PRACTICE plan

C
PHOTOVOLTAIC SYSTEM

SYSTEM SIZE:
AC / DC kW STC: 6.089kW \ 7.02kW

EQUIPMENT:
PV MODULES: (27) Tata TP260BZ
INVERTER(S): (1) SolarEdge SE6000A-US

SCOPE OF WORK:
INSTALLATION OF A SAFE AND CODE-COMPILANT GRID-TIED SOLAR PV SYSTEM ON AN EXISTING RESIDENTIAL ROOF TOP.

2. ALL ROOF PENETRATIONS ARE REQUIRED TO BE FLASHED. ALL TILE ROOFS ARE REQUIRED TO BE DOUBLE-FLASHED.
3. ROOF DECK FLASHING IS REQUIRED TO BE INSPECTED PRIOR TO PANEL INSTALLATION.
4. CONTRACTOR IS REQUIRED TO HOLD A CURRENT AND VALID C-10 OR C-46 LICENSE.
5. DESIGNED TO 110MPH 3-SECOND PEAK GUST.

SITE PLAN
SCALE: N.T.S.
GENERAL NOTES:

N1. DRAWINGS ARE DIAGRAMMATIC ONLY. THE LOCATION AND ROUTING OF RACEWAYS SHALL BE DETERMINED BY THE CONTRACTOR UNLESS OTHERWISE NOTED OR STANDARDIZED.

N2. IF A DISCREPANCY IN QUANTITY OR SIZE OF CONDUIT, WIRE, EQUIPMENT DEVICES, OVERCURRENT PROTECTION, GROUNDING SYSTEMS, ETC. (ALL EQUIPMENT AND MATERIALS) THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND INSTALLING ALL MATERIALS AND SERVICES REQUIRED BY THE STRICTEST CONDITIONS IN THE SPECIFICATIONS OR NOTED ON THE PLANS TO ENSURE COMPLETE COMPLIANCE WITH ALL CODES AND TO ENSURE THE LONGEYTY AND SAFETY OF THE OPERABLE SYSTEM.

N3. ALL OUTDOOR EQUIPMENT SHALL BE MIN. NEMA 3R RATED.

N4. METAL CONDUIT AND ENCLOSURES SHALL BE USED WHERE PV SOURCE OR OUTPUT CIRCUITS ARE RUN INSIDE A BUILDING.

N5. MODULES SHALL NOT BE PLACED OVER ANY PLUMBING VENTS AND AT LEAST 6" ABOVE FLUSH VENTS.

N6. THE ELECTRICAL CONTRACTOR SHALL COMPLY WITH ANY AND ALL REQUIREMENTS GIVEN BY UTILITY COMPANIES.

N7. FOR ADDITIONAL EQUIPMENT SPECIFICATIONS, SEE PROVIDED CUT SHEETS.

N8. ALL NEC REFERENCES SHALL BE DIRECTLY INTERCHANGEABLE WITH CEC REFERENCES.

N9. IT IS ILLEGAL FOR ANYONE UNLESS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR REGISTERED ARCHITECT TO ALTER ANY ITEMS ON THIS PLAN.

N10. THE ENGINEER HAS NOT BEEN RETAINED FOR JOB SUPERVISION.

N11. ALL OSHA REGULATIONS AND STANDARDS FOR SAFE AND HEALTHFUL WORKING CONDITIONS TO BE FOLLOWED.

N12. ALL CONTRACTORS WORKING ON ROOFS TO BE INSURED AS SUCH.

ELECTRICAL NOTES:

E1. MAXIMUM VOLTAGE DOES NOT EXCEED 600VDC, AND DC EQUIPMENT SHALL BE RATED FOR AT LEAST 600VDC.

E2. ANY EQUIPMENT OR ELECTRICAL MATERIALS USED FOR THIS INSTALLATION SHALL BE NEW AND LISTED BY A RECOGNIZED ELECTRICAL TESTING LABORATORY.

E3. AN INVERTER IN AN INTERACTIVE SOLAR PV SYSTEM SHALL AUTOMATICALLY DE-ENERGIZE ITS OUTPUT TO THE CONNECTED ELECTRICAL PRODUCTION AND DISTRIBUTION NETWORK UPON LOSS OF VOLTAGE IN THAT SYSTEM AND SHALL REMAIN IN THAT STATE UNTIL THE ELECTRICAL PRODUCTION AND DISTRIBUTION NETWORK VOLTAGE HAS BEEN RESTORED.

E4. ALL PV ARRAYS SHALL BE EQUIPPED WITH DC GROUND FAULT PROTECTION BY INVERTER(S), AND ARC FAULT PROTECTION IS INVERTER-INTEGRATED.

E5. ANY AC COMPONENT SHALL MEET OR EXCEED THE AVAILABLE FAULT CURRENT CALCULATED AT THAT COMPONENT.

E6. ALL MODULES AND ANY RELATED ROOF MOUNTED METALLIC EQUIPMENT SHALL BE PROPERLY BONDED AND GROUNDED.

E7. ALL WIRE, VOLTAGES, AMPERAGES AND EQUIPMENT IS SIZED ACCORDING TO TEMPERATURE DERATING AND LOCATION.

E8. ONLY COPPER (CU) CONDUCTORS SHALL BE USED FOR NEW WIRING. CONDUCTORS SHALL BE STRANDED OR SOLID WITH PROPERLY RATED CONNECTORS.

E9. ALL MODULES AND RACKING SHALL BE GROUNDED VIA UL2703-LISTED RACKING SYSTEM’S INTEGRATED GROUNDING (PLEASE SEE DATA SHEET).

STRUCTURAL NOTES:

S1. MOUNTS ARE DIAGRAMMATIC AND EXACT LOCATION MAY CHANGE, BUT SHALL BE ACCURATELY SPACED.

S2. MOUNTS SHALL BE STAGGERED WHEN NECESSARY TO EVENLY DISTRIBUTE LOAD AMONGST RAFTERS.

S3. DO NOT SPLICE RAILS IN MIDDLE 50% OF SPAN BETWEEN TWO MOUNTS.
**ARRAY 1 LAYOUT**

**SCALE:** 3/16" = 1'-0"

**NOTE:** MODULES SHALL NOT BE GREATER THAN 8 INCHES ABOVE ROOF COVERING

**MODULE SPECIFICATIONS**

- **Q21 TATA TP9082**
- **MODULE WEIGHT:** 41 lbs
- **MODULE LENGTH:** 66 in
- **MODULE WIDTH:** 39 in

**ROOF 1 SPECS**

- **NUMBER OF MODULES:** 16
- **TOTAL MOD. WEIGHT (lbs):** 736
- **MODULE WEIGHT (lbs):** 41 lbs
- **ARRAY WEIGHT (lbs):** 63.4 lbs
- **ARRAY DEAD LOAD (lbs/ft²):** 2.5 lbs/ft²
- **NUMBER OF MOUNTS:** 25
- **LOAD PER MOUNT (lbs):** 25 lbs
- **ARRAY AZIMUTH (°):** 25°
- **ARRAY DEADBOLT (°):** 3°
- **NUMBER OF FLOORS:** 2

**CUSTOMER INFORMATION:**

- **CUSTOMERNAME:**
- **ADDRESS:** 4444 C STREET
- **CITY:** ANYTOWN, MA

**DATE:** 12/1/16

**DESIGNED BY:**

**REV #:** 0

**DATE:** 12/1/16

**PV-2.0**
** MODULE SPECIFICATIONS **

- ** Number of Modules:** 9
- ** Total Mod. Weight (lbs):** 369
- ** Module Weight:** 41 lbs
- ** Module Length:** 65 inches
- ** Module Width:** 39.1 inches

** ROOF 2 SPECS **

- ** Rafter Size:** 2X4 DOMED
- ** Rafter Span:** 6'-6" (A-A)
- ** Rafter Spacing:** 24" (A-A)
- ** Roof Material:** COMPOSITE SHINGLE

** ARRAY 2 SPECS **

- ** Number of Modules:** 9
- ** Total Mod. Weight (lbs):** 406.6 lbs
- ** Array Weight (lbs):** 156.6 lbs
- ** Array Area (sqft):** 2.6
- ** Array Dead Load (lbs/sqft):** 17.9 lbs
- ** Number of Mounts:** 29
- ** Load per Mount (lbs):** 71.1 lbs
- ** Array Azimuth (°):** 21
- ** Array Tilt (°):** 0
- ** Number of Floors:** 1

** CUSTOMER INFORMATION: **

- ** Customer Name:** CUSTOMERNAME
- ** Address:** 4444 C STREET
- ** City:** ANYTOWN, MA

** DESIGNED BY: **

- ** PV-2.1 **
- ** REV #: **
- ** DATE: **
- ** 12/1/16 **
(4) #10 PV-Wire
(1) #10 EGC
FREE AIR

(4) #10 THWN-2
(1) #10 EGC
1/2" EMT

1 STRING OF 18 MODULES
OPT. CURRENT = 13.4A

1 STRING OF 9 MODULES
OPT. CURRENT = 6.7A

THERE SHALL BE ONE SOLAREDGE P300 DC OPTIMIZER PER MODULE.

(4) #10 THWN-2
(1) #10 EGC
3/4" EMT

(3) #10 THWN-2
(1) #10 EGC
1/2" EMT

IF APPLICABLE
MIN. NEMA3R UL LISTED JUNCTION BOX WITH 90°C TERMINAL RATINGS LOCATED ON ROOF

125A MAIN BREAKER

MPPT 1
AC OUTPUT
INVERTER

MPPT 2

AC OPERATING VOLTAGE (V): 240
AC OPERATING CURRENT (A): 35
NUMBER OF MPPT CHANNELS: 0
INVERTER EFFICIENCY: 0.975
INTEGRATED DC DISCONNECT

INVERTER 1 INPUT SPECIFICATIONS
NOMINAL CURRENT PER STRING (Inom): 13.4, 6.7
NOMINAL VOLTAGE (Vnom): 500
MAX SYSTEM VOLTAGE (Vmax): 15
MAX CURRENT PER STRING (Imax): 30
MAX INPUT CIRCUIT CURRENT (Imax): 350

27 MODULES TOTAL
27 x 231.3 (PTC WATTS) x 0.975 = 6089 CEC WATTS
SE6000A-US MAX OUTPUT CURRENT = 25A
BREAKER SIZE = 25A x 1.25 = 31.25A → 35A

CUSTOMER INFORMATION:

CUSTOMERNAME
4444 C STREET
ANYTOWN, MA

DESIGNED BY: REV #: DATE: PV-3.0
ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS
TERMINALS ON BOTH THE LINE AND LOAD
SIDE MAY BE ENERGIZED IN THE OPEN
POSITION

NEC 690.17(E)
PLACE THIS LABEL ON ALL DISCONNECTING MEANS WHERE ENERGIZED IN AN OPEN POSITION

WARNING
ELECTRIC SHOCK HAZARD
IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED

NEC 690.17(E)
PLACE THIS LABEL ON ALL DISCONNECTING MEANS WHERE ENERGIZED IN AN OPEN POSITION

WARNING
ELECTRIC SHOCK HAZARD
DO NOT TOUCH TERMINALS TERMINALS ON BOTH THE LINE AND LOAD SIDE MAY BE ENERGIZED IN THE OPEN POSITION

NEC 705.12(D)(2)(b)
PLACE THIS LABEL AT P.O.C. TO SERVICE DISTRIBUTION EQUIPMENT (I.E. MAIN PANEL (AND SUBPANEL IF APPLICABLE))

WARNING
INVERTER OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

NEC 705.12(D)(3)
PLACE LABEL ON ALL EQUIPMENT CONTAINING OVERCURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO A BUSBAR OR CONDUCTORS SUPPLIED FROM MULTIPLE SOURCES.

CAUTION
CONTAINS MULTIPLE POWER SOURCES

NEC 690.35(F)
PLACE THIS LABEL AT EACH JUNCTION BOX, COMBINER BOX, DISCONNECT AND DEVICE WHERE ENERGIZED, UNGROUNDED CIRCUITS MAY BE EXPOSED DURING SERVICE:

WARNING
PHOTOVOLTAIC POWER SOURCE

NEC 690.35(E) 3 & 4; 2012 IFC 605.11.1 PLACE ON ALL JUNCTION BOXES, EXPOSED RACEWAYS EVERY 10' AND 1' FROM BENDS AND PENETRATIONS, ADJACENT TO THE MAIN SERVICE DISCONNECT

NOTE:
BACKGROUND AND LETTERING COLORS FOR SIGNAGE/LABELS SHALL COMPLY WITH (IN ORDER OF PRIORITY) AHJ & FIRE DEPARTMENT AMENDMENTS, STATE CODE, AND ANSI GUIDELINES. THIS PAGE IS INTENDED FOR SIGNAGE/LABEL VERBIAGE ONLY.
POWER TO THIS BUILDING IS SUPPLIED FROM THE FOLLOWING SOURCES WITH DISCONNECTS LOCATED AS SHOWN

LOCATION OF MAIN SERVICE ENTRANCE AND UTILITY METER

LOCATION OF INVERTERS WITH INTEGRATED DC DISCONNECT

DIRECTORY LABEL PER NEC 705.10

CUSTOMER INFORMATION:
CUSTOMER NAME
4444 C STREET
ANYTOWN, MA

DESIGNED BY: [REVISION #: DATE: PV- 5.0]
**TP250 series**

60-cell multi-crystalline solar photovoltaic modules

**Manufactured in India on leading edge module production line using world class processes**

**Reliability under extreme weather conditions, certified to withstand snow loads of up to 5,400 Pa**

**Peace of mind guaranteed by Tata Power Solar 25-year linear module warranty**

**Reduced risk of failure – warranty claims of less than 0.07% over two decades**

**Greater energy generated due to positive power tolerance of up to 1W**

**TUV and UL certified Potential Induced Degradation free modules**

**PRODUCT FEATURES**

- 60 cell configuration with wattage ranging from 240 to 260W
- High fill factor for improved energy conversion efficiency
- Cells sorted by power and current to minimize mismatch losses in the field
- Electroluminescence tested for micro-cracks
- Highly reliable IP67 rated junction box
- MC4 compatible cable connectors
- Torsion and corrosion resistant with anodized aluminium frame
- Unique back sheet design for high resistance to moisture ingress
- Enhanced reliability throughout various distinctive encapsulant and back sheet
- Ultra-salt interconnect with stress relief for enhanced reliability
- Optimized edge clearance for high quality rugged design

**CERTIFICATIONS**

Certified to IEC 61215, IEC 61646, IEC 61701, IEC 61708 and IEC 61730 standards.

**WARRANTY**

Product warranty: 10 year warranty on material and workmanship
Power warranty: 25 year linear power output warranty

**About Tata Power Solar**

Tier 1 bankable module manufacturer with 25 year history

Backed by SIIB Tata Group;
eliminates need for expensive 3rd party insurance

**BP Solar heritage of state-of-the-art technology and stringent quality processes**

Over 500 MW of modules shipped globally

Highest standards of quality and management (ISO 9001: 14001)

**Modules in the TP250 series**

<table>
<thead>
<tr>
<th>TP240</th>
<th>TP245</th>
<th>TP250</th>
<th>TP255</th>
<th>TP260</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current at NOCT (%)</td>
<td>0.91</td>
<td>0.92</td>
<td>0.93</td>
<td>0.94</td>
</tr>
<tr>
<td>Module efficiency (%)</td>
<td>14.60</td>
<td>14.70</td>
<td>15.00</td>
<td>15.30</td>
</tr>
<tr>
<td>Voltage at Pmax (%)</td>
<td>29.7</td>
<td>29.9</td>
<td>30.2</td>
<td>30.4</td>
</tr>
<tr>
<td>Current at Pmax (%)</td>
<td>8.10</td>
<td>8.20</td>
<td>8.30</td>
<td>8.40</td>
</tr>
<tr>
<td>Open circuit voltage (V)</td>
<td>36.5</td>
<td>36.7</td>
<td>37.3</td>
<td>37.5</td>
</tr>
<tr>
<td>Short circuit current (A)</td>
<td>8.60</td>
<td>8.70</td>
<td>8.75</td>
<td>8.78</td>
</tr>
</tbody>
</table>

**Electrical parameters at standard test conditions (STC)**

- Nominal power output (W) 240, 245, 250, 255, 260
- Power tolerance (%): 0 to ± 5
- Module efficiency (%): 14.60 to 15.60
- Voltage at Pmax (%): 29.7 to 30.6
- Current at Pmax (%): 8.10 to 8.40
- Open circuit voltage (V): 36.5 to 37.9
- Short circuit current (A): 8.60 to 8.80

**Temperature coefficient characteristics**

- Module efficiency (%): -0.56 to 0.01
- Temperature coefficient of Pmax (%): -0.41
- Temperature coefficient of Voc (%): -0.33
- Temperature coefficient of Isc (%): 0.5

**Operating conditions**

- Maximum system voltage: 50V DC
- Maximum series fuse rating (A): 20
- Maximum reverse current (A): 20
- Operating temperature range (°C): -40 to +90
- Maximum static load (moist or wind): 113 psi (540 Pa)

**Module general characteristics**

- Module dimensions (L x W x Th): 1660 x 1050 x 40
- Module weight (kg): 19.4 (42.8)
- Number of cells & row: 60 cells & 56 cell
- Frame material: Anodized aluminium
- Glue: 2mm AR
- Junction box: IP67 rated
- Cable connector: MC4 compatible (6mm²)

**Packaging details**

- Number of modules per pallet: 26
- Number of pallets per 40FT container: 20
- Box-weight (kg): 600
- Box dimensions L x W x H (mm): 1700 x 1363 x 1500

**Technical Drawing**

- **8/24/2014**

For sales, service and other enquiries, email us modules@tatapowersolar.com

**www.tatapowersolar.com**

Tata Power Solar is committed to enabling solar energy and bring the power of the sun to people in the most efficient and cost effective way possible.
SolarEdge Single Phase Inverters
For North America

The best choice for SolarEdge enabled systems
- Integrated arc fault protection for NEC 2011 690.11 compliance
- Rapid shutdown for NEC 2014 690.12
- Superior efficiency (98%)
- Small, lightweight and easy to install on provided bracket
- Built-in module-level monitoring
- Internet connection through Ethernet or Wireless
- Outdoor and indoor installation
- Fixed voltage inverter, DC/AC conversion only
- Pre-assembled Safety Switch for faster installation
- Optional – revenue grade data, ANSI C12.1

OUTPUT
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal AC Power Output</td>
<td>1000 W</td>
<td>1250 W</td>
<td>1500 W</td>
<td>1875 W</td>
<td>2500 W</td>
<td>3125 W</td>
</tr>
</tbody>
</table>

INPUT
- Maximum DC Power (VDC):
  - SE3000A-US: 1000 W
  - SE3800A-US: 1250 W
  - SE5000A-US: 1500 W
  - SE6000A-US: 1875 W
  - SE7600A-US: 2500 W
  - SE10000A-US: 3125 W
  - SE11400A-US: 3750 W
- Maximum DC Input Voltage: 500 V
- Maximum Input Current (SE3000A-US): 9.5 A
- Maximum Input Short Circuit Current (SE3000A-US): 40 A
- Ground-Fault Isolation Detection: 600 mA Sensitivity
- Maximum Inverter Efficiency: 97.7%
- CEC Weighted Efficiency: 97.5%
- Nighttime Power Consumption: <2.5 W

ADDITIONAL FEATURES
- Supported Communication Interfaces: Ethernet, Zigbee (optional)
- Revenue Grade Data, ANSI C12.1: Optional
- Rapid Shutdown – NEC 2014 690.12: Yes
- Grid Connection Standards: UL1741, UL1099, UL1998, CSA 22.2
- Emissions: FCC part 15 class B

INFORMATION SPECIFICATIONS
- AC output conductor size / AWG range: 1/0" minimum / 16-6 AWG
- DC input conduct size (strings / strings): 1/0" minimum / 1-2 strings / 16-6 AWG
- Dimensions with Safety Switch (Width/Height): 30.5 x 12.5 x 7.2 / 775 x 315 x 184
- Weight with Safety Switch: 51.2 lbs / 23.2 kg

Cooling
- Natural Connection
- Natural connection and internal fan (user replaceable)
- Fans (user replaceable)
- Noise: <25 dBA
- Min. Max. Operating Temperature Range: -13 to +140 °F / -25 to +60 °C
- Protection Rating: NEMA 3R

www.solaredge.us
This authorizes the application of the Certification Mark(s) shown below to the models described in the Product(s)
Covered section when made in accordance with the conditions set forth in the Certification Agreement and Listing
Report. This authorization also applies to multiple listee model(s) identified on the correlation page of the Listing
Report.

Applicant: SolarEdge Technologies Ltd
Address: 6 HaHarash Street 45240
Hod Hasharon
Country: Israel
Contact: Mr. Oren Bachar or
Mr. Meir Adest
Phone: +972 9 957 6620 #293 or
+972 9 957 6620 #131
FAX: +972 9 957 6591
Email: OREN.B@SOLAREDGE.COM
Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Cortland, NY 13045
Control Number: 4004590
Authorized by: Thomas J. Patterson, Certification Manager

This document supersedes all previous Authorizations to Mark for the noted Report Number.

Intertek Testing Services NA Inc.
545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-439-5667 Fax 312-283-1672

UL 1741 Standard for Safety for Inverters, Converters, Controllers and Interconnection System

CSA C22.2 107.1 Issue:2001/09/01 Ed:3 General Use Power Supplies - (R2011)

Standard(s):
UL SUBJECT 1698B, Outline of Investigation for Photovoltaic (PV) DC Arc-Fault Circuit Protection - Issue
No.2, 2013/01/14

CSA TIL M-07, Interim Certification Requirements for Photovoltaic (PV) DC Arc-Fault Protection - Issue
No. 1, 2013/03/11
June 20, 2014

Letter Report No. 101703554CRT-001
Project No. G101703554

Mr. Meir Adest
SolarEdge Technologies Ltd
6 Ha’Harash St.
HOD HASHARON, ISRAEL

Subject: ETL Evaluation of SolarEdge Products to NEC Rapid Shutdown Requirements

Dear Mr. Meir Adest,

This letter represents the testing results of the below listed products to the requirements contained in the following standards:


This investigation was authorized by signed Quote 500534459 dated 06/10/2014. Rapid shutdown test were perform at SolarEdge Technologies Ltd, 6 Ha’Harash St HOD HASHARON, ISRAEL and witness by Intertek personal on 06/17/2014.

The evaluation covers installations consisting of optimizers and inverters with part numbers listed below. The testing done has verified that controlled conductors are limited to not more than 30 volts and 240 volt-amperes within 10 seconds of rapid shutdown initiation.

Applicable products:

- Power optimizers:
  - PBlxx-yyy-zzzz; where xxx is any number, 0-9, up to a maximum value where xxx = 350; yyy could be A0B or TFJ; and zzzz is any combination of four letters and numbers.
  - OP-XXX-LV, OP-XXX-MV, OP-XXX-IV, OP-XXX-EV; where xxx is any number, 0-9.
  - Paaa, Pbb, Pccc, Pdd, Peee; where aaa, bbb, ccc, ddd, eee is any number, 0-9 to a maximum up to aaaa=300, bbbb=350, cccc=500, dddd=600, eeee=700.
  - Pxxxx, Pyyy, Pzzz, Pnnmm, Pnnn and Ppoo; where xxx, yyy, zzz is any number, 0-9 to a maximum up to xxxxx=300, yyyy=350, zzzz=500; where mmmm, nnnn, oo is any number, 0-9 to a maximum up to mmmm=405, nnnn=300, oo=350

- 1-ph Inverters:

This letter report completes this portion of the evaluation covered by Intertek Project No.G101703554.

If there are any questions regarding the results contained in this report, or any of the other services offered by Intertek, please do not hesitate to contact the undersigned.

Please note, this Letter Report does not represent authorization for the use of any Intertek certification marks.

Completed by: Radhe Patel
Reviewed by: Howard Liu
Title: Engineering Team Lead
Title: Staff Engineer
Signature: [Signature]
Signature: [Signature]
Date: June 20th, 2014
Date: June 20th, 2014
The UFO family of components eliminates the need for separate grounding hardware by bonding solar modules directly to IronRidge XR Rails. All system types that feature the UFO family—Flush Mount, Tilt Mount and Ground Mount—are fully listed to the UL 2703 standard.

UFO hardware forms secure electrical bonds with both the module and the rail, resulting in many parallel grounding paths throughout the system. This leads to safer and more reliable installations.

**UFO Family of Components**

- **Universal Fastening Object (UFO)**: The UFO securely bonds solar modules to XR Rails. It comes assembled and lubricated, and can fit a wide range of module heights.

- **Stopper Sleeve**: The Stopper Sleeve snaps onto the UFO, converting it into a bonded end clamp.

- **Bonded Splice**: Each Bonded Splice uses self-drilling screws to form a secure connection. No bonding strap needed.

- **Grounding Lug**: A single Grounding Lug connects an entire row of PV modules to the grounding conductor.

- **Bonded Attachments**: The bonding bolt attaches and bonds the L-foot to the rail. It is installed with the same socket as the rest of the system.

- **Approved Enphase microinverters can provide equipment grounding of IronRidge systems, eliminating the need for grounding lugs and field-installed equipment ground conductors (EGC). A minimum of two microinverters mounted to the same rail and connected to the same Engage cable is required. Refer to installation manuals for additional details.**

**UL Certification**

The IronRidge Flush Mount, Tilt Mount, and Ground Mount Systems have been listed to UL 2703 by Intertek Group plc. UL 2703 is the standard for evaluating solar mounting systems. It ensures these devices will maintain strong electrical and mechanical connections over an extended period of time in extreme outdoor environments.

Refer to installation manuals for a detailed list.

### Cross-System Compatibility

<table>
<thead>
<tr>
<th>Feature</th>
<th>Flush Mount</th>
<th>Tilt Mount</th>
<th>Ground Mount</th>
</tr>
</thead>
<tbody>
<tr>
<td>XR Rails</td>
<td>✔</td>
<td>✔</td>
<td>☑️ XR1000 Only</td>
</tr>
<tr>
<td>UFO/Stopper</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Bonded Splice</td>
<td>✔</td>
<td>✔</td>
<td>N/A</td>
</tr>
<tr>
<td>Grounding Lugs</td>
<td>1 per Row</td>
<td>1 per Row</td>
<td>1 per Array</td>
</tr>
</tbody>
</table>

**Microinverters & Power Optimizers**

- Enphase - M250-72, M250-60, M215-60, C250-72
- Darfon - MIG240, MIG300, G320, G640
- SolarEdge - P300, P320, P400, P405, P600, P700, P730

**Fire Rating**

- Class A

**Modules**

Tested or Evaluated with over 400 Framed Modules

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

**MARKINGS**

Product markings are located on the 3/8” flange hex nut.

### RATINGS

UL 2703 LISTED

- Max Overcurrent Protective Device (OCPD) Rating: 25A
- Max Module Size: 249" x 593"
- Module Orientation: Portrait or Landscape
- Mechanical Load Rating: meets minimum requirements of the standard (10 PSF downward, 5 PSF upward, 5 PSF lateral).
- Actual system structural capacity is defined by PE stamped certification letters.

### CLASS A SYSTEM FIRE RATING PER UL 1703

- Any Roof Slope with Module Types 1, 2, and 3
- Any module-to-roof gap is permitted, with no perimeter guarding required. This rating is applicable with any third-party attachment.
- Class A rated PV systems can be installed on Class A, B, and C roofs without affecting the roof fire rating.

### STRUCTURAL CERTIFICATION

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

### MODULE COMPATIBILITY

**MAKE**

- Astronergy Solar
- Canadian Solar
- GigaWatt Solar
- Hyundai Solar
- JA Solar
- Jinko
- Kyocera
- LG
- Mitsubishi Solar
- Mototech
- Panasonic
- Phono Solar
- Phoenix Solar
- Renogy
- SolarWorld
- Silfab
- Suniva
- Sunpower
- Trina
- Wuxian
- Yingli

**MODELS**

- Modules with 35, 40, and 45mm frames and model identifier: See Models Table.
- Modules with 35 and 40mm frames and model identifier: AC-solar-XX-ZZ, where “XX” can be CH or CH-A; “ZZ” can be blank or CH-A.
- Framework modules with model identifier: CHSM806117-CH-A.
- Modules with 35 and 45mm frames and model identifier: C6500-solar-XX, where “XX” can be A or B.
- Framework modules with model identifier: CSM6000-6500-solar-XX, where “XX” can be A or B.
- Modules with 35 and 45mm frames and model identifier: SilFix-solar-XX, where “XX” can be CH or CH-A.
- Framework modules with model identifier: CSM6000-6500-solar-XX, where “XX” can be CH or CH-A.
- Modules with 35 and 45mm frames and model identifier: SolarFix-solar-XX, where “XX” can be CH or CH-A.
- Framework modules with model identifier: CSM6000-6500-solar-XX, where “XX” can be CH or CH-A.
- Modules with 35 and 45mm frames and model identifier: SunTracker-solar-XX, where “XX” can be CH or CH-A.
- Framework modules with model identifier: CSM6000-6500-solar-XX, where “XX” can be CH or CH-A.

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**FLUSH MOUNT INSTALLATION MANUAL - 9**
Dear Sir:

We have analyzed the IronRidge XR10 Rail for the subject solar module support system and determined that, for the configurations and criteria described below, it is in compliance with the applicable sections of the following Reference Documents:

Codes: ASCE/SEI 7-10 Min. Design Loads for Buildings & Other Structures
California Building Code 2012 Edition
Other: AC428, Acceptance Criteria for Modular Framing Systems Used to Support PV Modules, dated Effective November 1, 2012 by ICC-ES

The IronRidge XR10 Rail is an extruded aluminum section with an overall depth of 1.75 in. and a net area of 0.363 sq.in. The rails are used to support solar modules, typically, on the roof of a building. See Exhibit A – attached. The rails are clamped to aluminum angle brackets that are either attached directly to the roof framing or attached to a stand that is screwed to the roof framing. The rails are mounted across the slope with a small clearance (flush mounting) to the underlying roof structure. The installed solar modules are at the same slope as the underlying roof structure.

All loads are transferred to the roof framing through the angle brackets by simple bi-axial flexure of the rails. The maximum span of the rails is governed by either the mid-span flexural stresses or the deflection requirement that the rail not come into contact with the roof.

The effect of seismic loads (for all design categories A-F) have been determined to be less than the effect due to wind loads in all load conditions and combinations. Therefore, the maximum allowable spans for common load cases are shown in the tables below. Tables 1A-9A are for modules with a maximum long dimension of 67.5 inches and Tables 1B-9B are for modules with a maximum long dimension of 78.5 inches.

### Table 4A - MAXIMUM SPANS (in) - Roof Slope 7° to 27° - Wind Zone 1 (67.5” Max Module Length)

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Wind Speed</th>
<th>Ground Snow Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mph</td>
<td>0 psi</td>
</tr>
<tr>
<td>Category B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>Wind Speed</td>
<td>Ground Snow Load</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>mph</td>
<td>0 psi</td>
</tr>
<tr>
<td>Category C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>Wind Speed</td>
<td>Ground Snow Load</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>mph</td>
<td>0 psi</td>
</tr>
<tr>
<td>Category D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes – see page 20
Test Verification of Conformity

In the basis of the tests undertaken, the sample(s) of the below product have been found to comply with the requirements of the referenced specifications at the time the tests were carried out.

Applicant Name & Address: IronRidge, Inc.
1495 Zephyr Ave.
Hayward, CA 94544
USA

Product Description: Flush Mount System with XR Rails.

Ratings & Principle Characteristics:

- Fire Class Resistance Rating:
  - Flush Mount (Symmetrical). Class A Fire Rated for Low Slope applications when using Type 1, 2 and 3, listed photovoltaic modules. Class A Fire Rated for Steep Slope applications with Type1, 2 and 3, listed photovoltaic modules. Tested with a 5° gap (distance between the bottom of the module frame and the roof covering), per the standard this system can be installed at any gap allowed by the manufacturers installation instructions. No perimeter guarding is required. This rating is applicable with any IronRidge or 3rd party roof anchor.

Models:

IronRidge Flush Mount with XR Rails

IronRidge Flush Mount

Relevant Standards:


Verification Issuing Office:

Intertek Testing Services NA, Inc.
8431 Murphy Drive
Middleton, WI 53562

Date of Tests:

08/27/2014 to 03/17/2015

Test Report Number(s):

1017693423MD-001v1, 1017693423MD-001a, 1019159786MD-001 & 1019994922MD-001ar1-cr1.

This verification is part of the full test report(s) and should be read in conjunction with them. This report does not automatically imply product certification.

Completed by: Chris Zimbrick
Title: Technician I, Fire Resistance
Date: 05/25/2016

Reviewed by: Chad Naggs
Title: Technician I, Fire Resistance
Signature: Signature: 05/25/2016

This Verification is for the exclusive use of Intertek’s client and is provided pursuant to the agreement between Intertek and its Client. Intertek’s responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this Verification. Only the Client is authorized to permit copying or distribution of this Verification. Any use of the intended name or one of its nicknames for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test/inspection results referenced in this Verification are relevant only to the sample tested/inspected. This Verification by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

IronRidge
Mr. David F. Taggart
IronRidge XR10 Rail, Roof Flush Mounting System – Structural Analysis

Notes – Tabulated values are based on the following criteria:

1. Building mean roof height = 30 ft
2. Risk Category I
3. Solar maximum module long dimension is 67.5 inches for Tables 1A-9A and 78.5 inches for Tables 1B-9B.
4. Provide 2 in. clear between roof and rail
5. End cantilever span (max) = 0.40 x maximum span from above tables
6. No rail splices in end spans
7. No rail splices in middle 1/3 of interior spans
8. Single simple span(s). Spans listed in the tables above may be multiplied by 1.08 for continuous rails of 3 or more spans.

Our analysis assumes that the rails, including the connections and associated hardware, are installed in a workmanlike manner in accordance with the “IronRidge Roof Mount Installation Manual” by IronRidge and generally accepted standards of construction practice. Additional information is available at the IronRidge web site, IronRidge.com. Verification of PV Module capacity to support the loads associated with the given array shall be the responsibility of the Contractor or Owner and not IronRidge or Starling Madison Loofquist.

The adequacy of the supporting roof framing is to be determined by others.

Please feel free to contact me at your convenience if you have any questions.

Respectfully yours,

Tres Warner, P.E.
Design Division Manager

Starling Madison Loofquist, Inc. Consulting Structural and Forensic Engineers
**E-Mount Lag | QMSE - LAG**

**Lag pull-out (withdrawal) capacities (lbs) in typical lumber:**

<table>
<thead>
<tr>
<th>Lumber</th>
<th>Lag Bolt Specifications</th>
<th>Specific Gravity</th>
<th>5/16&quot; shank per 1&quot; threaded depth</th>
<th>5/16&quot; shank per 1&quot; threaded depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas Fir, Larch</td>
<td>0.50</td>
<td>795</td>
<td>289</td>
<td></td>
</tr>
<tr>
<td>Douglas Fir, Sitka</td>
<td>0.46</td>
<td>704</td>
<td>234</td>
<td></td>
</tr>
<tr>
<td>Engelmann Spruce, Lodgepole Pine (SEER 180°) (5 &amp; higher)</td>
<td>-</td>
<td>755</td>
<td>255</td>
<td></td>
</tr>
<tr>
<td>Hem.</td>
<td>0.45</td>
<td>922</td>
<td>212</td>
<td></td>
</tr>
<tr>
<td>Hem. Fis (Douglas)</td>
<td>0.48</td>
<td>715</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>Spruce, Fir</td>
<td>0.52</td>
<td>715</td>
<td>207</td>
<td></td>
</tr>
<tr>
<td>Spruce, Fir (First 1 million plus each higher grade of SEER and MLD)</td>
<td>0.50</td>
<td>795</td>
<td>289</td>
<td></td>
</tr>
</tbody>
</table>

Source: American Wood Council, NDS 2005, Table 11.2.2.2 A

Notes:
1) Thread must be embedded in a rafter or other structural roof member.
2) See NDS Table 11.2.2 A for required edge distances.

**RACKING COMPONENTS NOT INCLUDED**

**Available in Mill, and Bronze Anodized Finishes**

**SMALL ORDER PRICING**

**NOTICE OF REVISION**

**E-Mount Lag Installation Instructions**

**Installation Tools Required:** tape measure, roofing bar, chalk line, stud finder, caulking gun, sealant compatible with roofing materials, drill with 7/32" long-style bit, drill or impact gun with 1/2" socket.

**WARNING:** Quick Mount PV products are NOT designed for and should NOT be used to anchor fall protection equipment.

Locate, choose, and mark centers of rafters to be mounted. Select the courses of shingles where mounts will be placed.

Carefully lift composition roof shingle with roofing bar, just above placement of mount. Remove nails as required. See “Proper Flashing Placement” on next page.

Insert flashing between 1st and 2nd course. Slide up to top edge of flashing is at least 3/4" higher than the drip edge of the 3rd course and lower flashing edge is above the drip edge of 1st course. Mark center for drilling.

Using a 1/2 inch socket on an impact gun drive the lag screw until the QBlock stops rotating easily. DO NOT over-torque.

Using drill with 7/32" bit, drill pilot hole into rafter and rafter, taking care to drill square to the roof. Do not use mount as a drill guide. Drill should be 1½" deep hole into rafter.

Clean off any sawdust, and fill hole with sealant compatible with roofing materials.

Slide the flashing into position. Insert the rubber plug into the QBlock cavity.

Locate, choose, and mark centers of rafters to be mounted. Select the courses of shingles where mounts will be placed.

Carefully lift composition roof shingle with roofing bar just above placement of mount. Remove nails as required. See “Proper Flashing Placement” on next page.

Insert flashing between 1st and 2nd course. Slide up to top edge of flashing is at least 3/4" higher than the drip edge of the 3rd course and lower flashing edge is above the drip edge of 1st course. Mark center for drilling.

**NOTICE OF REVISION**

**BI 7.2.3-31**

**Bi 7.2.3-31**
### Maximum Rafter Spans (for non-cathedral ceilings)

| DL = 10 psf, Max PV weight = 3.5 psf, max PV supports at 2 x Rafter spacing (alternate rafter loading) |
|-----------------------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|                                                | 12" RAFTER SPACING | 16" RAFTER SPACING | 24" RAFTER SPACING |
|                                                | 2x6 | 2x8 | 2x10 | 2x12 | 2x6 | 2x8 | 2x10 | 2x12 | 2x6 | 2x8 | 2x10 | 2x12 |
| Hem-Fir SS                                      | 13" - 8" | 18" - 0" | 23" - 0" | 28" - 0" | 12" - 5" | 16" - 5" | 20" - 11" | 25" - 5" | 10" - 6" | 13" - 11" | 17" - 9" | 21" - 7" |
| Hem-Fir #1                                     | 12" - 5" | 16" - 5" | 20" - 11" | 25" - 5" | 10" - 9" | 14" - 2" | 18" - 1" | 22" - 0" | 8" - 9" | 11" - 7" | 14" - 9" | 18" - 0" |
| Hem-Fir #2                                     | 11" - 7" | 15" - 4" | 19" - 6" | 23" - 9" | 10" - 0" | 13" - 3" | 16" - 11" | 20" - 7" | 8" - 2" | 10" - 10" | 13" - 10" | 16" - 10" |
| Hem-Fir #3                                     | 8" - 11" | 11" - 9" | 15" - 0" | 18" - 3" | 7" - 8" | 10" - 2" | 13" - 0" | 15" - 9" | 6" - 3" | 8" - 3" | 10" - 7" | 12" - 10" |
| Spruce-Pine-Fir SS                             | 13" - 5" | 17" - 8" | 22" - 6" | 27" - 5" | 12" - 2" | 16" - 0" | 20" - 6" | 24" - 11" | 9" - 11" | 13" - 1" | 16" - 9" | 20" - 4" |
| Spruce-Pine-Fir #1                             | 11" - 9" | 15" - 6" | 19" - 10" | 24" - 1" | 10" - 2" | 13" - 5" | 17" - 2" | 20" - 11" | 8" - 4" | 11" - 0" | 14" - 0" | 17" - 0" |
| Spruce-Pine-Fir #2                             | 11" - 9" | 15" - 6" | 19" - 10" | 24" - 1" | 10" - 2" | 13" - 5" | 17" - 2" | 20" - 11" | 8" - 4" | 11" - 0" | 14" - 0" | 17" - 0" |
| Spruce-Pine-Fir #3                             | 8" - 11" | 11" - 9" | 15" - 0" | 18" - 3" | 7" - 8" | 10" - 2" | 13" - 0" | 15" - 9" | 6" - 3" | 8" - 3" | 10" - 7" | 12" - 10" |

### Notes and Assumptions for Use of Above Table

1. Prior to use of this Table, comply with the Prescriptive Process Flowchart for Residential PV <10 kW.
2. This Table to be utilized by appropriately knowledgeable engineering or construction individuals.
3. Use of this table assumes construction is Code Compliant, i.e., collar ties exist at appropriate spacing, rafters are correctly located on opposing sides of ridge beam.
4. Actual spans exceeding the Table values may be reduced by installing rafter braces to appropriate bearing wall locations, employ a Registered Design Professional (RDP) for proper details.
5. Ground Snow Loads ($P_g$) based on 780 CMR 58.00.
6. Allowable stress design based on NDS-2005, maximum total load deflection limited to L/180.
7. PV panels installed parallel to the roof plane and the distance between the roof covering and bottom of the PV panel is ≤ 12".