WYSSLING CONSULTING
CORPORATE EXPERIENCE WITH SMALL BUSINESS VALUE
Scott E. Wyssling, PE
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May 31, 2022
Revised October 21, 2022

Legacy Solar
3333 Digital Drive #600
Lehi, UT 84043

Scott Wyssling, PE

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Re: Engineering Services
Battle Residence
24 Valley Pines Circle, Spring Lake NC
13.640 kW System

To Whom It May Concern:

We have received information regarding solar panel installation on the roof of the above referenced structure. Our evaluation of the structure is to verify the existing capacity of the roof system and its ability to support the additional loads imposed by the proposed solar system.

A. Site Assessment Information

1. Site visit documentation identifying attic information including size and spacing of framing for the existing roof structure.
2. Design drawings of the proposed system including a site plan, roof plan and connection details for the solar panels. This information will be utilized for approval and construction of the proposed system.

B. Description of Structure:

Roof Framing: 2x6 dimensional lumber at 16” on center.
Roof Material: Composite Asphalt Shingles
Roof Slope: 20 & 14 degrees
Attic Access: Accessible
Foundation: Permanent

C. Loading Criteria Used

- **Dead Load**
  - Existing Roofing and framing = 7 psf
  - New Solar Panels and Racking = 3 psf
  - TOTAL = 10 PSF
- **Live Load** = 20 psf (reducible) – 0 psf at locations of solar panels
- **Ground Snow Load** = 10 psf
- **Wind Load** based on ASCE 7-10
  - Ultimate Wind Speed = 120 mph (based on Risk Category II)
  - Exposure Category C

Analysis performed of the existing roof structure utilizing the above loading criteria is in accordance with the North Carolina Residential Code (2015 IRC), including provisions allowing existing structures to not require strengthening if the new loads do not exceed existing design loads by 105% for gravity elements and 110% for seismic elements. This analysis indicates that the existing framing will support the additional panel loading without damage, if installed correctly.

D. Solar Panel Anchorage

1. The solar panels shall be mounted in accordance with the most recent Unirac installation manual. If during solar panel installation, the roof framing members appear unstable or deflect non-uniformly, our office should be notified before proceeding with the installation.
2. The maximum allowable withdrawal force for a $^{5}/_{16}$" lag screw is 235 lbs per inch of penetration as identified in the National Design Standards (NDS) of timber construction specifications. Based on a minimum penetration depth of 2½", the allowable capacity per connection is greater than the design withdrawal force (demand). Considering the variable factors for the existing roof framing and installation tolerances, the connection using two $^{5}/_{16}$" diameter lag screw with a minimum of 2½" embedment will be adequate and will include a sufficient factor of safety.
3. Considering the wind speed, roof slopes, size and spacing of framing members, and condition of the roof, the panel supports shall be placed no greater than 48" on center.
4. Panel supports connections shall be staggered to distribute load to adjacent framing members.

Based on the above evaluation, this office certifies that with the racking and mounting specified, the existing roof system will adequately support the additional loading imposed by the solar system. This evaluation is in conformance with the North Carolina Residential Code, current industry standards, and is based on information supplied to us at the time of this report.

Should you have any questions regarding the above or if you require further information do not hesitate to contact me.

Very truly yours,

Scott E. Wyssling, PE
North Carolina License No. 46546

NORTH CAROLINA PROFESSIONAL SEAL 046546 ENGINEER SCOTT E. WYSSLING

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Signed 10/21/202

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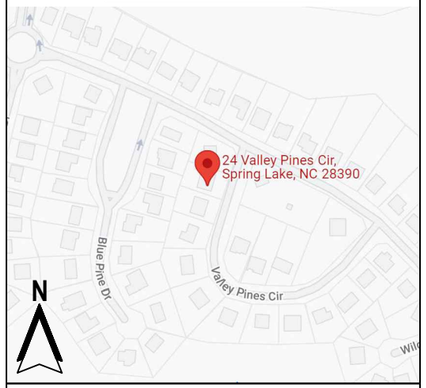
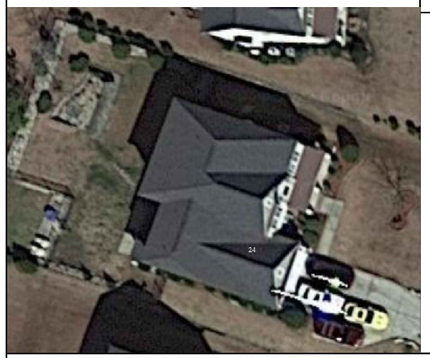
VICINITY MAP



AERIAL VIEW



BATTLE RESIDENCE
SCOPE OF WORK:

SYSTEM SIZE: 13.640 kW DC / 8.990 kW AC
MODULE: (31) APTOS DNA-120-MF10-440W [BLK]
INVERTER: (31) ENPHASE IQ8PLUS-72-2-US MICROINVERTERS
INTERCONNECTION: LOAD BREAKER
OCPD SIZE: 50A
MAIN SERVICE PANEL BUS RATING: (N) 225
MAIN SERVICE DISCONNECT RATING: (N) 200
SUB PANEL BUS RATING (IF APPLICABLE): (E) 200
SUB PANEL DISCONNECT RATING (IF APPLICABLE): (E) 100

DESIGN CRITERIA:

ROOF TYPE: COMP SHINGLE
WIND SPEED: 120 MPH
GROUND SNOW LOAD: 10 PSF
ASCE: 7-10
EXPOSURE CATEGORY: C
MOUNTING METHOD: ROOF FLUSH MOUNTED
RACKING: UNIRAC

RESERVED FOR AHJ SPECIFIC STAMPS / NOTES
(IF APPLICABLE)

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GOVERNING CODES:

2020 NATIONAL ELECTRIC CODE (NEC)
2018 NORTH CAROLINA RESIDENTIAL CODE (IRC) / 2015 IRC
2018 NORTH CAROLINA BUILDING CODE (IBC) / 2015 IBC
2018 NORTH CAROLINA FIRE CODE (IFC) / 2015 IFC

GENERAL NOTES

1. UTILITY SHALL BE NOTIFIED BEFORE ACTIVATION OF PHOTOVOLTAIC SYSTEM.
2. 110.2 APPROVAL: ALL ELECTRICAL EQUIPMENT SHALL BE LABELED, LISTED, OR CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY ACCREDITED BY THE UNITED STATES OCCUPATIONAL SAFETY HEALTH ADMINISTRATION
3. CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS PRIOR TO INITIATING CONSTRUCTION.
4. CONTRACTOR SHALL REVIEW ALL MANUFACTURER INSTALLATION DOCUMENTS PRIOR TO INITIATING CONSTRUCTION.
5. ALL EQUIPMENT AND ASSOCIATED CONNECTIONS, ETC, AND ALL ASSOCIATED WIRING AND INTERCONNECTIONS SHALL BE INSTALLED ONLY BY QUALIFIED PERSONNEL.
6. THE CONTRACTOR OR OWNER MUST PROVIDE ROOF ACCESS (LADDER TO ROOF) FOR ALL THE REQUIRED INSPECTIONS. LADDERS MUST BE OSHA APPROVED, MINIMUM TYPE I WITH A 250LB. RATING, IN GOOD CONDITION AND DESIGNED FOR ITS INTENDED USE.
7. CONTRACTOR SHALL VERIFY THAT THE ROOF STRUCTURE WILL WITHSTAND THE ADDITIONAL LOADS.
8. LAG SCREWS SHALL PENETRATE A MINIMUM 2" INTO SOLID SAWN STRUCTURAL MEMBERS AND SHALL NOT EXCEED MANUFACTURER RECOMMENDATIONS FOR FASTENERS INTO ENGINEERED STRUCTURAL MEMBERS.
9. AN ACCESS POINT SHALL BE PROVIDED THAT DOES NOT PLACE THE GROUND LADDER OVER OPENINGS SUCH AS WINDOWS OR DOORS ARE LOCATED AT STRONG POINTS OF BUILDING CONSTRUCTION AND IN LOCATIONS WHERE THE ACCESS POINT DOES NOT CONFLICT WITH OVERHEAD OBSTRUCTIONS SUCH AS TREE LIMBS, WIRES, OR SIGNS.
10. WHERE DC CONDUCTORS ARE RUN INSIDE BUILDING, THEY SHALL BE CONTAINED IN A METAL RACEWAY; THEY SHALL NOT BE INSTALLED WITHIN 10" OF THE ROOF DECKING OR SHEATHING EXCEPT WHERE COVERED BY THE PV MODULES AND EQUIPMENT.
11. PLUMBING AND MECHANICAL VENTS THROUGH THE ROOF SHALL NOT BE COVERED BY SOLAR MODULES - NO BUILDING, PLUMBING OR MECHANICAL VENTS TO BE COVERED, CONSTRUCTED OR ROUTED AROUND SOLAR MODULES.
12. ALL FIELD -INSTALLED JUNCTION, PULL AND OUTLET BOXES LOCATED BEHIND MODULES SHALL BE ACCESSIBLE DIRECTLY OR BY DISPLACEMENT OF A MODULE SECURED BY REMOVABLE FASTENERS.

ELECTRICAL NOTES

1. WIRING MATERIALS SHALL COMPLY WITH MAXIMUM CONTINUOUS CURRENT OUTPUT AT 25°C AND MAXIMUM VOLTAGE AT 600V; WIRE SHALL BE WET RATED AT 90°C.
2. EXPOSED PHOTOVOLTAIC SYSTEM CONDUCTORS ON THE ROOF WILL BE USE 2 OR PV-TYPE WIRE.
3. PHOTOVOLTAIC SYSTEM CONDUCTORS SHALL BE IDENTIFIED AND GROUPED. THE MEANS OF IDENTIFICATION SHALL BE PERMITTED BY SEPARATE COLOR-CODING, MARKING TAPE, TAGGING OR OTHER APPROVED MEANS.
4. ALL EXTERIOR CONDUIT, FITTINGS, AND BOXES SHALL BE RAIN-TIGHT AND APPROVED FOR USE IN WET LOCATIONS.
5. ALL METALLIC RACEWAYS AND EQUIPMENT SHALL BE BONDED AND ELECTRICALLY CONTINUOUS.
6. WHERE SIZES OF JUNCTION BOXES, RACEWAYS, AND CONDUITS ARE NOT SPECIFIED, CONTRACTOR SHALL SIZE THEM ACCORDING TO APPLICABLE CODES.
7. REMOVAL OF A UTILITY-INTERACTIVE INVERTER OR OTHER EQUIPMENT SHALL NOT DISCONNECT THE BUILDING CONNECTION BETWEEN THE GROUNDING ELECTRODE CONDUCTOR AND THE PV SOURCE AND/OR OUTPUT CIRCUIT GROUNDED CONDUCTOR.
8. FOR GROUNDED SYSTEMS, THE PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUITS SHALL BE PROVIDED WITH A GROUND-FAULT PROTECTION DEVICE OR SYSTEM THAT DETECTS A GROUND FAULT, INDICATES THAT FAULT HAS OCCURED AND AUTOMATICALLY DISCONNECTS ALL CONDUCTORS OR CAUSES THE INVERTER TO AUTOMATICALLY CEASE SUPPLYING POWER TO OUTPUT CIRCUITS.
9. FOR UNGROUNDED SYSTEMS, THE INVERTER IS EQUIPPED WITH GROUND FAULT PROTECTION AND A GFI FUSE PORT FOR GROUND FAULT INDICATION.
10. PV MODULE FRAMES SHALL BE BONDED TO RACKING RAIL OR BARE COPPER GEC/GEC PER THE MODULE MANUFACTURER'S LISTED INSTRUCTION SHEET.
11. PV MODULE RACKING RAIL SHALL BE BONDED TO BARE COPPER GEC VIA WEEB LUG, ILSCO GBL-4DBT LAY-IN LUG, OR EQUIVALENT LISTED LUG.
12. THE PHOTOVOLTAIC INVERTER WILL BE LISTED AS UL 1741 COMPLIANT.
13. RACKING AND BONDING SYSTEM TO BE UL2703 RATED.
14. ANY REQUIRED GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AS BUS BARS WITHIN LISTED EQUIPMENT.
15. WHEN BACKFED BREAKER IS THE METHOD OF UTILITY INTERCONNECTION, THE BREAKERS SHALL NOT READ "LINE AND LOAD".
16. WHEN APPLYING THE 120% RULE, THE SOLAR BREAKER TO BE POSITIONED AT THE OPPOSITE END OF THE BUS BAR FROM THE MAIN BREAKER.
17. THE WORKING CLEARANCE AROUND THE EXISTING ELECTRICAL EQUIPMENT AS WELL AS THE NEW ELECTRICAL EQUIPMENT WILL BE MAINTAINED.

LGCY POWER

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855-353-4899

Alex Nelson

Electrical LIC#: U33945

RESERVED FOR ENGINEERING STAMP
(IF APPLICABLE)

SYSTEM SIZE:
13640W DC - 8990W AC

MODULE:(31) APTOS
DNA-120-MF10-440W [BLK]

INVERTER(S):
(31) ENPHASE IQ8PLUS-72-2-US
( )

BATTERIES:(----)

AHJ: HARNETT

UTILITY: SOUTH RIVER
ELECTRIC
METER #: 20019537

SHEET INDEX:

BATTLE
RESIDENCE
24 VALLEY PINES CIR,
SPRING LAKE
NC, 28390

DRAWN BY:	DATE:
MW	8/15/2022

COVER SHEET

PV-1

ROOF DESCRIPTION

ROOF TYPE:		COMP SHINGLE	
ROOF	PITCH	AZIMUTH	RAFTER SIZE & SPACING
RS-1	20°	289°	2X6" @ 16"
RS-2	20°	289°	2X6" @ 16"
RS-3	14°	289°	2X6" @ 16"

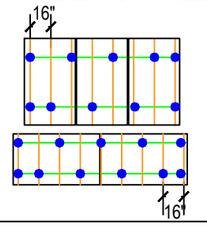
ARRAY AND ROOF AREA CALC'S

TOTAL ROOF SQ FT:		3380	
ROOF	MODULE COUNT	ARRAY SQ FT	ROOF SQ FT
RS-1	19	443.08	605
RS-2	7	163.24	257
RS-3	5	116.60	170
TOTAL:	31	722.92	1032
TOTAL % ARRAY/ROOF		21.39%	

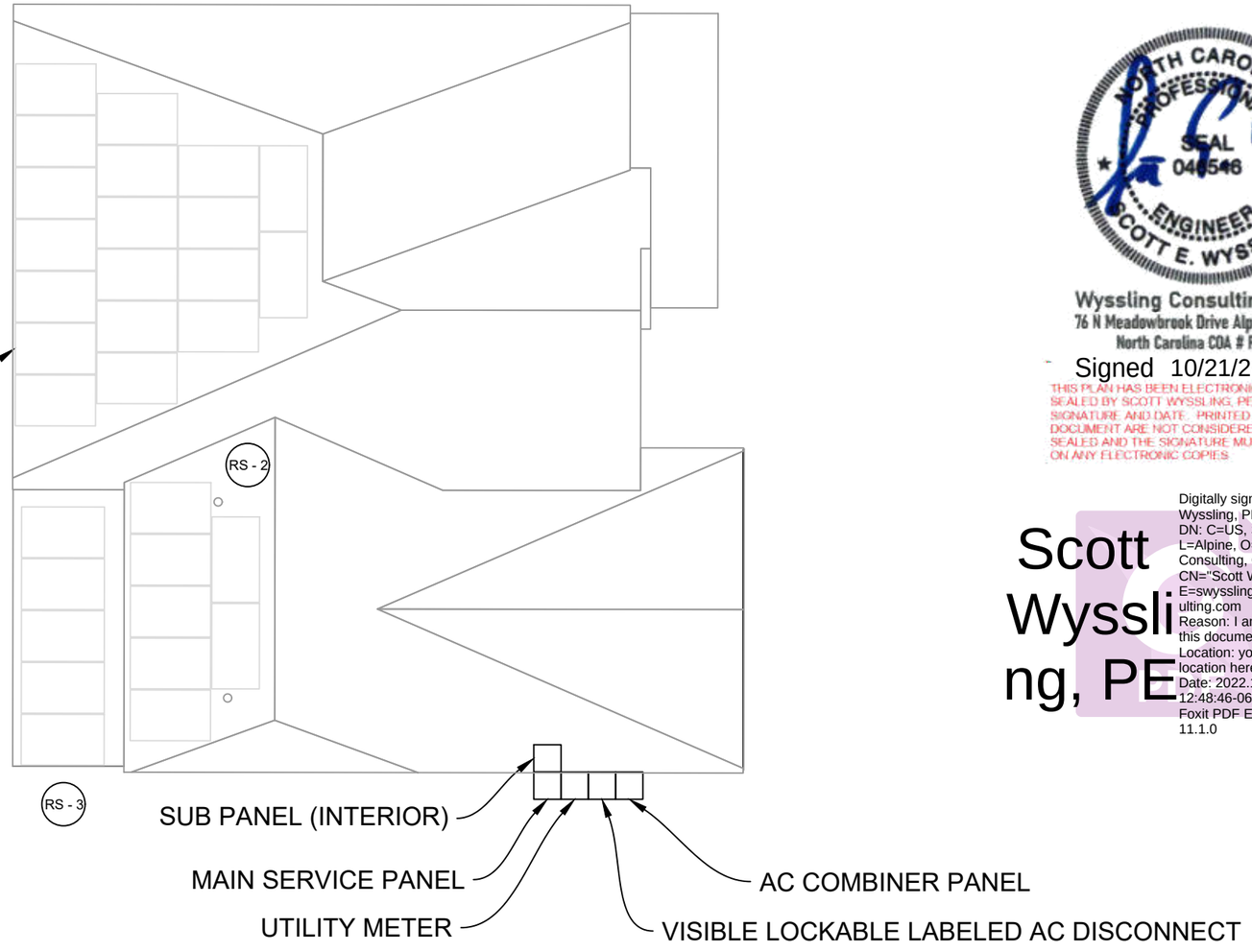
EQUIPMENT DETAILS

SOLAR MODULE:	(31) APTOS DNA-120-MF10-440W [BLK]
INVERTER:	(31) ENPHASE IQ8PLUS-72-2-US

RAFTER SPACING: 16" OC
CANTILEVER LENGTH <= 6"
SUPPORT LOCATIONS HAVE BEEN STAGGERED AND OPTIMIZED



(N) PV MODULE EQUIPPED W/
(1) MICROINVERTER PER MODULE (E-1)



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GENERAL NOTES:

- VERIFY ALL OBSTRUCTIONS IN THE FIELD.
- VERIFY ALL DIMENSIONS IN THE FIELD.
- CONDUIT TO BE RUN IN ATTIC IF POSSIBLE, OTHERWISE CONDUIT BLOCKS MIN. 1"/MAX 6" ABOVE ROOF SURFACE
- PV MODULES CANNOT BE INSTALLED OVER OR BLOCK ATTIC VENTS, FURNACE OR WATER HEATER VENTS ETC.
- DISCONNECT SHALL BE INSTALLED WITHIN ----' FROM UTILITY METER
- PV MODULE DIMENSIONS: 75.2" (L) x 44.65" (W)
- SCALE 3/32" = 1'-0"

N

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Alex Nelson

Electrical LIC#: U33945

RESERVED FOR ENGINEERING STAMP (IF APPLICABLE)

SYSTEM SIZE:
13640W DC - 8990W AC

MODULE:(31) APTOS DNA-120-MF10-440W [BLK]

INVERTER(S):
(31) ENPHASE IQ8PLUS-72-2-US
( )

BATTERIES:(----)

AHJ: HARNETT

UTILITY: SOUTH RIVER ELECTRIC
METER #: 20019537

SHEET INDEX:

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RESIDENCE
24 VALLEY PINES CIR,
SPRING LAKE
NC, 28390

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SITE PLAN

PV-2

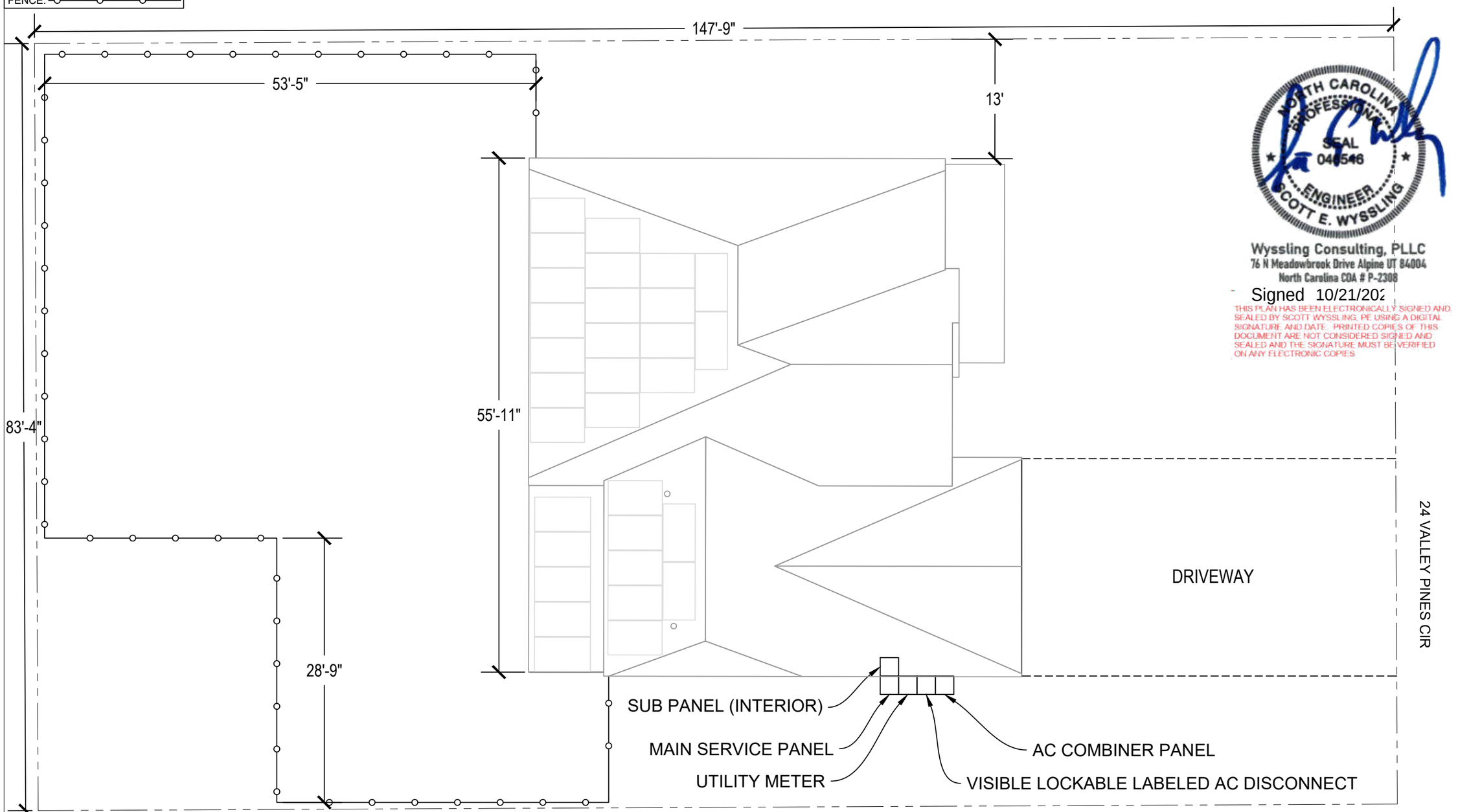
LEGEND:

SCALE 3/32" = 1'-0"

PROPERTY LINE: ——— – – ———

DRIVEWAY: – – – – – – – – – –

FENCE: —o———o———o———



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BATTERIES:(----)

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UTILITY: SOUTH RIVER ELECTRIC
METER #: 20019537

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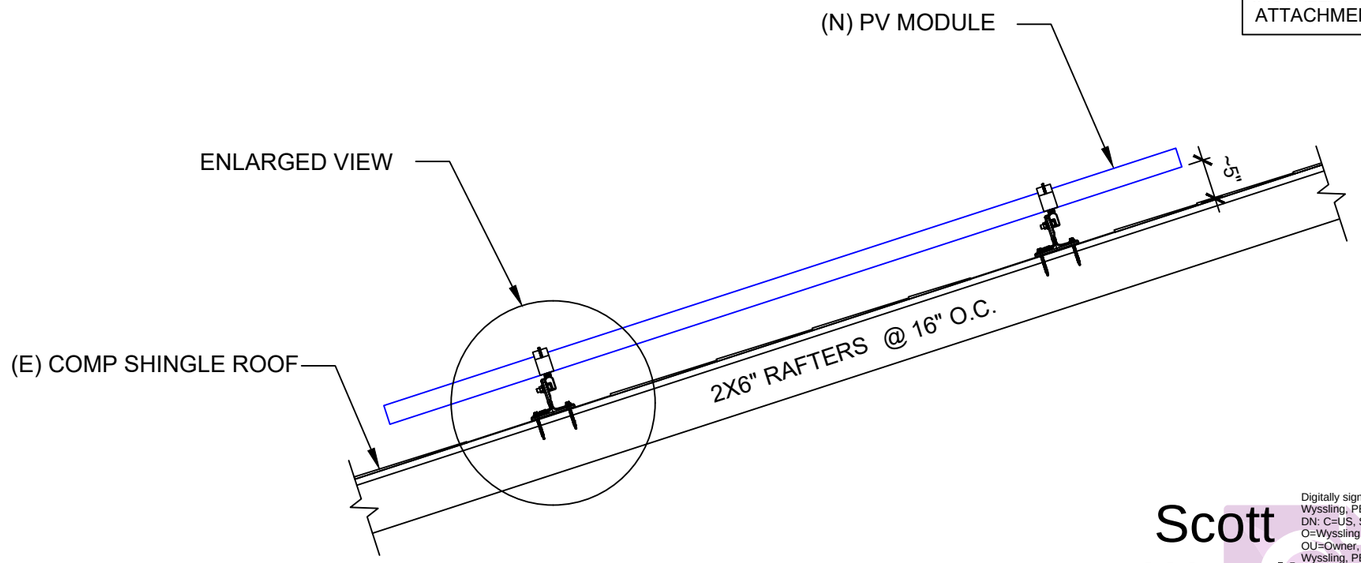
PROPERTY PLAN

PV-3

NOTE: ACTUAL ROOF CONDITIONS AND RAFTERS (OR SEAM) LOCATIONS MAY VARY. INSTALL PER MANUFACTURER(S) INSTALLATION GUIDELINES AND ENGINEERED SPANS FOR ATTACHMENTS



1 ATTACHMENT DETAIL

SCALE: NTS

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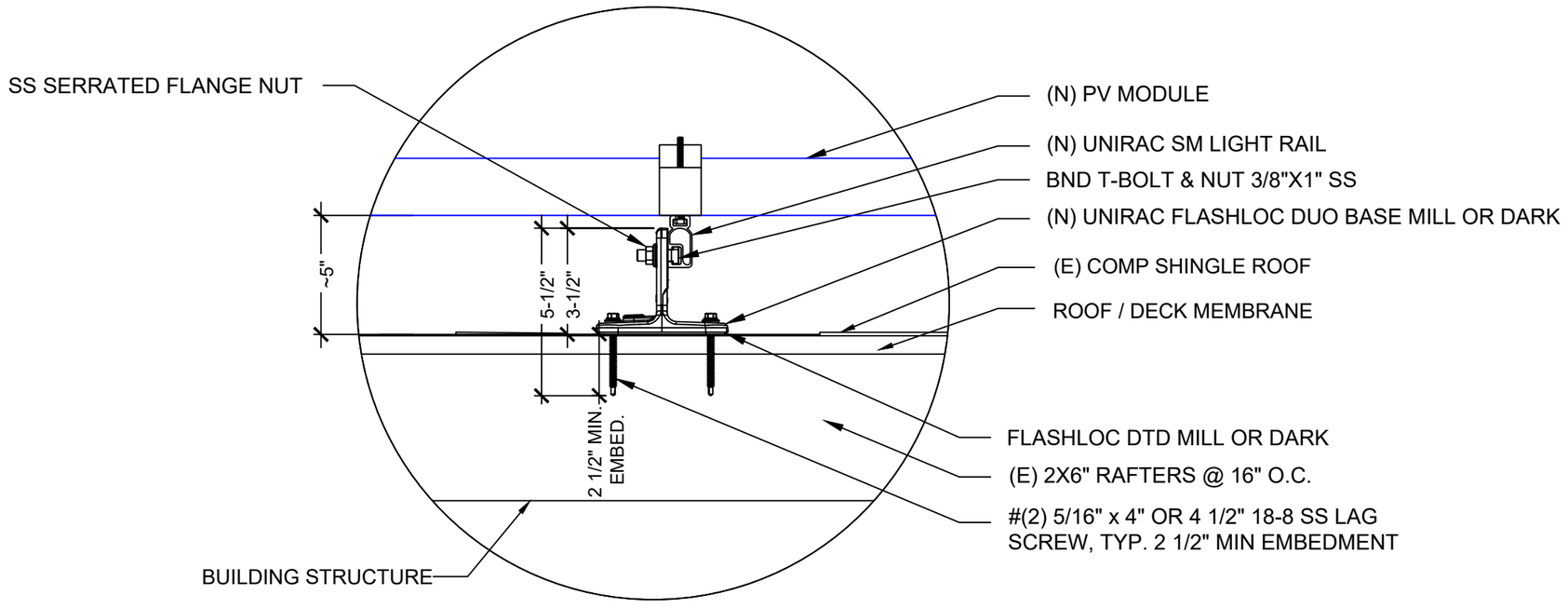

2 ATTACHMENT DETAIL(ENLARGED VIEW)

SCALE: NTS

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AHJ: HARNETT

UTILITY: SOUTH RIVER ELECTRIC
METER #: 20019537

SHEET INDEX:

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ATTACHMENT DETAILS

PV-4

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13640W DC - 8990W AC

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DNA-120-MF10-440W [BLK]

INVERTER(S):
(31) ENPHASE IQ8PLUS-72-2-US
( )

BATTERIES:(----)

AHJ: HARNETT

UTILITY: SOUTH RIVER
ELECTRIC
METER #: 20019537

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SITE PHOTOS

PV-5

PV MODULE SPECIFICATIONS	
MODEL	APTOS DNA-120-MF10-440W [BLK]
PMAX	440W
VOC	41.2V
VMP	34.5V
IMP	12.74A
ISC	13.54A

MICRO-INVERTER SPECIFICATIONS	
MODEL	ENPHASE IQ8PLUS-72-2-US
MAX INPUT DC VOLTAGE	60V
MAX DC SHORT CIRCUIT CURRENT	15
MAX OUTPUT POWER	290W
MAXIMUM CONT. OUTPUT CURRENT	1.21
CEC EFFICIENCY	97%

DESIGN CRITERIA AND CALCULATIONS BASED UPON:
NEC TABLE CEC/NEC 310.15(B)(16) 90°C (194°F)
ASHRAE 2% AVERAGE HIGH = 32°C
NEC TABLE 310.15(B)(2)(a) 75°C DERATE FACTOR = .96

INSTALLERS NOTES: MAIN SERVICE PANEL UPGRADE REQUIRED.

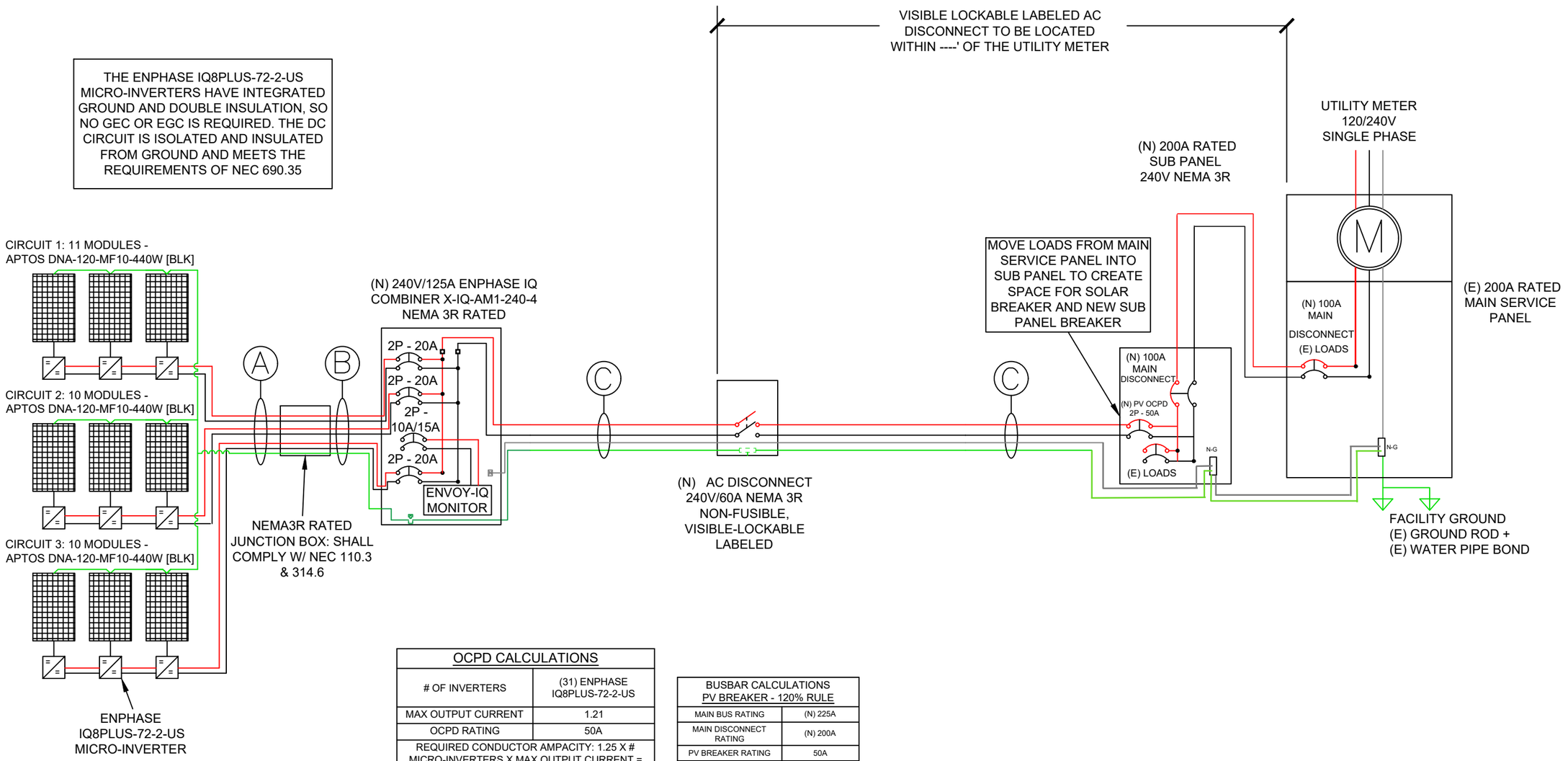
CONDUCTOR SCHEDULE

	CONDUCTORS				GROUND			CONDUIT
TAG ID	WIRES IN CONDUIT	MINIMUM WIRE SIZE	TYPE, MATERIAL	WIRE 75°C (167°F) AMPERAGE RATING TABLE 310.15 (B)(16)	MINIMUM WIRE SIZE	RATING TABLE 250.122	TYPE, MATERIAL	
A*	7	#12 AWG	Q-CABLE	35	#6 AWG	200	BARE, CU	3/4" EMT
B	7	#10 AWG	THWN-2, CU	35	#10 AWG	60	THWN-2, CU	3/4" EMT
C	4	#6 AWG	THWN-2, CU	65	#10 AWG	60	THWN-2, CU	3/4" EMT
D**	4	#6 AWG	THWN-2, CU	65	#6 AWG	200	THWN-2, CU	3/4" EMT

* TAG A CABLE WILL BE RUN THROUGH ATTIC WHERE POSSIBLE ** TAG D ONLY IF APPLICABLE *

CONDUIT AND CONDUCTOR SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UPSIZING AS REQUIRED BY FIELD CONDITIONS.

THE ENPHASE IQ8PLUS-72-2-US MICRO-INVERTERS HAVE INTEGRATED GROUND AND DOUBLE INSULATION, SO NO GEC OR EGC IS REQUIRED. THE DC CIRCUIT IS ISOLATED AND INSULATED FROM GROUND AND MEETS THE REQUIREMENTS OF NEC 690.35



OCPD CALCULATIONS	
# OF INVERTERS	(31) ENPHASE IQ8PLUS-72-2-US
MAX OUTPUT CURRENT	1.21
OCPD RATING	50A
REQUIRED CONDUCTOR AMPACITY: 1.25 X # MICRO-INVERTERS X MAX OUTPUT CURRENT =	
1.25 X 31 X 1.21 = 46.89A	
OCPD RATING (50A) >= 46.89A	

BUSBAR CALCULATIONS PV BREAKER - 120% RULE	
MAIN BUS RATING	(N) 225A
MAIN DISCONNECT RATING	(N) 200A
PV BREAKER RATING	50A
(MAIN BUS RATING X1.2) - MAIN DISCONNECT RATING >= OCPD RATING	
((N) 225A x 1.2) - (N) 200A >= 50A, OK	

LGCY POWER

LGCY POWER
3333 DIGITAL DR #600, LEHI,
UT 84043, UNITED STATES
855-353-4899

Alex Nelson

Electrical LIC#: U33945

RESERVED FOR ENGINEERING STAMP (IF APPLICABLE)

SYSTEM SIZE:
13640W DC - 8990W AC

MODULE:(31) APTOS DNA-120-MF10-440W [BLK]

INVERTER(S):
(31) ENPHASE IQ8PLUS-72-2-US
( )

BATTERIES:(----)

AHJ: HARNETT

UTILITY: SOUTH RIVER ELECTRIC
METER #: 20019537

SHEET INDEX:

BATTLE
RESIDENCE
24 VALLEY PINES CIR,
SPRING LAKE
NC, 28390

DRAWN BY:	DATE:
MW	8/15/2022

THREE LINE DIAGRAM

PV-6.1

1) LOCATED AT JUNCTION BOX, COMBINER BOX
NEC 690.13(B)

⚠ WARNING

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

DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT

2) LOCATED AT EACH DC DISCONNECTING MEANS
NEC 690.13(B)

PHOTOVOLTAIC DC DISCONNECT

OPERATING VOLTAGE:		VDC
OPERATING CURRENT:		AMPS
MAX SYSTEM VOLTAGE:		VDC
SHORT CIRCUIT CURRENT:		AMPS

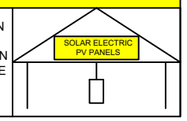
3) LOCATED AT EMT / CONDUIT RACEWAYS, SPACED AT MAXIMUM 10 FT OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
NEC 690.31(G)(3)(4)
LETTERS AT LEAST 3/8 INCH; WHITE ON RED BACKGROUND; REFLECTIVE.
IFC 605.11.1.1

WARNING: PHOTOVOLTAIC POWER SOURCE

4) LOCATED AT MAIN SERVICE PANEL
IFC 605.11.3.1(1) & NEC 690.56(C)(1)(a)

SOLAR 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



5) LOCATED AT RAPID SHUTDOWN DISCONNECT SWITCH
NEC 690.56(C)(3)

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

6) LOCATED AT PRODUCTION METER (IF INSTALLED)
NEC 705.12(D)(3)

SOLAR PHOTOVOLTAIC PRODUCTION METER

7) LOCATED AT INVERTER AND EACH AC DISCONNECTING MEANS
NEC 690.54

PHOTOVOLTAIC AC DISCONNECT

RATED AC OUTPUT CURRENT:		AMPS
NOMINAL OPERATING AC VOLTAGE:		VOLTS

8) LOCATED AT EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT
NEC 690.13(B)

⚠ WARNING

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

9) LOCATED AT POINT OF INTERCONNECTION, LABEL MUST IDENTIFY PHOTOVOLTAIC SYSTEM
NEC 705.12(B)(3-4) & NEC 690.59

⚠ WARNING

DUAL POWER SOURCE.
SECOND SOURCE IS PHOTOVOLTAIC SYSTEM

10) LOCATED AT SOLAR BREAKER (IF APPLICABLE)
NEC 705.12(B)(2)(b)

PV SOLAR BREAKER

DO NOT RELOCATE THIS OVERCURRENT DEVICE

11) LOCATED AT MAIN SERVICE DISCONNECT
NEC 690.13(B)

MAIN PHOTOVOLTAIC SYSTEM DISCONNECT

12) LOCATED AT SOLAR COMBINER PANEL (IF APPLICABLE)
NEC 690.13(B)

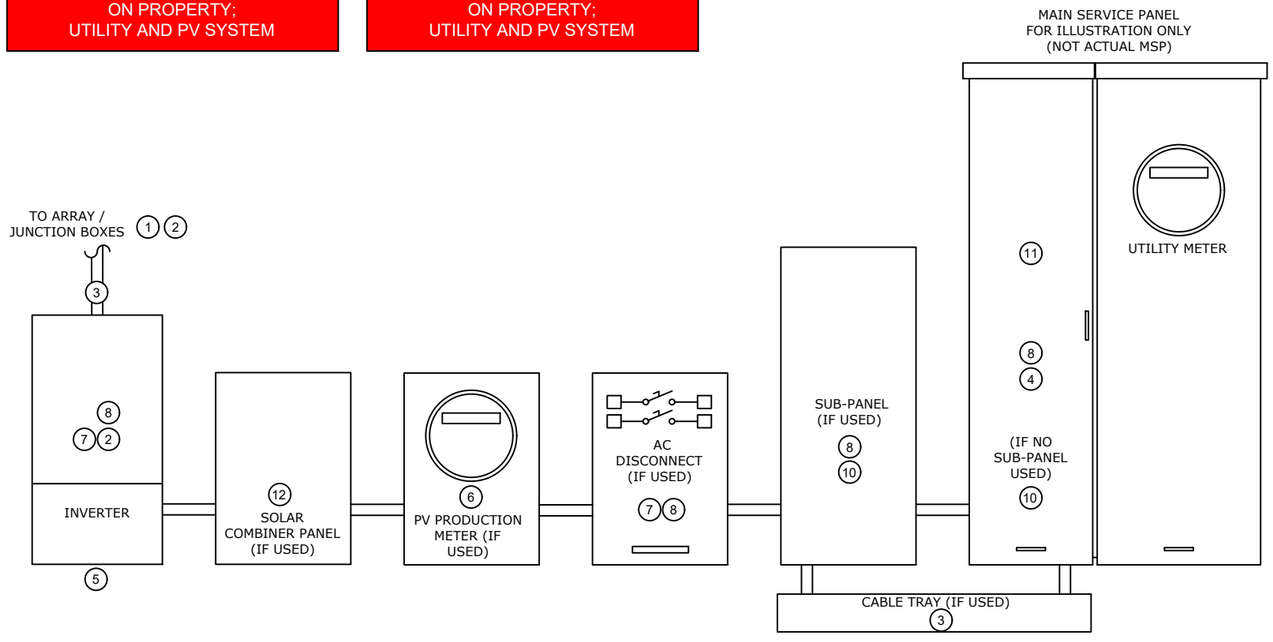
⚠ WARNING

PHOTOVOLTAIC SYSTEM
COMBINER PANEL
DO NOT ADD LOADS

FOR LINE-SIDE TAPS ONLY: LOCATED AT THE MAIN DISCONNECT IN THE MAIN SERVICE PANEL

DISCONNECT 1 OF 2
MULTIPLE POWER SOURCES
ON PROPERTY;
UTILITY AND PV SYSTEM

DISCONNECT 2 OF 2
MULTIPLE POWER SOURCES
ON PROPERTY;
UTILITY AND PV SYSTEM



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 NATIONAL ELECTRIC CODE, OSHA STANDARD 19010.145, ANSI Z535.

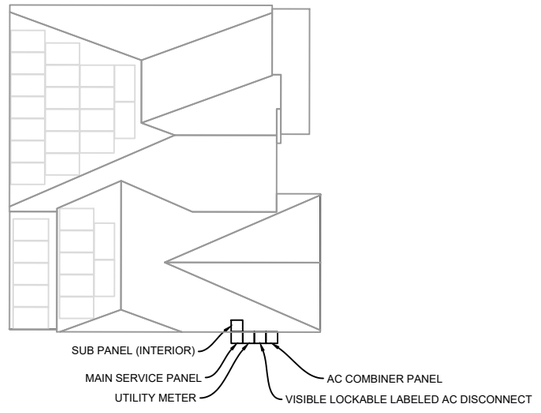
3. MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.

4. LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED [NEC 110.21] THEY SHALL BE PERMANENTLY ATTACHED, WEATHER/SUNLIGHT RESISTANT, AND SHALL NOT BE HAND WRITTEN NEC 11.21(B)

5. APPLICABLE LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8", WHITE ON RED BACKGROUND; REFLECTIVE, AND PERMANENTLY AFFIXED [IFC 605.11.1.1]

CAUTION

MULTIPLE SOURCES OF POWER.
POWER TO THIS BUILDING IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN:



24 VALLEY PINES CIR, SPRING LAKE, NC 28390

LGCY POWER

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Electrical LIC#: U33945

RESERVED FOR ENGINEERING STAMP (IF APPLICABLE)

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13640W DC - 8990W AC

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INVERTER(S):
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( )

BATTERIES:(----)

AHJ: HARNETT

UTILITY: SOUTH RIVER ELECTRIC
METER #: 20019537

SHEET INDEX:

BATTLE
RESIDENCE
24 VALLEY PINES CIR,
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NC, 28390

DRAWN BY:	DATE:
MW	8/15/2022

LABELS / PLACARD

PV-7

LGCY POWER

FIELD DESIGN REQUEST FORM

JOB INFORMATION

JOB NAME: | DATE:

ADDRESS:

CHANGE REQUEST

WHO AUTHORIZED THE CHANGE:

DESCRIBE THE NEEDED CHANGE & WHY:

NEW DESIGN LAYOUT

DRAW THE MOUNTING PLANE SHOWING THE NEW MODULE LAYOUT:

INSTALLER NAME(PRINT):

I UNDERSTAND AND AGREE TO THE CHANGES MADE ABOVE:

CUSTOMER NAME | CUSTOMER SIGNATURE | DATE

LGCY POWER

JOB HAZARD ANALYSIS

CUSTOMER NAME/JOB ID:_____ CUSTOMER ADDRESS

_____INSTALL DATE ___-__-___ Time___:___am/pm

HAZARD CATEGORY	HAZARD TYPE	HAZARD CONTROL MEASURES
LADDER SAFETY	• LOCATION • CONDITION • WORKING CLEARANCE	
FALL PROTECTION	• WORKING 6' OR HIGHER	
ELECTRICAL SAFETY	• ARCH FLASH • ELECTRIC SHOCK/ELECTROCUTION	
WEATHER CONDITIONS	• HEAT/COLD TEMP • RAINY/ICY/WINDY	
PUBLIC SAFETY	• WORK/OBJECTS OVERHEAD • SLIPS/TRIPS/FALLS • ACCESS TO LIVE ELECTRICAL	

NEAREST EMERGENCY FACILITY	
CONTACT IMMEDIATLY IN EMERGENCY (911 AND/OR)	

GENERAL SITE DISCRIPTION/NOTES

CREW MEMBERS ON SITE FOR INSTALL

NAME	SIGNATURE
FMU/LMD-	

ELECTRICAL COMPLETION PHOTOS QR CODE

ROOFTOP INSTALLATION PHOTOS QR CODE

MPU COMPLETION PHOTOS QR CODE

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NC, 28390

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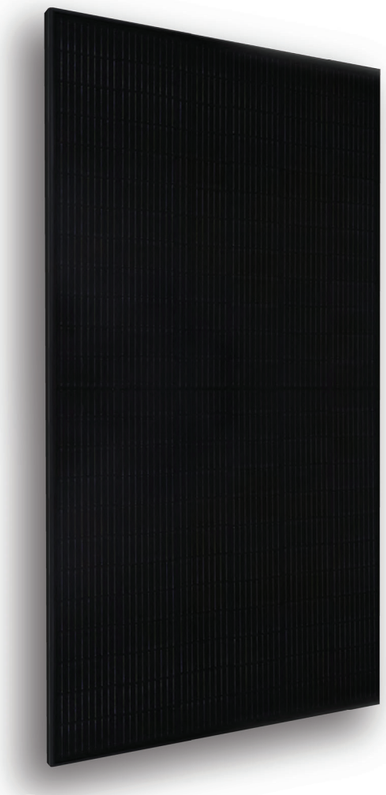
JOB HAZARD SHEET

PV-8

DNA™ 120

Solar for Innovators

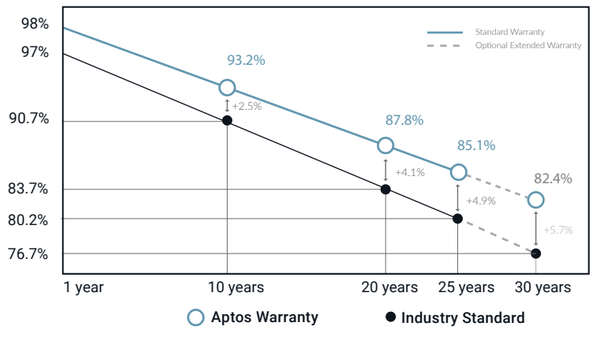
Residential | Commercial



Designed & Engineered in Silicon Valley
440W | 435W | 430W

Our DNA Split Cell Series uses advanced selective emitter PERC technology with thin film layers to improve heat tolerance, increase photon capture, minimize resistive loss, and use 5% more of the available active area for optimal power performance. Our panels exceed IEC standards and come with an industry leading, 30-year warranty.

Linear Performance Warranty



Features

Advanced Technology
Patented DNA™ technology boosts power performance & module efficiency

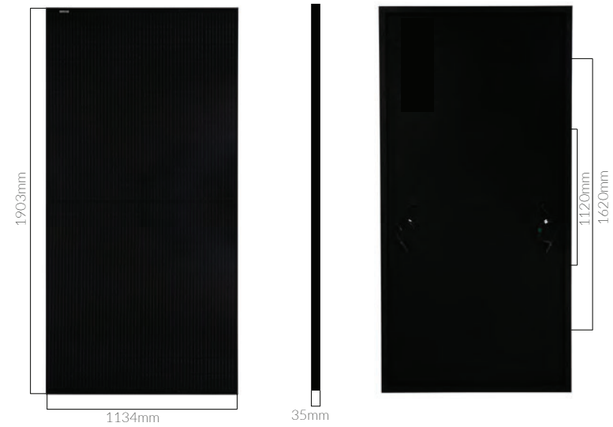
Maximum Panel Density
Advanced split cell technology with 9 ultra-thin busbars allows for less resistance and more photon capture

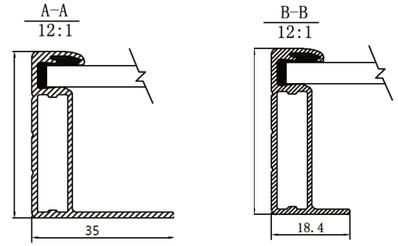
Durable Design
Robust product design is resilient in extreme weather. Up to 5400 Pa snow load and 5400 Pa wind load

A Safe Investment
Industry leading 30 year warranty

3140 De La Cruz Blvd., Ste 200
Santa Clara, CA 95054
www.aptossolar.com I info@aptossolar.com

DNA™ 120





Electrical Specifications

	DNA-120-MF10-440W	DNA-120-MF10-445W	DNA-120-MF10-440W
STCrated Output P_{mpp} (W)	440W	445W	450W
Module Efficiency	20.39%	20.62%	20.85%
Open Circuit Voltage V_{VOC} (V)	40.80	41.10	41.34
Short Circuit Current I_{SC} (A)	13.61	13.70	13.80
Rated Voltage V_{mmp} (V)	33.82	34.02	34.16
Rated Voltage I_{maz} (A)	13.01	13.09	13.17

Standard Test Conditions for front-face of panel: 1000 W/m², 25°C, measurement uncertainty ≤3%

Temperature Coefficients

Temperature Coefficients P_{mmp}	-0.35%/°C
Temperature Coefficients I_{sc}	+0.06%/°C
Temperature Coefficients V_{OC}	-0.31%/°C
Nominal Operating Cell Temperature (NOCT)	45°C

Test Operating Conditions

Maximum Series Fuse	25A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 5400 Pa Wind Load
Fire Performance Class	Class C/Type 1

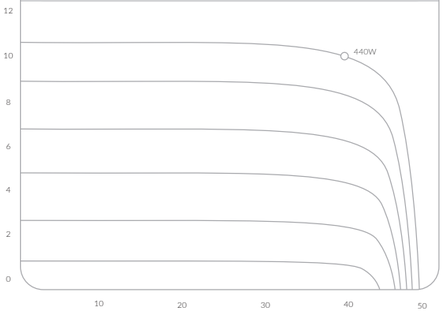
Packaging Configuration

Number of Modules per Pallet	31
Number of Pallets per 40ft. Container	24
Pallet Dimensions	2030 X 1220 X 1200
Pallet Weight (kg)	766
Container Weight (kg)	18,384

Mechanical Properties

Cell Type	Monocrystalline
Glass	3.2mm, anti-reflection coating, high transmission, low iron, tempered glass
Frame	Anodized Aluminum Alloy
Junction Box	IP68
Dimensions	1903 X 1134 X 35 mm
Output Cable	4mm2 (EU)12AWG,39.37in.(1200mm)
Weight	52.9lbs.(24kg)
Cable Length	1200mm
Encapsulant	POE

I-V Curve



Certifications

Intertek
UL61730-1, UL61730-2

Aptos Solar Technology reserves the right to make specification changes without notice

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

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

* 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

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

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

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

ENPHASE

FLASHLOC™ DUO

THE MOST VERSATILE DIRECT TO DECK ATTACHMENT

UNIRAC®
BETTER SOLAR STARTS HERE

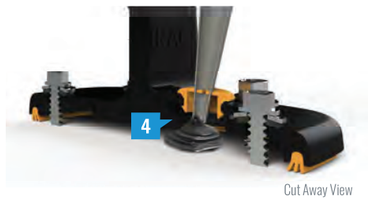
FLASHLOC™ **DUO** is the most versatile direct to deck and rafter attachment for composition shingle and rolled comp roofs. The all-in-one mount installs fast — no kneeling on hot roofs to install flashing, no prying or cutting shingles, no pulling nails. Simply drive the required number of screws to secure the mount and inject sealant into the base. **FLASH**LOC's patented TRIPLE SEAL technology preserves the roof and protects the penetration with a permanent pressure seal. Kitted with two rafter screws, sealant and hardware for maximum convenience (deck screws sold separately). Don't just divert water, **LOC it out!**

PROTECT THE ROOF

Install a high-strength waterproof attachment without lifting, prying or damaging shingles.

LOC OUT WATER

With an outer shield 1 contour-conforming gasket 2 and pressurized sealant chamber 3 the Triple Seal technology delivers a 100% waterproof connection.



HIGH-SPEED INSTALL

Simply drive the required number of screws and inject sealant into the port 4 to create a permanent pressure seal.

APRIL2021_FLASHLOCDUO_V1

FASTER INSTALLATION. 25-YEAR WARRANTY.

FOR QUESTIONS OR CUSTOMER SERVICE VISIT UNIRAC.COM OR CALL (505) 248-2702

FLASHLOC™ DUO

INSTALLATION GUIDE

UNIRAC®
BETTER SOLAR STARTS HERE

PRE-INSTALL: CLEAN SURFACE AND MARK LOCATION

Ensure existing roof structure is capable of supporting loads prescribed in Flashloc Duo D&E Guide. Clean roof surface of dirt, debris, snow and ice.

Snap chalk lines for attachment rows. On shingle roofs, snap lines 1/4" below upslope edge of shingle coarse. This line will be used to align the upper edge of the mount.

NOTE: Space mounts per span charts found in Flashloc Duo D&E Guide.

STEP ONE: SECURE

ATTACHING TO A RAFTER: Place FLASHLOC DUO over rafter location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. BACKFILL ALL PILOT HOLES WITH SEALANT.

ATTACHING TO SHEATHING: Place FLASHLOC DUO over desired location and align upper edge of mount with horizontal chalk line. Secure mount with the two (2) provided rafter screws. Next, secure mount with four (4) deck screws by drilling through the FLASHLOC DUO deck mount hole locations. Unirac recommends using a drill as opposed to an impact gun to prevent over-tightening or stripping roof sheathing.

IMPORTANT: SECURELY ATTACH MOUNT BUT DO NOT OVERTIGHTEN SCREWS.

STEP TWO: SEAL

Insert tip of UNIRAC approved sealant into port and inject until sealant exits vent. Continue array installation, attaching rails to mounts with provided T-bolts.

NOTE: When FLASHLOC DUO is installed over gap between shingle tabs or vertical joints, fill gap/joint with sealant between mount and upslope edge of shingle course.

CUT SHINGLES AS REQUIRED: DO NOT INSTALL THE FLASHLOC SLIDER ACCROSS THICKNESS VARIATIONS GREATER THAN 1/8" SUCH AS THOSE FOUND IN HIGH DEFINITION SHINGLES.

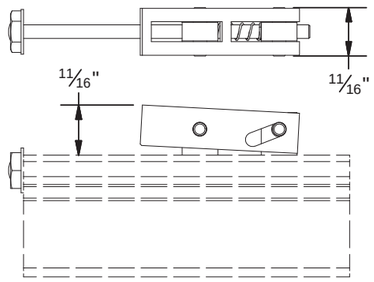
NOTE: When installing included rail attachment hardware, torque T-bolt nut to 30 ft-lbs.
NOTE: If an exploratory hole falls outside of the area covered by the sealant, flash hole accordingly.

USE ONLY UNIRAC APPROVED SEALANTS. PLEASE CONTACT UNIRAC FOR FULL LIST OF COMPATIBLE SEALANTS.

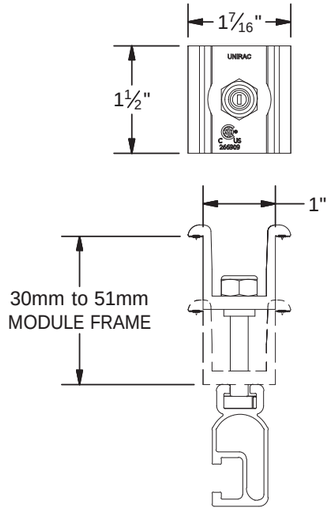
FASTER INSTALLATION. 25-YEAR WARRANTY.

FOR QUESTIONS OR CUSTOMER SERVICE VISIT UNIRAC.COM OR CALL (505) 248-2702

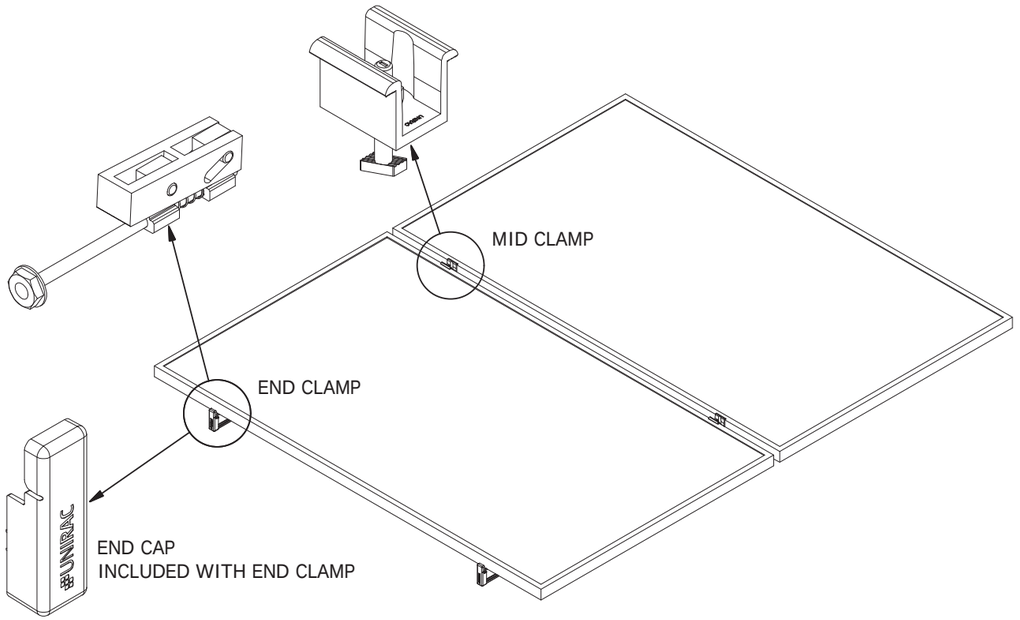
PRO SERIES END CLAMP



PRO SERIES MID CLAMP



PART # TABLE	
P/N	DESCRIPTION
302035M	ENDCLAMP PRO
302030M	MIDCLAMP PRO - MILL
302030D	MIDCLAMP PRO - DRK



UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	PRO SERIES BONDING CLAMPS
REVISION DATE:	10/26/2017

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

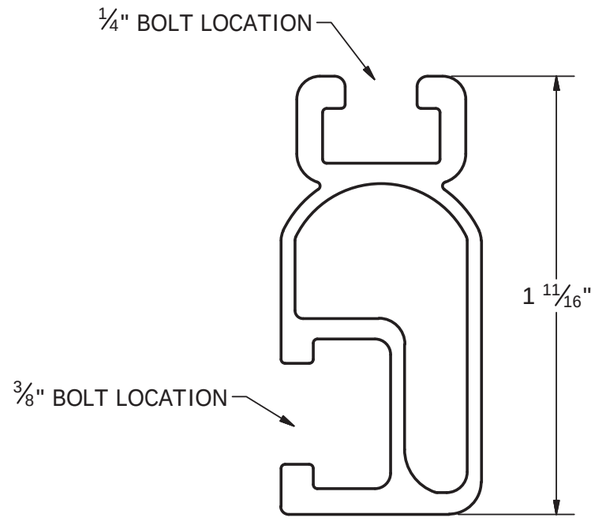
PRODUCT PROTECTED BY ONE OR MORE US PATENTS

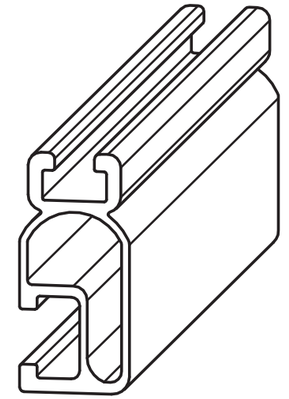
LEGAL NOTICE

SM-A01

SHEET

¼" BOLT LOCATION





PART # TABLE		
P/N	DESCRIPTION	LENGTH
315168M	SM LIGHT RAIL 168" MILL	168"
315168D	SM LIGHT RAIL 168" DRK	168"
315240M	SM LIGHT RAIL 240" MILL	240"
315240D	SM LIGHT RAIL 240" DRK	240"

UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART DETAIL
DESCRIPTION:	LIGHT RAIL
REVISION DATE:	9/11/2017

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE OR MORE US PATENTS

LEGAL NOTICE

SM-P02

SHEET

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SOLARMOUNT Installation Guide. SOLARMOUNT has been classified to the system level fire portion of UL 1703. This UL 1703 classification has been incorporated into our UL 2703 product certification. SOLARMOUNT has achieved system level performance for steep sloped roofs. System level fire performance is inherent in the SOLARMOUNT design, and no additional mitigation measures are required. The fire classification rating is only valid on roof pitches greater than 2:12 (slopes ⩾ 2 inches per foot, or 9.5 degrees). The system is to be mounted over fire resistant roof covering rated for the application. There is no required minimum or maximum height limitation above the roof deck to maintain the system fire rating for SOLARMOUNT. Module Types & System Level Fire Ratings are listed below:

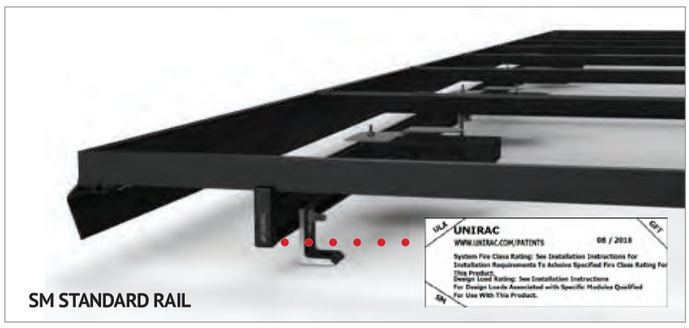
Rail Type	Module Type	System Level Fire Rating	Rail Direction	Module Orientation	Mitigation Required
Standard Rail	Type 1, Type 2, Type 3, Type 10, Type 19, Type 22, & Type 25	Class A, Class B & Class C	East-West	Landscape OR Portrait	None Required
			North-South	Landscape OR Portrait	None Required
Light Rail	Type 1 & Type 2	Class A, Class B & Class C	East-West	Landscape OR Portrait	None Required
			North-South	Landscape OR Portrait	None Required

This racking system may be used to ground and/or mount a PV module complying with UL1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

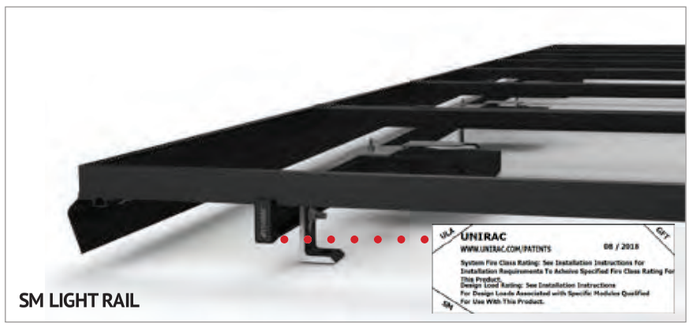
UL2703 CERTIFICATION MARKING LABEL

Unirac SOLARMOUNT is listed to UL 2703. Certification marking is embossed on all mid clamps as shown. Labels with additional information will be provided . After the racking system is fully assembled, a single label should be applied to the SOLARMOUNT rail at the edge of the array. **Before applying the label, the corners of the label that do not pertain to the system being installed must be removed so that only the installed system type is showing.**

Note: The sticker label should be placed such that it is visible, but not outward facing.

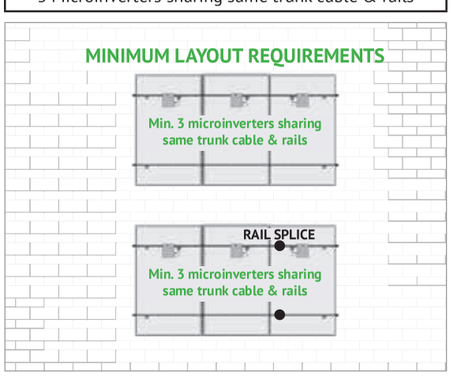


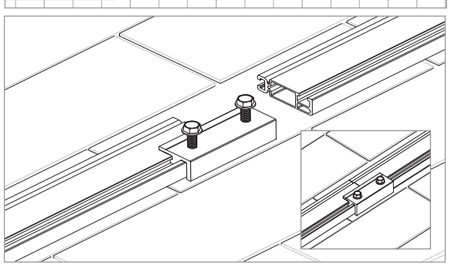
SM STANDARD RAIL



SM LIGHT RAIL

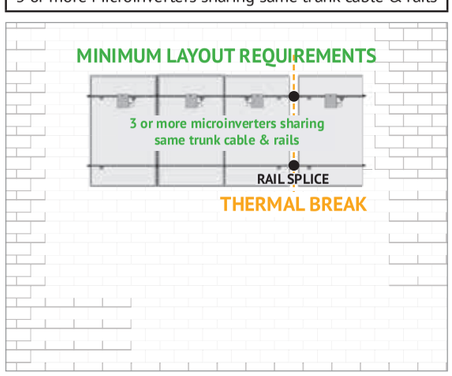
CONTINUOUS RAIL & ELECTRICAL BONDING SPLICE
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 Microinverters sharing same trunk cable & rails

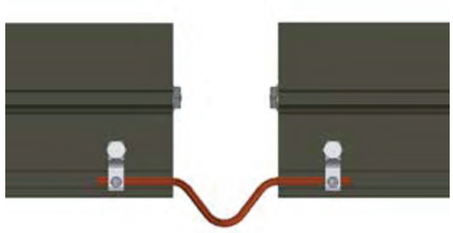




ELECTRICAL BONDING SPLICE

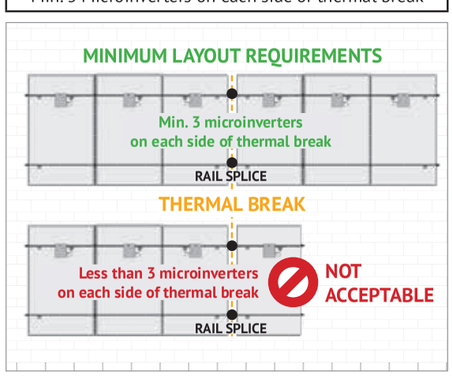
EXPANSION JOINT W/GROUNDING LUGS & COPPER JUMPER
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
3 or more Microinverters sharing same trunk cable & rails





EXPANSION JOINT USED AS THERMAL BREAK W/ GROUNDING LUGS & COPPER JUMPER

EXPANSION JOINT W/O ELECTRICAL BONDING CONNECTION
Enphase Microinverter (MI) Requirements (Model No. M215 & M250)
MIn. 3 Microinverters on each side of thermal break

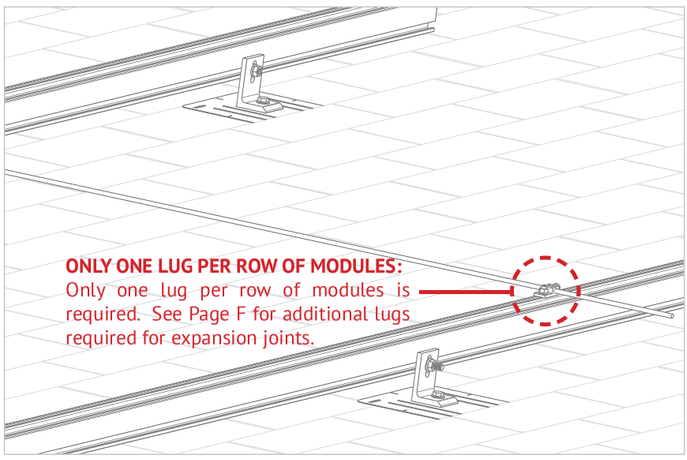


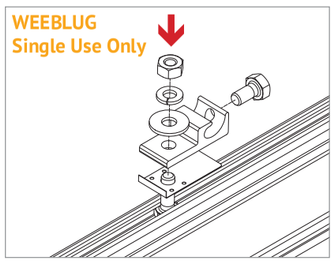
EXPANSION JOINT USED AS THERMAL BREAK W/O ELECTRICAL BONDING CONNECTION

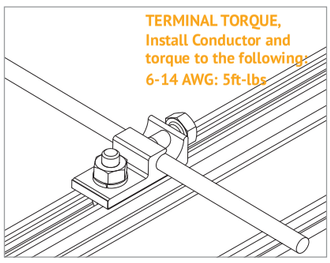
NOTE: THE ABOVE IMAGES ARE SAMPLE CONFIGURATIONS TO ILLUSTRATE THE REQUIREMENTS FOR SM SYSTEM GROUNDING THROUGH ENPHASE MICROINVERTERS DESCRIBED ON PAGE I

STANDARD SYSTEM GROUNDING

INSTALLATION GUIDE | K PAGE





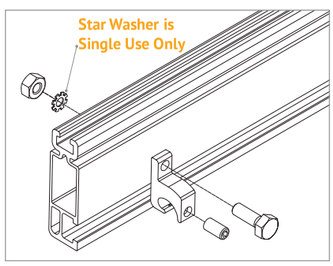


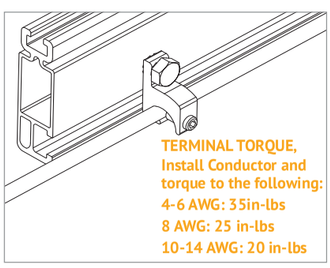
WEEBLUG CONDUCTOR - UNIRAC P/N 008002S:
Apply Anti Seize and insert a bolt in the aluminum rail and through the clearance hole in the stainless steel flat washer. Place the stainless steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless steel flat washer. Install stainless steel flat washer, lock washer and nut. Tighten the nut until the dimples are completely embedded into the rail and lug.
TORQUE VALUE 10 ft lbs. (See Note on PG. A)
See product data sheet for more details, Model No. WEEB-LUG-6.7

GROUNDING LUG MOUNTING DETAILS:
Details are provided for both the WEEB and Ilsco products. The WEEBLug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. Installation must be in accordance with NFPA NEC 70, however the electrical designer of record should refer to the latest revision of NEC for actual grounding conductor cable size.
Required if not using approved integrated grounding microinveters

GROUNDING LUG - BOLT SIZE & DRILL SIZE		
GROUND LUG	**BOLT SIZE**	**DRILL SIZE**
WEEBLug	1/4"	N/A - Place in Top SM Rail Slot
ILSCO Lug	#10-32	7/32"

- Torque value depends on conductor size.
- See product data sheet for torque value.



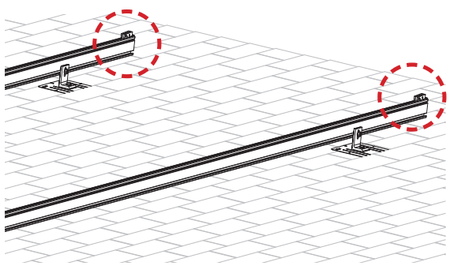


ILSCO LAY-IN LUG CONDUCTOR - UNIRAC P/N 008009P: Alternate Grounding Lug - Drill, deburr hole and bolt thru both rail walls per table.
TORQUE VALUE 5 ft lbs. (See Note on PG. A)
See ILSCO product data sheet for more details, Model No. GBL-4DBT.

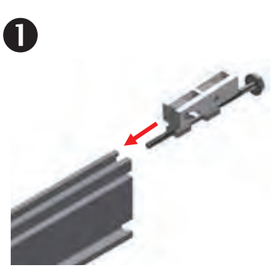
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

ENDCLAMP, FIRST MODULE

INSTALLATION GUIDE | L PAGE

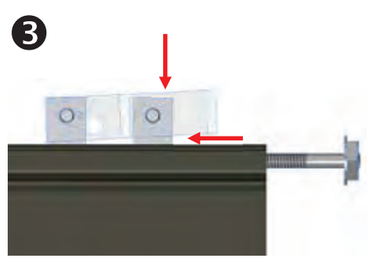


INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.

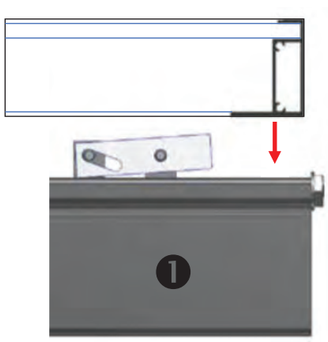


INSTALL END CLAMPS ON RAIL:
Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**

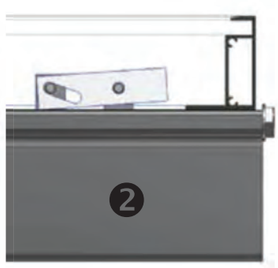
POSITION END CLAMPS:
Slide end clamp assembly on to rail until bolt head engages with end of rail
End clamps are positioned on rails prior to the first end module and prior to the last end module.

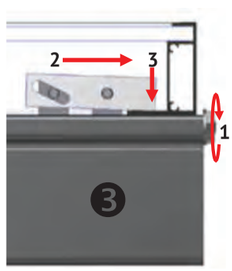


NOTE: To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.

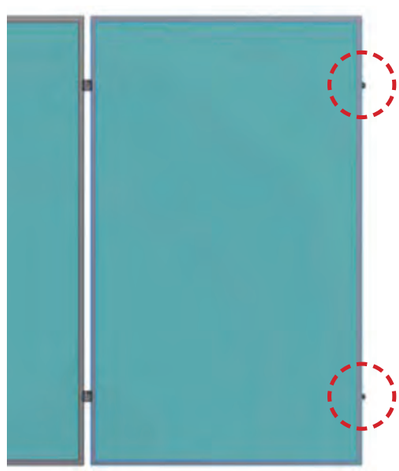


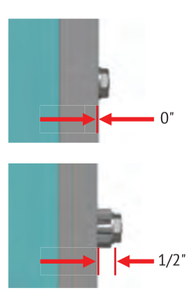
INSTALL FIRST MODULE:
Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.





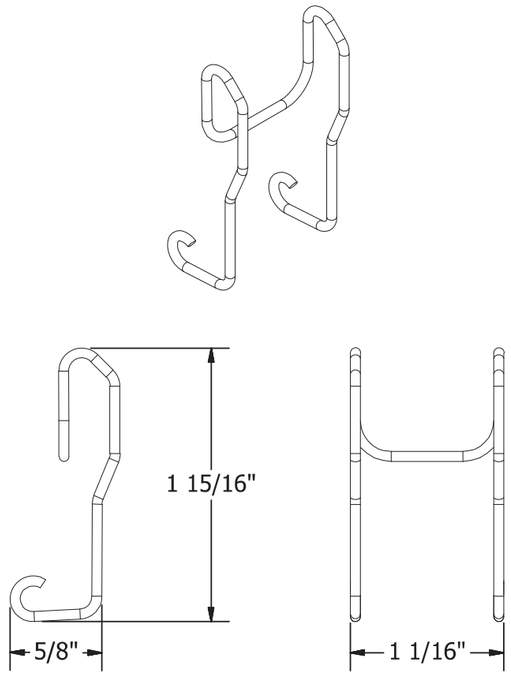
ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.
To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.
TORQUE VALUE (See table and notes on PG. A)
End clamp bolt to 5 ft-lbs, No anti-seize



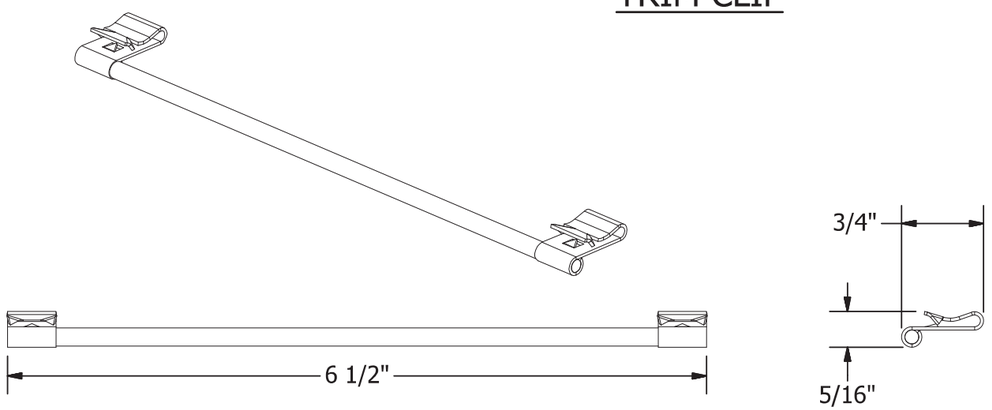


For best appearance, position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.

PART # TABLE	
P/N	DESCRIPTION
240905C	SFM TRIM CLIP
008015S	SFM WIRE BONDING CLIP



TRIM CLIP



WIRE BONDING CLIP

UNIRAC
1411 BROADWAY BLVD. NE
ALBUQUERQUE, NM 87102 USA
PHONE: 505.242.6411
WWW.UNIRAC.COM

PRODUCT LINE:	SFMCR
DRAWING TYPE:	PART
DESCRIPTION:	TRIM CLIP / WIRE BONDING CLIP
REVISION DATE:	6/27/2018

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE OR MORE US PATENTS
LEGAL NOTICE

SFMCR-P04
SHEET

Descriptive Report and Test Results

MASTER CONTRACT: 266909
REPORT: 70131735
PROJECT: 80050628

Edition 1: September 20, 2017; Project 70131735– Albuquerque
Issued by Michael Hoffnagle

Edition 2: December 6, 2017; Project 70161436– Albuquerque
Issued by Michael Hoffnagle

Edition 3: October 8, 2018; Project 70185553 - Irvine
Issued by Michael Hoffnagle

Edition 4: May 15, 2019; Project 70218415 - Irvine
Issued by Uday Singh

Edition 5: November 18, 2019; Project 80007667 - Irvine
Issued by Michael Hoffnagle

Edition 6: January 28, 2020; Project 80030869 - Irvine
Issued by Michael Hoffnagle

Edition 7: April 11, 2020; Project 80038806 - Irvine
Prepared By: Michael Hoffnagle
Authorized By: Sean Jiang

Edition 8: September 29, 2020; Project 80050628 - Irvine
Prepared By: Michael Hoffnagle
Authorized By: Michael Hoffnagle

Report pages reissued

Contents:

PRODUCTS

CLASS - C531302 - POWER SUPPLIES - PHOTOVOLTAICS-PV Racking and clamping systems
CLASS - C531382 - POWER SUPPLIES - PHOTOVOLTAICS-PV Racking and clamping systems - Certified to US Standards

34 Bunsen, Irvine, CA, U.S.A. 92618
Telephone: 949.733.4300 1.800.463.6727 Fax: 949.733.4320 www.csagroup.org

Models: SM SOLARMOUNT Flush-to-Roof is an extruded aluminum rail PV racking system that is installed parallel to the roof in landscape or portrait orientations.

ULA Unirac Large Array is a ground mount system using the SolarMount (SM) platform for the bonding and grounding of PV modules.

Solarmount

The system listed is designed to provide bonding/grounding, and mechanical stability for photovoltaic modules. The system is secured to the roof with the L-Foot components through the roofing material to building structure. Modules are secured to the racking system with stainless steel or aluminum mid clamps and Aluminum end clamps. The modules are bonded to the racking system with the stainless steel bonding mid clamps with piercing points. The system is grounded with 10 AWG copper wire to bonding/grounding lugs. Fire ratings of Class A with Type 1, 2, 3, or 10 for steep slope. Tested at 5" interstitial gap which allows installation at any stand-off height.

The grounding of the system is intended to comply with the latest edition of the National Electrical Code, to include NEC 250 & 690. Local codes compliance is required, in addition to national codes. All grounding/bonding connections are to be torqued in accordance with the Installation Manual and the settings used during the certification testing for the current edition of the project report.

The system may employ optimizers/micro-inverters and used for grounding when installed per installation instructions.

UL 2703 Mechanical Load ratings:

Downward Design Load (lb/ft²)	75.2
Upward Design Load (lb/ft²)	33.4
Down-Slope Load (lb/ft²)	5.0

Test Loads:

Downward Load (lb/ft²)	112.8
Upward Load (lb/ft²)	50.13
Down-Slope Load (lb/ft²)	7.5

Unirac Large Array

ULA is a ground mount system using the SolarMount (SM) platform for the bonding and grounding of PV modules. ULA aluminum components merge with SM rails and installer-supplied steel pipe. The SM rail system is secured to the horizontal Pipe using the Rail Bracket components. The Rear and Front cap secures the horizontal Pipe to the vertical Pipe. The Front cap is also used to secure the Cross brace. A Slider is attached to the vertical Pipe to secure the Cross brace. The SM rails, caps, slider, rail brackets, and cross braces materials are 6105-T5 aluminum extrusion. Fasteners materials are 304 stainless steel. Horizontal and vertical pipe materials meet the minimum requirements of ASTM A53 for galvanized steel pipe in 2" and 3" diameter.

The mechanical load ratings from the SM test data will be applied to the ULA model.

Fire Testing is not applicable due to being a ground mount system.

Conditions of Acceptability:

Installation is subject to acceptance of the local inspection authorities having jurisdiction. The certification of these products relates only to the methods of installation, bonding, and grounding as outlined in the Installation Manual for each product.

APPLICABLE REQUIREMENTS

UL 2703-1st Edition	- Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels.
LTR AE-001-2012	- List of Technical Requirements for Photovoltaic Module and Panel racking Systems

MARKINGS

The manufacturer is required to apply the following markings:

- Products shall be marked with the markings specified by the particular product standard.
- Products certified for Canada shall have all Caution and Warning markings in both English and French.

Additional bilingual markings not covered by the product standard(s) may be required by the Authorities Having Jurisdiction. It is the responsibility of the manufacturer to provide and apply these additional markings, where applicable, in accordance with the requirements of those authorities.

The products listed are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US (indicating that products have been manufactured to the requirements of both Canadian and U.S. Standards) or with adjacent indicator 'US' for US only or without either indicator for Canada only.

The following markings appear on the rail by adhesive label:

1. Submitter's name and/or CSA Master Contract number "266909";
2. Model designation;
3. Manufacturing date;
4. System fire class rating/designation of information location in Installation Manual;
5. Design load rating/designation of information location in Installation Manual;

The following markings appear on the Mid clamp by stamping:

1. Submitter's name and/or CSA Master Contract number "266909";
2. CSA mark
3. Mil ID for factory location

Nameplate adhesive label material approval information:

SATO AMERICA INC, SF401 DuraMark Polyester, MH48415 - Printing Materials – Component, UL 969-Marking and Labeling Systems

ALTERATIONS

Not Applicable

FACTORY TESTS

Not Applicable

SPECIAL INSTRUCTIONS FOR FIELD SERVICES

1. Component descriptions marked with either the "(INT)" or "(INT*)" identifiers may be substituted with other components providing the requirements specified under the notes in the "Description" are complied with.

COMPONENT SPECIAL PICKUP

1. Component descriptions marked with the identifier "(CT)" are subject to annual pickup and Conformity Testing.

DESCRIPTION

Notes:

1. Component Substitution
   a) Critical components (those identified by mfr name, cat no), which are NOT identified with either "INT" or "INT*" are not eligible for substitution without evaluation and report updating
   b) The term "INT" means a "Certified" and/or "Listed" (or a "Recognized" and/or "Accepted") component may be replaced by one "Certified" and/or "Listed" by another certification organization accredited by the appropriate accreditation body or scheme requirements to the correct standard, for the same application; providing the applicable country identifiers are included and requirements in item "d" below are complied with.
   c) The Term "(INT*)" means a "Recognized" and/or "Accepted" component may be replaced by a component that is CSA Certified. The applicable country identifiers shall be included, the requirements in item "d" below as well as any "conditions of suitability" for the component (as recorded in this descriptive report) shall be complied with;
   d) Components which have been substituted, must be of an equivalent rating, configuration (size, orientation, mounting) and the applicable minimum creepage and clearance distances are to be maintained from live parts to bonded metal parts and secondary parts.
   e) Substitution of a "Certified" and/or "Listed" component with a component that is "Recognized" or "Accepted" is not permitted without evaluation and report updating.
   f) Substitution of a "Recognized" and/or "Accepted" component by one that is not CSA Certified is not permitted without a proper evaluation as well as a report update because the Conditions of Acceptance of the original component may be different than the Conditions of Acceptance of the substitute component.

Table 2

Module Manufacturer	Model/Series Below models can be used together with racking system in this report to be a Class A fire system, only when they are rated for Fire Type 1, 2, 3, or 10 for steep slope applications.	
AU Optronics (BenQ Solar)	PM Series	
Aleo	P18, P19, S18, S19, S59, S79	
Aptos Solar	DNA-144 & DNA 120 Series	
Astronergy	CHSM6612 M, M/HV CHSM72M-HC, CHSM6612P Series CHSM6612P/HV Series	
Auxin	AXN6M610Txxx, AXN6P610Txxx, AXN6M612Txxx, AXN6P612Txxx	
Axitec	AC-XXXM/60S, AC-XXXP/60S, AC-XXXM/72S, AC-XXXP/156-60S, AC-XXXP/72S	
Boviet	BVM6610P-XXX, BVM6610M-XXX, BVM6612M-XXX, BVM6612P-XXX	
BYD	P6K Series MHK-36	
Canadian Solar	CS6P-M, CS6P-P, CSX-P, CS6X-P CS5A-M, CS6U-P, CS6U-M, CS6K-MS, CS6K-M, CS6K-P, ELPS CS6A-MM, ELPS CS6P-MM CS3U-P CS3U-MS, CS3K-P, CS3K-MS, CS1K-MS CS3K-MB, CS3K-PB, CS3U-MB, CS3W-P, CS3L-P, CS3U-PB, CS1H-MS, CS3U-MS	CS3U-xxxPB-AG, CS3U-xxxMB-AG, CS3KxxxPB-AG, CS3KxxxMB-AG, CS3WxxxP-PB-AG, CS1HxxxMS, CS1UxxxMS, CS3UxxxP HighEfficiency, CS3KxxxP HighEfficiency, CS6UxxxP High Efficiency, CS6KxxxP HighEfficiency, CS6KxxxMS AllBlack, ELPS CS6P-MM, ELPS CS6A-MM

March 28, 2022

Unirac
1411 Broadway Blvd. NE
Albuquerque, NM 87102

Attn.: Unirac - Engineering Department

Re: Engineering Certification for the Unirac U-Builder 2.0 SOLARMOUNT Flush Rail

PZSE, Inc. - Structural Engineers has reviewed the Unirac SOLARMOUNT rails, proprietary mounting system constructed from modular parts which is intended for rooftop installation of solar photovoltaic (PV) panels; and has reviewed the U-builder Online tool. This U-Builder software includes analysis for the SOLARMOUNT LIGHT rail, SOLARMOUNT STANDARD rail, and SOLARMOUNT HEAVY DUTY rail with Standard and Pro Series hardware. All information, data and analysis contained within are based on, and comply with the following codes and typical specifications:

1. Minimum Design Loads for Buildings and other Structures, ASCE/SEI 7-05 and ASCE/SEI 7-10
2. 2006-2015 International Building Code, by International Code Council, Inc.
3. 2006-2015 International Residential Code, by International Code Council, Inc.
4. AC428, Acceptance Criteria for Modular Framing Systems Used to Support Photovoltaic (PV) Panels, November 1, 2012 by ICC-ES.
5. 2015 Aluminum Design Manual, by The Aluminum Association, 2015

Following are typical specifications to meet the above code requirements:

Design Criteria: Ground Snow Load = 0 - 100 (psf)
Basic Wind Speed = 85 - 190 (mph)
Roof Mean Height = 0 - 60 (ft)
Roof Pitch = 0 - 45 (degrees)
Exposure Category = B, C & D

Attachment Spacing: Per U-builder Engineering report.

Cantilever: Maximum cantilever length is L/3, where "L" is the span noted in the U-Builder online tool.

Clearance: 2" to 10" clear from top of roof to top of PV panel.

Tolerance(s): 1.0" tolerance for any specified dimension in this report is allowed for installation.

Installation Orientation: See SOLARMOUNT Rail Flush Installation Guide.
Landscape - PV Panel long dimension is parallel to ridge/eave line of roof and the PV panel is mounted on the long side.
Portrait - PV Panel short dimension is parallel to ridge/eave line of roof and the PV panel is mounted on the short side.

Components and Cladding Roof Zones:
The Components and Cladding Roof Zones shall be determined based on ASCE 7-05 and ASCE 7-10 Component and Cladding design.

Notes:
1) U-builder Online tool analysis is only for Unirac SM SOLARMOUNT Rail Flush systems only and do not include roof capacity check.
2) Risk Category II per ASCE 7-10.
3) Topographic factor, kzt is 1.0.
4) Average parapet height is 0.0 ft.
5) Wind speeds are LRFD values.
6) Attachment spacing(s) apply to a seismic design category E or less.

Design Responsibility:
The U-Builder design software is intended to be used under the responsible charge of a registered design professional where required by the authority having jurisdiction. In all cases, this U-builder software should be used under the direction of a design professional with sufficient structural engineering knowledge and experience to be able to:

- Evaluate whether the U-Builder Software is applicable to the project, and
- Understand and determine the appropriate values for all input parameters of the U-Builder software.

This letter certifies that the Unirac SM SOLARMOUNT Rails Flush, when installed according to the U-Builder engineering report and the manufacture specifications, is in compliance with the above codes and loading criteria.

This certification excludes evaluation of the following components:
1) The structure to support the loads imposed on the building by the array; including, but not limited to: strength and deflection of structural framing members, fastening and/or strength of roofing materials, and/or the effects of snow accumulation on the structure.
2) The attachment of the SM SOLARMOUNT Rails to the existing structure.
3) The capacity of the solar module frame to resist the loads.

This requires additional knowledge of the building and is outside the scope of the certification of this racking system.

If you have any questions on the above, do not hesitate to call.

Prepared by:
PZSE, Inc. – Structural Engineers
Roseville, CA

DIGITALLY SIGNED
NORTH CAROLINA PROFESSIONAL SEAL 41973 EXP. 12/31/2022 ENGINEER PAUL K. ZACHER
03/28/2022

Certificate of Compliance

Certificate: 70131735 **Master Contract:** 266909

Project: 80096297 **Date Issued:** 2021-10-22

Issued To: **Unirac**
1411 Broadway NE
Albuquerque, New Mexico, 87102
United States

Attention: Klaus Nicolaedis

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: *Michael Hoffnagle*
Michael Hoffnagle

C US

PRODUCTS

CLASS - C531302 - POWER SUPPLIES - PHOTOVOLTAICS-PV Racking and clamping systems
CLASS - C531382 - POWER SUPPLIES - PHOTOVOLTAICS-PV Racking and clamping systems - Certified to US Standards

Models:	SM	-	SOLARMOUNT Flush-to-Roof is an extruded aluminum rail PV racking system that is installed parallel to the roof in landscape or portrait orientations.
	ULA	-	Unirac Large Array is a ground mount system using the SolarMount (SM) platform for the bonding and grounding of PV modules.

Solarmount

The system listed is designed to provide bonding/grounding, and mechanical stability for photovoltaic modules. The system is secured to the roof with the L-Foot components through the roofing material to building structure. Modules are secured to the racking system with stainless steel or aluminum mid clamps and Aluminum end clamps. The modules are bonded to the racking system with the stainless-steel bonding mid clamps with piercing points. The system is grounded with 10 AWG copper wire to bonding/grounding lugs. Fire ratings of Class A with Type 1, 2, 3, 10, 19, 22 or 25 for steep slope. Tested at 5" interstitial gap which allows installation at any stand-off height.

The grounding of the system is intended to comply with the latest edition of the National Electrical Code, to include NEC 250 & 690. Local codes compliance is required, in addition to national codes. All grounding/bonding connections are to be torqued in accordance with the Installation Manual and the settings used during the certification testing for the current edition of the project report.

The system may employ optimizers/micro-inverters and used for grounding when installed per installation instructions.

UL 2703 Mechanical Load ratings:

Downward Design Load (lb/ft²)	113.5
Upward Design Load (lb/ft²)	50.7
Down-Slope Load (lb/ft²)	16.13

Test Loads:

Downward Load (lb/ft²)	170.20
Upward Load (lb/ft²)	76.07
Down-Slope Load (lb/ft²)	24.2