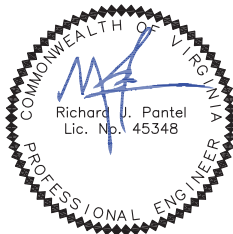


MALA RAJAMANI - 10.560kW DC, 8.376kW AC					Attachment 03																																					
VICINITY MAP		AERIAL MAP		<table><tr><th colspan="3">SHEET CATALOG</th></tr><tr><th>SHEET</th><th>REVISION</th><th>DESCRIPTION</th></tr><tr><td>CS-01</td><td>B</td><td>COVER SHEET</td></tr><tr><td>CS-02</td><td>B</td><td>GENERAL NOTES</td></tr><tr><td>E-01</td><td>B</td><td>SITE PLAN</td></tr><tr><td>E-01.1</td><td>B</td><td>SATELLITE VIEW</td></tr><tr><td>S-01</td><td>B</td><td>MOUNTING DETAILS</td></tr><tr><td>S-02</td><td>B</td><td>STRUCTURAL DETAILS</td></tr><tr><td>E-02</td><td>B</td><td>SINGLE LINE DIAGRAM</td></tr><tr><td>E-03</td><td>B</td><td>ELECTRICAL CALCULATIONS</td></tr><tr><td>PL-01</td><td>B</td><td>PLACARDS</td></tr><tr><td>SS</td><td>B</td><td>SPEC SHEET(S)</td></tr></table>			SHEET CATALOG			SHEET	REVISION	DESCRIPTION	CS-01	B	COVER SHEET	CS-02	B	GENERAL NOTES	E-01	B	SITE PLAN	E-01.1	B	SATELLITE VIEW	S-01	B	MOUNTING DETAILS	S-02	B	STRUCTURAL DETAILS	E-02	B	SINGLE LINE DIAGRAM	E-03	B	ELECTRICAL CALCULATIONS	PL-01	B	PLACARDS	SS	B	SPEC SHEET(S)
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HOUSE VIEW																																										
																																										
ENGINEERING SCOPE OF WORK																																										
1. ILLUMINE INTERNATIONAL INC. HAS ONLY PROVIDED DRAFTING SERVICES FOR THE PERMIT DRAWINGS. NO ACTUAL ENGINEERING WORK, ENGINEERING REVIEW OR ENGINEERING APPROVAL HAS BEEN CONDUCTED BY ILLUMINE INTERNATIONAL INC. UNLESS NOTED OTHERWISE. 2. WHEN A PROFESSIONAL ENGINEER APPROVES AND SEALS THE DESIGN FOR COMPONENTS OF THEIR RESPECTIVE DISCIPLINE (STRUCTURAL/ELECTRICAL) SHOWN ON THESE PERMIT DRAWINGS, THE PROFESSIONAL ENGINEER a. TAKES FULL DIRECT CONTROL OF THE ENGINEERED DESIGN b. IS GIVEN ACCESS TO PERSONALLY SUPERVISE AND RECTIFY ANY ASPECT OF THE ENGINEERED DESIGN c. HAS FULLY ACCEPTED RESPONSIBILITY FOR THE ENGINEERED DESIGN																																										
GENERAL NOTES																																										
1. MODULES ARE LISTED UNDER UL 1703 / 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 AND THE ACTUAL SITE CONDITION MIGHT VARY. 4. WORKING CLEARANCES AROUND THE NEW PV ELECTRICAL EQUIPMENT WILL 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 THE LOCAL JURISDICTION AND/OR THE UTILITY. 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.																																										
APPLICABLE CODES			 Reviewed and approved Richard Pantel, P.E. VA Lic. No. 45348 10/22/2025																																							
CUSTOMER INFORMATION						CONTRACTOR INFORMATION																																				
NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX																																										
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PRN NUMBER: COS-1017733 REV: B DRAFTED BY: RAJKUMAR G QC'ED BY: PANDI SRIRAM SCALE: AS NOTED PAPER SIZE: 17"X11"						COVER SHEET DATE: 10/09/2025 SHEET: CS-01																																				

INSTALLATION NOTES:

1. STRUCTURAL ROOF MEMBER LOCATIONS ARE ESTIMATED AND SHOULD BE LOCATED AND VERIFIED BY THE CONTRACTOR WHEN LAG BOLT PENETRATION OR MECHANICAL ATTACHMENT TO THE STRUCTURE IS REQUIRED.
2. ROOFTOP PENETRATIONS FOR SOLAR RACKING WILL BE COMPLETED AND SEALED WITH APPROVED SEALANT PER CODE BY A LICENSED CONTRACTOR.
3. LAGS MUST HAVE A MINIMUM 2.5" THREAD EMBEDMENT INTO THE STRUCTURAL MEMBER.
4. ALL PV RACKING ATTACHMENTS SHALL BE STAGGERED BY ROW BETWEEN THE ROOF FRAMING MEMBERS AS NECESSARY.
5. ROOF MOUNTED STANDARD RAIL REQUIRES ONE THERMAL EXPANSION GAP FOR EVERY RUN OF RAIL GREATER THAN 40'.
6. ALL CONDUCTORS AND CONDUITS ON THE ROOF SHALL BE MINIMUM 7/8" ABOVE THE ROOF SURFACE (INCLUDING CABLES UNDERNEATH MODULES AND RACKING).
7. ALL SOLAR PANEL ARRAY COMPONENTS SHALL BE INSTALLED PER THE MANUFACTURER'S APPROVED INSTALLATION SPECIFICATIONS.
8. THE EXISTING BUILDINGS STRUCTURE SHALL BE VERIFIED AS PROPERLY CONSTRUCTED AND MAINTAINED IN GOOD CONDITION. NO ALLOWANCE HAS BEEN MADE IN THESE DRAWINGS FOR ANY EXISTING DEFICIENCY IN DESIGN, MATERIAL, CONSTRUCTION, OR LACK OF MAINTENANCE FOR THE EXISTING STRUCTURE OR PROPOSED EQUIPMENT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING EXISTING CONDITIONS, PROPER FIT, AND CLEARANCES IN THE FIELD.
9. WATERPROOFING AROUND THE ROOF PENETRATIONS IS THE RESPONSIBILITY OF CONTRACTOR/INSTALLER.
10. MISCELLANEOUS ITEMS NOT EXPLICITLY LISTED OR IDENTIFIED IN THESE DRAWINGS HAVE NOT BEEN DESIGNED. IT IS RECOMMENDED THAT MATERIAL OF SUITABLE SIZE STRENGTH TO BE OBTAINED FROM A REPUTABLE MANUFACTURER FOR MISCELLANEOUS ITEMS.
11. IF PROJECT IS STAMPED AND SEALED BY AN ILLUMINE-I STRUCTURAL ENGINEER, SEE ASSOCIATED ILLUMINE-I STRUCTURAL REPORT FOR FULL COMPREHENSIVE SCOPE OF STRUCTURAL ENGINEERING INVESTIGATION AND APPROVAL.
12. IF ANY CONDITION THROUGHOUT THE ASSOCIATED REPORT OR PERMIT DRAWINGS IS NOT ALSO REPRESENTED ON-SITE, CONTRACTOR SHALL NOTIFY THE ENGINEER OF RECORD OF ANY DISCREPANCIES AND RECEIVE WRITTEN APPROVAL FROM THE ENGINEER OF RECORD BEFORE PROCEEDING WITH INSTALLATION.
13. CONTRACTOR TO PROVIDE MINIMUM 1/4" GAP BETWEEN ALL SOLAR PANELS.

ROOF ACCESS PATHWAYS AND SETBACKS:

1205.2.1 SOLAR PHOTOVOLTAIC SYSTEMS FOR GROUP R-3 BUILDINGS:

SOLAR PHOTOVOLTAIC SYSTEMS FOR GROUP R-3 BUILDINGS SHALL COMPLY WITH SECTIONS 1205.2.1.1 THROUGH 1205.2.1.3.

EXCEPTIONS:

1. THESE REQUIREMENTS SHALL NOT APPLY TO STRUCTURES DESIGNED AND CONSTRUCTED IN ACCORDANCE WITH THE INTERNATIONAL RESIDENTIAL CODE.
2. THESE REQUIREMENTS SHALL NOT APPLY TO ROOFS WITH SLOPES OF 2 UNITS VERTICAL IN 12 UNITS HORIZONTAL (16.7-PERCENT) OR LESS.

1205.2.1.1 PATHWAYS TO RIDGE:

NOT FEWER THAN TWO 36-INCH-WIDE (914 MM) PATHWAYS ON SEPARATE ROOF PLANES, FROM LOWEST ROOF EDGE TO RIDGE, SHALL BE PROVIDED ON ALL BUILDINGS. NOT FEWER THAN ONE PATHWAY SHALL BE PROVIDED ON THE STREET OR DRIVEWAY SIDE OF THE ROOF. FOR EACH ROOF PLANE WITH A PHOTOVOLTAIC ARRAY, NOT FEWER THAN ONE 36-INCH-WIDE (914 MM) PATHWAY FROM LOWEST ROOF EDGE TO RIDGE SHALL BE PROVIDED ON THE SAME ROOF PLANE AS THE PHOTOVOLTAIC ARRAY, ON AN ADJACENT ROOF PLANE OR STRADDLING THE SAME AND ADJACENT ROOF PLANES

1205.2.1.2 SETBACKS AT RIDGE:

FOR PHOTOVOLTAIC ARRAYS OCCUPYING 33 PERCENT OR LESS OF THE PLAN VIEW TOTAL ROOF AREA, A SETBACK OF NOT LESS THAN 18 INCHES (457 MM) WIDE IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE. FOR PHOTOVOLTAIC ARRAYS OCCUPYING MORE THAN 33 PERCENT OF THE PLAN VIEW TOTAL ROOF AREA, A SETBACK OF NOT LESS THAN 36 INCHES (457 MM) WIDE IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE.

1205.2.1.3 ALTERNATIVE SETBACKS AT RIDGE:

WHERE AN AUTOMATIC SPRINKLER SYSTEM IS INSTALLED WITHIN THE DWELLING IN ACCORDANCE WITH SECTION 903.3.1.3, SETBACKS AT THE RIDGE SHALL CONFORM TO ONE OF THE FOLLOWING:

1. FOR PHOTOVOLTAIC ARRAYS OCCUPYING 66 PERCENT OR LESS OF THE PLAN VIEW TOTAL ROOF AREA, A SETBACK OF NOT LESS THAN 18 INCHES (457 MM) WIDE IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE.
2. FOR PHOTOVOLTAIC ARRAYS OCCUPYING MORE THAN 66 PERCENT OF THE PLAN VIEW TOTAL ROOF AREA, A SETBACK OF NOT LESS THAN 36 INCHES (914 MM) WIDE IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE.

1205.2.2 EMERGENCY ESCAPE AND RESCUE OPENINGS. PANELS AND MODULES INSTALLED ON GROUP R-3 BUILDINGS SHALL NOT BE PLACED ON THE PORTION OF A ROOF THAT IS BELOW AN EMERGENCY ESCAPE AND RESCUE OPENING. A PATHWAY OF NOT LESS THAN 36 INCHES (914 MM) WIDE SHALL BE PROVIDED TO THE EMERGENCY ESCAPE AND RESCUE OPENING.

CUSTOMER INFORMATION	CONTRACTOR INFORMATION
NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX	
DRAWING INFORMATION	
PRN NUMBER: COS-1017733 REV: B DRAFTED BY: RAJKUMAR G QC'ED BY: PANDI SRIRAM SCALE: AS NOTED PAPER SIZE: 17"X11"	
 GENERAL NOTES DATE: 10/09/2025 SHEET: CS-02	

MALA RAJAMANI - 10.560kW DC, 8.376kW AC

NOTE: NO GATE AND FENCE

1'-6" FIRE SETBACK

PROPERTY LINE

26'-9"

6'-8"

3' FIRE SETBACK

RESIDENCE

PHOTOVOLTAIC ARRAY ON THE ROOF

3'-5"

66'-8"

66'-8"

5'-4"

DRIVEWAY

WALKWAY

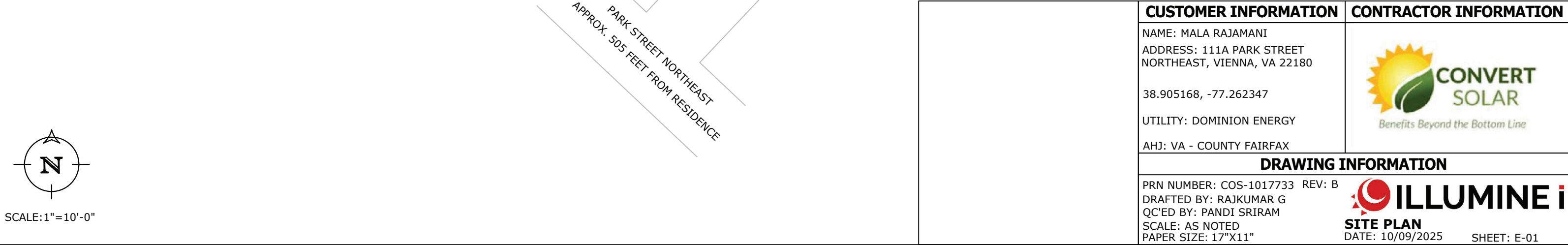
(E) MAIN SERVICE PANEL (INTERIOR)

(E) UTILITY METER (EXTERIOR)

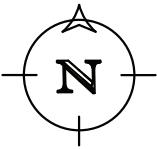
(N) AC DISCONNECT (EXTERIOR)

(N) ENPHASE IQ COMBINER 4C (EXTERIOR)

CONDUIT RUN

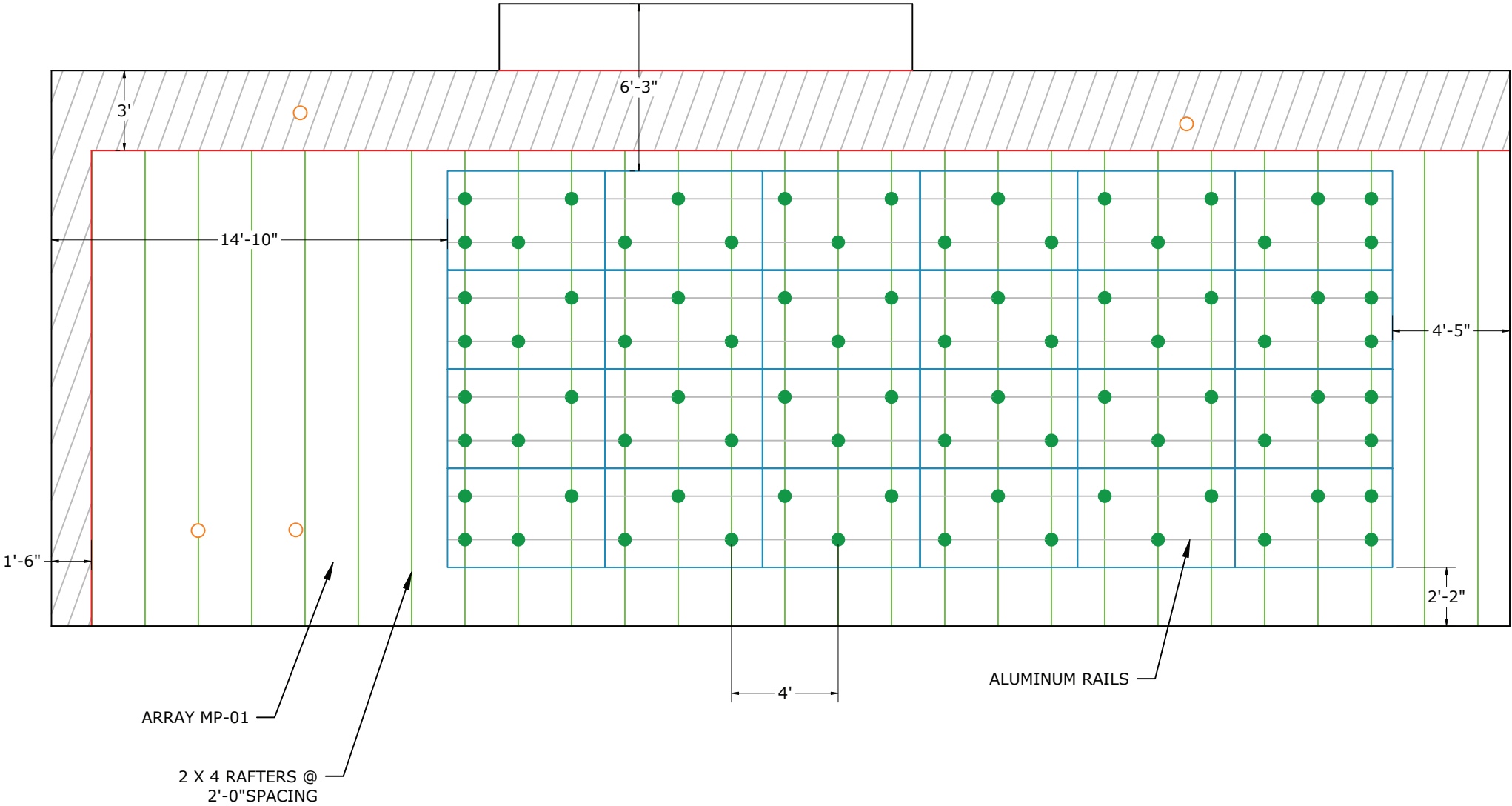


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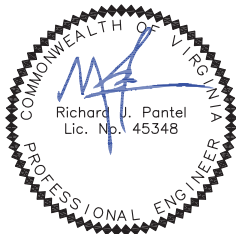


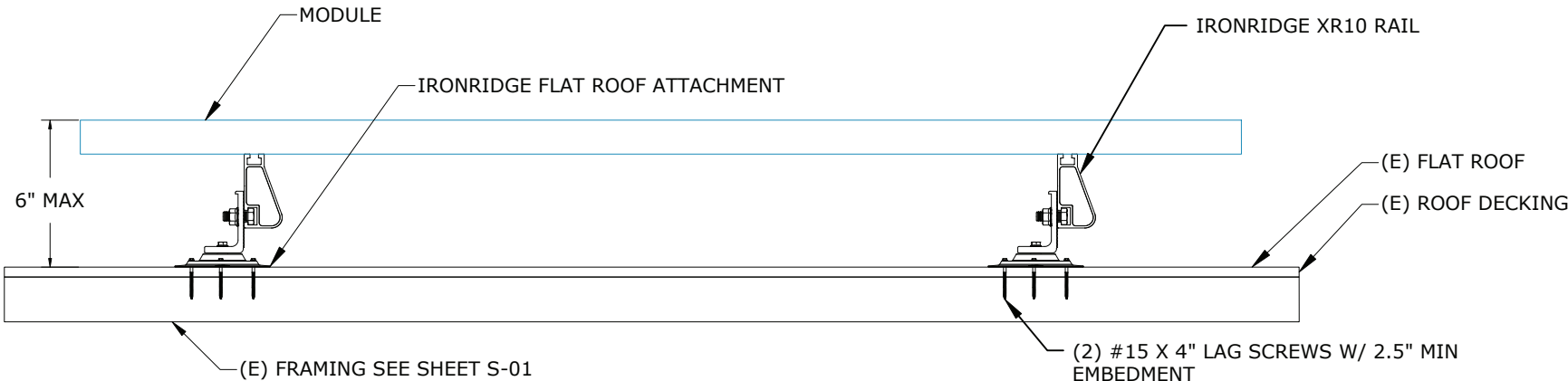
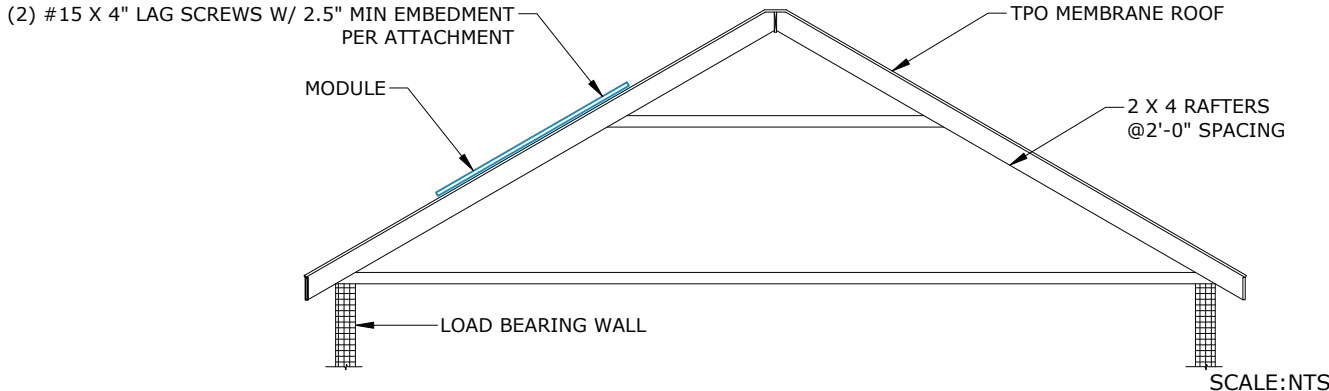
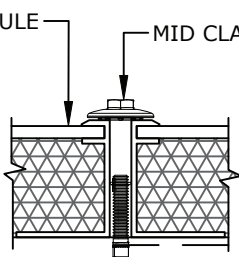
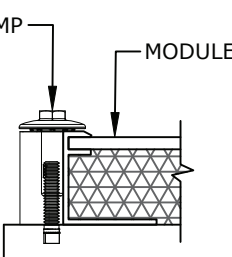
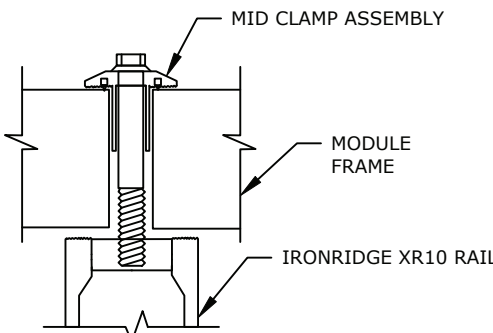
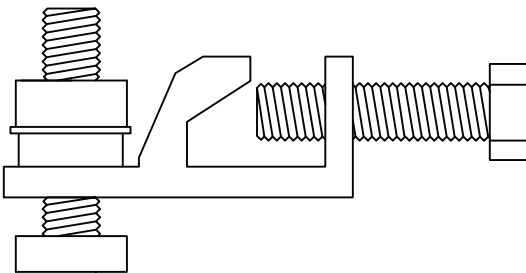
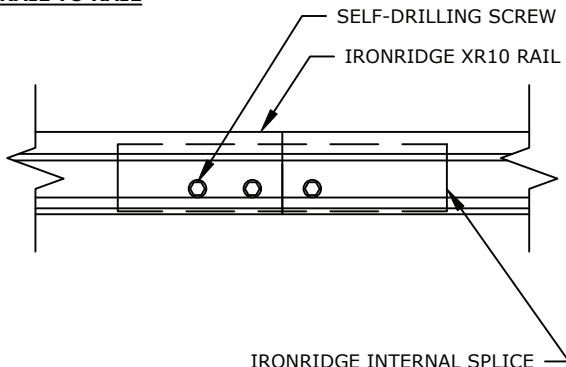
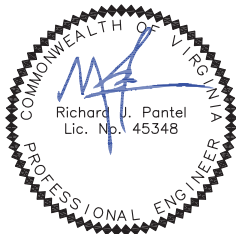
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DRAWING INFORMATION			
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NOTE: PENETRATIONS ARE STAGGERED



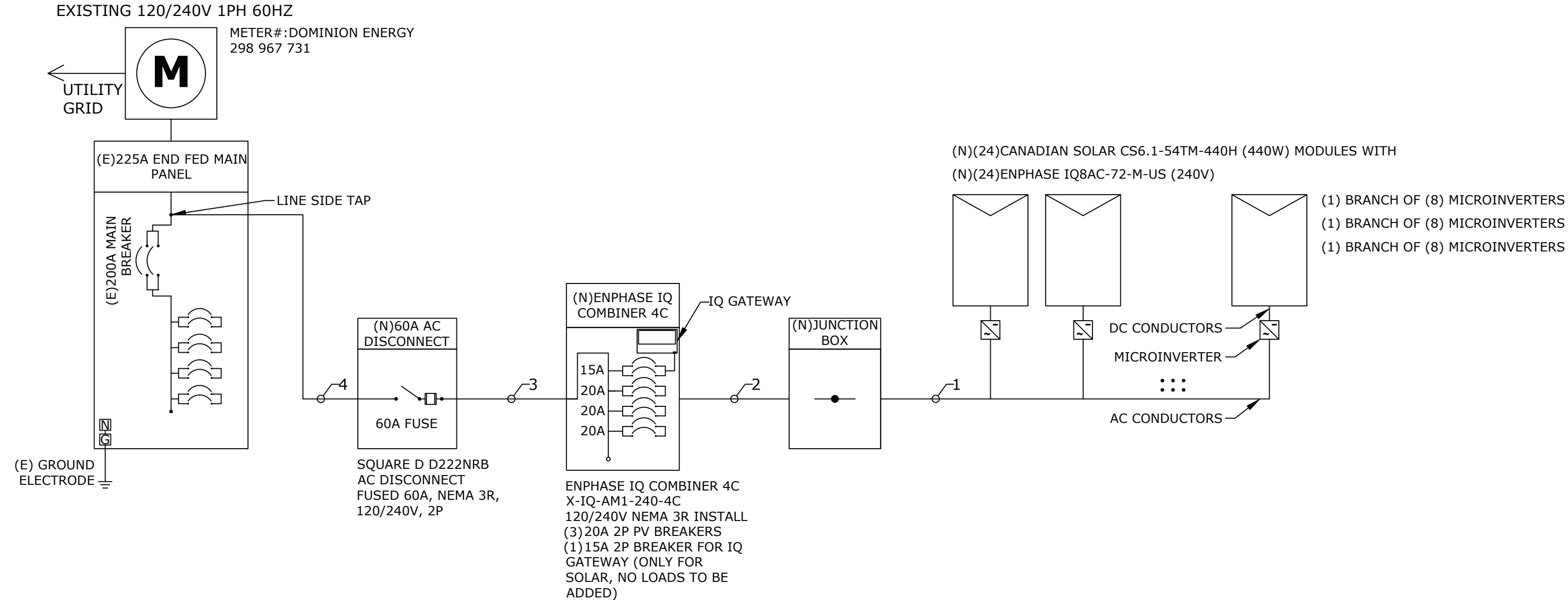
SCALE:3/16" = 1'-0"

SITE INFORMATION												CUSTOMER INFORMATION		CONTRACTOR INFORMATION		
S.NO	AZIMUTH	PITCH	NO. OF MODULES	ARRAY AREA (SQ. FT.)	ROOF TYPE	ATTACHMENT	ROOF EXPOSURE	FRAME TYPE	FRAME SIZE	FRAME SPACING	MAX RAIL SPAN	OVER HANG	NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX			
MP-01	45°	0°	24	527.03	TPO MEMBRANE	FLAT ROOF ATTACHMENT	ATTIC	RAFTERS	2 X 4	2'-0"	4'-0"	1'-6"				
												 Reviewed and approved Richard Pantel, P.E. VA Lic. No. 45348 10/22/2025		DRAWING INFORMATION		
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												 DATE: 10/09/2025 SHEET: S-01				

DEAD LOAD CALCULATIONS				ATTACHMENT DETAIL-IRONRIDGE FLAT ROOF ATTACHMENT	
BOM	QUANTITY	LBS/UNIT	TOTAL WEIGHT (LBS)	NOTE: (2) 5/16" LAG SCREWS SHALL BE ATTACHED TO THE RAFTERS  SCALE:NTS	
MODULES	24	50.7	1216.8		
MID-CLAMP	40	0.05	2		
END-CLAMP	16	0.05	0.8		
RAIL LENGTH	288	0.43	123.84		
SPLICE BAR	16	0.36	5.76		
FLAT ROOF ATTACHMENT	80	1.2	96		
MICROINVERTERS	24	2.43	58.32		
TOTAL WEIGHT OF THE SYSTEM (LBS)			1503.52		
TOTAL ARRAY AREA ON THE ROOF (SQ. FT.)			527.03		
WEIGHT PER SQ. FT.(LBS)			2.85		
WEIGHT PER PENETRATION (LBS)			18.79		
MODULE DATA				ROOF FRAMING DETAILS	
CANADIAN SOLAR CS6.1-54TM-440H (440W)				 SCALE:NTS	
MODULE DIM	70.9"x44.6"x1.38"				
LAG SCREWS	(2) #15 X 4" LAG SCREWS W/ 2.5" MIN EMBEDMENT				
MID-CLAMP AND END-CLAMP ASSEMBLY					
					
GROUNDING DETAILS					
<u>MODULE TO MODULE & MODULE TO RAIL</u>  GROUNDING MID-CLAMP SCALE: NTS		<u>GROUNDING LUG</u>  SCALE: NTS		<u>RAIL TO RAIL</u>  SCALE: NTS	
				 Reviewed and approved Richard Pantel, P.E. VA Lic. No. 45348 10/22/2025	
				CUSTOMER INFORMATION NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX	
					
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				 DATE: 10/09/2025 SHEET: S-02	

DC SYSTEM SIZE- 10560W, AC SYSTEM SIZE - 8376W

NOTE:
EACH MICROINVERTER IS RAPID SHUTDOWN COMPLIANT



CONDUCTOR AND CONDUIT SCHEDULE

TAG ID	CONDUIT SIZE	CONDUCTOR	NEUTRAL	GROUND
1	NONE	(2) 12 AWG ENPHASE Q CABLE PER BRANCH CIRCUIT	NONE	(1) 6 AWG BARE COPPER
2	METALLIC CONDUIT	(6) 10 AWG THHN/THWN-2	NONE	(1) 8 AWG THHN/THWN-2
3	CONDUIT	(2) 6 AWG THHN/THWN-2	(1) 6 AWG THHN/THWN-2	(1) 8 AWG THHN/THWN-2
4	CONDUIT	(2) 6 AWG THHN/THWN-2	(1) 6 AWG THHN/THWN-2	(1) 6 AWG THHN/THWN-2

CUSTOMER INFORMATION

NAME: MALA RAJAMANI
ADDRESS: 111A PARK STREET
NORTHEAST, VIENNA, VA 22180

38.905168, -77.262347

UTILITY: DOMINION ENERGY

AHJ: VA - COUNTY FAIRFAX

CONTRACTOR INFORMATION



DRAWING INFORMATION

PRN NUMBER: COS-1017733 REV: B
DRAFTED BY: RAJKUMAR G
QC'ED BY: PANDI SRIRAM
SCALE: AS NOTED
PAPER SIZE: 17"X11"



DC SYSTEM SIZE- 10560W, AC SYSTEM SIZE - 8376W

MODULE SPECIFICATION	
MODEL	CANADIAN SOLAR CS6.1-54TM-440H (440W)
MODULE POWER @ STC	440 W
OPEN CIRCUIT VOLTAGE: Voc	38.9 V
MAX POWER VOLTAGE: Vmp	31.6 V
SHORT CIRCUIT CURRENT: Isc	14.48 A
MAX POWER CURRENT: Imp	13.93 A
MICROINVERTER SPECIFICATIONS	
MODEL	ENPHASE IQ8AC-72-M-US (240V)
POWER RATING	349W
MAX. CONTINUOUS OUTPUT CURRENT	1.45A
CEC WEIGHTED EFFICIENCY	97%
MAX NO OF MICROINVERTERS / BRANCH	11
MAX DC VOLTAGE	60V

WIRE SIZE CALCULATIONS		
TAG 1: (AC)		
REQUIRED CONDUCTOR AMPACITY (1.45 * 8 * 1.25)		= 14.5 A
CORRECTED AMPACITY CALCULATION (0.96 * 1 * 30)		= 28.8 A
14.5A < 28.8A		
TAG 2: (AC)		
REQUIRED CONDUCTOR AMPACITY (1.45 * 8 * 1.25)		= 14.5 A
CORRECTED AMPACITY CALCULATION (0.96 * 0.8 * 40)		= 30.72 A
14.5A < 30.72A		
TAG 3: (AC)		
REQUIRED CONDUCTOR AMPACITY (1.45 * 24 * 1.25)		= 43.5 A
CORRECTED AMPACITY CALCULATION (0.96 * 1 * 75)		= 72 A
43.5A < 72A		
TAG 4: (AC)		
REQUIRED CONDUCTOR AMPACITY (1.45 * 24 * 1.25)		= 43.5 A
CORRECTED AMPACITY CALCULATION (0.96 * 1 * 75)		= 72 A
43.5A < 72A		

ELECTRICAL NOTES 1. CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC 310.10(C). 2. CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC 310.10(D). 3. MAXIMUM DC/AC VOLTAGE DROP SHALL BE NO MORE THAN 2%. 4. ALL CONDUCTORS SHALL BE IN CONDUIT UNLESS OTHERWISE NOTED. 5. BREAKER/FUSES SIZED ACCORDING PER NEC ARTICLE 240. 6. AC GROUNDING ELECTRODE CONDUCTOR (GEC) SIZED PER NEC 250.66. 7. EQUIPMENT GROUNDING CONDUCTOR (EGC) SIZED PER NEC 250.122. 8. AMBIENT TEMPERATURE ADJUSTMENT FACTOR IS BASED ON TABLE NEC 310.15(B)(1). 9. CURRENT CARRYING CONDUCTOR ADJUSTMENT FACTOR IS BASED ON NEC 310.15(C)(1). 10. MAX. SYSTEM VOLTAGE CORRECTION IS PER NEC 690.7. 11. CONDUCTORS ARE SIZED PER NEC 310.16.	OCPD CALCULATION			CUSTOMER INFORMATION		CONTRACTOR INFORMATION	
	ALLOWABLE BACKFEED: MAIN PANEL RATING = 225 A MAIN BREAKER RATING = 200 A LINE SIDE TAP 100% OF ALLOWABLE BACKFEED = 200 A			NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX			
	INVERTER OVERCURRENT PROTECTION: INVERTER OVERCURRENT PROTECTION = (MICROINVERTER O/P CURRENT * # OF MICROINVERTERS * CONTINUOUS LOAD(1.25)) = (1.45 * 24 * 1.25) = 43.5 A PV BREAKER SIZE / FUSE SIZE = 60 A ≥ 43.5 A						
	TOTAL REQUIRED PV BREAKER SIZE / FUSE SIZE = 60 A PV BREAKER / FUSE SIZE						
				DRAWING INFORMATION			
				PRN NUMBER: COS-1017733 REV: B DRAFTED BY: RAJKUMAR G QC'ED BY: PANDI SRIRAM SCALE: AS NOTED PAPER SIZE: 17"X11"			
						ELECTRICAL CALCULATIONS DATE: 10/09/2025 SHEET: E-03	

AC RACEWAYS
1

SW-1 DISCONNECT (SQUARE D D222NRB)
13

MSP - MAIN SERVICE PANEL
12

UTILITY METER
2

LABELING NOTES	
1	ALL PLAQUES AND SIGNAGE REQUIRED BY 2020 NEC AND 2021 VSFPC WILL BE INSTALLED AS REQUIRED
2	LABELS, WARNING(S) AND MARKING SHALL COMPLY WITH ANSI Z535.4, WHICH REQUIRES THAT DANGER WARNING, AND CAUTION SIGNS USED THE STANDARD HEADER COLORS, HEADER TEXT AND SAFETY ALERT SYMBOL ON EACH LABEL. THE ANSI STANDARD REQUIRES A HEADING THAT IS AT LEAST 50% TALLER THAN THE BODY TEXT, IN ACCORDANCE WITH NEC 110.21(B).
3	A PERMANENT PLAQUE OR DIRECTORY SHALL BE INSTALLED PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION IN ACCORDANCE WITH NEC 690.56(B).
4	LABEL(S) WITH MARKING, "WARNING PHOTOVOLTAIC POWER SOURCE, "SHALL BE LOCATED AT EVERY 10 FEET OF EACH DC RACEWAY AND WITH IN ONE FOOT OF EVERY TURN OR BEND AND WITH IN ONE FOOT OF EVERY TURN OR BEND AND WITH IN ONE FOOT ABOVE AND BELOW ALL PENETRATIONS OF ROOF/CEILING ASSEMBLIES, WALLS AND BARRIERS. THE LABEL SHALL HAVE 3/8" TALL LETTERS AND BE REFLECTIVE WITH WHITE TEXT ON A RED BACKGROUND



**WARNING:
PHOTOVOLTAIC POWER SOURCE**



**▲ CAUTION
SOLAR ELECTRIC SYSTEM CONNECTED**



SOLAR AC DISCONNECT

	CUSTOMER INFORMATION	CONTRACTOR INFORMATION
	NAME: MALA RAJAMANI ADDRESS: 111A PARK STREET NORTHEAST, VIENNA, VA 22180 38.905168, -77.262347 UTILITY: DOMINION ENERGY AHJ: VA - COUNTY FAIRFAX	
	DRAWING INFORMATION	
	PRN NUMBER: COS-1017733 REV: B DRAFTED BY: RAJKUMAR G QC'ED BY: PANDI SRIRAM SCALE: AS NOTED PAPER SIZE: 17"X11"	

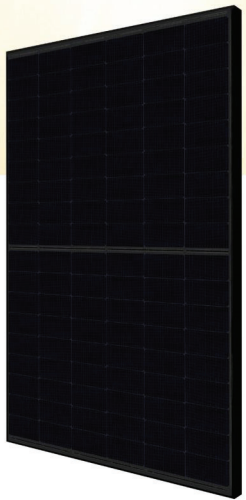


PLACARDS
DATE: 10/09/2025 SHEET: PL-01

MODULE SPEC SHEET



Preliminary Technical
Information Sheet



TOPHiKu6 (All-Black)

N-type TOPCon Technology

440 W ~ 460 W

CS6.1-54TM-440 | 445 | 450 | 455 | 460H

MORE POWER



Module power up to 460 W
Module efficiency up to 22.5 %



Excellent anti-LeTID & anti-PID performance.
Low power degradation, high energy yield



Lower temperature coefficient (Pmax): -0.29%/°C,
increases energy yield in hot climate



Lower LCOE & system cost

MORE RELIABLE



Minimizes micro-crack impacts



Heavy snow load up to 8100 Pa,
wind load up to 5000 Pa*

* For detailed information, please refer to the Installation Manual.

CSI Solar Co., Ltd.
199 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com



Industry Leading Product Warranty on Materials
and Workmanship*



Linear Power Performance Warranty*

1st year power degradation no more than 1%
Subsequent annual power degradation no more than 0.4%

*Subject to the terms and conditions contained in the applicable Canadian Solar Limited
Warranty Statement. Also this 25-year limited product warranty is available only for prod-
ucts installed and operating on residential rooftops in certain regions.

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001:2015 / Quality management system
ISO 14001:2015 / Standards for environmental management system
ISO 45001: 2018 / International standards for occupational health & safety
IEC62941: 2019 / Photovoltaic module manufacturing quality system

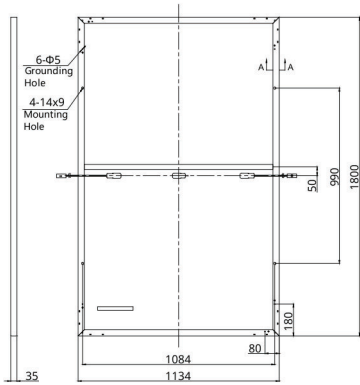
PRODUCT CERTIFICATES*

* The specific certificates applicable to different module types and markets will vary, and
therefore not all of the certifications listed herein will simultaneously apply to the products
you order or use. Please contact your local Canadian Solar sales representative to confirm
the specific certificates available for your Product and applicable in the regions in which
the products will be used.

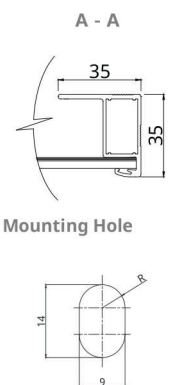
CSI Solar Co., Ltd. is committed to providing high quality solar
photovoltaic modules, solar energy and battery storage solu-
tions to customers. The company was recognized as the No. 1
module supplier for quality and performance/price ratio in the
IHS Module Customer Insight Survey. Over the past 22 years, it
has successfully delivered around 100 GW of premium-quality
solar modules across the world.

ENGINEERING DRAWING (mm)

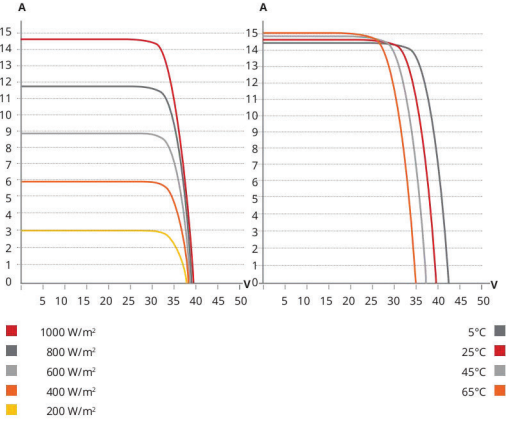
Rear View



Frame Cross Section



CS6.1-54TM-455H / I-V CURVES



ELECTRICAL DATA | STC*

CS6.1-54TM	440H	445H	450H	455H	460H
Nominal Max. Power (Pmax)	440 W	445 W	450 W	455 W	460 W
Opt. Operating Voltage (Vmp)	31.6 V	31.8 V	32.0 V	32.2 V	32.4 V
Opt. Operating Current (Imp)	13.93 A	14.00 A	14.07 A	14.14 A	14.20 A
Open Circuit Voltage (Voc)	38.9 V	39.1 V	39.3 V	39.5 V	39.7 V
Short Circuit Current (Isc)	14.48 A	14.55 A	14.61 A	14.68 A	14.75 A
Module Efficiency	21.6%	21.8%	22.0%	22.3%	22.5%
Operating Temperature	-40°C ~ +85°C				
Max. System Voltage	1000V (IEC/UL)				
Module Fire Performance	TYPE 2 (UL 61730 1000V) or CLASS C (IEC 61730)				
Max. Series Fuse Rating	25 A				
Application Classification	Class A				
Power Tolerance	0 ~ + 10 W				

* Under Standard Test Conditions (STC) of irradiance of 1000 W/m2, spectrum AM 1.5 and cell temperature of 25°C.

ELECTRICAL DATA | NMOT*

CS6.1-54TM	440H	445H	450H	455H	460H
Nominal Max. Power (Pmax)	333 W	337 W	340 W	344 W	348 W
Opt. Operating Voltage (Vmp)	29.9 V	30.1 V	30.3 V	30.4 V	30.6 V
Opt. Operating Current (Imp)	11.14 A	11.18 A	11.25 A	11.30 A	11.36 A
Open Circuit Voltage (Voc)	36.8 V	37.0 V	37.2 V	37.4 V	37.6 V
Short Circuit Current (Isc)	11.68 A	11.73 A	11.78 A	11.84 A	11.89 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m² spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

MECHANICAL DATA

Specification	Data
Cell Type	TOPCon cells
Cell Arrangement	108 [2 X (9 X 6)]
Dimensions	1800 × 1134 × 35 mm (70.9 × 44.6 × 1.38 in)
Weight	23 kg (50.7 lbs)
Front Cover	3.2 mm tempered glass with anti-ref- lective coating
Frame	Anodized aluminium alloy
J-Box	IP68, 3 bypass diodes
Cable	4 mm² (IEC), 12 AWG (UL)
Connector	T6 or MC4 or MC4-EVO2 or MC4- EVO2A
Cable Length (Including Connector)	Portrait: 350 mm (13.8 in) (+) / 250 mm (9.8 in) (-); landscape: 1150 mm (45.3 in)*
Per Pallet	31 pieces
Per Container (40' HQ)	744 pieces

* For detailed information, please contact your local Canadian Solar sales and
technical representatives.

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.29 % / °C
Temperature Coefficient (Voc)	-0.25 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	41 ± 3°C

PARTNER SECTION



* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. CSI Solar Co., Ltd. reserves the right to make necessary adjustment to the information described herein at any time without further notice.

Please be kindly advised that PV modules should be handled and installed by qualified people who have professional skills and please carefully read the safety and installation instructions before using our PV modules.

CSI Solar Co., Ltd.
199 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com

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INVERTER SPEC SHEET



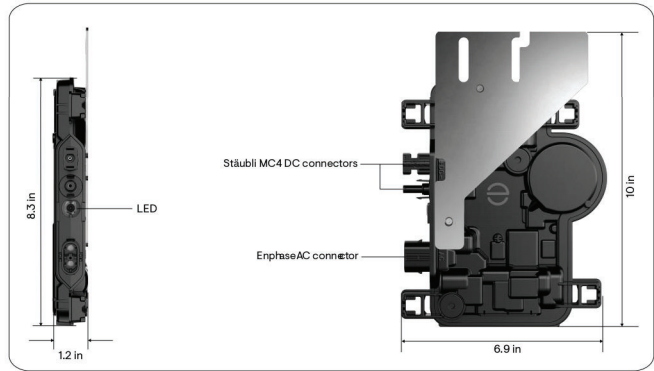
NORTH AMERICA DATA SHEET

IQ8AC Microinverter

Our newest IQ8 Series Microinverters^{1, 2, 3} are the industry’s first microgrid-forming⁴, software-defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently.



Key specifications	IQ8AC-72-M-US @240 VAC	IQ8AC-72-M-US @208 VAC
Peak output power	366 VA	350 VA
Nominal grid voltage (L-L)	240 V split-phase (L-L), 180°	208 V single-phase (L-L), 120°
Nominal frequency	60 Hz	60 Hz
CEC weighted efficiency	97.0%	96.5%
Maximum input DC voltage	60 V	60 V
MPPT voltage range	28–45 V	28–45 V
Maximum module I _{sc}	20 A	20 A
Ambient temperature range	–40°C to 65°C (–40°F to 149°F)	



¹ IQ8 Series Microinverters can be added to existing IQ7 systems on the same IQ Gateway only in the following grid-tied configurations: Solar Only or Solar + Battery (IQ Battery 3T/10T and IQ Battery 5P) without backup.
² IQ7 Series Microinverters cannot be added to a site with existing IQ8 Series Microinverters on the same gateway. Mixed system of IQ7 and IQ8 will not support IQ8-specific PCS features and grid-forming capabilities.
³ IQ Microinverters ship with default settings that meet North America’s IEEE 1547 interconnection standard requirements. Region-specific adjustments may be requested by an Authority Having Jurisdiction (AHJ) or utility representative, according to the IEEE 1547 interconnection standard. Use an IQ Gateway to make these changes during installation.
⁴ Meets UL 1741 only when installed with IQ System Controller 2 or 3.

Input data (DC)	Units	IQ8AC-72-M-US
Commonly used module pairings ⁵	W	295–500
Module compatibility	—	To meet compatibility, PV modules must be within the following maximum input DC voltage and maximum module I _{sc} . Module compatibility can be checked at https://enphase.com/installers/microinverters/calculator .
MPPT voltage range	V	28–45
Operating range	V	18–58
Minimum/Maximum start voltage	V	22/58
Maximum input DC voltage	V	60
Maximum continuous input DC current	A	14
Maximum input DC short-circuit current	A	25
Maximum module I _{sc}	A	20
Overvoltage class DC port	—	II
DC port backfeed current	mA	0
PV array configuration	—	Ungrounded array; no additional DC side protection required; AC side protection requires a maximum of 20 A per branch circuit

Output data (AC)	Units	IQ8AC-72-M-US @240 VAC	IQ8AC-72-M-US @208 VAC
Peak output power	VA	366	350
Maximum continuous output power	VA	349	345
Nominal grid voltage (L-L)	V	240, split-phase (L-L), 180°	208, single-phase (L-L), 120°
Minimum and maximum grid voltage ⁶	V	211–264	183–229
Maximum continuous output current	A	1.45	1.66
Nominal frequency	Hz	60	
Extended frequency range	Hz	47–68	
AC short-circuit fault current over three cycles	A _{rms}	2.70	
Maximum units per 20 A (L-L) branch circuit ⁷	—	11	9
Total harmonic distortion	%	<5	
Overvoltage class AC port	—	III	
AC port backfeed current	mA	18	
Power factor setting	—	1.0	
Grid-tied power factor (adjustable)	—	0.85 leading ... 0.85 lagging	
Peak efficiency	%	97.3	97.2
CEC weighted efficiency	%	97.0	96.5
Nighttime power consumption	mW	30	22

Mechanical data	IQ8AC-72-M-US
Ambient temperature range	–40°C to 65°C (–40°F to 149°F)
Relative humidity range	4% to 100% (condensing)
DC connector type	Stäubli MC4

⁵ No enforced DC/AC ratio.
⁶ Nominal voltage range can be extended beyond nominal if required by the utility.
⁷ Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

COMBINER SPEC SHEET



DATA SHEET



X-IQ-AM1-240-4
X2-IQ-AM1-240-4
(IEEE 1547:2018)
X-IQ-AM1-240-4C
X2-IQ-AM1-240-4C
(IEEE 1547:2018)

IQ Combiner 4/4C

The Enphase IQ Combiner 4/4C with IQ Gateway and integrated LTE-M1 cell modem (included only with IQ Combiner 4C) consolidates interconnection equipment into a single enclosure and streamlines IQ Microinverters and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and an Eaton BR series busbar assembly.



IQ Series Microinverters

The high-powered smart grid-ready IQ Series Microinverters (IQ6, IQ7, and IQ8 Series) dramatically simplify the installation process.



IQ System Controller 2

Provides microgrid interconnection device (MID) functionality by automatically detecting grid failures and seamlessly transitioning the home energy system from grid power to backup power.



IQ Battery

All-in-one AC coupled storage system that is reliable, smart, simple, and safe. It provides backup capability, and installers can quickly design the right system size to meet the needs of both new and retrofit solar customers.



IQ Load Controller

Helps prioritize essential appliances during a grid outage to optimize energy consumption and prolong battery life.



5-year limited warranty



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Smart

- Includes IQ Gateway for communication and control
- Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), included only with IQ Combiner 4C
- Includes solar shield to match IQ Battery aesthetics and deflect heat
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and consumption monitoring

Simple

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

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- Two-years labor reimbursement program coverage included for both the IQ Combiner SKU's
- UL Listed
- X2-IQ-AM1-240-4 and X2-IQ-AM1-240-4C comply with IEEE 1547:2018 (UL 1741-SB, 3rd Ed.)

IQ Combiner 4/4C

MODEL NUMBER	UNITS	DESCRIPTION
IQ Combiner 4 (X-IQ-AM1-240-4, X2-IQ-AM1-240-4)	—	IQ Combiner 4 with an IQ Gateway printed circuit board for integrated revenue-grade PV production metering (ANSI C12.20 ±0.5%) and consumption monitoring (±2.5%). Includes a silver solar shield to match the IQ Battery and IQ System Controller 2 and to deflect heat.
IQ Combiner 4C (X-IQ-AM1-240-4C, X2-IQ-AM1-240-4C)	—	IQ Combiner 4C with an IQ Gateway printed circuit board for integrated revenue-grade PV production metering (ANSI C12.20 ±0.5%) and consumption monitoring (±2.5%). Includes Enphase Mobile Connect cellular modem (CELLMODEM-M1-06-SP-05), a plug-and-play industrial-grade cell modem for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area). Includes a silver solar shield to match the IQ Battery and IQ System Controller 2 and to deflect heat.

WHAT'S IN THE BOX	UNITS	
IQ Gateway printed circuit board	—	IQ Gateway is the platform for total energy management for comprehensive, remote maintenance, and management of the Enphase Energy System.
Busbar	—	80 A busbar with support for one IQ Gateway breaker and four 20 A breakers for installing IQ Series Microinverters and IQ Battery
IQ Gateway breaker	A	Circuit breaker, 2-pole, 10/15
Production CT	—	Pre-wired revenue-grade solid-core CT, accurate up to ±0.5%
Consumption CT	—	Two consumption metering split core or clamp-type CTs, shipped with the box, accurate up to ±2.5%
Emphase Mobile Connect (only with IQ Combiner 4C)	—	4G-based LTE-M1 cellular modem (CELLMODEM-M1-06-SP-05) with a five-year T-Mobile data plan

MICROINVERTERS, ACCESSORIES AND REPLACEMENT PARTS (not included; order separately)	UNITS	
Supported microinverters	—	IQ6, IQ7, and IQ8. Do not mix IQ6/IQ7 Microinverters with IQ8
Enphase Communications Kit COMMS-CELLMODEM-M1-06	—	- Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with a 5-year T-Mobile data plan for Enphase sites
CELLMODEM-M1-06-SP-05 CELLMODEM-M1-06-AT-05	—	- 4G-based LTE-M1 cellular modem with a five-year T-Mobile data plan - 4G-based LTE-M1 cellular modem with a five-year AT&T data plan
Circuit breakers (off-the-shelf)	—	Supports Eaton BR2xx, Siemens Q2xx and GE/ABB THQL21xx Series breakers (xx may be '0, 15, 20, 30, 40, 50, or 60). Supports Eaton BR220B, BR230B, and BR240B circuit breakers compatible with hold-down kit.
Circuit breakers (provided by Enphase)	—	BRK-10A-2-240V, BRK-15A-2-240V, BRK-20A-2P-240V, BRK-15A-2P-240V-B, and BRK-20A-2P-240V-B
XA-SOLARSHIELD-ES	—	Replacement solar shield for IQ Combiner 4/4C
XA-ENV2-PCBA-4	—	IQ Gateway replacement printed circuit board (PCB) for IQ Combiner 4/4C
XA-PLUG-120-3	—	Accessory receptacle for power line carrier in IQ Combiner 4/4C (required for EPLC-01)
X-IQ-NA-HD-125A	—	Hold-down kit for Eaton circuit breaker with screws

ELECTRICAL SPECIFICATIONS	UNITS	
Rating	A	80
System voltage and frequency	—	120/240 VAC, 120/208 VAC, 60 Hz
Busbar rating	A	125
Fault current rating	kAIC	10
Maximum continuous current rating (input from PV/storage)	A	64
Maximum fuse/Circuit rating (output)	A	90
Branch circuits (solar and storage)	—	Up to four 2-pole Eaton BR, Siemens Q, or GE/ABB THQL Series distributed generation (DG) breakers only (not included)
Maximum total branch circuit breaker rating (input)	A	80 A of distributed generation/95 A with IQ Gateway breaker included

To learn more about Enphase offerings, visit enphase.com.

IQC-4-4C-DSH-00217-3.0-EN-US-2024-08-16

IQC-4-4C-DSH-00217-3.0-EN-US-2024-08-16

COMBINER SPEC SHEET

ELECTRICAL SPECIFICATIONS		UNITS	
IQ Gateway breaker	A	10 A or 15 A rating GE/Siemens/Eaton included	
Production metering CT	A	200 A solid core pre-installed and wired to IQ Gateway	
Consumption monitoring CT (CT-200-SPLIT/CT-200-CLAMP)	A	A pair of 200 A split core or clamp-type current transformers	
MECHANICAL DATA		UNITS	DESCRIPTION
Dimensions (W × H × D)	cm (in)	37.5 × 49.5 × 16.8 (14.75 × 19.5 × 6.63). Height is 53.5 (21.06) with mounting brackets	
Weight	kg (lb)	7.5 (16.5)	
Ambient temperature range	°C (°F)	−40 to 46 (−40 to 115)	
Cooling	—	Natural convection plus a heat shield	
Enclosure environmental rating	—	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction	
Wire sizes	—	• 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 4 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing	
Altitude	m (ft)	Up to 2,600 (8,530)	
COMMUNICATION INTERFACES		UNITS	DESCRIPTION
Integrated Wi-Fi	—	802.11b/g/n (dual band 2.4 GHz/5 GHz) for connecting the Enphase Cloud through the internet	
Wi-Fi range (recommended)	m (ft)	10 (32.8)	
Ethernet	—	Optional 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included) for connecting to the Enphase Cloud through the internet	
Digital I/O	—	Digital input/output for grid operator control	
USB 2.0	—	For Mobile Connect, Communications Kit 1 for IQ Battery 3/3T/10/10T, Communication Kit 2 for IQ Battery 5P	
Access point (AP) mode	—	For connection between the IQ Gateway and a mobile device running the Enphase Installer App	
Metering ports	—	Up to two Consumption CTs, one IQ Battery CT, and one Production CT	
Power line communication	kHz	9C–110	
Web API	—	See https://developer-v4.enphase.com	
Local API	—	See Guide for local API	
Cellular/Mobile Connect	—	CELLMODEM-M1-06-SP-05, CELLMODEM-M1-06-AT-05 (4G-based LTE-M1 cellular modem). Note that an Enphase Mobile Connect cellular modem is required for all installations with Enphase IQ Batteries and/or IQ System Controllers	
COMPLIANCE			
IQ Combiner with IQ Gateway		CA Rule 21 (UL 1741-SA) IEEE 1547:2018 - UL 1741-SB, 3rd Ed. (X2-IQ-AM1-240-4 and X2-IQ-AM1-240-4C) CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003, NOM-208-SCFI-2016 Production metering: ANSI C12.20 accuracy class 0.5 (PV production), UL 61010-1, CAN/CSA 22.2 No. 61010-1, IEEE 2030.5/CSIP Compliant	
COMPATIBILITY			
PV	Microinverters	IQ6, IQ7, and IQ8 Series Microinverters	
COMMS-KIT-01	IQ System Controller	EP200G101-M240US00	
	IQ System Controller 2	EP200G101-M240US01	
	IQ Battery	ENCHARGE-3-1P-NA, ENCHARGE-10-1P-NA, ENCHARGE-3T-1P-NA, ENCHARGE-10T-1P-NA	
COMMS-KIT-02 ¹	IQ System Controller 3	SC200D111C240US01, SC200G111C240US01	
	IQ Battery	IQBATTERY-5P-1P-NA	

¹ For information about IQ Combiner 4/4C compatibility with the 3rd-generation batteries, refer to the [compatibility matrix](#).

ATTACHMENT SPEC SHEET

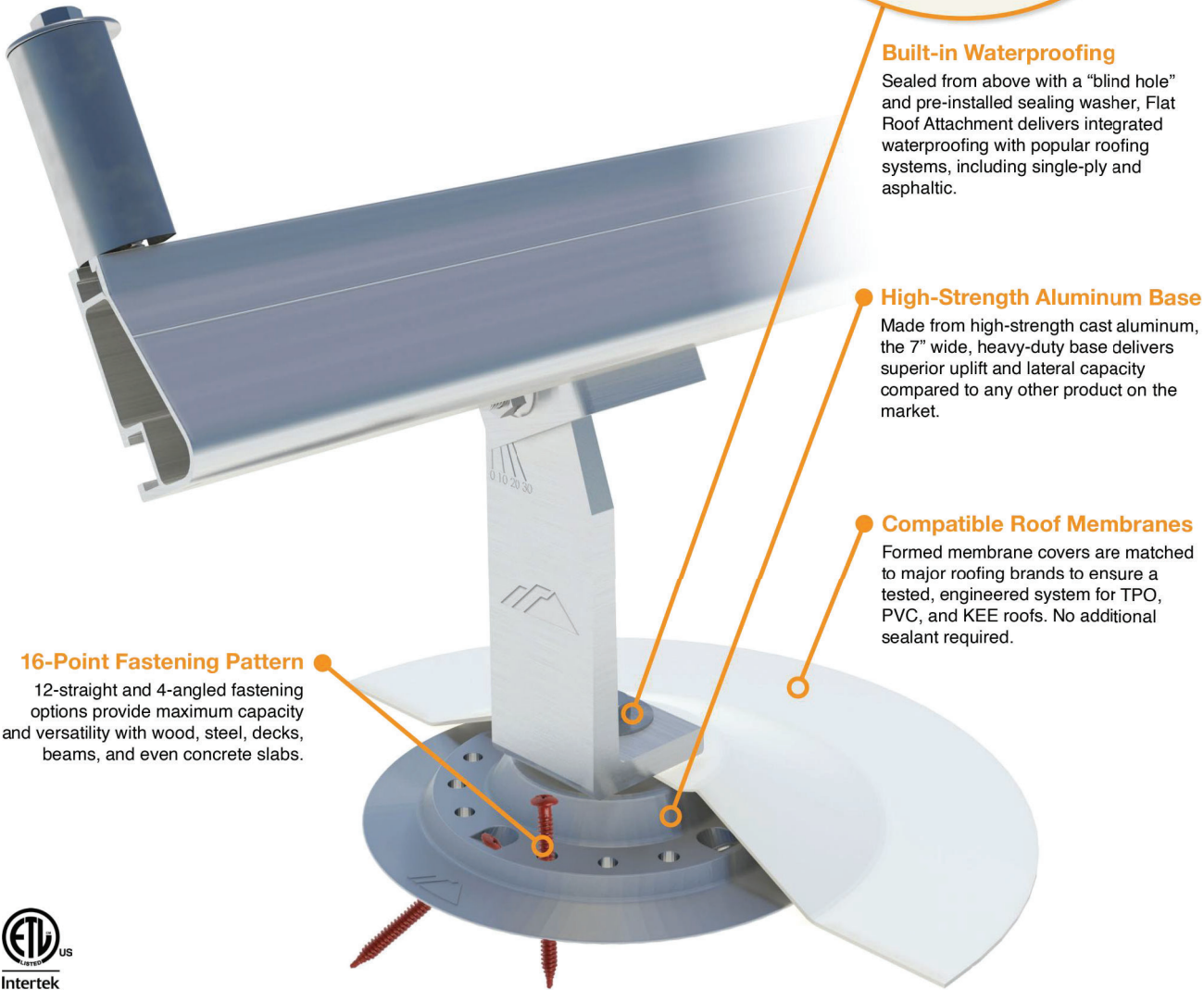
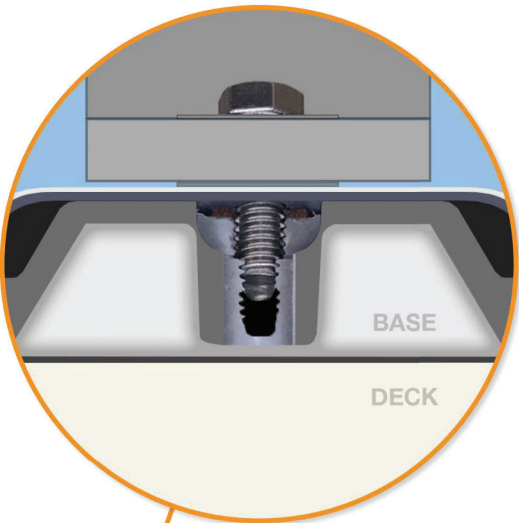


Flat Roof Attachment

Engineering Down to the Deck

Low-slope roofs (0-6°) are extremely common in residential and commercial buildings, but the roof construction and the structural system below vary significantly, creating a challenge for designing solar arrays.

The IronRidge Flat Roof Attachment combines a high-strength cast aluminum base with a 16-point fastening pattern to enable the widest range of design options on low-sloped roofs. In addition, it is compatible with most common low-slope roofing materials to ensure a system that is easy to integrate down to the deck.



Built-in Waterproofing

Sealed from above with a "blind hole" and pre-installed sealing washer, Flat Roof Attachment delivers integrated waterproofing with popular roofing systems, including single-ply and asphaltic.

High-Strength Aluminum Base

Made from high-strength cast aluminum, the 7" wide, heavy-duty base delivers superior uplift and lateral capacity compared to any other product on the market.

Compatible Roof Membranes

Formed membrane covers are matched to major roofing brands to ensure a tested, engineered system for TPO, PVC, and KEE roofs. No additional sealant required.

16-Point Fastening Pattern

12-straight and 4-angled fastening options provide maximum capacity and versatility with wood, steel, decks, beams, and even concrete slabs.



Tech Brief

Flashing Membrane Selection

Refer to table for selecting proper roof membrane. Contact support@ironridge.com for approved alternatives.

Roof Type					Other Sealing Methods
Material	Thickness	Color	Brand	SKU	
TPO	60 mil	White	Carlisle	FRA-M60T-CA-W1	Henry's 957 Sealant (or similar)
			Firestone	FRA-M60T-FS-W1	
			GAF	FRA-M60T-GF-W1	Three-Course Method (with roof coating)
			Johns Manville	FRA-M60T-JM-W1	
PVC	60 mil	White	GAF	FRA-M60P-GF-W1	Chem Link 9" E-Curb
			Sika Sarnafil	FRA-M60P-SN-W1	
KEE	60 mil	White	Carlisle	FRA-M60K-CA-W1	Follow a Roofer's Recommendations

Structural Selection

Refer to table to see how regional conditions, tilt angle, and rail size impacts the span between attachments.

Conditions			Rail Span					
Snow	Angle	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
0 PSF	5°	110						
		130						
		160						
	10°	110						
		130	XR10	XR100	XR1000			
		160						
	30°	110						
		130						
		160						
10-20 PSF	5°	110						
		130						
		160						
	10°	110						
		130						
		160						
	30°	110						
		130						
		160						
30-50 PSF	5°	110						
		130						
		160						
	10°	110						
		130						
		160						
	30°	110						
		130						
		160						

Values based on 72-cell modules in Wind Exposure Category B (ASCE 7-10)



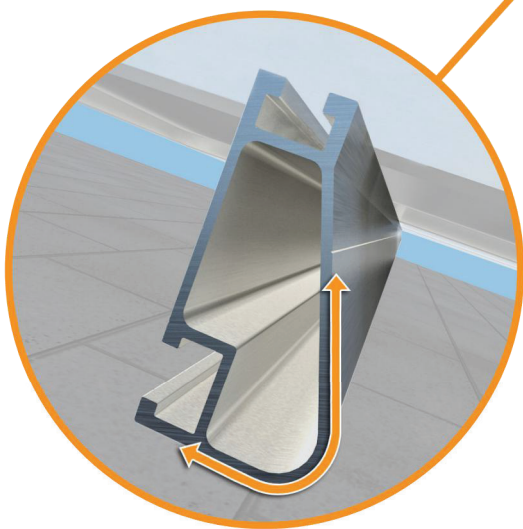
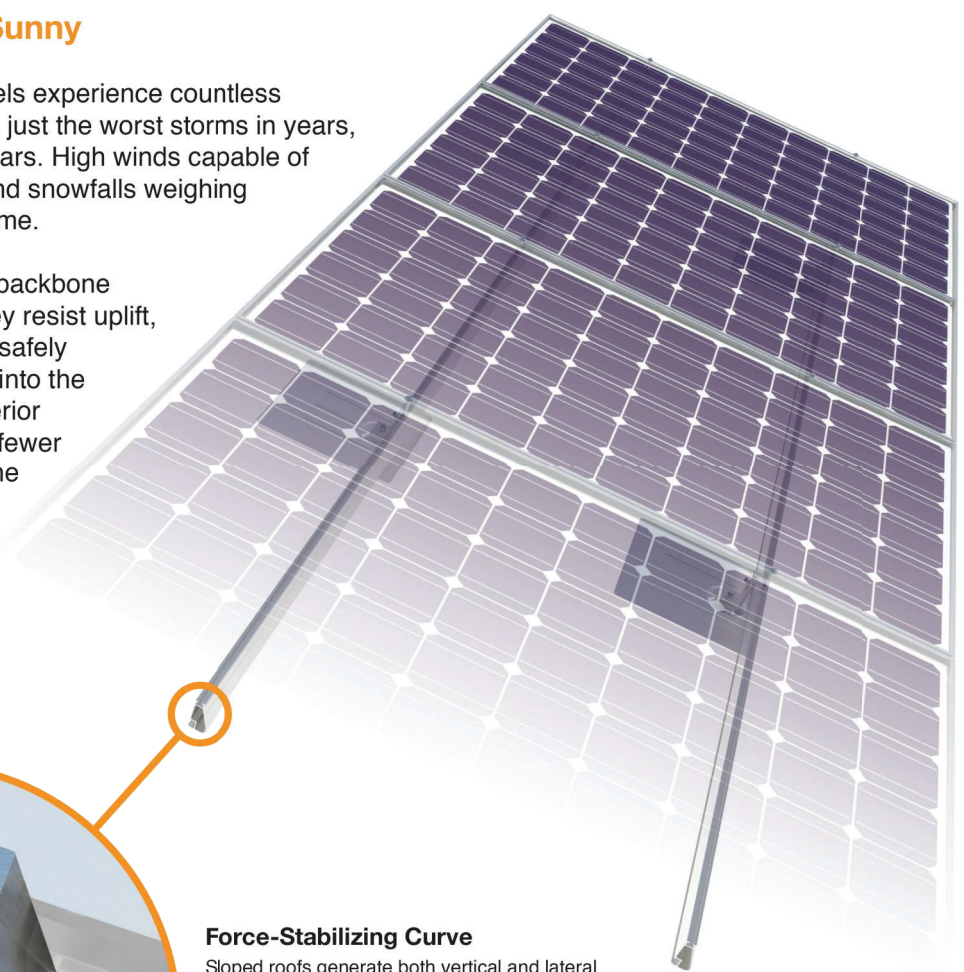


XR Rail® Family

Solar Is Not Always Sunny

Over their lifetime, solar panels experience countless extreme weather events. Not just the worst storms in years, but the worst storms in 40 years. High winds capable of ripping panels from a roof, and snowfalls weighing enough to buckle a panel frame.

XR Rails® are the structural backbone preventing these results. They resist uplift, protect against buckling and safely and efficiently transfer loads into the building structure. Their superior spanning capability requires fewer roof attachments, reducing the number of roof penetrations and the amount of installation time.



Force-Stabilizing Curve
Sloped roofs generate both vertical and lateral forces on mounting rails which can cause them to bend and twist. The curved shape of XR Rails® is specially designed to increase strength in both directions while resisting the twisting. This unique feature ensures greater security during extreme weather and a longer system lifetime.

Compatible with Flat & Pitched Roofs



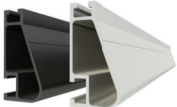
XR Rails® are compatible with FlashFoot® and other pitched roof attachments.



IronRidge® offers a range of tilt leg options for flat roof mounting applications.

Corrosion-Resistant Materials

All XR Rails® are made of 6000-series aluminum alloy, then protected with an anodized finish. Anodizing prevents surface and structural corrosion, while also providing a more attractive appearance.



Tech Brief

XR Rail® Family

The XR Rail® Family offers the strength of a curved rail in three targeted sizes. Each size supports specific design loads, while minimizing material costs. Depending on your location, there is an XR Rail® to match.



XR10

XR10 is a sleek, low-profile mounting rail, designed for regions with light or no snow. It achieves spans up to 6 feet, while remaining light and economical.

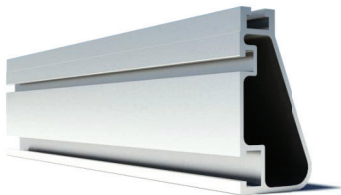
- 6' spanning capability
- Moderate load capability
- Clear & black anodized finish
- Internal splices available



XR100

XR100 is the ultimate residential mounting rail. It supports a range of wind and snow conditions, while also maximizing spans up to 10 feet.

- 10' spanning capability
- Heavy load capability
- Clear & black anodized finish
- Internal splices available



XR1000

XR1000 is a heavyweight among solar mounting rails. It's built to handle extreme climates and spans up to 12 feet for commercial applications.

- 12' spanning capability
- Extreme load capability
- Clear anodized finish
- Internal splices available

Rail Selection

The table below was prepared in compliance with applicable engineering codes and standards.* Values are based on the following criteria: ASCE 7-16, Gable Roof Flush Mount, Roof Zones 1 & 2e, Exposure B, Roof Slope of 8 to 20 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed certification letters.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	90	XR10		XR100		XR1000	
	120						
	140						
	160						
20	90						
	120						
	140						
	160						
30	90						
	160						
40	90						
	160						
80	160						
120	160						

*Table is meant to be a simplified span chart for conveying general rail capabilities. Use approved certification letters for actual design guidance.



iRooFAtm
Instant Roof Framing Analysis
www.iroofa.solar
tel: 540.313.5317 - email: info@iRooFA.solar

STRUCTURAL ANALYSIS
for the
ROOFTOP PV SOLAR INSTALLATION

Project: Mala Rajamani, 111A Park Street Northeast, Vienna, VA 22180

Prepared for:



COS

5770 Thurston Ave, #106 Virginia Beach - Virginia, VA 23455

Calculation Report Index

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	<i>Roof Structural Calculations for PV Solar Installation</i>
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11-11	Snow Loading Calculations
2-5	Loading Summary

Project No: 141.284, Rev. 0

Report Date: 10/22/2025

Report Prepared by:



Richard Pantel Digitally signed by Richard Pantel
Date: 2025.10.22 11:14:46 -05'00'

V251014
ID.ec24 12:10

Richard Pantel, P.E.
VA License No. 45348
Sealed 10/22/2025

Loading Summary

Exposure and Occupancy Categories		
B		Exposure Category (ASCE 7-22 Table 26.7.3, Page 274)
II		Building Use Occupancy / Risk Category (ASCE 7-22 Table 1.5-1, Page 5)

Wind Loading:			
v	135	mph	Over-ridden per client request. Original data from Municipality provided wind / snow loadings.
qz	27.76	psf	Velocity qz, calculated at height z [ASD]

Snow Loading			
pg	30.00	psf	Ground Snow Load pg (Over-ridden per client request. Original data from Municipality provided wind / snow loadings.)
Total Snow Load			
ps	20.00	psf	Effective snow load on roof and modules

Module Data			
Canadian Solar: CS6.1-54TM-440H			
Dimensions	mm	ft	in
Length	1,800	5.91	70.87
Width	1,134	3.72	44.65
Area (m ² , ft ²)	2.0	21.97	
Weight	kg	lb	
Module	23.00	50.71	

Roof Panel (Cladding) Loading Summary		Module Loading Summary			
Support Point Loads		Upward	Upward	Upward	Downward
Roof Zones		1	2	3	All
Net load per module	lb	-66	-95	-112	158

Positive values indicate net downward force

Primary Stanchion: IronRidge Flat Roof Attachment - 4 Bolts

StanchionFastener Pull-out and Spacing Calculations				
Framing spacing	<i>ft</i>	2.00		
Rails / Module	<i>ea</i>	2		
Max proposed stanchion span	<i>ft</i>	4.00		
# fasteners per stanchion		4		
Bolt thread embedment depth	<i>in</i>	0.50		
Safety Factor		1.10		
Pull-out for 1/4 threaded fasteners	<i>lb/in</i>	186	<i>lb per inch of embedment</i>	
Factored max fastener uplift capacity	<i>lb</i>	338		
Fastener details	<i>Material</i>	Stainless	<i>Size</i>	1/4
Max stanchion uplift capacity	<i>lb</i>	400	<i>Predrill hole 0.12" dia or use self tapping</i>	
Max support point uplift capacity	<i>lb</i>	338		

Roof Zones			1	2	3
Net lift per module	<i>lb</i>		66	95	112
Min tot bolt thread embedment depth req'd	<i>in</i>		0.10	0.14	0.17
Net uplift pressure	7. 0.60D - 0.6W	<i>psf</i>	-8.89	-12.80	-15.08
Allowable lift area / support point		<i>sf</i>	38.00	26.39	22.40
Max rail span per support spacing		<i>ft</i>	4.00	4.00	4.00

Landscape Modules					
Length along rafter	<i>ft</i>	3.72			
Lift calc'ed max stanchion EW spacing	<i>ft</i>	> 6	> 6	> 6	
Max stanchion EW spacing	<i>ft</i>	4.00	4.00	4.00	
Maximum module area / support point	<i>sf</i>	7.44	7.44	7.44	
Factored lift per support point	<i>lb</i>	-66	-95	-112	

Portrait Modules					
Length along rafter	<i>ft</i>	5.91			
Lift calc'ed max stanchion EW spacing	<i>ft</i>	> 6	> 6	6.00	
Max stanchion EW spacing	<i>ft</i>	4.00	4.00	4.00	
Maximum module area / support point	<i>sf</i>	11.81	11.81	11.81	
Factored lift per support point	<i>lb</i>	-105	-151	-178	

Plywood Nailing Calculations

Nail Size	<i>Gauge</i>	<i>Shank Dia</i>	<i>Length</i>	<i>W</i>
8D	10	0.134	2.5	54
10D	9	0.148	3	59
Load Duration Factor - Wind	1.6			
AWC 11.3.1 $W' = W * C_d * C_m * C_t * C_{eg} * LD$				
8D withdrawal force @ 2" penetration (lb)	138			
10D withdrawal force @ 2.5" penetration (lb)	189			
		1	2	3
# 8D's Req'd / stanchion in Landscape	<i>ea</i>	0.48	0.69	0.81
# 10D's Req'd / stanchion in Landscape	<i>ea</i>	0.35	0.50	0.59
# 8D's Req'd / stanchion in Portrait	<i>ea</i>	0.76	1.09	1.29
# 10D's Req'd / stanchion in Portrait	<i>ea</i>	0.56	0.80	0.94

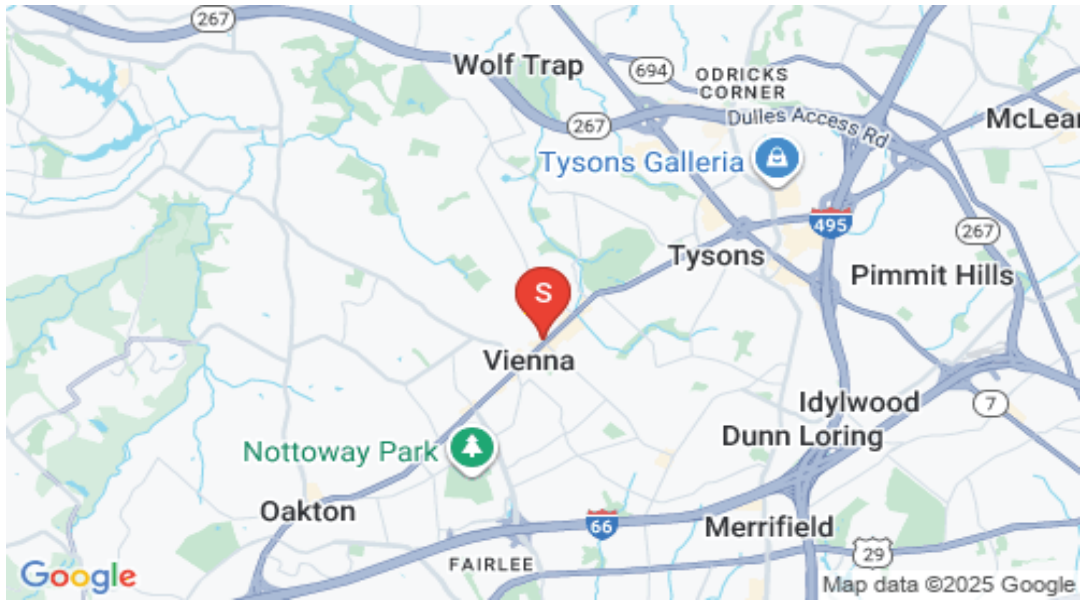
Stanchion support threaded fastener sizes are indicated in the Module Loading Summary table above. Lift forces were determined from GCp and other coefficients contained in the ASCE nomographs

Conclusions

We were asked to review the roof of Mala Rajamani, located at 111A Park Street Northeast, Vienna, VA, by COS, to determine its suitability to support a PV solar system installation.

The referenced building's roof structure was field measured by COS on 10/07/2025. The attached framing analyses reflect the results of those field measurements combined with the PV solar module locations shown on the PV solar roof layout design prepared by COS. Loads are calculated to combine the existing building and environmental loads with the proposed new PV array loads.

The IronRidge XR10 Rail racking and IronRidge Flat Roof Attachment - 4 Bolts stanchions were selected for this project by COS. The racking and support stanchions shall be placed as shown on their plans, dated 10/07/2025, and shall be fastened to the roof framing using fastener sizes indicated in this report. Rack support spacing shall be no more than that shown above. Note that support points for alternating rows shall share the same rafter cavity. Intermediate rows shall move the support points laterally to the next rafter cavity.



Google Location Map

Framing Summary

	Ex. Framing	Total Ex DL
MP 1: 1.50" x 3.50" member x 20.83' span with a 0° slope @ 24" OC	0.50 psf	2.89 psf
* Wood species used in these calculations assumes spruce, pine or fir, #2 grade.		

Based upon the attached calculations, the existing roof's framing system is capable of supporting the additional loading for the proposed PV solar system along with the existing building and environmental loads. No supplemental roof framing structural supports are required. No further structural alterations or modifications are needed to support the system. Minimum required anchorage fastening is described above.

Fastener notes: 1) Install fasteners with head and where required, washer, flush to material surface (no gap). Do not over-torque.

References and Codes:

- 1) ASCE 7-22 Minimum Design Loads for Buildings and Other Structures
- 2) 2021 IBC
- 3) 2021 Virginia Residential Code
- 4) American Wood Council, NDS 2018, Table 12.2A, 12.3.3A.
- 5) American Wood Council, Wood Structural Design, 1992, Figure 6.

Roof Structural Calculations for PV Solar Installation

Location: MP 1

Member: Rafter - Total Length 20.83 ft, Unsupported 0 ft

Array AR-1

Roof shape: Gable

Geometric Data				
Θ	deg.	1.2	Angle of roof plane from horizontal, in degrees	
ω	deg.	0.0	Angle the solar panel makes with the roof surface	
L	ft.	54.71	Length of roof plane, in feet (meters)	
W	ft.	21.83	Plan view width of roof plane, in feet (meters)	
h	ft.	28.02	Average height of roof above grade, in feet (meters)	

Roof Wind Zone Width			
	use, a =	3.00	ft

Wind Velocity Pressure, q_z evaluated at the height z					
$q_z =$	27.76	psf	$V_{asd} q_z =$	16.79	psf
V =	135				mph
Basic wind pressure					

Framing Data		
Wood type	US Spruce	
Wood source, moisture content	White 0.12%	
# Framing Members / Support		1
Rafter / Truss OC	in	24.00
Member Total Length	ft	20.83

2	# Rafters / Rack Support Width
4.00	Rack Support Spacing (ft)
48.00	Max. Rack Support Spacing (in)
4	Max # of mod's / Rafter

Member Properties		Member
Name		(1)1.5x3.5
Repetitive Member Factor (Cr)		1.15
Max Shear perp. to grain	psi	530
Max Shear parallel to grain	psi	1,100

* Mem properties based upon field measurements

Rafter

24.00	Collar tie OC spacing, in.
-------	----------------------------

Module Data			
Weight	kg	lb	psf load
Module	23.00	50.71	2.31
4 Stanchions	0.73	1.6	0.07

Existing Dead Loads	Units	Value	Description
Framing Member	psf	0.50	
Roof Deck & Surface Material*	psf	2.39	0.50 in. Plywood w/ TPO, 60-mil (Membrane Only)

* Roof surface: TPO, 60-mil (Membrane Only)

Rack Support Spacing and Loading			
Across rafters	ft	4.0	
Along rafter slope	ft	3.7	
Area / support point	sf	7.4	
Uphill gap between modules	in	1.0	0.08 ft

Member Total Length	ft	20.83	
Maximum member free span	ft	0.00	Rafter below Proposed Cd
Rafter segment to calc	ft	0.00	Free span
Deflection Ratio		180	Use max delta 1/x for deflection

Eave Overhang Length past Rafter Plate	1.00	ft
Uphill Distance from Eave to Lowest Support	2.95	ft

ASCE 7-22 Method for Calculating Uplift on PV Modules

Notation

Lp = Panel chord length.

p = uplift wind pressure

ya = Solar panel pressure equalization factor, defined in Fig. 29.4-8.

yE = Array edge factor as defined in Section 29.4.4.

θ = Angle of plane of roof from horizontal, in degrees.

29.4.3 Rooftop Solar Panels for Buildings of All Heights with Flat Roofs or Gable or Hip Roofs with Slopes Less Than 7°.

p = qh (GCrn) (lb/ft²) (29.4-5)

(GCrn) = (yp) (yc) (yE) (GCrn)nom (29.4-6)

yp =	0.9
yc =	0.954331

Min.d1: Exposed **FALSE**

Max.d1: Exposed **TRUE**

Use EXPOSED for uplift calculations

1.5(Lp) =	8.86
yE =	1.5

Zones	1	2	3
p, Windload (psf)	-20.08	-26.60	-30.40
Zones	1	2	3
GCp	-0.98	-2.09	-2.84

Downward, Zones 1, 2 & 3
GCp 0.27

ASCE 7-22 Chapter 2 Combinations of Loads, Table 2.4, Page 8 (in psf)

Zones	1	2	3	1, 2 & 3
2.2 SYMBOLS AND NOTATION	<i>Module Upward</i>	<i>Module Upward</i>	<i>Module Upward</i>	<i>Downward</i>
D = dead load of PV Module + Stanchion	2.38	2.38	2.38	2.38
S = snow load	20.00	20.00	20.00	20.00
W = wind load = (Vu Windload) = (Vasd Windload / 0.6)	-20.08	-26.60	-30.40	4.46

2.4 Combining Nominal Loads Using Allowable Stress Design (in psf)

2.4.1 Basic Combinations. Loads listed herein shall be considered to act in the following combinations; whichever produces the most unfavorable effect in the building, foundation, or structural member being considered. Effects of one or more loads not acting shall be considered.

Combination Formulae	Upward	Upward	Upward	Downward
Use this loading combination for DOWNWARD for Proposed PV Dead Load				
6. D + 0.75L - 0.75(0.60W) + 0.75(Lr or S or R)	22.38	22.38	22.38	24.39
Module Support point load (lb)	167	167	167	181
Cr Factored Module Support point load (lb)	145	145	145	158

Use this loading combination for UPWARD for Proposed PV Dead Load

7. 0.60D - 0.6W	-8.89	-12.80	-15.08	5.27
Module Support point load (lb)	-66	-95	-112	39

DOWNWARD*Presume loading directly over member.*

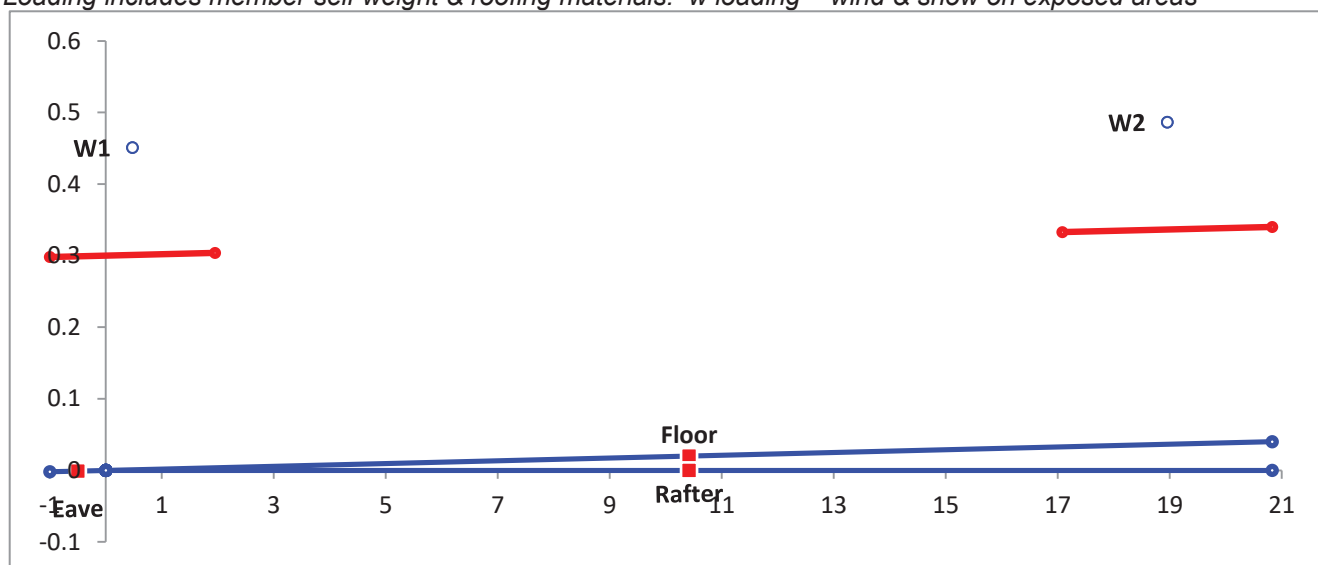
Combined Dead and Wind Pressure Downward Loading					
Rafter below Proposed Collar Tie					
PV Module Row	Point load loc's from Left support		Module Support Point Load	Comment	Module Orientation
	<i>ft from left</i>		<i>lb</i>		
1	1.95			Support outside of max stressed section	Landscape
1	5.67			Support outside of max stressed section	Landscape
2	5.75			Support outside of max stressed section	Landscape
2	9.47			Support outside of max stressed section	Landscape
3	9.56			Support outside of max stressed section	Landscape
3	13.28			Support outside of max stressed section	Landscape
4	13.36			Support outside of max stressed section	Landscape
4	17.08			Support outside of max stressed section	Landscape

Analysis for PV impacted areas

5. Simple Beam - Exposed Roof Snow Load - Above and Below PV				
Parameter	Units	Total	Allowed	Check
Delta @ mid span	in	#DIV/0!	0.00	#DIV/0!
M at mid span	lb-ft	#DIV/0!	1,667	#DIV/0!

Sum Downward Loading Conditions: PV; Beam DL; Exposed Roof Environmental Load				
Parameter	Units	Total	Allowed	Check
Delta	in	#DIV/0!	0.00	#DIV/0!
Percent Max Delta	%	#DIV/0!	100%	#DIV/0!
Moment	lb-ft	#DIV/0!	1,667	#DIV/0!
fs	psi	#DIV/0!	6,533	#DIV/0!

* Loading includes member self weight & roofing materials. w loading = wind & snow on exposed areas



Framing section with max stress: Rafter below Proposed Collar Tie

Snow Loading Analysis for MP 1

where:

		Fully Exposed	Exposure category
Ce	=	0.9	Exposure Factor, Ce (ASCE 7-22 Table 7.3-1, Page 61)
Ct	=	1.0	Thermal Factor, Ct (ASCE 7-22 Table 7.3-2, Page 61)
I	=	1.0	Snow Importance Factor, Is (ASCE 7-22 Table 1.5-2, Page 5)
pg	=	30	Ground Snow Load pg (Over-ridden per client request. Original data from Municipality)
Roof slope factor Cs for Warm Roofs, where Ct = 1.0			
			Roof surface condition = Slippery Roof
Cs	=	1.00	Roof Slope Factor, Cs (ASCE 7-22 Table 7.4-1a, Page 62)

Total Snow Load		Snow Load to Use	
ps	=	20.00 psf	20.00 psf

Snow Loading Analysis

where:

	Fully Exposed	Exposure category
C_e =	0.9	Exposure Factor, C _e (ASCE 7-22 Table 7.3-1, Page 61)
C_t =	1.0	Thermal Factor, C _t (ASCE 7-22 Table 7.3-2, Page 61)
I_s =	1.0	Snow Importance Factor, I _s (ASCE 7-22 Table 1.5-2, Page 5)
p_g =	30.00	Ground Snow Load p _g (Over-ridden per client request. Original data from Municipality)

p_f = **0.7C_eC_tI_sP_g** Flat Roof Snow Load, p_f (ASCE 7-22 Table 7.3-1, Page 61)

p_f = **18.90** psf

but where P_f is not less than the following:

Minimum Snow Load p_m (ASCE 7-22 Table 7.3.4, Page 62)

p_m = **20** psf. When P_g > 20 psf, then use P_f = 20 psf x I_s

p_f = **20.00** psf. Resultant Snow pressure to be used with Roof slope factor below

p_s = **C_sp_f** Sloped Roof Snow Load p_s (ASCE 7-22 Table 7.4, Page 61)

Roof Type Warm Roofs

Roof slope factor C_s for Warm Roofs, where C_t = 1.0

Roof surface condition = Slippery Roof

C_s = 1.00 Roof Slope Factor, C_s (ASCE 7-22 Table 7.4-1a, Page 62)

Total Snow Load

p_s = 20.00 psf

Roof snow load