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 (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.
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: 1
CONDUIT RUN: Interior
ECOBEE QTY: 1
LIGHT BULB QTY: 18
PV METER: Not Required

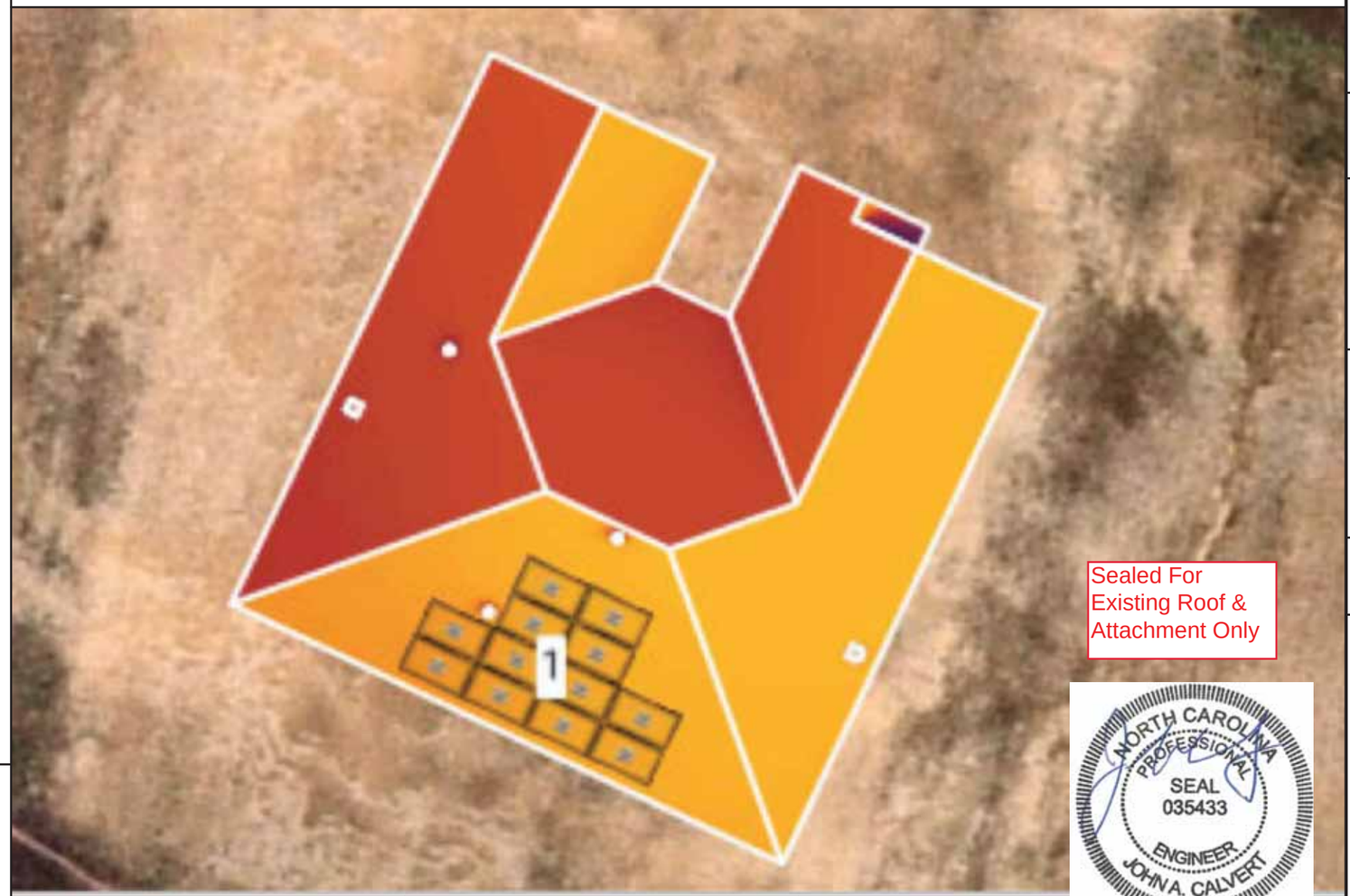
ROOF TYPE (1) INFORMATION:
ROOF TYPE: Comp Shingle
FRAMING TYPE: Manufactured Truss
SHEATHING TYPE: OSB
ATTACHMENT: SFM Infinity Switchblade Flashkit
RACKING: Unirac SFM Infinity @ 48" OC Portrait / 72" OC Landscape
NUMBER OF ATTACHMENTS: 21

ROOF TYPE (2) INFORMATION *(IF APPLICABLE)*:
SEE PV4.2

SYSTEM TO BE INSTALLED INFORMATION:

DC SYSTEM SIZE: 4.68 kW DC
AC SYSTEM SIZE: 3.48 kW AC
MODULE TYPE: (12) Trina TSM-DE09C.07 390
INVERTER TYPE: Enphase IQ8PLUS-72-2-US
MONITORING: Enphase IQ Combiner 4 X-IQ-AM1-240-4

AERIAL VIEW



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NORTH CAROLINA PROFESSIONAL SEAL 035433 ENGINEER JOHN A. CALVERT

Firm No. : D-0449

11/2/2022

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.

NOTICE TO CONTRACTOR
All construction must comply with current NC Building Codes and is subject to field inspection and verification.
APPROVED
Limited Building only review
Permit holder responsible for full compliance with the code
12/14/2022
Harnett COUNTY NORTH CAROLINA

SHEET INDEX

PV1 - COVER SHEET
PV2 - SITE PLAN
PV3 - ROOF PLAN
PV4 - STRUCTURAL
PV5 - ELECTRICAL 3-LINE DIAGRAM
PV6 - ELECTRICAL CALCULATIONS
PV7 - WARNING LABELS AND LOCATIONS
(ALL OTHER SHEETS AS REQUIRED)
SS - PRODUCT SPEC. SHEETS

UTILITY COMPANY:

Duke Energy NC

PERMIT ISSUER:

Harnett County

Digitally signed by John A. Calvert
Date: 2022.11.02 15:50:06 -06'00'

BLUE RAVEN SOLAR
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP CERTIFIED
PV INSTALLATION PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
800-377-4480

CUSTOMER INFORMATION:
Matthew Porter
155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

DRAWING BY:
PremiumCAD

PLOT DATE:
November 2, 2022

PROJECT NUMBER:
643068

SHEET NAME:
COVER SHEET

REVISION: 0

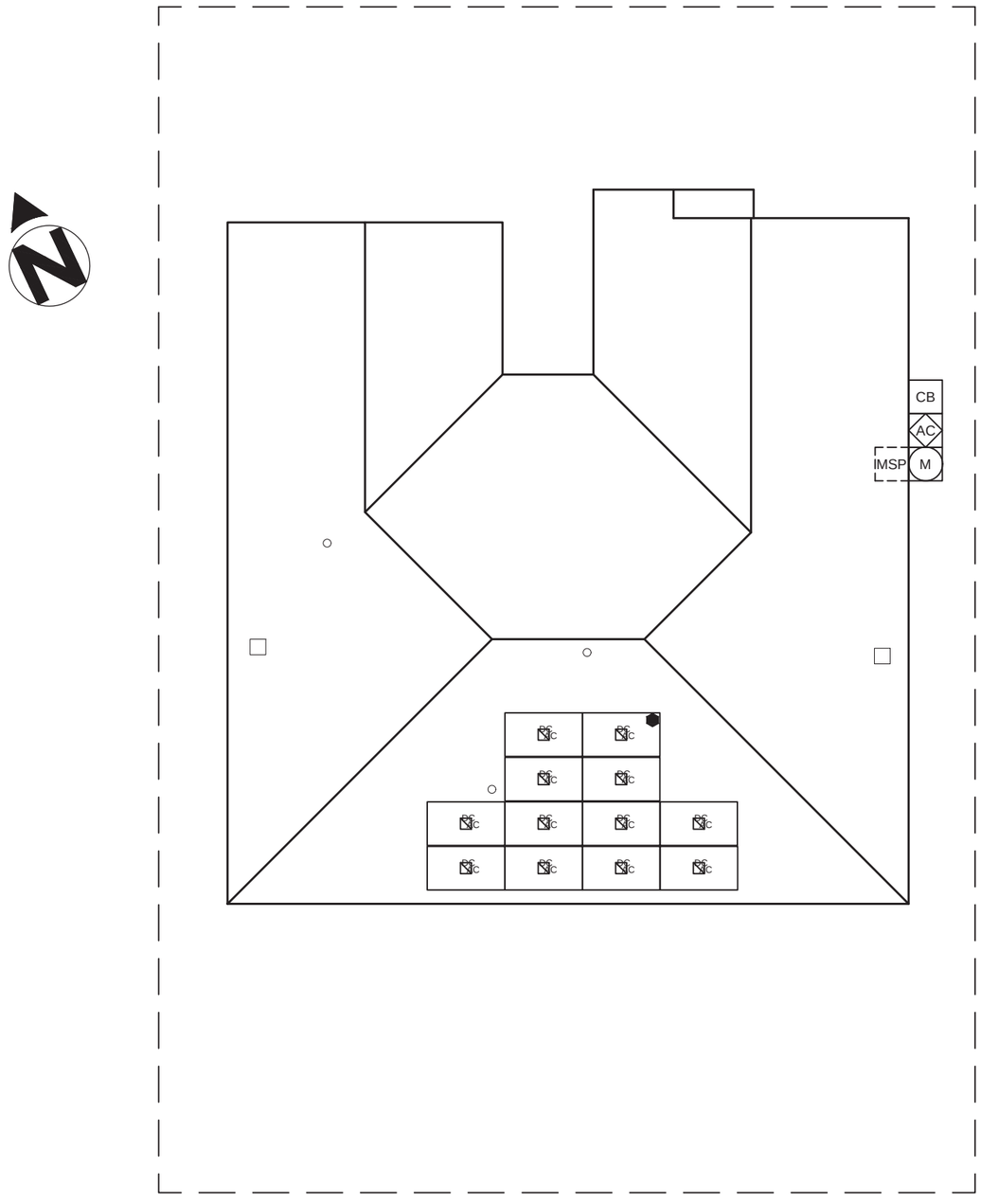
PAGE NUMBER: PV1

PV SYSTEM SPECIFICATIONS

TOTAL NUMBER OF MODULES: 12
MODULE MAKE AND MODEL: Trina TSM-DE09C.07 390
MODULE WATTAGE: 390W DC

INVERTER MAKE AND MODEL: Enphase IQ8PLUS-72-2-US
INVERTER TYPE: Microinverter (1 Inverter per PV Module)
INVERTER CURRENT OUTPUT: 1.21A AC
INVERTER NOMINAL VOLTAGE: 240V
INVERTER WATTAGE: 290W AC

FRONT OF HOME
155 ST CLAIR DR



LEGEND

- JUNCTION BOX
- M — UTILITY METER
- MSP — MAIN SERVICE PANEL
- AC — AC DISCONNECT
- CB — COMBINER BOX
- LC — LOAD CENTER
- SUB — SUBPANEL
- PV — PV METER
- TS — TRANSFER SWITCH
- ESS — SUNPOWER ESS
- HUB — SUNPOWER HUB+
- RPO — REMOTE POWER OFF
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

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

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11/2/2022

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800-377-4480

CUSTOMER INFORMATION:
Matthew Porter
155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

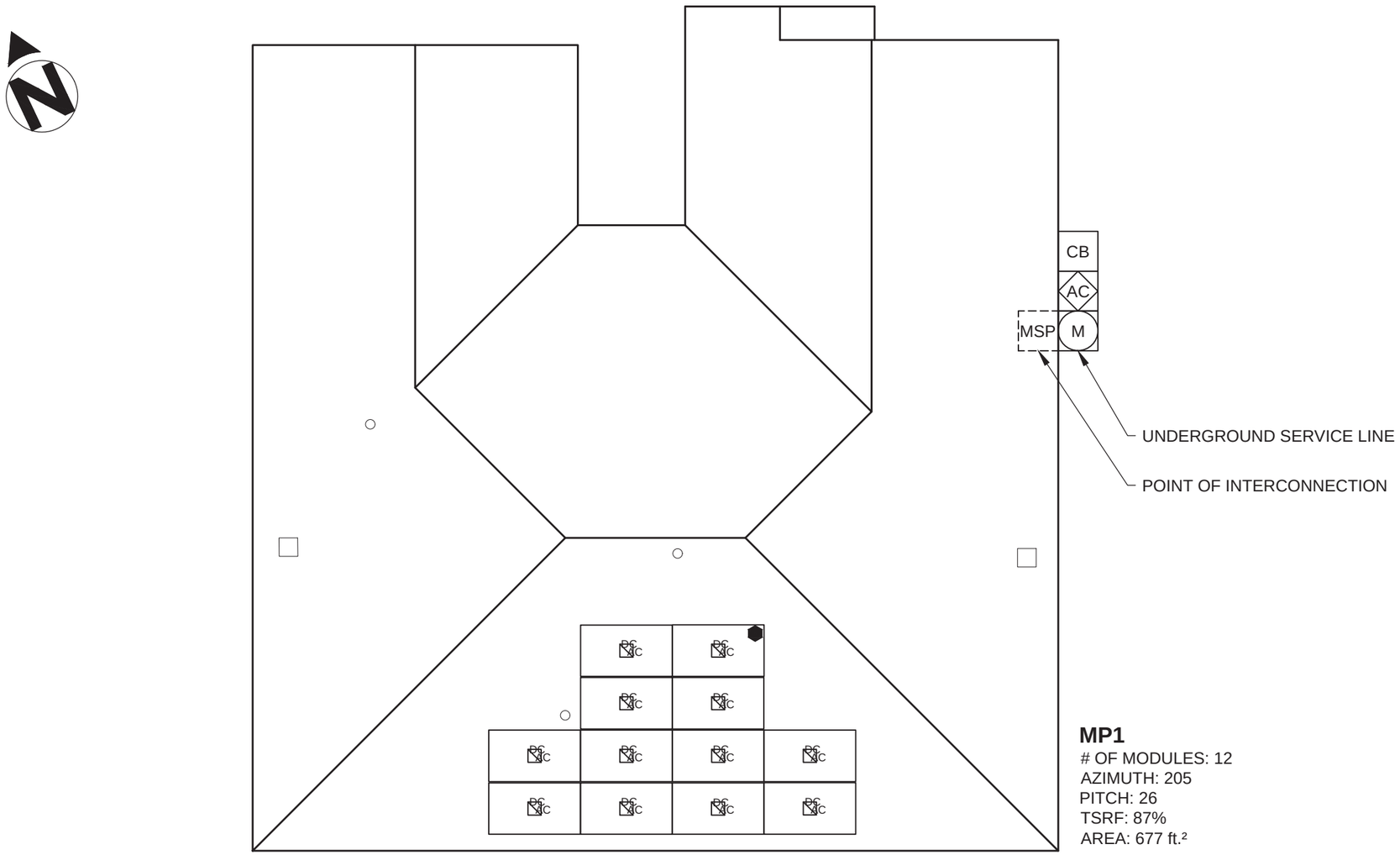
DRAWING BY: PremiumCAD
PLOT DATE: November 2, 2022
PROJECT NUMBER: 643068
SHEET NAME: SITE PLAN
REVISION: 0
PAGE NUMBER: PV2

PV SYSTEM SPECIFICATIONS

TOTAL NUMBER OF MODULES: 12
MODULE MAKE AND MODEL: Trina TSM-DE09C.07 390
MODULE WATTAGE: 390W DC

INVERTER MAKE AND MODEL: Enphase IQ8PLUS-72-2-US
INVERTER TYPE: Microinverter (1 Inverter per PV Module)
INVERTER CURRENT OUTPUT: 1.21A AC
INVERTER NOMINAL VOLTAGE: 240V
INVERTER WATTAGE: 290W AC

FRONT OF HOME



MP1
OF MODULES: 12
AZIMUTH: 205
PITCH: 26
TSRF: 87%
AREA: 677 ft.²

DC SYSTEM SIZE: 4.68 kW DC
MODULE: (Trina TSM-DE09C.07 390)
INVERTER(S): Enphase IQ8PLUS-72-2-US

LEGEND

- JUNCTION BOX
- M — UTILITY METER
- MSP — MAIN SERVICE PANEL
- AC — AC DISCONNECT
- CB — COMBINER BOX
- LC — LOAD CENTER
- SUB — SUBPANEL
- PV — PV METER
- TS — TRANSFER SWITCH
- ESS — SUNPOWER ESS
- HUB — SUNPOWER HUB+
- RPO — REMOTE POWER OFF
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

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

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800-377-4480

CUSTOMER INFORMATION:
Matthew Porter
155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

DRAWING BY: PremiumCAD
PLOT DATE: November 2, 2022
PROJECT NUMBER: 643068
SHEET NAME: ROOF PLAN
REVISION: 0
PAGE NUMBER: PV3

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

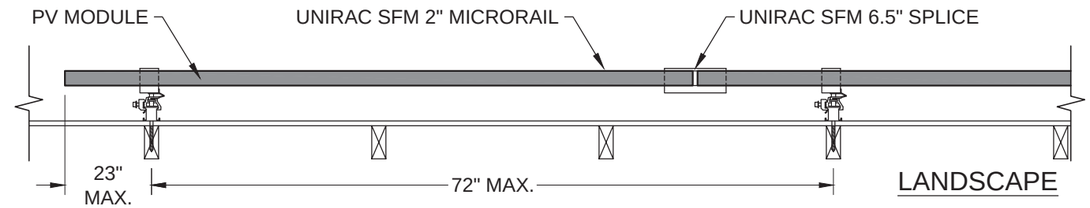
ATTACHMENT: SFM Infinity Switchblade Flashkit
RACKING: Unirac SFM Infinity
@ 48" OC Portrait / 72" OC Landscape
NUMBER OF ATTACHMENTS: 21

PV MODULE COUNT: 12 Modules
TOTAL ARRAY AREA: 244.8 ft² (20.4ft²/panel)
TOTAL ROOF AREA: 2804 ft²
ARRAY/ROOF AREA: 8.7%
ARRAY WEIGHT: 600 lbs (50 lbs/panel)
DISTRIBUTED LOAD: 2.45 lbs/ft²
POINT LOAD: 28.57 lbs/attachment

STRUCTURAL NOTES:

None

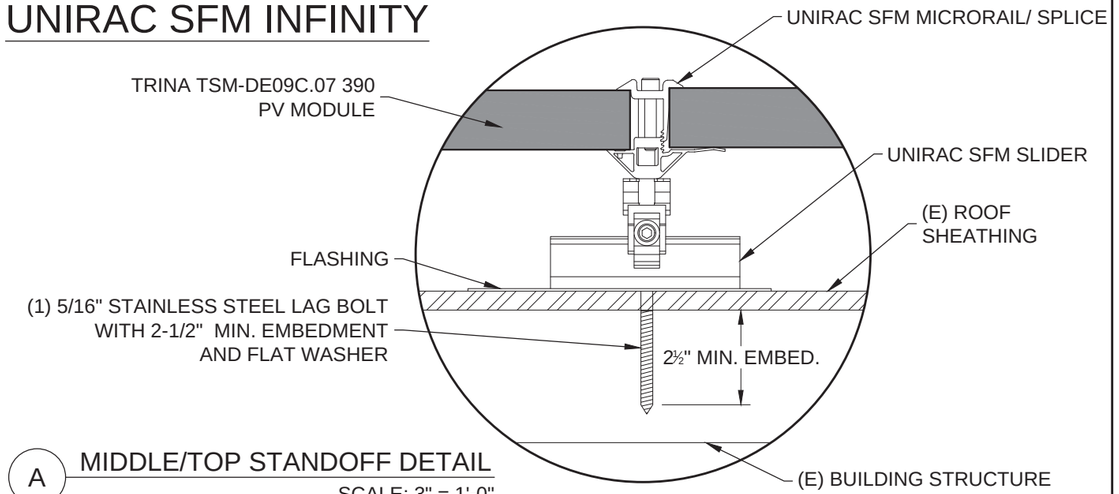
*NOTE: LISTED NUMBER OF ATTACHMENT POINTS ARE AN ESTIMATE ONLY AND MAY VARY BASED ON FIELD CONDITIONS. MAXIMUM ATTACHMENT SPACING TO BE FOLLOWED PER ENGINEER OF RECORD SPECIFICATIONS.



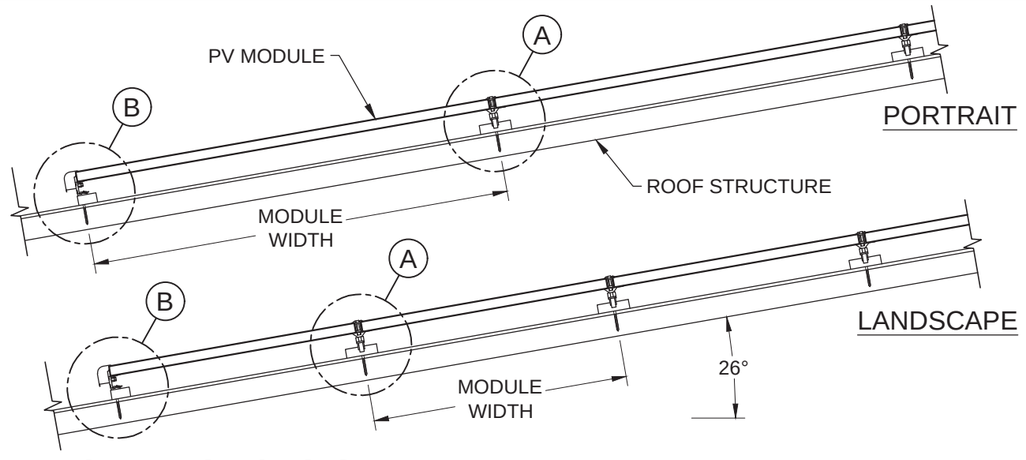
C ATTACHMENT SPACING- FRONT VIEW
SCALE: 3/4" = 1'-0"

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

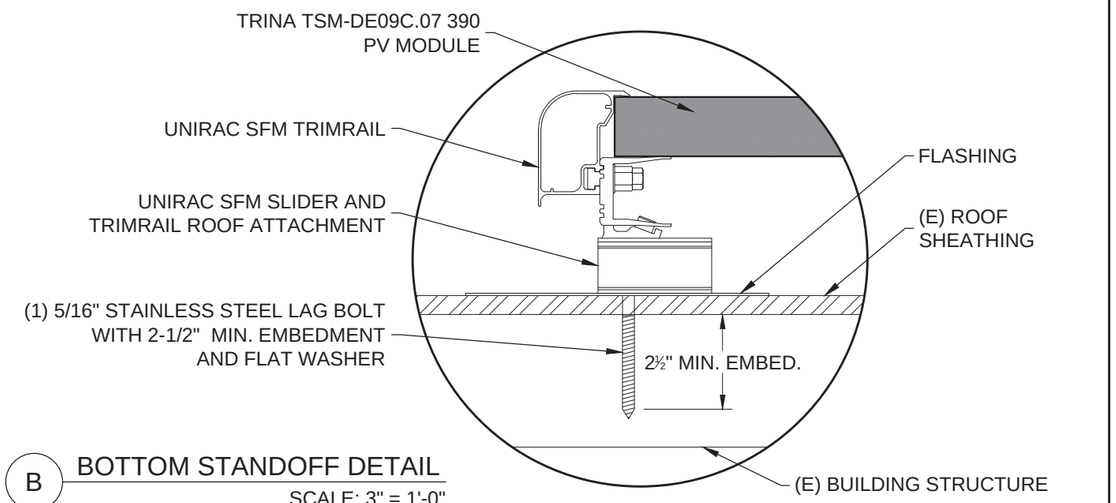
UNIRAC SFM INFINITY



A MIDDLE/TOP STANDOFF DETAIL
SCALE: 3" = 1'-0"



D ATTACHMENT SPACING- SIDE VIEW
SCALE: 1/2" = 1'-0"



B BOTTOM STANDOFF DETAIL
SCALE: 3" = 1'-0"

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CUSTOMER INFORMATION:
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155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

DRAWING BY:
PremiumCAD

PLOT DATE:
November 2, 2022

PROJECT NUMBER:
643068

SHEET NAME:
STRUCTURAL

REVISION:	PAGE NUMBER:
0	PV4

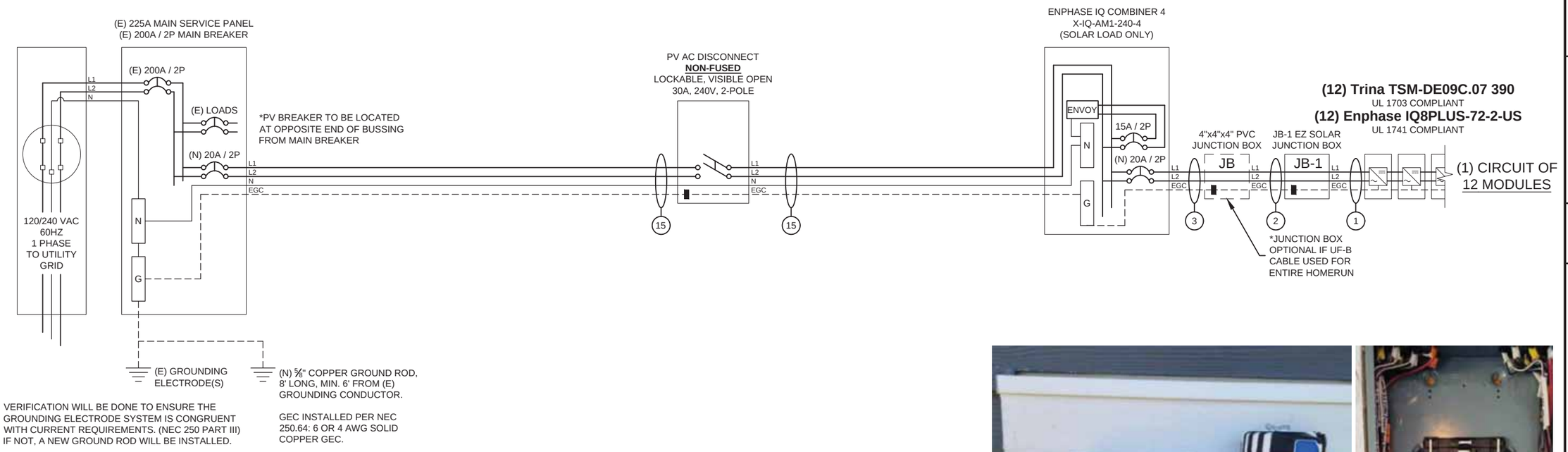
15	(1) 10 AWG THHN/THWN-2, CU., BLACK (L1) (1) 10 AWG THHN/THWN-2, CU., RED (L2) (1) 10 AWG THHN/THWN-2, CU., WHITE (N) (1) 10 AWG THHN/THWN-2, CU., GREEN (EGC) (1) 3/4 INCH EMT	14.5 A AC 240 V AC EXTERIOR	3	(1) 10 - 2 UF-B W/G, THHN/THWN-2, SOLID CU.	MAX 14.5 A AC 240 V AC EXTERIOR	2	(1) 10 - 2 UF-B (or NM) W/G, THHN/THWN-2, SO	MAX 14.5 A AC 240 V AC INTERIOR	1	(1) 12-2 TC-ER,THHN/THWN-2, CU. (1) 6 AWG BARE, CU (EGC)	MAX 14.5 A AC 240 V AC EXTERIOR

DESIGNER NOTES:

LOAD SIDE BREAKER IN MSP, INTERIOR POI

ELECTRICAL NOTES:

12 INVERTERS x 290 W AC = 3.48 kW AC
PANEL WATTAGE = 390 W DC



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 12O PERCENT OF THE AMPACITY OF THE BUSBAR.

UTILITY COMPANY: Duke Energy NC **PERMIT ISSUER:** Harnett County

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CONTRACTOR:
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CUSTOMER INFORMATION:
Matthew Porter
155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

DRAWING BY: PremiumCAD
PLOT DATE: November 2, 2022
PROJECT NUMBER: 643068
SHEET NAME: ELECTRICAL
REVISION: 0
PAGE NUMBER: PV5

MODULE SPECIFICATIONS	Trina TSM-DE09C.07 390
RATED POWER (STC)	390 W
MODULE VOC	40.8 V DC
MODULE VMP	33.8 V DC
MODULE IMP	11.5 A DC
MODULE ISC	12.1 A DC
VOC CORRECTION	-0.25 %/°C
VMP CORRECTION	-0.34 %/°C
SERIES FUSE RATING	25 A DC
ADJ. MODULE VOC @ ASHRAE LOW TEMP	44.4 V DC
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	29.0 V DC

MICROINVERTER SPECIFICATIONS	Enphase IQ8+ Microinverters
POWER POINT TRACKING (MPPT) MIN/MAX	30 - 58 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	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	12					
DC POWER RATING PER CIRCUIT (STC)	4680					
TOTAL MODULE NUMBER	12 MODULES					
STC RATING OF ARRAY	4680W DC					
AC CURRENT @ MAX POWER POINT (IMP)	14.5					
MAX. CURRENT (IMP X 1.25)	18.15					
OCPD CURRENT RATING PER CIRCUIT	20					
MAX. COMB. ARRAY AC CURRENT (IMP)	14.5					
MAX. ARRAY AC POWER	3480W AC					

AC VOLTAGE RISE CALCULATIONS	DIST (FT)	COND.	ΔRISE(V)	VEND(V	%VRISE
VRISE SEC. 1 (MICRO TO JBOX)	43.2	12 Cu.	2.09	242.09	0.87%
VRISE SEC. 2 (JBOX TO COMBINER BOX)	45	10 Cu.	1.66	241.66	0.69%
VRISE SEC. 3 (COMBINER BOX TO POI)	5	10 Cu.	0.18	240.18	0.08%
TOTAL VRISE			3.94	243.94	

PHOTOVOLTAIC AC DISCONNECT OUTPUT LABEL (NEC 690.54)	
AC OUTPUT CURRENT	14.5 A AC
NOMINAL AC VOLTAGE	240 V AC

CONDUCTOR SIZE CALCULATIONS					
MICROINVERTER TO JUNCTION BOX (1)	MAX. SHORT CIRCUIT CURRRENT (ISC) =	14.5	A AC		
	MAX. CURRENT (ISC X1.25) =	18.2	A AC		
	CONDUCTOR (TC-ER, COPPER (90°C)) =	12	AWG		
	CONDUCTOR RATING =	30	A		
	AMB. TEMP. AMP. CORRECTION =	0.96			
	ADJUSTED AMP. =	28.8	>	18.2	
JUNCTION BOX TO JUNCTION BOX (2)	MAX. SHORT CIRCUIT CURRRENT (ISC) =	14.5	A AC		
	MAX. CURRENT (ISC X1.25) =	18.2	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	>	18.2	
JUNCTION BOX TO COMBINER BOX (3)	MAX. SHORT CIRCUIT CURRRENT (ISC) =	14.5	A AC		
	MAX. CURRENT (ISC X1.25) =	18.2	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	>	18.2	
COMBINER BOX TO MAIN PV OCPD (15)	INVERTER RATED AMPS =	14.5	A AC		
	MAX. CURRENT (RATED AMPS X1.25) =	18.15	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	>	18.2	

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 DEVISES 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-011719-015866

CONTRACTOR:
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800-377-4480

CUSTOMER INFORMATION:
Matthew Porter
155 St Clair Dr
Fuquay Varina, North Carolina 27526

AC SYSTEM SIZE: 3.48 kW AC
DC SYSTEM SIZE: 4.68 kW DC

DRAWING BY:
PremiumCAD

PLOT DATE:
November 2, 2022

PROJECT NUMBER:
643068

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.
[2017 NEC 690.13(B)]
[2020 NEC 690.13(B)]

PHOTOVOLTAIC SYSTEM
⚠ AC DISCONNECT ⚠
RATED AC OUTPUT CURRENT 14.52 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.
[2017 NEC 690.54]
[2020 NEC 690.54]

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

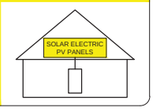
LABEL 3
IF INTERCONNECTING LOAD SIDE, INSTALL THIS LABEL ANYWHERE THAT IS POWERED BY BOTH THE UTILITY AND THE SOLAR PV SYSTEM, IE. MAIN SERVICE PANEL AND SUBPANELS.
[2017 NEC 705.12(B)(3)]
[2020 NEC 705.12(B)(3)]

⚠ 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.
[2017 NEC 705.12(B)(2)(3)(b)]
[2020 NEC 705.12(B)(3)(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
[2017 NEC 705.12(B)(2)(3)(c)]
[2020 NEC 705.12(B)(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.
[2017 NEC 690.56(C)(1)(a)]
[2020 NEC 690.56(C)]

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 7
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH
[2017 NEC 690.56(C)(3)]
[2020 NEC 690.56(C)(2)]

⚠ 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 SITE 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]
[2020 NEC 705.10]

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

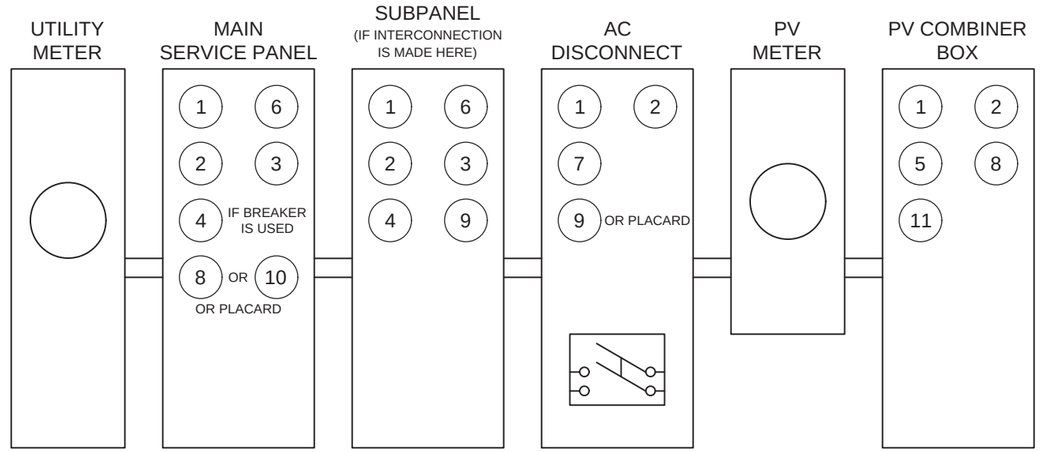
LABEL 9
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED.
[2017 NEC 705.10]
[2020 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)(a)]
[2020 NEC 705.10 AND 690.56(C)]

⚠ WARNING
PHOTOVOLTAIC SYSTEM COMBINER PANEL
DO NOT ADD LOADS

LABEL 11
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT AC COMBINER PANEL.
[2017 NEC 110.21(B)]
[2020 NEC 110.21(B)]



ADDITIONAL LABELS

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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ENPHASE

DATA SHEET

IQ8 and IQ8+ Microinverters

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

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

Enphase 25 year limited warranty

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

Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.

UL CERTIFIED SAFETY

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

Easy to install

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

High productivity and reliability

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

Microgrid-forming

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

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

IQ8 and IQ8+ Microinverters

INPUT DATA (DC)		IQ8-60-2-US	IQ8PLUS-72-2-US
Commonly used module pairings[1]	W	235 – 350	235 – 440
Module compatibility		60-cell/120 half-cell	60-cell/120 half-cell, 66-cell/132 half-cell and 72-cell/144 half-cell
MPPT voltage range	V	27 – 37	29 – 45
Operating range	V	25 – 48	25 – 58
Min/max start voltage	V	30 / 48	30 / 58
Max input DC voltage	V	50	60
Max DC current[2] [module Isc]	A	15	
Overvoltage class DC port		II	
DC port backfeed current	mA	0	
PV array configuration		1x1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit	
OUTPUT DATA (AC)		**IQ8-60-2-US**	**IQ8PLUS-72-2-US**
Peak output power	VA	245	300
Max continuous output power	VA	240	290
Nominal (L-L) voltage/range[3]	V	240 / 211 – 264	
Max continuous output current	A	1.0	1.21
Nominal frequency	Hz	60	
Extended frequency range	Hz	50 – 68	
AC short circuit fault current over 3 cycles	Arms	2	
Max units per 20 A (L-L) branch circuit[4]		16	13
Total harmonic distortion		<5%	
Overvoltage class AC port		III	
AC port backfeed current	mA	30	
Power factor setting		1.0	
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging	
Peak efficiency	%	97.5	97.6
CEC weighted efficiency	%	97	97
Night-time power consumption	mW	60	
MECHANICAL DATA			
Ambient temperature range		-40°C to +60°C (-40°F to +140°F)	
Relative humidity range		4% to 100% (condensing)	
DC Connector type		MC4	
Dimensions (HxWxD)		212 mm (8.3") x 175 mm (6.9") x 30.2 mm (1.2")	
Weight		1.08 kg (2.38 lbs)	
Cooling		Natural convection – no fans	
Approved for wet locations		Yes	
Pollution degree		PD3	
Enclosure		Class II double-insulated, corrosion resistant polymeric enclosure	
Environ. category / UV exposure rating		NEMA Type 6 / outdoor	
COMPLIANCE			
Certifications		CA Rule 21 (UL 1741-SA), UL 62109-1, 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 C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer's instructions.	

(1) No enforced DC/AC ratio. See the compatibility calculator at https://link.enphase.com/module-compatibility
(2) Maximum continuous input DC current is 10.6A (3) Nominal voltage range can be extended beyond nominal if required by the utility. (4) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

IQ8SP-DS-0002-01-EN-US-2022-03-17

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DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:
SPEC SHEET

REVISION: ----

PAGE NUMBER: SS

Data Sheet
Enphase Networking

Enphase IQ Combiner 4/4C

X-IQ-AM1-240-4

X-IQ-AM1-240-4C

X-IQ-AM1-240-4C

X-IQ-AM1-240-4

The **Enphase IQ Combiner 4/4C** with Enphase IQ Gateway and integrated LTE-M1 cell modem (included only with IQ Combiner 4C) consolidates interconnection equipment into a single enclosure and streamlines IQ microinverters 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 Gateway for communication and control
- Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), included only with IQ Combiner 4C
- Includes solar shield to match Enphase IQ Battery aesthetics and deflect heat
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and consumption monitoring

Simple

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

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- Two years labor reimbursement program coverage included for both the IQ Combiner SKU's
- UL listed

UL LISTED

To learn more about Enphase offerings, visit **enphase.com**

ENPHASE

Enphase IQ Combiner 4/4C

MODEL NUMBER	
IQ Combiner 4 (X-IQ-AM1-240-4)	IQ Combiner 4 with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes a silver solar shield to match the IQ Battery system and IQ System Controller 2 and to deflect heat.
IQ Combiner 4C (X-IQ-AM1-240-4C)	IQ Combiner 4C with Enphase IQ Gateway printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and consumption monitoring (+/- 2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), a plug-and-play industrial-grade cell modem for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.) Includes a silver solar shield to match the IQ Battery and IQ System Controller and to deflect heat.
ACCESSORIES AND REPLACEMENT PARTS	(not included, order separately)
Ensemble Communications Kit COMMS-CELLMODEM-M1-06 CELLMODEM-M1-06-SP-05 CELLMODEM-M1-06-AT-05	- Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with 5-year Sprint data plan for Ensemble sites - 4G based LTE-M1 cellular modem with 5-year Sprint data plan - 4G based LTE-M1 cellular modem with 5-year AT&T data plan
Circuit Breakers BRK-10A-2-240V BRK-15A-2-240V BRK-20A-2P-240V BRK-15A-2P-240V-B BRK-20A-2P-240V-B	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 Circuit breaker, 2 pole, 15A, Eaton BR215B with hold down kit support Circuit breaker, 2 pole, 20A, Eaton BR220B with hold down kit support
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 4/4C
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 4/4C (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Gateway printed circuit board (PCB) for Combiner 4/4C
X-IQ-NA-HD-125A	Hold down kit for Eaton circuit breaker with screws.
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating	65 A
Max. continuous current rating (input from PV/storage)	64 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. total branch circuit breaker rating (input)	80A of distributed generation / 95A with IQ Gateway breaker included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-SPLIT)	A pair of 200 A split core current transformers
MECHANICAL DATA	
Dimensions (WxHxD)	37.5 x 49.5 x 16.8 cm (14.75" x 19.5" x 6.63"). Height is 21.06" (53.5 cm) with mounting brackets.
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 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
Cellular	CELLMODEM-M1-06-SP-05, CELLMODEM-M1-06-AT-05 (4G based LTE-M1 cellular modem). Note that an Enphase Mobile Connect cellular modem is required for all Ensemble installations.
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
COMPLIANCE	
Compliance, IQ 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) Consumption metering: accuracy class 2.5
Compliance, IQ Gateway	UL 60601-1/CANCSA 22.2 No. 61010-1

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Mono Multi Solutions

Vertex S

BACKSHEET MONOCRYSTALLINE MODULE

PRODUCT: TSM-DE09C.07

PRODUCT RANGE: 380-405W

405W	0~+5W	21.1%
MAXIMUM POWER OUTPUT	POSITIVE POWER TOLERANCE	MAXIMUM EFFICIENCY

High value

- More productivity from same roof size.
- Outstanding visual appearance.
- Leading 210mm cell technology.

Small in size, big on power

- Small format module allow greater energy generation in limited space.
- Up to 405W, 21.1% module efficiency with high density interconnect technology.
- Multi-busbar technology for better light trapping effect, lower series resistance and improved current.
- Reduce installation cost with higher power bin and efficiency.
- Boost performance in warm weather with lower temperature coefficient (-0.34%) and operating temperature.

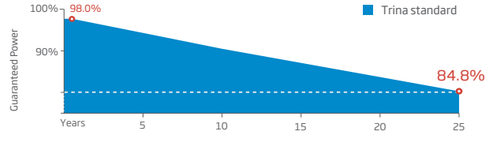
Universal solution for residential and C&I rooftops

- Designed for compatibility with existing mainstream optimizers, inverters and mounting systems.
- Perfect size and low weight makes handling and transportation easier and more cost-effective.
- Diverse installation solutions for flexibility in system deployment

High Reliability

- 25 year product warranty.
- 25 year performance warranty with lowest degradation.
- Minimized micro-cracks with innovative non-destructive cutting technology.
- Ensured PID resistance through cell process and module material control.
- Mechanical performance up to +6000 Pa and-4000 Pa negative load

Trina Solar's Backsheet Performance Warranty



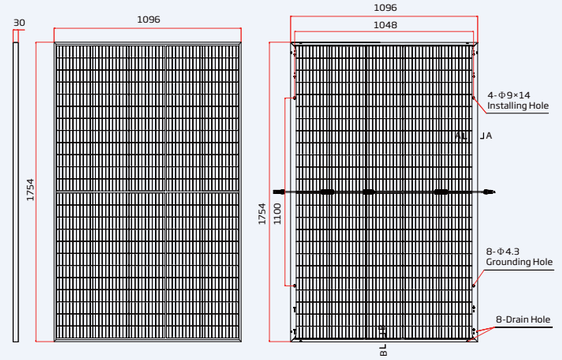
Comprehensive Products and System Certificates

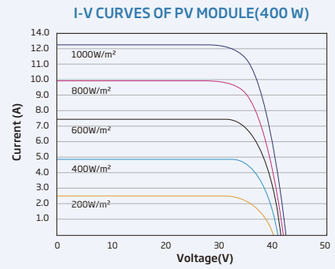
IEC61215/IEC61730/IEC61701/IEC62716/UL61730
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System

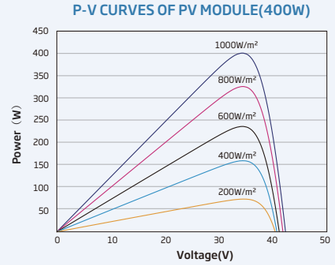
Trinasolar

Vertex S BACKSHEET MONOCRYSTALLINE MODULE

DIMENSIONS OF PV MODULE(mm)







ELECTRICAL DATA (STC)

Peak Power Watts-PMAX (Wp)*	380	385	390	395	400	405
Power Tolerance-PMAX (W)	0 ~ +5					
Maximum Power Voltage-VMPP (V)	33.4	33.6	33.8	34.0	34.2	34.4
Maximum Power Current-IMPP (A)	11.38	11.46	11.54	11.62	11.70	11.77
Open Circuit Voltage-VOC (V)	40.4	40.6	40.8	41.0	41.2	41.4
Short Circuit Current-ISC (A)	12.00	12.07	12.14	12.21	12.28	12.34
Module Efficiency η m (%)	19.8	20.0	20.3	20.5	20.8	21.1

STC: Irradiance 1000W/m2, Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%.

Electrical characteristics with different power bin (reference to 10% Irradiance ratio)

Total Equivalent power -PMAX (Wp)	407	412	417	423	428	433
Maximum Power Voltage-VMPP (V)	33.4	33.6	33.8	34.0	34.2	34.4
Maximum Power Current-IMPP (A)	12.19	12.26	12.34	12.44	12.51	12.59
Open Circuit Voltage-VOC (V)	40.4	40.6	40.8	41.0	41.2	41.4
Short Circuit Current-ISC (A)	12.92	13.00	13.08	13.20	13.25	13.36
Irradiance ratio (rear/front)	10%					

Power Bifaciality:70±5%.

ELECTRICAL DATA (NOCT)

Maximum Power-PMAX (Wp)	286	290	294	298	302	305
Maximum Power Voltage-VMPP (V)	31.4	31.6	31.8	31.9	32.1	32.4
Maximum Power Current-IMPP (A)	9.12	9.18	9.24	9.32	9.38	9.42
Open Circuit Voltage-VOC (V)	38.0	38.2	38.4	38.6	38.8	38.9
Short Circuit Current-ISC (A)	9.67	9.73	9.78	9.84	9.90	9.94

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

MECHANICAL DATA

Solar Cells	Monocrystalline
No. of cells	120 cells
Module Dimensions	1754×1096×30 mm (69.06×43.15×1.18 inches)
Weight	21.0 kg (46.3 lb)
Glass	3.2 mm (0.13 inches), High Transmission, AR Coated Heat Strengthened Glass
Encapsulant material	EVA/POE
Backsheet	Transparent backsheet
Frame	30mm(1.18 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm² (0.006 inches²), Portrait: 350/280 mm(13.78/11.02 inches) Landscape: N 1100 mm /P 1100 mm (43.31/43.31 inches)
Connector	MC4 EVO2 / TS4*

*Please refer to regional datasheet for specified connector.

TEMPERATURE RATINGS

NOCT (Nominal Operating Cell Temperature)	43°C (±2°C)
Temperature Coefficient of PMAX	- 0.34%/°C
Temperature Coefficient of VOC	- 0.25%/°C
Temperature Coefficient of ISC	0.04%/°C

MAXIMUMRATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1500V DC (IEC)
	1500V DC (UL)
Max Series Fuse Rating	25A

WARRANTY

25 year Product Workmanship Warranty
25 year Power Warranty
2% first year degradation
0.55% Annual Power Attenuation

(Please refer to product warranty for details)

PACKAGING CONFIGUREATION

Modules per box: 36 pieces
Modules per 40' container: 828 pieces

Trinasolar

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Version number: TSM_NA_2022_A

www.trinasolar.com

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Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

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PLOT DATE:

PROJECT NUMBER:

SHEET NAME:
SPEC SHEET

REVISION: ----

PAGE NUMBER: SS

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

SQUARE D

Green Premium

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 in² (2.08…13.3 mm²) 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)

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

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

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JB-1

Specification Sheet

PV Junction Box for Composition/Asphalt Shingle Roofs

A. System Specifications and Ratings

- Maximum Voltage: 600 Volts
- Maximum Current: 60 Amps
- Allowable Wire: 14 AWG – 6 AWG
- Spacing: Please maintain a spacing of at least ½" between uninsulated live parts and fittings for conduit, armored cable, and uninsulated lie parts of opposite polarity.
- Enclosure Rating: Type 3R
- Roof Slope Range: 2.5 – 12:12
- Max Side Wall Fitting Size: 1"
- Max Floor Pass-Through Fitting Size: 1"
- Ambient Operating Conditions: -35°C - +75°C
- Compliance:
  - JB-1: UL1741
  - Approved wire connectors: must conform to UL1741
- System Marking: **Intertek Symbol and File # 5015705**
- Periodic Re-inspections: If re-inspections yield loose components, loose fasteners, or any corrosion between components, components that are found to be affected are to be replaced immediately.

Table 1: Typical Wire Size, Torque Loads and Ratings

	1 Conductor	2 Conductor	Torque				
			Type	NM	Inch Lbs	Voltage	Current
ABB ZS6 terminal block	10-24 awg	16-24 awg	Sol/Str	0.5-0.7	6.2-8.85	600V	30 amp
ABB ZS10 terminal block	6-24 awg	12-20 awg	Sol/Str	1.0-1.6	8.85-14.16	600V	40 amp
ABB ZS16 terminal bock	4-24 awg	10-20 awg	Sol/Str	1.6-2.4	14.6-21.24	600V	60 amp
ABB M6/8 terminal block	8-22 awg		Sol/Str	.08-1	8.85	600V	50 amp
Ideal 452 Red WING-NUT Wire Connector	8-18 awg		Sol/Str			600V	
Ideal 451 Yellow WING-NUT Wire Connector	10-18 awg		Sol/Str			600V	
Ideal, In-Sure Push-In Connector Part #39	10-14 awg		Sol/Str			600V	
International Hydraulics 2S2/0	10-14 awg		Sol/Str	4	35		
	8 awg		Sol/Str	4.5	40		
Brumall 4-5,3	4-6 awg		Sol/Str		45	2000V	
	10-14 awg		Sol/Str		35		
Blackburn LL414	4-14 awg		Sol/Str				

Table 2: Minimum wire-bending space for conductors through a wall opposite terminals in mm (inches)

Wire size, AWG or		Wires per terminal (pole)							
		1		2		3		4 or More	
kcmil	(mm2)	mm	(inch)	mm	(inch)	mm	(inch)	mm	(inch)
14-10	(2.1-5.3)	Not specified		-		-		-	
8	(8.4)	38.1	(1-1/2)	-		-		-	
6	(13.3)	50.8	(2)	-		-		-	

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	JB-1 Body w/ E-Z LOK TECHNOLOGY	POLYCARBONATE WITH UV INHIBITORS	1
2	JB-1 Lid w/ Gasket	POLYCARBONATE WITH UV INHIBITORS	1
3	10-32 x 1-1/4" Phillips pan head bolt		5
4	#8 x 1-1/4" Phillips pan head screw		4

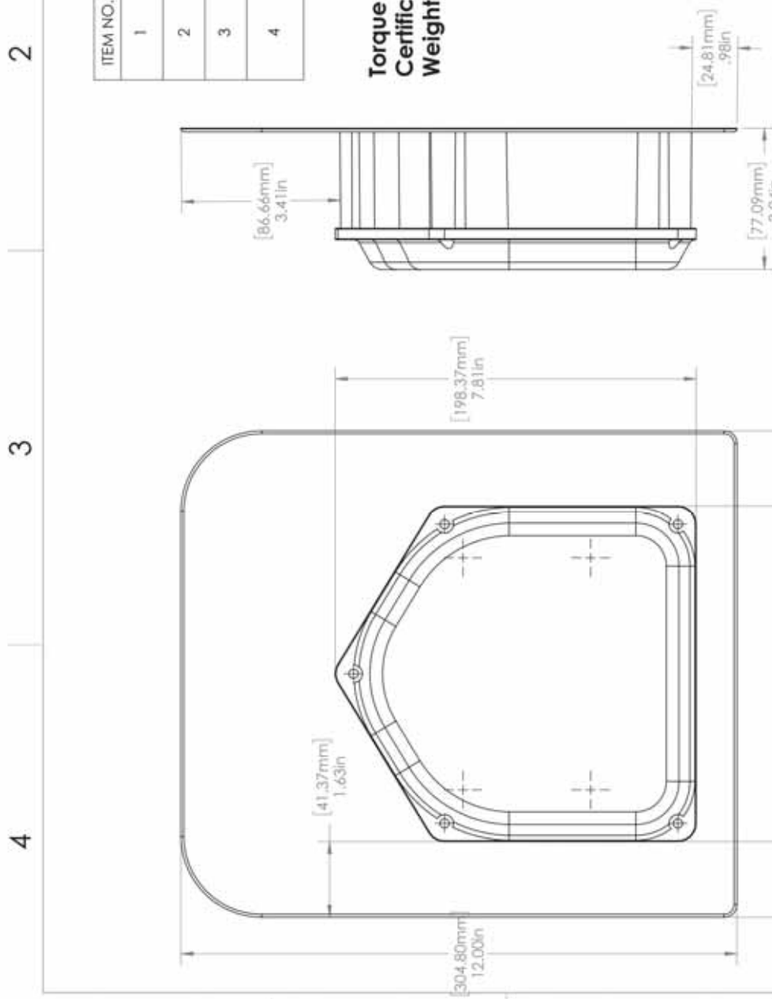
Torque Specification: 15-20 in-lbs
Certifications: UL Standard 1741, Nema Type 3R
Weight (LBS): UL Standard 1741, Nema Type 3R

EZ Solar
4411 S Wander Lane
Salt Lake City, UT 84124 USA
Phone (407) 907-0031
www.ezsolarproducts.com

TITLE: EZ SOLAR

SIZE B | DWG. NO. JB-1 | REV

SCALE: 1/2 | WEIGHT: | SHEET 1 OF 3



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Carlon®

Carlon® Non-Metallic Junction Boxes

Molded Non-Metallic Junction Boxes — 6P Rated

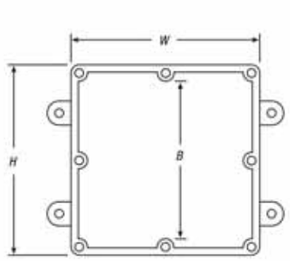
Non-metallic junction boxes are UL® Listed with a NEMA 6P rating per Section 314.28 of the National Electrical Code® and CSA Certified per Section 12 of the Canadian Electrical Code. Manufactured from PVC or PPO thermoplastic molding compound and featuring foam-in-place gasketed lids attached with stainless steel screws, these rugged enclosures offer all the corrosion resistance and physical properties you need for direct burial applications.

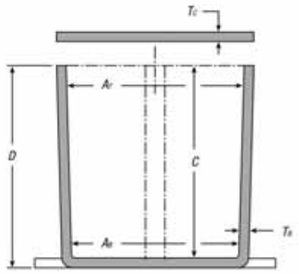
Type 6P enclosures are intended for indoor or outdoor use, primarily to provide a degree of protection against contact with enclosed equipment, falling dirt, hose-directed water, entry of water during prolonged submersion at a limited depth and external ice formation.

- All Carlon® Junction Boxes are UL® Listed/CSA Certified and maintain a minimum of a NEMA Type 4/4x Rating
- Part numbers with an asterisk (*) are UL® Listed and maintain a NEMA Type 6P Rating and Type 4/4X Rating

Except where noted by †

UL LISTED E11461





CAT. NO.	SIZE (IN.) H x W x D	STD. CTN.	DIMENSIONS (IN.) MIN Ar	MIN Ab	MIN B	MIN C	Ts	Tc	MATERIAL PVC	MATERIAL THERMO-PLASTIC	STD. WT. (LBS.)
E989NNJ*	4 x 4 x 2	10	3 1/16	3 1/16	N/A	2	.160	.155	X		3
E987N*	4 x 4 x 4	10	3 1/16	3 1/16	N/A	4	.160	.155	X		4
E989NNR* †	4 x 4 x 6	10	3 1/16	3 1/16	N/A	6	.160	.200	X		5
E989PPJ*	5 x 5 x 2	10	4 1/16	4 1/16	N/A	2	.110	.150		X	3
E987R-CAR*	6 x 6 x 4	2	6	5 1/16	N/A	4	.190	.190		X	3
E989RRR-UPC*	6 x 6 x 6	8	5 1/16	5 1/16	N/A	6	.160	.150		X	14
E989N-CAR	8 x 8 x 4	1	8	8	N/A	4	.185	.190		X	2
E989SSX-UPC	8 x 8 x 7	2	7 15/16	7 15/16	N/A	7	.160	.150		X	6
E989UUN	12 x 12 x 4	3	11 1/16	11 1/16	11 1/16	4	.160	.150		X	12
E989R-UPC	12 x 12 x 6	2	11 15/16	11 1/16	11 1/16	6	.265	.185		X	10

* UL Listed

† Not CSA Certified

NEC and National Electrical Code are registered trademarks of the National Fire Protection Association, Inc.

www.tnb.com

United States
Tel: 901.252.8000
800.816.7809
Fax: 901.252.1354

Technical Services
Tel: 888.862.3289

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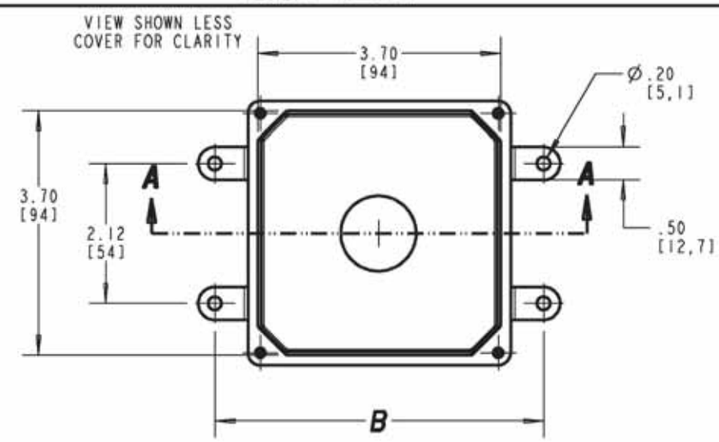

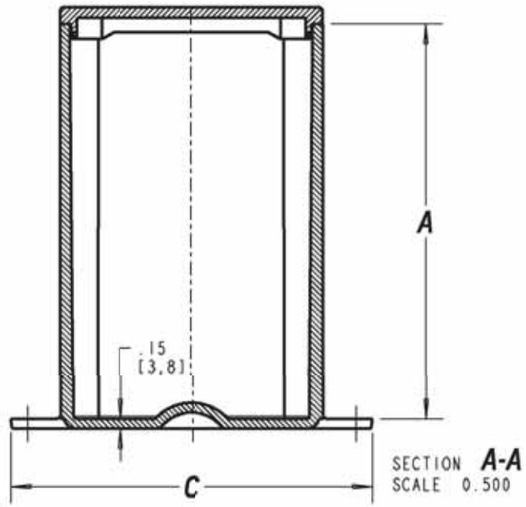

SIZE	A	B	C
E989NNJ E989NNJB E989NNJ-CAR E989NNJCL E989NNJL (4X4X2)	2.00 (50,8)	4.63 (117,8)	5.13 (130,2)
E989NNR E989NNR-CAR (4X4X6)	6.00 (152,4)	5.00 (127,0)	5.50 (139,7)

NOTES:
1. MATERIAL: PVC
2. NEMA TYPES: 4/4X, 6P

SECTION A-A
SCALE 0.500

GENERAL NOTES
1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.
2. DIMENSIONS IN BRACKETS [ ] ARE IN METRIC UNITS.

REVISIONS
F SEE ERN 2016195 FOR APPROVAL SIGNATURES & RELEASE DATE. PROJECT NO: 5AM000006

Thomas&Betts www.tnb.com

DESCRIPTION: MOLDED NON-METALLIC ENCLOSURE

ORIGINAL PROJECT NO / (ERN NO)	SHEET NO:	REV. NO:	DRAWING NO:
/ ( )	2 OF 2	F	WSD-AC01977

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SFM SUN FRAME MICRORAIL™

SYSTEM BONDING & GROUNDING

INSTALLATION GUIDE

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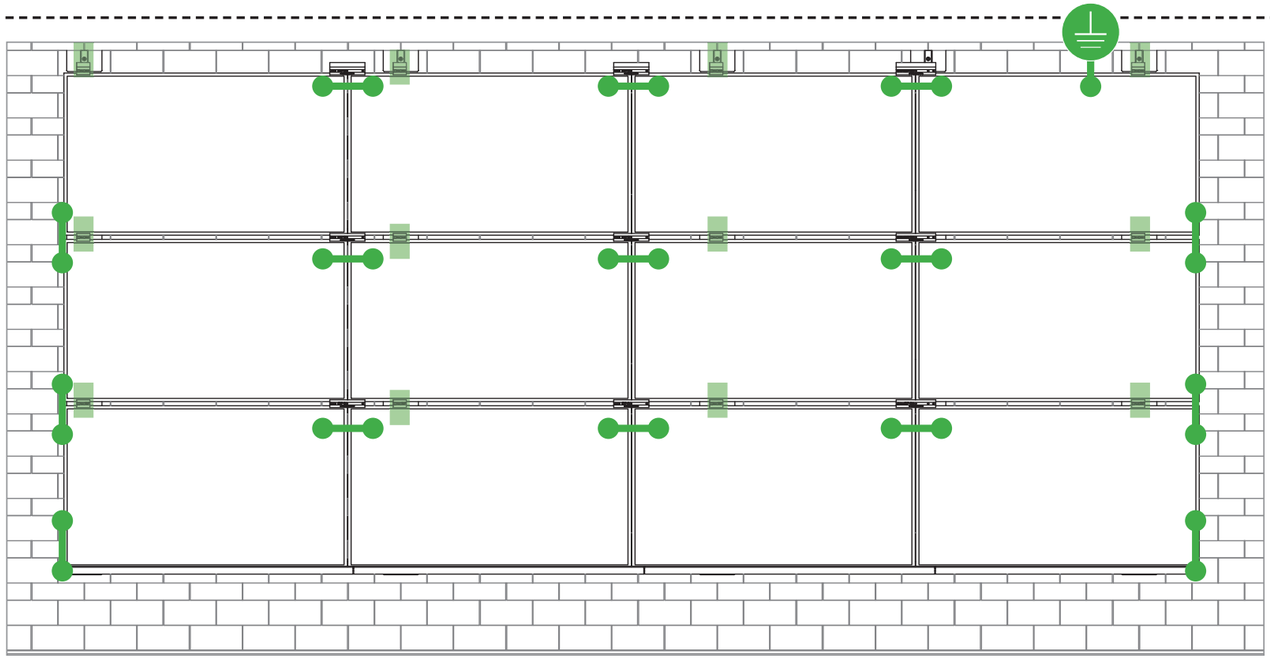
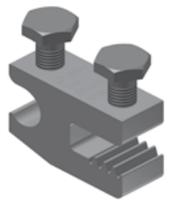


Star Washer is Single Use Only

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

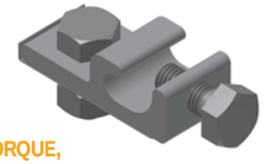
LUG DETAIL & TORQUE INFO
Ilsco Lay-In Lug (GBL-4DBT)
- 10-32 mounting hardware
- Torque = 5 ft-lb
- AWG 4-14 - Solid or Stranded



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

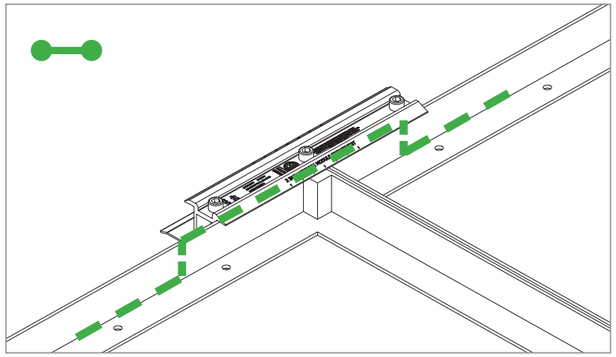


TERMINAL TORQUE, Install Conductor and torque to the following:
6-14 AWG: 7ft-lbs

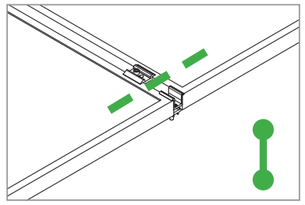
LUG DETAIL & TORQUE INFO
Wiley WEEBLug (6.7)
- 1/4" mounting hardware
- Torque = 10 ft-lb
- AWG 6-14 - Solid or Stranded

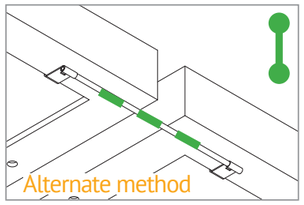
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

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.

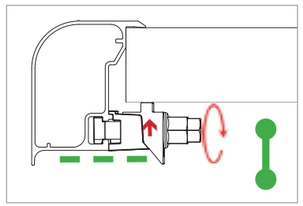


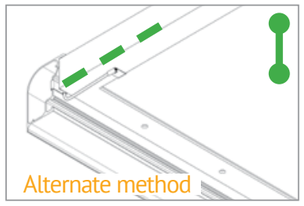
E-W BONDING PATH:
E-W module to module bonding is accomplished with 2 pre-installed bonding pins which engage on the secure side of the MicrorailTM and splice.





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)**

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SFM SUN FRAME MICRORAIL™

UL CODE COMPLIANCE NOTES

INSTALLATION GUIDE

T PAGE

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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SFM SUN FRAME MICRORAIL™

TESTED / CERTIFIED MODULE LIST

INSTALLATION GUIDE

V PAGE

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, 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, 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
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)(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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SFM SUN FRAME MICRORAIL™

TESTED / CERTIFIED MODULE LIST

INSTALLATION GUIDE

W PAGE

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)
Renesola	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

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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- Please see the SFM UL2703Construction Data Report at Unirac.com to ensure the exact solar module selected is approved for use with SFM
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Address:	1411 Broadway Blvd NE Albuquerque, NM 87102	**Address:**	
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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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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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Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand Name:	Unirac
Models:	Unirac SFM

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Listing Constructional Data Report (CDR)

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			
Contact			
Phone			
FAX			

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Listing Constructional Data Report (CDR)

1.0 Reference and Address			
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2.0 Product Description	
Product	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand name	Unirac
Description	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. 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. 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. 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.

2.0 Product Description	
Models	Unirac SFM
Model Similarity	NA
Ratings	Fuse Rating: 30A 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 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 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" Mamzimum 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 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 See section 7.0 illustractions # 1, 1a, 1b, and 1c for a complete list of PV modules evaluated with these racking systems
Other Ratings	NA

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7.0 Illustrations

Illustration 1 - Approved PV Modules

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, 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, 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
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
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)(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

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

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7.0 Illustrations

Illustration 1b - Approved PV Modules Continue

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)
Renesola	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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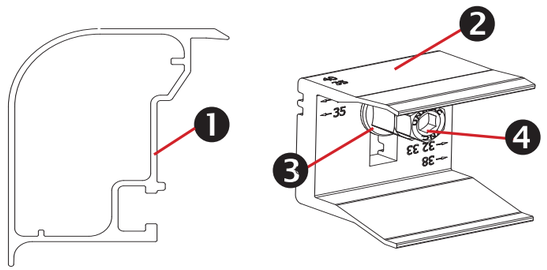
SFM SUN FRAME MICRORAIL™

SYSTEM COMPONENTS
INSTALLATION GUIDE

C PAGE



Trimrail™ and Module Clips

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

Trimrail™

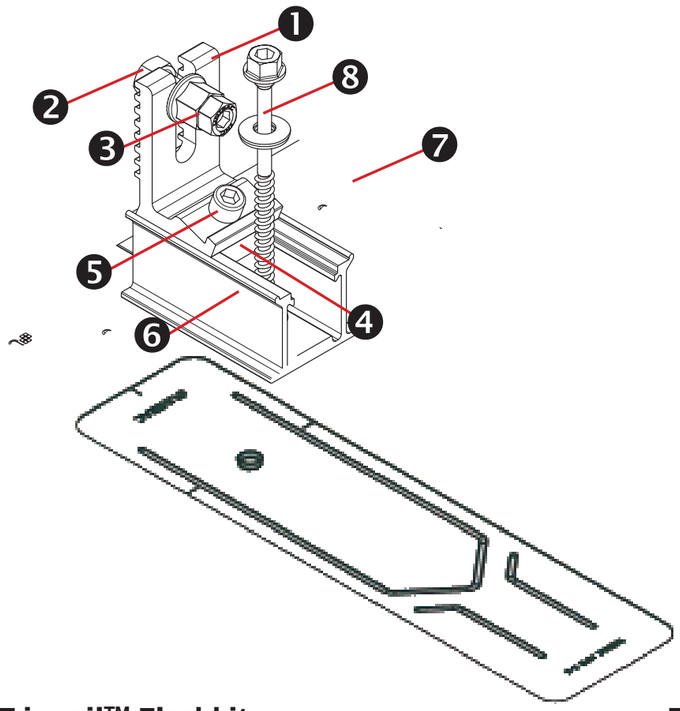
Functions:
- Required front row structural support (with module clips)
- Module mounting
- Installation aid
- Aesthetic trim

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.

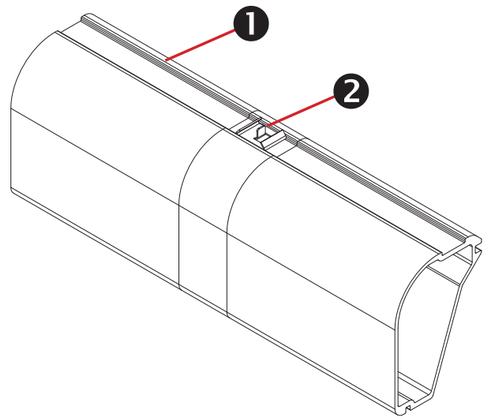


Trimrail™ Flashkit

Sub-Components:
L-Foot
Hex bolt
Tri-drive nut
Channel Nut
Scocket 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

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SFM SUN FRAME MICRORAIL™

SYSTEM COMPONENTS
INSTALLATION GUIDE

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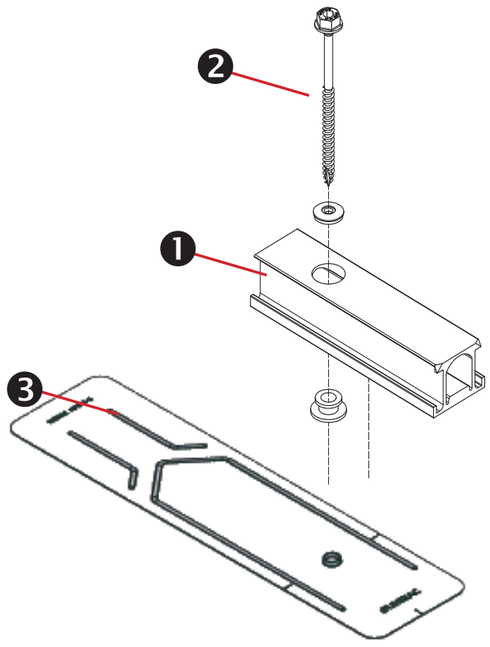
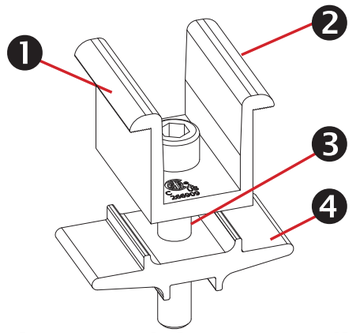


SFM Slider Flashkit

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

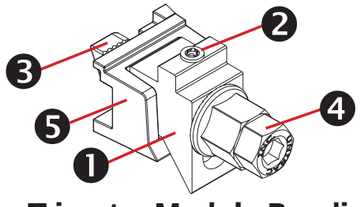
Features:
- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



Module-to-Module N-S Bonding

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

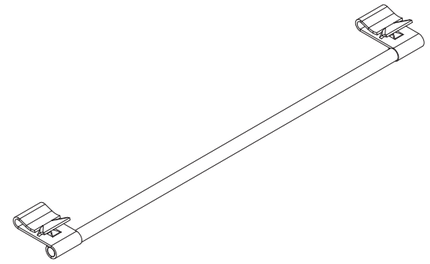
Functions/ Features:
- Row to row bonding
- Single Use Only
- Fits module sizes 32-40mm



Trim -to- Module Bonding Clamp and Floating Trim Clamp

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

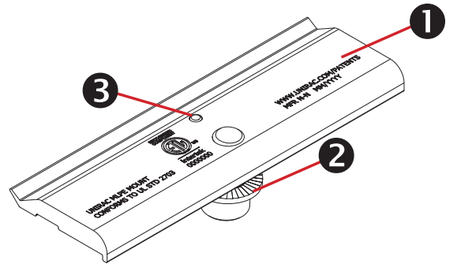
Functions/ Features:
- Module to Trimrail™ bonding - single use only
- Attaches Trimrail™ to module when fewer than 2 rafter attachment points are available
- Fits module sizes 32-40mm
- Fits module sizes 32-40mm



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

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SFM SUN FRAME MICRORAIL™

3" FLASHING & SLIDERS INSTALLATION GUIDE

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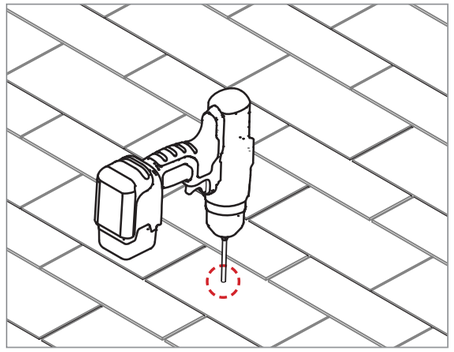
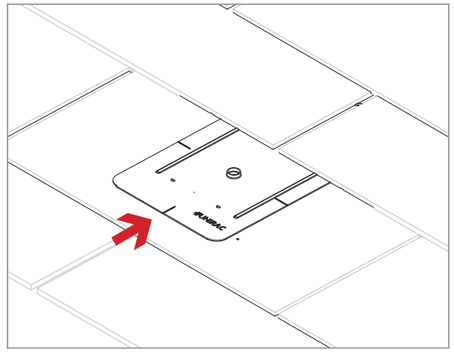
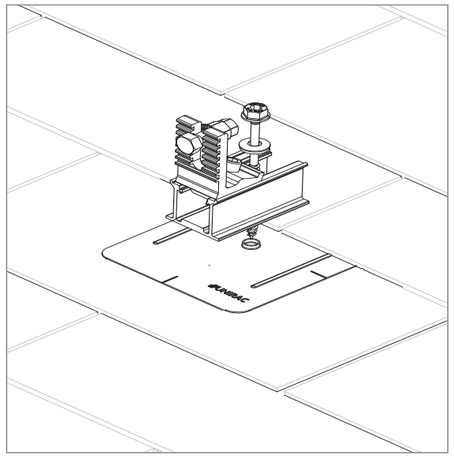
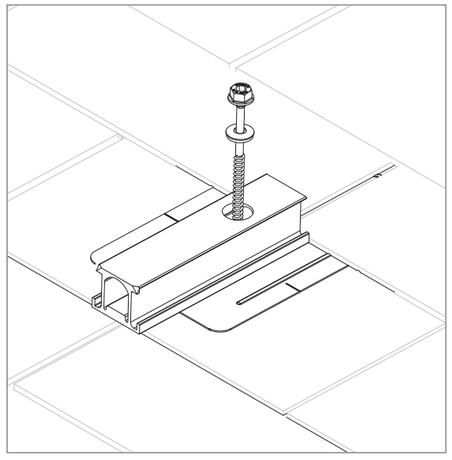


PILOT HOLES:
Drill pilot holes for lag screws or structural screws (as necessary) at marked attachement points



FLASHINGS:
Place flashings





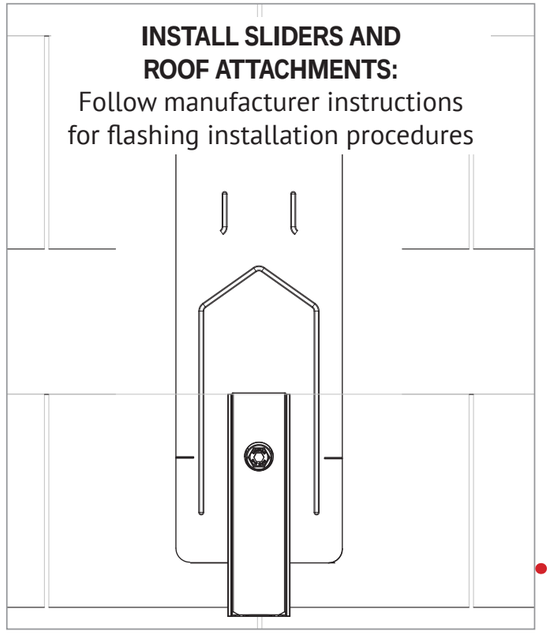
INSTALL SLIDERS AND TRIMRAIL ROOF ATTACHMENTS:

- Insert flashings per manufacturer instructions

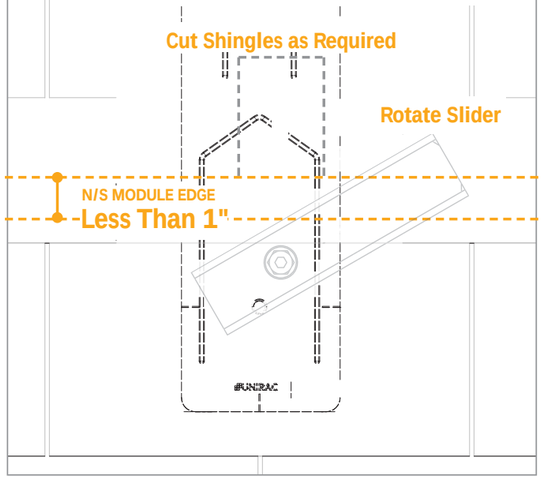
NOTE: Use Lag screw or structural fastener with a maximum diameter of 5/16"

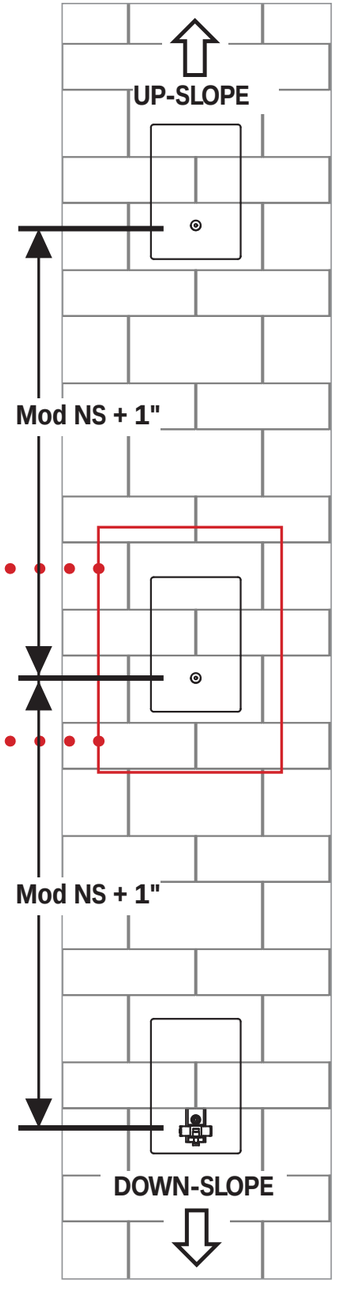
- Attach sliders to rafters
- Verify proper row to row spacing for module size (Mod NS + 1")
- Ensure that TrimrailTM roof attachments in each row have sufficient engagement with slider dovetails for proper attachment.

INSTALL SLIDERS AND ROOF ATTACHMENTS:
Follow manufacturer instructions for flashing installation procedures



NOTE: If N-S module edge is within 1" of the shingle course above, you have the option to pivot / rotate slider at the attachment point to span the next course and cut shingles as required.





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