RB ENGINEERING
LEADING THE WAY
Structural Engineering Firm
NC License No. C-2499

168 Quade Drive
Cary, North Carolina 27513
www.rbengineering.com

Phone: 919-677-9662 / Cell: 919-280-2695 / Fax: 919-677-9663
E-mail: rbittler@rbengineering.com

Mr. Wyatt Bailey
Yes! Solar Solutions of the Triangle
E-mail: wbailey@yessolarsolutions.com

July 25, 2024

Subject: Roof mounted solar panels – Lloyd Residence
554 Lambert Lane
Fuquay-Varina, North Carolina 27526

File No.: RB-249880

Dear Wyatt:

RB Engineering, Inc. is pleased to provide the following summary engineering letter concerning the subject project. The existing roof system is constructed with 2x8 timber rafters at 16 inches on center and a composition asphalt shingle roof. We have reviewed the proposed solar layout and have structurally evaluated the additional proposed roof loading with the following conclusions:

- The total surface area of the new proposed solar array (26 PV modules) is approximately 550 SF. The solar panel installation has been evaluated for an ultimate design wind speed of 115 mph.

- The subject roof mounted PV system attachment method is structurally adequate to transfer the design uplift loads in accordance with the 2018 North Carolina residential building code.

- The existing roof system is structurally adequate to transfer the applicable design loads - including the additional or modified design loading (dead, wind and snow loads) due to the proposed solar panel installation - in accordance with the 2018 North Carolina residential building code.

Our services were provided in accordance with the standard of practice for structural engineering and within the limits imposed by scope, schedule, and budget. If you have any questions or if I can be of further assistance to you on this project, please contact me at (919) 677-9662.

Respectfully submitted,

Ron Bittler, PE
President / Structural Engineer
RB Engineering, Inc.

NEW PHOTOVOLTAIC SYSTEM 11.050kW DC / 11.500kW AC
NEW ENERGY STORAGE SYSTEM 13.500kWh
554 LAMBERT LANE, FUQUAY-VARINA, NC 27526

AHJ

NC-TOWN OF FUQUAY-VARINA

UTILITY

DUKE ENERGY PROGRESS

CODES AND STANDARDS

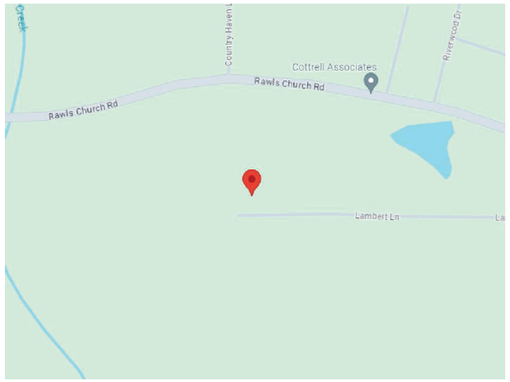
ELECTRIC CODE: NEC 2017 WITH NC AMENDMENTS
FIRE CODE: NCFC 2018
BUILDING CODE: NCBC 2018
RESIDENTIAL CODE: NCRC 2018
WIND SPEED: 116 MPH
SNOW LOAD: 15 PSF

HIGH TEMP: 36°C, LOW TEMP: -8.5°C

SCOPE OF WORK

(N) 11.050kW DC / 11.500kW AC ROOF MOUNT PV SYSTEM
(N) 13.500kWh ENERGY STORAGE SYSTEM
(26) HANWHA QCELLS Q.TRON BLK M-G2+ 425 MODULE
(1) TESLA POWERWALL 3 INTEGRATED SOLAR BATTERY
1707000-xx-y (240V) INVERTER
(10) TESLA SOLAR SHUTDOWN DEVICE (MCI-1)
(1) TESLA BACKUP GATEWAY 2 (1232100-xx-y)

VICINITY MAP



SHEET CATALOG

PV-1	COVER SHEET
PV-1.1	GENERAL NOTES
PV-2	SITE PLAN
PV-3	MOUNTING DETAILS-1
PV-3.1	MOUNTING DETAILS-2
PV-3.2	STRUCTURAL DETAILS
PV-4	SINGLE LINE DIAGRAM
PV-4.1	ELECTRICAL CALCULATIONS
PV-5	PLACARDS
SS	SPEC SHEETS

Ron Bittler, PE

Digitally signed by Ron Bittler, PE
DN: cn=Ron Bittler, PE, o, ou, email=rbittler@rbengineering.com, c=US
Date: 2024.07.25 13:33:10 -04'00'

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
08/05/2024
Harnett COUNTY NORTH CAROLINA

METER NUMBER: 339 604 106

CONTRACTOR INFORMATION

YES SOLAR SOLUTIONS

ADDRESS: 202 NORTH DIXON AVENUE, CARY, NC 27513

PHONE NUMBER: (919) 459-4155

LICENSE NUMBER: NC GC #67356 ; NC ELECTRIC #U.32326

LICENSE TYPE: NC GC/ELECTRIC

CUSTOMER INFORMATION

NAME: LLOYD RESIDENCE

ADDRESS: 554 LAMBERT LANE, FUQUAY-VARINA, NC 27526

COORDINATES: 35.532743, -78.790855

APN: 080664011125

11.050kW DC / 11.500kW AC ROOF MOUNT PV SYSTEM
13.500kWh ENERGY STORAGE SYSTEM

NORTH CAROLINA PROFESSIONAL SEAL 025611 ENGINEER RONALD P. BITTLER

STRUCTURAL
07.25.2024

STRUCTURAL REVIEW PROVIDED BY:
RONALD P. BITTLER, PE
RB ENGINEERING, INC. (C-2499)
168 QUADE DRIVE
CARY, NC 27513
919-677-9662
PROJECT #RB-249880

PROJECT ID	AUR-1001058
DATE	7/19/2024
CREATED BY	VK
SIGNATURE	

COVER SHEET
PV-1

NOTES:

1. MODULES ARE LISTED UNDER UL 1703 / UL 61730 AND CONFORM TO THE STANDARDS.
2. INVERTERS ARE LISTED UNDER UL 1741 AND CONFORM TO THE STANDARDS.
3. DRAWINGS ARE DIAGRAMMATIC, INDICATING GENERAL ARRANGEMENT OF THE PV SYSTEM. ACTUAL SITE CONDITIONS MAY VARY.
4. WORKING CLEARANCES AROUND THE NEW PV ELECTRICAL EQUIPMENT SHALL BE MAINTAINED IN ACCORDANCE WITH NEC 110.26.
5. ALL GROUND WIRING CONNECTED TO THE MAIN SERVICE GROUNDING IN MAIN SERVICE PANEL / SERVICE EQUIPMENT.
6. ALL CONDUCTORS SHALL BE 600V, 90°C STANDARD COPPER UNLESS OTHERWISE NOTED.
7. WHEN REQUIRED, A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
8. THE SYSTEM WILL NOT BE INTERCONNECTED BY THE CONTRACTOR UNTIL APPROVAL FROM UTILITY IS RECEIVED.
9. ROOF ACCESS POINT SHALL BE LOCATED IN AREAS THAT DO NOT REQUIRE THE PLACEMENT OF GROUND LADDERS OVER OPENINGS SUCH AS WINDOWS OR DOORS, AND LOCATED AT STRONG POINTS OF BUILDING CONSTRUCTION WHERE THE ACCESS POINT DOES NOT CONFLICT WITH OVERHEAD OBSTRUCTIONS SUCH AS TREES, WIRES OR SIGNS.
10. PV ARRAY COMBINER / JUNCTION BOX PROVIDES TRANSITION FROM ARRAY WIRING TO CONDUIT WIRING.
11. RACKING SYSTEM SHALL BE LISTED TO UL 2703.
12. FIRE RATING OF EXISTING ROOF ASSEMBLY SHALL BE MAINTAINED WITH ADDITION OF PHOTOVOLTAIC SYSTEM.

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GENERAL NOTES

PV-1.1

SCOPE OF WORK

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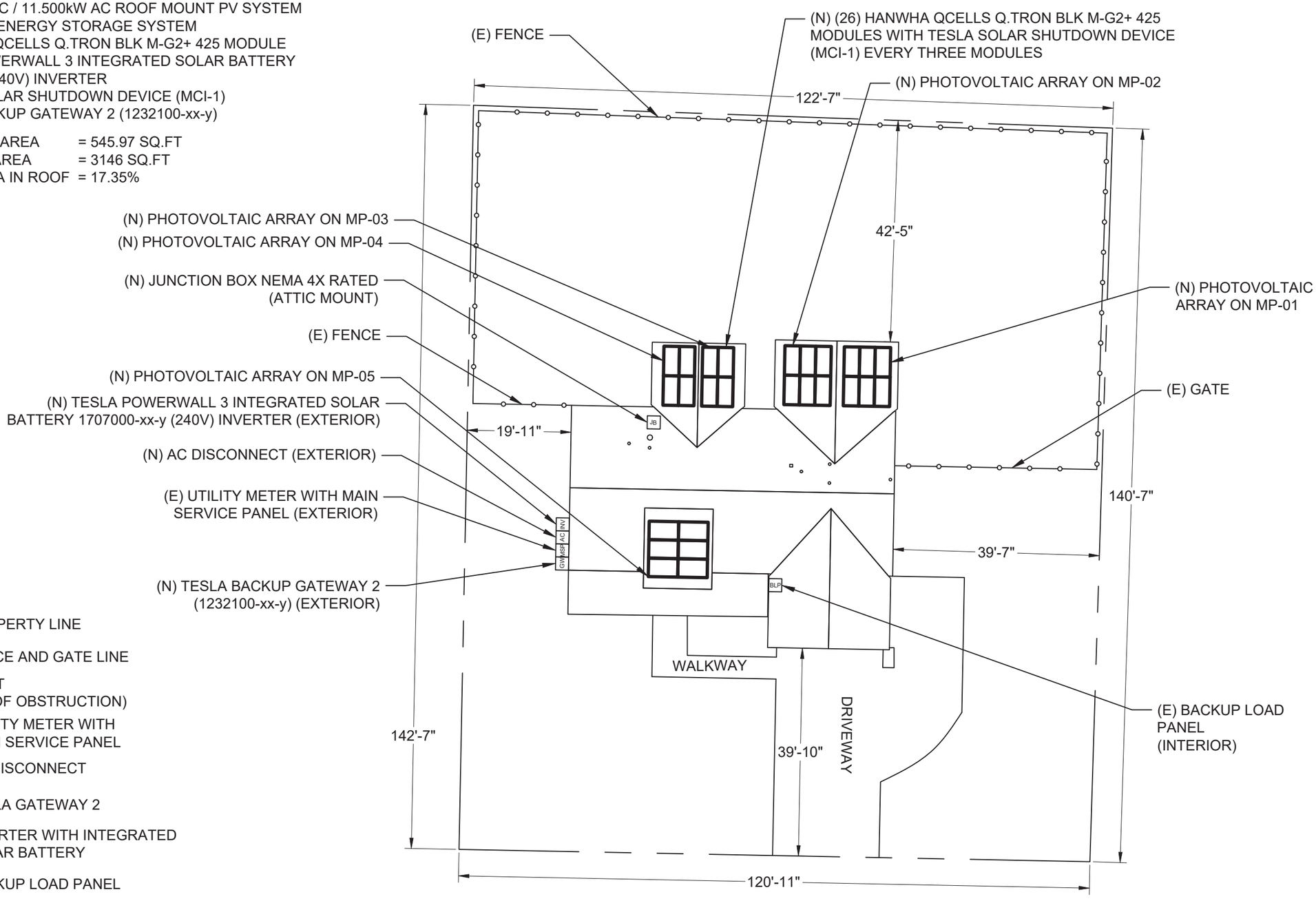
(N) 13.500kWh ENERGY STORAGE SYSTEM
(26) HANWHA QCELLS Q.TRON BLK M-G2+ 425 MODULE
(1) TESLA POWERWALL 3 INTEGRATED SOLAR BATTERY 1707000-xx-y (240V) INVERTER
(10) TESLA SOLAR SHUTDOWN DEVICE (MCI-1)
(1) TESLA BACKUP GATEWAY 2 (1232100-xx-y)

TOTAL ARRAY AREA = 545.97 SQ.FT
TOTAL ROOF AREA = 3146 SQ.FT
% ARRAY AREA IN ROOF = 17.35%



LEGEND

- PROPERTY LINE
- FENCE AND GATE LINE
- VENT (ROOF OBSTRUCTION)
- MSP — UTILITY METER WITH MAIN SERVICE PANEL
- AC — AC DISCONNECT
- GW — TESLA GATEWAY 2
- INV — INVERTER WITH INTEGRATED SOLAR BATTERY
- BLP — BACKUP LOAD PANEL
- JB — JUNCTION BOX

N

SCALE: 1" = 20'-0"

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13.500kWh ENERGY STORAGE SYSTEM

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SIGNATURE	

SITE PLAN
PV-2

WIND SPEED: 116 MPH AND SNOW LOAD: 15 PSF													
S.NO	AZIMUTH	PITCH	NO. OF MODULES	ARRAY AREA (SQ.FT)	ROOF TYPE	ATTACHMENT	ATTACHMENT QUANTITY	ROOF EXPOSURE	FRAME TYPE	FRAME SIZE	FRAME SPACING	MAX ATTACHMENT SPACING	MAX OVER HANG
MP-01	91°	37°	6	125.99	COMPOSITION SHINGLE	SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051)	24	ATTIC	RAFTERS	2" X 8"	16" O.C.	4'-0"	1'-6"
MP-02	271°	37°	6	125.99	COMPOSITION SHINGLE	SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051)	24	ATTIC	RAFTERS	2" X 8"	16" O.C.	4'-0"	1'-6"
MP-03	91°	37°	4	83.99	COMPOSITION SHINGLE	SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051)	16	ATTIC	RAFTERS	2" X 8"	16" O.C.	4'-0"	1'-6"
MP-04	271°	37°	4	83.99	COMPOSITION SHINGLE	SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051)	16	ATTIC	RAFTERS	2" X 8"	16" O.C.	4'-0"	1'-6"
MP-05	181°	18°	6	125.99	COMPOSITION SHINGLE	SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051)	24	ATTIC	RAFTERS	2" X 8"	16" O.C.	4'-0"	1'-6"

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13.500kWh ENERGY STORAGE SYSTEM

NORTH CAROLINA PROFESSIONAL SEAL 025611 ENGINEER RONALD P. BITTLER

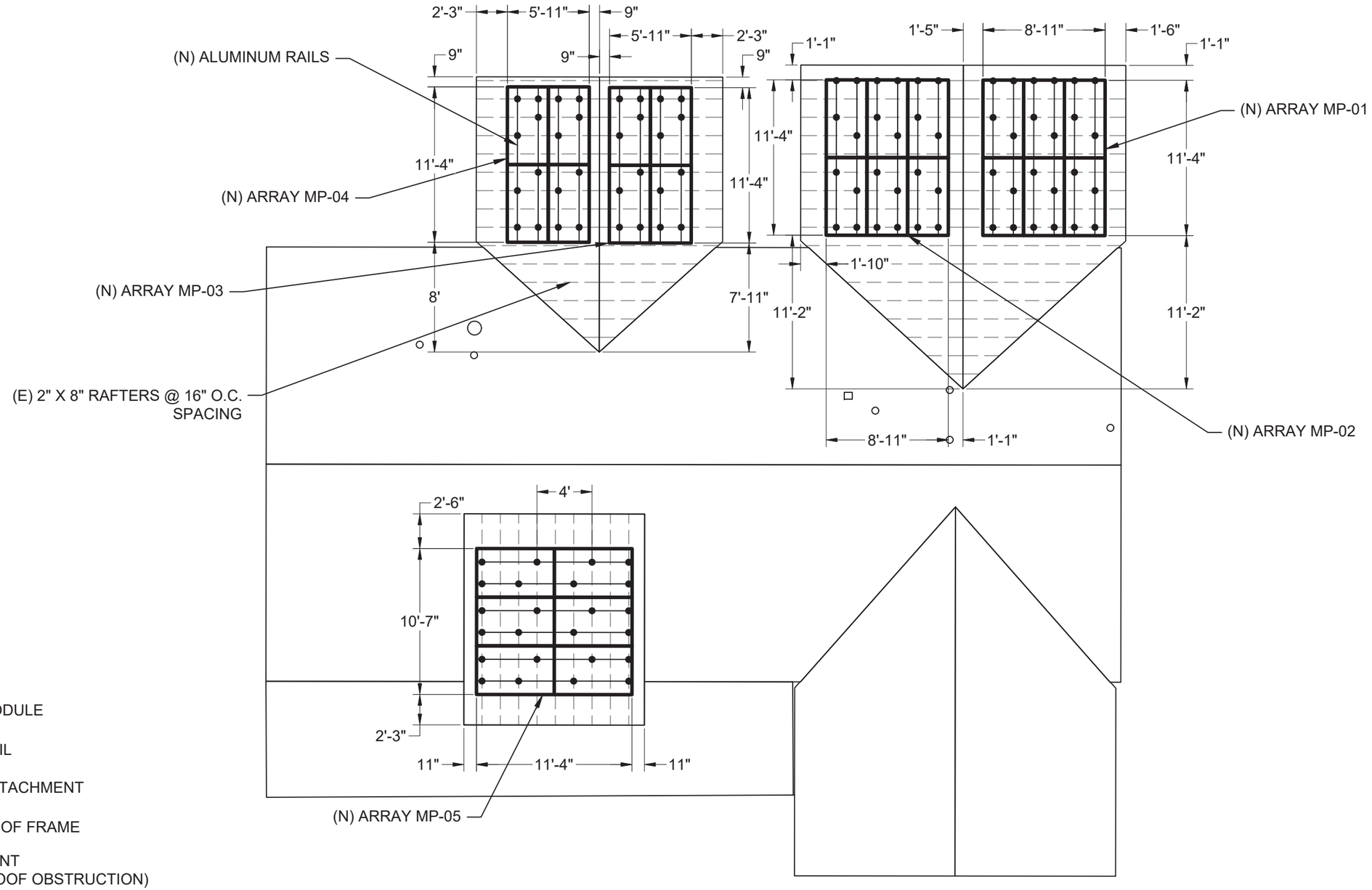
07.25.2024

PROJECT ID	AUR-1001058
DATE	7/19/2024
CREATED BY	VK
SIGNATURE	

MOUNTING DETAILS-1

PV-3

NOTE: PENETRATIONS ARE STAGGERED.



LEGEND

- MODULE
- RAIL
- ATTACHMENT
- ROOF FRAME
- VENT (ROOF OBSTRUCTION)

N

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

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MOUNTING DETAILS-2

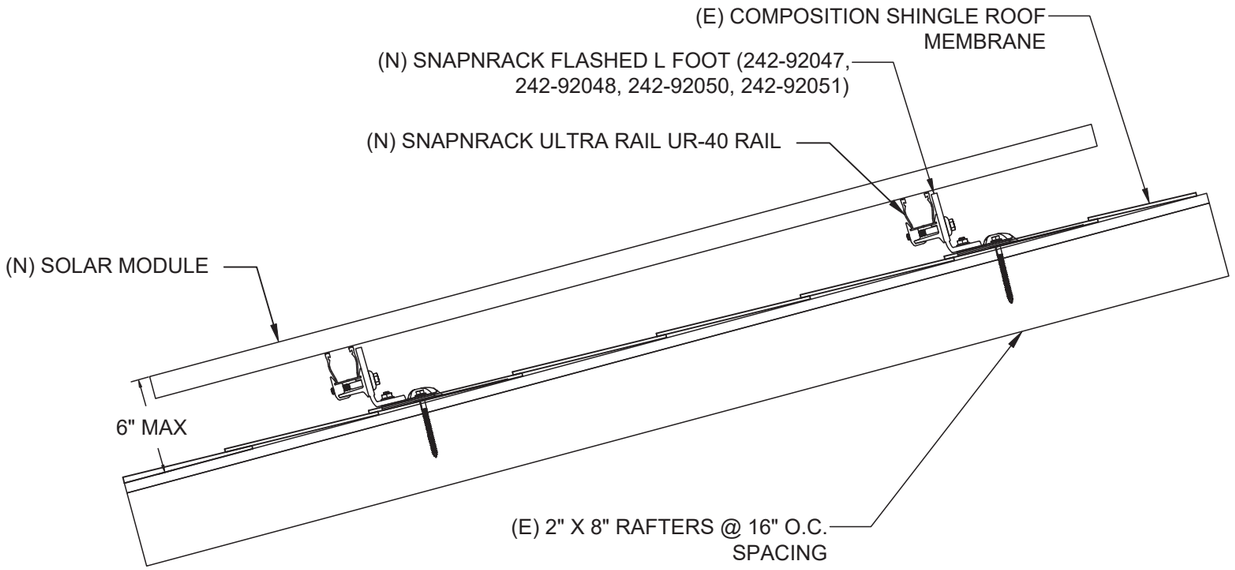
PV-3.1

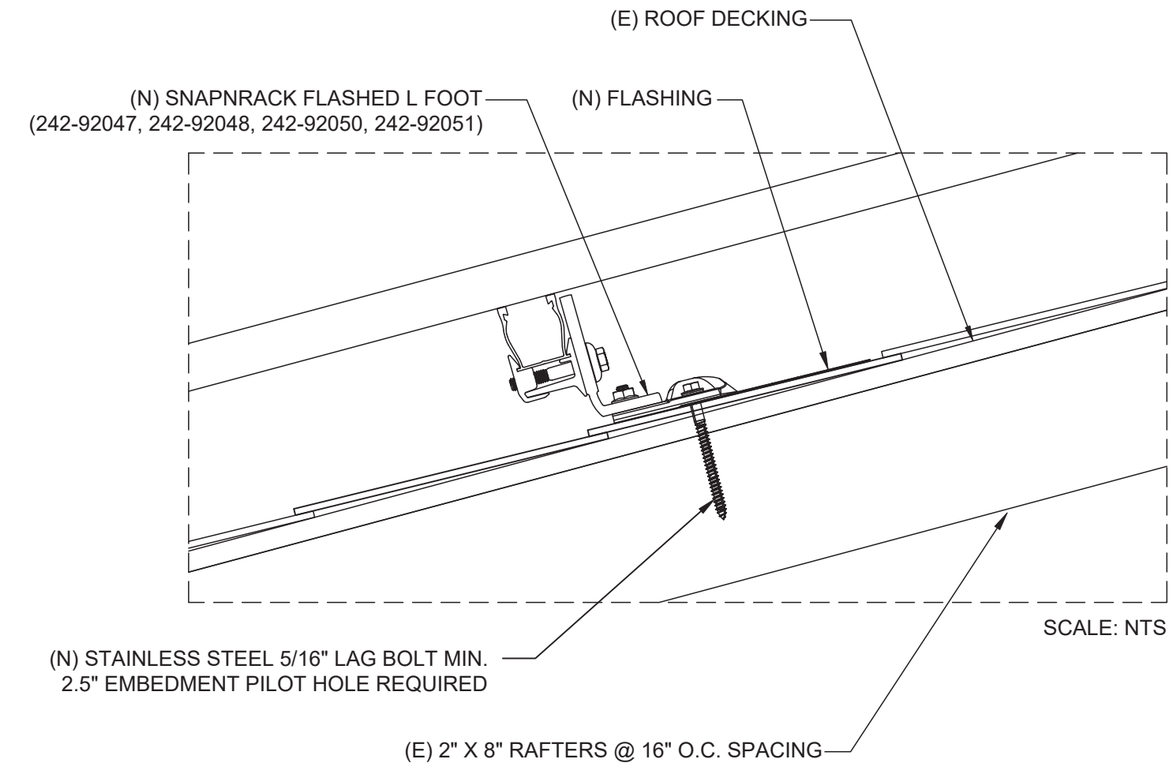
STRUCTURAL NOTES

1. ALL SOLAR PANEL COMPONENTS SHALL BE INSTALLED PER THE MANUFACTURER'S APPROVED INSTALLATION SPECIFICATIONS.
2. THE EXISTING BUILDING'S STRUCTURE SHALL BE VERIFIED AS PROPERLY CONSTRUCTED AND MAINTAINED IN GOOD CONDITION. NO ALLOWANCE HAS BEEN MADE FOR ANY EXISTING DEFICIENCY IN DESIGN, MATERIAL, CONSTRUCTION, OR LACK OF MAINTENANCE FOR THE EXISTING STRUCTURE OR PROPOSED EQUIPMENT. CONTRACTOR SHALL FIELD VERIFY EXISTING CONDITIONS, PROPER FIT, AND CLEARANCES IN THE FIELD.
3. IF ANY CONDITION THROUGHOUT THE ASSOCIATED REPORT OR PERMIT DRAWINGS IS NOT REPRESENTED ON-SITE, CONTRACTOR SHALL NOTIFY THE ENGINEER OF RECORD (EOR) OF ANY DISCREPANCIES AND RECEIVE WRITTEN APPROVAL FROM THE EOR BEFORE PROCEEDING WITH INSTALLATION.
4. MISCELLANEOUS ITEMS NOT EXPLICITLY NAMED & SHOWN IN THESE DRAWINGS HAVE NOT BEEN DESIGNED. IT IS RECOMMENDED THAT MATERIAL OF SUITABLE SIZE & STRENGTH BE OBTAINED FROM A REPUTABLE MANUFACTURER FOR MISCELLANEOUS ITEMS.
5. CONTRACTOR SHALL BE RESPONSIBLE TO COMPLETE, SEAL, & WATERPROOF ROOFTOP PENETRATIONS FOR SOLAR RACKING.
6. CONTRACTOR TO PROVIDE MINIMUM 1/4" GAP BETWEEN ALL SOLAR PANELS.
7. PROJECT WINDSPEED IS BASIC WIND SPEED PER CODE UNLESS NOTED OTHERWISE.

DEAD LOAD CALCULATIONS

BOM	QUANTITY	LBS/UNIT	TOTAL WEIGHT (LBS)
MODULES	26	46.7	1214.2
MID-CLAMP	26	0.17	4.42
END-CLAMP	52	0.3	15.6
RAIL LENGTH	302	0.42	126.84
SPLICE BAR	0	0.52	0
SNAPNRACK FLASHED L FOOT (242-92047, 242-92048, 242-92050, 242-92051) (242-92047, 242-92048, 242-92050, 242-92051)	104	1.3	135.2
MCI DEVICE	10	0.77	7.7
TOTAL WEIGHT OF THE SYSTEM (LBS)			1503.96
TOTAL ARRAY AREA ON THE ROOF (SQ. FT.)			545.97
WEIGHT PER SQ. FT.(LBS)			2.75
WEIGHT PER PENETRATION (LBS)			14.46





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13.500kWh ENERGY STORAGE SYSTEM

NORTH CAROLINA PROFESSIONAL SEAL 025611 ENGINEER RONALD P. BITTLER

07.25.2024

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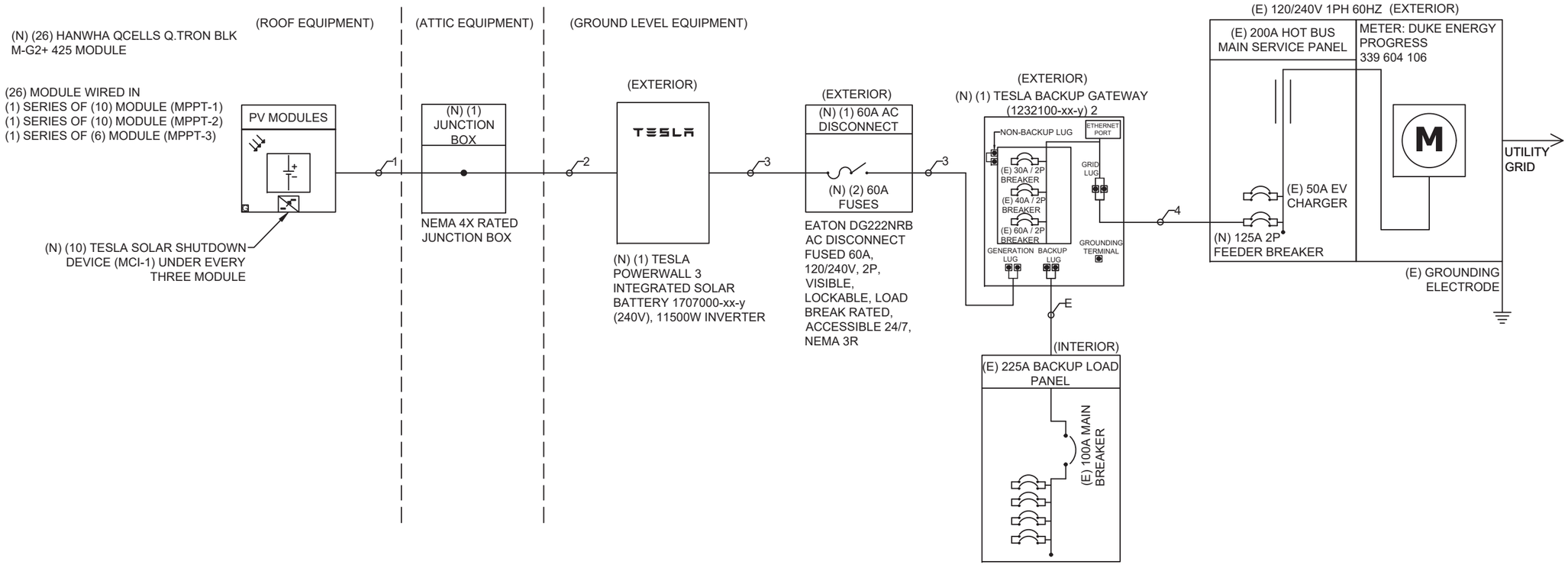
STRUCTURAL DETAILS

PV-3.2

MODULE SPECIFICATIONS	
MODEL	HANWHA QCELLS Q.TRON BLK M-G2+ 425
MODULE POWER @ STC	425W
OPEN CIRCUIT VOLTAGE:Voc	39.03V
MAX POWER VOLTAGE:Vmp	32.74V
SHORT CIRCUIT CURRENT:Isc	13.66A
MAX POWER CURRENT:Imp	12.98A
TEMPERATURE COEFFICIENT:Voc	-0.24%/K
MODULE DIMENSIONS: L x W x H	67.8" x 44.6" x 1.18"
NUMBER OF MODULES	26

INVERTER-1 SPECIFICATIONS	
MODEL	TESLA POWERWALL 3 INTEGRATED SOLAR BATTERY 1707000-xx-y (240V)
POWER RATING	11500W
MAX OUTPUT CURRENT	48A
CEC WEIGHTED EFFICIENCY	97.5%
MAX INPUT CURRENT	15A
MAX DC VOLTAGE	600V
NUMBER OF INVERTER	1

RSD CHARACTERISTICS	
MODEL	TESLA SOLAR SHUTDOWN DEVICE (MCI-1)
NOMINAL INPUT DC CURRENT	12A
MAX SYSTEM VOLTAGE	600VDC
MAX INPUT SHORT CIRCUIT CURRENT	19A
NUMBER OF RSD	10



CONDUCTOR SCHEDULE				
TAG ID	**CONDUIT SIZE**	**CONDUCTOR**	**NEUTRAL**	**GROUND**
1	NONE	(6) 10 AWG THHN/THWN-2	NONE	(1) 10 AWG THHN/THWN-2, EGC
2	3/4" EMT	(6) 10 AWG THHN/THWN-2, Cu	NONE	(1) 10 AWG THHN/THWN-2, EGC
3	1" EMT	(2) 4 AWG THHN/THWN-2, Cu	(1) 4 AWG THHN/THWN-2, Cu	(1) 10 AWG THHN/THWN-2, EGC
4	1-1/4" EMT	(2) 1/0 AWG THHN/THWN-2, Cu	(1) 1/0 AWG THHN/THWN-2, Cu	(1) 6 AWG THHN/THWN-2, EGC
E	EXISTING			

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13.500kWh ENERGY STORAGE SYSTEM

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SINGLE LINE DIAGRAM

PV-4

SYSTEM CHARACTERISTICS

DC SYSTEM SIZE	11050W
MAX OPEN CIRCUIT VOLTAGE	421.68V
OPERATING VOLTAGE	327.4V
MAX SHORT CIRCUIT CURRENT	51.22A
OPERATING CURRENT	38.94A

ELECTRICAL NOTES

1. CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC 310.10(D).
2. CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC 310.10(C).
3. MAXIMUM DC/AC VOLTAGE DROP SHALL BE NO MORE THAN 2%.
4. ALL CONDUCTORS SHALL BE IN CONDUIT UNLESS OTHERWISE NOTED.
5. BREAKER/FUSE SIZES PER NEC 240.
6. AC EQUIPMENT GROUNDING CONDUCTOR SIZED PER NEC 250.122.
7. AMBIENT TEMPERATURE CORRECTION FACTOR IS BASED ON NEC 310.15(B)(2)(a).
8. MAX. SYSTEM VOLTAGE COEFFICIENT IS FROM MODULE MANUFACTURER OR NEC 690.7 WHEN MANUFACTURER COEFFICIENT UNAVAILABLE.
9. CONDUCTORS ARE SIZED PER NEC TABLE 310.15(B)(16).
10. CONDUIT SHALL BE INSTALLED MINIMUM 7/8" FROM ROOF SURFACE.

DC WIRE SIZING CALCULATIONS BASED ON FOLLOWING EQUATIONS

REQUIRED CONDUCTOR AMPACITY:

Isc(A) * # OF PARALLEL STRINGS = MAX CURRENT PER 690.8(A)(1) * 125%
= MAX CURRENT PER 690.8(B)(1)

CORRECTED AMPACITY CALCULATIONS:

DERATED CONDUCTOR AMPACITY PER 690.8(B)(2) = AMPACITY * TEMPERATURE DERATE FACTOR * CONDUIT FILL DERATE

DERATED CONDUCTOR AMPACITY CHECK : MAX CURRENT PER 690.8(B)(1) < DERATED CONDUCTOR AMPACITY

AC WIRE SIZING CALCULATIONS BASED ON FOLLOWING EQUATIONS

REQUIRED CONDUCTOR AMPACITY:

INVERTER OUTPUT CURRENT * # OF INVERTERS = MAX CURRENT PER 690.8(A)(3) * 125%
= MAX CURRENT PER 690.8(B)(1)

CORRECTED AMPACITY CALCULATIONS:

DERATED CONDUCTOR AMPACITY PER 690.8(B)(2) = AMPACITY * TEMPERATURE DERATE FACTOR * CONDUIT FILL DERATE

DERATED CONDUCTOR AMPACITY CHECK : MAX CURRENT PER 690.8(B)(1) < DERATED CONDUCTOR AMPACITY

OCPD CALCULATION

MAIN PANEL RATING = 200A

INVERTER OVERCURRENT PROTECTION:

INVERTER OVERCURRENT PROTECTION = INVERTER O/P CURRENT * CONTINUOUS LOAD (1.25)
= 48 * 1.25
= 60A

PV OVERCURRENT PROTECTION = 60A

WIRE SIZE CALCULATIONS

AMBIENT TEMPERATURE @ 36°C

TAG 1: (DC)

REQUIRED CONDUCTOR AMPACITY (13.66 * 1.25 * 1.25) = 21.34A
CORRECTED AMPACITY CALCULATION (0.91 * 1 * 40) = 36.4A
21.34A < 36.4A (#10 AWG THHN/THWN-2)

TAG 2: (DC)

REQUIRED CONDUCTOR AMPACITY (13.66 * 1.25 * 1.25) = 21.34A
CORRECTED AMPACITY CALCULATION (0.91 * 0.8 * 40) = 29.12A
21.34A < 29.12A (3/4" EMT, #10 AWG THHN/THWN-2, Cu)

TAG 3: (AC)

REQUIRED CONDUCTOR AMPACITY (48 * 1 * 1.25) = 60A
CORRECTED AMPACITY CALCULATION (0.88 * 1 * 85) = 74.8A
60A < 74.8A (1" EMT, #4 AWG THHN/THWN-2, Cu)

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ELECTRICAL CALCULATIONS

PV-4.1

WARNING

ELECTRIC SHOCK HAZARD

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

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

LABEL LOCATION
AC DISCONNECT, POINT OF INTERCONNECTION
PER CODE: NEC 690.13

WARNING:PHOTOVOLTAIC POWER SOURCE

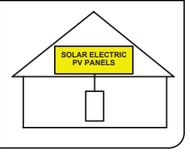
LABEL LOCATION
CONDUIT, INVERTER DC DISCONNECT
PER CODE: NEC 690.31(G)(3)

PHOTOVOLTAIC AC DISCONNECT

LABEL LOCATION
AC DISCONNECT, POINT OF INTERCONNECTION
PER CODE: NEC 690.13(B)

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
AC DISCONNECT, INVERTER DC DISCONNECT, POINT OF INTERCONNECTION
PER CODE: NEC 690.56(C)(1)(a)

RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

LABEL LOCATION
INVERTER DC DISCONNECT
PER CODE: NEC 690.56(C)(3)

PHOTOVOLTAIC SYSTEM AC DISCONNECT SWITCH

RATED AC OPERATING CURRENT **48.00** AMPS AC
AC NOMINAL OPERATING VOLTAGE **240** VAC

LABEL LOCATION
AC DISCONNECT, POINT OF INTERCONNECTION
PER CODE: NEC 690.54

WARNING

TRI POWER SOURCE SECOND SOURCE IS PHOTOVOLTAIC SYSTEM THIRD SOURCE IS BATTERY BACKUP SYSTEM.

LABEL LOCATION
POINT OF INTERCONNECTION
PER CODE: NEC 705.12(B)(3)

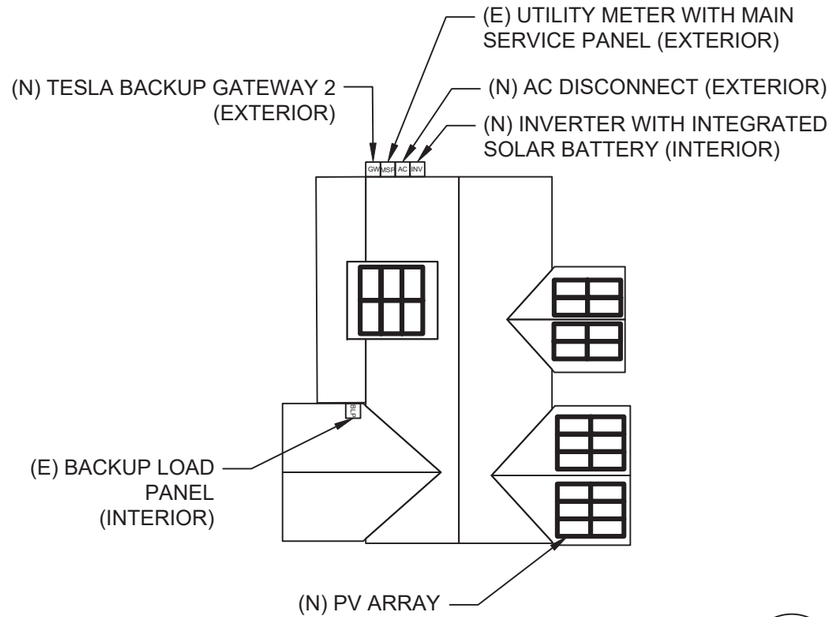
INVERTER-1

RATED MAXIMUM POWER-POINT CURRENT(Imp)	38.94	A
RATED MAXIMUM POWER-POINT VOLTAGE (Vmp)	327.4	V
MAXIMUM SYSTEM VOLTAGE (Voc)	421.68	V
MAXIMUM CIRCUIT CURRENT (Isc)	51.22	A

LABEL LOCATION
INVERTER DC DISCONNECT
PER CODE: NEC 690.53

CAUTION:MULTIPLE SOURCES OF POWER

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



554 LAMBERT LANE, FUQUAY-VARINA, NC 27526

LABEL LOCATION
SERVICE PANEL
PER CODE: NEC 705.10

NOTES

1.PLACARDS SHALL MEET THE REQUIREMENTS OF ARTICLES 690 AND 705, UNLESS OTHERWISE SPECIFIED PER LOCAL AHJ REQUIREMENTS.
2.PLACARDS SHALL MEET THE REQUIREMENTS OF SECTION 110.21(B) AS REQUIRED AND SHALL COMPLY WITH ANSI Z535.4-2011, PRODUCT SAFETY SIGNS AND LABELS.
3.PLACARDS SHALL BE PERMANENTLY AFFIXED TO THE EQUIPMENT OR WIRING METHOD.
4.PLACARDS SHALL BE SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AND SHALL NOT BE HANDWRITTEN.
5.PLACARDS SHALL NOT COVER EXISTING MANUFACTURER LABELS.
6.WARNING SIGNAGE TEXT SHALL BE MINIMUM 3/8" TALL.

CONTRACTOR INFORMATION

YES SOLAR SOLUTIONS

YES SOLAR SOLUTIONS

ADDRESS: 202 NORTH DIXON AVENUE, CARY, NC 27513

PHONE NUMBER: (919) 459-4155

LICENSE NUMBER: NC GC #67356 ; NC ELECTRIC #U.32326

LICENSE TYPE: NC GC/ELECTRIC

CUSTOMER INFORMATION

NAME: LLOYD RESIDENCE

ADDRESS: 554 LAMBERT LANE, FUQUAY-VARINA, NC 27526

COORDINATES: 35.532743, -78.790855

APN: 080664011125

11.050kW DC / 11.500kW AC ROOF MOUNT PV SYSTEM
13.500kWh ENERGY STORAGE SYSTEM

PROJECT ID	AUR-1001058
DATE	7/19/2024
CREATED BY	VK
SIGNATURE	

PLACARDS

PV-5

Q.TRON BLK M-G2+ SERIES

405 - 430 Wp | 108 Cells
22.0 % Maximum Module Efficiency

MODEL Q.TRON BLK M-G2+

High performance Qcells N-type solar cells

Q.ANTUM NEO Technology with optimized module layout boosts module efficiency up to 22.0 %.

A reliable investment

Inclusive 25-year product warranty and 25-year linear performance warranty[1].

Enduring high performance

Long-term yield security with Anti LeTID Technology, Anti PID Technology[2], Hot-Spot Protect.

Extreme weather rating

High-tech aluminium alloy frame, certified for high snow (8100 Pa) and wind loads (3600 Pa).

Innovative all-weather technology

Optimal yields, whatever the weather with excellent low-light and temperature behaviour.

The most thorough testing programme in the industry

Qcells 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.

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

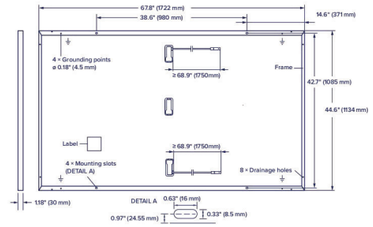
The ideal solution for:

Rooftop arrays on residential buildings

Q.TRON BLK M-G2+ SERIES

Mechanical Specification

Format	67.8 in × 44.6 in × 1.18 in (including frame) (1722 mm × 1134 mm × 30 mm)
Weight	46.7 lbs (21.2 kg)
Front Cover	0.13 in (3.2 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	Composite film
Frame	Black anodised aluminium
Cell	6 × 18 monocrystalline Q.ANTUM NEO 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), Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 68.9 in (1750mm), (−) ≥ 68.9 in (1750mm)
Connector	Stäubli MC4; IP68

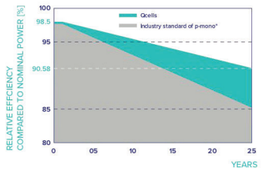


Electrical Characteristics

POWER CLASS			405	410	415	420	425	430
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC[1] (POWER TOLERANCE +5 W / −0 W)								
Minimum	Power at MPP[1]	P_{MPP} [W]	405	410	415	420	425	430
Minimum	Short Circuit Current[1]	I_{SC} [A]	13.33	13.41	13.49	13.58	13.66	13.74
Minimum	Open Circuit Voltage[1]	V_{OC} [V]	37.91	38.19	38.47	38.75	39.03	39.32
Minimum	Current at MPP	I_{MPP} [A]	12.69	12.76	12.83	12.91	12.98	13.05
Minimum	Voltage at MPP	V_{MPP} [V]	31.93	32.13	32.34	32.54	32.74	32.94
Minimum	Efficiency[1]	η [%]	≥20.7	≥21.0	≥21.3	≥21.5	≥21.8	≥22.0
MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT[2]								
Minimum	Power at MPP	P_{MPP} [W]	306.1	309.9	313.7	317.5	321.2	325.0
Minimum	Short Circuit Current	I_{SC} [A]	10.74	10.81	10.87	10.94	11.00	11.07
Minimum	Open Circuit Voltage	V_{OC} [V]	35.96	36.23	36.50	36.77	37.04	37.31
Minimum	Current at MPP	I_{MPP} [A]	9.98	10.04	10.10	10.15	10.21	10.27
Minimum	Voltage at MPP	V_{MPP} [V]	30.66	30.87	31.07	31.26	31.46	31.65

[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

Qcells PERFORMANCE WARRANTY

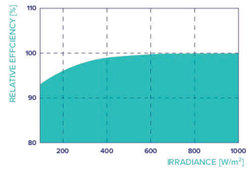


At least 98.5 % of nominal power during first year. Thereafter max. 0.33 % degradation per year. At least 95.53 % of nominal power up to 10 years. At least 90.58 % of nominal power up to 25 years.

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

*Standard terms of guarantee for the 5 PV companies with the highest production capacity in 2021 (February 2021)

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]	−0.24
Temperature Coefficient of P_{MPP}	γ	[%/K]	−0.30	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]	25	Fire Rating based on ANSI / UL 61730	C / TYPE 2
Max. Design Load, Push / Pull[3]		[lbs / ft²]	113 (5400 Pa) / 50 (2400 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]	169 (8100 Pa) / 75 (3600 Pa)		

[3] See Installation Manual

Qualifications and Certificates

UL61730-1 & UL61730-2, CE-compliant, Quality Controlled PV - TÜV Rheinland, IEC 61215:2016, IEC 61730:2016, U.S. Patent No. 9,893,215 (solar cells).

*Contact your Qcells Sales Representative for details regarding the module's eligibility to be Buy American Act (BAA) compliant.

Qcells pursues minimizing paper output in consideration of the global environment.

Note: Installation instructions must be followed. Contact our technical service for further information on approved installation 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 hqc-inquiry@qcells.com | WEB www.qcells.com

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13.500kWh ENERGY STORAGE SYSTEM

PROJECT ID	AUR-1001058
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CREATED BY	VK
SIGNATURE	

MODULE SPEC SHEET
SS

Powerwall 3

Power Everything

—

Powerwall 3 is a fully integrated solar and battery system, designed to accelerate the transition to sustainable energy. Customers can receive whole home backup, cost savings, and energy independence by producing and consuming their own energy while participating in grid services. Once installed, customers can manage their system using the Tesla App to customize system behavior to meet their energy goals.

Powerwall 3 achieves this by supporting up to 20 kW DC of solar and providing 11.5 kW AC of continuous power per unit. It has the ability to start heavy loads up to 185 A LRA, meaning a single unit can support the power needs of most homes. Powerwall 3 is designed for mass production, fast and efficient installations, easy system expansion, and simple connection to any electrical service.

Powerwall 3 Technical Specifications

System Technical Specifications	**Model Number**	1707000-xx-y
	Nominal Grid Voltage (Input & Output)	120/240 VAC
	Grid Type	Split phase
	Frequency	60 Hz
	Overcurrent Protection Device	Configurable up to 60 A
	Solar to Battery to Home/Grid Efficiency	89% [1,2]
	Solar to Home/Grid Efficiency	97.5% [3]
	Supported Islanding Devices	Backup Gateway 2, Backup Switch
	Connectivity	Wi-Fi (2.4 and 5 GHz), Dual-port switched Ethernet, Cellular (LTE/4G [4])
	Hardware Interface	Dry contact relay, Rapid Shutdown (RSD) certified switch and 2-pin connector, RS-485 for meters
	AC Metering	Revenue Grade (+/- 0.5%)
	Protections	Integrated arc fault circuit interrupter (AFCI), Isolation Monitor Interrupter (IMI), PV Rapid Shutdown (RSD) using Tesla Mid-Circuit Interrupters
	Customer Interface	Tesla Mobile App
	Warranty	10 years
Solar Technical Specifications	**Maximum Solar STC Input**	20 kW
	Withstand Voltage	600 V DC
	PV DC Input Voltage Range	60 — 550 V DC
	PV DC MPPT Voltage Range	150 — 480 V DC
	MPPTs	6
	Maximum Current per MPPT (I_{mp})	13 A [5]
	Maximum Short Circuit Current per MPPT (I_{sc})	15 A [5]
Battery Technical Specifications	**Nominal Battery Energy**	13.5 kWh AC [2]
	Maximum Continuous Discharge Power	11.5 kW AC
	Maximum Continuous Charge Power	5 kW AC
	Output Power Factor Rating	0 - 1 (Grid Code configurable)
	Maximum Continuous Current	48 A
	Maximum Output Fault Current	10 kA
	Load Start Capability (1 s)	185 A LRA
	Power Scalability	Up to 4 Powerwall 3 units supported

[1] Typical solar shifting use case.
[2] Values provided for 25°C (77°F), at beginning of life. 3.3 kW charge/discharge power.
[3] Tested using CEC weighted efficiency methodology.
[4] Cellular connectivity subject to network service coverage and signal strength.
[5] Where the DC input current exceeds the MPPT rating, a jumper can be used to combine two MPPTs into a single input to intake DC current up to 26 A I_{MP} / 30 A I_{SC}.

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SIGNATURE	

INVERTER SPEC SHEET

SS

Powerwall 3 Technical Specifications

Environmental Specifications

Operating Temperature	-20°C to 50°C (-4°F to 122°F) [6]
Operating Humidity (RH)	Up to 100%, condensing
Storage Temperature	-20°C to 30°C (-4°F to 86°F), up to 95% RH, non-condensing, State of Energy (SOE): 25% initial
Maximum Elevation	3000 m (9843 ft)
Environment	Indoor and outdoor rated
Enclosure Rating	NEMA 3R
Ingress Rating	IPX7 (Battery & Power Electronics) IPX5 (Wiring Compartment)
Pollution Rating	PD3
Operating Noise @ 1 m	<50 db(A) typical <62 db(A) maximum

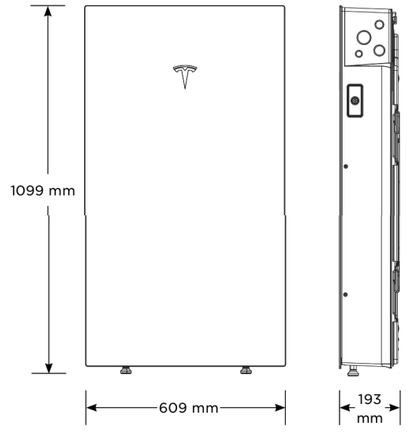
[6] Performance may be de-rated at operating temperatures above 40°C (104°F).

Compliance Information

Certifications	UL 1642, UL 1699B, UL 1741, UL 1741 SA, UL 1741 SB, UL 3741, UL 1973, UL 1998, UL 9540, IEEE 1547-2018, IEEE 1547.1, UN 38.3
Grid Connection	United States
Emissions	FCC Part 15 Class B
Environmental	RoHS Directive 2011/65/EU
Seismic	AC156, IEEE 693-2005 (high)
Fire Testing	Meets the unit level performance criteria of UL 9540A

Mechanical Specifications

Dimensions	1099 x 609 x 193 mm (43.25 x 24 x 7.6 in)
Weight	130 kg (287 lb)
Mounting Options	Floor or wall mount



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INVERTER SPEC SHEET

SS

Backup Gateway 2

Backup Gateway 2 controls connection to the grid when paired with Powerwall 3, automatically detecting outages and providing seamless transition to backup power. Backup Gateway 2 also provides energy metering for solar self-consumption, time-based control, and backup operation.

In this system configuration, Powerwall 3 acts as the Site Controller, with the Backup Gateway 2 Site Controller disabled.

Performance Specifications

Model Number	1232100-xx-y
AC Voltage (Nominal)	120/240 V
Feed-in Type	Split phase
Grid Frequency	60 Hz
Current Rating	200 A
Maximum Supply Short Circuit Current	10 kA [8]
Overcurrent Protection Device	100 - 200 A, Service entrance rated [9]
Overvoltage Category	Category IV
Internal Primary AC Meter	Revenue accurate (+/- 0.2%)
Internal Auxiliary AC Meter	Revenue accurate (+/- 2%)
Primary Connectivity	Ethernet, Wi-Fi
Secondary Connectivity	Cellular (3G, LTE/4G) [10]
User Interface	Tesla App
Operating Modes	Support for solar self-consumption, time-based control, and backup
Backup Transition	Automatic disconnect for seamless backup
Modularity	Supports up to 10 AC-coupled Powerwalls
Optional Internal Panelboard	200 A 6-space / 12 circuit breakers Siemens QP or Square D HOM breakers rated 10 - 80A or Eaton BR breakers rated 10 - 125A
Warranty	10 years

[10] When protected by Class J fuses, Backup Gateway 2 is suitable for use in circuits capable of delivering not more than 22kA symmetrical amperes.

[11] The customer is expected to provide internet connectivity for Backup Gateway 2; cellular should not be used as the primary mode of connectivity. Cellular connectivity subject to network operator service coverage and signal strength.

Environmental Specifications

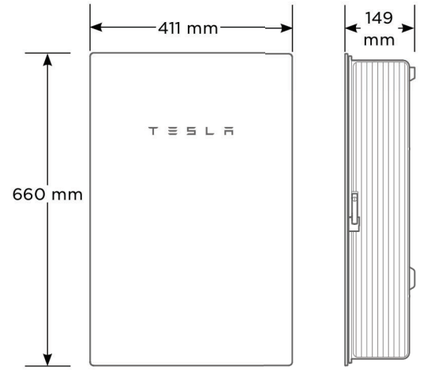
Operating Temperature	-20°C to 50°C (-4°F to 122°F)
Operating Humidity (RH)	Up to 100%, condensing
Maximum Elevation	3000 m (9843 ft)
Environment	Indoor and outdoor rated
Enclosure Type	NEMA 3R

Compliance Information

Certifications	UL 67, UL 869A, UL 916, UL 1741 PCS, CSA 22.2 0.19, CSA 22.2 205
Emissions	FCC Part 15, ICES 003

Mechanical Specifications

Dimensions	660 x 411 x 149 mm (25 x 16 x 6 in)
Weight	20.4 kg (45 lb)
Mounting options	Wall mount, Semi-flush mount



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SIGNATURE	

GATEWAY SPEC SHEET

SS

Solar Shutdown Device Technical Specifications

—

The Solar Shutdown Device is a Mid-Circuit Interrupter (MCI) and is part of the PV system rapid shutdown (RSD) function in accordance with Article 690 of the applicable NEC. When paired with Powerwall 3, solar array shutdown is initiated by any loss of AC power.

	Model	MCI-1	MCI-2
Electrical Specifications	Nominal Input DC Current Rating (I_{MP})	12 A	13 A
	Maximum Input Short Circuit Current (I_{SC})	19 A	17 A
	Maximum System Voltage (PVHCS)	600 V DC	1000 V DC [7]
RSD Module Performance	Maximum Number of Devices per String	5	5
	Control	Power Line Excitation	Power Line Excitation
	Passive State	Normally Open	Normally Open
	Maximum Power Consumption	7 W	7 W
	Warranty	25 years	25 years
Environmental Specifications	Operating Temperature	-40°C to 50°C (-40°F to 122°F)	-45°C to 70°C (-49°F to 158°F)
	Storage Temperature	–30°C to 70°C (–22°F to 158°F)	–30°C to 70°C (–22°F to 158°F)
	Enclosure Rating	NEMA 4X / IP65	NEMA 4X / IP65
Mechanical Specifications	Electrical Connections	MC4 Connector	MC4 Connector
	Housing	Plastic	Plastic
	Dimensions	125 x 150 x 22 mm (5 x 6 x 1 in)	173 x 45 x 22 mm (6.8 x 1.8 x 1 in)
	Weight	350 g (0.77 lb)	120 g (0.26 lb)
	Mounting Options	ZEP Home Run Clip M4 Screw (#10) M8 Bolt (5/16") Nail / Wood screw	Wire Clip
Compliance Information	Certifications	UL 1741 PVRSE, UL 3741, PVRSA (Photovoltaic Rapid Shutdown Array)	
	RSD Initiation Method	External System Shutdown Switch or Powerwall 3 Enable Switch	

[7] Maximum System Voltage is limited by Powerwall to 600 V DC.

UL 3741 PV Hazard Control (and PVRSA) Compatibility

The following categories of solar module meet the UL 3741 PVHCS listing when installed with Powerwall 3 and Solar Shutdown Devices.

Tesla Solar Roof	PV Hazard Control System: BIPV compliance document
Tesla or Hanwha (Q.Peak Duo BLK or BLK-G6+) Modules certified for use with ZEP racking	PV Hazard Control System: ZS PVHCS compliance document
Other module and racking combinations	PV Hazard Control System: Generic PV Array compliance document

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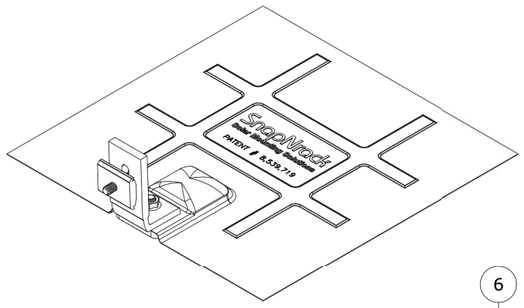
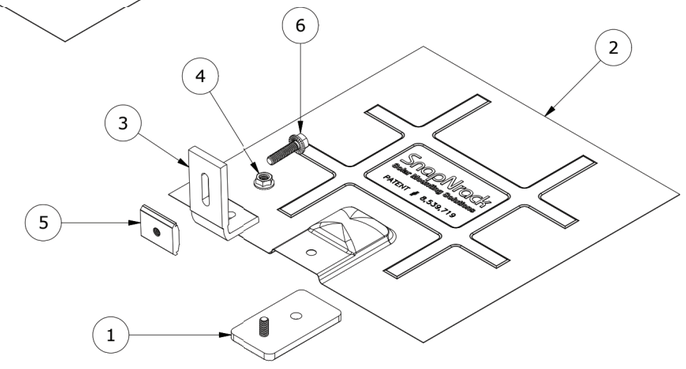
SIGNATURE	

RAPID SHUTDOWN SPEC SHEET

SS

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, FLASHED L FOOT	M.Watkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
242-92047, 242-92048, 242-92050, 242-92051	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.

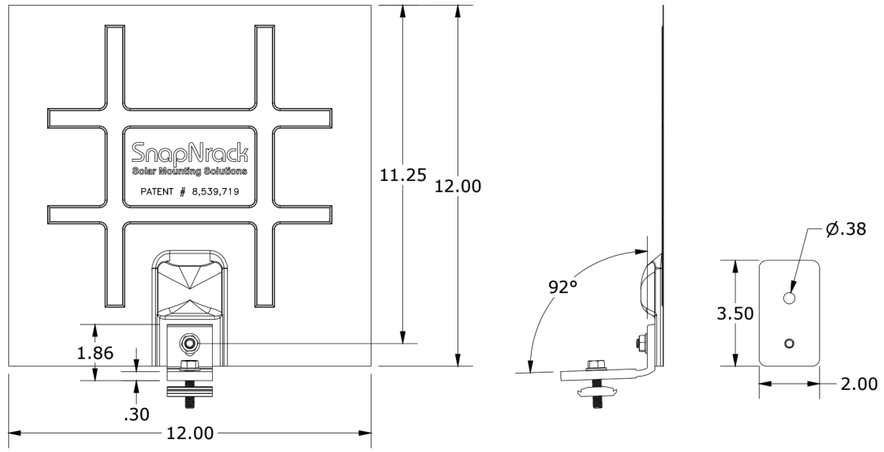


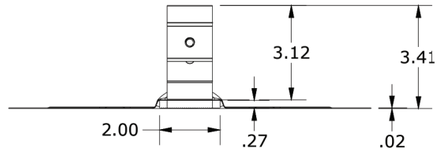


PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, L FOOT BASE, MILL
2	1	SNAPNRACK, L FOOT FLASHING, 12IN X 12IN, BLACK GALV
3	1	SNAPNRACK L FOOT, COMPOSITION 92DEG, CLEAR / BLACK
4	1	NUT, FLANGE, SERRATED, 5/16IN-18, SS
5	1	SNAPNRACK CHANNEL NUT 5/16IN-18
6	1	BOLT, FLANGED HEX, 5/16IN-18 X 1-1/4IN, SS

MATERIALS:	6000 SERIES ALUMINUM, STAINLESS STEEL	OPTIONS:
DESIGN LOAD (LBS):	309 UP, 1469 DOWN, 251 SIDE	CLEAR / BLACK ANODIZED
ULTIMATE LOAD (LBS):	928 UP, 4406 DOWN, 754 SIDE	GALV STEEL / ALUM FLASHING
TORQUE SPECIFICATION:	10+ LB-FT	
CERTIFICATION:	UL 2703, FILE E359313	
WEIGHT (LBS):	0.90 - 1.25	

DESCRIPTION:	DRAWN BY:	SnapNrack™ Solar Mounting Solutions
SNAPNRACK, FLASHED L FOOT	M.Watkins	
PART NUMBER(S):	REVISION:	595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA PHONE (415) 580-6900 • FAX (415) 580-6902
242-92047, 242-92048, 242-92050, 242-92051	A	THE INFORMATION IN THIS DRAWING IS CONFIDENTIAL AND PROPRIETARY. ANY REPRODUCTION, DISCLOSURE, OR USE THEREOF IS PROHIBITED WITHOUT THE WRITTEN CONSENT OF SUNRUN SOUTH LLC.





FLASHED L FOOT PROPERTIES		
SKU	FLASHING MATERIAL	L FOOT FINISH
242-92047	SILVER ALUMINUM	CLEAR
242-92048	BLACK ALUMINUM	BLACK
242-92050	BLACK GALV STEEL	CLEAR
242-92051	BLACK GALV STEEL	BLACK

ALL DIMENSIONS IN INCHES

CONTRACTOR INFORMATION

YES SOLAR SOLUTIONS

ADDRESS: 202 NORTH DIXON AVENUE, CARY, NC 27513

PHONE NUMBER: (919) 459-4155

LICENSE NUMBER: NC GC #67356 ; NC ELECTRIC #U.32326

LICENSE TYPE: NC GC/ELECTRIC

CUSTOMER INFORMATION

NAME: LLOYD RESIDENCE

ADDRESS: 554 LAMBERT LANE, FUQUAY-VARINA, NC 27526

COORDINATES: 35.532743, -78.790855

APN: 080664011125

11.050kW DC / 11.500kW AC ROOF MOUNT PV SYSTEM
13.500kWh ENERGY STORAGE SYSTEM

PROJECT ID	AUR-1001058
DATE	7/19/2024
CREATED BY	VK
SIGNATURE	

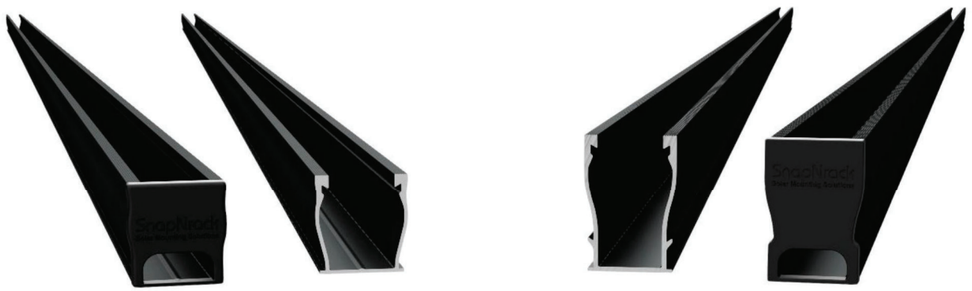
MOUNT SPEC SHEET

SS

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

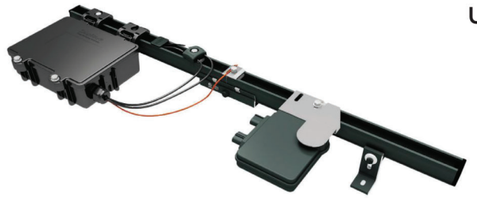
RESOURCES	snapnrack.com/resources
DESIGN	snapnrack.com/configurator
WHERE TO BUY	snapnrack.com/where-to-buy

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**

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RAIL SPEC SHEET
SS