



Planning & Building Department
6280 W 800N
McCordsville, IN 46055
Phone: 317.335.3604
Email: building@mccordsville.org

PUBLIC HEARING INFORMATION

Case #: BZA-22-002

Title: Blue Raven Solar's request for Development Standard Variance for roof-top solar panels

Meeting Date: this zoning petition is currently scheduled to be heard at the April 25th Board of Zoning Appeals meeting.

*Meeting agenda and staff report will be available on the website by end of business day on the Friday preceding the applicable meeting. Go to www.mcccordsville.org and click on "Agendas & Minutes".

Date: 3/10/22
Permit #: 20220078
Project Name: Jerry Dunn
Address: 6830 W Denton Dr. McCordsville, IN

To whom it may concern,

This letter is in response to our latest permit rejection.

"Sec. 401 b A variance will be required for solar panels on the front side of the building"

Our proposed solar system of 20 panels is mounted on the southernmost mounting plane of the home, which happens to be the front of Jerry's home, in the highest TSRF available. This configuration will allow our customers offset to 103% with an annual production of 11,250kwh. Without solar on southern mounting plane, they would decrease the system size to 18 panels due to insufficient space. This would cause a lose 5,382kwh annually and with a usage offset of 47.8%, which would only cover half of their energy needs.

For these reasons, there is no way for this customer to efficiently go solar without utilizing the southern plane of their home.

Please reach out to me directly if you have any questions.

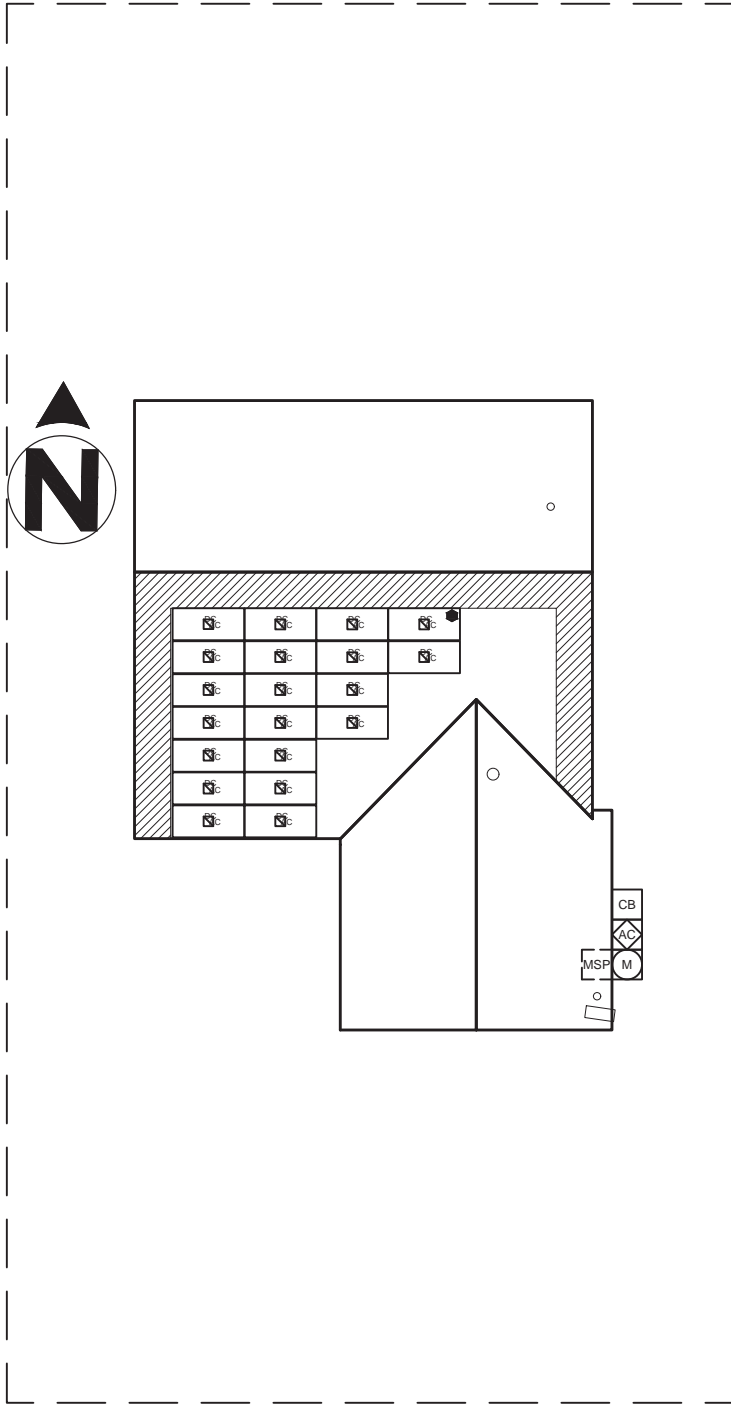
Thank you and I look forward to your response,

Jayson Day
Field and Design Operations Senior Manager
Jayson.Day@blueravensolar.com
design@blueravensolar.com
904.624.0798

Brian Funk
Design Specialist
brian.funk@blueravensolar.com
design@blueravensolar.com
385-273-1105



The Future of Energy. Today.



FRONT OF HOME
6830 W Denton Dr

Sealed For
Existing Roof &
Attachment Only



LEGEND

- JUNCTION BOX
- UTILITY METER
- MAIN SERVICE PANEL
- AC DISCONNECT
- COMBINER BOX
- LOAD CENTER
- SUBPANEL
- PV METER
- TRANSFER SWITCH
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

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



1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Jerry Dunn
6830 W Denton Dr
McCordsville, Indiana 46055
DC SYSTEM SIZE:
8 kW DC

DRAWING BY:
Enphase Energy

PLOT DATE:
February 22, 2022

PROJECT NUMBER:
467812

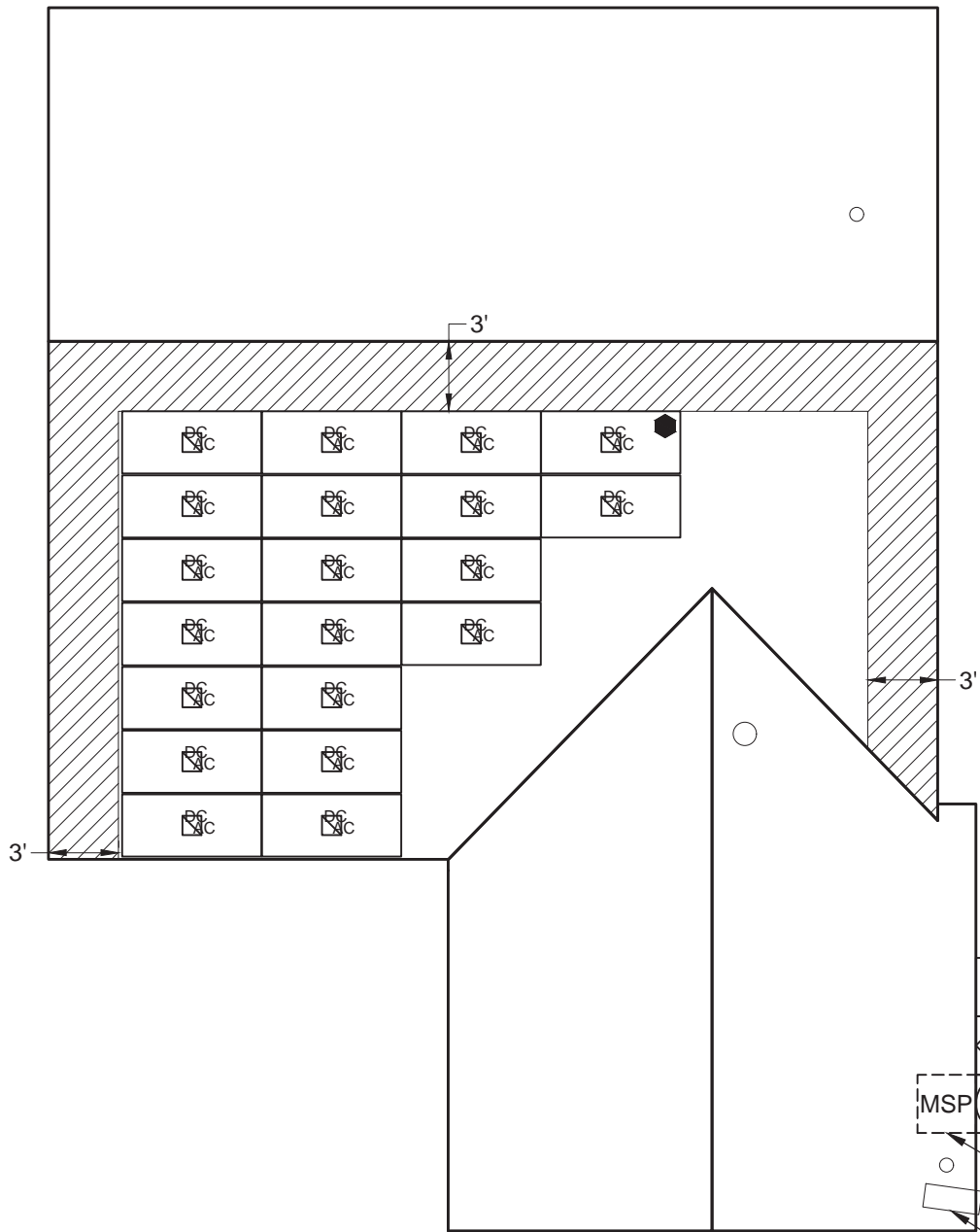
SHEET NAME:
SITE PLAN

REVISION:
0
PAGE NUMBER:
PV2

2/23/2022



MP1
OF MODULES: 20
AZIMUTH: 179
PITCH: 37
TSRF: 97%
AREA: 896 ft.²



Sealed For
Existing Roof &
Attachment Only



2/23/2022

LEGEND

- JUNCTION BOX
- UTILITY METER
- MAIN SERVICE PANEL
- AC DISCONNECT
- COMBINER BOX
- LOAD CENTER
- SUBPANEL
- PV METER
- TRANSFER SWITCH
- FIRE SETBACK
- TRENCHING
- PROPERTY LINE

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



1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.

NABCEP
CERTIFIED
PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Jerry Dunn
6830 W Denton Dr
McCordsville, Indiana 46055
DC SYSTEM SIZE:
8 kW DC

DRAWING BY:
Enphase Energy

PLOT DATE:
February 22, 2022

PROJECT NUMBER:
467812

SHEET NAME:
ROOF PLAN

REVISION:
0
PAGE NUMBER:
PV3

STRUCTURAL INFORMATION:

ROOF TYPE (1):

ROOF TYPE: Comp Shingle
SHEATHING TYPE: OSB
FRAMING TYPE: Manufactured Truss
FRAMING SIZE: 2x4 @ 24" OC
CEILING JOIST SIZE: 2x4 @ 24" OC

STANDOFF: SFM Infinity Switchblade Flashkit
RACKING: Unirac SFM Infinity
@ 48" OC Portrait / 72" OC Landscape

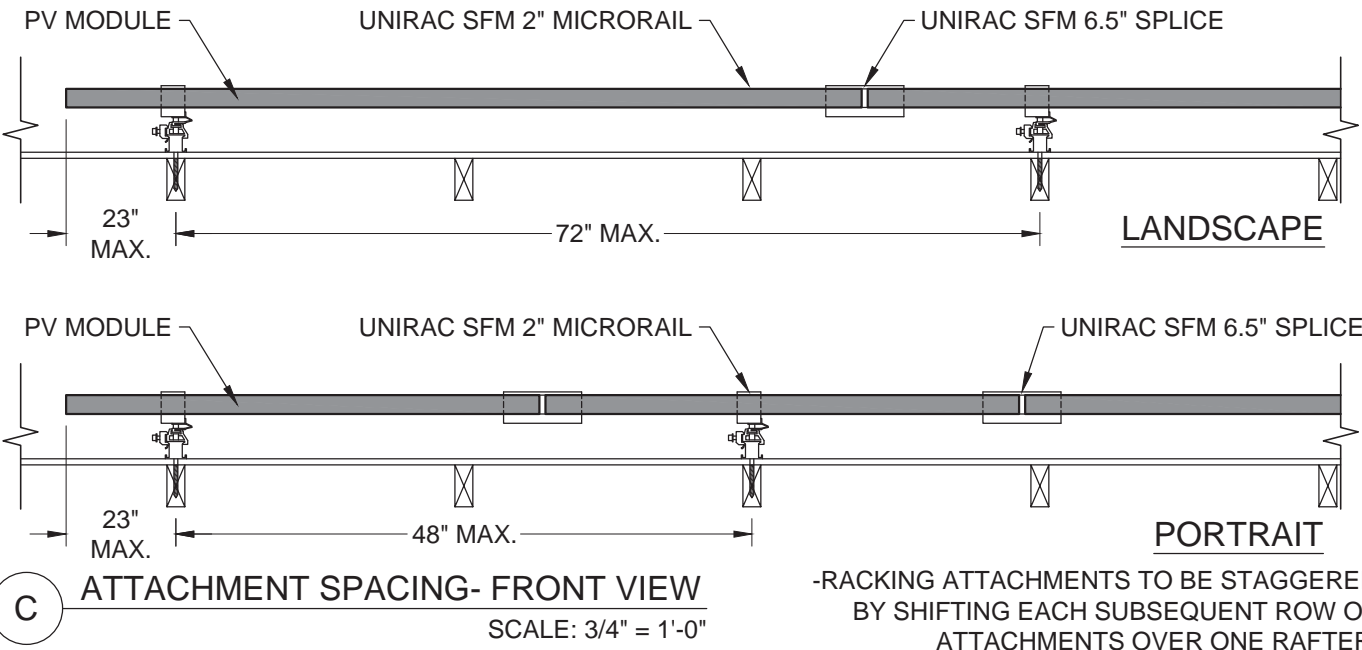
NUMBER OF ATTACHMENTS: 34

PV MODULE COUNT: 20 Modules
TOTAL ARRAY AREA: 350.2 ft² (17.51ft²/panel)
TOTAL ROOF AREA: 2128 ft²
ARRAY/ROOF AREA: 16.5%
ARRAY WEIGHT: 1,000 lbs (50 lbs/panel)
DISTRIBUTED LOAD: 2.86 lbs/ft²
POINT LOAD: 29.41 lbs/attachment

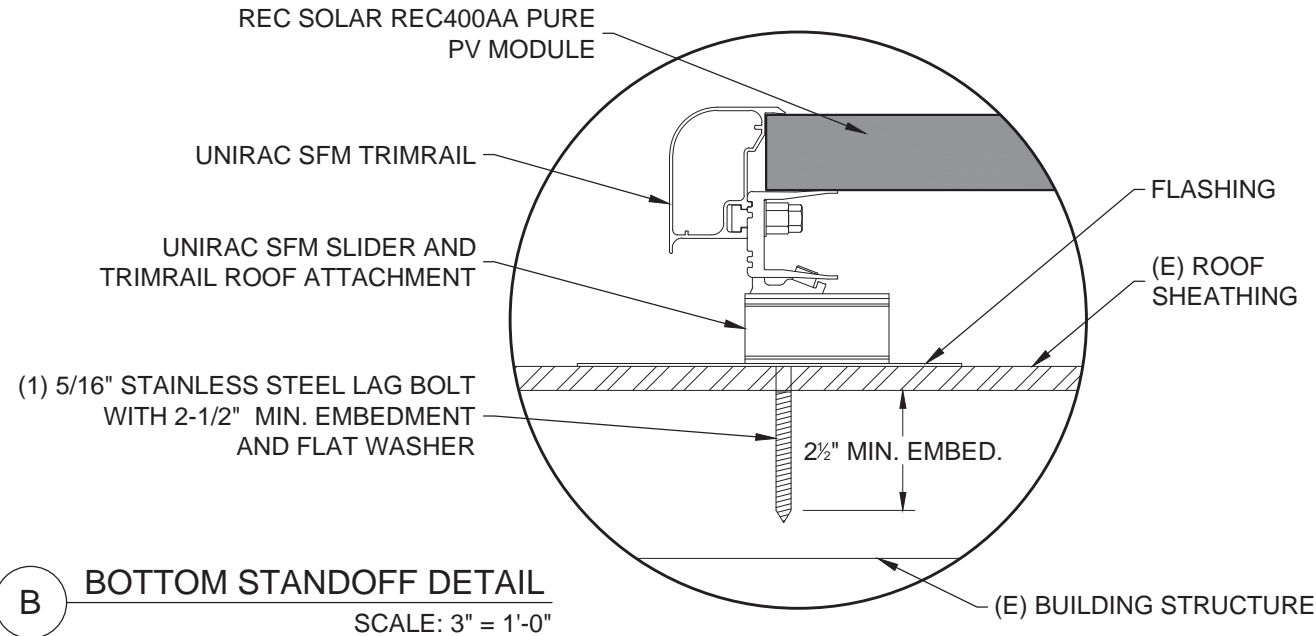
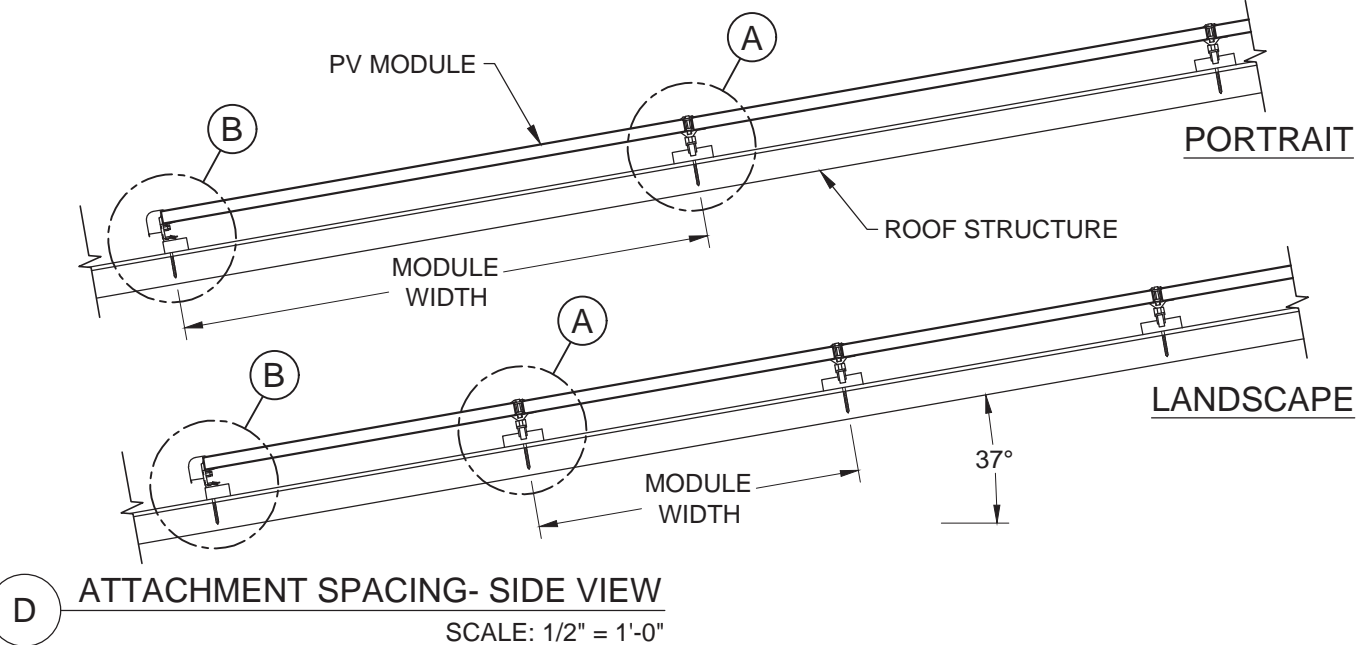
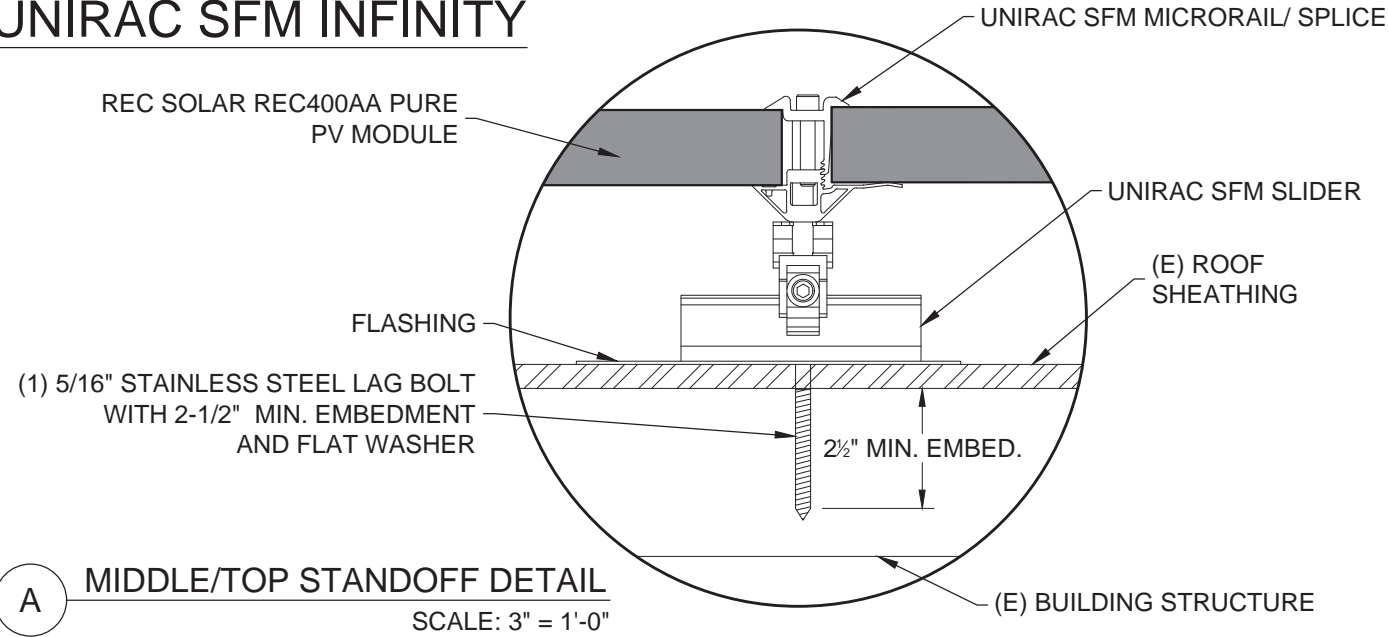
STRUCTURAL NOTES:

The bottom portion of MP 1 is vaulted, will need conduit run to the non vaulted portion of the MP

*NOTE: LISTED NUMBER OF ATTACHMENT POINTS ARE AN ESTIMATE ONLY AND MAY VARY BASED ON FIELD CONDITIONS. MAXIMUM ATTACHMENT SPACING TO BE FOLLOWED PER ENGINEER OF RECORD SPECIFICATIONS.



UNIRAC SFM INFINITY



Sealed For
Existing Roof &
Attachment Only



2/23/2022



1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:

Jerry Dunn
6830 W Denton Dr
McCordsville, Indiana 46055
DC SYSTEM SIZE:
8 kW DC

DRAWING BY: Enphase Energy	
PLOT DATE: February 22, 2022	
PROJECT NUMBER: 467812	
SHEET NAME: STRUCTURAL	
REVISION: 0	PAGE NUMBER: PV4

15	(1) 6 AWG THHN/THWN-2, CU., BLACK (L1)	24.2 A AC	3	(2) 10 AWG THHN/THWN-2, CU., BLACK (L1)	MAX 12.1 A AC	2	(1) 10 - 2 UF-B (or NM) W/G, THHN/THWN-2, SOLI	MAX 12.1 A AC	1	(1) 12-2 TC-ER,THHN/THWN-2, CU.	MAX 12.1 A AC	EXTERIOR
	(1) 6 AWG THHN/THWN-2, CU., RED (L2)	240 V AC		(2) 10 AWG THHN/THWN-2, CU., RED (L 2)	240 V AC			240 V AC		(1) 6 AWG BARE, CU (EGC)	240 V AC	
	(1) 10 AWG THHN/THWN-2, CU., WHITE (N)			(1) 10 AWG THHN/THWN-2, CU., GREEN (EGC)								
	(1) 10 AWG THHN/THWN-2, CU., GREEN (EGC)											
	(1) 3/4 INCH EMT	EXTERIOR		(1) 3/4 INCH EMT	EXTERIOR			INTERIOR			EXTERIOR	

DESIGNER NOTES:

LOAD SIDE BREAKER IN MSP, POI INTERIOR

ELECTRICAL NOTES:



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

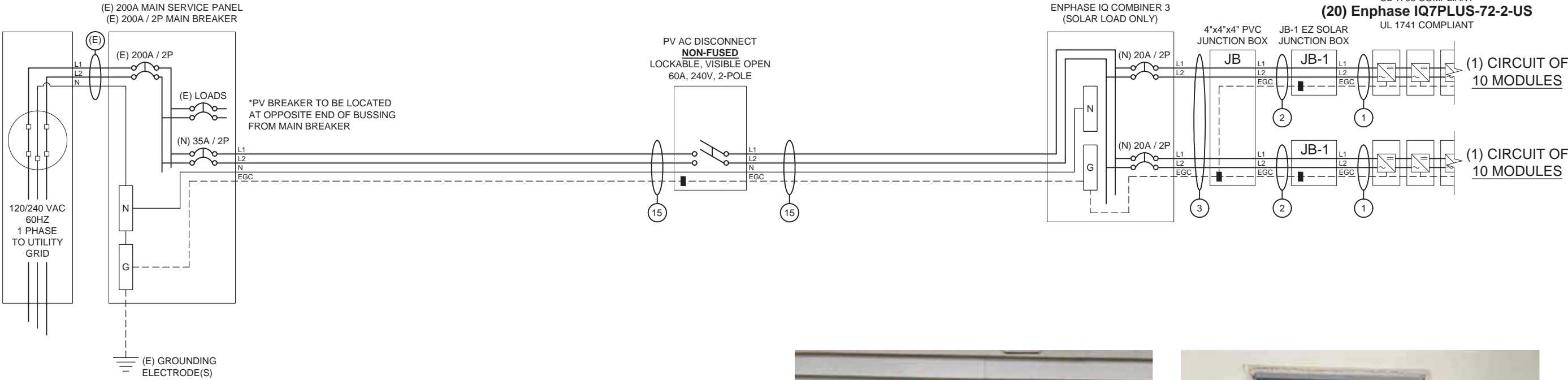
CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:

Jerry Dunn
6830 W Denton Dr
McCordsville, Indiana 46055

DC SYSTEM SIZE:
8 kW DC

DRAWING BY: Enphase Energy	
PLOT DATE: February 22, 2022	
PROJECT NUMBER: 467812	
SHEET NAME: ELECTRICAL	
REVISION: 0	PAGE NUMBER: PV5



INTERCONNECTION NOTES

705.12(B)(3) THE FOLLOWING METHOD(S) SHALL BE USED TO DETERMINE THE RATINGS OF BUSBARS: (2) WHERE TWO SOURCES, ONE A PRIMARY POWER SOURCE AND THE OTHER ANOTHER POWER SOURCE, ARE LOCATED AT OPPOSITE ENDS OF A BUSBAR THAT CONTAINS LOADS, THE SUM OF 125 PERCENT OF THE POWER-SOURCE(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUS BAR SHALL NOT EXCEED 120 PERCENT OF THE AMPACITY OF THE BUSBAR.



UTILITY COMPANY: Ninestar Connect



PERMIT ISSUER: Town of McCordsville

MODULE SPECIFICATIONS		REC Solar REC400AA Pure		DESIGN LOCATION AND TEMPERATURES							CONDUCTOR SIZE CALCULATIONS																								
RATED POWER (STC)		400 W		TEMPERATURE DATA SOURCE							ASHRAE 2% AVG. HIGH TEMP																								
MODULE VOC		48.8 V DC		STATE							Indiana																								
MODULE VMP		42.1 V DC		CITY							McCordsville																								
MODULE IMP		9.51 A DC		WEATHER STATION							INDIANAPOLIS INTL AP																								
MODULE ISC		10.3 A DC		ASHRAE EXTREME LOW TEMP (°C)							-22																								
VOC CORRECTION		-0.24 %/°C		ASHRAE 2% AVG. HIGH TEMP (°C)							32																								
VMP CORRECTION		-0.26 %/°C																																	
SERIES FUSE RATING		25 A DC																																	
ADJ. MODULE VOC @ ASHRAE LOW TEMP		54.3 V DC																																	
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP		37.8 V DC																																	
MICROINVERTER SPECIFICATIONS				Enphase IQ7+ Microinverters				SYSTEM ELECTRICAL SPECIFICATIONS				CIR 1				CIR 2				CIR 3				CIR 4				CIR 5				CIR 6			
POWER POINT TRACKING (MPPT) MIN/MAX				22 - 60 V DC				NUMBER OF MODULES PER MPPT				10				10																			
MAXIMUM INPUT VOLTAGE				60 V DC				DC POWER RATING PER CIRCUIT (STC)				4000				4000																			
MAXIMUM DC SHORT CIRCUIT CURRENT				15 A DC				TOTAL MODULE NUMBER																											
MAXIMUM USABLE DC INPUT POWER				440 W				STC RATING OF ARRAY																											
MAXIMUM OUTPUT CURRENT				1.21 A AC				AC CURRENT @ MAX POWER POINT (IMP)				12.1				12.1																			
AC OVERCURRENT PROTECTION				20 A				MAX. CURRENT (IMP X 1.25)				15.125				15.125																			
MAXIMUM OUTPUT POWER				290 W				OCPD CURRENT RATING PER CIRCUIT				20				20																			
CEC WEIGHTED EFFICIENCY				97 %				MAX. COMB. ARRAY AC CURRENT (IMP)																											
								MAX. ARRAY AC POWER																											

STANDARD LABELS

⚠️

WARNING

ELECTRIC SHOCK HAZARD

TERMINALS ON THE LINE AND
LOAD SIDES MAY BE ENERGIZED
IN THE OPEN POSITION

LABEL 1
FOR PV SYSTEM DISCONNECTING MEANS WHERE THE LINE AND LOAD TERMINALS MAY BE ENERGIZED IN THE OPEN POSITION. *[NEC 690.13(B)]*

⚠️

PHOTOVOLTAIC SYSTEM
AC DISCONNECT ⚠️

RATED AC OUTPUT CURRENT 24.2 A
NOMINAL OPERATING AC VOLTAGE 240 V

LABEL 2
SHALL BE MARKED AT AN ACCESSIBLE LOCATION AT THE DISCONNECTING MEANS AS A POWER SOURCE AND WITH THE RATED AC OUTPUT CURRENT AND THE NOMINAL OPERATING AC VOLTAGE. *[NEC 690.54]*

⚠️

WARNING

DUAL POWER SUPPLY

SOURCES: UTILITY GRID AND
PV SOLAR ELECTRIC SYSTEM

LABEL 3
IF INTERCONNECTING LOAD SIDE, INSTALL THIS LABEL ANYWHERE THAT IS POWERED BY BOTH THE UTILITY AND THE SOLAR PV SYSTEM, IE. MAIN SERVICE PANEL AND SUBPANELS. *[NEC 705.12(B)(3)]*

⚠️

WARNING

POWER SOURCE OUTPUT CONNECTION

DO NOT RELOCATE
THIS OVERCURRENT
DEVICE

LABEL 4
APPLY TO THE DISTRIBUTION EQUIPMENT ADJACENT TO THE BACK-FED BREAKER FROM THE POWER SOURCE. *[NEC 705.12(B)(2)]*

⚠️

WARNING

THIS EQUIPMENT FED BY MULTIPLE
SOURCES. TOTAL RATING OF ALL
OVERCURRENT DEVICES, EXCLUDING
MAIN SUPPLY OVERCURRENT
DEVICE, SHALL NOT EXCEED
AMPACITY OF BUSBAR.

LABEL 5
APPLY TO THE PV COMBINER BOX
[NEC 705.12 (3)(3)]

SOLAR PV SYSTEM EQUIPPED
WITH RAPID SHUTDOWN

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

LABEL 6
BUILDINGS WITH PV SYSTEMS SHALL HAVE A PERMANENT LABEL LOCATED AT EACH SERVICE EQUIPMENT LOCATION TO WHICH THE PV SYSTEMS ARE CONNECTED OR AT AN APPROVED READILY VISIBLE LOCATION AND SHALL INDICATE THE LOCATION OF RAPID SHUTDOWN INITIATION DEVICES. *[NEC 690.56(C)]*

RAPID SHUTDOWN
SWITCH FOR
SOLAR PV SYSTEM

LABEL 7
SIGN LOCATED AT RAPID SHUT DOWN DISCONNECT SWITCH *[NEC 690.56(C)(2)]*

LABELING NOTES
1) LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
2) LABELING REQUIREMENTS BASED ON THE 2017 & 2020 NEC CODE, OSHA STANDARD 19010.145, ANSIZ535.
3) MATERIAL BASED ON THE REQUIREMENTS OF THE AHJ.
4) LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED AND SHALL NOT BE HANDWRITTEN [NEC 110.21]

⚠️

WARNING

MAIN DISTRIBUTION UTILITY DISCONNECT(S)

POWER TO THIS BUILDING IS ALSO SUPPLIED
FROM A ROOF MOUNTED SOLAR ARRAY WITH
A RAPID SHUTDOWN DISCONNECTING MEANS
GROUPED AND LABELED WITHIN LINE OF SITE
AND 10 FT OF THIS LOCATION

⚠️

WARNING

POWER TO THIS BUILDING IS ALSO
SUPPLIED FROM MAIN DISTRIBUTION
UTILITY DISCONNECT LOCATED

⚠️

WARNING

POWER TO THIS BUILDING IS ALSO SUPPLIED
FROM A ROOF MOUNTED SOLAR ARRAY. SOLAR
ARRAY RAPID SHUTDOWN DISCONNECT IS
LOCATED OUTSIDE NEXT TO THE UTILITY METER.

⚠️

WARNING

PHOTOVOLTAIC SYSTEM
COMBINER PANEL

DO NOT ADD LOADS

WARNING: PHOTOVOLTAIC
POWER SOURCE

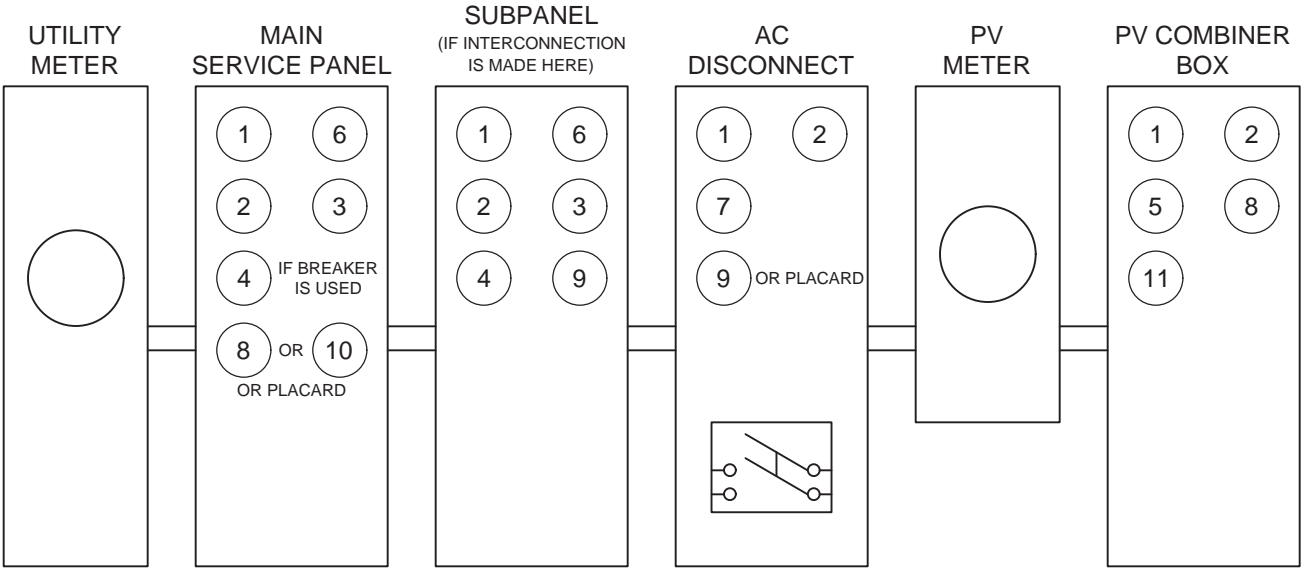
LABEL 8
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. *[2017 NEC 705.10]*

LABEL 9
PERMANENT PLAQUE OR DIRECTORY DENOTING THE LOCATION OF ALL ELECTRIC POWER SOURCE DISCONNECTING MEANS ON OR IN THE PREMISES SHALL BE INSTALLED AT EACH SERVICE EQUIPMENT LOCATION AND AT THE LOCATION(S) OF THE SYSTEM DISCONNECT(S) FOR ALL ELECTRIC POWER PRODUCTION SOURCES CAPABLE OF BEING INTERCONNECTED. *[2017 NEC 705.10]*

LABEL 10
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT MAIN SERVICE EQUIPMENT DENOTING THE LOCATION OF THE RAPID SHUTDOWN SYSTEM DISCONNECTING MEANS IF SOLAR ARRAY RAPID SHUTDOWN DISCONNECTING SWITCH IS NOT GROUPED AND WITHIN LINE OF SITE OF MAIN SERVICE DISCONNECTING MEANS. *[2017 NEC 705.10 AND 690.56(C)(1)]*

LABEL 11
PERMANENT PLAQUE OR DIRECTORY TO BE LOCATED AT AC COMBINER PANEL. *[NEC 110.21(B)]*

LABEL 12
AT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS. *[NEC 690.31(G)(3&4)]*



ADDITIONAL LABELS



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.

NABCEP
CERTIFIED

PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

CUSTOMER INFORMATION:
Jerry Dunn
6830 W Denton Dr
McCordsville, Indiana 46055

DC SYSTEM SIZE:
8 kW DC

DRAWING BY:
Enphase Energy

PLOT DATE:
February 22, 2022

PROJECT NUMBER:
467812

SHEET NAME:
LABELS

REVISION: 0
PAGE NUMBER: PV7

*ELECTRICAL DIAGRAM SHOWN ABOVE IS FOR LABELING PURPOSES ONLY. NOT AN ACTUAL REPRESENTATION OF EQUIPMENT AND CONNECTIONS TO BE INSTALLED. LABEL LOCATIONS PRESENTED MAY VARY DEPENDING ON TYPE OF INTERCONNECTION METHOD AND LOCATION PRESENTED ON 3 LINE DIAGRAM. 3 LINE DIAGRAM ON PV5 TO REFLECT ACTUAL REPRESENTATION OF PROPOSED SCOPE OF WORK.

Enphase
IQ 7 and IQ 7+
Microinverters

The high-powered smart grid-ready **Enphase IQ 7 Micro™** and **Enphase IQ 7+ Micro™** dramatically simplify the installation process while achieving the highest system efficiency.

Part of the Enphase IQ System, the IQ 7 and IQ 7+ Microinverters integrate with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.



Easy to Install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014 & 2017)

Productive and Reliable

- Optimized for high powered 60-cell/120 half-cell and 72-cell/144 half-cell* modules
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

Smart Grid Ready

- Complies with advanced grid support, voltage and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA)

* The IQ 7+ Micro is required to support 72-cell/144 half-cell modules.

Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)		IQ7-60-2-US		IQ7PLUS-72-2-US	
Commonly used module pairings ¹		235 W - 350 W +		235 W - 440 W +	
Module compatibility		60-cell/120 half-cell PV modules only		60-cell/120 half-cell and 72-cell/144 half-cell PV modules	
Maximum input DC voltage		48 V		60 V	
Peak power tracking voltage		27 V - 37 V		27 V - 45 V	
Operating range		16 V - 48 V		16 V - 60 V	
Min/Max start voltage		22 V / 48 V		22 V / 60 V	
Max DC short circuit current (module Isc)		15 A		15 A	
Overvoltage class DC port		II		II	
DC port backfeed current		0 A		0 A	
PV array configuration		1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20 A per branch circuit		1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20 A per branch circuit	
OUTPUT DATA (AC)		IQ 7 Microinverter		IQ 7+ Microinverter	
Peak output power		250 VA		295 VA	
Maximum continuous output power		240 VA		290 VA	
Nominal (L-L) voltage/range ²		240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current		1.0 A (240 V)	1.15 A (208 V)	1.21 A (240 V)	1.39 A (208 V)
Nominal frequency		60 Hz		60 Hz	
Extended frequency range		47 - 68 Hz		47 - 68 Hz	
AC short circuit fault current over 3 cycles		5.8 Arms		5.8 Arms	
Maximum units per 20 A (L-L) branch circuit ³		16 (240 VAC)	13 (208 VAC)	13 (240 VAC)	11 (208 VAC)
Overvoltage class AC port		III		III	
AC port backfeed current		18 mA		18 mA	
Power factor setting		1.0		1.0	
Power factor (adjustable)		0.85 leading ... 0.85 lagging		0.85 leading ... 0.85 lagging	
EFFICIENCY		@240 V	@208 V	@240 V	@208 V
Peak efficiency		97.6 %	97.6 %	97.5 %	97.3 %
CEC weighted efficiency		97.0 %	97.0 %	97.0 %	97.0 %
MECHANICAL DATA					
Ambient temperature range		-40°C to +65°C			
Relative humidity range		4% to 100% (condensing)			
Connector type		MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)			
Dimensions (HxWxD)		212 mm x 175 mm x 30.2 mm (without bracket)			
Weight		1.08 kg (2.38 lbs)			
Cooling		Natural convection - No fans			
Approved for wet locations		Yes			
Pollution degree		PD3			
Enclosure		Class II double-insulated, corrosion resistant polymeric enclosure			
Environmental category / UV exposure rating		NEMA Type 6 / outdoor			
FEATURES					
Communication		Power Line Communication (PLC)			
Monitoring		Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.			
Disconnecting means		The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.			
Compliance		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 C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.			

1. No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/en-us/support/module-compatibility>.
2. Nominal voltage range can be extended beyond nominal if required by the utility.
3. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.



1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL - THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



CONTRACTOR:
BRS FIELD OPS
385.498.6700



To learn more about Enphase offerings, visit enphase.com



To learn more about Enphase offerings, visit enphase.com



© 2020 Enphase Energy. All rights reserved. Enphase, the Enphase logo, Enphase IQ 7, Enphase IQ 7+, Enphase IQ Battery, Enphase Enlighten, Enphase IQ Envoy, and other trademarks or service names are the trademarks of Enphase Energy, Inc. Data subject to change. 2020-08-12

SHEET NAME

SPEC SHEET

PAGE NUMBER

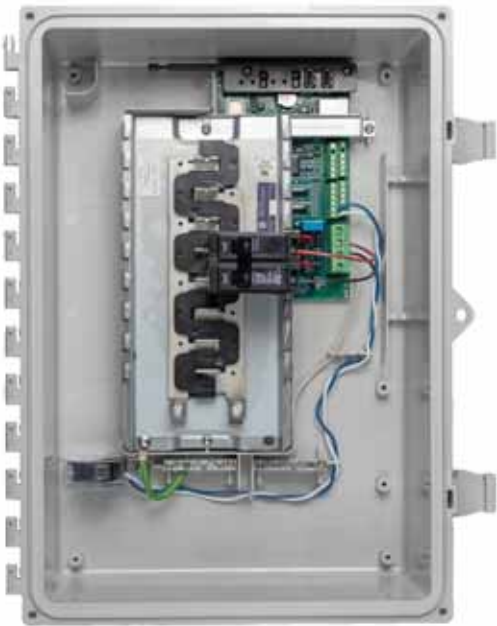
SS

REVISION

0

Enphase
IQ Combiner 3
(X-IQ-AM1-240-3)

The **Enphase IQ Combiner 3™** with Enphase IQ Envoy™ consolidates interconnection equipment into a single enclosure and streamlines PV 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 Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Optional AC receptacle available for PLC bridge
- Provides production metering and optional consumption monitoring

Simple

- Reduced size from previous combiner
- Centered mounting brackets support single stud mounting
- Supports back and side conduit entry
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year limited warranty
- UL listed



To learn more about Enphase offerings, visit enphase.com

Enphase IQ Combiner 3

MODEL NUMBER	
IQ Combiner 3 X-IQ-AM1-240-3	IQ Combiner 3 with Enphase IQ Envoy™ printed circuit board for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional* consumption monitoring (+/- 2.5%).
ACCESSORIES and REPLACEMENT PARTS (not included, order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G/12-year data plan) CELLMODEM-01 (3G/5-year data plan) CELLMODEM-M1 (4G based LTE-M/5-year data plan) Consumption Monitoring* CT CT-200-SPLIT <small>* Consumption monitoring is required for Enphase Storage Systems</small>	Plug and play industrial grade cellular modem with data plan for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.) Split core current transformers enable whole home consumption metering (+/- 2.5%).
Wireless USB adapter COMMS-KIT-01	Installed at the IQ Envoy. For communications with Enphase Encharge™ storage and Enphase Enpower™ smart switch. Includes USB cable for connection to IQ Envoy or Enphase IQ Combiner™ and allows redundant wireless communication with Encharge and Enpower.
Circuit Breakers BRK-10A-2-240 BRK-15A-2-240 BRK-20A-2P-240	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
EPLC-01	Power line carrier (communication bridge pair), quantity - one pair
XA-PLUG-120-3	Accessory receptacle for Power Line Carrier in IQ Combiner 3 (required for EPLC-01)
XA-ENV-PCBA-3	Replacement IQ Envoy printed circuit board (PCB) for Combiner 3
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	120/240 VAC, 60 Hz
Eaton BR series busbar rating	125 A
Max. continuous current rating (output to grid)	65 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. continuous current rating (input from PV)	64 A
Max. total branch circuit breaker rating (input)	80A of distributed generation / 90A with IQ Envoy breaker included
Production Metering CT	200 A solid core pre-installed and wired to IQ Envoy
MECHANICAL DATA	
Dimensions (WxHxD)	49.5 x 37.5 x 16.8 cm (19.5" x 14.75" x 6.63"). Height is 21.06" (53.5 cm with mounting brackets).
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	• 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
Ethernet	Optional, 802.3, Cat5E (or Cat 6) UTP Ethernet cable (not included)
Cellular	Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G) or CELLMODEM-M1 (4G based LTE-M) (not included)
COMPLIANCE	
Compliance, 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)
Compliance, IQ Envoy	UL 60601-1/CANCSA 22.2 No. 61010-1

To learn more about Enphase offerings, visit enphase.com

© 2018 Enphase Energy. All rights reserved. Enphase, the Enphase logo, IQ Combiner 3, and other trademarks or service names are the trademarks of Enphase Energy, Inc.
2019-11-04



1403 N RESEARCH WAY, BUILDING J
OREM, UT 84097

800-377-4480
[WWW.BLUERAVENSOLAR.COM](https://www.blueravensolar.com)

CONFIDENTIAL - THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



CONTRACTOR:
BRS FIELD OPS
385.498.6700

SHEET NAME
SPEC SHEET

PAGE NUMBER
SS

REVISION
0

SOLAR'S MOST TRUSTED





REC ALPHA[®]

PURE SERIES

PRODUCT SPECIFICATIONS

COMPACT PANEL SIZE

410 WP

222 W/M²

PRODUCT

LABOR

PERFORMANCE

25 YEAR

PROTRUST WARRANTY

ELIGIBLE



LEAD-FREE

ROHS COMPLIANT


EXPERIENCE



PERFORMANCE

REC ALPHA PURE SERIES

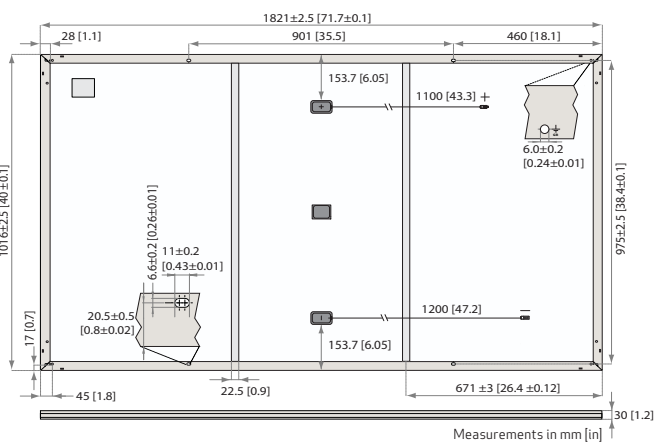
PRODUCT SPECIFICATIONS



SOLAR'S MOST TRUSTED

GENERAL DATA

Cell type:	132 half-cut REC heterojunction cells with lead-free, gapless technology, 6 strings of 22 cells in series
Glass:	3.2 mm solar glass with anti-reflective surface treatment in accordance with EN 12150
Backsheet:	Highly resistant polymer (black)
Frame:	Anodized aluminum (black)
Junction box:	3-part, 3 bypass diodes, lead-free IP68 rated, in accordance with IEC 62790
Connectors:	Stäubli MC4 PV-KBT4/KST4 (4 mm ²) in accordance with IEC 62852, IP68 only when connected
Cable:	4 mm ² solar cable, 1.1 m + 1.2 m in accordance with EN 50618
Dimensions:	1821 x 1016 x 30 mm (1.85 m ²)
Weight:	20.5 kg
Origin:	Made in Singapore



Measurements in mm [in]

STC

	Product Code*: RECxxxAA Pure					
Power Output - P _{MAX} (Wp)	385	390	395	400	405	410
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V _{MPP} (V)	41.2	41.5	41.8	42.1	42.4	42.7
Nominal Power Current - I _{MPP} (A)	9.35	9.40	9.45	9.51	9.56	9.61
Open Circuit Voltage - V _{OC} (V)	48.5	48.6	48.7	48.8	48.9	49.0
Short Circuit Current - I _{SC} (A)	10.18	10.19	10.20	10.25	10.30	10.35
Power Density (W/m ²)	208	211	214	216	219	222
Panel Efficiency (%)	20.8	21.1	21.4	21.6	21.9	22.2

NMOT

Power Output - P _{MAX} (Wp)	293	297	301	305	309	312
Nominal Power Voltage - V _{MPP} (V)	38.8	39.1	39.4	39.7	40.0	40.2
Nominal Power Current - I _{MPP} (A)	7.55	7.59	7.63	7.68	7.72	7.76
Open Circuit Voltage - V _{OC} (V)	45.7	45.8	45.9	46.0	46.1	46.2
Short Circuit Current - I _{SC} (A)	8.16	8.20	8.24	8.28	8.32	8.36

Values at standard test conditions (STC: air mass AM1.5, irradiance 1000 W/m², temperature 25°C), based on a production spread with a tolerance of P_{MAX}, V_{OC} & I_{SC} ±3% within one watt class. Nominal module operating temperature (NMOT: air mass AM1.5, irradiance 800 W/m², temperature 20°C, windspeed 1 m/s). * Where xxx indicates the nominal power class (P_{MAX}) at STC above.

MAXIMUM RATINGS

Operational temperature:	-40 ... +85°C
Maximum system voltage:	1000 V
Maximum test load (front):	+7000 Pa (713 kg/m ²)*
Maximum test load (rear):	-4000 Pa (407 kg/m ²)*
Max series fuse rating:	25 A
Max reverse current:	25 A

* See installation manual for mounting instructions.
Design load = Test load / 1.5 (safety factor)







WARRANTY

	Standard	REC ProTrust
Installed by an REC Certified Solar Professional	No	Yes
System Size	All	<25 kW 25-500 kW
Product Warranty (yrs)	20	25
Power Warranty (yrs)	25	25
Labor Warranty (yrs)	0	25
Power in Year 1	98%	98%
Annual Degradation	0.25%	0.25%
Power in Year 25	92%	92%

See warranty documents for details. Conditions apply

CERTIFICATIONS

IEC 61215:2016, IEC 61730:2016, UL 61730
IEC 62804 PID
IEC 61701 Salt Mist
IEC 62716 Ammonia Resistance
ISO 11925-2 Ignitability (Class E)
IEC 62782 Dynamic Mechanical Load
IEC 61215-2:2016 Hailstone (35mm)
IEC 62321 Lead-free acc. to RoHS EU 863/2015
ISO 14001, ISO 9001, IEC 45001, IEC 62941



Lead-Free recycling scheme

TEMPERATURE RATINGS*

Nominal Module Operating Temperature: 44°C (±2°C)

Temperature coefficient of P_{MAX}: -0.26 %/°C

Temperature coefficient of V_{OC}: -0.24 %/°C

Temperature coefficient of I_{SC}: 0.04 %/°C

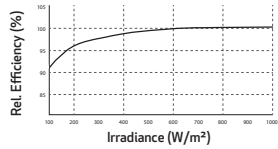
*The temperature coefficients stated are linear values

DELIVERY INFORMATION


Panels per pallet:	33
Panels per 40 ft GP/high cube container:	792 (24 pallets)
Panels per 13.6 m truck:	924 (28 pallets)
Panels per 53 ft truck:	891 (27 pallets)

LOW LIGHT BEHAVIOUR

Typical low irradiance performance of module at STC:




Founded in 1996, REC Group is an international pioneering solar energy company dedicated to empowering consumers with clean, affordable solar power. As Solar's Most Trusted, REC is committed to high quality, innovation, and a low carbon footprint in the solar materials and solar panels it manufactures. Headquartered in Norway with operational headquarters in Singapore, REC also has regional hubs in North America, Europe, and Asia-Pacific.



www.recgroup.com

Ref: PM-DS-12-06-Rev- E 11/21

Specifications subject to change without notice.



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

NABCEP

CERTIFIED

PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:

BRS FIELD OPS

385-498-6700

SHEET NAME:

SPEC SHEET

REVISION:

PAGE NUMBER:

SS

Product data sheet
Characteristics

DU222RB
Safety switch, general duty, non fusible, 60A,
2 poles, 10 hp, 240 VAC, NEMA 3R, bolt-on
provision

Product availability : Stock - Normally stocked in distribution facility



Price* : 353.00 USD



Main

Product	Single Throw Safety Switch
Current Rating	60 A
Certifications	UL listed file E2875
Enclosure Rating	NEMA 3R
Disconnect Type	Non-fusible disconnect switch
Factory Installed Neutral	None
Mounting Type	Surface
Number of Poles	2
Electrical Connection	Lugs
Duty Rating	General duty
Voltage Rating	240 V AC
Wire Size	AWG 12...AWG 3 aluminium AWG 14...AWG 3 copper

Complementary

Short-circuit withstand	200 kA
Maximum Horse Power Rating	10 hp 240 V AC 60 Hz 1 phase NEC 430.52
Tightening torque	35 lbf.in (3.95 N.m) 0.00...0.01 in² (2.08...5.26 mm²) AWG 14...AWG 10) 35 lbf.in (3.95 N.m) AWG 14...AWG 10) 45 lbf.in (5.08 N.m) 0.01 in² (8.37 mm²) AWG 8) 45 lbf.in (5.08 N.m) 0.02...0.03 in² (12.3...21.12 mm²) AWG 6...AWG 4) 50 lbf.in (5.65 N.m) 0.04 in² (26.67 mm²) AWG 3)
Height	9.63 in (244.60 mm)
Width	7.75 in (196.85 mm)
Depth	3.75 in (95.25 mm)

* Price is "List Price" and may be subject to a trade discount – check with your local distributor or retailer for actual price.

Apr 21, 2021



1

Ordering and shipping details

Category	00106 - D & DU SW,NEMA3R, 30-200A
Discount Schedule	DE1A
GTIN	00785901491491
Nbr. of units in pkg.	1
Package weight(Lbs)	4.65 lb(US) (2.11 kg)
Returnability	Yes
Country of origin	MX

Packing Units

Unit Type of Package 1	PCE
Package 1 Height	5.30 in (13.462 cm)
Package 1 width	7.20 in (18.288 cm)
Package 1 Length	10.00 in (25.4 cm)
Unit Type of Package 2	CAR
Number of Units in Package 2	5
Package 2 Weight	24.60 lb(US) (11.158 kg)
Package 2 Height	10.70 in (27.178 cm)
Package 2 width	10.20 in (25.908 cm)
Package 2 Length	23.50 in (59.69 cm)
Unit Type of Package 3	PAL
Number of Units in Package 3	120
Package 3 Weight	610.00 lb(US) (276.691 kg)
Package 3 Height	36.50 in (92.71 cm)
Package 3 width	40.00 in (101.6 cm)
Package 3 Length	48.00 in (121.92 cm)

Offer Sustainability

Sustainable offer status	Green Premium product
California proposition 65	WARNING: This product can expose you to chemicals including: Lead and lead compounds, which is known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov
REACH Regulation	REACH Declaration
REACH free of SVHC	Yes
EU RoHS Directive	Compliant EU RoHS Declaration
Toxic heavy metal free	Yes
Mercury free	Yes
RoHS exemption information	Yes
China RoHS Regulation	China RoHS declaration Pro-active China RoHS declaration (out of China RoHS legal scope)
Environmental Disclosure	Product Environmental Profile
PVC free	Yes

Contractual warranty

Warranty	18 months
----------	-----------



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

SHEET NAME:

SPEC SHEETS

REVISION:

0

PAGE NUMBER:

SS



2

SS

Carlon® Non-Metallic Junction Boxes

Molded Non-Metallic Junction Boxes — 6P Rated

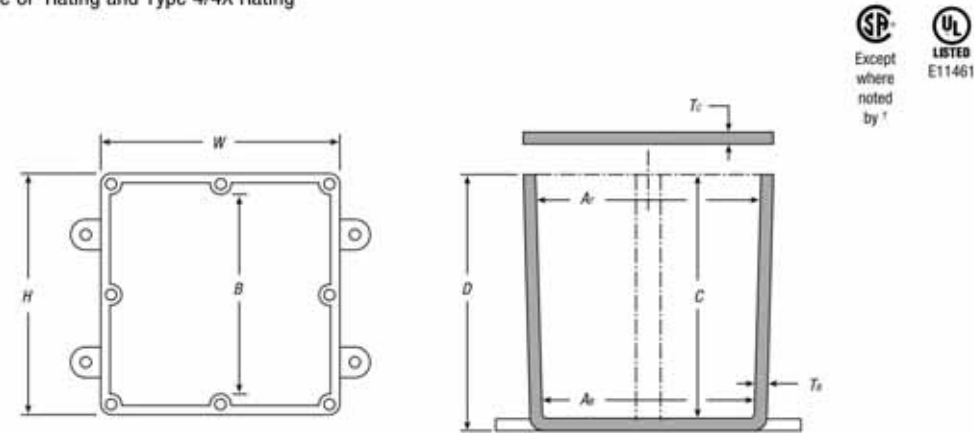
Non-metallic junction boxes are UL® Listed with a NEMA 6P rating per Section 314.28 of the National Electrical Code® and CSA Certified per Section 12 of the Canadian Electrical Code. Manufactured from PVC or PPO thermoplastic molding compound and featuring foam-in-place gasketed lids attached with stainless steel screws, these rugged enclosures offer all the corrosion resistance and physical properties you need for direct burial applications.

Type 6P enclosures are intended for indoor or outdoor use, primarily to provide a degree of protection against contact with enclosed equipment, falling dirt, hose-directed water, entry of water during prolonged submersion at a limited depth and external ice formation.

- All Carlon® Junction Boxes are UL® Listed/CSA Certified and maintain a minimum of a NEMA Type 4/4X Rating
- Part numbers with an asterisk (*) are UL® Listed and maintain a NEMA Type 6P Rating and Type 4/4X Rating

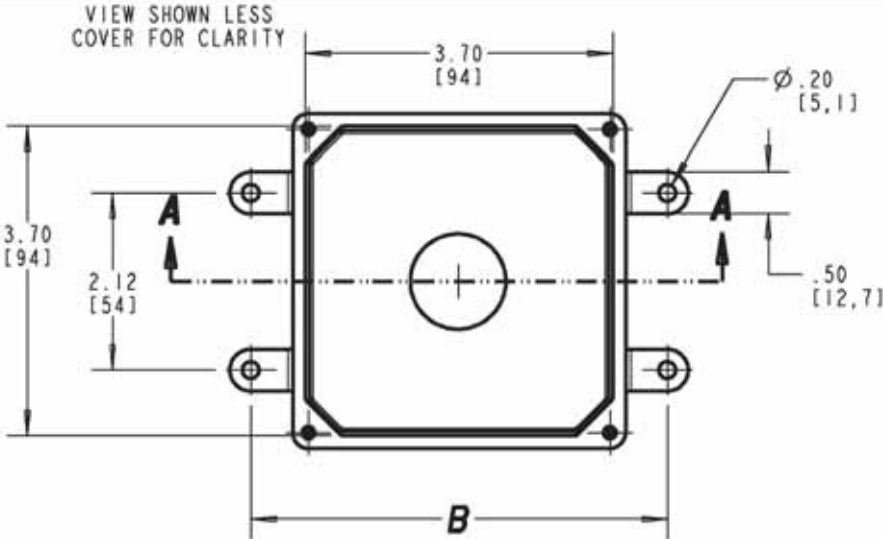


Boxes & Covers — Carlon® Enclosures & Junction Boxes



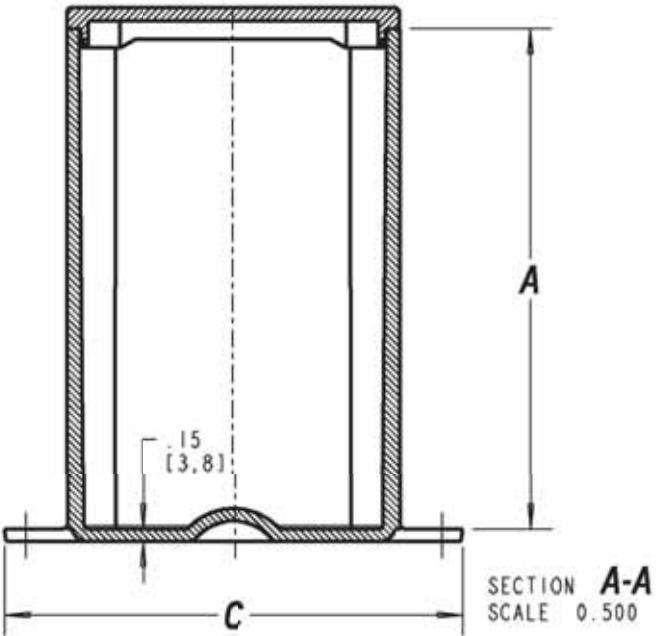
CAT. NO.	SIZE (IN.) H x W x D	STD. CTN.	DIMENSIONS (IN.)				MATERIAL				STD. WT. (LBS.)
			MIN A _i	MIN A _o	MIN B	MIN C	T _b	T _c	PVC	THERMO- PLASTIC	
E989NNJ*	4 x 4 x 2	10	3 3/8	3 3/8	N/A	2	.160	.155	X		3
E987N*	4 x 4 x 4	10	3 3/8	3 3/8	N/A	4	.160	.155	X		4
E989NNR*	4 x 4 x 6	10	3 3/8	3 3/8	N/A	6	.160	.200	X		5
E989PPJ*	5 x 5 x 2	10	4 1/8	4 1/8	N/A	2	.110	.150		X	3
E987R-CAR*	6 x 6 x 4	2	6	5 1/8	N/A	4	.190	.190		X	3
E989RRR-UPC*	6 x 6 x 6	8	5 1/8	5 1/8	N/A	6	.160	.150		X	14
E989N-CAR	8 x 8 x 4	1	8	8	N/A	4	.185	.190		X	2
E989SSX-UPC	8 x 8 x 7	2	7 7/8	7 7/8	N/A	7	.160	.150		X	6
E989UUN	12 x 12 x 4	3	11 1/8	11 1/8	11 1/8	4	.160	.150		X	12
E989R-UPC	12 x 12 x 6	2	11 1/8	11 1/8	11 1/8	6	.265	.185		X	10

* UL Listed
* Not CSA Certified
NEC and National Electrical Code are registered trademarks of the National Fire Protection Association, Inc.



SIZE	A	B	C
E989NNJ E989NNJB E989NNJ-CAR E989NNJCL E989NNJL (4X4X2)	2.00 (50.8)	4.63 (117.6)	5.13 (130.2)
E989NNR E989NNR-CAR (4X4X6)	6.00 (152.4)	5.00 (127.0)	5.50 (139.7)

NOTES:
1. MATERIAL: PVC
2. NEMA TYPES: 4/4X, 6P



GENERAL NOTES		<div>Thomas & Betts</div> <div>www.tnb.com</div>			
1. ALL DIMENSIONS ARE FOR REFERENCE ONLY.					
2. DIMENSIONS IN BRACKETS [] ARE IN METRIC UNITS.		DESCRIPTION: MOLDED NON-METALLIC ENCLOSURE			
REVISIONS					
F	SEE ERN 2016195 FOR APPROVAL SIGNATURES & RELEASE DATE. PROJECT NO: 5AM000006	ORIGINAL PROJECT NO / (ERN NO)	SHEET NO:	REV. NO:	DRAWING NO:
		/ ()	2 OF 2	F	WSD-AC01977

THIS DRAWING IS INTENDED FOR DESCRIPTIVE PURPOSES ONLY. AND THE RIGHT IS RESERVED TO DEVIATE FROM ANY OF THE DETAILS SHOWN HEREON.
Copyright Thomas & Betts - Proprietary, All Rights Reserved

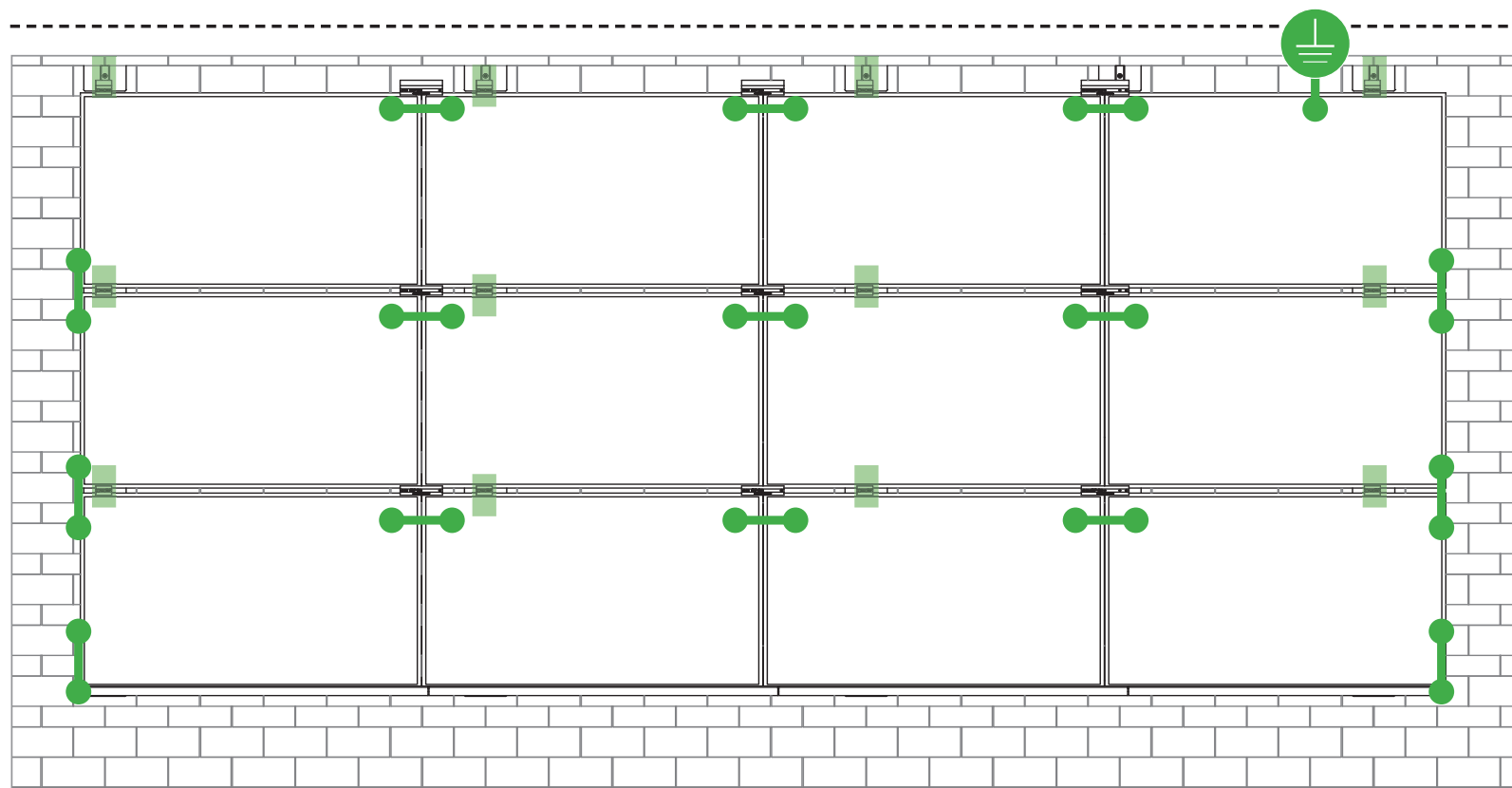
1403 N. Research Way
Orem, UT 84097
800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.

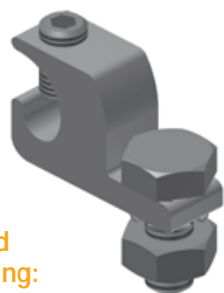


PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

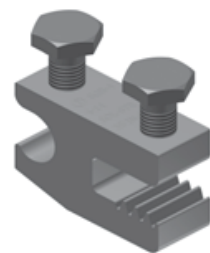


Star Washer is
Single Use Only

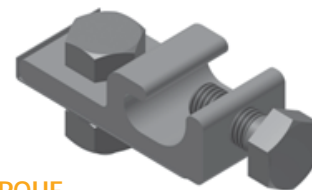


TERMINAL TORQUE,
Install Conductor and
torque to the following:
4-6 AWG: 35in-lbs
8 AWG: 25 in-lbs
10-14 AWG: 20 in-lbs

TERMINAL TORQUE,
Install Conductor and
torque to the following:
4-14 AWG: 35in-lbs



WEEBLUG
Single Use Only



TERMINAL TORQUE,
Install Conductor and
torque to the following:
6-14 AWG: 7ft-lbs

LUG DETAIL & TORQUE INFO Ilco Lay-In Lug (GBL-4DBT)

- 10-32 mounting hardware
- Torque = 5 ft-lb
- AWG 4-14- Solid or Stranded

LUG DETAIL & TORQUE INFO Ilco Flange Lug(SGB-4)

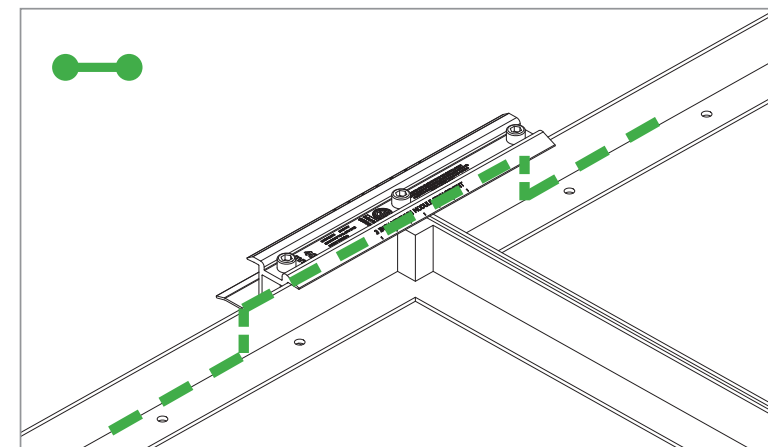
- 1/4" mounting hardware
- Torque = 75 in-lb
- AWG 4-14- Solid or Stranded

LUG DETAIL & TORQUE INFO Wiley WEEBLug (6.7)

- 1/4" mounting hardware
- Torque = 10 ft-lb
- AWG 6-14- Solid or Stranded

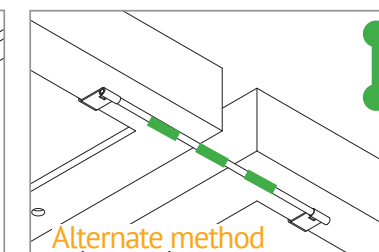
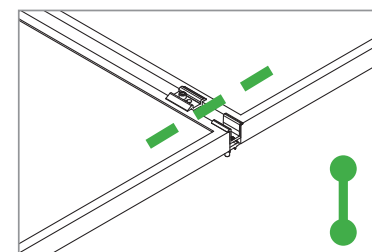
NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

System bonding is accomplished through modules. System grounding accomplished by attaching a ground lug to any module at a location on the module specified by the module manufacturer.



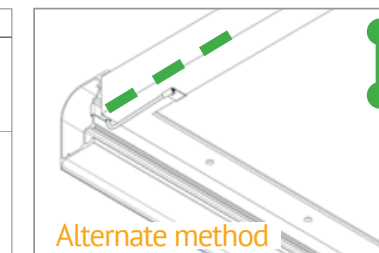
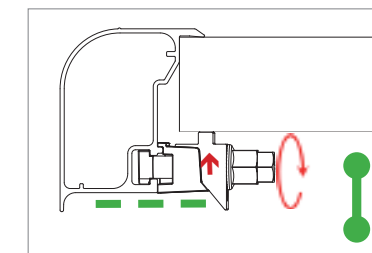
E-W BONDING PATH:

E-W module to module bonding is accomplished with 2 pre-installed bonding pins which engage on the secure side of the Microrail™ and splice.



N-S BONDING PATH:

N-S module to module bonding is accomplished with bonding clamp with 2 integral bonding pins. (refer also to alternate method)



TRIMRAIL BONDING PATH:

Trimrail to module bonding is accomplished with bonding clamp with integral bonding pin and bonding T-bolt. (refer also to alternate method)

1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION:

PAGE NUMBER:

SS



UL CODE COMPLIANCE NOTES

T

INSTALLATION GUIDE

PAGE

SYSTEM LEVEL FIRE CLASSIFICATION

The system fire class rating requires installation in the manner specified in the SUNFRAME MICRORAIL (SFM) Installation Guide. SFM has been classified to the system level fire portion of UL 1703. This UL 1703 classification has been incorporated into the UL 2703 product certification. SFM has achieved Class A, B & C system level performance for low slope & steep sloped roofs when used in conjunction with type 1 and type 2 modules. Class A, B & C system level fire

performance is inherent in the SFM design, and no additional mitigation measures are required. The fire classification rating is valid for any roof pitch. There is no required minimum or maximum height limitation above the roof deck to maintain the Class A, B & C fire rating for SFM. SUNFRAME MICRORAIL™ components shall be mounted over a fire resistant roof covering rated for the application.

Module Type	Roof Slope	System Level Fire Rating	Microrail Direction	Module Orientation	Mitigation Required
Type 1 and Type 2	Steep Slope & Low Slope	Class A, B & C	East-West	Landscape OR Portrait	None Required

UL2703 TEST MODULES

See pages V and W for a list of modules that were electrically and mechanically tested or qualified with the SUNFRAME MICRORAIL (SFM) components outlined within this Installation Guide.

- Maximum Area of Module = 27.76 sqft
- UL2703 Design Load Ratings:
 - a) Downward Pressure – 113 PSF / 5400 Pa
 - b) Upward Pressure – 50 PSF / 2400 Pa
 - c) Down-Slope Load – 21.6 PSF / 1034 Pa
- Tested Loads:
 - a) Downward Pressure – 170 PSF / 8000 Pa
 - b) Upward Pressure – 75 PSF / 3500 Pa
 - c) Down-Slope Load – 32.4 PSF / 1550 Pa
- Maximum Span = 6ft
- Use with a maximum over current protection device OCPD of 30A
- System conforms to UL Std 2703, certified to LTR AE-001-2012
- Rated for a design load of 2400 Pa / 5400 Pa with 24 inch span
- PV modules may have a reduced load rating, independent of the SFM load rating. Please consult the PV module manufacturer's installation guide for more information
- Down-Slope design load rating of 30 PSF/ 1400 Pa for module areas of 22.3 sq ft or less



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION:PAGE NUMBER:

SS



TESTED / CERTIFIED MODULE LIST

V

INSTALLATION GUIDE : PAGE

Manufacture	Module Model / Series
Aleo	P-Series
Astronergy	CHSM6612P, CHSM6612P/HV, CHSM6612M, CHSM6612M/HV, CHSM6610M (BL)(BF)/(HF), CHSM72M-HC
Auxin	AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T
Axitec	AXIblackpremium 60 (35mm), AXIpower 60 (35mm), AXIpower 72 (40mm), AXIpremium 60 (35mm), AXIpremium 72 (40mm).
Aptos	DNA-120-(BF/MF)26 DNA-144-(BF/MF)26
Boviet	BVM6610, BVM6612
BYD	P6K & MHK-36 Series
Canadian Solar	CS1(H/K/U/Y)-MS CS3(K/L/U), CS3K-MB-AG, CS3K-(MS/P) CS3N-MS, CS3U-MB-AG, CS3U-(MS/P), CS3W CS5A-M, CS6(K/U), CS6K-(M/P), CS6K-MS CS6P-(M/P), CS6U-(M/P), CS6V-M, CS6X-P
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04
Dehui	DH-60M

Manufacture	Module Model / Series
Eco Solargy	Orion 1000 & Apollo 1000
ET Solar	ET-M672BHxxxTW
FreeVolt	Mono PERC
GCL	GCL-P6 & GCL-M6 Series
Hansol	TD-AN3, TD-AN4, UB-AN1, UD-AN1
Heliene	36M, 60M, 60P, 72M & 72P Series
HT Solar	HT60-156(M) (NDV) (-F), HT 72-156(M/P)
Hyundai	KG, MG, TG, RI, RG, TI, MI, HI & KI Series HiA-SxxxHG
ITEK	iT, iT-HE & iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	JAP6 60-xxx, JAM6-60-xxx/SI, JAM6(K)-60/ xxx, JAP6(k)-72-xxx/4BB, JAP72SY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP60SY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM72SY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM60SY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HiT, IB, MW, MR
Jinko	JKM & JKMS Series Eagle JKMxxxM JKMxxxM-72HL-V
Kyocera	KU Series

Manufacture	Module Model / Series
LG Electronics	LGxxxN2T-A4 LGxxx(A1C/E1C/E1K/N1C/N1K/N2T/N2W/ Q1C/Q1K/S1C/S2W)-A5 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/ QAC/QAK)-A6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(N1C/Q1C/Q1K)-N5 LGxxx (N1C/N1K/N2W/Q1C/Q1K)-V5
	LR4-60(HIB/HIH/HPB/HPH)-xxxM LR4-72(HIH/HPH)-xxxM LR6-60(BP/HBD/HIBD)-xxxM (30mm) LR6-60(BK)(PE)(HPB)(HPH)-xxxM (35mm) LR6-60(BK)(PE)(PB)(PH)-xxxM (40mm) LR6-72(BP)(HBD)(HIBD)-xxxM (30mm) LR6-72(HV)(BK)(PE)(PH)(PB)(HPH)-xxxM (35mm) LR6-72(BK)(HV)(PE)(PB)(PH)-xxxM (40mm)
Mission Solar Energy	MSE Series
Mitsubishi	MJE & MLE Series
Neo Solar Power Co.	D6M & D6P Series

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- Please see the SFM UL2703Construction Data Report at Unirac.com to ensure the exact solar module selected is approved for use with SFM
- SFM Infinity is not compatible with module frame height of less than 30mm and more than 40mm. See Module Mounting section, page L for further information



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.

NABCEP

CERTIFIED

PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

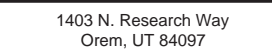
SHEET NAME:

SPEC SHEET

REVISION:

PAGE NUMBER:

SS



800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

Manufacture	Module Model / Series
REC (cont.)	TwinPeak Series TwinPeak 2 Series TwinPeak 2 BLK2 Series TwinPeak 2S(M)72(XV) TwinPeak 3 Series (38mm) TP4 (Black)
Renesola	Vitrus2 Series & 156 Series
Risen	RSM72-6 (MDG) (M), RSM60-6
S-Energy	SN72 & SN60 Series (40mm)
Seraphim	SEG-6 & SRP-6 Series
Sharp	NU-SA & NU-SC Series
Silfab	SLA, SLG, BC Series & SILxxx(BL/NL/NT/HL/ML/BK/NX/NU/HC)
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC)
SolarWorld	Sunmodule Protect, Sunmodule Plus
Sonali	SS 230 - 265
Suntech	STP
Suniva	MV Series & Optimus Series
Sun Edison/Flextronics	F-Series, R-Series & FLEX FXS Series
SunPower	X-Series, E-Series & P-Series
Talesun	TP572, TP596, TP654, TP660, TP672, Hipor M, Smart

Manufacture	Module Model / Series
Tesla	SC, SC B, SC B1, SC B2 TxxxS
Trina	PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE09.05, DE14, DE15, PE15H
Upsolar	UP-MxxxP(-B), UP-MxxxM(-B)
URE	D7MxxxH7A, D7(M/K)xxxH8A FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB)
Vikram	Eldora, Solivo, Somera
Waaree	AC & Adiya Series
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
ZN Shine	ZXM6-72

- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
- Items in parenthesis are those that may or may not be present in a compatible module's model ID
- Slashes "/" between one or more items indicates that either of those items may be the one that is present in a module's model ID
- Please see the SFM UL2703Construction Data Report at Unirac.com to ensure the exact solar module selected is approved for use with SFM
- SFM Infinity is not compatible with module frame height of less than 30mm and more than 40mm. See Module Mounting section, page L for further information

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION:

■■■■

PAGE NUMBER:

SS



AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:

Unirac, Inc

Manufacturer:

Address:

1411 Broadway Blvd NE
Albuquerque, NM 87102

Address:

Country:

USA

Country:

Party Authorized To Apply Mark:

Same as Manufacturer

Report Issuing Office:

Intertek Testing Services NA, Inc., Lake Forest, CA

Control Number:

5003705

Authorized by:

for L. Matthew Snyder, Certification Manager



This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019] PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand Name:	Unirac
Models:	Unirac SFM



AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:

Unirac, Inc

Manufacturer:

Address:

1411 Broadway Blvd NE
Albuquerque, NM 87102

Address:

Country:

USA

Country:

Party Authorized To Apply Mark:

Same as Manufacturer

Report Issuing Office:

Intertek Testing Services NA, Inc., Lake Forest, CA

Control Number:

5014989

Authorized by:

for L. Matthew Snyder, Certification Manager



This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019] PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand Name:	Unirac
Models:	Unirac SFM



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION:

PAGE NUMBER:

SS



AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:

Unirac, Inc

Manufacturer:

Address:

1411 Broadway Blvd NE
Albuquerque, NM 87102

Address:

Country:

USA

Country:

Party Authorized To Apply Mark:

Same as Manufacturer

Report Issuing Office:

Intertek Testing Services NA, Inc., Lake Forest, CA

Control Number:

5019851

Authorized by:

jorany alonso

for L. Matthew Snyder, Certification Manager



This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019]
	PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand Name:	Unirac
Models:	Unirac SFM



AUTHORIZATION TO MARK

This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s) Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing Report.

This document is the property of Intertek Testing Services and is not transferable. The certification mark(s) may be applied only at the location of the Party Authorized To Apply Mark.

Applicant:

Unirac, Inc

Manufacturer:

Address:

1411 Broadway Blvd NE
Albuquerque, NM 87102

Address:

Country:

USA

Country:

Party Authorized To Apply Mark:

Same as Manufacturer

Report Issuing Office:

Intertek Testing Services NA, Inc., Lake Forest, CA

Control Number:

5021866

Authorized by:

jorany alonso

for L. Matthew Snyder, Certification Manager



This document supersedes all previous Authorizations to Mark for the noted Report Number.

This Authorization to Mark is for the exclusive use of Intertek's Client and is provided pursuant to the Certification agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Authorization to Mark. Only the Client is authorized to permit copying or distribution of this Authorization to Mark and then only in its entirety. Use of Intertek's Certification mark is restricted to the conditions laid out in the agreement and in this Authorization to Mark. Any further use of the Intertek name for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. Initial Factory Assessments and Follow up Services are for the purpose of assuring appropriate usage of the Certification mark in accordance with the agreement, they are not for the purposes of production quality control and do not relieve the Client of their obligations in this respect.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

Standard(s):	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019]
	PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020]
Product:	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand Name:	Unirac
Models:	Unirac SFM



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION:

PAGE NUMBER:

SS



Listing Constructional Data Report (CDR)

1.0 Reference and Address		
Report Number	102393982LAX-002	Original 11-Apr-2016 Revised: 2-Jan-2022
Standard(s)	Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels [UL 2703:2015 Ed.1+R:29May2019] PV Module and Panel Racking Mounting System and Accessories [CSA TIL No. A-40:2020]	
Applicant	Unirac, Inc	Manufacturer 2
Address	1411 Broadway Blvd NE Albuquerque, NM 87102	Address
Country	USA	Country
Contact	Klaus Nicolaedis Todd Ganshaw	Contact
Phone	505-462-2190 505-843-1418	Phone
FAX	NA	FAX
Email	klaus.nicolaedis@unirac.com toddg@unirac.com	Email
Manufacturer 3		Manufacturer 4
Address		Address
Country		Country
Contact		Contact
Phone		Phone
FAX		FAX
Email		Email
Manufacturer 5		
Address		
Country		
Contact		
Phone		
FAX		



Listing Constructional Data Report (CDR)

1.0 Reference and Address			
Report Number	102393982LAX-002	Original 11-Apr-2016	Revised: 2-Jan-2022
Email			



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.

PV INSTALLATION
PROFESSIONAL
Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:


SHEET NAME:
SPEC SHEET

REVISION:

PAGE NUMBER:
SS

2.0 Product Description	
Product	Photovoltaic Mounting System, Sun Frame Microrail Installation Guide, PUB2021NOV29
Brand name	Unirac
Description	The product covered by this report is the Sun Frame Micro Rail roof mounted Photovoltaic Rack Mounting System. This system is designed to provide bonding and grounding to photovoltaic modules. The mounting system employs anodized or mill finish aluminum brackets that are roof mounted using the slider, outlined in section 4 of this report. There are no rails within this product, whereas the 3" Micro Rail, Floating Splice, and 9" Attached Splice electrically bond the modules together forming the path to ground.
	The Micro Rails are installed onto the module frame by using a stainless steel bolt anodized with black oxide with a stainless type 300 bonding pin, torqued to 20 ft-lbs, retaining the modules to the bracket. The bonding pin of the Micro Rail when bolted and torqued, penetrate the anodized coating of the photovoltaic module frame (at bottom flange) to contact the metal, creating a bonded connection from module to module.
	The grounding of the entire system is intended to be in accordance with the latest edition of the National Electrical Code, including NEC 250: Grounding and Bonding, and NEC 690: Solar Photovoltaic Systems or the Canadian Electrical Code, CSA C22.1 Part 1 in accordance to the revision in effect in the jurisdiction in which the project resides. Any local electrical codes must be adhered in addition to the national electrical codes. The Grounding Lug is secured to the photovoltaic module, torqued in accordance with the installation manual provided in this document.
	Other optional grounding includes the use of the Enphase UL2703 certified grounding system, which requires a minimum of 2 micro-inverters mounted to the same rail, and using the same engage cable.


2.0 Product Description	
Models	Unirac SFM
Model Similarity	NA
Ratings	Fuse Rating: 30A
	Module Orientation: Portrait or Landscape Maximum Module Size: 17.98 ft² UL2703 Design Load Rating: 33 PSF Downward, 33 PSF Upward, 10 PSF Down-Slope Tested Loads - 50 psf/2400Pa Downward, 50psf/2400Pa Uplift, 15psf/720Pa Down Slope Trina TSM-255PD05.08 and Sunpower SPR-E20-327 used for Mechanical Loading
	Increased size ML test: Maximum Module Size: 22.3 ft² UL2703 Design Load Rating: 113 PSF Downward, 50 PSF Upward, 30 PSF Down-Slope LG355S2W-A5 used for Mechanical Loading test. Mounting configuration: Four mountings on each long side of panel with the longest span of 24" UL2703 Design Load Rating: 46.9 PSF Downward, 40 PSF Upward, 10 PSF Down-Slope LG395N2W-A5, LG360S2W-A5 and LG355S2W-A5 used for used for Mechanical Loading test. Mounting configuration: Six mountings for two modules used with the maximum span of 74.5" IEC 61646 Test Loads - 112.78 psf/5400Pa Downward, 50psf/2400Pa Uplift
	Mechanical Load test to add FlashLoc Slider and Trim Assemblies to UL2703 and IEC 61646 Certifications, & Increase SFM System UL2703 Module Size: Maximum Module Size: 27.76 ft² UL2703 Design Load Rating: 113 PSF Downward, 50 PSF Upward, 21.6 PSF Down-Slope Jinko Eagle 72HM G5 used for Mechanical Loading test. Mounting configuration: Four mountings on each long side of panel with the longest span of 24" Maximum module size: 21.86 ft² IEC 61646 Test Loads - 112.78 psf/5400Pa Downward, 75psf/3600Pa Uplift SunPower model SPR-A430-COM-MLSD used for Mechanical Loading
Other Ratings	Fire Class Resistance Rating: - Class A for Steep Slope Applications when using Type 1 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A for Steep Slope Applications when using Type 2 Modules. Can be installed at any interstitial gap. Installations must include Trim Rail. - Class A Fire Rated for Low Slope applications with Type 1 or 2 listed photovoltaic modules. This system was evaluated with a 5" gap between the bottom of the module and the roof's surface
	See section 7.0 illustrations # 1, 1a, 1b, and 1c for a complete list of PV modules evaluated with these racking systems
Other Ratings	NA



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:
SPEC SHEET

REVISION:

PAGE NUMBER:
SS

7.0 Illustrations

Illustration 1 - Approved PV Modules

Manufacture	Module Model / Series	Manufacture	Module Model / Series
Aleo	P-Series	Eco Solargy	Orion 1000 & Apollo 1000
Astronergy	CH5M6612P, CH5M6612P/HV, CH5M6612M, CH5M6612M/HV, CH5M6610M (BL)(BF)/(HF), CH5M72M-HC	ET Solar	ET-M672BHxxxTW
		FreeVolt	Mono PERC
Auxin	AXN6M610T, AXN6P610T, AXN6M612T & AXN6P612T	GCL	GCL-P6 & GCL-M6 Series
		Hansol	TD-AN3, TD-AN4, UB-AN1, UD-AN1
Axitec	AXIblackpremium 60 (35mm), AXIpower 60 (35mm), AXIpower 72 (40mm), AXIpremium 60 (35mm), AXIpremium 72 (40mm).	Heliene	36M, 60M, 60P, 72M & 72P Series
		HT Solar	HT60-156(M) (NDV) (-F), HT 72-156(M/P)
Aptos	DNA-120-(BF/MF)26 DNA-144-(BF/MF)26	Hyundai	KG, MG, TG, RI, RG, TI, MI, HI & KI Series HiA-SxxxHG
		ITEK	IT, IT-HE & IT-SE Series
Boviet	BVM6610, BVM6612	Japan Solar	JPS-60 & JPS-72 Series
BYD	P6K & MHK-36 Series	JA Solar	JAP6 60-xxx, JAM6-60-xxx/Sl, JAM6(K)-60/xxx, JAP6(k)-72-xxx/4BB, JAP725YY-xxx/ZZ, JAP6(k)-60-xxx/4BB, JAP605YY-xxx/ZZ, JAM6(k)-72-xxx/ZZ, JAM725YY-xxx/ZZ, JAM6(k)-60-xxx/ZZ, JAM605YY-xxx/ZZ. i. YY: 01, 02, 03, 09, 10 ii. ZZ: SC, PR, BP, HIT, IB, MW, MR
Canadian Solar	CS1(H/K/U/Y)-MS CS3(K/L/U), CS3K-MB-AG, CS3K-(MS/P) CS3N-MS, CS3U-MB-AG, CS3U-(MS/P), CS3W CS5A-M, CS6(K/U), CS6K-(M/P), CS6K-MS CS6P-(M/P), CS6U-(M/P), CS6V-M, CS6X-P		
Centrosolar America	C-Series & E-Series	Jinko	JKM & JKMS Series Eagle JKMxxxM JKMxxxM-72HL-V
CertainTeed	CT2xxMxx-01, CT2xxPxx-01, CTxxxMxx-02, CTxxxM-03, CTxxxMxx-04, CTxxxHC11-04	Kyocera	KU Series
Dehui	DH-60M		

7.0 Illustrations

Illustration 1a - Approved PV Modules Continue

Manufacture	Module Model / Series	Manufacture	Module Model / Series
LG Electronics	LGxxxN2T-A4 LGxxx(A1C/E1C/E1K/N1C/N1K/N2T/N2W/Q1C/Q1K/S1C/S2W)-A5 LGxxxN2T-B5 LGxxxN1K-B6 LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxxN2T-J5 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxx(N1C/Q1C/Q1K)-N5 LGxxx (N1C/N1K/N2W/Q1C/Q1K)-V5	Panasonic	VBHNxxxSA15 & SA16, VBHNxxxSA17 & SA18, VBHNxxxSA17(E/G) & SA18E, VBHNxxxKA01 & KA03 & KA04, VBHNxxxZA01, VBHNxxxZA02, VBHNxxxZA03, VBHNxxxZA04
LONGi	LR4-60(HIB/HIH/HPB/HPH)-xxxM LR4-72(HIH/HPH)-xxxM LR6-60(BP/HBD/HIBD)-xxxM (30mm) LR6-60(BK)(PE)(HPB)(HPH)-xxxM (35mm) LR6-60(BK)(PE)(PB)(PH)-xxxM (40mm) LR6-72(BP)(HBD)(HIBD)-xxxM (30mm) LR6-72(HV)(BK)(PE)(PH)(PB)(HPH)-xxxM (35mm) LR6-72(BK)(HV)(PE)(PB)(PH)-xxxM (40mm)	Peimar	SGxxxM (FB/BF)
Mission Solar Energy	MSE Series	Phono Solar	P5-60, P5-72
Mitsubishi	MJE & MLE Series	Prism Solar	P72 Series
Neo Solar Power Co.	D6M & D6P Series	Q.Cells	Plus, Pro, Peak, G3, G4, G5, G6(+), G7, G8(+) Pro, Peak L-G2, L-G4, L-G5, L-G6, L-G7 Q.PEAK DUO BLK-G6+ Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO (BLK)-G8(+) Q.PEAK DUO L-G8.3/BFF Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO XL-G9/G9.2/G9.3 Q.PEAK DUO (BLK) ML-G10(+) Q.PEAK DUO XL-G(10/10.2/10.3/10.c/10.d)
		REC	Alpha (72) (Black) (Pure) N-Peak (Black) N-Peak 2 (Black) PEAK Energy Series PEAK Energy BLK2 Series PEAK Energy 72 Series



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION HEREIN CONTAINED SHALL NOT BE USED FOR THE BENEFIT OF ANYONE EXCEPT BLUE RAVEN SOLAR NOR SHALL IT BE DISCLOSED IN WHOLE OR IN PART TO OTHERS OUTSIDE RECIPIENTS ORGANIZATION, EXCEPT IN CONNECTION WITH THE SALE AND USE OF THE RESPECTIVE EQUIPMENT, WITHOUT THE WRITTEN PERMISSION OF BLUE RAVEN SOLAR LLC.



CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

PLOT DATE:

PROJECT NUMBER:

SHEET NAME:

SPEC SHEET

REVISION: PAGE NUMBER:

SS

7.0 Illustrations

Illustration 1b - Approved PV Modules Continue

Manufacture	Module Model / Series	Manufacture	Module Model / Series
REC (cont.)	TwinPeak Series	Tesla	SC, SC B, SC B1, SC B2 TxxxS
	TwinPeak 2 Series	Trina	PA05, PD05, DD05, DE06, DD06, PE06, PD14, PE14, DD14, DE09.05, DE14, DE15, PE15H
	TwinPeak 2 BLK2 Series		
	TwinPeak 2S(M)72(XV)	Upsolar	UP-MxxxP(-B), UP-MxxxM(-B)
	TwinPeak 3 Series (38mm)		
	TP4 (Black)	URE	D7MxxxH7A, D7(M/K)xxxH8A FAKxxx(C8G/E8G), FAMxxxE7G-BB FAMxxxE8G(-BB)
Renesola	Vitrus2 Series & 156 Series		
Risen	RSM72-6 (MDG) (M), RSM60-6		
S-Energy	SN72 & SN60 Series (40mm)	Vikram	Eldora, Solivo, Somera
Seraphim	SEG-6 & SRP-6 Series		
Sharp	NU-SA & NU-SC Series	Waaree	AC & Adiya Series
Silfab	SLA, SLG, BC Series & SILxxx(BL/NL/NT/HL/ ML/BK/NX/NU/HC)	Winaico	WST & WSP Series
	PowerXT-xxxR-(AC/PD/BD)	Yingli	YGE & YLM Series
	PowerXT-xxxC-PD	ZN Shine	ZXM6-72
	PowerXT-xxxR-PM (AC)		
SolarWorld	Sunmodule Protect, Sunmodule Plus		
Sonali	SS 230 - 265		
Suntech	STP		
Suniva	MV Series & Optimus Series		
Sun Edison/Flextronics	F-Series, R-Series & FLEX FXS Series		
SunPower	X-Series, E-Series & P-Series		
Talesun	TP572, TP596, TP654, TP660,		
	TP672, Hipor M, Smart		



1403 N. Research Way
Orem, UT 84097

800.377.4480
WWW.BLUERAVENSOLAR.COM

CONFIDENTIAL- THE INFORMATION
HEREIN CONTAINED SHALL NOT BE
USED FOR THE BENEFIT OF ANYONE
EXCEPT BLUE RAVEN SOLAR NOR
SHALL IT BE DISCLOSED IN WHOLE OR
IN PART TO OTHERS OUTSIDE
RECIPIENTS ORGANIZATION, EXCEPT
IN CONNECTION WITH THE SALE AND
USE OF THE RESPECTIVE EQUIPMENT,
WITHOUT THE WRITTEN PERMISSION
OF BLUE RAVEN SOLAR LLC.



PV INSTALLATION
PROFESSIONAL

Scott Gurney
#PV-011719-015866

CONTRACTOR:
BRS FIELD OPS
385-498-6700

DRAWING BY:

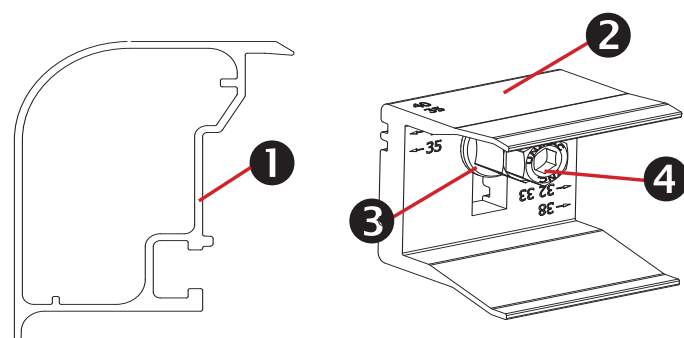
PLOT DATE:

PROJECT NUMBER:

SHEET NAME:
SPEC SHEET

REVISION:

PAGE NUMBER:
SS



Trimrail™ and Module Clips

Sub-Components:

1. Trim Rail
2. Module Clip
3. T-Bolt
4. Tri-Drive Nut

Trimrail™

Functions:

- Required front row structural support (with module clips)
- Module mounting
- Installation aid
- Aesthetic trim

Features:

- Mounts directly to L-feet
- Aligns and captures module leading edge
 - Supports discrete module thicknesses from 32, 33, 35, 38, and 40mm

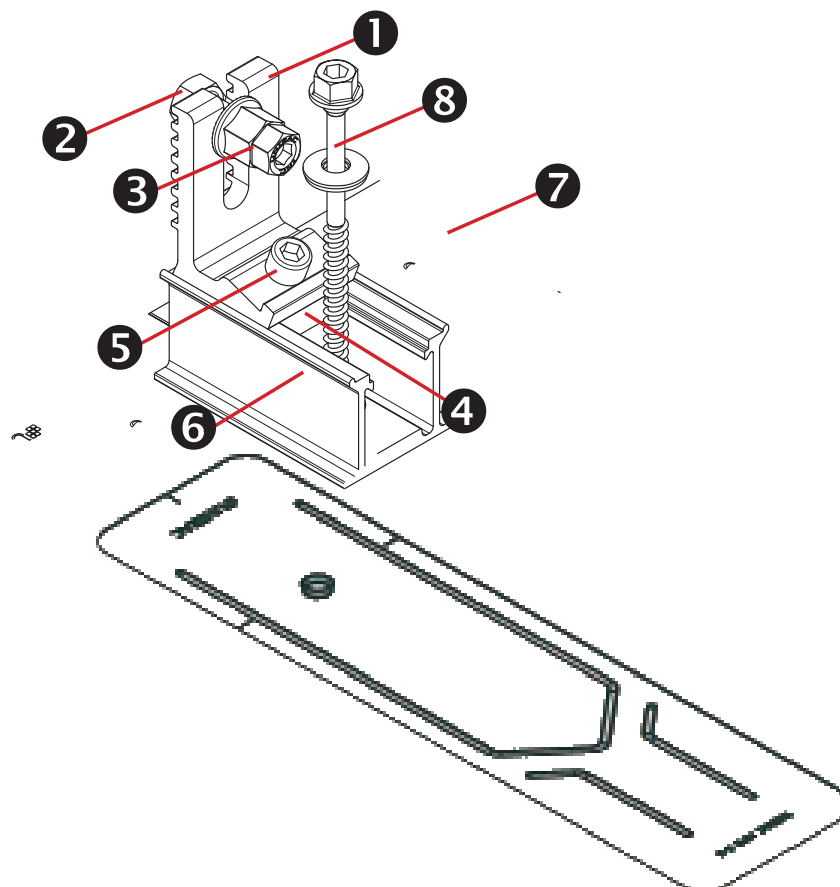
Module Clips

Functions:

- Required front row structural support (with trimrail)
- Module mounting

Features:

- Mounts to Trimrail™ with T-bolt and tri-drive nut
- Manually adjustable to fit module thicknesses 32, 33, 35, 38, and 40mm.



Trimrail™ Flashkit

Sub-Components:

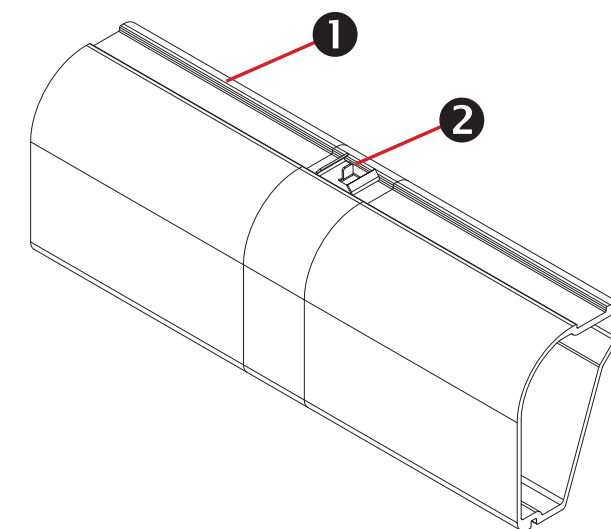
- L-Foot
- Hex bolt
- Tri-drive nut
- Channel Nut
- Socket Head Cap Screw
- 3" Channel/Slider w/grommet
- 3" Wide Flashing
- Structural Screw & SS EPDM Washer

Functions:

- Attach Trimrail™ to roof attachment / flashing
- Patented roof sealing technology at roof attachment point

Features:

- Slot provides vertical adjustments to level array
- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



Trimrail™ Splice

Sub-Components:

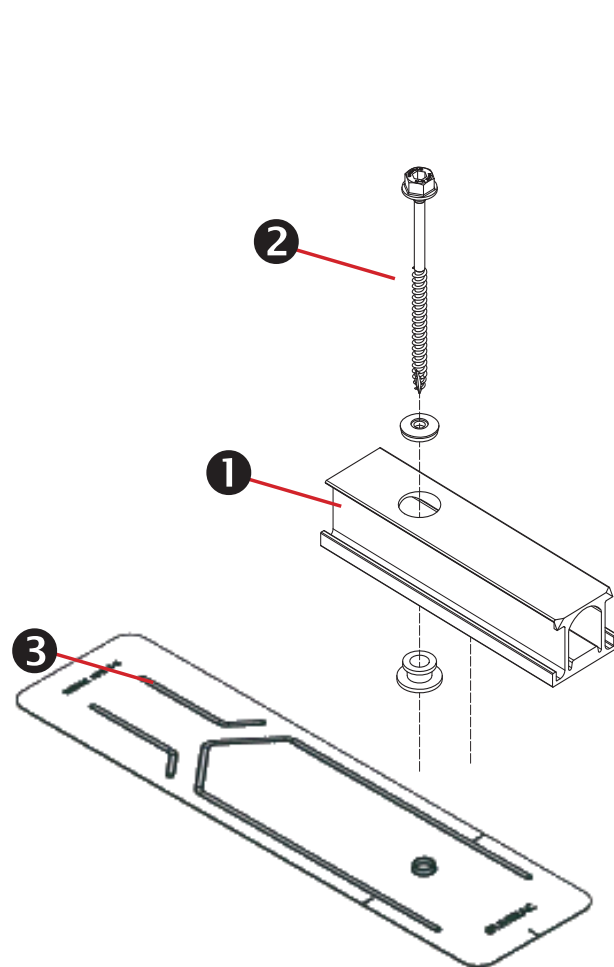
1. Structural Splice Extrusion
2. Bonding Clip

Functions:

- Front row structural support
- Installation aid
- Structurally connects 2 pieces of Trimrail™
- Electrically bonds 2 pieces of Trimrail™

Features:

- Aligns and connects Trimrail™ pieces
- Tool-less installation



SFM Slider Flashkit

Sub-Components:

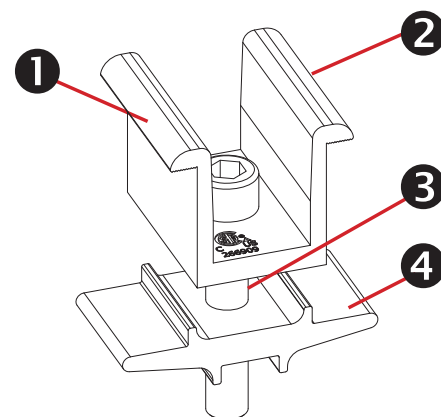
1. Slider w/grommet
2. Structural Screw & SS EPDM washer
3. 3" Wide Flashing

Functions:

- Patented Shed & Seal roof sealing technology at roof attachment point
- For use with compatible 2" Microrail or 8" Attached Splices

Features:

- Slider provides north/south adjustment along the slope of the roof
- Shed and Seal Technology



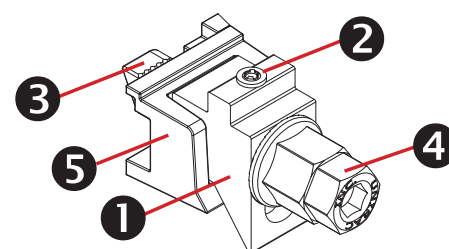
Module-to-Module N-S Bonding

Sub-Components:

1. Clamp
2. Bonding Pins (2)
3. 5/16" Socket Head Cap Screw
4. Clamp Base

Functions/ Features:

- Row to row bonding
- Single Use Only
- Fits module sizes 32-40mm



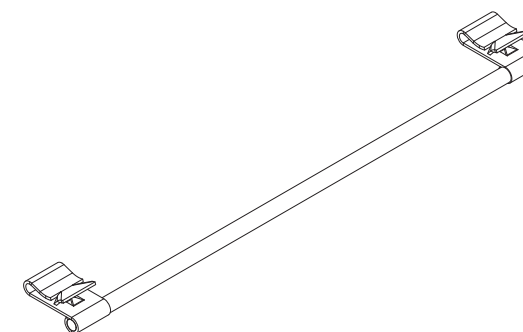
Trim -to- Module Bonding Clamp and Floating Trim Clamp

Sub-Components:

1. Wedge
2. Bonding Pin
3. T-Bolt
4. Nut
5. Cast Base

Functions/ Features:

- Module to Trimrail™ bonding - single use only
- Attaches Trimrail™ to module when fewer than 2 rafter attachment points are available
- Fits module sizes 32-40mm
- Fits module sizes 32-40mm



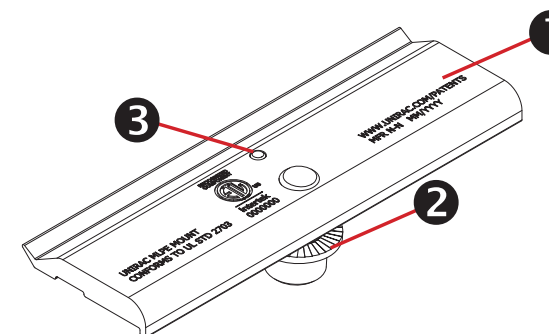
Wire Bonding Clip w/ 8AWG

Functions:

- Row to row bonding
- Module to Trimrail™ bonding
- Single Use Only

Features:

Tool-less installation



MLPE Mounting Assembly

Sub-Components:

1. MLPE Mount Base
2. 5/16 Socket Head Cap Screw
3. Bonding Pin

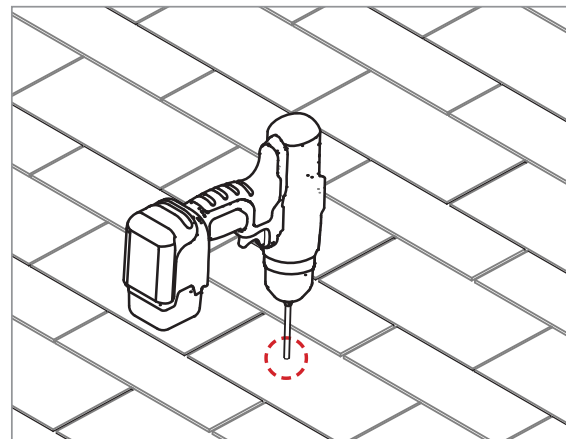
Functions:

- Securely mounts MLPE to module frames
- MLPE to module bonding

Features:

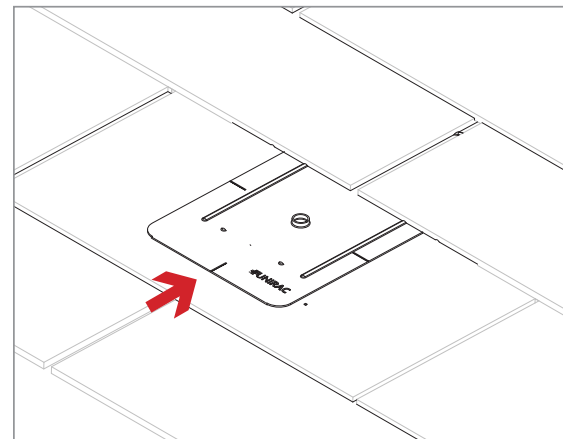
- Mounts easily to typical module flange
- UL2703 Recognized

MLPE = Module Level Power Electronics,
e.g. microinverter or power optimizer



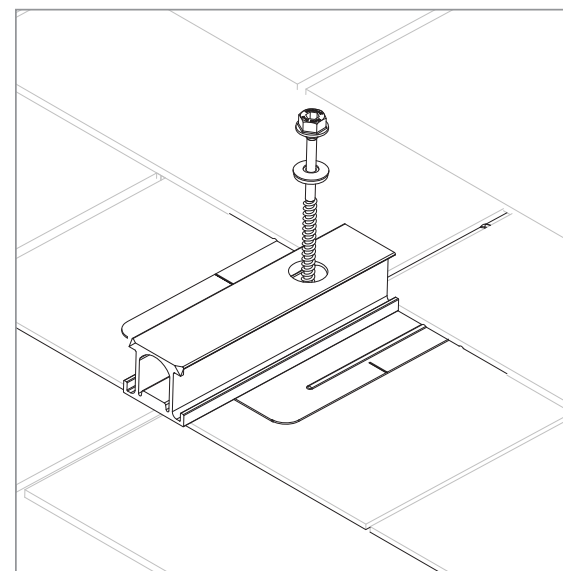
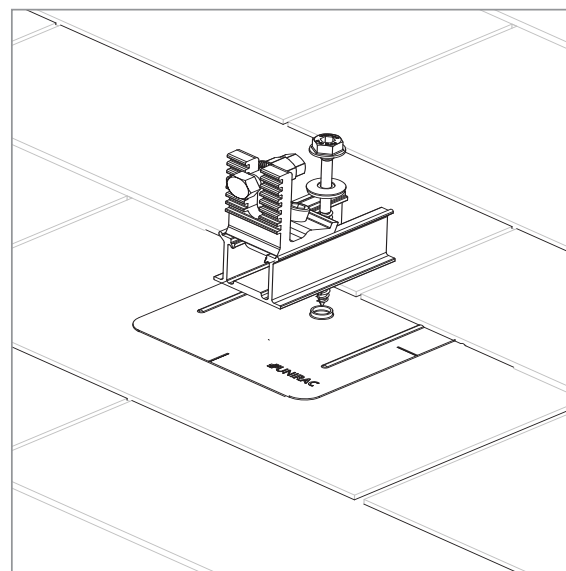
PILOT HOLES:

Drill pilot holes for lag screws or structural screws (as necessary) at marked attachment points



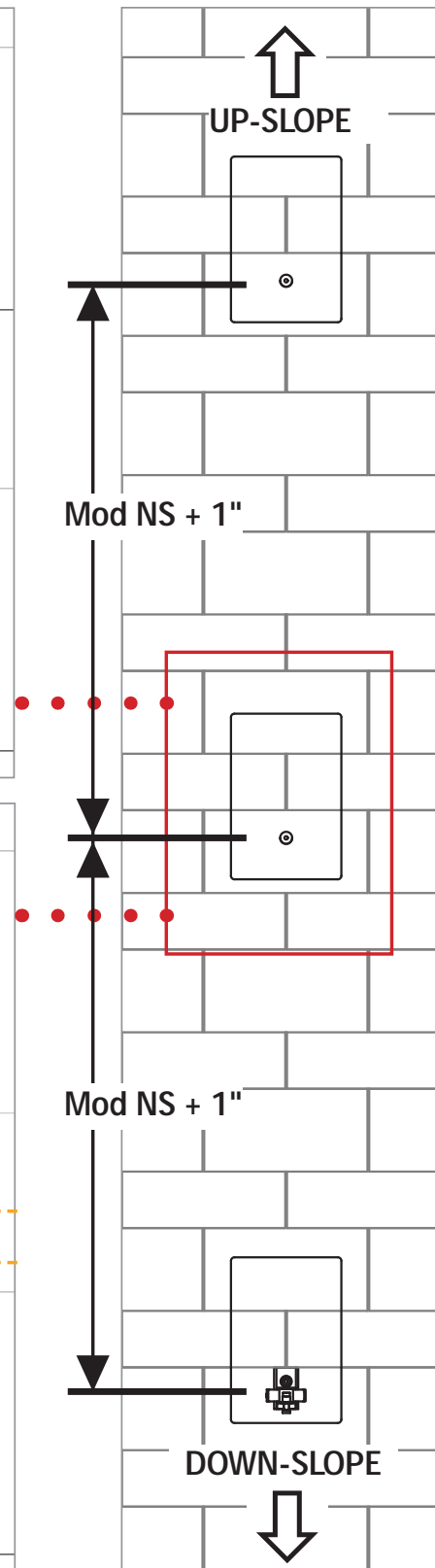
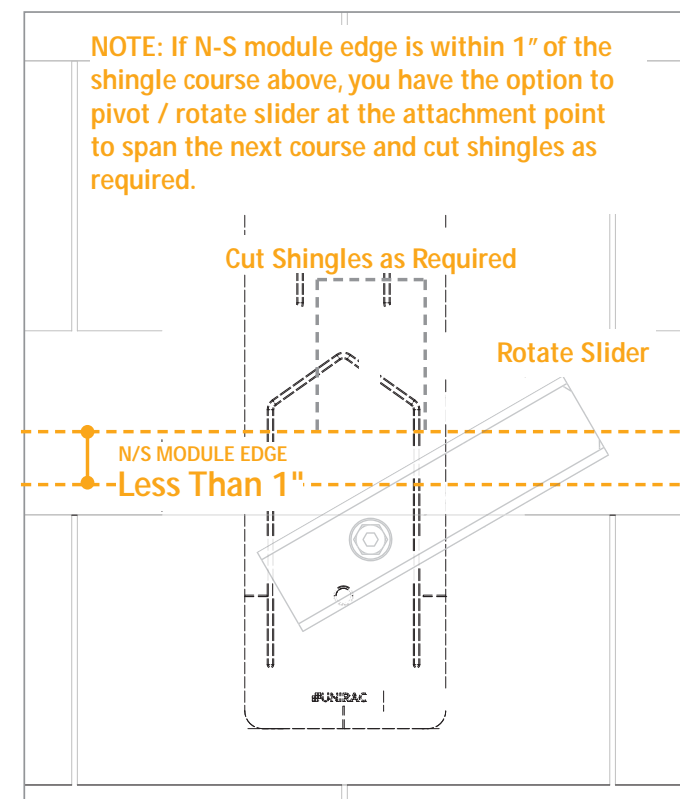
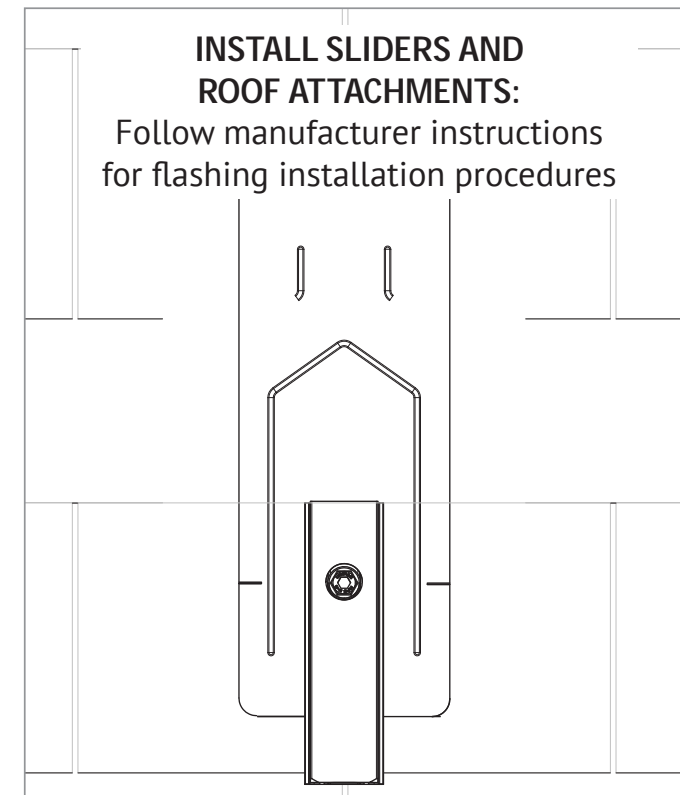
FLASHINGS:

Place flashings



INSTALL SLIDERS AND TRIMRAIL ROOF ATTACHMENTS:

- Insert flashings per manufacturer instructions
- **NOTE: Use Lag screw or structural fastener with a maximum diameter of 5/16"**
- Attach sliders to rafters
- Verify proper row to row spacing for module size (Mod NS + 1")
- Ensure that Trimrail™ roof attachments in each row have sufficient engagement with slider dovetails for proper attachment.



February 23, 2022

To: Blue Raven Solar
1403 North Research Way, Building J
Orem, UT. 84097

Subject: Certification Letter
Dunn Residence
6830 W Denton Dr
McCordsville, IN. 46055

To Whom It May Concern,

A jobsite observation of the condition of the existing framing system was performed by an audit team of Blue Raven Solar as a request from Domus Structural Engineering. All review is based on these observations and the design criteria listed below and only deemed valid if provided information is true and accurate.

On the above referenced project, the roof structural framing has been reviewed for additional loading due to the installation of the solar PV addition to the roof. The structural review only applies to the section of the roof that is directly supporting the solar PV system and its supporting elements. The observed roof framing is described below. If field conditions differ, contractor to notify engineer prior to starting construction.

The roof structure of (MP1) consists of composition shingle on roof plywood that is supported by pre-manufactured trusses that are spaced at @ 24" o.c.. The top chords, sloped at 37 degrees, are 2x4 sections, the bottom chords are 2x4 sections and the web members are 2x4 sections. The truss members are connected by steel gusset plates. The max unsupported projected horizontal top chord span is approximately 7'-9".

The existing roof framing system of (MP1) is judged to be adequate to withstand the loading imposed by the installation of the solar panels. No reinforcement is necessary.

The spacing of the solar standoffs should be kept at 72" o.c. for landscape and 48" o.c. for portrait orientation, with a staggered pattern to ensure proper distribution of loads.

The scope of this report is strictly limited to an evaluation of the fastener attachment, underlying framing and supporting structure only. The attachment's to the existing structure are required to be in a staggered pattern to ensure proper distribution of loading. All panels, racking and hardware shall be installed per manufacturer specifications and within specified design limitations. All waterproofing shall be provided by the manufacturer. Domus Structural Engineering assumes no responsibility for misuse or improper installation of the solar PV panels or racking.

Note: Seismic check is not required since $S_s < .4g$ and Seismic Design Category (SDC) < B

Design Criteria:

- Applicable Codes = 2014 Indiana State Building Code, ASCE 7-10
- Roof Dead Load = 7 psf (MP1)
- Roof Live Load = 20 psf
- Wind Speed = 115 mph (Vult), Exposure C, Risk Category II
- Ground Snow Load = 20 psf - Roof Snow Load = 14 psf
- Attachment: 1 - 5/16 dia. lag screw with 2.5 inch min. embedment depth, at spacing shown above.

Please contact me with any further questions or concerns regarding this project.

Sincerely,

John Calvert, P.E.
Project Engineer



Digitally signed by
John A. Calvert
Date: 2022.02.23
17:09:40 -07'00'

Gravity Loading

Roof Snow Load Calculations		
p_g = Ground Snow Load =	20 psf	
$p_f = 0.7 C_e C_t I p_g$		(ASCE7 - Eq 7-1)
C_e = Exposure Factor =	1	(ASCE7 - Table 7-2)
C_t = Thermal Factor =	1	(ASCE7 - Table 7-3)
I = Importance Factor =	1	
p_f = Flat Roof Snow Load =	14.0 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
C_s = Slope Factor =	1	
p_s = Sloped Roof Snow Load =	14.0 psf	

PV Dead Load = 3 psf (Per Blue Raven Solar)	
DL Adjusted to 37 Degree Slope	3.76 psf
PV System Weight	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
X Standoff Spacing =	4.00 ft
Y Standoff Spacing =	6.08 ft
Standoff Tributary Area =	24.33 sft
Point Loads of Standoffs	73 lb
Note: PV standoffs are staggered to ensure proper distribution of loading	

Roof Live Load = 20 psf	
Note: Roof live load is removed in area's covered by PV array.	

Roof Dead Load (MP1)		
Composition Shingle	4.00	
Roof Plywood	2.00	
2x4 Top Chords @ 24"o.c.	0.73	
Vaulted Ceiling	0.00	(Ceiling Not Vaulted)
Miscellaneous	0.27	
Total Roof DL (MP1)	7.0 psf	
DL Adjusted to 37 Degree Slope	8.8 psf	

Wind Calculations

Per ASCE 7-10 Components and Cladding

Input Variables	
Wind Speed	115 mph
Exposure Category	C
Roof Shape	Hip/Gable
Roof Slope	37 degrees
Mean Roof Height	20 ft
Effective Wind Area	21.3 ft

Design Wind Pressure Calculations	
Wind Pressure $P = qh \cdot G \cdot C_n$	
$qh = 0.00256 \cdot K_z \cdot K_{zt} \cdot K_d \cdot V^2$	(Eq. 30.3-1)
K_z (Exposure Coefficient) = 0.9	(Table 30.3-1)
K_{zt} (topographic factor) = 1	(Fig. 26.8-1)
K_d (Wind Directionality Factor) = 0.85	(Table 26.6-1)
V (Design Wind Speed) = 115 mph	(Fig. 26.5-1A)
Risk Category = II	(Table 1.5-1)
$qh = 25.90$	
$0.6 \cdot qh = 15.54$	

Standoff Uplift Calculations-Portrait				
	Zone 1	Zone 2	Zone 3	Positive
$GC_p =$	-0.94	-1.15	-1.15	0.86
Uplift Pressure =	-14.55 psf	-17.80 psf	-17.80 psf	22.4 psf
X Standoff Spacing =	4.00	4.00	2.67	
Y Standoff Spacing =	6.08	3.041666667	3.041666667	
Tributary Area =	24.33	12.17	8.11	
Dead Load on Attachment=	73.00	36.50	24.33	
Footing Uplift (0.6D+0.6W)=	-310 lb	-195 lb	-130 lb	

(Fig. 30.4-1)

Standoff Uplift Calculations-Landscape				
	Zone 1	Zone 2	Zone 3	Positive
$GC_p =$	-0.94	-1.15	-1.15	0.86
Uplift Pressure =	-14.55 psf	-17.80 psf	-17.80 psf	10.5 psf
X Standoff Spacing =	6.00	6.00	4.00	
Y Standoff Spacing =	3.50	1.75	1.75	
Tributary Area =	21.00	10.50	7.00	
Dead Load on Attachment=	63.00	31.50	21.00	
Footing Uplift (0.6D+0.6W) =	-268 lb	-168 lb	-112 lb	

(Fig. 30.4-1)

Standoff Uplift Check	
Maximum Design Uplift =	-310 lb
Standoff Uplift Capacity =	450 lb
450 lb capacity > 310 lb demand Therefore, OK	

Fastener Capacity Check	
Fastener =	1 - 5/16" dia. lag
Number of Fasteners =	1
Embedment Depth =	2.5
Pullout Capacity Per Inch =	250 lb
Fastener Capacity =	625 lb
w/ F.S. of 1.5 & DOL of 1.6=	667 lb
667.2 lb capacity > 310 lb demand Therefore, OK	

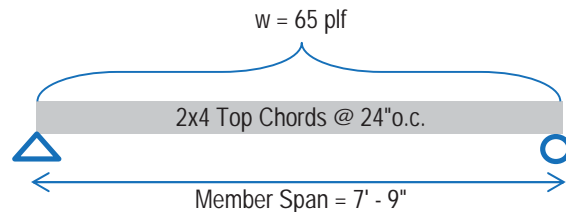
Framing Check

(MP1)

PASS

Dead Load 8.8 psf
PV Load 3.8 psf
Snow Load 14.0 psf

Governing Load Combo = DL + LL
Total Load 32.5 psf



Member Properties				
Member Size	S (in ³)	I (in ⁴)	Lumber Sp/Gr	Member Spacing
2x4	3.06	5.36	DF#2	@ 24"o.c.

Check Bending Stress							
Fb (psi) =	f _b	x	C _d	x	C _f	x	C _r
	900	x	1.25	x	1.5	x	1.15

(NDS Table 4.3.1)

Allowed Bending Stress = 1940.6 psi

Maximum Moment = $(wL^2) / 8$
= 488.328 ft#
= 5859.94 in#

Actual Bending Stress = (Maximum Moment) / S
= 1913.5 psi

Allowed > Actual -- 98.7% Stressed -- Therefore, OK

Check Deflection	
Allowed Deflection (Total Load) =	$L/180$ (E = 1600000 psi Per NDS)
	= 0.516 in
Deflection Criteria Based on =	Continuous Span
Actual Deflection (Total Load) =	$(wL^4) / (185 \cdot E \cdot I)$
	= 0.256 in
	= L/364 > L/180 Therefore OK

Allowed Deflection (Live Load) = $L/240$
0.387 in
Actual Deflection (Live Load) = $(wL^4) / (185 \cdot E \cdot I)$
0.158 in
L/589 > L/240 **Therefore OK**

Check Shear	
Member Area = 5.3 in ²	F _v (psi) = 180 psi (NDS Table 4A)
Allowed Shear = F _v * A = 945 lb	Max Shear (V) = w * L / 2 = 252 lb

Allowed > Actual -- 26.7% Stressed -- Therefore, OK