

ANN ARBOR HISTORIC DISTRICT COMMISSION

Staff Report

ADDRESS: 448 Fifth Street, Application Number HDC19-153

DISTRICT: Old West Side Historic District

REPORT DATE: September 12, 2019

REPORT PREPARED BY: Jill Thacher, Historic Preservation Coordinator

REVIEW COMMITTEE DATE: Monday, September 9, 2019

OWNER

Name: David Hall
Address: 448 Fifth Street
 Ann Arbor MI 48103
Phone: (734) 395-3782

APPLICANT

Homeland Builders/Solar
 4975 Miller
 Ann Arbor, MI 48103
 (313) 600-1066

BACKGROUND: This two-story brick Colonial Revival front-gabled house first appears in the 1905 City Directory. The occupant is listed as carpenter Albert Nordsman. The following year bottler George Voelker and his wife Catherine were the residents, and in 1910 widow Marie Dupper and her two daughters were sharing the house with the Voelkers. The house appears to have remained a two-family through the 1940s. The Voelkers lived in the house through 1915, and Mrs. Dupper until 1931. George (at right with horse Sam, courtesy AADL Old News) worked for Dupper's beer distribution business in a barn across the street (now the site of the Bach Elementary playground).



A small rear addition was approved by the HDC in October, 2011. A new dormer on the rear of the north elevation was approved in August, 2007. A one-story addition on the front of the house was approved by the HDC in April of 1994.

LOCATION: The property is located on the west side of Fifth Street, south of Liberty and north of Jefferson.

APPLICATION: The applicant seeks HDC approval to install a solar array on the south-facing roof of the main body of the house.

APPLICABLE REGULATIONS:

From the Secretary of the Interior's Standards for Rehabilitation:

- (2) The historic character of a property shall be retained and preserved. The removal of

historic materials or alteration of features and spaces that characterize a property shall be avoided.

- (9) New additions, exterior alterations, or related new construction shall not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.
- (10) New additions and adjacent or related new construction shall be undertaken in such a manner that if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

From the Secretary of the Interior's Guidelines for Rehabilitating Historic Buildings:

Roofs

Recommended: Identifying, retaining, and preserving roofs--and their functional and decorative features—that are important in defining the overall historic character of the building.

Not Recommended: Changing the configuration of a roof by adding new features such as dormer windows, vents, or skylights so that the historic character is diminished.

Energy Efficiency

Recommended: Placing a new addition that may be necessary to increase energy efficiency on non-character-defining elevations.

Not Recommended: Designing a new addition which obscures, damages, or destroys character-defining features.

Mechanical Equipment

Recommended: Providing adequate structural support for new mechanical equipment.

Not Recommended: Failing to consider the weight and design of new mechanical equipment so that, as a result, historic structural members or finished surfaces are weakened or cracked.

Installing a new mechanical system so that character-defining structural or interior features are radically changed, damaged, or destroyed.

From the Ann Arbor Historic District Design Guidelines (other Guidelines may apply):

Solar

Appropriate: Mounting solar panels at grade or on ground pole mountings. In the absence of an appropriate ground-based mounting location, panels should be mounted on side or rear facing roof surfaces.

Installing mechanical and service equipment on the roof related to the solar units and their related devices so that they are inconspicuous from the public right-of-way and do not damage or obscure character-defining features.

For sloped roof installations, mounting solar panels parallel to and within 8" of roof surface.

Not Appropriate: Mounting solar panels and their related devices on primary elevations or roofs that face the primary elevation or in planes that are highly visible from the street view. This location has the highest impact on the historic character of the historic building and all other options should be thoroughly explored.

Any other alteration or installation procedure that will cause irreversible changes to historic features or materials.

STAFF FINDINGS:

1. The application proposes to install an array of 21 solar panels on the south, side-facing roof on the main house block. The panels would flank the existing wall dormer. Black modules with black framing are appropriately proposed. Because the panels are confined to the south face of the roof, are one consistent color, and cover the majority of roof surface, staff believes the panels will not be a visual distraction from the historic structure. The roof material is asphalt, and the work is reversible.
2. Staff believes that the materials and design of the solar panels are compatible with the existing structure, neighboring buildings, and the surrounding historic district, and meet both the Secretary of the Interior's Standards and the *Ann Arbor Historic District Design Guidelines*.

POSSIBLE MOTIONS: (Note that the motion is only a suggestion. The Review Committee, consisting of staff and at least two Commissioners, will meet with the applicant on site and then make a recommendation at the meeting.)

I move that the Commission issue a certificate of appropriateness for the application at 448 Fifth Street, a contributing property in the Old West Side Historic District, to install a black-on-black solar array on the south-facing roof, as proposed. The work is compatible in exterior design, arrangement, texture, material and relationship to the rest of the building and the surrounding area and meets *The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings*, in particular standards 2, 9 and 10 and the guidelines for roofs, energy efficiency, and mechanical systems, as well as the *Ann Arbor Historic District Design Guidelines*, particularly as they pertain to solar installations.

MOTION WORKSHEET:

I move that the Commission issue a Certificate of Appropriateness for the work at 448 Fifth Street in the Old West Side Historic District

_____ Provided the following condition(S) is (ARE) met: 1) STATE CONDITION(s)

The work is generally compatible with the size, scale, massing, and materials and meets the Secretary of the Interior's Standards for Rehabilitation, standard(S) number(S) (*circle all that*

apply): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

ATTACHMENTS: application, photos, drawings, and technical information.

448 Fifth Street (2008 Survey Photo)





HISTORIC DISTRICT COMMISSION

PLANNING AND DEVELOPMENT SERVICES

City Hall: 301 E. Huron St. Ann Arbor, MI 48104-6120
 Mailing: P.O. Box 8647, Ann Arbor, MI 48107-8647
 Phone: 734.794.6265 ext. 42608 jthacher@a2gov.org
 Fax: 734.994.8460

Permit Number	HDC# 19-153
	BLDG#
RECEIVED	
AUG 14 2019	
PLANNING AND DEVELOPMENT SERVICES	

APPLICATION MUST BE FILLED OUT COMPLETELY

PROPERTY LOCATION/OWNER INFORMATION			
NAME OF PROPERTY OWNER DAVID HALL		HISTORIC DISTRICT	
PROPERTY ADDRESS 448 FIFTH STREET			CITY ANN ARBOR
ZIP CODE 48103	DAYTIME PHONE NUMBER (734) 395 3782	EMAIL ADDRESS DHALL@TRILTECH.COM	
PROPERTY OWNER'S ADDRESS (IF DIFFERENT FROM ABOVE)			STATE, ZIP
PROPERTY OWNER'S SIGNATURE			
SIGN HERE	<i>David R. Hall</i>	PRINT NAME	DATE
		DAVID R HALL	8/14/2019
APPLICANT INFORMATION			
NAME OF APPLICANT (IF DIFFERENT FROM ABOVE) HOMELAND BLDGS / SOLAR			
ADDRESS OF APPLICANT 4975 MILLER			CITY AZ
STATE	ZIP CODE 48103	PHONE / CELL # (313) 600-1066	FAX No
EMAIL ADDRESS dave@homeland solar (DAVE FRIEDRICH)			
APPLICANT'S SIGNATURE (If different from Property Owner)			
SIGN HERE	<i>[Signature]</i>	PRINT NAME	DATE
		X	8-14-19
BUILDING USE - CHECK ALL THAT APPLY			
<input checked="" type="checkbox"/> SINGLE FAMILY	<input type="checkbox"/> DUPLEX	<input type="checkbox"/> RENTAL	<input type="checkbox"/> MULTIPLE FAMILY
<input type="checkbox"/> COMMERCIAL	<input type="checkbox"/> INSTITUTIONAL		
PROPOSED WORK			
Describe in detail each proposed exterior alteration, improvement and/or repair (use additional paper, if necessary).			
Black-on-Black (w/ black rail) solar panels compliant w/ HD requirements to be installed on existing roof (south-face only).			
DESCRIBE CONDITIONS THAT JUSTIFY THE PROPOSED CHANGES			
Consistent w/ other compliant installations in HD done in recent and current year by applicant. Thank you.			
<i>[Signature]</i>			

For Further Assistance With Required Attachments, please visit www.a2gov.org/hdc



HISTORIC DISTRICT COMMISSION APPLICATION

FEE CHART	
DESCRIPTION	
Application for Staff Approval	\$35.00
Work started without approvals	Additional \$50.00
All other proposed work not listed below	\$100.00
Work started without approvals	Additional \$250.00
RESIDENTIAL - Single and 2-story Structures	
Addition: single story	\$300.00
Addition: taller than single story	\$550.00
New Structure - Accessory	\$100.00
New Structure - Principal	\$850.00
Replacement of single and 2-family window(s)	\$100 + \$25/window
COMMERCIAL - includes multi-family (3 or more unit) structures	
Additions	\$700.00
Replacement of multi-family and commercial window (s)	\$100 + \$50/window
Replacement of commercial storefront	\$250.00
DEMOLITION and RELOCATION	
Demolition of a contributing structure	\$1000.00
Demolition of a non-contributing structure	\$250.00
Relocation of a contributing structure	\$750.00
Relocation of a non-contributing structure	\$250.00

FOR COMMISSION REVIEWS:

- > Application withdrawals made before public notice is published will qualify for a 50% refund of the application fee.
- > Application withdrawals made after public notice is sent but before the public hearing will qualify for a 25% refund of the application fee.

INSTRUCTIONS FOR SUBMITTING APPLICATIONS

All HDC applications must be signed by the property owner and the applicant, if different, with the exception of staff approvals, which may be signed by only the applicant.

All completed HDC applications and their attachments may be submitted to Planning and Development Services by mail, in person (paper or digital), faxed, or via email to building@a2gov.org.

We accept CASH, CHECK, and all major credit cards. Checks should be made payable to "City of Ann Arbor"

HDC applications that are incomplete or not submitted with the required documentation or payment will not be processed or approved.

APPLICATION EXPIRATION

HDC applications expire three (3) years after the date of approval.

DATE OF HEARING ONLY

Date of Hearing: _____

Action: Approved HDC Denial Staff Denial

Staff Signature: _____

Comments: _____

Fee: \$ _____

Payment Type: Check Cash Credit Card



**EXPEDITED SOLAR PERMIT
APPLICATION –
RESIDENTIAL PROJECTS ONLY**

CONSTRUCTION AND BUILDING

City Hall: 301 E. Huron St. Ann Arbor, MI 48104-6120
 Mailing: P.O. Box 8647, Ann Arbor, MI 48107-8647
 Phone: 734.794.6263 ext. 0 building@a2gov.org
 Fax: 734.994.8460

APPLICATION MUST BE FILLED OUT COMPLETELY

**AUTHORITY: PA. 230 of 1972, AS AMENDED
 PENALTY: PERMIT WILL NOT BE ISSUED**

6/18/19

OFFICE USE ONLY	
Permit Number	BLDG# <u>n/a</u> ELEC# <u>19-1523</u>
DATE STAMP	
CITY OF ANN ARBOR RECEIVED JUN 14 2019 PLANNING AND DEVELOPMENT SERVICES	

-----TO BE COMPLETED BY CITY STAFF-----

Zoning Review required? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Electrical Review required? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Staff Initials: <u>JB</u> Date: <u>6/19/19</u>	Staff Initials: <u>JD</u> Date: <u>6/26/19</u>
Comments: <u>ROOF-MOUNT ONLY</u>	Comments: <u>Approved</u>

-----TO BE COMPLETED BY APPLICANT-----

STEP 1 – Project Information

Project Applicant:	Homeland Builders of Michigan		
Property Owner Name:	David and Barb Hall		
Project Address:	446 Fifth Street		
Zoning District:	R2D2		
Property Setbacks: (Ground mounted PV)	Front:	Sides:	Rear:
PV System Description:	<input checked="" type="radio"/> Roof-mounted <input type="radio"/> Ground-mounted		

STEP 2 – Eligibility Checklist

To Determine If You Are Eligible, Please Answer The Questions Below.	Yes	No
1. PV system is designed and proposed for a detached single-family house.	<input checked="" type="radio"/>	<input type="radio"/>
2. Solar installation has a rated capacity of 12kw or less.	<input checked="" type="radio"/>	<input type="radio"/>
3. Solar installation is not subject to Historic District Commission approval.	<input checked="" type="radio"/>	<input type="radio"/>
4. Mounting system is engineered and designed for PV.	<input checked="" type="radio"/>	<input type="radio"/>
5. Solar installation is compliant with all applicable electrical and building codes.	<input checked="" type="radio"/>	<input type="radio"/>
6. The Solar Installation Contractor complies with all licensing and other requirements of the jurisdiction and the state.	<input checked="" type="radio"/>	<input type="radio"/>
7. The PV system and all components will be installed per the manufacturer's specifications.	<input checked="" type="radio"/>	<input type="radio"/>



EXPEDITED SOLAR PERMIT APPLICATION SOLAR PERMIT STRUCTURE WORKSHEET con't

To Determine If You Are Eligible, Please Answer The Questions Below.	Yes	No
8. The project will comply with adopted National Electrical Code requirements.	<input checked="" type="radio"/>	<input type="radio"/>
9. Home will be code compliant to setbacks and height after PV installation.	<input checked="" type="radio"/>	<input type="radio"/>
10. The roof has no more than a single layer of roof covering (in addition to the solar equipment). If no, please complete Solar Permit Structure Worksheet.	<input checked="" type="radio"/>	<input type="radio"/>
11. To address uplift, panels are mounted parallel to the roof surface with no more than an 18" gap between the module frame and roof surface. (Except for flat roofs, no portion of the system may exceed the highest point of the roof).	<input checked="" type="radio"/>	<input type="radio"/>
12. Panels are mounted at no higher than the roof ridge or apex of roof (applies only to pitched roofs).	<input checked="" type="radio"/>	<input type="radio"/>
13. Total dead load of panels, supports, mountings, raceways, and all other appurtenances weigh no more than one of the following. If YES, indicate which: <input checked="" type="checkbox"/> No more than three and one-half (3.5) pounds per square foot (PSF) <input type="checkbox"/> Frameless panels on at least 3/12 pitch roof weighing no more than four and one-half (4.5) PSF <input type="checkbox"/> Frameless panels on at least 5/12 pitch roof weighing no more than five (5.0) PSF	<input checked="" type="radio"/>	<input type="radio"/>
14. Supports for solar panels are installed to spread the dead load across as many roof-framing members as needed to ensure that at no point loads in excess of fifty (50) pounds are created. (Distributed weight of less than 5 pounds per sqft).	<input checked="" type="radio"/>	<input type="radio"/>
15. Method and type of all weatherproofing roof penetrations are provided.	<input checked="" type="radio"/>	<input type="radio"/>
16. Completed solar structural worksheet	<input checked="" type="radio"/>	<input type="radio"/>
17. This document shall be submitted with an Electrical Permit	<input checked="" type="radio"/>	<input type="radio"/>
Comments:		

- **A Building Permit is required:** If you answered "No" to any of Questions 1-17, you are not eligible to participate in the expedited permitting process and must go through the standard permitting process dictated by the municipality.
 - If you answered "No" to any of Questions 10-17, you must provide a letter from a Professional Engineer or Registered Architect certifying that the existing structure can support the additional weight and wind loads of the solar energy system.
- If you answered "Yes" to all of the above questions, please sign below to affirm that all answers are correct, and that you have met all the conditions and requirements to participate in this expedited process.

Property Owner's Signature _____
David Bredich

 Solar Installation Contractor Signature

Date _____
 6-12-19

 Date



EXPEDITED SOLAR PERMIT APPLICATION **SOLAR PERMIT STRUCTURE WORKSHEET con't**

STEP 3 - Additional Information

Existing Use: One (1) and two (2) Family Dwellings Only

**Provide the total system
capacity rating (sum of
all panels):**

PV System: 7.44 kW-DC

SOLAR INSTALLATION CONTRACTOR

BUSINESS NAME:

Homeland Builders of Michigan

BUSINESS ADDRESS:

4975 Miller Rd, Ann Arbor, MI 48103

CONTACT NAME:

Dave Friedrichs

CONTACT PHONE NUMBER:

(313)600-1066



EXPEDITED SOLAR PERMIT APPLICATION

SOLAR PERMIT STRUCTURE WORKSHEET

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WORKSHEET MUST BE FILLED OUT COMPLETELY

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 PENALTY: PERMIT WILL NOT BE ISSUED

If array is roof mounted:

This section is for evaluating roof structural members that are site built. This includes rafter systems and site built trusses. Manufactured truss and roof joist systems, when installed with proper spacing, meet the roof structure requirements covered in item 2 below.

1. Roof construction: Rafters Trusses Other: _____
2. Describe site-built rafter or site-built truss system:
 - a. Rafter size: 2 x 4 inches
 - b. Rafter spacing: 24 inches off center
 - c. Lumber species: pine
 - d. Maximum unsupported span: 6 feet, 0 inches
 - e. Are the rafters over-spanned? (see the IRC span tables):
 - Yes
 - No

If **Yes**, complete the rest of the section.

3. If the roof system has the following (a through c, below):
 - a. over-spanned rafters or trusses,
 - b. the array over 5lbs/ft² on any roof construction, or
 - c. the attachments with a dead load exceeding 45 lbs per attachment;

Then, a Building Permit is **Required** – include the following below, with your application:

- i. A framing plan that shows details for how you will strengthen the rafters using span tables, as applicable.
- ii. Confirmation certified by a design professional that the roof structure will support the array.

*If an array is ground mounted **and** under 200 sqft, then a building permit is not required only an electrical permit. Please contact Zoning Compliance Officer; Jon Barrett - 734.794.6265*

4. What is the existing roof material?

Shingles

5. Provide method and type of weatherproofing for roof penetrations (i.e. flashing, caulk).

Roof Tech E-mount



EXPEDITED SOLAR PERMIT APPLICATION SOLAR PERMIT STRUCTURE WORKSHEET con't

6. Is the mounting structure an engineered product designed to mount PV modules?

Yes

No

If no, provide details of structural attachment in a letter certified by a design professional.

7. For manufacturing mounting systems, provide the following information about the mounting system:

- a. Mounting System Manufacturer Iron Ridge
- b. Product Name and Model Number XR100
- c. Total Weight of PV Modules and Rails 1,074.70 lbs.
- d. Total Number of Attachment Points 44
- e. Weight per Attachment Point (c ÷ d) 24.4 lbs.
- f. Maximum Spacing Between Attachment Points on a Rail 84 inches
(see product manual for maximum spacing allowed based on maximum design wind speed)
- g. Total Surface Area of PV Modules (square feet) 384 ft²
- h. Distributed Weight of PV Module on Roof (c ÷ g) 2.8 lbs./ft²

8. Indicate quantity, brand, make and model of the:

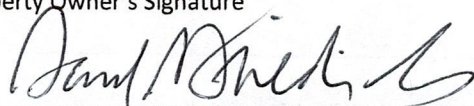
Inverter(s):

<u>1</u>	<u>SolarEdge</u>	<u>SE7600H-US</u>
Quantity	Make	Model

Modules:

<u>24</u>	<u>Jinko</u>	<u>JKM310M-60</u>
Quantity	Make	Model

Please sign below to affirm that all answers are correct and that you have met all the conditions and requirements to participate in this expedited process.

Property Owner's Signature

 Solar Installation Contractor Signature

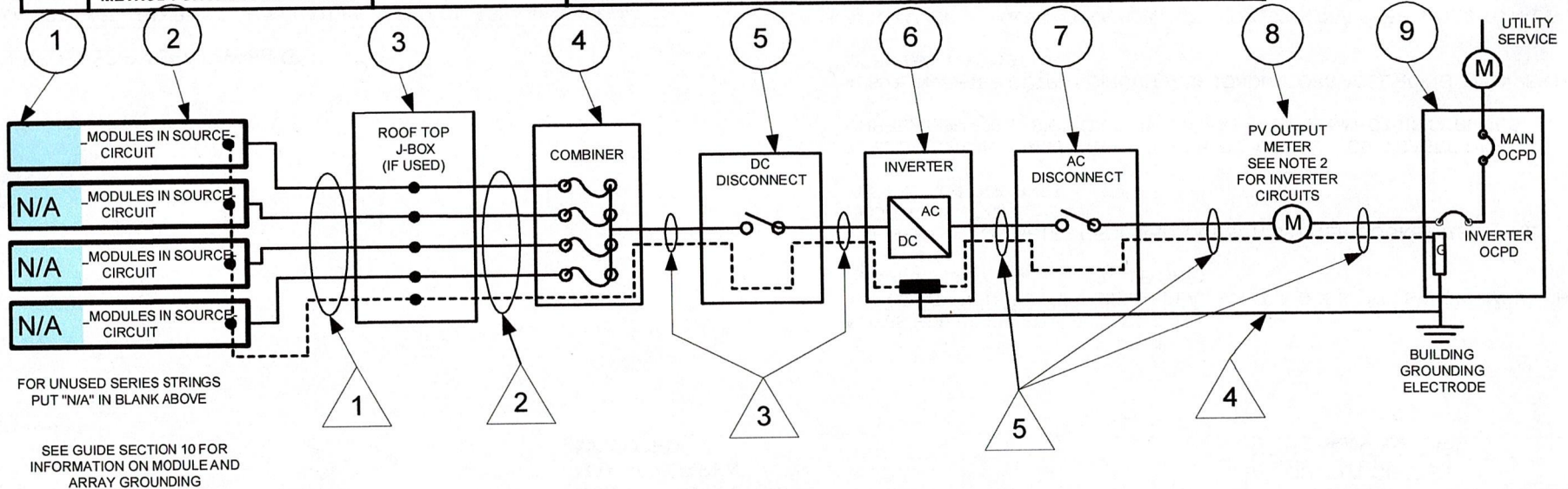
Date
6-12-2019
 Date

Site Plan Hall, 446 Fifth St, Ann Arbor, MI 48103



Mark Dorogi
(734)846-8911

EQUIPMENT SCHEDULE			
TAG	DESCRIPTION	PART NUMBER	NOTES
1	SOLAR PV MODULE		Jinko 310 W, 24 Panels, 7.44 kW DC
2	PV ARRAY		SolarEdge Power Optimizer P320
3	J-BOX (IF USED)		
4	COMBINER (IF USED)		
5	DC DISCONNECT		SolarEdge SE7600H-US, integral DC disconnect
6	DC/AC INVERTER		SolarEdge SE7600H-US
7	AC DISCONNECT (IF USED)		NEMA 3R, non-fused, 60A
8	GEN METER (IF USED)		
9	SERVICE PANEL		200A
	METHOD FOR RAPID SHUTDOWN		Inverter certified to UL1741



STANDARD ELECTRICAL DIAGRAM FOR SMALL-SCALE, SINGLE-PHASE PV SYSTEMS

SITE NAME: Hall

SITE ADDRESS: 446 Fifth Street

SYSTEM AC SIZE: 7.6 kW

CONTRACTOR / ENG. NAME: Homeland Builders of Michigan

CONTRACTOR / ENG. ADDRESS: 4975 Miller Rd, Ann Arbor, MI 48103

CONTRACTOR / ENG. LIC #: 2102200014

EXPIRATION DATE: 5/31/2020

DRAWN BY: M. Dorogi

DATE: 5/24/2019

DRAWING NO:

CONDUIT AND CONDUCTOR SCHEDULE					
Δ TAG	DESCRIPTION OF CONDUCTOR TYPE	Cond. Gauge	# of Conductors	Conduit Type	Conduit Size
1	CONDUCTOR TYPE: USE-2 or PV WIRE BARE COPPER EQ. GND. COND. (EGC)		2 1		
2	CONDUCTOR TYPE: THWN-2 or XHHW-2		2		
3	CONDUCTOR TYPE: THWN-2 or XHHW-2 INSULATED EGC		2 1		
4	DC GROUNDING ELECTRODE COND.		1		
5	CONDUCTOR TYPE: THWN-2 or XHHW-2 INSULATED EGC		2 1		

PV MODULE RATINGS	
MODULE MAKE	Jinko
MODULE MODEL	JKM310M-60
MAX. POWER POINT CURRENT (Imp)	9.4
MAX. POWER POINT VOLTAGE (Vmp)	33.0
OPEN-CIRCUIT VOLTAGE (Voc)	40.5
SHORT-CIRCUIT CURRENT (Isc)	9.92
MAX. SERIES FUSE (OCPD)	15A
MAX. POWER (Pmax)	310
MAX. VOLTAGE (TYP 600 VDC)	1000V

NOTES FOR ALL DRAWINGS

OCPD=OVERCURRENT PROTECTION DEVICE

NATIONAL ELECTRICAL CODE REFERENCES SHOWN AS (NEC XXX.XX)

INVERTER RATINGS

INVERTER MAKE	SolarEdge
INVERTER MODEL	SE7600H-US
MAX. DC VOLT RATING	400
MAX POWER @40°C	7600
NOMINAL AC VOLTAGE	240
MAX AC CURRENT	32
MAX OCPD	40

**LABELS PER ARTICLE 690 OF NEC
SIGN FOR DC DISCONNECT**

PHOTOVOLTAIC POWER SOURCE	
RATED MPP CURRENT	14A
RATED MPP VOLTAGE	400V
MAX. SYSTEM VOLTAGE	500V
MAX CIRCUIT CURRENT	60A
WARNING ELECTRICAL SHOCK HAZARD-LINE AND LOAD MAY BE ENERGIZED IN OPEN POSITION	
SIGN FOR INVERTER OCPD AND AC DISCONNECT (IF USED)	
AC POINT OF CONNECTION	
AC OUTPUT CURRENT	32A
NOMINAL AC VOLTAGE	240V

NOTES FOR ARRAY CIRCUIT WIRING

- 1) LOWEST EXPECT AMBIENT TEMPERATURE BASED ON ASHRAE MINIMUM MEAN EXTREME DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION. LOWEST EXPECTED AMBIENT TEMP 0 °C
- 2) HIGHEST CONTINUOUS AMBIENT TEMPERATURE BASED ON ASHRAE HIGHEST MONTH 2% DRY BULB TEMPERATURE FOR ASHRAE LOCATION MOST SIMILAR TO INSTALLATION LOCATION. HIGHEST CONTINUOUS TEMPERATURE 34 °C
- 3) 2005 ASHRAE FUNDAMENTALS 2% DESIGN TEMPERATURES DO NOT EXCEED 47°C IN THE UNITED STATES (PALM SPRINGS, CA IS 44.1°C). FOR LESS THAN 9 CURRENT-CARRYING CONDUCTORS IN ROOF-MOUNTED SUNLIT CONDUIT AT LEAST 1/2" ABOVE ROOF AND USING THE OUTDOOR DESIGN TEMPERATURE OF 47°C OR LESS (ALL OF UNITED STATES),
 - a) 12 AWG 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH Isc OF 7.68 AMPS OR LESS WHEN PROTECTED BY A 12 AMP OR SMALLER FUSE
 - b) 10 AWG 90°C CONDUCTORS ARE GENERALLY ACCEPTABLE FOR MODULES WITH Isc OF 9.6 AMPS OR LESS WHEN PROTECTED BY A 15 AMP OR SMALLER FUSE

NOTES FOR INVERTER CIRCUITS

- 1) IF UTILITY REQUIRES A VISIBLE-BREAK SWITCH, DOES THIS SWITCH MEET THE REQUIREMENT? Yes NO (CIRCLE ONE)
- 2) IF GENERATION METER REQUIRED, DOES THIS METER SOCKET MEET THE REQUIREMENT? Yes YES / NO (CIRCLE ONE)
- 3) SIZE PHOTOVOLTAIC POWER SOURCE (DC) CONDUCTORS BASED ON MAX CURRENT ON 690.53 SIGN OR OCPD RATING AT DISCONNECT (IF SUPPLIED)
- 4) SIZE INVERTER OUTPUT CIRCUIT (AC) CONDUCTORS ACCORDING TO INVERTER OCPD AMP RATING
- 5) TOTAL OF 1 INVERTER OCPD(S), ONE FOR EACH INVERTER. DOES TOTAL SUPPLY BREAKERS COMPLY WITH 120% BUSBAR EXCEPTION IN 690.64(B)(2)(a)? Yes NO (CIRCLE ONE)

STANDARD ELECTRICAL DIAGRAM FOR SMALL-SCALE, SINGLE-PHASE PV SYSTEMS

SITE NAME: Hall

SITE ADDRESS: 446 Fifth Street

SYSTEM AC SIZE: 7.6 kW

CONTRACTOR / ENG. NAME: Homeland Builders of Michigan

CONTRACTOR / ENG. ADDRESS: 4975 Miller Rd, Ann Arbor, MI 48103

CONTRACTOR / ENG. LIC # : 2102200014

EXPIRATION DATE: 5/31/2020

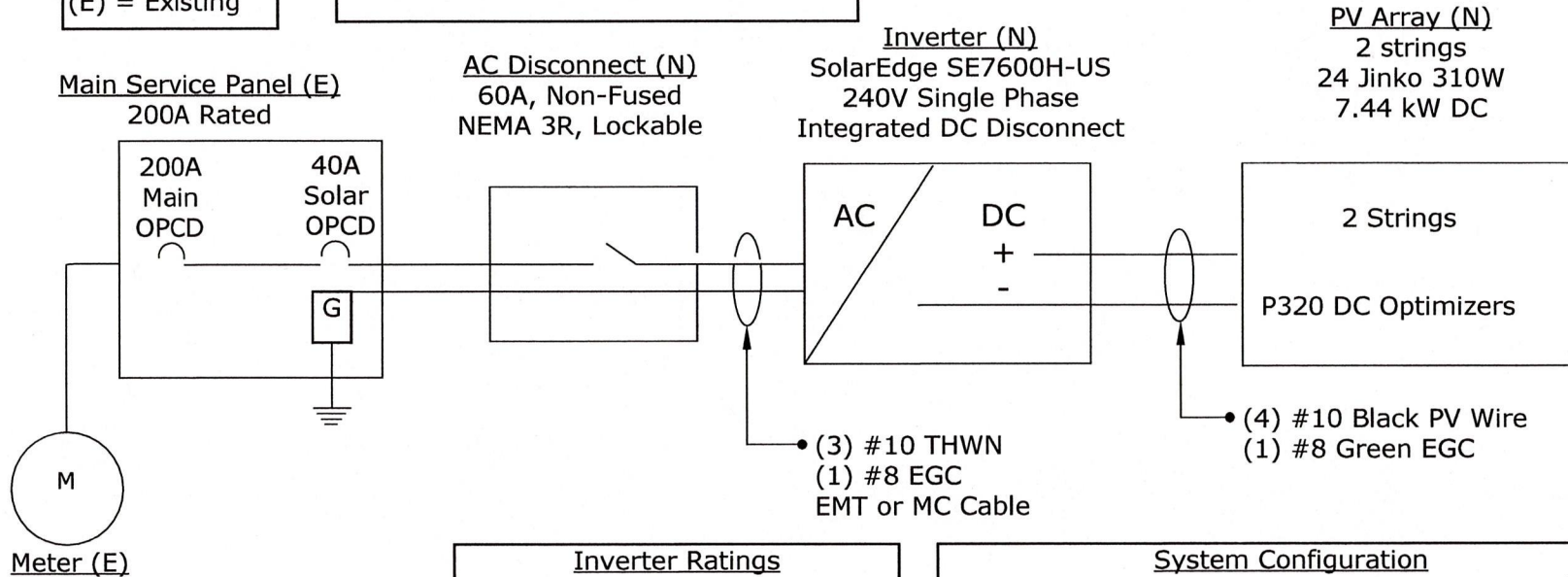
DRAWN BY: M. Dorogi

DATE: 5/24/2019

DRAWING NO:

(N) = New
(E) = Existing

Electrical One Line



Key Manufacturers:

- Solar Panels
Jinko Solar (U.S.) Inc
595 Market Street, Suite 2200
San Francisco, CA 94105
- Inverter
SolarEdge Technologies
47505 Seabridge Dr.
Fremont, CA 94538
- Racking
IronRidge
1495 Zephyr Avenue
Hayward, CA 94544

All components are UL listed and CEC Certified, where warranted

Inverter Ratings
SolarEdge SE7600H-US
Input: 20A @ 400V DC
Output: 32A @ 240V AC
UL1741, UL1699B, UL1714 SA,
CSA 22.2, NEMA 3R

Module Ratings
Jinko 310W Mono

Pmax-	310
Vmp-	33.0V
Imp-	9.40A
Voc-	40.5V
Isc-	9.92A

System Configuration

DC kW STC:	7.44
AC kW:	7.6
Operating AC Voltage:	240V single phase
Operating DC Voltage:	400V
Number of Strings:	2
Modules per String:	12
Module:	JKM310M-60
Number of Inverters:	1
Inverter:	SE7600H-US
Optimizer:	P400 SolarEdge
Main Breaker Rating:	200A
PV Breaker Rating:	40A

Electrical Notes:

1. All modules and rails will be grounded per code and per manufacturers instructions.
2. If existing grounding electrode cannot be verified, contractor shall install supplemental grounding electrode.
3. System will be commissioned by utility per Interconnection Agreement.

Installer
Homeland Solar
4975 Miller
Ann Arbor, MI 48103

Owner
Barb and David Hall
446 Fifth Street
Ann Arbor, MI 48103

drawn by
L. McFaul
04/23/2019



Eagle 60 290-310 Watt

MONO PERC MODULE

Positive power tolerance of 0-+3%



KEY FEATURES



Innovative Solar Cells

Five busbar monocrystalline PERC cell technology improves module efficiency



High Efficiency

Higher module conversion efficiency (up to 18.94%) due to Passivated Emmitter Rear Contact (PERC) technology



PID Free

World's 1st PID-Free module



Low-Light Performance

Advanced glass technology improves light absorption and retention



Strength and Durability

Certified for high snow (5400Pa) and wind (2400Pa) loads



Weather Resistance

Certified for salt mist and ammonia resistance

LINEAR PERFORMANCE WARRANTY

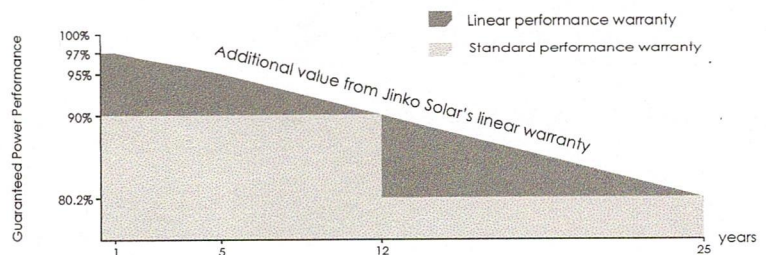
10 Year Product Warranty • 25 Year Linear Power Warranty

- ISO9001:2008 Quality Standards
- ISO14001:2004 Environmental Standards
- OHSAS18001 Occupational Health & Safety Standards

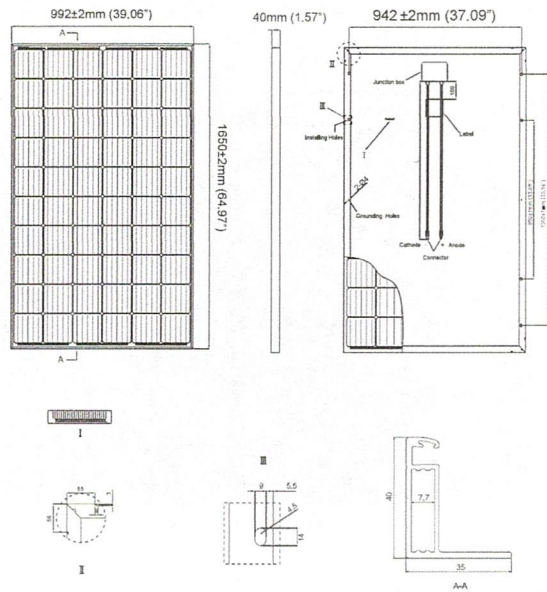
Nomenclature:

JKM310M - 60B

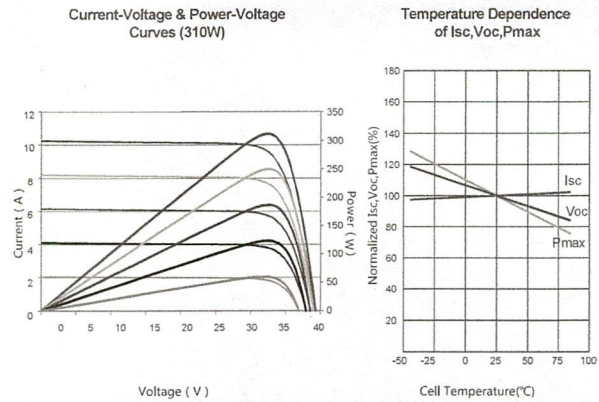
Code	Backsheet
null	White
B	Black



Engineering Drawings



Electrical Performance & Temperature Dependence



Mechanical Characteristics

Cell Type	Monocrystalline PERC 156×156mm (6 inch)
No. of Cells	60 (6×10)
Dimensions	1650×992×40mm (64.97×39.06×1.57 inch)
Weight	18.5 kg (40.8 lbs.)
Front Glass	3.2mm, Anti-reflection Coating, High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminium Alloy (Black)
Junction Box	IP67 Rated
Output Cables	12 AWG, Length: 900mm (35.43 inch)
Fire Type	Type 1

Packaging Configurations

(Two boxes=One Pallet)
26 pcs/box, 52 pcs/pallet, 728 pcs/40'HQ Container

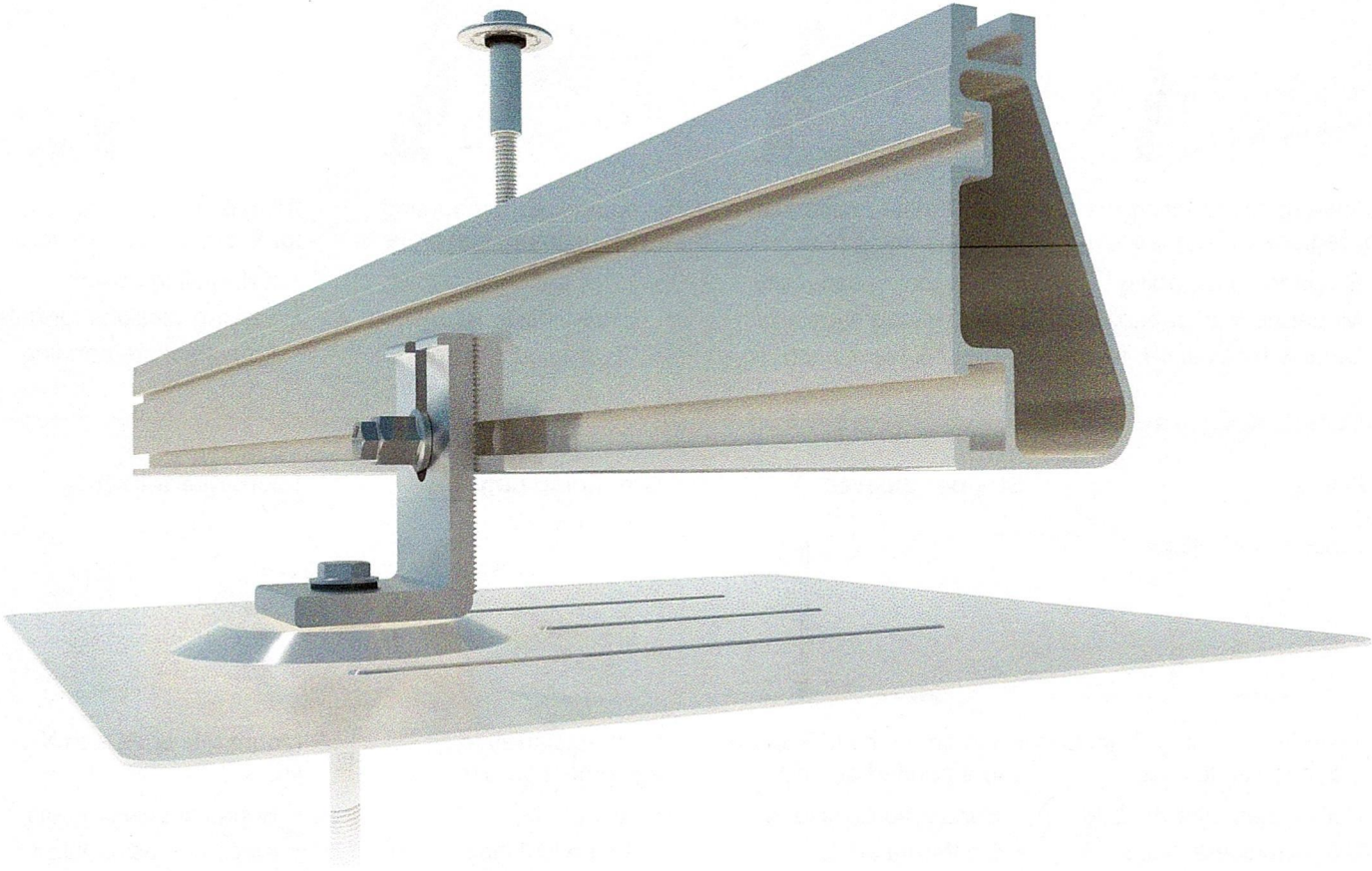
SPECIFICATIONS

Module Type	JKM290M-60		JKM295M-60		JKM300M-60		JKM305M-60		JKM310M-60	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	290Wp	216Wp	295Wp	220Wp	300Wp	224Wp	305Wp	227Wp	310Wp	231Wp
Maximum Power Voltage (Vmp)	32.2V	30.2V	32.4V	30.4V	32.6V	30.6V	32.8V	30.8V	33.0V	31.0V
Maximum Power Current (Imp)	9.02A	7.15A	9.10A	7.24A	9.21A	7.32A	9.30A	7.40A	9.40A	7.49A
Open-circuit Voltage (Voc)	39.5V	36.6V	39.7V	36.8V	40.1V	37.0V	40.3V	37.2V	40.5V	37.4V
Short-circuit Current (Isc)	9.55A	7.81A	9.61A	7.89A	9.72A	8.01A	9.83A	8.12A	9.92A	8.20A
Module Efficiency STC (%)	17.72%		18.02%		18.33%		18.63%		18.94%	
Operating Temperature (°C)	-40°C~+85°C									
Maximum System Voltage	1000VDC (UL and IEC)									
Maximum Series Fuse Rating	20A									
Power Tolerance	0~+3%									
Temperature Coefficients of Pmax	-0.39%/°C									
Temperature Coefficients of Voc	-0.29%/°C									
Temperature Coefficients of Isc	0.048%/°C									
Nominal Operating Cell Temperature (NOCT)	45±2°C									

* STC: Irradiance 1000W/m² Cell Temperature 25°C AM=1.5

NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM=1.5 Wind Speed 1m/s

* Power measurement tolerance: ± 3%



Built for solar's toughest roofs.

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

Our rigorous approach has led to unique structural features, such as curved rails and reinforced flashings, and is also why our products are fully certified, code compliant and backed by a 20-year warranty.



Strength Tested

All components evaluated for superior structural performance.



PE Certified

Pre-stamped engineering letters available in most states.



Class A Fire Rating

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



Design Assistant

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



UL 2703 Listed System

Meets newest effective UL 2703 standard.

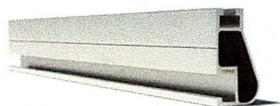


20-Year Warranty

Twice the protection offered by competitors.

XR Rails

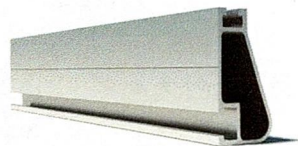
XR10 Rail



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

- 6' spanning capability
- Moderate load capability
- Clear & black anod. finish

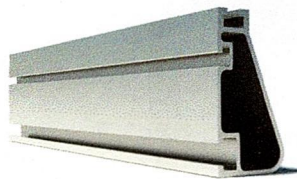
XR100 Rail



The ultimate residential solar mounting rail.

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

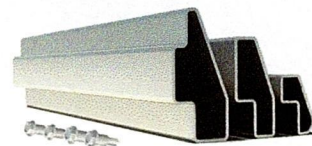
XR1000 Rail



A heavyweight mounting rail for commercial projects.

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

Bonded Splices

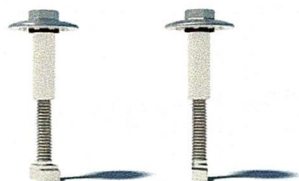


All rails use internal splices for seamless connections.

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

Clamps & Grounding

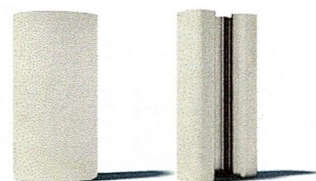
UFOs



Universal Fastening Objects bond modules to rails.

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

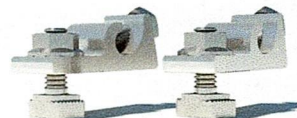
Stopper Sleeves



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

- Bonds modules to rails
- 6 different sizes
- Clear & black anod. finish

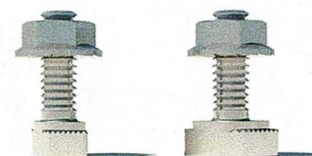
Grounding Lugs



Connects array to equipment ground.

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

Microinverter Kit

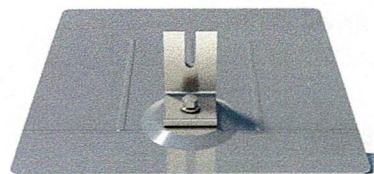


Mount MIs or POs to XR Rails.

- Bonds devices to rails
- Kit comes assembled
- Listed to UL 2703

Attachments

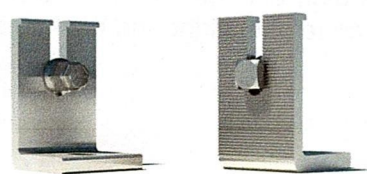
FlashFoot



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

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

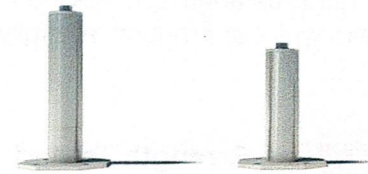
Bonded L-Feet



Drop-in design for rapid rail attachment.

- Bonding hardware included
- Forms secure rail connection
- Clear & black anod. finish

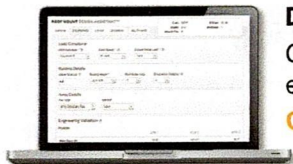
Standoffs



Raise Flush Mount System to various heights.

- Works with vent flashing
- Ships assembled
- 4" and 7" Lengths

Resources



Design Assistant

Go from rough layout to fully engineered system. For free.

[Go to IronRidge.com/design](http://IronRidge.com/design)



NABCEP Certified Training

Earn free continuing education credits, while learning more about our systems.

[Go to IronRidge.com/training](http://IronRidge.com/training)

Project Details			
Name	446 5th Street	Date	04/23/2019
Location	Ann Arbor, MI, 48103	Total modules	21
Module	Jinko: JKM310M-60L (35mm)	Total watts	6,510
Dimensions	65.55" x 39.45" x 1.38" (1664.97mm x 1002.03mm x 35.0mm)	Attachments	44

System Weight		Load Assumptions	
Total system weight	1,074.7 lbs	Wind exposure	B
Weight/attachment	24.4 lbs	Wind speed	110 mph
Racking weight	194.8 lbs	Ground snow load	20 psf
Distributed weight	2.8 psf	Attachment spacing	4.0'

Roof Information			
Roof material	Comp Shingle	Building height	15 ft
Roof attachment	L-Foot Only	Roof slope	18 °
Attachment hardware	Square	Risk category	II

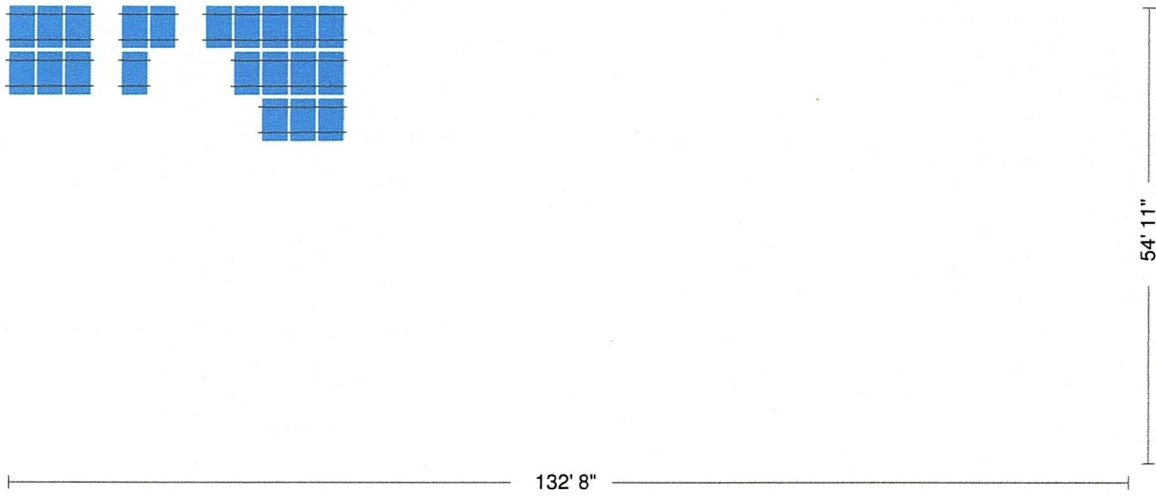
Span Details XR100 - Portrait		
Zone	Max span	Max cantilever
1	6' 6"	2' 7"
2	6' 6"	2' 7"
3	6' 6"	2' 7"

Reaction Forces XR100 - Portrait			
Zone	Down (lbs)	Uplift (lbs)	Lateral (lbs)
1	226	92	66
2	226	192	66
3	226	304	66

Roof Section 1

Definition	Roof Section Weights	Roof Section (all segments)
21 modules	Total weight: 1,074.7 lbs	Provided rail: 224' [16 x 14']
Portrait orientation	Weight/attachment: 24.4 lbs	Attachments: 44
Graphical entry	Total Area: 386.5 sq ft	Splices: 2
	Distributed weight: 2.8 psf	Clamps: 56

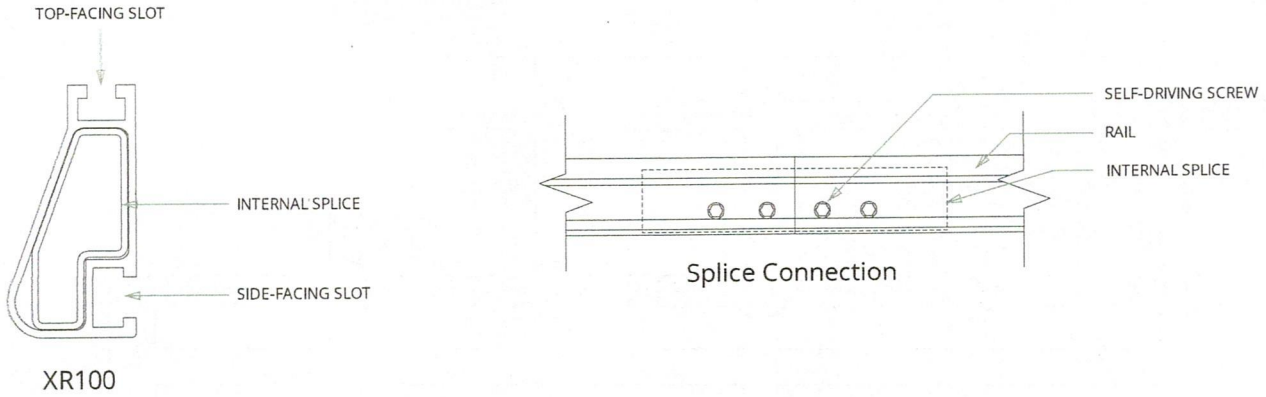
Diagram



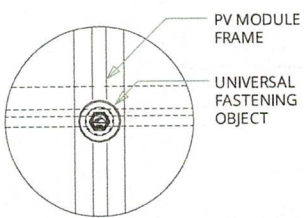
Segments

Columns	Length	Cantilever	Cantilever Violations	Rail	Attachments	Splices	Clamps
1	3' 5"	0"	None	28' [2 x 14']	4	0	4
2	6' 9"	1' 5"	None	28' [2 x 14']	4	0	6
3	10' 1"	1' 1"	None	28' [2 x 14']	6	0	8
Row segment totals (x 3) →				84' [6 x 14']	18	0	24
4	13' 5"	8"	None	28' [2 x 14']	8	0	10
5	16' 9"	4"	None	56' [4 x 14']	10	2	12

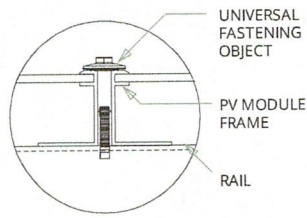
Splice Details



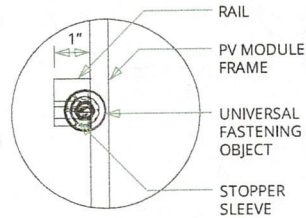
Clamp Detail



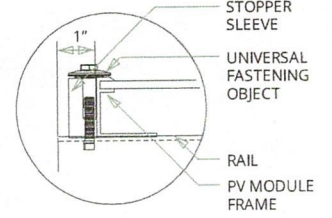
Mid Clamp, Plan



Mid Clamp, Front

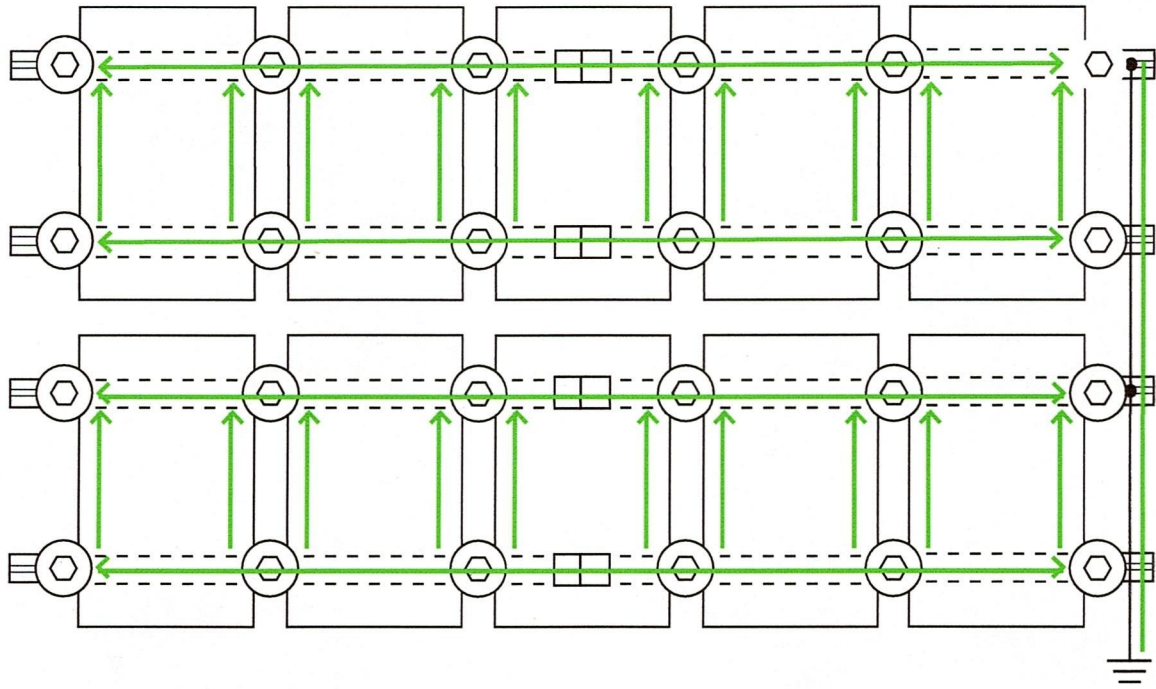


End Clamp, Plan



End Clamp, Front

Grounding Diagram



 UFO Clamp

 Fault Current Ground Path

 Grounding Lug *

 Min 10 AWG Copper Wire *

 Bonded Splice (Rail Connection)

* Grounding Lugs and Wire are not required in systems using Enphase microinverters.

Bill of Materials

Part	Spares	Total Qty
Rails & Splices		
XR-100-168A XR100, Rail 168" (14 Feet) Clear	0	16
XR-100-SPLC-M1 XR100 Bonded Splice (Incl. Self-tapping Screws)	0	2
Clamps & Grounding		
UFO-CL-01-A1 Universal Module Clamp, Clear	0	56
UFO-STP-35MM-M1 Stopper Sleeve, 35MM, Mill	0	28
XR-LUG-03-A1 Grounding Lug, Low Profile	0	7
Attachments		
LFT-03-M1 Slotted L-Foot, Mill	0	44
BHW-SQ-02-A1 Square-Bolt Bonding Hardware	0	44
Accessories		
29-4000-077 Wire Clips, Molded PVC Black, Polybag 20	0	3
BHW-MI-01-A1 Microinverter Bonding Hardware, T-Bolt	0	21

solar**edge**

Single Phase Inverter with HD-Wave Technology for North America

SE3000H-US / SE3800H-US / SE5000H-US /
SE6000H-US / SE7600H-US / SE10000H-US / SE11400H-US

INVERTERS



Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- High reliability without any electrolytic capacitors
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)





Single Phase Inverter

with HD-Wave Technology for North America
 SE3000H-US / SE3800H-US / SE5000H-US /
 SE6000H-US / SE7600H-US / SE10000H-US / SE11400H-US

	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	SE10000H-US	SE11400H-US	
OUTPUT								
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA
Max. AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	-	Vac
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac
AC Frequency (Nominal)					59.3 - 60 - 60.5 ⁽¹⁾			Hz
Maximum Continuous Output Current 208V	-	16	-	24	-	-	-	A
Maximum Continuous Output Current @240V	12.5	16	21	25	32	42	47.5	A
GFDI Threshold					1			A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds					Yes			
INPUT								
Maximum DC Power @240V	4650	5900	7750	9300	11800	15500	17650	W
Maximum DC Power @208V	-	5100	-	7750	-	-	-	
Transformer-less, Ungrounded					Yes			
Maximum Input Voltage					480			Vdc
Nominal DC Input Voltage					380	400		Vdc
Maximum Input Current 208V	-	9	-	13.5	-	-	-	
Maximum Input Current @240V	8.5	10.5	13.5	16.5	20	27	30.5	Adc
Max. Input Short Circuit Current					45			Adc
Reverse-Polarity Protection					Yes			
Ground-Fault Isolation Detection					600k Ω Sensitivity			
Maximum Inverter Efficiency	99			99.2				%
CEC Weighted Efficiency					99			%
Nighttime Power Consumption					< 2.5			W
ADDITIONAL FEATURES								
Supported Communication Interfaces					RS485, Ethernet, ZigBee (optional), Cellular (optional)			
Revenue Grade Data, ANSI C12.20					Optional ⁽²⁾			
Rapid Shutdown - NEC 2014 and 2017 690.12					Automatic Rapid Shutdown upon AC Grid Disconnect			
STANDARD COMPLIANCE								
Safety					UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCL according to T.I.L. M-07			
Grid Connection Standards					IEEE1547, Rule 21, Rule 14 (HI)			
Emissions					FCC Part 15 Class B			
INSTALLATION SPECIFICATIONS								
AC Output Conduit Size / AWG Range					3/4" minimum / 14-6 AWG	3/4" minimum / 14-4 AWG		
DC Input Conduit Size / # of Strings / AWG Range					3/4" minimum / 1-2 strings / 14-6 AWG	3/4" minimum / 1-3 strings / 14-6 AWG		
Dimensions with Safety Switch (HxWxD)					17.7 x 14.6 x 6.8 / 450 x 370 x 174	21.3 x 14.6 x 7.3 / 540 x 370 x 185		in / mm
Weight with Safety Switch	22 / 10	25.1 / 11.4	26.2 / 11.9			38.8 / 17.6		lb / kg
Noise					< 25	< 50		dBA
Cooling					Natural Convection	Natural convection		
Operating Temperature Range					-13 to +140 / -25 to +60 ⁽³⁾ (-40°F / -40°C option) ⁽⁴⁾			°F / °C
Protection Rating					NEMA 3R (Inverter with Safety Switch)			

⁽¹⁾ For other regional settings please contact SolarEdge support

⁽²⁾ Revenue grade inverter P/N: SExxxxH-US000NNC2

⁽³⁾ For power de-rating information refer to: <https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf>

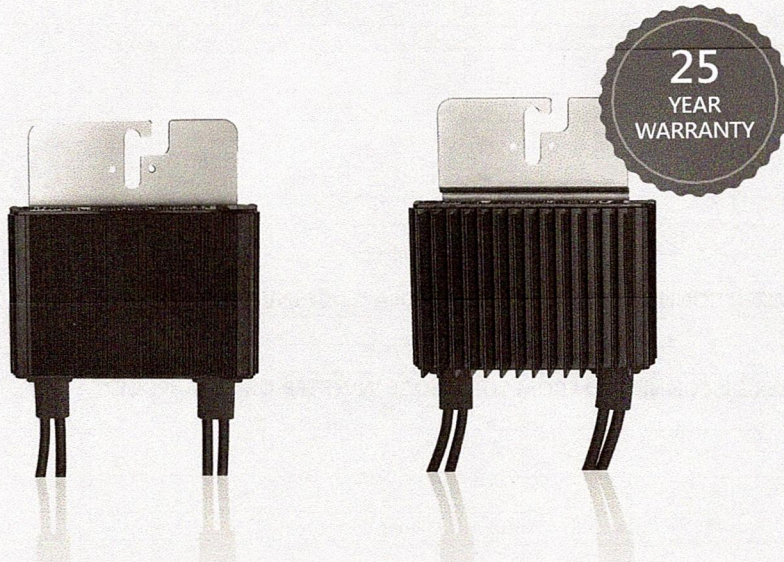
⁽⁴⁾ -40 version P/N: SExxxxH-US000NNU4



Power Optimizer

For North America

P320 / P340 / P370 / P400 / P405 / P505



POWER OPTIMIZER

PV power optimization at the module-level

- Specifically designed to work with SolarEdge inverters
- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, 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
- Meets NEC requirements for arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)
- Module-level voltage shutdown for installer and firefighter safety

/ Power Optimizer

For North America

P320 / P340 / P370 / P400 / P405 / P505

Optimizer model (typical module compatibility)	P320 (for 60-cell modules)	P340 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	P505 (for higher current modules)	
INPUT							
Rated Input DC Power ⁽¹⁾	320	340	370	400	405	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		60	80	125 ⁽²⁾	83 ⁽²⁾	Vdc
MPPT Operating Range	8 - 48		8 - 60	8 - 80	12.5 - 105	12.5 - 83	Vdc
Maximum Short Circuit Current (Isc)	11		10.1		14		Adc
Maximum DC Input Current	13.75		12.63		17.5		Adc
Maximum Efficiency	99.5						%
Weighted Efficiency	98.8						%
Overvoltage Category	II						
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREEDGE INVERTER)							
Maximum Output Current	15						Adc
Maximum Output Voltage	60			85			Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREEDGE INVERTER OR SOLAREEDGE INVERTER OFF)							
Safety Output Voltage per Power Optimizer	1 ± 0.1						Vdc
STANDARD COMPLIANCE							
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3						
Safety	IEC62109-1 (class II safety), UL1741						
RoHS	Yes						
INSTALLATION SPECIFICATIONS							
Maximum Allowed System Voltage	1000						Vdc
Compatible inverters	All SolarEdge Single Phase and Three Phase inverters						
Dimensions (W x L x H)	129 x 153 x 27.5 / 5.1 x 6 x 1.1			129 x 153 x 33.5 / 5.1 x 6 x 1.3	129 x 159 x 49.5 / 5.1 x 6.3 x 1.9	129 x 162 x 59 / 5.1 x 6.4 x 2.3	mm / in
Weight (including cables)	630 / 1.4			750 / 1.7	845 / 1.9	1064 / 2.3	gr / lb
Input Connector	MC4 ⁽³⁾						
Output Wire Type / Connector	Double Insulated; MC4						
Output Wire Length	0.95 / 3.0			1.2 / 3.9			m / ft
Input Wire Length	0.16 / 0.52						m / ft
Operating Temperature Range	-40 - +85 / -40 - +185						°C / °F
Protection Rating	IP68 / NEMA6P						
Relative Humidity	0 - 100						%

⁽¹⁾ Rated STC power of the module. Module of up to +5% power tolerance allowed

⁽²⁾ NEC 2017 requires max input voltage be not more than 80V

⁽³⁾ For other connector types please contact SolarEdge

PV System Design Using a SolarEdge Inverter ⁽⁴⁾⁽⁵⁾	Single Phase HD-Wave	Single phase	Three Phase 208V	Three Phase 480V	
Minimum String Length (Power Optimizers)	P320, P340, P370, P400	8	10	18	
	P405 / P505	6	8	14	
Maximum String Length (Power Optimizers)	25		25	50 ⁽⁶⁾	
Maximum Power per String	5700 (6000 with SE7600-US - SE11400-US)	5250	6000 ⁽⁷⁾	12750 ⁽⁸⁾	W
Parallel Strings of Different Lengths or Orientations	Yes				

⁽⁴⁾ For detailed string sizing information refer to: http://www.solaredge.com/sites/default/files/string_sizing_na.pdf

⁽⁵⁾ It is not allowed to mix P405/P505 with P320/P340/P370/P400 in one string

⁽⁶⁾ A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement

⁽⁷⁾ For SE14.4KUS/SE43.2KUS: It is allowed to install up to 6,500W per string when 3 strings are connected to the inverter (3 strings per unit for SE43.2KUS) and when the maximum power difference between the strings is up to 1,000W

⁽⁸⁾ For SE30KUS/SE33.3KUS/SE66.6KUS/SE100KUS: It is allowed to install up to 15,000W per string when 3 strings are connected to the inverter (3 strings per unit for SE66.6KUS/SE100KUS) and when the maximum power difference between the strings is up to 2,000W