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February 25, 2022

Legacy Solar
3333 Digital Drive #600
Lehi, UT 84043

Re: Engineering Services
Gavalier Residence
84 Windy Farm Drive, Fuquay-Varina NC
9.240 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: Prefabricated wood trusses at 22" on center. All truss members are constructed of 2x6 dimensional lumber.
Roof Material: Composite Asphalt Shingles
Roof Slope: 34 degrees
Attic Access: Accessible
Lumber type: Assumed Douglas Fir
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** = 15 psf
- **Wind Load** based on ASCE 7-10
 - Ultimate Wind Speed = 115 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.

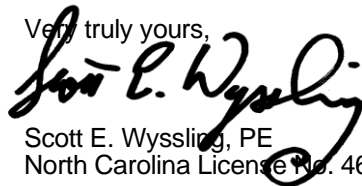
D. Solar Panel Anchorage

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 $\frac{5}{16}$ " 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 $2\frac{1}{2}$ ", 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 one $\frac{5}{16}$ " diameter lag screw with a minimum of $2\frac{1}{2}$ " 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 60" on centers.
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

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Wyssling Consulting, PLLC
76 N Meadowbrook Drive Alpine UT 84004
North Carolina COA # P-2308

Signed 2/25/2022

SCOPE OF WORK:

TO INSTALL A ROOF MOUNTED SOLAR PHOTOVOLTAIC SYSTEM AT THE OWNER RESIDENCE LOCATED AT 84 WINDY FARM DR, FUQUAY-VARINA, NC 27526. THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES

EQUIPMENT SUMMARY

21 APTOS SOLAR DNA-144-MF26-440 (440W) MODULES
21 ENPHASE IQ7PLUS-72-2-US (240V) MICROINVERTERS

GENERAL NOTES:

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

ELECTRICAL NOTES:

- THE EQUIPMENT AND ALL ASSOCIATED WIRING AND INTERCONNECTION SHALL BE INSTALLED ONLY BY QUALIFIED PEOPLE. A QUALIFIED PERSON IS ONE WHO HAS SKILLS AND KNOWLEDGE RELATED TO THE CONSTRUCTION AND OPERATION OF THE ELECTRICAL EQUIPMENT AND INSTALLATIONS AND HAS RECEIVED SAFETY TRAINING TO RECOGNIZE AND AVOID THE HAZARDS INVOLVED. (NEC 690.4(E) AND 705.6)
- LOCAL UTILITY PROVIDER SHALL BE NOTIFIED PRIOR TO USE AND ACTIVATION OF ANY SOLAR PHOTOVOLTAIC INSTALLATION. FOR A LINE SIDE TAP CONNECTION, UTILITY NEEDS TO BE NOTIFIED WELL IN ADVANCE TO COORDINATE BUILDING ELECTRICAL SHUT OFF.
- NEW CONDUIT ROUTING SHOWN IS ESSENTIALLY SCHEMATIC. SUBCONTRACTOR SHALL LAY OUT RUNS TO SUIT FIELD CONDITIONS AND THE COORDINATION REQUIREMENTS OF OTHER TRADES.
- ARRAY WIRING SHOULD NOT BE READILY ACCESSIBLE EXCEPT TO QUALIFIED PERSONNEL.
- ALL EXTERIOR CONDUIT, FITTINGS, AND BOXES SHALL BE WATERTIGHT AND APPROVED FOR USE IN WET LOCATIONS. (NEC 314.15A).
- WIRING METHODS FOR PV SYSTEM CONDUCTORS AREN'T PERMITTED WITHIN 10 IN. OF THE ROOF DECKING OR SHEATHING EXCEPT WHERE LOCATED DIRECTLY BELOW THE ROOF SURFACE THAT'S COVERED BY PV MODULES AND ASSOCIATED EQUIPMENT WIRING
- BACK-FED BREAKER MUST BE AT THE OPPOSITE END OF BUS BAR FROM THE MAIN BREAKER OR MAIN LUG SUPPLYING CURRENT FROM THE UTILITIES.
- ALL CONDUCTORS AND WIRE TIES EXPOSED TO SUNLIGHT ARE LISTED AS UV RESISTANT.
- CONTRACTOR SHALL FOLLOW ALL ELECTRICAL EQUIPMENT LABELING REQUIREMENTS IN NEC 690 AND IFC 2018
- MEASURE THE LINE-TO-LINE AND LINE-TO-NEUTRAL VOLTAGE OF ALL SERVICE ENTRANCE CONDUCTORS PRIOR TO INSTALLING ANY SOLAR EQUIPMENT. THE VOLTAGES FOR THE 240VAC RATED.

GOVERNING CODES

2017 NATIONAL ELECTRICAL CODE
2018 NORTH CAROLINA BUILDING CODE / 2015 IBC
2018 NORTH CAROLINA RESIDENTIAL CODE / 2015 IBC
2018 NORTH CAROLINA FIRE CODE / 2015 IFC

AUTHORITY HAVING JURISDICTION (AHJ): HARNETT COUNTY

WIRING AND CONDUIT NOTES:

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

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SYSTEM RATING

9.24 KWDC

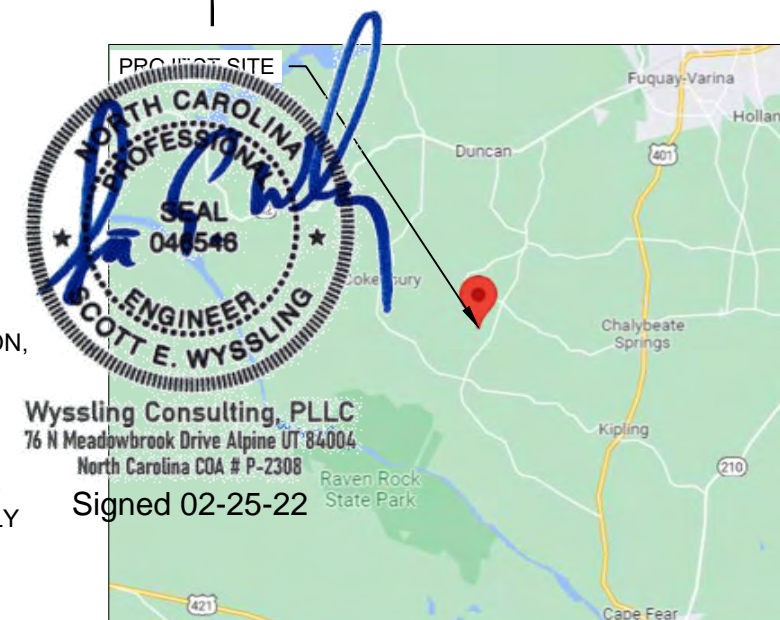
6.09 KWAC

SHEET INDEX

PV-0	COVER PAGE
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PV-2	ROOF PLAN & MODULES
PV-3	ATTACHMENT DETAIL
PV-4	ELECTRICAL LINE DIAGRAM & CALCS.
PV-4A	ELECTRICAL PHOTOS
PV-4B	SPECIFICATIONS & CALCULATION
PV-5	LABELS
PV-5A	JOB HAZARD ANALYSIS
PV-6+	EQUIPMENT SPECIFICATIONS



1 PV-0 HOUSE PHOTO SCALE: NTS



2 PV-0 VICINITY MAP SCALE: NTS



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

Scott Wyssling

ELECTRICAL LIC#: U34871

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

**BILL GAVALIER
RESIDENCE**
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavallier@gmail.com

DATE: 02/25/2022

SHEET NAME

COVER PAGE

SHEET SIZE

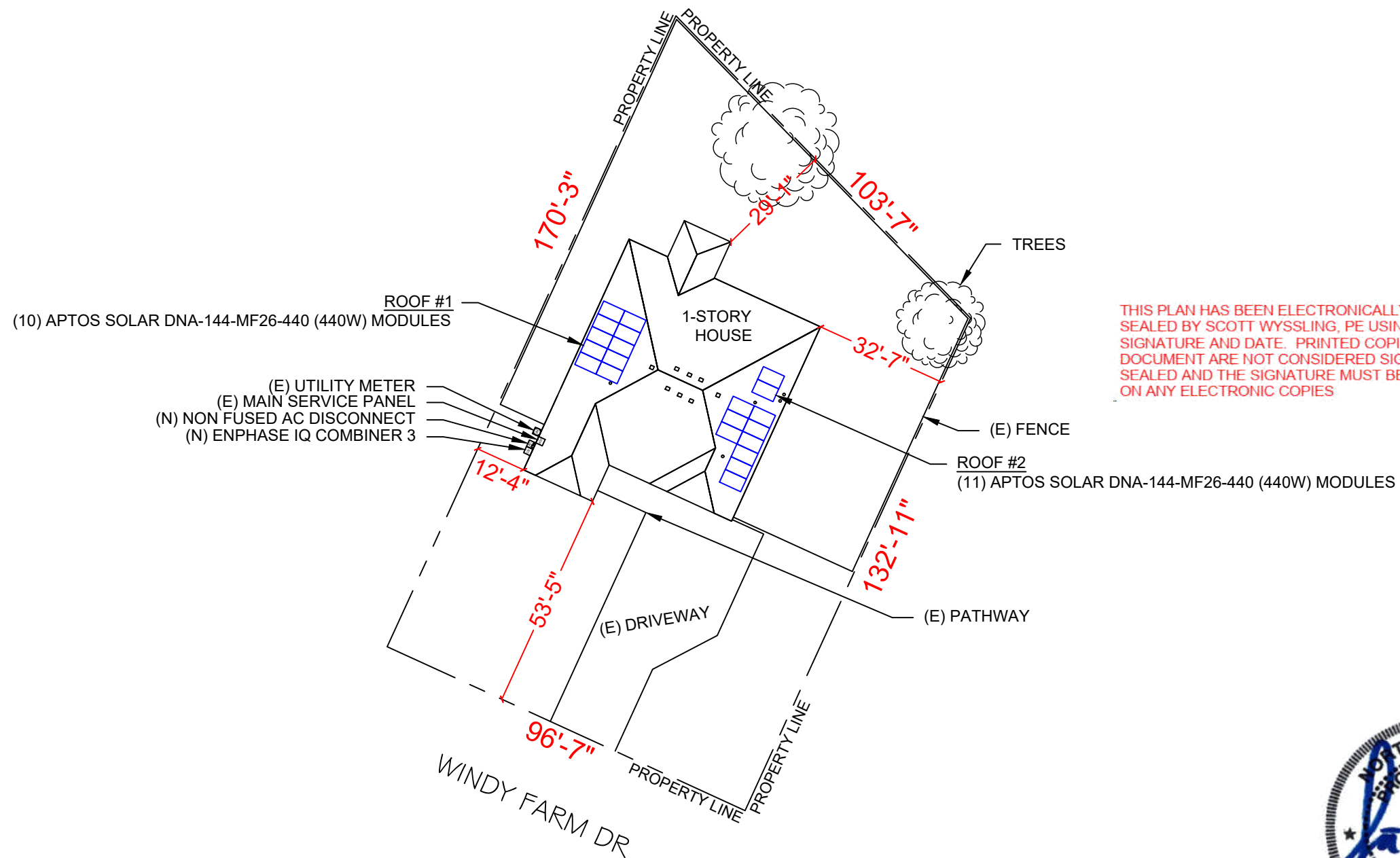
**ANSI B
11" X 17"**

SHEET NUMBER

PV-0

SITE NOTES

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



1

PLOT PLAN WITH ROOF PLAN

PV-1

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



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 PH NO. (330) 397-8775
 EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

SHEET NAME

SITE PLAN

SHEET SIZE

ANSI B
11" X 17"

SHEET NUMBER

PV-1



Wyssling Consulting, PLLC
 76 N Meadowbrook Drive Alpine UT 84004
 North Carolina COA # P-2308

Signed 02-25-22

INVERTER SPECIFICATIONS	
MANUFACTURER / MODEL	ENPHASE IQ7PLUS-72-2-US (240V)
MAX DC SHORT CIRCUIT CURRENT	15 A
CONTINUOUS OUTPUT CURRENT	1.21A (240V)

MODULE TYPE, DIMENSIONS & WEIGHT	
NUMBER OF MODULES:	21 MODULES
MODULE TYPE:	APTOS SOLAR DNA-144-MF26-440 (440W)
MODULE WEIGHT:	53.13 LBS/24.1 KG
MODULE DIMENSIONS:	82.48" X 40.90" =23.43 SF
UNIT WEIGHT OF AREA:	2.27 PSF

DESIGN SPECIFICATION	
RISK CATEGORY:	II
CONSTRUCTION:	SFD
ZONING:	RESIDENTIAL
SNOW LOAD (ASCE 7-10):	15 PSF
EXPOSURE CATEGORY:	C
WIND SPEED (ASCE 7-10):	115 MPH

PANEL HEIGHT OFF ROOF	5"
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ROOF DESCRIPTION					
ROOF	ROOF TILT	AZIMUTH	TRUSS SIZE	TRUSS SPACING	ROOF MATERIAL
#1	34°	295°	2"X6"	22" O.C	ASHPHALT SHINGLE
#2	34°	115°	2"X6"	22" O.C	ASHPHALT SHINGLE

ARRAY AREA & ROOF AREA CALC'S				
ROOF	# OF MODULES	ARRAY AREA (Sq. Ft.)	TOTAL ROOF AREA (Sq. Ft.)	TOTAL ROOF AREA COVERED BY ARRAY (%)
#1	10	195.50	642.97	30.41
#2	11	214.78	573.32	37.46

REVISIONS		
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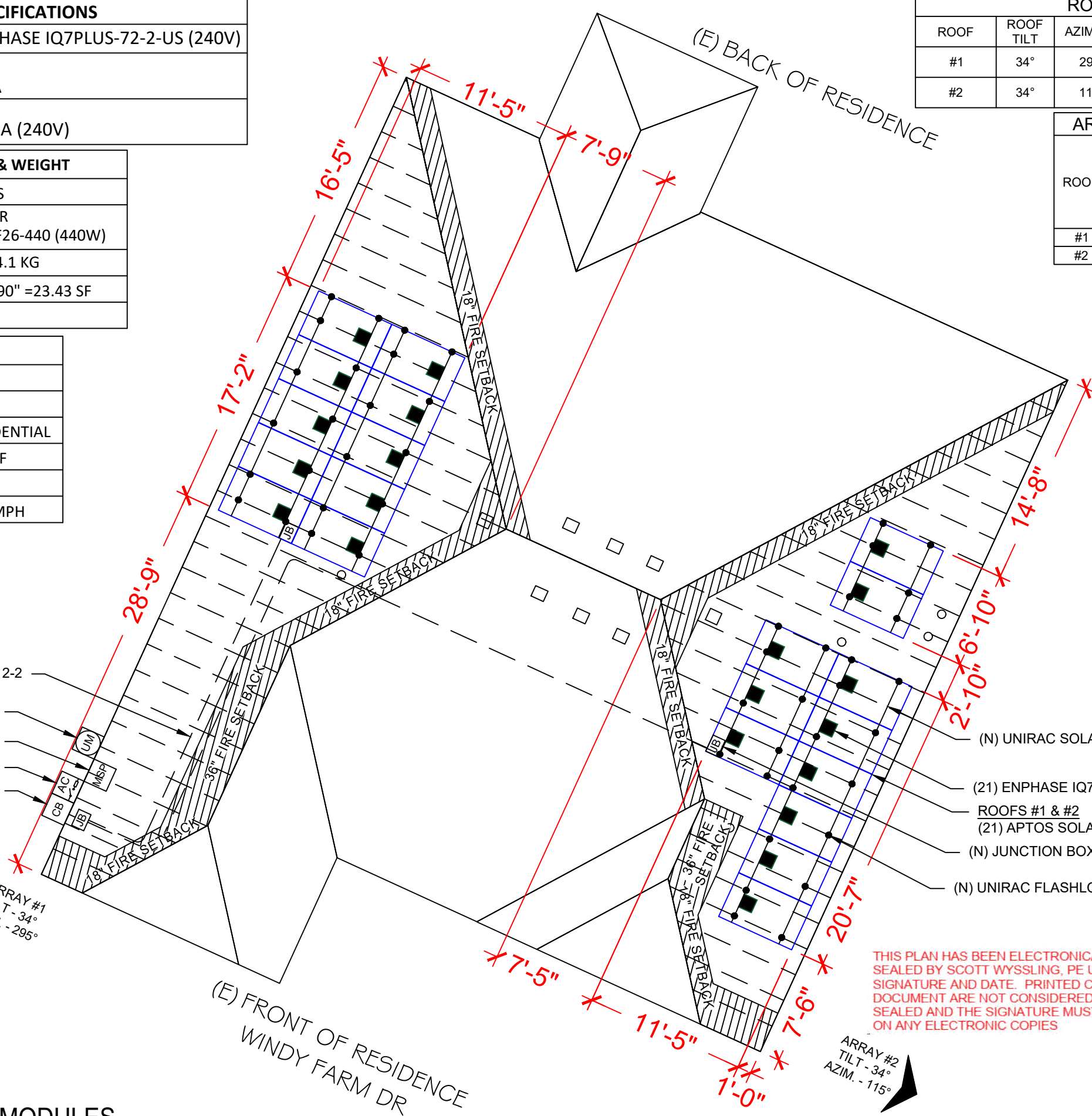
- (N) ROMEX 12-2
- (E) UTILITY METER
- (E) MAIN SERVICE PANEL
- (N) NON FUSED AC DISCONNECT
- (N) ENPHASE IQ COMBINER 3

- (N) UNIRAC SOLARMOUNT LIGHT RAIL
- (21) ENPHASE IQ7PLUS-72-2-US (240V) MICROINVERTERS
- ROOFS #1 & #2
- (21) APTOS SOLAR DNA-144-MF26-440 (440W) MODULES
- (N) JUNCTION BOX(TYP.)
- (N) UNIRAC FLASHLOC DUO ATTACHMENT MAX 60"

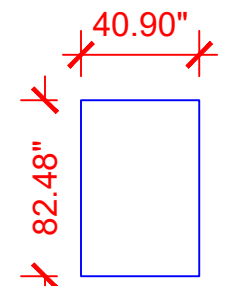


1 ROOF PLAN & MODULES

PV-2 SCALE: 1/8" = 1'-0"



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APTOS SOLAR DNA-144-MF26-440 (440W) MODULES

PROJECT NAME & ADDRESS

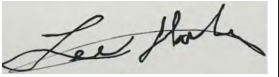
BILL GAVALIER RESIDENCE
 84 WINDY FARM DR
 FUQUAY-VARINA, NC 27526
 PH NO. (330) 397-8775
 EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

SHEET NAME
ROOF PLAN & MODULES

SHEET SIZE
**ANSI B
 11" X 17"**

SHEET NUMBER
PV-2



ELECTRICAL LIC#: U34871

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal



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76 N Meadowbrook Drive Alpine UT 84004
North Carolina COA # P-2308

Signed 02-25-22

PROJECT NAME & ADDRESS

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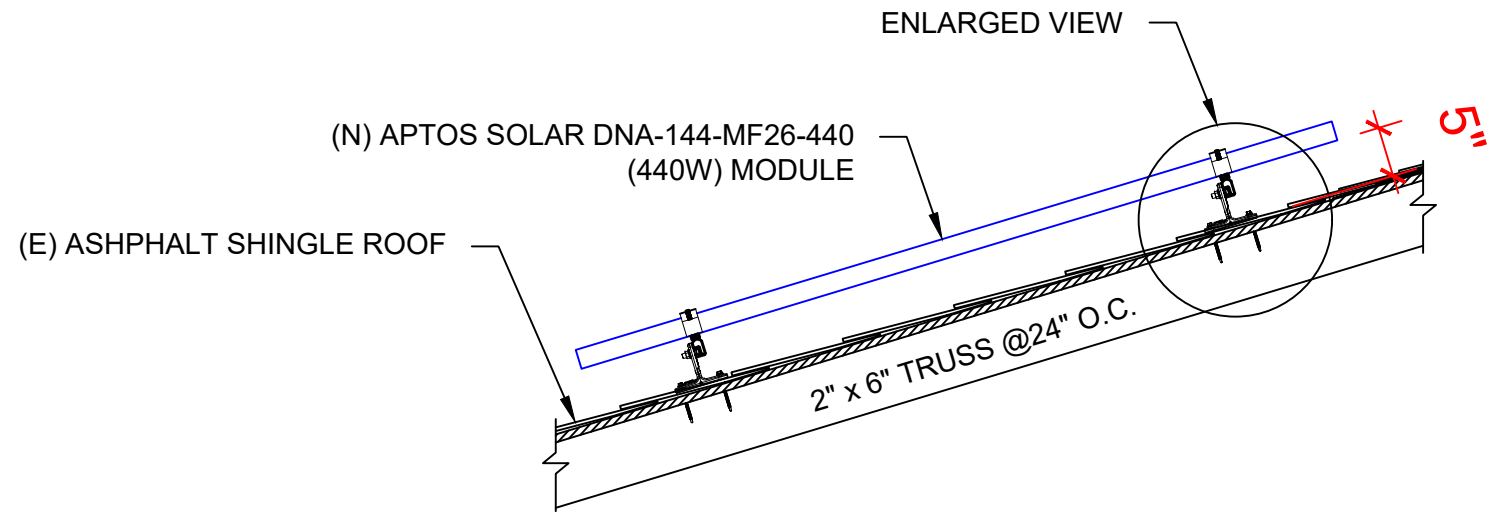
SHEET NAME
**ATTACHMENT
DETAILS**

SHEET SIZE

**ANSI B
11" X 17"**

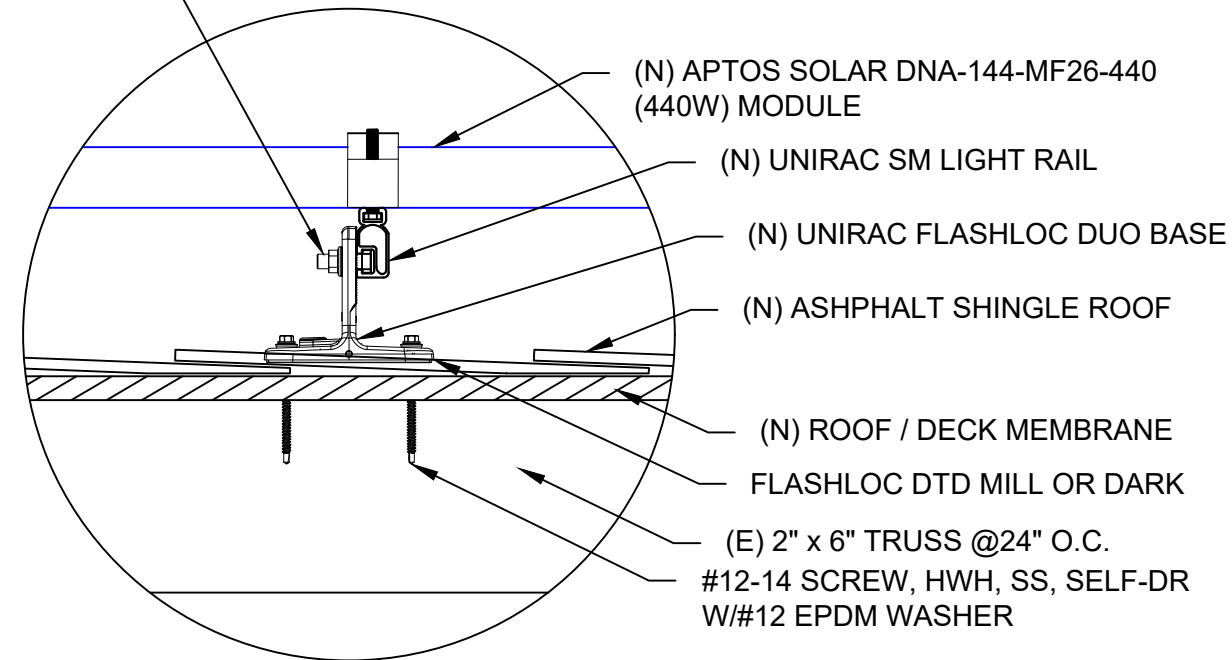
SHEET NUMBER

PV-3



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(N) BND T-BOLT & NUT 3/8"X1" SS
W/SS SERRATED FLANGE NUT



1 ATTACHMENT DETAILS

PV-3

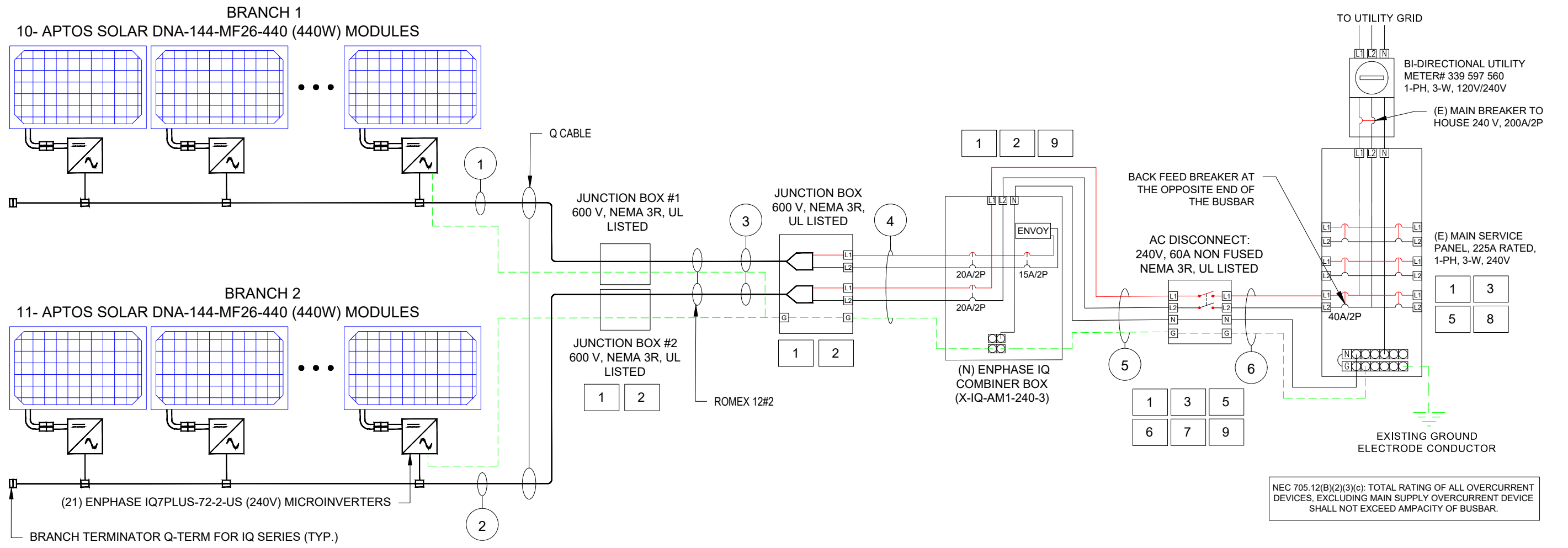
2 ENLARGED VIEW OF ATTACHMENT

PV-3

SCALE: NTS

ID	TYPICAL	INITIAL CONDUCTOR LOCATION	FINAL CONDUCTOR LOCATION	CONDUCTOR			CONDUIT	# OF PARALLEL CIRCUITS	CURRENT-CARRYING CONDUCTORS IN CONDUIT	CONDUIT FILL PERCENT	OCPD	EGC		TEMP. CORR. FACTOR		CONDUIT FILL FACTOR	CONT. CURRENT	MAX. CURRENT	BASE AMP.	DERATED AMP.	TERM. TEMP. RATING	LENGTH	VOLTAGE DROP
1	1	BRANCH	JUNCTION BOX-1	12 AWG	Q CABLE	-	-	1	2	N/A	N/A	6 AWG	BARE COPPER	0.71	(56°C)	N/A	12.1A	15.1A	N/A	N/A	90°C	36FT	0.47%
2	1	BRANCH	JUNCTION BOX-2	12 AWG	Q CABLE	-	-	1	2	N/A	N/A	6 AWG	BARE COPPER	0.71	(56°C)	N/A	13.3A	16.6A	N/A	N/A	90°C	47FT	0.56%
3	1	JUNCTION BOX-1&2	JUNCTION BOX-3	12-2 GAUGE	ROMEX	-	-	1	2	N/A	N/A	6 AWG	BARE COPPER	0.71	(56°C)	N/A	13.3A	16.6A	N/A	N/A	90°C	61FT	0.55%
4	1	JUNCTION BOX-3	IQ COMBINER BOX	10 AWG	THWN-2	COPPER	MIN 0.75" Dia EMT	2	4	19.09%	20A	10 AWG	THWN-2, COPPER	0.96	(34°C)	0.8	13.3A	16.6A	40A	30.7A	90°C	12FT	0.17%
5	1	IQ COMBINER BOX	NON FUSED AC DISCONNECT	8 AWG	THWN-2	COPPER	MIN 0.75" Dia EMT	1	3	26.73%	N/A	10 AWG	THWN-2, COPPER	0.96	(34°C)	1	25.4A	31.8A	55A	52.8A	90°C	5FT	0.09%
6	1	NON FUSED AC DISCONNECT	SUB PANEL	8 AWG	THWN-2	COPPER	MIN 0.75" Dia EMT	1	3	26.73%	40A	10 AWG	THWN-2, COPPER	0.96	(34°C)	1	25.4A	31.8A	55A	52.8A	90°C	5FT	0.09%

NOTE:- WIRE BETWEEN JB WILL FLOW INSIDE THE ATTIC



LGCY POWER

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Lee Shale

ELECTRICAL LIC#: U34871

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

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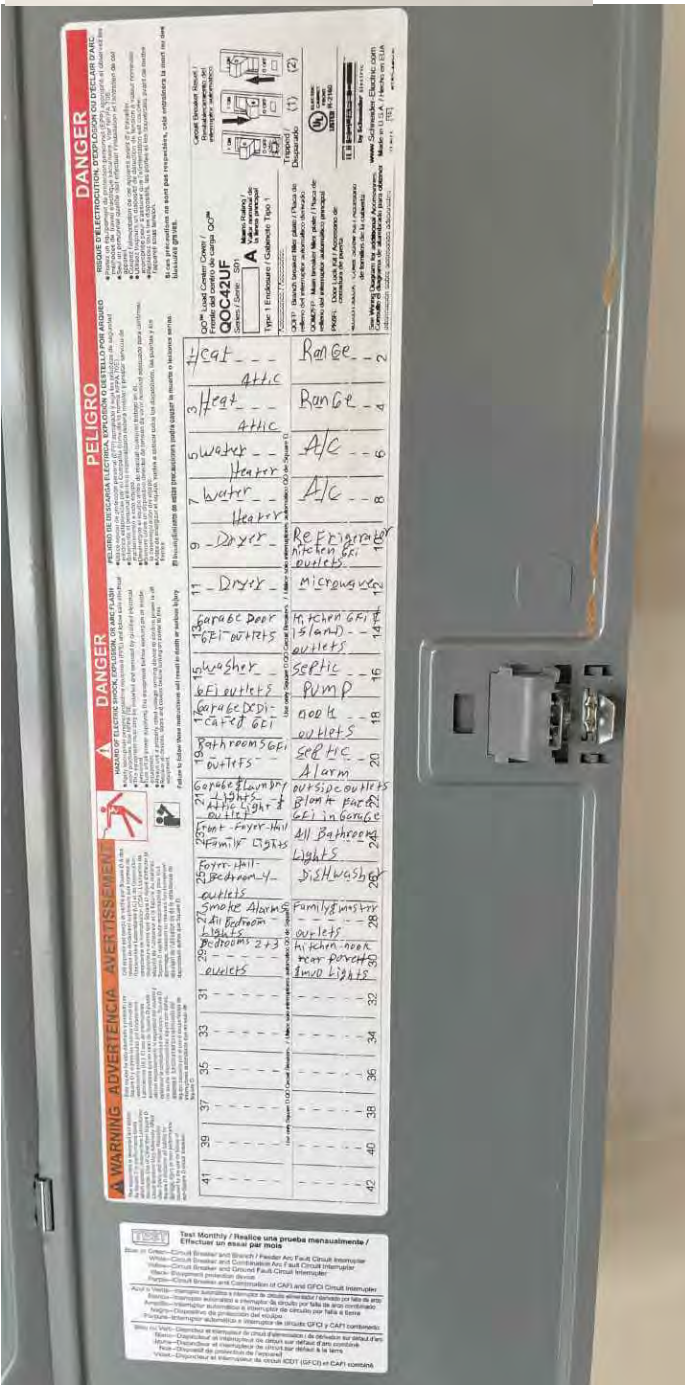
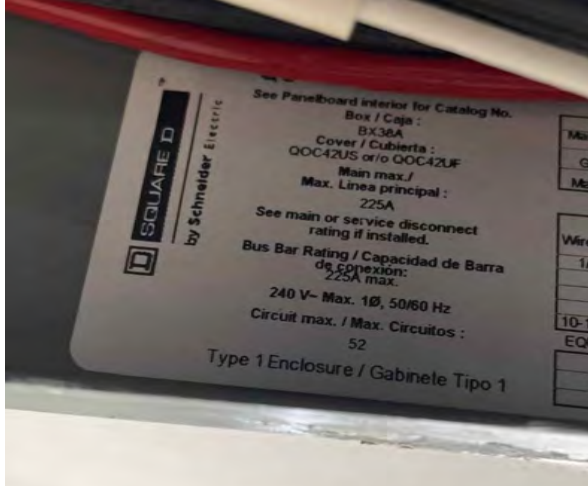
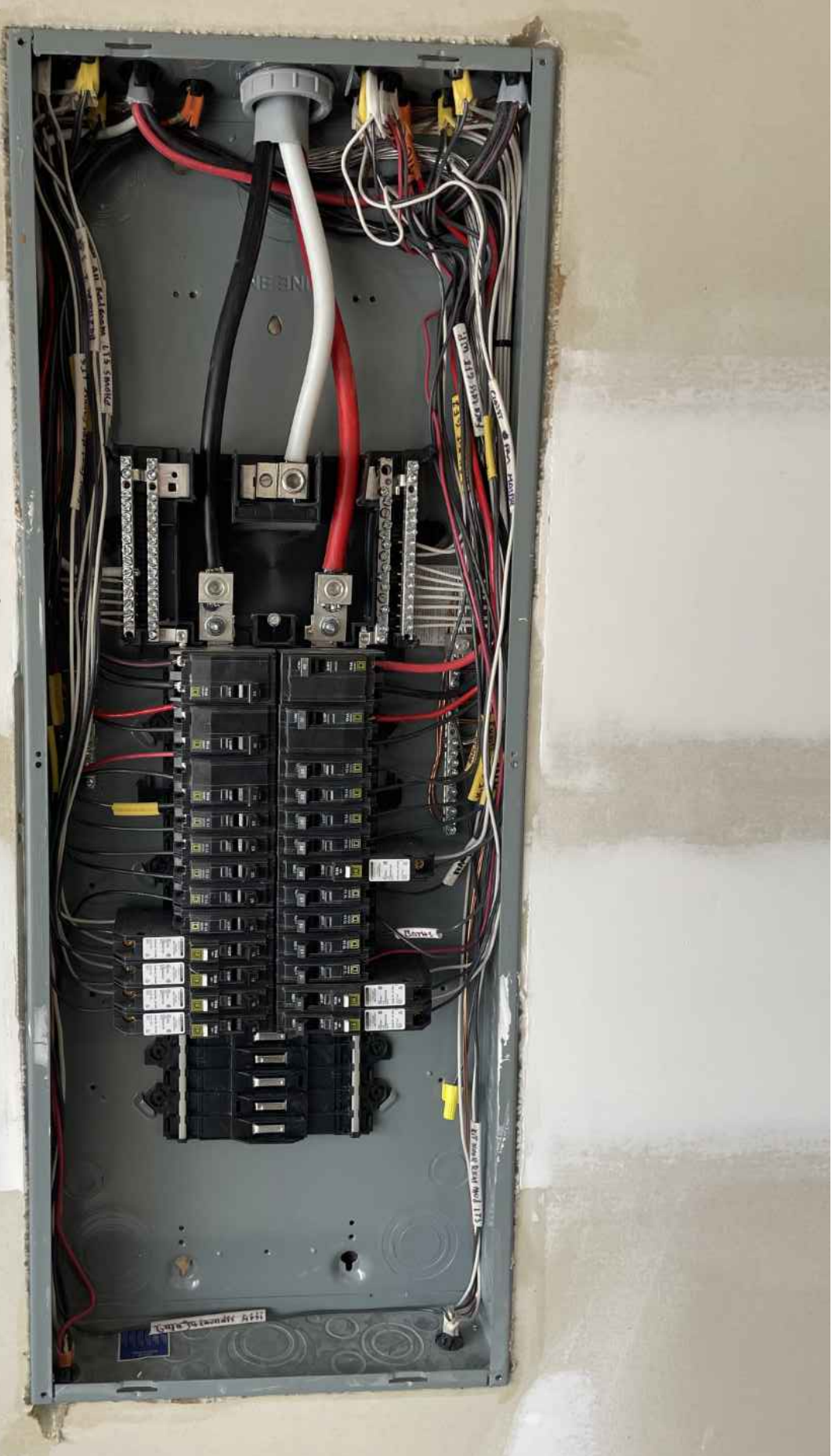
SHEET NAME
ELECTRICAL LINE & CALCS.

SHEET SIZE
**ANSI B
11" X 17"**

SHEET NUMBER
PV-4

SERVICE INFO

UTILITY PROVIDER: DUKE ENERGY
MAIN SERVICE VOLTAGE: 240V
MAIN PANEL BRAND: SQUARE D
MAIN CIRCUIT BREAKER RATING: 200A
MAIN SERVICE PANEL: 200A
MAIN SERVICE LOCATION: WEST
SERVICE FEED SOURCE: UNDERGROUND



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DATE: 02/25/2022

SHEET NAME
**ELECTRICAL
 PHOTOS**

SHEET SIZE
**ANSI B
 11" X 17"**

SHEET NUMBER
PV-4A

SOLAR MODULE SPECIFICATIONS	
MANUFACTURER / MODEL	APTOS SOLAR DNA-144-MF26-440 (440W)
VMP	41.0 V
IMP	10.74 A
VOC	49.9 V
ISC	11.33 A
TEMP. COEFF. VOC	-0.29%/°C
MODULE DIMENSION	82.48" (L) x 40.90" (W)
MODULE PTC RATING	411.07W 1
PANEL WATTAGE	440W

INVERTER SPECIFICATIONS	
MANUFACTURER / MODEL	ENPHASE IQ7PLUS-72-2-US (240V)
MAX DC SHORT CIRCUIT CURRENT	15 A
CONTINUOUS OUTPUT CURRENT	1.21A (240V)

AMBIENT TEMPERATURE SPECS	
RECORD LOW TEMP	-12°C
AMBIENT TEMP (HIGH TEMP 2%)	34°C
CONDUIT HEIGHT	0.5"
ROOF TOP TEMP	90°C
CONDUCTOR TEMPERATURE RATE	56°C
MODULE TEMPERATURE COEFFICIENT OF VOC	-0.29%/°C

PERCENT OF VALUES	NUMBER OF CURRENT CARRYING CONDUCTORS IN EMT
0.80	4-6
0.70	7-9
0.50	10-20

Voltage rise in Q Cable from the Microinverters to the Junction Box

For branch circuit #1 of 10 IQ 7+Micros, the voltage rise on the 240 VAC Q Cable is 0.47%

For branch circuit #2 of 11 IQ 7+Micros, the voltage rise on the 240 VAC Q Cable is 0.56%

Voltage rise from the Junction Box to the IQ Combiner box

$$\begin{aligned} \text{VRise} &= (\text{amps/inverter} \times \text{number of inverters}) \times (\text{resistance in } \Omega/\text{ft}) \times (\text{2-way wire length in ft.}) \\ &= (1.21 \text{ amp} \times 11) \times (0.00129 \Omega/\text{ft}) \times (12 \text{ ft} \times 2) \\ &= 13.31 \text{ amps} \times 0.00129 \Omega/\text{ft} \times 24 \text{ ft} \\ &= 0.41 \text{ volts} \end{aligned}$$

$$\% \text{VRise} = 0.41 \text{ volts} \div 240 \text{ volts} = 0.17\%$$

The voltage rise from the Junction Box to the IQ Combiner Box is 0.17%

Voltage rise from the IQ Combiner box to AC Disconnect

$$\begin{aligned} \text{VRise} &= (\text{amps/inverter} \times \text{number of inverters}) \times (\text{resistance in } \Omega/\text{ft.}) \times (\text{2-way wire length in ft.}) \\ &= (1.21 \text{ amp} \times 21) \times (0.000809 \Omega/\text{ft}) \times (5 \text{ ft.} \times 2) \\ &= 25.41 \text{ amps} \times 0.000809 \Omega/\text{ft} \times 10 \text{ ft.} \\ &= 0.21 \text{ volts} \end{aligned}$$

$$\% \text{VRise} = 0.21 \text{ volts} \div 240 \text{ volts} = 0.09\%$$

The voltage rise from the IQ Combiner Box to the AC Disconnect is 0.09%

Voltage rise from the AC Disconnect to the Main Service Panel

$$\begin{aligned} \text{VRise} &= (\text{amps/inverter} \times \text{number of inverters}) \times (\text{resistance in } \Omega/\text{ft.}) \times (\text{2-way wire length in ft.}) \\ &= (1.21 \text{ amp} \times 21) \times (0.000809 \Omega/\text{ft}) \times (5 \text{ ft.} \times 2) \\ &= 25.41 \text{ amps} \times 0.000809 \Omega/\text{ft} \times 10 \text{ ft.} \\ &= 0.21 \text{ volts} \end{aligned}$$

$$\% \text{VRise} = 0.21 \text{ volts} \div 240 \text{ volts} = 0.09\%$$

The voltage rise from the AC Disconnect to the Main Service Panel is 0.09%

Total system voltage rise for all three wire sections

$$0.56\% + 0.17\% + 0.09\% + 0.09\% = 0.91\%$$



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

ELECTRICAL LIC#: U34871

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliar@gmail.com

DATE: 02/25/2022

SHEET NAME
SPECIFICATION
& CALCS.

SHEET SIZE
ANSI B
11" X 17"

SHEET NUMBER
PV-4B

1

! WARNING

ELECTRIC SHOCK HAZARD

TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

LABEL LOCATION:
 MAIN SERVICE PANEL/AC DISCONNECT/
 AC COMBINER
 2017 NEC 690.13(B)

2

WARNING PHOTOVOLTAIC POWER SOURCE

LABEL LOCATION:
 DC CONDUIT
 EVERY 10' AND ON CONDUIT BODIES WHEN
 EXPOSED
 2017 NEC 690.31(G)(D)(3)

3

PHOTOVOLTAIC AC DISCONNECT

RATED AC OUTPUT CURRENT 25.41 A

NOMINAL OPERATING AC VOLTAGE 240 VAC

LABEL LOCATION:
 MAIN SERVICE PANEL/AC DISCONNECT
 2017 NEC 690.13(B) & 690.54

4

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL LOCATION:
 INVERTER
 AT OR WITHIN 3' OF THE DC COMBINER
 SWITCH
 2017 NEC 690.56(C)(3)

5

! CAUTION

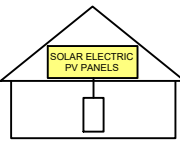
DUAL POWER SOURCE
 SECOND SOURCE US PHOTOVOLTAIC

LABEL LOCATION:
 MAIN SERVICE PANEL/AC DISCONNECT/AC COMBINER/
 REVENUE METER
 2017 NEC 705.12(B)(3)

6

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 LOCATION:
 MAIN SERVICE PANEL
 IF MSP IS OUTSIDE PLACE IT THERE / IF
 MSP IS INSIDE PLACE ON THE AC DISCONNECT
 2017 NEC 690.56(C)(1)(a)

7

PHOTOVOLTAIC SYSTEM UTILITY DISCONNECT SWITCH

LABEL LOCATION:
 AC DISCONNECT
 2017 NEC 690.56(C)(3)

8

PV SOLAR BREAKER

DO NOT RELOCATE THIS OVERCURRENT DEVICE

LABEL LOCATION:
 MAIN SERVICE PANEL
 2017 NEC 705.12(B)(2)(3)(c)

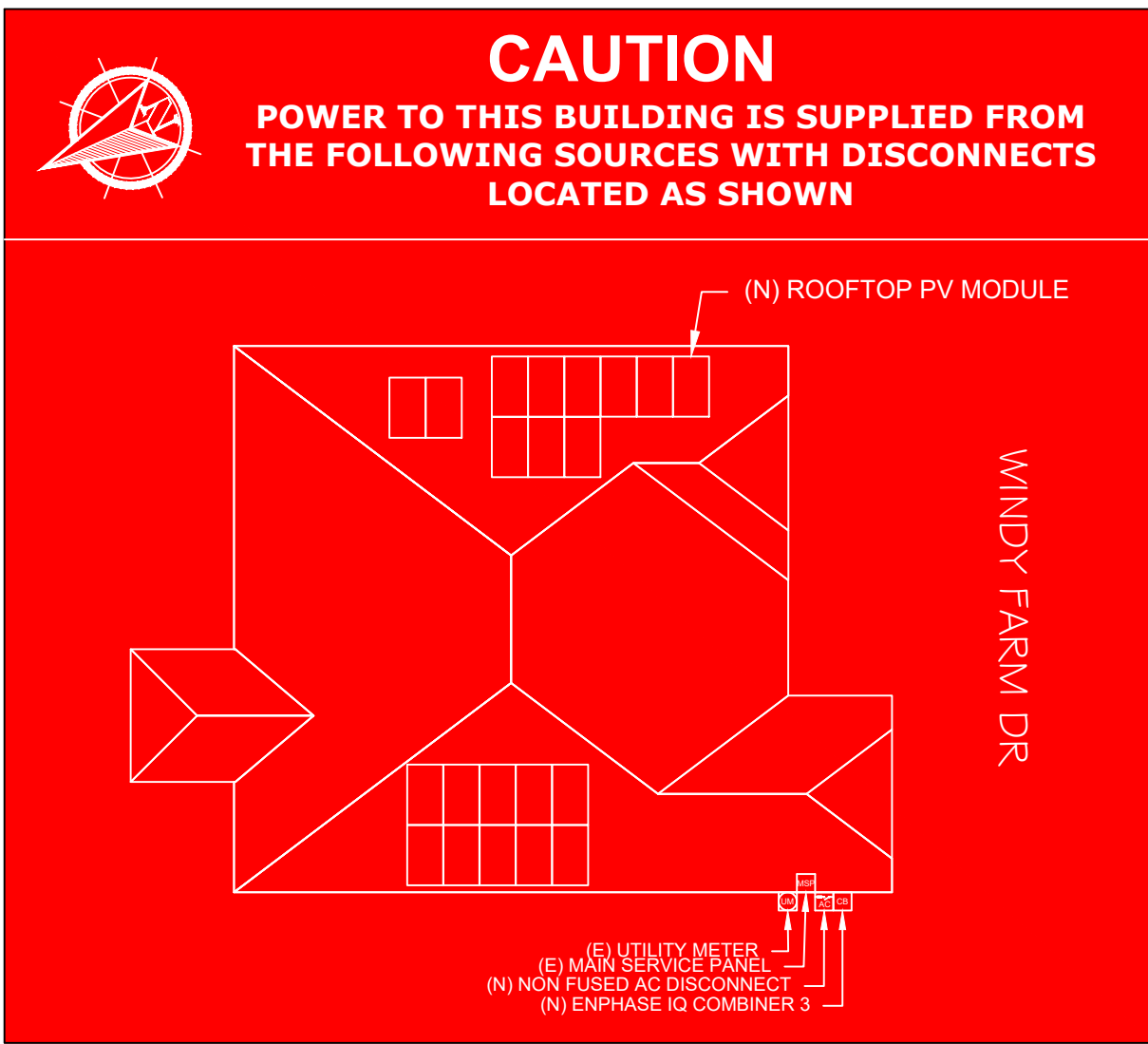
9

SERVICE DISCONNECT

SECTIONNEUR PRINCIPALE

SERVICIO DE DESCONEXION

LABEL LOCATION:
 AC DISCONNECT
 2017 NEC 230.66



LABEL LOCATION:
 EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S)
 FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED
 (PER CODE: NEC 705.10)

LGCY POWER

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



ELECTRICAL LIC#: U34871

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 84 WINDY FARM DR
 FUQUAY-VARINA, NC 27526
 PH NO. (330) 397-8775
 EMAIL ID: bill.gavallier@gmail.com

DATE: 02/25/2022

SHEET NAME
LABELS

SHEET SIZE
**ANSI B
11" X 17"**

SHEET NUMBER
PV-5

- ADHESIVE FASTENED SIGNS:
- ANSI Z535.4-2011 PRODUCT SAFETY SIGNS AND LABELS, PROVIDES GUIDELINES FOR SUITABLE FONT SIZES, WORDS, COLORS, SYMBOLS, AND LOCATION REQUIREMENTS FOR LABELS. NEC 110.21(B)(1)
 - THE LABEL SHALL BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED. NEC 110.21(B)(3).
 - ADHESIVE FASTENED SIGNS MAY BE ACCEPTABLE IF PROPERLY ADHERED. VINYL SIGNS SHALL BE WEATHER RESISTANT.



FIELD DESIGN REQUEST FORM

JOB INFORMATION	
JOB NAME:	
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



JOB HAZARD ANALYSIS

CUSTOMER NAME/JOB ID: _____
 CUSTOMER ADDRESS: _____
 INSTALL DATE: ____-____-____ TIME: ____:____am/pm

HAZARD CATEGORY	HAZARD TYPE	HAZARD CONTROL MEASURES
LADDER SAFETY	<ul style="list-style-type: none"> • LOCATION • CONDITION • WORKING CLEARANCE 	
FALL PROTECTION	<ul style="list-style-type: none"> • WORKING 6' OR HIGHER 	
ELECTRICAL SAFETY	<ul style="list-style-type: none"> • ARCH FLASH • ELECTRIC • SHOCK/ELECTROCUTION 	
WEATHER CONDITIONS	<ul style="list-style-type: none"> • HEAT/COLD TEMP • RAINY/ICY/WINDY 	
PUBLIC SAFETY	<ul style="list-style-type: none"> • WORK/OBJECTS OVERHEAD • SLIPS/TRIPS/FALLS • ACCESS TO LIVE ELECTRICAL 	

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

GENERAL SITE DESCRIPTION/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



LGCY POWER
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 FUQUAY-VARINA, NC 27526
 PH NO. (330) 397-8775
 EMAIL ID: bill.gavaliel@gmail.com

DATE: 02/25/2022

SHEET NAME
JOB HAZARD ANALYSIS

SHEET SIZE

ANSI B
11" X 17"

SHEET NUMBER

PV-5A


DNA™ 144


Solar for Innovators


Residential | Commercial

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

Our DNA™ Split Cell Series impressively combines advanced solar technologies to maximize performance. Our patented Dual Nano Absorber (DNA™) Technology allows the panel to operate at high-efficiencies in extreme temperatures. Contact our sales team today to learn more about our line of high-efficient solar panels.

 Patented DNA™ technology boosts power performance & module efficiency

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

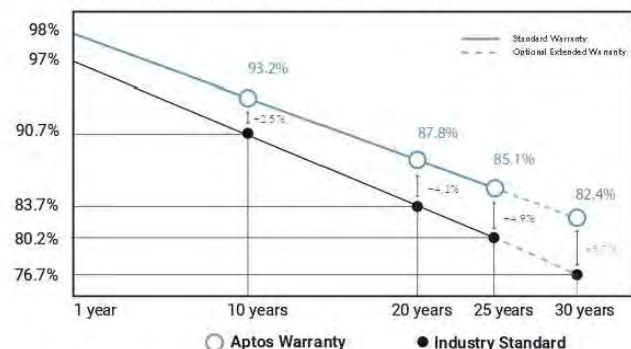
 Ideal solution for applications affected by shading

 All-black design for pristine aesthetics
No excessive silver bussing or ribbons

 Robust product design is resilient in extreme weather. Up to 5400 Pa snow load and 210 mph wind speeds

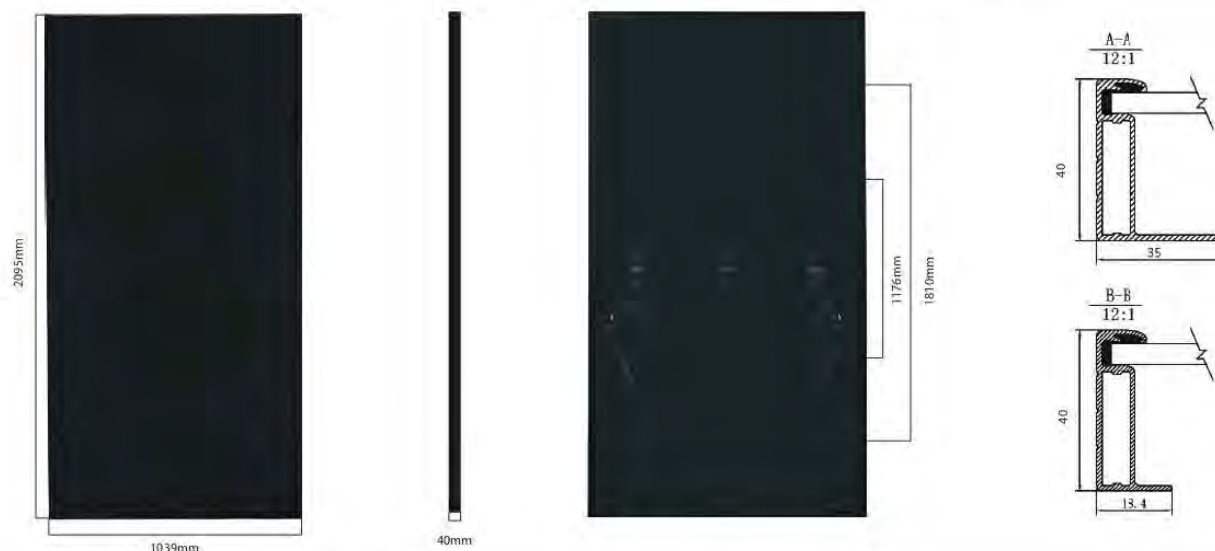


Linear Performance Warranty



DNA™ 144

Solar for Innovators



Electrical Specifications

	DNA-144-MF26-440W	DNA-144-MF26-435W	DNA-144-MF26-430W
STC rated Output P _{max} (W)	440W	435W	430W
Module Efficiency	20.21%	19.98%	19.76%
Open Circuit Voltage V _{OC} (V)	49.9	49.7	49.5
Short Circuit Current I _{SC} (A)	11.33	11.26	11.19
Rated Voltage V _{mp} (V)	41.0	40.8	40.6
Rated Voltage I _{mp} (A)	10.74	10.67	10.60

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

Temperature Coefficients

Temperature Coefficient P _{mp}	-0.36%
Temperature Coefficient I _{sc}	+0.05%/°C
Temperature Coefficient V _{oc}	-0.29%/°C
Normal Operating Cell Temperature (NOCT)	44°C

Test Operating Conditions

Maximum Series Fuse	20A
Maximum System Voltage	1,000 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 210mph Wind Rating
Fire Performance Class	Class C/Type 1

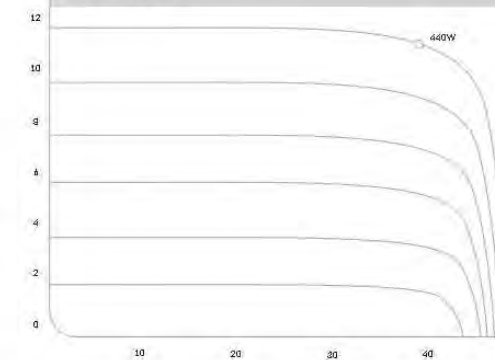
Packaging Configuration

Number of Modules per Pallet	27
Number of Pallets per 40ft. Container	22
Pallet Dimensions	2110 X 1120 X 2365
Pallet Weight (kg)	680
Container Weight (kg)	14960

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	2095 X 1039 X 40mm
Output Cable	4mm ² (EU)12AWG, 39.37in. (1200mm)
Weight	53.13lbs. (24.1kg)
Cable Length	1200mm
Encapsulant	POE

I-V Curve



Certifications

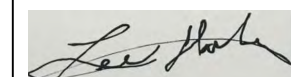


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Santa Clara, CA 95054
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Aptos Solar Technology reserves the right to make specification changes without notice



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



ELECTRICAL LIC#: U34871

REVISIONS

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Signature with Seal

PROJECT NAME & ADDRESS

**BILL GAVALIER
RESIDENCE**
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

SHEET NAME
**EQUIPMENT
SPECIFICATION**

SHEET SIZE

**ANSI B
11" X 17"**

SHEET NUMBER

PV-6

Enphase IQ 7 and IQ 7+ Microinverters

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

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

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



Easy to Install

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

Productive and Reliable

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

Smart Grid Ready

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

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

Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)	IQ7-60-2-US		IQ7PLUS-72-2-US	
Commonly used module pairings ¹	235 W - 350 W +		235 W - 440 W +	
Module compatibility	60-cell PV modules only		60-cell and 72-cell PV modules	
Maximum input DC voltage	48 V		60 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V	
Operating range	16 V - 48 V		16 V - 60 V	
Min/Max start voltage	22 V / 48 V		22 V / 60 V	
Max DC short circuit current (module Isc)	15 A		15 A	
Overvoltage class DC port	II		II	
DC port backfeed current	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	IQ 7 Microinverter		IQ 7+ Microinverter	
Peak output power	250 VA		295 VA	
Maximum continuous output power	240 VA		290 VA	
Nominal (L-L) voltage/range ²	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)
Nominal frequency	60 Hz		60 Hz	
Extended frequency range	47 - 68 Hz		47 - 68 Hz	
AC short circuit fault current over 3 cycles	5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit ³	16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Overvoltage class AC port	III		III	
AC port backfeed current	0 A		0 A	
Power factor setting	1.0		1.0	
Power factor (adjustable)	0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY	@240 V	@208 V	@240 V	@208 V
Peak efficiency	97.6 %	97.6 %	97.5 %	97.3 %
CEC weighted efficiency	97.0 %	97.0 %	97.0 %	97.0 %
MECHANICAL DATA				
Ambient temperature range	-40°C to +65°C			
Relative humidity range	4% to 100% (condensing)			
Connector type (IQ7-60-2-US & IQ7PLUS-72-2-US)	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)			
Dimensions (WxHxD)	212 mm x 175 mm x 30.2 mm (without bracket)			
Weight	1.08 kg (2.38 lbs)			
Cooling	Natural convection - No fans			
Approved for wet locations	Yes			
Pollution degree	PD3			
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure			
Environmental category / UV exposure rating	NEMA Type 6 / outdoor			
FEATURES				
Communication	Power Line Communication (PLC)			
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.			
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.			
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC-2014 and NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.			

1. No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/en-us/support/module-compatibility>.
2. Nominal voltage range can be extended beyond nominal if required by the utility.
3. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

To learn more about Enphase offerings, visit enphase.com

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ELECTRICAL LIC#: U34871

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

**BILL GAVALIER
RESIDENCE**
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

SHEET NAME
**EQUIPMENT
SPECIFICATION**

SHEET SIZE

**ANSI B
11" X 17"**

SHEET NUMBER

PV-7



To learn more about Enphase offerings, visit enphase.com



Enphase IQ Combiner 3

(X-IQ-AM1-240-3)

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



Smart

- Includes IQ Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and optional consumption monitoring
- Supports Ensemble Communications Kit for communication with Enphase Encharge™ storage and Enphase Enpower™ smart switch

Simple

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

Reliable

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

Enphase IQ Combiner 3

MODEL NUMBER	
IQ Combiner 3 X-IQ-AM1-240-3	IQ Combiner 3 with Enphase IQ Envoy™ printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional* consumption monitoring (+/- 2.5%).
ACCESSORIES and REPLACEMENT PARTS (not included, order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G/12-year data plan) CELLMODEM-01 (3G/5-year data plan) CELLMODEM-M1 (4G based LTE-M/5-year data plan)	Plug and play industrial grade cellular modem with data plan for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)
Consumption Monitoring* CT CT-200-SPLIT	Split core current transformers enable whole home consumption metering (+/- 2.5%).
* Consumption monitoring is required for Enphase Storage Systems	
Ensemble Communications Kit COMMS-KIT-01	Installed at the IQ Envoy. For communications with Enphase Encharge™ storage and Enphase Enpower™ smart switch. Includes USB cable for connection to IQ Envoy or Enphase IQ Combiner™ and allows wireless communication with Encharge and Enpower.
Circuit Breakers BRK-10A-2-240 BRK-15A-2-240 BRK-20A-2P-240	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-SOLARSHIELD-ES	Replace the default solar shield with this Ensemble Combiner Solar Shield to match the look and feel of the Enphase Enpower™ smart switch and the Enphase Encharge™ storage system
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 3 (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Envoy printed circuit board (PCB) for Combiner 3
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating (output to grid)	65 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. continuous current rating (input from PV)	64 A
Max. total branch circuit breaker rating (input)	80 A of distributed generation / 95 A with IQ Envoy breaker included
Envoy breaker	10A or 15A rating GE Q-line/Siemens Type QP /Eaton BR series included
Production Metering CT	200 A solid core pre-installed and wired to IQ Envoy
MECHANICAL DATA	
Dimensions (WxHxD)	49.5 x 37.5 x 16.8 cm (19.5" x 14.75" x 6.63"). Height is 21.06" (53.5 cm with mounting brackets).
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	<ul style="list-style-type: none"> • 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing.
Altitude	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
Cellular	CELLMODEM-M1 4G based LTE-M cellular modem (not included). Note that an Enphase Mobile Connect cellular modem is required for all Ensemble installations.
COMPLIANCE	
Compliance, Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production)
Compliance, IQ Envoy	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit enphase.com

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3333 DIGITAL DR#600, LEHI,
UT 84043, UNITED STATES
PHONE: 855-353-4899

Lee Ghalib

ELECTRICAL LIC#: U34871

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SHEET SIZE

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11" X 17"**

SHEET NUMBER

PV-8

FLASHLOC™ DUO

THE MOST VERSATILE DIRECT TO DECK ATTACHMENT

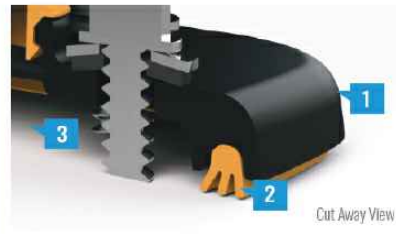


FLASHLOC™ DUO is the most versatile direct to deck and rafter attachment for composition shingle and rolled comp roofs. The all-in-one mount installs fast — no kneeling on hot roofs to install flashing, no prying or cutting shingles, no pulling nails. Simply drive the required number of screws to secure the mount and inject sealant into the base. **FLASHLOC'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.

FLASHLOC™ DUO

INSTALLATION GUIDE



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 course. 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.



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

Lee Shale
ELECTRICAL LIC#: U34871

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliar@gmail.com

DATE: 02/25/2022

SHEET NAME
EQUIPMENT
SPECIFICATION

SHEET SIZE

ANSI B
11" X 17"

SHEET NUMBER

PV-9

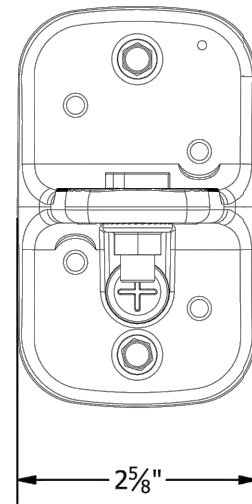
FASTER INSTALLATION. 25-YEAR WARRANTY.

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

FASTER INSTALLATION. 25-YEAR WARRANTY.

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

PART TABLE	
P/N	DESCRIPTION
004275M	FLASHLOC DUO MILL, 20 PACK
004275D	FLASHLOC DUO DARK, 20 PACK

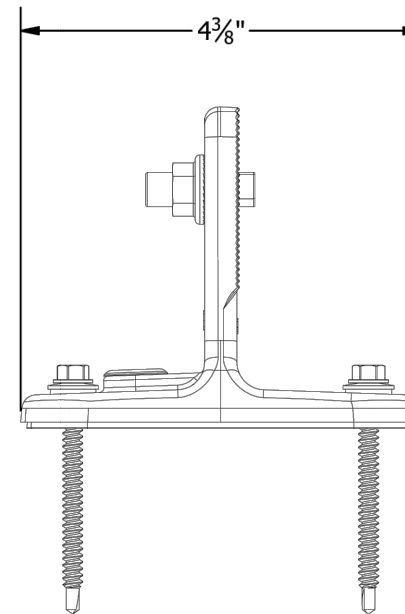
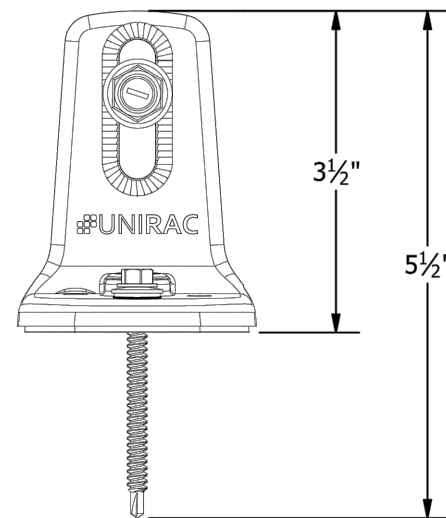
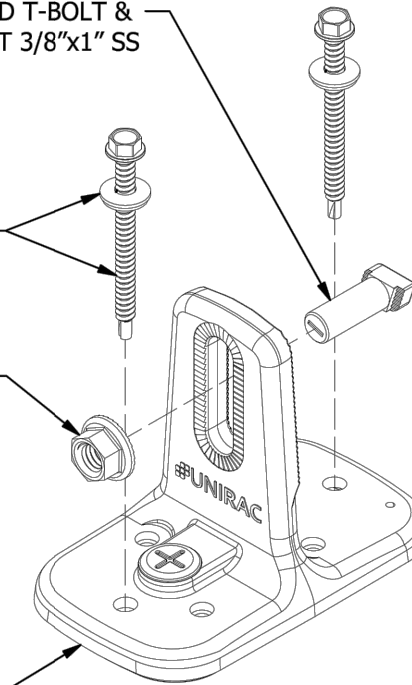


#12-14 SCREW, HWH, SS, SELF-DR
W/ #12 EPDM WASHER

SS SERRATED
FLANGE NUT

FLASHLOC DTD
MILL OR DARK

BND T-BOLT &
NUT 3/8"x1" SS



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

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	ASSEMBLY DETAIL
DESCRIPTION:	FLASHLOC DUO KIT
REVISION DATE:	4/29/2021

DRAWING NOT TO SCALE
ALL DIMENSIONS ARE
NOMINAL

PRODUCT PROTECTED BY
ONE OR MORE US PATENTS
LEGAL NOTICE

FL-A04

SHEET



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

ELECTRICAL LIC#: U34871

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

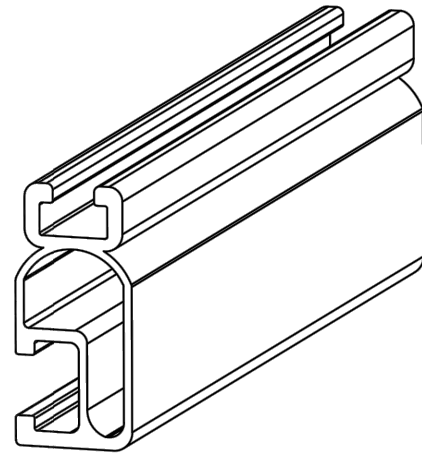
SHEET NAME
EQUIPMENT
SPECIFICATION

SHEET SIZE

ANSI B
11" X 17"

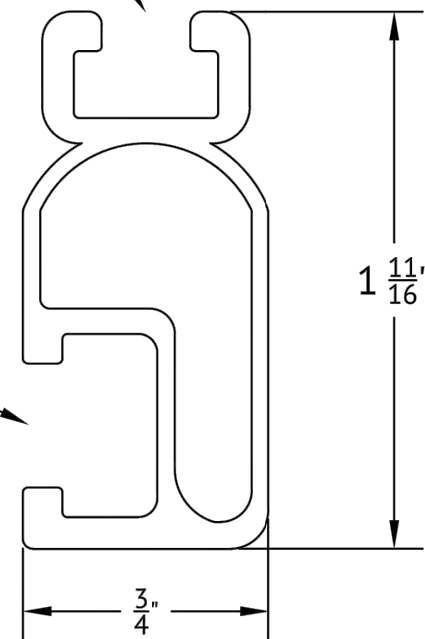
SHEET NUMBER

PV-9A



1/4" BOLT LOCATION

3/8" BOLT LOCATION



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

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART DETAIL
DESCRIPTION:	LIGHT RAIL
REVISION DATE:	APRIL 2016

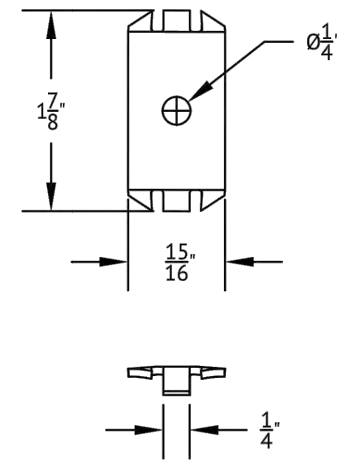
DRAWING NOT TO SCALE
 ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE
 OR MORE US PATENTS

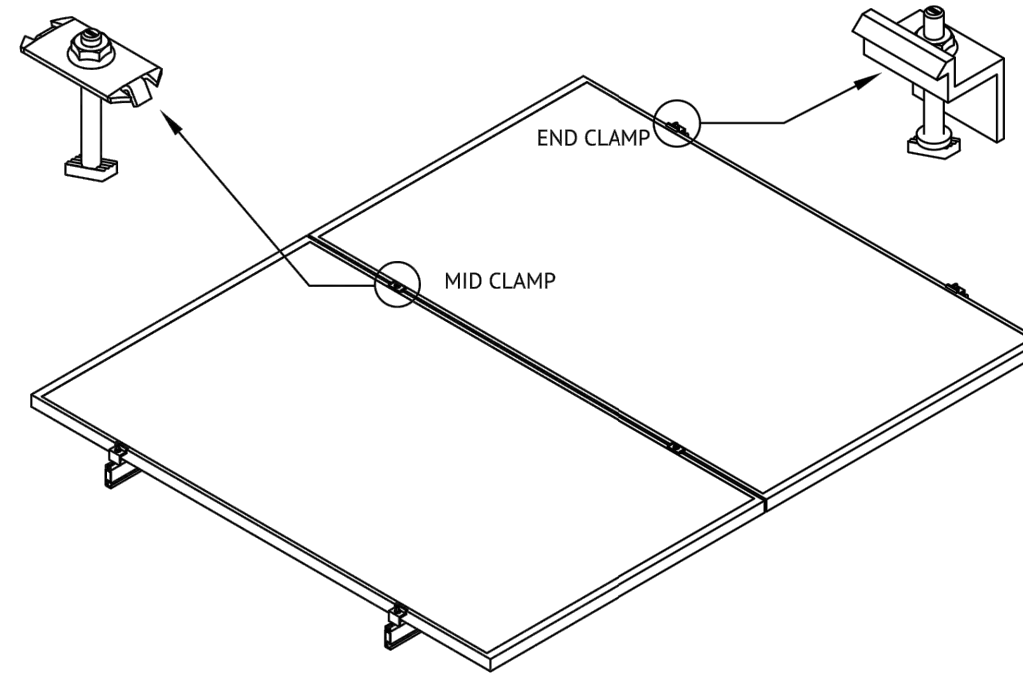
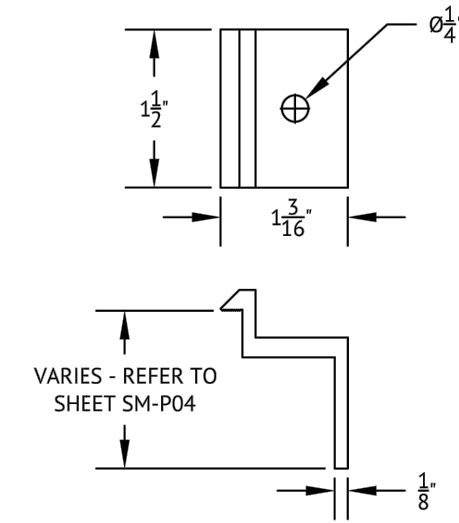
LEGAL NOTICE

SM-P02
 SHEET

BONDING SM MID CLAMP



BONDING SM END CLAMP



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

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	BONDING TOP CLAMPS
REVISION DATE:	APRIL 2016

DRAWING NOT TO SCALE
 ALL DIMENSIONS ARE NOMINAL

PRODUCT PROTECTED BY ONE
 OR MORE US PATENTS

LEGAL NOTICE

SM-A07
 SHEET



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

Lee Ghalib

ELECTRICAL LIC#: U34871

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
 84 WINDY FARM DR
 FUQUAY-VARINA, NC 27526
 PH NO. (330) 397-8775
 EMAIL ID: bill.gavaliel@gmail.com

DATE: 02/25/2022

SHEET NAME
EQUIPMENT SPECIFICATION

SHEET SIZE
ANSI B 11" X 17"

SHEET NUMBER
PV-10

SOLARMOUNT



SOLARMOUNT defined the standard in solar racking. Features are designed to get installers off the roof faster. Our grounding & bonding process eliminates copper wire and grounding straps to reduce costs. Systems can be configured with standard or light rail to meet your design requirements at the lowest cost possible. The superior aesthetics package provides a streamlined clean edge for enhanced curb appeal, with no special brackets required for installation.



Now Featuring:
THE NEW FACE OF SOLAR RACKING
Superior Aesthetics Package



LOSE ALL OF THE COPPER & LUGS
System grounding through Enphase microinverters and trunk cables



SMALL IS THE NEXT NEW BIG THING
Light Rail is Fully Compatible with all SM Components



ENHANCED DESIGN & LAYOUT TOOLS
Featuring Google Map Capabilities within U-Builder

FAST INSTALLATION. SUPERIOR AESTHETICS

OPTIMIZED COMPONENTS • VERSATILITY • DESIGN TOOLS • QUALITY PROVIDER

SOLARMOUNT



OPTIMIZED COMPONENTS

INTEGRATED BONDING & PRE-ASSEMBLED PARTS

Components are pre-assembled and optimized to reduce installation steps and save labor time. Our new grounding & bonding process eliminates copper wire and grounding straps or bonding jumpers to reduce costs. Utilize the microinverter mount with a wire management clip for an easier installation.

VERSATILITY

ONE PRODUCT - MANY APPLICATIONS

Quickly set modules flush to the roof or at a desired tilt angle. Change module orientation to portrait or landscape while securing a large variety of framed modules on flat, low slope or steep pitched roofs. Available in mill, clear and dark anodized finishes to outperform your projects financial and aesthetic aspirations.

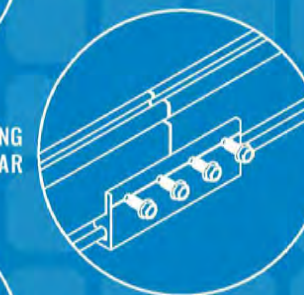
AUTOMATED DESIGN TOOL

DESIGN PLATFORM AT YOUR SERVICE

Creating a bill of materials is just a few clicks away with U-Builder, a powerful online tool that streamlines the process of designing a code compliant solar mounting system. Save time by creating a user profile, and recall preferences and projects automatically when you log in. You will enjoy the ability to share projects with customers: there's no need to print results and send to a distributor, just click and share.



INTEGRATED BONDING
MIDCLAMP



INTEGRATED BONDING
SPLICE BAR



INTEGRATED BONDING
L-FOOT w/ T-BOLT



INTEGRATED BONDING
MICROINVERTER MOUNT w/
WIRE MANAGEMENT



UNIRAC CUSTOMER SERVICE MEANS THE HIGHEST LEVEL OF PRODUCT SUPPORT



TECHNICAL SUPPORT

Unirac's technical support team is dedicated to answering questions & addressing issues in real time. An online library of documents including engineering reports, stamped letters and technical data sheets greatly simplifies your permitting and project planning process.



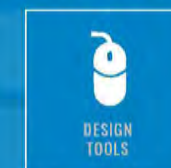
CERTIFIED QUALITY PROVIDER

Unirac is the only PV mounting vendor with ISO certifications for 9001:2015, 14001:2015 and OHSAS 18001:2007, which means we deliver the highest standards for fit, form, and function. These certifications demonstrate our excellence and commitment to first class business practices.



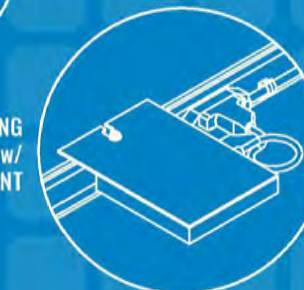
BANKABLE WARRANTY

Don't leave your project to chance. Unirac has the financial strength to back our products and reduce your risk. Have peace of mind knowing you are receiving products of exceptional quality. SOLARMOUNT is covered by a twenty five (25) year limited product warranty and a five (5) year limited finish warranty.



PERMIT DOCUMENTATION

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PROTECT YOUR REPUTATION WITH QUALITY RACKING SOLUTIONS BACKED BY ENGINEERING EXCELLENCE AND A SUPERIOR SUPPLY CHAIN

PL02017.0229 PRINTED



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

Lee Ghalib

ELECTRICAL LIC#: U34871

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavallier@gmail.com

DATE: 02/25/2022

SHEET NAME
**EQUIPMENT
SPECIFICATION**

SHEET SIZE

**ANSI B
11" X 17"**

SHEET NUMBER

PV-10A

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 \geq 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:

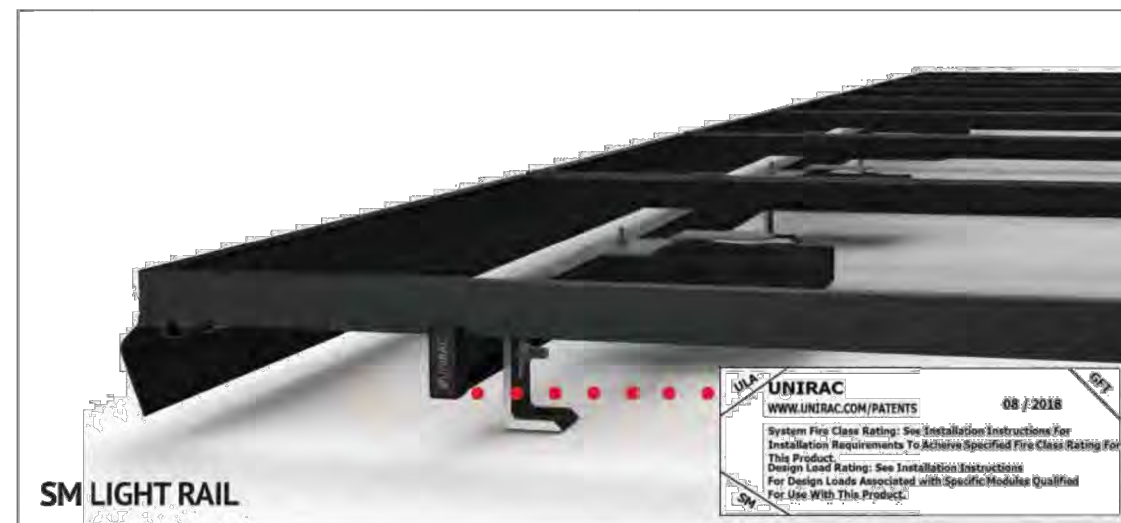
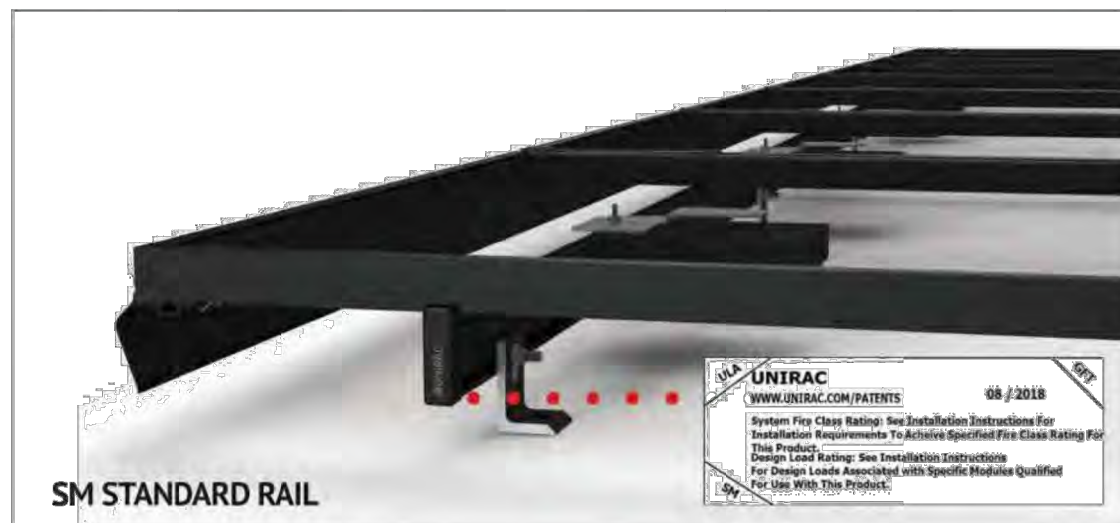
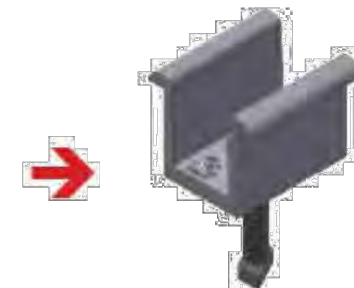
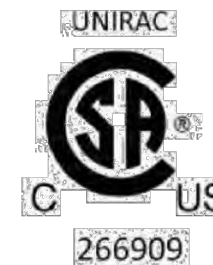
Rail Type	Module Type	System Level Fire Rating	Rail Direction	Module Orientation	Mitigation Required
Standard Rail	Type 1, Type 2, Type 3 & Type 10	Class A, Class B & Class C	East-West	Landscape OR Portrait	None Required
			North-South	Landscape OR Portrait	None Required
Light Rail	Type 1 & Type 2	Class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



REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

**BILL GAVALIER
RESIDENCE**
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavallier@gmail.com

DATE: 02/25/2022

SHEET NAME
**EQUIPMENT
SPECIFICATION**

SHEET SIZE

**ANSI B
11" X 17"**

SHEET NUMBER

PV-11

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

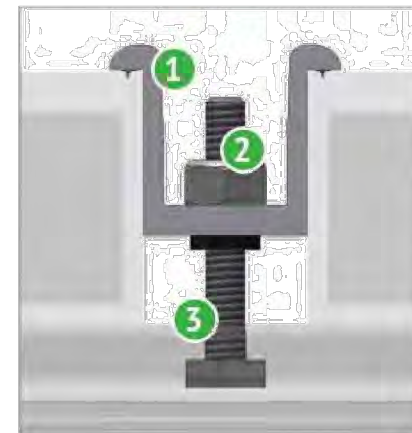
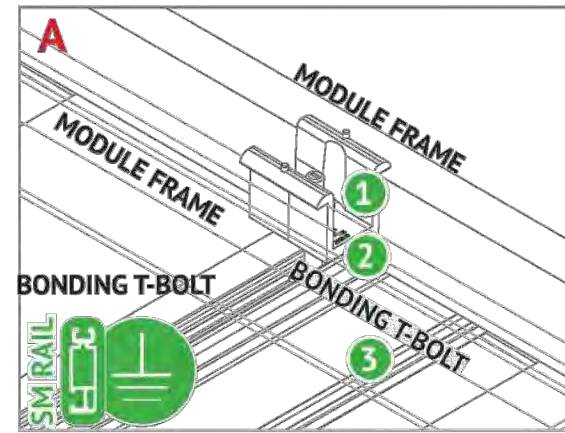
BILL GAVALIER
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84 WINDY FARM DR
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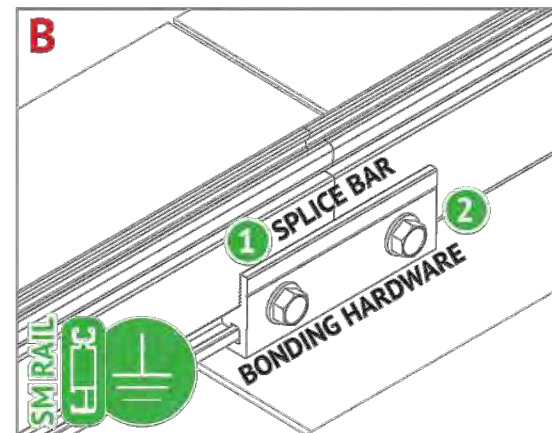
SHEET NUMBER
PV-11A



BONDING MIDCLAMP ASSEMBLY

BONDING MIDCLAMP ASSEMBLY

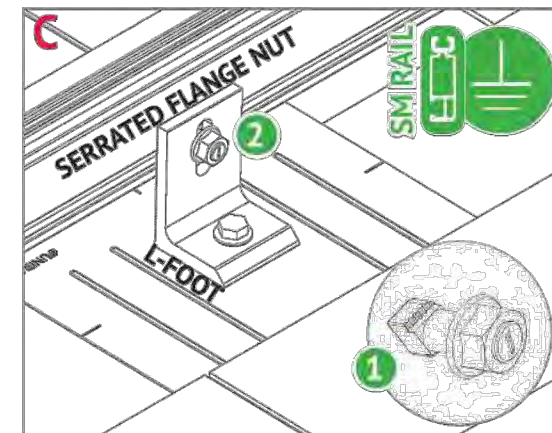
- 1 Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp
- 2 Stainless steel nut bonds aluminum clamp to stainless steel T-bolt
- 3 Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to SM rail



BONDING RAIL SPLICE BAR

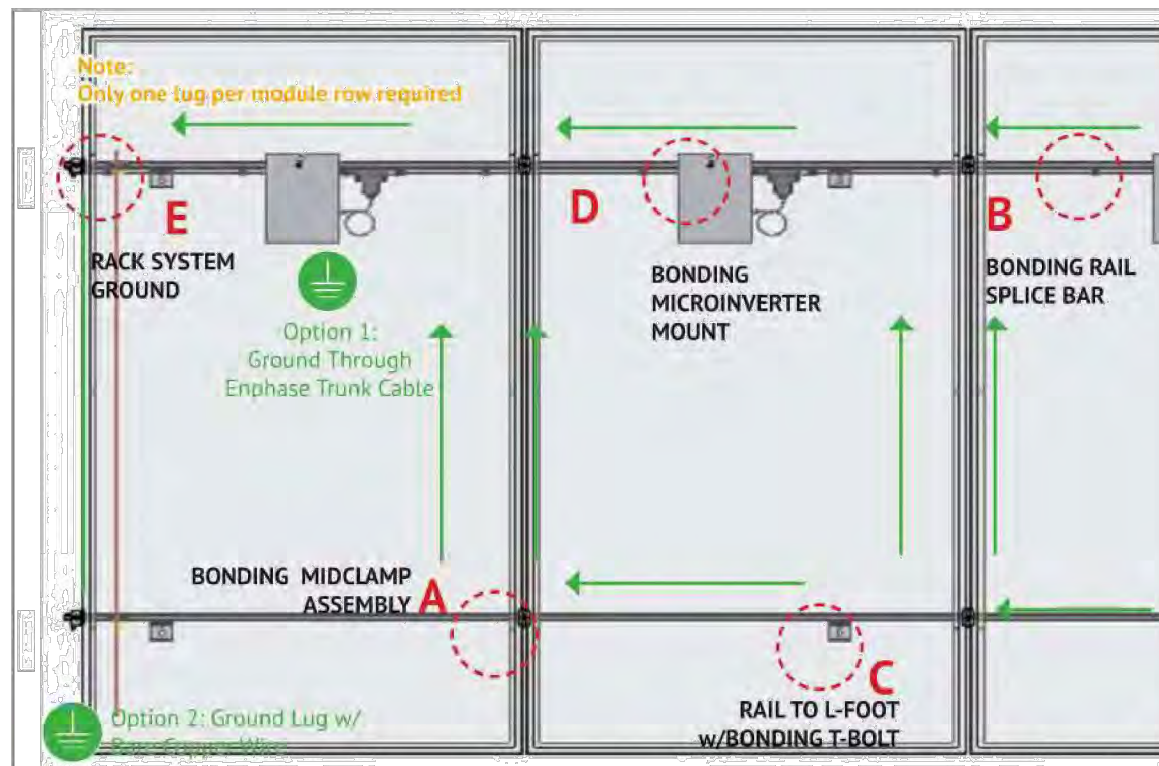
- 1 Bonding Hardware creates bond between splice bar and each rail section
- 2 Aluminum splice bar spans across rail gap to create rail to rail bond. Rail on at least one side of splice will be grounded.

Note: Splice bar and bolted connection are non-structural. The splice bar function is rail alignment and bonding.



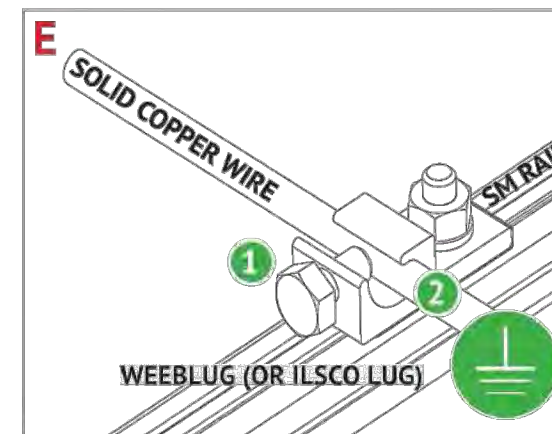
RAIL TO L-FOOT w/BONDING T-BOLT

- 1 Serrated flange nut removes L-foot anodization to bond L-Foot to stainless steel T-bolt
- 2 Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail



BONDING MICROINVERTER MOUNT

- 1 Hex nut with captive lock washer bonds metal microinverter flange to stainless steel T-bolt
- 2 Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, and L-foot to grounded SM rail **System ground including racking and modules may be achieved through the trunk cable of approved microinverter systems. See page I for details**



RACK SYSTEM GROUND

- 1 WEEB washer dimples pierce anodized rail to create bond between rail and lug
- 2 Solid copper wire connected to lug is routed to provide final system ground connection. **NOTE: IlSCO lug can also be used when secured to the side of the rail. See page I-3 for details**

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

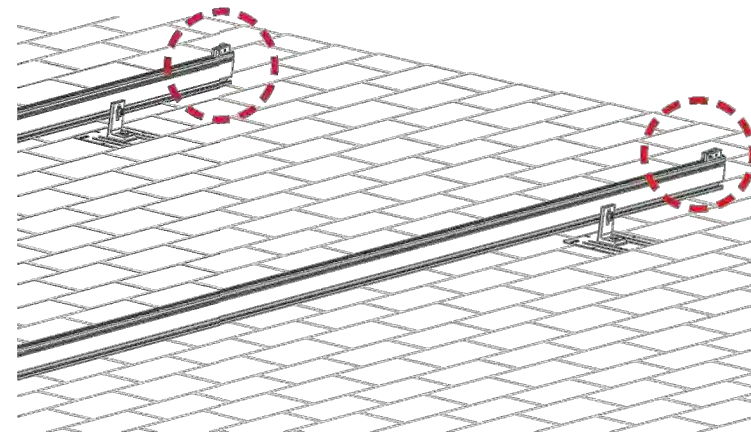
**BILL GAVALIER
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FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
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DATE: 02/25/2022

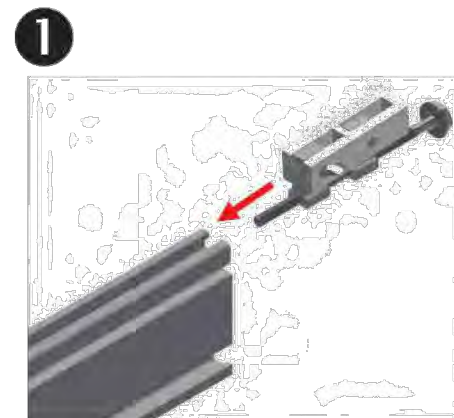
SHEET NAME
**EQUIPMENT
SPECIFICATION**

SHEET SIZE
**ANSI B
11" X 17"**

SHEET NUMBER
PV-11B



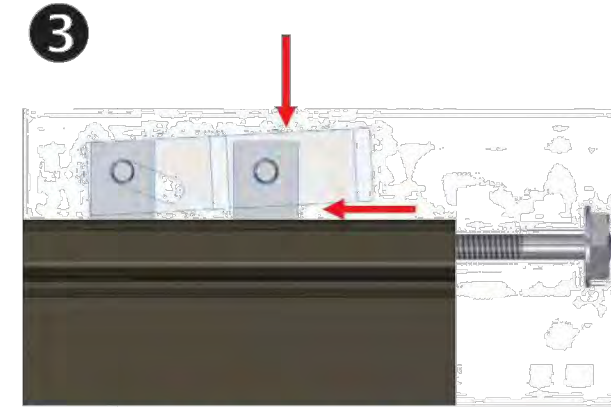
INSTALL MODULE END CLAMPS: The End clamp is supplied as an assembly with a 1/2" hex head bolt that is accessible at the ends of rails. The clamp should be installed on the rails prior to installing end modules.



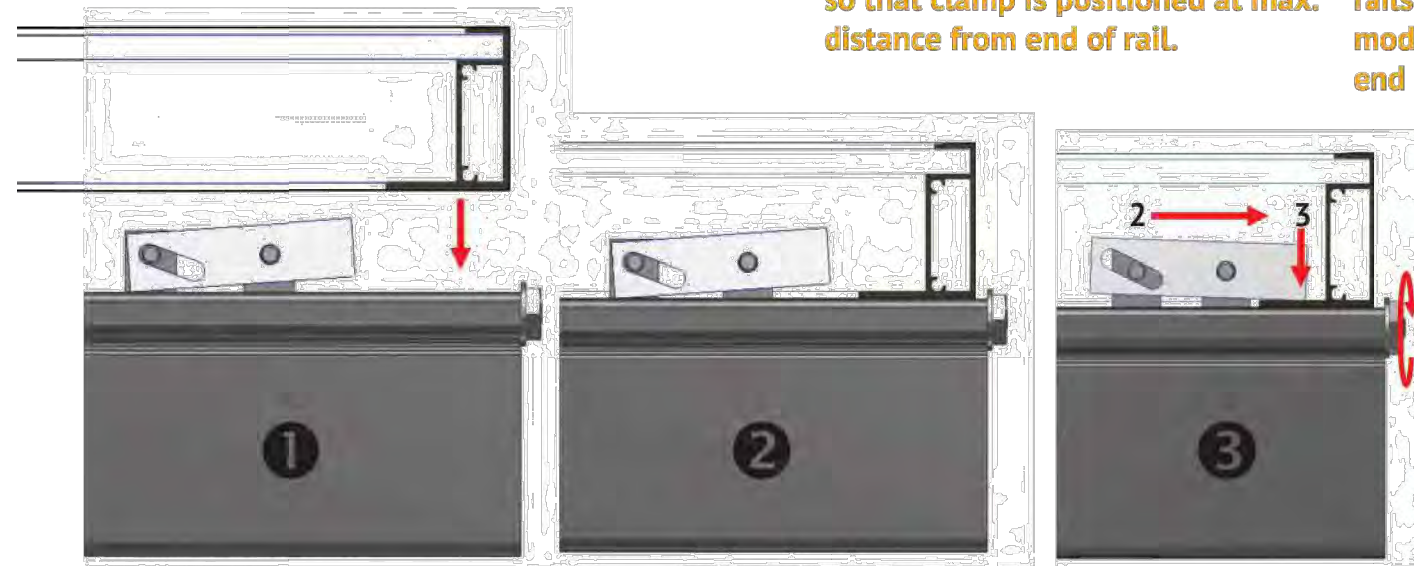
INSTALL END CLAMPS ON RAIL: Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**



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.**

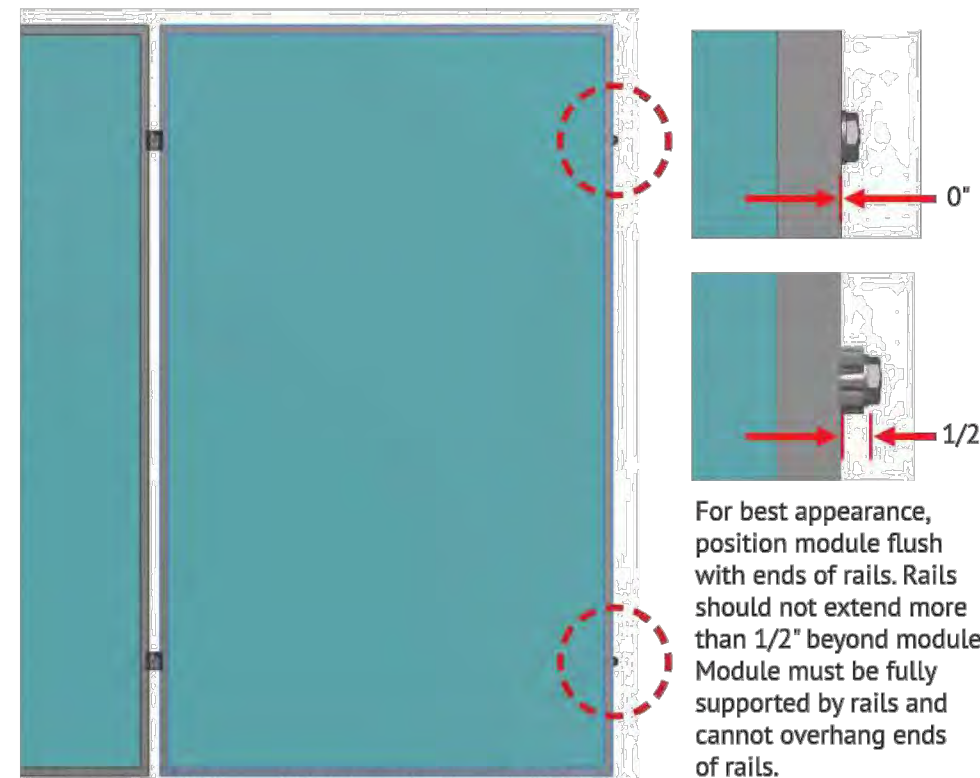


INSTALL FIRST MODULE: Install the first end module onto rails with the flange of the module frame positioned between end clamps and ends of rails.

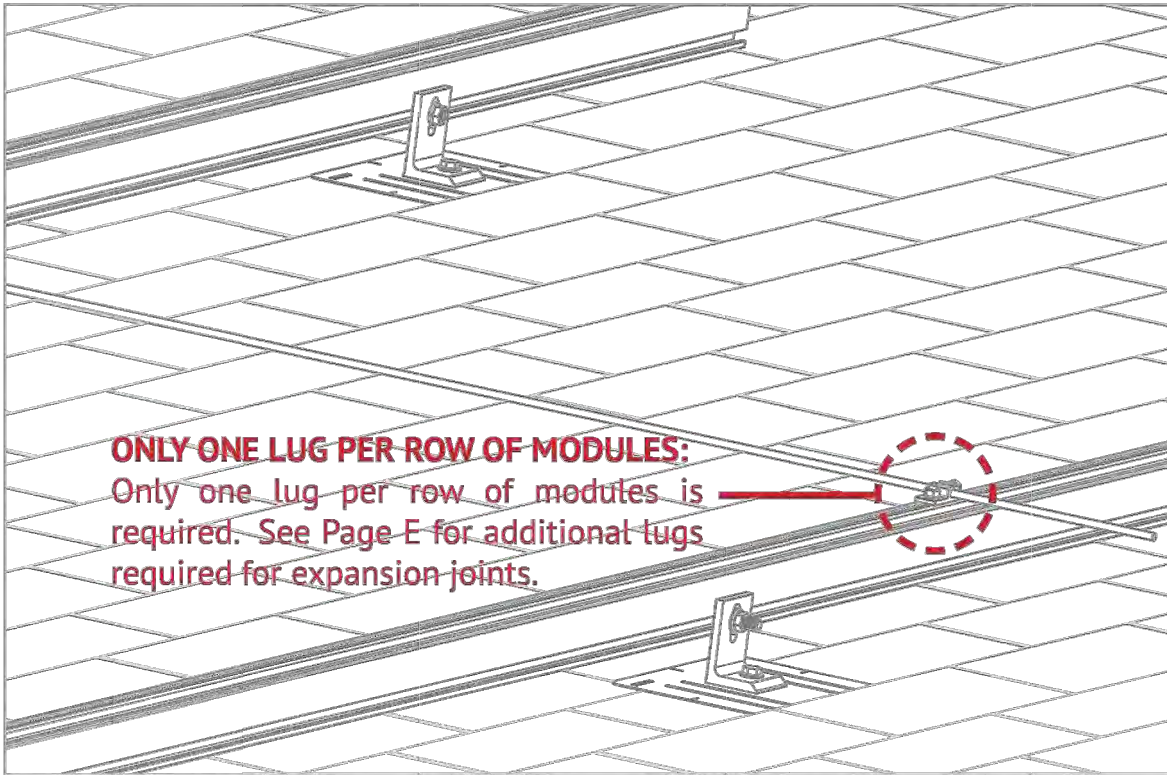
ENGAGE CLAMP: While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force.

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 3 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.



ONLY ONE LUG PER ROW OF MODULES:
Only one lug per row of modules is required. See Page E for additional lugs required for expansion joints.

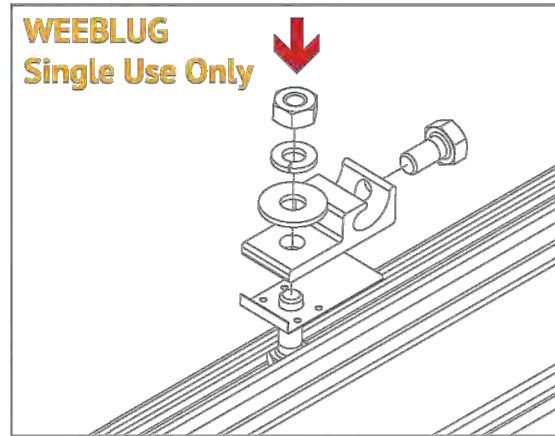
GROUNDING LUG MOUNTING DETAILS:

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.

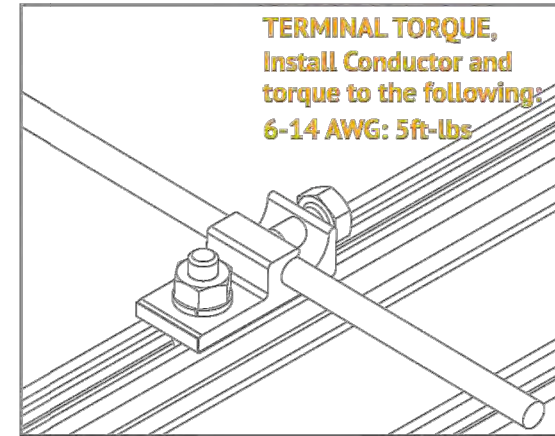
Required if not using approved integrated grounding microinverters

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.



WEEBLUG
Single Use Only



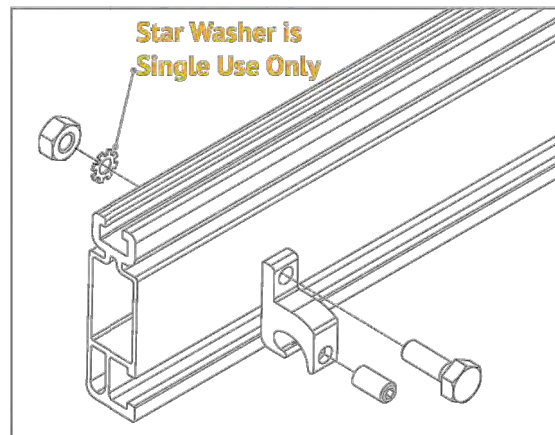
TERMINAL TORQUE,
Install Conductor and
torque to the following:
6-14 AWG: 5ft-lbs

WEEBLUG CONDUCTOR - UNIRAC P/N 008002S:

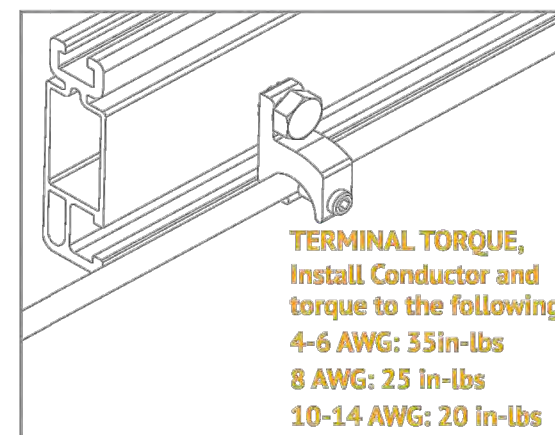
Apply Anti Seize and insert a bolt in the aluminum rail and through the clearance hole in the stainless steel flat washer. Place the stainless steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless steel flat washer. Install 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



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

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

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

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RESIDENCE
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FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliar@gmail.com

DATE: 02/25/2022

SHEET NAME
EQUIPMENT
SPECIFICATION

SHEET SIZE
ANSI B
11" X 17"

SHEET NUMBER
PV-11C

REVISIONS

DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

BILL GAVALIER
RESIDENCE
84 WINDY FARM DR
FUQUAY-VARINA, NC 27526
PH NO. (330) 397-8775
EMAIL ID: bill.gavaliere@gmail.com

DATE: 02/25/2022

SHEET NAME

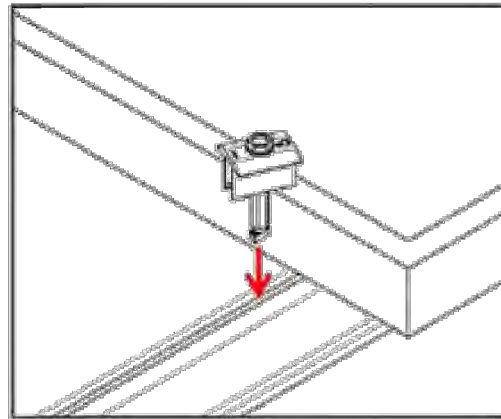
**EQUIPMENT
SPECIFICATION**

SHEET SIZE

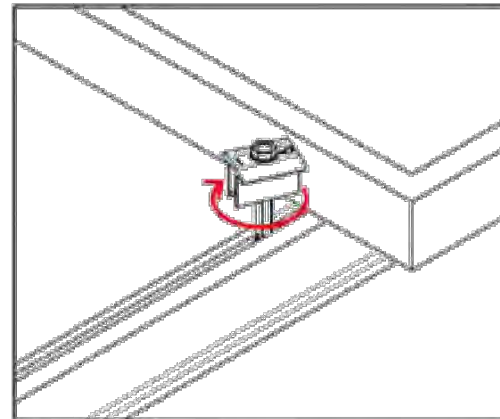
**ANSI B
11" X 17"**

SHEET NUMBER

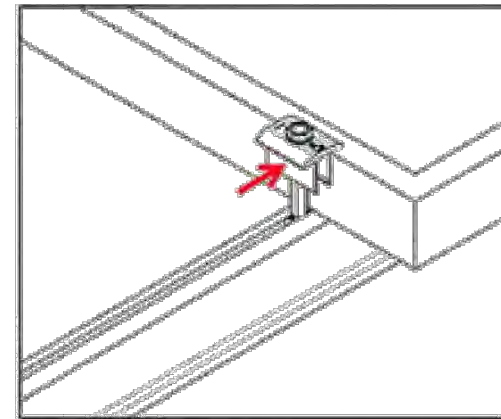
PV-11D



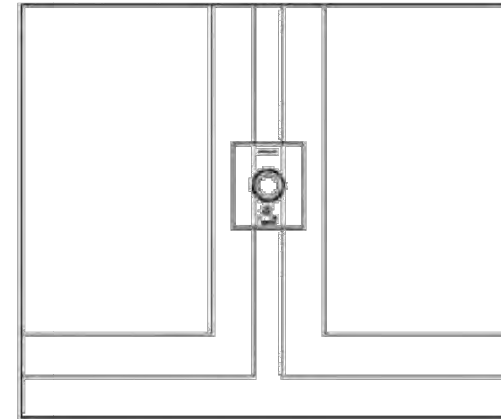
1. Position clamp to align T-bolt with rail slot. Lower clamp and insert T-bolt into rail slot



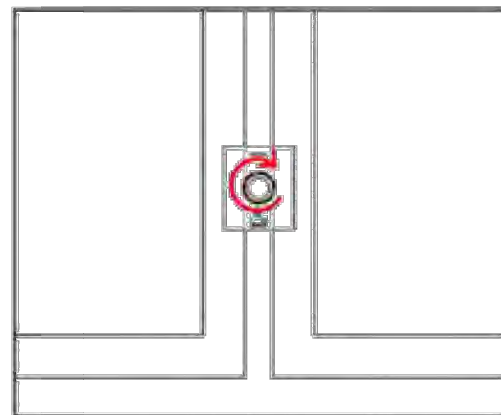
2. Rotate clamp clockwise 2/3 of a turn to engage T-bolt inside rail slot.



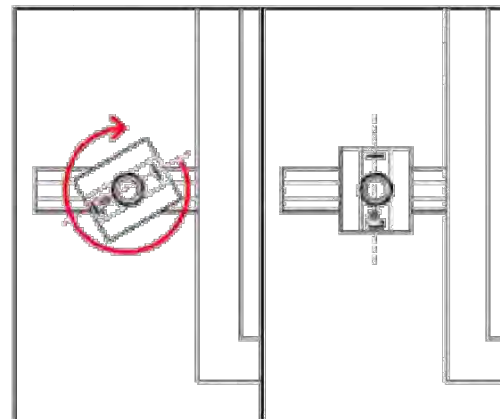
3. Slide clamp into position against module.



4. Place second module.



5. Tighten bolt and torque to 15 ft-lbs.



NOTE: If excessive force is applied in step 2, the cap may over-rotate causing it to be mis-aligned with the module frame. If this occurs, keep rotating the cap clockwise until it returns to the original position.



October 3, 2019

UniRac
 1411 Broadway Boulevard NE
 Albuquerque, New Mexico 87102-1545
 TEL: (505) 242-6411
 FAX: (505) 242-6412

Attn.: Unirac Engineering Department,

Re: Engineering Certification for UniRac's SolarMount Design & Engineering Guide

PZSE, Inc.-Structural Engineers has reviewed UniRac's "SolarMount Design & Engineering Guide" and specifically the enhancements of the SolarMount Flush-to-Roof System, Pressure Lookup Tables, and Downward & Upward Span Length Tables.

This certification excludes connections to building structures and the effects on building structure components. All information, data and analysis contained within the Installation Manual are based on, and comply with the following:

1. 2018 North Carolina Building Code, by The North Carolina State Building Code Council
2. 2009, 2012, 2015, & 2015 International Building Code, by International Code Council, Inc.
3. ASCE/SEI 7-05 & 7-10: Minimum Design Loads for Buildings and other Structures
4. 2010 & 2015 Aluminum Design Manual, by The Aluminum Association, 2015

This letter certifies that the structural calculations contained within UniRac's "SolarMount Design & Engineering Guide" are in compliance with the above Codes.

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

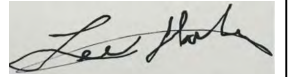
Prepared By:
 PZSE, Inc. – Structural Engineers
 Roseville, CA



1478 Stone Point Drive, Suite 190, Roseville, CA 95661
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 Experience | Integrity | Empowerment



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



ELECTRICAL LIC#: U34871

REVISIONS		
DESCRIPTION	DATE	REV

Signature with Seal

PROJECT NAME & ADDRESS

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 RESIDENCE
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 FUQUAY-VARINA, NC 27526
 PH NO. (330) 397-8775
 EMAIL ID: bill.gavaliar@gmail.com

DATE: 02/25/2022

SHEET NAME
**EQUIPMENT
 SPECIFICATION**

SHEET SIZE
**ANSI B
 11" X 17"**

SHEET NUMBER
PV-12