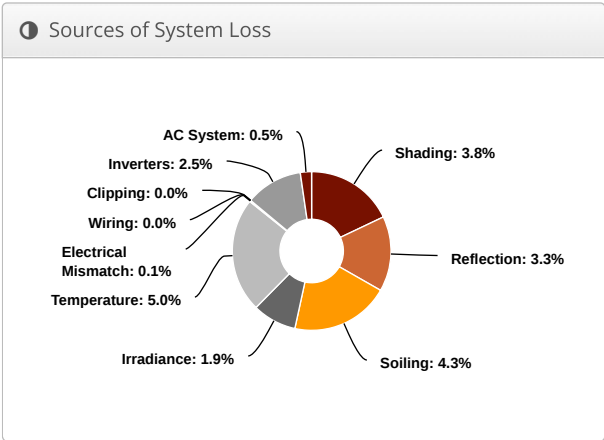
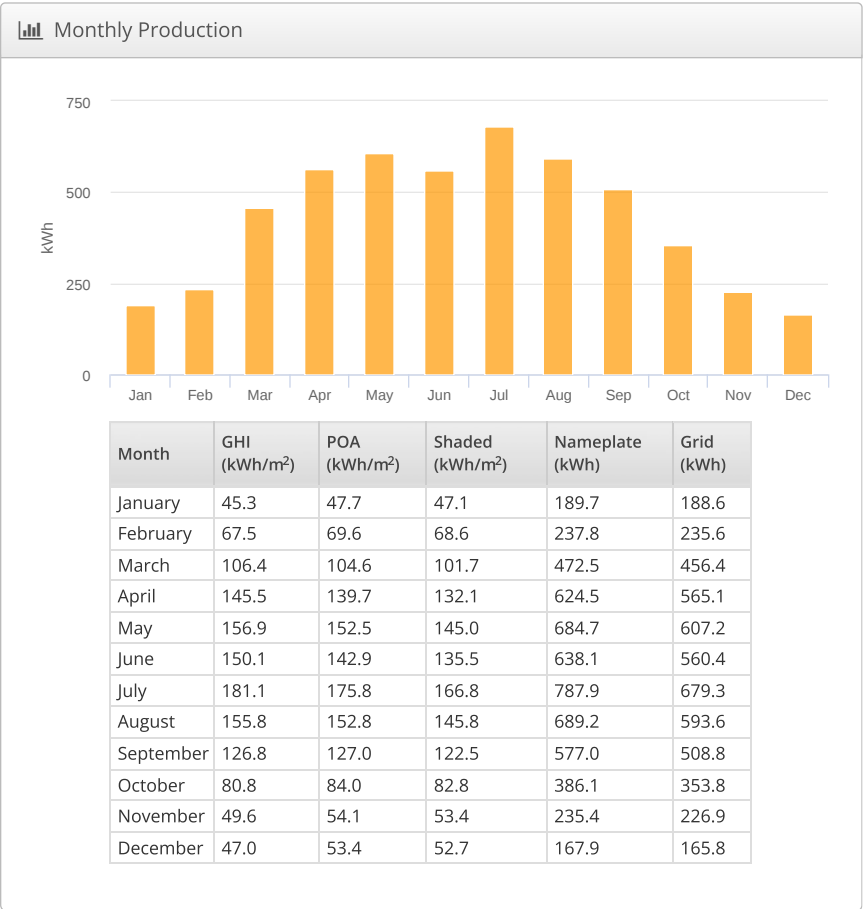


Design 1 Zotto, 43 Monument Ave. Bennington, VT

Report	
Project Name	Zotto
Project Address	43 Monument Ave. Bennington, VT
Prepared By	David Green tech@power-guru.com

System Metrics	
Design	Design 1
Module DC Nameplate	4.90 kW
Inverter AC Nameplate	4.41 kW Load Ratio: 1.11
Annual Production	5.142 MWh
Performance Ratio	80.5%
kWh/kWp	1,049.3
Weather Dataset	TMY, 10km Grid (42.85,-73.25), NREL (prospector)
Simulator Version	7e4677c281-9ba65ba0f7-d7a3048c80-53548c76f9

Project Location



System Cost	\$15,778.00
ITC Tax Credit (30%)	\$4,733.40
Net Cost*	\$11,044.60
Annual Saving Yr1	\$ 776.87
Net Present Value	\$34,952
IRR (Post Tax)	7.2%
Breakeven Point (Yrs)	12.0

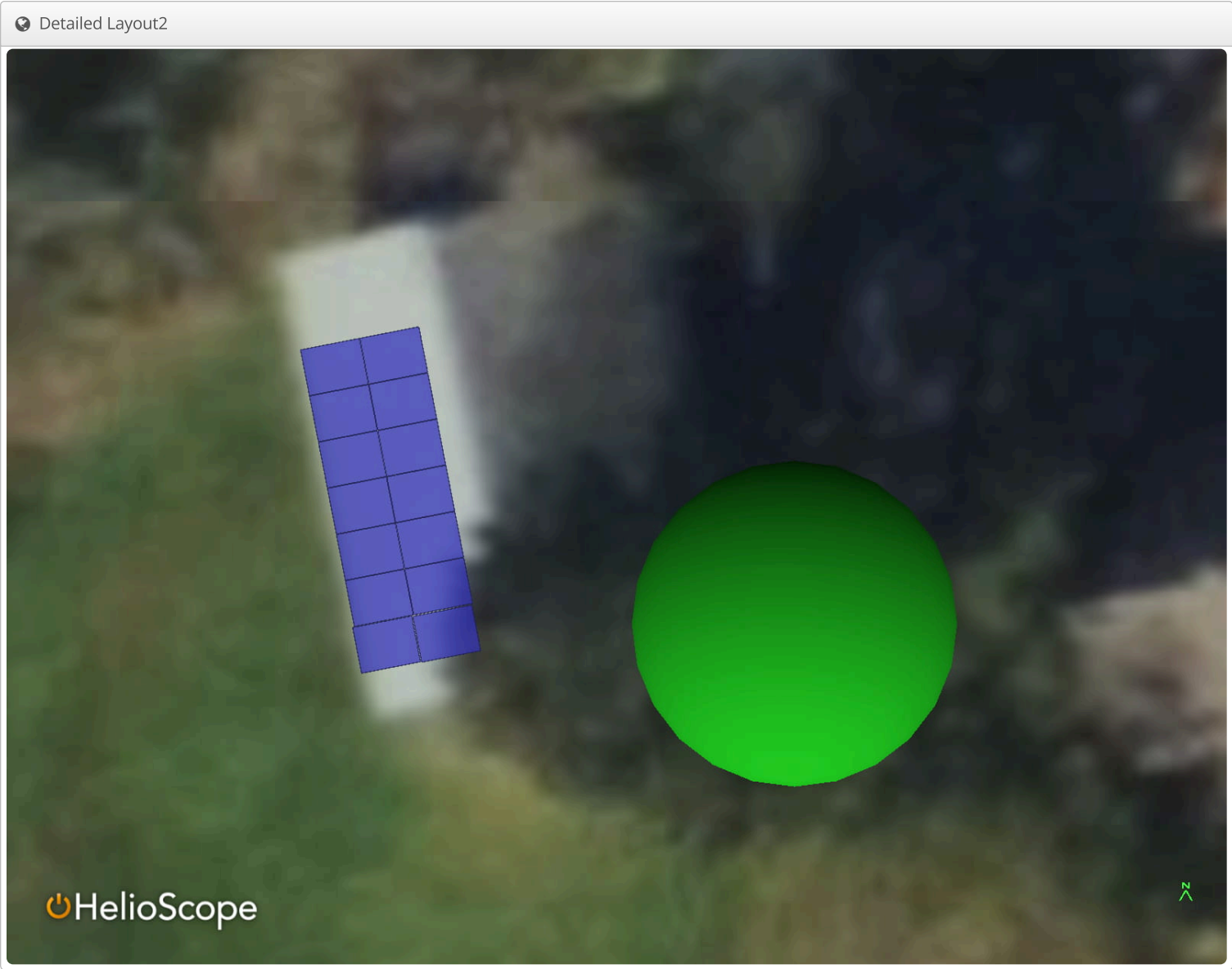
⚡ Annual Production			
	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,312.9	
	POA Irradiance	1,304.0	-0.7%
	Shaded Irradiance	1,253.9	-3.8%
	Irradiance after Reflection	1,212.9	-3.3%
	Irradiance after Soiling	1,160.6	-4.3%
	Total Collector Irradiance	1,160.7	0.0%
Energy (kWh)	Nameplate	5,690.8	
	Output at Irradiance Levels	5,581.5	-1.9%
	Output at Cell Temperature Derate	5,302.4	-5.0%
	Output after Electrical Mismatch	5,299.4	-0.1%
	Optimal DC Output	5,299.4	0.0%
	Constrained DC Output	5,299.3	0.0%
	Inverter Output	5,166.9	-2.5%
	Energy to Grid	5,141.5	-0.5%
Temperature Metrics			
Avg. Operating Ambient Temp		9.5 °C	
Avg. Operating Cell Temp		21.6 °C	
Simulation Metrics			
Operating Hours		4689	
Solved Hours		4689	

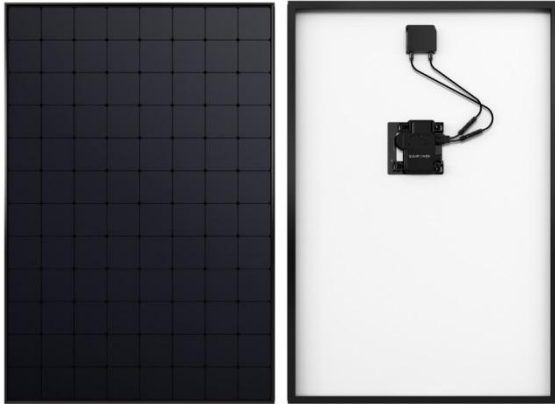
☁ Condition Set												
Description	Condition Set 1											
Weather Dataset	TMY, 10km Grid (42.85,-73.25), NREL (prospector)											
Solar Angle Location	Meteo Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Sandia Model											
Temperature Model Parameters	Rack Type			a		b			Temperature Delta			
	Fixed Tilt			-3.56		-0.075			3°C			
	Flush Mount			-2.81		-0.0455			0°C			
	East-West			-3.56		-0.075			3°C			
	Carport			-3.56		-0.075			3°C			
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	D
	13	26	2	1	1	1	1	1	1	1	6	31
Irradiation Variance	5%											
Cell Temperature Spread	4° C											
Module Binning Range	-2.5% to 2.5%											
AC System Derate	0.50%											
Module & Component Characterizations	Type	Component					Characterization					
	Module	SPR X21-350-BLK (SunPower)					Sunpower_SPR_X21_350_BLK.pan, PAN					
	Inverter	IQ7X-96-2-US (240V) (2022) (Enphase)					Spec Sheet					

Components		
Component	Name	Count
Inverters	IQ7X-96-2-US (240V) (2022) (Enphase)	14 (4.41 kW)
AC Panels	1 input AC Panel	1
AC Home Runs	500 MCM (Copper)	1 (440.2 ft)
AC Branches	10 AWG (Copper)	1 (26.1 ft)
Module	SunPower, SPR X21-350-BLK (350W)	14 (4.90 kW)

Wiring Zones									
Description		Combiner Poles		String Size		Stringing Strategy			
Wiring Zone		-		1-1		Along Racking			

Field Segments									
Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Portrait (Vertical)	30°	258.98108°	0.0 ft	1x1	14	14	4.90 kW





X-Series: X21-350-BLK | X21-335-BLK | X20-327-BLK

SunPower® Residential AC Module

Built specifically for use with the SunPower Equinox™ system, the only fully integrated solution designed, engineered and warranted by one manufacturer.



Maximum Power. Minimalist Design.

Industry-leading efficiency means more power and savings per available space. With fewer modules required and hidden microinverters, less is truly more.



Highest Lifetime Energy and Savings.

Designed to deliver 60% more energy over 25 years in real-world conditions like partial shade and high temperatures.¹

Fundamentally Different. And Better.



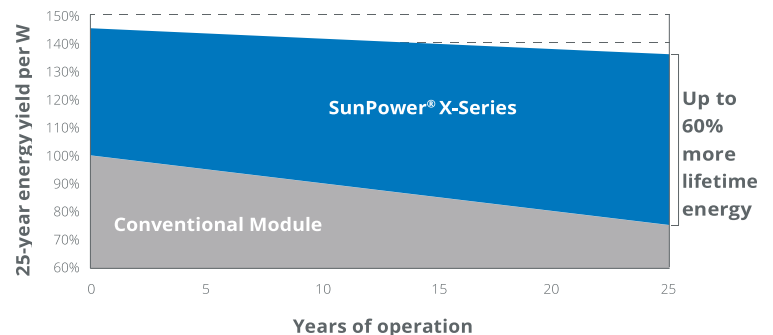
The SunPower® Moxeon® Solar Cell

- Enables highest-efficiency modules available.²
- Unmatched reliability³
- Patented solid metal foundation prevents breakage and corrosion



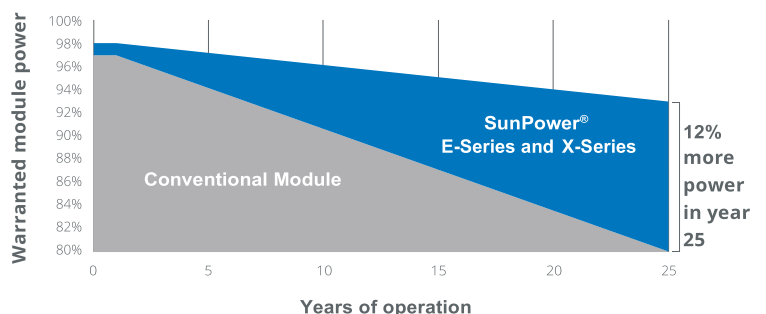
Factory-integrated Microinverter

- Simpler, faster installation
- Integrated wire management, rapid shutdown
- Engineered and calibrated by SunPower for SunPower modules



Best Reliability. Best Warranty.

With more than 25 million modules deployed around the world, SunPower technology is proven to last. That's why we stand behind our module and microinverter with the industry's best 25-year Combined Power and Product Warranty, including the highest Power Warranty in solar.



AC Electrical Data	
Inverter Model: Type E (IQ 7XS)	@240 VAC
Peak Output Power	320 VA
Max. Continuous Output Power	315 VA
Nom. (L-L) Voltage/Range ² (V)	240 / 211–264
Max. Continuous Output Current (A)	1.31
Max. Units per 20 A (LL) Branch Circuit ³	12 (single phase)
CEC Weighted Efficiency	97.5%
Nom. Frequency	60 Hz
Extended Frequency Range	47–68 Hz
AC Short Circuit Fault Current Over 3 Cycles	5.8 A rms
Overvoltage Class AC Port	III
AC Port Backfeed Current	18 mA
Power Factor Setting	1.0
Power Factor (adjustable)	0.7 lead. / 0.7 lag.
No active phase balancing for three-phase installations	

DC Power Data			
	X21-350-BLK-E-AC	X21-335-BLK-E-AC	X20-327-BLK-E-AC
Nom. Power ⁵ (P _{nom})	350 W	335 W	327 W
Power Tol.	+5/–0%	+5/–0%	+5/–0%
Module Efficiency	21.5%	21.0%	20.4%
Temp. Coef. (Power)	–0.29%/°C	–0.29%/°C	–0.29%/°C
Shade Tol.	• Three bypass diodes • Integrated module-level maximum power point tracking		

Tested Operating Conditions	
Operating Temp.	–40°F to +185°F (–40°C to +85°C)
Max. Ambient Temp.	122°F (50°C)
Max. Test Load ⁷	Wind: 154 psf, 7400 Pa, 754 kg/m ² back Snow: 208 psf, 10000 Pa, 1019 kg/m ² front
Design Load	Wind: 62 psf, 3000 Pa, 305 kg/m ² back Snow: 125 psf, 6000 Pa, 611 kg/m ² front
Impact Resistance	1 inch (25 mm) diameter hail at 52 mph (23 m/s)

Mechanical Data	
Solar Cells	96 Monocrystalline Maxeon Gen III
Front Glass	High-transmission tempered glass with anti-reflective coating
Environmental Rating	Outdoor rated
Frame	Class 1 black anodized (highest AAMA rating)
Weight	42.9 lbs (18.5 kg)
Recommended Max. Module Spacing	1.3 in. (33 mm)

1 SunPower 360 W compared to a conventional module on same-sized arrays (260 W, 16% efficient, approx. 1.6 m²), 4% more energy per watt (based on third-party module characterization and PVSIM), 0.75%/yr slower degradation (Campeau, Z. et al. "SunPower Module Degradation Rate," SunPower white paper, 2013).

2 Based on search of datasheet values from websites of top 10 manufacturers per IHS, as of January 2017.

3 #1 rank in "Fraunhofer PV Durability Initiative for Solar Modules: Part 3," PV Tech Power Magazine, 2015. Campeau, Z. et al. "SunPower Module Degradation Rate," SunPower white paper, 2013.

4 Factory set to 1547a-2014 default settings. CA Rule 21 default settings profile set during commissioning.

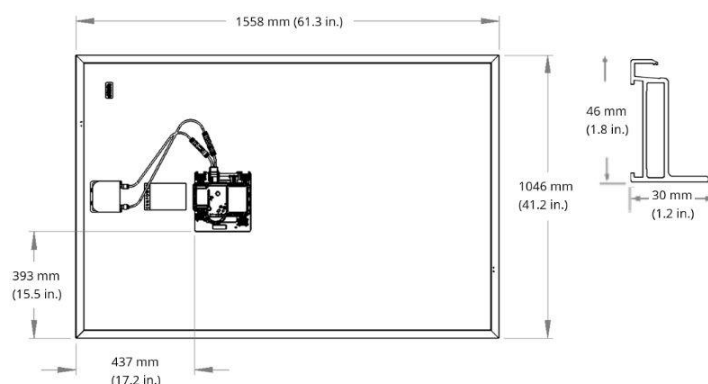
5 Standard Test Conditions (1000 W/m² irradiance, AM 1.5, 25°C). NREL calibration standard: SOMS current, LACCS FF and voltage. All DC voltage is fully contained within the module.

6 This product is UL Listed as PVRSE and conforms with NEC 2014 and NEC 2017 690.12; and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors; when installed according to manufacturer's instructions.

7 Please read the safety and installation instructions for more information regarding load ratings and mounting configurations.

See www.sunpower.com/facts for more reference information.
For more details, see extended datasheet www.sunpower.com/datasheets Specifications included in this datasheet are subject to change without notice.
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Warranties, Certifications, and Compliance	
Warranties	• 25-year limited power warranty • 25-year limited product warranty
Certifications and Compliance	• UL 1703 • UL 1741 / IEEE-1547 • UL 1741 AC Module (Type 2 fire rated) • UL 62109-1 / IEC 62109-2 • FCC Part 15 Class B • ICES-0003 Class B • CAN/CSA-C22.2 NO. 107.1-01 • CA Rule 21 (UL 1741 SA)⁴ (includes Volt/Var and Reactive Power Priority) • UL Listed PV Rapid Shutdown Equipment⁶ Enables installation in accordance with: • NEC 690.6 (AC module) • NEC 690.12 Rapid Shutdown (inside and outside the array) • NEC 690.15 AC Connectors, 690.33(A)–(E)(1) When used with InvisiMount racking and InvisiMount accessories (UL 2703): • Module grounding and bonding through InvisiMount • Class A fire rated When used with AC module Q Cables and accessories (UL 6703 and UL 2238)⁶: • Rated for load break disconnect
PID Test	Potential-induced degradation free



SUNPOWER®

Please read the Safety and Installation Instructions for details.

531946 RevC



SunPower® Residential AC Modules X-Series & M-Series

**Manufactured by
Maxeon Solar Technologies**

SPR-X21-350 | SPR-M410 | SPR-M420
SPR-M425 | SPR-M435 | SPR-M440

Product Features & Benefits

- Superior aesthetics
- High-efficiency
- Low degradation
- Sustainably made

Warranty Coverage



This solar panel is covered by a 40-year power, product and service warranty from Maxeon which overrides the 25-year SunPower warranty contained in the datasheet.¹

For AC-coupled systems, the built-in microinverter is covered by a 25-year product warranty from Enphase Energy.²

¹ In the United States, 40-year warranty terms require digital warranty registration and installation by an authorized Maxeon Partner. Please refer to our published warranty documents or contact sales@maxeon.com for more information.

² For questions about inverter warranty coverage, contact Enphase at spwrquery@enphaseenergy.com.

Enphase IQ 7X Microinverter

The high-powered smart grid-ready **Enphase IQ 7X Micro™** dramatically simplifies the installation process while achieving the highest system efficiency for systems with 96-cell modules.

Part of the Enphase IQ System, the IQ 7X Micro integrates with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

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



Easy to Install

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

Efficient and Reliable

- Optimized for high powered 96-cell* modules
- Highest CEC efficiency of 97.5%
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

Smart Grid Ready

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

* The IQ 7X is required to support 96-cell modules.



To learn more about Enphase offerings, visit enphase.com



Enphase IQ 7X Microinverter

INPUT DATA (DC)		IQ7X-96-2-US	
Commonly used module pairings ¹	320 W - 460 W +		
Module compatibility	96-cell PV modules		
Maximum input DC voltage	79.5 V		
Peak power tracking voltage	53 V - 64 V		
Operating range	25 V - 79.5 V		
Min/Max start voltage	33 V / 79.5 V		
Max DC short circuit current (module Isc)	10 A		
Overvoltage class DC port	II		
DC port backfeed current	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)		@ 240 VAC	@ 208 VAC
Peak output power	320 VA		
Maximum continuous output power	315 VA		
Nominal (L-L) voltage/range ²	240 V / 211-264 V		208 V / 183-229 V
Maximum continuous output current	1.31 A (240 VAC)		1.51 A (208 VAC)
Nominal frequency	60 Hz		
Extended frequency range	47 - 68 Hz		
AC short circuit fault current over 3 cycles	5.8 Arms		
Maximum units per 20 A (L-L) branch circuit ³	12 (240 VAC)		10 (208 VAC)
Overvoltage class AC port	III		
AC port backfeed current	18 mA		
Power factor setting	1.0		
Power factor (adjustable)	0.85 leading ... 0.85 lagging		
EFFICIENCY		@240 VAC	@208 VAC
CEC weighted efficiency	97.5 %		97.0 %
MECHANICAL DATA			
Ambient temperature range	-40°C to +60°C		
Relative humidity range	4% to 100% (condensing)		
Connector type (IQ7X-96-2-US)	MC4 (or Amphenol H4 UTX with optional Q-DCC-5 adapter)		
Dimensions (WxHxD)	212 mm x 175 mm x 30.2 mm (without bracket)		
Weight	1.08 kg (2.38 lbs)		
Cooling	Natural convection - No fans		
Approved for wet locations	Yes		
Pollution degree	PD3		
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure		
Environmental category / UV exposure rating	NEMA Type 6 / outdoor		
FEATURES			
Communication	Power Line Communication (PLC)		
Monitoring	Enlighten Manager and MyEnlighten monitoring options 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.

3. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

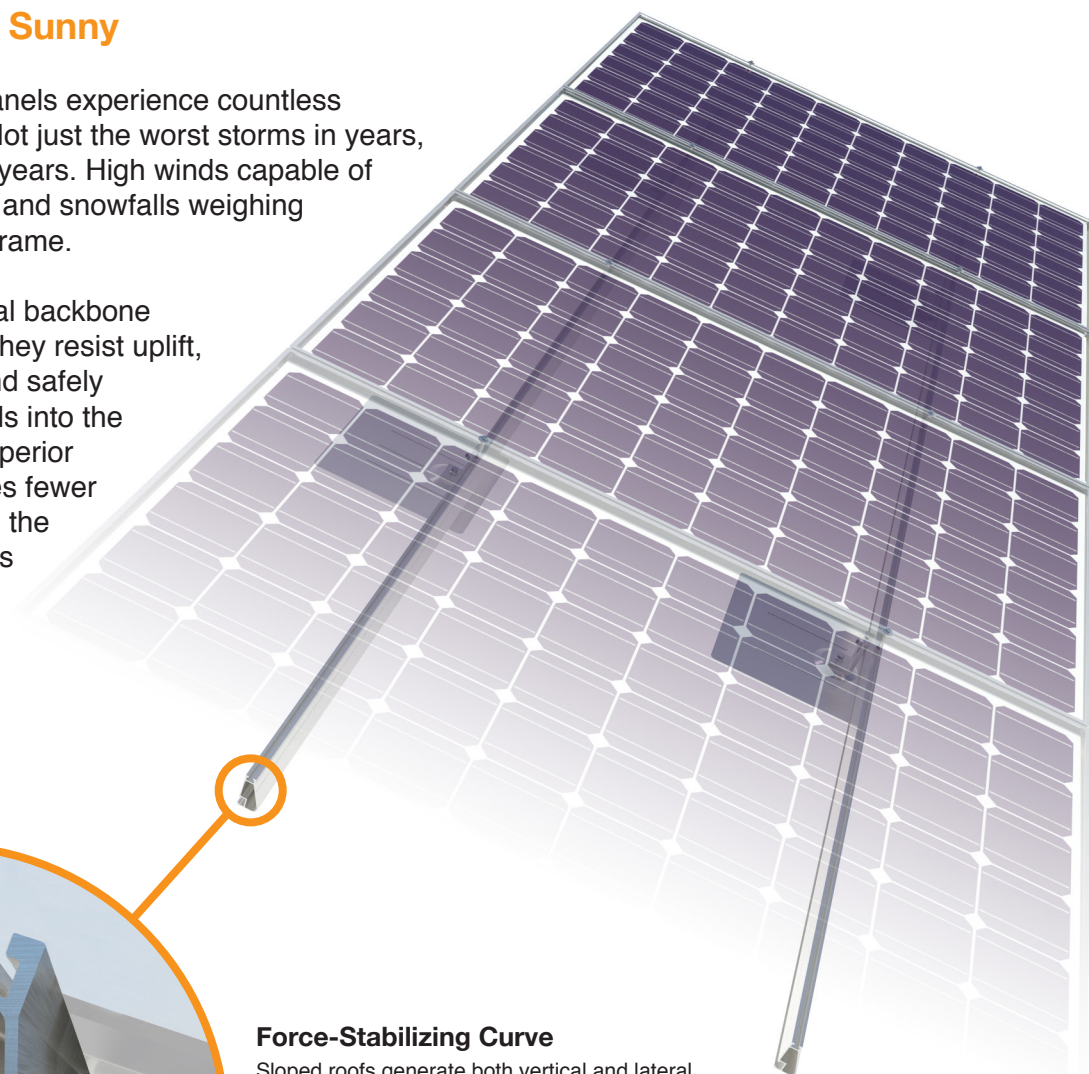
To learn more about Enphase offerings, visit enphase.com



Solar Is Not Always Sunny

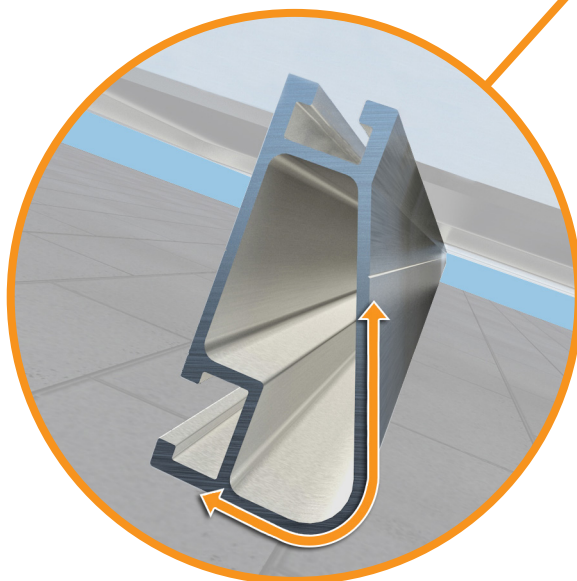
Over their lifetime, solar panels experience countless extreme weather events. Not just the worst storms in years, but the worst storms in 40 years. High winds capable of ripping panels from a roof, and snowfalls weighing enough to buckle a panel frame.

XR Rails® are the structural backbone preventing these results. They resist uplift, protect against buckling and safely and efficiently transfer loads into the building structure. Their superior spanning capability requires fewer roof attachments, reducing the number of roof penetrations and the amount of installation time.



Force-Stabilizing Curve

Sloped roofs generate both vertical and lateral forces on mounting rails which can cause them to bend and twist. The curved shape of XR Rails® is specially designed to increase strength in both directions while resisting the twisting. This unique feature ensures greater security during extreme weather and a longer system lifetime.



Compatible with Flat & Pitched Roofs



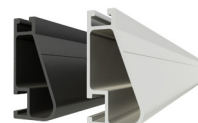
XR Rails® are compatible with FlashFoot® and other pitched roof attachments.



IronRidge® offers a range of tilt leg options for flat roof mounting applications.

Corrosion-Resistant Materials

All XR Rails® are made of 6000-series aluminum alloy, then protected with an anodized finish. Anodizing prevents surface and structural corrosion, while also providing a more attractive appearance.



XR Rail® Family

The XR Rail® Family offers the strength of a curved rail in three targeted sizes. Each size supports specific design loads, while minimizing material costs. Depending on your location, there is an XR Rail® to match.



XR10

XR10 is a sleek, low-profile mounting rail, designed for regions with light or no snow. It achieves spans up to 6 feet, while remaining light and economical.

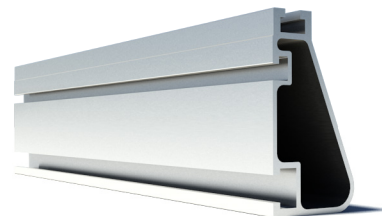
- 6' spanning capability
- Moderate load capability
- Clear & black anodized finish
- Internal splices available



XR100

XR100 is the ultimate residential mounting rail. It supports a range of wind and snow conditions, while also maximizing spans up to 10 feet.

- 10' spanning capability
- Heavy load capability
- Clear & black anodized finish
- Internal splices available



XR1000

XR1000 is a heavyweight among solar mounting rails. It's built to handle extreme climates and spans up to 12 feet for commercial applications.

- 12' spanning capability
- Extreme load capability
- Clear anodized finish
- Internal splices available

Rail Selection

The table below was prepared in compliance with applicable engineering codes and standards.* Values are based on the following criteria: ASCE 7-16, Gable Roof Flush Mount, Roof Zones 1 & 2e, Exposure B, Roof Slope of 8 to 20 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed certification letters.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	90	XR10			XR100		XR1000
	120						
	140						
	160						
20	90	XR10			XR100		XR1000
	120						
	140						
	160						
30	90	XR10			XR100		XR1000
	160						
40	90	XR10			XR100		XR1000
	160						
80	160	XR10			XR100		XR1000
120	160	XR10			XR100		XR1000

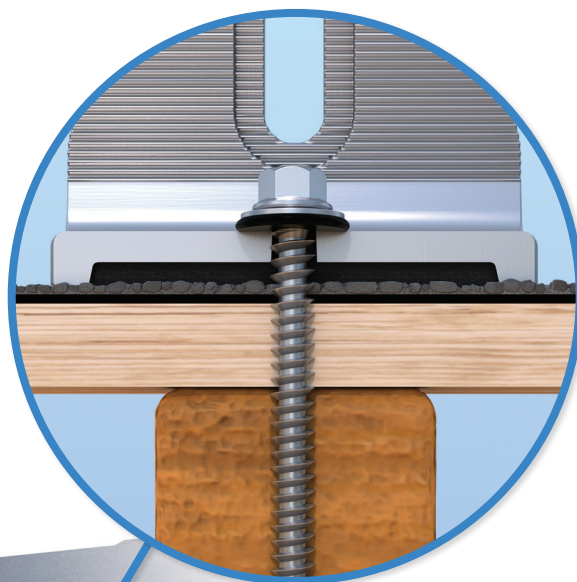
*Table is meant to be a simplified span chart for conveying general rail capabilities. Use approved certification letters for actual design guidance.



The Respect Your Roof Deserves

When integrating with a home, solar attachments must be dependable for the lifetime of the rooftop. Due to recent innovations, many asphalt shingles have bonded courses. A mount that protects without the need to pry shingles can really speed things up.

Halo UltraGrip®(HUG®) is here to respect the roof. Its Halo is a cast-aluminum barrier that encases the UltraGrip, our industrial-grade, foam-and-mastic seal. This allows HUG to accelerate the installation process and provide the utmost in waterproofing protection. Give your roof a HUG.®



Multi-Tiered Waterproofing

HUG® utilizes a multi-tiered stack of components to provide revolutionary waterproofing protection. The Halo cast-aluminum, raised-perimeter foundation surrounds the UltraGrip base—a foam-backed mastic seal combination that prevents water intrusion by adhering and sealing with the shingle surface.

Halo UltraGrip™ is part of the QuickMount® product line.

UltraGrip® Seal Technology

HUG UltraGrip utilizes a state-of-the-art seal design that uses a unique, foam-and-mastic combination. The foam-backed adhesive provides an entirely new flashing system that conforms and adheres to every nook and cranny of composition shingles, filling gaps and shingle step-downs (up to 1/8" in height).

Rafter Mount



Deck Mount



Rafter & Deck Mounting Options

Mount HUG® to the roof rafters, the roof deck, or both with our custom-engineered RD (rafter-or-deck) Structural Screw. The RD Structural Screw anchors HUG to the roof with an EPDM sealing washer, completing the stack of waterproofing barriers. See backside for more installation information.



Triple Rated & Certified to Respect the Roof™
UL 2703, 441 (27)
TAS 100(A)-95



Adaptive, Rafter-Friendly Installation



Hit the rafter? Good to go!

When you find a rafter, you can move on. Only 2 RD Structural Screws are needed.



Miss the rafter? Try it again.

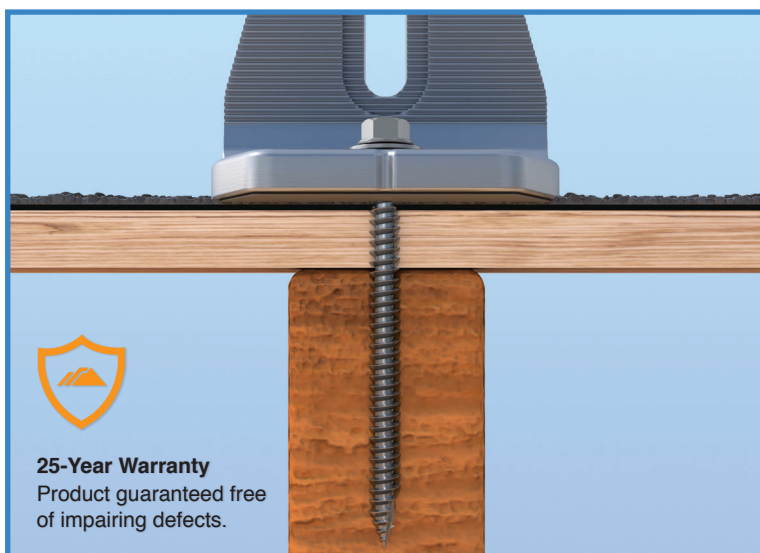
Place another screw to the left or right. If rafter is found, install 3rd and final screw.



Still no luck? Install the rest.

If more than 3 screws miss the rafter, secure six screws to deck mount it.

Trusted Strength & Less Hassle



Structural capacities of HUG® were reviewed in many load directions, with racking rail running cross-slope or up-slope in relation to roof pitch.

For further details, see the HUG certification letters for attaching to rafters and decking.

IronRidge designed the HUG, in combination with the RD Structural Screw to streamline installs, which means the following:

- No prying shingles
- No roof nail interference
- No pilot holes necessary
- No sealant (in most cases)
- No butyl shims needed

Attachment Loading



The rafter-mounted HUG has been tested and rated to support 1004 (lbs) of uplift and 368 (lbs) of lateral load.

Structural Design



Parts are designed and certified for compliance with the International Building Code & ASCE/SEI-7.

Water Seal Ratings



HUG passed both the UL 441 Section 27 "Rain Test" and TAS 100(A)-95 "Wind Driven Rain Test" by Intertek.

UL 2703 System



Systems conform to UL 2703 mechanical and bonding requirements. See Flush Mount Manual for more info.

