WYSSLING CONSULTING
CORPORATE EXPERIENCE WITH SMALL BUSINESS VALUE

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December 2, 2022

Sustainable Energy and Lighting Solutions
8351 Palmetto Commerce Parkway, Ste. 203
Ladson, SC 29456

Scott Wyssling, PE

Digitally signed by Scott Wyssling, PE
DN: C=US, S=Utah, L=Alpine, O=Wyssling Consulting, OU=Engineering, CN="Scott Wyssling, PE", E=swyssling@wysslingconsulting.com
Reason: I am the author of this document
Location: your signing location here
Date: 2022.12.02 14:05:50-07'00'
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Re: Engineering Services
Skatell Residence
1565 Chicora Road, Dunn, NC
21.860 kW System

To Whom It May Concern:

We have received information regarding solar panel installation on the roof of the above referenced structure. Our evaluation of the structure is to verify the existing capacity of the roof system and its ability to support the additional loads imposed by the proposed solar system.

A. Site Assessment Information

1. Site visit documentation identifying attic information including size and spacing of framing for the existing roof structure.
2. Design drawings of the proposed system including a site plan, roof plan and connection details for the solar panels. This information will be utilized for approval and construction of the proposed system.

B. Description of Structure:

Roof Framing:	2x6 dimensional lumber at 24” on center.
Roof Material:	Metal Roof
Roof Slope:	22.62, 33.69, 45 degrees
Attic Access:	Accessible
Foundation:	Permanent

C. Loading Criteria Used

- **Dead Load**
  - Existing Roofing and framing = 7 psf
  - New Solar Panels and Racking = 3 psf
  - TOTAL = 10 PSF
- **Live Load** = 20 psf (reducible) – 0 psf at locations of solar panels
- **Ground Snow Load** = 15 psf
- **Wind Load** based on ASCE 7-10
  - Ultimate Wind Speed = 117 mph (based on Risk Category II)
  - Exposure Category C

Analysis performed of the existing roof structure utilizing the above loading criteria is in accordance with the 2015 NCRC, including provisions allowing existing structures to not require strengthening if the new loads do not exceed existing design loads by 105% for gravity elements and 110% for seismic elements. This analysis indicates that the existing framing will support the additional panel loading without damage, if installed correctly.

D. Solar Panel Anchorage

1. The solar panels shall be mounted in accordance with the most recent S-5! installation manual. If during solar panel installation, the roof framing members appear unstable or deflect non-uniformly, our office should be notified before proceeding with the installation.
2. System will be attached to the metal roofing material utilizing the patented S-5! Connection. Installation of the connections shall be in accordance with the manufacturer's recommendations.
3. Considering the wind speed, roof slopes, size and spacing of framing members, and condition of the roof, the panel supports shall be placed no greater than 72" on center.
4. Panel supports connections shall be staggered to distribute load to adjacent framing members.

Based on the above evaluation, this office certifies that with the racking and mounting specified, the existing roof system will adequately support the additional loading imposed by the solar system. This evaluation is in conformance with the 2015 NCRC, current industry standards, and is based on information supplied to us at the time of this report.

Should you have any questions regarding the above or if you require further information do not hesitate to contact me.

Very truly yours,

Scott E. Wyssling, PE
North Carolina License No. 46546
North Carolina COA #P-2308

NORTH CAROLINA PROFESSIONAL SEAL 046546 ENGINEER SCOTT E. WYSSLING

Wyssling Consulting, PLLC
76 N Meadowbrook Drive Alpine UT 84004
North Carolina COA # P-2308

Signed 12/2/2022

NICK SKATELL - 21.860KW DC, 15.000KW AC, 21.496KWH STORAGE SYSTEM

SITE PLAN

NOTE: CONDUIT RUN IS IN ATTIC

Scott Wyssling, PE

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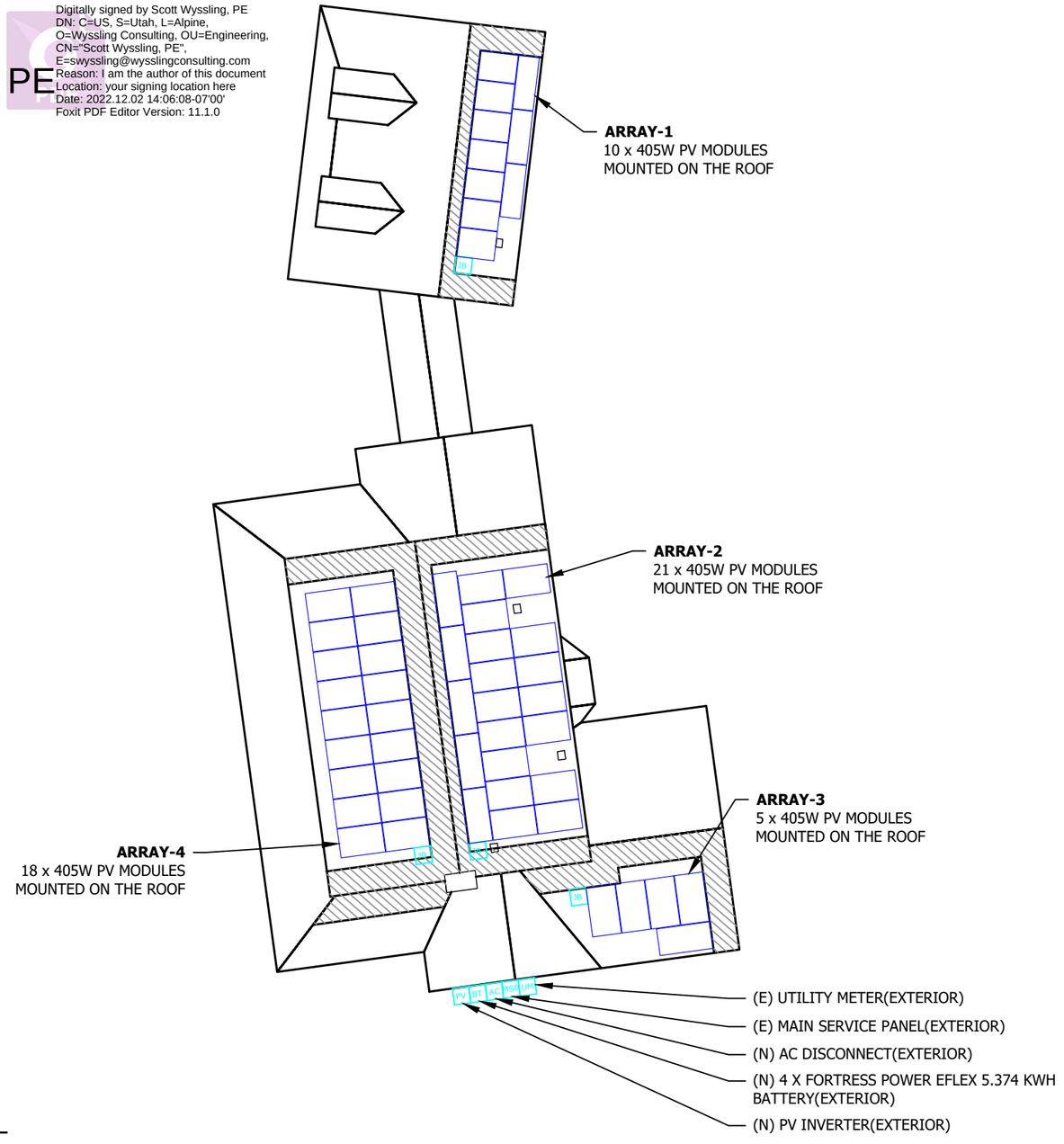
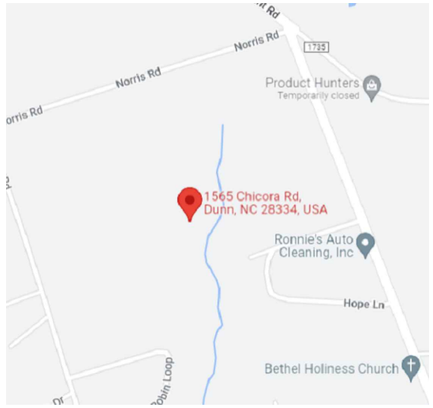


A | SITE PLAN
PV-1.0 | SCALE: 1/16"=1'-0"



A1 | VICINITY MAP
PV-1.0 | SCALE: NTS

GENERAL INFORMATION

ELECTRIC CODE	NEC 2020
FIRE CODE	NCFC 2018
RESIDENTIAL CODE	NCRC 2015
BUILDING CODE	NCBC 2018
WIND SPEED	117 MPH
SNOW LOAD	15 PSF

INDEX

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SYSTEM INFORMATION

DC SYSTEM SIZE : 21870W
AC SYSTEM SIZE : 15000W
MODULES:
(54) HYUNDAI SOLAR HIS-S405YH(BK) 405W
INVERTER:
(1) SOL ARK 15K-2P (240V), 15000W
MLPE:
(54) TIGO TS4-A-O
BATTERY:
(4) FORTRESS POWER EFLEX 5.374 KWH BATTERY

ENGINEER OF RECORD

NORTH CAROLINA PROFESSIONAL SEAL 040548 ENGINEER SCOTT E. WYSSLING

Wyssling Consulting, PLLC
76 N Meadowbrook Drive Alpine UT 84004
North Carolina COA # P-2308

Signed 12/2/2022

CUSTOMER INFORMATION

NAME & ADDRESS:
NICK SKATELL
1565 CHICORA RD.,
DUNN, NC 28334
35°30'54.4"N 78°67'48.1"W

AHJ: HARNETT COUNTY

UTILITY: DUKE ENERGY PROGRESS

SITE PLAN

PROJECT NUMBER:

DESIGNER/CHECKED BY:
DM/

SCALE:AS NOTED	PAPER SIZE:17"x11"	
DATE:11/28/22	REV:B	PV-1.0

GENERAL NOTES

GENERAL NOTES

1. MODULES ARE LISTED UNDER UL 1703 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(A)(1).
5. ALL GROUND WIRING CONNECTED TO THE MAIN SERVICE GROUNDING IN MAIN SERVICE PANEL/ SERVICE EQUIPMENT.
6. ALL CONDUCTORS SHALL BE 600V, 75°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

EQUIPMENT LOCATION:

11. ALL EQUIPMENT SHALL MEET MINIMUM SETBACKS AS REQUIRED BY NEC 110.26(A)(1).
12. WIRING SYSTEMS INSTALLED IN DIRECT SUNLIGHT MUST BE RATED FOR EXPECTED OPERATING TEMPERATURE AS SPECIFIED BY NEC 690.31(A),(C) AND NEC TABLES 310.15(B)(2)(A) AND 310.15(B)(3)(C).
13. JUNCTION AND PULL BOXES PERMITTED INSTALLED UNDER PV MODULES ACCORDING TO NEC 690.34.
14. ADDITIONAL AC DISCONNECT(S) SHALL BE PROVIDED WHERE THE INVERTER IS NOT WITHIN SIGHT OF THE AC SERVICING DISCONNECT.
15. ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.
16. ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

STRUCTURAL NOTES:

17. RACKING SYSTEM & PV ARRAY WILL BE INSTALLED ACCORDING TO CODE-COMPLIANT INSTALLATION MANUAL. TOP CLAMPS REQUIRE A DESIGNATED SPACE BETWEEN MODULES, AND RAILS MUST ALSO EXTEND A MINIMUM DISTANCE BEYOND EITHER EDGE OF THE ARRAY/SUBARRAY, ACCORDING TO RAIL MANUFACTURER'S INSTRUCTIONS.
18. JUNCTION BOX WILL BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS. IF ROOF-PENETRATING TYPE, IT SHALL BE FLASHED & SEALED PER LOCAL REQUIREMENTS.
19. ROOFTOP PENETRATIONS FOR PV RACEWAY WILL BE COMPLETED AND SEALED WITH APPROVED CHEMICAL SEALANT PER CODE BY A LICENSED CONTRACTOR.
20. ALL PV RELATED ROOF ATTACHMENTS TO BE SPACED NO GREATER THAN THE SPAN DISTANCE SPECIFIED BY THE RACKING MANUFACTURER.
21. WHEN POSSIBLE, ALL PV RELATED RACKING ATTACHMENTS WILL BE STAGGERED AMONGST THE ROOF FRAMING MEMBERS.

WIRING & CONDUIT NOTES:

22. ALL CONDUIT AND WIRE WILL BE LISTED AND APPROVED FOR THEIR PURPOSE. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING.
23. CONDUCTORS SIZED ACCORDING TO NEC 690.8, NEC 690.7.
24. DC WIRING LIMITED TO MODULE FOOTPRINT. MICRO INVERTER WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY WITH SUITABLE WIRING CLIPS.
25. AC CONDUCTORS COLORED OR MARKED AS FOLLOWS: PHASE A OR L1- BLACK PHASE B OR L2- RED, OR OTHER CONVENTION IF THREE PHASE PHASE C OR L3- BLUE, YELLOW, ORANGE**, OR OTHER CONVENTION NEUTRAL- WHITE OR GREY IN 4-WIRE DELTA CONNECTED SYSTEMS THE PHASE WITH HIGHER VOLTAGE TO BE MARKED ORANGE [NEC 110.15].

INTERCONNECTION NOTES:

26. LOAD-SIDE INTERCONNECTION SHALL BE IN ACCORDANCE WITH [NEC 690.64(B)]
27. THE SUM OF THE UTILITY OCPD AND INVERTER CONTINUOUS INPUT MAY NOT EXCEED 120% OF BUSBAR RATING [NEC 705.12(D)(2)(3)].
28. WHEN SUM OF THE PV SOURCES EQUALS >100% OF BUSBAR RATING, PV DEDICATED BACKFFED BREAKERS MUST BE LOCATED OPPOSITE END OF THE BUS FROM THE UTILITY SOURCE OCPD [NEC 705.12(D)(2)(3)].
29. AT MULTIPLE PV OUTPUT COMBINER PANEL, TOTAL RATING OF ALL OVER CURRENT DEVICES SHALL NOT EXCEED AMPACITY OF BUSBAR. HOWEVER, THE COMBINED OVER CURRENT DEVICE MAY BE EXCLUDED ACCORDING TO NEC 705.12(D)(2)(3)(C).
30. FEEDER TAP INTER CONNECTION (LOAD SIDE) ACCORDING TO NEC 705.12(D)(2)(1)SUPPLY SIDE TAP INTERCONNECTION ACCORDING TO NEC 705.12(A) WITH SERVICE ENTRANCE CONDUCTORS IN ACCORDANCE WITH NEC 230.42 BACK FEEDING BREAKER FOR UTILITY-INTERACTIVE INVERTER OUTPUT IS EXEMPT FROM ADDITIONAL FASTENING [NEC 705.12(D)(5)].

GROUNDING NOTES:

31. GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVISES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR SUCH USE.
32. PV EQUIPMENT SHALL BE GROUNDED ACCORDING TO NEC 690.43 AND MINIMUM NEC 250.122.
33. METAL PARTS OF MODULE FRAMES, MODULE RACKING, AND ENCLOSURES CONSIDERED GROUNDED IN ACCORD WITH 250.134 AND 250.136(A).
34. EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC 690.45 AND MICRO INVERTER MANUFACTURER'S INSTRUCTIONS.
35. EACH MODULE WILL BE GROUNDED USING WEEB GROUNDING CLIPS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ. IF WEEBS ARE NOT USED, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE SPECIFIED GROUNDING LUG HOLES PER THE MANUFACTURERS' INSTALLATION REQUIREMENTS.
36. THE GROUNDING CONNECTION TO A MODULE SHALL BE ARRANGED SUCH THAT THE REMOVAL OF A MODULE DOES NOT INTERRUPT A GROUNDING CONDUCTOR TO ANOTHER MODULE.
37. GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLORED GREEN OR MARKED GREEN IF #4 AWG OR LARGER [NEC 250.119]
38. THE GROUNDING ELECTRODE SYSTEM COMPLIES WITH NEC 690.47 AND NEC 250.50 THROUGH 250.106. IF EXISTING SYSTEM IS INACCESSIBLE, OR INADEQUATE, A GROUNDING ELECTRODE SYSTEM PROVIDED ACCORDING TO NEC 250,NEC 690.47 AND AHJ.
39. GROUND-FAULT DETECTION SHALL COMPLY WITH NEC 690.5 IN GENERAL AND NEC 690.5(A)(1) SPECIFICALLY.
40. DISCONNECTION AND OVER-CURRENT PROTECTION NOTES:
41. DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING ENERGIZED ARE CONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS).
42. DISCONNECTS TO BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH
43. RAPID SHUTDOWN OF ENERGIZED CONDUCTORS BEYOND 10 FT OF PV ARRAY OR 5 FT INSIDE A BUILDING WITHIN 10 SECONDS. CONTROLLED CONDUCTORS ≤30V AND ≤240VA [NEC 690.12]. LOCATION OF LABEL ACCORDING TO AHJ.
44. ALL OCPD RATINGS AND TYPES SPECIFIED ACCORDING TO NEC 690.8,690.9 AND 240.
45. MICRO INVERTER BRANCHES CONNECTED TO A SINGLE BREAKER OR GROUPED FUSES IN ACCORDANCE WITH NEC 110.3(B). 2.6.7 IF REQUIRED BY AHJ, SYSTEM WILL INCLUDE ARC-FAULT CIRCUIT PROTECTION ACCORDING TO NEC 690.11 AND UL1699B.

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North Carolina COA # P-2308

Signed 12/2/2022

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35°30'54.4"N 78°67'48.1"W

AHJ: HARNETT COUNTY

UTILITY: DUKE ENERGY PROGRESS

GENERAL NOTES

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DESIGNER/CHECKED BY:
DM/

SCALE:AS NOTED	PAPER SIZE:17"x11"	
DATE:11/28/22	REV:B	PV-2.0

MODULES DATA

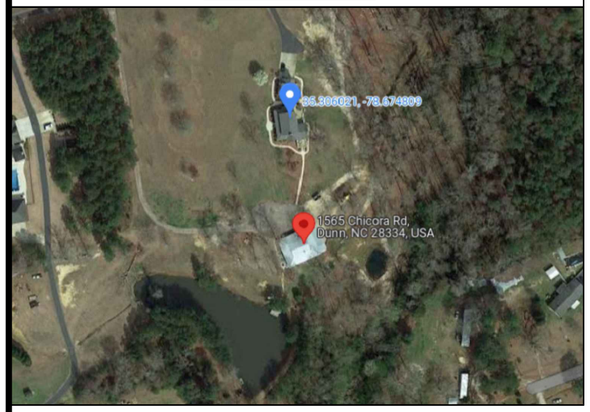
HYUNDAI SOLAR HIS-S405YH(BK) 405W	
MODULE DIMS	75.75"x40.87"x1.18"
LAG SCREWS	5/16"x3.5":2.5"MIN EMBEDMENT

FIRE SETBACK

MINIMUM FIRE ACCESS PATHWAYS PER CFC 2019
RIDGE TO ARRAY: 1'-6"
EAVE TO ARRAY : 3'-0"
HIP/VALLEY W/ ADJACENT ARRAY: 1'-6"
EACH SIDE HIP/VALLEY W/O ADJACENT ARRAY: 0'-0"

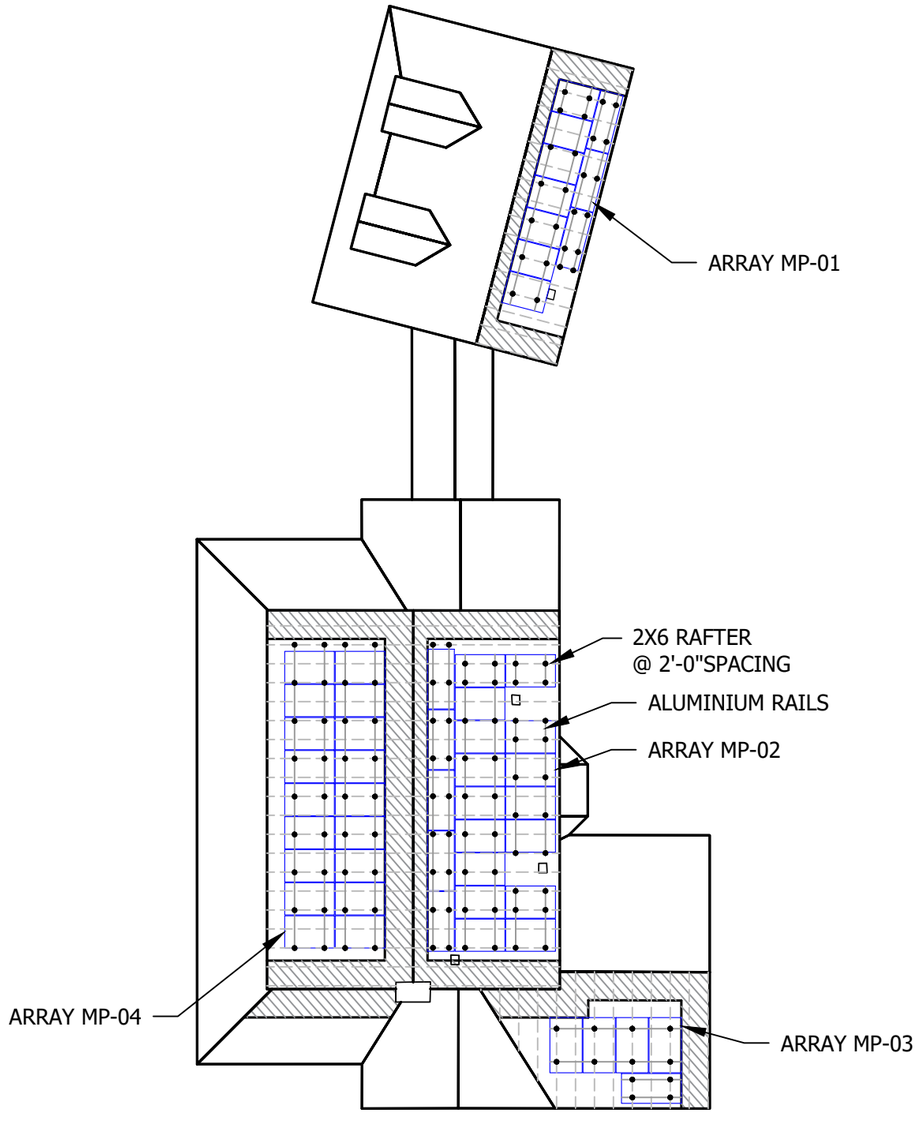
NOTE: INSTALLER TO VERIFY RAFTER SIZE, SPACING AND SLOPED SPANS, AND NOTIFY ANY DISCREPANCIES BEFORE PROCEEDING.

AERIAL VIEW



SITE INFORMATION

SR.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
MP-01	89°	45°	10	215.0	METAL	S-5! CORRUBRACKET	METAL DECK	RAFTERS	2 X 6	2'-0"	4'-0"	2'-0"
MP-02	82°	33.69°	21	451.5	METAL	S-5! CORRUBRACKET	METAL DECK	RAFTERS	2 X 6	2'-0"	4'-0"	2'-0"
MP-03	172°	22.62°	5	107.5	METAL	S-5! CORRUBRACKET	METAL DECK	RAFTERS	2 X 6	2'-0"	4'-0"	2'-0"
MP-04	262°	33.69°	18	387.0	METAL	S-5! CORRUBRACKET	METAL DECK	RAFTERS	2 X 6	2'-0"	4'-0"	2'-0"



B | MOUNTING DETAILS
PV-3.0 | SCALE: 1/16"=1'-0"

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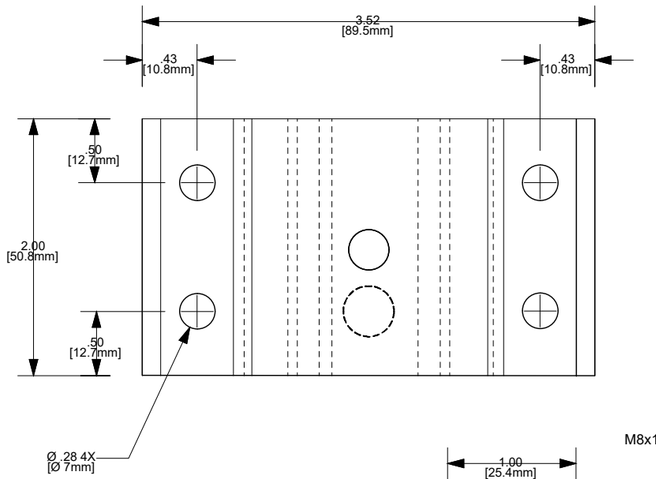

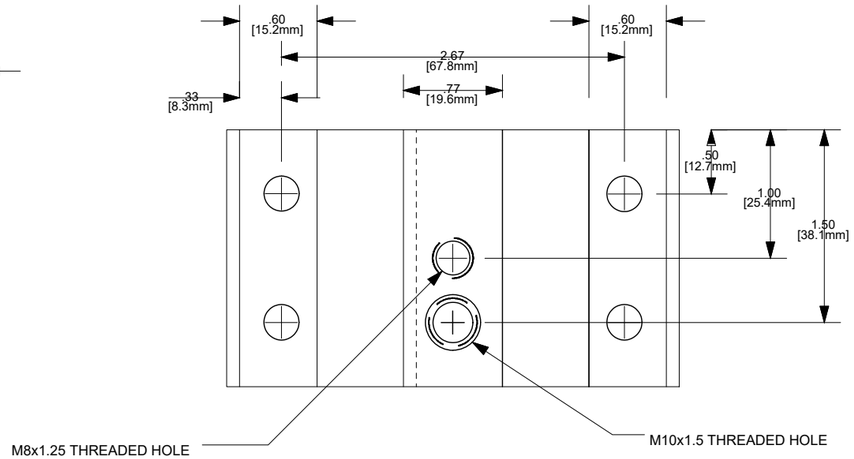

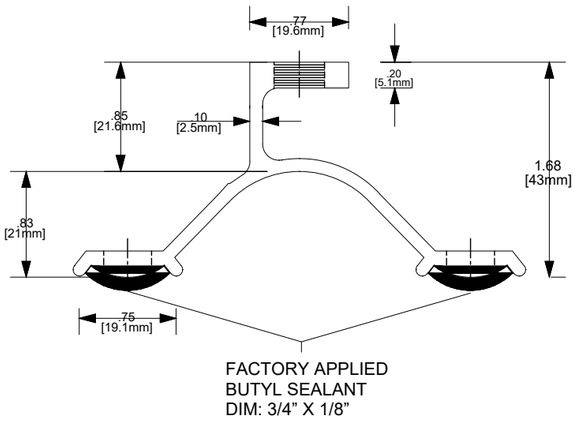

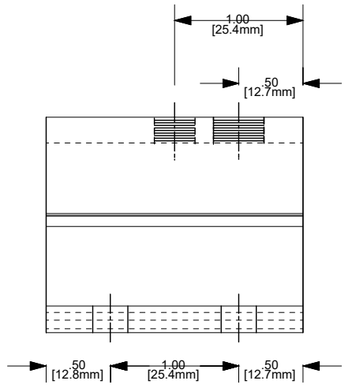

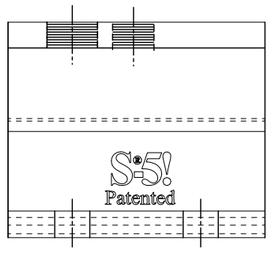

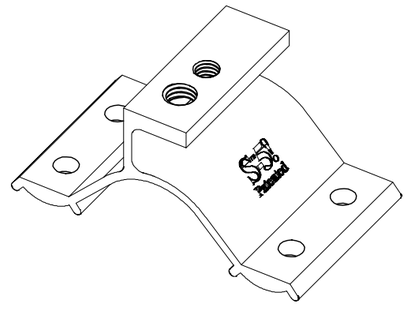

S-5! CORRUBRACKET

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STRUCTURAL DETAILS

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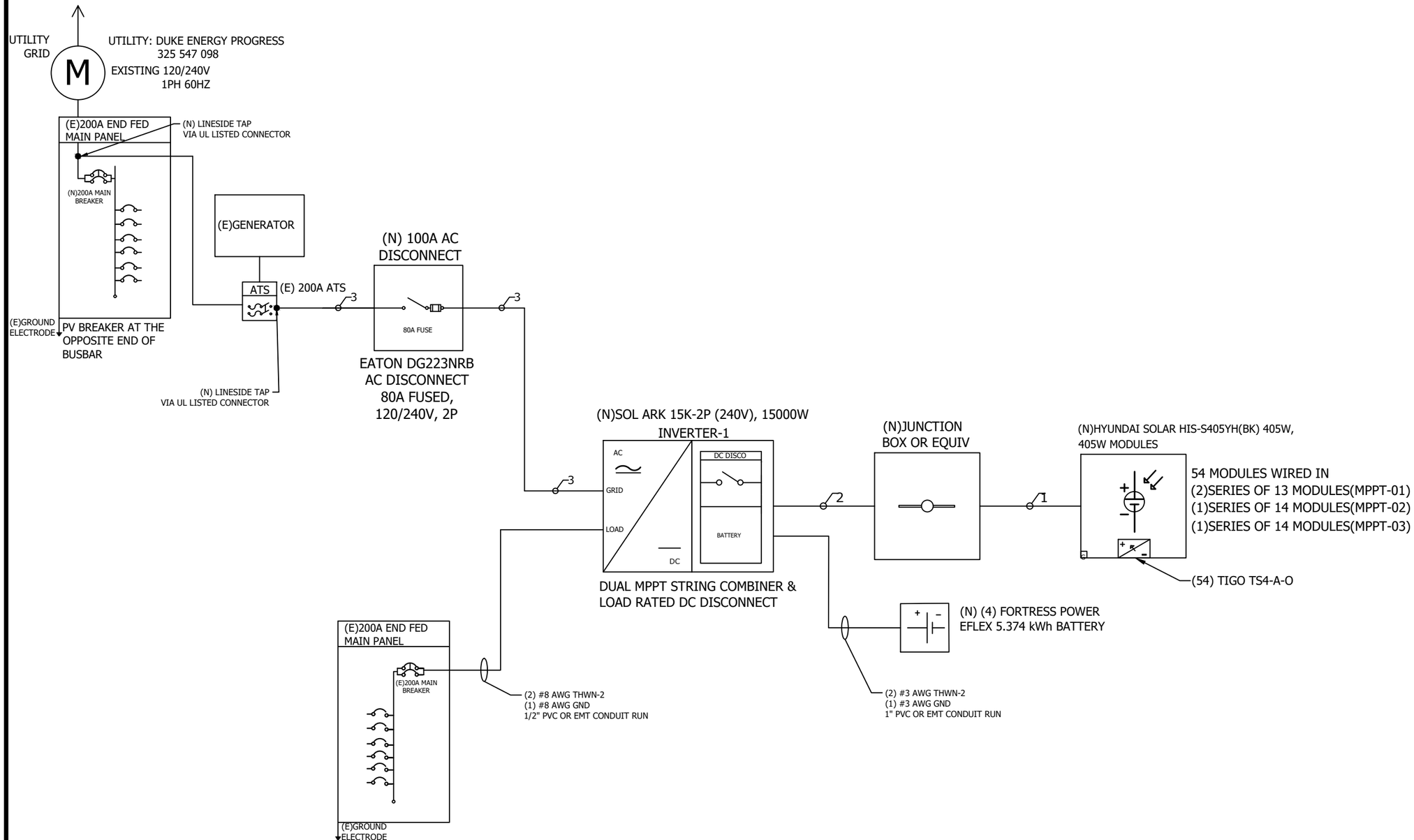
DM/

SCALE:AS NOTED	PAPER SIZE:17"x11"	
DATE:11/28/22	REV:B	PV-3.1

SINGLE LINE DIAGRAM: DC SYSTEM SIZE - 21.860KW DC, 15.000KW AC, 21.496KWH STORAGE SYSTEM



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SINGLE LINE DIAGRAM: DC SYSTEM SIZE - 21.860KW DC, 15.000KW AC, 21.496KWH STORAGE SYSTEM

MODULE SPECIFICATION	
MODEL	HYUNDAI SOLAR HIS-S405YH(BK) 405W
MODULE POWER @ STC	405W
OPEN CIRCUIT VOLTAGE:Voc	45.6V
MAX POWER VOLTAGE:Vmp	37.9V
SHORT CIRCUIT VOLTAGE:Isc	11.33A
MAX POWER CURRENT:Imp	10.69A

INVERTER-1 SPECIFICATIONS	
MODEL	SOL-ARK 15K-2P (240V, 2P)
POWER RATING	15000W
MAX OUTPUT CURRENT	62.5A
CEC WEIGHTED EFFICIENCY	96.5%
MAX INPUT CURRENT	26A
MAX DC VOLTAGE	500V

MLPE CHARACTERISTICS	
MODEL	TS4-A-O
MIN VOLTAGE	16 VDC
MAX VOLTAGE	90 VDC
MAX CURRENT	12A ADC
MAX POWER	500 W

CONDUIT SCHEDULE

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

ELECTRICAL CALCULATION

AC WIRE CALCULATIONS:- MATERIAL:COPPER & TEMPERATURE RATING:75°C

TAG ID	REQUIRED CONDUCTOR AMPACITY									CORRECTED AMPACITY CALCULATION							TERMINAL RATING CHECK			DERATED CONDUCTOR AMPACITY CHECK		
1	12.14	X	2	=	24.28	X	1	=	24.28A	35	X	0.91	X	0.8	=	25.48A	24.28A	<	30A	24.28A	<	25.48A
2	12.14	X	2	=	24.28	X	1	=	24.28A	35	X	0.91	X	0.8	=	25.48A	24.28A	<	30A	24.28A	<	25.48A
3	62.5	X	1	=	62.5	X	1.25	=	78.13A	100	X	0.91	X	1	=	91A	78.13A	<	80A	78.13A	<	91A

ELECTRICAL NOTES:

1. MAXIMUM DC/AC VOLTAGE DROP SHALL BE NO MORE THAN 2%.
2. BREAKER/FUSE SIZES CONFORMS TO NEC 240.6 CODE SECTION.
3. AC GROUNDING ELECTRODE CONDUCTOR SIZED PER NEC 250.66.
4. AMBIENT TEMPERATURE CORRECTION FACTOR IS BASED ON NEC 690.31(A).
5. AMBIENT TEMPERATURE ADJUSTMENT FACTOR IS BASED ON NEC 310.15(B)(2)(C) AND 310.15(B)(2)(B)
6. AC SYSTEM VOLTAGE CORRECTION IS PER NEC 690.7(A)
7. CONDUCTORS ARE SIZED PER WIRE AMPACITY TABLE NEC 310.15(B)(16).
8. CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC 310.10(D).
9. CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC 310.10(C).

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SYSTEM INFORMATION

DC SYSTEM SIZE : 21870W
AC SYSTEM SIZE : 15000W
MODULES:
(54) HYUNDAI SOLAR HIS-S405YH(BK) 405W
INVERTER:
(1) SOL ARK 15K-2P (240V), 15000W
MLPE:
(54) TIGO TS4-A-O
BATTERY:
(4) FORTRESS POWER EFLEX 5.374 KWH BATTERY

ENGINEER OF RECORD

CUSTOMER INFORMATION

NAME & ADDRESS:
NICK SKATELL
1565 CHICORA RD.,
DUNN, NC 28334
35°30'54.4"N 78°67'48.1"W

AHJ: HARNETT COUNTY

UTILITY: DUKE ENERGY PROGRESS

SINGLE LINE DIAGRAM

PROJECT NUMBER:

DESIGNER/CHECKED BY:
DM/

SCALE:AS NOTED | PAPER SIZE:17"x11"

DATE:11/28/22 | REV:B | PV-4.1

WARNING PLACARDS

WARNING

ELECTRIC SHOCK HAZARD
THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED

LABEL LOCATION
DC DISCONNECT,INVERTER
[PER CODE: NEC 690.41)]
[To be used when inverter is ungrounded]

WARNING

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

DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT

LABEL LOCATION
AC DISCONNECT,POINT OF INTERCONNECTION
[PER CODE: NEC 690.13(B)]

WARNING

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

LABEL LOCATION
AC DISCONNECT,POINT OF INTERCONNECTION
[PER CODE: NEC 690.13(B)]

WARNING-Electric Shock Hazard
No User Serviceable Parts inside
Contact authorized service provide for assistance

LABEL LOCATION
INVERTER, JUNCTION BOXES(ROOF),
AC DISCONNECT
[PER CODE: NEC 690.13]

WARNING:PHOTOVOLTAIC POWER SOURCE

LABEL LOCATION
CONDUIT, COMBINER BOX
[PER CODE: NEC690.31(G)(3)]

WARNING
DUAL POWER SOURCE SECOND SOURCE IS PHOTOVOLTAIC SYSTEM

LABEL LOCATION
POINT OF INTERCONNECTION
[PER CODE: NEC705.12(D)(4)]

PHOTOVOLTAIC SYSTEM AC DISCONNECT SWITCH
RATED AC OPERATING CURRENT 62.5 AMPS AC
AC NOMINAL OPERATING VOLTAGE 240 VAC

LABEL LOCATION
AC DISCONNECT , POINT OF INTERCONNECTION
[PER CODE: NEC 690.54]

WARNING
INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVER-CURRENT DEVICE

LABEL LOCATION
POINT OF INTERCONNECTION
(PER CODE: NEC 705.12(2)(b)
[Not Required if Panel board is rated not less than sum of ampere ratings of all overcurrent devices supplying it]

CAUTION: SOLAR CIRCUIT

LABEL LOCATION
MARKINGS PLACED ON ALL INTERIOR AND EXTERIOR DC CONDUIT, RACEWAYS, ENCLOSURES AND CABLE ASSEMBLES AT LEAST EVERY 10 FT, AT TURNS AND ABOVE/BELOW PENETRATIONS AND ALL COMBINER/JUNCTION BOXES.
(PER CODE: NEC1204.5)

SOLAR DISCONNECT

LABEL LOCATION
DISCONNECT, POINT OF INTERCONNECTION
[PER CODE: NEC 690.13(B)]

CAUTION: SOLAR ELECTRIC SYSTEM CONNECTED

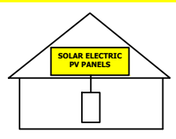
LABEL LOCATION
WEATHER RESISTANT MATERIAL, DURABLE ADHESDIVE, UL969 AS STANDARD TO WEATHER RATING (UL LISTING OF MARKINGS NOT REQUIRED), MIN ⅜" LETTER HEIGHT ARIAL OR SIMILAR FONT NON-BOLD,PLACED WITHIN THE MAIN SERVICE DISCONNECT,PLACED ON THE OUTSIDE OF THE COVER WHEN DISCONNECT IS OPERATED WITH THE SERVICE PANEL CLOSED.
(PWER CODE: NEC690.15 ,690.13(B))

RAPID SHUTDOWN SWITCH FOR SOLAR SYSTEM

LABEL LOCATION
INVERTER,POINT OF INTERCONNECTION
[PER CODE: NEC 690.56(C)(3)]

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



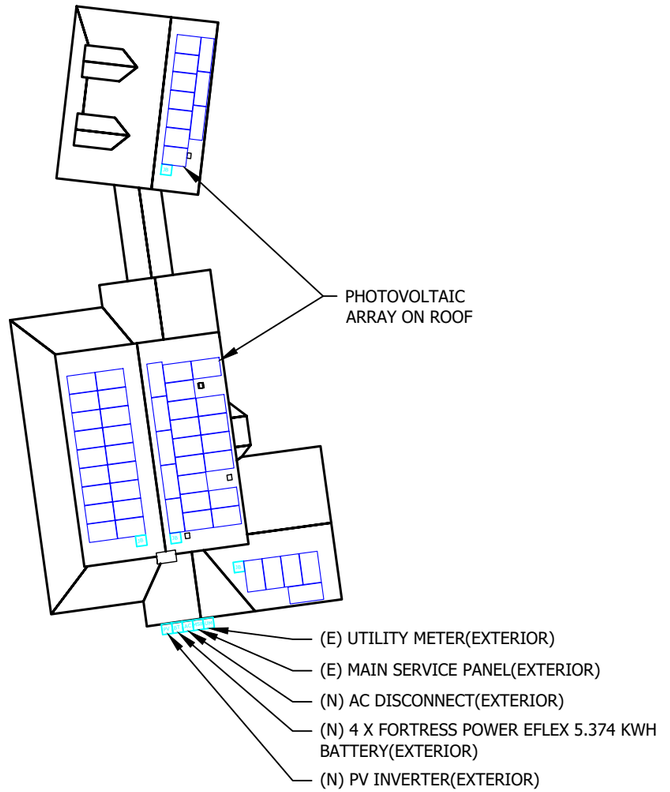
LABEL LOCATION
AC DISCONNECT, DC DISCONNECT, POINT OF INTERCONNECTION
(PER CODE: NEC690.56(C)(1)(A))

ALL PLACARDS SHALL BE OF WEATHER PROOF CONSTRUCTION, BACKGROUND ON ALL PLACARDS SHALL BE RED WITH WHITE LETTERING U.O.N.
PLACARD SHALL BE MOUNTED DIRECTLY ON THE EXISTING UTILITY ELECTRICAL SERVICE.FASTENERS APPROVED BY THE LOCAL JURISDICTION

NOTE:ALL SIGNAGE CANNOT BE HAND WRITTEN NEC 110.21

WARNING !

POWER TO THIS BUILDING IS ALSO SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN



SYSTEM UTILIZES MICRO-INVERTERS LOCATED UNDER SOLAR MODULE

1565 CHICORA RD., DUNN, NC 28334

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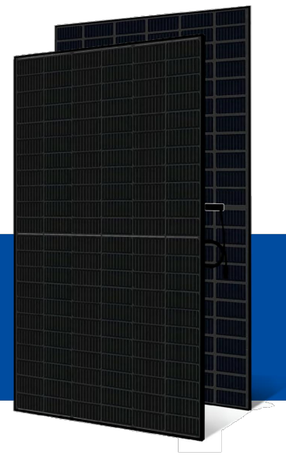
HYUNDAI SOLAR MODULE

25 YR WARRANTY Product & Performance

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.

Half-Cut & Multi-Wire Technology

9 Wires

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.

Anti-LID / PID

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

Mechanical Strength

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

UL / VDE Test Labs

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

Reliable Warranty

HYUNDAI

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

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

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.

Certification

US LISTED

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

Printed Date : 03/2022(final)

www.hyundai-es.co.kr

HYUNDAI ENERGY SOLUTIONS

Electrical Characteristics

		Mono-Crystalline Type(HiS-S____YH(BK))					
		385	390	395	400	405	410
Nominal Output (Pmpp)	W	385	390	395	400	405	410
Open Circuit Voltage (Voc)	V	44.5	44.8	45.0	45.3	45.6	45.9
Short Circuit Current (Isc)	A	11.04	11.11	11.18	11.25	11.33	11.40
Voltage at Pmax (Vmpp)	V	37.1	37.3	37.5	37.7	37.9	38.1
Current at Pmax (Impp)	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 Pmax	%/K	-0.347					
Temperature Coefficient of Voc	%/K	-0.268					
Temperature Coefficient of Isc	%/K	+0.032					

*All data at STC (Measurement tolerances Pmpp ±3%; Isc ; Voc ±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

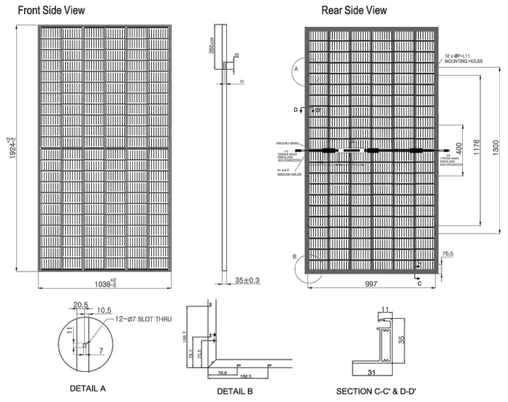
Dimensions	1,038 mm (W) x 1,924 mm (L) x 35 mm(H)
Weight	Approx. 21.1 kg
Solar Cells	132 half cut bifacial cells (2 parallel x 66 half cells in series)
Output Cables	Cable : 1,200mm / 4mm² Connector : MC4 genuine connector
Junction Box	IP68, weatherproof, IEC certified (UL listed)
Bypass Diodes	3 bypass 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

Installation Safety Guide

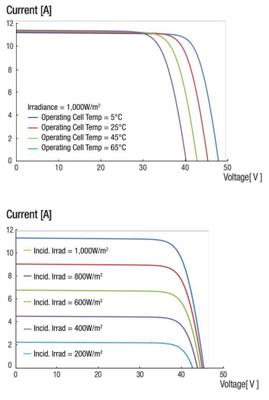
- Only qualified personnel should install or perform maintenance.
- Be aware of dangerous high DC voltage.
- Do not damage or scratch the rear surface of the module.
- Do not handle or install modules when they are wet.

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)

Module Diagram (unit : mm)



I-V Curves



Printed on FSC certified eco-friendly paper.

HYUNDAI ENERGY SOLUTIONS

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MODULE SPECSHEET

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DM/

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Sol-Ark®

15K-2P Spec Sheet

Solar	Input Power 19,500W
Max Allowed PV Power	19,500W
Max PV Power Delivered to Battery & AC Outputs	15,000W
Max DC Voltage (Voc)	500V @ 26A
MPPT Voltage Range	125-425V
Starting Voltage	125V
Number of MPPT	3
Max Solar Strings Per MPPT	2
Max DC Current per MPPT (Self Limiting)	26A
Max AC Coupled Input (Micro/String Inverters)	19,200W

AC	Output Power 15kW On-Grid & Off-Grid
Connections	120/240/208V Split Phase
Continuous AC Power to Grid (On-Grid)	15,000W 62.5A-L (240V)
Continuous AC Power to Load (Off-Grid)	12,000W 50A-L (240V)
Surge AC Power 10sec	24,000VA L-L (240V)
Surge AC Power 100ms	30,000VA L-L (240V)
Parallel Stacking	Yes - Up to 12
Frequency	60/50Hz
Continuous AC Power with Grid or Generator	48,000W 200A L-L (240V) 24,000W 200A L-N (120V)
CEC Efficiency	96.5% (Peak 97.5%)
Idle Consumption Typical—No Load	90W
Sell Back Power Modes	Limited to Household/Fully Grid-Tied
Design (DC to AC)	Transformerless DC
Response Time (Grid-Tied to Off-Grid)	5ms
Power Factor	+/- 0.9 - 1.0

Battery (optional)	Output Power 12,000W
Type	Lead-Acid or Li-Ion
Nominal DC Input	48V
Capacity	50 — 9900Ah
Voltage Range	43.0 — 63.0V
Continuous Battery Charging Output	275A
Charging Curve	3-Stage w/ Equalization
Grid to Batt Charging Efficiency	96.0%
External Temperature Sensor	Included
Current Shunt for Accurate % SOC	Integrated
External Gen Start Based on Voltage or %SOC	Integrated
Communication to Lithium Battery	CanBus & RS485

General	
Dimensions (H x W x D)	31.8" x 18.3" x 10.9"
Weight (package)	135 lbs
Enclosure	IP65 / NEMA 3R
Ambient Temperature	-40~60°C, >45°C Derating
Installation Style	Wall-Mounted
Wi-Fi & LAN Communication	Included
Standard Warranty (verified by HALT Testing)	10 Years

Protections & Certifications	
Electronics Certified Safety by SGS Labs to NEC & UL Specs - NEC 690.4B & NEC 705.4/6	Yes
Grid Sell Back — UL1741-2010/2018, IEE-E1547a-2003/2014, FCC 15 Class B, UL1741SB,	Yes
PV DC Disconnect Switch — NEC 240.15	Integrated
Ground Fault Detection — NEC 690.5	Integrated
PV Rapid Shutdown Control — NEC 690.12	Integrated
PV Arc Fault Detection — NEC 690.11	Integrated
PV Input Lightning Protection	Integrated
PV String Input Reverse Polarity Protection	Integrated
AC Output Breakers - 200A	Integrated
200A x 2 Battery Breaker / Disconnect	Integrated
Surge Protection	DC Type II / AC Type II

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Tigo® Flex MLPE

TS4-A-O

PV Module Advanced Add-On

The TS4-A-O (Optimization) is the advanced add-on optimization solution that brings smart module functionality to standard PV modules for higher reliability. Improve energy efficiency by upgrading underperforming PV systems or adding smart features to new installations.

The TS4-A-O with UHD-Core technology and expanded specifications supports PV modules up to 500W.

Included Features

Module-level **optimization** for increased energy yield and greater design flexibility

Manual or automatic module-level **shutdown**

Module-level **monitoring** for energy production tracking and system management

Easy Installation

Snap to standard module frame or remove brackets for rack mounting

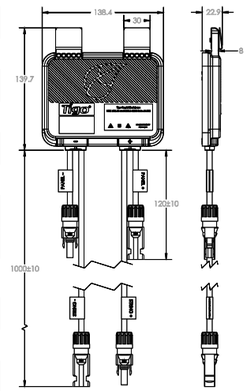
Smart Commissioning

Configure and commission with your Android or iOS mobile device

02/28/20

TS4-A-O SPECIFICATIONS

Environmental	
Operating Temperature Range	-40°C to +85°C (-40°F to +185°F)
Outdoor Rating	IP68
Maximum Elevation	2000m
Mechanical	
Dimensions	138.4mm x 139.7mm x 22.9mm
Weight	520g
Electrical	
Total Max Input Voltage (V_{OC} @ Lowest Temperature)	90V
Voltage Range	16 - 90V
Maximum Current	12A
Maximum Power	500W
Output Cable Length	1.2m (standard)
Connectors	MC4 (standard)
Communication Type	Wireless
Recommended Fuse Rating	15A



TAP required for module-level shutdown and CCA required for monitoring with TS4-A-O.

ORDERING INFORMATION

Standard	
451-00252-32	1500V UL / 1000V TÜV, 1.2m cable, MC4
Options	
451-00257-12	1000V UL / TÜV, 1.2m cable, MC4 comparable
451-00252-32	1500V UL / 1000V TÜV, 1.2m cable, MC4
451-00261-32	1500V UL / TÜV, 1.2m cable, EVO2

For sales info:
sales@tigoenergy.com

For product info:
Visit tigoenergy.com/products

For technical info:
Visit support.tigoenergy.com

For additional info and product selection assistance, use Tigo's online design tool at tigoenergy.com/design

Tigo®

PV 2.0

Tigo Energy, Inc. | www.tigoenergy.com | sales@tigoenergy.com

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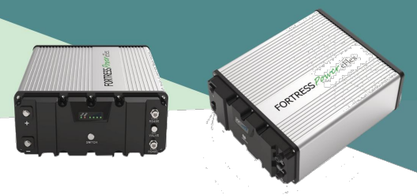
FORTRESS **POWER**

eFlex 5.4 Lithium Battery Storage



FORTRESS POWER
Secure your energy

We design the eFlex 5.4 with a goal of building the world most robust lithium battery for all different application scenarios and harish weather conditions.

- Tier 1 Automotive Prismatic Lithium Iron Phosphate Cell with the highest cycle life
- Patented Enclosure design achieves 4 times better thermal performance than our competitors
- IP 65 Dust and Water Proof design for outdoor install
- Flexible mounting options (wall mount, floor-stand or standard 19" industrial server rack mount)

Our market leading Digital Processor Battery Management System (BMS) includes:

- High amperage Contactor Disconnects
- Individual cell voltage & temperature monitoring and balancing for maximum reliability and longevity
- Canbus, Modbus, and Wi-Fi communication enable Internet-of-Things compatibility
- Advanced closed loop communication with most 48V inverters

Application Scenarios:

Electrical Specifications	
Nominal Voltage:	51.2V
Nominal Capacity:	105AH
Rated Capacity @ 0.5C (50A):	5.374 kWh
Resistance:	<10 mΩ
Efficiency (at 0.5C):	>98%
Self-Discharge:	<1 % / Month
Maximum Allowed Modules in Parallel:	15 (81 kWh)
Depth of Discharge	Up to 100%
Warranty	10 Years
Cycle Life	8,000 (@ 80% DoD)

Charge Specifications	
Recommended Charge Current:	<55A
Maximum Charge Current:	100A
Recommended Charge Voltage:	54.4V
BMS Charge Voltage Disconnect:	>56V

Discharge Specifications	
Recommended Continuous Discharge Rate:	60A (3KW DC)
Peak Continuous Discharge Rate:	100A (5 KW 60 Min)
Maximum Surge Power Rate:	130A (6.6 KW 5S)
Recommended Low Voltage Disconnect:	48V
Battery Low Voltage Protection:	<45V
Battery recovery Voltage:	45V

Temperature Specifications	
Discharge Temperature:	-4°F~131°F (-20°C ~ 55°C)
Charge Temperature:	32°F ~ 114°F (0°C ~ 45°C)
Storage Temperature:	20°F ~ 95°F (-6°C ~ 35°C)

Mechanical Specifications	
Dimensions: (L*W*H)	18x23x7.3 inches 446x546x183 mm
Weight:	108 lbs (49kg)
Terminal Type:	M8
Ring Terminal Size:	3/8ths or larger
Terminal Torque:	7.0 – 7.7 Nm (5.1 – 5.7 ft-lb)
Terminal Cover	1 set, Waterproof
Case Material:	Anodized Aluminum
Enclosure Protection:	IP65
Cell Type Chemistry:	Tier 1 Automatic Prismatic - $LiFePO_4$

Compliance Specifications:	
Certifications:	UL9540. UL1973, UL1642, CEC, SGIP
Shipping Classification:	UN 38.3, CLASS 9 (Lithium Ion Battery)

Basic Charging Profile	
Bulk + Absorb Charge:	54.4V
Absorb Time:	60 minutes
Float Charge:	54V
Inverter Charging:	2 Stage / No Float
Equalization:	No equalization (typical) 54.6V for 10 seconds (rare)
Temperature Compensation:	None

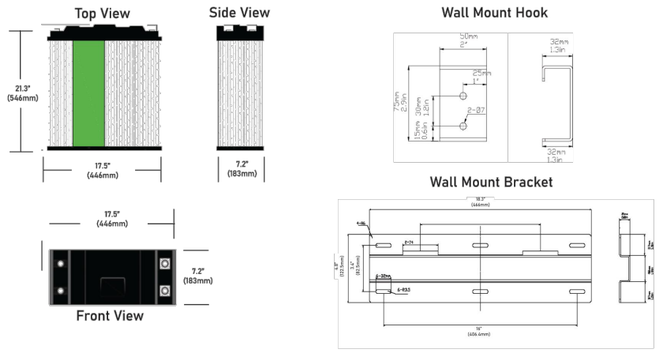
Intertek

UN38.3 PASSED
Transport Safety Certified

Compatible with Most Inverters on the Market: Schneider Sol-Ark Midnite Solar OutBack Power SMA Morningstar Phocos Victron Energy Growatt

www.FortressPower.com
Sales@FortressPower.com · 877-497-6937

DIMENSIONS:



FlexRack

for Fortress eFlex 5.4 kWh lithium batteries

- **INCLUDES INTERGRATED BUSBARS AND BATTERY CABLES FOR EASY STACKING**
- **EASY TO ADD DIN RAIL THERMOSTAT FOR COLD CLIMATES**
- **PASSIVE COOLING VENT FOR WARM CLIMATES**
- **BUILT ON WHEELS FOR EASY MOVEMENT AND POSITIONING**
- **EXPANDABLE UP TO 4 UNITS (15 EFLEX BATTERIES; TOTAL 81 KWH)**

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Sustainable Energy & Lighting Solutions
Your future is brighter with us!

SYSTEM INFORMATION

DC SYSTEM SIZE : 21870W
AC SYSTEM SIZE : 15000W

MODULES:
(54) HYUNDAI SOLAR HIS-S405YH(BK) 405W

INVERTER:
(1) SOL ARK 15K-2P (240V), 15000W

MLPE:
(54) TIGO TS4-A-O

BATTERY:
(4) FORTRESS POWER EFLEX 5.374 KWH BATTERY

ENGINEER OF RECORD

CUSTOMER INFORMATION

NAME & ADDRESS:
NICK SKATELL
1565 CHICORA RD.,
DUNN, NC 28334
35°30'54.4"N 78°67'48.1"W

AHJ: HARNETT COUNTY

UTILITY: DUKE ENERGY PROGRESS

ENPHASE ENERGY ENCHARGE 10 SPECSHEET

PROJECT NUMBER:

DESIGNER/CHECKED BY:
DM/

SCALE:AS NOTED	PAPER SIZE:17"x11"	
DATE:11/28/22	REV:B	PV-6.3

S-5!®

The Right Way!

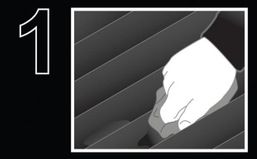
CorruBracket™

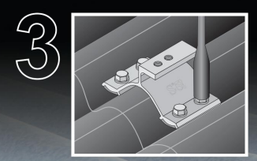
CorruBracket™ can be used to mount almost anything to corrugated metal roofing and is compatible with 7/8" and 3/4" corrugated roofing. No messy sealants to apply! No chance for leaks! The CorruBracket comes with factory-applied butyl sealant already in the base, and the S-5!® patented reservoir conceals the sealant, preventing UV degredation.

Installation is simple! CorruBracket is mounted directly into the supporting structure of the roof, i.e. roof decking, wood or steel purlins, or trusses. No surface preparation is necessary; simply wipe away excess oils and debris, peel the release paper, align, and apply. Secure through the pre-punched holes using the appropriate screws for the supporting structure.

CorruBracket is so strong, it will even support heavy-duty applications like snow retention. For corrugated profiles, the CorruBracket is the perfect match for our ColorGard® snow retention system. CorruBracket is economical and facilitates quick and easy installation.

The right way to attach almost anything to metal roofs!





CorruBracket™

S-5!® CorruBracket™ is the right way to attach almost anything to 7/8" and 3/4" corrugated roofing, including PV via DirectAttached™ or rail methods.

888-825-3432 | www.S-5.com

S-5!®

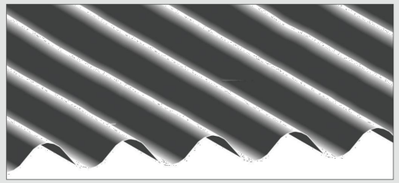
The Right Way!

CorruBracket™ is extremely versatile. It can be used for almost any attachment need on 7/8" and 3/4" corrugated metal roofing. No messy sealants to apply. The factory-applied butyl sealant waterproofs and makes installation a snap!

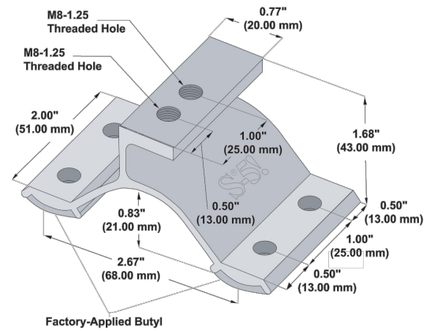
Each **CorruBracket™** comes with factory-applied butyl sealant in the base. CorruBracket is compatible with most common metal roofing materials. For design assistance, ask your distributor, or use our web-based calculator at **www.S-5.com** for job-specific system engineering and design of your next snow retention project. Also, please visit our website for more information including CAD details, metallurgical compatibilities and specifications.

The CorruBracket has been tested for load-to-failure results on wood decking, and metal and wood purlins. The independent lab test data found at www.S-5.com can be used for load-critical designs and applications. S-5!® holding strength is unmatched in the industry.

Example Profile



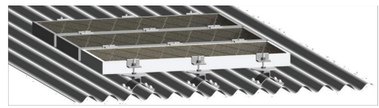
CorruBracket™



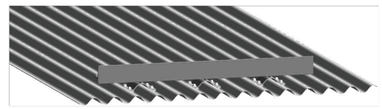
Please note: All measurements are rounded to the second decimal place. Contact your distributor for information about hardware requirements.

Example Applications

S-5-PV Kit (DirectAttached™ or Rail)



ColorGard®



S-5!® Warning! Please use this product responsibly!

Products are protected by multiple U.S. and foreign patents. For published data regarding holding strength, bolt torque, patents and trademarks visit the S-5! website at www.S-5.com.

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