

**GENERAL NOTES**

**CODES AND STANDARDS**

1. ALL WORK SHALL COMPLY WITH 2017 NATIONAL ELECTRIC CODE (NEC), 2018 NORTH CAROLINA BUILDING CODE (NCBC), 2018 NORTH CAROLINA RESIDENTIAL CODE (NCRC), PLUMBING CODE (NCPC), 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 WITH NO STORAGE BATTERIES.
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.

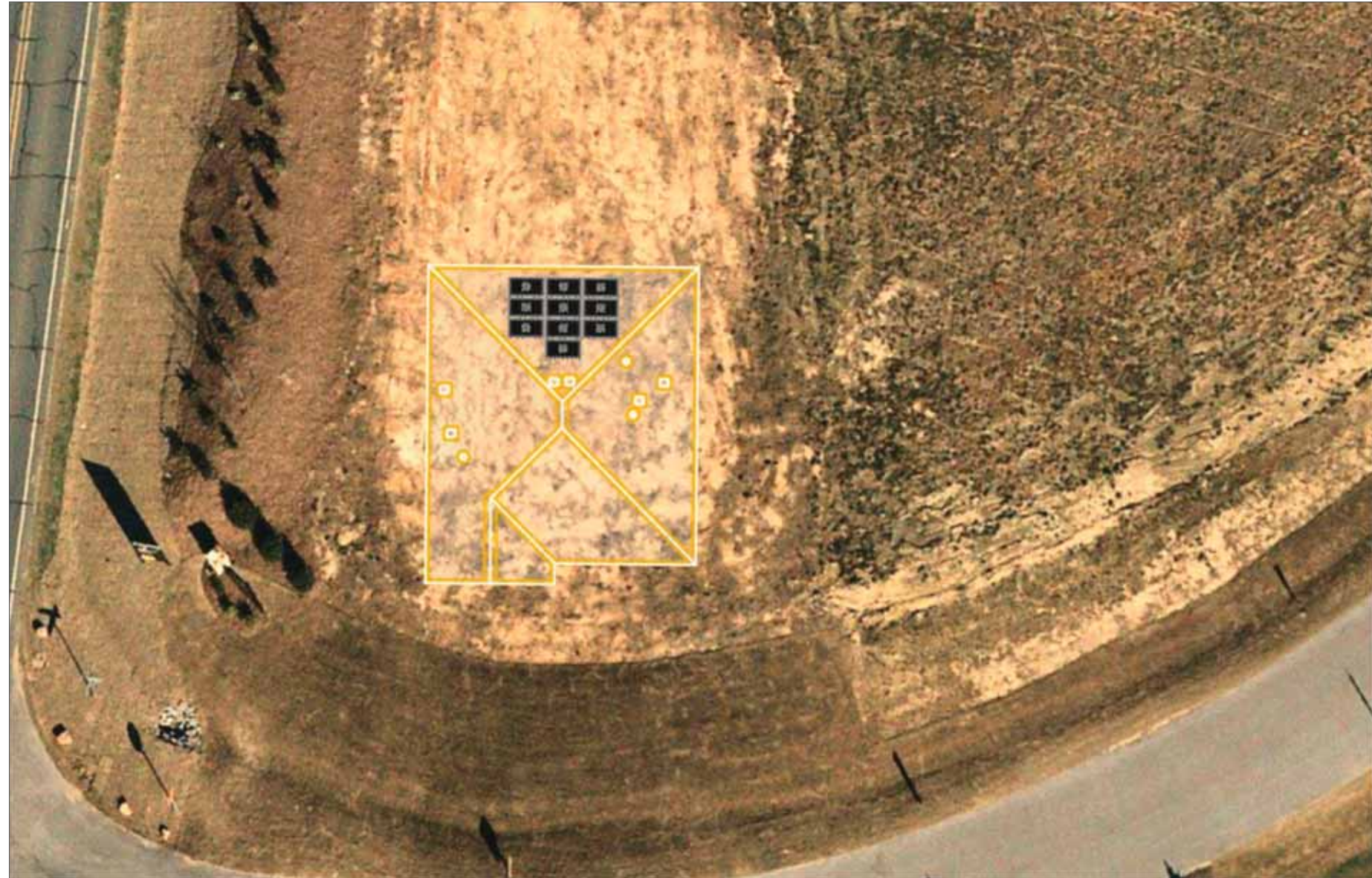
**SOLAR CONTRACTOR**

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 MANUFACTURERS' 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 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. ADDITIONAL AC DISCONNECTS SHALL BE PROVIDED WHERE THE INVERTER IS NOT ADJACENT TO THE UTILITY AC DISCONNECT, OR NOT WITHIN SIGHT OF THE UTILITY AC DISCONNECT.
4. ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.
5. ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

**AERIAL VIEW**



**DESIGN CRITERIA**

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

**SITE SPECIFICATIONS**

CONSTRUCTION - V-B  
 ZONING: RESIDENTIAL

**SHEET INDEX**

- PV1 - COVER SHEET
- PV2 - PROPERTY PLAN
- PV3 - SITE PLAN
- PV4 - EQUIPMENT & ATTACHMENT DETAIL
- PV5 - ELECTRICAL SINGLE LINE DIAGRAM
- PV6 - ELECTRICAL CALCULATIONS & ELECTRICAL NOTES
- PV7 - MAIN BREAKER DERATE CALCS. (IF NEEDED)
- PV8 - LABELS & LOCATIONS
- PV9 - CUSTOM DIRECTORY PLACARD (IF NEEDED - NEC 690.56(B))

UTILITY COMPANY: Duke Energy NC  
 PERMIT ISSUER: Harnett County

**SCOPE OF WORK**

INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM

3.25 kW DC PHOTOVOLTAIC SOLAR ARRAY  
 ROOF TYPE: Comp Shingle  
 MODULES: (10) REC Solar REC325TP3M  
 INVERTER(S): Enphase IQ7-60-2-US,----  
 RACKING: Unirac SFM Infinity



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CONTRACTOR:  
 BRS FIELD OPS  
 385.498.6700

SITE INFORMATION:

Jessica Walker  
 232 piney field rd  
 Fuquay-Varina, North Carolina 27526

DRAWING BY  
 Ethan Derieg

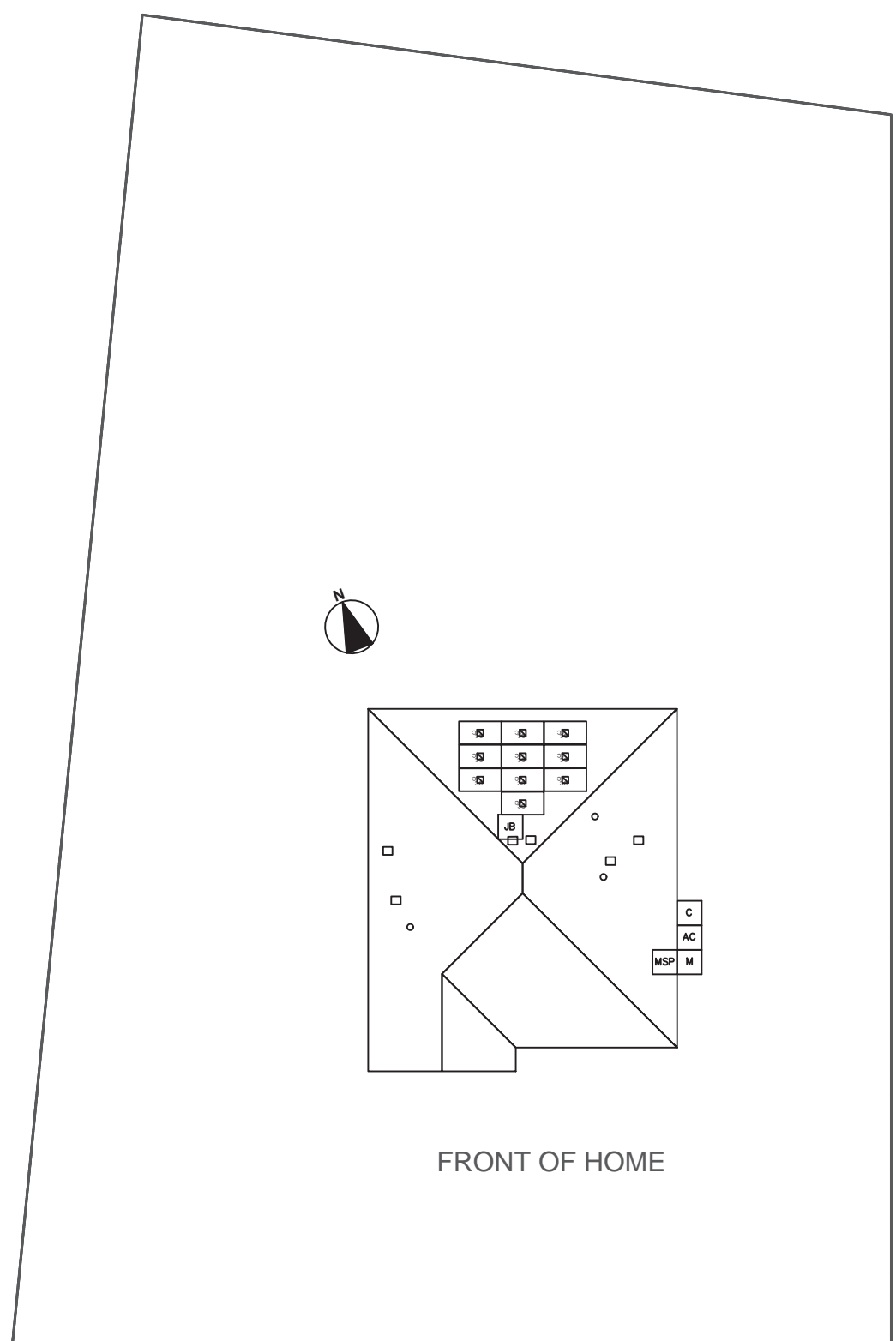
DATE  
 September 2, 2020

PROJECT NUMBER  
 84891681

SHEET NAME  
**COVER SHEET**

PAGE NUMBER  
**PV1**

REVISION  
**0**



**LEGEND**

- INV INVERTER & DC DISCONNECT
- SUB (E) SUBPANEL
- LC (N) LOAD CENTER
- AC AC DISCONNECT
- M UTILITY METER
- MSP MAIN SERVICE PANEL
- JB JUNCTION BOX
- TS TRANSFER SWITCH
- C COMBINER BOX/AGGREGATOR
- PV PV REVENUE METER
- [Hatched Box] FIRE SETBACK
- [Green Line] EMT CONDUIT RUN (TO BE DETERMINED IN FIELD)
- [Pink Line] PV WIRE STRING
- [Dashed Line] PROPERTY LINE

SCALE: 3/64" = 1'-0"  
 0' 21' 42' 64' 126'



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**PV INSTALLATION  
 PROFESSIONAL**  
 Scott Gurney  
 # PV-011719-015866

CONTRACTOR:  
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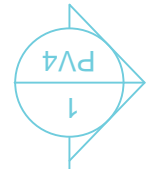
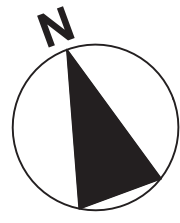
PROJECT NUMBER  
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SHEET NAME  
**PROPERTY PLAN**

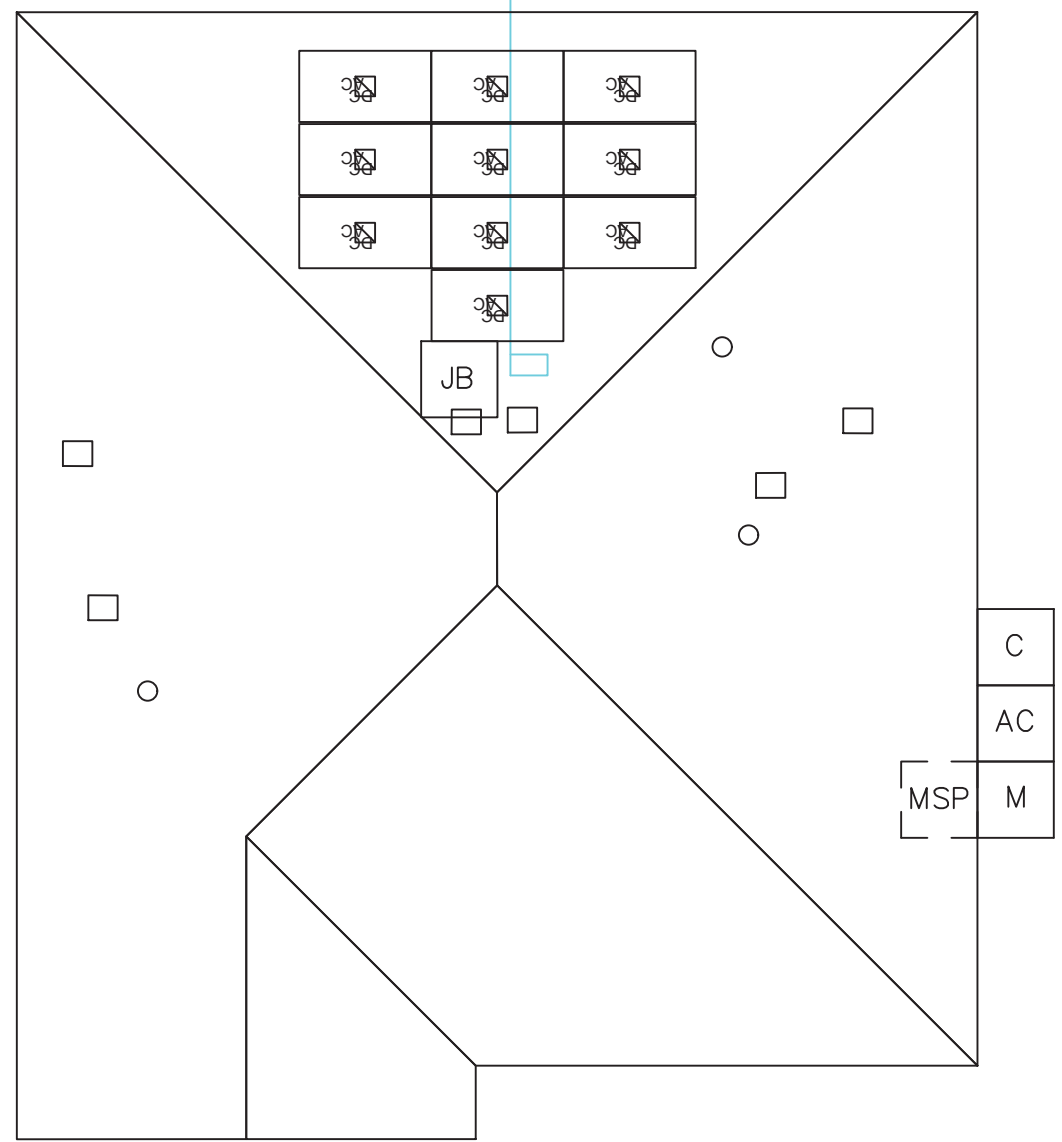
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 PV2

REVISION  
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232 piney field rd



MP1  
 # OF MODULES: 10  
 AZIMUTH:20°  
 PITCH:25°  
 TSRF:70%  
 AREA: 442 SQ. FT



FRONT OF HOME

**LEGEND**

- INV INVERTER & DC DISCONNECT
- SUB (E) SUBPANEL
- LC (N) LOAD CENTER
- AC AC DISCONNECT
- M UTILITY METER
- MSP MAIN SERVICE PANEL
- JB JUNCTION BOX
- TS TRANSFER SWITCH
- C COMBINER BOX/AGGREGATOR
- PV PV REVENUE METER
- FIRE SETBACK
- EMT CONDUIT RUN (TO BE DETERMINED IN FIELD)
- PV WIRE STRING
- PROPERTY LINE

SCALE: 1/8" = 1'-0"



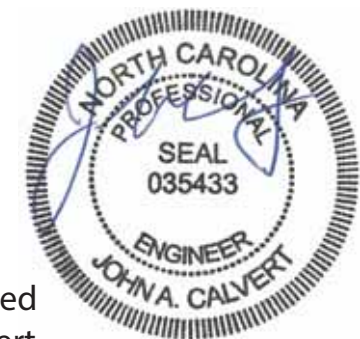
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Digitally signed  
 by John Calvert  
 Date: 2020.09.19  
 12:17:17 -06'00'

9/19/2020  
 Firm No. : D-0369

**SITE INFORMATION:**

Jessica Walker  
 232 piney field rd  
 Fuquay-Varina, North Carolina 27526

DRAWING BY  
 Ethan Derieg

DATE  
 September 2, 2020

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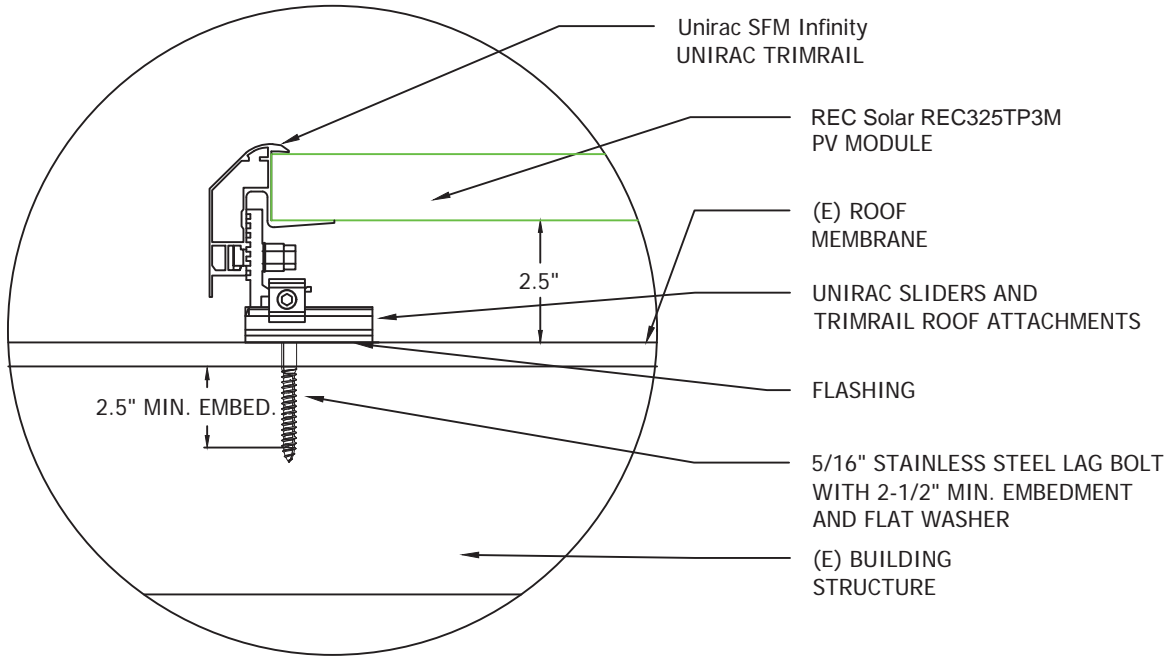
SHEET NAME  
**SITE PLAN**

PAGE NUMBER	REVISION
PV3	0

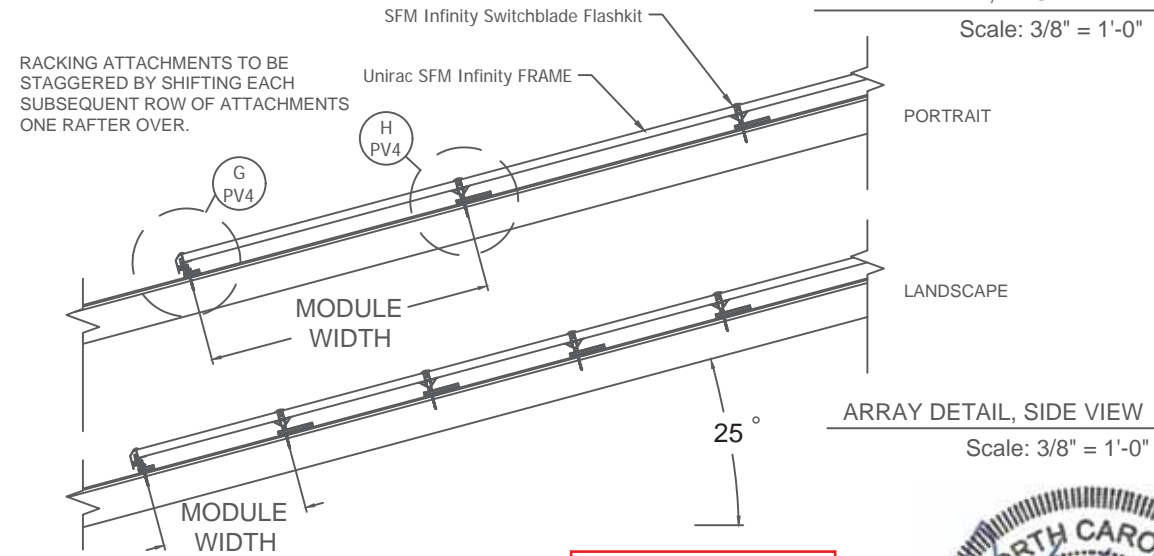
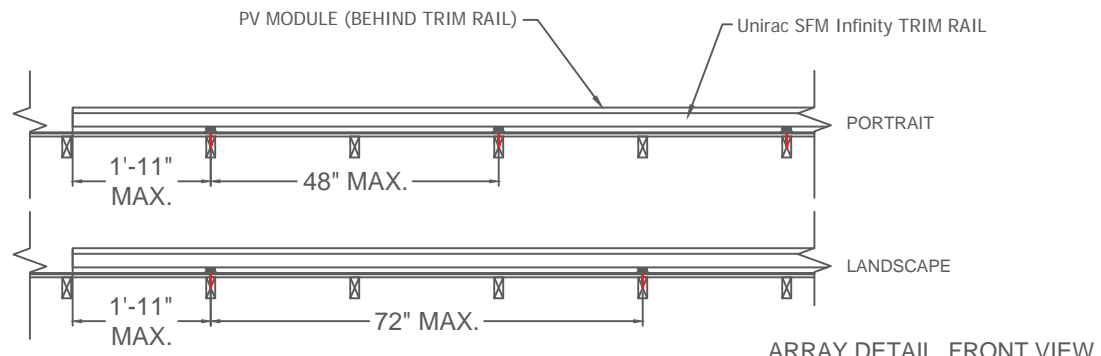
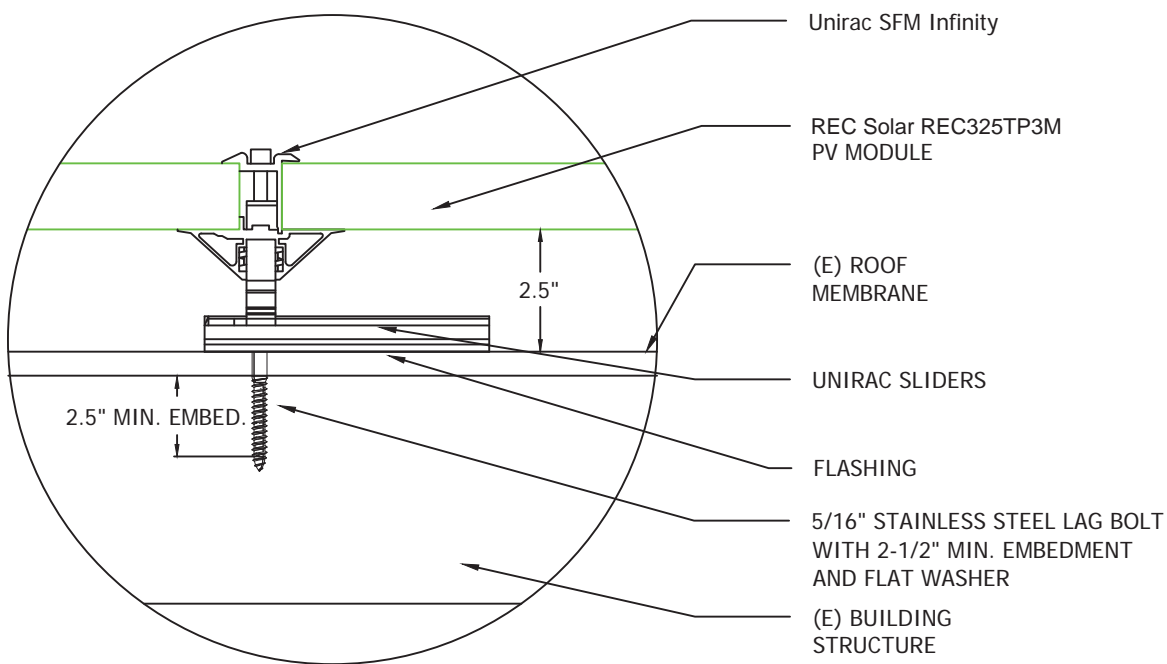
# PV ARRAY INFORMATION

**PV MODULE COUNT:** 10 MODULES  
**# OF ATTACHMENT POINTS:** 19  
**ARRAY AREA:** Module Count x 17.51ft<sup>2</sup> = 175.1ft<sup>2</sup>  
**ROOF AREA:** 2003.0ft<sup>2</sup>  
**% OF ARRAY/ROOF:** 8.7%  
**ARRAY WEIGHT:** Module Count x 50lbs = 500.0lbs  
**DISTRIBUTED LOAD:** Array Weight ÷ Array Area = 2.86 lbs/ft<sup>2</sup>  
**POINT LOAD:** Array Weight ÷ Attachments = 26.3lbs/attachment

**DETAIL, BOTTOM STANDOFF**  
 Scale: 3" = 1'-0"  
 G



**DETAIL, MIDDLE/TOP STANDOFF**  
 Scale: 3" = 1'-0"  
 H

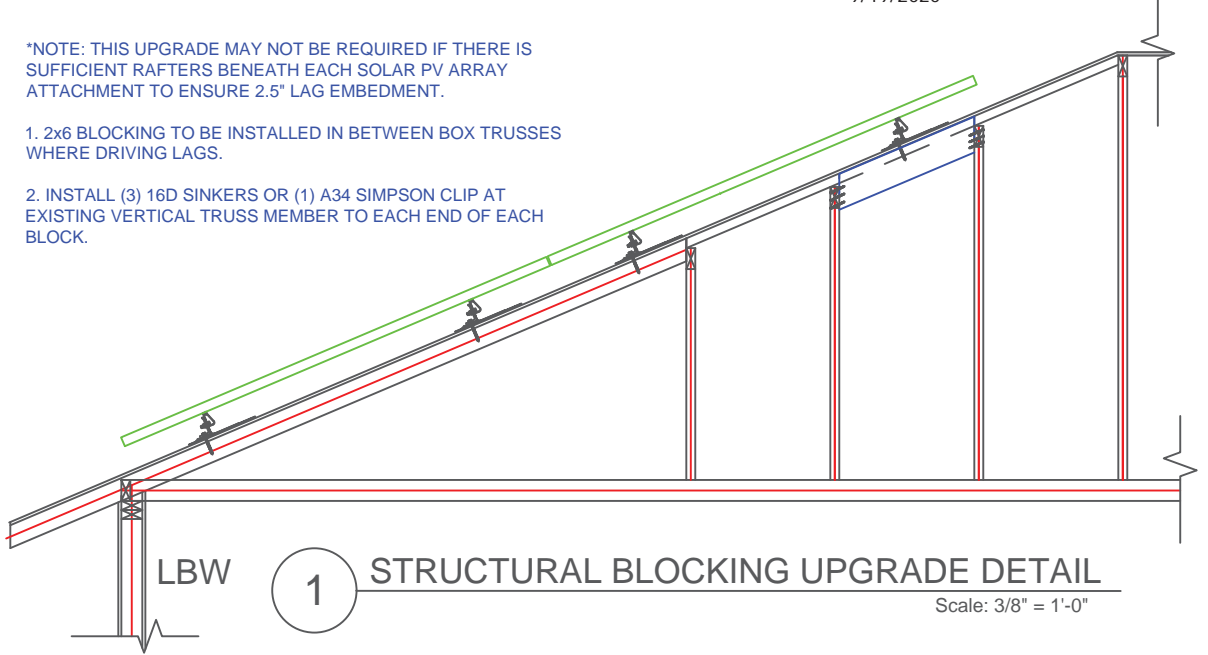


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**ROOF TYPE:** Comp Shingle  
**ROOF FRAMING TYPE:** Manufactured Truss  
**RAFTER OR TOP CHORD(TRUSS)** 2x4 @ 24"O.C.  
**CEILING JOIST OR BOTTOM CHORD(TRUSS)** 2x4 @ 24"O.C.

- \*NOTE: THIS UPGRADE MAY NOT BE REQUIRED IF THERE IS SUFFICIENT RAFTERS BENEATH EACH SOLAR PV ARRAY ATTACHMENT TO ENSURE 2.5" LAG EMBEDMENT.
- 2x6 BLOCKING TO BE INSTALLED IN BETWEEN BOX TRUSSES WHERE DRIVING LAGS.
  - INSTALL (3) 16D SINKERS OR (1) A34 SIMPSON CLIP AT EXISTING VERTICAL TRUSS MEMBER TO EACH END OF EACH BLOCK.



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DRAWING BY Ethan Derieg	
DATE September 2, 2020	
PROJECT NUMBER 84891681	
SHEET NAME EQUIP. DETAIL	
PAGE NUMBER PV4	REVISION 0

9/19/2020

Firm No. : D-0369

15	(1) 10 AWG THHN/THWN-2, CU., BLACK (L1)	10.0 A AC	3	(1) 10 - 2 UF-B W/G, THHN/THWN-2, SOLID CU.	MAX 10.0 A AC	2	(1) 10 - 2 UF-B (or NM) W/G, THHN/THWN-2, SC	MAX 10.0 A AC	1	(1) 12-2 TC-ER, THHN/THWN-2, CU.	MAX 10.0 A AC	EXTERIOR
	(1) 10 AWG THHN/THWN-2, CU., RED (L2)	240 V AC		(1) 3/4 INCH EMT	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) 3/4 INCH EMT	EXTERIOR		(1) 3/4 INCH EMT	EXTERIOR			INTERIOR				EXTERIOR



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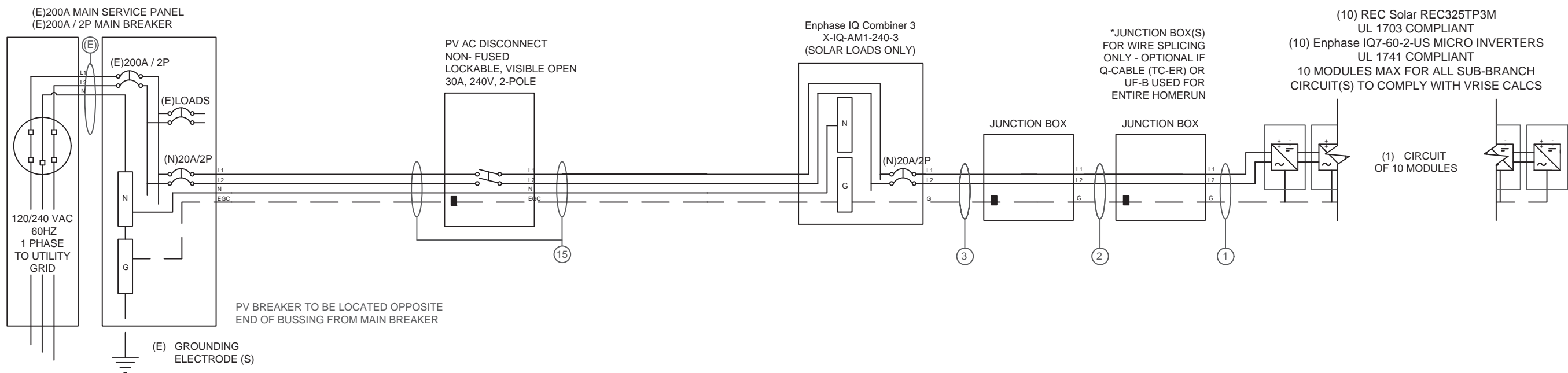
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CONTRACTOR:  
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Utility Company: Duke Energy NC Permit Issuer: Harnett County

10 INVERTERS x 240 W AC = 2.4 kW AC  
PANEL WATTAGE: 325W



**INTERCONNECTION NOTES**

1. ONE OF THE METHODS THAT FOLLOWS SHALL BE USED TO DETERMINE THE RATINGS OF BUSBARS AND PANELBOARDS. (a) THE SUM OF 125 PERCENT OF THE INVERTER(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUSBAR SHALL NOT EXCEED THE AMPACITY OF THE BUS BAR. (b) WHERE TWO SOURCES, ONE THE UTILITY AND THE OTHER AN INVERTER ARE LOCATED AT OPPOSITE ENDS OF A BUSBAR THAT CONTAINS LOADS, THE SUM OF 125 PERCENT OF THE INVERTER(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUSBAR SHALL NOT EXCEED 120 PERCENT OF THE AMPACITY OF THE BUSBAR [NEC 705.12].

**DISCONNECT NOTES**

1. DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING LIVE ARE CONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS)  
2. AC DISCONNECT MUST BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH



**SITE INFORMATION:**

Jessica Walker  
232 piney field rd  
Fuquay-Varina, North Carolina 27526  
DC SYSTEM SIZE: 3.25 kW DC

DRAWING BY Ethan Derieg	
DATE September 2, 2020	
PROJECT NUMBER 84891681	
SHEET NAME ELEC. 3 LINE DIAG.	
PAGE NUMBER PV5	REVISION 0

MODULE SPECIFICATIONS	REC Solar REC325TP3M
RATED POWER (STC)	325 W
MODULE VOC	39.5 V DC
MODULE VMP	34.1 V DC
MODULE IMP	9.54 A DC
MODULE ISC	10.36 A DC
VOC CORRECTION	-0.28 %/°C
VMP CORRECTION	-0.37 %/°C
SERIES FUSE RATING	20 A DC
ADJ. MODULE VOC @ ASHRAE LOW TEMP	43.4 V DC
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	28.8 V DC

MICROINVERTER SPECIFICATIONS	Enphase IQ7 Microinverters
POWER POINT TRACKING (MPPT) MIN/MAX	22 - 48 V DC
MAXIMUM INPUT VOLTAGE	48 V DC
MAXIMUM DC SHORT CIRCUIT CURRENT	15 A DC
MAXIMUM USABLE DC INPUT POWER	350 W
MAXIMUM OUTPUT CURRENT	1 A AC
AC OVERCURRENT PROTECTION	20 A
MAXIMUM OUTPUT POWER	240 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	SEYMOUR-JOHNSON AFB
ASHRAE EXTREME LOW TEMP (°C)	-10
ASHRAE 2% AVG. HIGH TEMP (°C)	35

SYSTEM ELECTRICAL SPECIFICATIONS	CIR 1	CIR 2	CIR 3	CIR 4	CIR 5	CIR 6
NUMBER OF MODULES PER MPPT	10					
DC POWER RATING PER CIRCUIT (STC)	3250					
TOTAL MODULE NUMBER	10 MODULES					
STC RATING OF ARRAY	3250W DC					
AC CURRENT @ MAX POWER POINT (IMP)	10.0					
MAX. CURRENT (IMP X 1.25)	12.5					
OCPD CURRENT RATING PER CIRCUIT	20					
MAX. COMB. ARRAY AC CURRENT (IMP)	10.0					
MAX. ARRAY AC POWER	2400W AC					

AC VOLTAGE RISE CALCULATIONS	DIST (FT)	COND.	√RISE(V)	VEND(V)	%VRISE	IQ7-10
VRISE SEC. 1 (MICRO TO JBOX)	36	12 Cu.	1.45	241.45	0.61%	
VRISE SEC. 2 (JBOX TO COMBINER BOX)	40	10 Cu.	1.02	241.02	0.42%	
VRISE SEC. 3 (COMBINER BOX TO POI)	15	10 Cu.	0.38	240.38	0.16%	
TOTAL VRISE			2.85	242.85	1.19%	

PHOTOVOLTAIC AC DISCONNECT OUTPUT LABEL (NEC 690.54)	
AC OUTPUT CURRENT	10.0 A AC
NOMINAL AC VOLTAGE	240 V AC

CONDUCTOR SIZE CALCULATIONS	
MICROINVERTER TO JUNCTION BOX (1)	MAX. SHORT CIRCUIT CURRENT (ISC) = 10.0 A AC MAX. CURRENT (ISC X1.25) = 12.5 A AC CONDUCTOR (TC-ER, COPPER (90°C)) = 12 AWG CONDUCTOR RATING = 30 A AMB. TEMP. AMP. CORRECTION = 0.96 ADJUSTED AMP. = 28.8 > 12.5
JUNCTION BOX TO JUNCTION BOX (2)	MAX. SHORT CIRCUIT CURRENT (ISC) = 10.0 A AC MAX. CURRENT (ISC X1.25) = 12.5 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 > 12.5
JUNCTION BOX TO COMBINER BOX (3)	MAX. SHORT CIRCUIT CURRENT (ISC) = 10.0 A AC MAX. CURRENT (ISC X1.25) = 12.5 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 > 12.5
COMBINER BOX TO MAIN PV OCPD (15)	INVERTER RATED AMPS = 10.0 A AC MAX. CURRENT (RATED AMPS X1.25) = 12.5 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 > 12.5



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### GROUNDING NOTES

- A GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH [NEC 690-47] AND [NEC 250-50] THROUGH [NEC 250-60] SHALL BE PROVIDED. PER NEC, GROUNDING ELECTRODE SYSTEM OF EXISTING BUILDING MAY BE USED AND BONDED TO 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.
- 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 250-64B. THE GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AT BUSBARS WITHIN LISTED EQUIPMENT PER [NEC 250.64C].
- 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.
- 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].
- MODULE SOURCE CIRCUITS SHALL BE GROUNDED IN ACCORDANCE TO [NEC 690.42].
- 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.
- EACH MODULE WILL BE GROUNDED USING THE SUPPLIED CONNECTIONS POINTS IDENTIFIED IN THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- ENCLOSURES SHALL BE PROPERLY PREPARED WITH REMOVAL OF PAINT/FINISH AS APPROPRIATE WHEN GROUNDING EQUIPMENT WITH TERMINATION GROUNDING LUGS.
- GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVICES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR DIRECT BURIAL.
- GROUNDING AND BONDING CONDUCTORS SHALL BE COPPER, SOLID OR

STRANDED, AND BARE WHEN EXPOSED.

- EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZE ACCORDING TO [NEC 690.45] AND BE A MINIMUM OF #10AWG WHEN NOT EXPOSED TO DAMAGE (#6AWG SHALL BE USED WHEN EXPOSED TO DAMAGE).
- GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN (OR MARKED GREEN IF #4 AWG OR LARGER)
- ALL CONDUIT BETWEEN THE UTILITY AC DISCONNECT AND THE POINT OF CONNECTION SHALL HAVE GROUNDED BUSHINGS AT BOTH ENDS.
- SYSTEM GEC SIZED ACCORDING TO [NEC 690.47], [NEC TABLE 250.66], DC SYSTEM GEC SIZED ACCORDING TO [NEC 250.166], MINIMUM #8AWG WHEN INSULATED, #6AWG WHEN EXPOSED TO DAMAGE.
- EXPOSED NON-CURRENT CARRYING METAL PARTS OF MODULE FRAMES, EQUIPMENTS, AND CONDUCTOR ENCLOSURES SHALL BE GROUNDED IN ACCORDANCE WITH 250.134 OR 250.136(A) REGARDLESS OF VOLTAGE.

### WIRING & CONDUIT NOTES

- ALL CONDUIT SIZES AND TYPES, SHALL BE LISTED FOR ITS PURPOSE AND APPROVED FOR THE SITE APPLICATIONS
- BOLTED CONNECTION REQUIRED IN DC DISCONNECTS ON THE WHITE GROUNDED CONDUCTOR (USE POLARIS BLOCK OR NEUTRAL BAR)
- ANY CONNECTION ABOVE LIVE PARTS MUST BE WATERTIGHT. REDUCING WASHERS DISALLOWED ABOVE LIVE PARTS, MEYERS HUBS RECOMMENDED
- 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), 300.4
- SOLADECK JUNCTION BOXES MOUNTED FLUSH W/ROOF SURFACE TO BE USED FOR WIRE MANAGEMENT AND AS FLASHED ROOF PENETRATIONS FOR INTERIOR CONDUIT RUNS.
- 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
- ALL CONDUCTORS AND OCPD SIZES AND TYPES SPECIFIED ACCORDING TO [NEC

690.8] FOR MULTIPLE CONDUCTORS

- 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)].
- 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
- 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% FOR DC CIRCUITS AND 3% FOR AC CIRCUITS
- NEGATIVE GROUNDED SYSTEMS DC CONDUCTORS SHALL BE COLOR CODED AS FOLLOWS: DC POSITIVE- RED (OR MARKED RED), DC NEGATIVE- GREY (OR MARKED GREY)
- POSITIVE GROUNDED SYSTEMS DC CONDUCTORS COLOR CODED: DC POSITIVE- GREY (OR MARKED GREY), DC NEGATIVE- BLACK (OR MARKED BLACK)
- 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
- RIGID CONDUIT, IF INSTALLED, (AND/OR NIPPLES) MUST HAVE A PULL BUSHING TO PROTECT WIRES.
- 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 690.13 AND 690.15
- 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).

### SITE INFORMATION:

Jessica Walker  
232 piney field rd  
Fuquay-Varina, North Carolina 27526  
DC SYSTEM SIZE: 3.25 kW DC

DRAWING BY  
Ethan Derieg

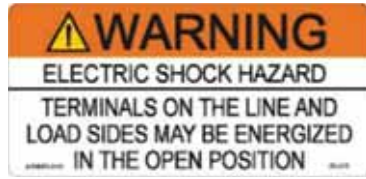
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PROJECT NUMBER  
84891681

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ELEC. CALCS.

PAGE NUMBER  
PV6

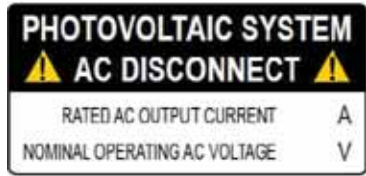
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**LABEL 1**  
FOR PV DISCONNECTING MEANS WHERE ALL TERMINALS OF THE DISCONNECTING MEANS MAY BE ENERGIZED IN THE OPEN POSITION. [NEC 690.13(B), NEC 705.22]



**LABEL 2**  
AT EACH DC DISCONNECTING MEANS, INCLUDING THE DC DISCONNECT AT THE INVERTER. [NEC 690.53, NEC 690.13(B)]



**LABEL 3**  
AT POINT OF INTERCONNECTION, MARKED AT AC DISCONNECTING MEANS. [NEC 690.54, NEC 690.13 (B)]



**LABEL 4**  
IF INTERCONNECTING ON THE LOAD SIDE, INSTALL THIS LABEL ANYWHERE THAT IS POWERED BY BOTH THE UTILITY AND THE SOLAR PV SYSTEM: THE MAIN SERVICE PANEL AND SUB-PANELS. [NEC 705.12(B)(3)]



**LABEL 5**  
PLACED ADJACENT TO THE BACK-FED BREAKER FROM THE INVERTER IF TIE IN CONSISTS OF LOAD SIDE CONNECTION TO BUSBAR. [NEC 705.12(B)(2)(3)(b)]



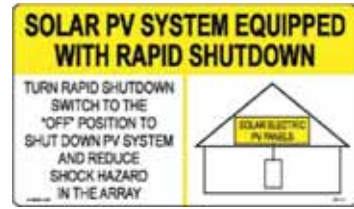
**LABEL 6**  
(ONLY IF 3 OR MORE SUPPLY SOURCES TO A BUSBAR)  
SIGN LOCATED AT LOAD CENTER IF IT CONTAINS 3 OR MORE POWER SOURCES. [NEC 705.12(B)(2)(3)(C)]

**LABELING NOTES:**

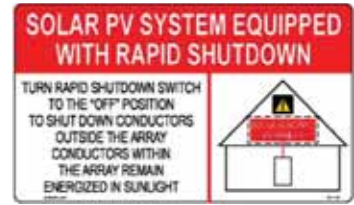
1. LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
2. LABELING REQUIREMENTS BASED ON THE 2017 NATIONAL ELECTRIC CODE, OSHA STANDARD 19010.145, ANSI Z535.
3. MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
4. LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AND SHALL NOT BE HANDWRITTEN [NEC 110.21]
5. LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8", WHITE ON RED BACKGROUND; REFLECTIVE, AND PERMANENTLY AFFIXED [IFC 605.11.1.1]



**LABEL 7**  
AT DIRECT-CURRENT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS; SPACED AT MAXIMUM 10FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS. [NEC 690.31(G)(3&4)]



**LABEL 8**  
FOR PV SYSTEMS THAT SHUT DOWN THE ARRAY AND CONDUCTORS LEAVING THE ARRAY: SIGN TO BE LOCATED ON OR NO MORE THAN 3 FT AWAY FROM SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED AND SHALL INDICATE THE LOCATION OF ALL IDENTIFIED RAPID SHUTDOWN SWITCHES IF NOT AT THE SAME LOCATION. [NEC 690.56(C)(1)(A)]



**LABEL 9**  
FOR PV SYSTEMS THAT ONLY SHUT DOWN CONDUCTORS LEAVING THE ARRAY: SIGN TO BE LOCATED ON OR NO MORE THAN 3 FT AWAY FROM SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED AND SHALL INDICATE THE LOCATION OF ALL IDENTIFIED RAPID SHUTDOWN SWITCHES IF NOT AT THE SAME LOCATION. [NEC 690.56(C)(1)(B)]



**LABEL 10**  
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH [NEC 690.56(C)(3)].



**LABEL 11**  
PERMANENT DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT LOCATION IF ALL ELECTRICAL POWER SOURCE DISCONNECTING MEANS (SOLAR ARRAY RAPID SHUTDOWN SWITCH) ARE GROUPED AND IN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 690.56(C) & NEC 705.10].



**LABEL 12**  
PERMANENT DIRECTORY TO BE LOCATED AT SOLAR ARRAY RAPID SHUTDOWN SWITCH DENOTING THE LOCATION OF THE SERVICE EQUIPMENT LOCATION IF SOLAR ARRAY RAPID SHUT DOWN DISCONNECT SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 705.10]

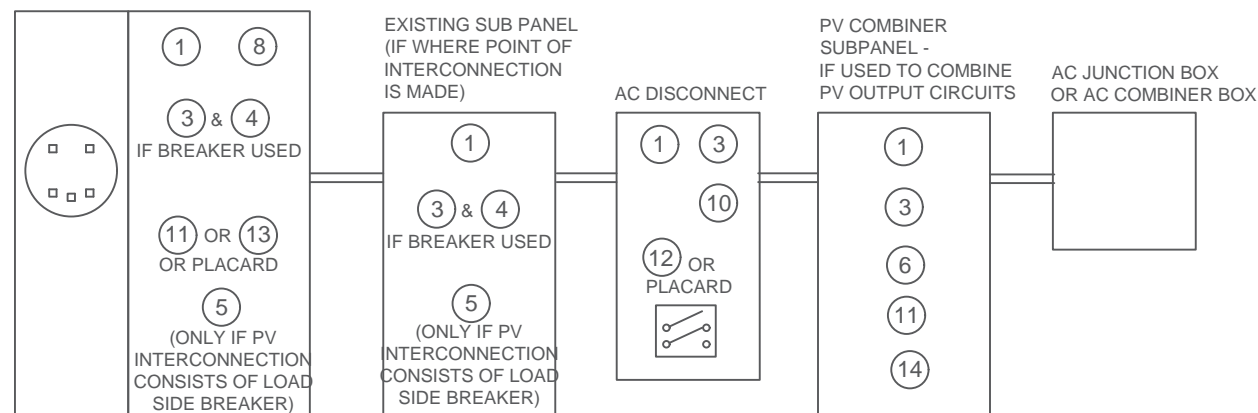


**LABEL 13**  
PERMANENT DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT DENOTING THE LOCATION OF THE PV RAPID SHUTDOWN SYSTEM DISCONNECTING MEANS IF SOLAR ARRAY RAPID SHUT DOWN DISCONNECT SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. [NEC 705.10, NEC 690.56(C)(1)]

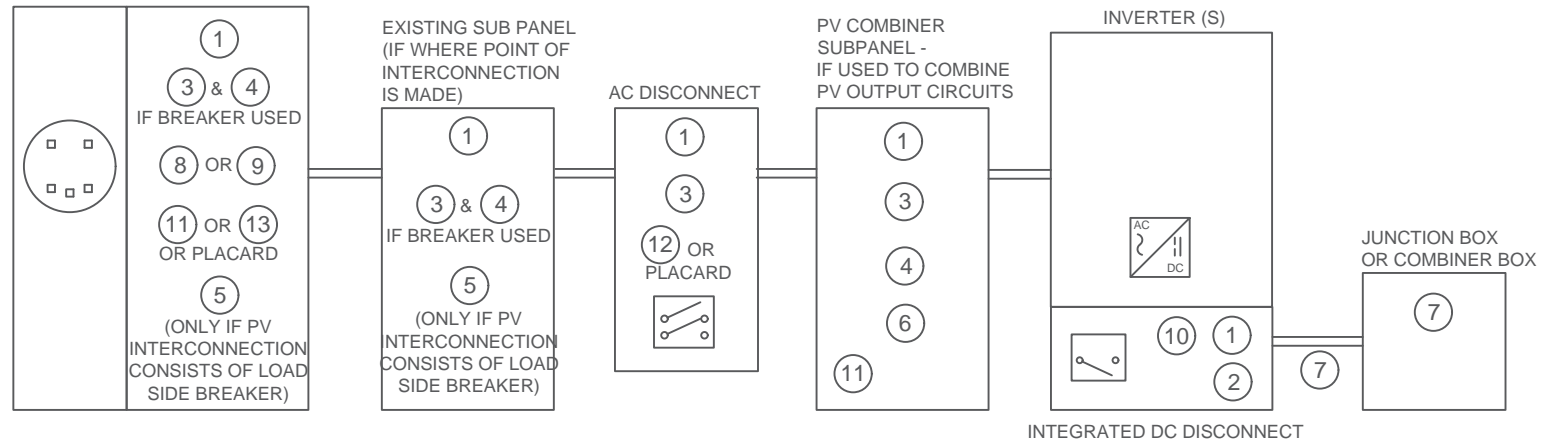


**LABEL 14**  
PERMANENT DIRECTORY TO BE LOCATED AT AC COMBINER PANEL [NEC 110.21(B)]

**LABELING DIAGRAM FOR MICRO INV.:**  
MAIN SERVICE PANEL



**LABELING DIAGRAM FOR STRING INV. / DC OPTIMIZER INV.:**  
MAIN SERVICE PANEL



\*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 PV5 OF 3 LINE DIAGRAM. PV5 LINE DIAGRAM TO REFLECT ACTUAL REPRESENTATION OF PROPOSED SCOPE OF WORK.



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CONTRACTOR:  
BRS FIELD OPS  
385.498.6700

SITE INFORMATION:

Jessica Walker  
232 piney field rd  
Fuquay-Varina, North Carolina 27526  
DC SYSTEM SIZE: 3.25 kW DC

DRAWING BY  
Ethan Derieg

DATE  
September 2, 2020

PROJECT NUMBER  
84891681

SHEET NAME  
LABELS

PAGE NUMBER  
PV8

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# 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 <sup>1</sup>	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	
Oversoltage class DC port	II		II	
DC port backfeed current	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	IQ 7 Microinverter		IQ 7+ Microinverter	
Peak output power	250 VA		295 VA	
Maximum continuous output power	240 VA		290 VA	
Nominal (L-L) voltage/range <sup>2</sup>	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 <sup>3</sup>	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Oversoltage 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 %		97.3 %	
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/IEEE 1547, 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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SHEET NAME

**SPEC SHEET**

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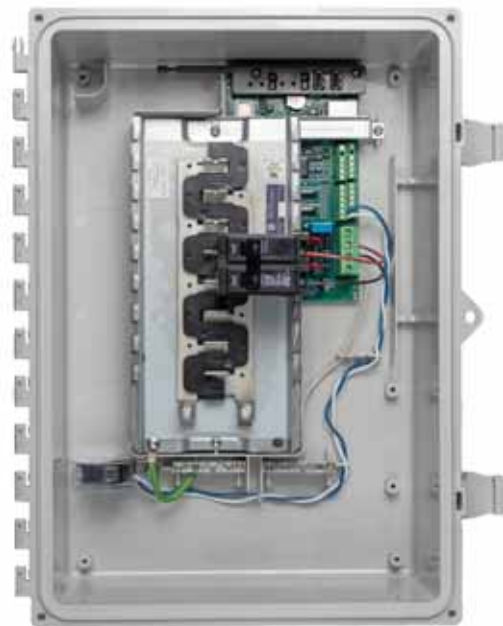
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# Enphase IQ Combiner 3 (X-IQ-AM1-240-3)

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"> <li>• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors</li> <li>• 60 A breaker branch input: 4 to 1/0 AWG copper conductors</li> <li>• Main lug combined output: 10 to 2/0 AWG copper conductors</li> <li>• Neutral and ground: 14 to 1/0 copper conductors</li> </ul> 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](http://enphase.com)

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2019-11-04



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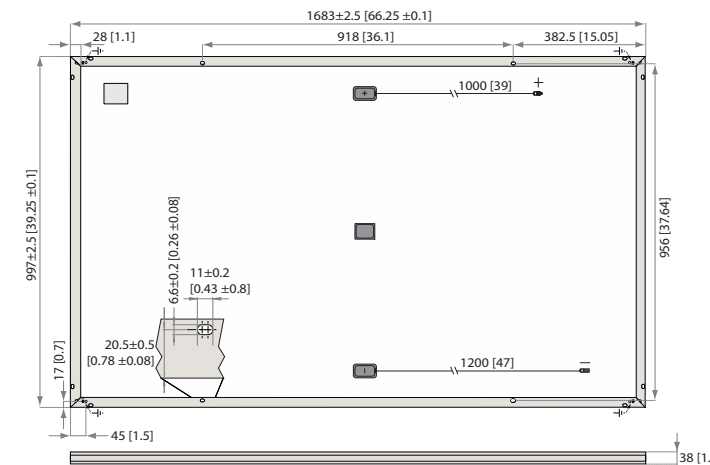
# REC TWINPEAK 3 MONO BLACK SERIES

## PREMIUM SOLAR PANELS WITH SUPERIOR PERFORMANCE

REC TwinPeak 3 Mono Black Series solar panels feature an innovative design with high panel efficiency and power output, enabling customers to get the most out of the space used for the installation.

Combined with industry-leading product quality and the reliability of a strong and established European brand, REC TwinPeak 3 Mono Black panels are ideal for residential and commercial rooftops worldwide.

# REC TWINPEAK 3 MONO BLACK SERIES



Measurements in mm [in]

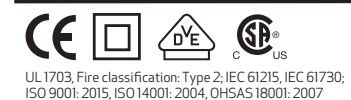
ELECTRICAL DATA @ STC		Product code*: RECxxxTP3M Black				
Power Output - P <sub>MAX</sub> (Wp)		315	320	325	330	335
Watt Class Sorting - (W)		-0/+5	-0/+5	-0/+5	0/+5	-0/+5
Nominal Power Voltage - V <sub>MPP</sub> (V)		33.6	33.8	34.1	34.3	34.6
Nominal Power Current - I <sub>MPP</sub> (A)		9.40	9.50	9.54	9.62	9.69
Open Circuit Voltage - V <sub>OC</sub> (V)		38.7	39.1	39.5	39.9	40.2
Short Circuit Current - I <sub>SC</sub> (A)		10.30	10.30	10.36	10.39	10.42
Panel Efficiency (%)		18.8	19.1	19.4	19.7	20.0

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m<sup>2</sup>, temperature 25°C), based on a production spread with a tolerance of P<sub>MAX</sub>, V<sub>OC</sub> & I<sub>SC</sub> ±3% within one watt class. At a low irradiance of 200 W/m<sup>2</sup> at least 95% of the STC module efficiency will be achieved. \*Where xxx indicates the nominal power class (P<sub>MAX</sub>) at STC indicated above.

ELECTRICAL DATA @ NMOT		Product code*: RECxxxTP3M Black				
Power Output - P <sub>MAX</sub> (Wp)		235	238	242	246	250
Nominal Power Voltage - V <sub>MPP</sub> (V)		31.3	31.5	31.7	31.9	32.2
Nominal Power Current - I <sub>MPP</sub> (A)		7.51	7.57	7.63	7.70	7.75
Open Circuit Voltage - V <sub>OC</sub> (V)		36.1	36.4	36.8	37.1	37.5
Short Circuit Current - I <sub>SC</sub> (A)		8.23	8.26	8.29	8.31	8.34

Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m<sup>2</sup>, temperature 20°C, wind speed 1 m/s). \*Where xxx indicates the nominal power class (P<sub>MAX</sub>) at STC indicated above.

### CERTIFICATIONS



### WARRANTY

	Standard		REC ProTrust	
	No	Yes	Yes	Yes
Installed by an REC Certified Solar Professional				
System Size	Any	<25 kW	25-500 kW	
Product Warranty (yrs)	20	25	25	
Power Warranty (yrs)	25	25	25	
Labor Warranty (yrs)	0	25	10	
Power in Year 1	97.5%	97.5%	97.5%	
Annual Degradation	0.7%	0.7%	0.7%	
Power in Year 25	80.7%	80.7%	80.7%	

See warranty documents for details. Some conditions apply.

- 20.0% EFFICIENCY
- 20 YEAR PRODUCT WARRANTY
- 25 YEAR LINEAR POWER OUTPUT WARRANTY

### TEMPERATURE RATINGS

Nominal Module Operating Temperature:	44.6°C (±2°C)
Temperature coefficient of P <sub>MAX</sub> :	-0.37 %/°C
Temperature coefficient of V <sub>OC</sub> :	-0.28 %/°C
Temperature coefficient of I <sub>SC</sub> :	0.04 %/°C

### GENERAL DATA

Cells:	120 half-cut mono-Si p-type PERC cells 6 strings of 20 cells in series
Glass:	0.13" (3.2 mm) solar glass with anti-reflective surface treatment
Back sheet:	Highly resistant polyester polyolefin construction (black)
Frame:	Anodized aluminum (black)
Junction box:	3-part with 3 bypass diodes, IP67 rated 12 AWG (4 mm <sup>2</sup> ) PV wire, 39" + 47" (1.0 m + 1.2 m)
Connectors:	Stäubli MC4 PV-KBT4/PV-KST4, 12 AWG (4 mm <sup>2</sup> )

### MAXIMUM RATINGS

Operational temperature:	-40 ... +185°F (-40 ... +85°C)
Maximum system voltage:	1000 V
Design load (+): snow	3600 Pa (75.2 lbs/ft <sup>2</sup> )*
Maximum test load (+):	5400 Pa (112.8 lbs/ft <sup>2</sup> )*
Design load (-): wind	1600 Pa (33.4 lbs/ft <sup>2</sup> )*
Maximum test load (-):	2400 Pa (50 lbs/ft <sup>2</sup> )*
Max series fuse rating:	20 A
Max reverse current:	20 A

\* Calculated using a safety factor of 1.5  
\* See installation manual for mounting instructions

### MECHANICAL DATA

Dimensions:	66.3 x 39.25 x 1.5 (1683 x 997 x 38 mm)
Area:	17.98 ft <sup>2</sup> (1.68 m <sup>2</sup> )
Weight:	41.7 lbs (18.9 kg)

Note! Specifications subject to change without notice.

Specifications subject to change without notice.

Ref: PM-05-07-16 Rev-A-05-20



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800-377-4480  
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385.498.6700



**MORE POWER OUTPUT PER M<sup>2</sup>**



**IMPROVED PERFORMANCE IN SHADED CONDITIONS**



**100% PID FREE**



**REDUCES BALANCE OF SYSTEM COSTS**



**ELIGIBLE FOR**

REC Group is an international pioneering solar energy company dedicated to empowering consumers with clean, affordable solar power in order to facilitate global energy transitions. Committed to quality and innovation, REC offers photovoltaic modules with leading high quality, backed by an exceptional low warranty claims rate of less than 100ppm. Founded in Norway in 1996, REC employs 2,000 people and has an annual solar panel capacity of 1.8 GW. With over 10 GW installed worldwide, REC is empowering more than 16 million people with clean solar energy. REC Group is a BlueStar/Elkem company with headquarters in Norway, operational headquarters in Singapore, and regional bases in North America, Europe, and Asia-Pacific.



SHEET NAME  
**SPEC SHEET**

PAGE NUMBER	REVISION
SS	0



Powering Business Worldwide

pe.eaton.com



## Eaton general duty non-fusible safety switch

**DG221UGB**

**UPC:**782113120102

**Dimensions:**

- **Height:** 10.69 IN
- **Length:** 6.88 IN
- **Width:** 6.38 IN

**Weight:**6 LB

**Notes:**WARNING! Switch is not approved for service entrance unless a neutral kit is installed.

**Warranties:**

- Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

**Specifications:**

- **Type:** Non-fusible, single-throw
- **Amperage Rating:** 30A
- **Enclosure:** NEMA 1, Indoor
- **Enclosure Material:** Painted steel
- **Fuse Configuration:** Non-fusible
- **Number Of Poles:** Two-pole
- **Number Of Wires:** Two-wire
- **Product Category:** General duty safety switch
- **Voltage Rating:** 240V

**Supporting documents:**

- [Eatons Volume 2-Commercial Distribution](#)
- [Eaton Specification Sheet - DG221UGB](#)

**Certifications:**

- UL Listed

**Product compliance:** No Data



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SHEET NAME  
**SPEC SHEET**

PAGE NUMBER	REVISION
SS	0



**SFM** SUN  
FRAME  
MICRORAIL™

# SYSTEM BONDING & GROUNDING

INSTALLATION GUIDE : PAGE **Q**



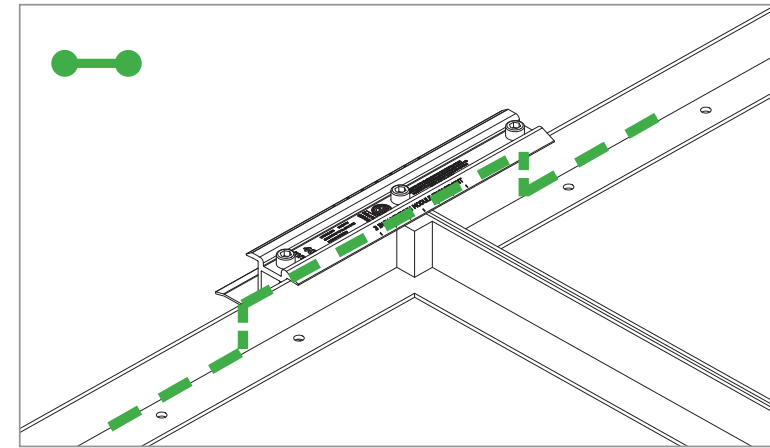
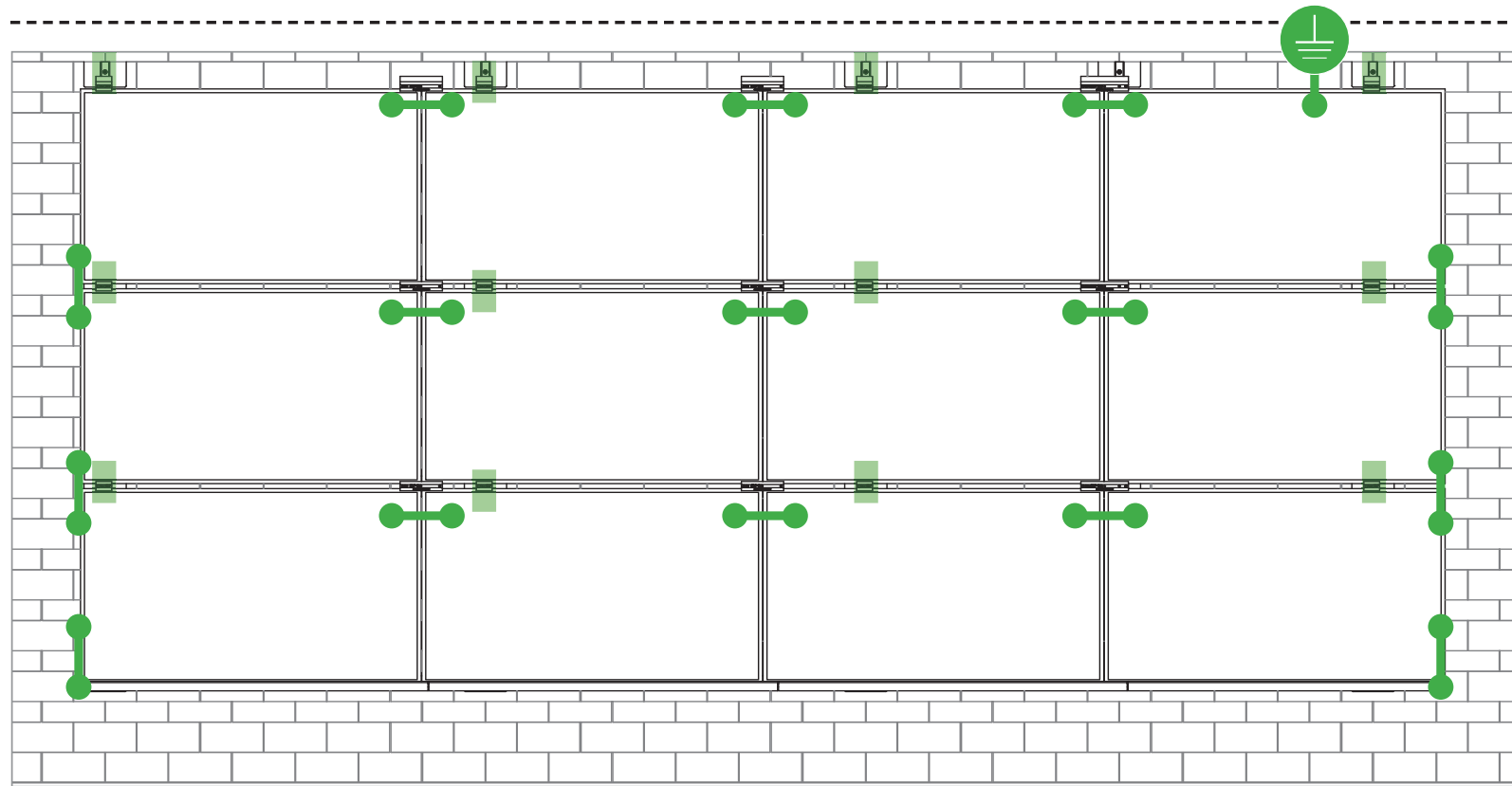
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RAVEN SOLAR LLC.

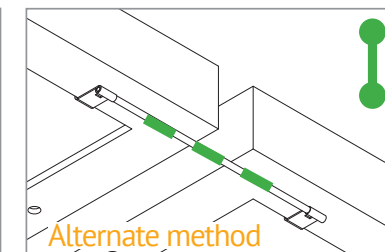
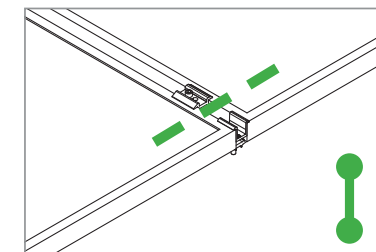


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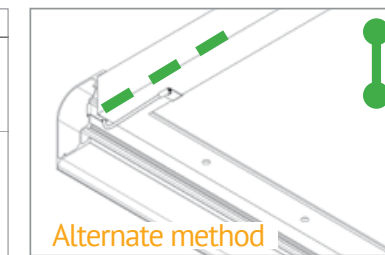
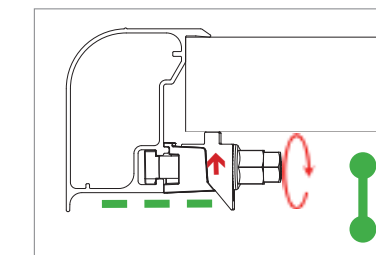
**E-W BONDING PATH:**

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:**

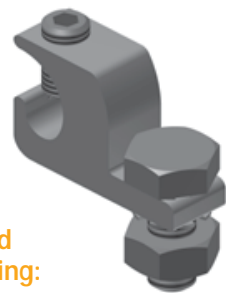
N-S module to module bonding is accomplished with bonding clamp with 2 integral bonding pins. (refer also to alternate method)



**TRIMRAIL BONDING PATH:**

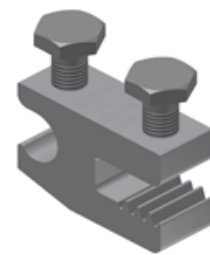
Trimrail to module bonding is accomplished with bonding clamp with integral bonding pin and bonding T-bolt. (refer also to alternate method)

Star Washer is  
Single Use Only

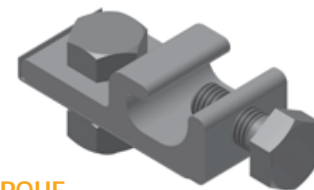


TERMINAL TORQUE,  
Install Conductor and  
torque to the following:  
4-6 AWG: 35in-lbs  
8 AWG: 25 in-lbs  
10-14 AWG: 20 in-lbs

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



WEEBLUG  
Single Use Only



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

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

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

**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.

SHEET NAME  
**SPEC SHEET**

PAGE NUMBER  
**SS**

REVISION  
**0**

### 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

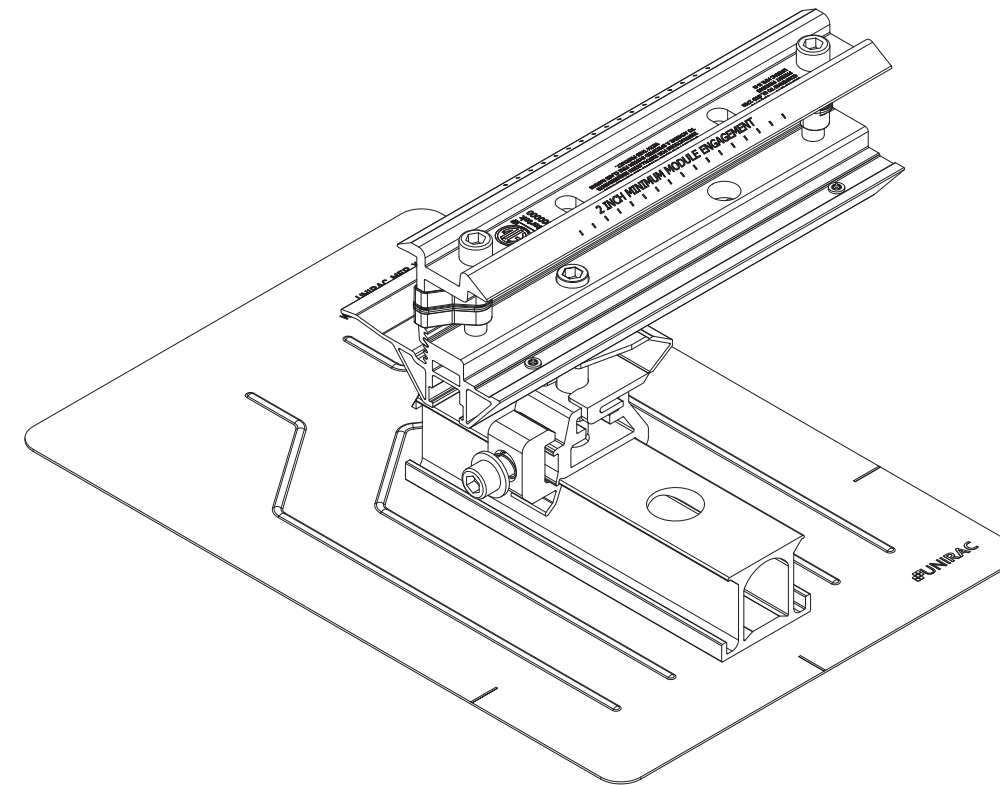
### UL2703 TEST MODULES

See page "S" 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 = 22.3 sqft
- UL2703 Design Load Ratings:
  - a) Downward Pressure – 113 PSF / 5400 Pa
  - b) Upward Pressure – 50 PSF / 2400 Pa
  - c) Down-Slope Load – 30 PSF / 1400 Pa
- Tested Loads:
  - a) Downward Pressure – 170 PSF / 8000 Pa
  - b) Upward Pressure – 75 PSF / 3500 Pa
  - c) Down-Slope Load – 45 PSF / 2100 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

### LABEL MARKINGS

- System fire class rating: See installation instructions for installation requirements to achieve a specified system fire class rating with Unirac .
- Unirac SUNFRAME MICRORAIL™ is listed to UL 2703.
- All splices within a system are shipped with marking indicating date and location of manufacture.



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	AXI Power, AXI Premium, AXI Black Premium
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS6V-M, CS6P-P, CS6K-M, CS5A-M, CS6K-MS, CS6U-P, CS6U-M, CS6X-P, CS6K-MS, CS6K-M, CS6K-P, CS6P-P, CS6P-M, CS3U-P, CS3U-MS, CS3K-P, CS3K-MS, CS1K-MS, CS3K, CS3U, CS3U-MB-AG, CS3K-MB-AG, CS6K, CS6U, CS3L, CS3W, CS1H-MS, CS1U-MS
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04
Dehui	DH-60M
Eco Solargy	Orion 1000 & Apollo 1000
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
ITEK	iT, iT-HE & iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series

Manufacture	Module Model / Series
JA Solar	JAP6 60-xxx, JAM6-60-xxx/SI, JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB, JAP72SYY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP60SYY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM72SYY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM60SYY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HiT, IB, MW
Jinko	JKM & JKMS Series
Kyocera	KU Series
LG Electronics	LG xxx S1C-A5, LG xxx N1C-A5, LGxxxQ1C(Q1K)-A5, LGxxxN1C(N1K)-A5, LGxxxS1CA5, LGxxxA1C-A5, LGxxxN2T-A4, LGxxxN2T-A5, LGxxxN2W-A5, LGxxxS2W-A5, LGxxxE1C-A5, LGxxxS2W-G4, LGxxxN1C(N1K)-G4, LGxxxN2W-G4, LGxxxS1C-G4, LGxxxE1K-A5, LGxxxN2T-J5, LGxxxN1K(N1C)-V5, LGxxxQ1C(N2W)-V5,
LONGi	LR6-60 & LR6-72 Series, LR4-60 & LR4-72 Series
Mission Solar Energy	MSE Series
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M & D6P 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
Q.Cells	Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7

Manufacture	Module Model / Series
REC	PEAK Energy Series, PEAK Energy BLK2 Series, PEAK Energy 72 Series, TwinPeak 2 Series, TwinPeak 2 BLK2 Series, TwinPeak Series
Renesola	Vitrus2 Series & 156 Series
Risen	RSM Series
S-Energy	SN72 & SN60 Series (40mm)
Seraphim	SEG-6 & SRP-6 Series
Sharp	NU-SA & NU-SC Series
Silfab	SLA, SLG & BC Series
Solaria	PowerXT
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
Tesla	SC, SC B, SC B1, SC B2
Trina	PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE14, DE15, PE15H
Upsolar	UP-MxxxP(-B), UP-MxxxM(-B)
URE	D7MxxxH8A, D7KxxxH8A, D7MxxxH7A
Vikram	Eldora, Solivo, Somera
Waaree	AC & Adiya Series
Winaico	WST & WSP Series
Yingli	YGE & YLM Series

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 32mm and more than 40mm. See page J for further information.



### AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

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**Applicant:** Unirac, Inc

**Manufacturer:**

**Address:** 1411 Broadway Blvd NE  
Albuquerque, NM 87102

**Address:**

**Country:** USA  
**Contact:** Klaus Nicolaedis

**Country:**  
**Contact:**

**Phone:** 505-462-2190  
505-843-1418

**Phone:**

**FAX:** NA  
**Email:** klaus.nicolaedis@unirac.com  
toddg@unirac.com

**FAX:**  
**Email:**

**Party Authorized To Apply Mark:** Same as Manufacturer  
**Report Issuing Office:** Lake Forest, CA

**Control Number:** 5003705

**Authorized by:**

*Claudia Ladynski*  
for L. Matthew Snyder, Certification Manager



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545 East Algonquin Road, Arlington Heights, IL 60005  
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

<b>Standard(s):</b>	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703: 2015 Ed.1] Photovoltaic Module Racking Systems [CSA LTR AE-001:2012 Ed.2012/10/23]
<b>Product:</b>	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2020MAY04
<b>Brand Name:</b>	Unirac
<b>Models:</b>	Unirac SFM



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**Country:**  
**Contact:**

**Phone:** 505-462-2190  
505-843-1418

**Phone:**

**FAX:** NA  
**Email:** klaus.nicolaedis@unirac.com  
toddg@unirac.com

**FAX:**  
**Email:**

**Party Authorized To Apply Mark:** Same as Manufacturer  
**Report Issuing Office:** Lake Forest, CA

**Control Number:** 5003705

**Authorized by:**

*Claudia Ladynski*  
for L. Matthew Snyder, Certification Manager



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545 East Algonquin Road, Arlington Heights, IL 60005  
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

<b>Standard(s):</b>	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703: 2015 Ed.1] Photovoltaic Module Racking Systems [CSA LTR AE-001:2012 Ed.2012/10/23]
<b>Product:</b>	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2020MAY04
<b>Brand Name:</b>	Unirac
<b>Models:</b>	Unirac SFM

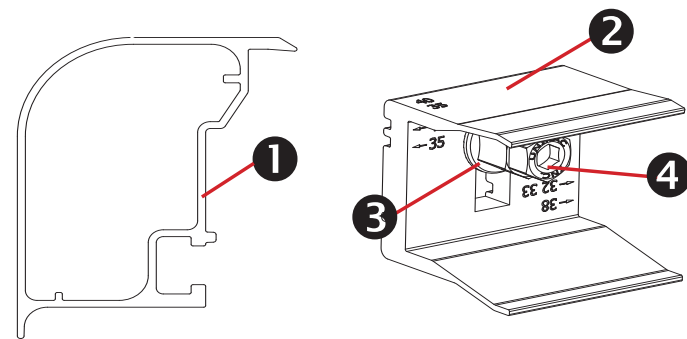


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385.498.6700



### 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

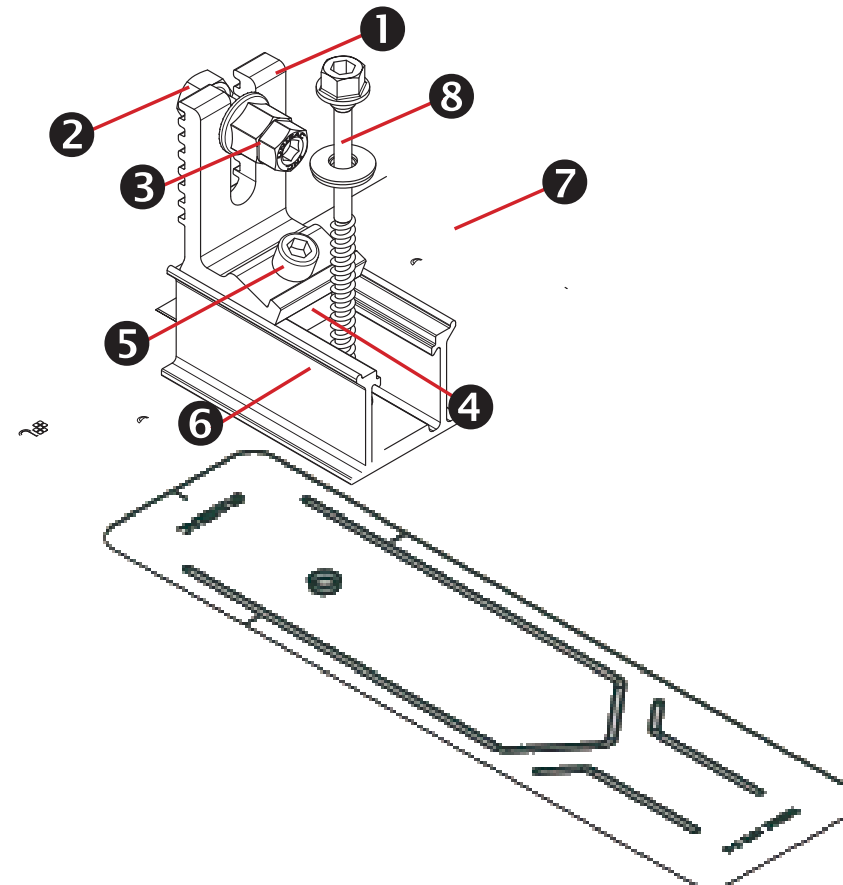
#### Module Clips

##### 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:

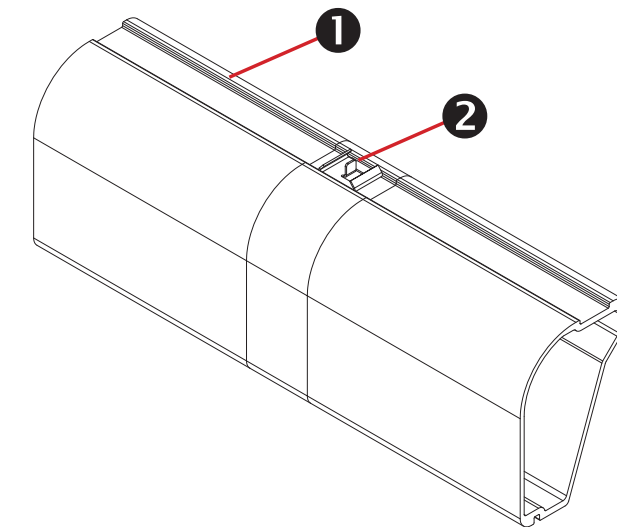
- L-Foot
- Hex bolt
- Tri-drive nut
- Channel Nut
- Socket Head Cap Screw
- 3\"Channel/Slider w/grommet
- 3\" Wide Flashing
- Structural Screw & SS EPDM Washer

##### 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

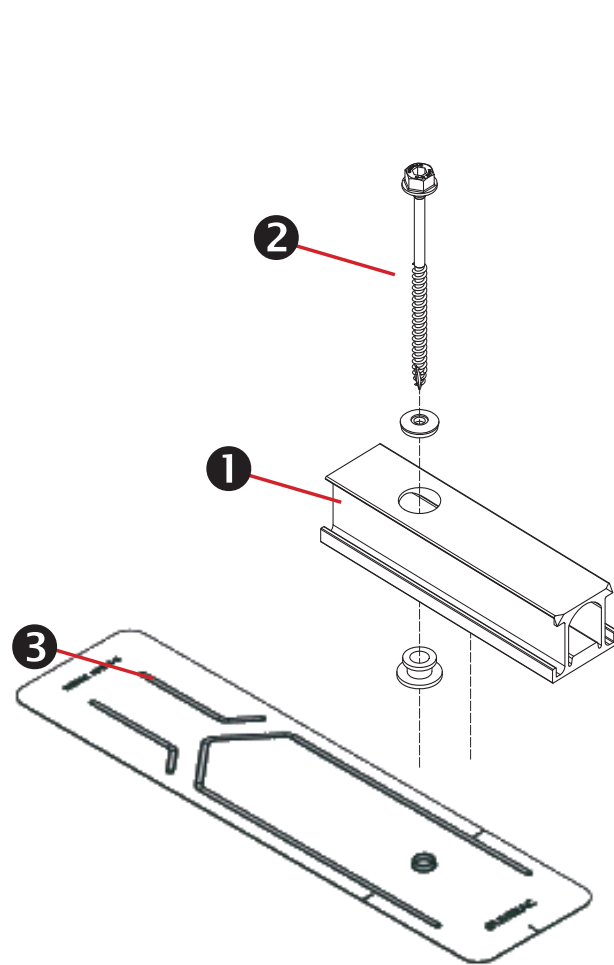
##### Functions:

- 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:

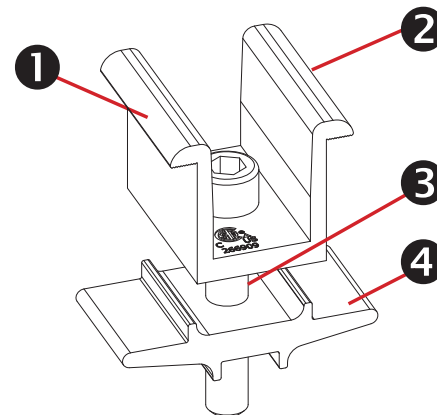
1. Slider w/grommet
2. Structural Screw & SS EPDM washer
3. 3" Wide Flashing

#### 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



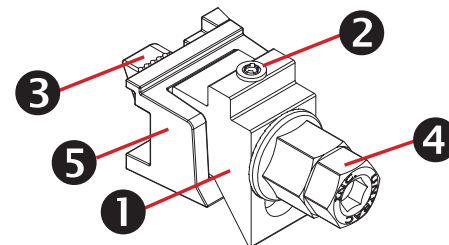
### Module-to-Module N-S Bonding

#### 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



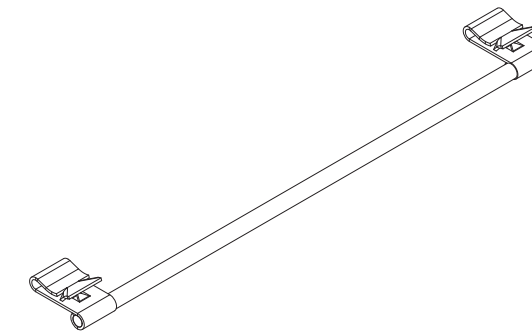
### Trim -to- Module Bonding Clamp and Floating Trim Clamp

#### 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



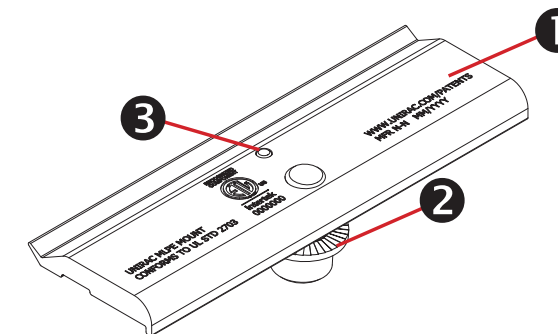
### Wire Bonding Clip w/ 8AWG

#### 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

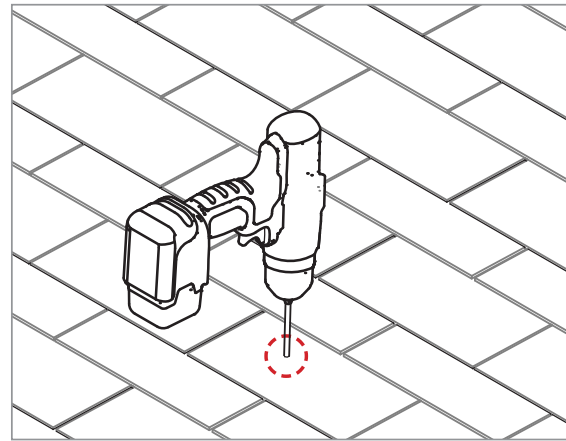
#### Functions:

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

#### Features:

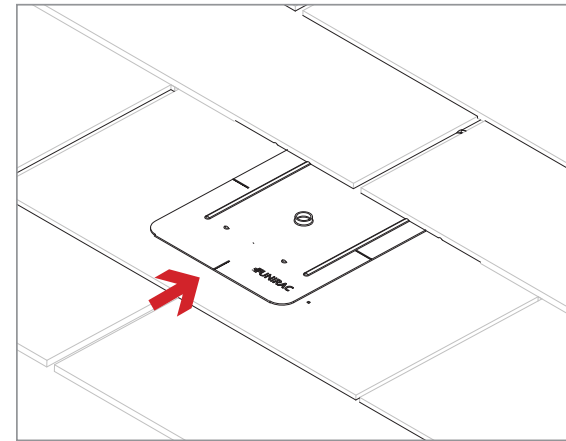
- Mounts easily to typical module flange
- UL2703 Recognized

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



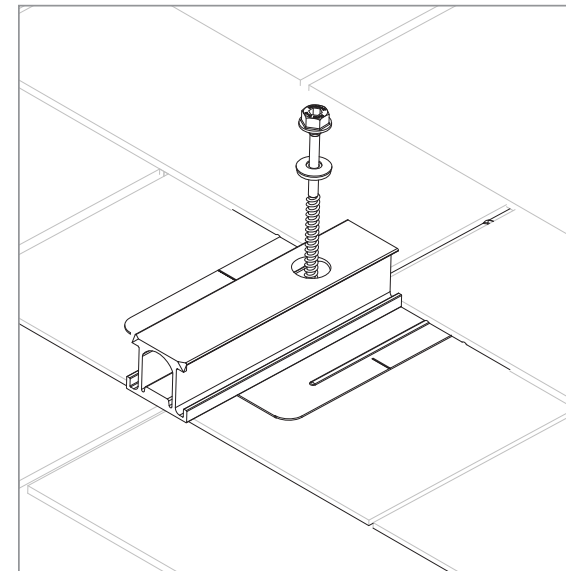
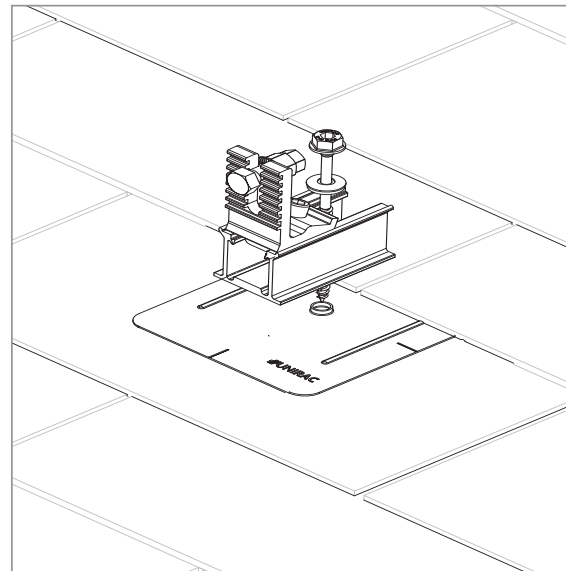
**PILOT HOLES:**

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.

