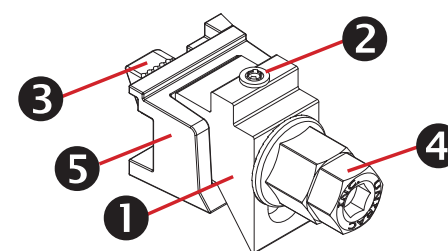
Module-to-Module N-S Bonding

Sub-Components:

1. Clamp
2. Bonding Pins (2)
3. 5/16" Socket Head Cap Screw
4. Clamp Base

Functions/ Features:

- Row to row bonding
- Single Use Only
- Fits module sizes 32-40mm



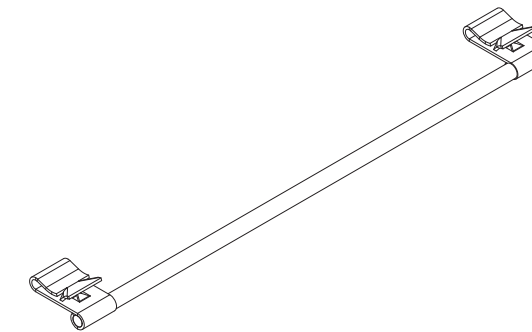
Trim -to- Module Bonding Clamp and Floating Trim Clamp

Sub-Components:

1. Wedge
2. Bonding Pin
3. T-Bolt
4. Nut
5. Cast Base

Functions/ Features:

- Module to Trimrail™ bonding - single use only
- Attaches Trimrail™ to module when fewer than 2 rafter attachment points are available
- Fits module sizes 32-40mm
- Fits module sizes 32-40mm



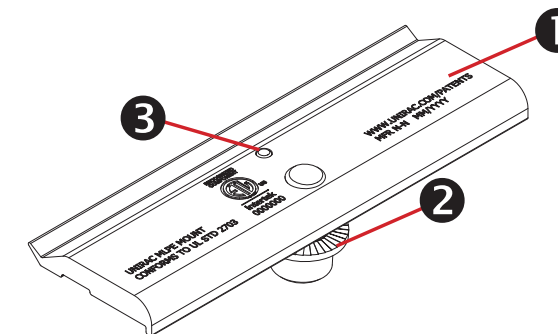
Wire Bonding Clip w/ 8AWG

Functions:

- Row to row bonding
- Module to Trimrail™ bonding
- Single Use Only

Features:

- Tool-less installation



MLPE Mounting Assembly

Sub-Components:

1. MLPE Mount Base
2. 5/16 Socket Head Cap Screw
3. Bonding Pin

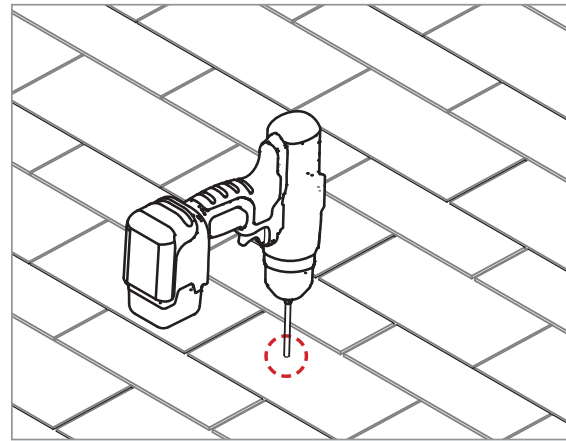
Functions:

- Securely mounts MLPE to module frames
- MLPE to module bonding

Features:

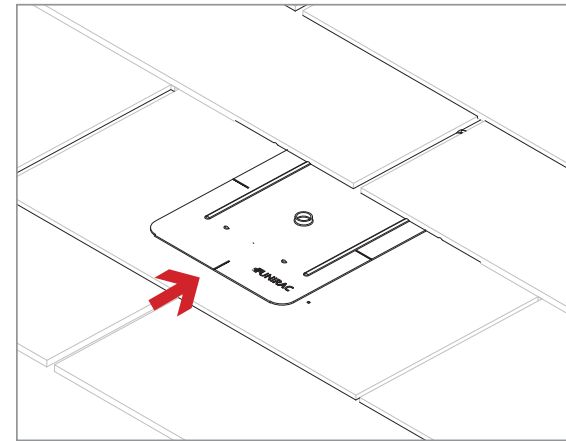
- Mounts easily to typical module flange
- UL2703 Recognized

MLPE = Module Level Power Electronics,
e.g. microinverter or power optimizer



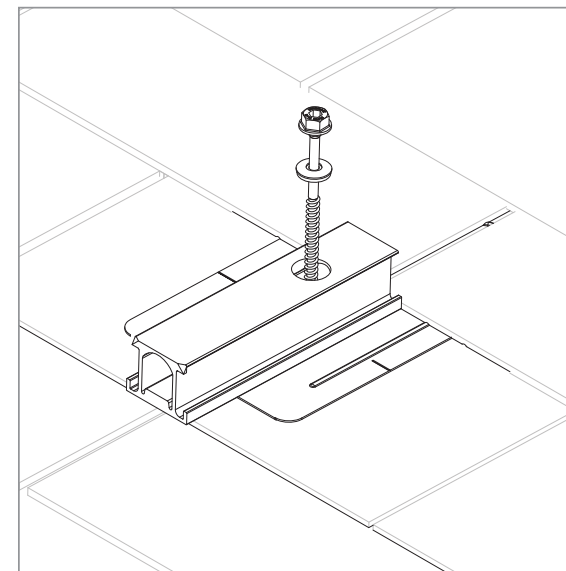
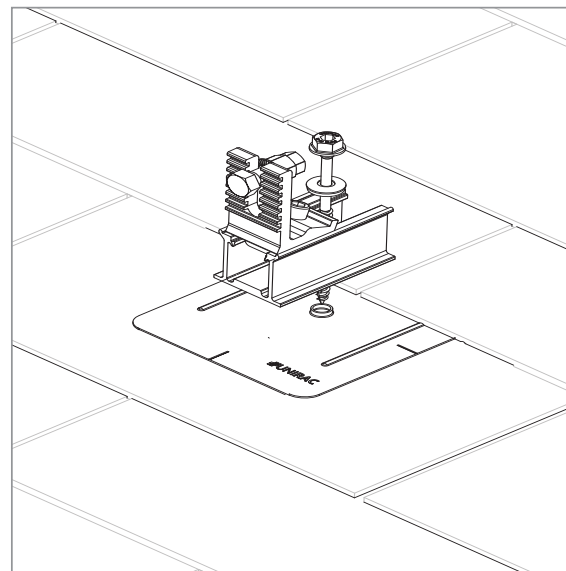
PILOT HOLES:

Drill pilot holes for lag screws or structural screws (as necessary) at marked attachment points



FLASHINGS:

Place flashings



INSTALL SLIDERS AND TRIMRAIL ROOF ATTACHMENTS:

- Insert flashings per manufacturer instructions
- **NOTE: Use Lag screw or structural fastener with a maximum diameter of 5/16"**
- Attach sliders to rafters
- Verify proper row to row spacing for module size (Mod NS + 1")
- Ensure that Trimrail™ roof attachments in each row have sufficient engagement with slider dovetails for proper attachment.

