Full Spectrum Solar Response to City of Stoughton Parks and Recreation Request for Proposal

1. GENERAL

Full Spectrum Solar proposes installing a 3.6 kW (peak DC) photovoltaic system for the Nordic Ridge Park Structure, utilizing Heliene 360 watt domestic modules, a 3.8 kW (AC) Fronius string inverter, aluminum/stainless IronRidge racking, and aluminum/stainless S-5 metal roof clips for $10,945. A SolarEdge inverter with module-by-module optimizers is offered as an option.

This proposal includes all materials and labor to provide a fully functioning, robust photovoltaic system. Our proposal also includes a review of the roof structure with the module loading, building and electrical permits, preparation of utility interconnection documents and Focus on Energy Reward paperwork, and operation/maintenance training.

Below in this section, under "*System Description*," we provide an equipment overview and system pricing. A more detailed description of the major equipment is included in the "6. Equipment" section of this proposal.

We anticipate installing the modules into an array of two rows at the top, east end of the roof (closest to the electrical panel), but the modules can be arranged differently as requested by the Owner. With this arrangement, the array will be 16.4' wide by 12.8' along the slope, leaving a large amount of area for any future expansion. The included Fronius Primo 3.8-1 inverter is rated to handle up to 5.4 kW (peak DC).

Attachments 1, 2, 3 and 4 contain the specifications and warranty information for Heliene, Fronius, IronRidge, and Full Spectrum Solar, respectively.

System Description
The following table provides an equipment and pricing overview.

System size	3.6 kW (peak DC), 3.8 kW (AC)
Photovoltaic modules	(10) Heliene 72M-360 (360 watts each)
Inverter	(1) Fronius Primo 3.8-1 (3.8 kW AC)
Online data monitoring	Fronius Solar.web (or SE Portal for the SolarEdge option)
Racking hardware	IronRidge XR rails, IR clips and grounding, S-5 clamps
Total system cost	$10,945
SolarEdge option	Includes P370 optimizers on each module. Add $475

2. CERTIFICATIONS

Full Spectrum Solar has a very strong culture of emphasizing workmanship above all else. We build the whole installation with attention to detail appropriate for photovoltaic

modules with an expected lifespan of 30 or more years. Our commitment to workmanship does not compromise our dependability. Our collective experience means we can anticipate potential challenges and prevent delays and change orders due to miscommunication.

We have thorough, bi-weekly safety meetings at our office, in addition to jobsite analysis with our crew leaders, in order to reduce our chances of workplace injury. Our Experience Modification Rating is 0.87.

Full Spectrum Solar installs systems with our own electricians and installation technicians, not subcontractors or temporary workers hired on a per-job basis. We always have at least one master electrician with a minimum of 14 years of experience supervising electrical work onsite, and one installation technician with a minimum of four years of experience providing roof work onsite. Full Spectrum Solar's installers are licensed electricians and several are NABCEP-certified. We have a complete electrical and assembly shop attached to our offices, and four completely loaded Sprinter vans for our installation crews, and a fifth for delivering materials.

Below are key personnel, with their individual certifications listed, and a list of our company certifications. Full resumes and certificates are available upon request.

Burke O'Neal – Co-owner, Project Manager, Designer, Master Electrician

- Twenty years of experience in all aspects of photovoltaic system construction, including electrical work, roofing, design and project management
- NABCEP Certified Installer 2004-2010 (Not renewed in order to focus studies on more advanced electrical classes)
- Bachelor of Science – Mechanical Engineering, University of Wisconsin - Madison
- Master Electrician #908748

Mike Joyce – Project Manager, Designer, NABCEP Certified Installer

- Ten years of experience in the design and installation of residential and commercial grid-tied photovoltaic systems ranging in size from 1.5 to over 100 KW DC
- Six years of engineering experience prior to Full Spectrum Solar
- NABCEP Certified Installer
- Bachelor of Science – Material Science Engineering, Iowa State University

Mark Warnick – Project Manager, Designer

- Ten years experience designing and managing the installation of photovoltaic systems
- MREA classroom instructor on photovoltaic systems and training for site assessor certification
- NABCEP Certified in PV Technical Sales

Mark O'Neal – Operations Manager, Co-owner

- Fifteen years of experience in the installation and repair of residential and commercial solar water heating and photovoltaic systems, shop material handling and staging, safety management, and vehicle/tool maintenance
- Bachelor of Science – Mechanical Engineering, University of Wisconsin - Madison

Leigh Weaver – Master Electrician

- Eleven years of experience in photovoltaic system electrical work
- Wisconsin Master Electrician #1080240

Greg Veldey – Journeyman Electrician, NABCEP Certified Installer

- Eight years of experience in the installation of photovoltaic systems, including electrical work under our electricians' supervision
- Master level electrical experience, licensed Journeyman Electrician License

Todd Lund – Solar Installation Technician, Roofing Specialist

- Six years of experience at FSS installing photovoltaic modules, and the associated racking and roof flashings
- Ten prior years of experience in commercial and residential roofing

Company Certifications

- State Dwelling Contractor Certification #1074469
- State Electrical Contractor Certification #1055530
- State HVAC Contractor Registration #1055530
- City of Madison Registrations: Elec-Master, HTG-Solar, HTG-Hot Water

Below are commercial references from just a small sample of the hundreds of satisfied Full Spectrum Solar customers. I also included a couple of residential references, because their installations were similar in size and interconnection to this project. Quality, communication, and responsiveness are our strengths, as our customers will attest.

Reference	System Description
Aaron Kostichka Vice President, LEED AP McGann Construction 3622 Lexington Ave. Madison, WI 53714 608-241-5585	Full Spectrum Solar designed and installed: • Three photovoltaic and nine solar thermal systems for Troy Gardens Co-Housing Community in 2006 • 400SF solar thermal system at Yahara River Apartments in 2003 • 20 kW photovoltaic system at Nakoosa Trail Apartments in 2012 • 71 kW photovoltaic system on a Middleton apartment building in 2015

Kay Schindel Energy Engineer City of Madison Engineering Division 1600 Emil Street Madison, WI 53713 608-266-4668	Full Spectrum Solar designed and installed a 4.2 kW awning-mounted photovoltaic system and a 19.11 kW roof mounted photovoltaic system on the City of Madison Engineering Building. We have also installed several solar water heating systems for the City.
Rich Arneson Vice President Stone House Development 625 N. Segoe Rd., Suite 107 Madison, WI 53705 608-251-6000	Full Spectrum Solar designed and installed photovoltaic systems at five of Stone House Development's properties: • 47.6 kW – Arbor Crossing Apartments, 2013 • 19.9 kW – The Overlook at Hilldale, 2011 • 19.7 kW – The Overlook at Midtown, 2011 • 29.9 kW – City Row Apartments, 2010 • 9.9 kW – Park Central Apartments, 2008
Svein Morner, Ph.D, P.E Sustainable Engineering Group 7475 Hubbard Ave. #201 Middleton, WI 53562 608-836-4488	Full Spectrum Solar designed and installed a 20 kW photovoltaic system for Sustainable Engineering Group's office in 2015. We have worked with SEG on other projects, including the Fort Atkinson and Oregon schools.
Brad Hinkfus Porchlight, Inc. 306 N. Brook Street Madison, WI 53715 608-257-2534	Full Spectrum Solar designed and installed a 20 kW photovoltaic system on Porchlight's Safe Haven housing in Madison in 2012 and a 6.1 kW photovoltaic system and a 200 square foot Heliodyne solar water heat on their Fitchburg transitional housing in 2006.
Pastor Susan Schneider Trinity Lutheran Church 608-249-8527 1904 Winnebago St. Madison, WI 53704	Full Spectrum Solar designed and installed a 20 kW photovoltaic system for Trinity Lutheran church in 2015. Full Spectrum Solar's owners financed the system through an innovative third- party ownership agreement. The church has significantly reduced its electricity costs through this arrangement.
Andrew Weiland Business Manager 608-729-5958 Oregon School District 601l Pleasant Oak Dr. Oregon, WI 53575	Full Spectrum Solar designed and installed a 60 kW photovoltaic system for Oregon Middle School in 2015, a 34 kW system for Brooklyn Elementary in spring of 2016, and a 136 kW system for Oregon High School in 2017.

Reference	System Description
Christian Wolf and Natalie Rudolph 1706 Regent Street Madison, WI 53726 (608) 772-9665 chriswolf1977@gmail.com	• 4.0 kW system installed in 2016 on their home in Madison • System includes (12) Heliene 335 watt modules, (12) SolarEdge P400 optimizers, a SolarEdge 3800 watt inverter with online monitoring, and Ironridge racking
Heather Allen 1402 Chandler St. Madison, WI 53711 608-261-9159 hallen@cityofmadison.com	• 3.6 kW system installed in late 2016 on her home in Madison • System includes (12) Silfab 300 modules, (12) SolarEdge P300 optimizers, a SolarEdge 3.8 kilowatt inverter with online monitoring, and Ironridge racking

3. PERMITS and PSC Forms

Full Spectrum Solar will obtain all required local and state permits, certificates, and approvals as required for system installation by local and state jurisdiction. Full Spectrum Solar will request necessary inspections for installation and commissioning from the respective authority. We will submit the required documentation to complete the Standard Distributed Generation Application Form (PSC 6027) and Distributed Generation Interconnection Agreement (PSC 6029) and submit to the utility.

4. SYSTEM DESIGN

Full Spectrum Solar proposes installing a 3.6 kW (peak DC) roof-mounted photovoltaic system, with web-based monitoring capability at the Nordic Ridge Park Structure. We will utilize (10) Heliene 360 watt domestic modules, a 3.8 kW (AC) Fronius string inverter, aluminum/stainless IronRidge racking, and aluminum/stainless S-5 metal roof clips. A SolarEdge inverter with module-by-module optimizers is offered as an option.

This proposal includes all materials and labor to provide a fully functioning, robust photovoltaic system. Our proposal also includes a review of the roof structure with the module loading, building and electrical permits, preparation of utility interconnection documents and Focus on Energy Reward paperwork, and operation/maintenance training.

The interconnection design will have the inverter, utility visible/lockable disconnect, and overcurrent protection installed in a suitable location approved by the Owner. The AC output will be connected to the Stoughton City Park electrical distribution system through properly sized wires and properly sized conduit. Full Spectrum Solar will communicate with Stoughton Utilities and comply with their interconnection requirements. Wiring methods will comply with Article 690 of the National Electrical Code. ANSI/NFPA-70

5. WARRANTY

The PV modules have a *25 year* limited power output warranty, which provides for the repair or replacement in the event of power dropping to less than 80% of the original rated power. The Fronius inverters have a *10 year* performance warranty providing for repair or replacement in the event of failure (including a labor reimbursement). The SolarEdge inverters have a *12 year* performance warranty providing repair or replacement in the event of failure (including a labor reimbursement), and the SolarEdge optimizers have a *25 year* warranty providing replacement in the event of failure (including a labor reimbursement). Full Spectrum Solar provides the Owner with a full one year warranty on the entire PV system including all materials, components, equipment, workmanship and labor, and a full *five year* workmanship warranty.

Attachments 1, 2, 3 and 4 contain the specifications and warranty information for Heliene, Fronius, IronRidge, and Full Spectrum Solar, respectively.

6. EQUIPMENT

Full Spectrum Solar is committed to equipment manufacturers with a proven, quality reputation. The following is detailed information about the major equipment used for this proposal.

Attachments 1, 2, and 3 contain the specifications and warranty information for Heliene, Fronius, and IronRidge, respectively.

Full Spectrum Solar will provide PV modules as required for the approved PV system design. The modules are tested and labeled by Underwriters Laboratories (UL) or another nationally recognized testing agency.

Our photovoltaic module manufacturer, Heliene, produces top quality modules in Ontario and Minnesota. We have a direct purchase agreement with Heliene, a respected, stable Canadian manufacturer. Because of our agreement, we are able to offer competitive pricing for a domestic product, and I can talk directly to their production engineers. Heliene modules feature a 25 year linear power output warranty.
Below is the requested information about the modules:

- Manufacturer: Heliene
- Model: 72m-370
- number of modules: 10
- generating capacity per module: 360 watts
- total DC capacity rating: 3.6 kW
- NREL PVWatts energy production estimate: With a 14% AC to DC derate, and an additional 3% snow cover derate – 4,489 kWh per year (see Attachment 7)

Full Spectrum Solar will provide an inverter as required for the approved PV system design. The inverter is tested and labeled by Underwriters Laboratories (UL) UL 1741 or another nationally recognized testing agency. The following is detailed information

about the Fronius inverter. The SolarEdge inverter option is comparable, but offers module-by-module optimization for better obstacle/snow shade tolerance, module level monitoring, and rapid DC voltage drop if the AC power is ever removed. Please let me know if you'd like details about the SolarEdge system.

The Fronius Symo 7.6-1 inverter is a 97.9% peak efficiency, transformerless 240 volt inverter. The few times we've had a Fronius inverter fail, they have sent a replacement unit within a couple of days. Their customer support is excellent. They include a standard 10 year warranty with an optional extension up to 20 years.

Full Spectrum Solar will use Fronius' web-based monitoring called Solar.Web. This system provides detailed real time and accumulated energy production information in a useful interface. It comes complete with Android and Apple phone mobile integration. Since the monitoring is through the inverter, any inverter errors or production alerts are immediately apparent without having to look at the inverter screen in the field (if internet access is provided at the shelter). We are happy to discuss any other monitoring options the Owner would like to consider.

Below is the requested information about the inverter:

- Manufacturer: Fronius
- Model: Primo 7.6-1
- Efficiency: 97.9% (peak), 95.5% (CEC)
- anti-islanding capability: UL 1741
- rated output AC voltage: 240 V
- DC input voltage range: 200-600 V (One 10-module string Vmp = 397 V @ STP)
- output frequency: 60 Hz

Information as requested on balance of system components:

- racking/support structure material: IronRidge (IR) XR10 aluminum rail, IR stainless steel module clips, IR aluminum support brackets, S-5 aluminum metal roof clamps
- racking/support structure design details/description: S-5 clamps supporting the IronRidge racking will be located every 4' east-west under the array. IronRidge software inputs and results will be provided to the building department and the Owner showing the span is acceptable. Two IR rails will run under each row of modules.
- racking structure foundation/anchor type: S-5 metal roof clamps, calculations showing a pull-off safety factor of at least 4 will be provided.
- array fastener material: S-5 clamps are aluminum with stainless steel fasteners
- electrical components: All electrical sized properly for ampacity and a voltage drop of less than 2% on the DC side, 1.5% on the AC side. All work done to NEC. Conduit will be routed from the roof into the electrical room, and flashed with appropriate, approved materials for the roofing brand.
- description of the web-based real-time monitoring system (assumes internet service is provided at the shelter, other options available for an extra fee): Fronius Solar Web is an all-in-one internet portal for configuring, monitoring, analysing and

visualising your photovoltaic system. Real time and extended information about power, energy production, any system errors and more is provided.

7. SYSTEM ACCEPTANCE TESTING

Full Spectrum Solar, in conjunction with the Utility, Authority having jurisdiction, and the Owner will will provide system acceptance testing at time of commissioning. The testing will shall determine that the PV system is functionally operative and meets the design requirements. The tests shall also verify that the system, as installed, is safe for personnel and will establish or verify system energy and power rating.

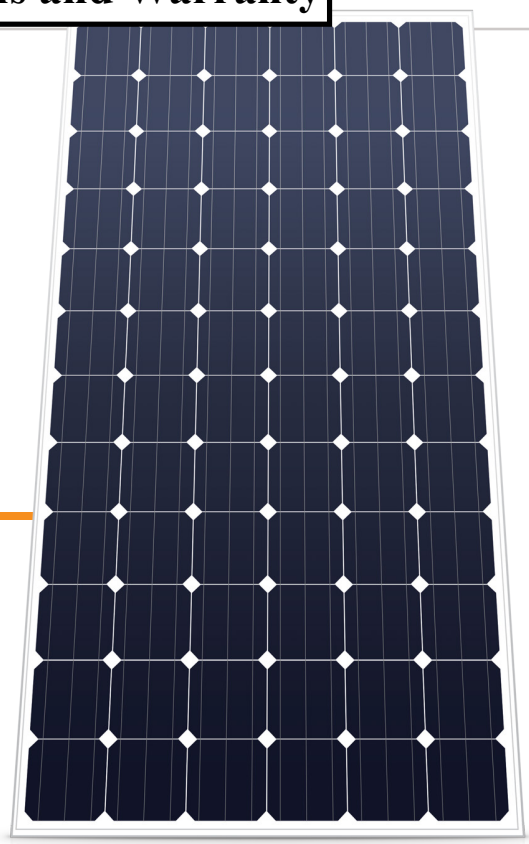
MONO

Attachment 1: Heliene Specifications and Warranty

HELIENE

72M

72-CELL MONOCRYSTALLINE MODULE



370 Wp
MAX POWER OUTPUT

19.3%
MAX EFFICIENCY

10 YEAR
PRODUCT WARRANTY

25 YEAR
LINEAR PERFORMANCE GUARANTEE

MADE WITH PRIDE IN North America BUY LOCAL

- GUARANTEED POSITIVE POWER SORTING: [-0 : +4.99 WP]
- AVAILABLE IN 1000V OR 1500V (DC) VOLTAGE RATING
- MANUFACTURED ACCORDING TO INTERNATIONAL QUALITY SYSTEM STANDARDS: ISO9001
- H-BLACK INTEGRATION AVAILABLE (ALL-BLACK MODULE)

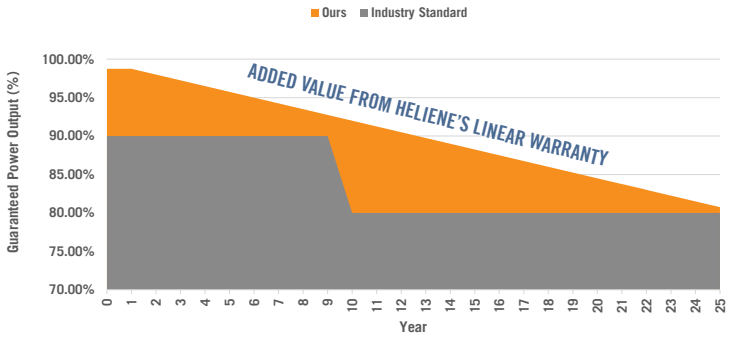
HELIENE INC. IS A PREMIER SOLAR MODULE MANUFACTURER, SERVICING THE GROWING SOLAR ENERGY MARKETS OF NORTH AMERICA.

COMBINING PROVEN EUROPEAN TECHNOLOGY WITH NORTH AMERICAN INGENUITY ALLOWS HELIENE TO MAKE A REAL COMMITMENT IN PROVIDING SMARTER ENERGY CHOICES FOR THE FUTURE.

HELIENE
www.heliene.com

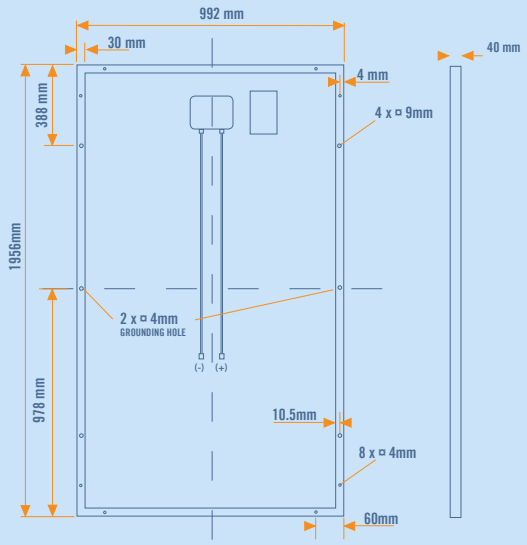
LINEAR PERFORMANCE GUARANTEE

10 YEAR WORKMANSHIP WARRANTY • 25 YEAR LINEAR PERFORMANCE GUARANTEE

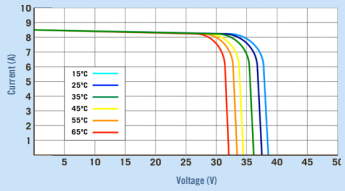


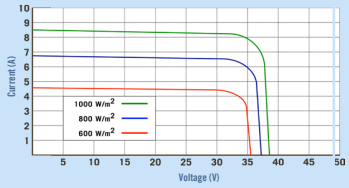
72M

DIMENSIONS FOR HELIENE 72M SERIES MODULES



I-V CURVE FOR HELIENE 72M SERIES





CERTIFICATIONS

ELECTRICAL DATA (STC)

Peak Rated Power	P_{mpp} (W)	370	360	350	335	325
Maximum Power Voltage	V_{mpp} (V)	40.153	39.713	39.133	38.213	37.72
Maximum Power Current	I_{mpp} (A)	9.28	9.13	9.01	8.83	8.69
Open Circuit Voltage	V_{oc} (V)	48.81	48.19	47.57	46.64	46.02
Short Circuit Current	Isc (A)	9.97	9.81	9.65	9.41	9.27
Module Efficiency *	Eff (%)	19.3	18.8	18.3	17.5	17.0
Power Output Tolerance	[- 0 , + 4.99] Wp					

STC - Standard Test Conditions: Irradiation 1000 W/m2 - Air mass AM 1.5 - Cell temperature 25 ºC
* Calculated using maximum power based on full positive output tolerance [-0 , +4.99] Wp

MECHANICAL DATA

Dimensions (L x W x D)	1956 x 992 x 40 mm (77 x 39 x 1.6 inch)
Weight	23.6 kg (52.4 lbs)
Output Cables	1.1 m (43.3 inch) symmetrical cables with MC4 type connectors
Junction Box	IP-67 rated with 3 bypass diodes
Frame	Double webbed 15 micron anodized aluminum alloy
Front Glass	Low-iron content, high-transmission PV solar glass
Solar Cells	72 Monocrystalline cells (156 x 156 mm)

CERTIFICATIONS

UL Listed	ULC/ORD-C1703-1 , UL1703, UL1703 Fire Classification Type 1
IEC Listed	IEC 61215, IEC 61730

All Heliene modules are certified under the California Energy Commision (CEC) Listing Report

TEMPERATURE RATINGS

Nominal Operating Cell Temperature (NOCT)	+45°C (±2°C)
Temperature Coefficient of P_{max}	-0.39%/°C
Temperature Coefficient of V_{oc}	-0.31%/°C
Temperature Coefficient of I_{sc}	0.045%/°C

PACKAGING CONFIGURATION

Modules per box:	26 pieces
Modules per 53' trailer:	780 pieces

MAXIMUM RATINGS

Operational Temperature	-40°C - +85°C
Max System Voltage	1500V (UL / IEC)
Max Series Fuse Rating	15 A

WARRANTY

10 Year Manufacturer's Workmanship Warranty
25 Year Linear Power Guarantee

(Refer to product warranty page for details)

HELIENE72M_IFD_1701

HELIENE

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

© 2017 Heliene Inc. All rights reserved. Specifications included in this datasheet are subject to change without notice.

HELIENE INC. PRODUCT WARRANTY

Heliene Canada will certify that the photovoltaic modules manufactured and serviced directly from its premises in Sault Ste. Marie conform to the requirements of the specified norm and will provide the following

a) Ten year guarantee for manufacturing or material defects

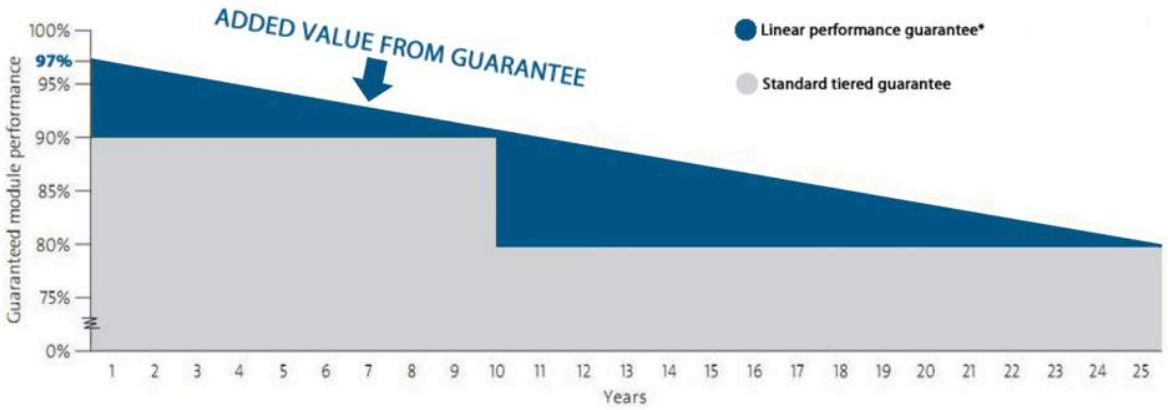
Heliene Canada guarantees that, for a period of ten years from the date of shipment, to the invoiced buyer, their modules are free from faults in their materials or our own manufacturing process, under normal conditions of installation and use.

Should at any time during the aforementioned guarantee validity period, the module not function correctly due to its manufacturing or to deterioration or wear of one of its relevant components, Heliene Inc. agrees, depending on the type of defect found, to repair, replace or refund for the particular faulty panel.

b) Twenty-five year linear power guarantee.

Heliene Inc. guarantees that, for a period of twenty five years from the date of shipment to the invoiced buyer, the average power the module generates and which is measured in standard test conditions (I=1000W/m2; AM 1.5; Tcel: 25C), will not be lower than 80% of its minimum value.

Initial degradation may occur of up to 3%, while 0.7% maximum year of year continual degradation until year 24 until 80% of initial power at year 25.



c) Exclusions and Limitations of the Guarantee

- The following cases shall not be covered by the guarantee-related rights herein
- Accidents due to the shipment (on FOB Sault Ste. Marie sales condition), or storage at client's site, on different commercial arrangements including warehousing, the limitation and exclusion of guarantee shall be negotiated and agreed by the parties.
- Incorrect handling, negligent installation, use or maintenance.
- Damage resulting from surges, storm discharges, floods, earthquakes, fires and actions by third parties or any other reason implying non conformity with standard conditions of operation.
- Manipulation of modules serial numbers leading to incorrect identification of the faulty module.

The guarantees expressed herein shall not cover the shipping costs incurred by the return of the repaired or replacement modules from/to site, whatever the cause is, nor the installation and/or reinstallation of the modules.

Martin Pochtaruk

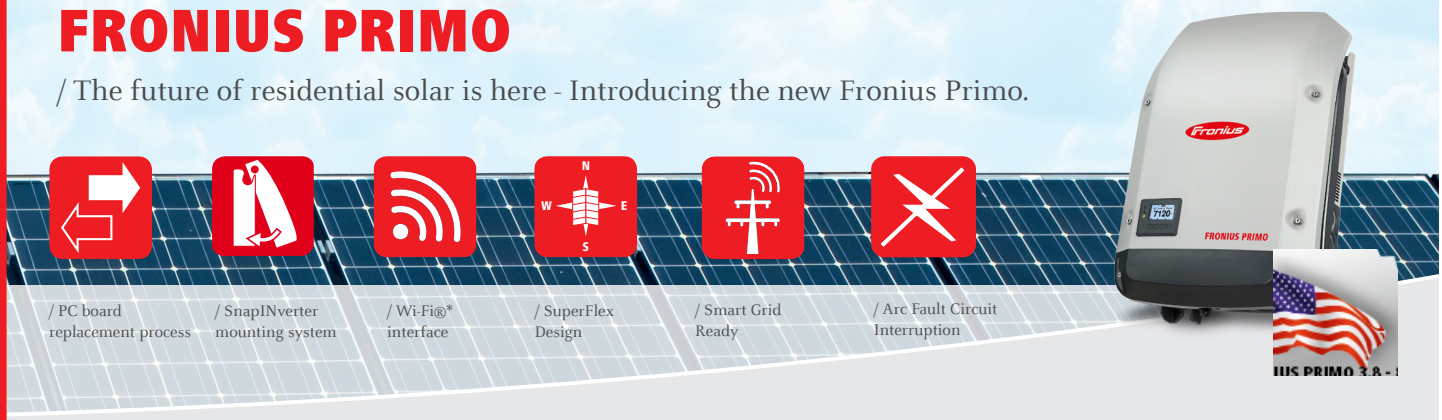
President – Heliene Inc.

Attachment 2: Fronius Specifications and Warranty

SHIFTING THE LIMITS

FRONIUS PRIMO

/ The future of residential solar is here - Introducing the new Fronius Primo.



/ With power categories ranging from 3.8 kW to 15.0 kW, the transformerless Fronius Primo is the ideal compact single-phase inverter for residential applications. The sleek design is equipped with the SnapINverter hinge mounting system which allows for lightweight, secure and convenient installation. The Fronius Primo has several integrated features that set it apart from competitors including dual powerpoint trackers, high system voltage, a wide input voltage range, Wi-Fi* and SunSpec Modbus interface, and Fronius' online and mobile monitoring platform Fronius Solar.web. The Fronius Primo also works seamlessly with the Fronius Rapid Shutdown Box for a reliable NEC 2014 solution** and offers a Revenue Grade Metering option completely integrated.

TECHNICAL DATA FRONIUS PRIMO

GENERAL DATA	FRONIUS PRIMO 3.8 - 8.2	FRONIUS PRIMO 10.0-15.0
Dimensions (width x height x depth)	16.9 x 24.7 x 8.1 in.	20.1 x 28.5 x 8.9 in.
Weight	47.29 lb.	82.5 lbs.
Degree of protection	NEMA 4X	
Night time consumption	< 1 W	
Inverter topology	Transformerless	
Cooling	Variable speed fan	
Installation	Indoor and outdoor installation	
Ambient operating temperature range	-40 - 131°F (-40 - 55°C)	-40 - 140°F (-40 - 60°C)
Permitted humidity	0 - 100 %	
DC connection terminals	4x DC+ and 4x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded)	4x DC+1, 2x DC+2 and 6x DC- screw terminals for copper (solid / stranded / fine stranded) or aluminum (solid / stranded)
AC connection terminals	Screw terminals 12 - 6 AWG	
Revenue Grade Metering	Optional (ANSI C12.1 accuracy)	
Certificates and compliance with standards	UL 1741-2010, UL1998 (for functions: AFCI and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690, C22. 2 No. 107.1-01 (September 2001) , UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013	UL 1741-2015, UL1998 (for functions: AFCI, RCMU and isolation monitoring), IEEE 1547-2003, IEEE 1547.1-2003, ANSI/IEEE C62.41, FCC Part 15 A & B, NEC Article 690-2014, C22. 2 No. 107.1-01 (September 2001) , UL1699B Issue 2 -2013, CSA TIL M-07 Issue 1 -2013

PROTECTIVE DEVICES	STANDARD WITH ALL PRIMO MODELS
AFCI & 2014 NEC Ready	Yes
Ground Fault Protection with Isolation Monitor Interrupter	Yes
DC disconnect	Yes
DC reverse polarity protection	Yes

INTERFACES	STANDARD WITH ALL PRIMO MODELS
Wi-Fi*/Ethernet/Serial	Wireless standard 802.11 b/g/n / Fronius Solar.web, SunSpec Modbus TCP, JSON / SunSpec Modbus RTU
6 inputs or 4 digital inputs/outputs	External relay controls
USB (A socket)	Datalogging and/or updating via USB
2x RS422 (RJ45 socket)	Fronius Solar Net, interface protocol
Datalogger and Webserver	Included

*The term Wi-Fi® is a registered trademark of the Wi-Fi Alliance.

**Fronius Primo 10.0-15.0 kW requires an external disconnect button for code compliance.

TECHNICAL DATA FRONIUS PRIMO

INPUT DATA	PRIMO 3.8-1	PRIMO 5.0-1	PRIMO 6.0-1	PRIMO 7.6-1	PRIMO 8.2-1
Recommended PV power (kWp)	3.0 - 6.0 kW	4.0 - 7.8 kW	4.8 - 9.3 kW	6.1 - 11.7 kW	6.6 - 12.7 kW
Max. usable input current (MPPT 1/MPPT 2)	18 A / 18 A	18 A / 18 A	18 A / 18 A	18 A / 18 A	18 A / 18 A
Total max. DC current	36 A				
Max. array short circuit current (1.25 Imax) (MPPT 1/MPPT 2)	22.5 A / 22.5 A				
Operating voltage range	80 V - 600 V				
Max. input voltage	600 V				
Nominal input voltage	410 V	420 V	420 V	420 V	420 V
Admissable conductor size DC	AWG 14 - AWG 6				
MPP Voltage Range	200 - 480 V	240 - 480 V	240 - 480 V	250 - 480 V	270 - 480 V
Number of MPPT	2				

OUTPUT DATA		PRIMO 3.8-1	PRIMO 5.0-1	PRIMO 6.0-1	PRIMO 7.6-1	PRIMO 8.2-1
Max. output power	240 V	3800 W	5000 W	6000 W	7600 W	8200 W
	208 V	3800 W	5000 W	6000 W	7600 W	7900 W
Max. continuous output current	240 V	15.8 A	20.8 A	25.0 A	31.7 A	34.2 A
	208 V	18.3 A	24.0 A	28.8 A	36.5 A	38.0 A
Recommended OCPD/AC breaker size	240 V	20 A	30 A	35 A	40 A	45 A
	208 V	25 A	30 A	40 A	50 A	50 A
Max. Efficiency		96.7 %	96.9 %	96.9 %	96.9 %	97.0 %
CEC Efficiency	240 V	95.0 %	95.5 %	96.0 %	96.0 %	96.5 %
Admissable conductor size AC		AWG 14 - AWG 6				
Grid connection		208 / 240 V				
Frequency		60 Hz				
Total harmonic distortion		< 5.0 %				
Power factor (cos $\varphi_{ac,r}$)		0.85-1 ind./cap				

INPUT DATA	PRIMO 10.0-1	PRIMO 11.4-1	PRIMO 12.5-1	PRIMO 15.0-1
Recommended PV power (kWp)	8.0 - 12.0 kW	9.1 - 13.7 kW	10.0 - 15.0 kW	12.0 - 18.0 kW
Max. usable input current (MPPT 1/MPPT 2)	33.0 A / 18.0 A			
Total max. DC current	51 A			
Max. array short circuit current (1.25 Imax) (MPPT 1/MPPT 2)	41.3 A / 22.5 A			
Operating voltage range	80 V - 600 V			
Max. input voltage	600 V			
Nominal input voltage	415 V	420 V	425 V	440 V
Admissable conductor size DC	AWG 14 - AWG 6 copper direct, AWG 6 aluminum direct (AWG 10 copper or AWG 8 aluminium for overcurrent protective devices up to 60A, from 61 to 100A minimum AWG 8 for copper or AWG 6 aluminium has to be used), AWG 4 - AWG 2 copper or aluminum with optional input combiner			
MPP Voltage Range	220 - 480 V	240 - 480 V	260 - 480 V	320 - 480 V
Integrated DC string fuse holders	4- and 4+ for MPPT 1 / no fusing required on MPPT 2			
Number of MPPT	2			

OUTPUT DATA		PRIMO 10.0-1	PRIMO 11.4-1	PRIMO 12.5-1	PRIMO 15.0-1
Max. output power	240 V	9995 W	11400 W	12500 W	15000 W
	208 V	9995 W	11400 W	12500 W	13750 W
Max. continuous output current	240 V	41.6 A	47.5 A	52.1 A	62.5 A
	208 V	48.1 A	54.8 A	60.1 A	66.1 A
Recommended OCPD/AC breaker size	240 V	60 A	60 A	70 A	80 A
	208 V	70 A	70 A	80 A	90 A
Max. Efficiency		96.7 %			
CEC Efficiency		96.0 %			96.5 %
Admissable conductor size AC		AWG 10 - AWG 2 copper (solid / stranded / fine stranded)(AWG 10 copper or AWG 8 aluminium for overcurrent protective devices up to 60A, from 61 to 100A minimum AWG 8 for copper or AWG 6 aluminium has to be used) , AWG 6 - AWG 2 copper(solid / stranded) MultiContactWiringable with AWG 12			
Grid connection		208 / 240 V			
Frequency		60 Hz			
Total harmonic distortion		< 2.5 %			
Power factor (cos $\varphi_{ac,r}$)		0-1 ind./cap.			

/ Perfect Welding / Solar Energy / Perfect Charging

WE HAVE THREE DIVISIONS AND ONE PASSION: SHIFTING THE LIMITS OF POSSIBILITY.

/ Whether welding technology, photovoltaics or battery charging technology – our goal is clearly defined: to be the innovation leader. With around 3,300 employees worldwide, we shift the limits of what's possible - our record of over 900 granted patents is testimony to this. While others progress step by step, we innovate in leaps and bounds. Just as we've always done. The responsible use of our resources forms the basis of our corporate policy.

Further information about all Fronius products and our global sales partners and representatives can be found at **www.fronius.com**

v05 May 2015 EN

C US

SUNSPEC ALLIANCE

Fronius USA LLC
6797 Fronius Drive
Portage, IN 46368 USA
pv-support-usa@fronius.com
www.fronius-usa.com

SHIFTING THE LIMITS

FRONIUS SOLAR.WEB APP

/ The free app for the easy viewing of PV system data

/ **The free Fronius Solar.web app** is the mobile version of the online service. You can keep an eye on the energy yield of your PV system while out and about by simply installing the app on your iPhone, iPod, iPad, or Android Smartphone. Display up-to-date system production data or past values. And you are not restricted to viewing the data of just one system, as the Fronius Solar.web app allows you to access all of your systems registered via the Fronius Solar.web portal. Use Fronius demo systems for a sneak peek at what the application can do.

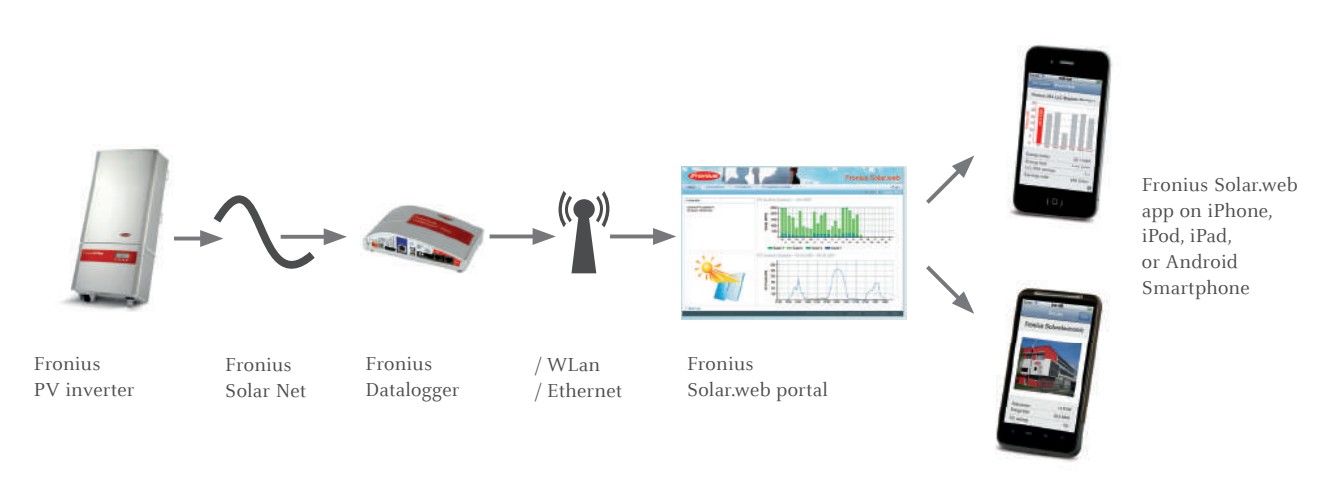
/ **The Fronius Solar.web app** for Apple products is available from the iTunes store (http://itunes.com/apps/solarweb) and the relevant app for Android Smartphones from the Android market (http://market.android.com).

/ **Fronius Solar.web:** the free online Fronius Solar.web portal is used for performing simple and straightforward analysis, monitoring and visualization of PV system data. Since several systems can be registered, you can easily compare them using a single login. Expand the reach of the Solar. web portal by downloading the app onto your Smartphone so that you can view the energy yield of your system in any location. Fronius Solar.web is available at www.fronius-usa. com / then – Solar Electronics / then – Info & Support / then – Fronius Solar.web.

/ **Fronius Datalogger:** a Fronius Datalogger must be installed in order to view your own system data via Fronius Solar.web. Fronius recommends the Fronius Datalogger Web, although Fronius Datalogger easy or pro can also be used. Fronius Dataloggers can be added to your system at anytime.

View the energy yield of your PV system whenever you are out and about.

FRONIUS SOLAR.WEB APP CONFIGURATION DIAGRAM



REQUIREMENTS FOR APPLE PRODUCTS:

iPhones, iPods and iPads with the iOS 4.2 operating system or higher

SYSTEM REQUIREMENTS FOR ANDROID SMARTPHONES:

SOFTWARE:
Android 2.1 (Eclair) or higher

HARDWARE:
/ Minimum: e.g. HTC Wildfire (528 MHz, 384MB RAM, resolution 240x320)
/ Optimum: e.g. HTC Desire (HD), Motorola Milestone 2, Samsung Galaxy S
(1 GHz, 512MB RAM and more, resolution 800x480 or higher)

Fronius Solar.web for
Android Smartphones

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www.fronius.com

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SHIFTING THE LIMITS

Fronius USA Premium Warranties

Fronius USA Premium Standard 10-Year Warranty

The Fronius USA Premium 10-Year Warranty applies to the following products:

• Fronius IG Series Inverters - IG 2000 / IG 2500LV / IG 3000 / IG 4000 / IG 4500LV / IG 5100
• Fronius IG Plus Advanced Series Inverters – 3.0-1UNI / 3.8-1UNI / 5.0-1UNI / 6.0-1UNI / 7.5-1UNI / 10.0-1UNI / 11.4-1UNI / 10.0-3Delta / 11.4-3Delta /IG 12-0-3WYE277
• Fronius CL Series – PV Central Inverters – CL 33.3 / CL 36.0 / CL 44.4 / CL 48.0 / CL 55.5 / CL 60.0

Fronius Premium Extended Warranties

Fronius USA Premium 5-Year Extended Warranty applies to the following products:

• Fronius IG Series Inverters - IG 2000 / IG 2500LV / IG 3000 / IG 4000 / IG 4500LV / IG 5100
• Fronius IG Plus Advanced Series Inverters – 3.0-1UNI / 3.8-1UNI / 5.0-1UNI / 6.0-1UNI / 7.5-1UNI / 10.0-1UNI / 11.4-1UNI / 10.0-3Delta / 11.4-3Delta /IG 12-0-3WYE277

Fronius USA Premium 10-Year Extended Warranty applies to the following products:

• Fronius IG Series Inverters - IG 2000 / IG 2500LV / IG 3000 / IG 4000 / IG 4500LV / IG 5100
• Fronius IG Plus Advanced Series Inverters – 3.0-1UNI / 3.8-1UNI / 5.0-1UNI / 6.0-1UNI / 7.5-1UNI / 10.0-1UNI / 1.4-1UNI / 10.0-3Delta / 11.4-3Delta /IG 12-0-3WYE277
• Fronius CL Series – PV Central Inverters – CL 33.3 / CL 36.0 / CL 44.4 / CL 48.0 / CL 55.5 / CL 60.0

Please contact your Fronius Authorized Distributor or Integrator. The purchase the Fronius Premium 5 or 10-Year Warranty Extension must be done through your Solar Dealer or Installer whom will forward the details to the Fronius Authorized Distributor or directly to Fronius if they are a direct account of Fronius. See the **Fronius USA 5-Year and 10-Year Warranty Extension** document for further details. You can download this document from www.fronius-usa.com.

SHIFTING THE LIMITS

Fronius Warranty Conditions

The **Fronius Premium 10-Year Warranty** comes standard on the solar inverter models shipped from Fronius in the models listed above. Fronius warranties offer the straight forward protection and support that Fronius customers have come to expect from an industry leader.

The Fronius 5-Year and 10-Year Extended Warranties are available for purchase, for a nominal investment to increase the Fronius inverter warranty to 15 or 20 years. Please contact your supplier to purchase a Fronius Extended Warranty.

At Fronius, we have been designing and manufacturing high quality power electronics equipment for over 65 years. And all our production facilities are ISO 9001 certified. You will probably not encounter any service-related issues with your FRONIUS Solar Inverter (IG, IG Plus Advanced, and CL models). However, in the unlikely event that you discover a problem within your warranty term caused by defects in either workmanship or materials, we will see that it is either repaired or replaced. Repair or replacement depends on Fronius' evaluation of the issue and what we decide makes the most sense according to the situation. The warranty is based on the inverter's serial number, allowing the warranty to be transferred to another owner if the FRONIUS Solar Inverter remains installed in the original installation location. As the warranty is tied to the serial number, there is no paperwork to transfer the warranty to a new owner.

The FRONIUS Solar Inverters are designed to withstand normal operating conditions and typical wear and tear when the FRONIUS Solar Inverter is used for its original intent, in compliance with the local electrical codes, the FRONIUS Installation and Operational Manual(s) supplied with the original equipment. This warranty does not cover damages by improper installation or operation, misuse, abuse, manipulation, alterations or repair attempts, accidents, fire, floods, force Majeure, and incidental or consequential damage caused by defects with other components of the solar system. This warranty does not extend beyond the original cost of the FRONIUS Solar Inverter.

Any Fronius inverter that requires a warranty replacement within 180 days of shipping from Fronius, typically at least 90 days from the inverter and system commissioning, will be replaced by Fronius with a brand new inverter as standard policy.

Fronius service process for warranty returns and repairs:

• **Obtain a Returned Merchandise Authorization (RMA)**
- ✓ All returned FRONIUS Solar Inverters require an RMA.
- ✓ Call Fronius USA Technical Support at 810-220-4414 to obtain an RMA.
  - ✓ Technical Support is available Monday through Friday, excluding holidays, from 6:00 am to 6:00 pm P.S.T., and weekends by appointment only.

NOTE: ***There is no paperwork involved on the part of the installer to obtain an RMA as all information required will be obtained during the phone call.***

- **Steps and information required for the RMA application:**
  - ✓ Contact with a Fronius Technical Support Representative at 810-220-4414 to evaluate and troubleshoot the issue **while the inverter is in the field**, as many problems can be resolved on site.
  - ✓ If troubleshooting does not fix the problem, the following information will be required by the Technical Support Representative for the RMA application. The representative will collect this information over the phone:
    1. Model and Serial Number of the FRONIUS Solar Inverter.
    2. Detailed description of the problem including the Inverter's diagnostic code(s).
    3. Shipping address for the warranty replacement equipment.
    4. When the replacement inverter will be required.

Note: Failure to contact Fronius Technical support in advance of conducting service on any Fronius product will result in no service compensation being paid.

Once the RMA has been issued:

- ✓ Fronius USA will ship a replacement inverter or part ahead to the installer and every reasonable effort will be made to ship the replacement within the specified time as per point #4 above. Fronius will prepay the shipping costs.
- ✓ When the replacement inverter or part arrives and is installed, the installer simply places the defective item into the box from the replacement item.
    - Apply the included UPS call tag to the box and call UPS.
    - The defective inverter must be returned to Fronius USA within 14 days of receiving the replacement unit or a charge may be applied for the replacement. No service reimbursement will be issued until the product is returned.
    - All FRONIUS Solar Inverters authorized for return by Fronius USA must be returned in its original shipping container or packaging providing equal protection.

Warranty period for any repaired or replaced inverter: 12 months after shipment from Fronius USA or the original remaining warranty period, whichever is greater.

Service reimbursement: Fronius offers a service reimbursement amount of $250.00 per qualifying RMA.

Damage caused by shipping or mishandling: Visually evident damage caused by shipping or mishandling is to be reported to the freight carrier within 24 hours. Shipping damage is the responsibility of the freight carrier, not Fronius, and should always be duly noted with the freight carrier prior to accepting and signing for the product.

Some states do not allow the exclusion or limitation of incidental or consequential damages. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. Fronius USA, LLC General Terms and Conditions also apply.

Additional Information: Contact your local Solar Dealer, Fronius Distribution Partner, or Fronius for additional information on the Fronius 10-Year Premium Warranty. Additional resources may also be found on the Fronius USA Solar web site www.fronius-usa.com, including information on service assistance, online training, accessories, product information, or product manuals.

You may also contact Fronius Directly: Fronius Technical Support is available 6am to 6pm (P.S.T.) Monday through Friday excluding holidays and weekends by appointment only at 219-734-5601.

Fronius USA, LLC
6797 Fronius Drive
Portage, IN 46368
Ph. 219-734-5601
www.fronius-usa.com

Attachment 3: IronRidge Specifications and Warranty

Tech Brief

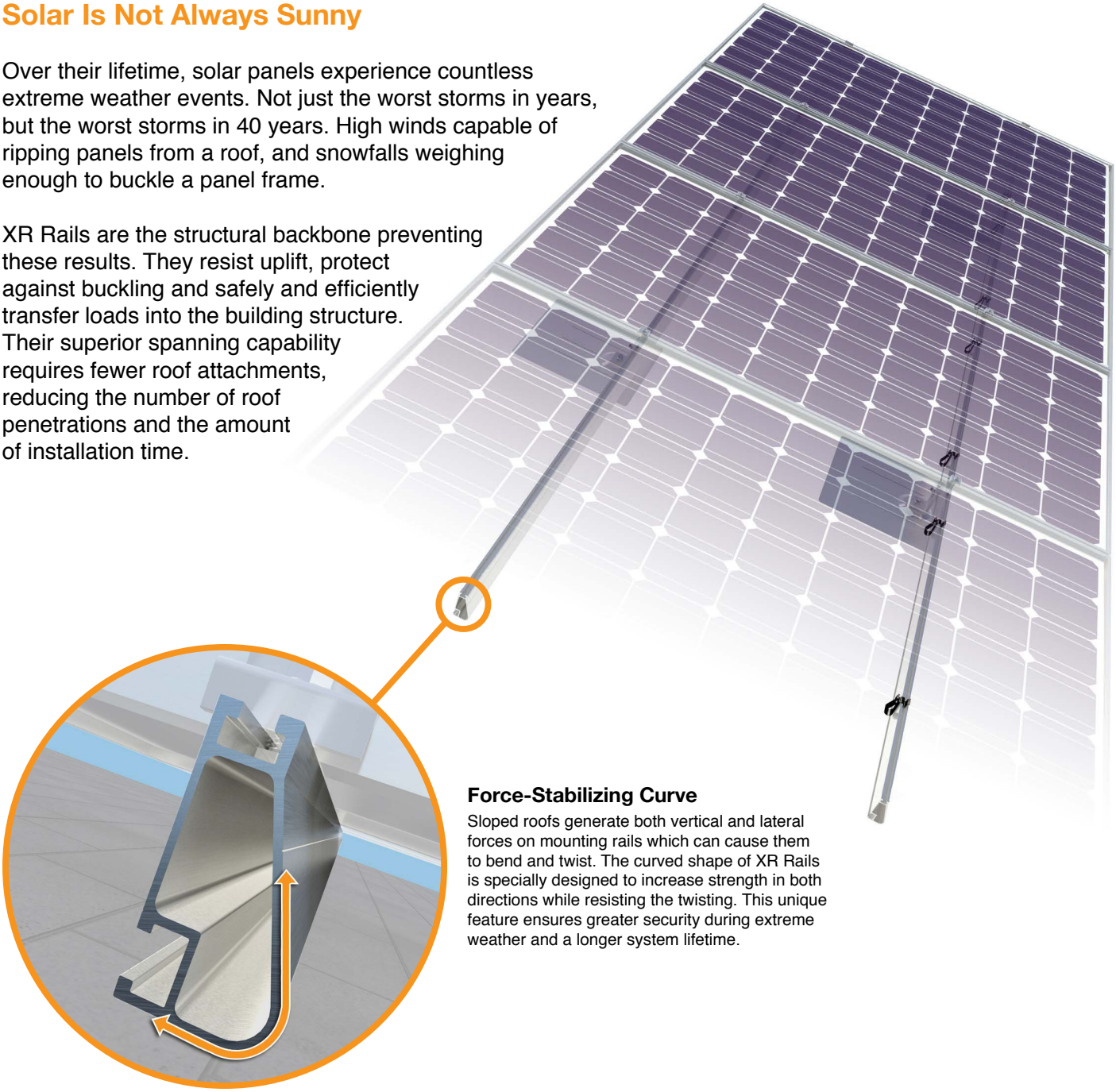
IRONRIDGE

XR Rail Family

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 marine-grade 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

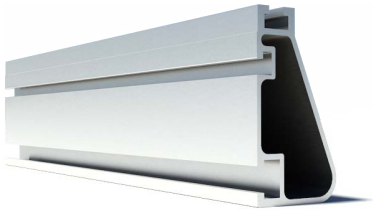
XR10 is a sleek, low-profile mounting rail, designed for regions with light or no snow. It achieves 6 foot spans, while remaining light and economical.

- 6' spanning capability
- Moderate load capability
- Clear 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 8 feet.

- 8' 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 12 feet or more for commercial applications.

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

Rail Selection

The following table was prepared in compliance with applicable engineering codes and standards. Values are based on the following criteria: ASCE 7-10, Roof Zone 1, Exposure B, Roof Slope of 7 to 27 degrees and Mean Building Height of 30 ft. Visit IronRidge.com for detailed span tables and certifications.

Load		Rail Span					
Snow (PSF)	Wind (MPH)	4'	5' 4"	6'	8'	10'	12'
None	100	XR10				XR1000	
	120						
	140			XR100			
	160						
10-20	100						
	120						
	140						
	160						
30	100						
	160						
40	100						
	160						
50-70	160						
80-90	160						

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1435 Baechtel Road
Willits, California 95490
Tel: 707-459-9523
Fax: 707-459-1833
www.ironridge.com

IronRidge Limited Warranties

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) 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.

Attachment 4: Full Spectrum Solar Warranty

FULL SPECTRUM SOLAR
Next Energy, LLC
1240 East Washington
Madison, WI 53703
Tel/Fax (608) 284-9495
info@fullspectrumsolar.com
www.fullspectrumsolar.com

Installation & Repair – Residential & Commercial – New Construction & Retrofit – Solar Electric & Solar Thermal

FIVE-YEAR WORKMANSHIP WARRANTY ON INSTALLED PHOTOVOLTAIC SYSTEMS

SCOPE OF COVERAGE

This warranty applies to complete photovoltaic systems designed and installed by FULL SPECTRUM SOLAR (hereinafter F.S.S.). It extends to the original owner and any subsequent owners or lessees.

WARRANTY

F.S.S. warrants its installation against any defects in labor and workmanship under normal use and service for a period of five (5) years from the date of completed system installation.

Any defect caused by labor or workmanship performed by F.S.S. will be corrected, repaired, or replaced by F.S.S. without charge to the customer during the first five (5) years of system operation. This service will occur within a reasonable amount of time when such defects become evident.

F.S.S. will provide field inspection of warranted items to verify failure, establish probable cause, and determine the corrective action required within a reasonable time, at no charge to the owner, when such failure is reported.

EXCLUSIONS

The above warranty does not apply to the following conditions:

1. Defects in system components and materials, and labor to correct, repair, or replace these defective components and materials. These components will be covered by the corresponding manufacturers' limited warranties, which will vary in length and terms of coverage. These components include, but are not limited to: solar modules, inverters, and other electrical equipment.
2. Those conditions resulting from a defect in a component that is not part of the products installed by F.S.S.
3. Damage of any sort or nature resulting from abuse, misuse, neglect, vandalism, accidents or fire, Force Majeure Events, utility power spikes, or other causes beyond the control of F.S.S.
4. Normal fading and minor deterioration of exterior surfaces due to exposure to the elements.
5. Conditions resulting from repair or alteration by anyone other than the original equipment manufacturer or person duly authorized by F.S.S. for such repair or alteration. This includes, but is not limited to, conditions relating to: disconnecting or moving modules, and service or adjustments to electrical equipment.
6. F.S.S. makes no warranty as to the performance of the system as this depends upon weather variables, which are impossible to predict or control.
7. F.S.S. shall not be liable for consequential damages (such as damage to your home, loss of time, inconvenience, loss of energy offset by the system, or loss of use of the product) or any incidental expenses resulting from any breach of the above expressed warranty.

RIGHT TO ARBITRATION

Any dispute between the buyer and F.S.S. pertaining to this warranty may at the option of the buyer be resolved by arbitration according to the rules of the American Arbitration Association or by mediation.