



City of Cartersville Historic Preservation Commission COP Application Staff Report
Case: COP 23-03

HPC Meeting – 2/21/23

Application Information

Address: 145 W. Main Street
 Applicant: Scott Nicholls, rep. (Justin and Madison Davis, owners)
 Historic District: DBD
 Zoning: DBD
 Setbacks: Front= oft. Rear= oft. Side=oft.

Brief Description: Add solar panels to roof

Applicable Guidelines to Consider

Residential Design Guidelines	
<i>Part One: Maintaining, Repairing, Replacing Structures Contributing to a Historic District.</i>	
A. Wood	K. Utilities and Energy Retrofit
B. Masonry	L. Accessibility, Health, and Safety Considerations
C. Architectural Metals	M. Additions to Historic Buildings
D. Paint	N. Aesthetic Recommendations
E. Roofs	
F. Exterior Walls	PART TWO: New Construction
G. Driveways, Walkways, and Off-Street Parking	
H. Lighting	PART THREE: Relocation
I. Windows and Doors	
J. Entrances, Porches and Balconies	PART FOUR: Demolition
Commercial Design Guidelines (Historic Downtown Business District)	
X	PART ONE: General Guidelines for Structures Contributing to the District. Sections: 8, 9, 11, 14
	PART TWO: Guidelines for New Construction

Project Description:

1. Add solar panels to the roof of the building and canopy.

Staff Comments:

History of the Property- The structure was constructed c.1900 according to the GHRS. Bartow County Tax assessor's records state 1945.

COP17-19 Multiple façade revisions for new coffee shop. Approved 9-19-17.

COP06-01 Add fencing behind building. Approved. 2-21-06

COP05-06. Add windows, awning, paint. Approved 5-13-05.

Analysis of the COP:

The proposed project is unique for the district. This is the first solar panel addition to a DBD building reviewed by the HPC. No other solar panels are known to exist downtown or visible in aerials.

The project proposes to install (31) HiMo panels, 82(L) x 41(W) x 1.4 (D), installed using the EcoFoot2+ low profile installation system on the roof of the building and canopy. The panels will be installed with a 10 degree tilt. Roof plans and details of the solar panels are provided.

The panels should be hidden from view from Noble St and from the site eastward on E. Main St. The panels will be visible from E. Main St west of the site due to the grade change and from 2nd and 3rd floor windows in the area. Other mechanical equipment like HVAC and exhaust systems are visible from ROWs.

A letter from Dunlap Associates states that the roof framing systems are sufficient to support the solar panels and will not be adversely affected.

Part 1, Section 5, Roofs, of the General Standards for existing structures in the DBD historic district provides some guidance for assessing this project:

5. *Roofs:*

- A. Preserve original pitch and shape of the roof forms where they contribute to the historic character of the building. Replace existing roof materials with the same type of material where it is visible from the street unless an alternative material is approved by the Commission. Rooftop mechanical systems, satellite dishes, and similar devices shall be unobtrusive and located out of public view unless approved by the Commission.

Commissioners Work Sheet

Materials:

	Existing Materials	Materials to be Used
Roof	Undetermined	
Siding		
Windows		
Doors		
Exterior Lighting		
Foundation		
Awning		
Steps		
Porches		
Ornamentation		

Hardscaping

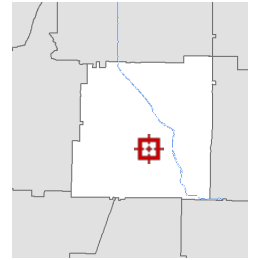
- Patio:
- Drives:
- Fencing:
- Lighting:

Notes:

I move to (approve, approve w/ conditions, or deny) the application for (state proposed changes) at (address) (as submitted, or with the following conditions). I find (compliance or noncompliance) with the guidelines referenced in the staff report and those brought up during discussion.



Overview



Legend

- Parcels
- Roads

Parcel ID	C002-0013-007	Alternate ID	32217	Owner Address	DAVIS JUSTIN W & MADISON G
Sec/Twp/Rng	n/a	Class	Commercial		145 MAIN ST
Property Address	145 W MAIN ST	Acreage	0.1		CARTERSVILLE, GA 30120
District	Downtown Development Authority				
Brief Tax Description	LL483 145 W MAIN Noble & Main Coffee				
	(Note: Not to be used on legal documents)				

Date created: 2/16/2023
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Developed by **Schneider**
 GEOSPATIAL



Cartersville Historic Preservation Commission CERTIFICATE OF PRESERVATION APPLICATION

*Applicant: Scott Nicholls

Project Address: 145 West Main Street Cartersville Ga 30120

Mailing Address (if different than project address):

Phone: 384 404-3894 4451

Email: Scott.Nicholls@CreativeSolarUSA.com

*NOTE: If applicant is not the owner, as listed on the property deed, a letter from the owner authorizing the proposed work must be included along with the owners phone number and address.

PROCEDURE

Application Requirements

All Applications must be complete and include support materials listed on the reverse of this form and a \$25 non-refundable application fee.

Application Deadlines

See 3rd page of application for application submittal deadlines.

Application Representation

The applicant or authorized representative of the applicant should attend the public hearing to support the application.

Building Permits Requirements

In Addition to a COP application, building permits must be acquired from the Community Development Department. Building permits will not be issued without proof of a COP.

Deadline for Project Completion

After approval, the COP is valid for 18 months and void if construction does not begin within 6 months of approval.

Office Use Only	
Case Number	<u>CP 23-03</u>
Date Received	<u>1-20-23</u>
Contributing	<u>X C1945</u>
Zoning	<u>DBO</u>
Legal Advertisement	_____
Notified Adjacent	<u>2/14/23</u>
HPC Hearing	<u>2/21/23</u>
HPC Decision	_____
COP Expiration	_____
Project Completion	_____
Tax Parcel	<u>C002-0013-007</u>

PROJECT

Existing Building Type:

- Residential One, Two or Multi-family _____
Garage, Storage _____
- Commercial
- Other _____

Brief Project Description (example: addition of sunroom, installation of fence):

Installation of 13.6Kw of Solar Panels to the roof of structure

INFORMATION

Type of Project (check all that apply)

- New building
- Addition to building
- Relocation of building(s)
- Demolition
- Fence(s), wall(s), landscaping
- Minor exterior change
- Major restoration, rehabilitation, or remodeling
- Other _____

Start Date: 3/1/23

Anticipated Completion: 4/1/23

Contractor/Consultant/Architect:

AUTHORIZATION

In consideration for the City of Cartersville's review of this application for a proposed change to a locally designated property, the applicant agrees to hereby indemnify and hold harmless the City and its' agents and employees from and against any and all claims, damages, and/or liability arising from or related to this application or any issuance of a permit hereunder.

Date 1/19/23 Signature



APPLICATION CHECKLIST

The following list includes the support material necessary for review of a particular project.

New Buildings and New Additions

- site plan
- architectural elevations
- floor plan
- landscape plan (vegetation not required)
- description of construction materials
- photographs of proposed site and adjoining properties

Major Restoration, Rehabilitation, or Remodeling

- architectural elevations or sketches
- description of proposed changes
- description of construction materials
- photographs of existing building
- documentation of earlier historic appearances (restoration only)

Minor Exterior Changes

- description of proposed changes
- description of construction materials
- photographs of existing building

Site Changes – Parking areas, Drives, Walks

- site plan or sketch of site
- description of construction materials
- photographs of site

Site Changes – Fences, Walls, Systems

- site plan or sketch of site
- architectural elevations or sketches
- description of construction materials
- photographs of site

Site Changes – Signs

- specifications
- description of construction materials and illumination

Demolition

Must include a complete plan for the new development.

- timetable
- demolition budget
- new construction budget
- evidence of adequate financing

NOTE: Only complete applications will be placed on the agenda for design review. Submit to:

City of Cartersville
 Planning and Development Department
 P.O. Box 1390
 Cartersville, GA 30120

PROJECT DESCRIPTION

Include support materials and attach additional sheets if needed. If the proposed scope of work will involve more than one type of project, please divide the description. [Example: (1) Addition to rear (2) New roof]

1. Installation of 31 Grid Tied 440w Solar Panels

2. Electrical tie in of Solar Panels to the Main Panel

as well as installation of emergency rapid shutdown switch as well as A/C Disconnects.

PRECEDENCE OF DECISIONS

Each application will be considered on it's own merit with reference to the Secretary of the Interior's Standards and the Commission's published Design Standards. While the Historic Preservation Commission may consider past actions when making decisions on an Application for a Certificate of Preservation, it is not held by those decisions when considering new application that may appear similar in character.

November 21, 2022

Client: Creative Solar --c/o David Reeves 2931 Lewis
Street, #300 Kennesaw, GA 30144

Project: NOBLE AND MAIN COFFEE SHOP
145 W. Main Street, Cartersville, GA 30120

This certification letter follows my site visit and review of the existing roof framing for supporting solar panel array on the roof of the project building.

The solar array placement will not adversely affect the structural performance of the existing roof framing system as the Ballasted Ecofoot+ mounting system and solar array layout supersedes and replaces the original design live load capacity of 20 psf with panel and mounting dead load of 7.5 psf.

In this regard, the existing roof framing system for this building is adequate to support the solar array. And, critical loading combinations for dead, wind and seismic will not exceed original design criteria.



To whom it may concern,

I, Justin Davis, am the owner of Noble & Main Coffee Company, LLC, as well as the property located at 145 W Main St, Cartersville, GA. I certify that Creative Solar USA has my permission to install a solar array on our property and to work with the City of Cartersville and any other necessary authorities to obtain the permits necessary to do so.

Sincerely,

A handwritten signature in black ink, appearing to read "Justin Davis", with a stylized flourish at the end.

Justin Davis

David Hardegree

From: Jessica Worley <jessica.worley@creativesolarusa.com>
Sent: Friday, February 3, 2023 11:41 AM
To: David Hardegree
Subject: Re: [EXTERNAL] 145 W. Main Street Solar electrical permit
Attachments: ECO Foot 2 install guide.pdf; ECO Foot 2 spec sheet.pdf

CAUTION! : This email originated from outside the City of Cartersville network. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Sender: jessica.worley@creativesolarusa.com

Hi David,

They are a ballast mount that will be tilted 10 degrees. The ballast trays will sit directly on the roof. There will be no reflective issue as solar panels these days do not reflect so it will not disturb any of the surrounding buildings. The panel layout should not be visible from the street. Attached is the ballast mount for the racking.

(N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. FLAT ROOF, 22 PV MODULES (SILVER FRAME, WHITE BACKSHEET), 10° TILT, 161° AZIMUTH

(N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. FLAT ROOF, 9 PV MODULES (SILVER FRAME, WHITE BACKSHEET), 15° TILT, 252° AZIMUTH



Jessica Worley
Sales Support | Creative Solar USA Inc.
phone: (770) 485-7438 x:321
email: jessica.worley@creativesolarusa.com



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On Wed, Feb 1, 2023 at 1:54 PM David Hardegree <dhardegree@cityofcartersville.org> wrote:

Hi Jessica,

Thanks for the follow up. I'm headed out of town for the remainder of the week with limited email access. I may have some more questions to discuss with you next week when I'm back. The one question I currently have is will the panels be installed flat against the roof, flat- but raised up above the roof line, or tilted on angle. The (2) issues that need to be addressed from the historic district perspective is 1) will the panels be visible from Main or Noble Streets, and 2) will they create a reflective issue with adjacent, multi- story buildings?

David

David Hardegree, AICP

City of Cartersville

Planning and Development Department

2nd Floor, City Hall

10 N. Public Square

Cartersville, GA 30120

Direct: 770-387-5614

Main 770-387-5600

www.cityofcartersville.org

From: Jessica Worley <jessica.worley@creativesolarusa.com>

Sent: Wednesday, February 1, 2023 10:45 AM

To: David Hardegree <dhardegree@cityofcartersville.org>

Subject: [EXTERNAL] 145 W. Main Street Solar electrical permit

CAUTION! : This email originated from outside the City of Cartersville network. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Sender: jessica.worley@creativesolarusa.com

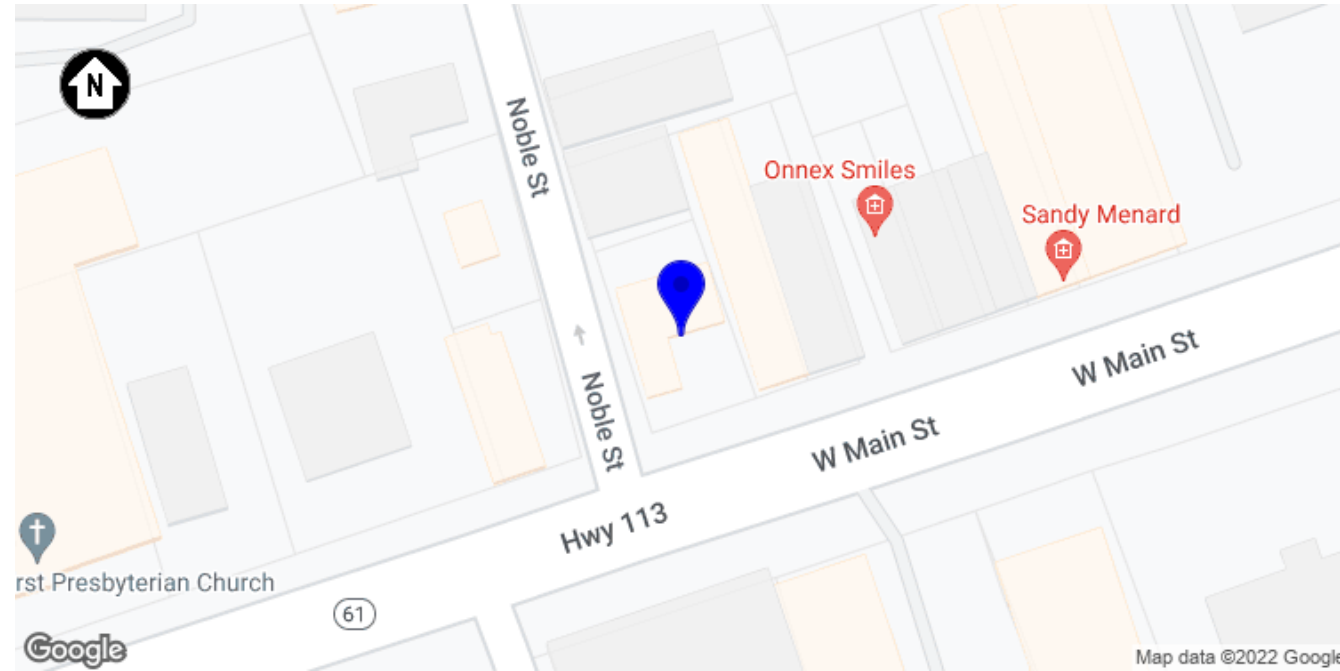




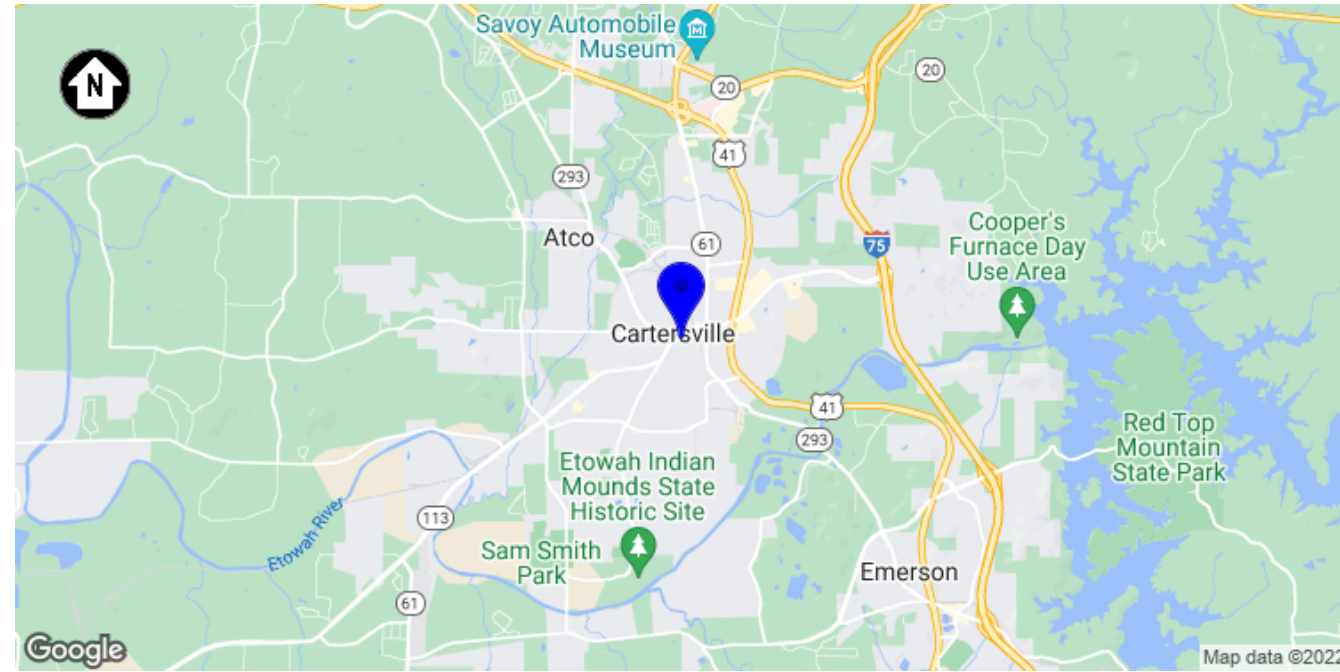
DIRECTORY OF PAGES	
PV-1	PROJECT SUMMARY
PV-2	SITE PLAN
PV-3	SINGLE-LINE DIAGRAM
PV-4	SAFETY LABELS
PV-7	FIRE SAFETY PLAN
APPENDIX	ELECTRICAL CALCULATIONS
	MODULE DATASHEET
	OPTIMIZER DATASHEET
	DISCONNECT DATASHEET

PROJECT DETAILS	
PROPERTY OWNER	NOBLE AND MAIN COFFEE
PROPERTY ADDRESS	145 W MAIN ST, CARTERSVILLE, GA 30120 US
ZONING	RESIDENTIAL
USE AND OCCUPANCY CLASSIFICATION	ONE- OR TWO-FAMILY DWELLING GROUP (GROUP R3)
AHJ	CITY OF CARTERSVILLE
UTILITY COMPANY	CITY OF CARTERSVILLE - (GA)
METER SERIAL NUMBER	27904182
ELECTRICAL CODE	2020 NEC (NFPA 70)
FIRE CODE	2018 IFC
OTHER BUILDING CODES	2020 GA MIN. STANDARD BUILDING CODE 2020 GA MIN. ONE AND TWO FAMILY DWELLINGS CODE 2020 GA MIN. STANDARD PLUMBING CODE 2020 GA MIN. STANDARD BUILDING CODE

CONTRACTOR INFORMATION	
COMPANY	AWC ELECTRICAL
LICENSE NUMBER	EN211480
ADDRESS	2931 LEWIS ST #300, KENNESAW, GA 30156
PHONE NUMBER	(770) 485-7438
CONTRACTOR SIGNATURE	



1 PLOT
PV-1 SCALE: NTS



2 LOCALE
PV-1 SCALE: NTS

SCOPE OF WORK

THIS PROJECT INVOLVES THE INSTALLATION OF A GRID-INTERACTIVE PV SYSTEM. PV MODULES WILL BE MOUNTED USING A PREENGINEERED MOUNTING SYSTEM. THE MODULES WILL BE ELECTRICALLY CONNECTED WITH DC TO AC POWER INVERTERS AND INTERCONNECTED TO THE LOCAL UTILITY USING MEANS AND METHODS CONSISTENT WITH THE RULES ENFORCED BY THE LOCAL UTILITY AND PERMITTING JURISDICTION.

THIS DOCUMENT HAS BEEN PREPARED FOR THE PURPOSE OF DESCRIBING THE DESIGN OF A PROPOSED PV SYSTEM WITH ENOUGH DETAIL TO DEMONSTRATE COMPLIANCE WITH APPLICABLE CODES AND REGULATIONS. THE DOCUMENT SHALL NOT BE RELIED UPON AS A SUBSTITUTE FOR FOLLOWING MANUFACTURER INSTALLATION INSTRUCTIONS. THE SYSTEM SHALL COMPLY WITH ALL MANUFACTURERS LISTING AND INSTALLATION INSTRUCTIONS, AS WELL AS ALL APPLICABLE CODES. NOTHING IN THIS DOCUMENT SHALL BE INTERPRETED IN A WAY THAT OVERRIDES THEM. CONTRACTOR IS RESPONSIBLE FOR VERIFICATION OF ALL CONDITIONS, DIMENSIONS, AND DETAILS IN THIS DOCUMENT.

SYSTEM DETAILS	
DESCRIPTION	NEW GRID-INTERACTIVE PV SYSTEM WITH NO ENERGY STORAGE
DC RATING OF SYSTEM	13.64KW
AC RATING OF SYSTEM	11.40KW
AC OUTPUT CURRENT	47.5A
INVERTER(S)	1 X SOLAR EDGE SE11400A-US000NNR2
MODULE	LONGI SOLAR LR4-72HPH 440M
ARRAY WIRING	(1) STRING OF 9 (2) STRINGS OF 11

INTERCONNECTION DETAILS	
POINT OF CONNECTION	NEW LOAD-SIDE AC CONNECTION PER NEC 705.12(B)(3)(2) AT MSP
UTILITY SERVICE	120/240V 1Φ
LOCATION	MAIN SERVICE PANEL W/225A BUSBAR 200A MCB

SITE DETAILS	
ASHRAE EXTREME LOW	-8°C (18°F)
ASHRAE 2% HIGH	33°C (91°F)
CLIMATE DATA SOURCE	GAINESVILLE/LEE GIL (KGVL)
WIND SPEED	110 MPH (ASCE7-10)
RISK CATEGORY	II
WIND EXPOSURE CATEGORY	B
GROUND SNOW LOAD	10 PSF



GRID-TIED SOLAR POWER SYSTEM

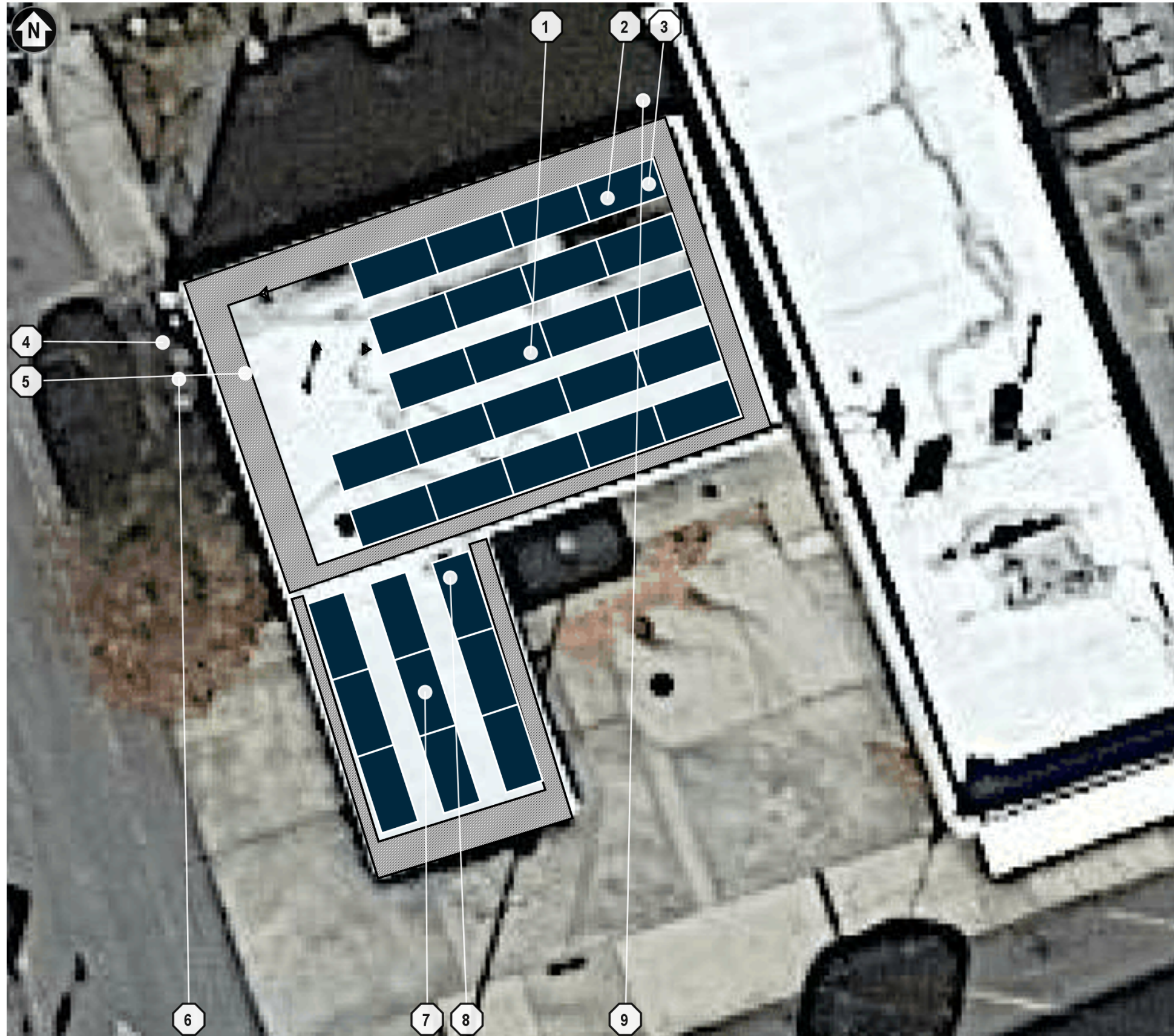
NOBLE-AND-MAIN RESIDENCE
145 W MAIN ST
CARTERSVILLE, GA 30120

PROJECT SUMMARY

DOC ID: 176337-217747-1
DATE: 5/10/22
CREATOR: B.P.
REVIEWER:

REVISIONS	

PV-1



1 SITE PLAN
PV-2 SCALE: 1" = 10'

GENERAL NOTES	
1	EQUIPMENT LIKELY TO BE WORKED UPON WHILE ENERGIZED SHALL BE INSTALLED IN LOCATIONS THAT SATISFY MINIMUM WORKING CLEARANCES PER NEC 110.26.
2	CONTRACTOR SHALL USE ONLY COMPONENTS LISTED BY A NATIONALLY RECOGNIZED TESTING LABORATORY FOR THE INTENDED USE.
3	CONTRACTOR IS RESPONSIBLE FOR FURNISHING ALL EQUIPMENT, CABLES, ADDITIONAL CONDUITS, RACEWAYS, AND OTHER ACCESSORIES NECESSARY FOR A COMPLETE AND OPERATIONAL PV SYSTEM.
4	WHERE DC PV SOURCE OR DC PV OUTPUT CIRCUITS ARE RUN INSIDE THE BUILDING, THEY SHALL BE CONTAINED IN METAL RACEWAYS, TYPE MC METAL-CLAD CABLE, OR METAL ENCLOSURES FROM THE POINT OF PENETRATION INTO THE BUILDING TO THE FIRST READILY ACCESSIBLE DISCONNECTING MEANS, PER NEC 690.31(D).
5	ALL EMT CONDUIT FITTINGS SHALL BE LISTED AS WEATHERPROOF FITTINGS AND INSTALLED TO ENSURE A RAINTIGHT FIT, PER NEC 358.42.

- ① (N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. FLAT ROOF, 22 PV MODULES (SILVER FRAME, WHITE BACKSHEET), 10° TILT, 161° AZIMUTH
- ② (N) STRING COMBINER, OUTDOOR, OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 0.5" ABOVE ROOF SURFACE
- ③ (N) TRANSITION BOX, OUTDOOR, OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 0.5" ABOVE ROOF SURFACE
- ④ (E) UTILITY METER, OUTDOOR
- ⑤ (E) MAIN SERVICE PANEL (MSP), OUTDOOR
- ⑥ (N) VISIBLE, LOCKABLE, READILY-ACCESSIBLE AC DISCONNECT LOCATED WITHIN 10 FT OF UTILITY METER, OUTDOOR
- ⑦ (N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. FLAT ROOF, 9 PV MODULES (SILVER FRAME, WHITE BACKSHEET), 15° TILT, 252° AZIMUTH
- ⑧ (N) TRANSITION BOX, OUTDOOR, OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 0.5" ABOVE ROOF SURFACE
- ⑨ (N) INVERTER, OUTDOOR

P-176337



GRID-TIED SOLAR POWER SYSTEM

NOBLE-AND-MAIN RESIDENCE
145 W MAIN ST
CARTERSVILLE, GA 30120

SITE PLAN

DOC ID: 176337-217747-1
DATE: 5/10/22
CREATOR: B.P.
REVIEWER:

REVISIONS	

PV-2

GENERAL ELECTRICAL NOTES

- UTILITY HAS 24-HR UNRESTRICTED ACCESS TO ALL PHOTOVOLTAIC SYSTEM COMPONENTS LOCATED AT THE SERVICE ENTRANCE.
- CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC ARTICLE 300.6 (C) (1) AND ARTICLE 310.10 (D).
- CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC ARTICLE 310.10 (C).

GROUNDING NOTES

- ALL EQUIPMENT SHALL BE PROPERLY GROUNDED PER THE REQUIREMENTS OF NEC ARTICLES 250 & 690
- PV MODULES SHALL BE GROUNDED TO MOUNTING RAILS USING MODULE LUGS OR RACKING INTEGRATED GROUNDING CLAMPS AS ALLOWED BY LOCAL JURISDICTION. ALL OTHER EXPOSED METAL PARTS SHALL BE GROUNDED USING UL-LISTED LAY-IN LUGS.
- INSTALLER SHALL CONFIRM THAT MOUNTING SYSTEM HAS BEEN EVALUATED FOR COMPLIANCE WITH UL 2703 "GROUNDING AND BONDING" WHEN USED WITH PROPOSED PV MODULE.
- IF THE EXISTING MAIN SERVICE PANEL DOES NOT HAVE A VERIFIABLE GROUNDING ELECTRODE, IT IS THE CONTRACTOR'S RESPONSIBILITY TO INSTALL A SUPPLEMENTAL GROUNDING ELECTRODE.
- AC SYSTEM GROUNDING ELECTRODE CONDUCTOR (GEC) SHALL BE A MINIMUM SIZE #8AWG WHEN INSULATED, #6AWG IF BARE WIRE.
- EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC ARTICLE 690.45, AND BE A MINIMUM OF #10AWG WHEN NOT EXPOSED TO DAMAGE, AND #6AWG SHALL BE USED WHEN EXPOSED TO DAMAGE
- GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN, OR MARKED GREEN IF #4AWG OR LARGER

GRID-TIED SOLAR POWER SYSTEM

NOBLE-AND-MAIN RESIDENCE

145 W MAIN ST

CARTERSVILLE, GA 30120

SINGLE-LINE DIAGRAM

PROJECT ID: 176337

DATE: 05/10/22

CREATED BY: B.P.

CHECKED BY:

REVISIONS

PV-3

1 SINGLE-LINE DIAGRAM
PV-3 SCALE: NTS

MODULES										
REF.	QTY.	MAKE AND MODEL	P _{MAX}	PTC	ISC	IMP	VOC	VMP	TEMP. COEFF. OF VOC	FUSE RATING
PM1-31	31	LONGI SOLAR LR4-72HPH 440M	440W	410W	11.46A	10.71A	48.9V	41.1V	-0.132V/°C (-0.27%/°C)	20A

INVERTERS									
REF.	QTY.	MAKE AND MODEL	AC VOLTAGE	GROUND	RATED POWER	MAX OUTPUT CURRENT	MAX INPUT CURRENT	MAX INPUT VOLTAGE	WEIGHTED EFFICIENCY
I1	1	SOLAR EDGE SE11400A-US (240V)	240V	NOT SOLIDLY GROUNDED	11,400W	47.5A	34.5A	500V	97.5%

OPTIMIZERS							
REF.	QTY.	MODEL	RATED INPUT POWER	MAX OUTPUT CURRENT	MAX INPUT ISC	MAX DC VOLTAGE	WEIGHTED EFFICIENCY
PO1-31	31	SOLAR EDGE S440	440W	15A	14.5A	60V	98.6%

DISCONNECTS				OCPDS				
REF.	QTY.	MAKE AND MODEL	RATED CURRENT	MAX RATED VOLTAGE	REF.	QTY.	RATED CURRENT	MAX VOLTAGE
SW1	1	EATON DG222URB OR EQUIV.	60A	240VAC	CB1	1	60A	240VAC

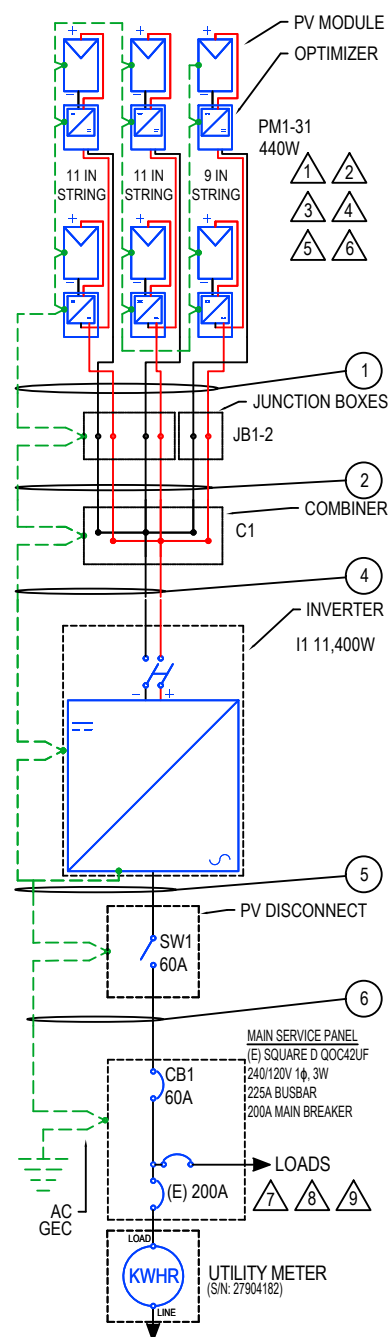
SYSTEM SUMMARY			
	STRING 1	STRING 2	STRING 3
DC SOURCE CIRCUIT CURRENT	15A	15A	15A
NUMBER OF OPTIMIZERS	11	11	9
NOMINAL STRING VOLTAGE	350V	350V	350V
ARRAY OPERATING CURRENT	13.8A	13.8A	11.3A
ARRAY STC POWER	13,640W		
ARRAY PTC POWER	12,722W		
MAX AC CURRENT	48A		
MAX AC POWER OUTPUT	11,400W		
DERATED AC POWER OUTPUT	11,400W		

NOTES

- SOLAR EDGE SYSTEM MEETS REQUIREMENTS FOR PHOTOVOLTAIC RAPID SHUTDOWN SYSTEM (PVRSS), AS PER NEC 690.12(B)(2).
- MATING CONNECTORS SHALL COMPLY WITH NEC 690.33.
- THE SPECIFIED OPTIMIZER CAN BE SUBSTITUTED WITH A P505 OR S500. THESE OPTIMIZERS HAVE AN INPUT VOLTAGE WINDOW WIDE ENOUGH TO ACCOMMODATE THE OUTPUT VOLTAGE RANGE OF THE MODULE AT THE DESIGN TEMPERATURES, HAVE A MAX INPUT CURRENT RATING THAT IS ABOVE THE MAX OUTPUT CURRENT OF THE MODULE, AND A MAX POWER INPUT THAT IS ABOVE THE RATED POWER OUTPUT OF THE MODULE.
- DC PV CONDUCTORS ARE NOT SOLIDLY-GROUNDED. NO DC PV CONDUCTOR SHALL BE WHITE- OR GRAY-COLORED
- ALL METAL ENCLOSURES, RACEWAYS, CABLES AND EXPOSED NONCURRENT-CARRYING METAL PARTS OF EQUIPMENT SHALL BE GROUNDED TO EARTH AS REQUIRED BY NEC 250.4(A) AND PART III OF ARTICLE 250 AND EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO NEC 690.45. THE GROUNDING ELECTRODE SYSTEM SHALL ADHERE TO NEC 690.47(A) AND NEC 250.169. THE DC GROUNDING ELECTRODE SHALL BE SIZED ACCORDING TO NEC 250.166 AND INSTALLED IN COMPLIANCE WITH NEC 250.64.
- MAX DC VOLTAGE OF ARRAY FIXED BY THE INVERTER AT 350V REGARDLESS OF TEMPERATURE. THE MAX DC VOLTAGE OF THE MODULE AT -8°C IS 53.3V (-8°C - 25°C) X -0.132V/C + 48.9V = 53.3V).
- POINT-OF-CONNECTION IS ON LOAD SIDE OF SERVICE DISCONNECT, IN COMPLIANCE WITH NEC 705.12(B)(3)(2). OUTPUT IS BACKFED THROUGH BREAKER IN MAIN PANEL.
- THE BREAKER SHALL BE LOCATED AT THE OPPOSITE END OF THE BUSBAR FROM THE MAIN BREAKER. THE BREAKER SHALL NOT BE MARKED FOR "LINE" AND "LOAD".
- PV SYSTEM DISCONNECT SHALL BE A VISIBLE KNIFE-BLADE TYPE DISCONNECT THAT IS ACCESSIBLE AND LOCKABLE BY THE UTILITY IN ACCORDANCE WITH NEC 690.13(E). THE DISCONNECT SHALL BE LOCATED WITHIN 10 FT OF UTILITY METER AND INSTALLED IN COMPLIANCE WITH NEC 705.20 AND GROUPED AS REQUIRED BY NEC 230.72.

CONDUCTOR AND CONDUIT SCHEDULE W/ELECTRICAL CALCULATIONS

ID	TYPICAL	CONDUCTOR	CONDUIT / CABLE	CURRENT-CARRYING CONDUCTORS IN CONDUIT / CABLE	OCPD	EGC	TEMP. CORR. FACTOR	FILL FACTOR	CONT. CURRENT	MAX. CURRENT (125%)	BASE AMP.	DERATED AMP.	TERM. TEMP. RATING	AMP. @ TERM. TEMP. RATING
1	3	10 AWG PV WIRE, COPPER	FREE AIR	N/A	N/A	6 AWG BARE, COPPER	0.76 (55°C)	1.0	15A	18.75A	55A	41.8A	75°C	50A
2	1	8 AWG THWN-2, COPPER	0.75" DIA. EMT	4	N/A	12 AWG THWN-2, COPPER	0.96 (33°C)	0.8	15A	18.75A	55A	42.24A	90°C	55A
3	1	8 AWG THWN-2, COPPER	0.5" DIA. EMT	2	N/A	12 AWG THWN-2, COPPER	0.96 (33°C)	1.0	15A	18.75A	55A	52.8A	90°C	55A
4	1	4 AWG THWN-2, COPPER	0.75" DIA. EMT	2	N/A	10 AWG THWN-2, COPPER	0.96 (33°C)	1.0	45A	56.25A	95A	91.2A	90°C	95A
5	1	6 AWG THWN-2, COPPER	0.75" DIA. EMT	2	60A	10 AWG THWN-2, COPPER	0.96 (33°C)	1.0	47.5A	59.37A	75A	72A	75°C	65A
6	1	6 AWG THWN-2, COPPER	0.75" DIA. EMT	2	60A	10 AWG THWN-2, COPPER	0.96 (33°C)	1.0	47.5A	59.37A	75A	72A	75°C	65A



MAIN SERVICE PANEL (E) SQUARE D QOC42UF
240/120V 1φ, 3W
225A BUSBAR
200A MAIN BREAKER

UTILITY METER (S/N: 27904182)

DC RACEWAYS

3

JB1 - TRANSITION BOX
(MODEL NOT SPECIFIED)

4

JB2 - TRANSITION BOX
(MODEL NOT SPECIFIED)

4

C1 - STRING COMBINER
(MODEL NOT SPECIFIED)

4

SW1 - DISCONNECT
(EATON DG222URB)

4

6

7

I1 - INVERTER
(SOLAR EDGE SE11400A-US000NNR2)

4

5

MSP - MAIN SERVICE PANEL
(SQUARE DQOC42UF)

1

2

6

7

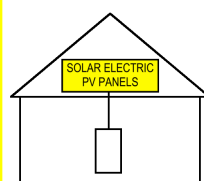
8

9

1 SEE NOTE NO. 5 (MSP)

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.



NEC690.56(C)(1) AND IFC1204.5.1,1204.5.1

3 SEE NOTE NO. 6 (DC RACEWAYS)

WARNING PHOTOVOLTAIC POWER SOURCE

NEC690.31(D)(2)

4 EACH DISCONNECTING MEANS FOR PHOTOVOLTAIC EQUIPMENT (JB1, JB2, C1, SW1, I1)

! WARNING !

ELECTRIC SHOCK HAZARD. TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION.

NEC690.13(B)

7 AC SOLAR DISCONNECT (SW1, CB1 IN MSP)

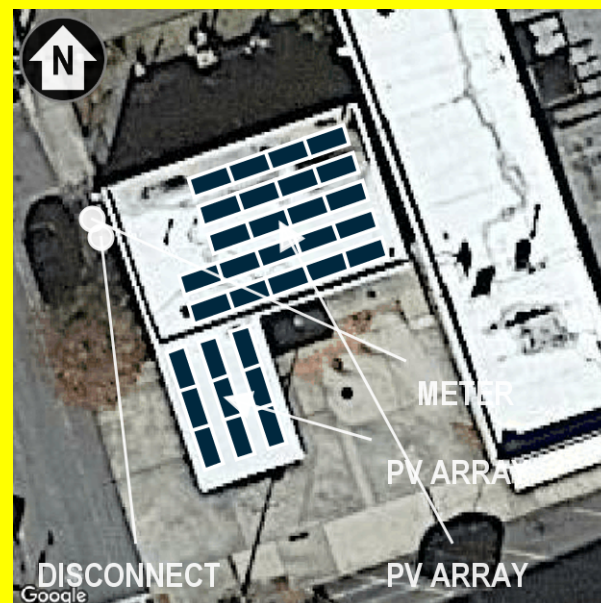
PV SYSTEM DISCONNECT

NEC690.13(B)

2 POINT-OF-INTERCONNECTION OR AT MAIN SERVICE DISCONNECT (MSP)

! CAUTION: MULTIPLE SOURCES OF POWER !

POWER TO THIS BUILDING IS ALSO FROM ROOF ARRAYS WITH SAFETY DISCONNECTS AS SHOWN



INSTALLED BY AWC ELECTRICAL • 7704857438

NEC690.56(B),705.10

5 DC DISCONNECT (I1)

DIRECT-CURRENT PV POWER SOURCE
MAXIMUM VOLTAGE: 350V
MAX CIRCUIT-CURRENT: 56.2A
DC-TO-DC CONVERTER RATED CURRENT: 15.0A

NEC690.53

8 ANY AC ELECTRICAL PANEL THAT IS FED BY BOTH THE UTILITY AND THE PHOTOVOLTAIC SYSTEM (MSP)

! CAUTION !
MULTIPLE SOURCES OF POWER

NEC705.10

6 AC DISCONNECT (SW1, CB1 IN MSP)

MAXIMUM AC OPERATING CURRENT: 47.5A
MAXIMUM AC OPERATING VOLTAGE: 240V

NEC690.54

9 SOLAR BREAKER (MSP)

! WARNING !
POWER SOURCE OUTPUT CONNECTION. DO NOT RELOCATE THIS OVERCURRENT DEVICE.

NEC705.12(B)(3)(2)

LABELING NOTES

- 1 ALL PLAQUES AND SIGNAGE REQUIRED BY 2020 NEC AND 2018 IFC WILL BE INSTALLED AS REQUIRED.
- 2 LABELS, WARNING(S) AND MARKING SHALL COMPLY WITH ANSI Z535.4, WHICH REQUIRES THAT DANGER, WARNING, AND CAUTION SIGNS USED THE STANDARD HEADER COLORS, HEADER TEXT, AND SAFETY ALERT SYMBOL ON EACH LABEL. THE ANSI STANDARD REQUIRES A HEADING THAT IS AT LEAST 50% TALLER THAN THE BODY TEXT, IN ACCORDANCE WITH NEC 110.21(B).
- 3 A PERMANENT PLAQUE OR DIRECTORY SHALL BE INSTALLED PROVIDING THE LOCATION OF THE SERVICE DISCONNECTING MEANS AND THE PHOTOVOLTAIC SYSTEM DISCONNECTING MEANS IF NOT IN THE SAME LOCATION IN ACCORDANCE WITH NEC 690.56(B).
- 4 THE DIAGRAM INDICATING THE LOCATIONS OF DISCONNECTS SHALL BE CORRECTLY ORIENTED WITH RESPECT TO THE DIAGRAM'S LOCATION, IN ACCORDANCE WITH NEC 705.10
- 5 LABEL(S) WITH MARKING, "TURN RAPID SHUTDOWN SWITCH TO THE 'OFF' POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN THE ARRAY," SHALL BE LOCATED WITHIN 3 FT OF SERVICE DISCONNECTING MEANS. THE TITLE SHALL UTILIZE CAPITALIZED LETTERS WITH A MINIMUM HEIGHT OF 3/8" IN BLACK ON A YELLOW BACKGROUND, AND REMAINING TEXT SHALL BE CAPITALIZED WITH A MINIMUM HEIGHT OF 3/16" IN BLACK ON WHITE BACKGROUND
- 6 LABEL(S) WITH MARKING, "WARNING PHOTOVOLTAIC POWER SOURCE," SHALL BE LOCATED AT EVERY 10 FEET OF EACH DC RACEWAY AND WITHIN ONE FOOT OF EVERY TURN OR BEND AND WITHIN ONE FOOT ABOVE AND BELOW ALL PENETRATIONS OF ROOF/CEILING ASSEMBLIES, WALLS AND BARRIERS. THE LABEL SHALL HAVE 3/8" TALL LETTERS AND BE REFLECTIVE WITH WHITE TEXT ON A RED BACKGROUND

P-176337



GRID-TIED SOLAR POWER SYSTEM

NOBLE-AND-MAIN RESIDENCE
145 W MAIN ST
CARTERSVILLE, GA 30120

SAFETY LABELS

DOC ID: 176337-217747-1

DATE: 5/10/22

CREATOR: B.P.

REVIEWER:

REVISIONS

PV-4



1 FIRE SAFETY PLAN
 PV-7 SCALE: 1" = 10'

GENERAL NOTES	
1	AT LEAST TWO 36"-WIDE PATHWAYS ON SEPARATE ROOF PLANES, FROM LOWEST ROOF EDGE TO RIDGE, SHALL BE PROVIDED ON ALL BUILDINGS. THERE SHALL BE AT LEAST ONE PATHWAY ON THE STREET OR DRIVEWAY SIDE OF THE ROOF. FOR EACH ROOF PLANE WITH A PV ARRAY, AT LEAST ONE SUCH PATHWAY SHALL BE PROVIDED ON THE SAME ROOF PLANE, OR ON AN ADJACENT ROOF PLANE, OR STRADDLING THE SAME AND ADJACENT ROOF PLANES. (IFC 1204.2.1.1)
2	FOR PV ARRAYS OCCUPYING MORE THAN 1/3 OF THE PLAN VIEW TOTAL ROOF AREA, A MIN. 3'-WIDE SETBACK IS REQUIRED ON BOTH SIDES OF A HORIZONTAL RIDGE. (IFC 1204.2.1.2)
3	PV MODULES SHALL NOT BE INSTALLED ON THE PORTION OF A ROOF THAT IS BELOW AN EMERGENCY ESCAPE AND RESCUE OPENING. A 36"-WIDE PATHWAY SHALL BE PROVIDED TO THE EMERGENCY ESCAPE AND RESCUE OPENING. (IFC 1204.2.2)

- ① ROOF ACCESS POINT
- ② ROOF ACCESS POINT
- ③ ROOF ACCESS POINT
- ④ ROOF ACCESS POINT
- 5 CABLES, WHEN RUN BETWEEN ARRAYS, SHALL BE ENCLOSED IN CONDUIT.

P-176337



GRID-TIED SOLAR POWER SYSTEM
 NOBLE-AND-MAIN RESIDENCE
 145 W MAIN ST
 CARTERSVILLE, GA 30120

FIRE SAFETY PLAN

DOC ID: 176337-217747-1
 DATE: 5/10/22
 CREATOR: B.P.
 REVIEWER:

REVISIONS	

PV-7

Conductor, Conduit, and OCPD Sizing Validation

1. Maximum System Voltage Test

1.1. Solar Edge inverter w/31 LONGi Solar LR4-72HPH 440M (440W)s

Array Properties

Array Type	Distributed MPPT System Inverter Array
System Description	Solar Edge inverter w/31 LONGi Solar LR4-72HPH 440M (440W)s
Module	LR4-72HPH 440M (440W)
Highest number of modules in series in a PV Source Circuit	1
Design Low Temp.	-8°C
Module Voc	48.9V
Temp. Coefficient Voc	-0.132V/C

NEC Code Calculations

A. Maximum Voltage of PV Source Circuit <i>see 690.7(A)</i>	53.26V
--	--------

NEC 690.7(A) requires that if the PV module manufacturer provides a temperature coefficient of open-circuit voltage, it must be used to calculate the PV array's maximum system voltage. It includes an information note recommending the use of the ASHRAE 'Extreme Annual Mean Minimum Design Dry Bulb Temperature' as the design low temperature. Using these values, the module Voc (48.9V) will increase to 53.26V at the design low temperature (-8°C).

$$(-8^{\circ}\text{C} - 25^{\circ}\text{C}) \times -0.132\text{V/C} + 48.9\text{V} = 53.26\text{V}$$

The module Voc at the design low temperature is 53.26V.
 $53.26\text{V} \times 1 = 53.26\text{V}$

B. Maximum Voltage of DC-DC Converter Source Circuit <i>see 690.7(B)(2)</i>	350V
--	------

All PV circuits have a voltage that does not exceed 600V. This system's DC-DC Converter Source Circuits are fed by Solar Edge S440 dc-to-dc converter optimization devices. Each device is connected to a single LR4-72HPH 440M (440W) PV module. The voltage of this circuit is regulated by the inverter at a constant 350V.

NEC Code Validation Tests

1.	PV Source Circuit maximum Voc must not exceed 600V $53.26\text{V} < 600\text{V} = \text{true}$	PASS
2.	DC-DC Converter Source Circuit voltage must not exceed 600V $350\text{V} < 600\text{V} = \text{true}$	PASS

2. Wire, Conduit, and OCPD Code Compliance Validation

2.1. #1: String of Optimizer(s): Optimizer to Transition Box

Circuit Section Properties

Conductor	10 AWG PV Wire, Copper
Equipment Ground Conductor (EGC)	6 AWG Bare, Copper
OCPD(s)	N/A
Raceway/Cable	Free Air
Lowest Terminal Temperature Rating	75°C
Maximum Wire Temperature	55°C
Power Source Description	DC-to-DC converter source circuit consisting of 11 Solar Edge S440 optimizers.
Power Source Current	15A
Voltage	350V

NEC Code Calculations

A. Continuous Current <i>see 690.8(A)(1)(d)</i>	15A
--	-----

The continuous current of DC-to-DC converter source circuit is equal to the rated maximum output current of the optimizer.
 Rated Max. Output Current of optimizer is 15A

B. Ampacity of Conductor <i>see Table 310.15(B)(17)</i>	55A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in free air is 55A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	41.8A
--	-------

The temperature factor for 90°C insulation at 55°C is 0.76.
 The fill factor for conductors in free air is 1.
 The ampacity derated for Conditions of Use is the product of the conductor ampacity (55A) multiplied by the temperature factor (0.76) and by the fill factor (1).
 $55\text{A} \times 0.76 \times 1 = 41.8\text{A}$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	35A
--	-----

The lowest temperature rating for this conductor at any termination is 75°C.
 Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 75°C rating would be the amount referenced in the 75°C column in Table 310.15(B)(16), which is 35A.

E. Minimum Required EGC Size <i>see Table 250.122 and 690.45</i>	12 AWG
---	--------

The smallest EGC size allowed is 12 AWG for OCPD rating 20A according to Table 250.122.
 According to 690.45, it is not necessary to increase the size of the PV array's EGC when conductors are oversized for voltage drop considerations.

NEC Code Validation Tests

1.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $41.8\text{A} \geq 15\text{A} = \text{true}$	PASS
2.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $55\text{A} > 15\text{A} \times 1.25 = \text{true}$	PASS
3.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $35\text{A} \geq 15\text{A} \times 1.25 = \text{true}$	PASS
4.	EGC must meet code requirements for minimum size (Table 250.122) $6\text{ AWG} \geq 12\text{ AWG} = \text{true}$	PASS
5.	EGC must meet code requirements for physical protection (250.120(C)) $6\text{ AWG} \geq 6\text{ AWG} = \text{true}$	PASS

2.2. #2: String of Optimizer(s): Transition Box to String Combiner

Circuit Section Properties

Conductor	8 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	12 AWG THWN-2, Copper
OCPD(s)	N/A
Raceway/Cable	0.75" dia. EMT
Lowest Terminal Temperature Rating	90°C
Maximum Wire Temperature	33°C
Power Source Description	DC-to-DC converter source circuit consisting of 11 Solar Edge S440 optimizers.
Power Source Current	15A
Voltage	350V

NEC Code Calculations

A. Continuous Current <i>see 690.8(A)(1)(d)</i>	15A
--	-----

The continuous current of DC-to-DC converter source circuit is equal to the rated maximum output current of the optimizer.

Rated Max. Output Current of optimizer is 15A

B. Ampacity of Conductor <i>see Table 310.15(B)(16)</i>	55A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in conduit/cable is 55A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	42.24A
--	--------

The temperature factor for 90°C insulation at 33°C is 0.96.

The fill factor for a conduit/cable that has 4 wires is 0.8.

The ampacity derated for Conditions of Use is the product of the conductor ampacity (55A) multiplied by the temperature factor (0.96) and by the fill factor (0.8).

$55A \times 0.96 \times 0.8 = 42.24A$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	55A
--	-----

The lowest temperature rating for this conductor at any termination is 90°C.

Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 90°C rating would be the amount referenced in the 90°C column in Table 310.15(B)(16), which is 55A.

E. Minimum Required EGC Size <i>see Table 250.122 and 690.45</i>	12 AWG
---	--------

The smallest EGC size allowed is 12 AWG for OCPD rating 20A according to Table 250.122.

According to 690.45, it is not necessary to increase the size of the PV array's EGC when conductors are oversized for voltage drop considerations.

F. Minimum Recommended Conduit Size <i>see 300.17</i>	0.75" dia.
--	------------

The total area of all conductors is 0.173in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.75.

Qty	Description	Size	Type	Area	Total Area
4	Conductor	8 AWG	THWN-2	0.0366in ²	0.1464in ²
2	Equipment Ground	12 AWG	THWN-2	0.0133in ²	0.0266in ²
6					0.173in ²

$0.173in^2 / 0.4 = 0.4325in^2$ (Corresponding to a diameter of 0.75")

NEC Code Validation Tests

1.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $42.24A \geq 15A = \text{true}$	PASS
2.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $55A > 15A \times 1.25 = \text{true}$	PASS
3.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $55A \geq 15A \times 1.25 = \text{true}$	PASS
4.	EGC must meet code requirements for minimum size (Table 250.122) $12 \text{ AWG} \geq 12 \text{ AWG} = \text{true}$	PASS
5.	Conduit must meet code recommendation for minimum size (300.17) $0.75in. \geq 0.75in. = \text{true}$	PASS

2.3. #3: String of Optimizer(s): Transition Box to String Combiner

Circuit Section Properties

Conductor	8 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	12 AWG THWN-2, Copper
OCPD(s)	N/A
Raceway/Cable	0.5" dia. EMT
Lowest Terminal Temperature Rating	90°C
Maximum Wire Temperature	33°C
Power Source Description	DC-to-DC converter source circuit consisting of 9 Solar Edge S440 optimizers.
Power Source Current	15A
Voltage	350V

NEC Code Calculations

A. Continuous Current <i>see 690.8(A)(1)(d)</i>	15A
--	-----

The continuous current of DC-to-DC converter source circuit is equal to the rated maximum output current of the optimizer.

Rated Max. Output Current of optimizer is 15A

B. Ampacity of Conductor <i>see Table 310.15(B)(16)</i>	55A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in conduit/cable is 55A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	52.8A
--	-------

The temperature factor for 90°C insulation at 33°C is 0.96.

The fill factor for a conduit/cable that has 2 wires is 1.

The ampacity derated for Conditions of Use is the product of the conductor ampacity (55A) multiplied by the temperature factor (0.96) and by the fill factor (1).

$55A \times 0.96 \times 1 = 52.8A$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	55A
--	-----

The lowest temperature rating for this conductor at any termination is 90°C.

Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 90°C rating would be the amount referenced in the 90°C column in Table 310.15(B)(16), which is 55A.

E. Minimum Required EGC Size <i>see Table 250.122 and 690.45</i>	12 AWG
---	--------

The smallest EGC size allowed is 12 AWG for OCPD rating 20A according to Table 250.122.

According to 690.45, it is not necessary to increase the size of the PV array's EGC when conductors are oversized for voltage drop considerations.

F. Minimum Recommended Conduit Size <i>see 300.17</i>	0.5" dia.
--	-----------

The total area of all conductors is 0.0865in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.5.

Qty	Description	Size	Type	Area	Total Area
2	Conductor	8 AWG	THWN-2	0.0366in ²	0.0732in ²
1	Equipment Ground	12 AWG	THWN-2	0.0133in ²	0.0133in ²
3					0.0865in ²

$0.0865in^2 / 0.4 = 0.2162in^2$ (Corresponding to a diameter of 0.5")

NEC Code Validation Tests

1.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $52.8A \geq 15A = \text{true}$	PASS
2.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $55A > 15A \times 1.25 = \text{true}$	PASS
3.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $55A \geq 15A \times 1.25 = \text{true}$	PASS
4.	EGC must meet code requirements for minimum size (Table 250.122) $12 \text{ AWG} \geq 12 \text{ AWG} = \text{true}$	PASS
5.	Conduit must meet code recommendation for minimum size (300.17) $0.5in. \geq 0.5in. = \text{true}$	PASS

2.4. #4: String Combiner Output: String Combiner to Inverter

Circuit Section Properties

Conductor	4 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	10 AWG THWN-2, Copper
OCPD(s)	N/A
Raceway/Cable	0.75" dia. EMT
Lowest Terminal Temperature Rating	90°C
Maximum Wire Temperature	33°C
Power Source Description	Array of 3 strings, with 11, 11, and 9 Solar Edge S440 power optimizers and LONGi Solar LR4-72HPH 440M PV modules
Power Source Current	45A
Voltage	41.1V

NEC Code Calculations

A. Continuous Current <i>see 690.8(A)(1)(c)</i>	45A
--	-----

The continuous current of the array is equal to the rated maximum output current of the optimizer multiplied by the number of paralleled strings.
 $15A \times 3 = 45A$

B. Ampacity of Conductor <i>see Table 310.15(B)(16)</i>	95A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in conduit/cable is 95A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	91.2A
--	-------

The temperature factor for 90°C insulation at 33°C is 0.96.
 The fill factor for a conduit/cable that has 2 wires is 1.
 The ampacity derated for Conditions of Use is the product of the conductor ampacity (95A) multiplied by the temperature factor (0.96) and by the fill factor (1).
 $95A \times 0.96 \times 1 = 91.2A$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	95A
--	-----

The lowest temperature rating for this conductor at any termination is 90°C.
 Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 90°C rating would be the amount referenced in the 90°C column in Table 310.15(B)(16), which is 95A.

E. Minimum Required EGC Size <i>see Table 250.122 and 690.45</i>	10 AWG
---	--------

The smallest EGC size allowed is 10 AWG for OCPD rating 56A according to Table 250.122.
 According to 690.45, it is not necessary to increase the size of the PV array's EGC when conductors are oversized for voltage drop considerations.

F. Minimum Recommended Conduit Size <i>see 300.17</i>	0.75" dia.
--	------------

The total area of all conductors is 0.1859in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.75.

Qty	Description	Size	Type	Area	Total Area
2	Conductor	4 AWG	THWN-2	0.0824in ²	0.1648in ²
1	Equipment Ground	10 AWG	THWN-2	0.0211in ²	0.0211in ²
3					0.1859in ²

$0.1859\text{in}^2 / 0.4 = 0.4648\text{in}^2$ (Corresponding to a diameter of 0.75")

NEC Code Validation Tests

1.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $91.2A \geq 45A = \text{true}$	PASS
2.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $95A > 45A \times 1.25 = \text{true}$	PASS
3.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $95A \geq 45A \times 1.25 = \text{true}$	PASS
4.	EGC must meet code requirements for minimum size (Table 250.122) $10 \text{ AWG} \geq 10 \text{ AWG} = \text{true}$	PASS
5.	Conduit must meet code recommendation for minimum size (300.17) $0.75\text{in.} \geq 0.75\text{in.} = \text{true}$	PASS

2.5. #5: Inverter Output: Inverter to Utility Disconnect

Circuit Section Properties

Conductor	6 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	10 AWG THWN-2, Copper
OCPD(s)	60A
Raceway/Cable	0.75" dia. EMT
Lowest Terminal Temperature Rating	75°C
Maximum Wire Temperature	33°C
Power Source Description	Solar Edge SE11400A-US000NNR2 11400W Inverter
Power Source Current	47.5A
Voltage	240V
Inverter Max OCPD rating	60A

NEC Code Calculations

A. Continuous Current <i>see Article 100</i>	47.5A
---	-------

Equipment maximum rated output current is 47.5A

B. Ampacity of Conductor <i>see Table 310.15(B)(16)</i>	75A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in conduit/cable is 75A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	72A
--	-----

The temperature factor for 90°C insulation at 33°C is 0.96.
 The fill factor for a conduit/cable that has 2 wires is 1.
 The ampacity derated for Conditions of Use is the product of the conductor ampacity (75A) multiplied by the temperature factor (0.96) and by the fill factor (1).
 $75A \times 0.96 \times 1 = 72A$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	65A
--	-----

The lowest temperature rating for this conductor at any termination is 75°C.
 Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 75°C rating would be the amount referenced in the 75°C column in Table 310.15(B)(16), which is 65A.

E. Minimum Allowed OCPD Rating <i>see 240.4</i>	59A
--	-----

NEC 690.9(B) requires that the OCPD be rated for no less than 1.25 times the Continuous Current of the circuit.
 $47.5A \times 1.25 = 59.37A$ rounded down to 59A

F. Minimum Required EGC Size <i>see Table 250.122</i>	10 AWG
--	--------

The smallest EGC size allowed is 10 AWG for OCPD rating 60A according to Table 250.122.

G. Minimum Recommended Conduit Size <i>see 300.17</i>	0.75" dia.
--	------------

The total area of all conductors is 0.1732in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.75.

Qty	Description	Size	Type	Area	Total Area
2	Conductor	6 AWG	THWN-2	0.0507in ²	0.1014in ²
1	Neutral	6 AWG	THWN-2	0.0507in ²	0.0507in ²
1	Equipment Ground	10 AWG	THWN-2	0.0211in ²	0.0211in ²
4					0.1732in ²

$0.1732\text{in}^2 / 0.4 = 0.433\text{in}^2$ (Corresponding to a diameter of 0.75")

NEC Code Validation Tests

1.	OCPD rating must be at least 125% of Continuous Current (240.4) $60A \geq 47.5A \times 1.25 = \text{true}$	PASS
2.	Derated ampacity must exceed OCPD rating, or rating of next smaller OCPD (240.4) $72A \geq 60A \text{ (OC PD Rating)} = \text{true}$	PASS
3.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $72A \geq 47.5A = \text{true}$	PASS
4.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $75A > 47.5A \times 1.25 = \text{true}$	PASS
5.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $65A \geq 47.5A \times 1.25 = \text{true}$	PASS
6.	EGC must meet code requirements for minimum size (Table 250.122) $10 \text{ AWG} \geq 10 \text{ AWG} = \text{true}$	PASS
7.	Conduit must meet code recommendation for minimum size (300.17) $0.75\text{in.} \geq 0.75\text{in.} = \text{true}$	PASS

2.6. #6: Utility Disconnect Output: Utility Disconnect to Main Service Panel

Circuit Section Properties

Conductor	6 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	10 AWG THWN-2, Copper
OCPD(s)	60A
Raceway/Cable	0.75" dia. EMT
Lowest Terminal Temperature Rating	75°C
Maximum Wire Temperature	33°C
Power Source Description	Solar Edge SE11400A-US000NNR2 11400W Inverter
Power Source Current	47.5A
Voltage	240V

NEC Code Calculations

A. Continuous Current <i>see Article 100</i>	47.5A
---	-------

Equipment maximum rated output current is 47.5A

B. Ampacity of Conductor <i>see Table 310.15(B)(16)</i>	75A
--	-----

Ampacity (30°C) for a copper conductor with 90°C insulation in conduit/cable is 75A.

C. Derated Ampacity of Conductor <i>see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100</i>	72A
--	-----

The temperature factor for 90°C insulation at 33°C is 0.96.
The fill factor for a conduit/cable that has 2 wires is 1.
The ampacity derated for Conditions of Use is the product of the conductor ampacity (75A) multiplied by the temperature factor (0.96) and by the fill factor (1).
 $75A \times 0.96 \times 1 = 72A$

D. Max Current for Terminal Temp. Rating <i>see 110.14(C)</i>	65A
--	-----

The lowest temperature rating for this conductor at any termination is 75°C.
Using the method specified in 110.14(C), the maximum current permitted to ensure that the device terminal temperature does not exceed its 75°C rating would be the amount referenced in the 75°C column in Table 310.15(B)(16), which is 65A.

E. Minimum Allowed OCPD Rating <i>see 240.4</i>	59A
--	-----

NEC 690.9(B) requires that the OCPD be rated for no less than 1.25 times the Continuous Current of the circuit.
 $47.5A \times 1.25 = 59.37A$ rounded down to 59A

F. Minimum Required EGC Size <i>see Table 250.122</i>	10 AWG
--	--------

The smallest EGC size allowed is 10 AWG for OCPD rating 60A according to Table 250.122.

G. Minimum Recommended Conduit Size <i>see 300.17</i>	0.75" dia.
--	------------

The total area of all conductors is 0.1732in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.75.

Qty	Description	Size	Type	Area	Total Area
2	Conductor	6 AWG	THWN-2	0.0507in ²	0.1014in ²
1	Neutral	6 AWG	THWN-2	0.0507in ²	0.0507in ²
1	Equipment Ground	10 AWG	THWN-2	0.0211in ²	0.0211in ²
4					0.1732in ²

$0.1732in^2 / 0.4 = 0.433in^2$ (Corresponding to a diameter of 0.75")

NEC Code Validation Tests

1.	OCPD rating must be at least 125% of Continuous Current (240.4) $60A \geq 47.5A \times 1.25 = true$	PASS
2.	Derated ampacity must exceed OCPD rating, or rating of next smaller OCPD (240.4) $72A \geq 60A$ (OCPD Rating) = true	PASS
3.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $72A \geq 47.5A = true$	PASS
4.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $75A > 47.5A \times 1.25 = true$	PASS
5.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $65A \geq 47.5A \times 1.25 = true$	PASS
6.	EGC must meet code requirements for minimum size (Table 250.122) $10 AWG \geq 10 AWG = true$	PASS
7.	Conduit must meet code recommendation for minimum size (300.17) $0.75in. \geq 0.75in. = true$	PASS

Hi-MO 4m

LR4-72HPH 430~460M

- Suitable for ground power plants and distributed projects
- Advanced module technology delivers superior module efficiency
 - M6 Gallium-doped Wafer
 - 9-busbar Half-cut Cell
- Excellent outdoor power generation performance
- High module quality ensures long-term reliability

12 12-year Warranty for Materials and Processing

25 25-year Warranty for Extra Linear Power Output

Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730
 ISO 9001:2015: ISO Quality Management System
 ISO 14001: 2015: ISO Environment Management System
 TS62941: Guideline for module design qualification and type approval
 ISO 45001: 2018: Occupational Health and Safety

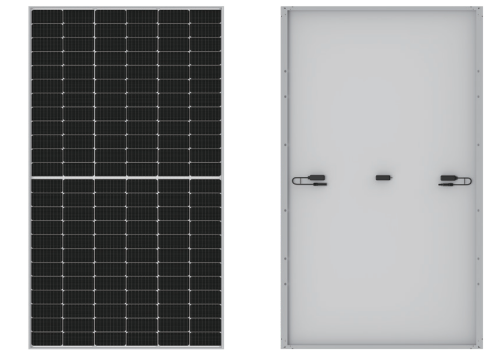
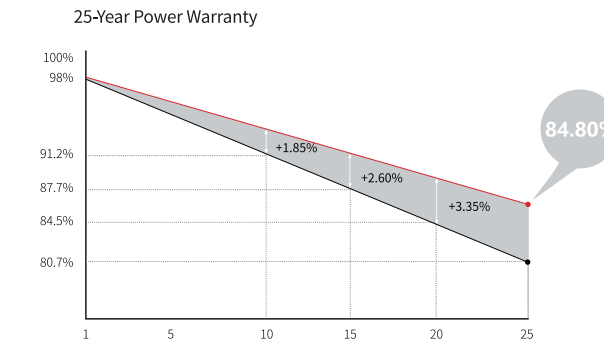


Hi-MO 4m

LR4-72HPH 430~460M

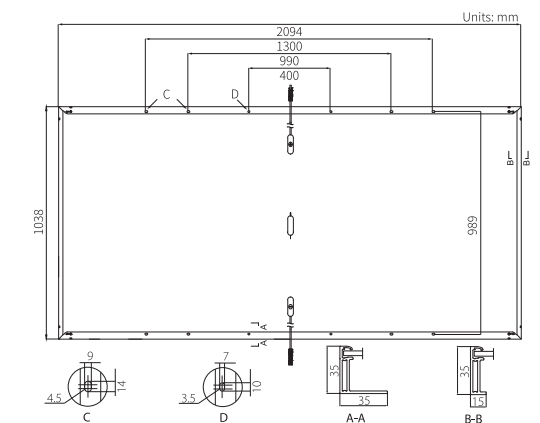
21.2% MAX MODULE EFFICIENCY	0~+5W POWER TOLERANCE	<2% FIRST YEAR POWER DEGRADATION	0.55% YEAR 2-25 POWER DEGRADATION	HALF-CELL Lower operating temperature
---------------------------------------	---------------------------------	---	---	---

Additional Value



Mechanical Parameters

Cell Orientation	144 (6×24)
Junction Box	IP68, three diodes
Output Cable	4mm ² , +400, -200mm/±1400mm length can be customized
Glass	Single glass, 3.2mm coated tempered glass
Frame	Anodized aluminum alloy frame
Weight	23.3kg
Dimension	2094×1038×35mm
Packaging	30pcs per pallet / 150pcs per 20' GP / 660pcs per 40' HC



Electrical Characteristics	STC : AM1.5 1000W/m ² 25°C				NOCT : AM1.5 800W/m ² 20°C 1m/s				Test uncertainty for Pmax: ±3%					
	LR4-72HPH-430M	LR4-72HPH-435M	LR4-72HPH-440M	LR4-72HPH-445M	LR4-72HPH-450M	LR4-72HPH-455M	LR4-72HPH-460M	STC	NOCT	STC	NOCT	STC	NOCT	
Module Type														
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	430	321.1	435	324.9	440	328.6	445	332.3	450	336.1	455	339.8	460	343.5
Open Circuit Voltage (Voc/V)	48.5	45.5	48.7	45.7	48.9	45.8	49.1	46.0	49.3	46.2	49.5	46.4	49.7	46.6
Short Circuit Current (Isc/A)	11.31	9.15	11.39	9.21	11.46	9.27	11.53	9.33	11.60	9.38	11.66	9.43	11.73	9.48
Voltage at Maximum Power (Vmp/V)	40.7	37.9	40.9	38.1	41.1	38.3	41.3	38.5	41.5	38.6	41.7	38.8	41.9	39.0
Current at Maximum Power (Imp/A)	10.57	8.47	10.64	8.53	10.71	8.59	10.78	8.64	10.85	8.70	10.92	8.75	10.98	8.80
Module Efficiency(%)	19.8		20.0		20.2		20.5		20.7		20.9		21.2	

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ +5 W
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1500V (IEC/UL)
Maximum Series Fuse Rating	20A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Fire Rating	UL type 1 or 2

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

Temperature Coefficient of Isc	+0.048%/°C
Temperature Coefficient of Voc	-0.270%/°C
Temperature Coefficient of Pmax	-0.350%/°C



No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China.
 Web: en.longi-solar.com

Specifications included in this datasheet are subject to change without notice. LONGI reserves the right of final interpretation. (20210508V13)

Power Optimizer For Residential Installations

S440, S500



POWER OPTIMIZER

Enabling PV power optimization at the module level

- Specifically designed to work with SolarEdge residential inverters
- Detects abnormal PV connector behavior, preventing potential safety issues*
- Module-level voltage shutdown for installer and firefighter safety
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch loss, from manufacturing tolerance to partial shading
- Faster installations with simplified cable management and easy assembly using a single bolt
- Flexible system design for maximum space utilization
- Compatible with bifacial PV modules

* Functionality subject to inverter model and firmware version

solaredge.com



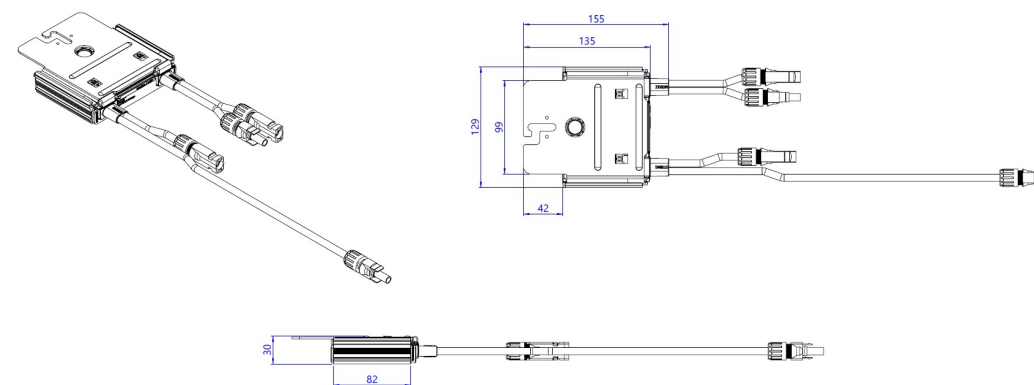
Power Optimizer For Residential Installations S440, S500

	S440	S500	UNIT
Rated Input DC Power ⁽¹⁾	440	500	W
Absolute Maximum Input Voltage (Voc)	60		Vdc
MPPT Operating Range	8 - 60		Vdc
Maximum Short Circuit Current (Isc) of Connected PV Module	14.5	15	Adc
Maximum Efficiency	99.5		%
Weighted Efficiency	98.6		%
Overvoltage Category	II		
OUTPUT DURING OPERATION			
Maximum Output Current	15		Adc
Maximum Output Voltage	60		Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM INVERTER OR INVERTER OFF)			
Safety Output Voltage per Power Optimizer	1		Vdc
STANDARD COMPLIANCE			
EMC	FCC Part 15 Class B, IEC61000-6-2, IEC61000-6-3, CISPR11, EN-55011		
Safety	IEC62109-1 (class II safety), UL1741		
Material	UL94 V-0, UV Resistant		
RoHS	Yes		
Fire Safety	VDE-AR-E 2100-712:2013-05		
INSTALLATION SPECIFICATIONS			
Maximum Allowed System Voltage	1000		Vdc
Dimensions (W x L x H)	129 x 155 x 30		mm
Weight (including cables)	655 / 1.5		gr / lb
Input Connector	MC4 ⁽²⁾		
Input Wire Length	0.1		m
Output Connector	MC4		
Output Wire Length	(+/-) 2.3, (-) 0.10		m
Operating Temperature Range ⁽³⁾	-40 to +85		°C
Protection Rating	IP68 / NEMA6P		
Relative Humidity	0 - 100		%

(1) Rated power of the module at STC will not exceed the Power Optimizer Rated Input DC Power. Modules with up to +5% power tolerance are allowed
 (2) For other connector types please contact SolarEdge
 (3) For ambient temperature above +70°C / +158°F power de-rating is applied. Refer to [Power Optimizers Temperature De-Rating Technical Note](#) for more details

PV System Design Using a SolarEdge Inverter		Single Phase HD-Wave	Three Phase	Three Phase for 277/480V Grid	
Minimum String Length (Power Optimizers)	S440, S500	8	16	18	
Maximum String Length (Power Optimizers)		25	50		
Maximum Nominal Power per String ⁽⁴⁾		5700	11250 ⁽⁵⁾	12750 ⁽⁶⁾	W
Parallel Strings of Different Lengths or Orientations			Yes		

(4) If the inverters rated AC power ≤ maximum nominal power per string, then the maximum power per string will be able to reach up to the inverters maximum input DC power Refer to: <https://www.solaredge.com/sites/default/files/se-power-optimizer-single-string-design-application-note.pdf>
 (5) For the 230/400V grid: it is allowed to install up to 13,500W per string when the maximum power difference between each string is 2,000W
 (6) For the 277/480V grid: it is allowed to install up to 15,000W per string when the maximum power difference between each string is 2,000W
 (7) It is not allowed to mix S-series and P-series Power Optimizers in new installations



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CE RoHS

Eaton general duty non-fusible safety switch

DG222URB

UPC:782113144238

Dimensions:

- **Height:** 14.38 IN
- **Length:** 7.38 IN
- **Width:** 8.69 IN

Weight:9 LB

Notes:WARNING! Switch is not approved for service entrance unless a neutral kit is installed.

Warranties:

- Eaton Selling Policy 25-000, one (1) year from the date of installation of the Product or eighteen (18) months from the date of shipment of the Product, whichever occurs first.

Specifications:

- **Type:** Non-fusible, single-throw
- **Amperage Rating:** 60A
- **Enclosure:** NEMA 3R, Rainproof
- **Enclosure Material:** Painted galvanized steel
- **Fuse Configuration:** Non-fusible
- **Number Of Poles:** Two-pole
- **Number Of Wires:** Two-wire
- **Product Category:** General duty safety switch
- **Voltage Rating:** 240V

Supporting documents:

- [Eatons Volume 2-Commercial Distribution](#)
- [Eaton Specification Sheet - DG222URB](#)

Certifications:

- UL Listed

Product compliance: No Data

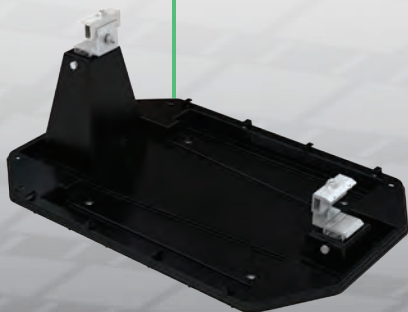
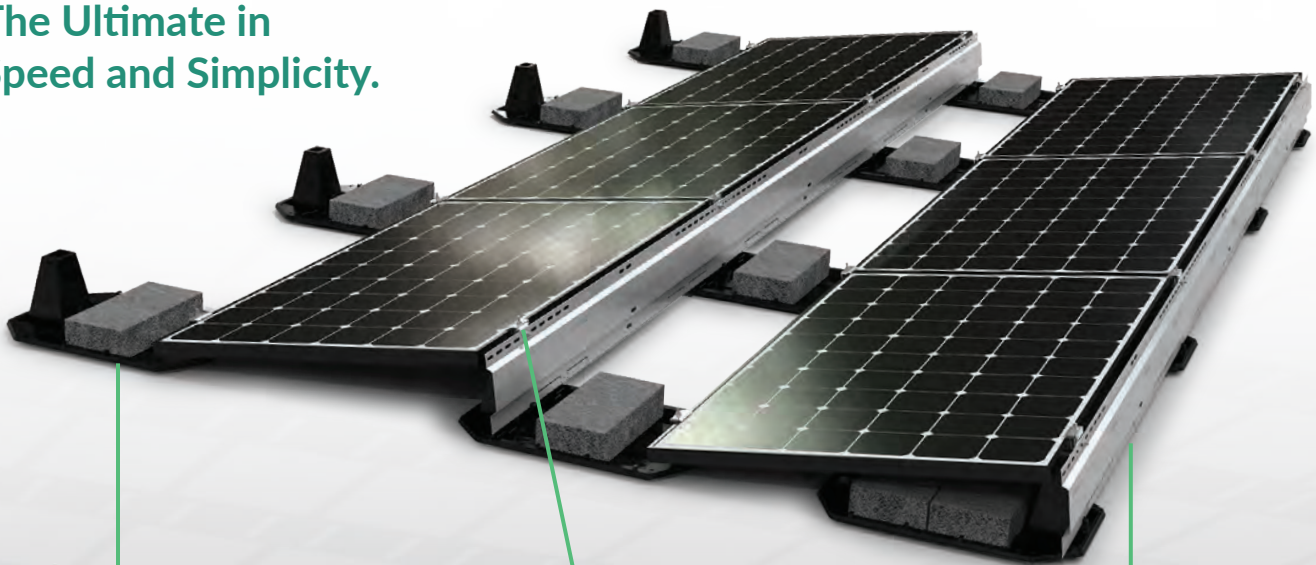
EcoFoot2[®]+

Ballasted Racking System

Installer-Preferred for Low-Slope Roofs

Three Main Components.

The Ultimate in
Speed and Simplicity.



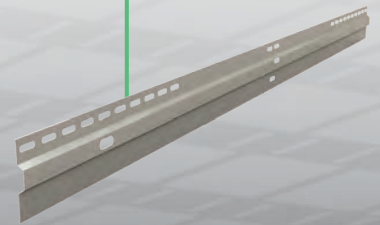
Base

UL-Listed ASA based resin is a durable material commonly used for automotive and construction products. Wire Clips are built-in for easy wire management. Class A fire rated and UL2703 Certified.



Universal Clamp

The preassembled Universal Clamp is ready to go right out of the box. Simply drop the Clamp into the Base. Integrated Bond Pin achieves integrated grounding without the use of grounding washers. Fits 30-50mm module frames with a single component.



Wind Deflector

Corrosion-resistant wind deflector on every module helps minimize uplift, reduce ballast requirements and carries UL2703 validated ground path from modules and racking components.



EcolibriumSolar

Contact: 740.249.1877 | sales@ecolibrumsolar.com | www.ecolibrumsolar.com

Pure Performance

Unbeatable, Right Out of the Box.

No other racking products install flat roof arrays better than EcoFoot2+ Racking Solution. Installers prefer EcoFoot2+ because it's fast, simple, and durable. The line-up is unbeatable:

- Ready-to-go, preassembled components and simple installation
- No PV panel prep required: bases self-align
- Low-effort roof layout, just two chalk lines required
- No training required, 5-minute learning curve

Master the Most Challenging Rooftop



Stackable Bases fit up to 50kW of Bases delivered on a standard pallet.

Technical Specifications

Dimensions: 26.5"L x 18.25"W x 8.3"H
Typical System Weight: 3.5–6 lbs. per sq. ft.
Module orientation: Landscape/Portrait
Tilt angle: Landscape 10°/Portrait 5°
Module inter-row spacing: 18.9"
Roof pitch: 0° to 7°
Clamping range: 30-50mm
Ballast requirements: 4" x 8" x 16"
Warranty: 25 years
Slip sheets: not required by Ecolibrium Solar.
If required by roofer, use 20"x29" under Base.

System Benefits

- Low part count
- Rapid system deployment
- Preassembled Universal Clamp
- Increased design flexibility
- More ballast capacity
- Simplified logistics
- Ship up to 50kW per pallet

Validation Summary

- Certified to UL2703 Fire Class A for Type I and II modules
- Certified to UL2703
- Grounding and Bonding
- Wind tunnel tested to 150mph
- SEAOC seismic compliant
- CFD and structurally tested
- DNV GL rated at 13.5 panels per installer-hour



Commercial



Residential



Design Flexibility



Wire Management Built-In

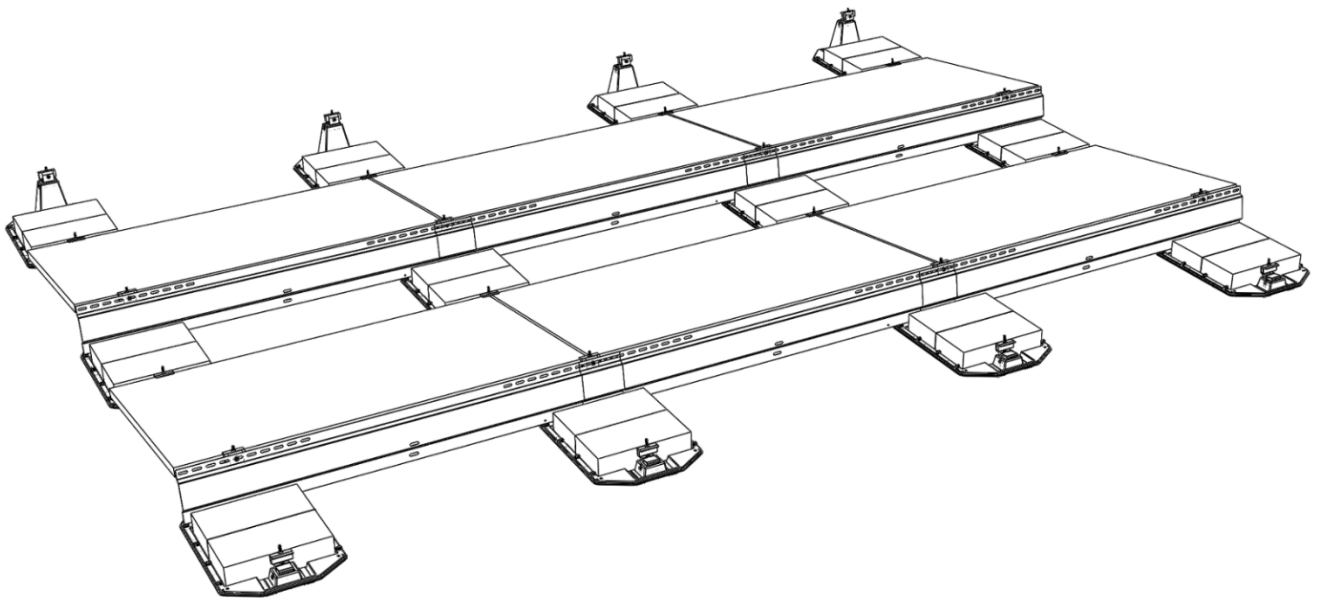


Ecolibrium Solar

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EcoFoot2+[®]



Installation Guide

EcoFoot2+[®] 10-Degree Ballasted Racking System

Document No. ECO-002_850

Rev 1.7, January 2020

Sales: 740-249-1877
Sales@EcolibriumSolar.com
Field Support: 866-488-6794
FieldSupport@EcolibriumSolar.com

Revision History

Revision	Description of Changes	Date
1.0	Initial EcoFoot2+ Release	2014-August-18
1.1	Updated for UL1703	2014-November-25
1.2	Module Removal Addendum	2015-January-08
1.3	Updated for UL2703	2017-January-10
1.4	Updated for Compatible Modules and Reformatting	2017-April-13
1.5	Updated for Grounding Method, Product Logo and Trademark Notice	2017-May-24
1.6	Updated UL2703 Fire Rating language Mid-Support Span Addendum B Added Ground Path Addendum C Added	2018-January-05
1.7	Update UL2703 Stamp	2020-January-27

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Field Support Contact Information

Ecolibrium Solar proudly offers dedicated engineering expertise and superior customer support. For questions about the installation procedures or a specific application, please contact our Field Support Specialists at 866-488-6794 or FieldSupport@EcolibriumSolar.com.

Installer Responsibility

The installer is solely responsible for:

- Utilizing all necessary safety equipment, as required by applicable rules and regulations.
- Complying with all applicable local and national building codes, including any that may supersede this manual.
- Ensuring that Ecolibrium Solar® EcoFoot2+® and other products are appropriate for the specific installation and are designed for the installation environment.
- Ensuring that the roof, its rafters, connections, and other structural support members can support the array under all conditions.
- Maintaining the waterproof integrity of the roof including selection of appropriate flashing if the system is being installed using attachments.
- Ensuring safe installation of all electrical aspects of the entire system

Legal Notices

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Disclaimer of Liability

ECOLIBRIUM SOLAR® does not assume responsibility and expressly disclaims liability for loss, damage, or expense arising out of, or in any way connected with installation, operation, use, or maintenance by using this manual.

ECOLIBRIUM SOLAR assumes no responsibility for any infringement of patents or other rights of third parties, which may result from use of modules. No license is granted by implication or under any patent or patent rights. The information in this manual is believed to be reliable, but does not constitute an expressed and/or implied warranty.

ECOLIBRIUM SOLAR reserves the right to make changes to the product, specifications, data sheets and this manual without prior notice. This document is not prescriptive regarding safety and does not purport to address all the safety concerns that may arise with its use. Contractors should become familiar with all applicable safety, health, and regulatory requirements before beginning work.

Unauthorized field modification of ECOLIBRIUM SOLAR components or assemblies may affect ECOLIBRIUM SOLAR warranty coverage. Provide written drawings for ECOLIBRIUM SOLAR's review, comment and approval prior to attempting any field modifications.

Warnings & Safety

Both electrical and roofing knowledge are required to correctly and safely install a solar photovoltaic system. Only qualified and certified installation professionals should install EcoFoot2+. Failure to follow the methods and procedures outlined in this guide may result in injury and/or damage to property.

Carefully read this guide before starting any work. Store a copy of this guide on the job site at all times and contact Ecolibrium Solar with any installation questions related to EcoFoot2+.

Please note the following warnings when installing EcoFoot2+:

- EcoFoot2+ components fit together tightly and could cause pinch injuries.
- EcoFoot2+ components may be hot to the touch if left in the sun.

Please follow the safety requirements below when installing EcoFoot2+:

- Always keep children and unauthorized people away from work areas.
- Always wear required OSHA approved Personal Protective Equipment (PPE).
- Always use insulated tools when working with or near electrical systems.
- Always provide OSHA approved fall protection for all installation personnel.
- Never wear jewelry during mechanical and electrical installation work.
- Never work in rain, snow or extremely windy conditions.
- Never leave a module unsupported or unsecured on the roof.
- Never install broken photovoltaic modules.
- Never use photovoltaic modules as a work surface.

EcoFoot2+ General Application Notes

Site-Specific System Design: Ecolibrium Solar provides drafting services on all EcoFoot2+ projects. This service produces a site-specific design package with an Engineered Stamped Layout including detailed ballast plan and bill of materials.

Roof Type: EcoFoot2+ is designed to mount photovoltaic modules to a range of roof surfaces, including: EPDM, TPO, PVC, Mineral Cap Sheet (a.k.a. Rolled Asphalt), Tar and Gravel.

Roof Slope Range: 0-7 degrees maximum, 3-degree limit for unattached seismic.

Wind Zone: EcoFoot2+ is designed to mount photovoltaic modules on flat roof surfaces with a maximum pitch of 7 degrees in areas with extreme wind conditions. Please contact Ecolibrium Solar for clarification or assistance.

Installation Requirements: EcoFoot2+ is ballasted photovoltaic racking designed as a system which requires all EcoFoot2+ components, the specific module, and ballast placement prescribed in the PE stamped design. The absence of any of these elements in any given sub-array could present a compromised condition on the roof. Arrays shall not be left unattended in such a state during an installation.

This install guide officially documents the components used and proper methods for an EcoFoot2+ installation. Bonding elements are incorporated into EcoFoot2+ components. As the system is built on the roof, components and modules are bonded together. Specific steps to ensure a bonded system are described through the installation guide. It is the installer’s responsibility to ensure that the system is safely and properly installed, and that the system is bonded back to a final ground point.

When wiring the array, keep bare copper from contacting bare aluminum.

Thermal and Seismic Design Requirements: EcoFoot2+ is a flexible and expandable design that accommodates various array geometries.

Maximum widths for arrays are as follows:

- 60-cell modules, 26 modules in a row
- 72-cell modules, 22 modules in a row

Minimum spacing between sub-arrays is 6”. Site specifics may further limit array sizes and spacing.

Re-Inspection: Ecolibrium recommends periodic re-inspection of the installation for loose components, loose fasteners, and any corrosion, such that if found, the affected components are to be immediately replaced.

Compatible Modules: Ecolibrium Solar has evaluated many photovoltaic modules for installation compatibility with the EcoFoot 2+ 10-degree racking system. A list of compatible modules may be found in “EcoFoot2+ Install Guide Appendix - Compatible Modules.pdf” on our website: www.ecolibriumsolar.com

UL2703 Qualification: In cases where UL 2703 certification is required, the EcoFoot2+ system conforms to the UL2703 Standard for grounding and bonding and fire ratings. The EcoFoot2+ system may be used to ground and/or mount a PV module complying with UL1703 only when the specific module has been evaluated for grounding and /or mounting in compliance with the included instructions.

EcoFoot2+ Racking maintains a Class A fire rating when installed in landscape orientation according to the installation instructions, on a low slope roof Class A roof with Type 1 and Type 2 modules.

Further information about Ecolibrium Solar’s UL2703 Listing, including module load ratings may be found in “EcoFoot2+ Install Guide Appendix - UL2703 Qualification.pdf” at www.ecolibriumsolar.com.

UL2703 System Label: The label shown below is stamped into to the Wind Deflector (identified as component 5 in the installation guide).

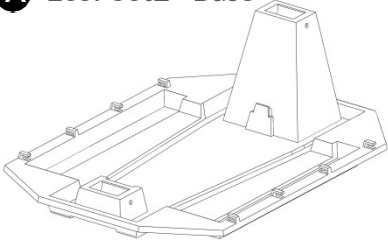


The Date Code **ABCYZZ** shown above will appear on production parts, letters defined as follows:

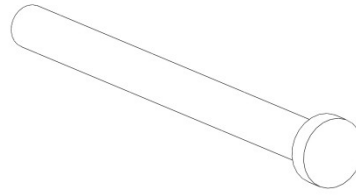
- ABC shall be an acronym for identifying the source factory
- Y shall be the Quarter of the year (i.e. 1, 2, 3, 4) of manufacture
- ZZ shall be the last 2 digits of the year of manufacture

EcoFoot2+® Core Components

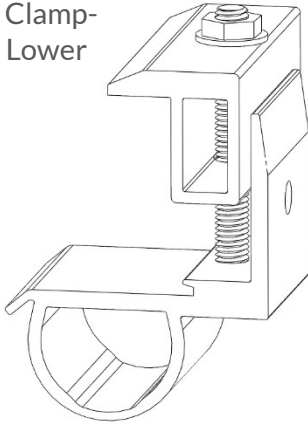
A EcoFoot2+ Base



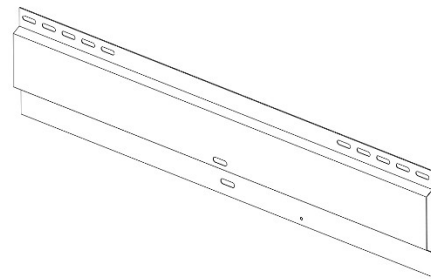
D Clevis Pin



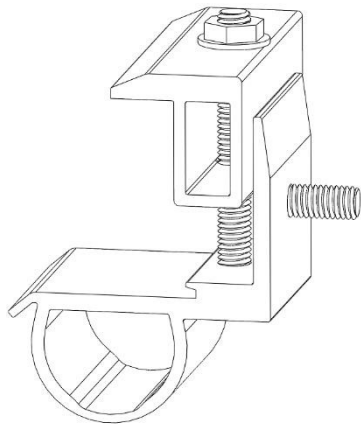
B Clamp-Lower



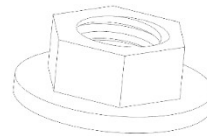
E Deflector



C Clamp-Upper



F Nut



EcoFoot2+™ Installation Instructions

- 1 Chalk lines on roof denoting two outside edges of the EcoFoot2+® according to project drawing. Place EcoFoot2+® Bases (A) in position.

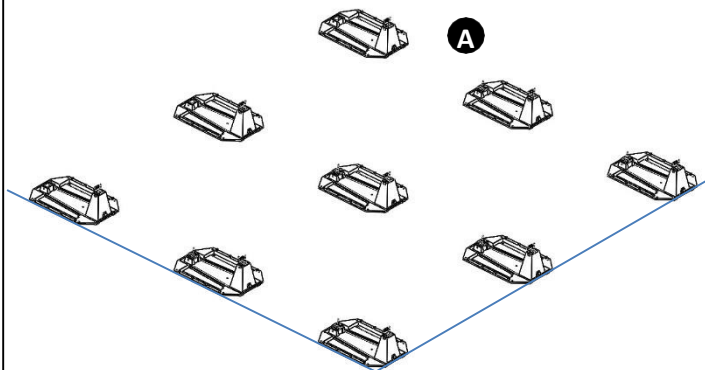
Tip: Ensure lines are square using 3-4-5 principle.

Tip: As you build the array, panels will space Bases. Roughly place a few rows of Bases at a time so that they are within reach of final location.

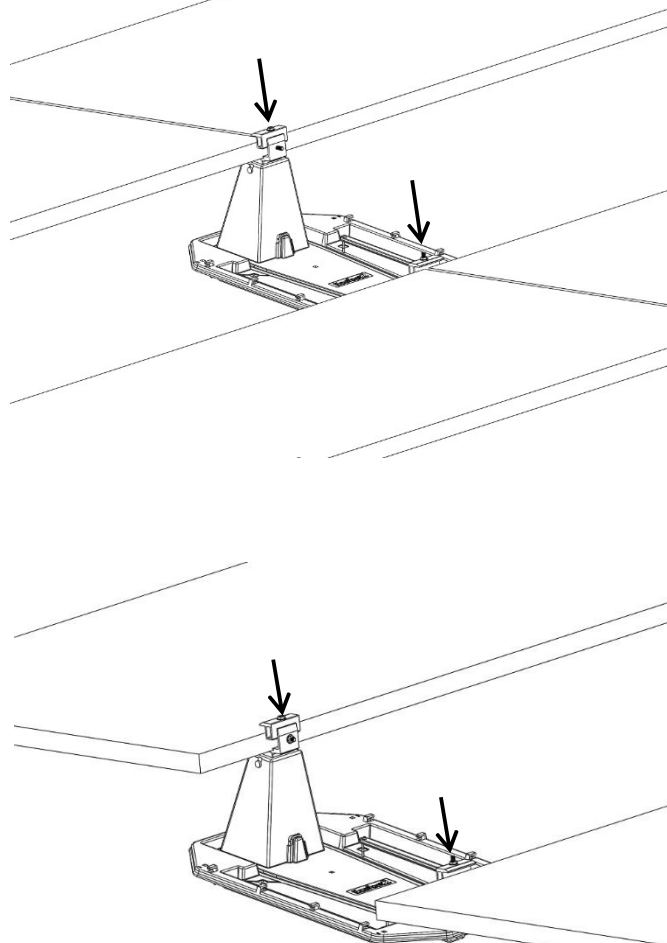
Tip: If installation requires 2 blocks or fewer on the north row, north row Bases can be turned around 180 degrees and tucked under the panel.

Tip: If installation requires butyl, then butyl will be preinstalled on the bottom of the Base with protective tape. Ensure these butyl components are placed where specified in project drawing.

Remove protective tape after step 6.

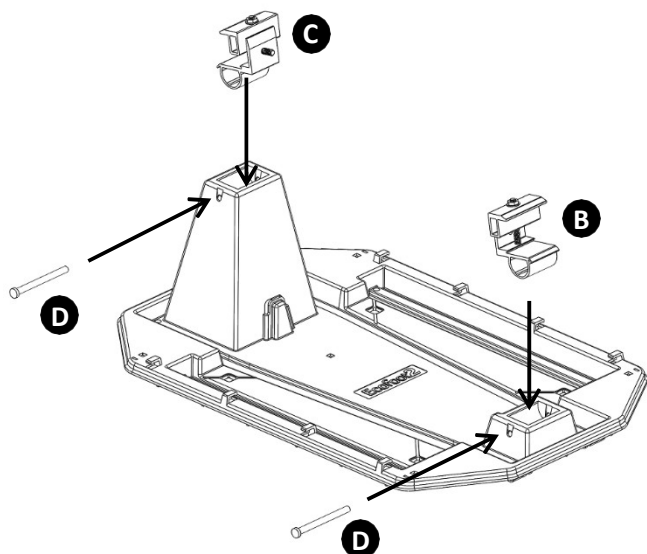


- 3 Place module onto EcoFoot2+® Base (A). Using a 1/2" deep socket, torque Nuts (F) to 14 ft-lbs. Space modules 1/2" apart using the alignment marks on the Clamps.



- 2 Place Lower Clamp (B) and Upper Clamp (C) into EcoFoot2+ Base (A) as shown. Push Clevis Pin (D) completely into EcoFoot2+® Base(A) to secure Rocker.

Tip: Only install Clamps where modules will rest. Refer to diagram below for correct placement and orientation of Clamps.

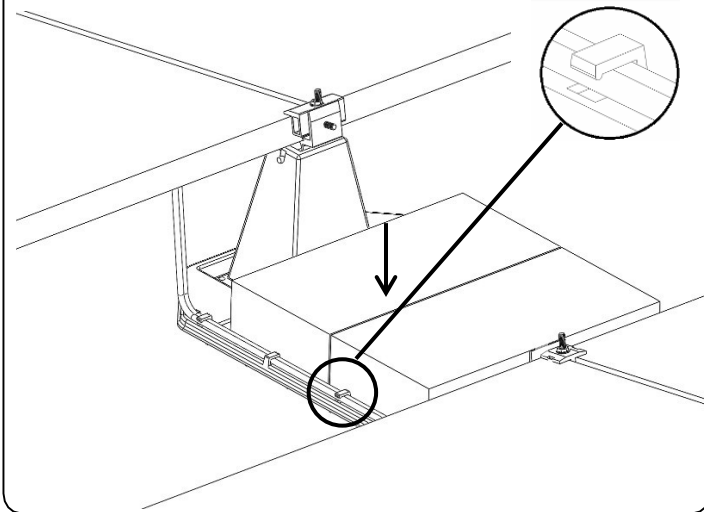


- 4** Place Ballast (not included) as required per PE Certified Ballast Plan provided.

Tip: See note below for ballast block placement. In freeze/thaw environments, use concrete block with minimum compressive strength of 3,000psi (ref ASTM C1491-03 Standard Specifications for Concrete Roof Pavers).

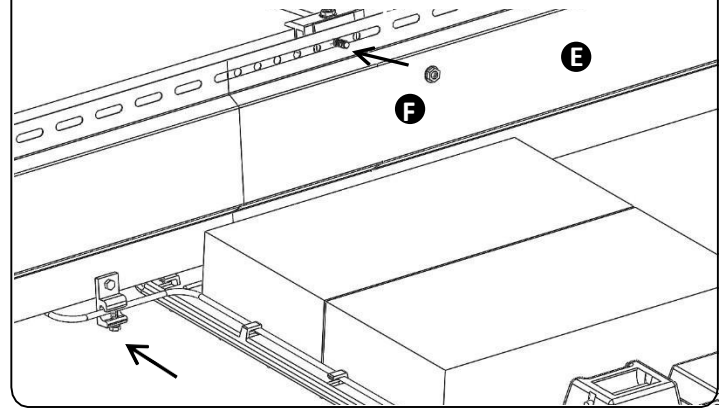
- 5** Route, connect and secure conductors.

Tip: Wire clips attached to the module flange (not included) can be used to dress conductors in a row of modules. Integrated snap features in the Base can be used to dress conductors bridging rows.



- 6** Place Deflectors (E) into slot on EcoFoot2+® Base and attach to Rocker using Nut (F) provided. Using a 1/2" deep socket, torque Nut (F) to 14 ft-lbs. Application of anti-seize on threaded post is recommended.

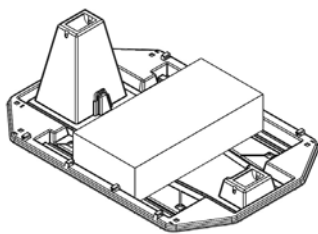
- 7** EcoFoot2+ is listed to carry module-to-module ground bond through the wind deflector. Each row of modules/wind deflectors must be grounded per the NEC and ANSI/NFPA 70 as described in Addendum C of this Install Guide. See Addendum C for requirements and Ground and Bond Path.



EcoFoot2+® Ballast Block Placement

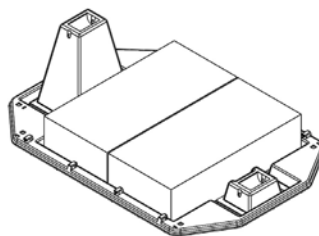
One Block

When using a single ballast block, lay the block flat in the center of EcoFoot2+ Base tray.



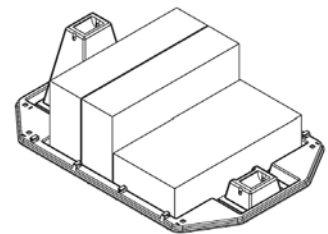
Two Blocks

When using two ballast blocks, lay the blocks flat in the EcoFoot2+ Base tray.

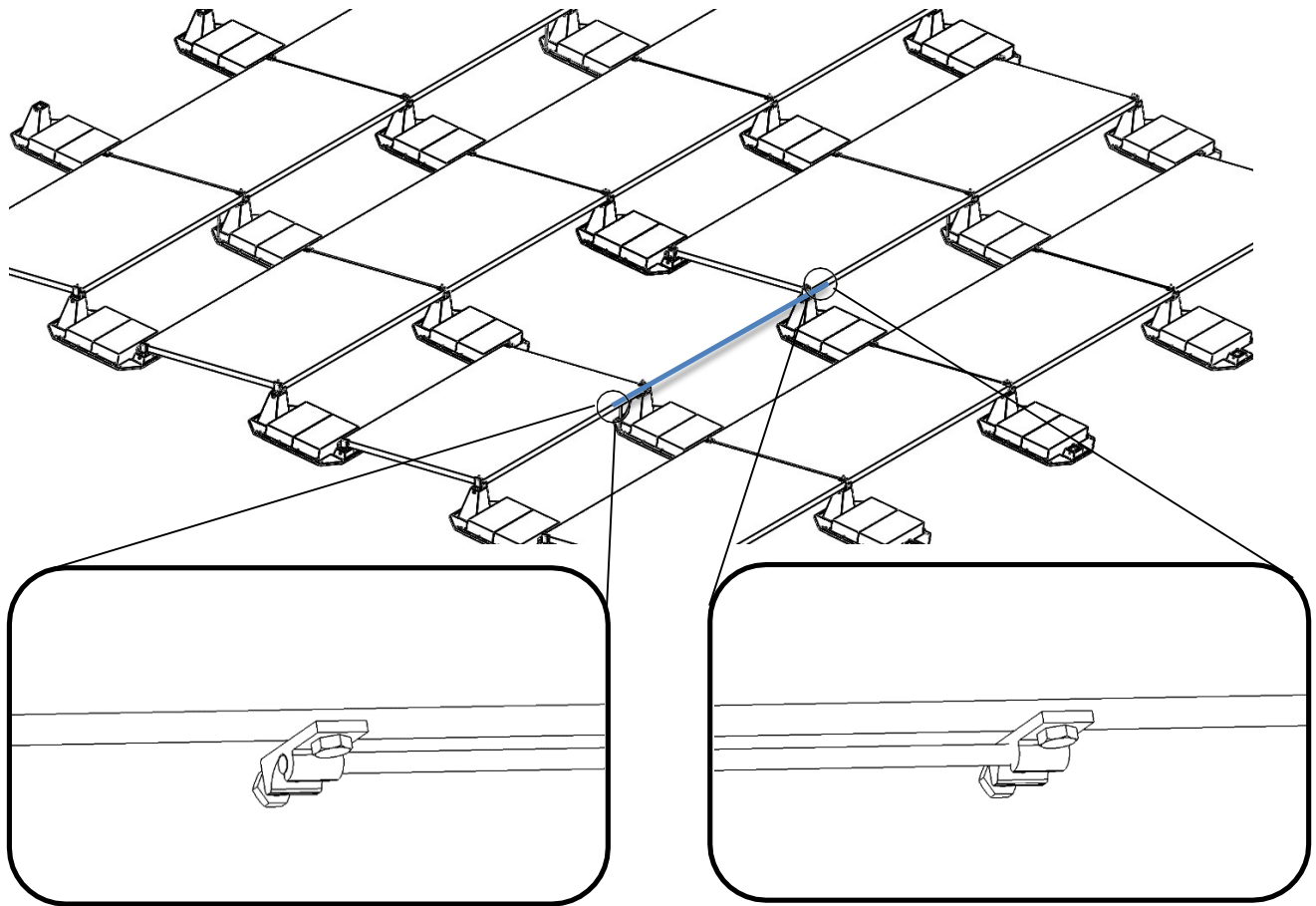


Three Blocks

When placing three ballast blocks in the EcoFoot2+ Base tray, lay one block flat and two on the long edge. This configuration helps to prevent blocks from becoming dislodged accidentally.



ADDENDUM A Module Removal



Note: If a module is to be removed from an array, the following steps must be taken.

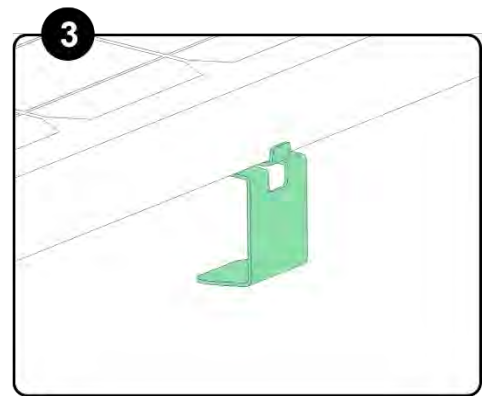
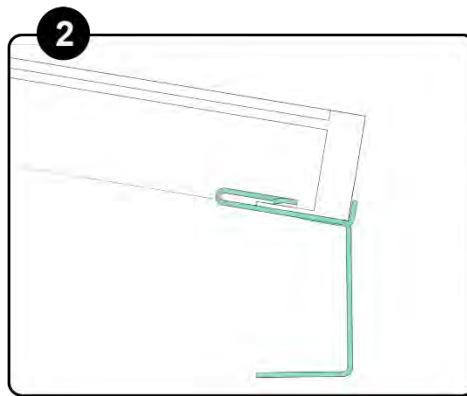
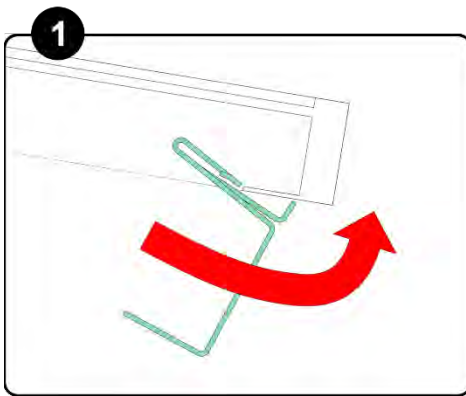
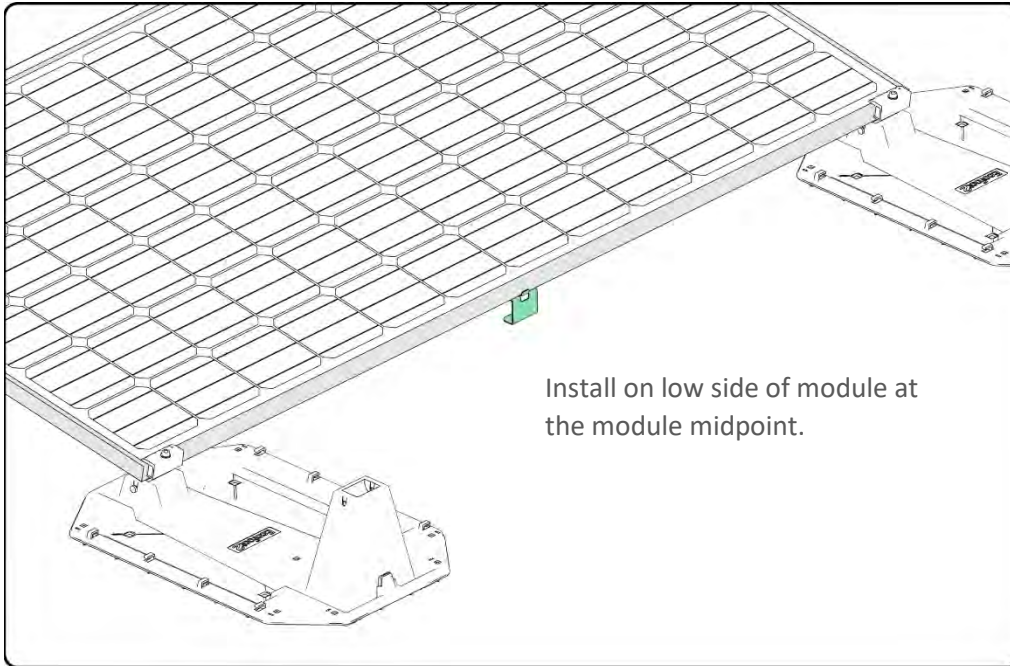
- a) **Determine module to be removed**
Identify and mark the module to be removed.
- b) **Install ground lug on adjacent modules**
Install a WEEB Lug 6.7 on both modules adjacent to the module to be removed. Utilize the grounding hole on the frame of the module.
- c) **Connect Bonding Jumper**
Lay a bare #6 CU conductor into the two lay in lugs connected to the adjacent modules. Tighten lay-in lug terminal screw onto the conductor and torque to 7 ft- lbs.

When wiring the array, keep bare copper from contacting bare aluminum.

ADDENDUM B Universal Support Brackets Installation

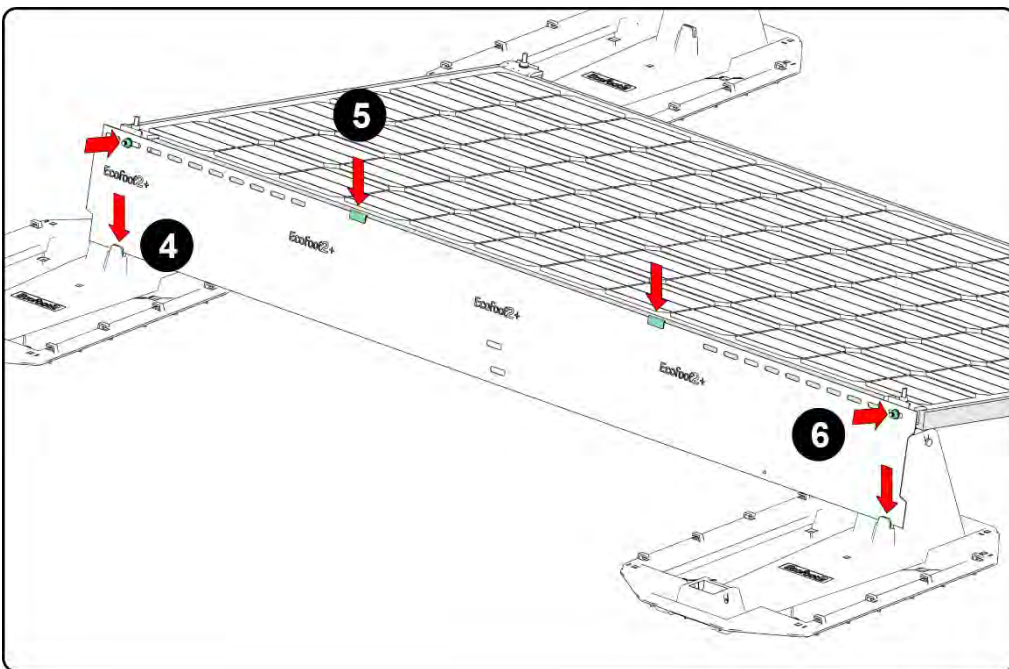
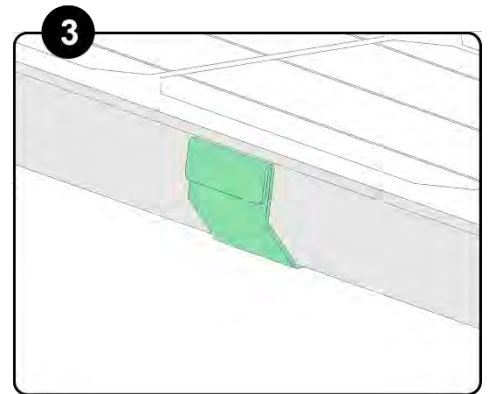
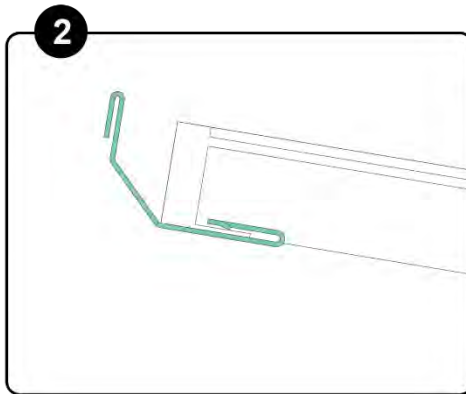
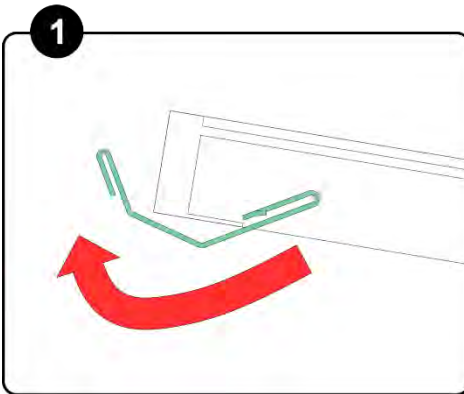
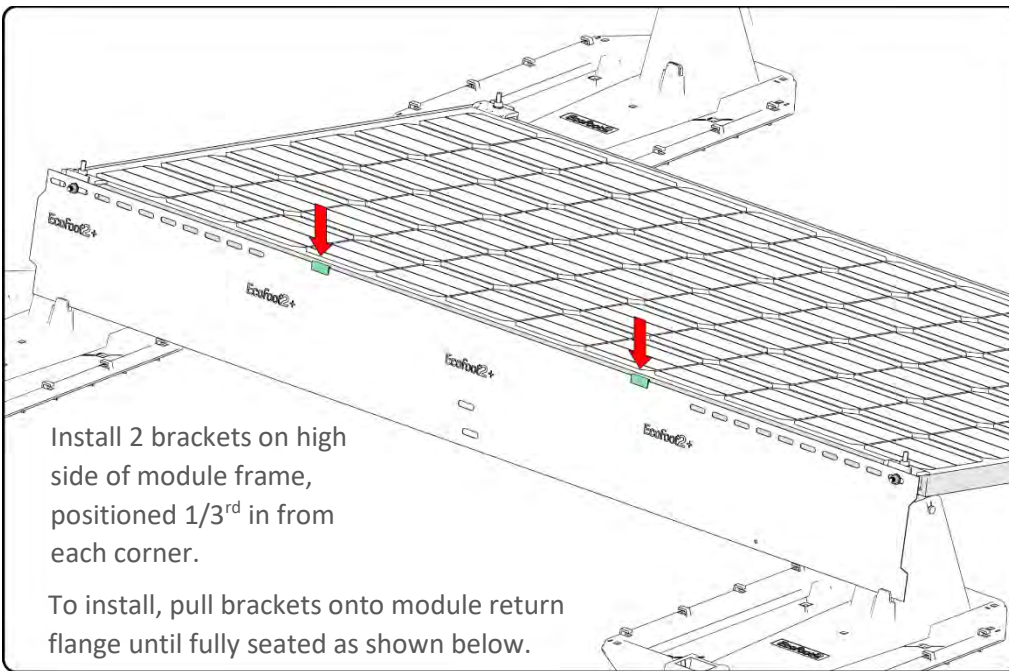
Universal Mid Support Brackets are a non-standard item and only used in heavy load conditions with light-duty panels. The design team at Ecolibrium Solar will indicate use when required.

Installing Lower Universal Mid-Support



To install, pull bracket onto the midpoint of module return flange until upright locking tab pops up on the frame's edge. This indicates the bracket is fully engaged.

Installing Upper Universal Mid-Support



Installing the Wind Deflector

- 4 Drop bottom of Wind Deflector into slot located on EcoFoot2+ Base..
- 5 Clip top of Wind Deflector into 2 Upper Universal Mid-Support Brackets.
- 6 Attach Wind Deflector to EcoFoot2+ Rocker using Nut provided.

ADDENDUM C Grounding & Bonding

The EcoFoot2+ system has been tested by TÜV Rheinland and conforms to UL 2703 for Grounding and Bonding when installed per the published installation instructions.

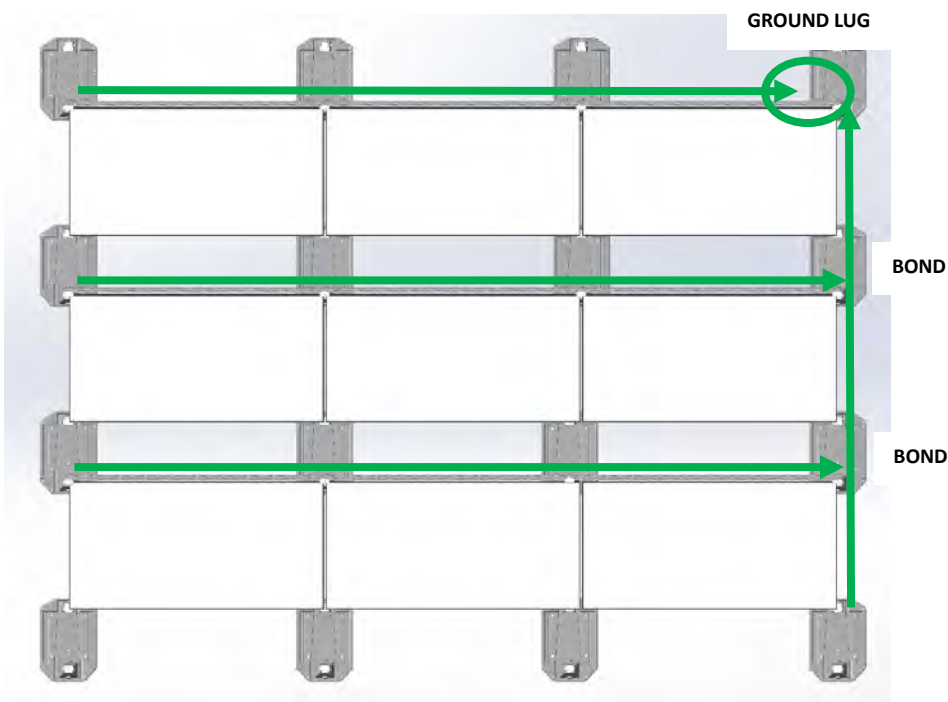
EcoFoot2+ carries module-to-module ground bond through the Wind Deflector, Item E listed in the “EcoFoot2+ Core Components” table in this document.

Each row of modules/wind deflectors in an array of up to 400 modules must be grounded per the NEC and ANSI/NFPA 70 either through the designated ground hole in the Wind Deflector, or by drilling a ¼” ground hole into the Wind Deflector a minimum of ½” from any edge. One Ground Lug is required for every 400 modules connected within an array.

Ecolibrium Solar recommends using #6 copper ground wire in conjunction with WEEB grounding devices such as the WEEB-LUG-6.7 or WEEB DSK516. Lugs are a single use component.

Other grounding methods must be reviewed and approved by a licensed master electrician or electrical engineer and Authority Having Jurisdiction (AHJ).

Ground hole with Lug Installed



Green lines represent ground bond path. Wind Deflectors carry module-to-module east/west ground bond. Bonding jumpers carry row-to-row north/south ground bond.

Images from recent installation at Canton Wine and Spirits Warehouse, 2017 Marietta Hwy, Canton, GA 30114

