

**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**

1. A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
2. THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
3. ROOFTOP MOUNTED PHOTOVOLTAIC PANELS AND MODULES SHALL BE TESTED, LISTED AND IDENTIFIED BY RECOGNIZED ELECTRICAL TESTING LABORATORY.
4. MODULES AND SUPPORT STRUCTURES SHALL BE GROUNDED
5. SOLAR INVERTER SHALL BE LISTED TO UL1741
6. ALL CONDUCTORS SHALL BE COPPER AND SHOULD BE 75 AND 90 DEG RATED
7. 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.
8. 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.
9. ALL PV MODULES AND ASSOCIATED EQUIPMENT AND WIRING SHALL BE PROTECTED FROM PHYSICAL DAMAGE.

**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:** 115 MPH  
**GROUND SNOW LOAD:** 20 PSF  
**WIND EXPOSURE FACTOR:** B

**UTILITY COMPANY:**  
DUKE ENERGY  
  
**PERMIT ISSUER (AHJ):**  
CITY OF DURHAM

**SCOPE OF WORK**  
 INSTALLATION OF UTILITY INTERACTIVE PHOTOVOLTAIC SOLAR SYSTEM.

SR.#	PROJECT INFORMATION	
1	PV MODULES	20 x SILFAB ELITE SIL-410 BG
2	MICROINVERTERS	20 x IQ8PLUS-72-2-US
3	ROOF TYPE	ASPHALT SHINGLES
4	RACKING	PSR-B84 RAILS (BLACK)
5	MOUNTING TYPE	COMP MOUNT FLASHING (BLACK)
6	DC SIZE	8.2 KW
7	AC SIZE	5.8 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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**Customer Information:**

**Andrew H Wakefield**

21 Fairfield Ln  
 Lillington NC 27546

**Customer Signature:**

**Sheet Name:**

Drawing Index

**JOB NUMBER:**

23-596-AW

**Date:**

11/10/2023

**Revision:**

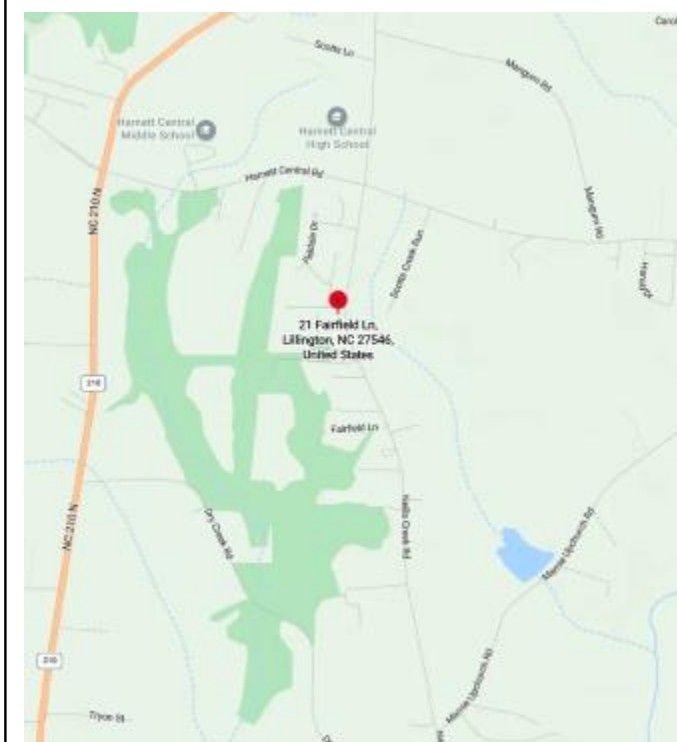
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**Sheet Size:**

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**Sheet Number:**

PV1

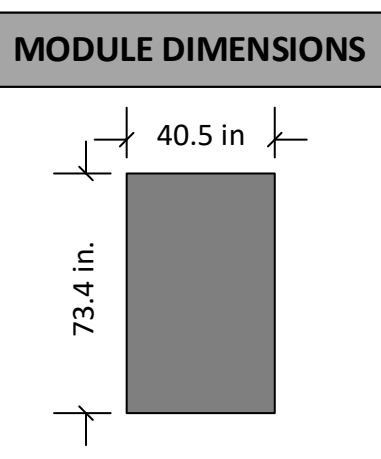


**VICINITY MAP**

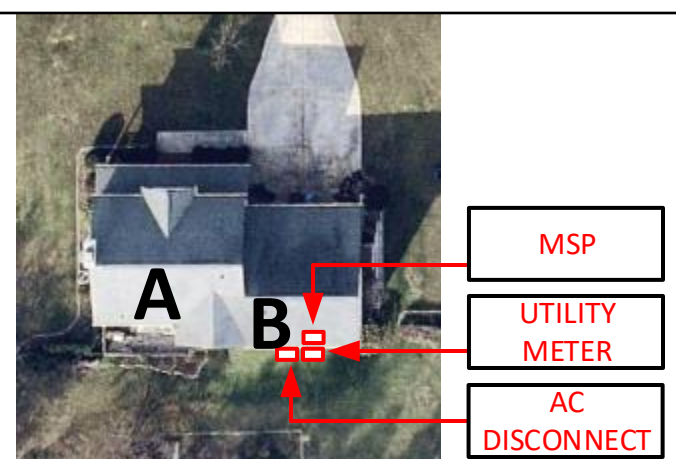
**TOP VIEW OF THE BUILDING**



ROOF DESCRIPTION			
ROOFS	PITCH	AZIMUTH	NO. OF MODULES
A	34°	180°	10
B	18°	180°	10
Vent		<ul style="list-style-type: none"> <li>No vents will be covered by PV modules during the installation</li> </ul>	



PV System Dead Load (Panel + Racking weight) / PV System Area (No. of panels x Weight of panel(lbs.) + Length of racking(ft.) x 1.15 lb.ft) / (No. of panels x Height x Width) = Total psf			
ROOFS	A	B	
DEAD LOAD (PSF)	2.87	2.87	



**SYSTEM DETAILS**

NUMBER OF PANELS : 20  
 PANELS MODEL : SILFAB ELITE SIL-410 BG  
 DC SIZE : 8.2 kW  
 AC SIZE : 5.8 kVA



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**Sheet Name:**

Site Layout

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23-596-AW

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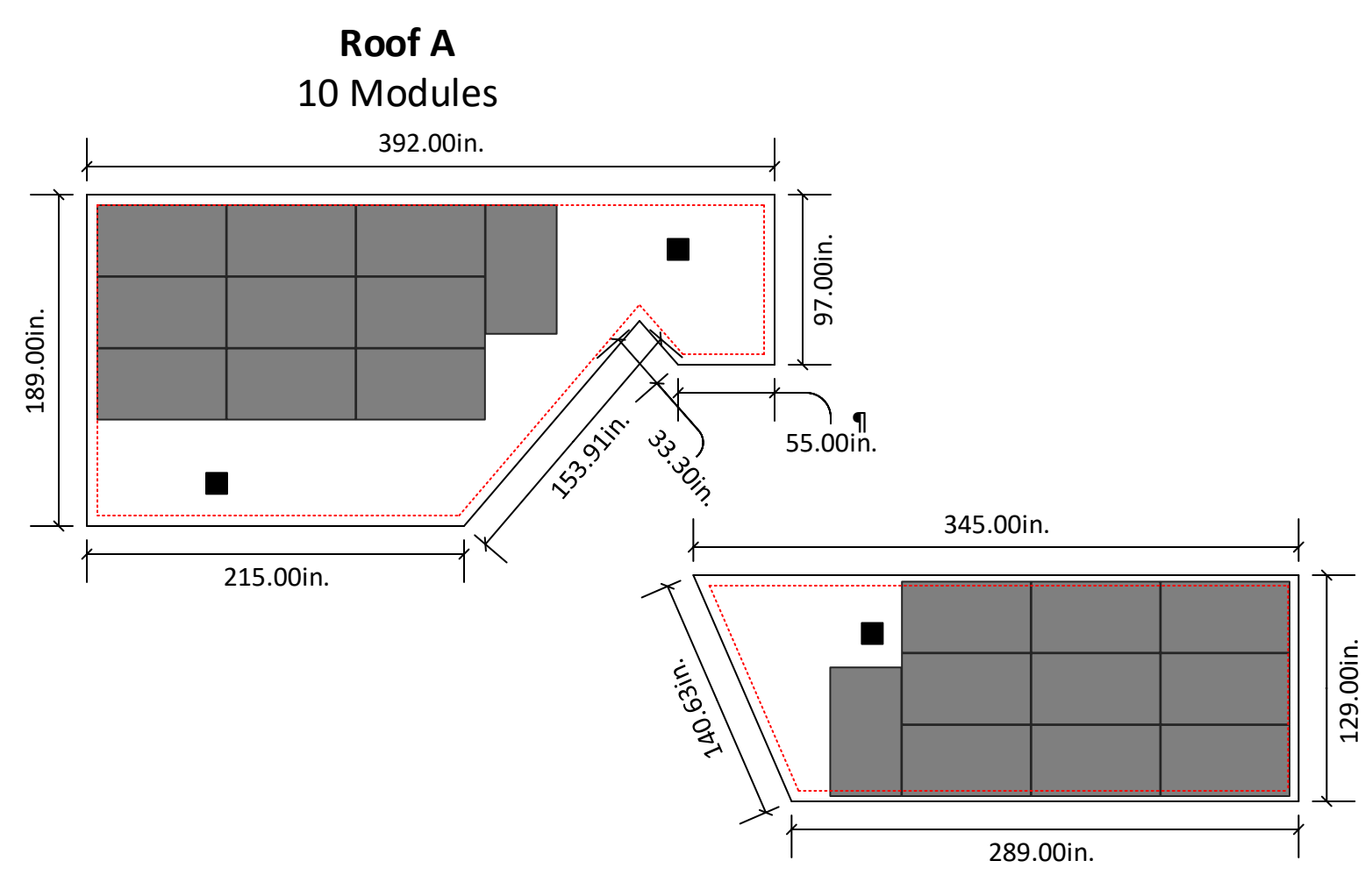
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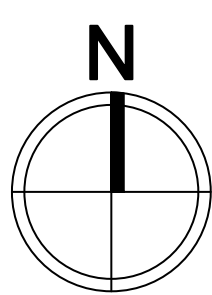
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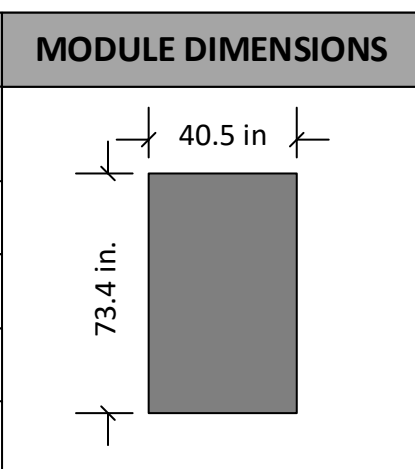


6in setback from sides of the roof

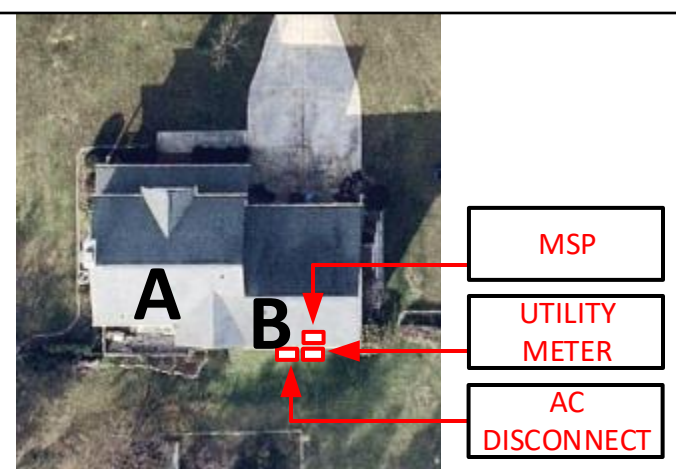
**SITE LAYOUT**  
 SCALE: 1/8" - 1'



ROOF DESCRIPTION			
ROOFS	PITCH	AZIMUTH	NO. OF MODULES
A	34°	180°	10
B	18°	180°	10



STRING LAYOUT					
ENPHASE IQ COMBINER 4					
Strings #	No. of Modules	Color	Strings #	No. of Modules	Color
String 1	10	Blue			Green
String 2	10	Orange			Purple
		Brown			Light Blue



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AC SIZE : 5.8 kVA

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**Sheet Name:**

String Mapping

**JOB NUMBER:**

23-596-AW

**Date:**

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**Revision:**

A

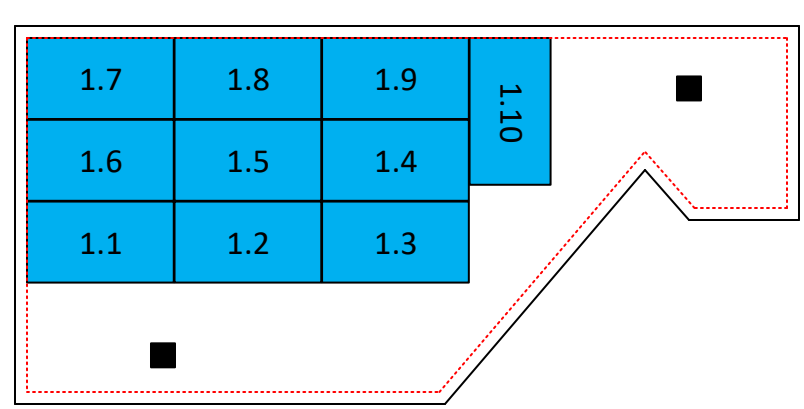
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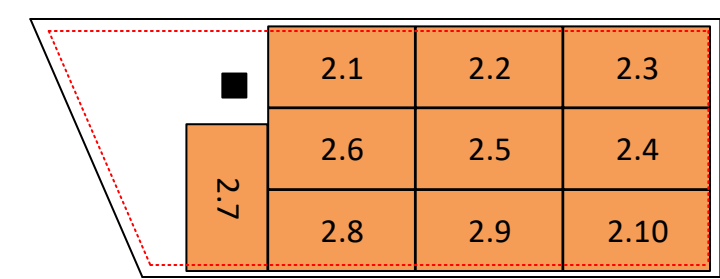
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PV3

**Roof A**  
10 Modules

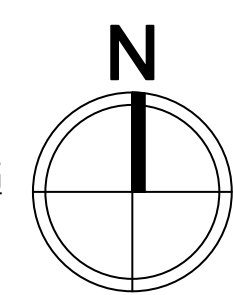


**Roof A**  
10 Modules



6in setback from  
sides of the roof

STRING MAPPING  
SCALE: 1/8" - 1'



**STRING CALCULATION**

String #	No of Modules	Estimated Power	I <sub>max</sub>	V <sub>oc</sub>	V <sub>mpp</sub>	V <sub>rise</sub> (<= 2%)
1	10	4,100 W	15.12 AC	<30	240V AC	1.64+0.32 = 1.96
2	10	4,100 W	15.12 AC	<30	240V AC	0.97+0.32 = 1.29

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

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**Sheet Name:**

Electrical One Line Diagram

**JOB NUMBER:**

23-596-AW

**Date:**

11/10/2023

**Revision:**

A

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17" X 22"

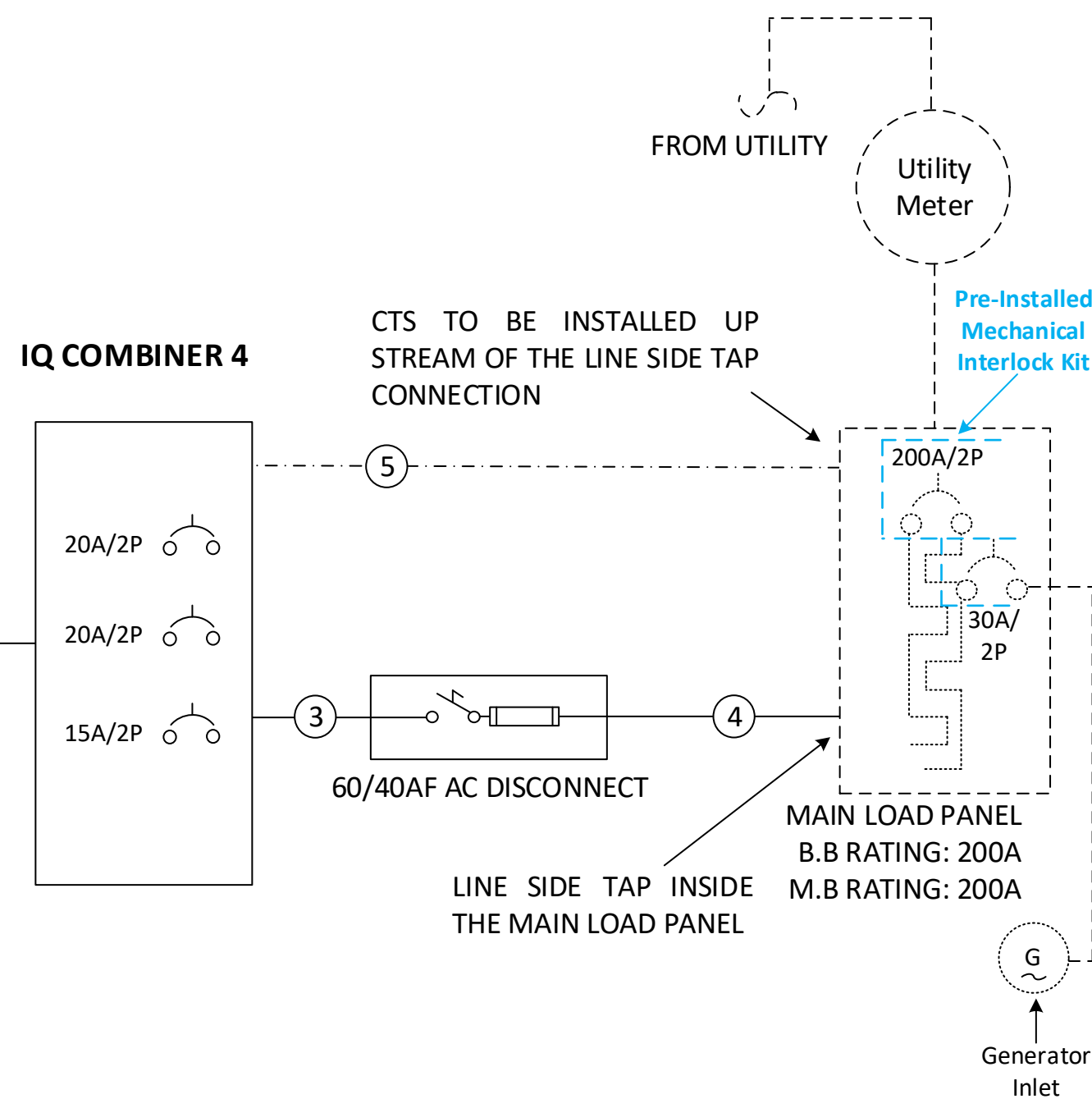
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PV4

**Note:** Before connecting the generator to the system, all the other generation sources like Utility and PV must be disconnected from system manually.

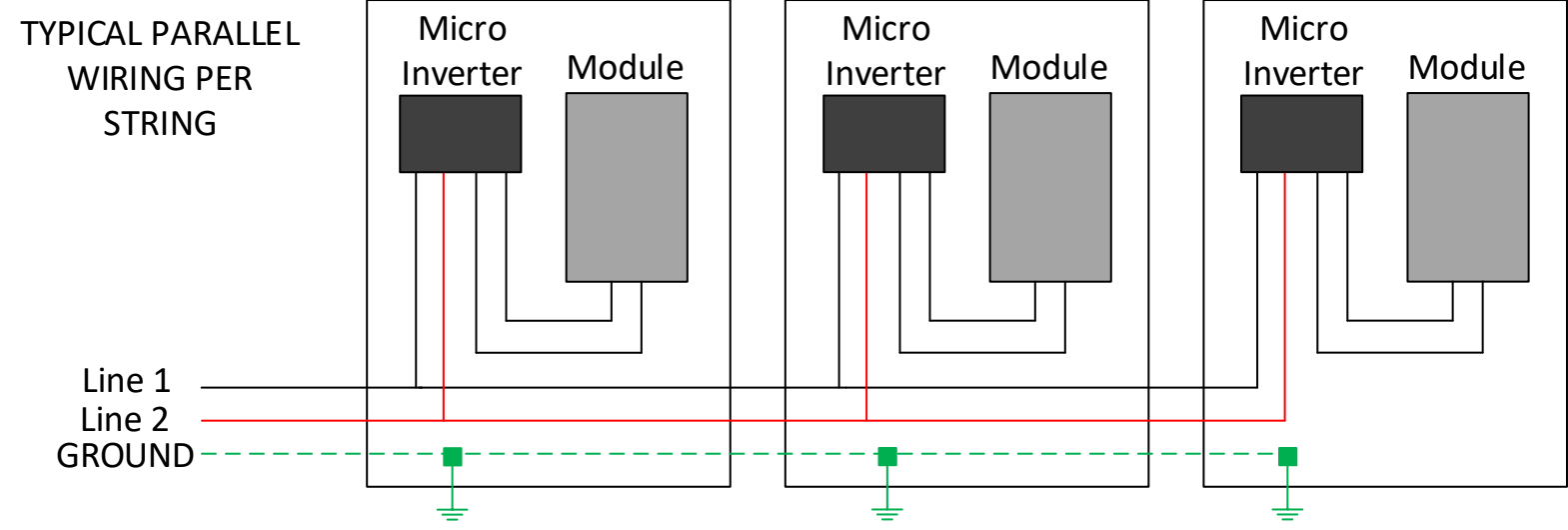
- System Size: 8,200W DC
- (20) SILFAB ELITE SIL-410 BG
- (20) ENPHASE IQ8PLUS-72-2-US MICROINVERTERS
- Inverter Output: 1.21A max @ 240 VAC (each microinverter)
- 290 VA AC output max (each micro inverter)
- 5.8 kVA AC output max

- 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.



Sr.No	#Wire	Conduit Size	Ground Wire	Amperage
1	1 x #12 Q Cable		#10 Bare CU	20
2	4 x #10 THHN Cu	3/4" EMT	#10 Green	20
3	3 x #6 THHN Cu	3/4" LFNC	#8 Green	40
4	3 x #6 THHN Cu	3/4" EMT		40
5	Lead Wire 18AWG, PVC Extruded	3/4" EMT		



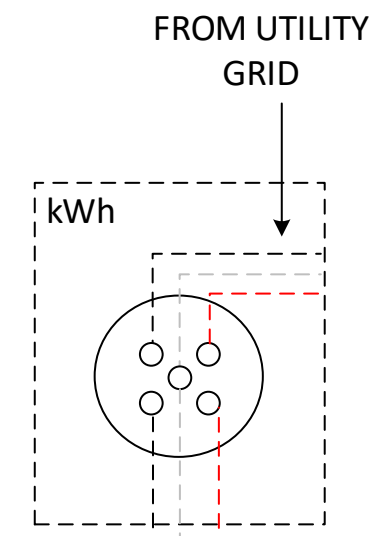


Line 1	—
Line 2	—
Neutral	—
Ground	—
CT Wire	—

**Note:** Line 1 from all strings will be passed from the Production CT.

**Note:** The arrow on Production and Consumption CTs must point towards the loads and away from the source.

**Note:** Before connecting the generator to the system, all the other generation sources like Utility and PV must be disconnected from system manually.



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**Sheet Name:**

Detailed Electrical Diagram

**JOB NUMBER:**

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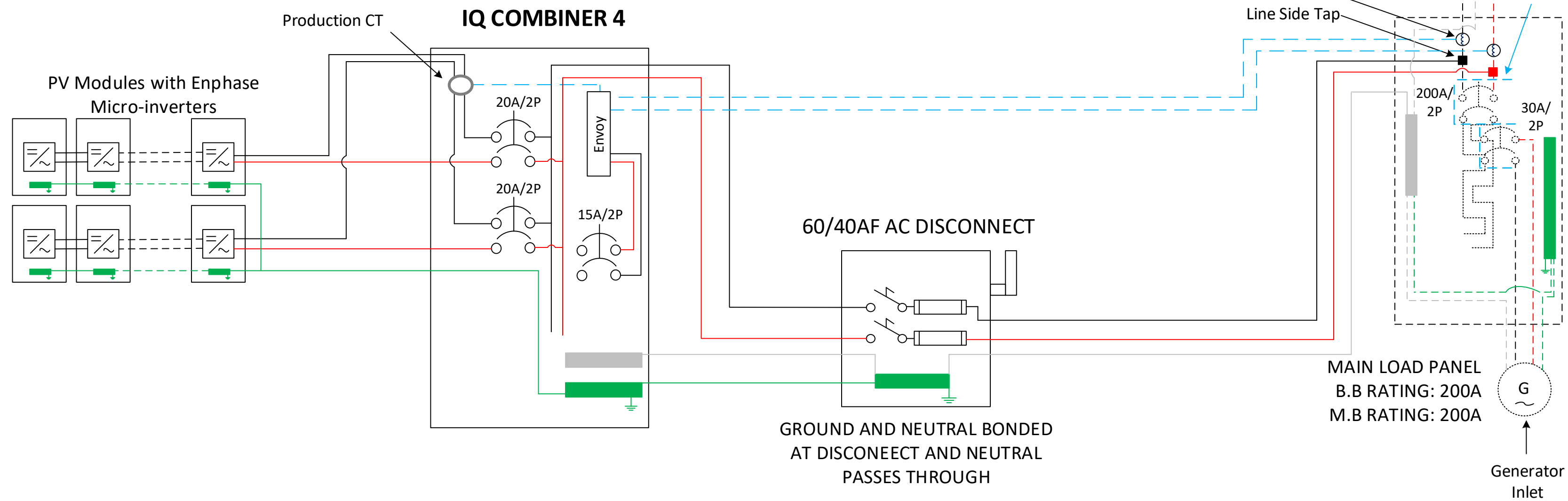
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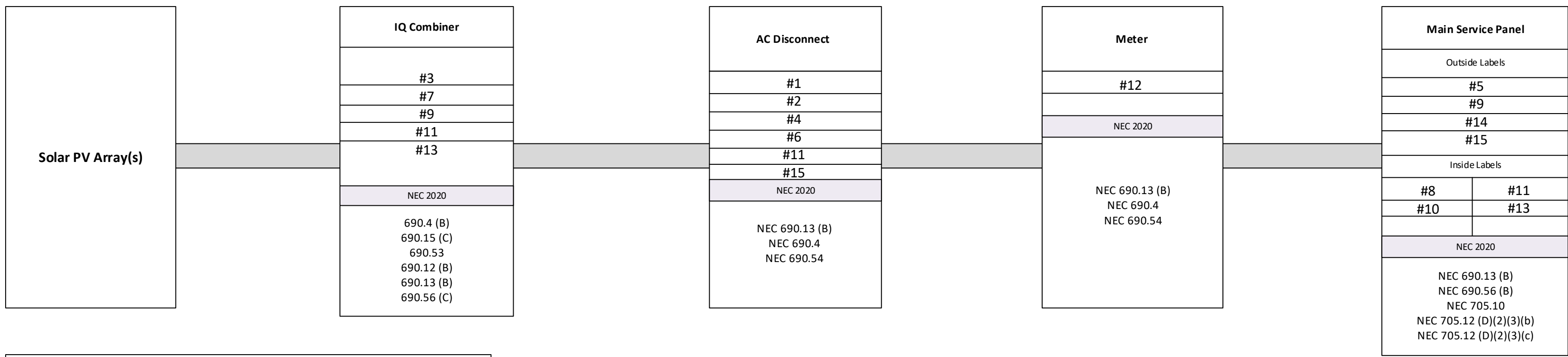
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PV5



Solar connection will be done by Line Side Tap





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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 CONDUIT, RACEWAYS, ENCLOSURES, CABLE ASSEMBLIES, 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 AC CONDUITS, RACEWAYS, ENCLOSURES AND CABLE ASSEMBLIES, AT TURNS ABOVE AND/OR BELOW PENETRATIONS, ALL 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

**#2** RAPID SHUTDOWN SWITCH FOR SOLAR PV SYSTEM

**#3** PHOTOVOLTAIC POWER SOURCE  
OPERATING AC VOLTAGE **240** V  
MAXIMUM OPERATING AC OUTPUT CURRENT **30.25** A

**#4** AC DISCONNECT PHOTOVOLTAIC SYSTEM POWER SOURCE  
RATED AC OUTPUT CURRENT **30.25** AMPS  
NOMINAL OPERATING AC VOLTAGE **240** VOLTS

**#5** SOLAR AC DISCONNECT LOCATED AT SOUTH SIDE WALL OF THE HOUSE BESIDE THE UTILITY METER

**#6** SERVICE DISCONNECT LOCATED INSIDE THE MAIN LOAD PANEL

**#7** PHOTOVOLTAIC SYSTEM COMBINER PANEL DO NOT ADD LOADS

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

**#9** WARNING  
DUAL POWER SUPPLY SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

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

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

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

**#13** 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

**#14** CAUTION  
POWER TO THIS BUILDING IS SUPPLIED FROM THE FOLLOWING SOURCES  
UTILITY GRID  
ELECTRICAL GENERATOR  
PV SOLAR ELECTRICAL SYSTEM

**#15** GENERATOR DISCONNECT LOCATED INSIDE THE MAIN LOAD PANEL

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**Customer Signature:**

**Sheet Name:**  
PV Labels

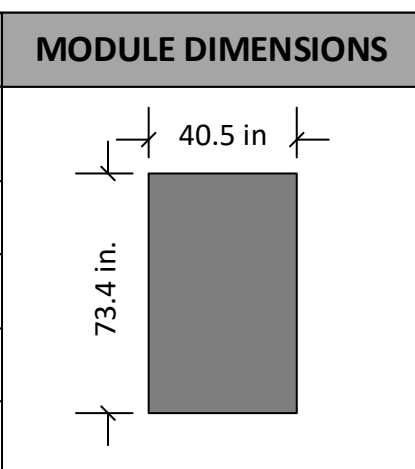
**JOB NUMBER:**  
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**Sheet Number:** PV6



ROOF DESCRIPTION			
ROOFS	PITCH	AZIMUTH	NO. OF MODULES
A	34°	180°	10
B	18°	180°	10



Rails and Splices : PSR-B84 (BLACK)

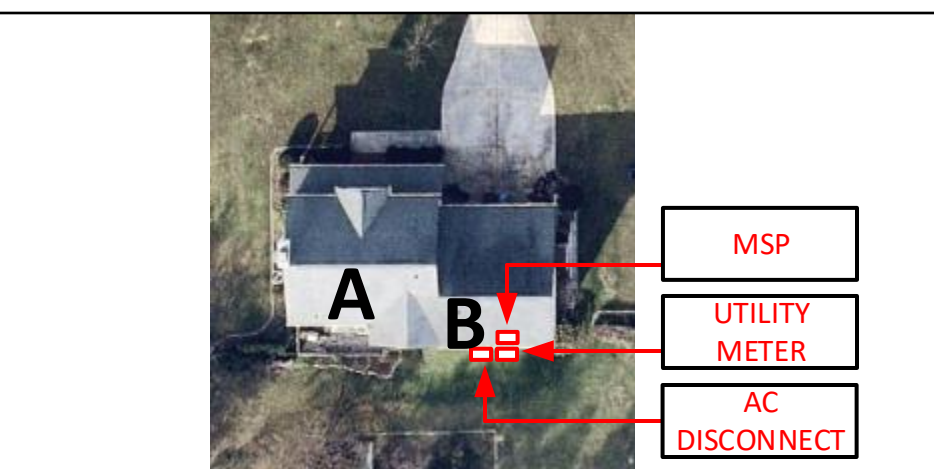
Rafter Spacing : 24 in

Attachment Span: 4ft

Roof Attachment : Pegasus Comp Mount

There is one layer of shingles  
Roofing material is asphalt shingles

The roof is located in 115mph wind zone



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**Sheet Name:**

Bill of Material

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**Sheet Number:**

PV7

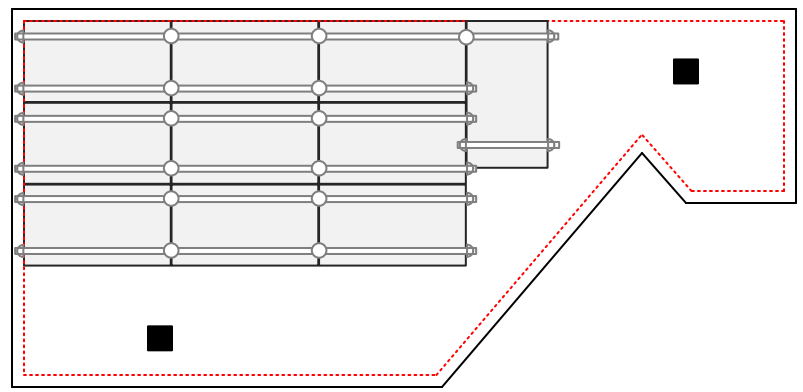


PV LABELS		
Sr No	Code	Qty
01	03-302	01
02	02-316	01
03	03-390	01
04	03-306	01
05	8M-001	01
06	8M-002	01
07	03-355	01
08	05-108	01
09	05-211	02
10	05-372	01
11	05-215	03
12	07-359	01
13	07-111	02
14	8M-005	01
15	8M-003	02

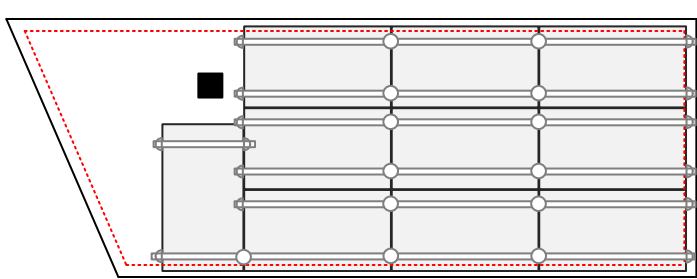
- RAILS AND MOUNTING SYSTEM**
- 40 x PSR-B84: Pegasus Rail, Black, 84" (7 Feet)
  - 26 x PSR-SPL: Pegasus - Bonded, Structural Splice
  - 26 x PSR-MCB: Pegasus - Multiclamper, Mid/End, 30 to 40 mm, Black
  - 32 x PSR-HEC: Pegasus - Hidden End Clamp
  - 20 x PSR-MLP: Pegasus - MLPE Mount
  - 12 x PSR-LUG: Pegasus - Grounding Lug
  - 30 x PSR-WMC: Pegasus - Wire Management Clip
  - 04 x PSR-CBG: Pegasus - Cable Grip
  - 32 x PSR-CAP: Pegasus - End Cap
  - 68 x PSCR-UBBDT: Pegasus Comp Mount - Open Slot, Black L Foot, Black Flashing, Dovetail 3/8" T-Bolt
  - 40 x Heyco Wire Clips
  - 08 x RT Mini II Mounts
  - 32 x Screw 5.0 x 60
  - 08 x RT2-04-FBN25SL 5/16"
  - 08 x LFT-03-M1: Slotted L-Foot Mill

- SOLAR MODULES**
- 20 x SILFAB ELITE SIL-410 BG
- INVERTER & SUPPORTING ITEMS**
- 20 x Enphase IQ8PLUS-72-2-US micro inverter
  - 01 x X-IQ-AM1-240-4 IQ Combiner 4
- ENPHASE CABLES AND ACCESSORIES**
- 24 x Q-12-20-200: Q Cable
  - 01 x Q-12-RAW-300:Q Cable, 12 AWG (70ft)
  - 04 x Q-CONN-10M Male Field-wireable connector
  - 04 x Q-CONN-10F Female Field-wireable connector
  - 02 x Q-TERM-10: Terminator Cap
  - 05 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**
- 02 x Eaton BR220B with hold down kit support (Circuit breaker, 2 pole, 20A)
  - 02 x IPCS 4002: Line/Load Side Hot Taps (#4/0 main - #2-10 tap) Medium types
  - 01 x D222NRB: 250volt/60amp/2pole fusible disconnect (NEMA 3R)
  - 02 x SQUARE D FRNR40: 250volt/40amp fuses
  - 10 x FM-CM-001-B: Conduit Flashings

**Roof A**  
10 Modules

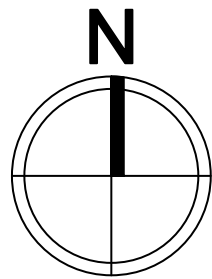


**Roof B**  
10 Modules



6in setback from sides of the roof

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



**Customer Information:**

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Attachment Details

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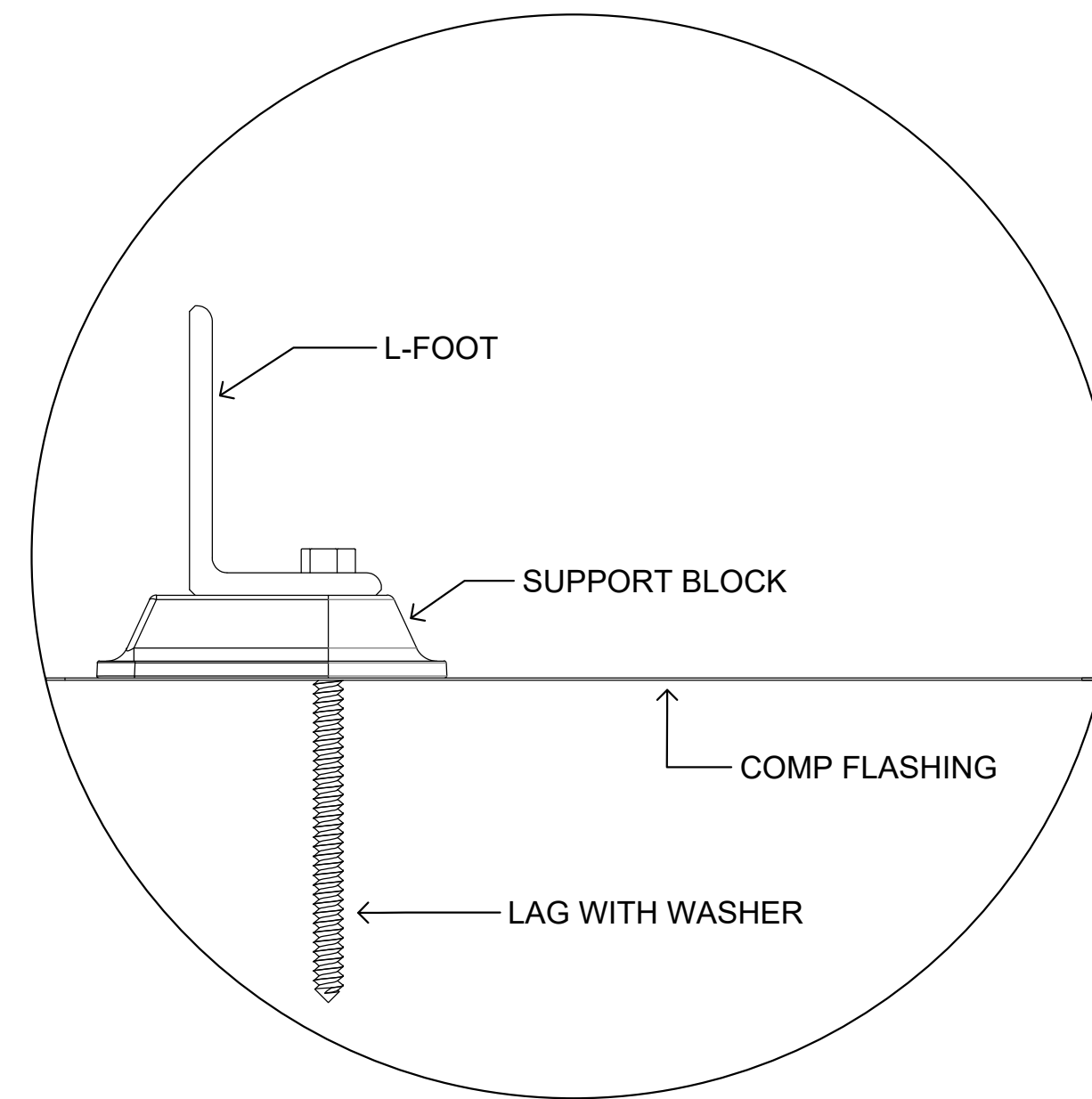
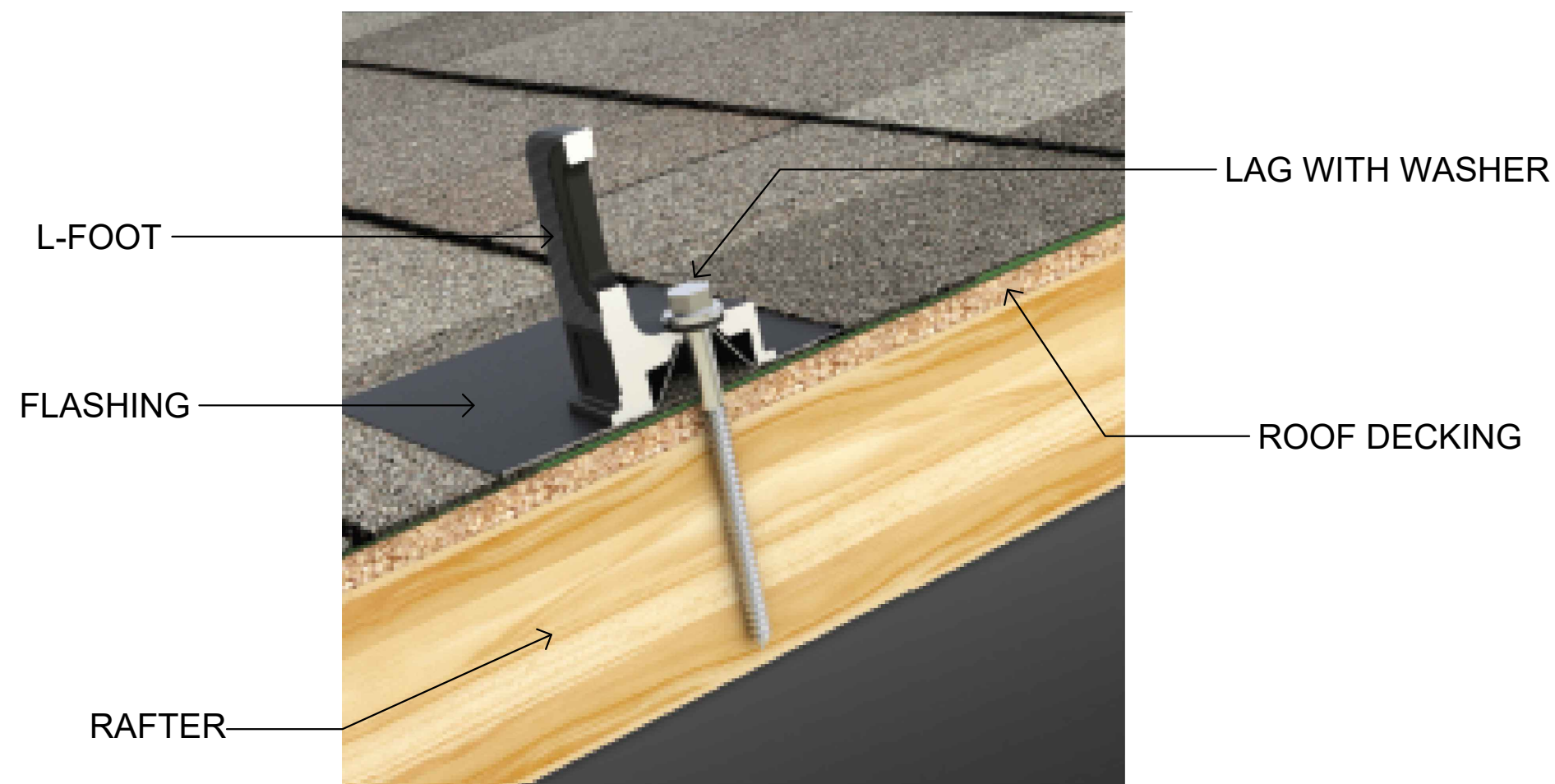
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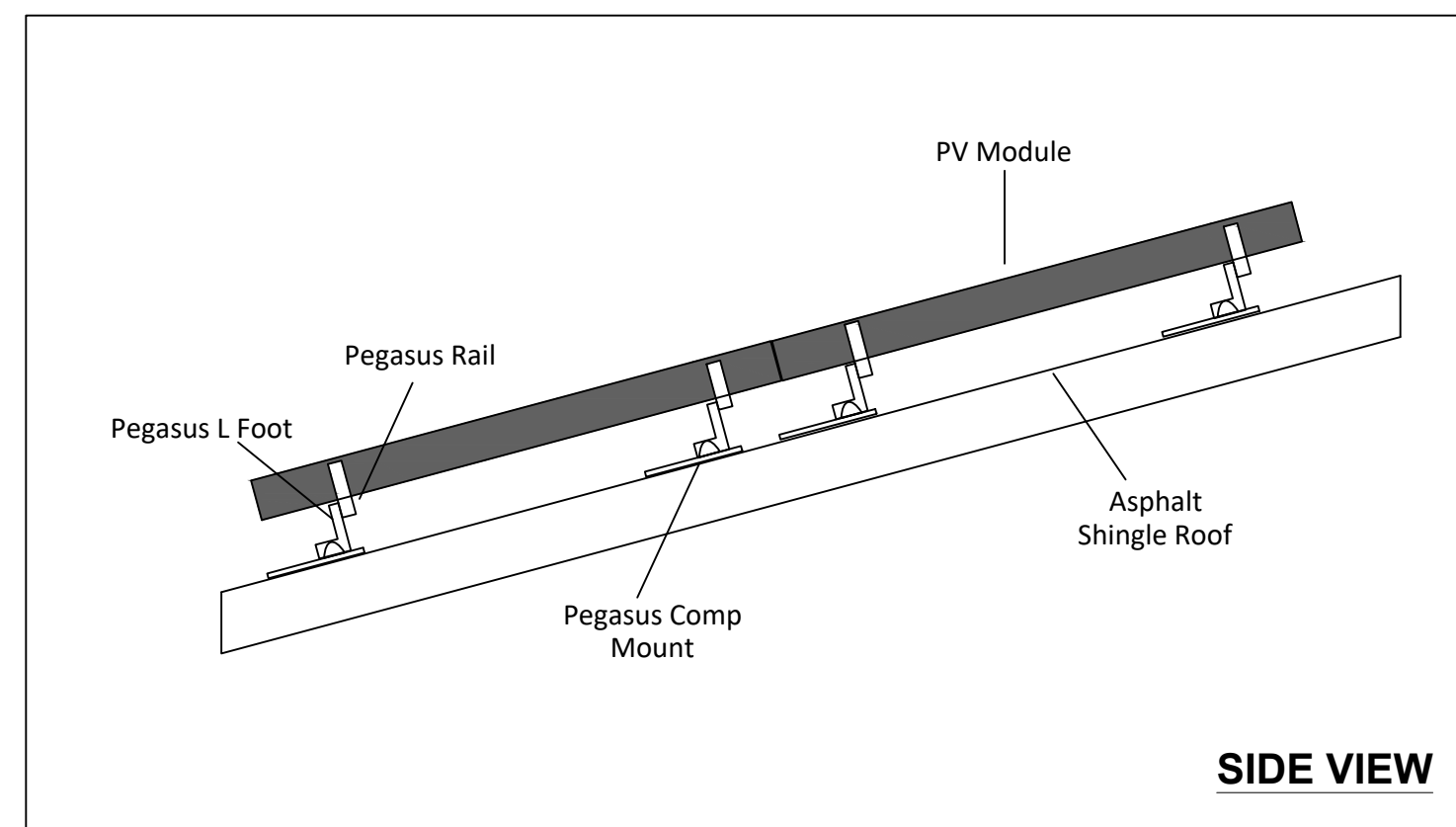
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PV8



					
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	
<b>Roof A</b>	<p><b>PV System Dead Load</b> (Panel + Racking weight) / PV System Area (10 panels x 48.5 lbs./panel + 71 ft. of racking x 1.17 lb.ft) / (10 panels x 6.11' x 3.37') = 2.87 psf</p>

PV Dead Load	
<b>Roof B</b>	<p><b>PV System Dead Load</b> (Panel + Racking weight) / PV System Area (10 panels x 48.5 lbs./panel + 71 ft. of racking x 1.17 lb.ft) / (10 panels x 6.11' x 3.37') = 2.87 psf</p>