Teaching plan
PHOTOVOLTAIC SYSTEM

SYSTEM SIZE:
AC / DC kW STC: 2.687kW \ 3kW

EQUIPMENT:
PV MODULES: (10) LG LG300N1K-G4
INVERTER(S): (1) ABB PVI-3.0-OUTD-S-US-A

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

APPLICATION CODES:
2016 CEC (BASED ON 2014 NEC)
2016 CBC
2016 CRC
2016 CPC
2016 CMC
2016 CFC
LOCAL AMENDMENTS TO CA CODES

CONTRACTOR INFORMATION:
PV INSTALLER
8888 B STREET
ANYTOWN, CA 99999

JURISDICTIONAL INFORMATION:
ANYTOWN, CITY OF
5555 C STREET
ANYTOWN, CA 99999

NOTES TO INSTALLER:
I CERTIFY THAT NO CHANGES HAVE BEEN MADE TO THE ARRAY LAYOUT:

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.
GENERAL NOTES:

1. Drawings are diagrammatic only. The location and routing of raceways shall be determined by the contractor unless otherwise noted or standardized.

2. 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 longevity and safety of the operable system.

3. All outdoor equipment shall be min. NEMA 3R rated.

4. Metal conduit and enclosures shall be used where PV source or output circuits are run inside a building.

5. Modules shall not be placed over any plumbing vents and at least 6" above flush vents.

6. The electrical contractor shall comply with any and all requirements given by utility companies.

7. For additional equipment specifications, see provided cut sheets.

8. All NEC references shall be directly interchangeable with CEC references.

9. 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.

10. The engineer has not been retained for job supervision.

11. All OSHA regulations and standards for safe and healthful working conditions to be followed.

12. All contractors working on roofs to be insured as such.

STRUCTURAL NOTES:

1. Mounts are diagrammatic and exact location may change, but shall be accurately spaced.

2. Mounts shall be staggered when necessary to evenly distribute load amongst rafters.

3. Do not splice rails in middle 50% of span between two mounts.

ELECTRICAL NOTES:

1. Maximum voltage does not exceed 600Vdc, and DC equipment shall be rated for at least 600Vdc.

2. Any equipment or electrical materials used for this installation shall be new and listed by a recognized electrical testing laboratory.

3. 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.

4. All PV arrays shall be equipped with DC ground fault protection by inverter(s), and arc fault protection is inverter-integrated.

5. Any AC component shall meet or exceed the available fault current calculated at that component.

6. All modules and any related roof mounted metallic equipment shall be properly bonded and grounded.

7. All wire, voltages, amperages and equipment is sized according to temperature derating and location.

8. Only copper (Cu) conductors shall be used for new wiring. Conductors shall be stranded or solid with properly rated connectors.

9. All modules and racking shall be grounded via UL2703-listed racking system’s integrated grounding (please see data sheet) or with tin plated direct burial rated lay in lugs using stainless steel hardware, star washers, and thread forming bolts.

CUSTOMER INFORMATION:

Customer Name:
4444 C Street
Anytown, CA 99999

Customer Name:
4444 C STREET
ANYTOWN, CA 99999

Designed By: 
PV-1.0
MODULE SPECIFICATIONS
LG300N1K-G4

MODULE WEIGHT: 37.48
MODULE LENGTH: 64.07
MODULE WIDTH: 39.37

RAFTER SPS:
RAFTER SP: 10'-7"
RAFTER SPA: 24'

ROOF MATERIAL: COMPOSITE SHINGLE

ARRAY 1 SPEC
NUMBER OF MODULES: 10
TOTAL MOD. WEIGHT (lbs): 374.8
MODULE WEIGHT (lbs): 37.48
ARRAY WEIGHT (lbs): 332.8
ARRAY AREA (sqft): 176.5
ARRAY DEAD LOAD (lbs/sqft): 2.5
NUMBER OF MOUNTS: 22
COMBINED MOUNT WT: 19.7
ARRAY AZIMUTH (°): 180
ARRAY TILT (°): 22
NUMBER OF FLOORS: 1

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

ARRAY LAYOUT
SCALE: 3/16" = 1'-0"

MOUNTING DETAIL
SCALE: NTS

SYMBOL KEY:
- RAIL
- RAFTERS
- ROOF
- FIRE CLEARANCE
- STRING CONFIG.
- STRUCTURAL UPGRDES
- SOLAR MODULE
- MOUNT
- SKYLIGHT
- CHIMNEY
- PLUMBING OR ATTIC VENT
- ATTIC VENT

CUSTOMER INFORMATION:
CUSTOMER NAME:
4444 C STREET
ANYTOWN, CA 99999

DESIGNED BY: REV #: DATE: PV-2.0
0 12/11/16
**Module Electrical Specifications**

- **Module:** LG300N1K-G4
- **Short Circuit Current (Isc):** 9.7 A
- **Open Circuit Voltage (Voc):** 39.7 V
- **Operating Current (Imp):** 9.26 A
- **Operating Voltage (Vmp):** 32.5 V
- **Max Series Fuse Rating:** 20 A
- **STC Rating:** 300 W
- **PTC Rating:** 279.9 W
- **Design Conditions**
  - Highest 2% Design Temp (°C): 37
  - Min. Mean Extreme Annual DB (°C): -3

**Inverter 1 Specifications**

- **Model:** ABB PVI-3.0-OUTD-S-US-A
- **MPPT Channel:** 1
- **Max Power Point Current (Imp):** 9.3 A
- **Max Power Point Voltage (Vmp):** 328 V
- **Max System Voltage (Voc):** 428 V

**Module Calculations**

- **Max Voc =** 10 x [39.7 V + (39.7 V x -0.0028 x (-3°C - 25°C))] = 428VDC
- **Imax =** 9.7 A x 1 STRING x 1.25 = 12.125 A
- **100 x 1.2 =** 120
- **100(100 MCB)/125% =** 16 A
- **Max Allowable Inv. Output Current Rating =** 16 A
- **Conduit Elevation:** 1/2 TO 3-1/2" = 22 °C
- **High Ambient Temperature:** 37 °C
- **Max System Output Current =** 16.125 A

**Inverter Calculations**

- **PV: 300 W**
- **Max Output Current =** 14.5 A
- **Breaker Size =** 14.5 A x 1.25 = 18.125 A → 20 A
- **PV: 3.0-OUTD-S-US-A Max Output Current =** 14.5 A
- **Continuous Use =** Imax * 1.25 = 15.16 A
- **Conditions of Use =** Imax / Tcorr / Cfill = 12.1A/0.71/1 = 17.04 A
- **Conductor Size For 17.04 A =** #10 AWG
- **Conduit Filling (Cfill) =** 1
- **Conduit Fill (Cfill) =** 1

**Customer Information**

- **Customer Name:**
  - 4444 C STREET
  - ANYTOWN, CA 99999

**Miscellaneous**

- **Customer Name:**
  - 4444 C STREET
  - ANYTOWN, CA 99999

**Design by: REV #: DATE:**

- **01/12/16 PV-3.0**
**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))

**CAUTION**
CONTAINS MULTIPLE POWER SOURCES

**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.

**INTERACTIVE PHOTOVOLTAIC POWER SOURCE**

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATED AC OUTPUT CURRENT (A)</td>
<td>14.5</td>
</tr>
<tr>
<td>NOMINAL OPERATING AC VOLTAGE (V)</td>
<td>240</td>
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</tbody>
</table>

**INVERTER 1 MPPT DC DISCONNECT**

<table>
<thead>
<tr>
<th>Element</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RATED MAX POWER POINT CURRENT (Imp)</td>
<td>9.3</td>
</tr>
<tr>
<td>RATED MAX POWER POINT VOLTAGE (Vmp)</td>
<td>325</td>
</tr>
<tr>
<td>MAX SYSTEM VOLTAGE (Voc)</td>
<td>428</td>
</tr>
<tr>
<td>MAX CIRCUIT CURRENT (Isc)</td>
<td>12.1</td>
</tr>
</tbody>
</table>

**CUSTOMER INFORMATION:**

CUSTOMER NAME
4444 C STREET
ANYTOWN, CA 99999

DESIGNED BY:  REV #: DATE: PV- 4.0 12/1/16
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
LG NeON™ 2 Black now performs better on sunny days thanks to its improved temperature coefficient.

Double-Sided Cell Structure
The rear of the cell in LG NeON™ 2 Black will contribute to generation just like the front; the light beam reflected from the rear of the module is reallocoted to generate a great amount of additional power.

Enhanced Performance Warranty
LG NeON™ 2 Black has an enhanced performance warranty. The annual degradation has fallen from -0.7%/yr to -0.6%/yr. Even after 25 years, the cell guarantees 2.4%p more output than the previous LG NeON™ modules.

Aesthetic Roof
LG NeON™ 2 Black has been designed with aesthetics in mind; thinner wires that appear all black at a distance. The product may increase the value of a property with its modern design.

Better Performance on a Sunny Day
LG NeON™ 2 Black now performs better on sunny days thanks to its improved temperature coefficient.

High Power Output
Compared with previous models, the LG NeON™ 2 Black has been designed to significantly enhance its output efficiency, thereby making it efficient even in limited space.

Outstanding Durability
With its newly reinforced frame design, LG has extended the warranty of the LG NeON™ 2 Black for an additional 2 years. Additionally, LG NeON™ 2 Black can endure a front load up to 6000 Pa, and a rear load up to 5400 Pa.

Mechanical Properties

| Cells       | 6 x 10 |
| Cell Vendor | LG     |
| Cell Type   | Monocrystalline / N-type |
| n of Solar   | 6 x 10 LG Monocrystalline |
| Module Size  | 156.75 x 156.75 mm (6 inches) |
| Dimensions (L x W x H) | 1640 x 1000 x 40 mm |
| Front Load   | 6500 Pa / 125 psf |
| Rear Load    | 5400 Pa / 113 psf |
| Weight       | 6.57 kg / 14.5 lbs |
| Connector Type | MC4, MC4 Compatible, IP67 |
| Junction Box | IP67 with 3 Bypass Diodes |
| Glass Type   | High Transmission Tempered Glass |
| Frame Material | Anodized Aluminum |

Electrical Properties (STC *)

| Module Type | 300 W |
| Nominal Power | 300 W |
| MPP Voltage (Vmpp) | 36.3 V |
| MPP Current (Impp) | 8.00 A |
| Open Circuit Voltage (Voc) | 46.0 V |
| Short Circuit Current (Isc) | 20.0 A |
| Maximum Power (Pmax) | 222 W |
| Temperature Coefficient (Vmp) | -0.38%/°C |
| Temperature Coefficient (Isc) | -0.28%/°C |
| Temperature Coefficient (Pmax) | -0.38%/°C |

Temperature Characteristics

| Module Type | 300 W |
| NOCT | 46 ± 3 °C |
| Front | -0.38%/°C |
| Rear | -0.28%/°C |
| Bin | 0.05%/°C |

Certifications and Warranty

| Certification | IEC 61215, IEC 61730-1/-2 |
| Warranty | 12 years |
| Warranty | Linear warranty |
| Warranty | Enhanced Performance Warranty |

Dimensions (mm/in)

| Distance between mounting holes | 1300 / 52.18 |
| Cable length | 1000 / 39.37 |
| Mounting holes (8ea) | 1100 / 43.31 |
| Grounding holes (12ea) | 1000 / 39.37 |
| Drain holes (4ea) | 960 / 37.80 |
| (X view) | Ø8.2 / Ø0.32 |
| (Y view) | Ø4.3 / Ø0.17 |
| (Z view) | Ø8.2 / Ø0.32 |

North America Solar Business Team
LG Electronics USA, Inc.
1000 Sylvan Ave, Englewood Cliffs, NJ 07632
Contact: lg.solar@lge.com
www.lgsolarusa.com

North America Solar Business Team
LG Electronics USA, Inc.
1000 Sylvan Ave, Englewood Cliffs, NJ 07632
Contact: lg.solar@lge.com
www.lgsolarusa.com

Innovation for a Better Life

LG’s new module, LG NeON™ 2 Black, adopts Cello technology. Cello technology replaces 3 busbars with 12 thin wires to enhance power output and reliability. LG NeON™ 2 Black demonstrates LG’s efforts to increase durability, performance under real environment, and aesthetic design suitable for roofs.

Innovation for a Better Life

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LG NeON™ 2 Black now performs better on sunny days thanks to its improved temperature coefficient.

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Better Performance on a Sunny Day
LG NeON™ 2 Black now performs better on sunny days thanks to its improved temperature coefficient.
**Mechanical Installation**

**Module Mounting**
- The LG Electronics (LGE) Limited Warranty for solar modules is contingent upon modules being mounted in accordance with the requirements described in this section.
- Any module without a frame (laminate) shall not be considered to comply with the requirements of UL 1703 unless the module with hardware that has been tested and evaluated with the module under this standard or by a field inspection certifying that the installed module complies with the requirements of UL 1703.

**Site Consideration**
LGE solar modules should be mounted in a location that meets the following requirements.

**Operating Temperature**
- Maximum Operating Temperature: +60°C (149°F)
- Minimum Operating Temperature: -40°C (-40°F)

**Design Strength**
- LGE solar modules are certified to basic loads 75lb/ft². (Mounting by using frame bolts holes)

**Excluded Operating Environments**
- The solar modules from LG Electronics can not be operated in a location where they could come in direct contact with salt water or ammonia.
- When installed on a roof, the solar module must be mounted over a fire-resistant roof covering rated for the application. The fire resistance of the solar module is class C after ANSI/UL790.
- A slope less than 5° is not required to maintain a fire class rating.
- The solar module is only ETL listed for use when its factory frame is fully intact.
- Removal or alteration must be done by an authorized and qualified individual.
- Creating additional mounting holes may damage the solar module and reduce the strength of the frame.
- We recommend a 6mm gap between module frames to avoid tension from thermal expansion.
- The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.
- The module is considered to be in compliance with UL1703 only when the module is mounted in the manner specified by the mounting instructions below.
- The solar module may be mounted by using the following methods: (“Torque:8.12ft-lb”)
- LG modules Fire performance Type III shall be mounted with framing and mounting products certified and listed for system fire class rating in accordance with UL1703 edition 2014 and UL2703 edition 2014.
- It is recommended to check with local authorities for fire safety guidelines and requirements for any building or structure on to which the panels will be installed.
- When installing modules in heavy snow areas, it is recommended to be taken an appropriate countermeasure to prevent possible damages to the lower side frame by slipping snow. (A snow guard should be installed in accordance with the manufacturer’s instructions.)

**Mounting Methods**

**General Information**
- Select the appropriate orientation to maximize sunlight exposure.
- Module should not be mounted or stored in a way that the front/top glass faces downward in order to prevent water from entering the junction box, which could cause a safety hazard.
- Clearance between the solar module frames and structures such as roofs or ground is required to prevent wiring damage and to allow air to circulate behind the solar module. The recommended standoff height is a minimum of 100mm.
Additional highlights
- RS-485 communication interface (for connection to laptop or data logger)
- Available with the optional VSN700 Watt Logger Card for easy and affordable wireless monitoring
- Compliant with NEC 690.12 when used with ABB’s Rapid Shutdown device
- Comes standard with DC Arc Fault Circuit Interruptor (AFCI) to comply with NEC 690.11

This family of single-phase string inverters complements the typical number of rooftop solar panels enabling homeowners to get the most efficient energy harvesting for the size of the property.

This inverter offers a dual input section that processes two strings with independent Multiple Power Point Tracking (MPPT).

The high-speed MPPT offers real-time power tracking and improved energy harvesting. The flat efficiency curve ensures high-efficiency at all output levels allowing a consistent and stable performance across the entire input voltage and output power range.

The transformless operation gives the highest efficiency of up to 97.2 percent. The wide input voltage range makes the inverter suitable to low-power installations with reduced string size. This rugged, outdoor inverter has been designed to be a completely sealed unit, to withstand the harshest environmental conditions.

Highlights:
- Single-phase and three-phase output grid connection
- Wide input-voltage range for increased stringing flexibility and energy harvesting
- The high-speed and precise MPPT algorithm offers real-time power tracking and improved energy harvesting across the entire input voltage and output power range.
- Outdoor NIEMA 4X rated enclosure for unrestricted use under any environmental conditions
- Integrated DC disconnect switch in compliance with international Standards (-S Version)

Power and productivity for a better world™

---

### Technical data and types

<table>
<thead>
<tr>
<th>Type code</th>
<th>PVI-3.0-OUTD-US</th>
<th>PVI-3.6-OUTD-US</th>
<th>PVI-3.8-OUTD-US</th>
<th>PVI-4.2-OUTD-US</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal output power</td>
<td>3000W</td>
<td>3600W</td>
<td>3300W</td>
<td>4000W</td>
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<tr>
<td>Maximum output power wattage</td>
<td>3300W</td>
<td>4000W</td>
<td>3600W</td>
<td>4300W</td>
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<tr>
<td>Rated grid AC voltage</td>
<td>208V</td>
<td>240V</td>
<td>277V</td>
<td>208V</td>
</tr>
<tr>
<td>Maximum AC OCPD rating</td>
<td>20A</td>
<td>20A</td>
<td>15A</td>
<td>25A</td>
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<tr>
<td>Efficiency</td>
<td>96.9%</td>
<td>97%</td>
<td>97%</td>
<td>97%</td>
</tr>
<tr>
<td>Power factor</td>
<td>&gt; 0.995 (adjustable to ±0.8)</td>
<td>&gt; 0.995 (adjustable to ±0.8)</td>
<td>&gt; 0.995 (adjustable to ±0.8)</td>
<td>&gt; 0.995 (adjustable to ±0.8)</td>
</tr>
<tr>
<td>Stand-by consumption</td>
<td>&lt; 8W</td>
<td>&lt; 8W</td>
<td>&lt; 8W</td>
<td>&lt; 8W</td>
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<tr>
<td>Communication</td>
<td>16 characters x 2 lines LCD display, VSN710 Data Logger (opt.)</td>
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</tr>
</tbody>
</table>

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ABB solar inverters | Product flyer for PVI-3.0/3.6/3.8/4.2-TL-OUTD | 3.0kW to 4.2kW
**Certificate of Compliance**

Certificate: 2708406  
Master Contract: 259813  
Project: 2722409  
Date Issued: April 24, 2014  
Issued to: ABB, Inc.  
16250 W. Glendale Drive  
New Berlin, WI 53151  
USA

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators ‘C’ and ‘US’ for Canada and US or with adjacent indicator ‘US’ for US only or without either indicator for Canada only.

Issued by: Jocelyn Jens  
Product Group Coordinator  
Authorized by: Lindsay Clark  
Operations Manager

**PRODUCTS**

CLASS 5311 09 - POWER SUPPLIES - Distributed Generation Power Systems Equipment  
CLASS 5311 89 - POWER SUPPLIES - Distributed Generation - Power Systems Equipment  
- Certified to U.S. Standards


Notes:
1. All above models in this series may include expansion board with wireless antennae option and will be identified with model designation including “-Z” suffix.
2. For details related to rating, size, configuration, etc. reference should be made to the CSA Certification Record or the Certificate of Compliance Annex A.
ABB solar inverters

### Technical data and types

<table>
<thead>
<tr>
<th>Type code</th>
<th>2-String pass-through</th>
<th>2-String combined</th>
<th>4-String combined</th>
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<tbody>
<tr>
<td>PV source conductor input</td>
<td>Max input current (per string)</td>
<td>11.25A</td>
<td>11.25A</td>
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<tr>
<td>Max input voltage</td>
<td>600V</td>
<td>600V</td>
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<tr>
<td>Number of input strings</td>
<td>2</td>
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<td>4</td>
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<tr>
<td>Conductor size</td>
<td>14-8 AWG</td>
<td>14-8 AWG</td>
<td>12 AWG</td>
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<td>Number of output circuits</td>
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<tr>
<td>DC disconnect</td>
<td>Yes</td>
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<tr>
<td>Power consumption</td>
<td>&lt;5W, 24V/0.2A</td>
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<td>Maximum power conductor size</td>
<td>12 AWG</td>
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<td>E-stop button</td>
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<tr>
<td>Environment</td>
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<td></td>
<td></td>
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<tr>
<td>Mounting range</td>
<td>Dimensions H x W x D</td>
<td>10.54&quot; x 8.54&quot; x 5.32&quot; (without mounting bracket)</td>
<td>12.86&quot; x 10.24&quot; x 5.32&quot;</td>
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<tr>
<td>Weight</td>
<td>BB</td>
<td>6.86 lb</td>
<td>12.86 lb</td>
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<td>Operating temperature range</td>
<td>-25°C to +70°C</td>
<td>-25°C to +70°C</td>
<td>-25°C to +70°C</td>
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<tr>
<td>Warranty</td>
<td>2 years</td>
<td>2 years</td>
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<td>Rapid shutdown: 3SFA611821R1026</td>
<td></td>
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<tr>
<td>Optional emergency stop</td>
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</table>

### Block diagram for rapid shunt down models

**RS2-1CN6 two strings in, one PV output**

This 2-string model combines the strings to one PV output circuit. The RS2-1CN6 includes a disconnect switch on the front cover to disconnect the PV output conductors from the equipment downstream. Auxiliary terminals are provided for connecting an emergency stop button, if desired.

**RS4-2CN6 four strings in, two PV outputs**

This 4-string model combines 2-strings together in two separate PV output circuits. The RS4-2CN6 includes a disconnect switch on the front cover to disconnect the PV output conductors from the equipment downstream. Auxiliary terminals are provided for connecting an emergency stop button, if desired.

**RS2-2PN6 two strings in, two strings out**

The RS2-2PN6 is a 2-string pass-through with no string combining and no local disconnecting means included. Auxiliary terminals are provided for connecting an emergency stop button, if desired.

---

2 ABB solar inverters | Product flyer for RSD

---

Information in this document is subject to change without notice.
Certificate

License Holder: Power-One
3201 East Harbour Drive
Phoenix AZ 85034
USA

Test report no.: USA-ZZ 31580190 001
Client Reference: Bob White
Tested to:
UL 1741:2010
CSA C22.2.107.1-01 (R2006)

Certified Product: Rapid Shut Down Device

Model Designation: 1) RS4-2CN6, 2) RS2-2PN6, 3) RS2-1CN6
(trademark: ABB)

Rated Voltage: DC 90-580V
Rated Current: 10A max. (per channel)
Protection Class: I
Max. Short-Circuit Current (input/output): 1) 11.25/22.5A
2) 22.5A
(contd.)

Special Remarks: To be installed according to the licensee's installation instructions.
Also evaluated to NFPA 70: 2014, Article 690.12.

Appendix: 1, 1-6

Date of Issue (day/mo/yr) 13/04/2015

Licensed Test mark:

TUV Rheinland

---

Certificate

License Holder: Power-One
3201 East Harbour Drive
Phoenix AZ 85034
USA

Test report no.: USA-ZZ 31580190 001
Client Reference: Bob White
Tested to:
UL 1741:2010
CSA C22.2.107.1-01 (R2006)

Certified Product: Rapid Shut Down Device

Output Current: 1) 20A max. (per channel)
2) 10A max. (per channel)
3) 20A max.

Rated Ambient Temperature: -25°C to +70°C
Enclosure Index: Type 4X

Date of Issue (day/mo/yr) 13/04/2015

Licensed Test mark:
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.

The UFO securely bonds solar modules to XR Rails. It comes assembled and lubricated, and the Stopper Sleeve snaps onto the UFO, converting it into a bonded end clamp.

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

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

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.

UL Certification

<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>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>UFO/Stopper</td>
<td>✓</td>
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<td>✓</td>
</tr>
<tr>
<td>Bonded Splice</td>
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<td>Grounding Lugs</td>
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<td>1 per Row</td>
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</tr>
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<td>P320, P400, P405,</td>
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<td>P600, P700, P730</td>
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<tr>
<td>Fire Rating</td>
<td>Class A</td>
<td>Class A</td>
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</tr>
</tbody>
</table>
| Modules             | Tested or Evaluated with over 400 Framed Modules | | Refer to installation manuals for a detailed list.
**RATINGS**

**MODULE COMPATIBILITY**

- Max Overcurrent Protective Device (OCPD) Rating: 25A
- Max Module Size: 249
- 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

---

**MARKINGS**

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

---

© 2015 IRONRIDGE, INC. VERSION 1.20 FLUSH MOUNT INSTALLATION MANUAL - 2

---

© 2015 IRONRIDGE, INC. VERSION 1.20 FLUSH MOUNT INSTALLATION MANUAL - 3
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>
<thead>
<tr>
<th>Exposure</th>
<th>Wind Speed mph</th>
<th>0 psf</th>
<th>10 psf</th>
<th>20 psf</th>
<th>30 psf</th>
<th>40 psf</th>
<th>50 psf</th>
<th>60 psf</th>
<th>70 psf</th>
<th>80 psf</th>
<th>90 psf</th>
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<tbody>
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| Category C |
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| 105 | 75 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 110 | 75 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 120 | 70 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 130 | 65 | 64 | 54 | 48 | 43 | 39 | 35 | 33 | 31 | 29 |
| 140 | 60 | 60 | 53 | 48 | 43 | 39 | 35 | 33 | 31 | 29 |
| 150 | 56 | 56 | 52 | 47 | 43 | 39 | 35 | 33 | 31 | 29 |
| 160 | 53 | 53 | 51 | 46 | 42 | 39 | 35 | 33 | 31 | 29 |
| 170 | 50 | 50 | 50 | 45 | 41 | 38 | 35 | 33 | 31 | 29 |

| Category D |
| 100 | 75 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 105 | 73 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 110 | 70 | 65 | 55 | 49 | 43 | 39 | 35 | 33 | 31 | 29 |
| 120 | 64 | 64 | 54 | 48 | 43 | 39 | 35 | 33 | 31 | 29 |
| 130 | 60 | 60 | 53 | 47 | 43 | 39 | 35 | 33 | 31 | 29 |
| 140 | 55 | 55 | 52 | 46 | 42 | 39 | 35 | 33 | 31 | 29 |
| 150 | 52 | 52 | 50 | 46 | 42 | 39 | 35 | 33 | 31 | 29 |
| 160 | 49 | 49 | 49 | 45 | 41 | 38 | 35 | 33 | 31 | 29 |
| 170 | 46 | 46 | 46 | 44 | 40 | 37 | 35 | 33 | 31 | 29 |

Notes – see page 20
### Table 5A - MAXIMUM SPANS (in) - Roof Slope 7° to 27° - Wind Zone 2 (67.5" Max Module Length)

<table>
<thead>
<tr>
<th>XR10 Rail</th>
<th>Wind Speed</th>
<th>Ground Snow Load</th>
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</thead>
<tbody>
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<td>Exposure</td>
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**Category B**

<table>
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</thead>
<tbody>
<tr>
<td></td>
<td>Exposure</td>
<td>100</td>
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<td></td>
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<td></td>
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</tbody>
</table>

### Table 6A - MAXIMUM SPANS (in) - Roof Slope 7° to 27° - Wind Zone 3 (67.5" Max Module Length)

<table>
<thead>
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<th>XR10 Rail</th>
<th>Wind Speed</th>
<th>Ground Snow Load</th>
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<tbody>
<tr>
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**Category C**

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**Category D**

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<td></td>
<td></td>
<td>160</td>
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</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:  
* onride Inc.  
* 2701 Zephyr Village, Suite 103  
* 2970 Teller Street  
* Phoenix, AZ 85032  
* USA

Product Description:  
Flush Mount System with XR Rails.

Ratings & Principle Characteristics:  
* Fire, Lass Resistance Rating:
  - Flush Mount (Symmetrical) Class A Fire Rated for Low Slope applications when using Type 1 and 3 listed photovoltaic modules. Class A Fire Rated for Steep Slope application with Type 2 and 6 listed photovoltaic modules. Tested @ the 0.57 gap (distance between the bottom of the module frame and tile roof covering) the standard system can be installed at any gap allowed by the manufacturer's installation instructions. The imetra guard is equipped. This rating is applicable with any onride flush mount with 3rd party OOF anchor.

Models:  
* onride Flush Mount with XR Rails

Brand Name:  
onride Flush Mount

Relevant Standards:  
Intertek Testing Inc.  
* 6 Murphy Drive  
* Middleton, WI 53562

Date of Tests:  
* 12/4/14  
* 1/26/14  
* 2/16/14  
* 4/19/14  
* 6/23/14  
* 7/28/14  
* 10/3/14  
* 11/17/14  
* 2/19/15  
* 4/6/15  
* 6/15/15  
* 7/22/15  
* 9/25/15

This verification report 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:  
* D. Zimbrick  
* Technician, Fire Resistance

Reviewed by:  
* Chad Naggs  
* Technician, Fire Resistance

Signature:  
* A  

Date:  
* 12/4/14

---

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 1
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 workmanship 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 website, 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 LoFquist.

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 LoFquist, Inc.  
Consulting Structural and Forensic Engineers

December 18, 2014  
Page 20 of 20
E-Mount Lag | QMSE - LAG

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

**Notes:**
1) Thread must be embedded in a rafter or other structural roof member.
2) See NDS Table 11.5.1C for required edge distances.

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

- **Douglas Fir, Larch:**
  - 0.50: 798
  - 0.46: 705

- **Englemann Spruce, Lodgepole Pine (5% or higher):**
  - 0.46: 705

- **Hardwoods:**
  - Hick. F (in): 0.45: 698
  - 0.46: 705

- **Southern Pines:**
  - 0.50: 915

- **Spruce, Pine, Fir (4 ft. or 2 million plus and higher grades of Northern and Mill):**
  - 0.50: 798

**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.

**Steps:**
1. Locate, choose, and mark centers of rafters to be mounted. Select the courses of shingles where mounts will be placed.
2. Carefully lift composition roof shingle with roofing bar, just above placement of mount. Remove nails as required. See “Proper Flashing Placement” on next page.
3. 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.
4. 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 long style bit, aka aircraft extension bit to drill a 1 1/4" deep hole into rafter.
5. DO NOT over-torque.
6. Clean off any sawdust, and fill hole with sealant compatible with roofing materials.
7. Slide the flashing into position. Insert the rubber plug into the QBlock cavity.
8. Using a 1/2 inch socket on an impact gun drive the lag screw until the QBlock stops rotating easily. DO NOT over-torque.
9. Slide the washer and the L-foot (not included) onto the lag screw.
10. Using drill with 7/32" bit, drill pilot hole into roof and rafter, taking care to drill square to the roof. Do not use mount as a drill guide. Drill should be long style bit, aka aircraft extension bit to drill a 1 1/4" deep hole into rafter.
11. DO NOT over-torque.
12. Clean off any sawdust, and fill hole with sealant compatible with roofing materials.
13. Slide the flashing into position. Insert the rubber plug into the QBlock cavity.
14. Using a 1/2 inch socket on an impact gun drive the lag screw until the QBlock stops rotating easily. DO NOT over-torque.
15. Slide the washer and the L-foot (not included) onto the lag screw.

**Diagram:**
- This edge towards roof ridge
- Available in mill and bronze anodized finishes
- Lag pull-out (withdrawal) capacities (lbs) in typical lumber
- Lag Bolt Specifications
- Specific Gravity: 0.50: 798, 0.46: 705
- 5/16" shaft per 2" thread depth: 0.50: 798, 0.46: 705
- 5/16" shaft per 1" thread depth: 0.50: 798, 0.46: 705

**Notes:**
1. Thread must be embedded in a rafter or other structural roof member.
2. See NDS Table 11.5.1C for required edge distances.
The LGate 120 is a single-phase electronic watt-hour meter for remote monitoring of solar photovoltaic systems. It features a smart communications module to automatically transmit meter data over cellular or Ethernet networks allowing system owners and operators to easily manage distributed solar assets.

DATA COLLECTION
AC energy data is collected by the meter and passed to the communications module. Additional system performance data can be collected directly from meteorological sensors and supported inverters via available RS-485 or Zigbee connections. All data is stored in non-volatile memory and then automatically uploaded to the SolarOS and SolarNOC platforms.

NETWORK CONNECTIVITY
The communications gateway inside the LGate 120 supports plug and play connectivity through a cellular or available Ethernet network connection. Once the unit is installed and powered on, it will immediately begin transmitting data without any configuration. For maximum reliability, the communications gateway will automatically route uploads between the wireless and wired connections if either of the networks are unavailable.

FEATURES
- ANSI C12.20 power meter
- RS-485 and Zigbee inputs
- GSM cellular or Ethernet connectivity
- Over the air firmware updates
- Easy, low cost installation
- Doesn’t require entrance into the building
- Plug and play activation
- LCD display

The LGate 120 combines a revenue-grade, solid-state power meter with an advanced communications gateway. These components work in conjunction to remotely monitor the performance of residential solar energy installation regardless of panel or inverter type. The LGate 120 is a one-piece completely under glass meter which installs easily using a standard socket base. Performance data is uploaded in near real-time to the Locus Energy SolarOS monitoring platform which provides a suite of tools and analytics for asset managers.

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# Single Meter Sockets - Without Bypass

## Application
- Single meter position
- Receive ANSI C12.10 watthour meters
- Surface or flush mount (see chart)

## Construction
- Ring type
- NEMA Type 3R
- ANSI 61 gray E-coat finish
- Aluminum snap ring included

## Standards
- UL 414 Listed
- ANSI C12.7

## Accessories
- 5th Jaw Kit - 50365
- 200A Triplex Ground - ETB200
- AW Hub

## Knockout Layouts

### Knockouts - Conduct Sizes
- **1W = 1/4”**
- **1A = 1/2”**
- **2A = 1/2” - 1/4”**
- **4F = 2” - 11/2” - 11/4” - 1”**
- **4G = 21/2” - 2” - 11/2” - 11/4”**
- **Top Provision = See Chart**

## Knockout Layouts

### Top Provision

#### Fig. 1

<table>
<thead>
<tr>
<th>Style #</th>
<th>Suffixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>011 F</td>
<td>- Flush Mount</td>
</tr>
<tr>
<td>(U) 204</td>
<td>- MS68 - 2” Conduit Hub</td>
</tr>
<tr>
<td>011 SF</td>
<td>- MS68A - MS68 + MS68</td>
</tr>
<tr>
<td>527</td>
<td>- AL Screw Type Ring</td>
</tr>
<tr>
<td>SF</td>
<td>- Semi-Flush Mount</td>
</tr>
<tr>
<td>SS</td>
<td>- Stainless Steel</td>
</tr>
</tbody>
</table>

### Top Provision Layouts

#### Fig. 2

- **1A**

#### Fig. 3

- **4F**

#### Fig. 4

- **4G**

### Data subject to change without notice. Consult local utility for area acceptance. All dimensions are in inches.
October 22nd, 2013

This letter is to certify that the LGate 120 and LGate 320 are communication boards built into the Vision Meter 2S CL200 and 16S CL320 socket meters, respectively. Each of these meters was certified to the ANSI C12.20 (class 0.2%) standard by Underwriters Laboratory on June 7, 2013 as part of the Vision Meter Family (Project Number 12CA71134, Job Number 1001541515, and Report Number R12CA71134-ANSI).

ANSI C12.20 is currently recognized as the industry standard for electrical socket meters in both utility and PV monitoring applications. These tests cover both meter accuracy as well as several safety standards including electrical and environmental safety, as well as resistance to various types of mechanical shock. As electrical socket meters are generally installed and maintained by trained and certified professionals, rather than consumers, they do not fit the typical criteria for additional types of UL or IEC certification.

If you have any further questions regarding the product certification of any Locus Energy LGate-branded device, please contact us at support@locusenergy.com.

The Locus Energy Team