



1011 N Causeway Blvd, Suite 19 ♦ Mandeville, Louisiana 70471 ♦ Phone: 985.624.5001 ♦ Fax: 985.624.5303

June 2022

Property Owner: Joshua Hopkins

Property Address: 347 Bedrock Street, Lake City, FL 32024

**RE: Photovoltaic System Roof Installations**

I have reviewed the existing structure referenced above to determine the adequacy of the existing structure support the proposed installation of an array of solar panels on the roof.

Based on my review, the existing structure is adequate to support the proposed solar panel installation. This assessment is based on recent on-site inspection by solar inspectors and photographs of the existing structure. The photovoltaic system is designed to withstand uplift and downward forces; our assessment is regarding the structure's support of the array. Stresses induced by the introduction of individual mount loads on the rafters or truss top chord are within acceptable limits as shown on the attached calculations. The structural considerations used in our review and assessment include the following:

**Evaluation Criteria:**

Applied Codes: ASCE 7-16 FBC 2020 NEC 2017

Risk Category: II

Design Wind Speed (3-second gust): 165 MPH

Wind Exposure Category: C

Ground Snow Load: 0 PSF

Seismic Design Category: D

**Existing Structure:**

Roof Material: Shingle

Roofing Structure: 2x Truss Top Chord @ 24" O.C.

Roof Slope: 6/12



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**PRINCIPAL Infrastructure®**

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**Effect of the Solar Array on Structure Loading:**

**Gravity Loads:**

Per IBC Section 1607.12.5.1, the areas of the roof where solar panels are located are considered inaccessible, and therefore not subject to roof live loading. Live load in these areas is replaced by the dead load of the solar array, 3 psf. The total gravity load on the structure is therefore reduced and the structure may remain unaltered. Connections of the mounts to the underlying structure are to be installed in a staggered pattern, except at the array ends, to distribute the loading evenly to the roof structure. The stresses within the rafters or truss top chord due to the introduction of discrete mount loads are within acceptable limits, as shown on the attached calculations.

**Wind Load:**

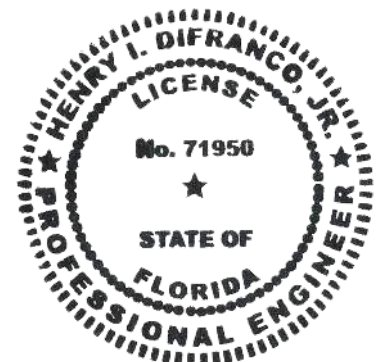
The solar panel array will be flush mounted (no more than 6" above the surrounding roof surface, and parallel to the roof surface. Any additional wind loading on the structure due to the presence of the array is negligible. The array structure is designed by the manufacturer to withstand uplift and downward forces resulting from wind and snow loads. The attached calculations verify the capacity of the connection of the solar array to the roof to resist uplift due to wind loads, the governing load case.

**Snow Load:**

The reduced friction of the glass surface of the solar panels allows for the lower slope factor ( $C_s$ ) per Section 7.4 of ASCE 7-16 resulting in a reduced design snow load for the structure. This analysis conservatively considered the snow load to be unchanged.

**Seismic Load:**

Analysis shows that additional seismic loads due to the array installation will be small. Even conservatively neglecting the wall materials, the solar panel installation represents an increase in the total weight of the roof and corresponding seismic load of less than 10%. This magnitude of additional forces meets the requirements of the exception in Section 11B.4 of ASCE 7-16. The existing lateral force resisting system of the structure is therefore allowed to remain unaltered.



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Conclusion:

To the best of my professional knowledge and belief, the subject construction and photovoltaic system installation will be in compliance with all state and local building codes and guidelines in effect at the time of our review.

Limitations:

Engineer's assessment of the existing structure is based on recent field reports and current photographs of the elements of the structure that were readily accessible at the time of inspection. The design of the solar panel racking (mounts, rails, connectors, etc.), connections between the racking and panels, and electrical engineering related to the installation are the responsibility of others. The photovoltaic system installation must be by competent personnel in accordance with manufacturer recommendations and specifications and should meet or exceed industry standards for quality. The contractor is responsible for ensuring that the solar array is installed according to the approved plans and must notify the engineer of any undocumented damage or deterioration of the structure, or of discrepancies between the conditions depicted in the approved plans and those discovered on site so that the project may be reevaluated and altered as required. Engineer does not assume any responsibility for improper installation of the proposed photovoltaic system.



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**Uplift and Wind Downforce Calculation Summary (ASCE 7-16)**  
**Mount, Rack, & Panel Proportioning**  
**Point Load Check and Rafter Stress Analysis**

Property Owner:	Joshua Hopkins	Max. Individual Panel Dimensions		
Project Address:	347 Bedrock Street	Length (in)	Width (in)	Area (sf)
City, State:	Lake City, FL 32024	77	39	20.85

Building Characteristics, Design Input, and Adjustment Factors					
Roof Dimensions:	Length:	80	Greater Dimension:	80	
	Width:	75	Least Dimension:	75	
Roof Height (h):		15	Fig 30.4-1, valid under 60'	✓	
Pitch:	6 on 12 =	26.6°	Must be less than 45°	✓	
Roof Configuration		Hip			
Roof Structure		2x Truss Top Chord			
Roof Material		Plywood			
Risk Category:		II			
Basic Wind Speed:		165	From 26.5-1		
Exposure Category:		C	Fig. 26.7		
Topographic Factor ( $K_{zt}$ )		1.21	Fig. 26.8-1		
Wind Pressure @ h=30, $p_{net30}$		See Table Below	Fig. 30.4-1		
Ht. & Exposure Adjustment ( $\lambda$ )		1.21	Fig. 30.4-1		
Adjusted Wind Pressures, $p_{net}$		See Table Below	Eq. 30.4-1		
Effective Wind Area (sf):		10.43	(Area per individual mount)		
Roof Zone Strip (a), in ft, Fig. 30.4-1, Note 5					
1 - Least Roof Horizontal Dimension (L or W) x 0.10		7.5			
2 - Roof Height x 0.4		6			
3 - Least Roof Horizontal Dimension (L or W) x 0.04		3			
4 - Least of (1) and (2)		6			
5 - Greater of (3) and (4)		6			
6 - Greater of (5) and 3 feet	a=	6			



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Net Design Pressures, $p_{net}$ (Fig 30.4-1), Components & Cladding					
	Uplift (-psf)			Factored Pressure (0.6W, ASCE 7-16)	$\theta$
		$P_{30net}$	$I K_{zt} P_{30net}$		
gable /hip /flat					
Gable					
Hip					
	Zone 1	66.7	97.7	58.6	$20^\circ < \theta \leq 27^\circ$
	Zone 2e,2r,3	92.2	135.0	81.0	



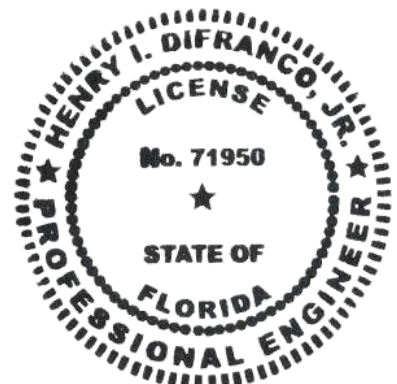
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Snow Load		
Ground Snow Load, $p_g$	0.0	From ASCE 7 or AHJ
Terrain Category:	C	Para 6.5.6.3
Exposure	Fully	
Exposure Factor $C_e$	0.9	Table 7-2
Thermal Factor, $C_t$	1.2	Table 7-3
Importance Factor, $I_s$	1.0	Table 1.5.2
Roof Configuration	Hip	
Roof Slope	26.6°	
Distance from Eave to Ridge	37.5	
$p_m$ , Minimum required Snow Load	N/A	Para. 7.3.4
$p_f$ , Calculated Snow Load	0.00	Eq. 7.3-1
$p_f$ , Design Snow Load	0.00 psf	

Rail & Mount Selection		
Manufacturer:	Unirac	Allowable Mount Spacing by Uplift Pressure
Model:	Flashloc Comp Kit	< 37 psf : 2 rails, mounts @ 4 ft. o.c.
Substrate	Wood Rafters/Truss Top Chord	37 to 56 psf : 2 rails, mounts @ 2 ft. o.c.
Connector:	5/16" x 4" Lag Screw	56 to 75 psf : 3 rails, mounts @ 4 ft. o.c.
		75 to 112 psf : 3 rails, mounts @ 2 ft. o.c.
Allowable Uplift:	480 lb., max.	112 to 150 psf : 4 rails, mounts @ 2 ft. o.c.
		> 150 psf : Mount capacity exceeded

Rail & Mount Layout by Zone		
Zone 1: 3 rails, mounts @ 4 ft. o.c.	Zone 2r: 3 rails, mounts @ 2 ft. o.c.	
Zone 1': N/A	Zone 3: 3 rails, mounts @ 2 ft. o.c.	
Zone 2: N/A	Zone 3e: N/A	
Zone 2e: 3 rails, mounts @ 2 ft. o.c.	Zone 3r: N/A	
Zone 2n: N/A		
(From rail analysis, allowable spacing and number of rails are controlled by individual mount pullout before rail bending)		



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NEW PHOTOVOLTAIC SYSTEM 11.46 KW DC  
347 BEDROCK STREET, LAKE CITY, FL 32024



CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

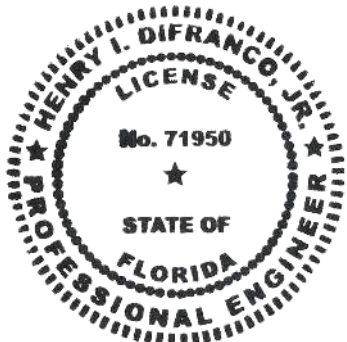
PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



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SHEET TITLE

COVER PAGE

DRAWN DATE 6/24/2022

DRAWN BY JVK

SHEET NUMBER

G-001

GENERAL NOTES

1.1.1 PROJECT NOTES:  
1.1.2 THIS PHOTOVOLTAIC (PV) SYSTEM SHALL COMPLY WITH THE NATIONAL ELECTRIC CODE (NEC) ARTICLE 690, ALL MANUFACTURERS'S LISTING AND INSTALLATION INSTRUCTIONS, AND THE RELEVANT CODES AS SPECIFIED BY THE AUTHORITY HAVING JURISDICTION'S (AHJ) APPLICABLE CODES.  
1.1.3 THE UTILITY INTERCONNECTION APPLICATION MUST BE APPROVED AND PV SYSTEM INSPECTED PRIOR TO PARALLEL OPERATION  
1.1.4 GROUND FAULT DETECTION AND INTERRUPTION (GFDI) DEVICE IS INTEGRATED WITH THE MICRO-INVERTER IN ACCORDANCE WITH NEC 690.41(B)  
1.1.5 ALL PV SYSTEM COMPONENTS; MODULES, UTILITY-INTERACTIVE INVERTERS, AND SOURCE CIRCUIT COMBINER BOXES ARE IDENTIFIED AND LISTED FOR USE IN PHOTOVOLTAIC SYSTEMS AS REQUIRED BY NEC 690.4: PV MODULES: UL1703, IEC61730, AND IEC61215, AND NFPA 70 CLASS C FIRE INVERTERS: UL 1741 CERTIFIED, IEEE 1547, 929, 519 COMBINER BOX(ES): UL 1703 OR UL 1741 ACCESSORY  
1.1.6 MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC. IF UNAVAILABLE, MAX DC VOLTAGE CALCULATED ACCORDING TO NEC 690.7.  
1.1.7 ALL INVERTERS, PHOTOVOLTAIC MODULES,PHOTOVOLTAIC PANELS, AND SOURCE CIRCUIT COMBINERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER 690.4. SHALL BE INSTALLED ACCORDING TO ANY INSTRUCTIONS FROM LISTING OR LABELING [NEC 110.3].  
1.1.8 ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE. IF EXPOSED TO SUNLIGHT, IT SHALL BE UV RESISTANT. ALL PLAQUES AND SIGNAGE WILL BE INSTALLED AS REQUIRED BY THE NEC AND AHJ.

1.2.1 SCOPE OF WORK:  
1.2.2 PRIME CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND SPECIFICATIONS OF THE GRID-TIED PHOTOVOLTAIC SYSTEM RETROFIT. PRIME CONTRACTOR WILL BE RESPONSIBLE FOR COLLECTING EXISTING ONSITE REQUIREMENTS TO DESIGN, SPECIFY, AND INSTALL THE EXTERIOR ROOF-MOUNTED PORTION OF THE PHOTOVOLTAIC SYSTEMS DETAILED IN THIS DOCUMENT

1.3.1 WORK INCLUDES:  
1.3.2 PV RACKING SYSTEM INSTALLATION - UNIRAC SOLAR  
1.3.3 PV MODULE AND INVERTER INSTALLATION - CANADIAN SOLAR INC. CS3N-395MS / ENPHASE IQ8PLUS-72-2-US INVERTER  
1.3.4 PV EQUIPMENT ROOF MOUNT  
1.3.5 PV SYSTEM WIRING TO A ROOF-MOUNTED JUNCTION BOX  
1.3.6 PV LOAD CENTERS (IF INCLUDED)  
1.3.7 PV METERING/MONITORING (IF INCLUDED)  
1.3.8 PV DISCONNECTS  
1.3.9 PV GROUNDING ELECTRODE & BONDING TO (E) GEC  
1.3.10 PV FINAL COMMISSIONING  
1.3.11 (E) ELECTRICAL EQUIPMENT RETROFIT FOR PV  
1.3.12 SIGNAGE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE

PROJECT INFORMATION

OWNER

NAME: JOSHUA HOPKINS

PROJECT MANAGER

NAME: SHAHIN HAYNES  
PHONE: 8665071461

CONTRACTOR NAME

ADT SOLAR LLC  
PHONE: 5052180838

SCOPE OF WORK

SYSTEM SIZE: STC:29 X 395W= 11.46 kW DC  
PTC: 29 x 372.75W = 10.81 kW DC  
(29) CANADIAN SOLAR INC. CS3N-395MS  
(29) ENPHASE IQ8PLUS-72-2-US

ATTACHMENT TYPE: ROOF MOUNT  
MSP UPGRADE: YES  
UTILITY METER UPGRADE: NO

AUTHORITIES HAVING JURISDICTION

BUILDING: COUNTY OF COLUMBIA (FL)  
ZONING: COUNTY OF COLUMBIA (FL)  
UTILITY: CLAY ELECTRIC COOPERATIVE, INC (FL)  
METER NO: 154 738 290

DESIGN SPECIFICATION

OCCUPANCY: II  
CONSTRUCTION: SINGLE-FAMILY  
ZONING: RESIDENTIAL  
GROUND SNOW LOAD: REFER STRUCTURAL LETTER  
WIND EXPOSURE: REFER STRUCTURAL LETTER  
WIND SPEED: 165 MPH

APPLICABLE CODES & STANDARDS

BUILDING: IBC 2018, IRC 2018, FBC 2020 (7TH EDITION)  
ELECTRICAL: NEC 2017  
FIRE: IFC 2020

VICINITY MAP



SATELLITE VIEW



SHEET INDEX

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2.1.1 SITE NOTES:

2.1.2 A LADDER WILL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.

2.1.3 THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS A UTILITY INTERACTIVE SYSTEM WITH NO STORAGE BATTERIES.

2.1.4 THE SOLAR PV INSTALLATION WILL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.

2.1.5 PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION NEC 110.26.

2.1.6 ROOF COVERINGS SHALL BE DESIGNED, INSTALLED, AND MAINTAINED IN ACCORDANCE WITH THIS CODE AND THE APPROVED MANUFACTURER'S INSTRUCTIONS SUCH THAT THE ROOF COVERING SERVES TO PROTECT THE BUILDING OR STRUCTURE.

2.2.1 EQUIPMENT LOCATIONS:

2.2.2 ALL EQUIPMENT SHALL MEET MINIMUM SETBACKS AS REQUIRED BY NEC 110.26.

2.2.3 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).

2.2.4 JUNCTION AND PULL BOXES PERMITTED INSTALLED UNDER PV MODULES ACCORDING TO NEC 690.34.

2.2.5 ADDITIONAL AC DISCONNECT(S) SHALL BE PROVIDED WHERE THE INVERTER IS NOT WITHIN SIGHT OF THE AC SERVICING DISCONNECT.

2.2.6 ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.

2.2.7 ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

2.3.1 STRUCTURAL NOTES:

2.3.2 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 RAI MANUFACTURER'S INSTRUCTIONS.

2.3.3 JUNCTION BOX WILL BE INSTALLED PER MANUFACTURERS' SPECIFICATIONS. IF ROOF-PENETRATING TYPE, IT SHALL BE FLASHED & SEALED PER LOCAL REQUIREMENTS.

2.3.4 ROOFTOP PENETRATIONS FOR PV RACEWAY WILL BE COMPLETED AND SEALED W/ APPROVED CHEMICAL SEALANT PER CODE BY A LICENSED CONTRACTOR.

2.3.5 ALL PV RELATED ROOF ATTACHMENTS TO BE SPACED NO GREATER THAN THE SPAN DISTANCE SPECIFIED BY THE RACKING MANUFACTURER.

2.3.6 WHEN POSSIBLE, ALL PV RELATED RACKING ATTACHMENTS WILL BE STAGGERED AMONGST THE ROOF FRAMING MEMBERS.

2.4.1 WIRING & CONDUIT NOTES:

2.4.2 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.

2.4.3 CONDUCTORS SIZED ACCORDING TO NEC 690.8, NEC 690.7.

2.4.4 VOLTAGE DROP LIMITED TO 1.5%.

2.4.5 DC WIRING LIMITED TO MODULE FOOTPRINT.

MICROINVERTER WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY W/ SUITABLE WIRING CLIPS.

2.4.6 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].

2.5.1 GROUNDING NOTES:

2.5.2 GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVICES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR SUCH USE.

2.5.3 PV EQUIPMENT SHALL BE GROUNDED ACCORDING TO NEC 690.43 AND MINIMUM NEC TABLE 250.122.

2.5.4 METAL PARTS OF MODULE FRAMES, MODULE RACKING, AND ENCLOSURES CONSIDERED GROUNDED IN ACCORD WITH 250.134 AND 250.136(A).

2.5.5 EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC 690.45 AND MICROINVERTER MANUFACTURERS' INSTRUCTIONS.

2.5.6 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.

2.5.7 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.

2.5.8 GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLORED GREEN OR MARKED GREEN IF #4 AWG OR LARGER [NEC 250.119]

2.5.9 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.

2.5.10 GROUND-FAULT DETECTION SHALL COMPLY WITH NEC 690.41(B)(1) AND (2) TO REDUCE FIRE HAZARDS

2.6.1 DISCONNECTION AND OVER-CURRENT PROTECTION NOTES:

2.6.2 DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING ENERGIZED ARE RECONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS).

2.6.3 DISCONNECTS TO BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL, BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH

2.6.4 PV SYSTEM CIRCUITS INSTALLED ON OR IN BUILDINGS SHALL INCLUDE A RAPID SHUTDOWN FUNCTION TO REDUCE SHOCK HAZARD FOR EMERGENCY RESPONDERS IN ACCORDANCE WITH 690.12(A) THROUGH (D).

2.6.5 ALL OCPD RATINGS AND TYPES SPECIFIED ACCORDING TO NEC 690.8, 690.9, AND 240.

2.6.6 MICROINVERTER 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 UL 1699B.

2.7.1 INTERCONNECTION NOTES:

2.7.2 LOAD-SIDE INTERCONNECTION SHALL BE IN ACCORDANCE WITH [NEC 705.12 (B)]

2.7.3 THE SUM OF THE UTILITY OCPD AND INVERTER CONTINUOUS OUTPUT MAY NOT EXCEED 120% OF BUSBAR RATING [NEC 705.12(B)(2)(3)(b)].

2.7.4 THE SUM OF 125 PERCENT OF THE POWER SOURCE(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUSBAR SHALL NOT EXCEED 120 PERCENT OF THE AMPACITY OF THE BUSBAR, PV DEDICATED BACKFEED BREAKERS MUST BE LOCATED OPPOSITE END OF THE BUS FROM THE UTILITY SOURCE OCPD [NEC 705.12(B)(2)(3)].


2.7.5 AT MULTIPLE ELECTRIC POWER SOURCES OUTPUT COMBINER PANEL, TOTAL RATING OF ALL OVERCURRENT DEVICES SHALL NOT EXCEED AMPACITY OF BUSBAR. HOWEVER, THE COMBINED OVERCURRENT DEVICE MAY BE EXCLUDED ACCORDING TO NEC 705.12 (B)(2)(3)(C).

2.7.6 FEEDER TAP INTERCONNECTION (LOADSIDE) ACCORDING TO NEC 705.12 (B)(2)(1)

2.7.7 SUPPLY SIDE TAP INTERCONNECTION ACCORDING TO NEC 705.12 (A) WITH SERVICE ENTRANCE CONDUCTORS IN ACCORDANCE WITH NEC 230.42

2.7.8 BACKFEEDING BREAKER FOR ELECTRIC POWER SOURCES OUTPUT IS EXEMPT FROM ADDITIONAL FASTENING [NEC 705.12 (B)(5)].

CONTRACTOR



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PROJECT NAME & ADDRESS  
JOSHUA HOPKINS  
  
347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

SHEET TITLE  
NOTES

DRAWN DATE6/24/2022

DRAWN BYJVK

SHEET NUMBER  
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TOTAL HOME SQUARE FOOTAGE IS: 3888.45 FT<sup>2</sup>  
TOTAL ARRAY SQUARE FOOTAGE IS: 635.39 FT<sup>2</sup>  
% COVERED BY SOLAR IS: 16.34%

(29) CANADIAN SOLAR INC. CS3N-395MS  
(29) ENPHASE IQ8PLUS-72-2-US

ADDRESS : 347 BEDROCK STREET  
CITY ZIP : LAKE CITY, FL 32024  
METER NO: 154 738 290

DC SIZE 29 X 395W = 11.455 kW DC-STC  
AC SIZE 29X 290W = 8.410 kW AC

CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 kW DC-(STC)  
AC SIZE: 8.410 kW AC



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1011 N. CAUSEWAY BLVD. STE 19  
MANDEVILLE, LA 70471  
985.624.5001  
INFO@PI-AEC.COM  
FLORIDA FIRM NO. 30649

SHEET TITLE

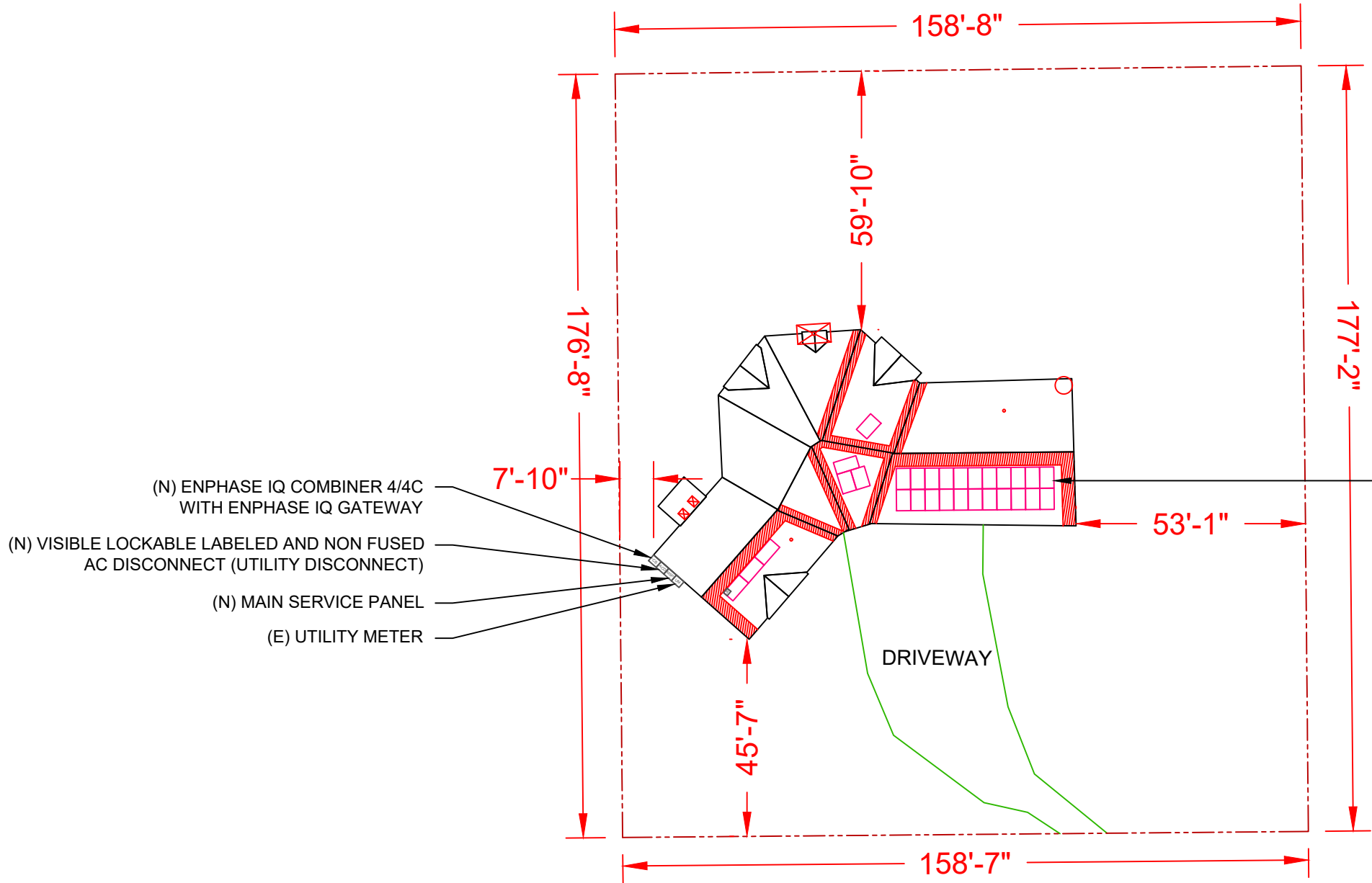
**SITE PLAN**

DRAWN DATE 6/24/2022

DRAWN BY JVK

SHEET NUMBER

**A-101**



29 CANADIAN SOLAR INC. CS3N-395MS MODULES WITH  
ENPHASE IQ8PLUS-72-2-US MICROINVERTERS UNDER  
EACH MODULE (240V)

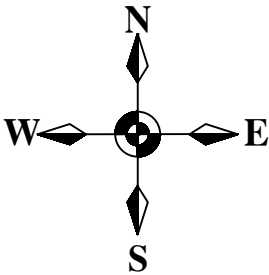
(N) ENPHASE IQ COMBINER 4/4C  
WITH ENPHASE IQ GATEWAY  
(N) VISIBLE LOCKABLE LABELED AND NON FUSED  
AC DISCONNECT (UTILITY DISCONNECT)  
(N) MAIN SERVICE PANEL  
(E) UTILITY METER

DRIVEWAY

BEDROCK STREET

LEGEND

- FIRE SETBACK
- PROPERTY LINE
- JUNCTION BOX
- SKYLIGHT (ROOF OBSTRUCTION)
- CHIMNEY (ROOF OBSTRUCTION)
- VENT, ATTIC FAN (ROOF OBSTRUCTION)



1 | SITE PLAN  
SCALE: 1/32" = 1'-0"

ROOF SECTION(S)

ROOF 1	TILT - 26° AZIMUTH - 181° MODULE - 22 SYSTEM SIZE (KW)- 8.69
ROOF 2	TILT - 26° AZIMUTH - 42° MODULE - 1 SYSTEM SIZE (KW)- 0.40
ROOF 3	TILT - 30° AZIMUTH - 163° MODULE - 3 SYSTEM SIZE (KW)- 1.19
ROOF 4	TILT - 26° AZIMUTH - 131° MODULE - 3 SYSTEM SIZE (KW)- 1.19

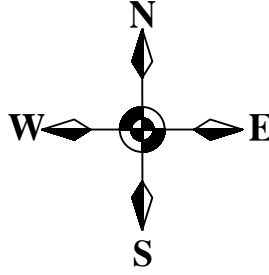
- ① - MODULE STRING
- ② - MODULE STRING
- ③ - MODULE STRING

LEGEND

- FIRE SETBACK
- PROPERTY LINE
- JB

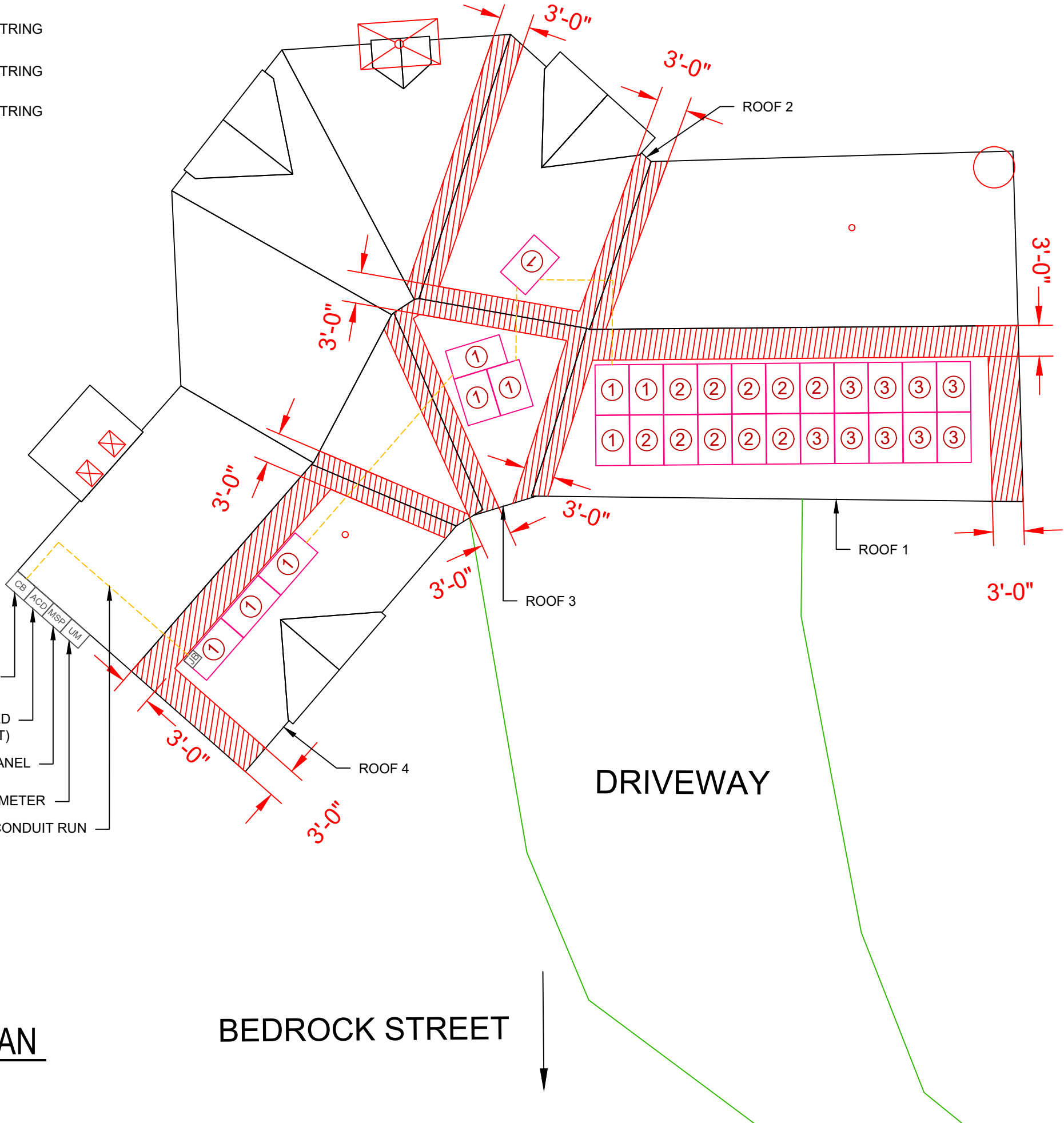
 - JUNCTION BOX
- SKYLIGHT (ROOF OBSTRUCTION)
- CHIMNEY (ROOF OBSTRUCTION)
- VENT, ATTIC FAN (ROOF OBSTRUCTION)

- (N) ENPHASE IQ COMBINER 4/4C  
WITH ENPHASE IQ GATEWAY
- (N) VISIBLE LOCKABLE LABELED AND NON FUSED  
AC DISCONNECT (UTILITY DISCONNECT)
- (N) MAIN SERVICE PANEL
- (E) UTILITY METER
- (N) CONDUIT RUN



1 | ELECTRICAL PLAN

SCALE:3/32" = 1'-0"



CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

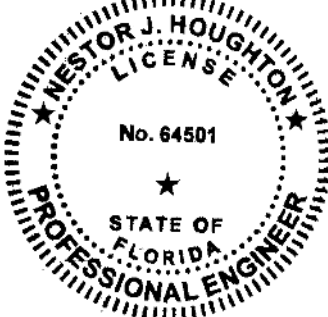
PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



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985.624.5001  
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FLORIDA FIRM NO. 30649

SHEET TITLE

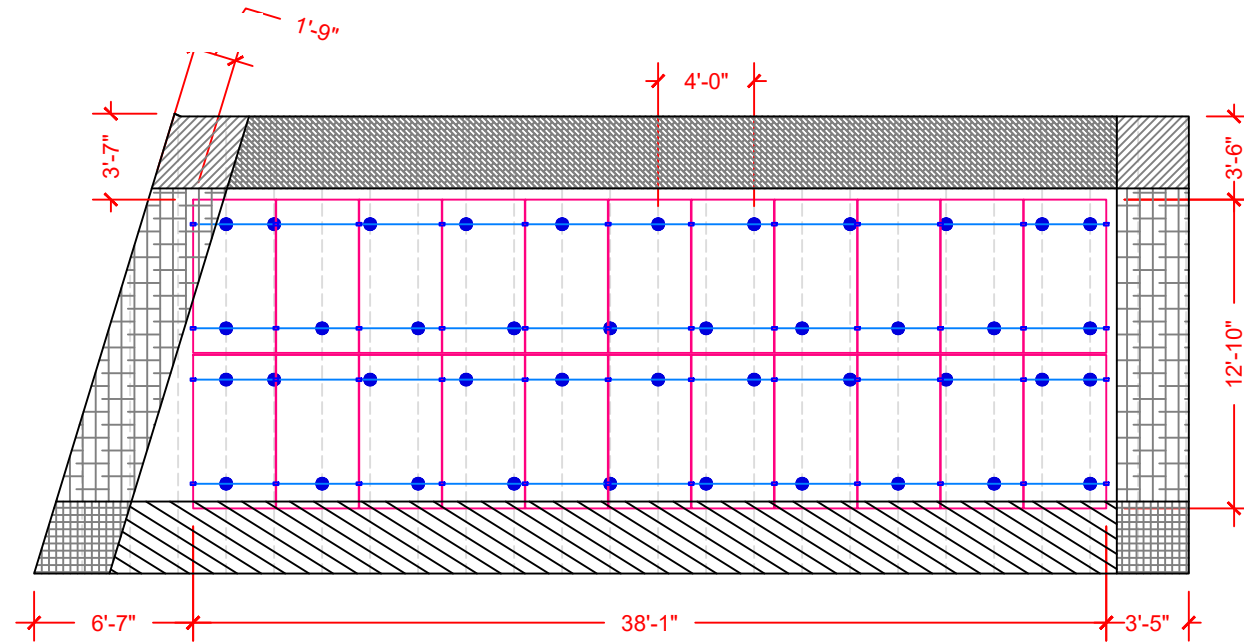
ELECTRICAL PLAN

DRAWN DATE 6/24/2022

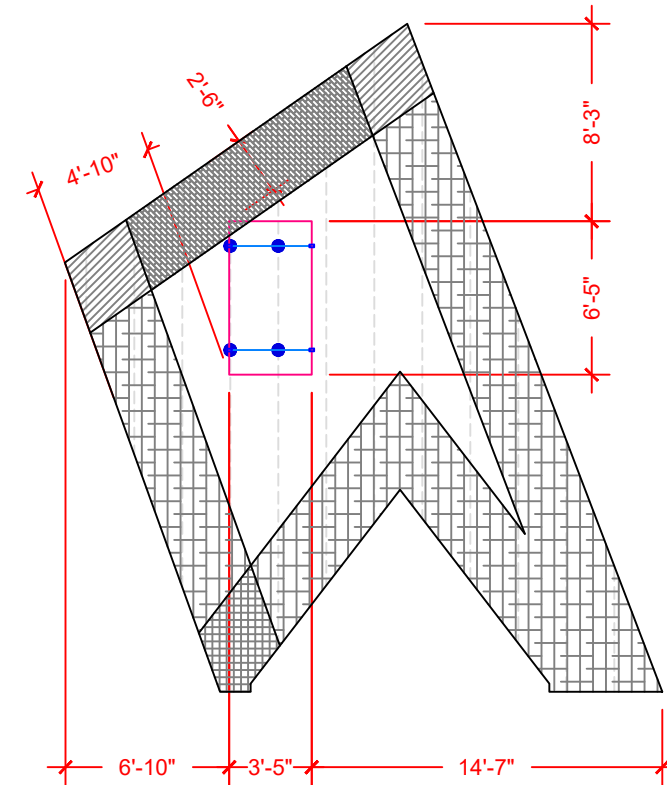
DRAWN BY JVK

SHEET NUMBER

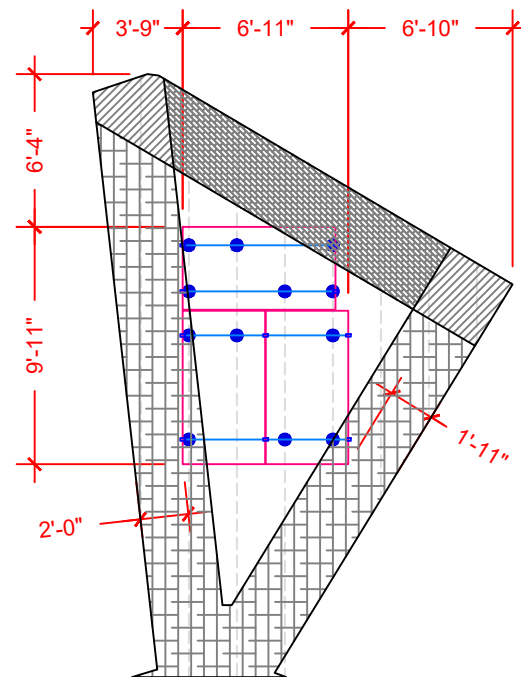
A-102



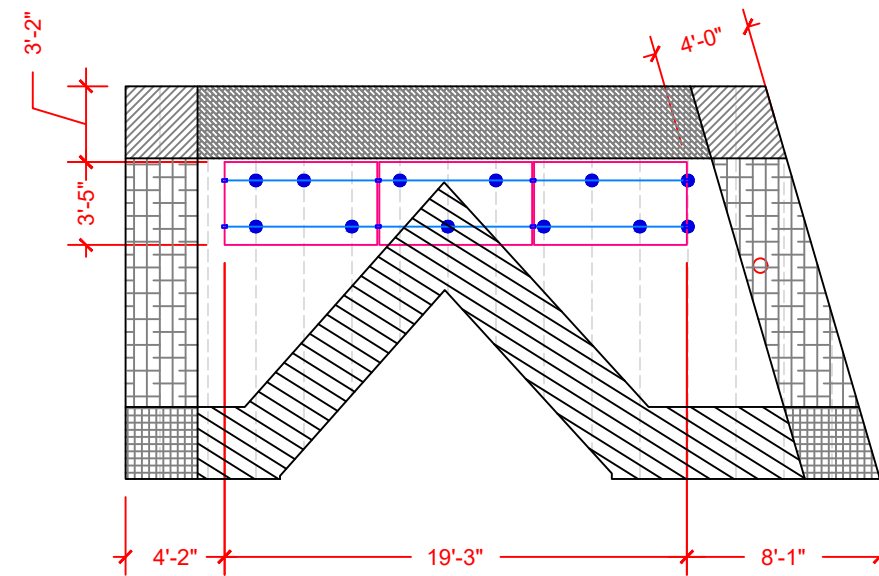
ARRAY 1  
TILT- 26 DEG  
AZIMUTH - 181 DEG







ARRAY 2  
TILT- 26 DEG  
AZIMUTH - 42 DEG



ARRAY 3  
TILT- 30 DEG  
AZIMUTH - 163 DEG



ARRAY 4  
TILT- 26 DEG  
AZIMUTH - 131 DEG

-  - CLAMP
-  - UNIRAC FLASHLOC
-  - RAIL
-  - RAFTER

70 - TOTAL MOUNT

Note 1: Windspeed value is design 3-sec gust in accordance with ASCE 7-16

Note 2: a) Lag bolt shall be mounted into rafters

b) Notify Engineer immediately if conditions differ or prevent installation per plan.

Note 3: These drawings were prepared under my supervision. I have researched the code and to the best of my knowledge And belief, these drawings comply with the 2020 Florida Building Code.

Note 4: Installer shall adjust mount spacing by zone to match prescribed values on engineer's calculation letter

Note 5: Maximum rail cantilever distance beyond outermost mount is One-third the zone-specific mount spacing.

# 1 | ATTACHMENT PLAN

SCALE: 1/8"=1'-0"

## CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

## PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

## SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



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MANDEVILLE, LA 70471  
985.624.5001  
INFO@PI-AEC.COM  
FLORIDA FIRM NO. 30649

## SHEET TITLE

ATTACHMENT PLAN

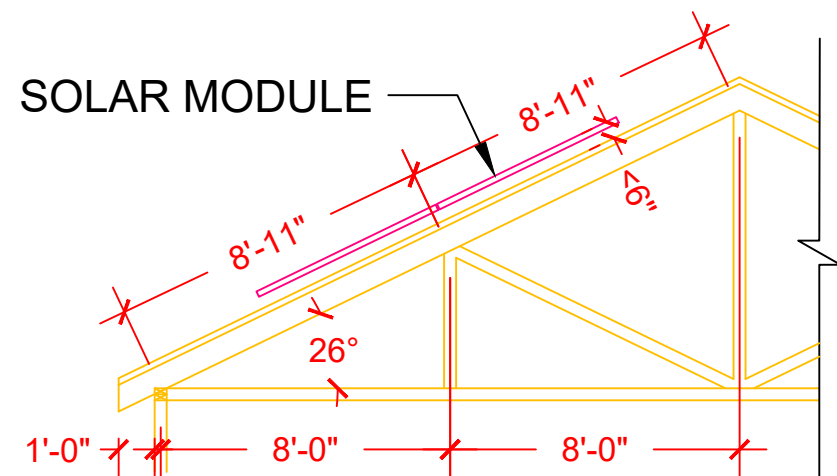
DRAWN DATE 6/24/2022

DRAWN BY JVK

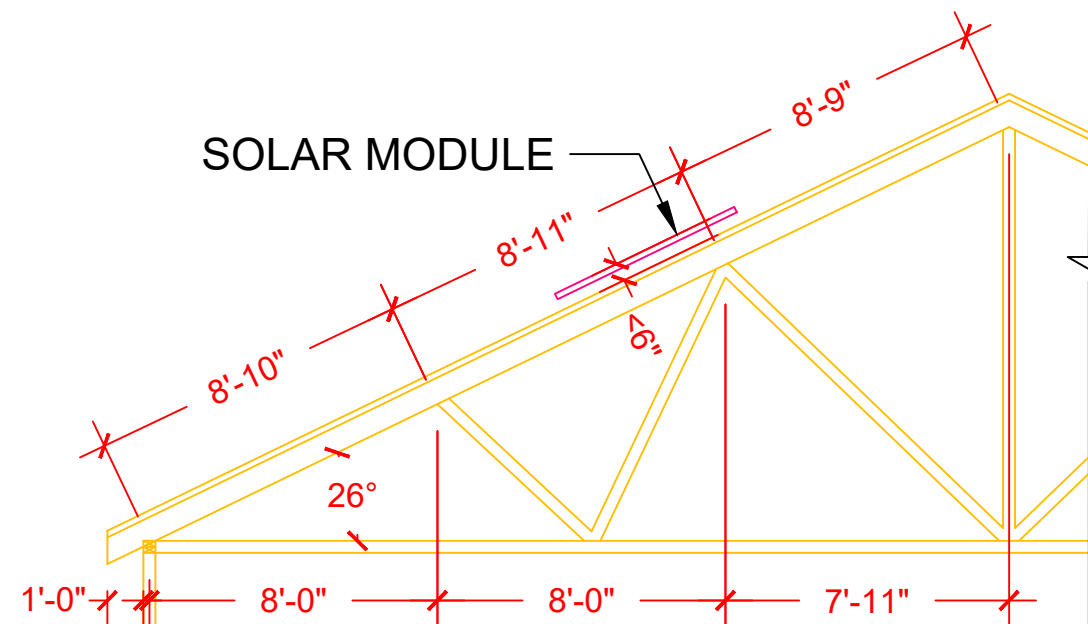
## SHEET NUMBER

A-103

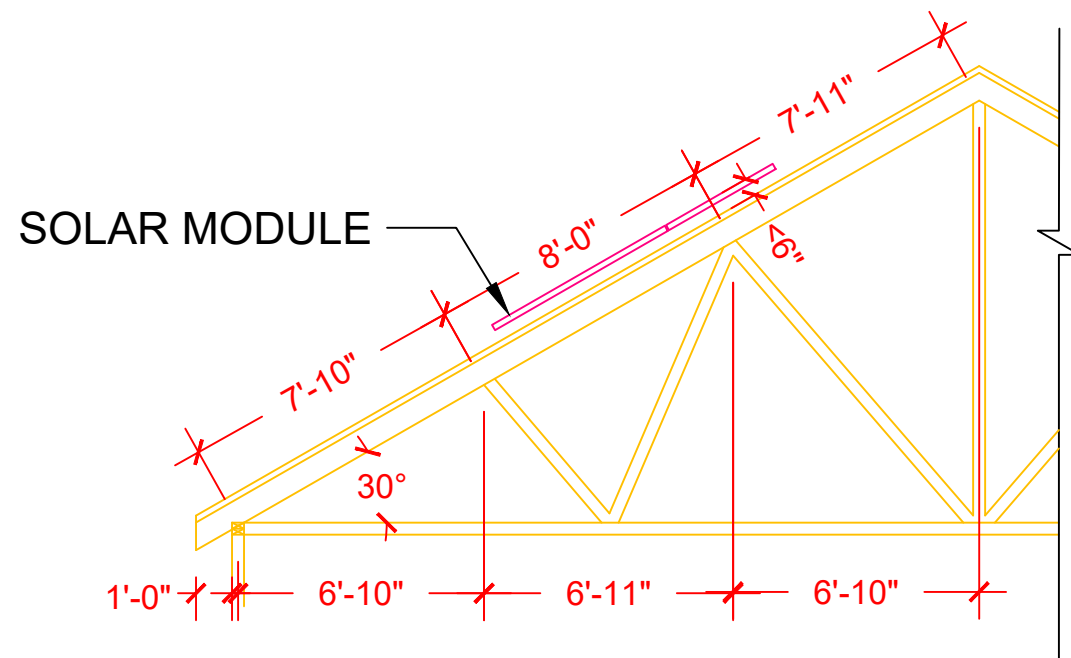




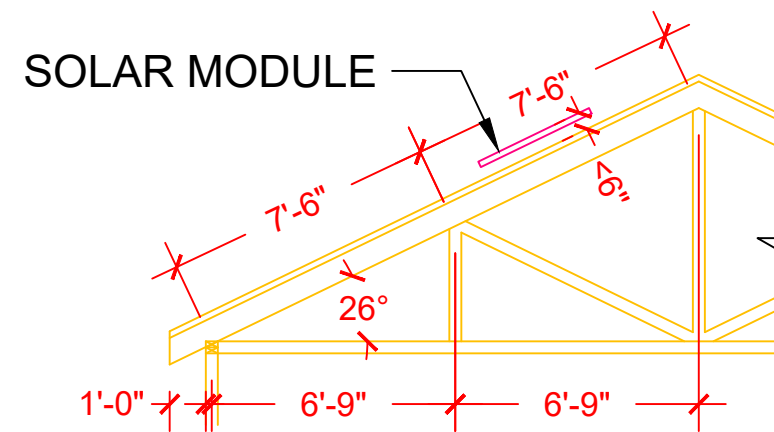
**ROOF 1**



**ROOF 2**



**ROOF 3**



**ROOF 4**

**ROOF SECTION(S)**

ROOF 1	ROOF MATERIAL - COMPOSITE SHINGLE TRUSS SIZE - 2"X4" O.C. SPACING - 24"
ROOF 2	ROOF MATERIAL - COMPOSITE SHINGLE TRUSS SIZE - 2"X4" O.C. SPACING - 24"
ROOF 3	ROOF MATERIAL - COMPOSITE SHINGLE TRUSS SIZE - 2"X4" O.C. SPACING - 24"
ROOF 4	ROOF MATERIAL - COMPOSITE SHINGLE TRUSS SIZE - 2"X4" O.C. SPACING - 24"

**CONTRACTOR**



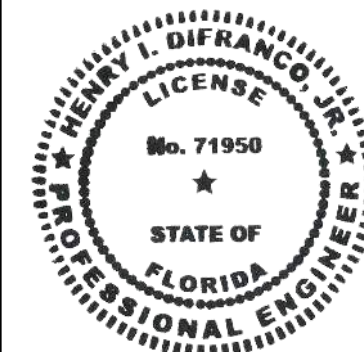
22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

**PROJECT NAME & ADDRESS**

JOSHUA HOPKINS  
**347 BEDROCK STREET,  
LAKE CITY,  
FL 32024**  
COUNTY:-COLUMBIA COUNTY

**SYSTEM SIZE**

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



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INFO@PI-AEC.COM  
FLORIDA FIRM NO. 30649

**SHEET TITLE**

**STRUCTURAL PLAN**

DRAWN DATE 6/24/2022

DRAWN BY JVK

**SHEET NUMBER**

**A-104**

All dimensions and information provided by Sunpro inspection.

**1 | STRUCTURAL PLAN**

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



SOLAR MODULE SPECIFICATIONS	
MANUFACTURER / MODEL #	CANADIAN SOLAR INC. CS3N-395MS
VMP	37V
IMP	10.68A
VOC	44.3V
ISC	11.44A
TEMP. COEFF. VOC	-0.26%/°C
MODULE DIMENSION	76.4"L x 41.3"W x 1.4"D (In Inch)

INVERTER SPECIFICATIONS	
MANUFACTURER / MODEL #	ENPHASE IQ8PLUS-72-2-US MICROINVERTER
MIN/MAX DC VOLT RATING	30V MIN/ 58V MAX
MAX INPUT POWER	235W-440W
NOMINAL AC VOLTAGE RATING	240V/ 211-264V
MAX AC CURRENT	1.21A
MAX MODULES PER STRING	13 (SINGLE PHASE)
MAX OUTPUT POWER	290 VA

DC SIZE 29 X 395W = 11.455 kW DC-STC  
AC SIZE 29X 290W = 8.410 kW AC

WIRE /CONDUIT SCHEDULE	
TAG	DESCRIPTION
1	(3) #10/2 ROMEX IN ATTIC/(6) #10 THWN-2 ON EXTERIOR & (1)#10 THWN -2 / (GN)
2	(3) #6 THWN-2 & (1)#10 THWN-2 GROUND / (GN)
3	(3) #6 THWN-2 & (1)#10 THWN-2 GROUND / (GN)
4	(3) #2/0 THWN-2 / (GN)
5	(1)#6 BARE GROUND

(GN) GENERAL CONDUIT NOTE :  
CONDUIT TO BE UL LISTED FOR WET LOCATIONS AND UV PROTECTED (EX. -EMT,SCH 80 PVC OR RMC)\*FMC MAYBE USED IN INDOOR APPLICATIONS WHERE PERMITTED BY NEC ART .348

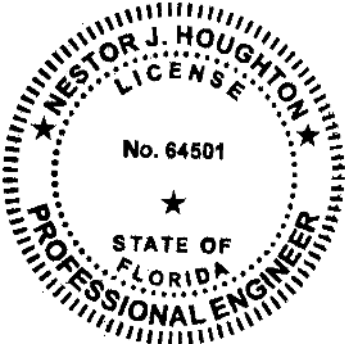
CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS  
JOSHUA HOPKINS  
347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE  
DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



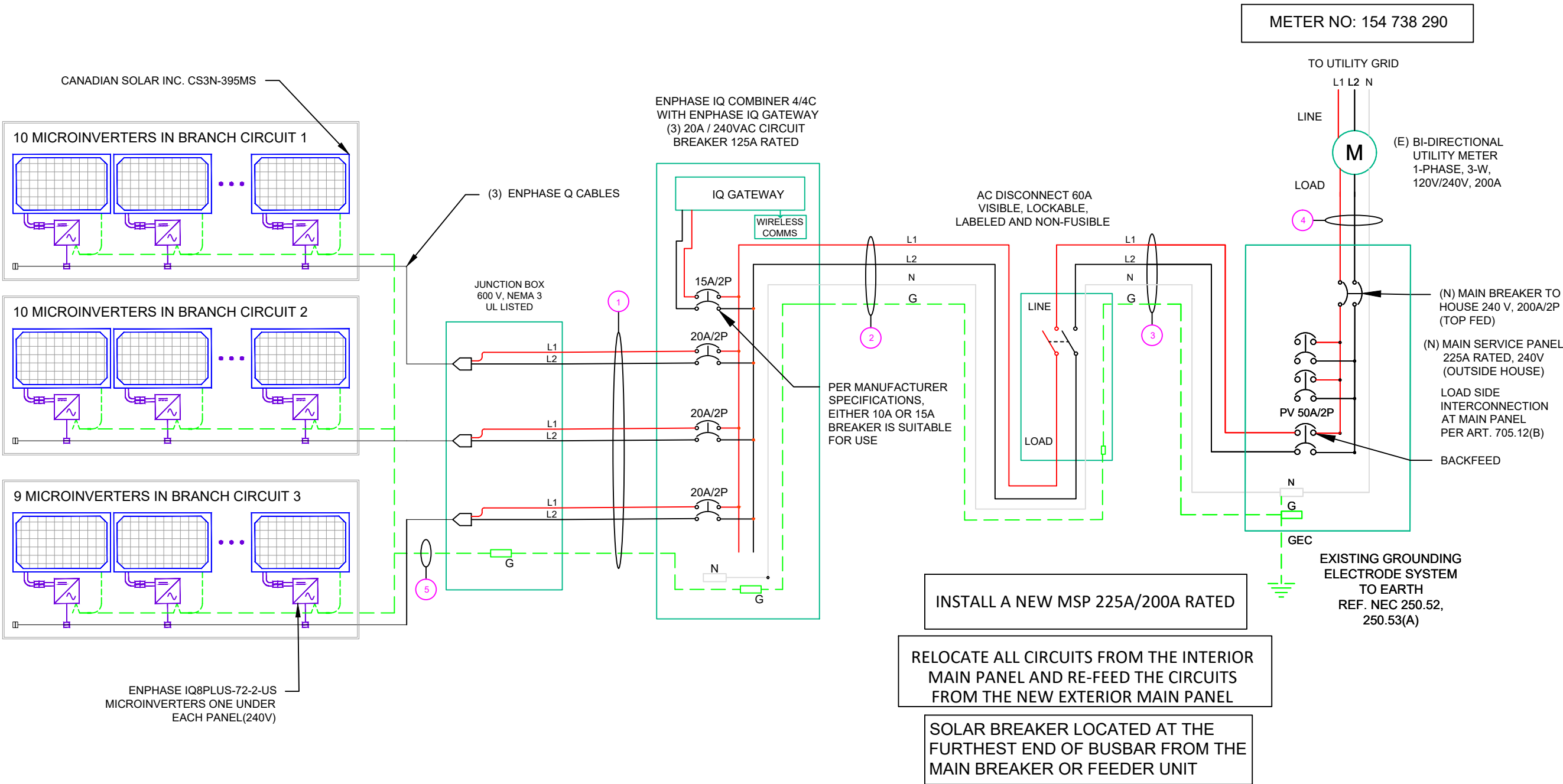
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MANDEVILLE, LA 70471  
985.624.5001  
INFO@PI-AEC.COM  
FLORIDA FIRM NO. 30649

SHEET TITLE  
LINE DIAGRAM

DRAWN DATE 6/24/2022  
DRAWN BY JVK

SHEET NUMBER  
E-601



AMBIENT TEMPERATURE SPECS	
RECORD LOW TEMP	-6°
AMBIENT TEMP (HIGH TEMP 2%)	35°
CONDUIT HEIGHT	0.5"
CONDUCTOR TEMPERATURE RATE	90°

PERCENT OF VALUES	NUMBER OF CURRENT CARRYING CONDUCTORS
.80	4-6
.70	7-9
.50	10-20

### CALCULATIONS:

#### 1. CURRENT CARRYING CONDUCTOR

##### (A) BEFORE IQ COMBINER 4/4C PANEL

AMBIENT TEMPERATURE - (35)°C ...NEC 310.15(B)(3)(c)  
 TEMPERATURE DERATE FACTOR - 0.96 ...NEC 310.15(B)(2)(a)  
 GROUPING FACTOR - 0.8...NEC 310.15(B)(3)(a)

##### CONDUCTOR AMPACITY

= (INV O/P CURRENT ) x 1.25 / A.T.F / G.F ...NEC 690.8(B)  
 = [(10 x 1.21) x 1.25] / [0.96 x 0.8]  
 = 19.69A

SELECTED CONDUCTOR - #10 THWN-2 ...NEC 310.15(B)(16)

##### (B) AFTER IQ COMBINER 4/4C PANEL

TEMPERATURE DERATE FACTOR - 0.96  
 GROUPING FACTOR - 1

##### CONDUCTOR AMPACITY

= (TOTAL INV O/P CURRENT) x 1.25 / 0.96/ 1 ...NEC 690.8(B)  
 = [(29 x 1.21) x 1.25] / [0.96 x 1]  
 = 45.69 A

SELECTED CONDUCTOR - #6 THWN-2 ...NEC 310.15(B)(16)


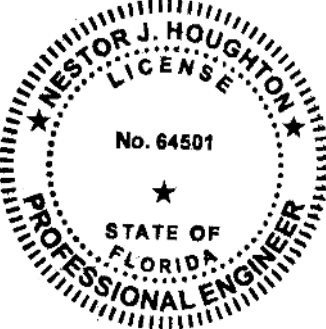
#### 2. PV OVER CURRENT PROTECTION ...NEC 690.9(B)

= TOTAL INVERTER O/P CURRENT x 1.25  
 = (29 x 1.21) x 1.25 = 43.86 A  
 SELECTED OCPD = 50 A ...NEC 240.6

#### 3. 120% RULE FOR BACKFEED BREAKER

...NEC 705.12(B)(2)(3)(b)

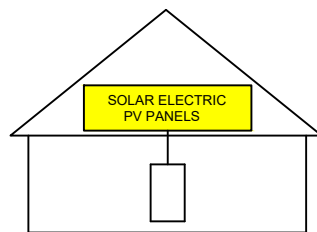
MCB + PV BREAKER <= (1.2 x BUS BAR  
 RATING RATING RATING)  
 (200 + 50) <= 1.2 x 225A  
 250.00 <= 270.00 HENCE OK

<b>CONTRACTOR</b>	
	
22171 MCH RD MANDEVILLE, LA 70471 PHONE: 9152011490	
PROJECT NAME & ADDRESS JOSHUA HOPKINS  347 BEDROCK STREET, LAKE CITY, FL 32024 COUNTY:-COLUMBIA COUNTY	
<b>SYSTEM SIZE</b> DC SIZE: 11.455 KW DC-(STC) AC SIZE: 8.410 KW AC	
	
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<b>SHEET TITLE</b> <b>ELECTRICAL</b> <b>CALCULATIONS</b>	
DRAWN DATE	6/24/2022
DRAWN BY	JVK
<b>SHEET NUMBER</b> <b>E-602</b>	

**WARNING: PHOTOVOLTAIC  
POWER SOURCE**

## 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



## AC DISCONNECT

**WARNING**  
**ELECTRIC SHOCK HAZARD**

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

**PHOTOVOLTAIC SYSTEM  
AC DISCONNECT**

OPERATING VOLTAGE: \_\_\_\_ VOLTS  
OPERATING CURRENT: \_\_\_\_ AMPS

**SOLAR  
BREAKER**

## AC COMBINER BOX

PHOTOVOLTAIC  
MICROINVERTERS  
LOCATED UNDER  
EACH PV MODULE IN  
ROOFTOP ARRAY

PHOTOVOLTAIC SYSTEM  
EQUIPPED WITH  
RAPID SHUTDOWN

RATED AC OUTPUT CURRENT: \_\_\_\_  
NOM. OPERATING VOLTAGE: \_\_\_\_

**WARNING**  
**DUAL POWER SOURCES**

SOURCES: UTILITY GRID AND PV  
SOLAR ELECTRIC SYSTEM

\_\_\_\_ KW SOLAR  
DISCONNECT LOCATED

\_\_\_\_ FT ←

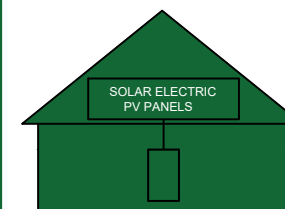
→ FT \_\_\_\_

**WARNING**  
**INVERTER OUTPUT CONNECTION**

DO NOT RELOCATE THIS  
OVERCURRENT DEVICE

**EMERGENCY RESPONDER  
THIS SOLAR PV SYSTEM EQUIPPED  
WITH RAPID SHUTDOWN**

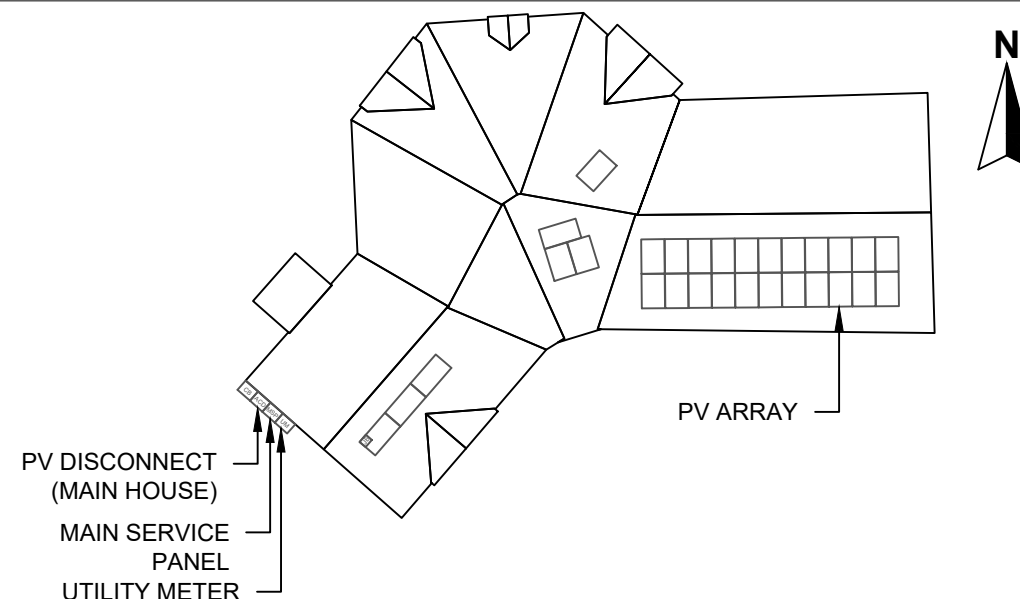
TURN RAPID SHUTDOWN  
SWITCH TO THE 'OFF'  
POSITION TO SHUTDOWN  
ENTIRE PV SYSTEM.



THE LABEL SHALL BE REFLECTIVE, WITH ALL LETTERS CAPITALIZED AND HAVING  
A MINIMUM HEIGHT OF 3/8 IN. (9.5 MM), IN WHITE ON A RED BACKGROUND.

## CAUTION

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



CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS

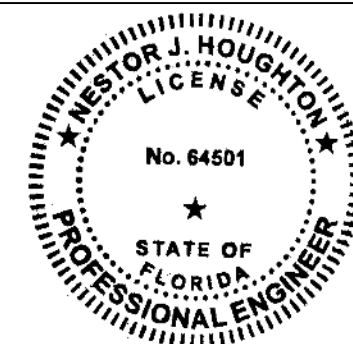
JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC



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MANDEVILLE, LA 70471  
985.624.5001  
INFO@PI-AEC.COM  
FLORIDA FIRM NO. 30649

SHEET TITLE

**PLACARD**

DRAWN DATE 6/24/2022

DRAWN BY JVK

SHEET NUMBER

**E-603**





**HiKuBlack Mono PERC**  
**BLACK FRAME ON BLACK BACKSHEET**  
**F23 Frame**  
**380 W ~ 405 W**  
**CS3N-380 | 385 | 390 | 395 | 400 | 405MS**

**MORE POWER**

- 405 W** Module power up to 405 W  
Module efficiency up to 19.9 %
- \$** Lower LCOE & BOS cost
- Bar Chart** Comprehensive LID / LeTID mitigation technology, up to 50% lower degradation
- Calculator** Better shading tolerance

**MORE RELIABLE**

- Shield** Minimizes micro-crack impacts
- \*\*\*** Heavy snow load up to 8100 Pa, enhanced wind load up to 6000 Pa\*

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

**CSI SOLAR (USA) CO., LTD.**  
1350 Treat Blvd. Suite 500, Walnut Creek, CA 94598, USA | [www.csisolar.com/na](http://www.csisolar.com/na) | [service.ca@csisolar.com](mailto:service.ca@csisolar.com)

**25 Years** Industry Leading Product Warranty on Materials and Workmanship\*

**25 Years** Linear Power Performance Warranty\*

**1<sup>st</sup> year power degradation no more than 2%**  
**Subsequent annual power degradation no more than 0.55%**

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

**MANAGEMENT SYSTEM CERTIFICATES\***

ISO 9001: 2015 / Quality management system  
ISO 14001: 2015 / Standards for environmental management system  
ISO 45001: 2018 / International standards for occupational health & safety

**PRODUCT CERTIFICATES\***

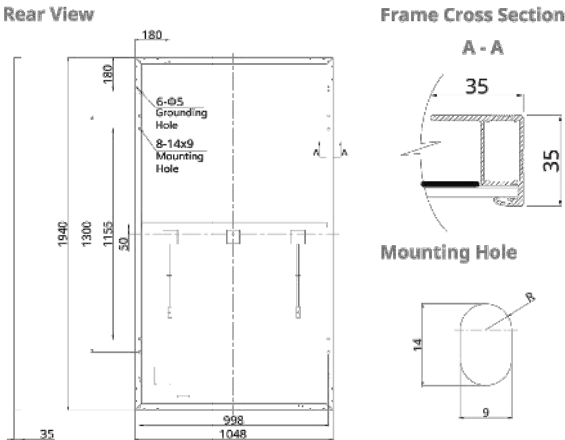
IEC 61215 / IEC 61730 / CE  
FSEC (US Florida) / UL 61730 / IEC 61701 / IEC 62716



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

**CSI SOLAR (USA) CO., LTD.** is committed to providing high quality solar photovoltaic modules, solar energy and battery storage solutions to customers. The company was recognized as the No. 1 module supplier for quality and performance/price ratio in the IHS Module Customer Insight Survey. Over the past 20 years, it has successfully delivered over 63 GW of premium-quality solar modules across the world.

**ENGINEERING DRAWING (mm)**



**ELECTRICAL DATA | STC\***

**CS3N**                      **380MS** **385MS** **390MS** **395MS** **400MS** **405MS**

Nominal Max. Power (Pmax)	380 W	385 W	390 W	395 W	400 W	405 W
Opt. Operating Voltage (Vmp)	36.4 V	36.6 V	36.8 V	37.0 V	37.2 V	37.4 V
Opt. Operating Current (Imp)	10.44 A	10.52 A	10.60 A	10.68 A	10.76 A	10.83 A
Open Circuit Voltage (Voc)	43.7 V	43.9 V	44.1 V	44.3 V	44.5 V	44.7 V
Short Circuit Current (Isc)	11.26 A	11.32 A	11.38 A	11.44 A	11.50 A	11.56 A
Module Efficiency	18.7%	18.9%	19.2%	19.4%	19.7%	19.9%

Operating Temperature	-40°C ~ +85°C
Max. System Voltage	1000V (UL)
Module Fire Performance	TYPE 2 (UL 61730 1000V)
Max. Series Fuse Rating	20 A
Application Classification	Class A
Power Tolerance	0 ~ + 10 W

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

**ELECTRICAL DATA | NMOT\***

**CS3N**                      **380MS** **385MS** **390MS** **395MS** **400MS** **405MS**

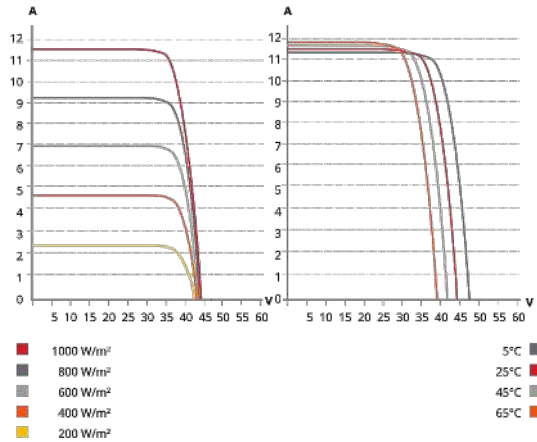
Nominal Max. Power (Pmax)	284 W	288 W	291 W	295 W	299 W	303 W
Opt. Operating Voltage (Vmp)	34.0 V	34.2 V	34.4 V	34.6 V	34.7 V	34.9 V
Opt. Operating Current (Imp)	8.35 A	8.42 A	8.48 A	8.54 A	8.60 A	8.66 A
Open Circuit Voltage (Voc)	41.2 V	41.4 V	41.6 V	41.8 V	41.9 V	42.1 V
Short Circuit Current (Isc)	9.08 A	9.13 A	9.18 A	9.23 A	9.28 A	9.33 A

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

\* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. CSI Solar Co., Ltd. reserves the right to make necessary adjustment to the information described herein at any time without further notice. Please be kindly advised that PV modules should be handled and installed by qualified people who have professional skills and please carefully read the safety and installation instructions before using our PV modules.

**CSI SOLAR (USA) CO., LTD.**

**CS3N-400MS / I-V CURVES**



**MECHANICAL DATA**

Specification	Data
Cell Type	Mono-crystalline
Cell Arrangement	132 [2 X (11 X 6)]
Dimensions	1940 X 1048 X 35 mm (76.4 X 41.3 X 1.38 in)
Weight	23.4 kg (51.6 lbs)
Front Cover	3.2 mm tempered glass
Frame	Anodized aluminium alloy
J-Box	IP68, 3 bypass diodes
Cable	12 AWG (UL)
Cable Length (Including Connector)	Portrait: 400 mm (15.7 in) (+) / 280 mm (11.0 in) (-) (supply additional cable jumper: 2 lines/pallet); landscape: 1250 mm (49.2 in)*
Connector	T4 or MC4 series
Per Pallet	30 pieces
Per Container (40' HQ)	720 pieces

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

**TEMPERATURE CHARACTERISTICS**

Specification	Data
Temperature Coefficient (Pmax)	-0.34 % / °C
Temperature Coefficient (Voc)	-0.26 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	42 ± 3°C

**PARTNER SECTION**



**CONTRACTOR**



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

**PROJECT NAME & ADDRESS**

**JOSHUA HOPKINS**

**347 BEDROCK STREET,  
LAKE CITY,  
FL 32024**

**COUNTY:-COLUMBIA COUNTY**

**SYSTEM SIZE**

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

**SHEET TITLE  
RESOURCE  
DOCUMENT**

DRAWN DATE    6/24/2022

DRAWN BY       JVK

**SHEET NUMBER**

**R-001**

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DATA SHEET



# IQ8 and IQ8+ 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.



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 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.



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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IQ8SP-DS-0002-01-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 and IQ8+ Microinverters

INPUT DATA (DC)		IQ8-60-2-US		IQ8PLUS-72-2-US	
Commonly used module pairings <sup>1</sup>	W	235 – 350		235 – 440	
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	
Operating range	V	25 – 46		25 – 58	
Min/max start voltage	V	30 / 46		30 / 58	
Max input DC voltage	V	50		60	
Max DC current <sup>2</sup> [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	
Peak output power	VA	245		300	
Max continuous output power	VA	240		290	
Nominal (L-L) voltage/range <sup>3</sup>	V			240 / 211 – 264	
Max continuous output current	A	1.0		1.21	
Nominal frequency	Hz			60	
Extended frequency range	Hz			50 – 68	
Max units per 20 A (L-L) branch circuit <sup>4</sup>		16		13	
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	
CEC weighted efficiency	%	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 1 m		<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/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01  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) No enforced DC/AC ratio. See the compatibility calculator at <https://link.enphase.com/module-compatibility> (2) Maximum continuous input DC current is 10.6A (3) Nominal voltage range can be extended beyond nominal if required by the utility. (4) Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

IQ8SP-DS-0002-01-EN-US-2021-10-19

## CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

## PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

## SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

## SHEET TITLE RESOURCE DOCUMENT

DRAWN DATE 6/24/2022

DRAWN BY JVK

## SHEET NUMBER

R-002

## Enphase IQ Combiner 4/4C

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



To learn more about Enphase offerings, visit [enphase.com](https://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

Ensemble Communications Kit COMMS-CELLMODEM-M1-06 CELLMODEM-M1-06-SP-05 CELLMODEM-M1-06-AT-05	(not included, order separately) - Includes COMMS-KIT-01 and CELLMODEM-M1-06-SP-05 with 5-year Sprint data plan for Ensemble sites - 4G based LTE-M1 cellular modem with 5-year Sprint data plan - 4G based LTE-M1 cellular modem with 5-year AT&T data plan
Circuit Breakers BRK-10A-2-240V BRK-15A-2-240V BRK-20A-2P-240V BRK-15A-2P-240V-B BRK-20A-2P-240V-B	Supports Eaton BR210, BR215, BR220, BR230, BR240, BR250, and BR260 circuit breakers. Circuit breaker, 2 pole, 10A, Eaton BR210 Circuit breaker, 2 pole, 15A, Eaton BR215 Circuit breaker, 2 pole, 20A, Eaton BR220 Circuit breaker, 2 pole, 15A, Eaton BR215B with hold down kit support 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
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) w th 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	• 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](https://enphase.com)

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### CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

### PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024  
COUNTY:-COLUMBIA COUNTY

### SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

## SHEET TITLE RESOURCE DOCUMENT

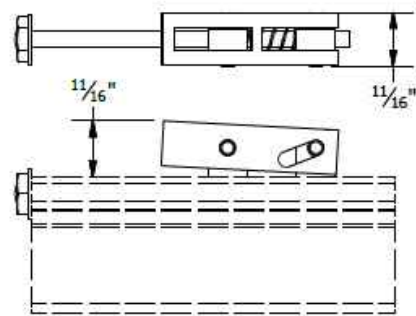
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DRAWN BY	JVK

### SHEET NUMBER

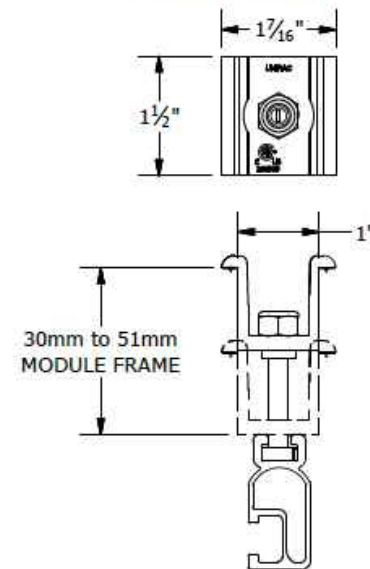
R-003



PRO SERIES END CLAMP

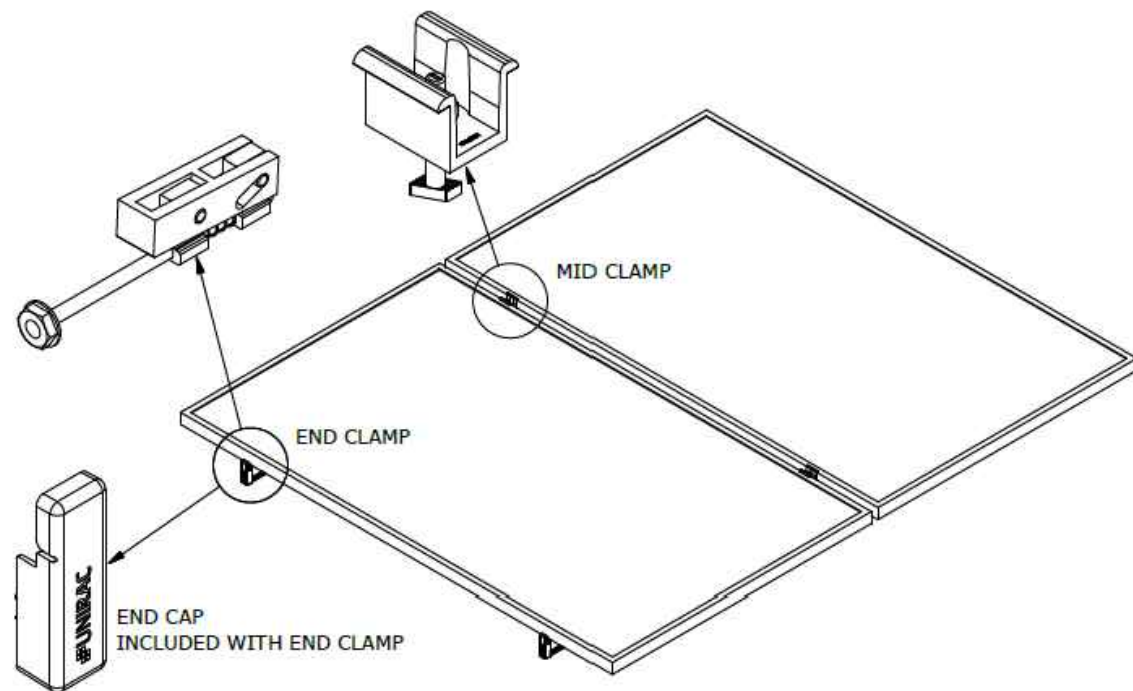


PRO SERIES MID CLAMP



PART # TABLE

P/N	DESCRIPTION
302035M	ENDCLAMP PRO
302030M	MIDCLAMP PRO - MILL
302030D	MIDCLAMP PRO - DRK



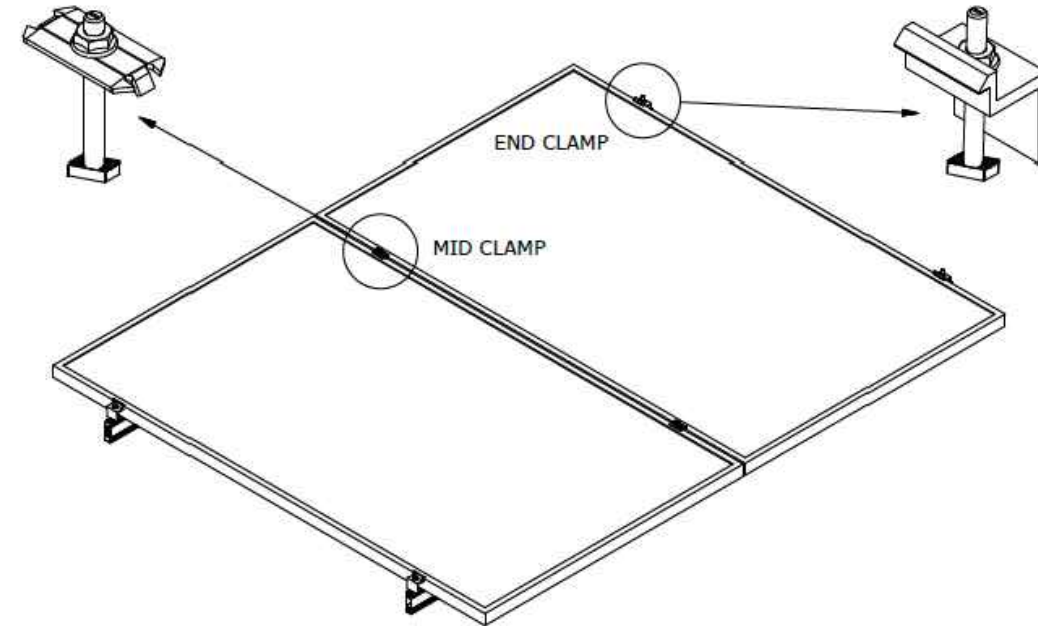
1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	PRO SERIES BONDING CLAMPS
REVISION DATE:	10/26/2017

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE  
NOMINAL

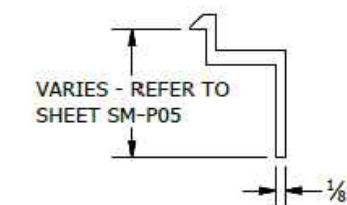
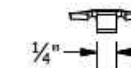
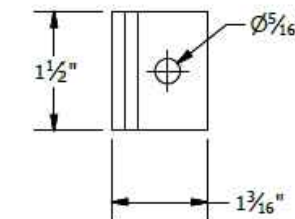
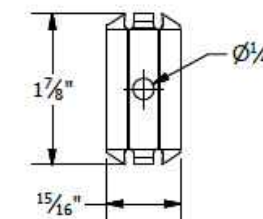
PRODUCT PROTECTED BY  
ONE OR MORE US PATENTS  
LEGAL NOTICE

SM-A01  
SHEET



PART # TABLE

P/N	DESCRIPTION
302027C	SM BND MIDCLAMP BC SS
302027D	SM BND MIDCLAMP BC DRK SS
302028C	SM BND MIDCLAMP EF SS
302028D	SM BND MIDCLAMP EF DRK SS
302029C	SM BND MIDCLAMP DK SS
302029D	SM BND MIDCLAMP DK DRK SS
	FOR BONDING END CLAMP REFER TO SHEET SM-P05



BONDING SM MID CLAMP BONDING SM END CLAMP



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	BONDING TOP CLAMPS
REVISION DATE:	10/26/2017

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SM-A01A  
SHEET

CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

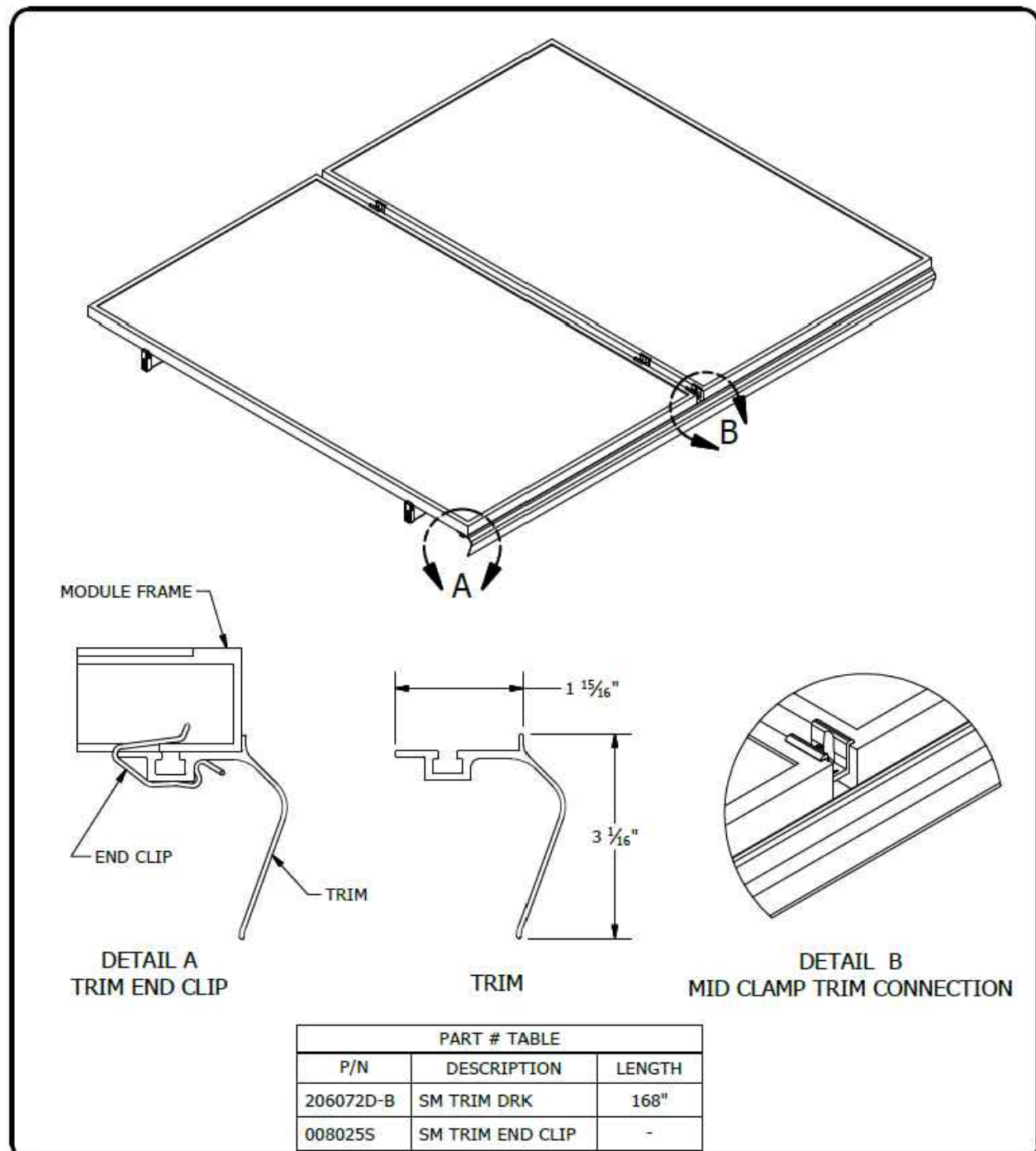
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DOCUMENT**

DRAWN DATE 6/24/2022

DRAWN BY JVK

SHEET NUMBER

R-004



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	SM TRIM END CLIP
REVISION DATE:	9/27/2017

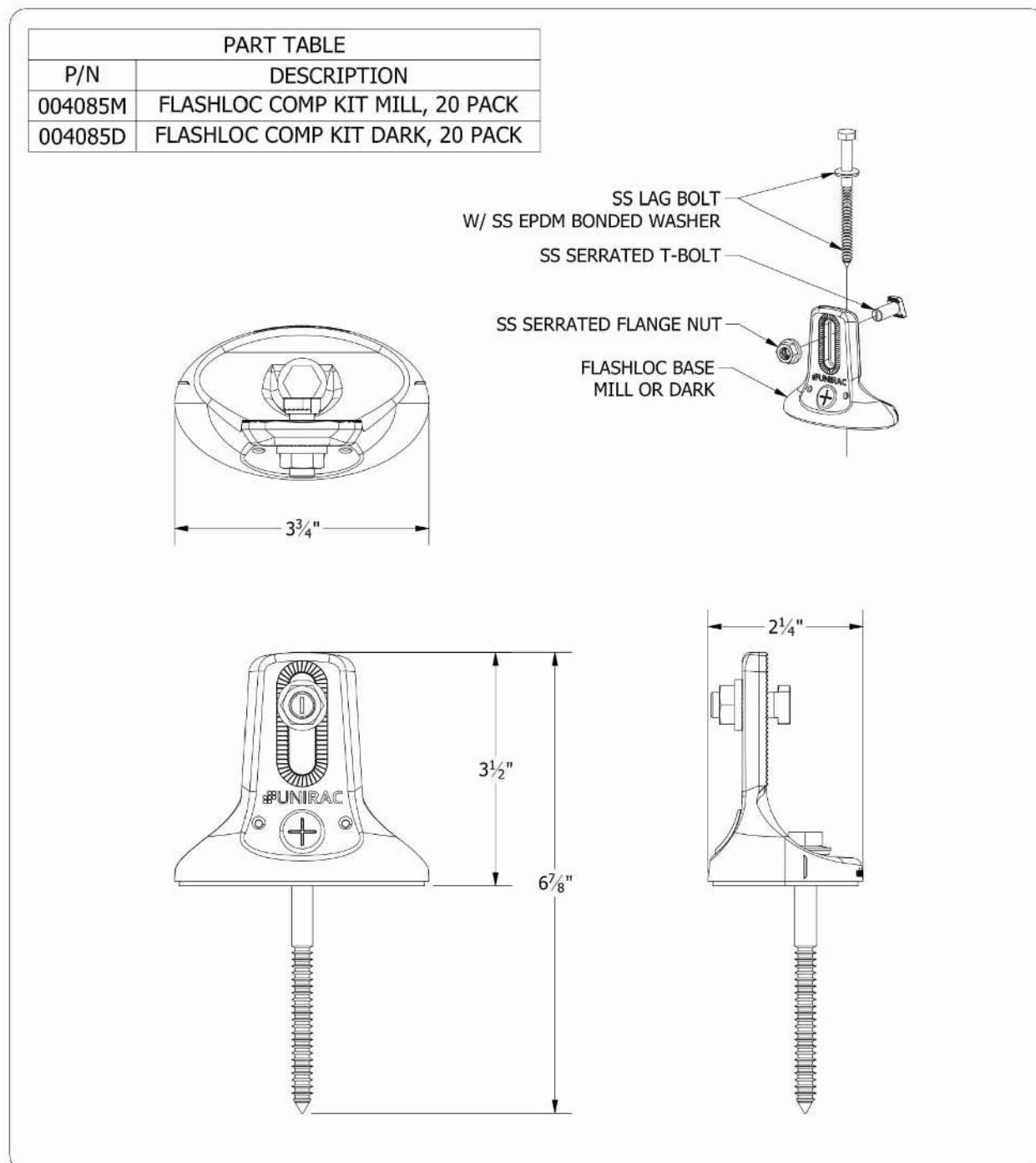
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**SM-A02**

SHEET



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ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART DRAWING
DESCRIPTION:	FLASHLOC COMP KIT
REVISION DATE:	10/3/2019

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**FL-A01**

SHEET

CONTRACTOR

22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)

AC SIZE: 8.410 KW AC

SHEET TITLE

**RESOURCE  
DOCUMENT**

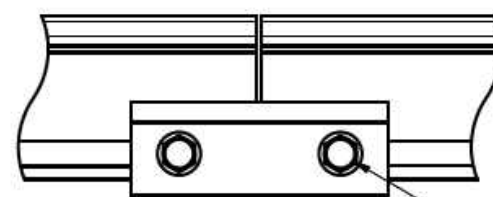
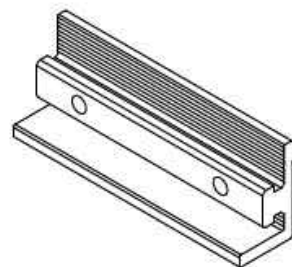
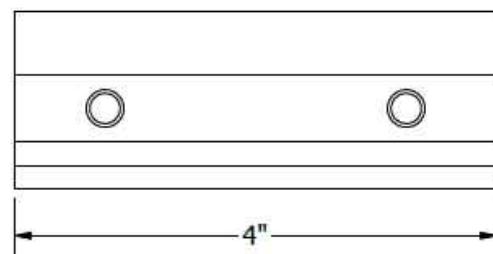
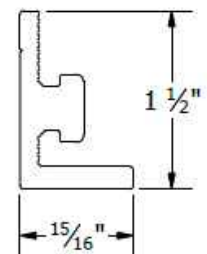
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DRAWN BY	JVK

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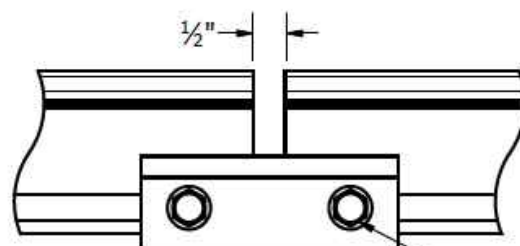


# BONDING SPLICE BAR



TYPICAL SPLICE BAR DETAIL

5/16"-18 TYPE F THREAD CUTTING SCREWS INCLUDED



TYPICAL EXPANSION JOINT DETAIL

NOTE THAT ONLY 2 SCREWS ARE USED AT AN EXPANSION JOINT. THE SPLICE BAR DOES NOT BOND ACROSS AN EXPANSION JOINT. SEE INSTALLATION GUIDE FOR INSTRUCTION.

PART # TABLE

P/N	DESCRIPTION
303019M	BND SPLICE BAR PRO SERIES MILL
303019D	BND SPLICE BAR PRO SERIES DRK



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	BONDING SPLICE BAR PRO SERIES
REVISION DATE:	8/23/2018

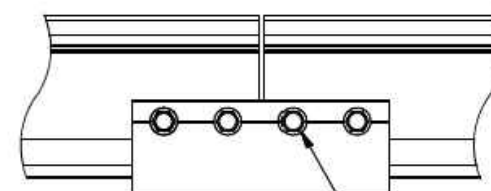
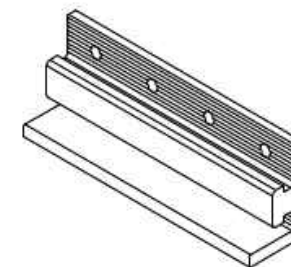
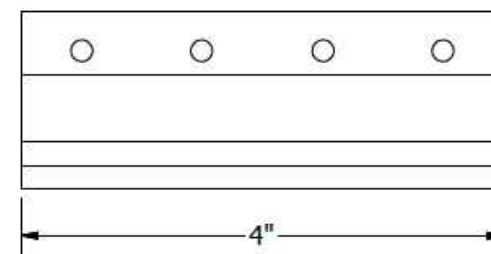
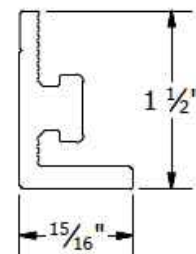
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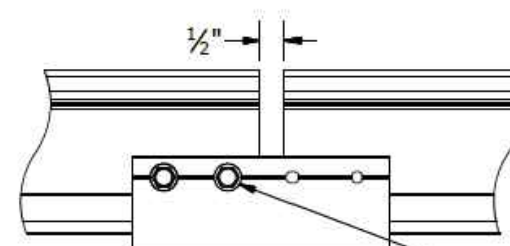
SHEET

# BONDING SPLICE BAR



TYPICAL SPLICE BAR DETAIL

#12 X 3/4" SELF DRILLING SS SCREWS INCLUDED



TYPICAL EXPANSION JOINT DETAIL

NOTE THAT ONLY 2 SCREWS ARE USED AT AN EXPANSION JOINT. THE SPLICE BAR DOES NOT BOND ACROSS AN EXPANSION JOINT. SEE INSTALLATION GUIDE FOR INSTRUCTION.

PART # TABLE

P/N	DESCRIPTION
303018C	BND SPLICE BAR SERRATED CLR
303018D	BND SPLICE BAR SERRATED DRK



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	BONDING SPLICE BAR
REVISION DATE:	9/27/2017

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SHEET

## CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

## PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

## SYSTEM SIZE

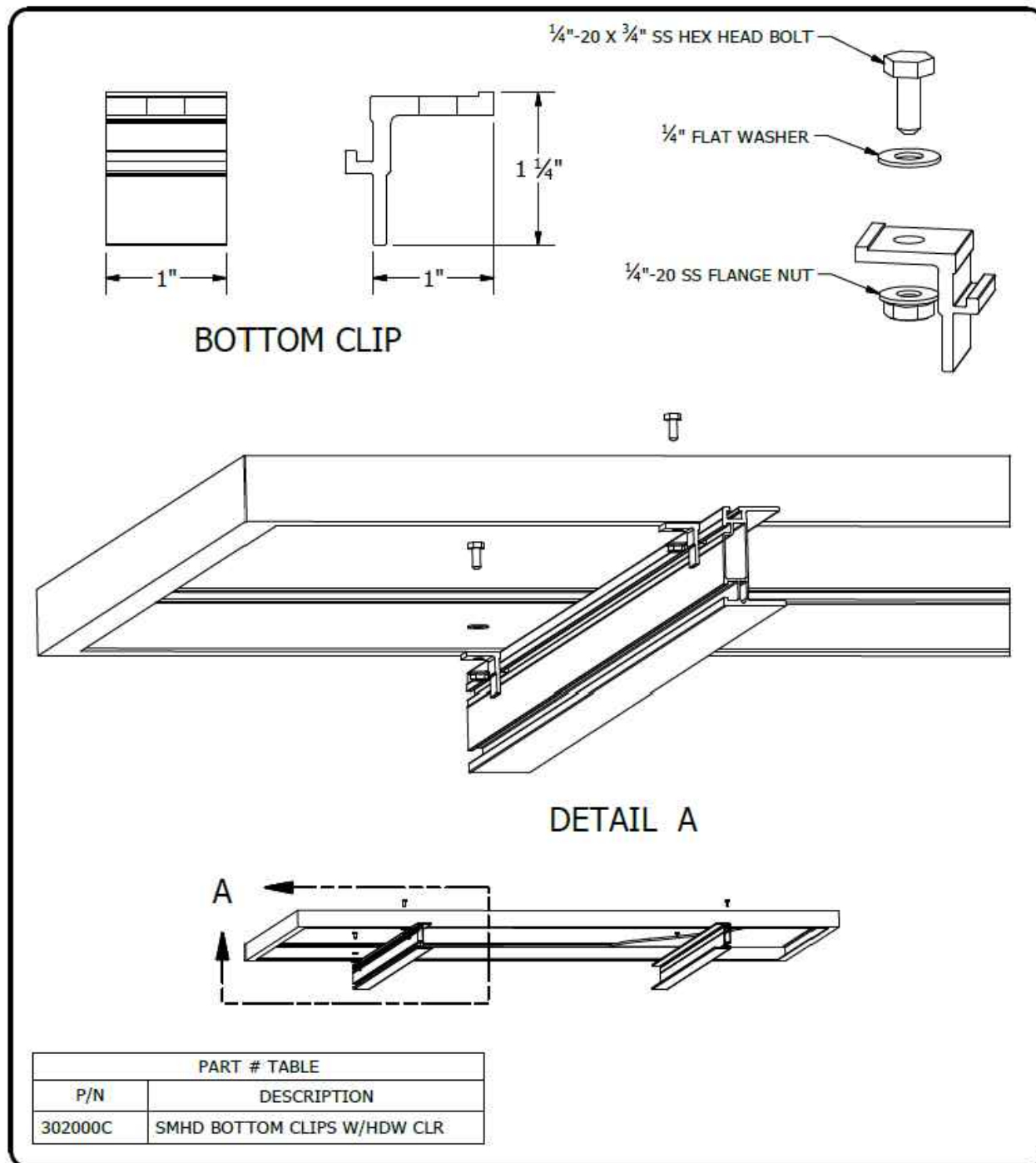
DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

## SHEET TITLE RESOURCE DOCUMENT

DRAWN DATE	6/24/2022
DRAWN BY	JVK

## SHEET NUMBER

R-006



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT HD
DRAWING TYPE:	PART & ASSEMBLY
DESCRIPTION:	BOTTOM CLIP
REVISION DATE:	9/27/2017

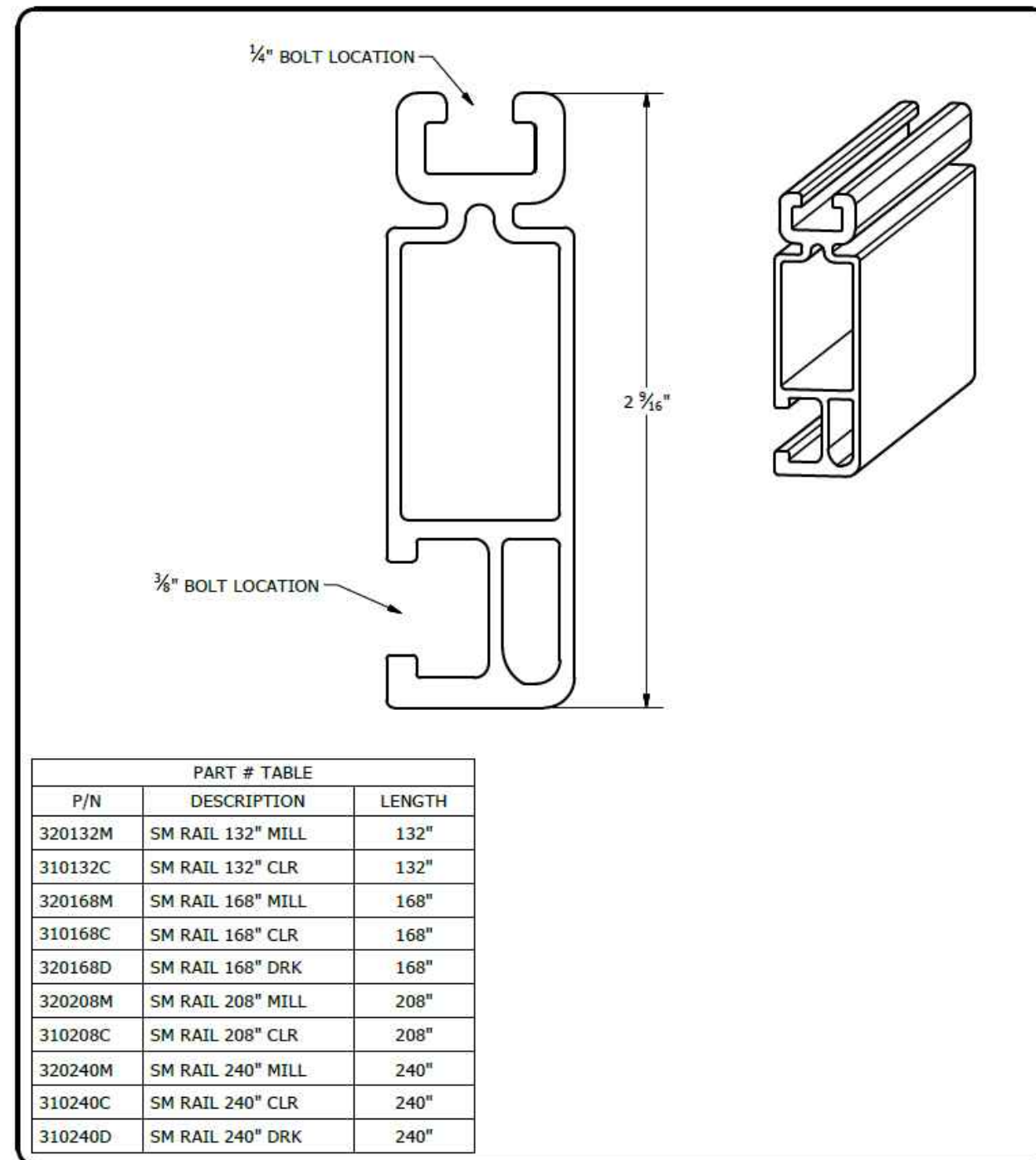
DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE  
NOMINAL

PRODUCT PROTECTED BY  
ONE OR MORE US PATENTS

LEGAL NOTICE

**SM-A10**

SHEET



1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE:	SOLARMOUNT
DRAWING TYPE:	PART DETAIL
DESCRIPTION:	STANDARD RAIL
REVISION DATE:	9/11/2017

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE  
NOMINAL

PRODUCT PROTECTED BY  
ONE OR MORE US PATENTS

LEGAL NOTICE

**SM-P01**

SHEET

CONTRACTOR

22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS

JOSHUA HOPKINS

347 BEDROCK STREET,  
LAKE CITY,  
FL 32024

COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE

DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

SHEET TITLE

**RESOURCE  
DOCUMENT**

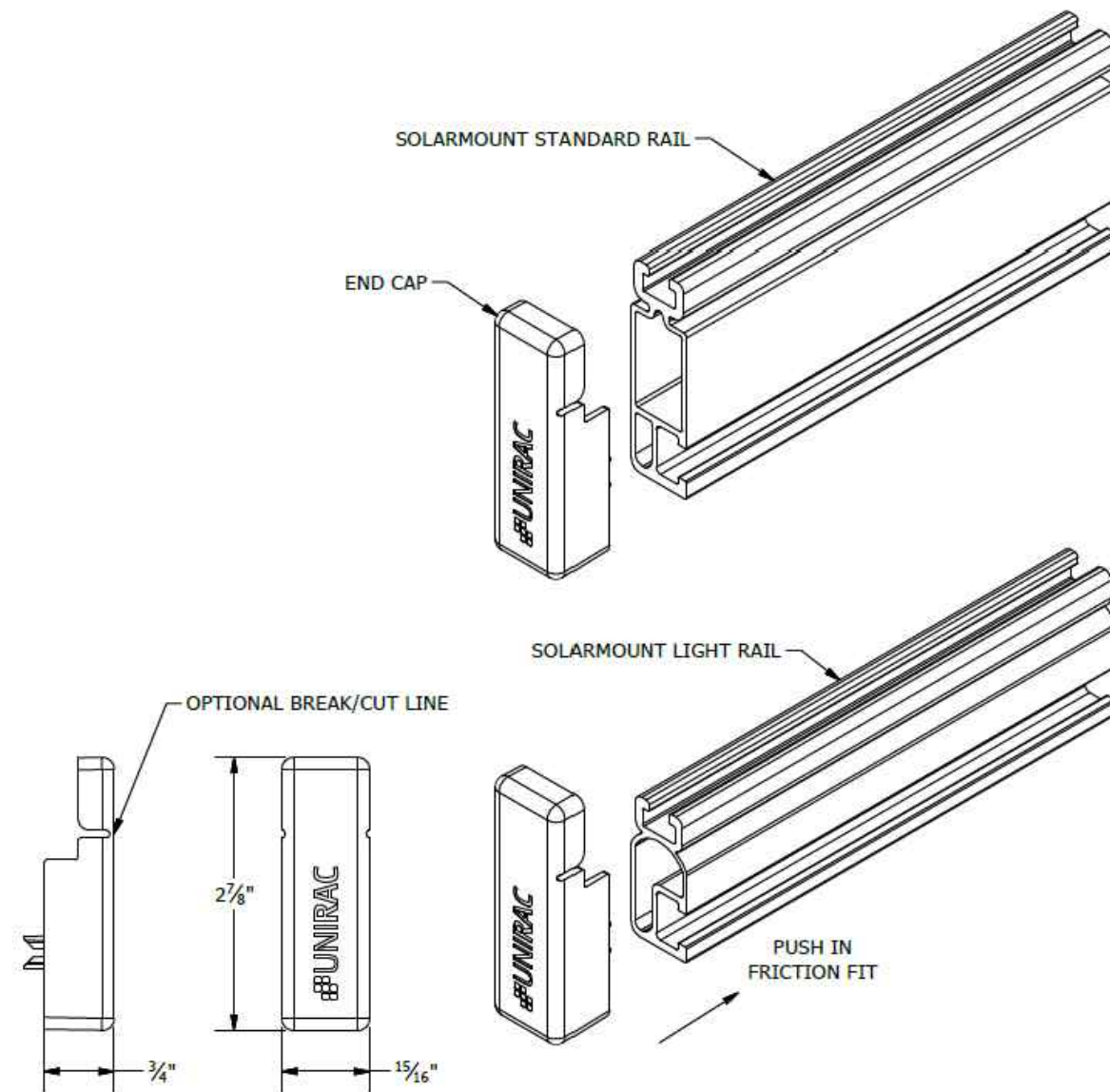
DRAWN DATE	6/24/2022
DRAWN BY	JVK

SHEET NUMBER

**R-007**



- NOTES:
1. END CAP INCLUDED WITH EVERY END CLAMP.
  2. END CAP FITS SOLARMOUNT LIGHT AND STANDARD RAIL PROFILES.

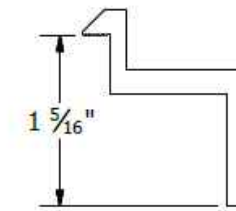


**UNIRAC**  
1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

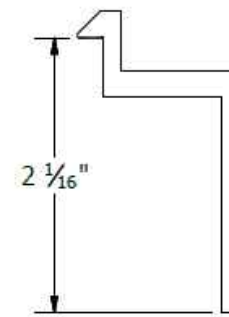
PRODUCT LINE: SOLARMOUNT  
DRAWING TYPE: PART DETAIL  
DESCRIPTION: END CAPS  
REVISION DATE: 9/27/2017

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE  
NOMINAL  
PRODUCT PROTECTED BY  
ONE OR MORE US PATENTS  
LEGAL NOTICE

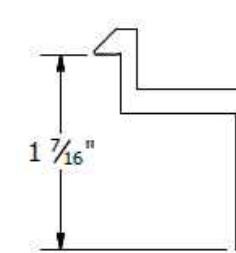
**SM-P04**  
SHEET



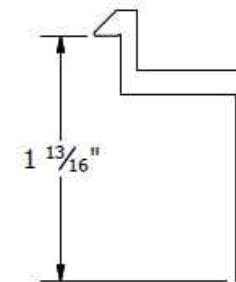
**B CLAMP**  
30mm to 32mm Module Thickness  
(1.18" to 1.26")



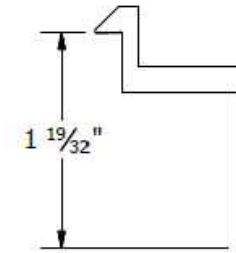
**E CLAMP**  
50mm to 51mm Module Thickness  
(1.97" to 2.00")



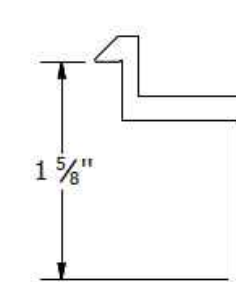
**C CLAMP**  
33mm to 36mm Module Thickness  
(1.30" to 1.42")



**F CLAMP**  
45mm to 47mm Module Thickness  
(1.77" to 1.85")

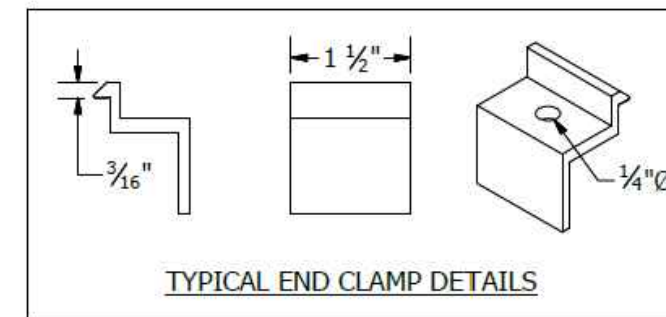


**D CLAMP**  
38mm to 40mm Module Thickness  
(1.50" to 1.57")



**K CLAMP**  
39mm to 41mm Module Thickness  
(1.54" to 1.61")

PART # TABLE	
P/N	DESCRIPTION
302021C	SM ENDCLAMP B CLR AL
302021D	SM ENDCLAMP B DRK AL
302022C	SM ENDCLAMP C CLR AL
302022D	SM ENDCLAMP C DRK AL
302023C	SM ENDCLAMP D CLR AL
302023D	SM ENDCLAMP D DRK AL
303024C	SM ENDCLAMP E CLR AL
302024D	SM ENDCLAMP E DRK AL
302025C	SM ENDCLAMP F CLR AL
302025D	SM ENDCLAMP F DRK AL
302026C	SM ENDCLAMP K CLR AL
302026D	SM ENDCLAMP K DRK AL



**UNIRAC**  
1411 BROADWAY BLVD. NE  
ALBUQUERQUE, NM 87102 USA  
PHONE: 505.242.6411  
WWW.UNIRAC.COM

PRODUCT LINE: SOLARMOUNT  
DRAWING TYPE: PART DETAIL  
DESCRIPTION: END CLAMPS -  
TOP MOUNTING  
REVISION DATE: 9/27/2017

DRAWING NOT TO SCALE  
ALL DIMENSIONS ARE  
NOMINAL  
PRODUCT PROTECTED BY  
ONE OR MORE US PATENTS  
LEGAL NOTICE

**SM-P05**  
SHEET

CONTRACTOR



22171 MCH RD  
MANDEVILLE, LA 70471  
PHONE: 9152011490

PROJECT NAME & ADDRESS  
**JOSHUA HOPKINS**

**347 BEDROCK STREET,  
LAKE CITY,  
FL 32024**  
COUNTY:-COLUMBIA COUNTY

SYSTEM SIZE  
DC SIZE: 11.455 KW DC-(STC)  
AC SIZE: 8.410 KW AC

SHEET TITLE  
**RESOURCE  
DOCUMENT**

DRAWN DATE 6/24/2022  
DRAWN BY JVK

SHEET NUMBER  
**R-008**