

PROJECT NAME: HENSLEY, DEVIN & KATELYNN

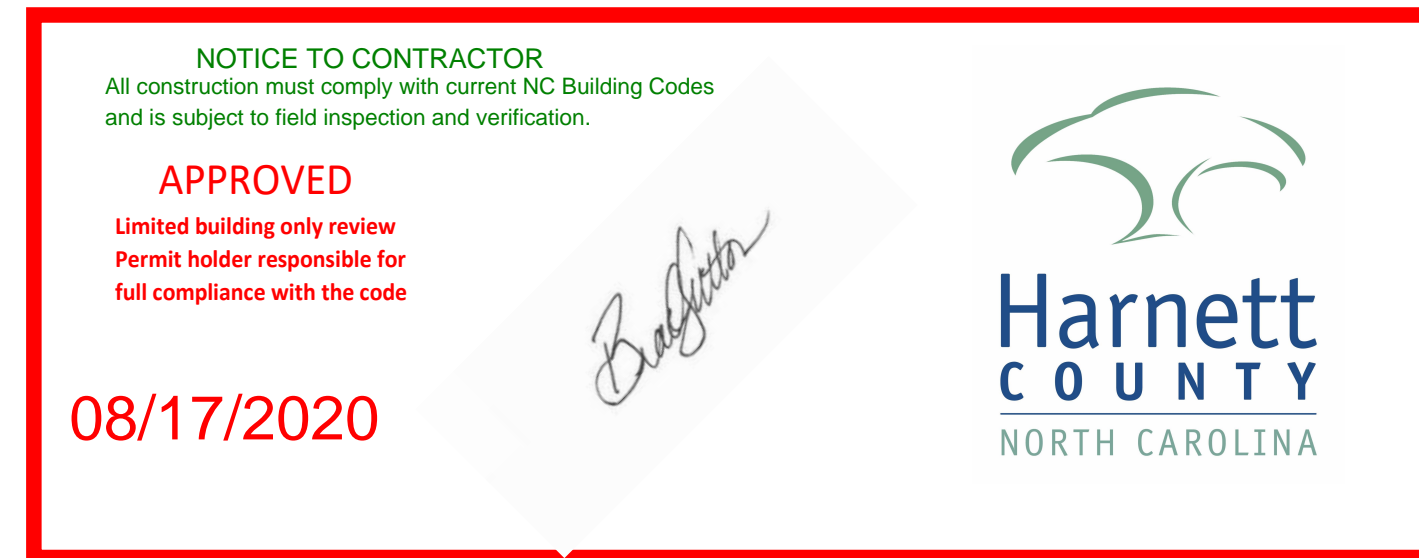
13-2016-1

THIS DISTRIBUTED GENERATION FACILITY WAS INSTALLED
IN ACCORDANCE WITH THE CURRENT STATE ADOPTED
NATIONAL ELECTRICAL CODE



DESIGN SUMMARY

- **SIZE:** 2.400 kW PV Solar System (6 modules)
- **STYLE:** Residential, asphalt shingle roof, flush mount, grid tied, net-metered
- **LOCATION:** Southeast & North West facing roofs of home
- **ORIENTATION:** Portrait, 20° pitch, 108° & 289° azimuth
- **MODULE:** Hanwha Q.PEAK DUO L-G5.2 400W, 79.3"x 39.4"x 1.38" thick, 51.8 lbs
- **RACKING:** Iron Ridge XR-100 with asphalt shingle flashings
- **INVERTER:** Enphase IQ7+ Microinverters
- **VOLTAGE:** 120/240V, 1Φ
- **MONITORING:** Enphase Enlighten Online Monitoring



CONTRACTOR

MOXIE SOLAR

(855) 669-4387
INFO@MOXIESOLAR.COM
230 SUGAR CREEK LANE
NORTH LIBERTY, IA 52317

OWNER

DEVIN HENSLEY

(910) 302-0072
devin.hensley@icloud.com
18 Kimberly Ct
Lillington, NC 27546

A H J

HARNETT COUNTY

(910) 893-7525
108 E Front Street
Lillington, NC 27546

UTILITY

DUKE ENERGY

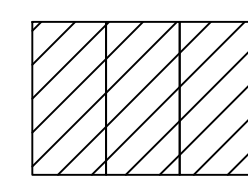
(866) 233-2290

REVISIONS

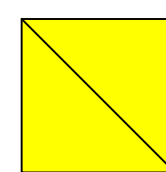
6/15/20	PLAN SET	
06/29/20	PLAN SET	
07/06/20	REV 3	AH
08/05/20	REV 4	AH
08/10/20	REV5	AH

DESIGN SUMMARY

01



PV Solar Array
Roof of building



Enphase Microinverter
Array



AC Solar Disconnect
Building Exterior



PV Solar Dedicated Load Center
Building Exterior



Main Service Panel
Building Interior



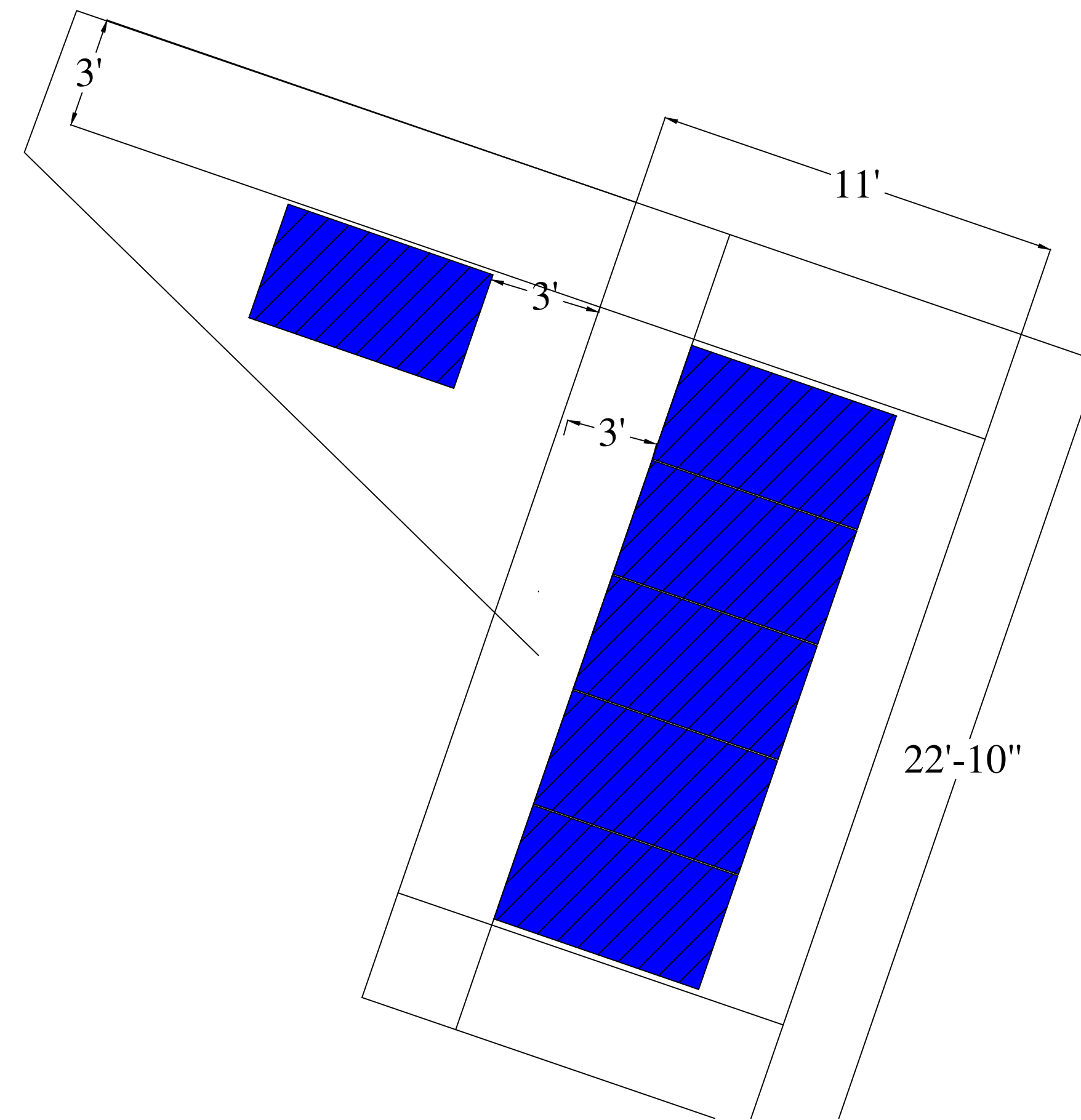
Utility Meter
Building Exterior





BUILD SUMMARY

- **MODULE:** QTY (6) Q.PEAK DUO L-G5.2 400W, 79.3"x 39.4"x 1.38" thick, 51.8 lbs
- **STRUCTURE:** Wood Prefabricated 2"x 4" Trusses @ 24" OC
- **RACKING:** Iron Ridge XR-100. Run rails across the trusses. Penetrate every 4ft or less into trusses. Installer must verify all penetrations are secure and centered in wood members. Any damaged wood members must be repaired immediately by scab, sister, or full replacement. Max Rail Overhang = 19" from last attachment point. Module Overhang = 18" .
- **ACCESS:** 2-story residence.
- **INVERTERS:** Mount Microinverters at the module locations.
- **MONITORING:** Enphase Enlighten online monitoring utilizing existing wireless router.
- **ADDITIONAL WORK:** None



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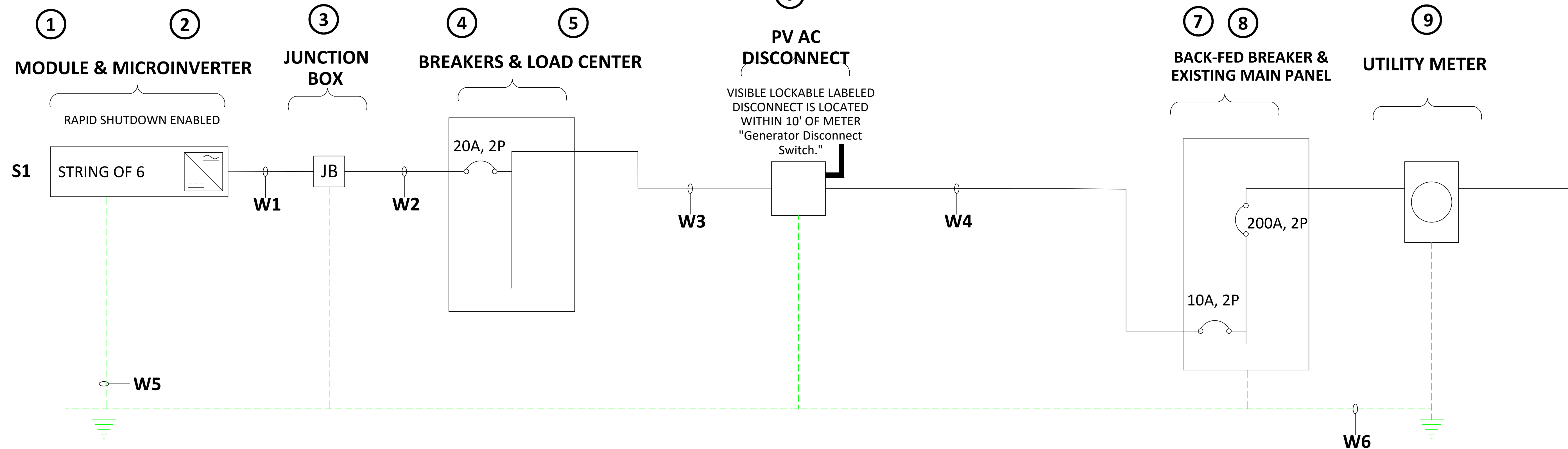
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6/15/20	PLAN SET	
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08/10/20	REV5	AH

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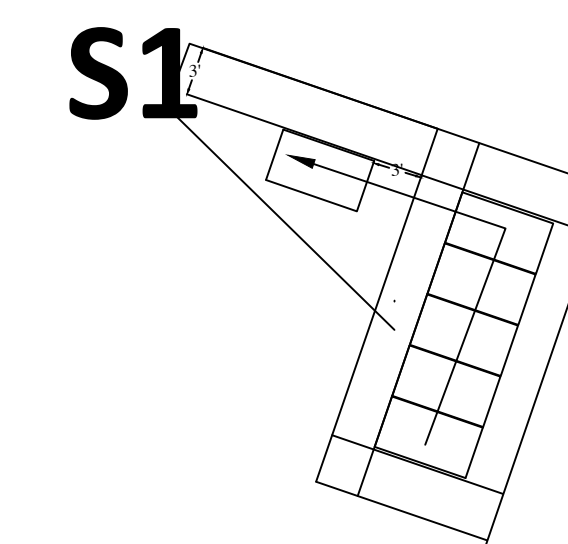


1 ONE-LINE ELECTRICAL DIAGRAM - 2.400 KW (DC)

03 NO SCALE

EQUIPMENT SCHEDULE							
TAG	ITEM	TAG	MAKE	MODEL	VOLTAGE	QTY	LOCATION
1	MODULE		HANWHA	Q.PEAK DUO L-G5.2 400W (DC)	DC	6	ROOF TOP
2	MICROINVERTER		ENPHASE	IQ7PLUS-72-2-US 290W(AC)	120/240V, 1Φ	6	ROOF TOP
3	JUNCTION BOX		SOLADECK	0799	120/240V, 1Φ	1	ROOF TOP
4	BREAJERS		EATON	20A,2P BR220	120/240V, 1Φ	1	LOAD CENTER
5	LOAD CENTER		ENPHASE	IQ COMBINER X-IQ-AM1-240-3	120/240V, 1Φ	1	BLD EXTERIOR
6	DISCONNECT		EATON	30A ENCLOSURE NON FUSED	120/240V, 1Φ	1	BLD EXTERIOR
7	BACK-FED BREAKER		SEIMENS	10A, 2-POLE Q210	120/240V, 1Φ	1	MAIN PANEL
8	MAIN PANEL		SEIMENS	200A ENCLOUSRE 200A MAIN	120/240V, 1Φ	1	BLD INTERIOR
9	UTILITY METER		ITRON	CL200	120/240V, 1Φ	1	BLD EXTERIOR

mov					
TAG	RUN	CONDUCTOR TYPE	GUAGE	CONDU IT	RUN LENGTH
W1	ARRAY TO JUNCTION BOX	ENPHASE Q Cable	#12	¾"	60 FT
W2	JUNCTION BOX TO LOAD CENTER	THWN-2,CU	#10	¾"	30 FT
W3	INVERTER TO DISCONNECT	THWN-2, Cu	#10	¾"	20 FT
W4	DISCONNECT TO BACK-FED	THWN-2, Cu	#10	¾"	5 FT
W5	GROUND ELECTRODE	BARE, Cu	#6	-	-
W6	EQUIPMENT GROUND	THWN-2, Cu	#6 (MIN)	-	85 FT



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06/29/20 PLAN SET

07/06/20 REV 3 AH

08/05/20 REV 4 AH

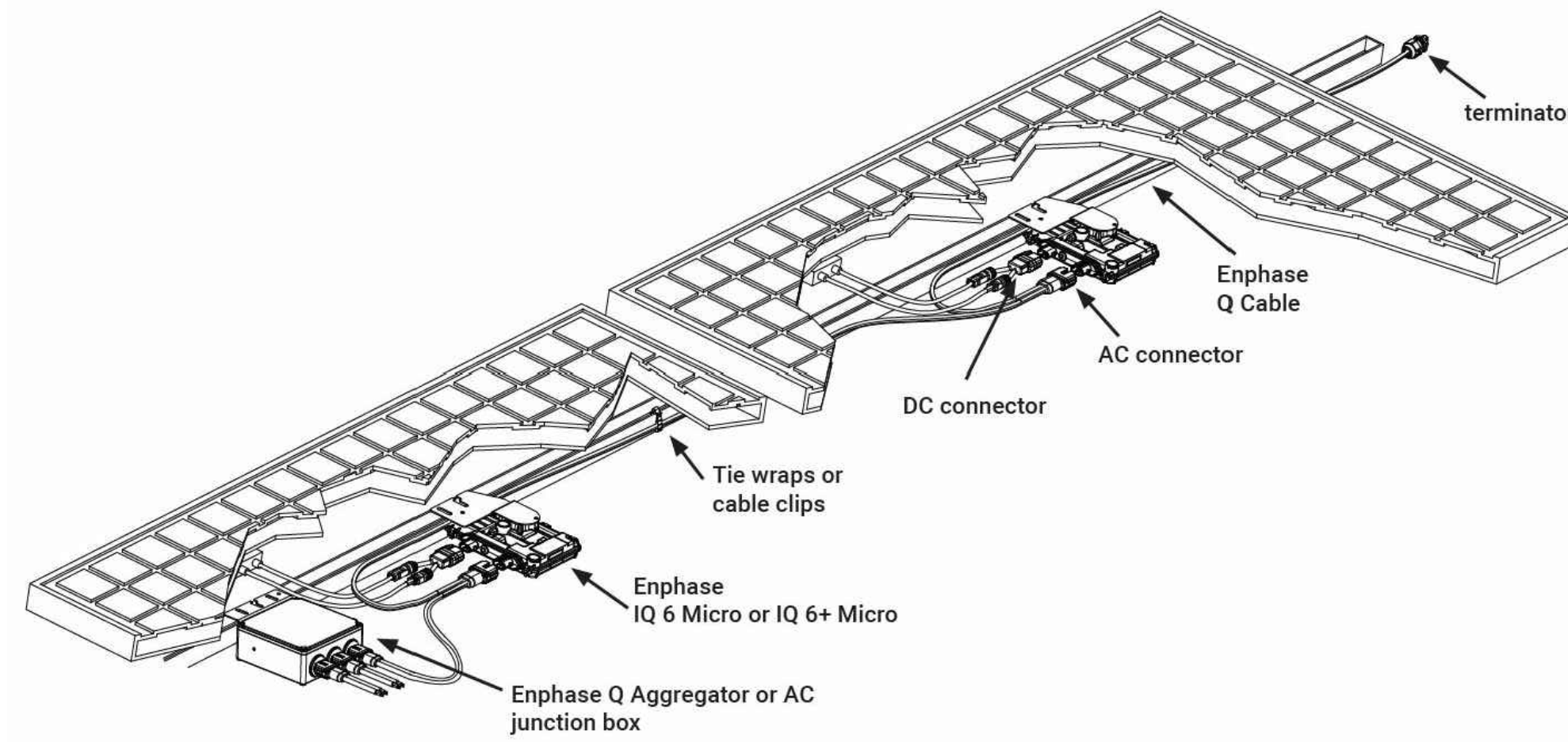
08/10/20 REV5 AH

ELECTRICAL

03



CODE REVIEW & CALCULATIONS



SOLAR PHOTOVOLTAIC (PV) SYSTEM WITH SOLAREEDGE

Inverter Type: IQ7Plus MicroInverters
 Minimum String Length: N/A
 Maximum String Length: 13 Panels @ 240V
 Nominal String Voltage: 240V (AC)
 Nominal Output Current (Per MicroInverter): 1.21A

Hanwha Q.PEAK DUO L-G5.2 400W

NEC 690.7 MAXIMUM VOLTAGE

690.7(A): Maximum Photovoltaic System Voltage
 Q.PEAK DUO L-G5.2 400W Module Voc = 49.00V
 Module $V_{max} = (25^{\circ}C - (-40^{\circ}C))(-0.0027V/^{\circ}C)(49.00V) + (49.00V) = 57.60V$ (DC)
 Module V_{max} Output = 57.60V (DC) < IQ7+ MicroInverter Vmax Input = 60V (DC)

NEC 690.8 CIRCUIT SIZING AND CURRENT

690.8(A)(1): Photovoltaic Source Circuit Currents
 Module to MicroInverter $I_{max} = 1.21A \times 6 \times 125\% = 9.075A$

690.8(A)(3): Inverter Output Circuit Current.
 MicroInverter Rated Continuous Output Power = 290W
 MicroInverter rated Continuous Output Current = 1.21A
 System $I_{max} = 9.075A$

NEC 690.9 OVERCURRENT PROTECTION

690.9(B): Overcurrent Device Ratings
 Disconnect Fuse: $1.21A \times 6 \times 125\% = 9.075A \rightarrow 10$ Amp OCPD

NEC 690.12 RAPID SHUTDOWN OF PV SYSTEMS ON BUILDINGS

PLAN: Rapid Shutdown enabled disconnect shall be located next to the service and be labeled in accordance with 690.56(B) and (C).

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DETAILS & CALCULATIONS

1 MODULE AND MICROINVERTER CONNECTION DETAIL

04 NO SCALE

FlashFoot2



2 IRON RIDGE ASPHALT SHINGLE FLASHING DETAIL

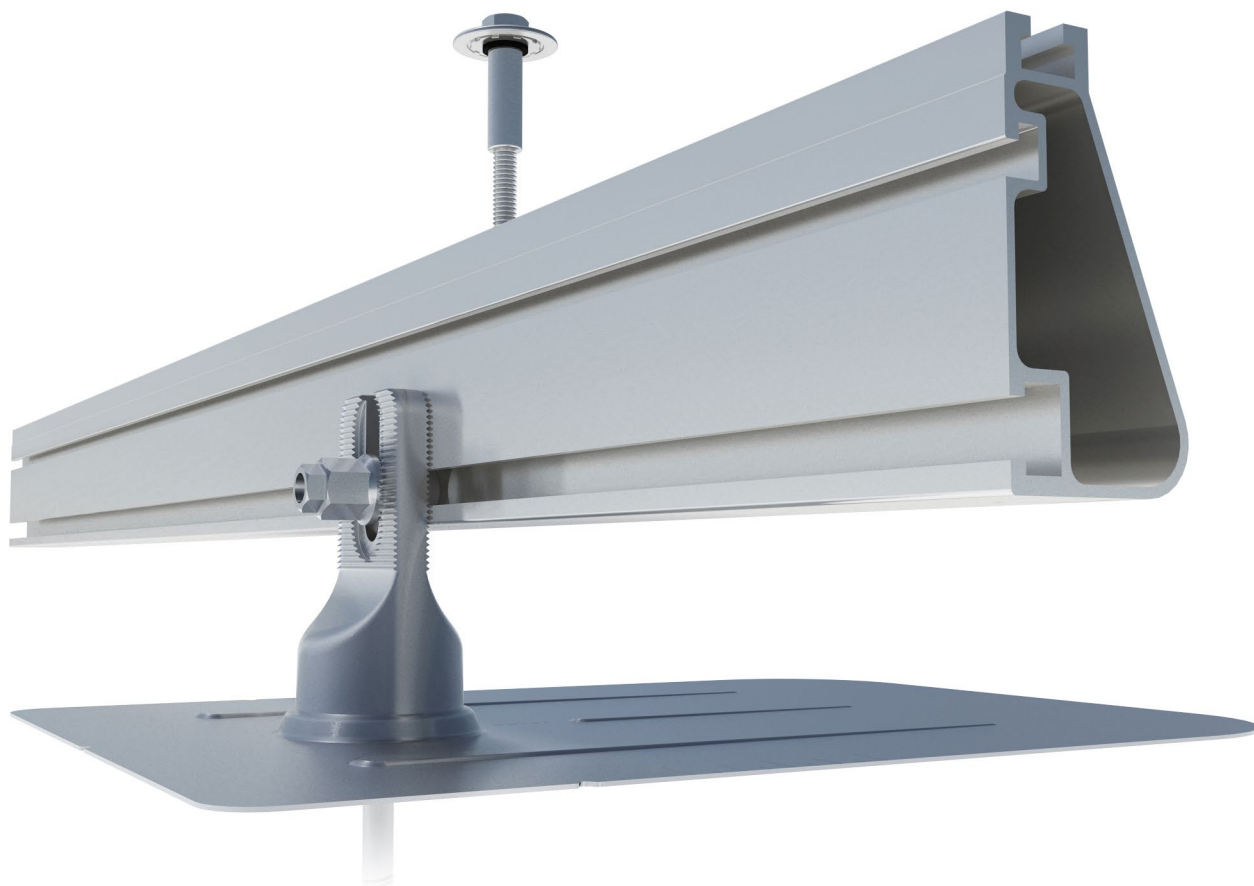
04 NO SCALE

SYSTEM AC DISCONNECT AT SERVICE

PHOTOVOLTAIC SYSTEM AC DISCONNECT
 MAXIMUM OPERATING AC CURRENT: 7.26 AMPS
 NOMINAL OPERATING AC VOLTAGE: 120/240 VAC

3 PHOTOVOLTAIC MARKING AND LABELING

04 NO SCALE



Built for solar's toughest roofs.

IronRidge builds the strongest mounting system for pitched roofs in solar. Our components have been tested to the limit and proven in extreme environments, including Florida's high-velocity hurricane zones.

Our rigorous approach has led to unique structural features, such as curved rails and reinforced flashings, and is also why our products are fully certified, code compliant and backed by a 25-year warranty.



Strength Tested

All components evaluated for superior structural performance.



PE Certified

Pre-stamped engineering letters available in most states.



Class A Fire Rating

Certified to maintain the fire resistance rating of the existing roof.



Design Assistant

Online software makes it simple to create, share, and price projects.



UL 2703 Listed System

Entire system and components meet newest effective UL 2703 standard.



25-Year Warranty

Products guaranteed to be free of impairing defects.

XR Rails ☺

XR10 Rail



A low-profile mounting rail for regions with light snow.

- 6' spanning capability
- Moderate load capability
- Clear and black finish

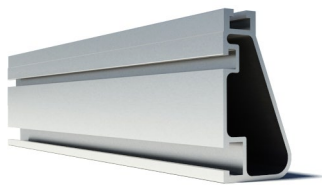
XR100 Rail



The ultimate residential solar mounting rail.

- 8' spanning capability
- Heavy load capability
- Clear and black finish

XR1000 Rail



A heavyweight mounting rail for commercial projects.

- 12' spanning capability
- Extreme load capability
- Clear anodized finish

Bonded Splices



All rails use internal splices for seamless connections.

- Self-drilling screws
- Varying versions for rails
- Forms secure bonding

Clamps & Grounding ☺

UFOs



Universal Fastening Objects bond modules to rails.

- Fully assembled & lubed
- Single, universal size
- Clear and black finish

Stopper Sleeves



Snap onto the UFO to turn into a bonded end clamp.

- Bonds modules to rails
- Sized to match modules
- Clear and black finish

CAMO



Bond modules to rails while staying completely hidden.

- Universal end-cam clamp
- Tool-less installation
- Fully assembled

Bonding Hardware



Bond and attach XR Rails to roof attachments.

- T & Square Bolt options
- Nut uses 7/16" socket
- Assembled and lubricated

Attachments ☺

FlashFoot2



Flash and mount XR Rails with superior waterproofing.

- Twist-on Cap eases install
- Wind-driven rain tested
- Mill and black finish

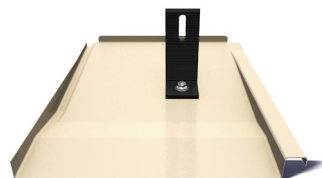
Conduit Mount



Flash and mount conduit, strut, or junction boxes.

- Twist-on Cap eases install
- Wind-driven rain tested
- Secures 3/4" or 1" conduit

Knockout Tile



Replace tiles and ensure superior waterproofing.

- Flat, S, & W tile profiles
- Form-fit compression seal
- Single-lag universal base

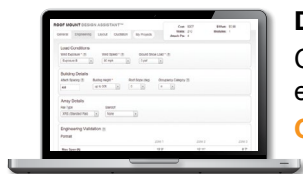
All Tile Hook



Mount on tile roofs with a simple, adjustable hook.

- Works on flat, S, & W tiles
- Single-socket installation
- Optional deck flashing

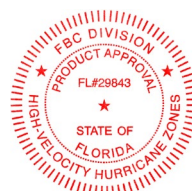
Resources



Design Assistant

Go from rough layout to fully engineered system. For free.

[Go to IronRidge.com/design](http://IronRidge.com/design)



Endorsed by FL Building Commission

Flush Mount is the first mounting system to receive Florida Product approval for 2017 Florida Building Code compliance.

[Learn More at bit.ly/floridacert](http://bit.ly/floridacert)

Enphase IQ Envoy

The **Enphase IQ Envoy™** communications gateway delivers solar production and energy consumption data to Enphase Enlighten™ monitoring and analysis software for comprehensive, remote maintenance and management of the Enphase IQ System.

With integrated revenue grade production metering and optional consumption monitoring, the Envoy IQ is the platform for total energy management and integrates with the Enphase IQ Battery™.



Smart

- Enables web-based monitoring and control
- Bidirectional communications for remote upgrades
- Supports power export limiting and zero-export applications

Simple

- Easy system configuration using Enphase Installer Toolkit™ mobile app
- Flexible networking with Wi-Fi, Ethernet, or cellular

Reliable

- Designed for installation indoors or outdoors
- Five-year warranty



LISTED

To learn more about Enphase offerings, visit enphase.com

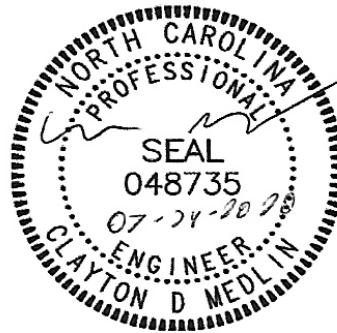
Enphase IQ Envoy

MODEL NUMBERS	
Enphase IQ Envoy™ ENV-IQ-AM1-240	Enphase IQ Envoy communications gateway with integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional consumption monitoring (+/- 2.5%). Includes one 200A continuous rated production CT .
ACCESSORIES (order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G / 12-year data plan) CELLMODEM-01 (3G / 5-year data plan) CELLMODEM-M1 (4G based LTE-M / 5-year data plan)	Plug and play industrial grade cellular modem with data plan 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.)
Consumption Monitoring CT CT-200-SPLIT	Split-core current transformers enable whole home metering.
POWER REQUIREMENTS	
Power requirements	120/240 VAC split-phase. Max 20 A overcurrent protection required.
CAPACITY	
Number of microinverters polled	Up to 600
MECHANICAL DATA	
Dimensions (WxDxH)	21.3 x 12.6 x 4.5 cm (8.4" x 5" x 1.8")
Weight	17.6 oz (498 g)
Ambient temperature range	-40° to 65° C (-40° to 149° F) -40° to 46° C (-40° to 115° F) if installed in an enclosure
Environmental rating	IP30. For installation indoors or in an NRTL-certified, NEMA type 3R enclosure.
Altitude	To 2000 meters (6,560 feet)
Production CT	- Is limited to 200A of continuous current / 250A OCPD – 72kW AC - Internal aperture measures 19.36mm to support 250MCM THWN conductors (max)
Consumption CT	- For electrical services to 250A with parallel runs up to 500A - Internal aperture measures 0.84" x 0.96" (21.33mm x 24.38mm) to support 3/0 THWN conductor - CT wire insulation rating of 600V
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Ethernet	802.3, Cat5E (or Cat 6) UTP Ethernet cable, not included
Mobile	Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G), not included
COMPLIANCE	
Compliance	UL 916 CAN/CSA C22.2 No. 61010-1 47 CFR, Part 15, Class B, ICES 003 IEC/EN 61010-1:2010, EN50065-1, EN61000-4-5, EN61000-6-1, EN61000-6-2 Metering: ANSI C12.20 accuracy class 0.5

To learn more about Enphase offerings, visit enphase.com

Roof Assessment for Solar Panel Installation

Date: July 24, 2020
Prepared for: Cashion & Sons Hensley 6pT
Project Number: 200580
Assessment Date: July 23, 2020
Site Address: 18 Kimberly ct. Lillington NC 27546
Purpose: Structural Roof Assessment for installation of 6 panel solar array.
Prepared by: Landon Wilson & Clay Medlin, PE, NC #048735
NC COL: C-3298, CDR & Assoc., Inc.



CDR & Assoc., Inc. thanks you for the opportunity to provide you with a letter for the inspection of the roof framing for the installation of solar panel system on the roof of the foresaid property hereafter referred to as "house". All references to directions or locations indicated in this report are by facing the front of the house.

Observations and Analysis of Roof

- **Basis of Evaluation:** The engineering analysis is based on measurements and photographs taken onsite by CDR+A technician, Alex Nelson.
- **Roof Construction:** A layer of asphalt shingles over wood decking on 2x4 Roof Trusses spaced at 24" on center.
- **Roof Pitch:** 8/12
- **Solar Panel Array:** 6 panels.
- **Total Array Square Footage:** The panels are approximately 39.37" x 64.57" or 17.65 sf each, round up to 18 sf x 6 panels = total surface area of 109 sf.
- **Total weight of Array:** Panel weighs approximately 40 lbs. ea. X 6 = 240 lbs. for the Array.
- **Total Additional Weight on Roof:** 240 lbs / 109 sf = 2.22 psf add for rail mount system, assume 3 psf additional load on roof structure.
- **Rail Mount System:** The panels are mounted on aluminum rails at top and bottom of the panels for each row of panels.

- **Analysis of Roof Structure:**

- Additional dead load 15 psf (12 psf from roof + 3 psf for panels)
 - Roof Live Load - 20 psf. (Allowable Residential Code w/o reductions)
 - The 2x4 SYP Trusses spaced 24" apart were analyzed (worst case).
 - Roof Pitch 8/12.
 - The maximum unbraced span: 5' 6" measured horizontal.
 - Analysis with the additional roof load determined that the roof Trusses are 77% stressed. The Trusses are in compliance with the current Residential Building Code.
-
- **Wind Speed:** Components and cladding 117 mph wind load uplift of -30 psf.
 - **Total Wind Load Uplift:** -30 psf x 109 sf = 3,270 lbs total uplift for solar array.
 - **Number of Attachment Anchors:** Use a minimum of two (2) bracket per panel (one top and bottom) = 12 total attachment brackets.
 - **Wind Load Uplift per Anchor:** 3,270 lbs total uplift / 12 = 273 lbs for solar array.
 - **Strength of Hold-down Anchors:** The Flashfoot attachment bracket are to be lagged directly into the top of the wood truss member with a 4" long (minimum) 5/16" wood screw per manufactures spec. The load testing results determined an average pullout failure load of 462 lbs per screw, exceeding the required 273 lbs per anchor. The loading proposed creates a safety factor of 1.70 or greater for the attachment.

Conclusions & Recommendations

By analysis it was determined that the roof truss members were adequate for the addition load of the solar panel array.

The installation of the solar panel array using Flashfoot attachment bracket lagged directly into the top of the wood truss member is adequate for the loads imposed on them.

Closure

We appreciate the opportunity to provide structural assessment services to you. Please contact us should you have any questions.

Sincerely,

CDR+A Structural Engineers