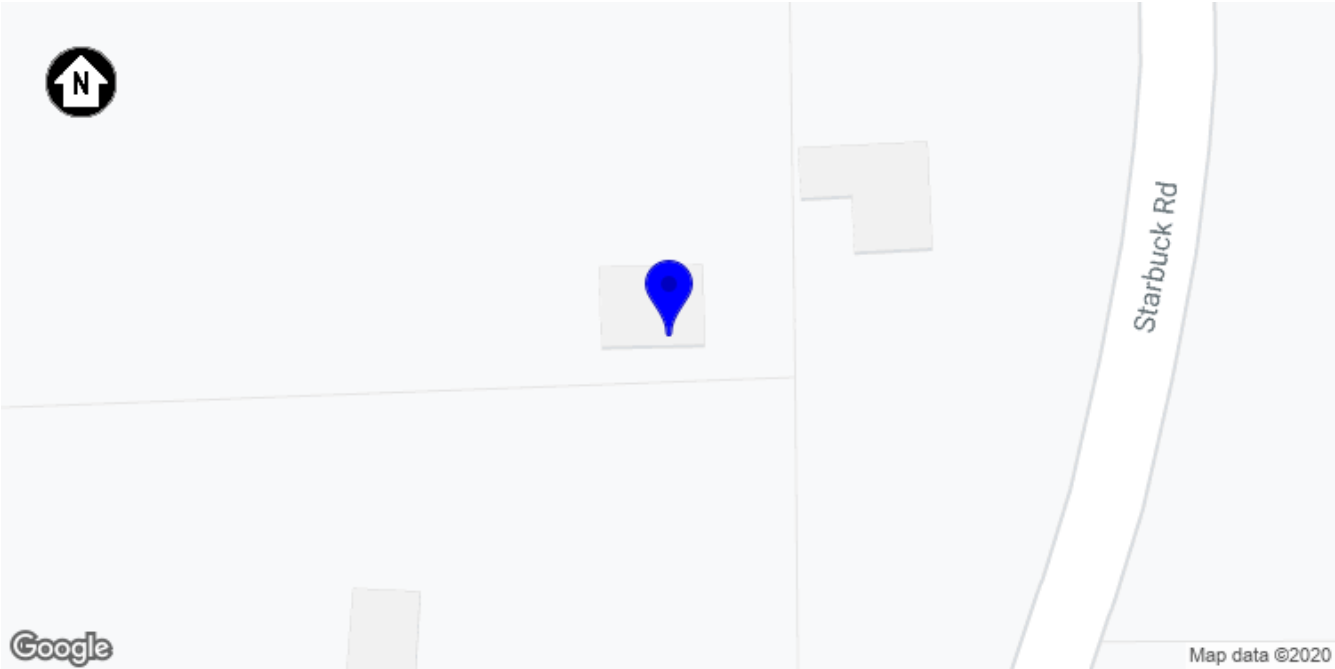


DIRECTORY OF PAGES	
PV-1	PROJECT SUMMARY
PV-2	SITE PLAN
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PV-4	SAFETY LABELS
PV-5	ATTACHMENT PLAN
PV-6	ATTACHMENT DETAILS
PV-7	FIRE SAFETY PLAN
APPENDIX	ELECTRICAL CALCULATIONS
	MODULE DATASHEET
	ARRAY WIRING BOX DATASHEET
	INVERTER DATASHEET
	MOUNTING SYSTEM DATASHEET
	MOUNTING SYSTEM ENGINEERING LETTER
	UL 2703 GROUND AND BONDING CERTIFICATION
	ANCHOR DATASHEET

PROJECT DETAILS	
PROPERTY OWNER	KATHY ROBERTS
PROPERTY ADDRESS	1710 STARBUCK RD, RESCUE, CA 95672 US
APN	102231001000
ZONING	RESIDENTIAL
USE AND OCCUPANCY CLASSIFICATION	ONE- OR TWO-FAMILY DWELLING GROUP (GROUP R3)
AHJ	COUNTY OF SACRAMENTO
UTILITY COMPANY	PACIFIC GAS & ELECTRIC CO
ELECTRICAL CODE	2019 CEC
FIRE CODE	2019 CFC
OTHER BUILDING CODES	2019 CA BUILDING CODE 2019 CA RES. BUILDING CODE 2019 CA PLUMBING CODE 2019 CA MECHANICAL CODE 2019 CA FUEL GAS CODE 2019 CA ENERGY CODE

OWNER-BUILDER	
PROPERTY OWNER	KATHY ROBERTS
OWNER SIGNATURE	



1 PLOT
PV-1 SCALE: NTS



2 LOCALE
PV-1 SCALE: NTS

SCOPE OF WORK
THIS PROJECT INVOLVES THE INSTALLATION OF A PHOTOVOLTAIC POWER SYSTEM. SOLAR PANELS WILL BE RACKED USING A PREENGINEERED RACKING SYSTEM. THE RACKED 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 PHOTOVOLTAIC SYSTEM WITH NO BATTERY STORAGE
DC RATING OF SYSTEM	2.21KW
AC RATING OF SYSTEM	1.96KW
AC OUTPUT CURRENT	8.2A
INVERTER(S)	7 X ENPHASE IQ6PLUS-72-X-US
MODULE	TRINA SOLAR TSM-315DD05H.08(II)
ARRAY WIRING	(1) BRANCH OF 7 IQ6PLUS-72-X-US MICROINVERTERS

INTERCONNECTION DETAILS	
POINT OF CONNECTION	NEW LOAD-SIDE AC CONNECTION PER CEC 705.12(B) AT MSP
UTILITY SERVICE	120/240V 1ϕ
LOCATION	MAIN SERVICE PANEL W/TOP-FED 200A BUSBAR 200A MCB

SITE DETAILS	
ASHRAE EXTREME LOW	-3°C (27°F)
ASHRAE 2% HIGH	38°C (100°F)
CLIMATE DATA SOURCE	SACRAMENTO MATHER AIRPORT (KMHR)
RISK CATEGORY	II
WIND EXPOSURE CATEGORY	C

P-141439



GRID-TIED SOLAR POWER SYSTEM

ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

PROJECT SUMMARY

DOC ID: 141439-175038-1
DATE: 7/28/20
CREATOR: T.C.
REVIEWER:

REVISIONS

PV-1



GENERAL NOTES	
1	EQUIPMENT LIKELY TO BE WORKED UPON WHILE ENERGIZED SHALL BE INSTALLED IN LOCATIONS THAT SATISFY MINIMUM WORKING CLEARANCES PER CEC 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	ALL EMT CONDUIT FITTINGS SHALL BE LISTED AS WEATHERPROOF FITTINGS AND INSTALLED TO ENSURE A RAINTIGHT FIT, PER CEC 358.42.

- 1 (N) PROPOSED ROOF-MOUNTED PHOTOVOLTAIC ARRAY. 4:12 (18°) SLOPED ROOF, 7 PV MODULES (BLACK FRAME, BLACK BACKSHEET), 181° AZIMUTH
- 2 (N) TRANSITION BOX (JB1), OUTDOOR , OUTPUT CIRCUIT CONDUCTORS SHALL BE RUN IN EMT CONDUIT OVER ROOF NO CLOSER THAN 0.5" ABOVE ROOF SURFACE

1

SITE PLAN

PV-2

SCALE: 1" = 10'

P-141439



GRID-TIED SOLAR POWER SYSTEM

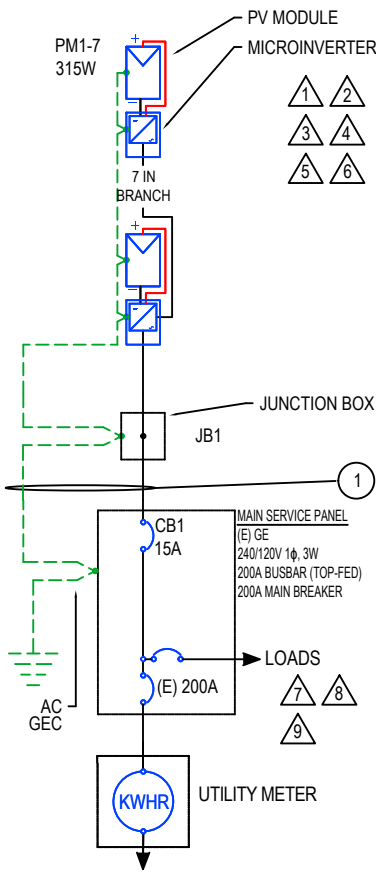
ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

SITE PLAN

DOC ID: 141439-175038-1
DATE: 7/28/20
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PV-2



MODULES												
REF.	QTY.	MAKE AND MODEL		PMAX	PTC	ISC	IMP	VOC	VMP	TEMP. COEFF. OF VOC		FUSE RATING
PM1-7	7	TRINA SOLAR TSM-315DD05H.08(II)		315W	292W	9.93A	9.51A	40.4V	33.1V	-0.117V/°C (-0.29%/°C)		20A

INVERTERS										
REF.	QTY.	MAKE AND MODEL	AC VOLTAGE	GROUND	MAX OCPD RATING	RATED POWER	MAX OUTPUT CURRENT	MAX INPUT CURRENT	MAX INPUT VOLTAGE	CEC WEIGHTED EFFICIENCY
I1-7	7	ENPHASE IQ6PLUS-72-2-US	240V	NOT SOLIDLY GROUNDED	20A	280W	1.2A	15.0A	62V	97.0%

PASS-THRU BOXES AND COMBINERS				OCPDS			
REF.	QTY.	MAKE AND MODEL		RATED CURRENT	MAX RATED VOLTAGE		
JB1	1	ENPHASE IQ COMBINER OR EQUIV.		48A	240VAC		

REF.	QTY.	MAKE AND MODEL		RATED CURRENT	MAX VOLTAGE
CB1	1			15A	240VAC

SYSTEM SUMMARY	
INVERTERS PER BRANCH	7
MAX AC CURRENT	8.19A
MAX AC OUTPUT	1,960W
ARRAY STC POWER	2,205W
ARRAY PTC POWER	2,045W
MAX AC CURRENT	8A
MAX AC POWER OUTPUT	1,960W
DERATED AC POWER OUTPUT	1,960W

NOTES

⚠

THE DC AND AC CONNECTORS OF THE ENPHASE IQ6PLUS-72-X-US AND ARE LISTED TO MEET REQUIREMENTS AS A DISCONNECT MEANS AS ALLOWED BY CEC 690.15(D) AND CEC 690.33.

⚠

MICROINVERTER BRANCH CIRCUIT CONDUCTORS ARE MANUFACTURED ENPHASE Q CABLES LISTED FOR USE IN 20A OR LESS CIRCUITS OF ENPHASE IQ MICROINVERTERS. THEY ARE ROHS, OIL RESISTANT, AND UV RESISTANT. THEY CONTAIN TWO 12 AWG CONDUCTORS OF TYPE THHN/THWN-2 DRY/WET AND CERTIFIED TO UL3003 AND UL 9703. THE CABLE'S DOUBLE INSULATED RATING REQUIRES NO NEUTRAL OR GROUNDED CONDUCTOR.

⚠

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 CEC 250.4(A) AND PART III OF ARTICLE 250 AND EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZED ACCORDING TO CEC 690.45(A). THE GROUNDING ELECTRODE SYSTEM SHALL ADHERE TO CEC 690.47(A) AND CEC 250.169. THE DC GROUNDING ELECTRODE SHALL BE SIZED ACCORDING TO CEC 250.166

⚠

AN AUXILIARY GROUNDING ELECTRODE MAY BE INSTALLED IN COMPLIANCE WITH NEC SECTION 690.47(B).

⚠

MAX DC VOLTAGE OF PV MODULE IS EXPECTED TO BE 43.7V AT -3°C (-3°C - 25°C) X -0.117V/°C + 40.4V = 43.7V).

⚠

POINT-OF-CONNECTION IS ON LOAD SIDE OF SERVICE DISCONNECT, IN COMPLIANCE WITH CEC 705.12(B). OUTPUT IS BACKFED THROUGH BREAKER IN MAIN PANEL.

⚠

THE PV BREAKER SHALL NOT BE MARKED FOR "LINE" AND "LOAD".

⚠

THE PV BREAKER SHALL BE LOCATED AT THE OPPOSITE END OF THE BUSBAR FROM THE MAIN BREAKER.

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	LENGTH	VOLTAGE DROP
1	1	12 AWG THWN-2, COPPER	0.5" DIA. EMT	2	15A	12 AWG THWN-2, COPPER	0.91 (38°C)	1.0	8.19A	10.24A	30A	27.3A	75°C	25A	50FT	0.67%

GENERAL ELECTRICAL NOTES	
1	UTILITY HAS 24-HR UNRESTRICTED ACCESS TO ALL PHOTOVOLTAIC SYSTEM COMPONENTS LOCATED AT THE SERVICE ENTRANCE.
2	MODULES CONFORM TO AND ARE LISTED UNDER UL 1703.
3	CONDUCTORS EXPOSED TO SUNLIGHT SHALL BE LISTED AS SUNLIGHT RESISTANT PER NEC ARTICLE 300.6 (C) (1) AND ARTICLE 310.10 (D).
4	CONDUCTORS EXPOSED TO WET LOCATIONS SHALL BE SUITABLE FOR USE IN WET LOCATIONS PER NEC ARTICLE 310.10 (C).

GROUNDING NOTES	
1	ALL EQUIPMENT SHALL BE PROPERLY GROUNDED PER THE REQUIREMENTS OF NEC ARTICLES 250 & 690
2	PV MODULES SHALL BE GROUNDED TO MOUNTING RAILS USING MODULE LUGS OR RACKING INTEGRATED
2	GROUNDING CLAMPS AS ALLOWED BY LOCAL JURISDICTION. ALL OTHER EXPOSED METAL PARTS SHALL BE GROUNDED USING UL-LISTED LAY-IN LUGS.
3	INSTALLER SHALL CONFIRM THAT MOUNTING SYSTEM HAS BEEN EVALUATED FOR COMPLIANCE WITH UL 2703 "GROUNDING AND BONDING" WHEN USED WITH PROPOSED PV MODULE.
4	ALL GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE
5	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.
6	AC SYSTEM GROUNDING ELECTRODE CONDUCTOR (GEC) SHALL BE A MINIMUM SIZE #8AWG WHEN INSULATED, #6AWG IF BARE WIRE.
7	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
8	GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN, OR MARKED GREEN IF #4AWG OR LARGER

1

PV-3

SINGLE-LINE DIAGRAM

SCALE: NTS

P-141439

CARSTAIRS
ENERGY

GRID-TIED SOLAR POWER SYSTEM

ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

SINGLE-LINE DIAGRAM

PROJECT ID: 141439

DATE: 07/28/20

CREATED BY: T.C.

CHECKED BY:

REVISIONS

PV-3

MSP - MAIN SERVICE PANEL
(GE)

1

2

3

4

5

6

1

SEE NOTE NO. 4 (MSP)

PHOTOVOLTAIC 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.

SOLAR ELECTRIC
PV PANELS

CEC 690.56(C)(1)

3

AC DISCONNECT (CB1 IN MSP)

MAXIMUM AC OPERATING CURRENT: 8.2A
MAXIMUM AC OPERATING VOLTAGE: 240V

CEC 690.54

4

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

! WARNING !
DUAL POWER SOURCE. SECOND SOURCE IS
PHOTOVOLTAIC SYSTEM.

CEC 705.12(B)(3)

2

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

! CAUTION !
POWER TO THIS BUILDING IS ALSO FROM ROOF MOUNTED SOLAR ARRAY WITH SAFETY DISCONNECTS
AS SHOWN

N

SOLAR ARRAY

CEC 690.56(B)

5

SOLAR BREAKER (MSP)

! WARNING !
INVERTER OUTPUT CONNECTION. DO NOT
RELOCATE THIS OVERCURRENT DEVICE.

CEC 705.12(B)(2)(3)(B)

6

SOLAR BACKFEED BREAKER AS MAIN AC SOLAR
DISCONNECT (CB1 IN MSP)

PV SYSTEM DISCONNECT

CEC 690.13(B)

LABELING NOTES	
1	ALL PLAQUES AND SIGNAGE REQUIRED BY 2019 CEC AND 2019 CFC 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 CEC 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 CEC 690.56(B).
4	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

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ENERGY

GRID-TIED SOLAR POWER SYSTEM

ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

SAFETY LABELS

DOC ID: 141439-175038-1

DATE: 7/28/20

CREATOR: T.C.

REVIEWER:

REVISIONS

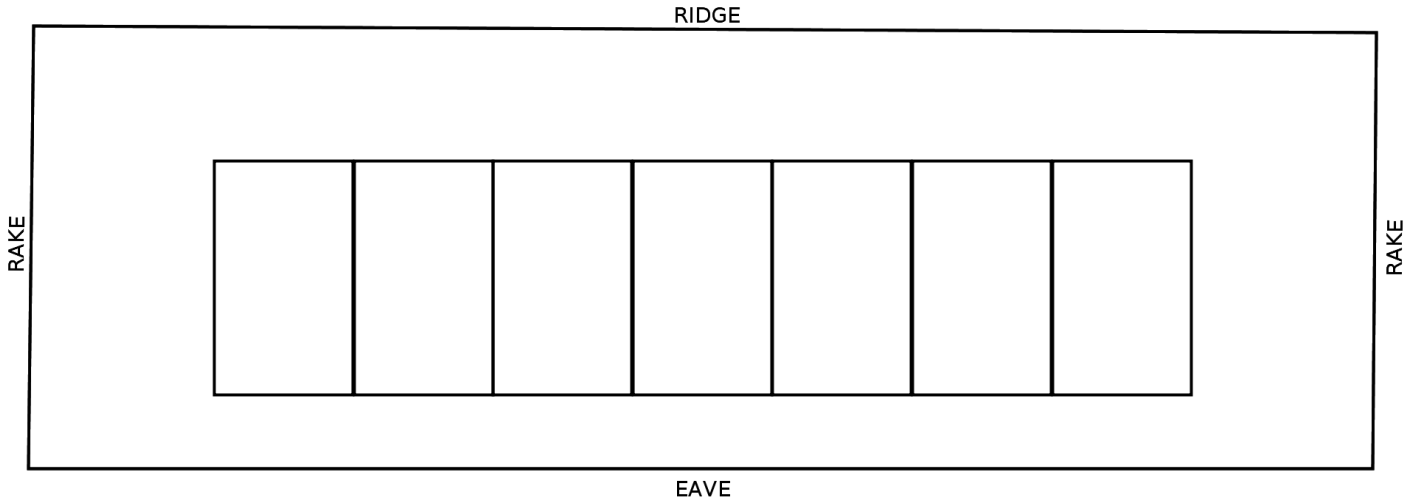
PV-4

ROOF PROPERTIES	
ROOF MATERIAL	COMPOSITION SHINGLE (1 LAYER)
SLOPE	4/12 (18.4°)
MEAN ROOF HEIGHT	21.7FT
DECK SHEATHING	15/32" OSB
CONSTRUCTION	TRUSSES (2X4 TOP-CHORD), 24IN OC

MODULE MECHANICAL PROPERTIES	
MODEL	TRINA SOLAR TSM-315DD05H.08(II)
DIMENSIONS (AREA)	65.9IN X 39.1IN X 1.4IN (17.9 SQ FT)
WEIGHT	41.4LB

MOUNTING SYSTEM PROPERTIES	
MAX. ALLOW. RAIL SPAN	48.0IN (ZONES 1, 2, AND 3)
MAX. MOUNT SPACING	48.0IN (ZONES 1, 2, AND 3)
MAX. ALLOW. CANTILEVER	19.2IN (ZONES 1, 2, AND 3)
GROUNDING AND BONDING	INTEGRAL GROUNDING CERTIFIED TO UL 2703 REQUIREMENTS

NOTES	
1	TRUSS LOCATIONS ARE APPROXIMATE. ACTUAL LOCATIONS MAY DIFFER AND CONTRACTOR MAY NEED TO ADJUST MOUNT LOCATIONS. IN NO CASE SHALL THE MOUNT SPACING EXCEED "MAX. MOUNT SPACING"



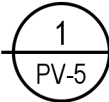
WIND ZONE I



WIND ZONE II



WIND ZONE III



ATTACHMENT PLAN (ORTHOGONAL PROJECTION)
SCALE: 1/4" = 1'

P-141439



GRID-TIED SOLAR POWER SYSTEM

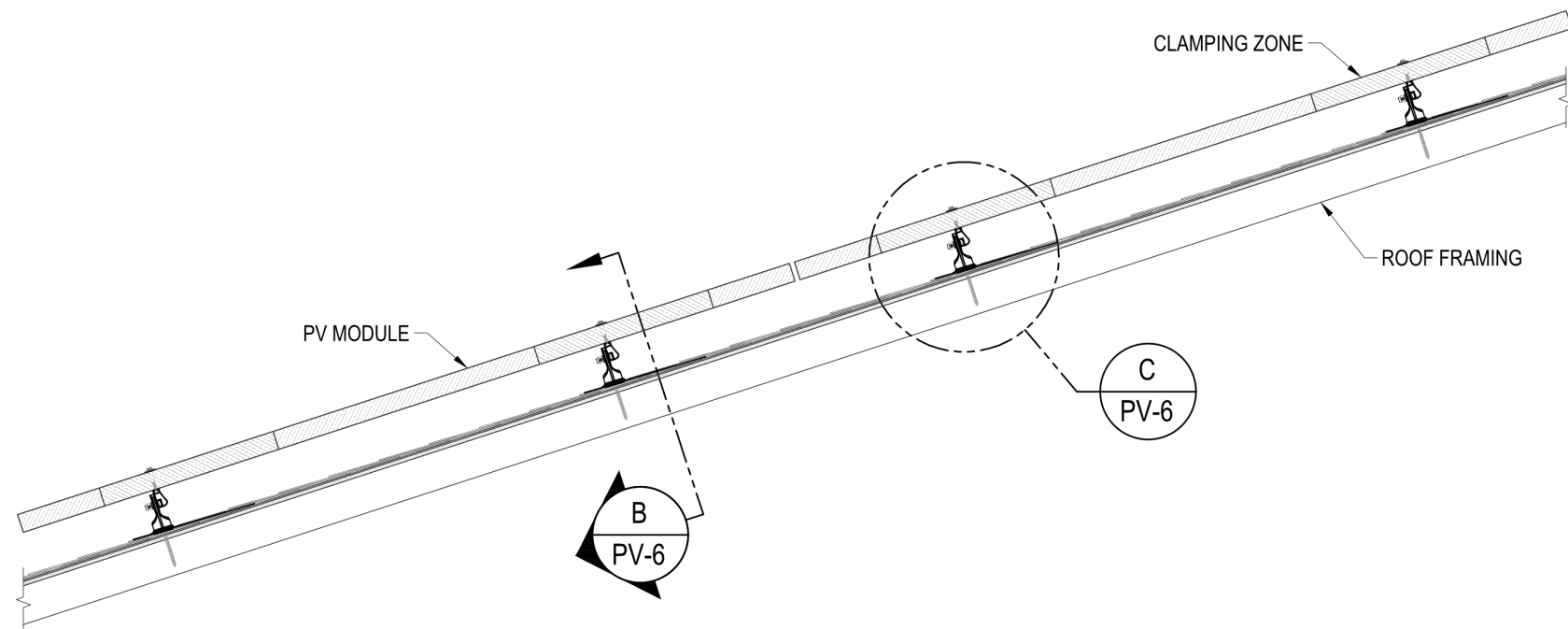
ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

ATTACHMENT
PLAN

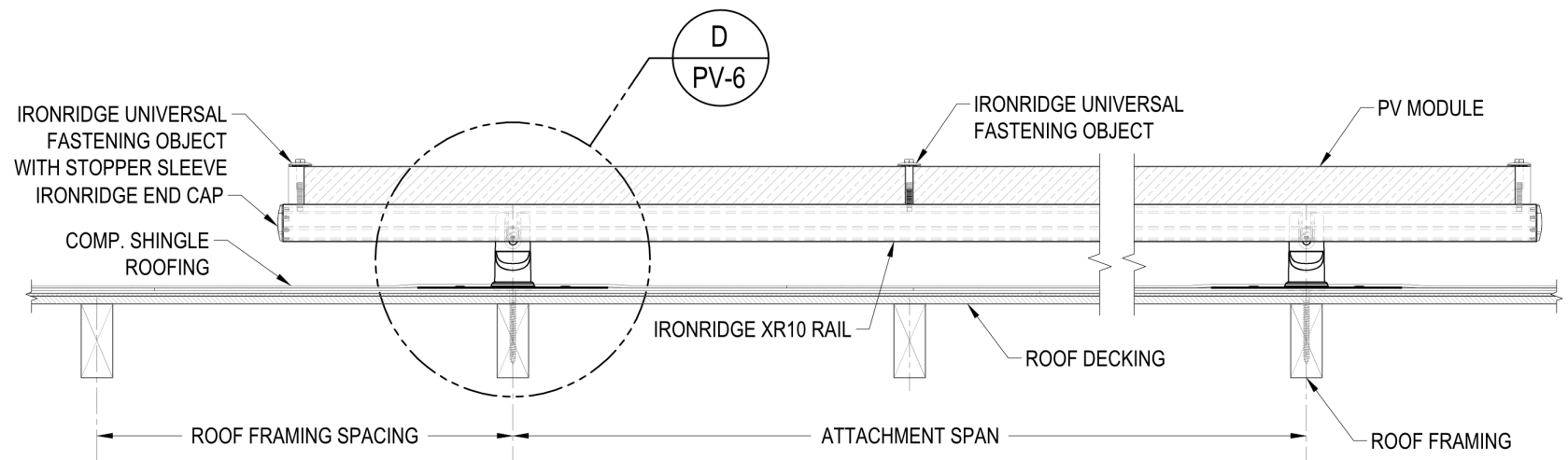
DOC ID: 141439-175038-1	
DATE: 7/28/20	
CREATOR: T.C.	
REVIEWER:	

REVISIONS	

PV-5

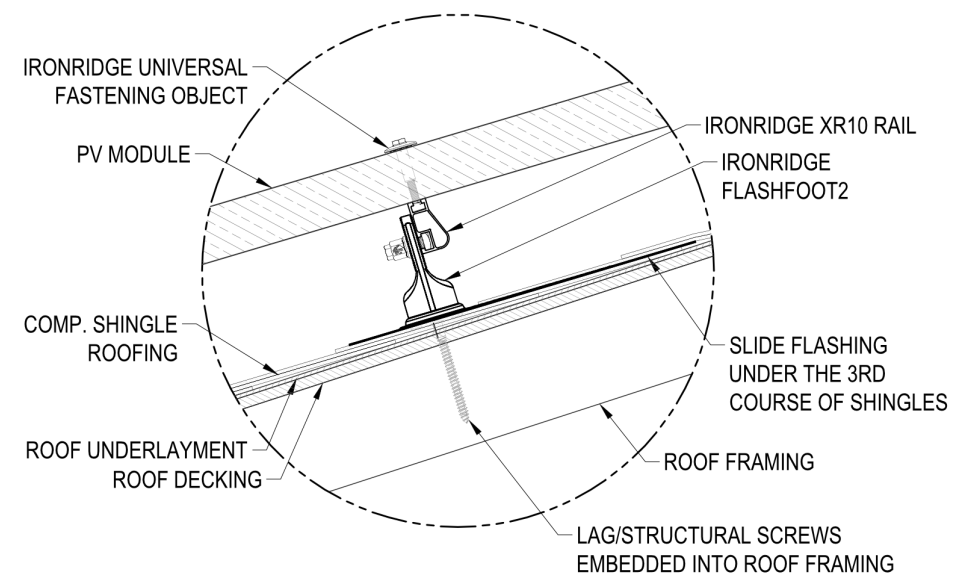


A
PV-6 RACKING ELEVATION (TRANSVERSE VIEW)
SCALE: NTS

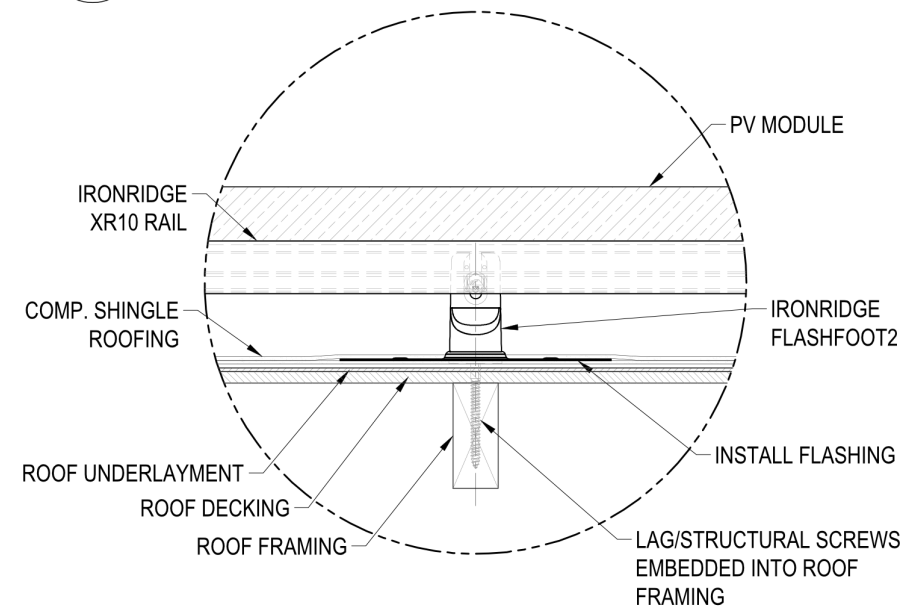


B
PV-6 RACKING ELEVATION (LONGITUDINAL VIEW)
SCALE: NTS

MOUNTING SYSTEM NOTES	
1	FLASHING SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURERS' INSTRUCTIONS.
2	IF THERE IS ANY CONFLICT BETWEEN WHAT IS DEPICTED HERE AND INSTRUCTIONS PROVIDED BY A MANUFACTURER, THE MANUFACTURER'S INSTRUCTIONS SHALL SUPERCEDE.



C
PV-6 ATTACHMENT DETAIL (TRANSVERSE VIEW)
SCALE: NTS



D
PV-6 ATTACHMENT DETAIL (LONGITUDINAL VIEW)
SCALE: NTS

P-141439



GRID-TIED SOLAR POWER SYSTEM

ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

ATTACHMENT DETAILS

DOC ID: 141439-175038-1

DATE: 7/28/20

CREATOR: T.C.

REVIEWER:

REVISIONS

PV-6



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

GENERAL NOTES	
1	ROOF ACCESS POINTS SHALL BE LOCATED AT STRONG POINTS OF BUILDING CONSTRUCTION IN LOCATIONS NOT ABOVE OPENINGS, SUCH AS WINDOWS OR DOORS, AND WHERE THEY DO NOT CONFLICT WITH OVERHEAD OBSTRUCTIONS SUCH AS TREE LIMBS, WIRES, OR SIGNS. (CFC 1204.1.1)
2	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. (CFC 1204.2.1.1)
3	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. (CFC 1204.2.1.2)
4	FOR SINGLE-RIDGE GROUP R-3 BUILDINGS TWO, 36"-WIDE ACCESS PATHWAYS ARE REQUIRED FROM THE EAVE TO THE RIDGE ON EACH ROOF SLOPE WHERE PV MODULES ARE INSTALLED. (CFC 1204.1.2.3)
5	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. (CFC 1204.2.2)

- 1 3.0 FT. WIDE FIRE ACCESS PATHWAY, PER CFC 1204.1.2.3
- 2 ROOF ACCESS POINT
- 3 3.0 FT. WIDE SMOKE-VENTILATION SETBACK, PER CFC 1204.2.1.2
- 4 3.0 FT. WIDE FIRE ACCESS PATHWAY, PER CFC 1204.1.2.3
- 5 ROOF ACCESS POINT
- 6 THIS SYSTEM UTILIZES MICROINVERTERS. THERE ARE NO DC CIRCUITS OUTSIDE OF THE ARRAY PERIMETER OR INSIDE THE BUILDING.
- 7 CABLES, WHEN RUN BETWEEN ARRAYS, SHALL BE ENCLOSED IN CONDUIT.

P-141439

CARSTAIRS
ENERGY

GRID-TIED SOLAR POWER SYSTEM

ROBERTS RESIDENCE
1710 STARBUCK RD
RESCUE, CA 95672

FIRE SAFETY PLAN

DOC ID: 141439-175038-1
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REVISIONS

PV-7

Conductor, Conduit, and OCPD Sizing Validation

1. Maximum System Voltage Test

1.1. Enphase inverter w/7 Trina Solar TSM-315DD05H.08(II) (315W)s

Array Properties

Array Type	Microinverter Array
System Description	Enphase inverter w/7 Trina Solar TSM-315DD05H.08(II) (315W)s
Module	TSM-315DD05H.08(II) (315W)
Highest number of modules in series in a PV Source Circuit	1
Design Low Temp.	-3°C
Module Voc	40.4V
Temp. Coefficient Voc	-0.117V/C

CEC Code Calculations

A. Maximum Voltage of PV Source Circuit	43.68V
see 690.7(A)	

CEC 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 (40.4V) will increase to 43.68V at the design low temperature (-3°C).

$(-3^{\circ}\text{C} - 25^{\circ}\text{C}) \times -0.117\text{V/C} + 40.4\text{V} = 43.68\text{V}$

The module Voc at the design low temperature is 43.68V.

$43.68\text{V} \times 1 = 43.68\text{V}$

CEC Code Validation Tests

1.	PV Source Circuit maximum Voc must not exceed 600V $43.68\text{V} < 600\text{V} = \text{true}$	PASS
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2. Wire, Conduit, and OCPD Code Compliance Validation

2.1. #1: AC Branch Output: Transition Box to Main Service Panel

Circuit Section Properties

Conductor	12 AWG THWN-2, Copper
Equipment Ground Conductor (EGC)	12 AWG THWN-2, Copper
OCPD(s)	15A
Raceway/Cable	0.5" dia. EMT
Lowest Terminal Temperature Rating	75°C
Maximum Wire Temperature	38°C
Power Source Description	Branch of 7 IQ6PLUS-72-X-US microinverters
Current	8.19A
Voltage	240V

CEC Code Calculations

A. Continuous Current	8.19A
see Article 100	

Equipment maximum rated output current is $7 \times 1.17\text{A} = 8.19\text{A}$

B. Ampacity of Conductor	30A
see Table 310.15(B)(16)	

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

C. Derated Ampacity of Conductor	27.3A
see Table 310.15(B)(3)(c), Table 310.15(B)(3)(a), and Article 100	

The temperature factor for 90°C insulation at 38°C is 0.91.
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 (30A) multiplied by the temperature factor (0.91) and by the fill factor (1).
 $30\text{A} \times 0.91 \times 1 = 27.3\text{A}$

D. Max Current for Terminal Temp. Rating	25A
see 110.14(C)	

The lowest temperature limit 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 25A.

E. Minimum Allowed OCPD Rating	10A
see 240.4	

CEC 690.9(B) requires that the OCPD be rated for no less than 1.25 times the Continuous Current of the circuit.
 $8.19\text{A} \times 1.25 = 10.24\text{A}$ rounded down to 10A

F. Maximum Allowed OCPD Rating	20A
see 240.4(D)	

CEC 240.4(D) requires that OCPD rating not exceed 20A when protecting a Copper 12 AWG conductor.

G. Minimum Required EGC Size	14 AWG
see Table 250.122	

The smallest EGC size allowed is 14 AWG for OCPD rating 15A according to Table 250.122.

H. Minimum Recommended Conduit Size	0.5" dia.
see 300.17	

The total area of all conductors is 0.0399in². With a maximum fill rate of 0.4, the recommended conduit diameter is 0.5.

Qty	Description	Size	Type	Area	Total Area
2	Conductor	12 AWG	THWN-2	0.0133in²	0.0266in²
1	Equipment Ground	12 AWG	THWN-2	0.0133in²	0.0133in²
3					0.0399in²

$0.0399\text{in}^2 / 0.4 = 0.0997\text{in}^2$ (Corresponding to a diameter of 0.5")

CEC Code Validation Tests

1.	OCPD rating must be at least 125% of Continuous Current (240.4) $15\text{A} \geq 8.19\text{A} \times 1.25 = \text{true}$	PASS
2.	Derated ampacity must exceed OCPD rating, or rating of next smaller OCPD (240.4) $27.3\text{A} \geq 15\text{A}$ (OCPD Rating) = true	PASS
3.	OCPD rating must not exceed max OCPD rating for conductor (240.4) 15A (OCPD Rating) $\leq 20\text{A} = \text{true}$	PASS
4.	Derated Ampacity must be greater than or equal to the Continuous Current (Article 100) $27.3\text{A} \geq 8.19\text{A} = \text{true}$	PASS
5.	Conductor Ampacity must be at least 125% of Continuous Current (215.2(A)(1)) $30\text{A} > 8.19\text{A} \times 1.25 = \text{true}$	PASS
6.	Max current for terminal must be at least 125% of the Continuous Current. (110.14(C)) $25\text{A} \geq 8.19\text{A} \times 1.25 = \text{true}$	PASS
7.	EGC must meet code requirements for minimum size (Table 250.122) $12\text{ AWG} \geq 14\text{ AWG} = \text{true}$	PASS
8.	Conduit must meet code recommendation for minimum size (300.17) $0.5\text{in.} \geq 0.5\text{in.} = \text{true}$	PASS

THE

ALLMAX^M plus⁺

FRAMED 120 HALF-CELL MODULE



120-Cell MONOCRYSTALLINE MODULE

285-320W POWER OUTPUT RANGE

19.3% MAXIMUM EFFICIENCY

0~+5W POSITIVE POWER TOLERANCE

Founded in 1997, Trina Solar is the world's leading comprehensive solutions provider for solar energy. we believe close cooperation with our partners is critical to success. Trina Solar now distributes its PV products to over 60 countries all over the world. Trina is able to provide exceptional service to each customer in each market and supplement our innovative, reliable products with the backing of Trina as a strong, bankable partner. We are committed to building strategic, mutually beneficial collaboration with installers, developers, distributors and other partners.

Comprehensive Products And System Certificates

IEC61215/IEC61730/UL1703/IEC61701/IEC62716
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse gases Emissions Verification
OHSAS 18001: Occupation Health and Safety Management System



Trina solar

PRODUCTS	BACKSHEET COLOR	POWER RANGE
TSM-DD05H.08(II)	White	285-320W
TSM-DD05H.05(II)	Black	285-320W

FRAME COLOR: Black



Increased value

- Reduce BOS cost with high power bin
- Low thermal coefficients for greater energy production at higher temperature



Half-cell design brings higher efficiency

- New cell string layout and split J-box location to reduce the energy loss caused by inter-row shading
- Integrated LRF(Light Redirecting Film) to enhance power, specially for ground-mount applications (optional)
- Lower cell connection power losses due to half-cell layout (120 monocrystalline)



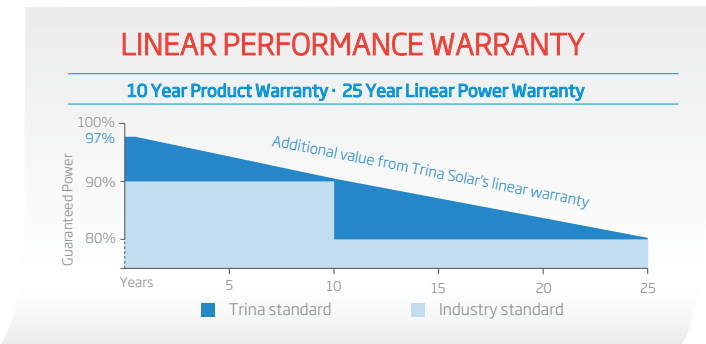
Highly reliable due to stringent quality control

- Over 30 in-house tests (UV, TC, HF etc)
- Increased module robustness to minimize micro-cracks
- PID resistant and free of snail trails
- Internal test requirement of Trina more stringent than certification authority



Certified to withstand the most challenging environmental conditions

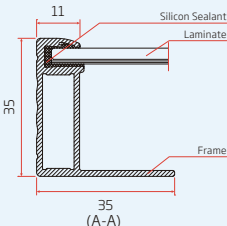
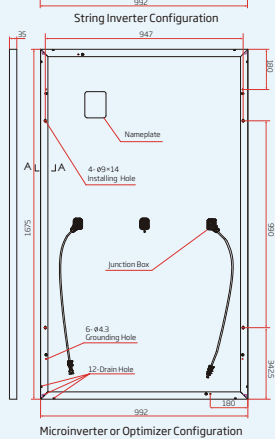
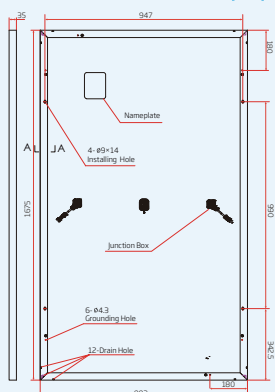
- 2400 Pa negative load
- 5400 Pa positive load



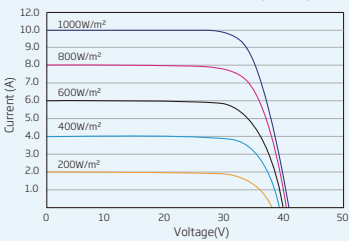
ALLMAX^M plus⁺

FRAMED 120 HALF-CELL MODULE

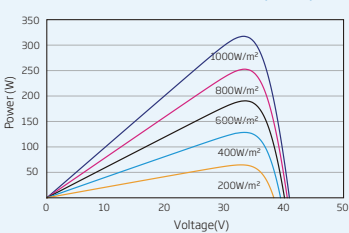
DIMENSIONS OF PV MODULE(mm)



I-V CURVES OF PV MODULE(315W)



P-V CURVES OF PV MODULE(315W)



ELECTRICAL DATA (STC)

Peak Power Watts-P _{MAX} (Wp)*	285	290	295	300	305	310	315	320
Power Output Tolerance-P _{MAX} (W)	0 ~ +5							
Maximum Power Voltage-V _{MPP} (V)	31.6	31.9	32.1	32.4	32.6	32.9	33.1	33.3
Maximum Power Current-I _{MPP} (A)	9.01	9.09	9.19	9.27	9.36	9.43	9.51	9.60
Open Circuit Voltage-V _{OC} (V)	38.9	39.1	39.5	39.7	40.0	40.2	40.4	40.6
Short Circuit Current-I _{SC} (A)	9.45	9.55	9.65	9.70	9.75	9.83	9.93	10.00
Module E ^o ciency η _m (%)	17.2	17.5	17.8	18.1	18.4	18.7	19.0	19.3

STC: Irradiance 1000W/m², Cell Temperature 25°C, Air Mass AM1.5.
*Measuring tolerance: ±3%.

ELECTRICAL DATA (NOCT)

Maximum Power-P _{MAX} (Wp)	212	216	220	224	228	231	235	238
Maximum Power Voltage-V _{MPP} (V)	29.6	29.8	30.0	30.3	30.6	30.8	30.9	31.2
Maximum Power Current-I _{MPP} (A)	7.17	7.26	7.32	7.39	7.44	7.51	7.58	7.64
Open Circuit Voltage-V _{OC} (V)	36.3	36.5	36.8	37.0	37.3	37.5	37.6	37.8
Short Circuit Current-I _{SC} (A)	7.63	7.71	7.79	7.83	7.87	7.94	8.02	8.08

NOCT: Irradiance at 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

MECHANICAL DATA

Solar Cells	Monocrystalline 156.75 × 78.375 mm (6.17 × 3.09 inches)
Cell Orientation	120 cells (6 × 20)
Module Dimensions	1675 × 992 × 35 mm (65.94 × 39.06 × 1.38 inches)
Weight	18.8 kg (41.4 lb)
Glass	3.2 mm (0.13 inches)
Encapsulant Material	EVA
Backsheet	White [DD05H.08(II)]; Black [DD05H.05(II)]
Frame	35 mm (1.38 inches) Anodized Aluminium Alloy
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm ² (0.006 inches ²), Portrait: N 140mm/P 285mm(5.51/11.22inches) Landscape: N 1200 mm /P 1200 mm (47.24/47.24 inches)
Connector	MC4

TEMPERATURE RATINGS

NOCT(Nominal Operating Cell Temperature)	44°C (±2°C)
Temperature Coe ^o cient of P _{MAX}	-0.37%/°C
Temperature Coe ^o cient of V _{OC}	-0.29%/°C
Temperature Coe ^o cient of I _{SC}	0.05%/°C

(DO NOT connect Fuse in Combiner Box with two or more strings in parallel connection)

WARRANTY

- 10 year Product Workmanship Warranty
- 25 year Linear Power Warranty

(Please refer to product warranty for details)

MAXIMUM RATINGS

Operational Temperature	-40~+85°C
Maximum System Voltage	1000V DC (IEC) 1000V DC (UL)
Max Series Fuse Rating	20A

PACKAGING CONFIGURATION

- Modules per box: 30 pieces
- Modules per 40' container: 780 pieces

Trina solar



CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.
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Version number: TSM_DD05H(II)_EN_2019_A
www.trinasolar.com

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

The **Enphase IQ Combiner™** with Enphase IQ Envoy™ consolidates interconnection equipment into a single enclosure and streamlines PV installations by providing a consistent, pre-wired solution for residential applications.



Smart

- Includes IQ Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular

Simple

- Three pre-installed 20 A / 240 VAC circuit breakers
- Provides production metering and optional consumption monitoring.

Reliable

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

Enphase IQ Combiner

MODEL NUMBER	
IQ Combiner X-IQ-AM1-240-B	IQ Combiner with Enphase IQ Envoy™ for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional consumption monitoring (+/- 2.5%).
ACCESSORIES (order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G / 12-year data plan) CELLMODEM-01 (3G / 5-year data plan)	Plug and play industrial grade cellular modem with data plan for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)
Consumption Monitoring CT CT-200-SPLIT	Split core current transformers enable whole home consumption metering (+/- 2.5%).
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
Solar branch circuit breakers	Three 2-pole 20 A/240 VAC DIN rail-mounted breakers
Maximum system voltage	240 VAC
Rated output current	48 A
Rated input current, each input	16 A
Maximum fuse/circuit breaker rating (output)	60 A
Production Metering CT	200 A solid core pre-installed and wired to IQ Envoy
MECHANICAL DATA	
Dimensions (WxHxD)	38.0 x 38.7 x 20.3 cm (15.0" x 15.3" x 8.0")
Weight	5.1 kg (11.2 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Vented, natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire size	14 to 6 AWG copper conductors for branch inputs. 14 to 4 AWG copper conductors for combined output. 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	802.3, Cat5E (or Cat 6) UTP Ethernet cable - not included
Cellular	Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G) - not included
COMPLIANCE	
Compliance, Combiner	UL 1741
Compliance, IQ Envoy	UL 916 CAN/CSA C22.2 No. 61010-1 47 CFR, Part 15, Class B, ICES 003 IEC/EN 61010-1:2010, EN50065-1, EN61000-4-5, EN61000-6-1, EN61000-6-2 Metering: ANSI C12.20 accuracy class 0.5

Enphase IQ 6 and IQ 6+ Microinverters

The high-powered smart grid-ready **Enphase IQ 6 Micro™** and **Enphase IQ 6+ Micro™** dramatically simplify the installation process while achieving the highest efficiency for module-level power electronics.

Part of the Enphase IQ System, the IQ 6 and IQ 6+ Micro integrate seamlessly with the Enphase IQ Envoy™, Enphase Q Aggregator™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

The IQ 6 and IQ 6+ Micro 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 two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014 & 2017)

Productive and Reliable

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

Smart Grid Ready

- Complies with fixed power factor, 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 6+ Micro is required to support 72-cell modules



To learn more about Enphase offerings, visit enphase.com



Enphase IQ 6 and IQ 6+ Microinverters

INPUT DATA (DC)	IQ6-60-2-US		IQ6PLUS-72-2-US	
Commonly used module pairings¹	195 W - 330 W +		235 W - 400 W +	
Module compatibility	60-cell PV modules only		60-cell and 72-cell PV modules	
Maximum input DC voltage	48 V		62 V	
Peak power tracking voltage	27 V - 37 V		27 V - 45 V	
Operating range	16 V - 48 V		16 V - 62 V	
Min/Max start voltage	22 V / 48 V		22 V / 62 V	
Max DC short circuit current (module Isc)	15 A		15 A	
Overvoltage class DC port	II		II	
DC port backfeed under single fault	0 A		0 A	
PV array configuration	1 x 1 ungrounded array; No additional DC side protection required; AC side protection requires max 20A per branch circuit			
OUTPUT DATA (AC)	IQ 6 Microinverter		IQ 6+ Microinverter	
Peak output power	240 VA		290 VA	
Maximum continuous output power	230 VA		280 VA	
Nominal (L-L) voltage/range²	240 V / 211-264 V	208 V / 183-229 V	240 V / 211-264 V	208 V / 183-229 V
Maximum continuous output current	0.96 A	1.11 A	1.17 A	1.35 A
Nominal frequency	60 Hz		60 Hz	
Extended frequency range	47 - 68 Hz		47 - 68 Hz	
Power factor at rated power	1.0		1.0	
Maximum units per 20 A (L-L) branch circuit	16 (240 VAC)		13 (240 VAC)	
	14 (208 VAC)		11 (208 VAC)	
Overvoltage class AC port	III		III	
AC port backfeed under single fault	0 A		0 A	
Power factor (adjustable)	0.7 leading ... 0.7 lagging		0.7 leading ... 0.7 lagging	
EFFICIENCY	@240 V	@208 V	@240 V	@208 V
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 locking type			
Dimensions (WxHxD)	219 mm x 191 mm x 37.9 mm (without bracket)			
Weight	1.29 kg (2.84 lbs)			
Cooling	Natural convection - No fans			
Approved for wet locations	Yes			
Pollution degree	PD3			
Enclosure	Class II double-insulated			
Environmental category / UV exposure rating	NEMA Type 6 / outdoor			
FEATURES				
Communication	Power line			
Monitoring	Enlighten Manager and MyEnlighten monitoring options Compatible with 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 and NEC-2017 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.

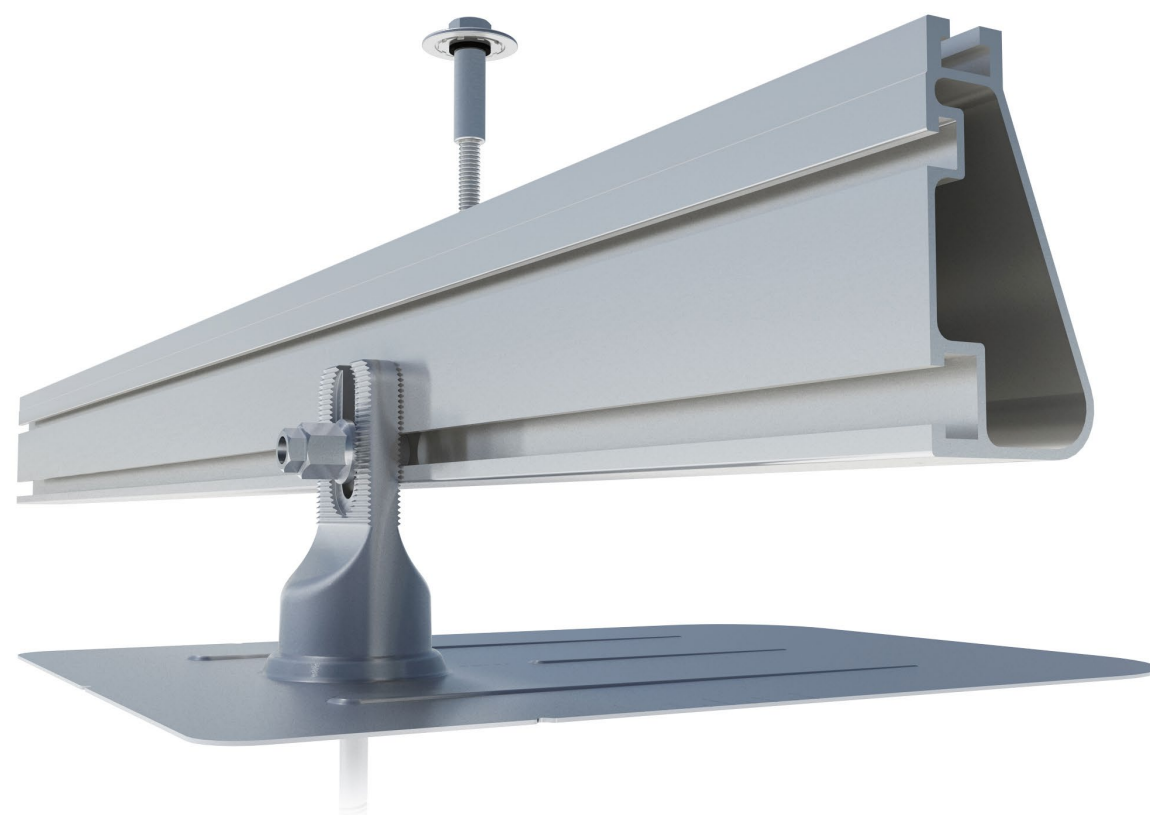
To learn more about Enphase offerings, visit enphase.com





Datasheet

Flush Mount System



Built for solar's toughest roofs.

IronRidge builds the strongest mounting system for pitched roofs in solar. Every component has been tested to the limit and proven in extreme environments.

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



Strength Tested

All components evaluated for superior structural performance.



Class A Fire Rating

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



UL 2703 Listed System

Entire system and components meet newest effective UL 2703 standard.



PE Certified

Pre-stamped engineering letters available in most states.



Design Assistant

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



25-Year Warranty

Products guaranteed to be free of impairing defects.

Datasheet

XR Rails ☺

XR10 Rail



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

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

XR100 Rail



The ultimate residential solar mounting rail.

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

XR1000 Rail



A heavyweight mounting rail for commercial projects.

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

Bonded Splices



All rails use internal splices for seamless connections.

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

Clamps & Grounding ☺

UFOs



Universal Fastening Objects bond modules to rails.

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

Stopper Sleeves



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

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

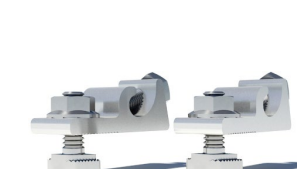
CAMO



Bond modules to rails while staying completely hidden.

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

Grounding Lugs



Connect arrays to equipment ground.

- Low profile
- Single tool installation
- Mounts in any direction

Attachments ☺

FlashFoot2



Flash and mount XR Rails with superior waterproofing.

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

Conduit Mount



Flash and mount conduit, strut, or junction boxes.

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

Slotted L-Feet



Drop-in design for rapid rail attachment.

- Secure rail connections
- Slot for vertical adjusting
- Clear and black finish

Bonding Hardware



Bond and attach XR Rails to roof attachments.

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

Resources



Design Assistant

Go from rough layout to fully engineered system. For free.
[Go to IronRidge.com/design](https://www.ironridge.com/design)



NABCEP Certified Training

Earn free continuing education credits, while learning more about our systems.
[Go to IronRidge.com/training](https://www.ironridge.com/training)



1495 Zephyr Avenue
Hayward, CA 94544
1-800-227-9523
IronRidge.com

Attn: Corey Geiger, COO, IronRidge Inc.
Date: September 7th, 2018

Re: Structural Certification and Span Tables for IronRidge Flush Mount System

This letter addresses the structural performance and code compliance of IronRidge's Flush Mount System. The Flush Mount System is a proprietary rooftop mounting system used to support photovoltaic (PV) modules installed in portrait or landscape orientation and set parallel to the underlying roof surface. PV modules are supported by extruded aluminum XR Rails and secured to the rails with IronRidge mounting clamps. The XR Rails are side mounted to a selected roof attachment with 3/8" stainless steel bonding hardware and then attached directly to the roof structure or to a stanchion that is fastened to the underlying roof structure. Assembly details of a typical Flush Mount installation and its core components are shown in Exhibit EX-0015.

The IronRidge Flush Mount System is designed and certified to the structural requirements of the reference standards listed below, for the load conditions and configurations tabulated in the attached span tables.

- ASCE/SEI 7-10 Minimum Design Loads for Buildings and Other Structures (ASCE 7-10)
- 2015 International Building Code (IBC-2015)
- 2016 California Building Code (CBC-2016)
- 2015 Aluminum Design Manual (ADM-2015)

The tables included in this letter provide the maximum allowable spans of XR Rails in the Flush Mount System for the respective loads and configurations listed, covering wind exposure categories B, C, & D, roof zones 1, 2 & 3, and roof slopes from 0° to 45°. The span tables are applicable provided that the following conditions are met:

1. *Span* is the distance between two adjacent roof attachment points (measured at the center of the attachment fastener)
2. The underlying roof pitch, measured between roof surface and horizontal plane, is 45° or less.
3. The *mean roof height*, defined as the average of the roof eave height and the roof ridge height measured from grade, does not exceed 30 feet.
4. Module length shall not exceed the listed maximum dimension provided for the respective span table and module width shall not exceed 48".
5. All Flush Mount components shall be installed in a professional workmanlike manner per IronRidge's *Flush Mount installation manual* and other applicable standards for general roof construction practice.



1495 Zephyr Avenue
Hayward, CA 94544
1-800-227-9523
IronRidge.com

The span tables provided in this letter are certified based on the structural performance of IronRidge XR Rails only with no consideration of the structural adequacy of the chosen roof attachments, PV modules, or the underlying roof supporting members. It is the responsibility of the installer or system designer to verify the structural capacity and adequacy of the aforementioned system components in regards to the applied or resultant loads of any chosen array configuration.

Sincerely,

Gang Xuan, SE
Senior Structural Engineer

FRAMELESS MODULE KITS

Insert Frameless Kit T-bolt in top rail slot. Place star washer over T-bolt, allowing it to rest on top of rail. Secure module clamps with a hex nut and torque to **80 in-lbs**.

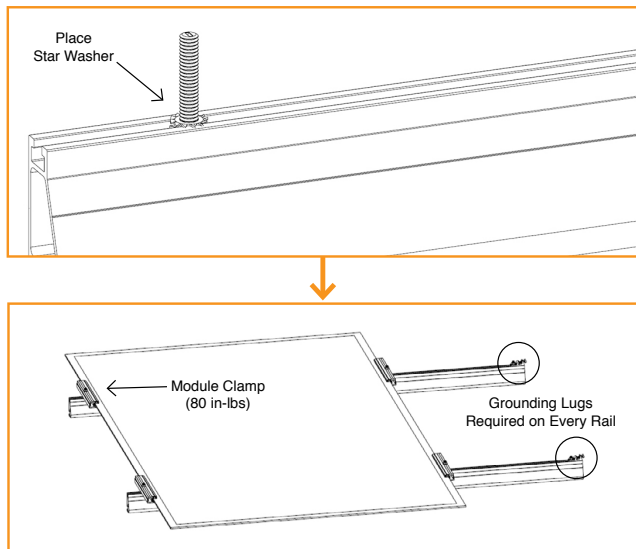
☞ **Tested or evaluated module clamps:**

- Sunforson silver or black SFS-UTMC-200(B) mid and SFS-UTEC-200(B) end clamps.
- Sunpreme silver or black mid and end clamps with part numbers 7500105X where "X" is 1, 5, 6 or 7.
- IronRidge silver or black mid and end clamps with part numbers FMLS-XC-001-Y where "X" is E or M and "Y" is B or blank.

☞ **Follow module manufacturer's installation instructions to install the module clamps.**

☞ **Frameless modules require using a Grounding Lug on every rail.**

☞ **For Sunpreme Modules Only: If required to use slide prevention hardware, see Module Slide Prevention Addendum (Version 1.10).**



MODULE COMPATIBILITY

The Flush Mount System may be used to ground and/or mount a PV module complying with UL 1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions. Unless otherwise noted, “xxx” refers to the module power rating and both black and silver frames are included in the certification.

MAKE	MODELS
Amerisolar	Amerisolar modules with 35, 40 and 50 mm frames AS-bYxxxZ Where "b" can be 5 or 6; "Y" can be M, P, M27, P27, M30, or P30; "xxx" is the module power rating; and "Z" can be blank, W or WB
Astronergy Solar	Astronergy modules with 30, 35, 40 and 45 mm frames aaSMbbyyC/zz-xxx Where “aa” can be CH or A; "bb" can be 60, 66, or 72; “yy” can be blank, 10 or 12; "C" can M, P, M(BL), M-HC, M(BL)-HC, P-HC, (DG), or (DGT); “zz” can be blank, HV, F-B, or F-BH ; and “xxx” is the module power rating Astronergy frameless modules CHSM6610P(DG)-xxx Where “xxx” is the module power rating
Auxin	Auxin modules with 40 mm frames AXN6y6zAxxx Where "y" can be M or P; "z" can be 08, 09, 10, 11, or 12; "A" can be F or T; and "xxx" is the module power rating
Axitec	Axitec Modules with 35 and 40 mm frames AC-xxxY/aaZZb Where "xxx" is the module power rating; "Y" can be M, P or MH; "aa" can be blank, 125- or 156-; "ZZ" can be 54, 60, 72, 120, or 144; "b" can be S or SB
Boviet	Boviet modules with 40mm frames BVM66aaYY-xxx Where "aa" can be 9, 10 or 12; "YY" is M or P; and "xxx" is the module power rating
BYD	Where "xxx" is the module power rating; "Y" can be M, P or MH; "aa" can be blank, 125- or 156-; "ZZ" can be 54, 60, 72, 120, or 144; "b" can be S or SB
Canadian Solar	Canadian Solar modules with 30, 35 and 40 mm frames CSbY-xxxZ Where "b" can be 1, 3 or 6; "Y" can be H, K, P, U, V, W, or X; "xxx" refers to the module power rating; and "Z" can be M, P, MS, PX , M-SD, P-AG, P-SD, MB-AG, PB-AG, MS-AG, or MS-SD Canadian Solar frameless modules CSbY-xxx-Z Where "b" can be 3 or 6; "Y" is K, P, U, or X; "xxx" is the module power rating, and "Z" can be M-FG, MS-FG, P-FG, MB-FG, or PB-FG
CertainTeed	CertainTeed modules with 35 and 40 frames CTxxxYZZ-AA Where "xxx" is the module power rating; "Y" can be M, P or HC; "ZZ" can be 00,01, 10, or 11; and "AA" can be 01, 02, 03 or 04
CSUN	Csun modules with 35 and 40 mm frames YYxxx-zzAbb Where "YY" is CSUN or SST; xxx is the module power rating; "zz" is blank, 60, or 72; and "A" is blank, P or M; "bb" is blank, BB, BW, or ROOF
Ecosolargy	Ecosolargy modules with 35, 40 and 50 mm frames ECOxxxYzzA-bbD Where "xxx" is the module power rating; "Y" can be A, H, S, or T; "zz" can be 125 or 156; "A" can be M or P; "bb" can be 60 or 72; and "D" can be blank or B

MODULE COMPATIBILITY

ET Solar	ET Solar modules with 35, 40 and 50 mm frames ET-Y6ZZxxxAA Where “Y” can be P, L, or M; “ZZ” can be 60 or 72; “xxx” refers to the module power rating; and “AA” can be WB, WW, BB, WBG, WWG, WBAC, WBCO, WWCO, WWBCO or BBAC
Flex	Flex modules with 35, 40 and 50 mm frames and model identifier FXS-xxxYY-ZZ; where "xxx" is the module power rating; "YY" can be BB or BC; and "ZZ" can be MAA1B, MAA1W, MAB1W, SAA1B, SAA1W, SAC1B, SAC1W, SAD1W, SBA1B, SBA1W, SBC1B, or SBC1W
GCL	GCL modules with 35 mm and 40 mm frames GCL-a6/YY xxx Where "a" can be M or P; "YY" can be 60, 72, or 72H; and xxx is the module power rating
GigaWatt Solar	Gigawatt modules with 40 mm frames GWxxxYY Where “xxx” refers to the module power rating; and “YY” can be either PB or MB
Hansol	Hansol modules with 35 and 40 frames HSxxxYY-zz Where "xxx" is the module power rating; "YY" can be PB, PD, PE, TB, TD, UB, UD, or UE; and "zz" can be AN1, AN3, AN4, HV1, or JH2
Hanwha Solar	Hanwha Solar modules with 40, 45 and 50 mm frames HSLaaP6-YY-1-xxxZ Where "aa" can be either 60 or 72; "YY" can be PA or PB; "xxx" refers to the module power rating; and "Z" can be blank or B
Hanwha Q CELLS	Hanwha Q CELLS Modules with 32, 35, 40 and 42mm frames and model identifier aaYY-ZZ-xxx where "aa" can be Q. or B.; "YY" can be PLUS, PRO, PEAK, LINE PRO, LINE PLUS, or PEAK DUO; and "ZZ" can be G3, G3.1, G4, G4.1, L-G2, L-G2.3, L-G3, L-G3.1, L-G3y, L-G4, L-G4.2, L-G4y, LG4.2/TAA, BFR-G3, BLK-G3, BFR-G3.1, BLK-G3.1, BFR-G4, BFR-G4.1, BFR G4.3, BLK-G4.1, G4/SC, G4.1/SC, G4.1/TAA, G4.1/MAX, BFR G4.1/TAA, BFR G4.1/MAX, BLK G4.1/TAA, BLK G4.1/SC, EC-G4.4, G5, BLK-G5, L-G5, L-G5.1, L-G5.2, L-G5.2/H, L-G5.3, G6, G6+, BLK-G6, L-G6, L-G6.1, L-G6.2, L-G6.3, G7, BLK-G6+, BLK-G7, G7.2, G8, BLK-G8, G8+, BLK-G8+ L-G7, L-G7.1, L-G7.2, L-G7.3, L-G8, L-G8.1, L-G8.2, or L-G8.3; and "xxx" is the module power rating
Heliene	Heliene modules with 40 mm frames YYZZxxx Where "YY" can be 36, 60, 72, or 96; "ZZ" can be M, P, or MBLK; and "xxx" is the module power rating
HT-SAAE	HT-SAAE modules with 40 mm frames HT72-156Z-xxx Where "Z" can be M, P, M-C, P-C, M(S), M(VS), M(V), P(V), M(V)-C, P(V)-C; and "xxx" is the module power rating
Hyundai	Hyundai modules with 33, 35, 40 and 50 mm frames HiY-SxxxZZ Where "Y" can be A, M or S; "xxx" refers to the module power rating; and "ZZ" can be HG, HI, KI, MI, MF, MG, RI, RG(BF), RG(BK), SG, TI, or TG
Itek	Itek Modules with 40 and 50 mm frames IT-xxx-YY Where "xxx" is the module power rating; and "YY" can be blank, HE, or SE, or SE72
JA Solar	JA Solar modules with 35, 40 and 45 mm frames JAyyzz-bbww-xxx/aa Where “yy” can be M, P, M6 or P6; “zz” can be blank, (K), (L), (R), (V), (BK), (FA), (TG), (FA)(R), (L)(BK), (L)(TG), (R)(BK), (R)(TG), (V)(BK), (BK)(TG), or (L)(BK)(TG); “bb” can be 48, 60, or 72; “ww” can be S01, S02, S03, S09, or S10; “xxx” is the module power rating; and “aa” can be MP, SI, SC, PR, 3BB, 4BB, 4BB/RE, 5BB
Jinko	Jinko modules with 35 and 40 mm frames JKMYxxxZZ-aa Where "Y" can either be blank or S; "xxx" is the module power rating; "ZZ" can be P, PP, M; and "aa" can be blank, 60, 60B, 60H, 60L, 60BL, 60HL, 60HBL, 60-J4, 60B-J4, 60B-EP, 60(Plus), 60-V, 60-MX, 72, 72-V, 72H-V, 72L-V, 72HL-V or 72-MX Jinko frameless modules JKMxxxPP-DV Where "xxx" is the module power rating
Kyocera	Kyocera Modules with 46mm frames KYxxxZZ-AA Where "Y" can be D or U; "xxx" is the module power rating; "ZZ" can be blank, GX, or SX; and "AA" can be LPU, LPU, LPU, LPS, LPB, LFB, LFB2, LFB2, LPB2, 3AC, 3BC, 3FC, 4AC, 4BC, 4FC, 4UC, 5AC, 5BC, 5FC, 5UC, 6BC, 6FC, 8BC, 6MCA, or 6MPA
LG	LG modules with 35, 40 and 46 mm frames LGxxxYaZ-bb Where "xxx" is the module power rating; "Y" can be A, E, N, Q, S; "a" can be 1 or 2; "Z" can be C, K, T, or W; and "bb" can be A3, A5, B3, G3, G4, K4, or V5
Longi	Longi modules with 30, 35 and 40 mm frames LRa-YYZZ-xxxM Where "a" can be 4 or 6; "YY" can be blank, 60 or 72; "ZZ" can be blank, BK, BP, HV, PB, PE, PH, HBD, HPB, or HPH; "xxx" is the module power rating
Mission Solar	Mission Solar modules with 40 mm frames MSEbbxxxZZaa Where "bb" can be blank or 60A; "xxx" is the module power rating; "ZZ" can be blank, MM, SE, SO or SQ, and "aa" can be blank, 1J, 4J, 4S, 5K, 5T, 6J, 6S, 6W, 8K, 8T, or 9S
Mitsubishi	Mitsubishi modules with 46 mm frames PV-MYYxxxZZ Where "YY" can be LE or JE; xxx is the module power rating; and "ZZ" can be either HD, HD2, or FB

MODULE COMPATIBILITY

Motech	IM and XS series modules with 40, 45 and 50 mm frames
Neo Solar Power	Neo Solar Power modules with 35 mm frames D6YxxxZZaa Where "Y" can be M or P; xxx is the module power rating; "ZZ" can be B3A, B4A, E3A, E4A, H3A, H4A; and "aa" can be blank, (TF), ME or ME (TF)
Panasonic	Panasonic modules with 35 and 40 mm frames BHNxxxYYzzA Where "xxx" refers to the module power rating; "YY" can be either KA, SA or ZA; "zz" can be either 01, 02, 03, 04, 06, 06B, 11, 11B, 15, 15B, 16, 16B, 17, or 18; and "A" can be blank, E or G
Peimar	Peimar modules with 40 mm frames SGxxxYzz Where "xxx" is the module power rating; "Y" can be M or P; and "zz" can be blank, (BF), or (FB)
Phono Solar	Phono Solar modules with 35, 40 and 45 mm frames PSxxxY-ZZ/A Where xxx refers to the module power rating; "Y" can be M or P; "ZZ" can be 20 or 24; and "A" can be F, T or U
Prism Solar	Prism Solar frameless modules BiYY-xxxBSTC Where "YY" can be 48, 60, 60S, 72 or 72S; and "xxx" is the module power rating
REC Solar	REC modules with 30, 38 and 45 mm frames RECxxxYYZZ Where "xxx" is the module power rating; "YY" can be AA, M, NP, PE, PE72, TP, TP2, TP2M, TP2SM, or TP2S; and "ZZ" can be blank, Black, BLK, BLK2, SLV, or 72
Renesola	ReneSola modules with 35, 40 and 50 mm frames JCxxxY-ZZ Where "xxx" refers to the module power rating; "Y" can be F, M or S; and "ZZ" can be Ab, Ab-b, Abh, Abh-b, Abv, Abv-b, Bb, Bb-b, Bbh, Bbh-b, Bbv, Bbv-b, Db, or Db-b
Renogy	Renogy Modules with 40 and 50 mm frames RNG-xxxY Where "xxx" is the module power rating; and "Y" can be D or P
Risen	Risen Modules with 35 and 40 mm frames RSMyy-6-xxxZZ Where "yy" can be 60 or 72; "xxx" is the module power rating; and "ZZ" can be M or P Frameless modules RSMyy-6-xxxZZ Where "yy" can be 60 or 72; "xxx" is the module power rating; and "ZZ" can be MDG or PDG
S-Energy	S-Energy modules with 40 frames SNxxxY-ZZ Where "xxx" is the module power rating; "Y" can be M or P; and "ZZ" can be 10, or 15
Seraphim Energy Group	Seraphim modules with 35 and 40 mm frames SEG-6YY-xxxZZ Where "YY" can be MA, MB, PA, or PB; "xxx" is the module power rating; and "ZZ" can be BB, BW, WB or WW
Seraphim USA	Seraphim modules with 40 and 50 mm frames SRP-xxx-6YY Where "xxx" is the module power rating; and "YY" can be MA, MB, PA, PB, QA-XX-XX, and QB-XX-XX
Sharp	Sharp modules with 35 and 40 mm frames NUYYxxx Where "YY" can be SA or SC; and "xxx" is the module power rating
Silfab	Silfab Modules with 38 mm frames SYY-Z-xxx Where "YY" can be SA or LA; SG or LG; "Z" can be M, P, or X; and "xxx" is the module power rating
Solaria	Solaria modules with 40 mm frames PowerXT xxxY-ZZ Where "xxx" is the module power rating; "Y" can be R or C; and "ZZ" can be AC, BD, BX, BY, PD, PX, PZ, WX or WZ
Solarcity	Solarcity modules with 40 mm frames SCxxxYY Where "xxx" is the module power rating; and "YY" can be blank, B1 or B2
SolarTech	SolarTech modules with 42 mm frames STU-xxxYY Where "xxx" is the module power rating; and "YY" can be PERC or HJT
SolarWorld AG / Industries GmbH	SolarWorld Sunmodule Plus, Protect, Bisun, XL, Bisun XL, may be followed by mono, poly, duo, black, bk, or clear; modules with 31, 33 or 46 mm frames SW-xxx Where "xxx" is the module power rating
SolarWorld Americas Inc.	SolarWorld Sunmodule Plus, Protect, Bisun, XL, Bisun XL, may be followed by mono, poly, duo, black, bk, or clear; modules with 33 mm frames SWA-xxx Where "xxx" is the module power rating
Stion	Stion Thin film modules with 35 mm frames STO-xxx or STO-xxxA Thin film frameless modules STL-xxx or STL-xxxA Where "xxx" is the module power rating
SunEdison	SunEdison Modules with 35, 40 and 50 mm frames SE-YxxxZABCDE Where "Y" can be B, F, H, P, R, or Z; "xxx" refers to the module power rating; "Z" can be 0 or 4; "A" can be B,C,D,E,H,I,J,K,L,M, or N ; "B" can be B or W; "C" can be A or C; "D" can be 3, 7, 8, or 9; and "E" can be 0, 1 or 2

MODULE COMPATIBILITY

Suniva	Suniva modules with 35, 38, 40, 46 and 50 mm frames OPTxxx-AA-B-YYY-Z MVXxxx-AA-B-YYY-Z Where "xxx" is the module power rating; "AA" is either 60 or 72; "B" is either 4 or 5; "YYY" is either 100,101,700,1B0, or 1B1; and "Z" is blank or B
Sunpower	Sunpower standard (G3 or G4) or InvisiMount (G5) 40 and 46 mm frames SPR-Zb-xxx-YY Where "Z" is either A, E, P or X; "b" can be blank, 17, 18, 19, 20, 21, or 22; "xxx" is the module power rating and "YY" can be blank, BLK, COM, C-AC, D-AC, E-AC, G-AC, BLK-C-AC, or BLK-D-AC
Sunpreme	Sunpreme frameless modules GXB-xxxYY Where "xxx" is the module power rating; and "YY" can be blank or SL
Sunspark	Sunspark modules with 40 mm frames SYY-xxZ Where "YY" can be MX or ST; "xxx" is the module power rating; and "Z" can be P or W
Suntech	Vd, Vem, Wdb, Wde, and Wd series modules with 35, 40 and 50 mm frames
Talesun	Talesun modules with 35 and 40 frames TP6yyZxxx-A Where "yy" can be 60, 72, H60 or H72; "Z" can be M, or P; "xxx" is the module power rating; and "A" can be blank, B, or T
Trina	Trina Modules with 30, 35, 40 and 46mm frames TSM-xxxYYZZ Where "xxx" is the module power rating; "YY" can be DD05, DD06, DE14, DE15, DEG15, PA05, PC05, PD05, PD06, PA14, PC14, PD14, PE14, or PE15 ; and "ZZ" can be blank, .05, .08, .10, .18, .08D, .18D, 0.82, .002, .00S, 05S, 08S, A, A.05, A.08, A.10, A.18, A(II), A.05(II), A.08(II), A.082(II), A.10(II), A.18(II), H, H(II), H.05(II), H.08(II), HC.20(II), HC.20(II), or M Frameless modules TSM-xxxYY Where "YY" can be either DEG5(II), DEG5.07(II), DEG5.40(II), DEG5.47(II), DEG14(II), DEG14C(II), DEG14C.07(II), DEG14.40(II), PEG5, PEG5.07, PEG5.40, PEG5.47, PEG14, or PEG14.40
Vikram	Vikram solar modules with 40 mm frames Syy.ZZ.AAA.bb Where "yy" can be M, P, MBB, MH, MS, MHBB, or PBB; "ZZ" can be 60 or 72; "AAA" is the module power rating; and "bb" can be 03.04 or 05
Winaico	Winaico modules with 35 and 40 mm frames Wsy-xxxz6 Where "y" can be either P or T; "xxx" is the module power rating; and "z" can be either M or P
Yingli	Panda, YGE and YGE-U series modules with 35, 40 and 50 mm frames

FlashFoot2

The Strongest Attachment in Solar

IronRidge FlashFoot2 raises the bar in solar roof protection. The unique water seal design is both elevated and encapsulated, delivering redundant layers of protection against water intrusion. In addition, the twist-on Cap perfectly aligns the rail attachment with the lag bolt to maximize mechanical strength.

Twist-On Cap

FlashFoot2's unique Cap design encapsulates the lag bolt and locks into place with a simple twist. The Cap helps FlashFoot2 deliver superior structural strength, by aligning the rail and lag bolt in a concentric load path.

Three-Tier Water Seal

FlashFoot2's seal architecture utilizes three layers of protection. An elevated platform diverts water away, while a stack of rugged components raises the seal an entire inch. The seal is then fully-encapsulated by the Cap. FlashFoot2 is the first solar attachment to pass the TAS-100 Wind-Driven Rain Test.

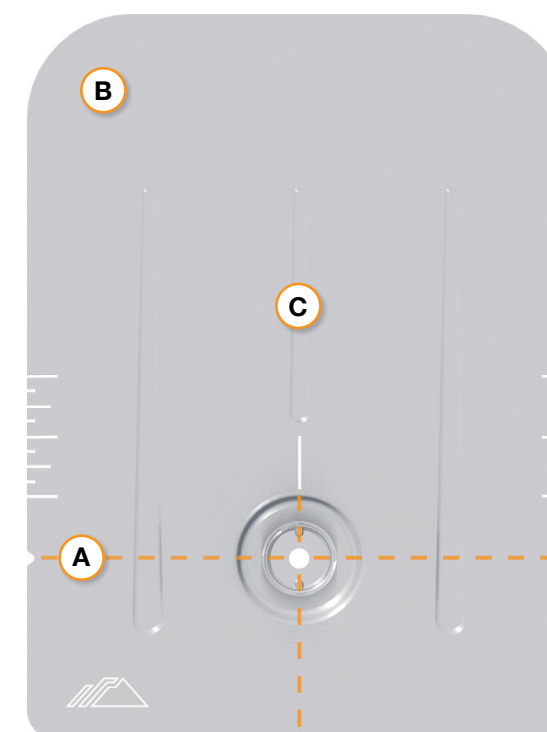
Single Socket Size

A custom-design lag bolt allows you to install FlashFoot2 with the same 7/16" socket size used on other Flush Mount System components.

Water-Shedding Design

An elevated platform diverts water away from the water seal.

Installation Features



A Alignment Markers

Quickly align the flashing with chalk lines to find pilot holes.

B Rounded Corners

Makes it easier to handle and insert under the roof shingles.

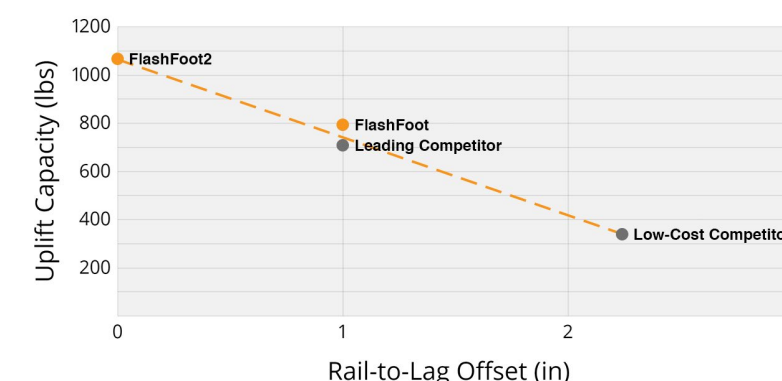
C Reinforcement Ribs

Help to stiffen the flashing and prevent any bending or crinkling during installation.

Benefits of Concentric Loading

Traditional solar attachments have a horizontal offset between the rail and lag bolt, which introduces leverage on the lag bolt and decreases uplift capacity.

FlashFoot2 is the only product to align the rail and lag bolt. This concentric loading design results in a stronger attachment for the system.



Testing & Certification

Structural Certification

Designed and Certified for Compliance with the International Building Code & ASCE/SEI-7.

Water Seal Ratings

Water Sealing Tested to UL 441 Section 27 "Rain Test" and TAS 100-95 "Wind Driven Rain Test" by Intertek. Ratings applicable for composition shingle roofs having slopes between 2:12 and 12:12.

UL 2703

Conforms to UL 2703 Mechanical and Bonding Requirements. See Flush Mount Install Manual for full ratings.