

GENERAL NOTES

1. All electrical materials shall be new and listed by recognized electrical testing laboratory
Custom made equipment shall have complete test data submitted by the manufacturer attesting to its safety
2. Outdoor equipment shall be NEMA 3R rated or equivalent
3. All metallic equipment shall be grounded
4. Contractor shall obtain electrical permits prior to installation and shall coordinate all inspections, testing commissioning and acceptance with the client, utility co. and city inspectors as needed.
5. The electrical contractor shall verify the exact locations of service points and service sizes with the serving utility company and comply with all utility companies requirements.
6. Drawings are diagrammatic only, routing of raceways shall be option of the contractor unless otherwise noted and shall be coordinated with other trades.
7. If the roof material or the roof structure not adequate for PV installation, call the engineer of record print to installation. The contractor is responsible to verify that the roof is capable of withstanding the extra weight.
8. If the distances for cable runs are different than shown, the contractor shall notify the electrical engineer to validate the wire size. Final drawings will be red-lined and updated as appropriate.
9. Whenever a discrepancy in quality of equipment arises on the drawing or specifications, the contractor shall be responsible for providing and installing all materials and services required by the strictest conditions noted on the drawings or in the specifications to ensure complete compliance and longevity of the operable system required by the engineer of record.

PHOTOVOLTAIC NOTES:

1. Rooftop mounted photovoltaic panels and modules shall be tested, listed and identified by recognized testing laboratory
2. Solar system shall not cover any plumbing or mechanical vents
3. Modules and support structures shall be grounded unless racking has integrated ground.
4. Removal of an interactive inverter or other equipment shall not disconnect the bonding connection between the grounding electrode conductor and the photovoltaic source and/or output circuit grounded conductors.
5. All PV modules and associated equipment and wiring shall be protected from physical damage.
6. 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.
7. Inverter is equipped with integrated DC disconnect, thus providing ground fault protection
8. All conductors shall be copper and 75 deg rated
9. A single conductor shall be permitted to be used to perform the multiple functions of dc grounding, AC grounding and bonding between AC and DC systems.
10. Non-current carrying metal parts of equipment shall be effectively bonded together. Bond both ends of raceways.

ENGINEERINC

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Burbank, CA 91502
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Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of California.

License No. 88083, Expiration Date: 03/31/2024

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GOVERNING CODES

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

- 2017 National Electrical Code
- 2018 International Residential Code
- 2018 International Building Code
- 2018 Mechanical Code
- 2018 International Fire Code
- 2018 International Energy Conservation Code

AS ADOPTED BY THE STATE OF NORTH CAROLINA
ALL OTHER ORDINANCE ADOPTED BY THE LOCAL GOVERNING AGENCIES

SYSTEM RATING

DC 4.80KW STC
AC 3.48KW STC

EQUIPMENT SUMMARY

12 HYUNDAI 400 WATT MODULES
WITH IQ8+ MICROINVERTERS

ELECTRICAL INFORMATION

EXISTING
MAIN SERVICE PANEL BUS SIZE: **200A**
MAIN SERVICE BREAKER SIZE: **200A**
MOUNTING SYSTEM: SNAPNRACK

BUILDING INFORMATION

CONSTRUCTION TYPE: V-B
OCCUPANCY: R-3
ROOF: Comp Shingle
Truss 2 x 4 @ 24" O.C.



Exp: 12/31/2023
Date Certified and
Signed: 02/10/2023

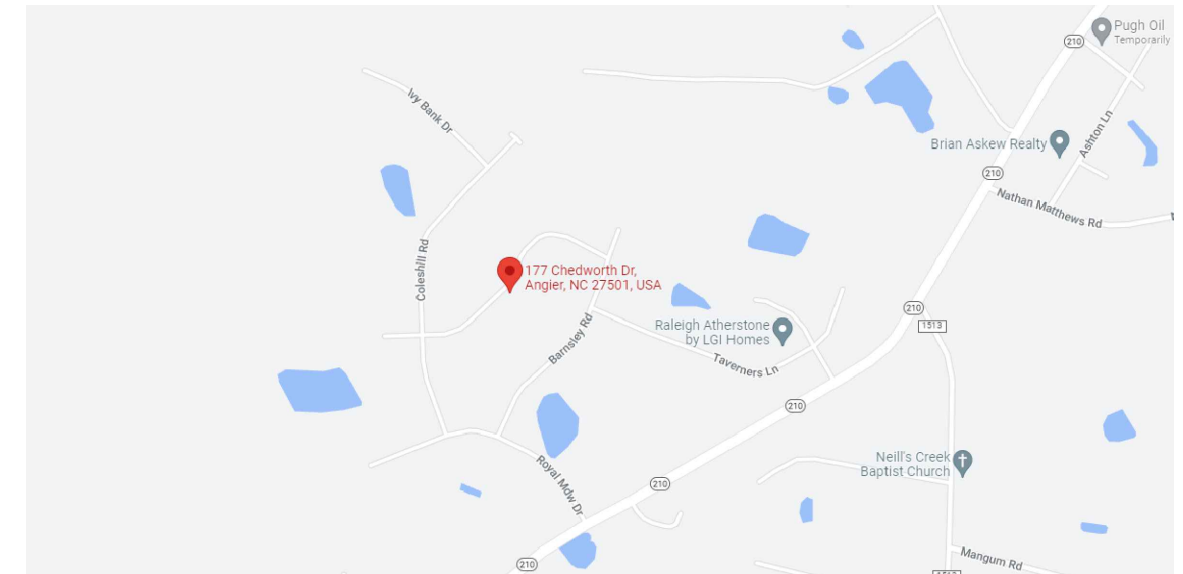
CONTRACTOR

Renewable Energy Design Group

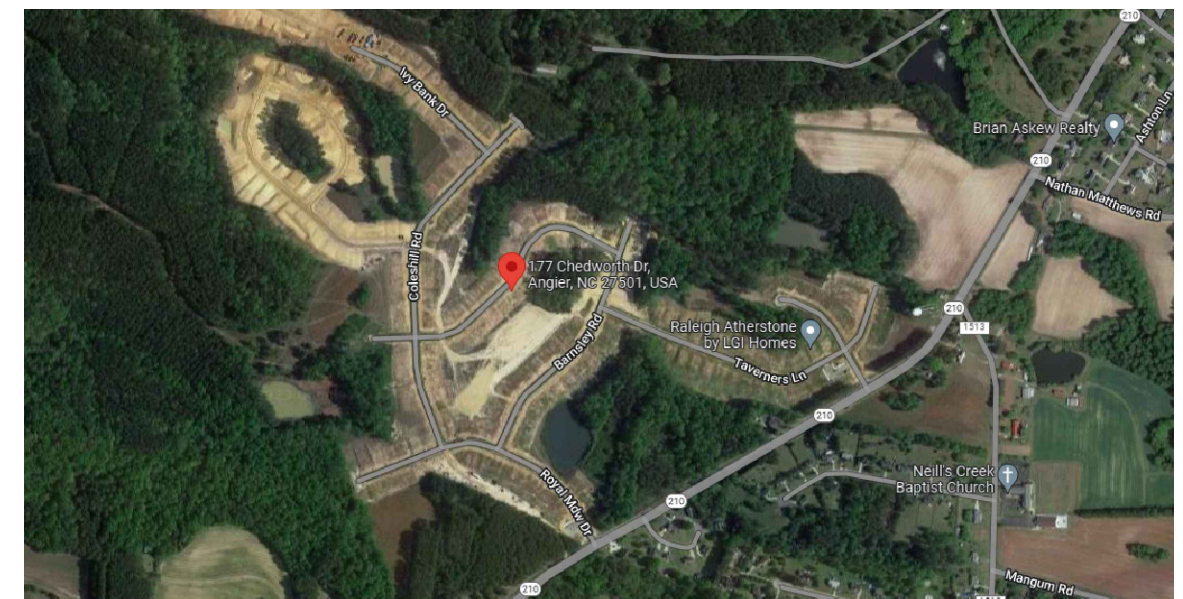
Phone number: (877)-520-7652
Address: 90 Beechwood Dr
Lewisville, North Carolina 27023

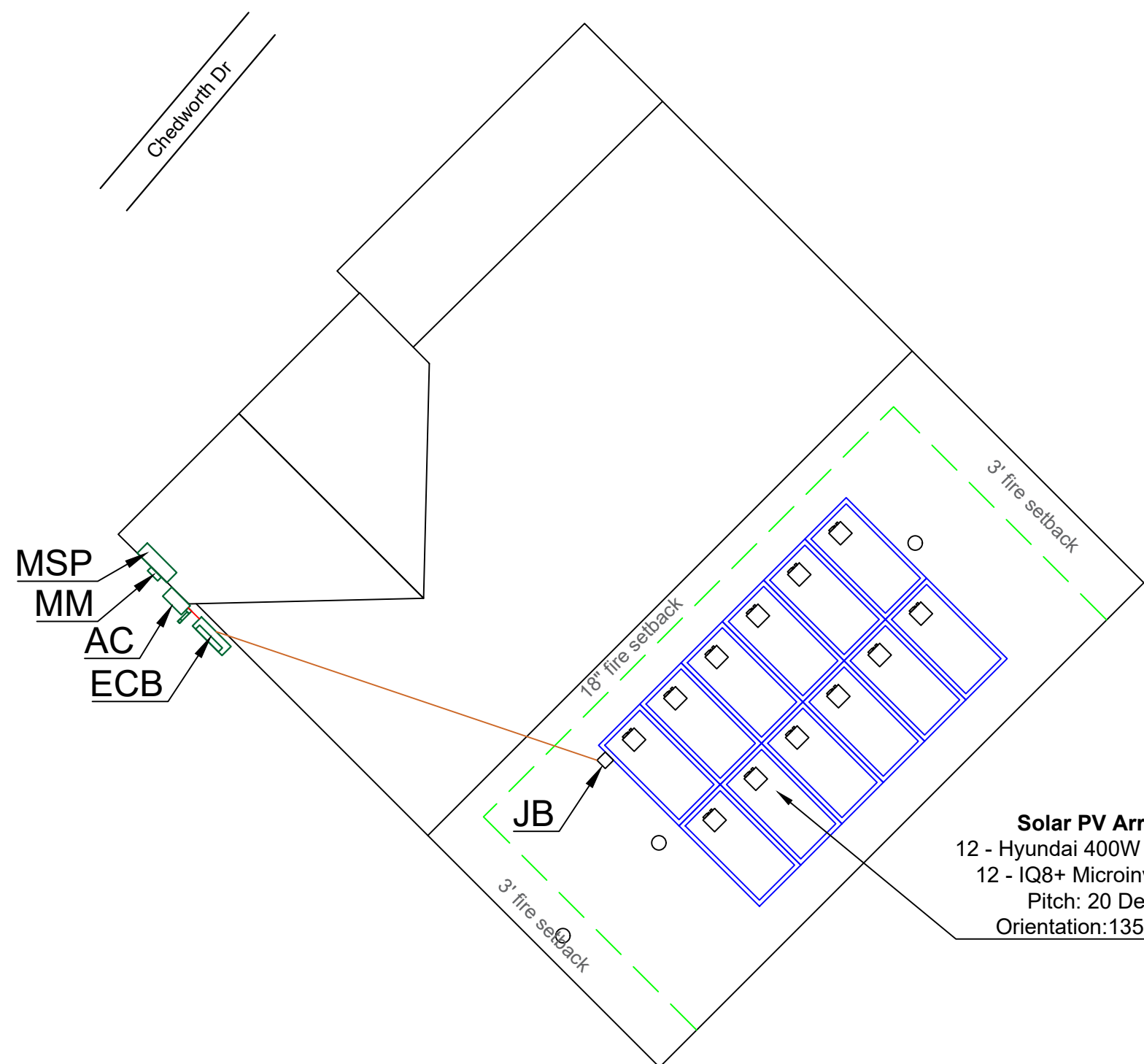
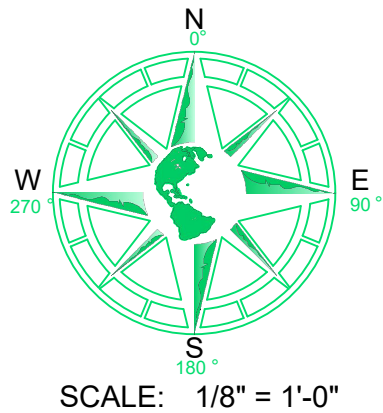
Owner: _____ PE Solar Abdo Alammari 5625
Property Address: _____ 177 Chedworth Dr, Angier, NC 27501
Property Type: _____ Single Family Residence
Drawn by: _____ New@engineerinc.io
Date: _____ 01/19/2023

VICINITY MAP (SCALE: NTS)







SATELLITE VIEW (SCALE: NTS)





INDEX

- MSP (E) **200A** Main Service Panel
- MM (N) Main Meter
- AC..... (N) 30A AC Disconnect
- ECB....(N) Enphase Combiner Box
- JB (N) Junction Box
- (N) Microinverter
-  Solar Module
-  EMT type Conduit
-  Fire Setback Line

SOLAR MODULES

12 Hyundai 400 Watt
Model #*(HiS-S400YH(BK))*

INVERTER

INVERTER TYPE: Micro:
12 Enphase IQ8+
Model # IQ8PLUS-72-2-US(240V)

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SITE MAP & PV LAYOUT

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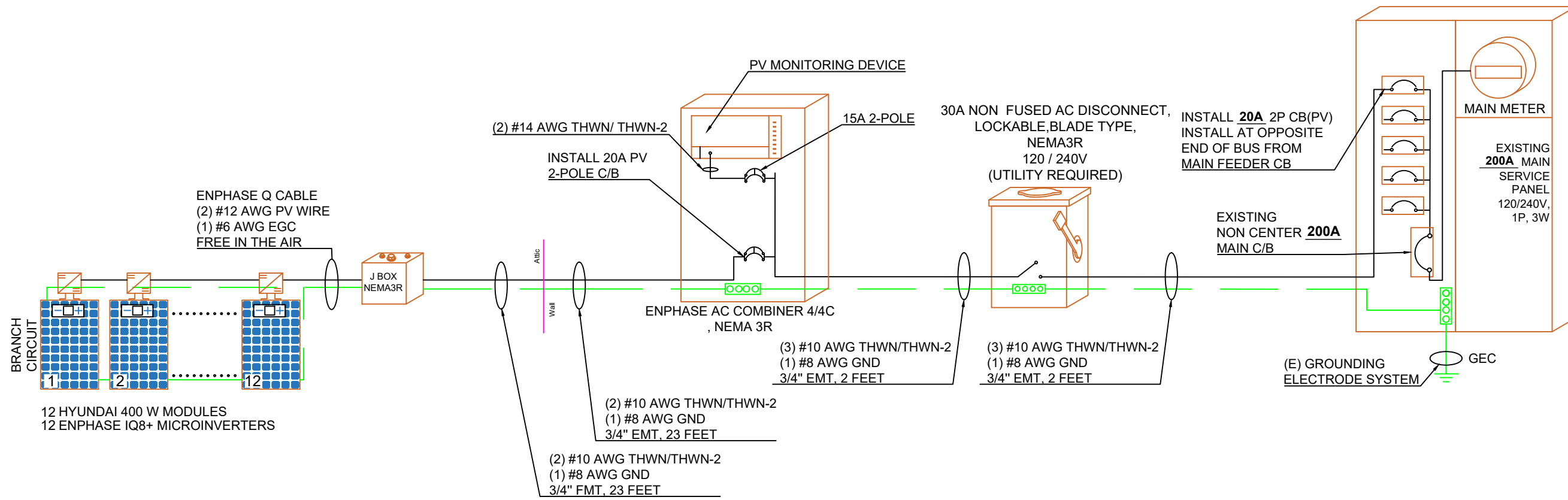
Drawn by: *New@engineerinc.io*
DATE: 01/19/2023

Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

PV 1.0

NOTE: Service Panel does not contain center fed Main Breaker:



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PV ARRAY RATING						WIRE SIZE CALCULATION		
BRANCH CIRCUIT						BRANCH CIRCUIT		
Number Modules	12	Type	Hyundai 400 Watt	(HiS-S400YH(BK))	Number OF Microinverters in Circuit	12		
Number MicroInverters	12	Type	Enphase IQ8+ Microinverters	IQ8PLUS-72-2-US(240V)	Microinverter Maximum Output Current (A)	1.21		
Location	Watts STC, (400Watts/Module) 12 * 400 = 4800				Branch Circuit Total Current (A)	$12 * 1.21 * 1.25 = 18.15$		
Array Currents	I-SC	11.25	A	I-MP	10.61	A	Breaker Size Per Branch Circuit (A)	20
Module Voltage	V-OC	45.3	V	V-MP	37.7	V		
FROM JBOX TO MAIN PANEL								
Total Number Of Microinverters	12	Total Amps From All Microinverters (A)	$12 * 1.21 = 14.52$		Consider Continuous (A)	$14.52 * 1.25 = 18.15$		
Temp. Derate Factor(0.91 at wall of the Building) (A)			$18.15 / 0.91 = 19.95$		Wire Size from NEC Table 310.15(b)16	10 AWG		
Ambiend Tem Factor Per NEC Table 310.15(b)(2)(a)			0.91					
MAIN PANEL								
PV Backfeed Breaker Size (A)	20	Main Breaker (A)	200	Main Bus Rating (A)	200	Total Amps On Bus (A)	$200 + 20 = 220$	$\leq 240(A)$

ELECTRICAL 1-LINE DIAGRAM

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Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name:
PE Solar Abdo Alammari 5625

Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

PV 2.0

LABEL 1

CAUTION
AUTHORIZED SOLAR
PERSONNEL ONLY!

LABEL 2

CAUTION
SOLAR DC CURRENT PRESENT
DURING DAYLIGHT HOURS

(STICKER TO BE LOCATED ON
CONDUIT WITH DC CURRENT
EVERY 4' HORIZONTALLY OR
10' VERTICALLY AND 1' FROM
EACH SIDE OF A BEND)

LABEL 3

WARNING!
ELECTRIC SHOCK HAZARD.
IF GROUND FAULT IS INDICATED,
NORMALLY GROUNDED
CONDUCTORS MAY BE
UNGROUND AND ENERGIZED.

LABEL 4

DC DISCONNECT
DC PHOTOVOLTAIC POWER SOURCE
RATED MAX POWER POINT CURRENT- ____ AMPS
RATED MAX POWER POINT VOLTAGE- ____ VOLTS
MAXIMUM SYSTEM VOLTAGE- ____ VOLTS
SHORT CIRCUIT CURRENT- ____ AMPS

LABEL 5

WARNING!
ELECTRIC SHOCK HAZARD.
DO NOT TOUCH THE TERMINALS.
TERMINALS ON BOTH THE LINE AND
LOAD SIDES MAY BE ENERGIZED IN
THE OPEN POSITION.

LABEL 6

PV SUB-PANEL ONLY
(TO BE LOCATED ON
SUB-PANEL ONLY
WHEN SUB-PANEL IS
DEDICATED FOR PV ONLY)

LABEL 7

AC DISCONNECT
AC PHOTOVOLTAIC POWER SOURCE
RATED AC OUTPUT CURRENT: **18.15 A MAX**
NOMINAL AC OPERATING VOLTAGE: **240 Vac**

LABEL 8

**THIS PANEL FED BY
MULTIPLE SOURCES
(UTILITY & SOLAR)**

LABEL 9

SOLAR

(STICKER LOCATED
INSIDE PANEL
NEXT TO SOLAR BREAKER)

LABEL 10

WARNING!
INVERTER OUTPUT CONNECTION. DO NOT
RELOCATE THIS OVERCURRENT DEVICE

(STICKER LOCATED
INSIDE PANEL
BELOW PV BREAKER)

LABEL 11

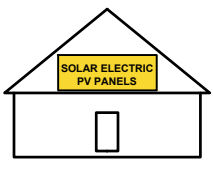
**PV LOAD CENTER SIZED FOR PV
BREAKERS ONLY OR RENDERED UNABLE
TO ACCEPT ANY ADDITIONAL LOADS.**

(STICKER LOCATED
ON THE PV SUB PANEL)

LABEL 12

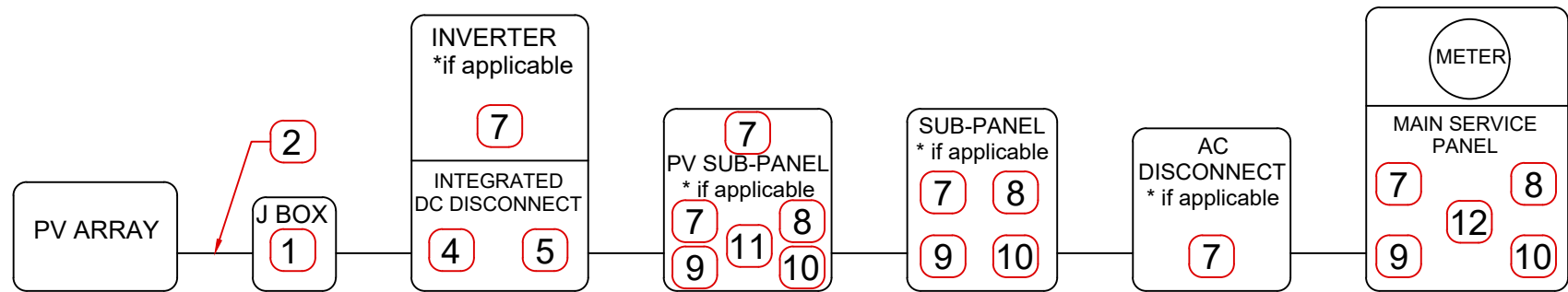
**SOLAR PV SYSTEM EQUIPPED
WITH RAPID SHUTDOWN**

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



DIRECTORY

Permanent directory or plaque providing location of service disconnecting means and photovoltaic system disconnecting means, if not located at the same location. (Plaques shall be metal or plastic, with engraved or machine printed letters, or electro-photo plating, in a contrasting color to the plaque. Plaques shall be permanently attached to the equipment or in the required location using an approved method that is suitable to withstand the environment to which it is exposed. Plaques and signage shall meet legibility, defacement, exposure and adhesion requirements of Underwriters Laboratories marking and labeling system 969(UL969).



MARKINGS, LABELS AND WIRING SIGNS

- A. Purpose: Provide emergency responders with appropriate warning and guidance with respect to isolating solar electric system. This can facilitate identifying energized electrical lines that connect solar panels to the inverter, as these should not be cut when venting for smoke removal
- B. Main Service Disconnect.
 - 1. Residential buildings - The marking main be placed within the main service disconnect. The marking shall be placed outside cover if the main service disconnect is operable with the service panel closed.
 - 2. Commercial buildings - Tha marking shall be placed adjacent to the main service disconnect clearly visible from the location where the level is operated
 - 3. Markings: Verbiage, Format and Type of Material.
 - a. Verbiage: CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED
 - b. Format: White lettering on a red background. Minimum 3/8 inches letter height. All letters shall be capitalized. Arial or similar font, non bold.
 - c. Material: 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. Markings: Verbiage, Format and Type of Material.
 - a. Placement : Markings shall be placed every 10 feet on all interior and exterior DC conduits, raceways, enclosures, and cable assemblies, at turns, above and for below penetrations, all DC combiners and junction boxes
 - b. Verbiage: CAUTION: SOLAR CIRCUIT Note: The format and type of material shall adhere to "V. V-3b, c" of this requirement.
 - c. Inverters are not required to have caution markings
 - 1. Marking is required on all interior and exterior DC conduit raceways, enclosures, cable assemblies, and junction boxes, combiner boxes and disconnects.
 - 2. The materials used for marking shall be reflective, weather resistant material suitable for the environment. Minimum 3/8 "letter height; all upper case letters Arial or similar font; Red background with white lettering.
 - 3. Marking shall contain the words: **WARNING : PHOTOVOLTAIC POWER SOURCE.**
 - 4. Marking shall be placed adjacent to the main service disconnect in a location clearly visible from the location where the disconnect is operated

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**Renewable Energy
Design Group**

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**SYSTEM
LABELING DETAIL**

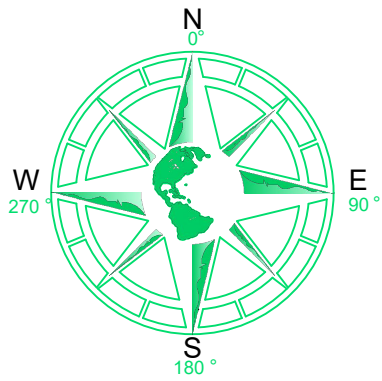
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DATE: 01/19/2023

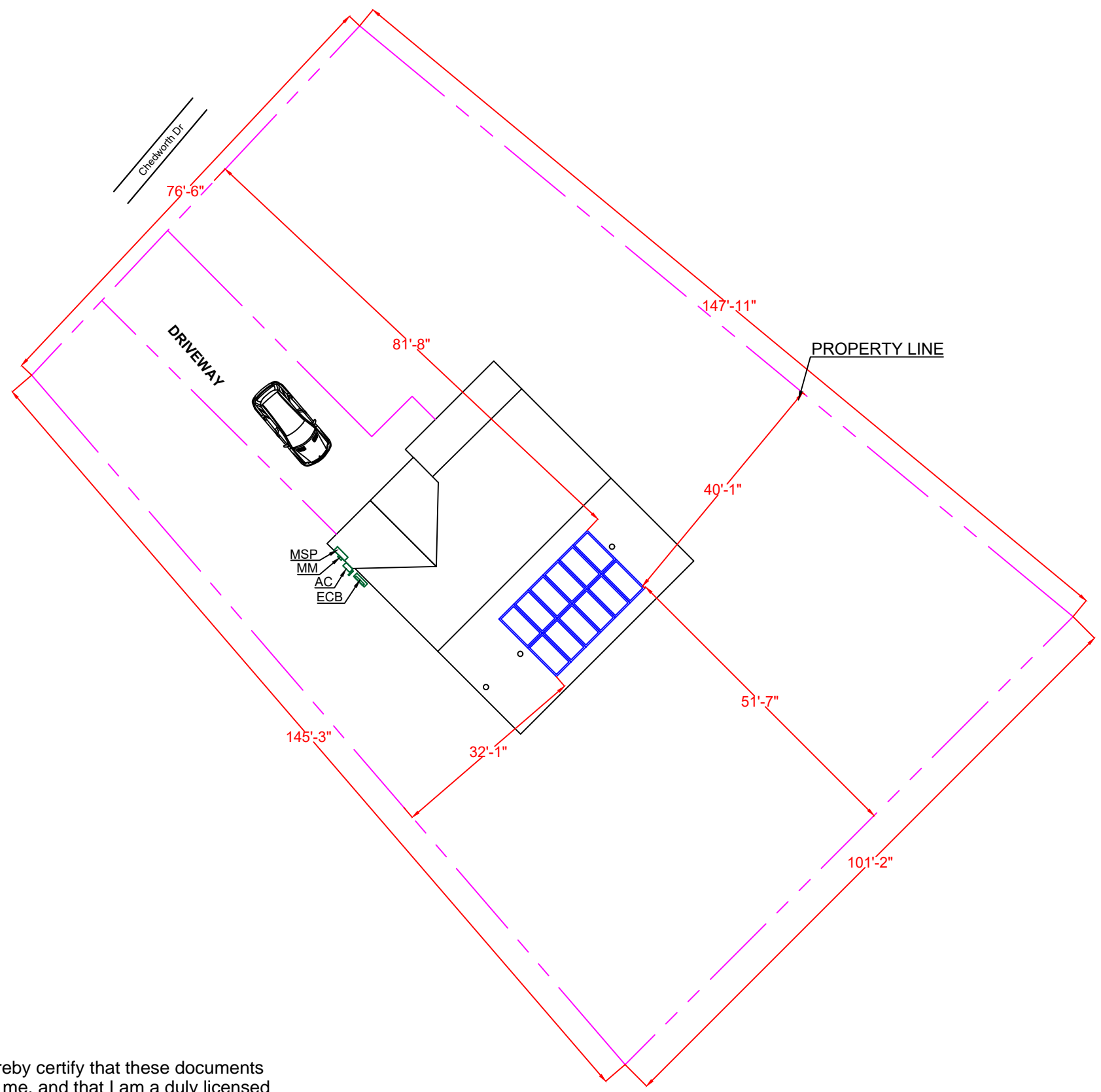
Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

PV 3.0



SCALE: 1/32" = 1'-0"



LEGEND
 MSP..... Main Service Panel
 MM Main Meter
 ECB..... Enphase Combiner Box
 AC AC Disconnect

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Exp: 12/31/2023
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PROPERTY PLAN

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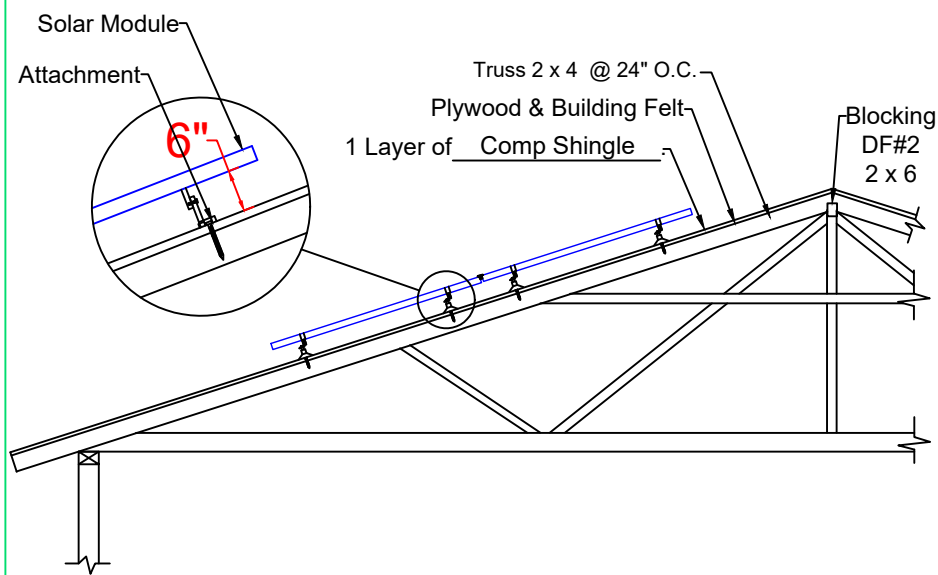
Drawn by: New@engineerinc.io
 DATE: 01/19/2023

Project Name:
 PE Solar Abdo Alammari 5625
 Property Address:
 177 Chedworth Dr,
 Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

PV 4.0

MODULES ON ROOF



- ATTACHMENT
- RAIL
- Truss 2 x 4 @ 24" O.C.

DESIGN CRITERIA

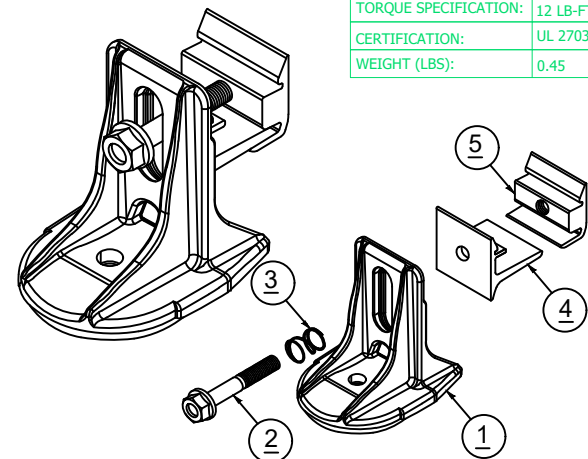
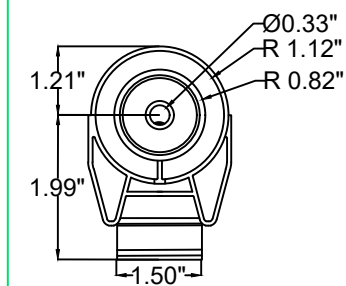
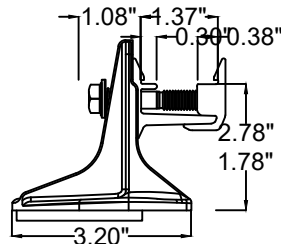
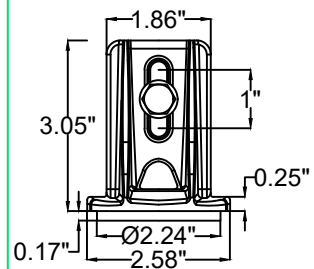
Modules:
12
Max Distributed Load: 3 PSF

POINT LOAD CALCULATION PER ARRAY

Module Weight (lbs)	46.51
# Of Modules	12
Total Module Weight (lbs)	558.12
Rack Weight (lbs)	111.62
Microinverters Weight (lbs)	28.56
Total System Weight (lbs)	698.3
# Of Standoffs	24
Max Span Between Standoffs (in)	48
Loading Per Standoff (lbs)	29.09
Total Area (sq.ft.)	264
Loading (PSF)	2.64

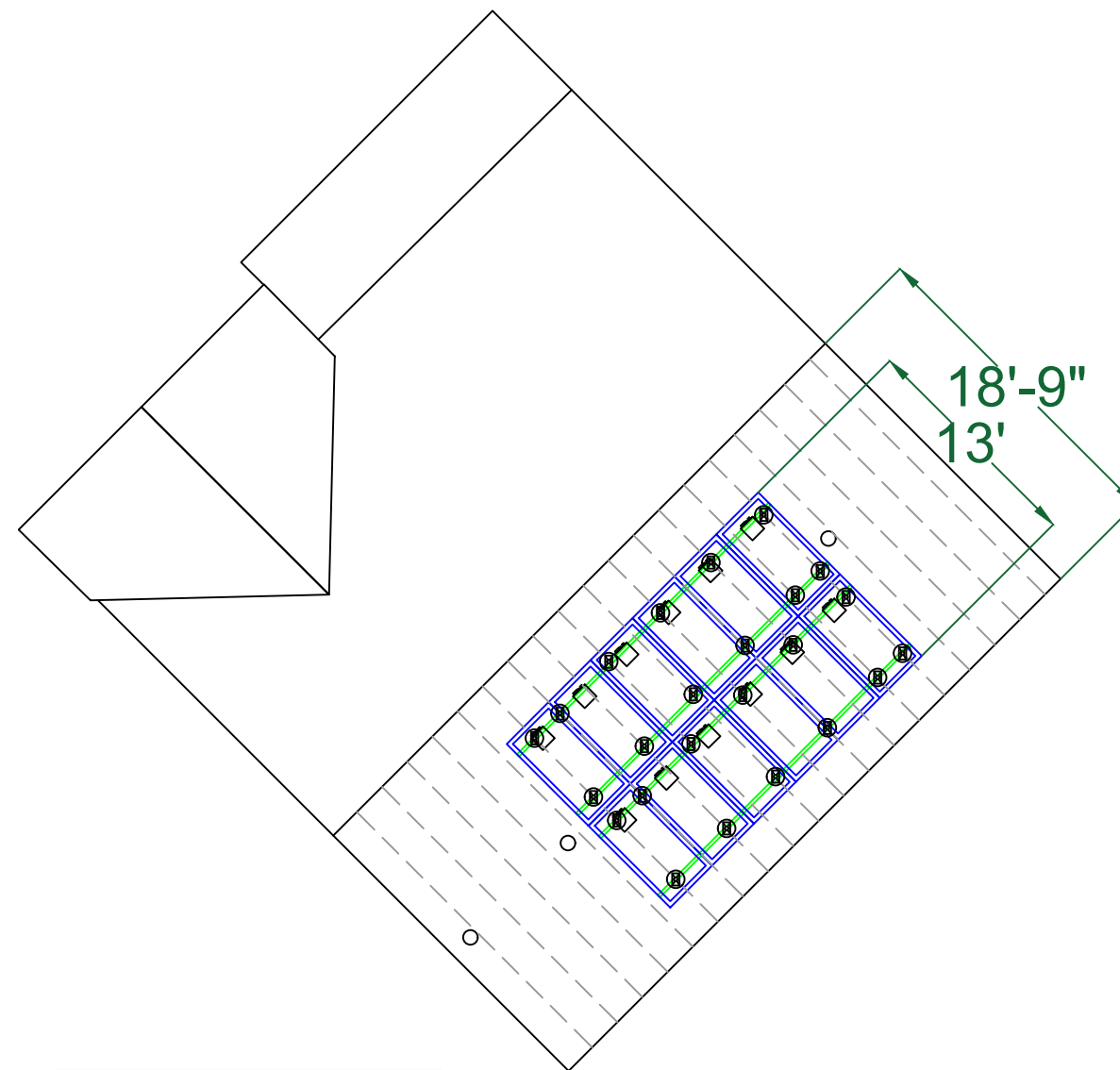
Prior to the commencement of work, the contractor shall verify the existing roof and framing conditions. Notify New@engineerinc.io of any Discrepancies prior to starting construction. Prior to the commencement of work, the contractor shall inspect framing for any damage such as water damage, cracked framing, etc. and notify New@engineerinc.io if any issues are found. These Plans are stamped for structural code compliance of the roof framing supporting the proposed PV installation reference only. These plans are not stamped for water leakage. PV modules, racking, and attachment components must follow manufacturer guidelines and requirements. Attachments to be installed in a staggered orientation to properly distribute loads.

SNAPNRACK, ULTRA RAIL SPEEDSEAL™ FOOT



PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, SPEEDSEAL FOOT, BASE, SEALING, SILVER/BLACK
2	1	BOLT, FLANGE, SERRATED, 5/16IN-18 X 2IN, SS
3	1	SNAPNRACK, RL UNIVERSAL, MOUNT SPRING, SS
4	1	SNAPNRACK, ULTRA RAIL MOUNT THRU PRC, CLEAR/BLACK
5	1	SNAPNRACK, ULTRA RAIL MOUNT TAPPED PRC, CLEAR/BLACK

MATERIALS:	DIE CAST A380 ALUMINUM, 6000 SERIES ALUMINUM, STAINLESS STEEL	
DESIGN LOAD (LBS):	802 UP, 1333 DOWN, 357 SIDE	OPTIONS:
ULTIMATE LOAD (LBS):	2118 UP, 4006 DOWN, 1331 SIDE	CLEAR/BLACK
TORQUE SPECIFICATION:	12 LB-FT	
CERTIFICATION:	UL 2703, FILE E359313; WIND-DRIVEN RAIN TEST FROM SUBJECT UL 2582	
WEIGHT (LBS):	0.45	



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ATTACHMENT LAYOUT

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Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name: PE Solar Abdo Alammari 5625
Property Address: 177 Chedworth Dr, Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

PV 5.0

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Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of California.

License No. 88083, Expiration Date: 03/31/2024



IQ8 Series Microinverters

Our newest IQ8 Microinverters are the industry's first microgrid-forming, software-defined microinverters with split-phase power conversion capability to convert DC power to AC power efficiently. The brain of the semiconductor-based microinverter is our proprietary application-specific integrated circuit (ASIC) which enables the microinverter to operate in grid-tied or off-grid modes. This chip is built in advanced 55nm technology with high speed digital logic and has super-fast response times to changing loads and grid events, alleviating constraints on battery sizing for home energy systems.



Part of the Enphase Energy System, IQ8 Series Microinverters integrate with the Enphase IQ Battery, Enphase IQ Gateway, and the Enphase App monitoring and analysis software.



IQ8 Series Microinverters redefine reliability standards with more than one million cumulative hours of power-on testing, enabling an industry-leading limited warranty of up to 25 years.



Connect PV modules quickly and easily to IQ8 Series Microinverters using the included Q-DCC-2 adapter cable with plug-n-play MC4 connectors.



IQ8 Series Microinverters are UL Listed as PV Rapid Shut Down Equipment and conform with various regulations, when installed according to manufacturer's instructions.

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IQ8SE-DS-0001-01-EN-US-2021-10-19

Easy to install

- Lightweight and compact with plug-n-play connectors
- Power Line Communication (PLC) between components
- Faster installation with simple two-wire cabling

High productivity and reliability

- Produce power even when the grid is down
- More than one million cumulative hours of testing
- Class II double-insulated enclosure
- Optimized for the latest high-powered PV modules

Microgrid-forming

- Complies with the latest advanced grid support
- Remote automatic updates for the latest grid requirements
- Configurable to support a wide range of grid profiles
- Meets CA Rule 21 (UL 1741-SA) requirements

IQ8 Series Microinverters

INPUT DATA [DC]	IQ8-60-2-US	IQ8PLUS-72-2-US	IQ8M-72-2-US	IQ8A-72-2-US	IQ8H-240-72-2-US	IQ8H-208-72-2-US ⁽¹⁾
Commonly used module pairings ²	W 235 – 350	235 – 440	260 – 460	295 – 500	320 – 540+	295 – 500+
Module compatibility	60-cell/120 half-cell		60-cell/120 half-cell and 72-cell/144 half-cell			
MPPT voltage range	V 27 – 37	29 – 45	33 – 45	36 – 45	38 – 45	38 – 45
Operating range	V 25 – 48			25 – 58		
Min/max start voltage	V 30 / 48			30 / 58		
Max input DC voltage	V 50			60		
Max DC current ³ [module Isc]	A		15			
Overvoltage class DC port			II			
DC port backfeed current	mA		0			
PV array configuration	1x1 Ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit					
OUTPUT DATA [AC]	IQ8-60-2-US	IQ8PLUS-72-2-US	IQ8M-72-2-US	IQ8A-72-2-US	IQ8H-240-72-2-US	IQ8H-208-72-2-US
Peak output power	VA 245	300	330	366	384	366
Max continuous output power	VA 240	290	325	349	380	360
Nominal (L-L) voltage /range ⁴	V	240 / 211 – 264				208 / 183 – 250
Max continuous output current	A 1.0	1.21	1.35	1.45	1.58	1.73
Nominal frequency	Hz	60				
Extended frequency range	Hz	50 – 68				
Max units per 20 A (L-L) branch circuit ⁵	16	13	11	11	10	9
Total harmonic distortion		<5%				
Overvoltage class AC port		III				
AC port backfeed current	mA	30				
Power factor setting		1.0				
Grid-tied power factor (adjustable)		0.85 leading – 0.85 lagging				
Peak efficiency	% 97.5	97.6	97.6	97.6	97.6	97.4
CEC weighted efficiency	% 97	97	97	97.5	97	97
Night-time power consumption	mW	60				
MECHANICAL DATA						
Ambient temperature range	-40°C to +60°C (-40°F to +140°F)					
Relative humidity range	4% to 100% (condensing)					
DC Connector type	MC4					
Dimensions (HxWxD)	212 mm (8.3") x 175 mm (6.9") x 30.2 mm (1.2")					
Weight	1.08 kg (2.38 lbs)					
Cooling	Natural convection – no fans					
Approved for wet locations	Yes					
Acoustic noise at 1m	<60 dBA					
Pollution degree	PD3					
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure					
Environ. category / UV exposure rating	NEMA Type 6 / outdoor					
COMPLIANCE						
Certifications	CA Rule 21 (UL 1741-SA), UL 62109-1, UL1741/IEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 1071-01					
	This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC 2014, NEC 2017, and NEC 2020 section 690.12 and C22.1-2018 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according to manufacturer's instructions.					

(1) The IQ8H-208 variant will be operating in grid-tied mode only at 208V AC. (2) No enforced DC/AC ratio. See the compatibility calculator at <https://link.enphase.com/module-compatibility> (3) Maximum continuous input DC current is 10.6A (4) Nominal voltage range can be extended beyond nominal if required by the utility. (5) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

IQ8SE-DS-0001-01-EN-US-2021-10-19

CONTRACTOR

Renewable Energy Design Group

Phone number: (877)-520-7652
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INVERTER DATA SHEET

ENGINEER INC

Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

D 6.0

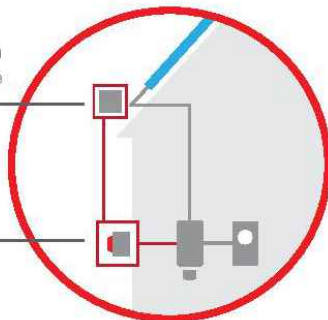
Rapid shutdown is built-in

The 2014 edition of the National Electrical Code (NEC 2014) added new rapid shutdown requirements for PV systems installed on buildings. Enphase Microinverters fully meet rapid shutdown requirements in the new code without the need to install any additional electrical equipment.

What's new in NEC 2014?
NEC 2014, Section 690.12 applies to PV conductors over 10 feet from the PV array and requires that the conductors power down to 30 volts and 240 volt-amperes within 10 seconds of rapid shutdown initiation.

String inverters require work arounds for rapid shutdown

Work around.
Specialized Rapid Shutdown electrical box installed on the roof within 10 feet of array.

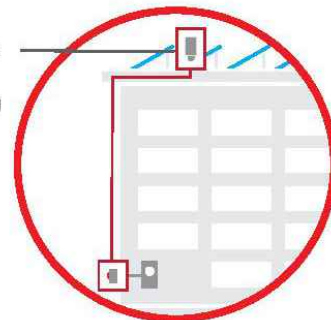


Residential String Inverter

Work around.
Shutoff switch that is easily accessible to first responders on the ground.

Work around.
Extra conduit in installation.

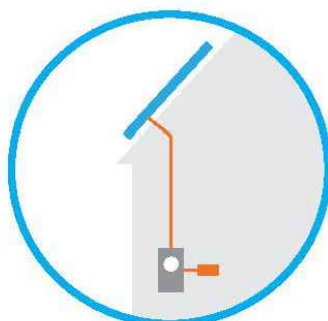
Work around.
String inverter installed on roof, a hostile environment that string inverters are not built to live in.



Commercial String Inverter

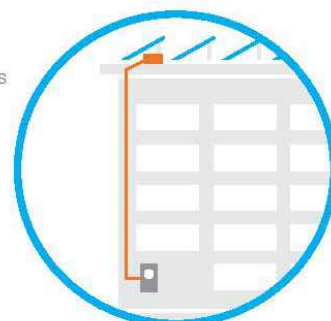
Enphase comes standard with rapid shutdown capability

All Enphase microinverters, even those that were previously installed, inherently meet rapid shutdown requirements, no additional equipment or workarounds needed.



Residential Microinverter

Enphase microinverters can safely shut down automatically, leaving only low-voltage DC electricity isolated to the PV module.



Commercial Microinverter

To learn more, visit enphase.com



QUICK INSTALL GUIDE



Install the Enphase IQ8 Series Microinverter

To install Enphase IQ8 Series Microinverters, read and follow all warnings and instructions in this guide and in the *Enphase IQ8 Series Microinverter Installation and Operation Manual* at enphase.com/support. Safety warnings are listed on the back page of this guide.

The Enphase Microinverter models listed in this guide do not require grounding electrode conductors (GEC), equipment grounding conductors (EGC), or grounded conductor (neutral). The microinverter has a Class II double-insulated rating, which includes ground fault protection (GFP). To support GFP, use only PV modules equipped with DC cables labeled *PV Wire* or *PV Cable*.

IMPORTANT: Enphase IQ8 Series Microinverters require the IQ Cable. An IQ Gateway is required to monitor performance of the IQ Microinverters. The Q Accessories work only with Enphase IQ8 Series Microinverters.

Note: After you log in to your Enphase Installer Platform account from Enphase Installer app, Scan the microinverter QR code and connect to the Enphase IQ Gateway to track the system installation progress.

PREPARATION

- A) Download the Enphase Installer App and open it to log in to your Enphase Installer Platform account. With this app, scan the microinverter QR code and connect to the Enphase IQ Gateway to track system installation progress. To download, go to enphase.com/toolkit or scan the QR code at right.



- B) Refer to the following table and check PV module electrical compatibility at: enphase.com/en-us/support/module-compatibility.

Model	DC connector	Typical PV module* cell count
IQ8-60-2-US	MC-4 locking type	Pair with 60 cell / 120-half-cell modules
IQ8PLUS-72-2-US	MC-4 locking type	Pair with 60 cell / 120-half-cell, 66 cell, or 72 cell / 144-half-cell
IQ8M-72-2-US		
IQ8A-72-2-US		
IQ8H-240-72-2-US	MC-4 locking type	Pair with 60 cell / 120-half-cell, 66 cell, or 72 cell / 144-half-cell
IQ8H-208-72-2-US		

* Enphase IQ8 Series Microinverters are compatible with bi-facial PV modules if the temperature adjusted electrical parameters (maximum power, voltage and current) of the modules, considering the front side electrical parameters (i.e., 0% back side gain), are within the allowable microinverter input parameters range.

- C) In addition to the Enphase Microinverters, PV modules and racking, you will need these **Enphase IQ8 Series Microinverters**:
- Enphase IQ Gateway (model ENV-IQ-AM1-240) communications gateway or Enphase IQ Combiner (check enphase.com for models); is required to monitor solar production.
 - Tie wraps or cable clips (Q-CLIP-100)
 - Enphase Sealing Caps (Q-SEAL-10): for any unused connectors on the Enphase IQ Cable
 - Enphase Terminator (Q-TERM-10): one needed at the end of each AC cable segment
 - Enphase Disconnect Tool (Q-DISC-10)
 - Enphase IQ Cable:

Cable model	Connector spacing*	PV module orientation	Connectors per box
Q-12-10-240	1.3m	Portrait (all)	240
Q-12-17-240	2.0m	Landscape (60- and 66-cell)	240
Q-12-20-200	2.3m	Landscape (72-cell)	200

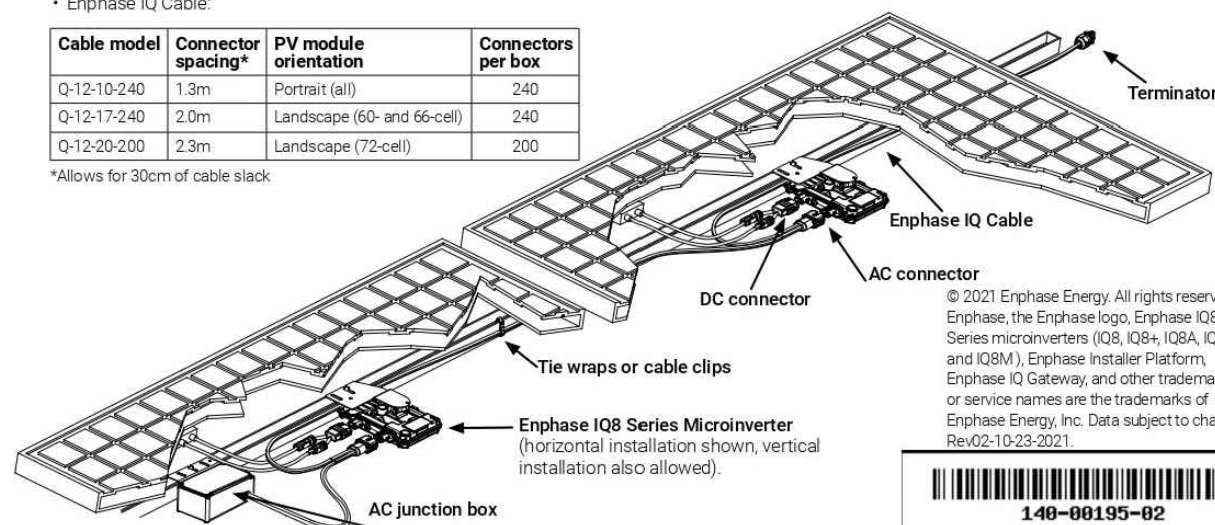
*Allows for 30cm of cable slack

- D) Check that you have these other items:
- AC junction box.
 - Tools: screwdrivers, wire cutter, voltmeter, torque wrench, sockets, and wrenches for mounting hardware
- E) Protect your system with lightning and/or surge suppression devices. It is also important to have insurance that protects against lightning and electrical surges.
- F) Plan your AC branch circuits to meet the following limits for maximum number of microinverters per branch when protected with a 20-amp over-current protection device (OCPD).

Maximum* IQ8 Series Microinverters per AC branch circuit (single-phase)		
IQ8 (240V)	IQ8+ (240V)	IQ8M (240V)
16	13	11
IQ8A (240V)		
IQ8A (240V)	IQ8H (240V)	IQ8H (208V)
11	10	9

*Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

- G) Size the AC wire gauge to account for voltage rise. Select the correct wire size based on the distance from the beginning of the Enphase IQ Cable to the breaker in the load center. Design for a voltage rise total of less than 2% for these sections. Refer to the Voltage Rise Technical Brief at enphase.com/support for more information.
- Best practice:** Center-feed the branch circuit to minimize voltage rise in a fully-populated branch.



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CONTRACTOR

Renewable Energy Design Group

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ENPHASE RAPID SHUTDOWN, COMPATIBILITY WITH PV

ENGINEERINC

Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM
Scale: AS INDICATED

D 7.0

HYUNDAI SOLAR MODULE

YH
SERIES

Dual Black Max

HiS-S385YH(BK) HiS-S390YH(BK) HiS-S395YH(BK)
HiS-S400YH(BK) HiS-S405YH(BK) HiS-S410YH(BK)



Bifacial Cells
132



More Power Generation
In Low Light



UL 1,500V
IEC 1,500V
Saves BOS Costs



All black Module
For Sleek Design
(Black Meshed
T-Back sheet)



Maximized Power Generation

Increased total power output through capturing light from both the front and back of Bifacial solar modules. Back side power gain up to 25% of the front output depending on PV system design.



Mechanical Strength

Tempered glass and reinforced frame design withstand rigorous weather conditions such as heavy snow(5,400Pa) and strong wind(4,000Pa).

Hyundai's Warranty Provisions

- 25 YEARS** - 25-Year Product Warranty
- Materials and workmanship
- 25 YEARS** - 25-Year Performance Warranty
- Initial year : 98.0%
- Linear warranty after second year: with 0.54%p annual degradation, 85.0% is guaranteed up to 25 years

Certification



UL61730 certified by UL, Type 1(for Fire Class A)



Half-Cut & Multi-Wire Technology

Improved current flow with half-cut technology and 9 thin wiring technology allows high module efficiency of up to 20.5%. It also reduces power generation loss due to micro-cracks.



UL / VDE Test Labs

Hyundai's R&D center is an accredited test laboratory of both UL and VDE.



Anti-LID / PID

Both LID(Light Induced Degradation) and PID(Potential Induced Degradation) are significantly reduced to ensure higher actual yield during lifetime.



Reliable Warranty

Global brand with powerful financial strength provide reliable 25-year warranty.

About Hyundai Energy Solutions

Established in 1972, Hyundai Heavy Industries Group is one of the most trusted names in the heavy industries sector and is a Fortune 500 company. As a global leader and innovator, Hyundai Heavy Industries is committed to building a future growth engine by developing and investing heavily in the field of renewable energy.

As a core energy business entity of HHI, Hyundai Energy Solutions has strong pride in providing high-quality PV products to more than 3,000 customers worldwide.

Electrical Characteristics

		Mono-Crystalline Type(HiS-S YH(BK))					
		385	390	395	400	405	410
Nominal Output (P _{mpp})	W	385	390	395	400	405	410
Open Circuit Voltage (V _{oc})	V	44.5	44.8	45.0	45.3	45.6	45.9
Short Circuit Current (I _{sc})	A	11.04	11.11	11.18	11.25	11.33	11.40
Voltage at P _{max} (V _{mpp})	V	37.1	37.3	37.5	37.7	37.9	38.1
Current at P _{max} (I _{mpp})	A	10.40	10.47	10.54	10.61	10.69	10.76
Module Efficiency	%	19.3	19.5	19.8	20.0	20.3	20.5
Cell Type	-	Mono crystalline, 9busbar					
Maximum System Voltage	V	1,500					
Temperature Coefficient of P _{max}	%/K	-0.347					
Temperature Coefficient of V _{oc}	%/K	-0.268					
Temperature Coefficient of I _{sc}	%/K	+0.032					

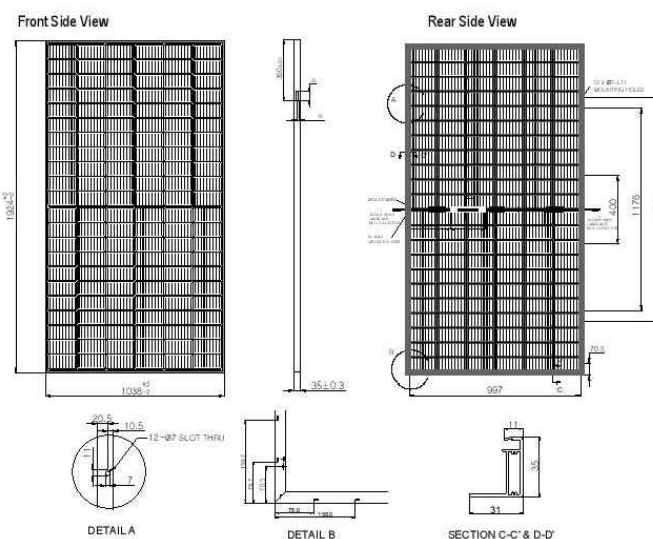
*All data at STC (Measurement tolerances P_{mpp} ±3%; I_{sc} ; V_{oc} ±3%). Above data may be changed without prior notice.

Additional Power Gain from rear side		385	390	395	400	405	410
5%	W	399	404	410	415	425	431
15%	W	437	443	449	454	466	472
25%	W	475	482	488	494	506	513

Mechanical Characteristics

Dimensions	1,038 mm (W) x 1,924 mm (L) x 35 mm(H)
Weight	Approx. 21.1 kg
Solar Cells	132 half cut bifacial cells (2 parallel x 66 half cells in series)
Output Cables	Cable : 1,200mm / 4mm ² Connector : MC4 genuine connector
Junction Box	IP68, weatherproof, IEC certified (UL listed)
Bypass Diodes	3 bypass diodes to prevent power decrease by partial shade
Construction	Front : 3.2mm, High Transmission, AR Coated Tempered Glass Encapsulant : EVA I Back Sheet : Black Meshed Transparent Backsheet
Frame	Anodized aluminum alloy type 6063

Module Diagram (unit: mm)

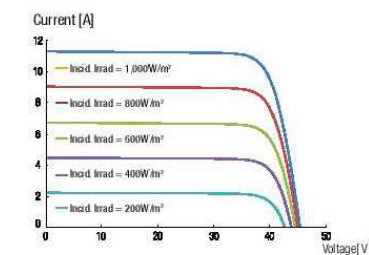
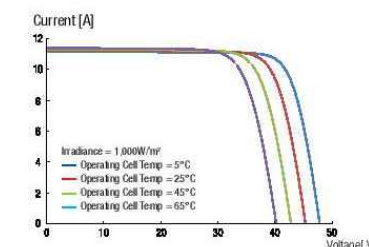


Installation Safety Guide

- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not damage or scratch the rear surface of the module.
- Do not handle or install modules when they are wet.

Nominal Operating Cell Temperature	45.5°C ± 2
Operating Temperature	-40°C ~ +85°C
Maximum System Voltage	DC 1,500V
Maximum Reverse Current	20A
Maximum Test Load	Front 5,400 Pa (113psf) Rear 4,000 Pa (84psf)

I-V Curves



CONTRACTOR

Renewable Energy Design Group

Phone number: (877)-520-7652
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MODULE DATA SHEET

ENGINEERINC

Drawn by:New@engineerinc.io
DATE: 01/19/2023

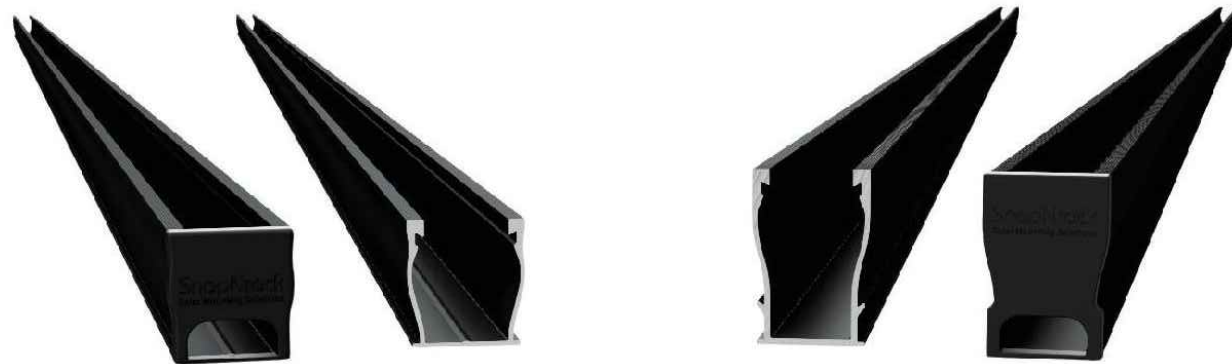
Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

D 8.0

Ultra Rail

UR-40
UR-60

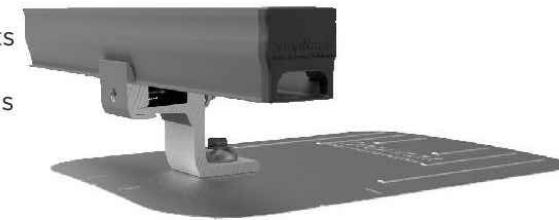


SnapNrack Ultra Rail System

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

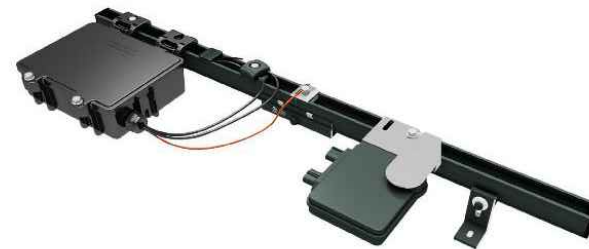
The Entire System is a Snap to Install

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



Unparalleled Wire Management

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



The Ultimate Value in Rooftop Solar



Industry leading Wire Management Solutions



Mounts available for all roof types



Single Tool Installation



All SnapNrack Module Clamps & Accessories are compatible with both rail profiles

Heavy Duty UR-60 Rail

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



Start Installing Ultra Rail Today

RESOURCES
DESIGN
WHERE TO BUY

snapnrack.com/resources
snapnrack.com/configurator
snapnrack.com/where-to-buy

Quality. Innovative. Superior.

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

877-732-2860

www.snapnrack.com

contact@snapnrack.com

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Phone number: (877)-520-7652
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Lewisville, North Carolina 27023



RACKING DATA SHEET


ENGINEER INC

Drawn by: New@engineerinc.io
DATE: 01/19/2023

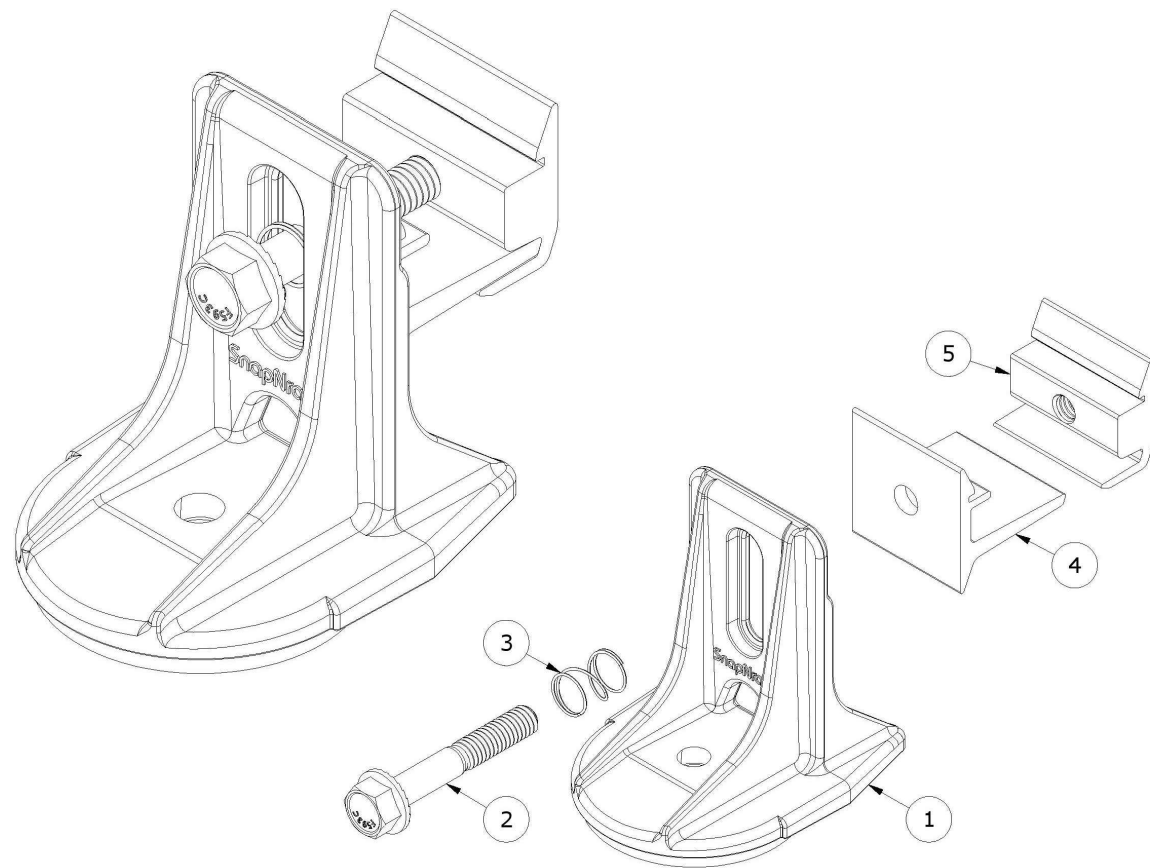
Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM
Scale: AS INDICATED

D 9.0


DESCRIPTION: SNAPNRACK, ULTRA RAIL SPEEDSEAL™ FOOT	DRAWN BY: mwatkins	
PART NUMBER(S): 242-02163, 242-02167	REVISION: A	

595 MARKET STREET, 29TH FLOOR • SAN FRANCISCO, CA 94105 USA
PHONE (415) 580-6900 • FAX (415) 580-6902
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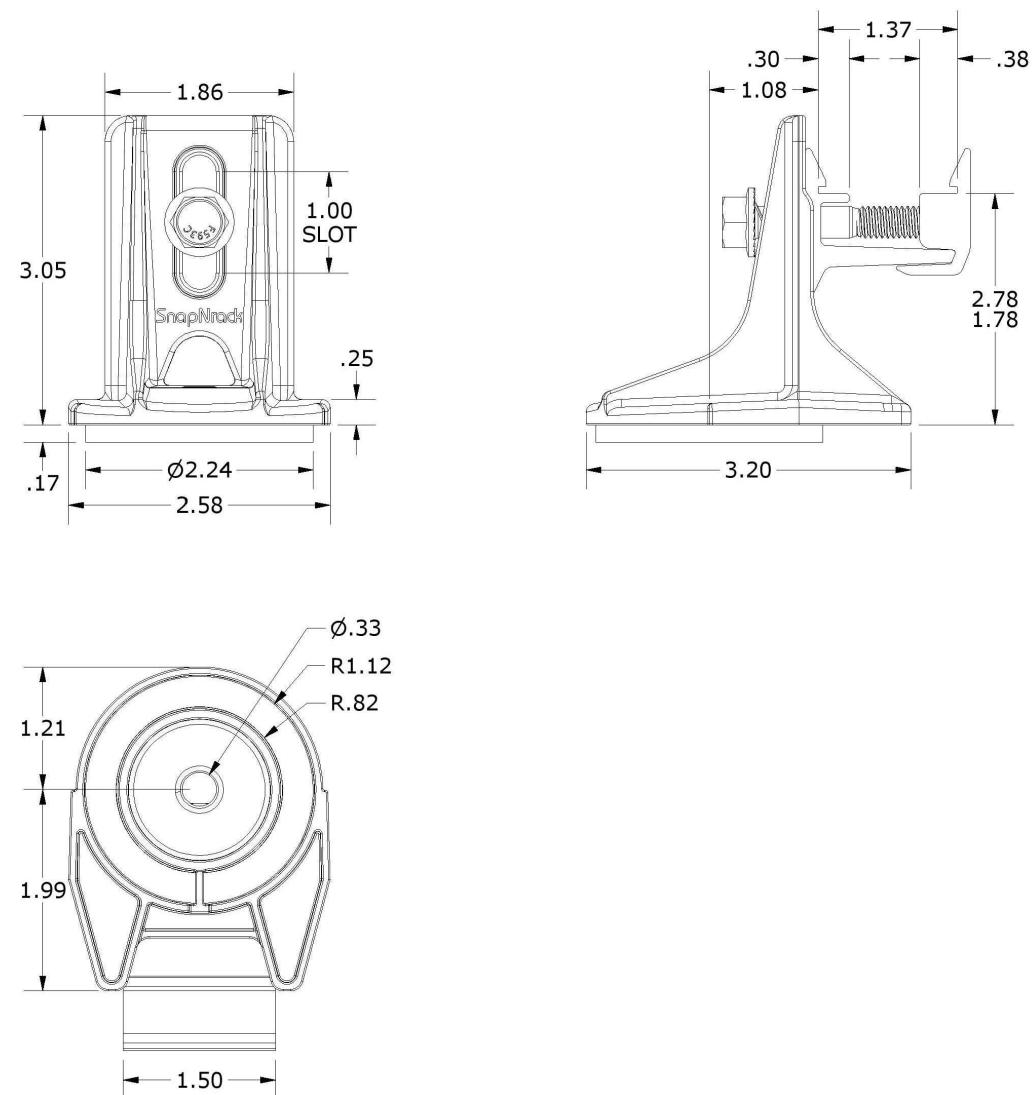


PARTS LIST		
ITEM	QTY	DESCRIPTION
1	1	SNAPNRACK, SPEEDSEAL FOOT, BASE, SEALING, SILVER / BLACK
2	1	BOLT, FLANGE, SERRATED, 5/16IN-18 X 2IN, SS
3	1	SNAPNRACK, RL UNIVERSAL, MOUNT SPRING, SS
4	1	SNAPNRACK, ULTRA RAIL MOUNT THRU PRC, CLEAR / BLACK
5	1	SNAPNRACK, ULTRA RAIL MOUNT TAPPED PRC, CLEAR / BLACK

MATERIALS:	DIE CAST A380 ALUMINUM, 6000 SERIES ALUMINUM, STAINLESS STEEL	
DESIGN LOAD (LBS):	802 UP, 1333 DOWN, 357 SIDE	OPTIONS:
ULTIMATE LOAD (LBS):	2118 UP, 4006 DOWN, 1331 SIDE	CLEAR / BLACK
TORQUE SPECIFICATION:	12 LB-FT	
CERTIFICATION:	UL 2703, FILE E359313; WIND-DRIVEN RAIN TEST FROM SUBJECT UL 2582	
WEIGHT (LBS):	0.45	

DESCRIPTION: SNAPNRACK, ULTRA RAIL SPEEDSEAL™ FOOT	DRAWN BY: mwatkins	
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**Renewable Energy
Design Group**

Phone number: (877)-520-7652
Address: 90 Beechwood Dr
Lewisville, North Carolina 27023



ATTACHMENT DATA SHEET

ENGINEERINC

Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name:
PE Solar Abdo Alammari 5625
Property Address:
177 Chedworth Dr,
Angier, NC 27501

Project: PV SYSTEM Scale: AS INDICATED

D 10.0

Enphase IQ Combiner 4/4C

X-IQ-AM1-240-4
X-IQ-AM1-240-4C



X-IQ-AM1-240-4C

X-IQ-AM1-240-4



To learn more about Enphase offerings, visit enphase.com

The **Enphase IQ Combiner 4/4C** with Enphase 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 Eaton BR series busbar assembly.

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 Enphase 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)
- 80A 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



Enphase IQ Combiner 4/4C

MODEL NUMBER	
IQ Combiner 4 (X-IQ-AM1-240-4)	IQ Combiner 4 with Enphase 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 system and IQ System Controller 2 and to deflect heat.
IQ Combiner 4C (X-IQ-AM1-240-4C)	IQ Combiner 4C with Enphase 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 and to deflect heat.
ACCESSORIES AND REPLACEMENT PARTS (not included, order separately)	
Ensemble Communications Kit	- Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with 5-year Sprint data plan for Ensemble sites
COMMS-CELLMODEM-M1-06	- 4G based LTE-M1 cellular modem with 5-year Sprint data plan
CELLMODEM-M1-06-SP-05	- 4G based LTE-M1 cellular modem with 5-year AT&T data plan
CELLMODEM-M1-06-AT-05	
Circuit Breakers	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers.
BRK-10A-2-240V	Circuit breaker, 2 pole, 10A, Eaton BR210
BRK-15A-2-240V	Circuit breaker, 2 pole, 15A, Eaton BR215
BRK-20A-2P-240V	Circuit breaker, 2 pole, 20A, Eaton BR220
BRK-15A-2P-240V-B	Circuit breaker, 2 pole, 15A, Eaton BR215B with hold down kit support
BRK-20A-2P-240V-B	Circuit breaker, 2 pole, 20A, Eaton BR220B with hold down kit support
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-SOLARSHIELD-ES	Replacement solar shield for IQ Combiner 4/4C
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 4/4C (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Gateway printed circuit board (PCB) for Combiner 4/4C
X-IQ-NA-HD-125A	Hold down kit for Eaton circuit breaker with screws.
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating	65 A
Max. continuous current rating (input from PV/storage)	64 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. total branch circuit breaker rating (input)	80A of distributed generation / 95A with IQ Gateway breaker included
Envoy breaker	10A or 15A rating GE/Siemens/Eaton included
Production metering CT	200 A solid core pre-installed and wired to IQ Gateway
Consumption monitoring CT (CT-200-SPLIT)	A pair of 200 A split core current transformers
MECHANICAL DATA	
Dimensions (WxHxD)	37.5 x 49.5 x 16.8 cm (14.75" x 19.5" x 6.63"). Height is 21.06" (53.5 cm) with mounting brackets.
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	<ul style="list-style-type: none"> • 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	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Cellular	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 Ensemble installations.
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
COMPLIANCE	
Compliance, IQ Combiner	UL 1741, CAN/CSA C22.2 No. 107.1, 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production) Consumption metering: accuracy class 2.5
Compliance, IQ Gateway	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit enphase.com

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CONTRACTOR

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Lewisville, North Carolina 27023



ENPHASE AC COMBINER BOX DATASHEET

ENGINEERINC

Drawn by: New@engineerinc.io
DATE: 01/19/2023

Project Name:
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Property Address:
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Angier, NC 27501

Project: PV SYSTEM
Scale: AS INDICATED

D 11.0