LUCENT ENGINEERING
Solar Professional Engineering Consulting 2021.11.17

Lucent Engineering, P.C.
814 E 1475 N
Lehi, UT 84043
m: (309) 645-0999
admin@lucenteng.co

December 2, 2021

Encōr Solar, LLC
3401 N. Thanksgiving Way, Ste 450
Lehi, UT 84043

John Leesman
Digitally signed by John Leesman
DN: CN=John Leesman, dnQualifier=A01410D0000017B12F005B900010DA0, O=Lucent Engineering P.C., C=US
Location: Boulder, CO
Reason: I am the author of this document
Date: 2021.12.02 08:49:35-07'00'

RE: Engineering Services
Cardenas Residence
3574 Neills Creek Rd, Lillington, NC
10 kW System
Solo Job #1694396

To Whom It May Concern,

We have reviewed the following information regarding the solar panel installation for this project. Alterations to these documents or plans shall not be made without direct written consent of the Engineer of Record.

A. Assumptions from Field Observation provided by Encōr Solar, LLC

The following structural design regarding the proposed alterations have been prepared from these assumptions. The verification of the field observations is the responsibility of the contractor. **Prior to commencement of work, the contractor shall verify the framing sizes, spacings, and spans noted in the sealed plans, calculations, and/or certification letter and notify the Engineer of Record of any discrepancies.**

	Roof
Roof Finish :	Asphalt Shingle
Roof Underlayment :	OSB
Roof Profile :	Gable
Roof Structural System :	Metal Plate Trusses
Truss Top Chord/Setup :	2 x 4 / Fink
Chord/Rafter Wood Grade :	Southern Pine #2 or better
Truss/Rafter Spacing :	24" o.c.
Roof Slope :	25 deg
Max Top Chord/Rafter Span :	7.43 ft
Bearing Wall Type :	Convl Lt-Frame Constr
Foundation :	Permanent Concrete
Stories :	Single

B. Building Design Criteria

Code :	2018 IRC (ASCE 7-16)	Risk Category :	II
Roof Live Load :	20 psf (0 psf at panels)	Occupancy Class :	R-3
Ground Snow Load :	15 psf	Roof Dead Load :	6.5 psf
Ult Wind Speed :	120 mph	PV Dead Load :	3 psf
Exposure Category :	C	Total Dead Load :	9.5 psf

C. Summary of Existing Structure Results

Roof
After review of the field observations and based on our calculations and in accordance with the applicable building codes and current industry standards, the existing roof structure supporting the proposed alterations consisting of the solar array has been determined to be:

- Adaquate to support the additional imposed loads. **No structural upgrades are required.**

D. Solar Panel Support Bracket Anchorage

1. Solar panels shall be designed, mounted, and installed in accordance with the most recent "UniRac Installation Manual", which can be found on the UniRac website (http://unirac.com/).
2. Manufacturer's Panel Bracket Connection to Roof Chord/Rafter Member:

Fastener :	(1) 5/16" Lag Screw per Bracket
NDS Withdrawl Value :	307 lbs/inch
Min. Thread Length and Pentration Depth :	2.5"

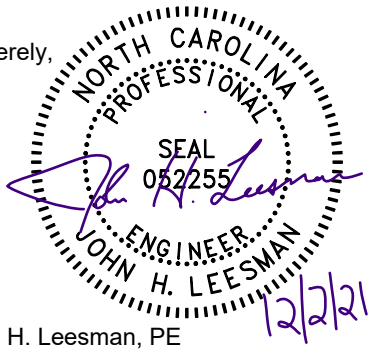
3. Considering the existing roof's slope, size, spacing, condition, and calculated loads, the panel bracket supports shall be placed no greater than 72 in. o/c.
4. Panel supports connections shall be staggered to distribute load to adjacent trusses.

E. Overall Summary

Based on the information supplied to us at the time of this report, on the evaluation of the existing structure, and solar array panel bracket connection, it is our opinion that the roof system will adequately support the additional loads imposed by the solar array. This evaluation conforms to 2018 IRC and current industry standards.

Should you have any questions regarding this letter or if you require further information, do not hesitate to contact me.

Sincerely,



John H. Leesman, PE
License No. 52255

Limits of Scope of Work and Liablity

The existing structure is assumed to have been designed and constructed following appropriate codes at the time of erection and assumed to have appropriated permits. The calculations performed are only for the roof framing supporting the solar array installation referenced in the stamped plans and were completed according to generally recognized structural analysis standards and procedures, professional engineering, and design experience opinions and judgements. Existing deficiencies which are unknown or were not observed during the time the site observation are not included in this scope of work. All solar panel modules, racking, and mounting equipment shall be designed and installed per the manufacturer's approved installation specifications. The Engineer of Record and the engineering consulting firm assume no responsibility for misuse or improper installation. This analysis is not stamped for water leakage. Framing was determined on information in provided plans and/or photos, along with engineering judgement. Prior to commencement of work, the contractor shall verify the framing sizes, spacings, and spans noted in the stamped plans, calculations, and/or certification letter and notify the Engineer of Record of any discrepancies prior to starting construction. 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. The contactor shall also verify that there are no damage/deficiencies (i.e., dry rot, water damage, termite damage, framing member/connection damage, etc.) to framing that was not addressed in the stamped plans, calculations, and/or certification letter and notify the Engineer of Record of any concerns prior to starting construction.

AERIAL VIEW:

STREET VIEW:

ENCŌR

CONTRACTOR INFORMATION:
PALMETTO
1505 King Street EXT Ste 114
Charleston SC, 29405

SITE INFORMATION

Arturo Cardenas
3574 Neills Creek Rd
Lillington, NC 27546
AC SYSTEM SIZE: 10 kW AC
DC SYSTEM SIZE: 10 kW DC
Lat, 35.458905
Long, -78.778465
(25) Hanwha Q.PEAK DUO BLK ML-G10+ 400 PV MODULES
(1) SolarEdge SE10000H-US (240V) INVERTER(S)
Duke Energy Progress

SHEET INDEX:

DRAWN BY: SoloCAD

DATE:
December 1, 2021

COVER PAGE - PV01

GENERAL NOTES

1. INSTALLATION OF SOLAR PHOTOVOLTAIC SYSTEM SHALL BE IN ACCORDANCE WITH NEC ARTICLE 690, AND ALL OTHER APPLICABLE NEC CODES WHERE NOTED OR EXISTING.
2. PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL COMPLY WITH NEC ARTICLE 110.
3. ALL WIRES, INCLUDING THE GROUNDING ELECTRODE CONDUCTOR SHALL BE PROTECTED FROM PHYSICAL DAMAGE IN ACCORDANCE WITH NEC ARTICLE 250
4. THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE; THIS SYSTEM IS UTILITY INTERACTIVE PER UL 1741 AND DOES NOT INCLUDE STORAGE BATTERIES OR OTHER ALTERNATIVE STORAGE SOURCES.
5. ALL DC WIRES SHALL BE SIZED ACCORDING TO [NEC 690.8]
6. DC CONDUCTORS SHALL BE WITHIN PROTECTED RACEWAYS IN ACCORDANCE WITH [NEC 690.31]
7. ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL JURISDICTIONAL BUILDING CODE.

PHOTOVOLTAIC (PV) SYSTEM SPECIFICATIONS

EQUIPMENT:
AC SYSTEM SIZE: 10 kW AC
DC SYSTEM SIZE: 10 kW DC
(25) Hanwha Q.PEAK DUO BLK ML-G10+ 400 PV MODULES
(1) SolarEdge SE10000H-US (240V) INVERTER(S)
RACKING: SnapNrack - 72" O.C.

NORTH CAROLINA PROFESSIONAL SEAL 052255 ENGINEER JOHN H. LEESMAN
12/2/21

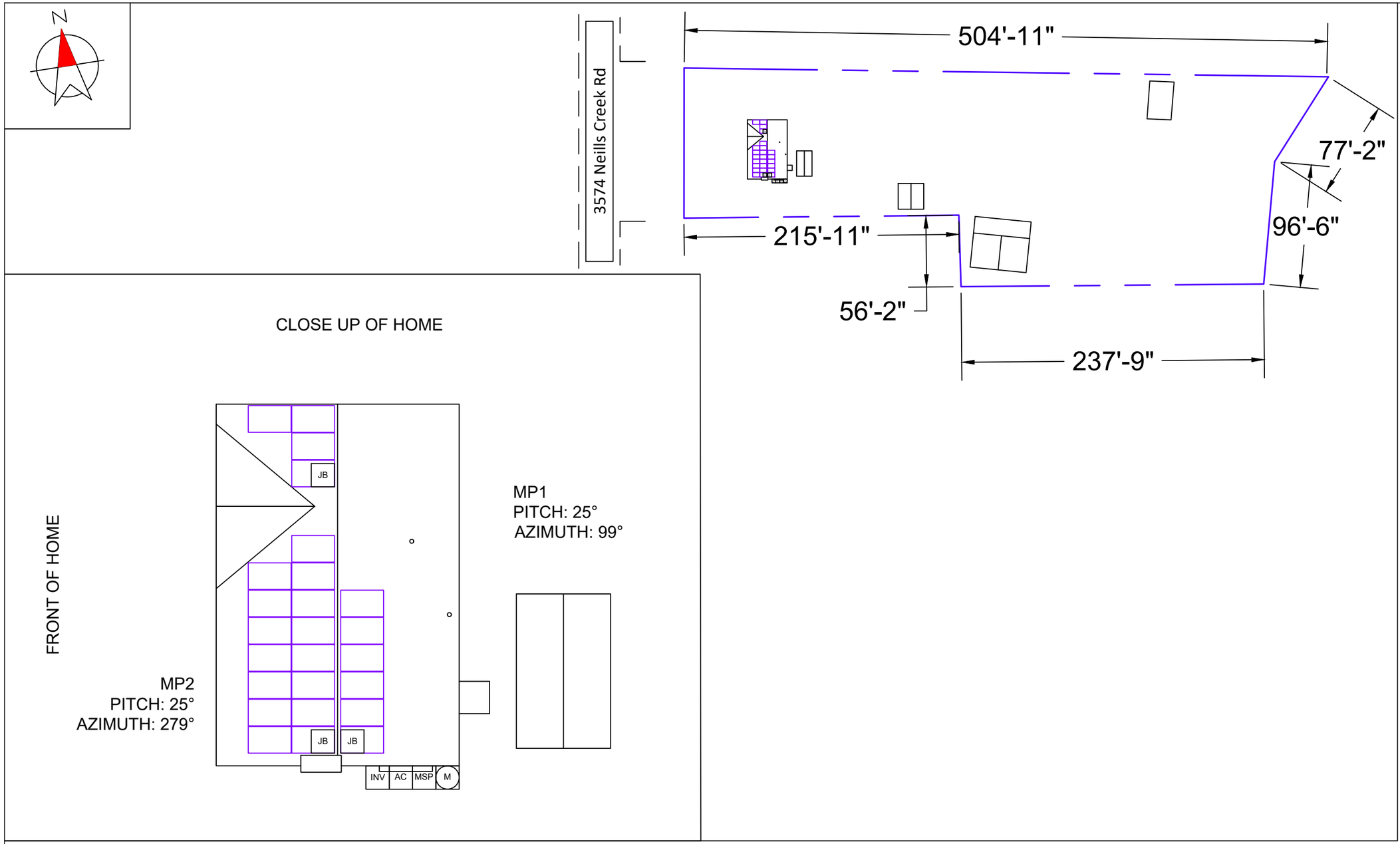
APPLICABLE GOVERNING CODES

2017 NEC
2018 IRC
2018 IFC
2018 IBC
2018 NC RBC

NOTICE TO CONTRACTOR
All construction must comply with current NC Building Codes and is subject to field inspection and verification.
APPROVED
Limited building only review
Permit holder responsible for full compliance with the code
04/12/2022
Harnett COUNTY NORTH CAROLINA

SITE SPECIFICATIONS

OCCUPANCY: R-3
ZONING: RESIDENTIAL



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EQUIPMENT LEGEND:

M	UTILITY METER	AC	VISIBLE, LOCKABLE, LABELED AC DISCONNECT	INV	INVERTER	SUB	SUB PANEL
MSP	MAIN SERVICE PANEL	PV	METER SOCKET (FOR UTILITY PV METER)	C	COMBINER BOX	LC	LOAD CENTER

FIRE ACCESS PATHWAY (3' TYP)
PROPERTY LINE
BATT BATTERY(IES)

VISIBLE, LOCKABLE, LABELED AC DISCONNECT LOCATED WITHIN 10' OF UTILITY METER

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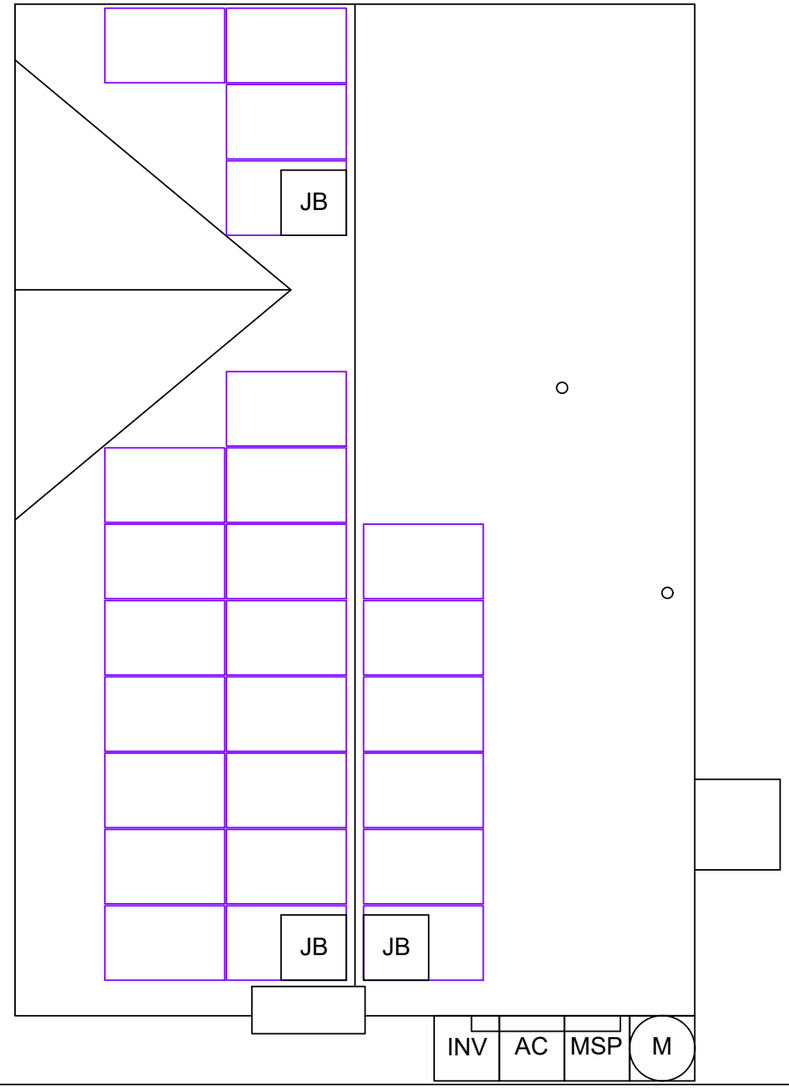
DATE: December 1, 2021

SITE PLAN - PV02



EQUIPMENT INFORMATION:	
RAIL MANUFACTURER	SnapNrack
RAIL PART NUMBER	Standard Rail
ATTACHMENTS	Unirac - FLASHKIT PRO
ATTACHMENT QTY	38
SPLICE QTY	6
MIDCLAMP QTY	40
ENDCLAMP QTY	20

ROOF INFO:	
ROOF TYPE	asphalt_shingle
ROOF FRAMING	manufactured_truss
RAFTER/TOP CHORD SIZE	2x4
RAFTER/TOP CHORD SPACING	24"
ATTACHMENT SPACING	72

PHOTOVOLTAIC ARRAY STRUCTURAL CRITERIA:	
PV MODULE COUNT:	25
ARRAY AREA:	MODULE COUNT * 18.06ft² = 451.5
ROOF AREA:	1475.11 ft²
PERCENT OF ROOF COVERED:	31%
ARRAY WEIGHT:	MODULE COUNT * 50lbs = 1250
DISTRIBUTED LOAD:	ARRAY LBS/ATTACHMENTS = 32.89
POINT LOAD: (lbs/ft²)	(ARRAY) WEIGHT/AREA = 2.77 lbs/ft²

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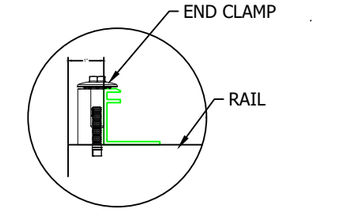
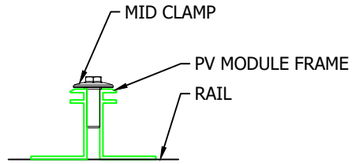
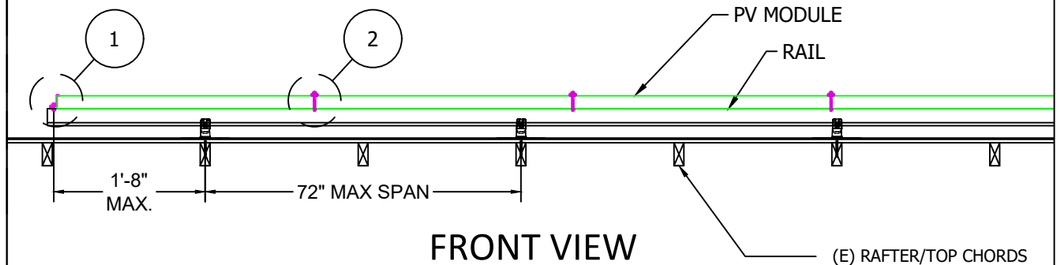
ROOF ATTACHMENTS - PV03



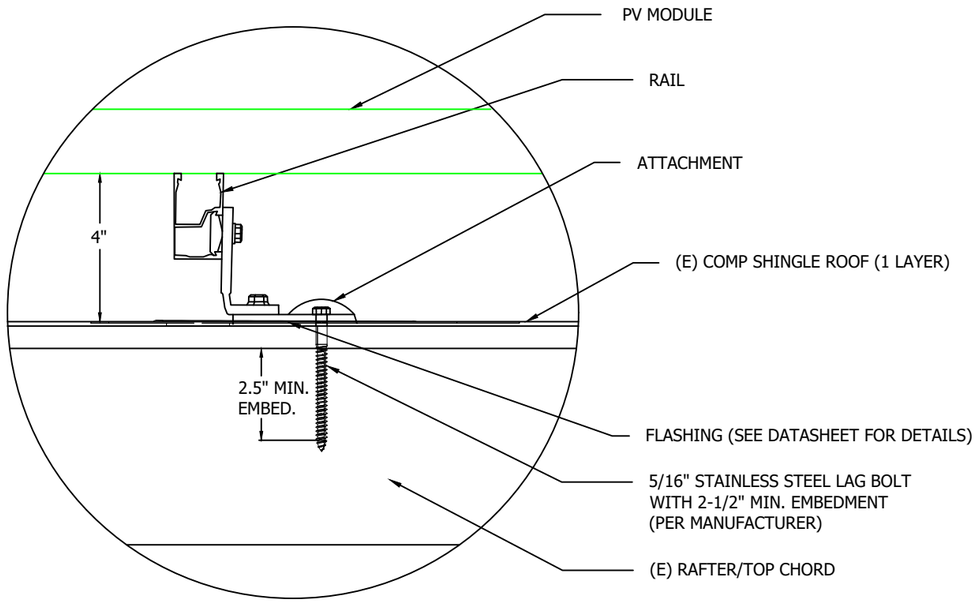
1 END CLAMP DETAILS



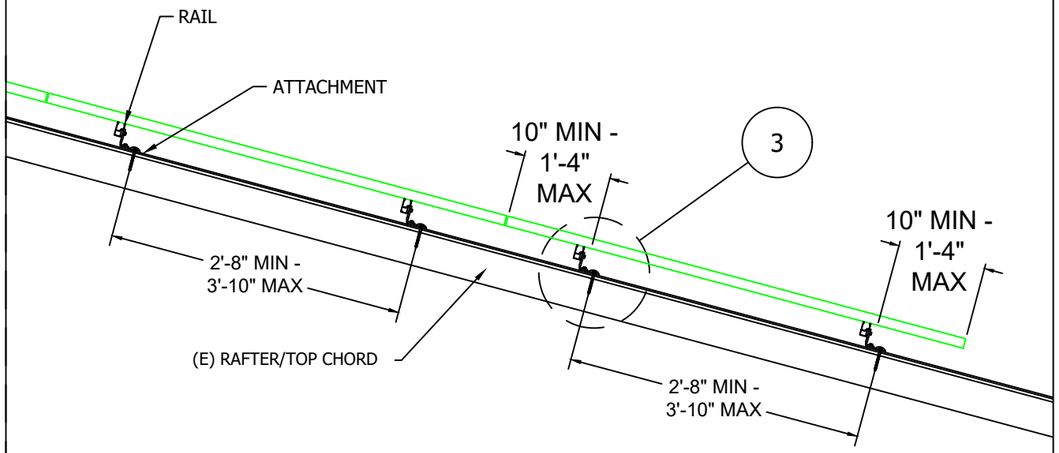
2 MID CLAMP DETAILS



FRONT VIEW



3 DETAIL, MOUNTING AND FLASHING



SIDE VIEW

EQUIPMENT INFORMATION:	
RAIL MANUFACTURER	SnapNrack
RAIL PART NUMBER	Standard Rail
ATTACHMENTS	Unirac - FLASHKIT PRO
ATTACHMENT QTY	38
SPLICE QTY	6
MIDCLAMP QTY	40
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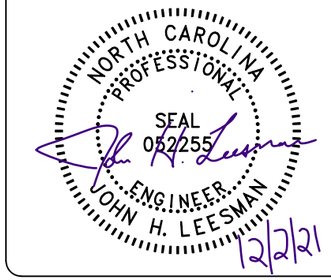

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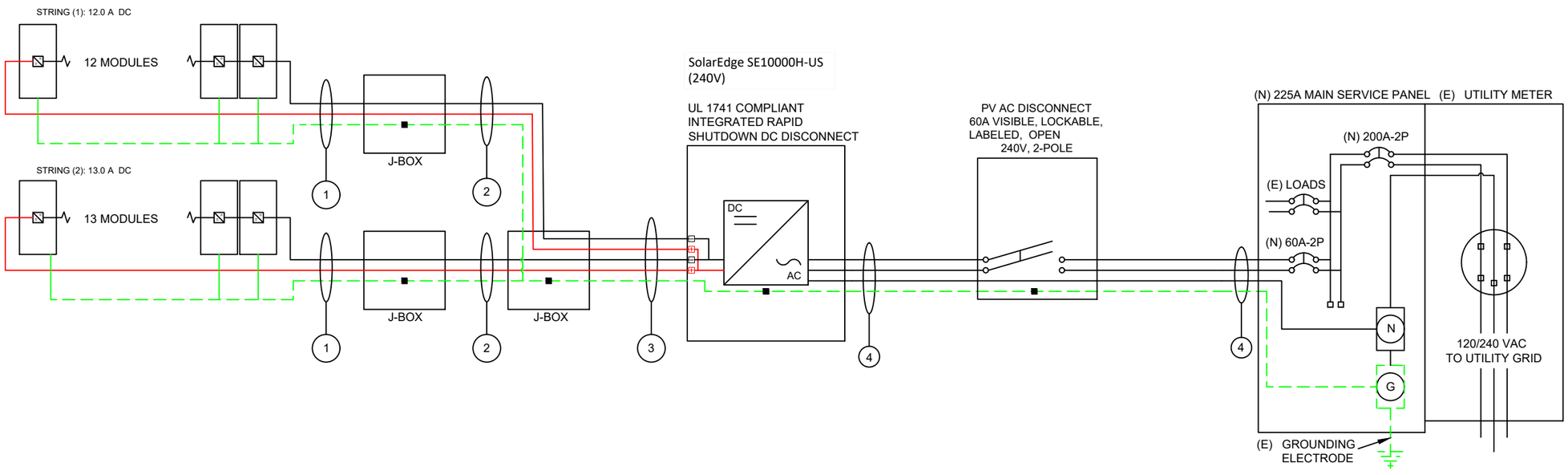
MOUNTING DETAIL - PV04

EQUIPMENT SCHEDULE:			
TYPE:	QTY:	DESCRIPTION:	RATING:
MODULES:	(25)	Hanwha Q.PEAK DUO BLK ML-G10+ 400	400 W
INVERTERS:	(1)	SolarEdge SE10000H-US (240V)	10000 W
AC DISCONNECT(S):	(1)	PV AC DISCONNECT, 240V, 2-POLE	60A
DC OPTIMIZERS:	(25)	SolarEdge P400	15 Adc

Conduit & Conductor Schedule									
TAG	WIRE GAUGE	DESCRIPTION	QTY	CONDUIT SIZE	CONDUCTOR RATING	# OF CONDUCTORS DERATE	TEMP. DERATE	CONDUCTOR RATING W/DERATES	CONDUIT FILL
1	10 AWG	PV-WIRE , USE-2, COPPER (L 1, L 2)	(2)	N/A - FREE AIR	40A	N/A - FREE AIR	0.91	36.4A	N/A - FREE AIR
	6 AWG	BARE, COPPER (GROUND)	(1)						
2	10 AWG	THWN-2, or THHN, or 10/2 NM-B COPPER - (L 1, L 2)	(2)	3/4" EMT	40A	1	0.91	36.4A	11.9%
	10 AWG	THWN-2, or THHN, or 10/2 NM-B COPPER - (GROUND)	(1)						
3	10 AWG	THHN/THWN-2, COPPER - (L1, L2)	(4)	3/4" EMT	40A	0.8	0.91	29.12A	19.8%
	10 AWG	THHN/THWN-2 - (GROUND)	(1)						
4	6 AWG	THWN-2 COPPER - (L1, L2, NEUTRAL)	(3)	3/4" EMT	65A	1	0.91	59.15A	32.6%
	10 AWG	THWN-2 COPPER - (GROUND)	(1)						



GROUNDING & GENERAL NOTES:

1. PV INVERTER IS UNGROUNDED, TRANSFORMER-LESS TYPE.
2. EGC TO BE SPLICED TO NEW OR EXISTING ELECTRODE
3. ANY EXISTING WIRING INVOLVED WITH PV SYSTEM CONNECTION THAT IS FOUND TO BE INADEQUATE PER CODE SHALL BE CORRECTED PRIOR TO FINAL INSPECTION.
4. JUNCTION BOX QUANTITIES, AND PLACEMENT SUBJECT TO CHANGE IN THE FIELD - JUNCTION BOXES DEPICTED ON ELECTRICAL DIAGRAM REPRESENT WIRE TYPE TRANSITIONS.
5. AC DISCONNECT NOTED IN EQUIPMENT SCHEDULE OPTIONAL IF OTHER AC DISCONNECTING MEANS IS LOCATED WITHIN 10' OF SERVICE DISCONNECT.

INTERCONNECTION NOTES:

1. INTERCONNECTION SIZING, LIMITATIONS AND COMPLIANCE DETERMINED IN ACCORDANCE WITH [NEC 705.12], AND [NEC 690.64].
3. GROUND FAULT PROTECTION IN ACCORDANCE WITH [NEC 215.9], [NEC 230.95] AND [NEC 690.5]
4. ALL EQUIPMENT TO BE RATED FOR BACKFEEDING.
5. PV BREAKER TO BE POSITIONED AT THE OPPOSITE END OF THE BUSBAR RELATIVE TO THE MAIN BREAKER.

DISCONNECT NOTES

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

VISIBLE, LOCKABLE, LABELED AC DISCONNECT LOCATED WITHIN 10' OF UTILITY METER

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12/2/21

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LINE DIAGRAM - PV05

WARNING

ELECTRIC SHOCK HAZARD

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

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

WARNING

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

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

WARNING

INVERTER OUTPUT CONNECTION

DO NOT RELOCATE THIS OVERCURRENT DEVICE

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

WARNING

DUAL POWER SUPPLY

SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

LABEL 4
EQUIPMENT CONTAINING OVERCURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO A BUSBAR OR CONDUCTOR SUPPLIED FROM MULTIPLE SOURCES SHALL BE MARKED TO INDICATE THE PRESENCE OF ALL SOURCES [NEC 705.12(B)(3)]

PHOTOVOLTAIC AC DISCONNECT

RATED AC OUTPUT CURRENT: 42
NOMINAL OPERATING AC VOLTAGE: 240

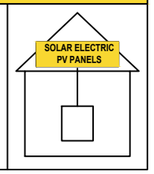
LABEL 5
AT POINT OF INTERCONNECTION, MARKED AT AC DISCONNECTING MEANS.
[NEC 690.54, NEC 690.13 (B)]

WARNING: PHOTOVOLTAIC POWER SOURCE

LABEL 6
AT DIRECT-CURRENT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS; SPACED AT MAXIMUM 10FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
[NEC 690.31(G)(3&4)]

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

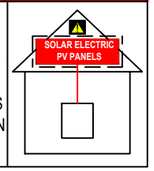
TURN RAPID SHUTDOWN SWICH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY



LABEL 7
FOR PV SYSTEMS THAT SHUT DOWN THE ARRAY AND CONDUCTORS LEAVING THE ARRAY:
SIGN TO BE LOCATED ON OR NO MORE THAN 3 FT AWAY FROM SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED AND SHALL INDICATE THE LOCATION OF ALL IDENTIFIED RAPID SHUTDOWN SWITCHES IF NOT AT THE SAME LOCATION.
[NEC 690.56(C)(1)(A)]

SOLAR PV SYSTEM EQUIPPED WITH RAPID SHUTDOWN

TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN CONDUCTORS OUTSIDE THE ARRAY. CONDUCTORS WITHIN THE ARRAY REMAIN ENERGIZED IN SUNLIGHT

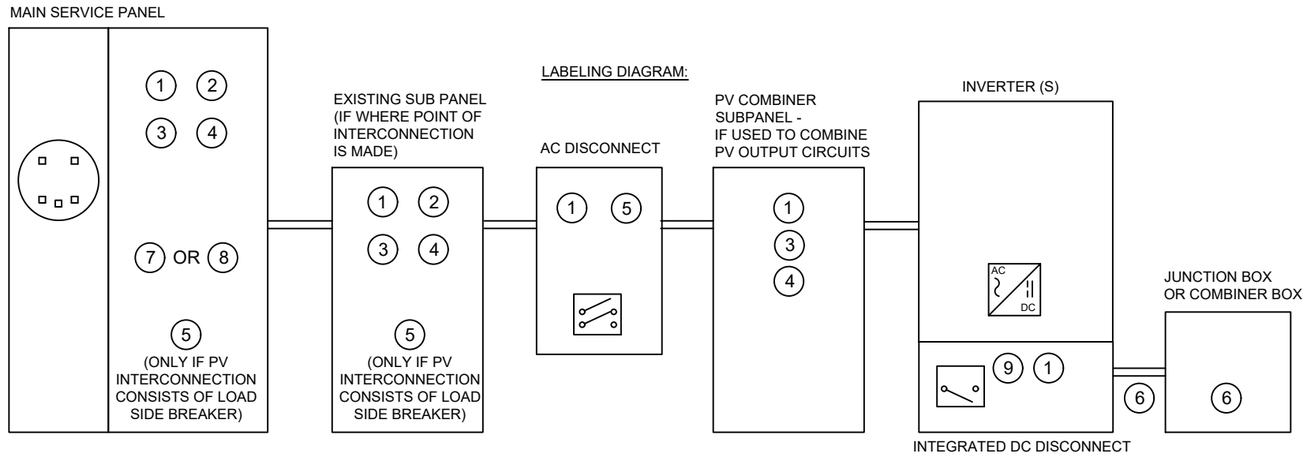


LABEL 8
FOR PV SYSTEMS THAT ONLY SHUT DOWN CONDUCTORS LEAVING THE ARRAY:
SIGN TO BE LOCATED ON OR NO MORE THAN 3 FT AWAY FROM SERVICE DISCONNECTING MEANS TO WHICH THE PV SYSTEMS ARE CONNECTED AND SHALL INDICATE THE LOCATION OF ALL IDENTIFIED RAPID SHUTDOWN SWITCHES IF NOT AT THE SAME LOCATION.
[NEC 690.56(C)(1)(b)]

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL 9
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH [NEC 690.56(C)(3)].

LABELING DIAGRAM:



*ELECTRICAL DIAGRAM SHOWN ABOVE IS FOR LABELING PURPOSES ONLY. NOT AN ACTUAL REPRESENATION OF EQUIPMENT AND CONNECTIONS TO BE INSTALLED. LABEL LOCATIONS PRESENTED MAY VERY DEPENDING ON TYPE OF INTERCONNECTION METHOD AND LOCATION PRESENTED ON THE ELECTRICAL DIAGRAM PAGE.

LABELING NOTES:

1. LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
2. LABELING REQUIREMENTS BASED ON THE 2017 NATIONAL ELECTRIC CODE, OSHA STANDARD 19010.145, ANSI Z535.
3. MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
4. LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED [NEC 110.21(B)(3)]
5. LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8", WHITE ON RED BACKGROUND; REFLECTIVE, AND PERMANENTLY AFFIXED [IFC 605.11.1.1]

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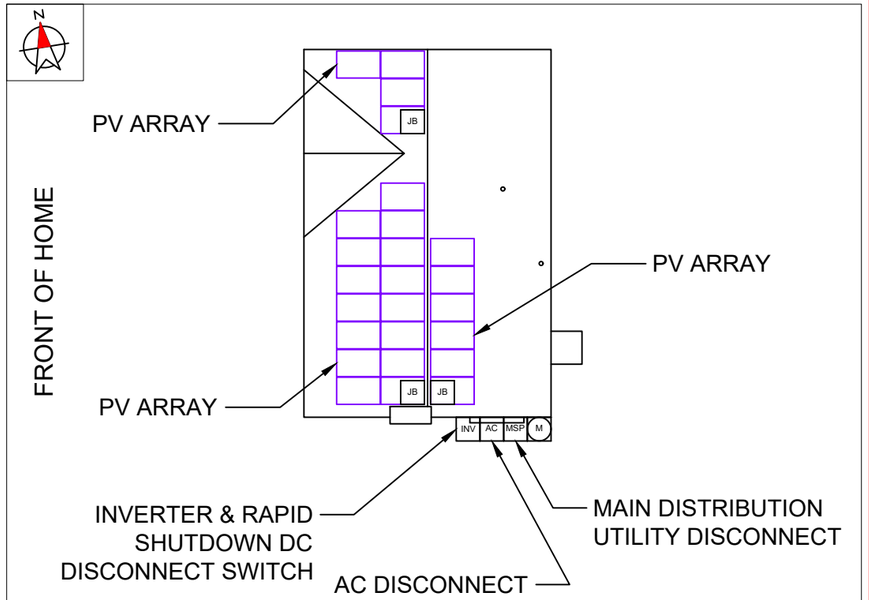
DATE:
December 1, 2021

LABELS - PV06

CAUTION

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM ROOF MOUNTED SOLAR ARRAYS WITH SAFETY DISCONNECTS AS SHOWN:



3574 Neills Creek Rd, Lillington NC 27546

DIRECTORY

PERMANENT PLAQUE OR DIRECTORY PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM.

(ALL PLAQUES AND SIGNAGE WILL BE INSTALLED AS OUTLINED WITHIN: NEC 690.56(B)&(C), [NEC 705.10])

ENCŌR

CONTRACTOR INFORMATION:

PALMETTO
1505 King Street EXT Ste 114
Charleston SC, 29405

SITE INFORMATION

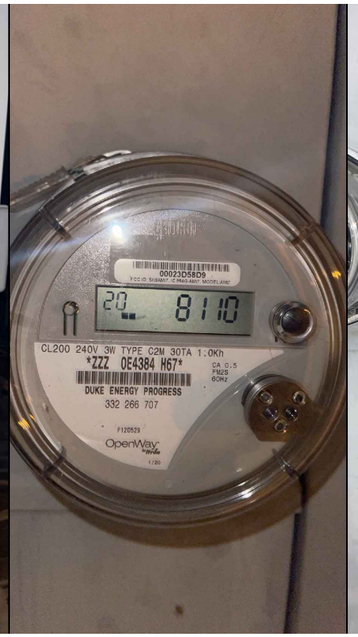
Arturo Cardenas
3574 Neills Creek Rd
Lillington, NC 27546
AC SYSTEM SIZE: 10 kW AC
DC SYSTEM SIZE: 10 kW DC
Lat, 35.458905
Long, -78.778465
(25) Hanwha Q.PEAK DUO BLK ML-G10+ 400 PV MODULES
(1) SolarEdge SE10000H-US (240V) INVERTER(S)
Duke Energy Progress

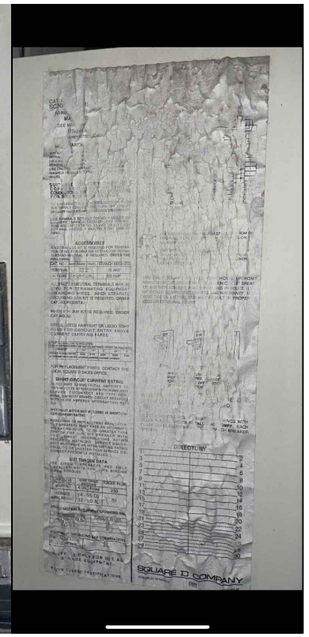
DRAWN BY: SoloCAD

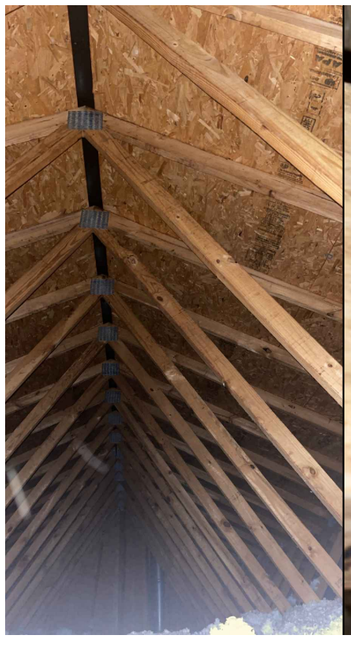
DATE:
December 1, 2021

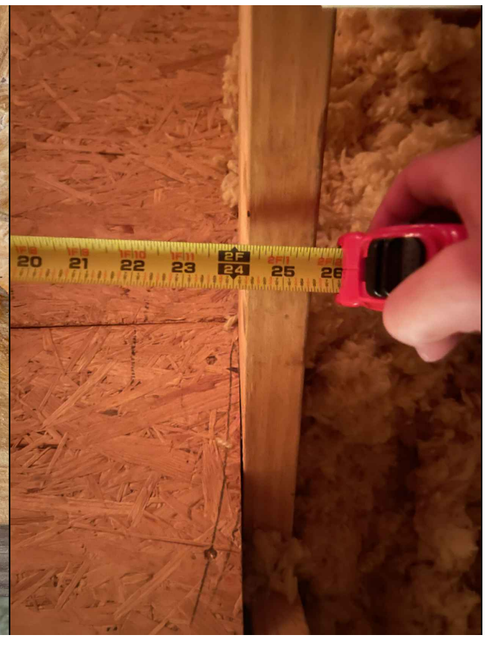
PLACARD - PV07

SITE PHOTOS:









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Duke Energy Progress

DRAWN BY: SoloCAD

DATE:
December 1, 2021

SITE PHOTOS - PV08

Q.PEAK DUO BLK ML-G10+
385-405

ENDURING HIGH PERFORMANCE

25 YR Warranty
Product & Performance

EUPD RESEARCH TOP BRAND PV MODULES EUROPE 2021

Q CELLS Yield Security

BREAKING THE 20% EFFICIENCY BARRIER
Q.ANTUM DUO Z Technology with zero gap cell layout boosts module efficiency up to 20.9%.

THE MOST THOROUGH TESTING PROGRAMME IN THE INDUSTRY
Q CELLS is the first solar module manufacturer to pass the most comprehensive quality programme in the industry: The new “Quality Controlled PV” of the independent certification institute TÜV Rheinland.

INNOVATIVE ALL-WEATHER TECHNOLOGY
Optimal yields, whatever the weather with excellent low-light and temperature behavior.

ENDURING HIGH PERFORMANCE
Long-term yield security with Anti LID Technology, Anti PID Technology[1], Hot-Spot Protect and Traceable Quality Tra.Q™.

EXTREME WEATHER RATING
High-tech aluminum alloy frame, certified for high snow (5400 Pa) and wind loads (4000 Pa).

A RELIABLE INVESTMENT
Inclusive 25-year product warranty and 25-year linear performance warranty[2].

[1] APT test conditions according to IEC / TS 62804-1:2015, method A (–1500 V, 96 h)
[2] See data sheet on rear for further information.

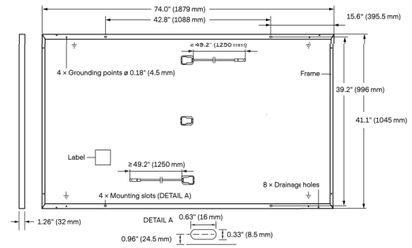
THE IDEAL SOLUTION FOR:
Rooftop arrays on residential buildings

Engineered in Germany

Q CELLS

MECHANICAL SPECIFICATION

Format	74.0 in × 41.1 in × 1.26 in (including frame) (1879 mm × 1045 mm × 32 mm)
Weight	48.5 lbs (22.0 kg)
Front Cover	0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Black anodized aluminum
Cell	6 × 22 monocrystalline Q.ANTUM solar half cells
Junction Box	2.09-3.98 in × 1.26-2.36 in × 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 49.2 in (1250 mm), (–) ≥ 49.2 in (1250 mm)
Connector	Stäubli MC4; IP68

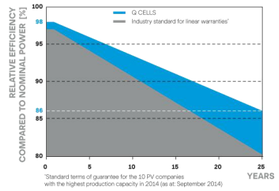


ELECTRICAL CHARACTERISTICS

POWER CLASS			385	390	395	400	405
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / –0 W)							
Minimum	Power at MPP[1]	P_{MPP} [W]	385	390	395	400	405
Minimum	Short Circuit Current[1]	I_{SC} [A]	11.04	11.07	11.10	11.14	11.17
Minimum	Open Circuit Voltage[1]	V_{OC} [V]	45.19	45.23	45.27	45.30	45.34
Minimum	Current at MPP	I_{MPP} [A]	10.59	10.65	10.71	10.77	10.83
Minimum	Voltage at MPP	V_{MPP} [V]	36.36	36.62	36.88	37.13	37.39
Minimum	Efficiency[1]	η [%]	≥19.6	≥19.9	≥20.1	≥20.4	≥20.6
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]							
Minimum	Power at MPP	P_{MPP} [W]	288.8	292.6	296.3	300.1	303.8
Minimum	Short Circuit Current	I_{SC} [A]	8.90	8.92	8.95	8.97	9.00
Minimum	Open Circuit Voltage	V_{OC} [V]	42.62	42.65	42.69	42.72	42.76
Minimum	Current at MPP	I_{MPP} [A]	8.35	8.41	8.46	8.51	8.57
Minimum	Voltage at MPP	V_{MPP} [V]	34.59	34.81	35.03	35.25	35.46

[1] Measurement tolerances P_{MPP} ±3%; I_{SC}; V_{OC} ±5% at STC: 1000 W/m², 25±2 °C, AM 1.5 according to IEC 60904-3 • [2] 800 W/m², NMOT, spectrum AM 1.5

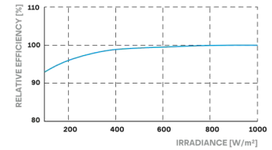
Q CELLS PERFORMANCE WARRANTY



At least 98% of nominal power during first year. Thereafter max. 0.5% degradation per year. At least 93.5% of nominal power up to 10 years. At least 86% of nominal power up to 25 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Q CELLS sales organisation of your respective country.

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²)

TEMPERATURE COEFFICIENTS						
Temperature Coefficient of I_{SC}	α	[%/K]	+0.04	Temperature Coefficient of V_{OC}	β	[%/K]	–0.27
Temperature Coefficient of P_{MPP}	γ	[%/K]	–0.34	Nominal Module Operating Temperature	NMOT	[°F]	109±5.4 (43±3 °C)

PROPERTIES FOR SYSTEM DESIGN

Maximum System Voltage V_{SYS}	[V]	1000 (IEC) / 1000 (UL)	PV module classification	Class II
Maximum Series Fuse Rating	[A DC]	20	Fire Rating based on ANSI / UL 61730	TYPE 2
Max. Design Load, Push / Pull[3]	[lbs/ft²]	75 (3600 Pa) / 55 (2660 Pa)	Permitted Module Temperature on Continuous Duty	–40 °F up to +185 °F (–40 °C up to +85 °C)
Max. Test Load, Push / Pull[3]	[lbs/ft²]	113 (5400 Pa) / 84 (4000 Pa)		

[3] See Installation Manual

QUALIFICATIONS AND CERTIFICATES

UL 61730, CE-compliant,
Quality Controlled PV - TÜV Rheinland,
IEC 61215:2016, IEC 61730:2016,
U.S. Patent No. 9,893,215 (solar cells),
QCPV Certification ongoing.

C SP US Certified UL 61730

CE

TÜVRheinland CERTIFIED www.tuv.com ID 111120277

PACKAGING INFORMATION

Horizontal packaging	76.4 in 1940 mm	43.3 in 1100 mm	48.0 in 1220 mm	1656 lbs 751 kg	24 pallets	24 pallets	32 modules

Note: Installation instructions must be followed. See the installation and operating manual or contact our technical service department for further information on approved installation and use of this product.

Hanwha Q CELLS America Inc.
400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA | **TEL** +1 949 748 59 96 | **EMAIL** inquiry@us.q-cells.com | **WEB** www.q-cells.us

Single Phase Inverter with HD-Wave Technology

for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US /
SE7600H-US / SE10000H-US / SE11400H-US

INVERTERS

12-25 YEAR WARRANTY

Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)

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Single Phase Inverter with HD-Wave Technology for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US/
SE7600H-US / SE10000H-US / SE11400H-US

	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	SE10000H-US	SE11400H-US	
OUTPUT								
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA
Maximum AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	✓	Vac
AC Frequency (Nominal)	59.3 - 60 - 60.5[1]							Hz
Maximum Continuous Output Current @240V	12.5	16	21	25	32	42	47.5	A
Maximum Continuous Output Current @208V	-	16	-	24	-	-	48.5	A
GFDI Threshold	1							A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							
INPUT								
Maximum DC Power @240V	4650	5900	7750	9300	11800	15500	17650	W
Maximum DC Power @208V	-	5100	-	7750	-	-	15500	W
Transformer-less, Ungrounded	Yes							
Maximum Input Voltage	480							Vdc
Nominal DC Input Voltage	380				400			Vdc
Maximum Input Current @240V[2]	8.5	10.5	13.5	16.5	20	27	30.5	Adc
Maximum Input Current @208V[2]	-	9	-	13.5	-	-	27	Adc
Max. Input Short Circuit Current	45							Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	99	99.2						%
CEC Weighted Efficiency	99						99 @ 240V 98.5 @ 208V	%
Nighttime Power Consumption	< 2.5							W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)							
Revenue Grade Data, ANSI C12.20	Optional[3]							
Rapid Shutdown - NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect							
STANDARD COMPLIANCE								
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07							
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (HI)							
Emissions	FCC Part 15 Class B							
INSTALLATION SPECIFICATIONS								
AC Output Conduit Size / AWG Range	1" Maximum / 14-6 AWG					1" Maximum /14-4 AWG		
DC Input Conduit Size / # of Strings / AWG Range	1" Maximum / 1-2 strings / 14-6 AWG					1" Maximum / 1-3 strings / 14-6 AWG		
Dimensions with Safety Switch (HxWxD)	17.7 x 14.6 x 6.8 / 450 x 370 x 174					21.3 x 14.6 x 7.3 / 540 x 370 x 185		in / mm
Weight with Safety Switch	22 / 10		25.1 / 11.4	26.2 / 11.9		38.8 / 17.6		lb / kg
Noise	< 25				<50			dBA
Cooling	Natural Convection							
Operating Temperature Range	-13 to +140 / -25 to +60[4] (-40°F / -40°C option)[5]							°F / °C
Protection Rating	NEMA 4X (Inverter with Safety Switch)							

[1] For other regional settings please contact SolarEdge support
[2] A higher current source may be used; the inverter will limit its input current to the values stated
[3] Revenue grade inverter P/N: SExxxxH-US000NNC2
[4] For power de-rating information refer to: https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf
[5] -40 version P/N: SExxxxH-US000NNU4

RoHS

Power Optimizer

For North America

P320 / P340 / P370 / P400 / P401 / P405 / P485 / P505

POWER OPTIMIZER

PV power optimization at the module-level

- Specifically designed to work with SolarEdge inverters
- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module-level monitoring
- Meets NEC requirements for arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)
- Module-level voltage shutdown for installer and firefighter safety

solaredge.com

solaredge

Power Optimizer

For North America

P320 / P340 / P370 / P400 / P401 / P405 / P485 / P505

Optimizer model (typical module compatibility)	P320 (for 60-cell modules)	P340 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P401 (for high power 60 and 72 cell modules)	P405 (for high-voltage modules)	P485 (for high-voltage modules)	P505 (for higher current modules)	
INPUT									
Rated Input DC Power[1]	320	350	370	400	405		485	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		60	80	60	125[2]		83[2]	Vdc
MPPT Operating Range	8 - 48		8 - 60	8 - 80	8-60	12.5 - 105		12.5 - 83	Vdc
Maximum Short Circuit Current (Isc)	11	11.02	11	10.1	11.75	11		14	Adc
Maximum DC Input Current	13.75			12.5	14.65	12.5		17.5	Adc
Maximum Efficiency	99.5								%
Weighted Efficiency	98.8							98.6	%
Overvoltage Category	II								
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)									
Maximum Output Current	15								Adc
Maximum Output Voltage	60					85			Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)									
Safety Output Voltage per Power Optimizer	1 ± 0.1								Vdc
STANDARD COMPLIANCE									
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3								
Safety	IEC62109-1 (class II safety), UL1741								
Material	UL94 V-0, UV Resistant								
RoHS	Yes								
INSTALLATION SPECIFICATIONS									
Maximum Allowed System Voltage	1000								Vdc
Compatible inverters	All SolarEdge Single Phase and Three Phase inverters								
Dimensions (W x L x H)	129 x 153 x 27.5 / 5.1 x 6 x 1.1		129 x 153 x 33.5 / 5.1 x 6 x 1.3	129 x 153 x 29.5 / 5.1 x 6 x 1.16	129 x 159 x 49.5 / 5.1 x 6.3 x 1.9			129 x 162 x 59 / 5.1 x 6.4 x 2.3	mm / in
Weight (including cables)	630 / 1.4		750 / 1.7	655 / 1.5	845 / 1.9			1064 / 2.3	gr / lb
Input Connector	MC4[3]						Single or dual MC4[3][4]	MC4[3]	
Input Wire Length	0.16 / 0.52			0.16 or 0.9 /0.52 or 2.95[5]	0.16 / 0.52				m / ft
Output Wire Type / Connector	Double Insulated / MC4								
Output Wire Length	0.9 / 2.95	1.2 / 3.9							m / ft
Operating Temperature Range[6]	-40 to +85 / -40 to +185								°C / °F
Protection Rating	IP68 / NEMA6P								
Relative Humidity	0 - 100								%

(1) Rated power of the module at STC will not exceed the optimizer "Rated Input DC Power". Modules with up to +5% power tolerance are allowed
(2) NEC 2017 requires max input voltage be not more than 80V
(3) For other connector types please contact SolarEdge
(4) For dual version for parallel connection of two modules use P485-4NMDMRM. In the case of an odd number of PV modules in one string, installing one P485 dual version power optimizer connected to one PV module. When connecting a single module seal the unused input connectors with the supplied pair of seals
(5) Longer inputs wire length are available for use. For 0.9m input wire length order P401-xxxLxxx
(6) For ambient temperature above +85°C / +185°F power de-rating is applied. Refer to Power Optimizers Temperature De-Rating Technical Note for more details

PV System Design Using a SolarEdge Inverter[7][8]		Single Phase HD-Wave	Single phase	Three Phase for 208V grid	Three Phase for 277/480V grid	
Minimum String Length (Power Optimizers)	P320, P340, P370, P400, P401	8		10	18	
	P405, P485, P505	6		8	14	
Maximum String Length (Power Optimizers)		25		25	50[9]	
Maximum Power per String		5700 (6000 with SE7600-US - SE11400-US)	5250	6000[10]	12750[11]	W
Parallel Strings of Different Lengths or Orientations		Yes				

(7) For detailed string sizing information refer to: http://www.solaredge.com/sites/default/files/string_sizing_na.pdf
(8) It is not allowed to mix P405/P485/P505 with P320/P340/P370/P400/P401 in one string
(9) A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement
(10) For 208V grid: it is allowed to install up to 6,500W per string when the maximum power difference between each string is 1,000W
(11) For 277/480V grid: it is allowed to install up to 15,000W per string when the maximum power difference between each string is 2,000W

Intertek

RoHS

SnapNrack™
Solar Mounting Solutions

UR-40
UR-60

Ultra Rail

The Ultimate Value in Rooftop Solar

- Industry leading Wire Management Solutions
- Mounts available for all roof types
- Single Tool Installation
- All SnapNrack Module Clamps & Accessories are compatible with both raiil profiles

Start Installing Ultra Rail Today

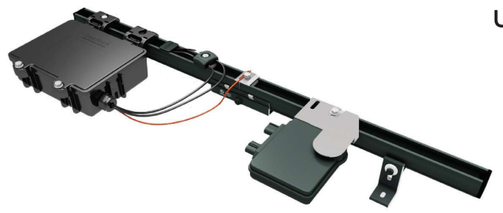
RESOURCES	snapnrack.com/resources
DESIGN	snapnrack.com/configurator
WHERE TO BUY	snapnrack.com/where-to-buy

SnapNrack Ultra Rail System

A sleek, straightforward rail solution for mounting solar modules on all roof types. Ultra Rail features two rail profiles; UR-40 is a lightweight rail profile that is suitable for most geographic regions and maintains all the great features of SnapNrack rail, while UR-60 is a heavier duty rail profile that provides a larger rail channel and increased span capabilities. Both are compatible with all existing mounts, module clamps, and accessories for ease of install.

The Entire System is a Snap to Install

- New Ultra Rail Mounts include snap-in brackets for attaching rail
- Compatible with all the SnapNrack Mid Clamps and End Clamps customers love
- Universal End Clamps and snap-in End Caps provide a clean look to the array edge



Unparalleled Wire Management

- Open rail channel provides room for running wires resulting in a long-lasting quality install
- Industry best wire management offering includes Junction Boxes, Universal Wire Clamps, MLPE Attachment Kits, and Conduit Clamps
- System is fully bonded and listed to UL 2703 Standard

Heavy Duty UR-60 Rail

- UR-60 rail profile provides increased span capabilities for high wind speeds and snow loads
- Taller, stronger rail profile includes profile-specific rail splice and end cap
- All existing mounts, module clamps, and accessories are retained for the same great install experience

Quality. Innovative. Superior.

SnapNrack Solar Mounting Solutions are engineered to optimize material use and labor resources and improve overall installation quality and safety.

877-732-2860 **www.snapnrack.com** **contact@snapnrack.com**

FLASHKIT PRO

UNIRAC®
FEATURING SHED & SEAL TECHNOLOGY

FLASHKIT PRO is the complete attachment solution for composition shingle roofs. Featuring Unirac's patented **SHED & SEAL** technology, a weather proof system which provides the ultimate protection against roof leaks. Kitted in 10 packs for maximum convenience, flashings and hardware are available in Mill or Dark finishes. With **FLASH**KIT pro, you have everything you need for a quick, professional installation.

TRUSTED WATER SEAL FLASHINGS
FEATURING SHED & SEAL TECHNOLOGY

YOUR COMPLETE SOLUTION
Flashings, lags, continuous slot L-Feet and hardware

CONVENIENT 10 PACKS
Packaged for speed and ease of handling

THE COMPLETE ROOF ATTACHMENT SOLUTION

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

FLASHKIT PRO

INSTALLATION GUIDE

UNIRAC®
FEATURING SHED & SEAL TECHNOLOGY

FLASHKIT PRO IS THE COMPLETE FLASHING AND ATTACHMENT SOLUTION FOR COMPOSITION ROOFS.

INSTALL **FLASH**KIT PRO FLASHING

INSTALL L-FOOT

ATTACH L-FOOT TO RAIL

PRE-INSTALL

- Locate roof rafters and snap chalk lines to mark the installation point for each roof attachment.
- Drill a 7/32" pilot hole at each roof attachment. Fill each pilot hole with sealant.

STEP 1 INSTALL **FLASH**KIT PRO FLASHING

- Add a U-shaped bead of roof sealant to the underside of the flashing with the open side of the U pointing down the roof slope. Slide the aluminum flashing underneath the row of shingles directly up slope from the pilot hole as shown. Align the indicator marks on the lower end of the flashing with the chalk lines on the roof to center the raised hole in the flashing over the pilot hole in the roof. When installed correctly, the flashing will extend under the two courses of shingles above the pilot hole.

STEP 2 INSTALL L-FOOT

- Fasten L-foot and Flashing into place by passing the included lag bolt and pre-installed stainless steel-backed EPDM washer through the L-foot EPDM grommet, and the raised hole in the flashing, into the pilot hole in the roof rafter.
- Drive the lag bolt down until the L-foot is held firmly in place. It is normal for the EPDM on the underside of the stainless steel backed EPDM washer to compress and expand beyond the outside edge of the steel washer when the proper torque is applied.

TIP:

- Use caution to avoid over-torqueing the lag bolt if using an impact driver.
- Repeat Steps 1 and 2 at each roof attachment point.

STEP 3 ATTACH L-FOOT TO RAIL

- Insert the included 3/8"-16 T-bolts into the lower slot on the Rail (sold separately), spacing the bolts to match the spacing between the roof attachments.
- Position the Rail against the L-Foot and insert the threaded end of the T-Bolt through the continuous slot in the L-Foot. Apply anti-seize to bolt threads to prevent galling of the T-bolt and included 3/8" serrated flange nut. Place the 3/8" flange nut on the T-bolt and finger tighten. Repeat STEP 3 until all L-Feet are secured to the Rail with a T-bolt. Adjust the level and height of the Rail and torque each bolt to 30ft-lbs.

FASTER INSTALLATION. 25-YEAR WARRANTY.

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