

## HISTORIC AND DESIGN REVIEW COMMISSION

March 16, 2016

Agenda Item No: 2

**HDRC CASE NO:** 2016-096  
**ADDRESS:** 1415 FULTON AVE  
**LEGAL DESCRIPTION:** NCB 2755 BLK 61 LOT 21  
**ZONING:** R4 H  
**CITY COUNCIL DIST.:** 1  
**DISTRICT:** Fulton Historic District  
**APPLICANT:** Tyrone Holloway/Erus Energy, LLC  
**OWNER:** Gerado Soliz  
**TYPE OF WORK:** Solar panel installation  
**REQUEST:**

The applicant is requesting a Certificate of Appropriateness for approval to install 20 solar panels to the roof of the storage building located in the rear of 1415 Fulton Ave.

### APPLICABLE CITATIONS:

*Historic Design Guidelines, Chapter 3, Guidelines for Additions*

#### 6. Designing for Energy Efficiency

#### C. SOLAR COLLECTORS

- i. Location*—Locate solar collectors on side or rear roof pitch of the primary historic structure to the maximum extent feasible to minimize visibility from the public right-of-way while maximizing solar access. Alternatively, locate solar collectors on a garage or outbuilding or consider a ground-mount system where solar access to the primary structure is limited.
- ii. Mounting (sloped roof surfaces)*—Mount solar collectors flush with the surface of a sloped roof. Select collectors that are similar in color to the roof surface to reduce visibility.
- iii. Mounting (flat roof surfaces)*—Mount solar collectors flush with the surface of a flat roof to the maximum extent feasible. Where solar access limitations preclude a flush mount, locate panels towards the rear of the roof where visibility from the public right-of-way will be minimized.

### FINDINGS:

- a. The applicant has proposed to install a 20 solar panel on the standing seam metal roof of the accessory structure located to the rear of the primary structure. Staff visited the site on March 7, 2016, and found that given the set back and orientation of the accessory structure and the neighboring structures, the proposed solar installation will not be seen from the public right of way. This is consistent with Guidelines for Additions 6.C., which states installations, should be in locations that minimize visibility from the public right-of-way.
- b. There will be two sub-arrays, both mounted on pitched roof with clamps screwed into the roof membrane. Each clamp consists of an ironbridge flashfoot attached to a rail, that connects the PV module frame. The panels will be flush mounted on each pitch; the clamps and rail system forces the panels to sit about 4" above the standing seam metal roof. This is consistent with Guidelines for Additions 6.C.ii, which states solar collectors should be flush with the roof surface.

### RECOMMENDATION:

Staff recommends approval as submitted based on findings a and b.

### CASE MANAGER:

Lauren Sage

















## PROJECT SUMMARY

### SCOPE OF WORK

TO INSTALL A SOLAR PHOTOVOLTAIC (PV) SYSTEM AT THE :  
SOLIZ, GENARDO RESIDENCE

LOCATED AT 1415 FULTON AVENUE,  
IN SAN ANTONIO, TEXAS 78201

THE POWER GENERATED BY THE PV SYSTEM WILL BE INTERCONNECTED  
WITH THE UTILITY GRID THROUGH THE EXISTING ELECTRICAL SERVICE  
EQUIPMENT. THE PV SYSTEM DOES NOT INCLUDE STORAGE BATTERIES.

### GOVERNING CODES

2011 NATIONAL ELECTRIC CODE (NEC)  
2012 INTERNATIONAL RESIDENTIAL CODE (IRC)  
2012 INTERNATIONAL FIRE CODE (IFC)

PLUS APPLICABLE CITY AMENDMENTS

### SHEET INDEX

SHEET #	DRAWING
PV1	SITE PLAN
PV1.2	PV LAYOUT DETAILS
PV1.3	MODULE ELEVATION DETAILS
PV2	ONE-LINE DIAGRAM
PV3	THREE-LINE DIAGRAM
PV4	ARRAY WIRING DIAGRAM
PV5	EQUIPMENT LABELING
PV6	NOTES & REFERENCES

### BUILDING INFORMATION

BUILDING TYPE: SINGLE FAMILY RESIDENCE  
BUILDING HEIGHT: ONE STORY  
ROOF TYPE: ASPHALT SHINGLE  
FRAMING TYPE: MANUFACTURED TRUSS  
TRUSS SPACING: 24" ROOF SLOPE: 1"  
ARRAY SLOPE: 20°  
AZIMUTH 1: 180°

### LEGEND

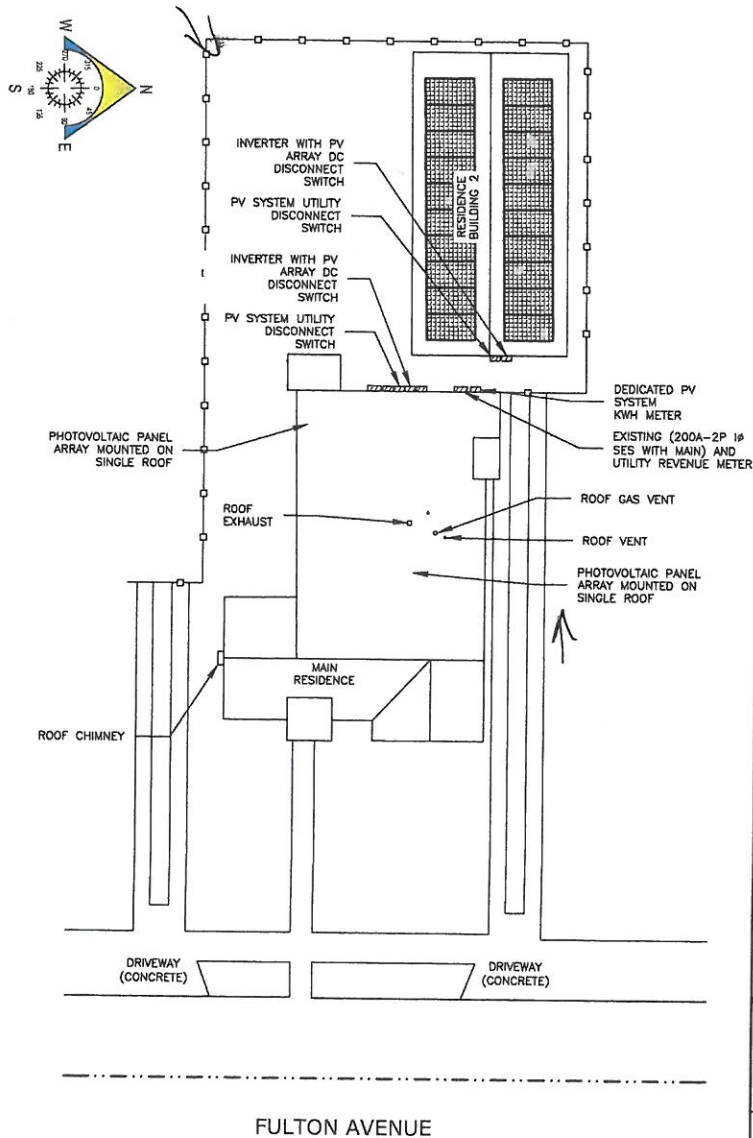
● - SEWER VENTS	○ - SATELLITE DISH
⊙ - SOLAR TUBE	■ - PV MODULE
⊕ - GAS VENT	□ - SKYLITE
□ - HOOD & EXHAUST VENT	⊗ - SWAMP COOLER
--- BLOCK FENCING	
--- PROPERTY LINE	

### NOTE

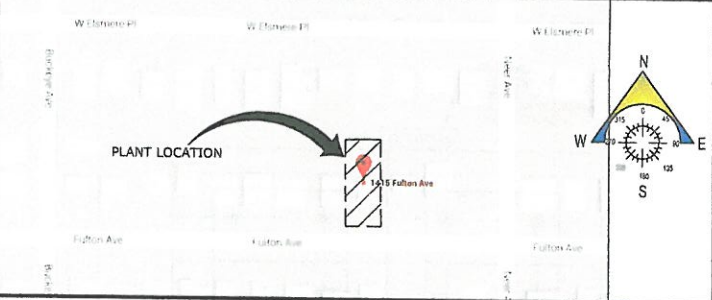
1. UTILITY HAS 24-HOUR UNRESTRICTED AND UNOBSTRUCTED ACCESS TO THE UTILITY DISCONNECT SWITCH.
2. UTILITY HAS 24-HOUR UNRESTRICTED ACCESS TO THE DEDICATED PHOTOVOLTAIC SYSTEM KWH METER.

### EQUIPMENT SUMMARY

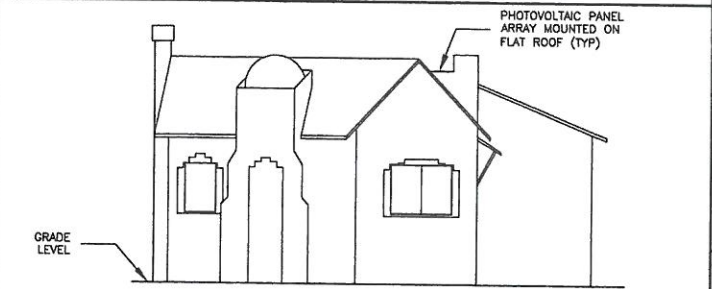
EQUIP.	MFG	MODEL #	QTY.
PV MODULE	YINGLI SOLAR	YL290P-35B	19
PV INVERTER	SOLAR EDGE	SE5000A-US	1
RACKING	IRONRIDGE		



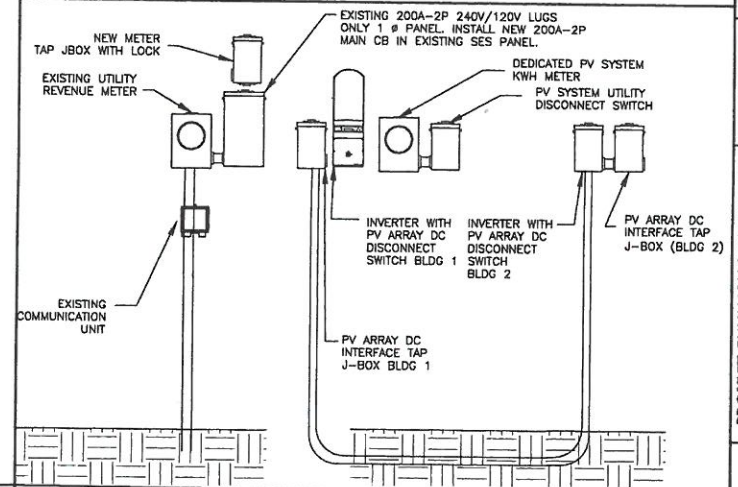
SITE PLAN



KEY MAP



ELEVATION



EQUIPMENT LOCATION ELEVATION

ERUSENERGY

TEXAS REG. NO. 30936  
2141 E. CAMELBACK RD. # 250  
PHOENIX, AZ 85016  
[844] 272-8336, [602] 507-6530  
ERUS PROJECT # SA-70011-15













SALES REP. MAILLARD R.  
DESIGNER PEARCE T.  
PROJECT MGR. HOLLOWAY, T.  
DESIGN DATE 1-11-2018  
UTILITY OPS  
SCALE: NTS

PROJECT SUMMARY & SITEPLAN  
6.69kW/4/5.51kW PHOTOVOLTAIC SYSTEM  
1415 FULTON AVENUE,  
SAN ANTONIO, TEXAS 78201  
CUSTOMER: SOLIZ, GENARDO

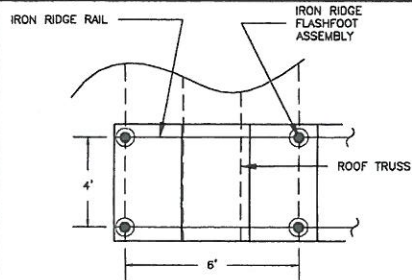
PV1



# LEGEND

-  MFR.: YINGLI SOLAR,  
MODEL # YL290P-358  
QUANTITY: 18
-  - TRUSSES/RAFTERS @ 24" O.C.
-  - STANCHION/ROOF PENETRATION
-  - IRON RIDGE RAIL
-  - SEWER VENTS
-  - SOLAR TUBE
-  - GAS VENT
-  - HOOD & EXHAUST VENT
-  - SATELLITE DISH
-  - SKYLITE
-  - COVER
-  - 2X BLOCKING (IF REQUIRED)

## TYPICAL PV MOUNTING DETAIL



NOTE:  
1. ALL CONSTRUCTION/ INSTALLATION IS TO COMPLY WITH  
FOLLOWING CODES:

2009 INTERNATIONAL BUILDING CODE (IRC)  
2011 NATIONAL ELECTRICAL CODE (NEC)

\*\* ALL DIMENSIONS ARE APPROXIMATE

### 9 PANEL ARRAY (TYP.)

#### UPLIFT CALCULATIONS

PANEL GROUP AREA 189 SQ. FT. X WIND LOAD 30PSF =  
TOTAL LOAD 5,670 LBS.

CONNECTOR TYPE: 5/16" LAG SCREWS (EMBED MIN 2")  
# OF MOUNTING POINTS: 12 (12 LAG SCREWS)

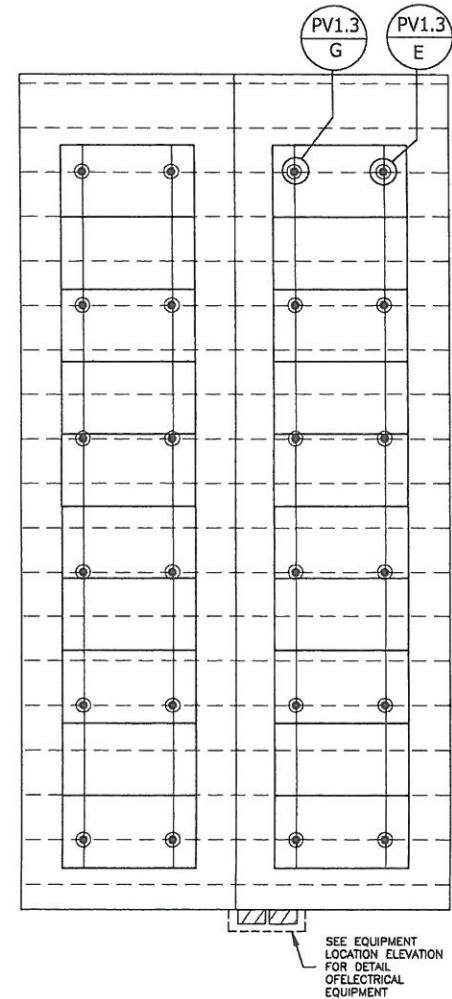
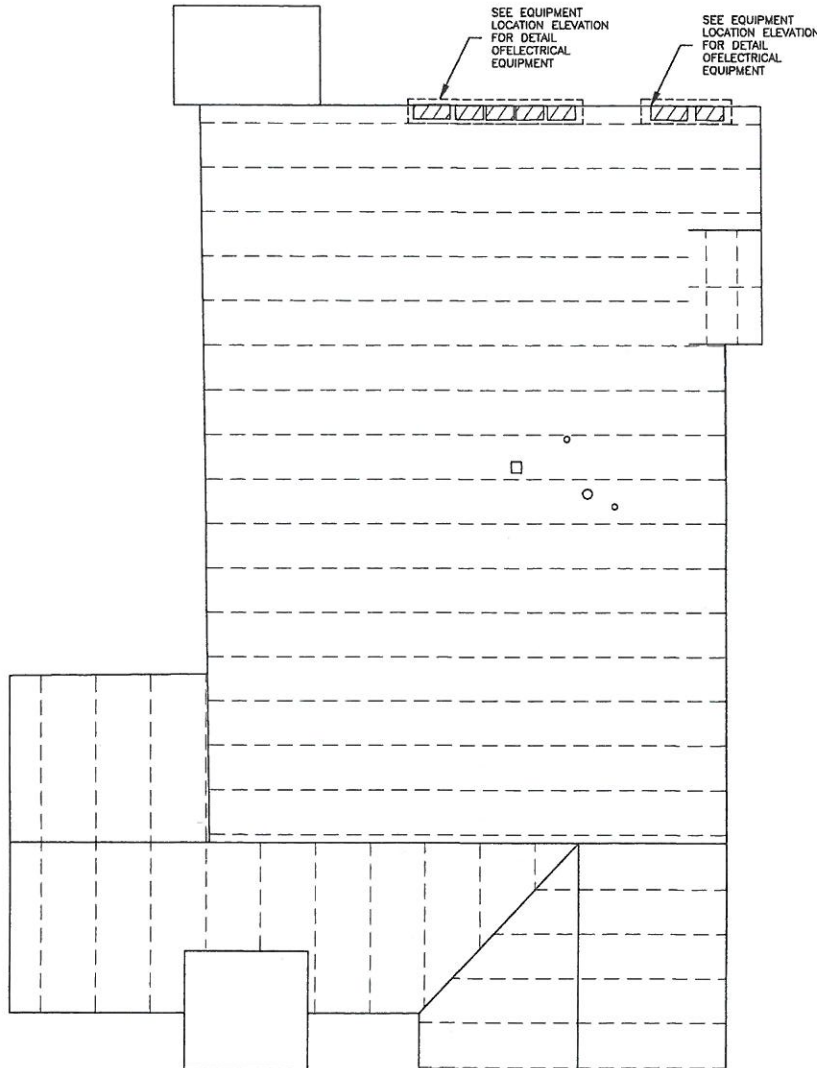
PULL OUT STRENGTH: 210 LBS. PER INCH OF EMBED  
12 X 2 X 210 LBS. = 5,040 LBS.

#### POINT LOAD CALCULATION

ARRAY WEIGHT: 241LBS / 12 MOUNTING POINTS=  
20.1 LBS. PER MOUNTING POINT.

#### WORST CASE DISTRIBUTION LOAD CALCULATION

241 LBS. / 189 SQ. FT. = 1.28 PSF



## PV PANEL ARRAY PLAN

PORTANT MOUNTED PANELS

PITCHED SHINGLE ROOF

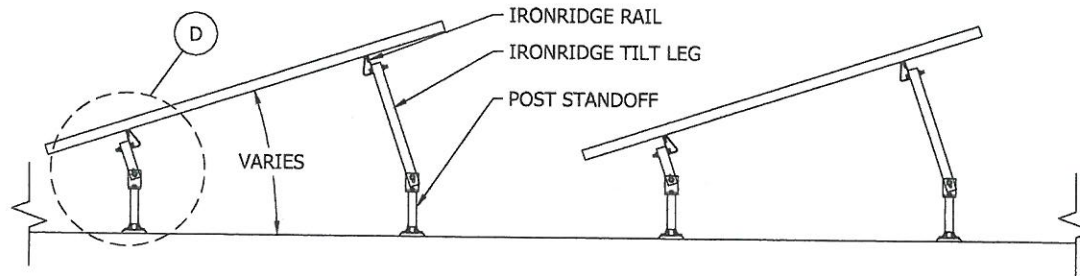
ERUS ENERGY

PROJECT INFORMATION	SALES REP.	MALLARD R.	TEXAS ROC LIC. #30936
	DESIGNER	PEARCE T.	2141 E. CAMELBACK RD. # 250
	QUOTE#	N/A	PHOENIX, AZ 85016
	UTILITY	SAN ANTONIO PROJECT MGR. HOLLOWAY, T	[844] 272-8336, [602] 507-6530
PV LAYOUT PLAN	DATE	DESIGN DATE	1-11-2016
	SCALE	NTS	ERUS PROJECT # SA-70011-15
	CUSTOMER	SOLIZ, GERARDO	
	SYSTEM	6.69kW/2/5.51kW< PHOTOVOLTAIC SYSTEM	

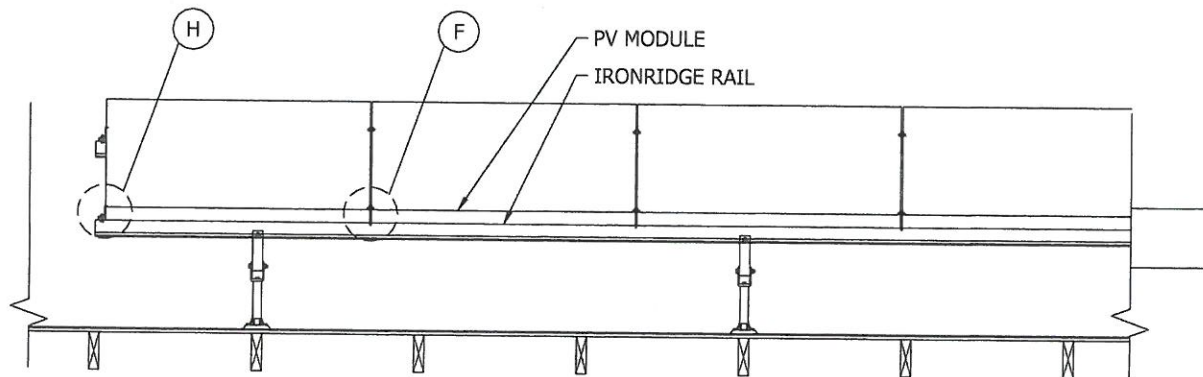
PV1.2



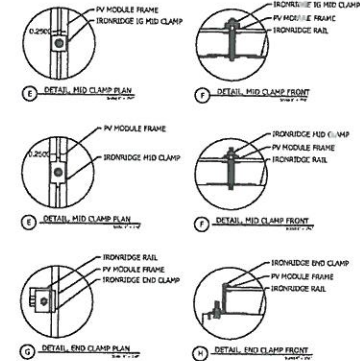
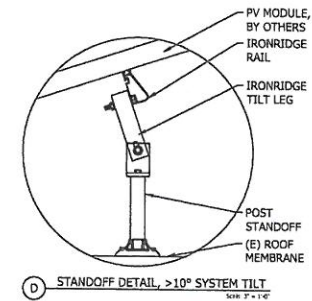
OMIT - DOES NOT APPLY TO ACCESSORY STRUCTURE



(B) SIDE VIEW, TILT MOUNT ON FLAT ROOF  
Scale: 1" = 1'-0"



(C) FRONT VIEW, TILT MOUNT ON FLAT ROOF  
Scale: 1" = 1'-0"

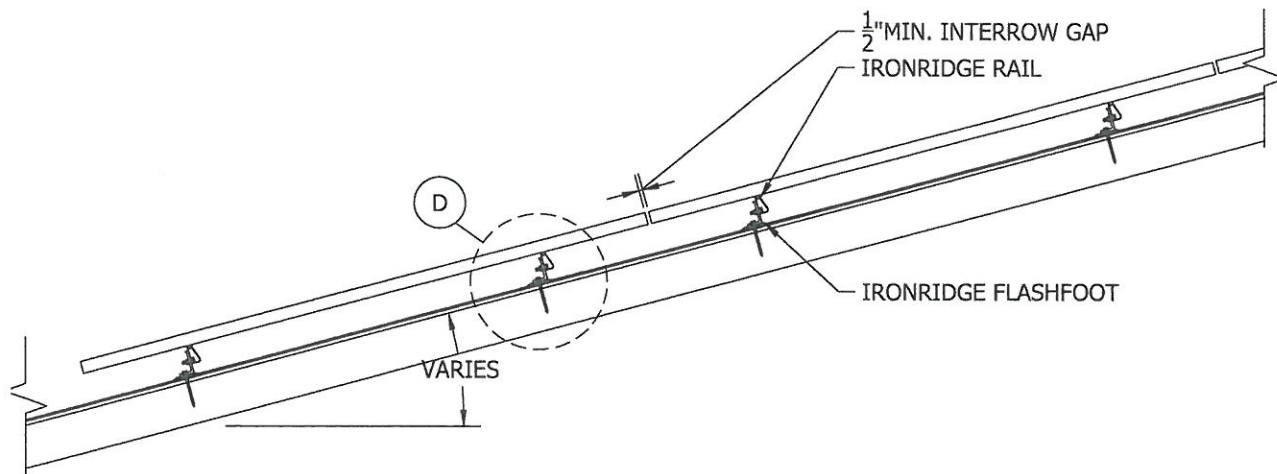


ERUSENERGY

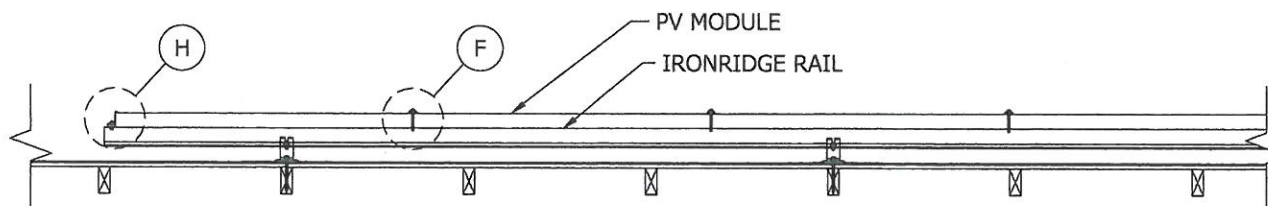
SALES REP.	MAILLARD R.	TEXAS ROC UC. #30936
DESIGNER	PEARCE T.	2141 E. CAMELBACK RD. # 250
PROJECT	WGR HOLLOWAY, T	PHOENIX, AZ 85016
DESIGN DATE	1-11-2016	[844] 272-8336, [602] 507-6530
SCALE	NTS	ERUS PROJECT / SA-70011-15
PROJECT INFORMATION	QUOTE#	6.69KW/15.51WVdc PHOTOVOLTAIC SYSTEM
SALES REP.	MAILLARD R.	14115 FULTON AVENUE,
DESIGNER	PEARCE T.	SAN ANTONIO, TEXAS 78201
PROJECT	WGR HOLLOWAY, T	CUSTOMER: SOLIZ, GERARDO
DESIGN DATE	1-11-2016	
SCALE	NTS	

PV1.3

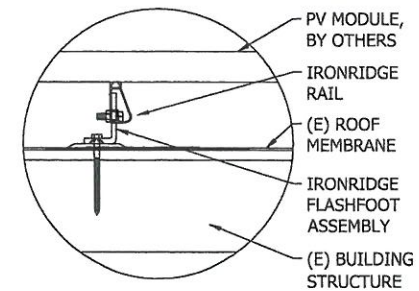
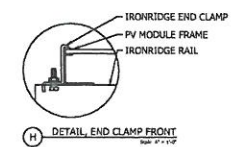
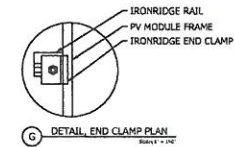
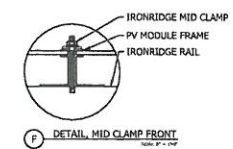
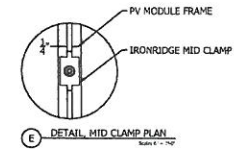




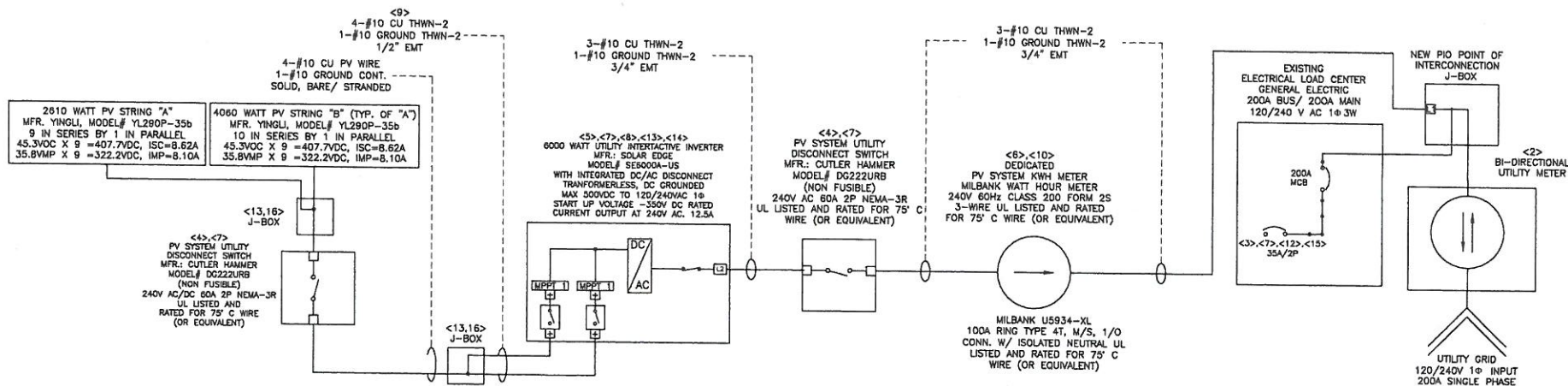
**B** SIDE VIEW, FLUSH MOUNT ON PITCHED ROOF  
NTS



**C** FRONT VIEW, FLUSH MOUNT PITCHED ROOF  
NTS







- <1> EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE NEC 2011 AND ALL APPLICABLE REQUIREMENTS OF THE SERVING ELECTRICAL UTILITY COMPANY AND OF THE LOCAL AUTHORITY HAVING JURISDICTIONS.
- <2> BI-DIRECTIONAL UTILITY METER TO BE INSTALLED BY UTILITY COMPANY (WHEN REQUIRED)
- <3> PER NEC 690.54 LABEL OVER CURRENT DEVICE "PHOTOVOLTAIC ELECTRIC POWER SOURCE" WITH THE RATED AC OUTPUT OPERATING CURRENT AND THE OPERATING VOLTAGE. PER NEC 705.12 (D)(7) LABEL DEVICE "WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS DEVICE"
- <4> LABEL "PHOTOVOLTAIC SYSTEM UTILITY DISCONNECT SWITCH". SWITCH COVER TO BE LOCKED AT ALL TIMES. SWITCH TO BE VISIBLE BLADE AND ACCESSIBLE PER UTILITY REQUIREMENTS AND CONFORM TO NEC 705.22 AND THE OPERATING VOLTAGE PER NEC 690.54.
- <5> LABEL "PHOTOVOLTAIC ARRAY DC DISCONNECT SWITCH" PER NEC 690.14(C)(2). LABEL WITH OPERATING CURRENT, OPERATING VOLTAGE, MAXIMUM SYSTEM VOLTAGE, AND SHORT CIRCUIT CURRENT PER NEC 690.53. SWITCH TO BE LOCKED PER 690.7(D).
- <6> LABEL "PHOTOVOLTAIC SYSTEM METER"
- <7> PROVIDE WARNING SIGN PER NEC 690.17 READING "WARNING-ELECTRICAL SHOCK HAZARD- DO NOT TOUCH TERMINALS ON BOTH LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OFF POSITION".
- <8> LISTED OR LABELED EQUIPMENT SHALL BE INSTALLED AND USED IN ACCORDANCE WITH ANY INSTRUCTIONS INCLUDED IN THE LISTING OR LABELING PER NEC 110.3(B).
- <9> METALLIC CONDUIT SHALL BE USED WITHIN BUILDING PER NEC 690.3(E).
- <10> COMBINED DIRECT-CURRENT GROUNDING ELECTRODE CONDUCTOR AND ALTERNATING-CURRENT EQUIPMENT GROUNDING CONDUCTOR. THIS COMBINED GROUNDING CONDUCTOR SHALL BE THE LARGER OF THE SIZES SPECIFIED BY NEC 2011 250.122 OR 250.166(B) AND SHALL BE INSTALLED IN ACCORDANCE WITH 250.64(E).
- <11> GEC TO BE INSTALLED AS REQUIRED BY MANUFACTURER INSTRUCTIONS AND NEC 690.47.
- <12> PER NEC 705.12(D)(2): THE SUM OF THE AMPERE RATINGS OF OVER CURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO THE BUS BAR SHALL NOT EXCEED THE 120% THE RATING OF THE BUS BAR OR CONDUCTOR FOR A DWELLING UNIT.
- <13> PER NEC 690.35(F): THE PHOTOVOLTAIC POWER SOURCE SHALL BE LABELED WITH FOLLOWING WARNING AT EACH JUNCTION BOX, COMBINER BOX, DISCONNECT, AND DEVICE WHERE ENERGIZED, UNDER GROUND CIRCUIT MAY BE EXPOSED DURING SERVICE: "WARNING ELECTRIC SHOCK HAZARD. THE DC CONDUCTOR OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED."
- <14> ANTI-ISLANDING PROTECTION ENSURES THE SYSTEM WILL NOT EXPORT POWER INTO A BALANCED 60Hz RESONANT LOAD WHILE THE UTILITY IS DISCONNECTED.
- <15> PER NEC 690.64(B)(7): UNLESS THE PANEL BOARD IS RATED NOT LESS THAN THE SUM OF THE AMPERE RATINGS OF ALL OVER CURRENT DEVICES SUPPLYING IT. A CONNECTION IN A PANELBOARD SHALL BE POSITIONED AT THE OPPOSITE (LOAD) END FROM THE INPUT FEEDER LOCATION OR MAIN CIRCUIT LOCATION. THE BUS OR CONDUCTORS RATING SHALL BE SIZED FOR THE LOADS CONNECTED IN ACCORDANCE WITH ARTICLE 220. A PERMANENT WARNING LABEL SHALL BE APPLIED TO THE DISTRIBUTION EQUIPMENT WITH THE FOLLOWING OR EQUIVALENT MARKING: "WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVER CURRENT DEVICE"

CONDUCTOR SIZING PER NEC TABLE 310.15(B)(16) & 310.15(B)(2)(A) AND ADJUSTMENT FACTORS .56 (56-60°C) AND .82 (42-45°C). OVERCURRENT DEVICE SIZING PER NEC 240.4(B) AND 240.6(A).

#### DC CALCULATIONS:

PER NEC 690.8(A)(1) AND (B)(1):  
ISC X 1.25X 1.25

CONDUCTOR SIZING PER NEC TABLES 310.15(B)(3) AND 310.15(B)(3)(c)

#### AC CALCULATIONS:

PER NEC 690.8(A)(3) AND (B)(1):  
1X 1.25

MINIMUM DISTANCE FROM CONDUIT TO ROOFTOP IS 3.5" PER NEC 310.15(B)(c)

ALL SUPPLIED EQUIPMENT IS UL LISTED

EQUIPMENT TO BE INSTALLED PER LISTING AND / OR LABELING TO 2011 NEC REQUIREMENTS.

GROUNDING CONDUCTORS CONNECTED TO EACH MODEL FRAME AND RACK ASSEMBLY

ALL SOLAR PANELS ARE LISTED TO UL1703 AND HAVE A CLASS C FIRE RATING.

#### MODULE INFORMATION:

MODEL# = YL290P-35b (290=Pmax)  
NOMINAL POWER (Pnom) = 290W  
OPEN CIRCUIT VOLTAGE (Voc) = 45.3V  
MAX POWER VOLTAGE (Vmp) = 35.8V  
SHORT CIRCUIT CURRENT (Isc) = 8.62A  
MAX POWER CURRENT (Imp) = 8.10A  
SERIES FUSE RATING = 15A

POWER OPTIMIZER = SOLAR EDGE 300  
RATED INPUT DC POWER = 300W  
MAXIMUM INPUT VOLTAGE = 48V  
MPPT OPERATING RANGE = 8-48V  
SHORT CIRCUIT CURRENT (Isc) = 10A  
MAX DC INPUT CURRENT = 12.5A  
MAX DC OUTPUT CURRENT = 15A  
MAX OUTPUT VOLTAGE = 60V  
MAX ALLOWED SYSTEM VOLTAGE = 1000V

#### ELECTRICAL CALCULATIONS

690.7: MAXIMUM SYSTEM VOLTAGE (DC)  
45.3V x 9 x 1.14 = 464.78V

690.8(A)(1): MAXIMUM PV SOURCE CIRCUIT CURRENT (DC)  
8.62A x 1 x 1.25 = 10.77A

690.8(B)(1): SIZING OF CONDUCTORS  
10.77A x 1.25 = 13.463A

#### DC CONDUCTOR AMPACITY CALCULATIONS:

10AWG CU = 40A @ 90°C  
40A x .8 x 0.71 (EXTREME ATTIC CONDITIONS) = 22.72A  
22.72A > 13.463A, THEREFORE 10 AWG CU IS SUFFICIENT.

690.8(A)(3): INVERTER OUTPUT CIRCUIT CURRENT  
21A x 1.25 = 26.25A or 5000W/240V x 1.25 = 26.04A

#### AC CONDUCTOR AMPACITY CALCULATIONS:

10 AWG CU = 40A @ 90°C  
40A x 1 x 0.87 = 34.8A  
65.25A > 34.8A, THEREFORE 6 AWG CU IS SUFFICIENT.

#### 705.12(D)(2): BACKFEED BREAKER CALCULATION:

BUS BAR RATING: 100A  
MCB RATING: 100A  
100A x 1.2 = 120A - 100A = 20A MAX BACKFEED

59.375A (INVERTER OUTPUT CIRCUIT CURRENT) < 60A  
THEREFORE 60A BREAKER IS SUFFICIENT.

#### SYMBOL & ABBREVIATION KEY

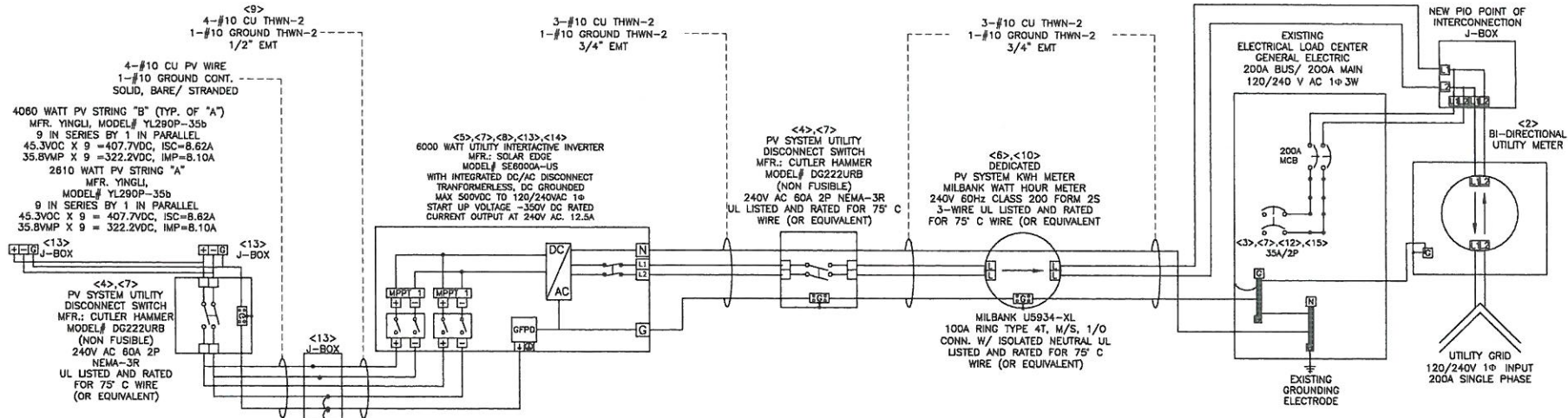
IRREVERSIBLE BOND	+
SPLICE	*
GROUNDING ELECTRODE CONDUCTOR	GEC
GROUND FAULT PROTECTION DEVICE	GFPD
ARC FAULT CIRCUIT INTERRUPTER	AFCI
SECURE POWER SYSTEM	SPS
MAIN CIRCUIT BREAKER	MCB
MAIN LUG ONLY	MLO
OVERCURRENT PROTECTION DEVICE	OCPD
PHOTOVOLTAIC	PV
SERVICE ENTRANCE SECTION	SES
NEUTRAL	NEU.
GROUND	GND.

#### CONDUCTOR COLORING:

DC:  
POSITIVE= RED  
NEGATIVE= BLACK  
GROUND= GREEN

AC:  
L1= BLACK  
L2= RED  
NEUTRAL= WHITE  
GROUND= GREEN





- <1> EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE NEC 2011 AND ALL APPLICABLE REQUIREMENTS OF THE SERVING ELECTRICAL UTILITY COMPANY AND OF THE LOCAL AUTHORITY HAVING JURISDICTIONS.
- <2> BI-DIRECTIONAL UTILITY METER TO BE INSTALLED BY UTILITY COMPANY (WHEN REQUIRED)
- <3> PER NEC 690.54 LABEL OVER CURRENT DEVICE "PHOTOVOLTAIC ELECTRIC POWER SOURCE" WITH THE RATED AC OUTPUT OPERATING CURRENT AND THE OPERATING VOLTAGE. PER NEC 705.12 (D)(7) LABEL DEVICE "WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS DEVICE"
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- <10> COMBINED DIRECT-CURRENT GROUNDING ELECTRODE CONDUCTOR AND ALTERNATING-CURRENT EQUIPMENT GROUNDING CONDUCTOR, THIS COMBINED GROUNDING CONDUCTOR SHALL BE THE LARGER OF THE SIZES SPECIFIED BY NEC 2011 250.122 OR 250.166(B) AND SHALL BE INSTALLED IN ACCORDANCE WITH 250.64(E).
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CONDUCTOR SIZING PER NEC TABLE 310.15(B)(16) & 310.15(B)(2)(A) AND ADJUSTMENT FACTORS .58 (56-60°C) AND .82 (42-45°C).  
OVERCURRENT DEVICE SIZING PER NEC 240.4(B) AND 240.6(A).

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PER NEC 690.8(A)(1) AND (B)(1):  
ISC X 1.25X 1.25

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1X 1.25

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EQUIPMENT TO BE INSTALLED PER LISTING AND / OR LABELING TO 2011 NEC REQUIREMENTS.

GROUNDING CONDUCTORS CONNECTED TO EACH MODEL FRAME AND RACK ASSEMBLY

ALL SOLAR PANELS ARE LISTED TO UL1703 AND HAVE A CLASS C FIRE RATING.

MODULE INFORMATION:

MODEL# = YL290P-35b (290=Pmax)  
NOMINAL POWER (P<sub>nom</sub>) = 290W  
OPEN CIRCUIT VOLTAGE (V<sub>oc</sub>) = 45.3V  
MAX POWER VOLTAGE (V<sub>mp</sub>) = 35.8V  
SHORT CIRCUIT CURRENT (I<sub>sc</sub>) = 8.62A  
MAX POWER CURRENT (I<sub>mp</sub>) = 8.10A  
SERIES FUSE RATING = 15A

POWER OPTIMIZER = SOLAR EDGE 300  
RATED INPUT DC POWER = 300W  
MAXIMUM INPUT VOLTAGE = 48V  
MPPT OPERATING RANGE = 8-48V  
SHORT CIRCUIT CURRENT (I<sub>sc</sub>) = 10A  
MAX DC INPUT CURRENT = 12.5A  
MAX DC OUTPUT CURRENT = 15A  
MAX OUTPUT VOLTAGE = 60V  
MAX ALLOWED SYSTEM VOLTAGE = 1000V

**ELECTRICAL CALCULATIONS**

690.7. MAXIMUM SYSTEM VOLTAGE (DC)  
45.3V x 9 x 1.14 = 464.78V

690.8(A)(1): MAXIMUM PV SOURCE CIRCUIT CURRENT (DC)  
8.62A x 1 x 1.25 = 10.77A

690.8(B)(1): SIZING OF CONDUCTORS  
10.77A x 1.25 = 13.463A

DC CONDUCTOR AMPACITY CALCULATIONS:  
10AWG CU = 40A @ 90°C  
40A x .8 X 0.71 (EXTREME ATTC CONDITIONS) = 22.72A  
22.72A > 13.463A, THEREFORE 10 AWG CU IS SUFFICIENT.

690.8(A)(3): INVERTER OUTPUT CIRCUIT CURRENT  
21A x 1.25 = 26.25A or 5000W/240V x 1.25 = 26.04A

AC CONDUCTOR AMPACITY CALCULATIONS:  
10 AWG CU = 40A @ 90°C  
40A x 1 x 0.71 = 28.4A  
28.4A > 26.25A, THEREFORE 10 AWG CU IS SUFFICIENT.

705.12(D)(2): BACKFEED BREAKER CALCULATION:  
BUS BAR RATING: 100A  
MCB RATING: 100A  
100A x 1.2 = 120A - 100A = 20A MAX BACKFEED

26.25A (INVERTER OUTPUT CIRCUIT CURRENT) < 30A  
THEREFORE 30A BREAKER IS SUFFICIENT.

SYMBOL & ABBREVIATION KEY	
IRREVERSIBLE BOND	⚡
SPLICE	*
GROUNDING ELECTRODE CONDUCTOR	GEC
GROUND FAULT PROTECTION DEVICE	GFPD
ARC FAULT CIRCUIT INTERRUPTER	AFCI
SECURE POWER SYSTEM	SPS
MAIN CIRCUIT BREAKER	MCB
MAIN LUG ONLY	MLO
OVERCURRENT PROTECTION DEVICE	OCPP
PHOTOVOLTAIC	PV
SERVICE ENTRANCE SECTION	SES
NEUTRAL	NEU.
GROUND	GND.

**CONDUCTOR COLORING:**

DC:  
POSITIVE= RED  
NEGATIVE= BLACK  
GROUND= GREEN

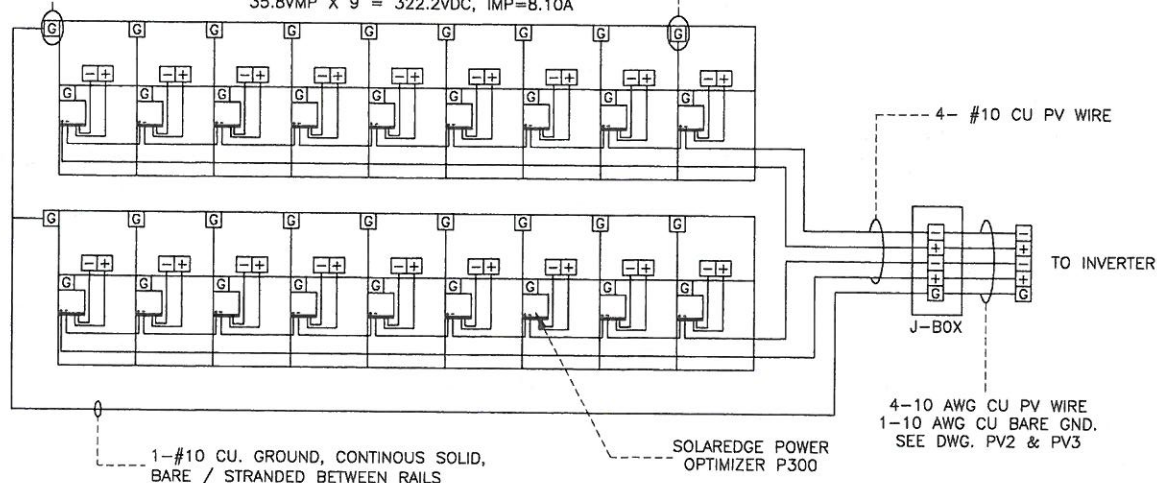
AC:  
L1= BLACK  
L2= RED  
NEUTRAL= WHITE  
GROUND= GREEN



ETL LISTED METASOLE END CLAMP  
(OR EQUIVALENT) BONDING SYSTEM TO  
EQUIPMENT GROUND CONDUCTOR (TYPICAL)

2610 WATT PV STRING "A" (TYP. OF 27)  
MFR. YINGLI, MODEL# YL290P-35b  
9 IN SERIES BY 1 IN PARALLEL  
45.3VOC X 9 = 407.7VDC, ISC=8.62A  
35.8VMP X 9 = 322.2VDC, IMP=8.10A

METASOLE MIDDLE CLAMP (OR EQUIVALENT)  
BONDING MODULE TO CLAMP BASE (TYPICAL)



#### ALL BACK COATED MULTICRYSTALLINE

- EQUIPMENT SHALL BE INSTALLED IN ACCORDANCE WITH THE 2011 NEC AND ALL APPLICABLE REQUIREMENTS OF THE LOCAL AUTHORITY HAVING JURISDICTION.
- GROUND WIRE MUST BE CONTINUOUS AND INSTALLED TO ALLOW FOR PANEL REMOVAL WITHOUT DISRUPTING CONTINUITY. ALL MODULE GROUND CONNECTIONS SHALL BE MADE IN ACCORDANCE WITH NEC 690.4(C).
- FOLLOW MANUFACTURERS SUGGESTED INSTALLATION PRACTICES AND WIRING SPECIFICATIONS.
- WIRES SHALL BE RATED AND LABELED "SUNLIGHT RESISTANT" WHERE EXPOSED TO AMBIENT TEMPERATURES.
- PER NEC 690.35(F). THE PHOTOVOLTAIC POWER SOURCE SHALL BE LABELED WITH THE FOLLOWING WARNING AT EACH JUNCTION BOX, COMBINER BOX, DISCONNECT, AND DEVICE WHERE ENERGIZED UNGROUNDED CIRCUITS MAY BE EXPOSED DURING SERVICE "WARNING ELECTRIC SHOCK HAZARD. THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AD MAY BE ENERGIZED.

#### MODULE INFORMATION:

MODEL# = YL290P-35b (290=Pmax)  
NOMINAL POWER (Pnom) = 290W  
OPEN CIRCUIT VOLTAGE (Voc) = 45.3V  
MAX POWER VOLTAGE (Vmp) = 35.8V  
SHORT CIRCUIT CURRENT (Isc) = 8.62A  
MAX POWER CIRCUIT (Imp) = 8.10A  
SERIES FUSE RATING = 15A  
POWER OPTIMIZER = SOLAR EDGE 300  
RATED INPUT DC POWER = 300W  
MAXIMUM INPUT VOLTAGE = 48V  
MPPT OPERATING RANGE = 8-48V  
SHORT CIRCUIT CURRENT (Isc) = 10A  
MAX DC INPUT CURRENT = 12.5A  
MAX DC OUTPUT CURRENT = 15A  
MAX OUTPUT VOLTAGE = 60V  
MAX ALLOWED SYSTEM VOLTAGE =

#### ARRAY CONFIGURATION STRING 1 (TYP. OF 2)

NUMBER OF STRINGS = 2  
NUMBER OF MODULES PER STRING = 9  
TOTAL POWER DC PER STRING = 2610W  
FIXED VOLTAGE PER STRING = 350VDC  
VOC PER OPTIMIZER = 1 VDC  
VOC STRING TOTAL = 9 VDC

CURRENT PER OPTIMIZER = 10.2 ADC  
VOLTAGE PER OPTIMIZER = 25 VDC

NEC 690.7:

VOC X 1.14 = V

45.3 X 1.14 = 51.64 V

ERUS ENERGY

PROJECT INFORMATION	SALES REP.	MULLARD R.	TEXAS ROC LIC. #30936
QUOTE#	DESIGNER	PEARCE T.	2141 E. CAMELBACK RD. # 250
REV	PROJECT MGR	HOLLOWAY, T	PHOENIX, AZ 85016
UTILITY	CPS	DESIGN DATE	[844] 272-8336, [602] 507-0530
SCALE	NTS		ERUS PROJECT # SA-70011-15

ARRAY DIAGRAM	6.69kW/15.51W/100 PHOTOVOLTAIC SYSTEM
CUSTOMER:	1415 FULL TON AVENUE San Antonio, TEXAS 78201
SCALE:	SOLIZ, GERARDO

PV4



LOCATED AT THE SAME

BE CONNECTED AS

ANCES ON OR IN THE  
IONS OF ALL ELECTRIC

## MAIN SERVICE PANEL

(BLACK WITH WHITE LETTERING, TEXT 3/16")

PHOTOVOLTAIC POWER SOURCE  
OPERATING AC VOLTAGE: \_\_\_\_\_ V  
MAXIMUM OPERATING AC  
OUTPUT CURRENT: \_\_\_\_\_ AMPS

(ORANGE WITH BLACK LETTERING  
"WARNING" TEXT 3/16", TEXT 1/8")

**WARNING**  
INVERTER OUTPUT CONNECTION  
DO NOT RELOCATE THIS  
OVERCURRENT DEVICE

(ORANGE WITH BLACK LETTERING, "WARNING" TEXT 1/4", TEXT 3/16")

**WARNING**  
ELECTRIC SHOCK HAZARD  
-DO NOT TOUCH TERMINALS-  
TERMINALS ON BOTH LINE AND  
LOAD SIDES MAY BE ENERGIZED  
IN THE OFF POSITION

(BLACK WITH WHITE LETTERING, TEXT 1/8")

PHOTOVOLTAIC POWER SOURCE  
BREAKERS ARE BACKFEEDING

**\*\*NOTE: ALL LABELS TO BE ENGRAVED AND  
MECHANICALLY BONDED UNLESS OTHERWISE STATED**

## 2011 NEC

### DC DISCONNECT

(BLACK WITH WHITE LETTERING, TEXT 3/16", TEXT 1/8")

PHOTOVOLTAIC ARRAY  
DC DISCONNECT SWITCH  
PHOTOVOLTAIC POWER SOURCE  
INVERTER MAX. VOLTAGE RATING: \_\_\_\_\_ VDC  
OPERATING CURRENT (I<sub>mp</sub>) : \_\_\_\_\_ ADC  
OPERATING VOLTAGE (V<sub>mpp</sub>) : \_\_\_\_\_ VDC  
MAX. CIRCUIT CURRENT (I<sub>max</sub>) : \_\_\_\_\_ ADC

(ORANGE WITH BLACK LETTERING, "WARNING" TEXT 1/4", TEXT 3/16")

**WARNING**  
ELECTRIC SHOCK HAZARD  
-DO NOT TOUCH TERMINALS-  
TERMINALS ON BOTH LINE AND  
LOAD SIDES MAY BE ENERGIZED  
IN THE OFF POSITION

(ORANGE WITH BLACK LETTERING, "WARNING" TEXT 1/4", TEXT 3/16")

**WARNING**  
ELECTRIC SHOCK HAZARD.  
THE DC CONDUCTORS OF THIS  
PHOTOVOLTAIC SYSTEM ARE  
UNGROUND AND MAY BE  
ENERGIZED

### AC DISCONNECT

(BLACK WITH WHITE LETTERING, TEXT 1/8")

PHOTOVOLTAIC SYSTEM  
UTILITY DISCONNECT SWITCH

(ORANGE WITH BLACK LETTERING, "WARNING" TEXT 1/4", TEXT 3/16")

**WARNING**  
ELECTRIC SHOCK HAZARD  
-DO NOT TOUCH TERMINALS-  
TERMINALS ON BOTH LINE AND  
LOAD SIDES MAY BE ENERGIZED  
IN THE OFF POSITION

### J-BOX

(ORANGE WITH BLACK LETTERING, "WARNING" TEXT 1/4", TEXT 3/16")

**WARNING**  
ELECTRIC SHOCK HAZARD.  
THE DC CONDUCTORS OF THIS  
PHOTOVOLTAIC SYSTEM ARE  
UNGROUND AND MAY BE  
ENERGIZED

### DEDICATED PV SYSTEM KWH METER

(BLACK WITH WHITE LETTERING, TEXT 1/8")

PHOTOVOLTAIC SYSTEM  
UTILITY DISCONNECT SWITCH

ERUS ENERGY

PROJECT INFORMATION	SALES REP.	VALLARD R.	TEXAS ROC. LIC. #30936
QUOTE#	DESIGNER	PERCE T.	2141 E. CAMELBACK RD. # 250
PLAN	SAN ANTONIO	PROJECT MGR. KOLLOWAY, T.	PHOENIX, AZ 85016
UTILITY	CPS	DESIGN DATE	[844] 272-9336, [602] 507-6530
SCALE:	NTS		ERUS PROJECT # SA-70011-15
LABEL SHEET			
6.69kW/15.51kW PHOTOVOLTAIC SYSTEM			
1415 FULTON AVENUE			
SAN ANTONIO, TEXAS 78201			
CUSTOMER:			SOLIZ, GERARDO

PV5





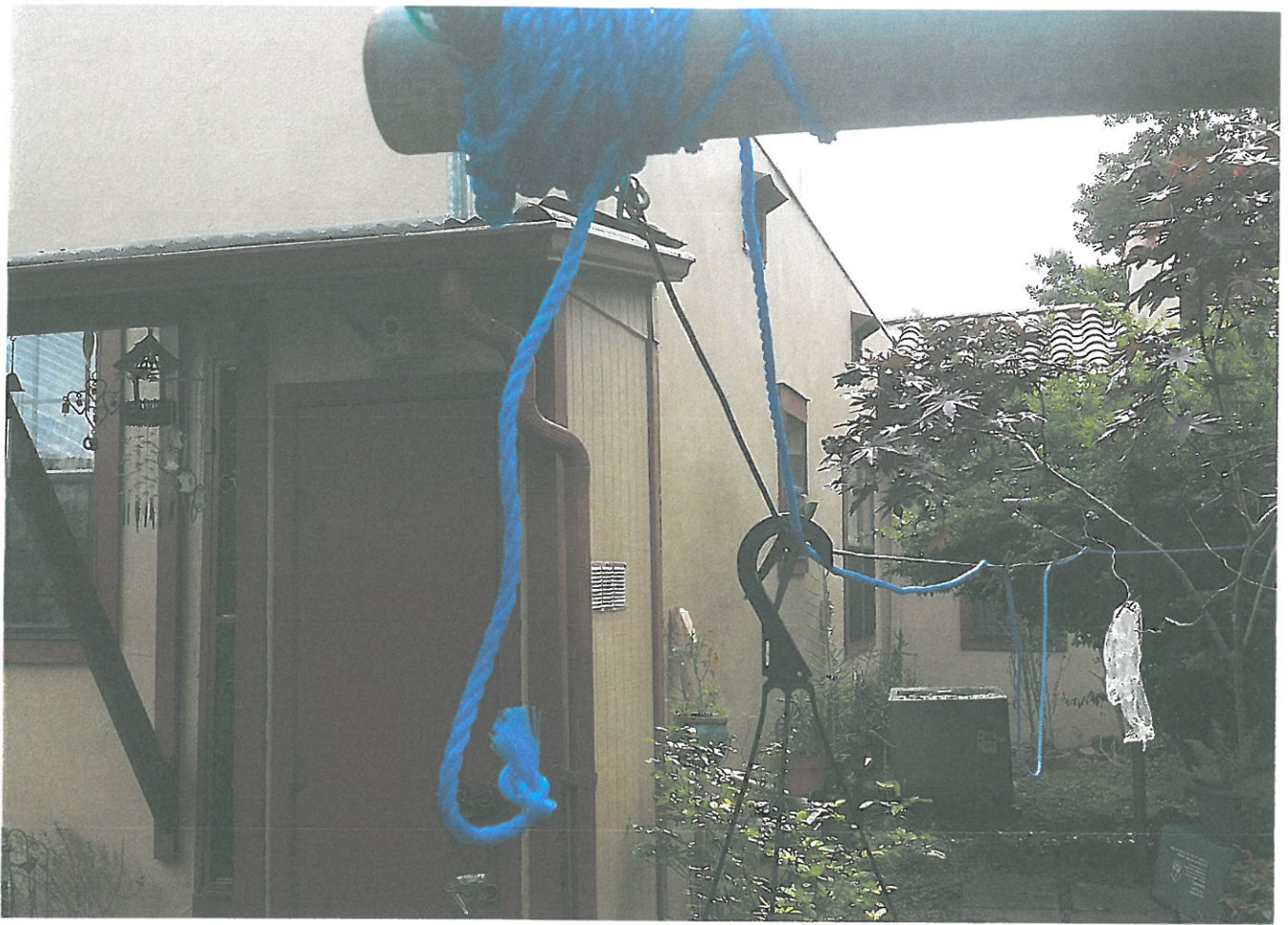










































# Roof Mounting System

**2015 Edition** VR15E





This **Engineering Design Guide** was created to help our engineering partners more easily design and specify PV roof mount applications using IronRidge components. In addition to this document, IronRidge provides a complete system of technical support including installation guides, pre-stamped certification letters for most PV-friendly states, our online Design Assistant software, and live, knowledgeable person-to-person customer service.

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- 7 Adjustable L-Foot  
FlashFoot™  
Under Clamp
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Tilt Mount Standoff  
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## Introduction

IronRidge provides a comprehensive platform for designing a wide variety of photovoltaic systems for roof mounting applications. Due to its modular architecture, it can handle nearly all commercially available PV modules and layout designs. The IronRidge Roof Mount provides an all-in-one mounting solution, with the roof attachment FlashFoot, XR rails, and integrated grounding. IronRidge products are engineered to last in the most extreme weather conditions and have been installed in every continent in the world.

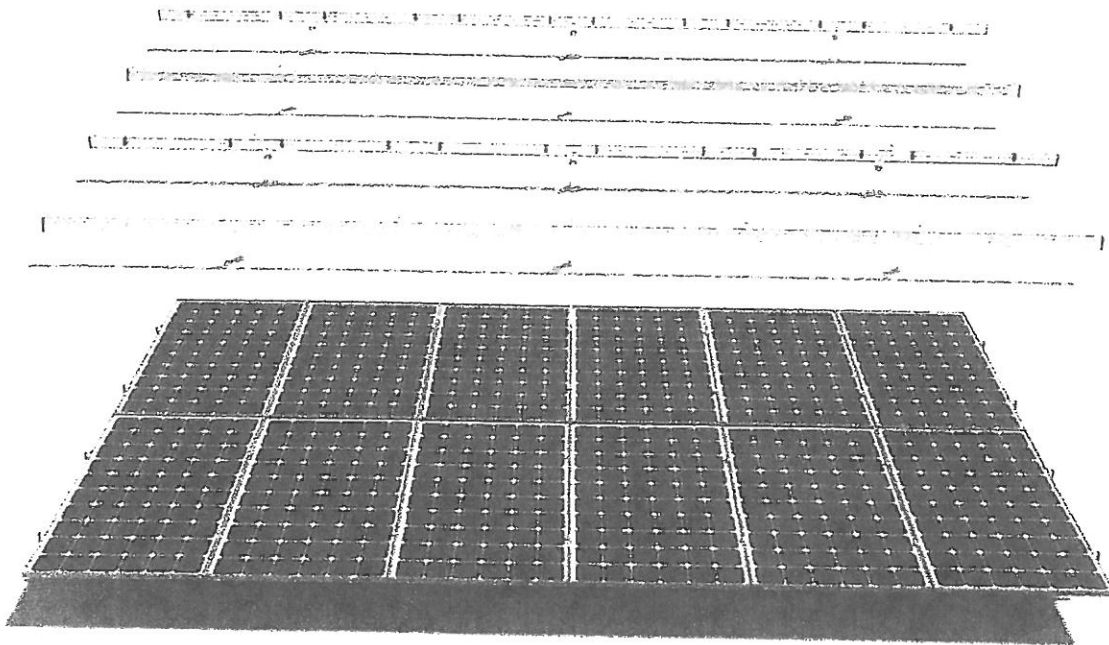
## Technical Specifications

Below is a brief summary of the technical specifications of the IronRidge Roof Mount platform. More detail will be provided in the following pages. If there is additional information you require that is not listed in this Engineering Design Guide, please do not hesitate to contact us at [support@ironridge.com](mailto:support@ironridge.com).

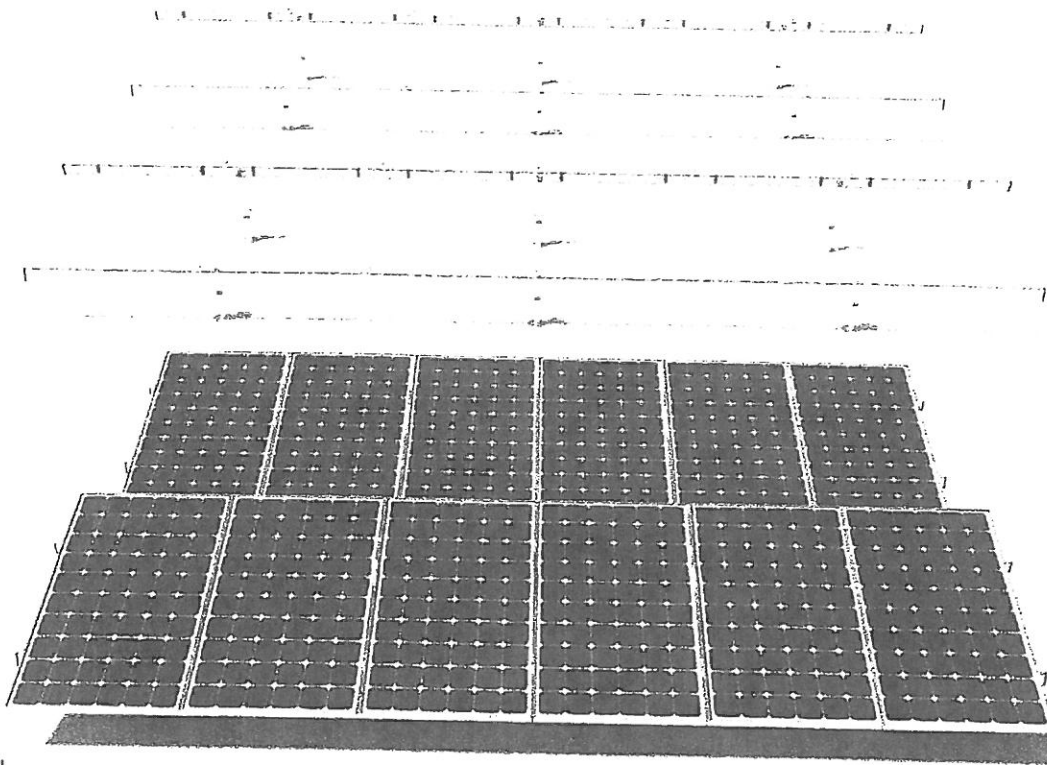
<b>Allowable Roof Slope</b>	0 to 45 Degrees	<b>Warranty</b>	20 Year
<b>Span Lengths</b>	Up to 12'	<b>Tilt Legs</b>	Yes (10" to 40")
<b>Rail Lengths</b>	Standard & Custom	<b>Adjustable Tilt Legs</b>	Up to 45 Degrees
<b>Rail Finish</b>	Clear, Black	<b>Adjustable L Feet</b>	1-1/8" vertical adjustability
<b>Building Height</b>	Certified to 60'	<b>Splices</b>	Patent-pending internal
<b>Max Wind Speed</b>	170 Mph (for 7-10)	<b>Stand-offs</b>	Yes (3", 4", 6", 7")
<b>Module Orientation</b>	Landscape & Portrait	<b>Tilt Stand-offs</b>	Yes (3.75", 6", 9")
<b>Wind Exposure</b>	Category B, C & D	<b>Flashing</b>	FlashFoot (All-in-One Attachment)
<b>Cantilever</b>	40% of Maximum Span	<b>T-bolts</b>	Multiple Sizes
<b>Max Ground Snow Load</b>	90 psf	<b>Wire Clips</b>	Black Polycarbonate
<b>Component Materials</b>	Aluminum and Stainless Steel	<b>End Caps</b>	Black Polycarbonate
<b>Hardware</b>	Stainless Steel Fasteners	<b>Engineering Support</b>	Yes (P.E. Certified)



### Assembled Views



### Flush Mounted



### Tilt Mounted

For a complete 360 degree interactive roof mounting viewing environment, go to: [ironridge.com/products/roofmounting/360view](http://ironridge.com/products/roofmounting/360view).



## XR Rails

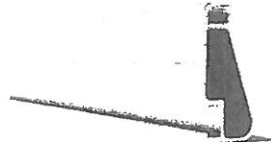
### XR10 Rail



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

- 6' spanning capability
- Moderate load capability
- Clear anodized finish

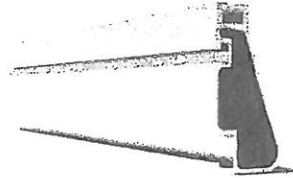
### XR100 Rail



The ultimate residential solar mounting rail.

- 8' spanning capability
- Heavy load capability
- Clear & black anod. finish

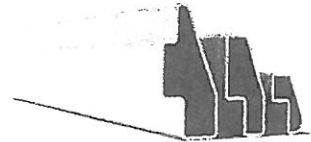
### XR1000 Rail



A heavyweight mounting rail for commercial projects.

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

### Internal Splices ☺



All rails use internal splices for seamless connections.

- Self-tapping screws
- Varying versions for rails
- Grounding Straps offered

## Attachments

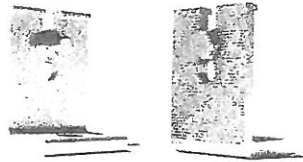
### FlashFoot



Anchor, flash, and mount with all-in-one attachments.

- Ships with all hardware
- IBC & IRC compliant
- Certified with XR Rails

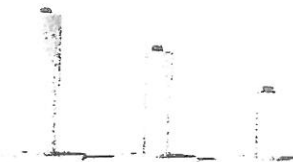
### Slotted L-Feet



Drop-in design for rapid rail attachment.

- High-friction serrated face
- Heavy-duty profile shape
- Clear & black anod. finish

### Standoffs



Raise flush or tilted systems to various heights.

- Works with vent flashing
- Ships pre-assembled
- Lengths from 3" to 9"

### Tilt Legs

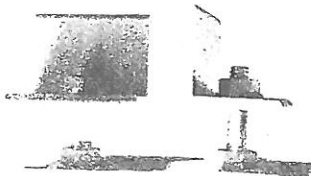


Tilt assembly to desired angle, up to 45 degrees.

- Attaches directly to rail
- Ships with all hardware
- Fixed and adjustable

## Clamps & Grounding

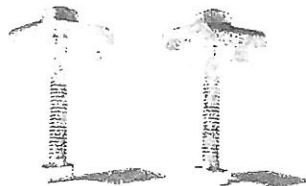
### End Clamps



Slide in clamps and secure modules at ends of rails.

- Clear and black anod.
- Sizes from 1.22" to 2.3"
- Optional Under Clamps

### Mid Clamps ☺



Attach and ground modules in the middle of the rail.

- Parallel bonding T-bolt
- Reusable up to 10 times
- Mill & black stainless

### Grounding Lugs ☺



Ground system using the rail's top slot.

- No clips or washers
- Eliminates pre-drilling
- Easy top-slot mounting

### Accessories



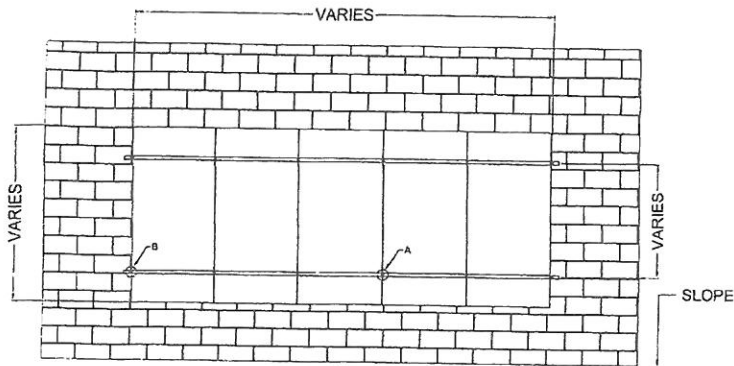
Provide a finished and organized look for rails.

- Snap-in Wire Clips
- Perfected End Caps
- UV-protected polymer

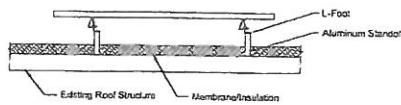


### Assembly CAD Details

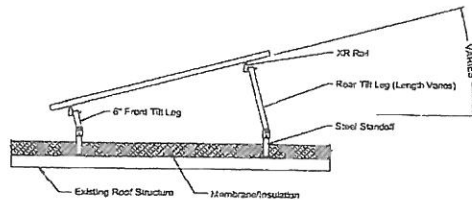
[Download AutoCAD File](#) | [Download PDF](#)



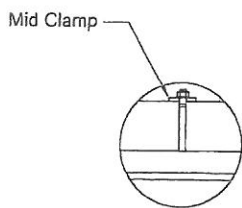
Typical Flush Mount Array - Plan View  
1/2" = 1' - 0"



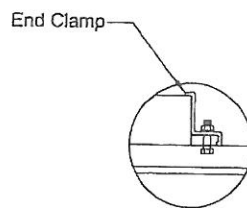
Section - Flush Mount - Flat Roof  
3/4" = 1' - 0"



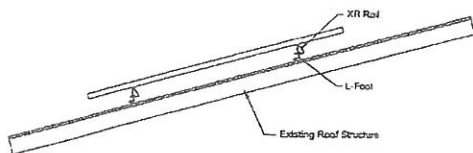
Section - Tilt Mount - Flat Roof  
3/4" = 1' - 0"



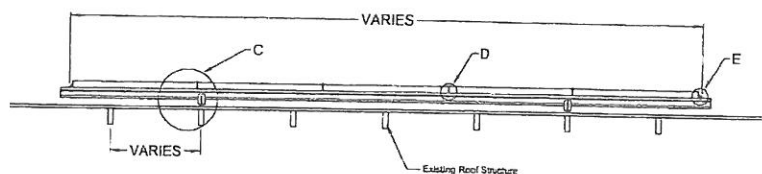
Detail D - Mid Clamp to Rail - Elevation  
6" = 1' - 0"



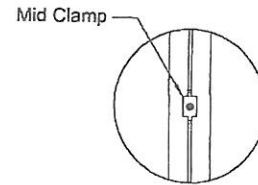
Detail E - End Clamp to Rail - Elev.  
6" = 1' - 0"



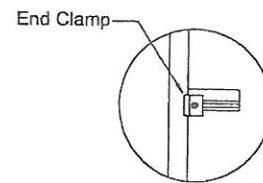
Section - Flush Mount - Sloped Roof  
3/4" = 1' - 0"



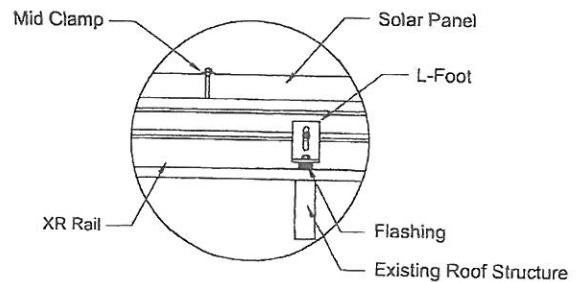
Typical Flush Mount Array - Elevation  
3/4" = 1' - 0"



Detail A - Mid Clamp to Rail - Plan  
3" = 1' - 0"



Detail B - End Clamp to Rail - Plan  
3" = 1' - 0"

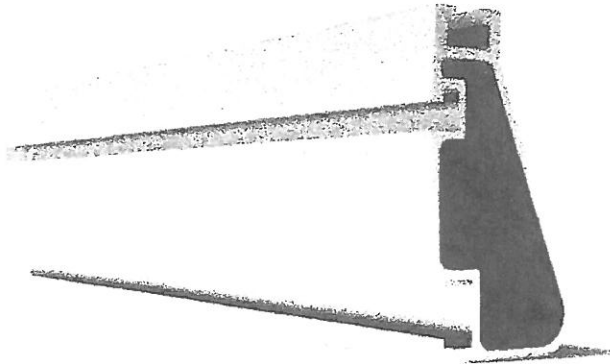


Detail C - Typical Roof Connection  
3" = 1' - 0"



### XR1000 Rail

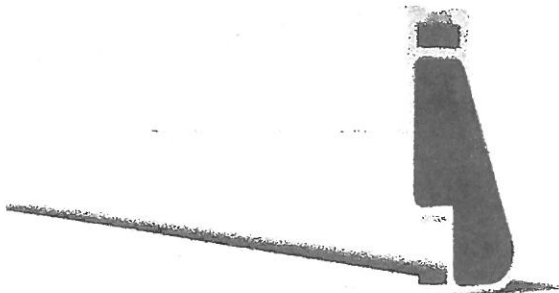
XR1000 is a heavyweight among solar mounting rails, built to handle extreme climates and spans 12 feet or more for commercial applications.



Property	Value
Material	6000 Series Aluminum
Finish	Clear Anodized
Beam Height	3.00"
Weight / Linear Foot	0.945 Lbs
Total Cross-Sectional Area	0.807 In <sup>2</sup>
Section Modulus (X-axis)	0.530 In <sup>3</sup>
Moment of Inertia (X-axis)	0.843 In <sup>4</sup>
Moment of Inertia (Y-axis)	0.182 In <sup>4</sup>
Torsional Constant	0.436 In <sup>3</sup>
Polar Moment of Inertia	0.3299 In <sup>4</sup>

### XR100 Rail

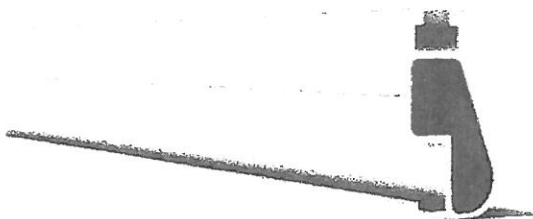
XR100 is the ultimate residential mounting rail. It supports a range of wind and snow conditions, while also maximizing spans.



Property	Value
Material	6000 Series Aluminum
Finish	Clear & Black Anodized
Beam Height	2.44"
Weight / Linear Foot	0.68 Lbs
Total Cross-Sectional Area	0.582 In <sup>2</sup>
Section Modulus (X-axis)	0.297 In <sup>3</sup>
Moment of Inertia (X-axis)	0.390 In <sup>4</sup>
Moment of Inertia (Y-axis)	0.085 In <sup>4</sup>
Torsional Constant	0.214 In <sup>3</sup>
Polar Moment of Inertia	0.126 In <sup>4</sup>

### XR10 Rail

XR10 is a low-profile mounting rail, perfectly matched to regions with light snow. It achieves 6 foot spans, while staying light and economical.

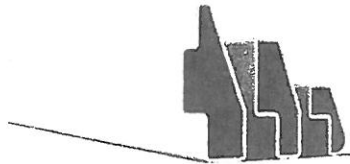


Property	Value
Material	6000 Series Aluminum
Finish	Clear Anodized
Beam Height	1.75"
Weight / Linear Foot	0.436 Lbs
Total Cross-Sectional Area	0.363 In <sup>2</sup>
Section Modulus (X-axis)	0.136 In <sup>3</sup>
Moment of Inertia (X-axis)	0.124 In <sup>4</sup>
Moment of Inertia (Y-axis)	0.032 In <sup>4</sup>
Torsional Constant	0.076 In <sup>3</sup>
Polar Moment of Inertia	0.033 In <sup>4</sup>



### Internal Splice

IronRidge Rails are easy to extend with our patent-pending Internal Splices.



Property	Value
Material	6000 Series Aluminum
Finish	Mill
Length	12"
Hardware	2 SS Self-tapping Screws

### End Clamp

IronRidge End Clamps secure PV modules to XR Rails using the top slot, independent upon the module's mounting holes.



Property	Value
Material	5000 & 6000 Series Aluminum
Finish	Mill & Black
Height	Varies depending on Module
Width	1.5"
Depth	1.5"
Weight	0.2 Lbs
Hardware	1/4"-20 SS Nut and Bolt

### Mid Clamp

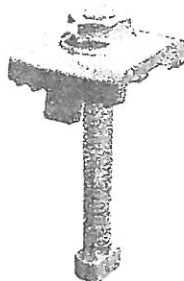
IronRidge Mid Clamps secure PV modules to the rail when there are multiple modules in a row.



Property	Value
Material	5000 Series Aluminum
Finish	Mill & Black
Spacing between Modules	1/4"
Width	1"
Depth	1.5"
Weight	0.2 Lbs
Hardware	1/4"-20 SS Nut and Bolt

### Grounding Mid Clamp

Grounding Mid Clamps pierce through anodized coatings to ground array, being ETL listed to UL 2703.

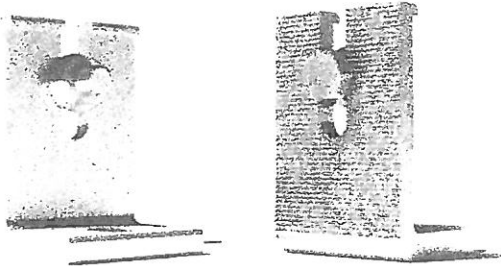


Property	Value
Material	304 Stainless Steel
Finish	Mill & Black
Spacing between Modules	1/4"
Width	1"
Depth	1.2"
Weight	0.3 Lbs
Hardware	1/4"-20 SS Nut and Bolt



### Slotted L-Foot

Our Slotted L-feet are engineered for most roof mounting applications. Vertical slots allow for easily dropping in rails with attached hardware and provide adjustability to account for roof irregularities.



Property	Value
Material	6000 Series Aluminum
Finish	Mill & Black
Height	3"
Width	2"
Depth	2"
Length of Vertical Slot	1.125"
Weight	0.16 Lbs
Hardware	3/8" SS

### FlashFoot™

IronRidge FlashFoot™ is an all-in-one solar mounting product for composition shingle roofs that eliminates the need for separate standoffs, flashings, and L-feet. FlashFoot incorporates a number of structural and waterproofing features to securely attach IronRidge Rails to roof structures, while also protecting against water intrusion and weather damage. Comes with flashing, lag bolt, and L-Foot.



Property	Value
Material	Aluminum
Finish	Mill & Black
Height	3.5"
Length	12"
Width	12"
Dual Mechanical Seal	Yes
Open L-Foot Slot	Yes
Weight	1.35 Lbs
Hardware	5/16" and 3/8" SS

### Under Clamp

IronRidge Under Clamps secure PV modules to the XR1000 Rail using the mounting holes of the PV module and the side slot of the rail.



Property	Value
Material	6000 Series Aluminum
Finish	Mill
Spacing between Modules	1/4"
Width	1.6"
Depth	1.5"
Weight	0.05 Lbs
Hardware	1/4"-20 SS Nut and Bolt



### Flush Mount Standoff

Our Flush Mount Aluminum Standoffs are sized to integrate easily with Oatey Flashings. IronRidge Flush Mount Standoffs are available in four lengths ranging from 3" to 7". Standoffs include L-Foot mounting hardware. Lag bolts not included.



Property	Value
Material (Post)	6000 Series Aluminum
Material (Base)	5000 Series Aluminum
Finish	Mill
Heights	3", 4", 6", 7"
Post Diameter	1.5"
Depth	4"
Weight	0.84 Lbs
Hardware	5/16"

### Tilt Mount Standoff

Our Tilt Mount Aluminum Standoffs are sized to integrate easily with Oatey Flashings. IronRidge Tilt Mount Standoffs are available in four lengths ranging from 3.75" to 9". They ship pre-assembled, and include L-Foot Mounting hardware. Lag bolts included.



Property	Value
Material (Post)	6000 Series Aluminum
Material (Base)	A360 (Cast AL)
Finish	Mill
Heights	3.75", 6", 9"
Post Diameter	1.25"
Base Diameter	4"
Weight	0.85 Lbs
Hardware	5/16" SS L-Foot & Lag Bolts

### Fixed Tilt Length Leg

Our Fixed Tilt Legs attach directly to IronRidge XR Rails. This simple design provides adjustability in all 3 axes, and a variety of lengths cover most angles. Each Tilt Leg Kit comes with the shorter front leg, the longer rear leg, mounting brackets and hardware.

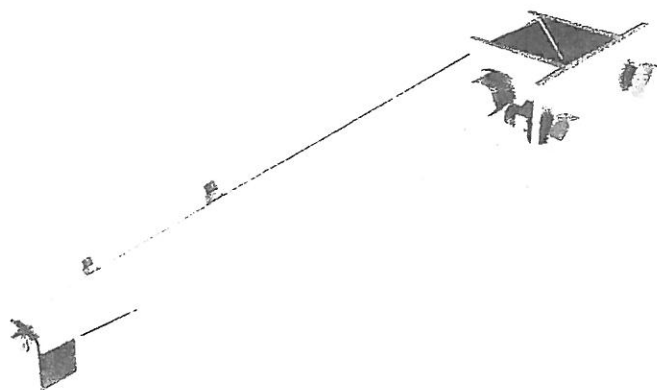


Property	Value
Material (Legs)	6000 Series Aluminum
Material (Brackets)	5000 Series Aluminum
Finish	Mill
Length (Short Leg)	6"
Length (Long Legs)	10", 15", 20", 25", 30", 40"
Leg Diameter	1.5" Square Tube
Tube Weight / Linear Foot	0.80 Lbs
Height (Brackets)	2.6"
Width (Brackets)	1.85"
Depth (Brackets)	2"
Hardware	3/8" SS



## Adjustable Tilt Length Leg

As with our Fixed Tilt Legs, the Adjustable Tilt Legs attach directly to IronRidge XR Rails. Each Tilt Leg Assembly kit comes with the shorter fixed front leg, the longer adjustable rear leg, and all the necessary hardware.



Property	Value
Material (Legs)	6000 Series Aluminum
Material (Brackets)	5000 Series Aluminum
Finish	Mill
Length (Short Leg)	6"
16" Range (Long Leg)	18" – 22"
28" Range (Long Leg)	30" – 46"
56" Range (Long Leg)	58" – 94"
Outer Tube Diameter	1.8" Square Tube
Inner Tube Diameter	1.5" Square Tube
Upper Bracket	2.2"x4.25"x2"
Lower Bracket	2.6"x1.85"x2"
Hardware	3/8" SS

## Grounding Strap

Grounding Straps are used to bond rail-to-rail connections. They are only required on the rail with the grounding lug. Grounding Strap Expansion Joint also available.



Property	Value
Material	Tin-plated Copper Flat Braid
Weight	0.054 Lbs
Wire Gauge	9 AWG

## End Caps

End caps provide a finished look while protecting against the collection of water and debris inside the rail.



Property	Value
Material	Polycarbonate
Color	Black
UV Protection	Yes

## Wire Clips

IronRidge Wire Clips snap into the top slot of XR Rails, and accommodate up to ten 5mm panel wires, or one MC4, one Enphase wire and one dual Enphase wire. The Wire Clips are molded from black polycarbonate with UV protection.



Property	Value
Material	Polycarbonate
Color	Black
UV Protection	Yes
Weight	0.01 Lbs



### Microinverter Mounting Kit

Mount either one or two microinverters, depending on model.



Property	Value
Material	Stainless Steel
Color	Mill
Hardware	1/4 x 3/4" Hex or T-Bolts
Weight	0.06 Lbs

### Grounding Lug

Manufactured from high strength copper alloy with stainless steel screw, UL listed and CSA certified. Hex bolt and grounding T-bolt versions available. Hex bolt version not compatible with XR10 or XR100 rails.



Property	Value
Material	SS & Tin-plated Copper
Weight	0.154 Lbs
Conductor Size	4-14 AWG
Listing	UL 467 Compliant
Hardware	#10 & 1/4" SS

### Third-Party Grounding Components

Wiley grounding clips (WEEB DMC) are used in conjunction with the IronRidge Mid Clamps for grounding PV modules to rails.



Property	Value
Material	304 Stainless Steel
ETL Listed	ANSI/UL 467 Compliant
Maximum Conductor Size	6 AWG (with two WEEBs contacting each module)
Hardware	None

Wiley grounding lugs are used in conjunction with copper wire to provide a continuous ground for every row of rails.



Property	Value
WEEB Material	304 Stainless Steel
Lug Material	Tin-plated Copper
ETL Listed	ANSI/UL 467 Compliant
Ground Conductor	One 14 AWG to 6 AWG or two 10 AWG, two 12 AWG
Hardware	1/4"-20 & 1/4"-28 SS

Wiley bonding jumpers are used to provide a continuous ground between spliced rail sections. Order one jumper for every splice.



Property	Value
WEEB Material	304 Stainless Steel
Braid Material	Tin-plated Copper
ETL Listed	ANSI/UL 467 Compliant
Hardware	1/4"-20 SS



## Summary

With the IronRidge Design Assistant™ our customers move from laboriously designing systems across the span of weeks, to intuitively designing while pricing, a bill of materials and engineering calculations all updates in real-time.

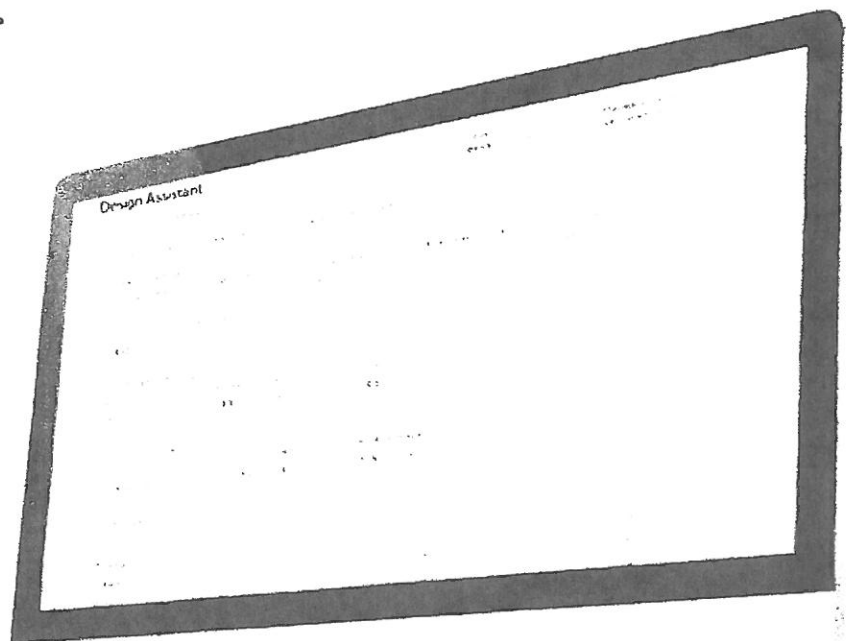
If you choose to register for an online account, you will then be able to save your work and prevent losing your project's configuration settings.

The application is so quick and easy to use, multiple what-if scenarios can be evaluated through immediate engineering and pricing feedback. Engineered calculations comply with ASCE 7-10 building codes for expedited P.E. approval.

The IronRidge Design Assistant™ is provided free of charge to IronRidge customers.

**Design, engineer and quote,  
online, in just minutes.**

[ironridge.com/support/designassistant](http://ironridge.com/support/designassistant)





## Code Compliance

IronRidge Roof Mount components, when installed in accordance with the IronRidge Roof Mount Installation Manual, will be structurally adequate and will meet the structural requirements of:

- ASCE/SEI 7-10 Min. Design Loads for Buildings & Other Structures
- California Building Code 2013 Edition
- AC428, Acceptance Criteria for Modular Framing Systems Used to Support PV Modules, Effective November 1, 2012 (ICC-ES)
- Aluminum Design Manual, 2010 Edition
- Florida Building Code 2010 Edition
- Florida Residential Building Code 2010 Edition
- International Building Code 2012 Edition
- International Residential Building Code 2012 Edition

### **IronRidge Rails with Integrated Grounding conforms to:**

- UL Subject 2703 Outline of Investigation for Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels
- ETL Listed requirements and certification

## Thermal Expansion (Expansion Joints)

For rows exceeding 100 feet of rail, a Grounding Strap Expansion Joint is required for thermal expansion. Insert Internal Splice into first rail and secure with screw. Assemble and secure Expansion Joint an inch from rail end. Slide second rail over Internal Splice, attach other end of Expansion Joint with hardware, and secure with screw. Torque screws and nuts to 84 in-lbs.



## AWC Lag Pull-out Chart

Lag pull-out (withdrawal) capacities (lbs) in typical roof lumber (ASD)

Material	Specific Gravity	Lag Screw Specifications*
Douglas Fir, Larch	0.50	266
Douglas Fir, South	0.46	235
Engelmann Spruce, Lodgepole Pine (MSR 1650 f & higher)	0.46	235
Hem, Fir, Redwood (close grain)	0.43	212
Hem, Fir (North)	0.46	235
Southern Pine	0.55	307
Spruce, Pine, Fir	0.42	205
Spruce Pine Fir (E of 2 million psi and higher grades of MSR and MEL)	0.50	266

Sources: American Wood Council, NDS 2005, Table 11.2A, 11.3.2A.

- Notes: (1) Thread must be embedded in the side grain of a rafter or other structural member integral with the building structure.  
 (2) Lag bolts must be located in the middle third of the structural member.  
 (3) These values are not valid for wet services.  
 (4) This table does not include shear capacities. If necessary, contact a local engineer to specify lag bolt size with regard to shear forces.  
 (5) Install lag bolts with head and washer flush to surface (no gap). Do not over-torque.  
 (6) Withdrawal design values for lag screw connections shall be multiplied by applicable adjustment factors if necessary. See Table 10.3.1 in the American Wood Council NDS for Wood Construction.



\*5/16" shaft, per inch thread depth (Use flat washers with lag screws).



## Rails & Splices

When top mounting panels, the lengths of XR Rails required for each row may be determined by multiplying the quantity of modules in a row by the module's width. Add to this ¼ inch space between each module and 1.5 inches to each end for the total length of rail required for that row.

### XR Rails

Part Number	Description	Weight	Packaging
XR-1000-132A	XR1000, Rail 132" (11 Feet), Clear	11.24 Lbs	Sub-bundles of 4; Bundles of 80
XR-1000-168A	XR1000, Rail 168" (14 Feet), Clear	14.30 Lbs	Sub-bundles of 4; Bundles of 80
XR-1000-204A	XR1000, Rail 204" (17 Feet), Clear	17.36 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-132A	XR100, Rail 132" (11 Feet), Clear	7.69 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-132B	XR100, Rail 132" (11 Feet), Black	7.69 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-168A	XR100, Rail 168" (14 Feet), Clear	9.76 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-168B	XR100, Rail 168" (14 Feet), Black	9.76 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-204A	XR100, Rail 204" (17 Feet), Clear	11.88 Lbs	Sub-bundles of 4; Bundles of 80
XR-100-204B	XR100, Rail 204" (17 Feet), Black	11.88 Lbs	Sub-bundles of 4; Bundles of 80
XR-10-132A	XR10, Rail 132" (11 Feet), Clear	4.80 Lbs	Sub-bundles of 4; Bundles of 160
XR-10-168A	XR10, Rail 168" (14 Feet), Clear	6.11 Lbs	Sub-bundles of 4; Bundles of 160
XR-10-204A	XR10, Rail 204" (17 Feet), Clear	7.41 Lbs	Sub-bundles of 4; Bundles of 160

### Internal Splices

Part Number	Description	Weight	Packaging
XR-1000-SPLC	XR1000 Splice	0.55 Lbs	1 Splice/Kit; 20 Splices/Box
XR-100-SPLC	XR100 Splice	0.54 Lbs	1 Splice/Kit; 20 Splices/Box
XR-10-SPLC	XR10 Splice	0.53 Lbs	1 Splice/Kit; 20 Splices/Box

## Clamps

Module Clamp size depends on the module thickness. Use the table below to determine which Module Clamp will fit your projects module thickness.

Module Thickness		Clamp Info		Part Numbers			
Mm	Inches	Type	Bolt Height	End Clamp	Hex Mid Clamp	T-bolt Mid Clamp	Grounding Mid Clamp
31.0 - 32.5	1.22 - 1.28	I	2.00"	29-7000-125	29-7000-105	29-70TB-105	RS-GD-MCL-200
32.5 - 33.5	1.28 - 1.32	L	2.00"	29-7000-130	29-7000-105	29-70TB-105	RS-GD-MCL-200
33.3 - 34.8	1.31 - 1.37	A	2.00"	29-7000-134	29-7000-105	29-70TB-105	RS-GD-MCL-200
34.8 - 36.8	1.37 - 1.45	B	2.00"	29-7000-224	29-7000-105	29-70TB-105	RS-GD-MCL-225
39.0 - 41.0	1.53 - 1.61	C	2.25"	29-7000-157	29-7000-101	29-70TB-101	RS-GD-MCL-225
41.1 - 42.7	1.62 - 1.68	J	2.25"	29-7000-165	29-7000-101	29-70TB-101	RS-GD-MCL-250
42.7 - 44.2	1.68 - 1.74	E	2.25"	29-7000-171	29-7000-101	29-70TB-101	RS-GD-MCL-250
45.0 - 47.0	1.77 - 1.85	F	2.50"	29-7000-214	29-7000-108	29-70TB-108	RS-GD-MCL-250
46.7 - 48.3	1.84 - 1.90	K	2.50"	29-7000-187	29-7000-108	29-70TB-108	RS-GD-MCL-275
49.0 - 51.1	1.93 - 2.01	G	2.50"	29-7000-204	29-7000-108	29-70TB-108	RS-GD-MCL-275
57.4 - 58.9	2.26 - 2.32	H	2.75"	29-7000-230	29-7000-104	29-70TB-104	Unsupported





### End Clamps

Part Number	Description	Weight	Packaging
29-7000-125	Kit, 4pcs, End Clamp I, 1.25", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-130	Kit, 4pcs, End Clamp I, 1.30", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-134	Kit, 4pcs, End Clamp A, 1.34", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-224	Kit, 4pcs, End Clamp B, 1.41", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-157	Kit, 4pcs, End Clamp C, 1.57", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-165	Kit, 4pcs, End Clamp J, 1.65", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-171	Kit, 4pcs, End Clamp E, 1.71", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-214	Kit, 4pcs, End Clamp F, 1.81", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-187	Kit, 4pcs, End Clamp K, 1.87", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-204	Kit, 4pcs, End Clamp G, 1.97", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-230	Kit, 4pcs, End Clamp H, 2.30", Mill	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-125B	Kit, 4pcs, End Clamp I, 1.25" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-130B	Kit, 4pcs, End Clamp I, 1.30", Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-134B	Kit, 4pcs, End Clamp A, 1.34" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-224B	Kit, 4pcs, End Clamp B, 1.41" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-157B	Kit, 4pcs, End Clamp C, 1.57" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-165B	Kit, 4pcs, End Clamp J, 1.65" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-171B	Kit, 4pcs, End Clamp E, 1.71" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-214B	Kit, 4pcs, End Clamp F, 1.81" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-187B	Kit, 4pcs, End Clamp K, 1.87" Black	0.3 Lbs	Kits of 4; Boxes of 25
29-7000-204B	Kit, 4pcs, End Clamp G, 1.97" Black	0.3 Lbs	Kits of 4; Boxes of 25

### Mid Clamps

Part Number	Description	Weight	Packaging
29-7000-105	Kit, 4pcs, Mid Clamp A/B/I, 2.00", Mill (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-101	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Mill (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-108	Kit, 4pcs, Mid Clamp F/K/G, 2.50", Mill (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-104	Kit, 4pcs, Mid Clamp H 2.75", Mill (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-105	Kit, 4pcs, Mid Clamp A/B/I, 2.00", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-101	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-108	Kit, 4pcs, Mid Clamp F/K/G, 2.50", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-104	Kit, 4pcs, Mid Clamp H, 2.75", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-105B	Kit, 4pcs, Mid Clamp A/B/I, 2.0", Black (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-101B	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Black (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-108B	Kit, 4pcs, Mid Clamp F/K/G, 2.5", Black (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-7000-104B	Kit, 4pcs, Mid Clamp H, 2.75", Black (Hex)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-105B	Kit, 4pcs, Mid Clamp A/B/I, 2.00", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-101B	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-108B	Kit, 4pcs, Mid Clamp F/K/G, 2.50", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
29-70TB-104B	Kit, 4pcs, Mid Clamp H, 2.75", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50



**Grounding Mid Clamps**

Part Number	Description	Weight	Packaging
RS-GD-MCL-200	Kit, 4pcs, Mid Clamp A/B/I, 2.00", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-225	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-250	Kit, 4pcs, Mid Clamp F/K/G, 2.50", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-275	Kit, 4pcs, Mid Clamp H 2.75", Mill (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-200B	Kit, 4pcs, Mid Clamp A/B/I, 2.00", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-225B	Kit, 4pcs, Mid Clamp C/D/J/E, 2.25", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-250B	Kit, 4pcs, Mid Clamp F/K/G, 2.50", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50
RS-GD-MCL-275B	Kit, 4pcs, Mid Clamp H, 2.75", Black (T-bolt)	0.3 Lbs	Kits of 4; Boxes of 50

**Under Clamps**

Part Number	Description	Weight	Packaging
29-7000-117	Kit, 4pcs, Under Clamp	0.4 Lbs	Kits of 4; Boxes of 25

**Attachments**
**Slotted L-Feet**

Part Number	Description	Weight	Packaging
RS-LFT-001	4-pack, Slotted L-Foot, Mill	1.14 Lbs	4 L-feet/Pack; 25 Kits/Box
RS-LFT-001B	4-pack, Slotted L-Foot, Black	1.14 Lbs	4 L-feet/Pack; 25 Kits/Box

**FlashFoot™**

Part Number	Description	Weight	Packaging
RF-FLSH-001	Kit, 6-pack, IronRidge FlashFoot (Mill) (L-foot Included)	8.1 Lbs	6 Flashings/Box
RF-FLSH-001B	Kit, 6-pack, IronRidge FlashFoot (Black) (L-foot Included)	8.1 Lbs	6 Flashings/Box

**Flush Mount Standoffs**

Part Number	Description	Weight	Packaging
51-6003-500L	Kit, 3" Standoff, Flush Mount, Mill	0.51 Lbs	20 Standoffs / Box
51-6004-500L	Kit, 4" Standoff, Flush Mount, Mill	0.56 Lbs	20 Standoffs / Box
51-6006-500L	Kit, 6" Standoff, Flush Mount, Mill	0.75 Lbs	20 Standoffs / Box
51-6007-500L	Kit, 7" Standoff, Flush Mount, Mill	0.84 Lbs	20 Standoffs / Box

**Tilt Mount Standoffs**

Part Number	Description	Weight	Packaging
RF-TLT-SO-375	Kit, Quick Mount PV, Low Slope Mount 3.75"	1.34 Lbs	12 Standoffs / Box
RF-TLT-SO-700	Kit, Quick Mount PV, Low Slope Mount 7.00"	1.63 Lbs	12 Standoffs / Box
RF-TLT-SO-900	Kit, Quick Mount PV, Low Slope Mount 9.00"	2.10 Lbs	12 Standoffs / Box



### Adjustable Tilt Legs

Part Number	Description	Weight	Packaging
51-7516-016H	Adjustable Tilt Leg, 16 inches (18-22")	4.29 Lbs	12 Adjustable Tilt Legs/Box
51-7528-028H	Adjustable Tilt Leg, 28 inches (30-46")	6.34 Lbs	12 Adjustable Tilt Legs/Box
51-7556-056H	Adjustable Tilt Leg, 56 inches (58-94")	10.39 Lbs	12 Adjustable Tilt Legs/Box

### Fixed Tilt Legs

Part Number	Description	Weight	Packaging
51-7210-010	Tilt Leg Kit, 10", Mill	1.87 Lbs	20 Fixed Tilt Legs/Box
51-7215-015	Tilt Leg Kit, 15", Mill	2.20 Lbs	20 Fixed Tilt Legs/Box
51-7220-020	Tilt Leg Kit, 20", Mill	2.56 Lbs	20 Fixed Tilt Legs/Box
51-7225-025	Tilt Leg Kit, 25", Mill	2.85 Lbs	20 Fixed Tilt Legs/Box
51-7230-030	Tilt Leg Kit, 30", Mill	3.20 Lbs	20 Fixed Tilt Legs/Box
51-7240-040	Tilt Leg Kit, 40", Mill	3.85 Lbs	20 Fixed Tilt Legs/Box

### Accessories

Part Number	Description	Weight	Packaging
XR-1000-CAP	XR1000 End Cap (Polybag, 20)	7 Lbs/Box	20 End Caps/ Bag; 500 Caps / Box
XR-100-CAP	XR100 End Cap (Polybag, 20)	5 Lbs/Box	20 End Caps/ Bag; 500 Caps / Box
XR-10-CAP	XR10 End Cap (Polybag, 20)	4 Lbs/Box	20 End Caps/ Bag; 500 Caps / Box
29-4000-077	Wire Clip (Polybag, 20)	6.70 Lbs/Box	20 Clips / Bag; 500 Clips / Box
29-5003-005	Kit, ¼ x ¾ Microinverter Mounting	10.30 Lbs/Box	150 Kits / Box
29-50TB-005	Kit, ¼ x ¾ Microinverter Mounting, T-Bolt	10.30 Lbs/Box	150 Kits / Box

### Grounding

Part Number	Description	Weight	Packaging
RS-GDST-001	Grounding Strap	2.7 Lbs/Box	50 Kits / Box
RS-GDXP-001	Grounding Strap Expansion Joint	2.0 Lbs/Box	25 Kits / Box
RS-GDLG-001	Grounding Lug (XR1000 Compatible Only)	7.7 Lbs/Box	50 Kits / Box
RS-GDLG-002	Grounding Lug (T-Bolt)	7.9 Lbs/Box	50 Kits / Box
29-4000-001	WEEB DMC Compression Clip	.50 Lbs/Box	100 Clips / Box
29-4000-002	WEEB Grounding Lug	12.45 Lbs/Box	100 Lugs / Box
29-4000-003	WEEB Bonding Jumper	17.55 Lbs/Box	100 Jumpers / Box



## System Support

IronRidge provides a complete system of technical support including installation guides, pre-stamped certification letters for most PV-friendly states, our online Design Assistant software, and live, knowledgeable person-to-person customer service.

## Downloadable Support Documents

Our website at [www.ironridge.com/products/roofmounting/systemsupport](http://www.ironridge.com/products/roofmounting/systemsupport) contains all of the technical support information necessary to design, quote, certify, and install an IronRidge Roof Mount system. The specific documents that can be found here include:

- CAD files (AutoCAD format)
- Engineering Design Guide
- Pre-stamped Certification Letters
- Installation Guides
- Parts Catalog

## 3rd Party Partners

We've engineered best-of-class 3rd party solutions with our Roof Mount platform to further improve the quality we offer customers. Where appropriate, pre-stamped certification letters are included to simplify and expedite the design, quoting, and permitting processes. At this time, we work with roofing products from the following companies:

- Ecofasten
- Enphase
- Quick Mount PV
- SSI
- Wiley

## Design Assistant

The IronRidge Design Assistant automates much of the Design and Engineering phases of a project. Easily accessible from our website, the Design Assistant provides a highly intuitive layout interface, automatically calculates critical engineering information based on your project's specific load conditions, provides the ability to add optional components and 3rd party products, and determines an accurate bill of materials and quotations.

The Roof Mount Design Assistant can be accessed at: [www.ironridge.com/rm](http://www.ironridge.com/rm)



## Warranty Information

Effective for IronRidge, Inc. ("IronRidge") mounting structure components ("Products") manufactured after April 1st, 2012, IronRidge provides the following warranties, for Products installed properly and used for the purpose for which the Products are designed:

- finishes shall be free of visible defects, peeling, or cracking, under normal atmospheric conditions, for a period of three (3) years from the earlier of (i) the date of complete installation of the Product or (ii) thirty days after the original purchaser's date of purchase of the Product ("Finish Warranty");
- components shall be free of structurally-related defects in materials for a period of ten (10) years from the earlier of (i) the date of complete installation of the Product or (ii) thirty days after the original purchaser's date of purchase of the Product;
- components shall be free of functionally-related manufacturing defects for a period of twenty (20) years from date of manufacture.

The Finish Warranty does not apply to: (a) surface oxidation of the galvanized steel components or any foreign residue deposited on Product finish; and (b) Products installed in corrosive atmospheric conditions, as defined solely by IronRidge; corrosive atmospheric conditions include, but are not limited to, conditions where Product is exposed to corrosive chemicals, fumes, cement dust, salt water marine environments or to continual spraying of either salt or fresh water. The Finish Warranty is VOID if (c) the practices specified by AAMA 609 & 610-02 – "Cleaning and Maintenance for Architecturally Finished Aluminum" ([www.aamanet.org](http://www.aamanet.org)) are not followed by Purchaser for IronRidge's aluminum based components; and (d) if the practices specified by ASTM A780 / A780M - 09 "Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings" are not followed by Purchaser for IronRidge's galvanized steel-based components.

The warranties above do not cover any parts or materials not manufactured by IronRidge, and exclude non-functionally-related defects, as defined solely by IronRidge. The warranties do not cover any defect that has not been reported to IronRidge in writing within twenty (20) days after discovery of such defect.

In the event of breach of or non-compliance with the warranties set forth above, IronRidge's sole obligation and liability, and the sole and exclusive remedy for such breach or non-compliance, shall be correction of defects by repair, replacement, or credit, at IronRidge's sole discretion. Such repair, replacement or credit shall completely satisfy and discharge all of IronRidge's liability with respect to these warranties.

Refurbished Product may be used to repair or replace the defective components. Transportation, installation, labor, or any other costs associated with Product replacement are not covered by these warranties and are not reimbursable. These warranties additionally do not cover (a) normal wear, or damage resulting from misuse, overloading, abuse, improper installation (including failure to follow professional instruction and certification), negligence, or accident, or from force majeure acts including any natural disasters, war or criminal acts; and (b) Products that have been altered, modified or repaired without written authorization from IronRidge or its authorized representative; and (c) Products used in a manner or for a purpose other than that specified by IronRidge. A formal document proving the purchase and the purchase date of the Product is required with any warranty claim.

Except as set forth above, IronRidge sells the Products on an "AS IS" basis, which may not be free of errors or defects, and ALL EXPRESS OR IMPLIED REPRESENTATIONS AND WARRANTIES, INCLUDING ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, QUALITY, WORKMANLIKE EFFORT, CORRESPONDENCE TO DESCRIPTION, DESIGN, TITLE OR NON-INFRINGEMENT, OR ARISING FROM COURSE OF DEALING, COURSE OF PERFORMANCE OR TRADE PRACTICE, ARE HEREBY DISCLAIMED.



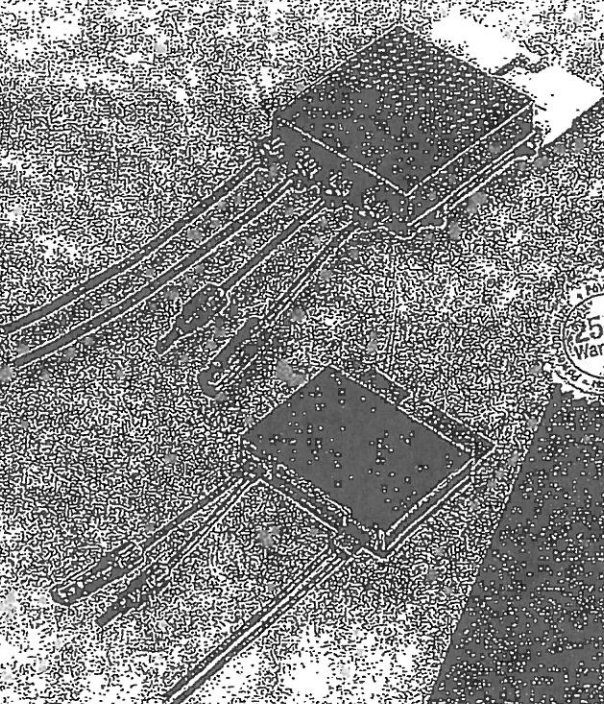
# solar**edge**

## SolarEdge Power Optimizer

Module Add-On

P300 / P350 / P405 / P500

POWER OPTIMIZER



### PV power optimization at the module-level

- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of modules mismatch-loss, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module level monitoring
- Module-level voltage shutdown for installer and firefighter safety

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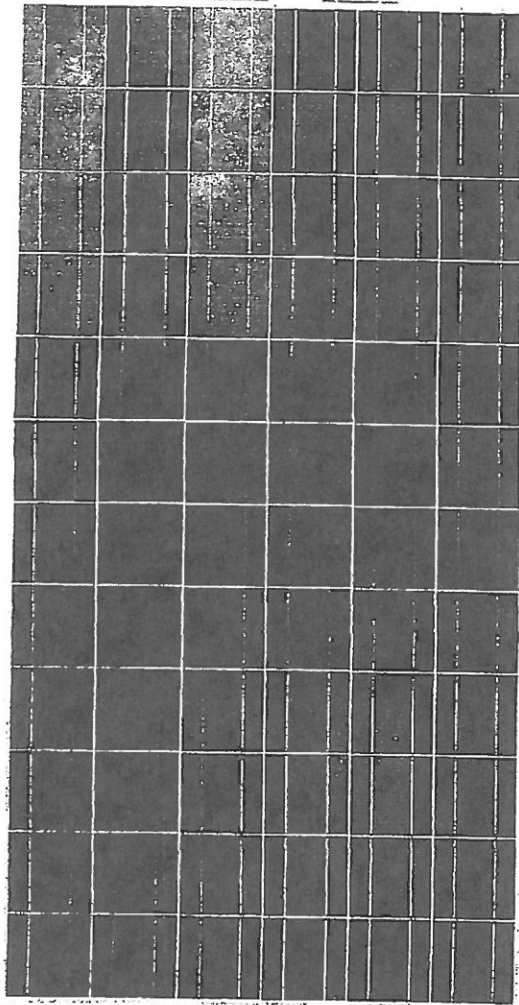


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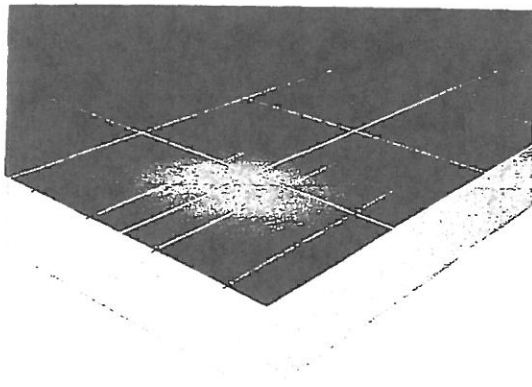
YINGLI SOLAR

OFFICIAL SPONSOR



Yingli Green Energy Holding Company Limited (NYSE: YGE) is one of the world's largest fully vertically integrated PV manufacturers, which markets its products under the brand "Yingli Solar". With over 4.5GW of modules installed globally, we are a leading solar energy company built upon proven product reliability and sustainable performance. We are the first renewable energy company and the first Chinese company to sponsor the FIFA World Cup™.

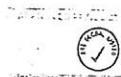
- High efficiency, multicrystalline silicon solar cells with high transmission and textured glass deliver a module efficiency of up to 16.2%, minimizing installation costs and maximizing the kWh output of your system per unit area.
- Tight positive power tolerance of 0W to +5W ensures you receive modules at or above nameplate power and contributes to minimizing module mismatch losses leading to improved system yield.
- Top ranking in the "TÜV Rheinland Energy Yield Test" and the "PHOTON Test" demonstrates high performance and annual energy production.
- Tests by independent laboratories prove that Yingli Solar modules:
  - ✓ Fully conform to certification and regulatory standards.
  - ✓ Withstand wind loads of up to 2.4kPa and snow loads of up to 5.4kPa, confirming mechanical stability.
  - ✓ Successfully endure ammonia and salt-mist exposure at the highest severity level, ensuring their performance in adverse conditions.
- Manufacturing facility certified by TÜV Rheinland to ISO 9001:2008, ISO 14001:2004 and BS OHSAS 18001:2007.



- 10-year limited product warranty<sup>1</sup>.
- Limited power warranty<sup>1</sup>: 10 years at 91.2% of the minimal rated power output, 25 years at 80.7% of the minimal rated power output.

<sup>1</sup>In compliance with our Warranty Terms and Conditions.

IEC 61215, IEC 61730, MCS, CE, ISO 9001:2008, ISO 14001:2004, BS OHSAS 18001:2007, SA 8000, PV Cycle



PV CYCLE

YINGLISOLAR.COM

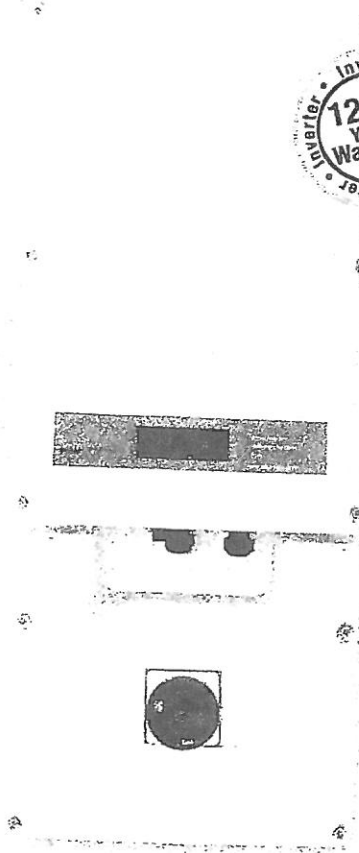




## SolarEdge Single Phase Inverters

### For North America

SE3000A-US / SE3800A-US / SE5000A-US / SE6000A-US /  
SE7600A-US / SE10000A-US / SE11400A-US



INVERTERS

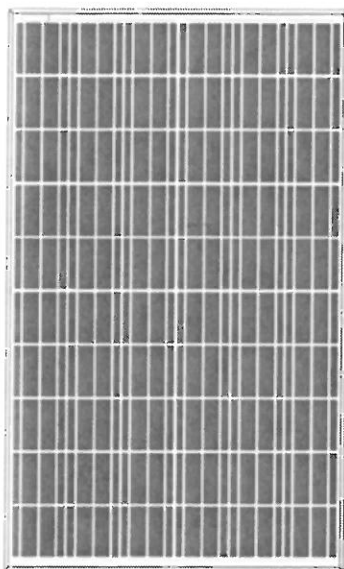
### The best choice for SolarEdge enabled systems

- ✓ Integrated arc fault protection (Type 1) for NEC 2011 690.11 compliance
- ✓ Superior efficiency (98%)
- ✓ Small, lightweight and easy to install on provided bracket
- ✓ Built-in module-level monitoring
- ✓ Internet connection through Ethernet or Wireless
- ✓ Outdoor and indoor installation
- ✓ Fixed voltage inverter, DC/AC conversion only
- ✓ Pre-assembled Safety Switch for faster installation
- ✓ Optional – revenue grade data, ANSI C12.1

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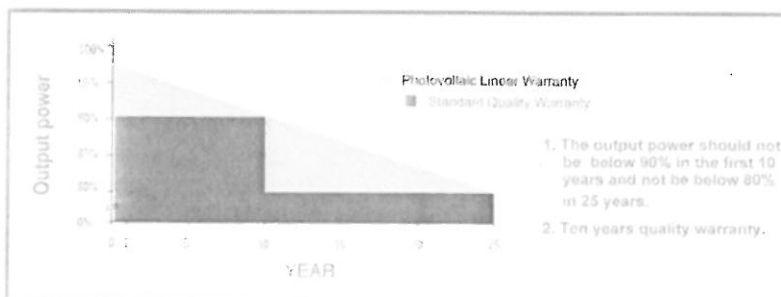
[www.solaredge.us](http://www.solaredge.us)

## BVM6610P



### Key Features

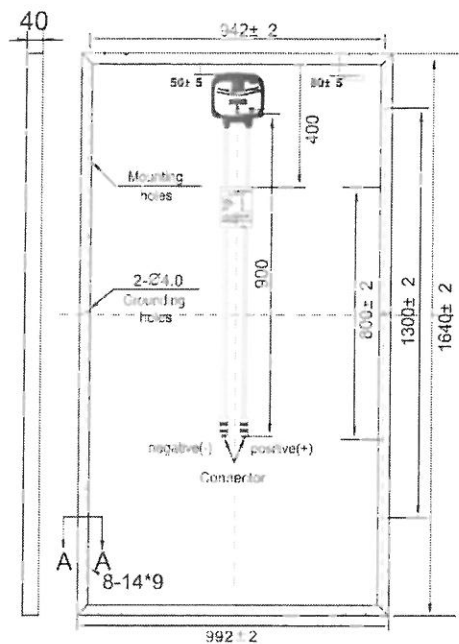
1. Guaranteed positive tolerance  $0/+5w$  ensures power output reliability.
2. Strong aluminum frame module can bear snow loads up to 5400Pa and wind loads up to 2400Pa.
3. Excellent performance under low light environments (mornings, evenings and cloudy days).
4. 10 years for product defects in materials and workmanship and 25 years for 80% of warranted minimum power.
5. Certifications and standards, IEC61215, IEC61730, conformity to CE.
6. Manufactured according to International Quality and Environment Management System (ISO9001, ISO14001).



### Electrical Characteristics

Type	BVM6610P-245	BVM6610P-250	BVM6610P-255	BVM6610P-260
Max-Power Pmax(W)	245	250	255	260
Max-Power current Imp (A)	8.20	8.31	8.39	8.42
Max-Power voltage Vmp(V)	29.9	30.1	30.5	30.7
Short-circuit current Isc (A)	8.74	8.85	8.95	9.01
Open-circuit voltage Voc(V)	37.1	37.5	37.8	38.0
Maximum load rating(Pa )	5400			
Max-system voltage(V)	1000V(TUV)			
Max.Series Fuse(A)	15			
Pmax temperature coefficient	-0.45%/°C			
Voc temperature coefficient	-0.35%/°C			
Isc temperature coefficient	-0.04%/°C			
Nominal Operating Cell Temperature ( NOCT)	45±2°C			
Class AAA solar simulator (IEC60904-4),power measurement uncertainty is within±3%				
Data under standard testing conditions(stc):1000W/m², AM1.5,25°C				





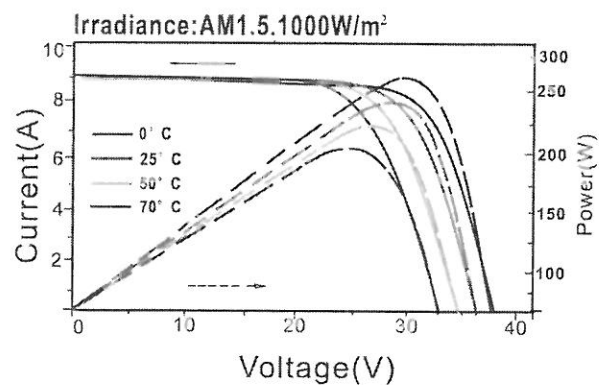
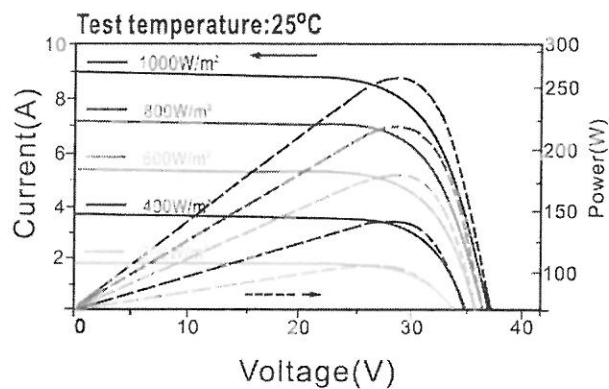
## Packing Information

Packing Configuration	26pcs/carton
Quantity/Pallet	52pcs/pallet
Loading Capacity	728pcs/40ft

## Maximum Ratings

Dielectric Insulation Voltage	3000V
Operating Temperature(°C)	-40~+85
Storage Temperature (°C)	-30~+50

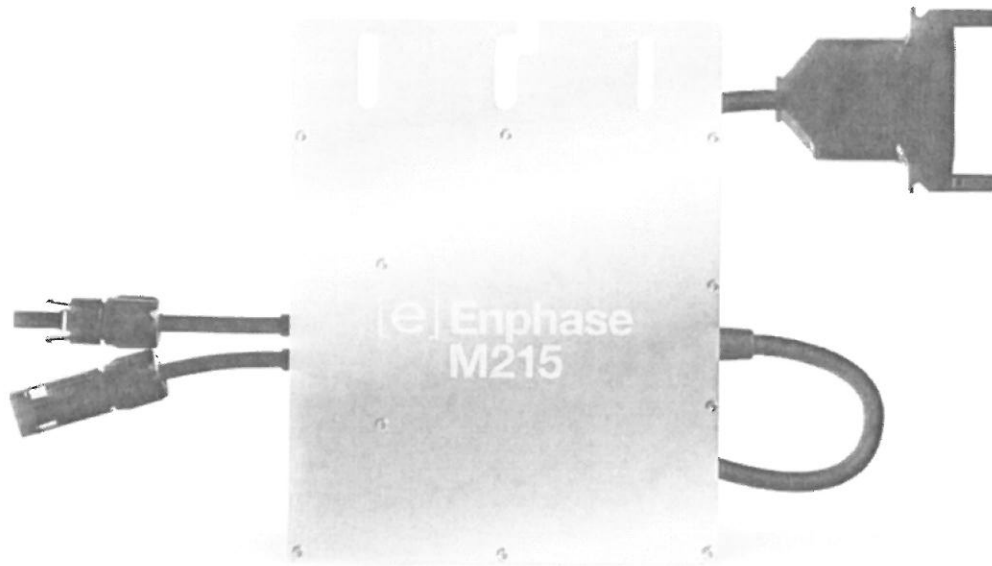
## I-V Curves at different Irradiances



## Mechanical Characteristics

Output Cable	4mm, TUV certified, 900mm
Type of Connector	Compatible with MC4 plug
Cell Configuration	60pcs, Poly-Crystalline Silicon (6X10)
Cell Size (mm)	156X156
Dimension (mm)	1640X992X40
Weight (kg)	18.5
Draining Hole Number	10
Glass	High Transparency, Low Iron, Tempered Glass 3.2mm

# Enphase® M215



The **Enphase® M215 Microinverter** with integrated ground delivers increased energy harvest and reduces design and installation complexity with its all-AC approach. With the advanced M215, the DC circuit is isolated and insulated from ground, so **no Ground Electrode Conductor (GEC) is required for the microinverter**. This further simplifies installation, enhances safety, and saves on labor and materials costs.

The Enphase M215 integrates seamlessly with the Engage® Cable, the Envoy® Communications Gateway™, and Enlighten®, Enphase's monitoring and analysis software.

## PRODUCTIVE

- Maximizes energy production
- Minimizes impact of shading, dust, and debris
- No single point of system failure

## SIMPLE

- No GEC needed for microinverter
- No DC design or string calculation required
- Easy installation with Engage Cable

## RELIABLE

- More than 1 million hours of testing and millions of units shipped
- Industry-leading warranty, up to 25 years



# Enphase® M215 Microinverter // DATA

INPUT DATA (DC)	M215-60-2LL-S22-IG, M215-60-2LL-S25-IG	
Recommended input power (STC)	190 - 270 W	
Maximum input DC voltage	48 V	
Peak power tracking voltage	27 V - 39 V	
Operating range	16 V - 48 V	
Min/Max start voltage	22 V / 48 V	
Max DC short circuit current	15 A	
OUTPUT DATA (AC)	@208 VAC	@240 VAC
Peak output power	225 W	225 W
Rated (continuous) output power	215 W	215 W
Nominal output current	1.03 A (A rms at nominal duration)	0.9 A (A rms at nominal duration)
Nominal voltage/range	208 V / 183-229 V	240 V / 211-264 V
Nominal frequency/range	60.0 / 57-61 Hz	60.0 / 57-61 Hz
Extended frequency range*	57-62.5 Hz	57-62.5 Hz
Power factor	>0.95	>0.95
Maximum units per 20 A branch circuit	25 (three phase)	17 (single phase)
Maximum output fault current	850 mA rms for 6 cycles	850 mA rms for 6 cycles
EFFICIENCY		
CEC weighted efficiency, 240 VAC	96.5%	
CEC weighted efficiency, 208 VAC	96.5%	
Peak inverter efficiency	96.5%	
Static MPPT efficiency (weighted, reference EN50530)	99.4 %	
Night time power consumption	65 mW max	
MECHANICAL DATA		
Ambient temperature range	-40°C to +65°C	
Dimensions (WxHxD)	171 mm x 173 mm x 30 mm (without mounting bracket)	
Weight	1.6 kg (3.4 lbs)	
Cooling	Natural convection - No fans	
Enclosure environmental rating	Outdoor - NEMA 6	
Connector type	M215-60-2LL-S22-IG: MC4 M215-60-2LL-S25-IG: Amphenol H4	
FEATURES		
Compatibility	Compatible with 60-cell PV modules.	
Communication	Power line	
Integrated ground	The DC circuit meets the requirements for ungrounded PV arrays in NEC 690.35. Equipment ground is provided in the Engage Cable. No additional GEC or ground is required. Ground fault protection (GFP) is integrated into the microinverter.	
Monitoring	Enlighten Manager and MyEnlighten monitoring options	
Compliance	UL1741/IEEE1547, FCC Part 15 Class B, CAN/CSA-C22.2 NO. 0-M91, 0.4-04, and 107.1-01	

\* Frequency ranges can be extended beyond nominal if required by the utility

To learn more about Enphase Microinverter technology,  
visit [enphase.com](http://enphase.com)

