

PHOTOVOLTAIC ROOF MOUNT SYSTEM

CODE AND STANDARDS

THE INSTALLATION OF SOLAR ARRAYS AND PHOTOVOLTAIC POWER SYSTEMS SHALL COMPLY WITH THE FOLLOWING CODES:

- 2020 NATIONAL ELECTRICAL CODE
- 2018 NORTH CAROLINA RESIDENTIAL CODE
- 2018 NORTH CAROLINA BUILDING CODE
- ALL OTHER ORDINANCE ADOPTED BY THE LOCAL GOVERNING AGENCIES

SITE NOTES / OSHA REGULATION

- A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
- THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
- ROOFTOP MOUNTED PHOTOVOLTAIC PANELS AND MODULES SHALL BE TESTED, LISTED AND IDENTIFIED BY RECOGNIZED ELECTRICAL TESTING LABORATORY.
- MODULES AND SUPPORT STRUCTURES SHALL BE GROUNDED
- SOLAR INVERTER SHALL BE LISTED TO UL1741
- ALL CONDUCTORS SHALL BE COPPER AND SHOULD BE 75 AND 90 DEG RATED
- REMOVAL OF AN INTERACTIVE INVERTER OR OTHER EQUIPMENT SHALL NOT DISCONNECT THE BONDING CONNECTION BETWEEN THE GROUNDING ELECTRODE CONDUCTOR, THE PHOTOVOLTAIC SOURCE AND OUTPUT CIRCUIT GROUNDED CONDUCTORS.
- LIVE PARTS OF PV SOURCE CIRCUITS AND PV OUTPUT CIRCUITS OVER 150V TO GROUND SHALL NOT BE ACCESSIBLE TO OTHER THAN QUALIFIED PERSONS WHILE ENERGIZED.
- ALL PV MODULES AND ASSOCIATED EQUIPMENT AND WIRING SHALL BE PROTECTED FROM PHYSICAL DAMAGE.
- NFPA 855 ONLY PERMITS RESIDENTIAL ESS TO BE INSTALLED IN THE FOLLOWING AREAS: ATTACHED GARAGES, DETACHED GARAGES, ON EXTERIOR WALLS AT LEAST 3 FT AWAY FROM DOORS OR WINDOWS, OUTDOORS AT LEAST 3 FT AWAY FROM DOORS OR WINDOWS, UTILITY CLOSETS, STORAGE OR UTILITY SPACES.

SOLAR CONTRACTOR

1. MODULE CERTIFICATIONS INCLUDE UL1703, IEC61646, IEC61370.
2. IF APPLICABLE, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE MARKED GROUNDING LUG HOLES PER THE MANUFACTURERS INSTALLATION REQUIREMENTS.
3. AS INDICATED BY DESIGN, OTHER NRTL LISTED MODULE GROUNDING DEVICES MAY BE USED IN PLACE OF STANDARD GROUNDING LUGS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ.
4. ALL MICROINVERTERS, PHOTOVOLTAIC MODULES, AC COMBINERS, DC-AC CONVERTERS AND SOURCE CIRCUIT COMBINERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER NEC690.4(B).
5. ALL SIGNAGE TO BE INSTALLED IN ACCORDANCE WITH LOCAL BUILDING CODE.
6. TERMINALS AND LUGS WILL BE TIGHTENED TO MANUFACTURER TORQUE SPECIFICATIONS (WHEN PROVIDED) IN ACCORDANCE WITH NEC CODE 110.14(D) ON ALL ELECTRICAL CONNECTIONS.
7. MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC UNLESS NOT AVAILABLE.

DESIGN CRITERIA
WIND SPEED: 135 MPH
GROUND SNOW LOAD: 20 PSF
WIND EXPOSURE FACTOR: B

UTILITY COMPANY:
DUKE ENERGY
PERMIT ISSUER (AHJ):
HARNETT COUNTY

SCOPE OF WORK
 INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM.

SR.#

PROJECT INFORMATION

1	PV MODULES	23 x SILFAB ELITE SIL-410 BG
2	INVERTER	23 x IQ8PLUS-72-2-US
3	BATTERY	01 X IQ5P
4	ROOF TYPE	ASPHALT SHINGLES
5	RACKING	PSR-B84 RAILS (BLACK)
6	MOUNTING TYPE	COMP MOUNT FLASHING (BLACK)
7	DC SIZE	9.43 KW
8	AC SIZE	6.67 KVA

SR.#

PROJECT INFORMATION

1	PV1	DRAWING INDEX
2	PV2	SITE LAYOUT
3	PV3	STRING MAPPING
4	PV4	ELECTRICAL ONE LINE DIAGRAM
5	PV5	DETAILED ELECTRICAL WIRING SCHEMATIC
6	PV6	PV LABELS
7	PV7	BILL OF MATERIALS
8	PV8	ATTACHMENT DETAILS



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Drawing Index

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A

Sheet Size:

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 17" X 22"

Sheet Number:


PV1

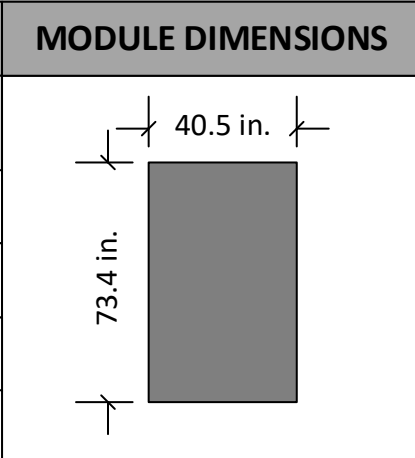


VICINITY MAP

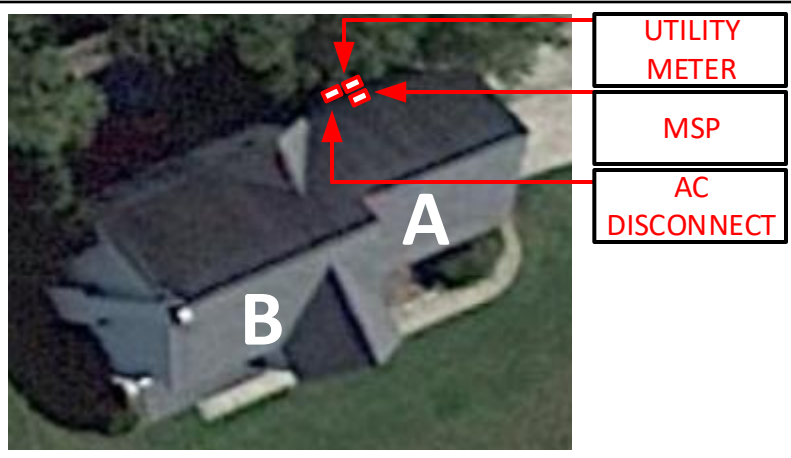
TOP VIEW OF THE BUILDING



ROOF DESCRIPTION			
ROOF	PITCH	AZIMUTH	NO. OF MODULES
A	34°	156°	15
B	45°	156°	08
Vent		<ul style="list-style-type: none"> Roof A and B have no vents. No vents will be covered by PV Module during the installation 	



PV System Dead Load (Panel + Racking weight) / PV System Area (No. of panels x Weight of panel(lbs.) + Length of racking(ft.) x 1.17 lb.ft) / (No. of panels x Height x Width) = Total psf			
ROOFS	A	B	
DEAD LOAD (PSF)	2.90	2.60	



SYSTEM DETAILS

NUMBER OF PANELS : 23
 PANELS MODEL : SILFAB ELITE SIL-410 BG
 DC SIZE : 9.43 KW
 AC SIZE : 6.67 KVA



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Site Layout

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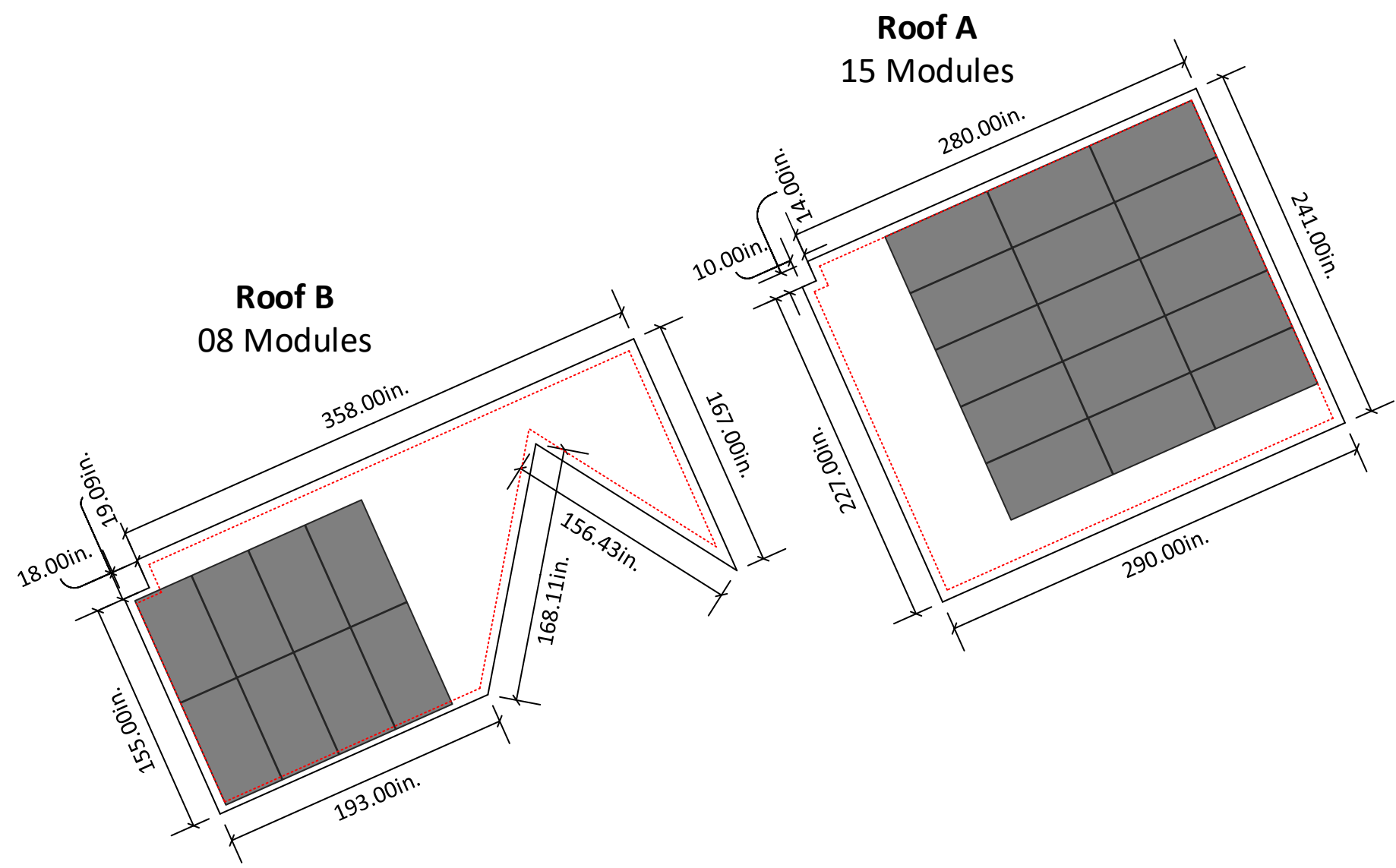
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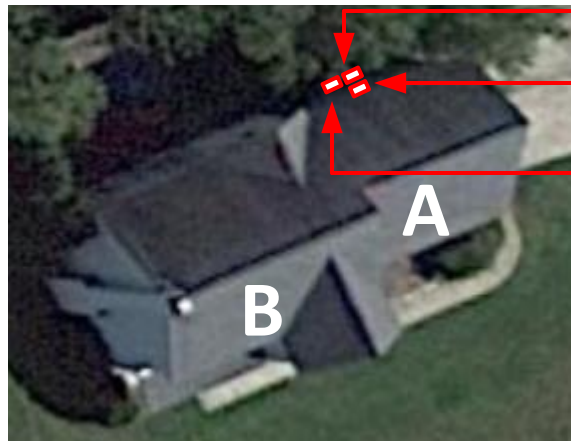


6in setback from sides of the roof

SITE LAYOUT
 SCALE: 1/8" - 1'



ROOF DESCRIPTION				MODULE DIMENSIONS	STRING LAYOUT						
ROOF	PITCH	AZIMUTH	NO. OF MODULES		ENPHASE IQ COMBINER 4						
A	34°	156°	15		Strings #	No. of Modules	Color	Strings #	No. of Modules	Color	
B	45°	156°	08		String 1	09					
					String 2	08					
					String 3	06					



UTILITY METER
MSP
AC DISCONNECT



SYSTEM DETAILS

NUMBER OF PANELS : 23
 PANELS MODEL : SILFAB ELITE SIL-410 BG
 DC SIZE : 9.43 KW
 AC SIZE : 6.67 KVA

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String Mapping

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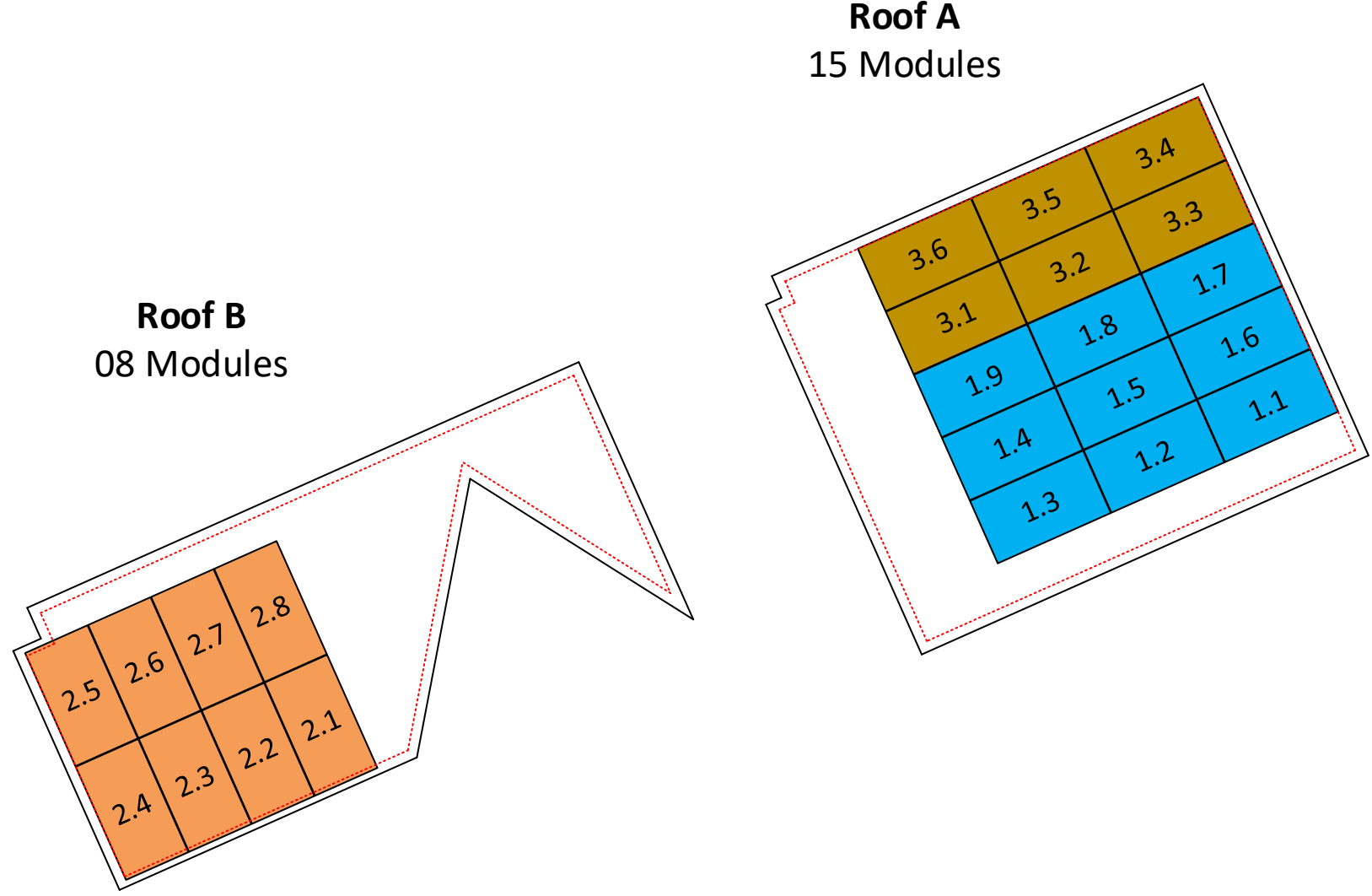
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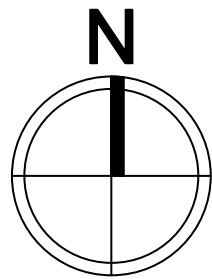
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PV3



6in setback from sides of the roof

STRING MAPPING
 SCALE: 1/8" - 1'



STRING CALCULATION

String #	No of Modules	Estimated Power	I _{max}	V _{oc}	V _{mpp}	V _{rise} (<= 2%)
1	09	3,690 W	16.31 AC	<30	240V AC	1.37+0.35 = 1.72
2	08	3,280 W	14.5 AC	<30	240V AC	1.39+0.35 = 1.74
3	06	2,460 W	10.87 AC	<30	240V AC	1.39+0.35 = 1.74

NEC Code 2020 and UL Standard References

Rapid Shut Down	NEC 690.12 (A-D), UL1741	Grounding	NEC Article 250.30(A)
Disconnecting Means	NEC 690.13	Conduit Fill	NEC Table C.9, 310.15(B)(3)(a)
Feeder Sizing	NEC Table 310, 15(B)(16, 17)	Interconnection	NEC 705.12
Over current Protection	NEC 690.9		



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Electrical One Line Diagram

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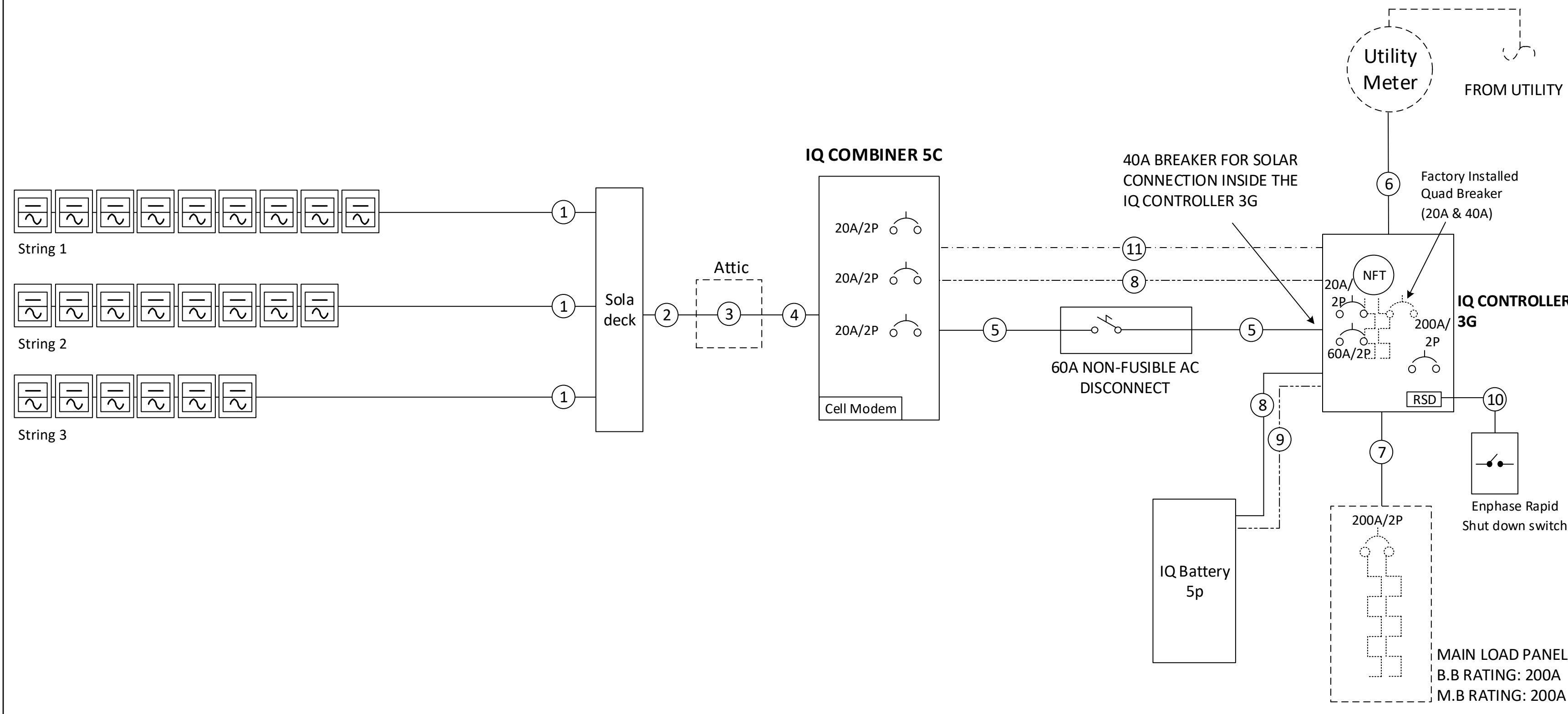
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PV4



23 X SILFAB ELITE SIL-410 BG
410W
ENPHASE IQ8PLUS-72-2-US MICROINVERTERS
290VA
RAPID SHUTDOWN EQUIPPED

Note: Power Drop Required: Service Side Work

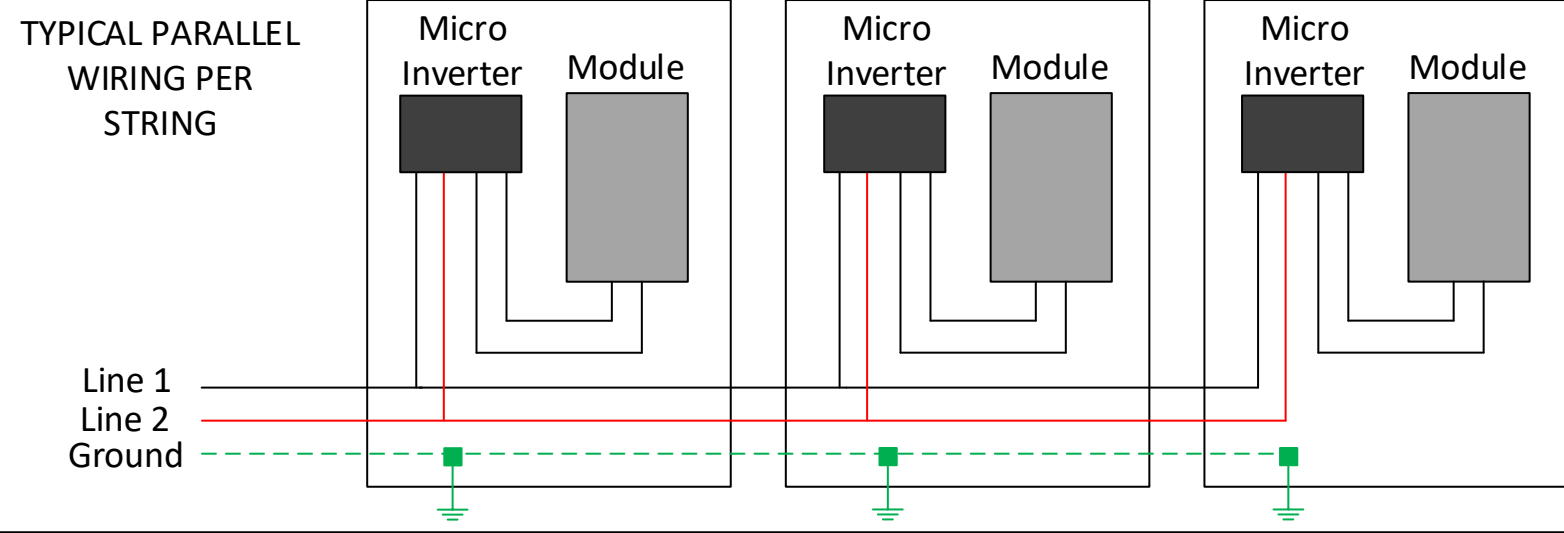


WARNING: The drain wire should only be terminated on one end of the control wiring between the system components, to prevent ground loops.
WARNING: The drain wire should not be terminated in IQ Battery 5P

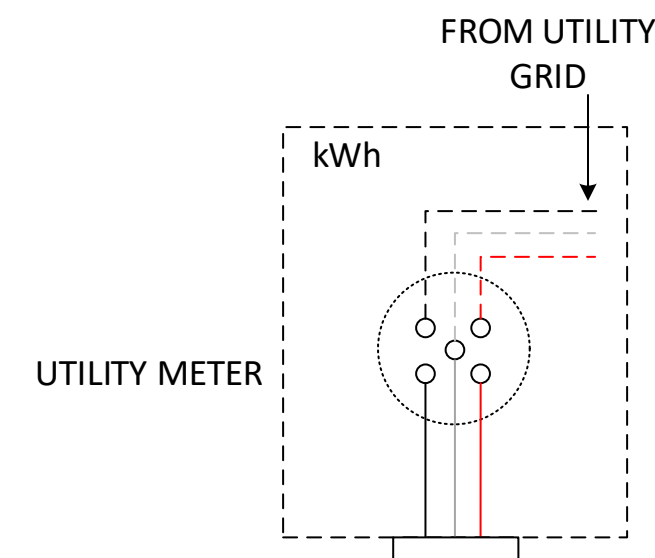
Sr.No	#Wire	Conduit Size	Ground Wire	Amperage
1	1 x #12 Q Cable		#10 Bare CU	20
2	3 x #10 MC Cable			20
3	6 x #10 THHN Cu	3/4" LFMC	#10 Green	20
4	6 x #10 THHN Cu	3/4" EMT	#10 Green	20
5	3 x #6 THHN Cu	3/4" LFNC	#8 Green	60
6	3 x 3/0 THHN Cu	2" PVC	#4 Green	200
7	3 x 3/0 THHN Cu	2" PVC	#4 Green	200
8	2 x #8 THHN Cu	3/4" EMT	#10 Green	20
9	Enphase Control Cable (4 conductors)			
10	4 x #12 THHN Cu	3/4" LFNC	#10 Green	16
11	Lead Wire 18AWG, PVC Extruded	3/4" EMT		

- System Size: 9,430W DC
- Battery Total Energy: 5.0 kWh
- (23) SILFAB ELITE SIL-410 BG
- (23) ENPHASE IQ8PLUS-72-2-US MICROINVERTERS
- Inverter Output: 1.21A max @ 349 VAC (each microinverter)
- 290 VA AC output max (each micro inverter)
- 6.67 kVA AC output max

- Grounding will be done via Pegasus grounding lugs and mid-clamps to ensure the rail and panels are continuously grounded.
- Rapid Shutdown is included in the Micro Inverters, refer to Micro Inverter attached datasheets.
- The load center / disconnect will be visible, lockable accessible to utility linesmen and will be properly labelled as per NEC requirements. It will be located on the exterior wall of the building, next to the utility meter.



Line 1	—
Line 2	—
Neutral	—
Ground	—
CT Wire	—
Wired Control Communication	—



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Detailed Electrical Diagram

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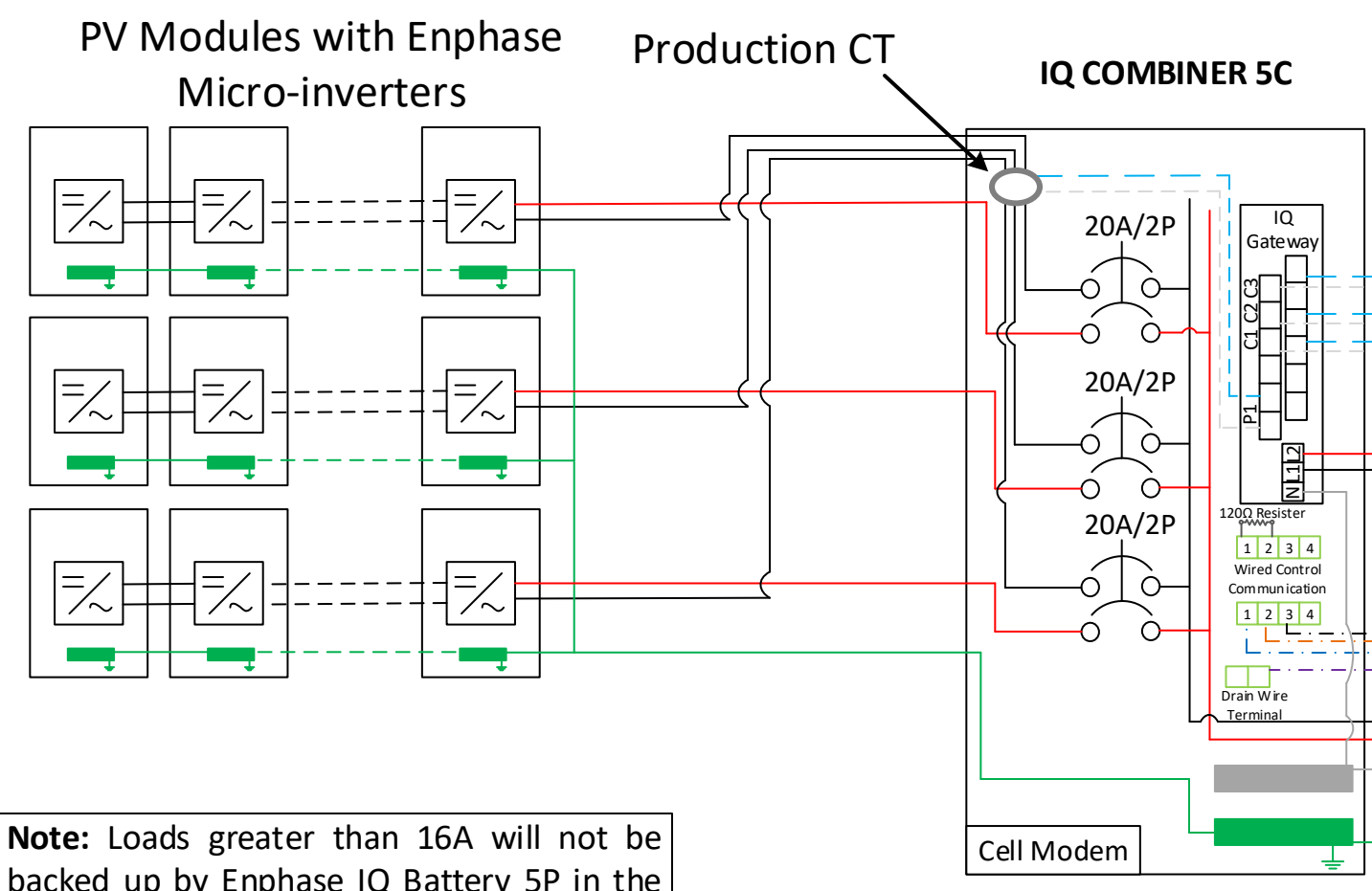
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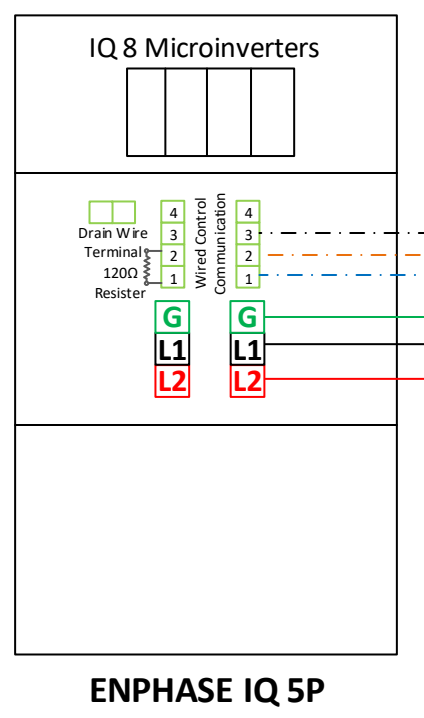
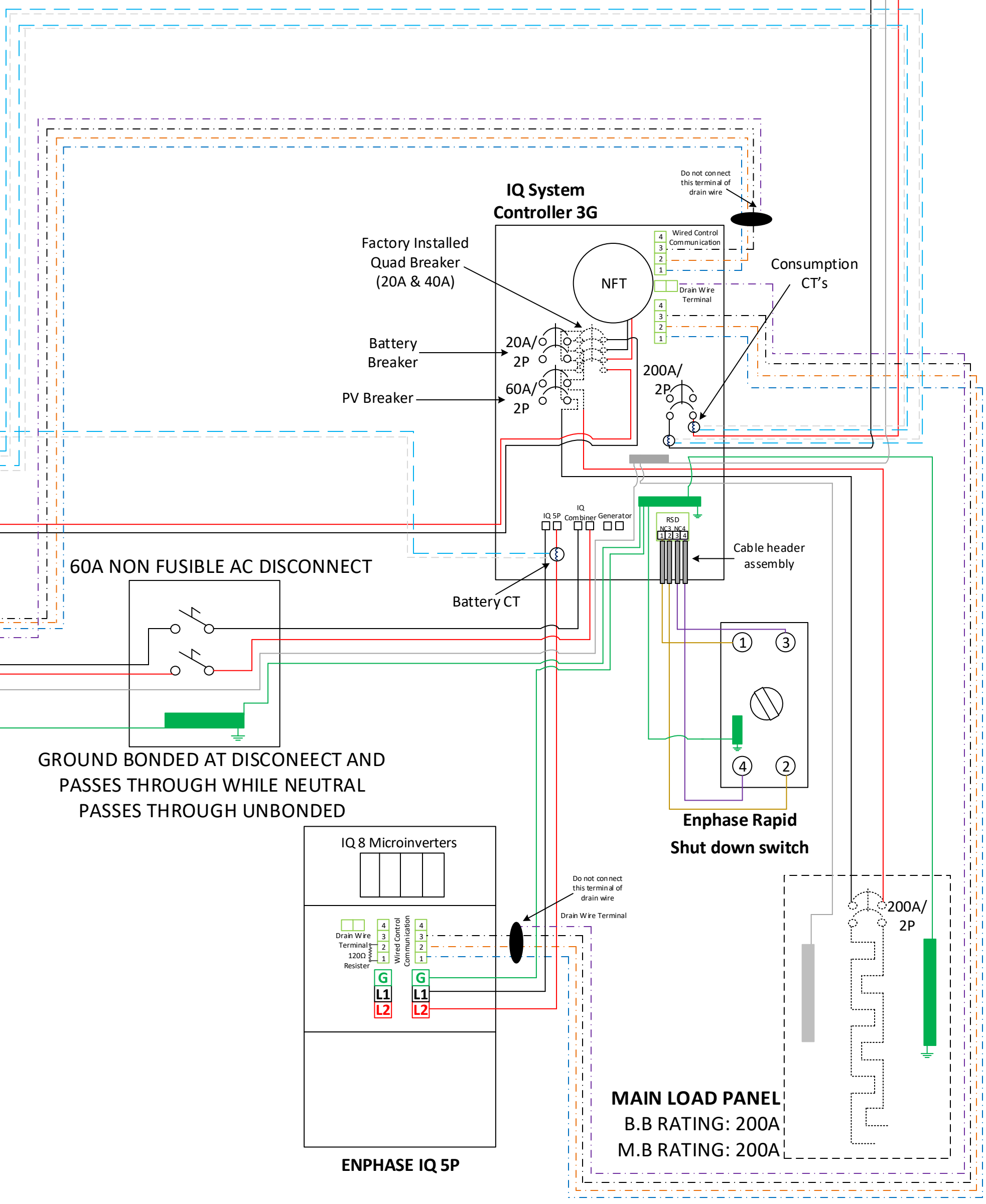
Note: Loads greater than 16A will not be backed up by Enphase IQ Battery 5P in the sub load panel.
Note: Ground and neutral should not be bound in the IQ Controller 3G

Note: Line 1 from all strings will be passed from the Production CT.
Note: The arrow on Enphase Production and Consumption CTs must point towards the loads and away from the source.
Note: The arrow on the Battery CT should point away from the battery.

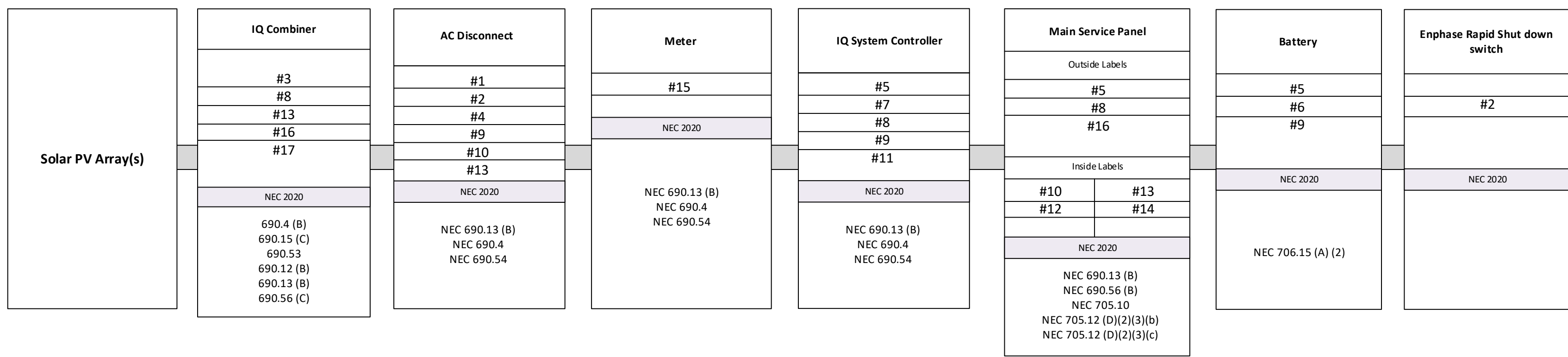
Note: 15A breaker from IQ Gateway will be removed and envoy will be wired to the 20Amp Quad breaker on IQ System Controller 3G.
Note: Do not plug in both positive (B1) and negative (B2) battery DC circuit connectors before and during the electrical work on batteries.

Note: Red wire in enphase control cable should be trimmed/cut.

WARNING: The drain wire should only be terminated on one end of the control wiring between the system components, to prevent ground loops.
WARNING: Connect the drain wire to the drain terminal only at one end of a CTRL cable. Do not connect drain wires at both ends of a CTRL cable.



MAIN LOAD PANEL
B.B RATING: 200A
M.B RATING: 200A



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LABELING AND WARNING SIGNS: NEC 2020

A. PURPOSE
 PROVIDE EMERGENCY RESPONDERS WITH APPROPRIATE WARNING AND GUIDANCE WITH RESPECT TO ISOLATING THE SOLAR ELECTRIC SYSTEM. THIS CAN FACILITATE IDENTIFYING ENERGIZED ELECTRICAL LINES THAT CONNECT THE SOLAR PANELS TO THE INVERTER, AS SHOULD NOT BE CUT WHEN VENTING FOR SMOKE REMOVAL.

B. MAIN SERVICE DISCONNECT:

1. RESIDENTIAL BUILDINGS- THE MARKING MAY BE PLACED WITHIN THE MAIN SERVICE DISCONNECT. THE MARKING SHALL BE PLACED ON THE OUTSIDE COVER IF THE MAIN SERVICE DISCONNECT IS OPERABLE WITH THE SERVICE PANEL CLOSED.
2. COMMERCIAL BUILDINGS- THE MARKINGS SHALL BE PLACED ADJACENT TO THE MAIN SERVICE DISCONNECT CLEARLY VISIBLE FROM THE LOCATION WHERE THE LEVER IS OPERATED
3. MARKINGS, VERBIAGE, FORMAT AND TYPE OF MATERIAL
 - a. VERBIAGE: CAUTION; SOLAR ELECTRIC SYSTEM CONNECTED
 - b. FORMAT:
 - (1) WHITE LETTERING ON A RED BACKGROUND
 - (2) MINIMUM 3/8 INCH LETTER HEIGHT
 - (3) ALL LETTERS SHALL BE CAPITALIZED
 - (4) ARIAL OR SIMILAR FONT, NON-BOLD
 - c. MATERIAL:
 - (1) REFLECTIVE, WEATHER RESISTANT MATERIAL SUITABLE FOR THE ENVIRONMENT (USE UL-969) AS STANDARD FOR WEATHER RATING); DURABLE ADHESIVE MATERIALS MEET THIS REQUIREMENT.

C. MARKING REQUIREMENTS ON DC CONDUIT, RACEWAYS, ENCLOSURES, CABLE ASSEMBLIES, DC COMBINERS AND JUNCTION BOXES;

1. MARKING: PLACEMENT, VERBIAGE, FORMAT AND TYPE OF MATERIAL
 - a. PLACEMENT: MARKINGS SHALL BE PLACED EVERY 10 (TEN) FEET ON ALL INTERIOR AND EXTERIOR DC CONDUITS, RACEWAYS, ENCLOSURES AND CABLE ASSEMBLIES, AT TURNS ABOVE AND/OR BELOW PENETRATIONS, ALL DC COMBINERS AND JUNCTION BOXES.
 - b. VERBIAGE: CAUTION SOLAR CIRCUIT
 - c. THE FORMAT AND TYPE OF MATERIAL SHALL ADHERE TO SECTION B-3.B & C ABOVE

D. INVERTERS ARE NOT REQUIRED TO HAVE CAUTION MARKINGS

#1 PHOTOVOLTAIC
AC DISCONNECT

#6 BATTERY

#12 WARNING
TURN OFF PHOTOVOLTAIC AC DISCONNECT PRIOR TO WORKING INSIDE PANEL

#2 RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

#7 MAIN BATTERY SYSTEM DISCONNECT

#13 WARNING
ELECTRIC SHOCK HAZARD
TERMINAL ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

#3 PHOTOVOLTAIC POWER SOURCE
OPERATING AC VOLTAGE 240 V
MAXIMUM OPERATING AC OUTPUT CURRENT 34.78 A

#8 WARNING
THREE POWER SOURCES
SOURCES: UTILITY GRID, BATTERY AND PV SOLAR ELECTRIC SYSTEM

#14 WARNING
POWER SOURCE OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT DEVICE

#9 SERVICE DISCONNECT LOCATED IN MAIN LOAD PANEL

#15 WARNING
THIS SERVICE METER IS ALSO SERVED BY A PHOTOVOLTAIC SYSTEM

#4 AC DISCONNECT PHOTOVOLTAIC SYSTEM POWER SOURCE
RATED AC OUTPUT CURRENT 34.78 AMPS
NOMINAL OPERATING AC VOLTAGE 240 VOLTS

#10 BATTERY DISCONNECT LOCATED IN THE IQ CONTROLLER 3G

#16 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

#5 SOLAR AC DISCONNECT LOCATED AT NORTH-WEST SIDE WALL OF THE HOUSE BESIDE THE UTILITY METER

#11 WARNING
SOLAR ELECTRIC CIRCUIT BREAKER IS BACKFEED

#17 PHOTOVOLTAIC SYSTEM COMBINER PANEL DO NOT ADD LOADS

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Sheet Name:
 PV Labels

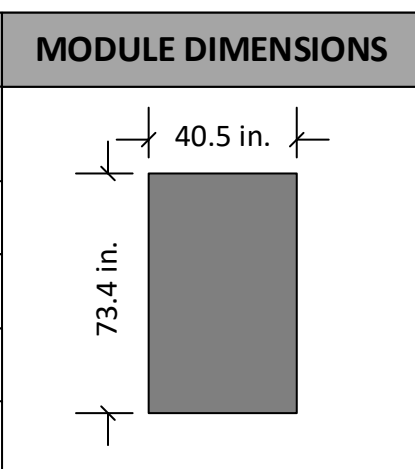
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Sheet Number: PV6



ROOF DESCRIPTION			
ROOF	PITCH	AZIMUTH	NO. OF MODULES
A	34°	156°	15
B	45°	156°	08



Rails and Splices : PSR-B84 (BLACK)

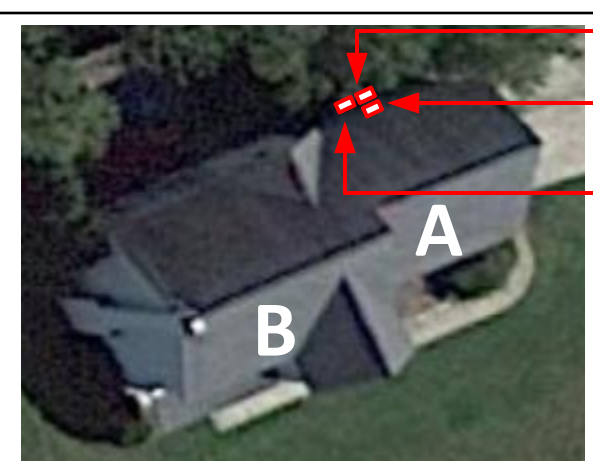
Rafter Spacing for Roof A : 16 in
Rafter Spacing for Roof B : 24 in

Attachment Span: 4ft

Roof Attachment : Pegasus Comp Mount

There is one layer of shingles
Roofing material is asphalt shingles

The roof is located in 135mph wind zone



- UTILITY METER
- MSP
- AC DISCONNECT



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Bill of Material

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PV7



PV LABELS		
Sr No	Code	Qty
01	03-302	01
02	02-316	02
03	03-390	01
04	03-306	01
05	8M-001	04
06	03-395	02
07	03-304	01
08	03-230	03
09	8M-002	04
10	8M-004	02
11	05-342	01
12	05-372	01
13	05-215	03
14	05-216	01
15	07-359	01
16	07-111	02
17	03-355	01

RAILS AND MOUNTING SYSTEM

- 38 x PSR-B84: Pegasus Rail, Black, 84" (7 Feet)
- 24 x PSR-SPL: Pegasus - Bonded, Structural Splice
- 32 x PSR-MCB: Pegasus - Multiclamp, Mid/End, 30 to 40 mm, Black
- 28 x PSR-HEC: Pegasus - Hidden End Clamp
- 23 x PSR-MLP: Pegasus - MLPE Mount
- 11 x PSR-LUG: Pegasus - Grounding Lug
- 35 x PSR-WMC: Pegasus - Wire Management Clip
- 05 x PSR-CBG: Pegasus - Cable Grip
- 28 x PSR-CAP: Pegasus - End Cap
- 66 x PSCR-UBBDT: Pegasus Comp Mount - Open Slot, Black L Foot, Black Flashing, Dovetail 3/8" T-Bolt
- 46 x Heyco Wire Clips

SOLAR MODULES

- 23 x SILFAB ELITE SIL-410 BG

MICROINVERTERS & SUPPORTING ITEMS

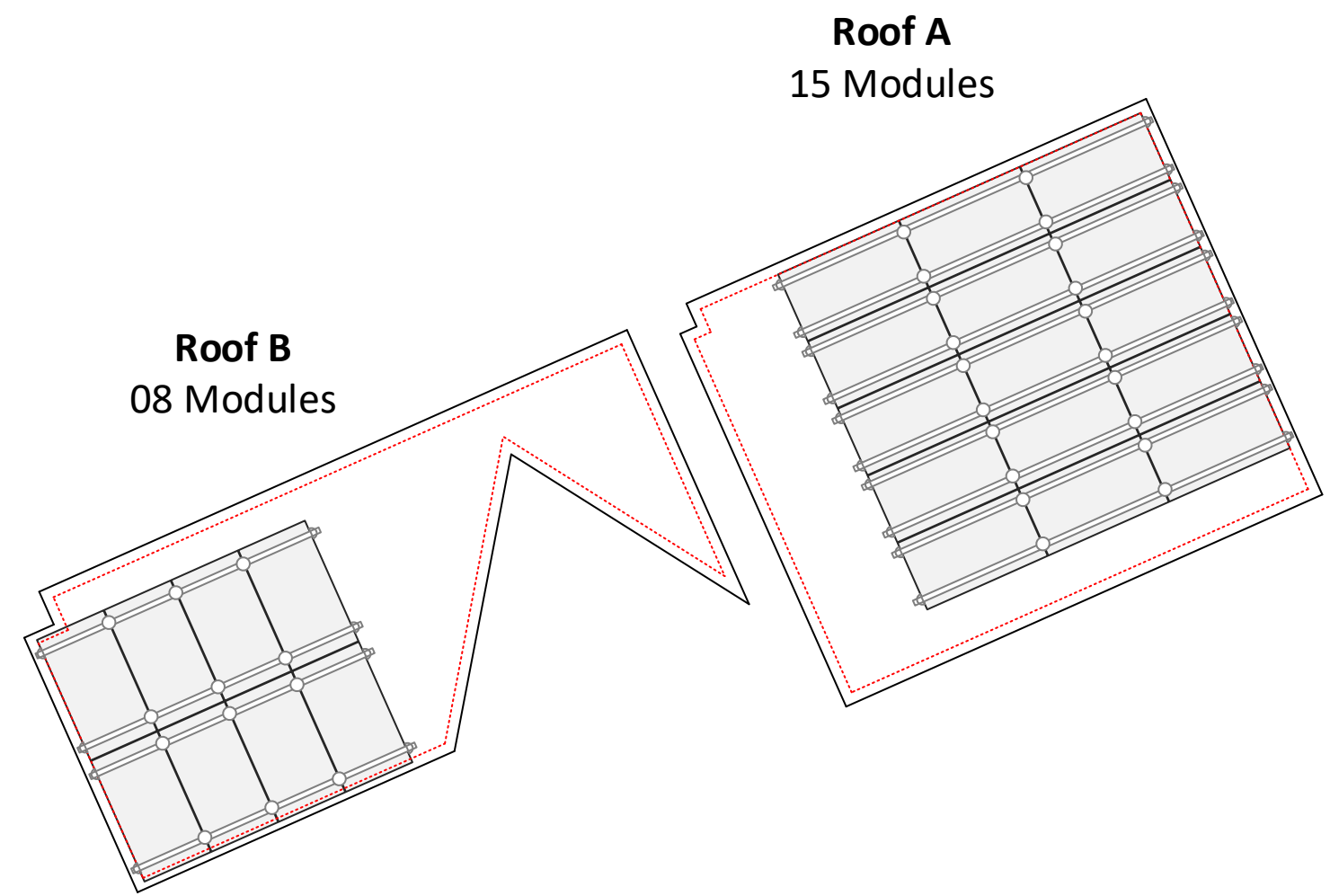
- 23 x Enphase IQ8PLUS-72-2-US micro inverter
- 01 x X-IQ-AM1-240-5C: IQ Combiner 5C
- 01 x SC200G111C240US01: IQ System Controller 3G
- 01 x IQBATTERY-5P-1P-NA: IQ Battery 5P
- 01 x CTRL-SC3-NA-01: Enphase Control Cable (70 ft.)

ENPHASE CABLES AND ACCESSORIES

- 09 x Q-12-10-240: Q Cable
- 18 x Q-12-20-200: Q Cable
- 01 x Q-12-RAW-300:Q Cable, 12 AWG (30ft)
- 04 x Q-CONN-10M Male Field-wireable connector
- 04 x Q-CONN-10F Female Field-wireable connector
- 03 x Q-TERM-10: Terminator Cap
- 04 x Q-SEAL-10: Female Sealing Cap
- 01 x Q-CLIP-100: Q Cable rail mount cable management clip (Pack of 100)
- 01 x Q-DISC-10: Disconnect tool

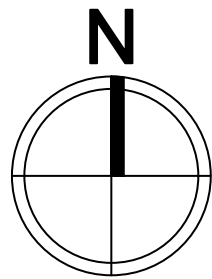
ELECTRICAL ITEMS

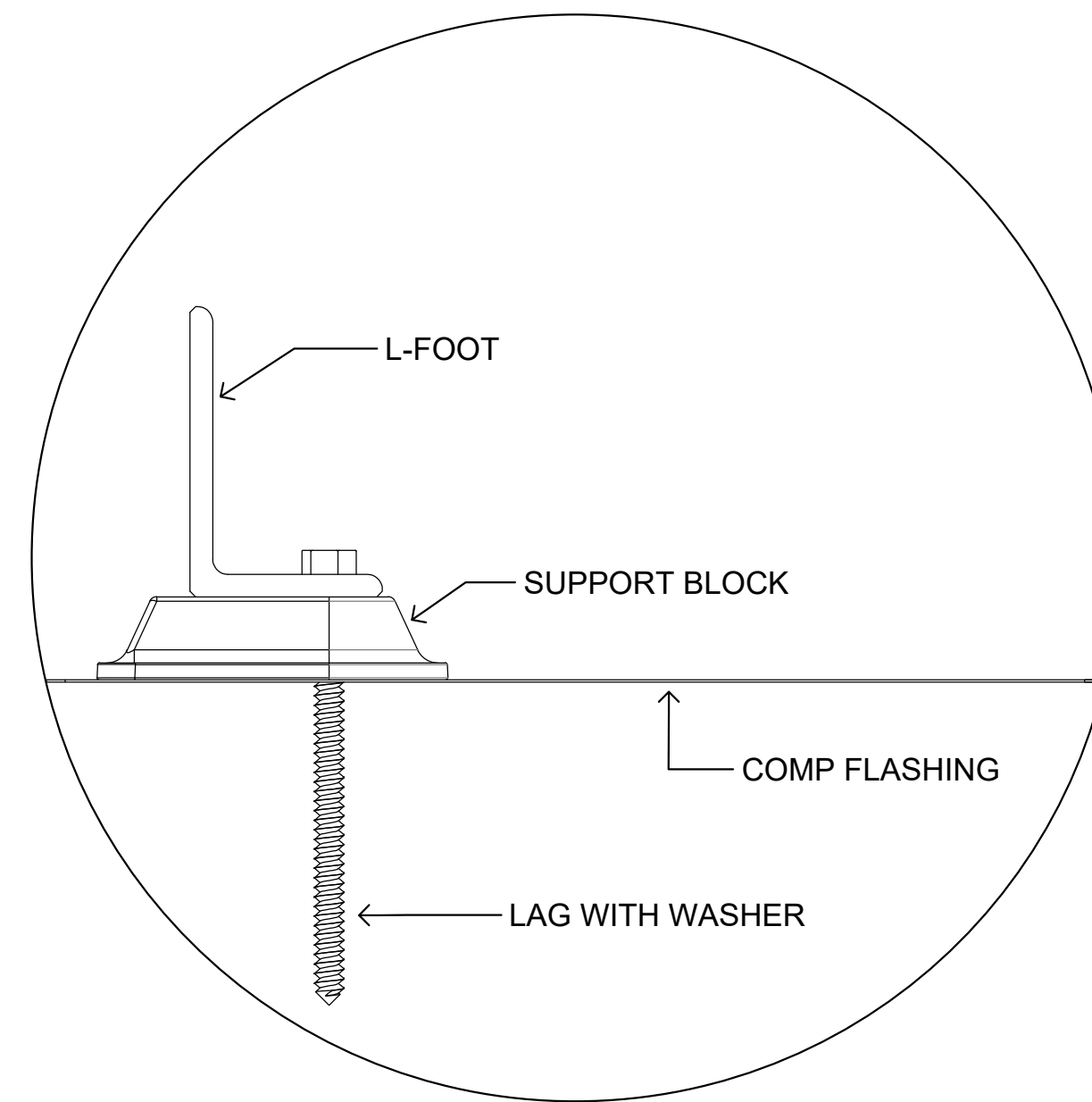
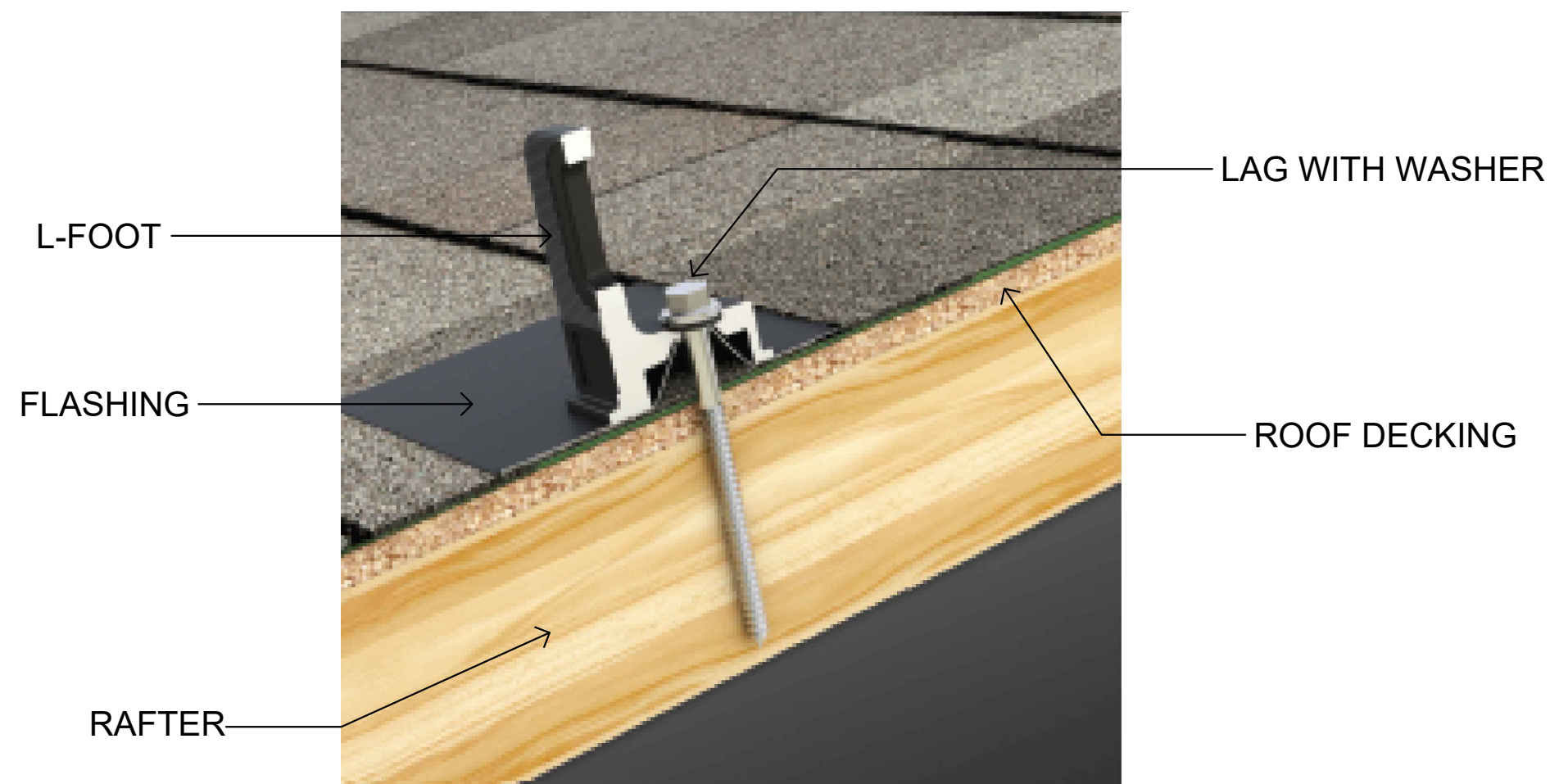
- 03 x Eaton BR220B with hold down kit support (Circuit breaker, 2 pole, 20A)
- 01 x X-IQ-NA-HD-125A: Hold down kit for Eaton circuit breaker with screws
- 01 x BRK-200A-2P-240V: Main Breaker, 2-Pole, 200Amps(Eaton CSR2200N)
- 01 x BRK-60A-2P-240V: Circuit Breaker, 2 pole, 60A (Eaton BR260)
- 01 x BRK-20A-2P-240V-B: Circuit Breaker, 2 pole, 20A (Eaton BR220B)
- 01 x DU222RB: 250volt/60amp/2pole non fusible disconnect (NEMA 3R)
- 02 x EZSLR JB-1.2: SolaDeck



6in setback from sides of the roof

BILL OF MATERIAL
SCALE: 1/8" - 1'





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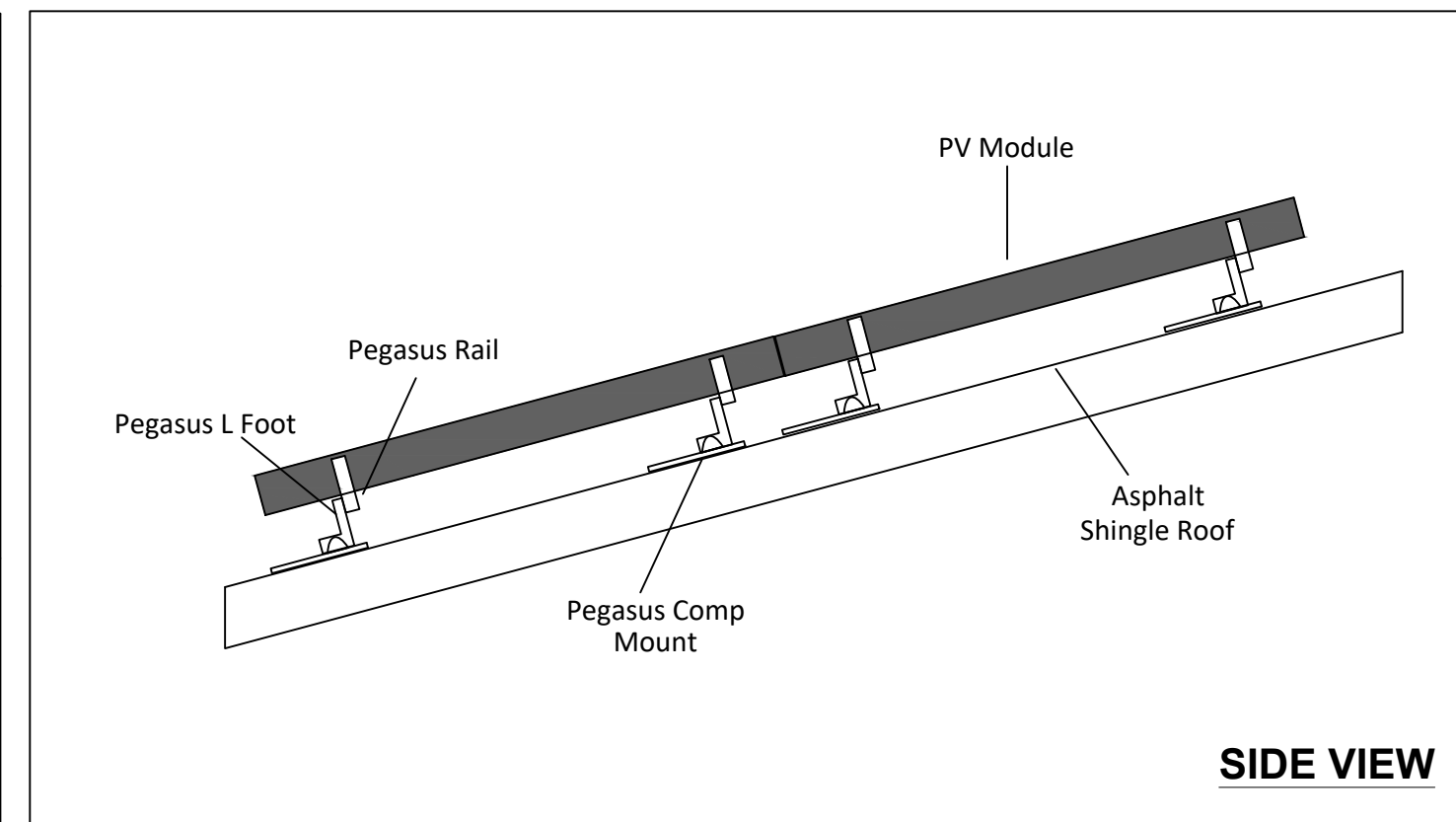
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Multi-Clamp	Hidden End Clamp	MLPE Mount	Dovetail T-Bolt	Ground Lug	Cable Grip
Torque Value 100 in-lbs.	Torque Value 135 in-lbs.	Torque Value 135 in-lbs.	Torque Value 300 in-lbs.	Torque Value 135 in-lbs.	Torque Value 135 in-lbs.



PV Dead Load	
Roof A	<p>PV System Dead Load (Panel + Racking weight) / PV System Area (15 panels x 45.8 lbs./panel + 185 ft. of racking x 1.17 lb.ft) / (15 panels x 6.11' x 3.37') = 2.90 psf</p>

PV Dead Load	
Roof B	<p>PV System Dead Load (Panel + Racking weight) / PV System Area (08 panels x 45.8 lbs./panel + 55 ft. of racking x 1.17 lb.ft) / (08 panels x 6.11' x 3.37') = 2.60 psf</p>