HISTORIC AND DESIGN REVIEW COMMISSION

July 06, 2016

Agenda Item No: 14

HDRC CASE NO:	**2016-234**
ADDRESS:	2234 W MISTLETOE
LEGAL DESCRIPTION:	NCB 6830 BLK 0 LOT 27 E 10 FT OF 26
ZONING:	R6 H
CITY COUNCIL DIST.:	7
DISTRICT:	Monticello Park Historic District
APPLICANT:	APEX Home Energy Savings
OWNER:	Aurello Montemayor
TYPE OF WORK:	Installation of Solar Panels

REQUEST:

The applicant is requesting a Certificate of Appropriateness for approval to install 8 solar panels on the rear slope of the roof.

APPLICABLE CITATIONS:

Historic Design Guidelines, Chapter 3, Guidelines for Additions

6. Designing for Energy Efficiency

C. SOLAR COLLECTORS
i. Location—Locate solar collectors on side or rear roof pitch of the primary historic structure to the maximum extent feasible to minimize visibility from the public right-of-way while maximizing solar access. Alternatively, locate solar collectors on a garage or outbuilding or consider a ground-mount system where solar access to the primary structure is limited.
ii. Mounting (sloped roof surfaces)—Mount solar collectors flush with the surface of a sloped roof. Select collectors that are similar in color to the roof surface to reduce visibility.
iii. Mounting (flat roof surfaces)—Mount solar collectors flush with the surface of a flat roof to the maximum extent feasible. Where solar access limitations preclude a flush mount, locate panels towards the rear of the roof where visibility from the public right-of-way will be minimized.

FINDINGS:

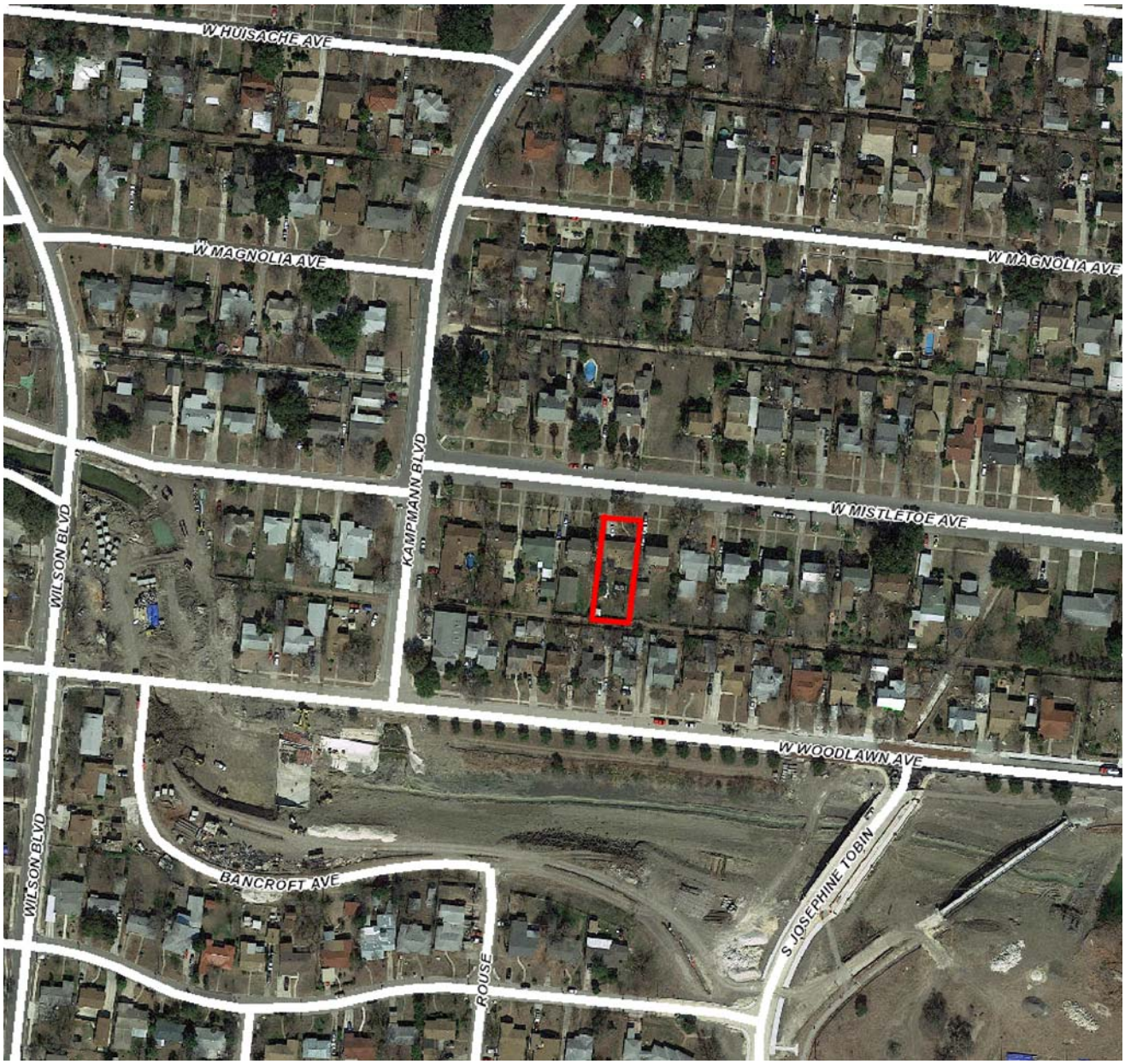
a. The house at 2234 W Mistletoe has a side-gabled roof, a heavily vegetated front lawn, and two large front trees.
b. The applicant is proposing to install 8 solar panels on the composition shingle roof of the primary structure. The panels will be located on the rear slope facing the interior of the lot. According to the Guidelines for Additions 6.C., installations should be in locations that minimize visibility from the public right-of-way.
c. Staff visited the site on June 21, 2016, and found that would not be seen from the public right-of-way, therefore the proposal is consistent with the Guidelines.
d. The applicant is proposing to mount the panels flush with the pitched roof. This is consistent with Guidelines for Additions 6.C.ii, which states solar collectors should be flush with the roof surface.
e. Staff visited the site June 21, 2016 and found two large front yard trees and a side gabled roof.

RECOMMENDATION:

Staff recommends approval as submitted based on findings a through e.

CASE MANAGER:

Lauren Sage



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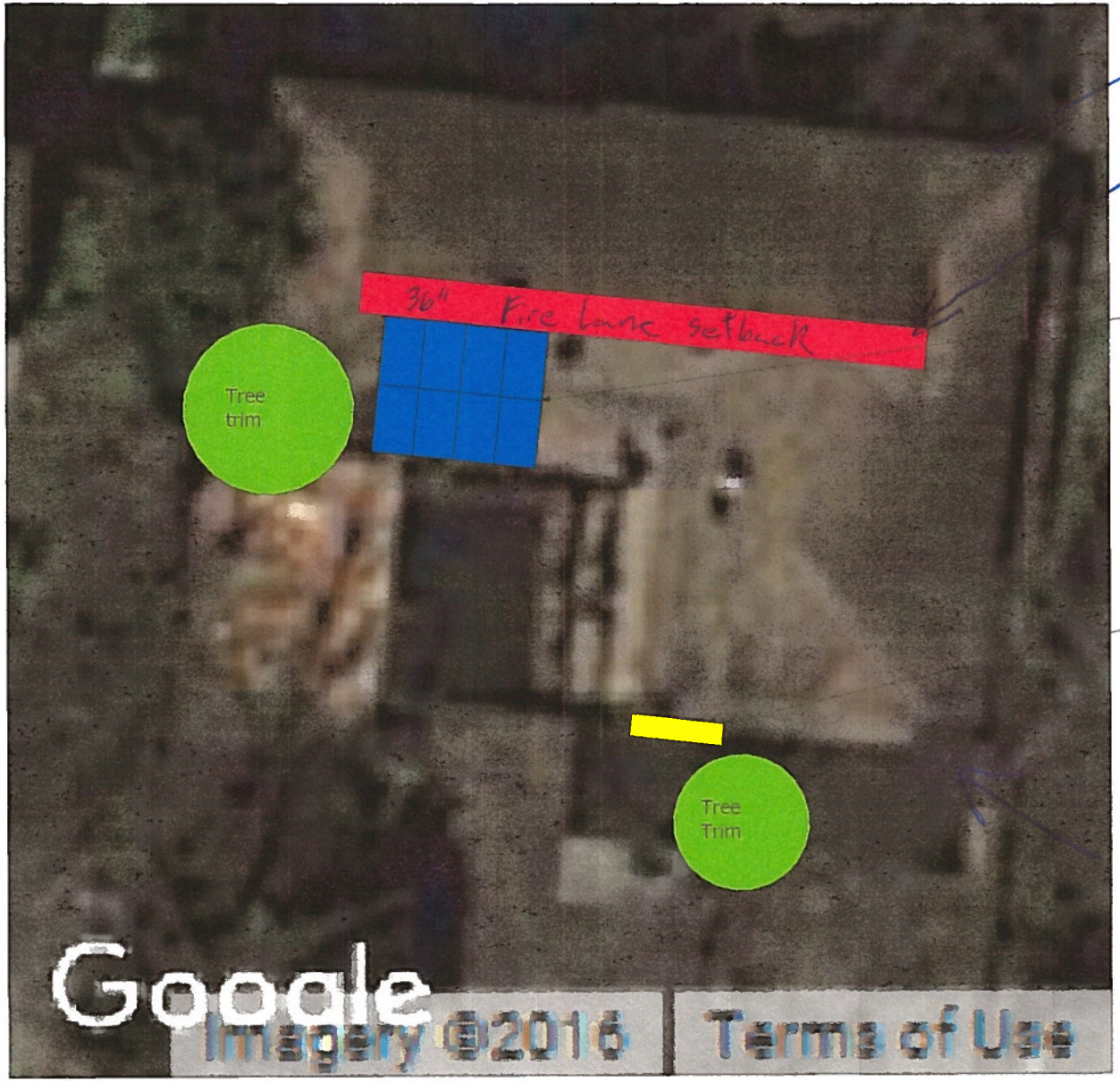
DFR-1206



Street
front of Home

36" Fire Path

Azimuth:180
Tilt:10
8-Enphase M-215
8-Au Optronics 260W

CPS Revenue Meter
6 315 858
PV Equipment

Back of Home

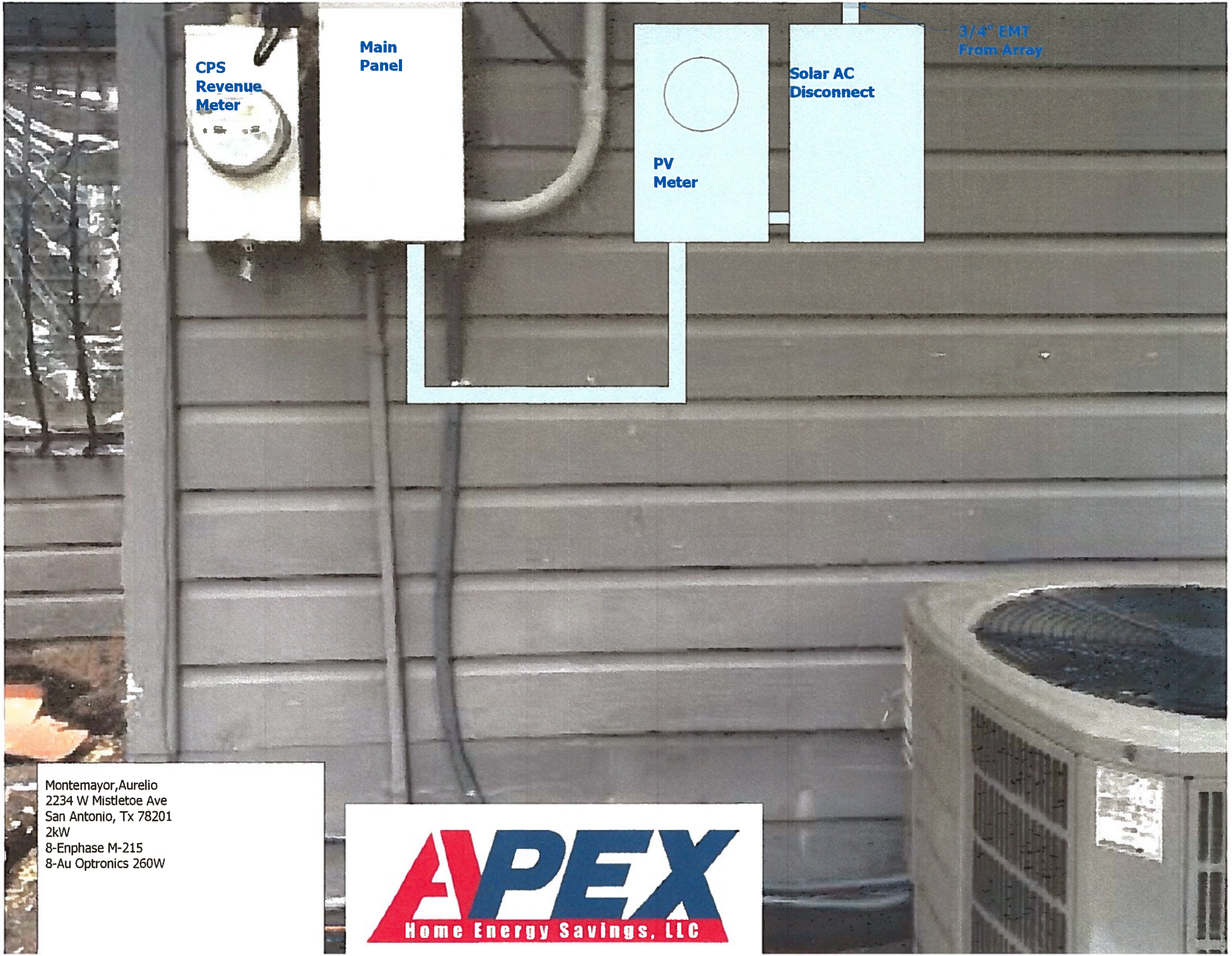
APEX
Home Energy Savings, LLC

N
W
E
S

Apex Home Energy
5411 Bandera Rd.
Unit 304
San Antonio, Tx
(210) 660-5120

Drawn By:
Shad Haigwood
NABCEP 042013-44

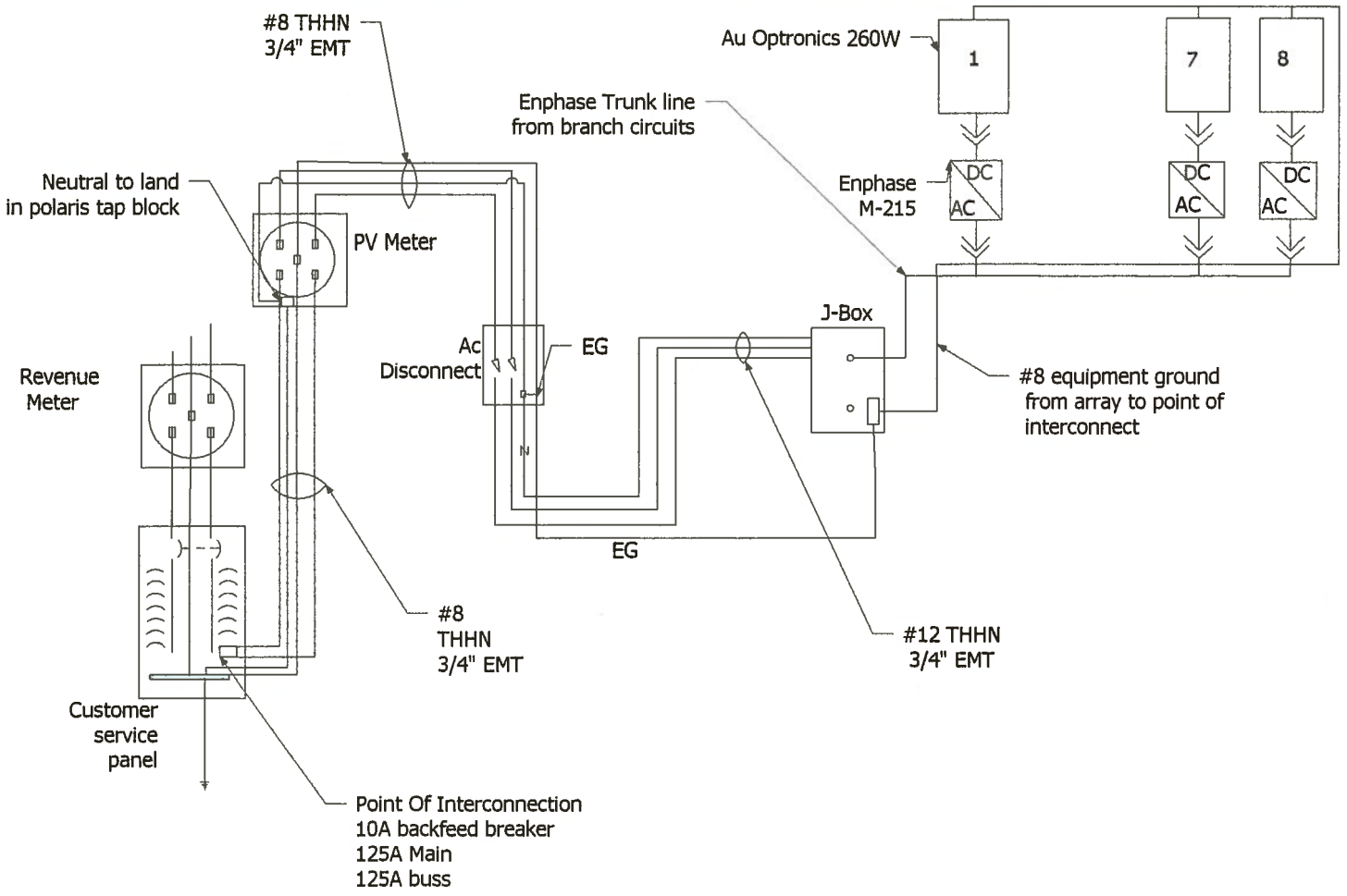
Montemayor,Aurelio
2234 W Mistletoe Ave
San Antonio, Tx 78201
2kW
8-Enphase M-215
8-Au Optronics 260W



Montemayor,Aurelio
2234 W Mistletoe Ave
San Antonio, Tx 78201
2kW
8-Enphase M-215
8-Au Optronics 260W

APEX
Home Energy Savings, LLC

Montemayor,Aurelio
2234 W Mistletoe Ave
San Antonio, Tx 78201
2kW
8-Enphase M-215
8-Au Optronics 260W
1- Branch circuit of 8/8.8A
Total:8.8A@ 240V

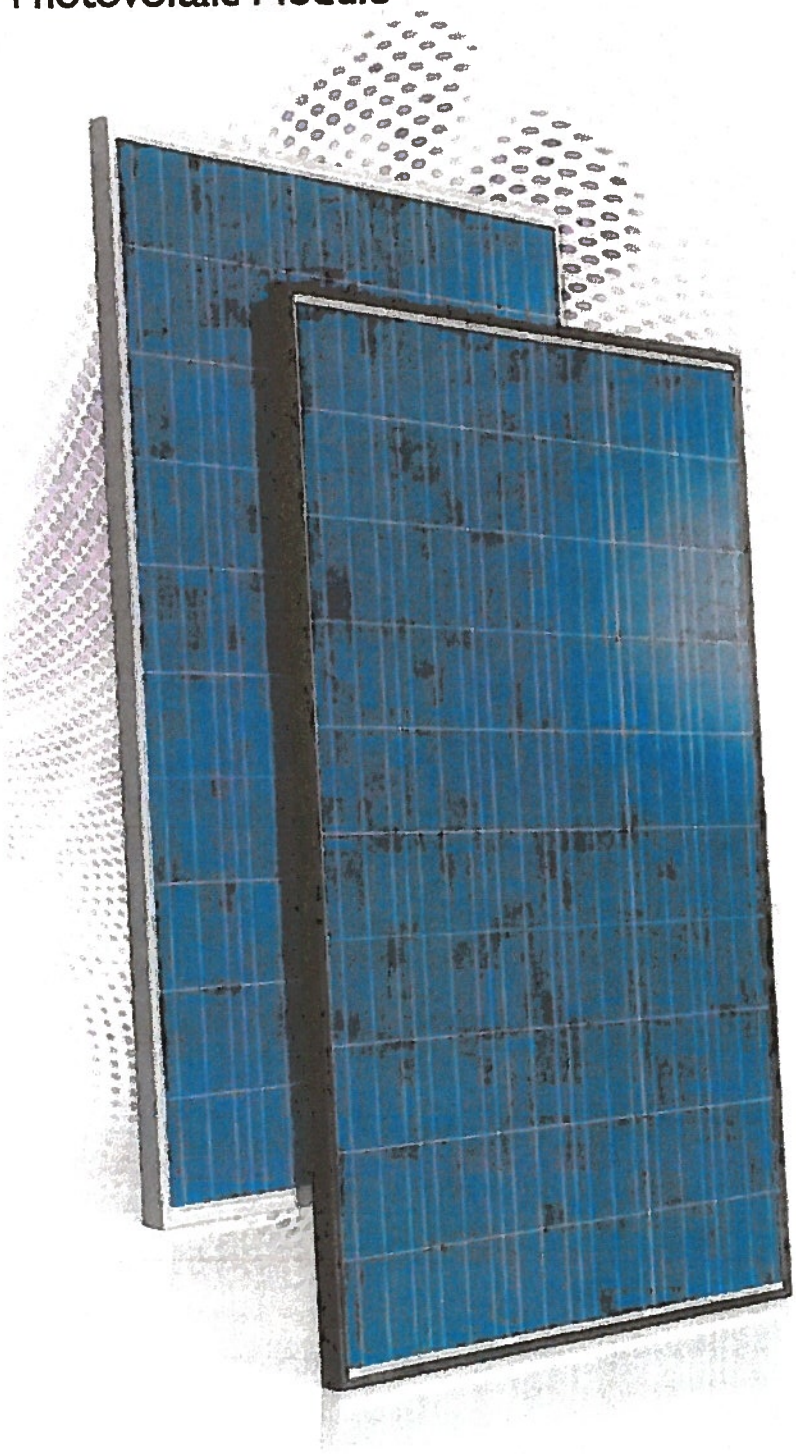


Apex Home Energy
5411 Bandera Rd.
Unit 304
San Antonio, Tx
(210) 660-5120
Drawn By: Shad Haigwood
NABCEP 042013-44

APEX
Home Energy Savings, LLC

GreenTriplex
PM245P00

Multi-Crystalline Photovoltaic Module



Power Range
240 ~ 260 Wp

Highly Strengthened Design
Module complies with advanced loading tests to meet 5400 Pa loading requirements

IP-67 Rated Junction Box
Advanced water and dust proof level

Flammability Test
Low ignitability ensuring fire safety

Anti-Reflection Coated Glass
Anti-reflective surface enhances the power performance

PID-Free

Resistance to Salt Corrosion and Humidity
Module complies with IEC 61701: Salt Mist Corrosion Testing

Ammonia Test
Reliable in ammonia rich environment

BenQ Solar

GreenTriplex PM245P00 (240 ~ 260 Wp)

Electrical Data

Typ. Nominal Power P_N	240 W	245 W	250 W	255 W	260 W
Typ. Module Efficiency	14.9%	15.2%	15.5%	15.8%	16.1%
Typ. Nominal Voltage V_{mp} (V)	29.9	30.3	30.6	30.8	31.2
Typ. Nominal Current I_{mp} (A)	8.03	8.09	8.17	8.28	8.34
Typ. Open Circuit Voltage Voc (V)	37.0	37.2	37.4	37.6	37.7
Typ. Short Circuit Current Isc (A)	8.58	8.64	8.69	8.76	8.83
Maximum Tolerance of P_N			0 / +3%		

- Above data are the effective measurement at Standard Test Conditions (STC)
- STC: Irradiance 1000 W/m², spectral distribution AM 1.5, temperature 25 ± 2 °C, in accordance with EN 60904-3
- The given electrical data are nominal values which account for basic measurements and manufacturing tolerances of ±10%, with the exception of P_N. The classifications is performed according to P_N

Temperature Coefficient

NOCT	46 ± 2 °C
Typ. Temperature Coefficient of P_N	-0.44 % / K
Typ. Temperature Coefficient of Voc	-0.32 % / K
Temperature Coefficient of Isc	0.04 % / K

- NOCT: Normal Operation Cell Temperature, measuring conditions: irradiance 800 W/m², AM 1.5, air temperature 20 °C, wind speed 1 m/s

Mechanical Characteristics

Dimensions (L x W x H)	1639 x 983 x 40 mm (64.53 x 38.70 x 1.57 in)
Weight	18.5 kg (40.79 lbs)
Front Glass	High transparent solar glass (tempered), 3.2 mm (0.13 in)
Cell	60 multicrystalline solar cells, 156 x 156 mm (6 x 6 in)
Cell Encapsulation	EVA
Back Sheet	Composite film
Frame	Anodized aluminum frame
Junction Box	IP-67 rated with 3 bypass diodes
Connector Type & Cables	TE Connectivity PV4: 1 x 4 mm² (0.04 x 0.16 in²), Length: each 1.0 m (39.37 in) YUKITA YS-254/YS-255: 1 x 4 mm² (0.04 x 0.16 in²), Length: each 1.065 m (41.93 in)

Operating Conditions

Operating Temperature	-40 ~ +85 °C
Ambient Temperature Range	-40 ~ +45 °C
Max. System Voltage IEC/UL	1000 V / 1000 V
Serial Fuse Rating	15 A
Maximum Surface Load Capacity	Tested up to 5400 Pa according to IEC 61215 (advanced test)

Warranties and Certifications

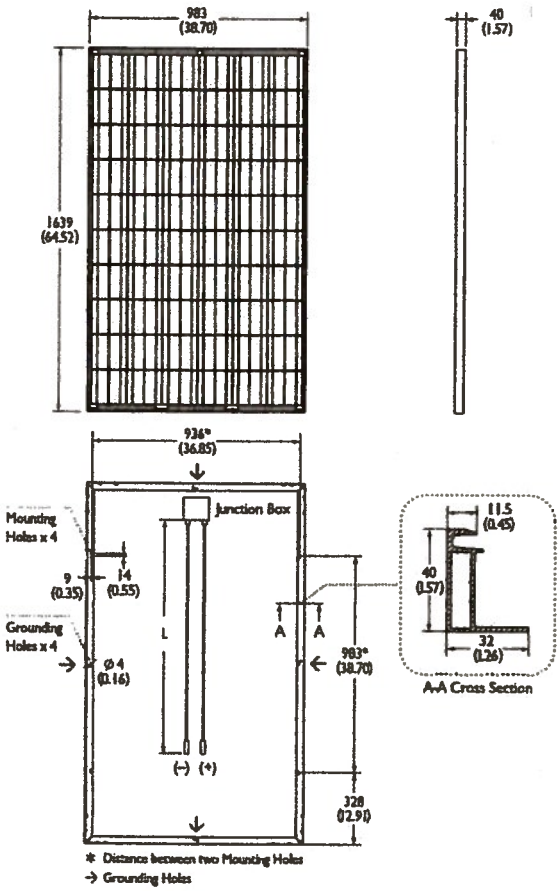
Product Warranty	Maximum 10 years for material and workmanship
Performance Guarantee	Guaranteed linear degradation to 80% for 25 years *1
Certifications	According to IEC/EN 61215, IEC/EN 61730 and UL 1703 guidelines *2

*1: Please refer to warranty letter for detail
*2: Please confirm other certifications with official dealers

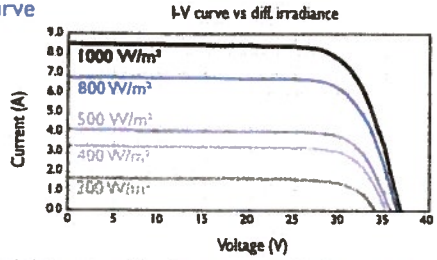
Packing Configuration

Container	20' GP	40' GP	40' HQ
Pieces per Pallet	26	26	26
Pallets per Container	6	14	28
Pieces per Container	156	364	728

Dimensions mm (inch)



I-V Curve



Current/voltage characteristics with dependence on irradiance and module temperature.

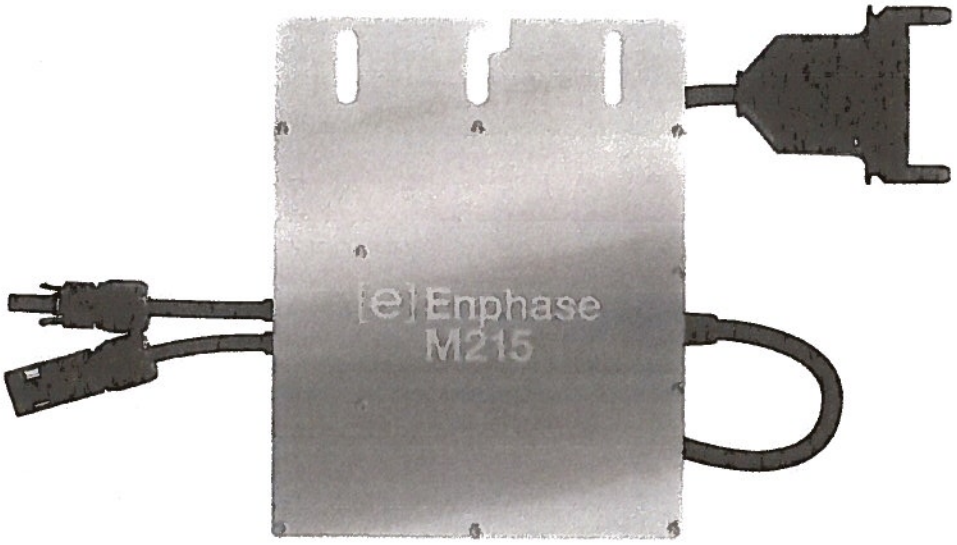
Dealer Stamp

AU Optronics Corporation
No. 1, Li-Hsin Rd. 2, Hsinchu Science Park, Hsinchu 30078, Taiwan
Tel: +886-3-500-8899 www.BenQSolar.com

BenQ Solar

Enphase® **Microinverters**

Enphase® M215



The **Enphase® M215 Microinverter** with integrated ground delivers increased energy harvest and reduces design and installation complexity with its all-AC approach. With the advanced M215, the DC circuit is isolated and insulated from ground, so **no Ground Electrode Conductor (GEC) is required for the microinverter.** This further simplifies installation, enhances safety, and saves on labor and materials costs.

The Enphase M215 integrates seamlessly with the Engage® Cable, the Envoy® Communications Gateway™, and Enlighten®, Enphase's monitoring and analysis software.

PRODUCTIVE

- Maximizes energy production
- Minimizes impact of shading, dust, and debris
- No single point of system failure

SIMPLE

- No GEC needed for microinverter
- No DC design or string calculation required
- Easy installation with Engage Cable

RELIABLE

- More than 1 million hours of testing and millions of units shipped
- Industry-leading warranty, up to 25 years

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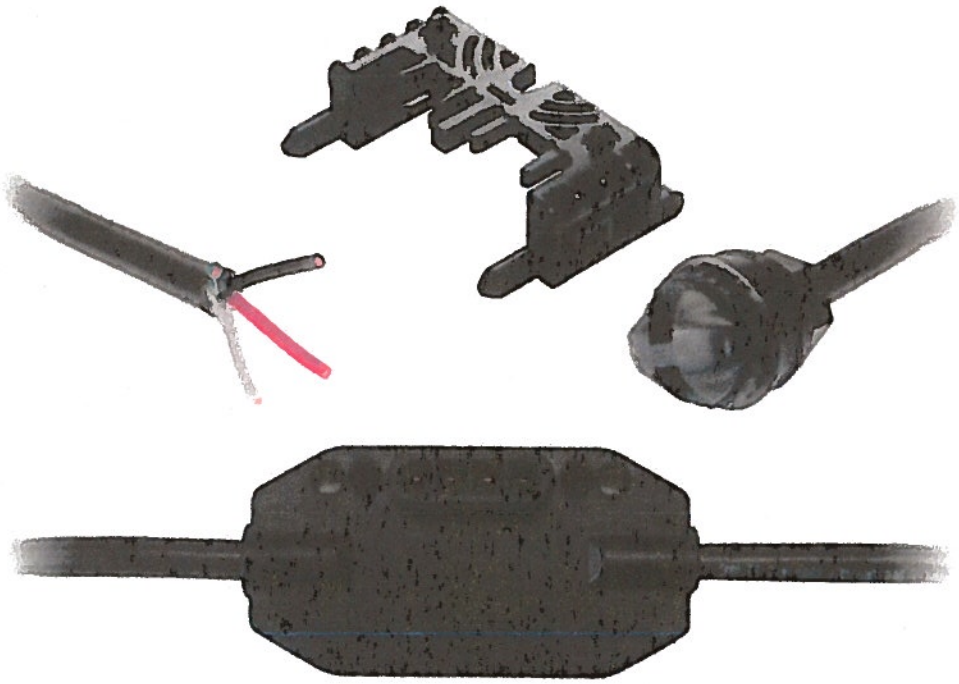
Engage Cable System and Accessories

Enphase® Engage Cable



The **Engage™ Cable** is a continuous length of 12AWG cable with pre-installed connectors for Enphase Microinverters. The cable is handled like standard outdoor-rated electrical wire, allowing it to be cut, spliced and extended as needed.

The **Engage Accessories** complement the Engage Cable and give it the ability to adapt to any installation.

FAST
- Quick installation
- Large branch capacity

FLEXIBLE
- Simple design
- No additional cables

SAFE
- No high voltage DC
- Reduced fire risk

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Enphase® **Engage** Cable System // DATA

CABLE TYPES / ORDERING OPTIONS

Voltage	Connector Spacing	PV Module Orientation	Model Number	#Connectors*	Weight**
240 VAC, 4 conductors	1.025 meter (40")	Portrait	ET10-240-40	40	40 lbs
240 VAC, 4 conductors	1.7 meter (67")	Landscape	ET17-240-40	40	45 lbs
208 VAC, 5 conductors	1.025 meter (40")	Portrait	ET10-208-30	30	30 lbs
208 VAC, 5 conductors	1.7 meter (67")	Landscape	ET17-208-30	30	35 lbs

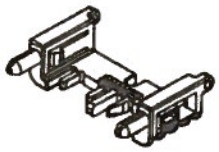
*additional lengths available through Enphase authorized distributors. **weights are approximate

CABLE SPECIFICATIONS

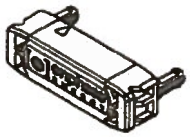
Description	Rating
Cable temperature rating	90°C (194°F) wet/dry
Cable insulator rating	THWN-2
UV exposure rating	UL 746 C, F1
Conductor size	12 AWG
Compliance	IEC 60529 IP67, CAN/CSA 22.2 No. 21, 182.3, UL 486A/B, 514C, 6703, and 9703
Cable rating	TC-ER
Cable Diameter	240 VAC: 10.75mm (0.425") 208 VAC: 11.75mm (0.463")
Minimum bend radius	12 cm (4.75")

ENGAGE ACCESSORIES

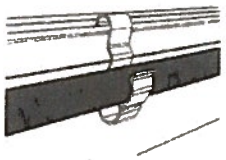
Branch Terminator
One terminator needed per branch circuit
ET-TERM-10 (sold in packs of 10)



Disconnect Tool
Plan to use at least one per installation
ET-DISC-05 (sold in packs of 5)



Watertight Sealing Cap
One needed to cover each unused connector on the cabling
ET-SEAL-10 (sold in packs of 10)



Cable Clip
Many needed to fasten cabling to the racking or to secure looped cabling
ET-CLIP-100 (sold in packs of 100)

Engage Coupler
Used for splicing two power cables within an array
ET-SPLK-05 (sold in packs of 5)

To learn more about Enphase Microinverter technology, visit enphase.com

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Equipment Grounding in an Enphase System

Overview

An Enphase Energy Microinverter system offers the safest photovoltaic system available. The Enphase Microinverter system provides a system that is safer for service personnel, safer for fire fighter personnel, and less prone to the fire hazards that come with higher voltage DC photovoltaic systems. Many of these safety advantages are widely known:

- DC voltages are maintained at low, safe levels
- Conduits and conductors are de-energized when the main breaker is shut-off.
- Enphase Microinverter systems are free of DC arc-fault hazards and requirements

However, one advantage that is rarely discussed is the high levels of ground bonding that exists in an Enphase Microinverter system.

Each and every microinverter in an Enphase system is bonded to ground through the Enphase Engage cabling system. The Enphase Engage cable provides for a robust grounding path to each microinverter, and when properly bonded to racking and to modules frames provides for robust equipment grounding to the equipment, also. When the microinverters, racking, and modules are properly bonded together, then the equipment grounding may also be provided through the microinverter. This can provide a significant cost savings to the labor and balance of system costs in an Enphase Microinverter system.

Enphase Grounding and the 2011 National Electrical Code

Equipment Grounding and System Grounding Requirements

The Enphase M250-IG and M215-60-2LL-S22-IG meet the requirements of the National Electrical Code Article 690.35 Ungrounded Photovoltaic Power Systems. NEC 690.35 allows for photovoltaic power systems to be installed with ungrounded photovoltaic source and output circuits. Systems that meet the requirements of NEC 690.35 are exempt from the requirements of NEC 690.41 System Grounding.

The NEC calls out two distinct types of grounding; equipment grounding and system grounding. Equipment grounding provides for the grounding of metal equipment and enclosures and is generally provided for with equipment grounding conductors (EGCs). System grounding provides the primary grounding path between a grounding electrode (I.E. ground rod or ufer) and a grounded system. System grounding requires the installation of a grounding electrode conductor (GEC). In an Enphase system, the DC conductors are not bonded to ground and the microinverters do not require a GEC, but do require that EGCs are provided for equipment grounding.

The term ungrounded is somewhat misleading, because ungrounded photovoltaic systems are still required to have equipment grounding provided to the metal frames, equipment, and enclosures in the system, but are not required to meet the requirements for system grounding. This means that a grounding electrode conductor (GEC) is not required to be installed to the enclosure of each Enphase Microinverter.

Systems that do bond the DC conductors of the photovoltaic source and output circuits must meet the installation requirements for the grounding electrode conductors (GEC) as called out in NEC 250.64, which requires that the GEC be continuous and protected against damage. The grounding electrode conductor (GEC) must also be a minimum 8CU conductor, as required by NEC 250.166.

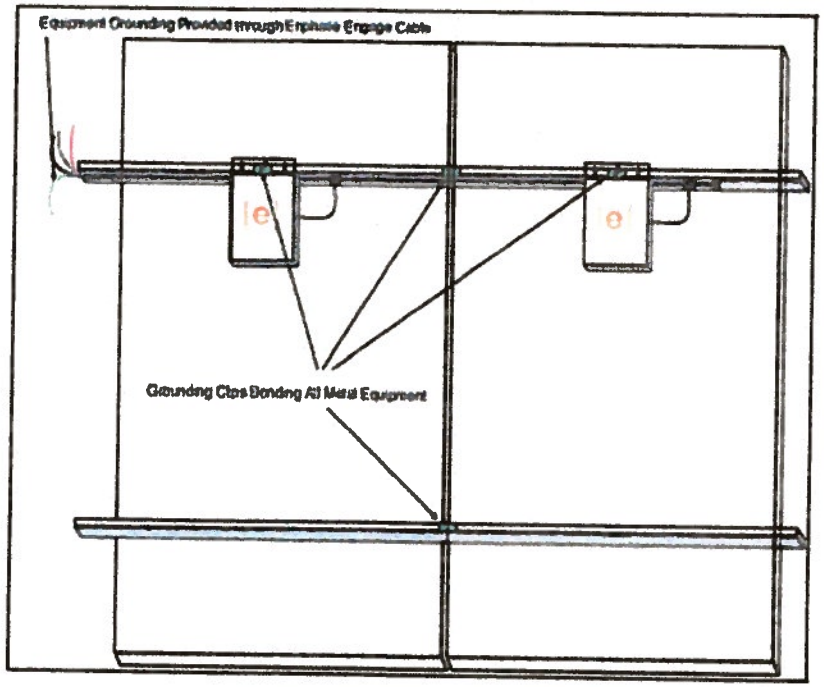
Equipment Grounding Requirements for an Enphase System

In an Enphase system with Integrated Ground Microinverters, the requirements for providing a GEC to the microinverters is removed, and only equipment grounding is required. In these systems, it is reasonable and safe to provide the equipment grounding through the Enphase Engage cabling.

NEC Article 690.43 Equipment Grounding specifies that all exposed non-current-carrying metal parts of PV module frames, electrical equipment, and conductor enclosures shall be provided with equipment grounding.

690.43(C) Structure as Equipment Grounding Conductor allows for equipment to be used as the equipment grounding conductor in a photovoltaic system. Specifically, "*Devices listed and identified for grounding the metallic frames of PV modules or other equipment shall be permitted to bond the exposed metal surfaces or other equipment to mounting surfaces.*"

In an Enphase microinverter system, if the microinverters and modules are bonded to the racking assemblies with the use of listed and approved grounding clips or grounding components, then the equipment grounding conductor provided to the microinverters through the Enphase Engage cable may also be used to ground the other photovoltaic system components.



**Always check with your Authority Having Jurisdiction about your proposed grounding methodology prior to the installation of the system.

Meeting the Requirements of NEC 690.35 Ungrounded Photovoltaic Power Systems

Enphase microinverters meet the requirements of NEC Article 690.35 for Ungrounded Photovoltaic Power systems. The article states:

690.35 Ungrounded Photovoltaic Power Systems. Photovoltaic Power Systems shall be permitted to operate with ungrounded photovoltaic source and output circuits where the system complies with 690.35(A) through (G).

(A) **Disconnects.** In an Enphase microinverter system the AC and DC connectors are the disconnecting means.
(B) **Overcurrent Protection.** In an Enphase system, the AC circuit breaker or fused disconnecting feeding the branch circuit provides overcurrent protection for the inverter output circuit. As per 690.9(A) Exception (b), overcurrent protection is not required on the DC conductors.
(C) **Ground Fault Protection.** In an Enphase microinverter system, ground fault protection is provided in the microinverter. In the Enphase microinverters with integrated grounding, the ground fault protection is provided by a ground fault sensing circuit.
(D) **The DC conductors must be PV Wire.** The DC conductors in an Enphase Microinverter are PV Wire.
(E) Allowed for use in ungrounded battery systems
(F) **Labeling.** The Enphase Microinverters are labeled as specified
(G) **Listing.** The Enphase Microinverters are listed for use in an ungrounded photovoltaic system

"Utility-Interactive": What it Means, What Protection it Ensures

Marv Dargatz, Director of Engineering 02/04/2010

Introduction

"Utility-Interactive" is a common term in the PV industry, but what does it actually mean? What does it guarantee, and what kind of protection does it ensure?

Section 100 of the NEC defines "Utility-Interactive" as, "An inverter intended for use in parallel with an electric utility to supply common loads that may deliver power to the utility." In other words, it describes the type of inverter that lets PV system owners export their excess power back to the utility.

PV inverters that are marked "Utility-Interactive" have undergone extensive testing to verify that they cannot energize the AC (utility) side unless they are actually connected to the utility. Utility-Interactive inverters are designed to export AC current only when they are actually connected to the grid and only when the grid is within specific voltage and frequency limits.

Basically, the "Utility-Interactive" designation ensures that the utility side of the inverter meets strict regulatory and safety requirements. It provides assurance that the inverter will not present a shock hazard should the utility circuit breaker be opened, even when DC input voltage is present. The inverter is a current source, not a voltage source, and as required by IEEE1547, the inverter must not regulate utility voltage.

Protective Boundary

A Utility-Interactive inverter forms a protective barrier between the DC (power source) side of the inverter and the AC (utility) interface. In the event of an out-of-tolerance utility connection, the inverter "ceases to energize," or shuts down, the AC (utility) side. Figure 1 is a general system diagram showing the line of demarcation between the DC power source and the utility.

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enphaseenergy.com

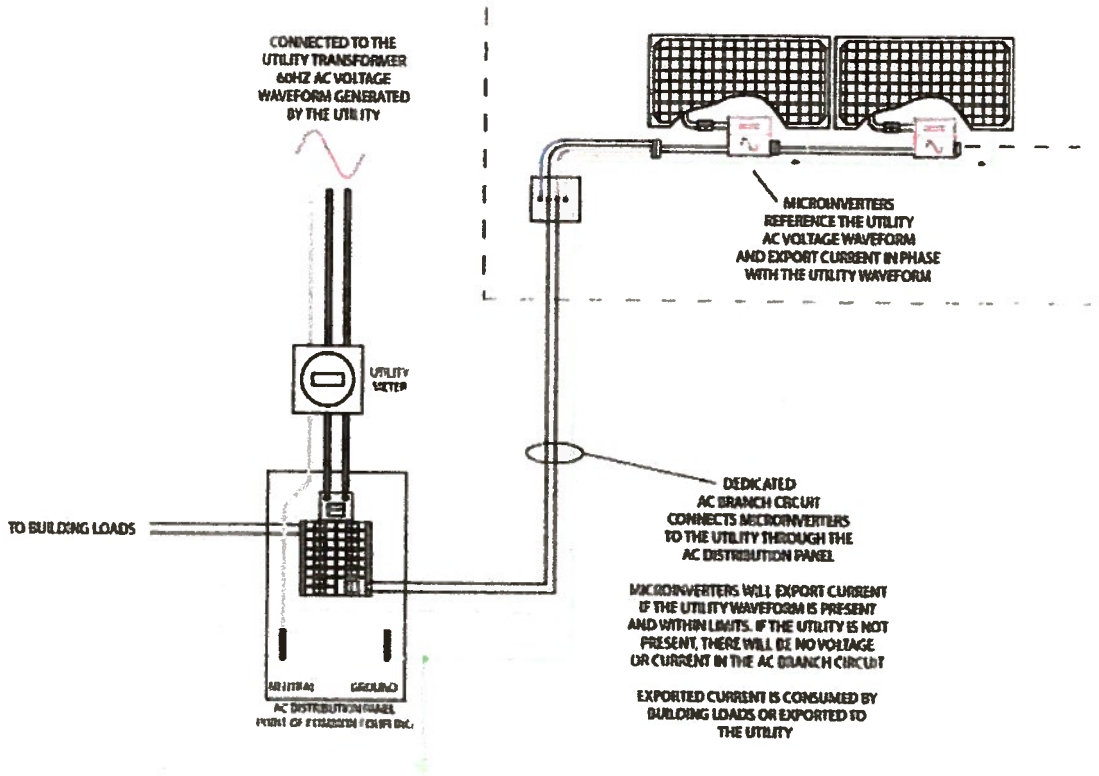

Figure 1

Testing Details

Before receiving the "Utility-Interactive Inverter" marking, an inverter must be listed to the UL1741 standard, which requires passing the tests described in Table 1 below. The tests include requirements outlined in IEEE1547, under which the manufacturer must state the accuracy of the time and amplitude characteristics of the "utility protective functions." The accuracy of the protective functions is tested during the UL1741 listing process.

	Test Title	Description	Comment
1	Utility low-voltage trip accuracy	With the utility frequency held at a nominal value, the voltage is lowered until the inverter "ceases to energize" the utility.	The normal low-voltage trip point is 88% of the nominal line-to-neutral voltage (Vnom).
2	Utility low-voltage trip time	Measures the time from when the utility voltage falls below 88% to when the inverter "ceases to energize."	Normal trip time is 2 seconds.

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enphaseenergy.com

	Test Title	Description	Comment
3	Utility low-low trip accuracy	Same as #1	<50% Vnom
4	Utility low-low trip time	Same as #2	0.16 seconds
5	Utility high-voltage trip accuracy	With the utility frequency held at a nominal value, the voltage is raised until the inverter "ceases to energize" the utility.	The normal high-voltage trip point is 110% of Vnom.
6	Utility high-voltage trip time	Measures the time from when the utility voltage rises above 110% of Vnom to when the inverter "ceases to energize."	1 second
7	Utility high-high voltage trip accuracy	Same as #5	120% of Vnom
8	Utility high-high voltage trip time	Same as #6, but the voltage threshold is 120% of Vnom.	0.16 seconds
9	Utility low-frequency trip accuracy	With the utility voltage held at a nominal value, the frequency is lowered until the inverter "ceases to energize."	The low-trip limit is 59.3Hz nominal.
10	Utility low-frequency trip time	Measures the time from when the utility frequency falls below the low-frequency trip limit to when the inverter "ceases to energize."	0.16 seconds
11	Utility high-frequency trip accuracy	With the utility voltage held at nominal, the frequency is raised until the inverter "ceases to energize."	High-trip limit is 60.5Hz nominal.
12	Utility high-frequency trip time	Measures the time from when the utility frequency rises above the high-frequency trip limit to when the inverter "ceases to energize."	0.16 seconds
13	Utility loss-of-phase disconnection	While the inverter is exporting power, one phase is opened.	Inverter must "cease to energize" within 2 seconds.
14	Utility anti-islanding	Tested at 33%, 66%, and 100% of rated output power	Inverter must "cease to energize" within 2 seconds of creation of an island.
15	Output current harmonics	Current harmonics through the 40th are quantified at 33%, 66%, and 100% of inverter rated output power.	Must be within limits specified in IEEE1547, 4.3.3, table 3.
16	Utility connection synchronization	Tests to ensure that the inverter does not connect out-of-phase with the utility.	Voltage, frequency, and phase must be within limits specified in IEEE1547, table 5.

	Test Title	Description	Comment
17	Utility reconnection timer	The inverter must wait for the grid to be within limits prior to reconnecting after a utility protective function trip.	5 minute timer is default. Can be adjusted per Utility request.
18	Limitation of DC injection into the utility	Injecting DC current into the utility can cause problems with equipment.	Must be less than 0.5% of inverter rated current.
19	Voltage surge withstand	Tested per the appropriate location category as defined in IEEE c62.41.	
20	Loss-of-control circuit	Tested as part of the "abnormals" tests in UL1741.	
21	EMI susceptibility	Tested per IEEE c37.90	
22	EMI emissions	Tested per FCC part 15	

Table 1

Only inverters that pass these tests and meet all other UL1741 requirements for an "inverter for use with distributed energy resources" can be marked "Utility-Interactive." The "Utility-Interactive" marking means that the inverter has met all utility-side safety requirements. Absence of the mark means that the inverter has not met all requirements for safe power export to the grid.

Other Benefits of Utility-Interactive

The "Utility-Interactive" inverter designation also insures protection of any power-consuming equipment connected to the utility. If the utility has a problem, the inverter will not damage appliances and electronic equipment, nor will it harm utility protection equipment such as protection relays, reverse power protectors, and reclosers. There is also a limited evaluation of product performance relative to unit rating label parameters.

Successful completion of the full suite of UL1741 tests by an inverter also ensures the safety of installation and maintenance personnel and system owners from physical harm due to fire or shock. If the utility is disconnected from the inverter by whatever means, the AC output terminals of a utility-interactive inverter are de-energized and completely safe to touch, with no danger of arcing or ignition.

Utility Reconnection

Utilities are typically interested in reconnection timer requirements. A Utility-Interactive inverter will not export power to the utility for 300 seconds (5 minutes) following an out-of-spec utility condition, and the utility must remain within acceptable limits during the full 300 seconds prior to the inverter recommencing exportation of power.

Table 2 summarizes the default acceptable limits for voltage and frequency. The inverter monitors the utility continually for out-of-spec conditions. If the utility exceeds these limits during the 300-second period, the timer is reset automatically. The 300-second timer and the voltage and frequency limits can be adjusted to different values with utility agreement. In fact, systems with a combined peak production capability of greater than 30kW must have adjustable set points.

Parameter	Low Limit	High Limit
Voltage	88% of Vnom	110% of Vnom
Frequency	59.3Hz	60.5Hz

Table 2

Production Testing

As part of the product listing process, the listing agency must inspect the product manufacturing facility at least four times per year. The inverter must be manufactured in compliance with a report that describes all components critical to maintaining product safety. Also, certain prescribed production tests must be performed on each unit prior to shipment from the factory. The tests verify the utility protective functions and integrity of the insulation system between DC input, AC output, and grounded metal components. Most manufacturers test well beyond basic safety requirements.

Summary

The "Utility-Interactive" marking provides significant assurance of inverter performance, utility compatibility, and safety. The label informs system designers, AHJs, system owners, and utility personnel that the product is appropriate for converting PV energy to electricity that can be exported safely to the utility grid.

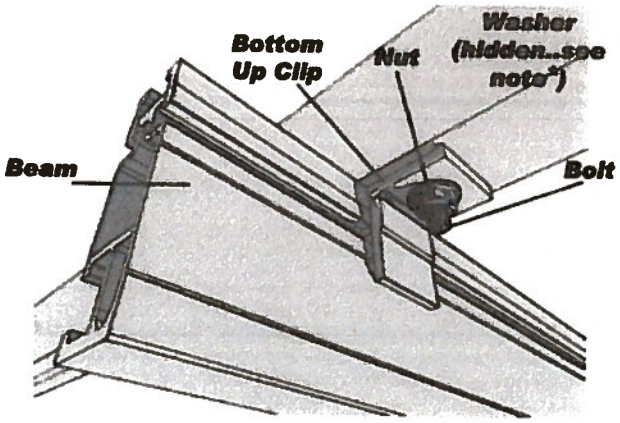
The "Utility-Interactive" designation reduces the burden on system designers, plan checkers, inspectors, and utility personnel. Inverters that carry the marking can be connected safely to the utility to export AC power. Of course, installers must still verify that specific details of each installation are in compliance with national and local codes, as well as follow manufacturer's installation, operation, and maintenance instructions.

SOLARMOUNT Technical Datasheet

Pub 130817

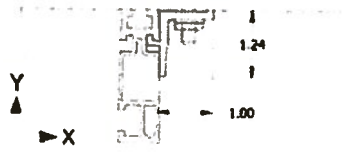
SOLARMOUNT Module Connection Hardware

SOLARMOUNT Bottom Up Module Clip
Part No. 302000C



- **Bottom Up Clip material:** One of the following extruded aluminum alloys: 6005-T5, 6105-T5, 6061-T6
- **Ultimate tensile:** 38ksi, Yield: 35 ksi
- **Finish:** Clear Anodized
- **Bottom Up Clip weight:** ~0.031 lbs (14g)
- Allowable and design loads are valid when components are assembled with SOLARMOUNT series beams according to authorized UNIRAC documents
- Assemble with one ¼"-20 ASTM F593 bolt, one ¼"-20 ASTM F594 serrated flange nut, and one ¼" flat washer
- Use anti-seize and tighten to 10 ft-lbs of torque
- Resistance factors and safety factors are determined according to part 1 section 9 of the 2005 Aluminum Design Manual and third-party test results from an IAS accredited laboratory
- Module edge must be fully supported by the beam

* **NOTE ON WASHER:** Install washer on bolt head side of assembly. **DO NOT** install washer under serrated flange nut

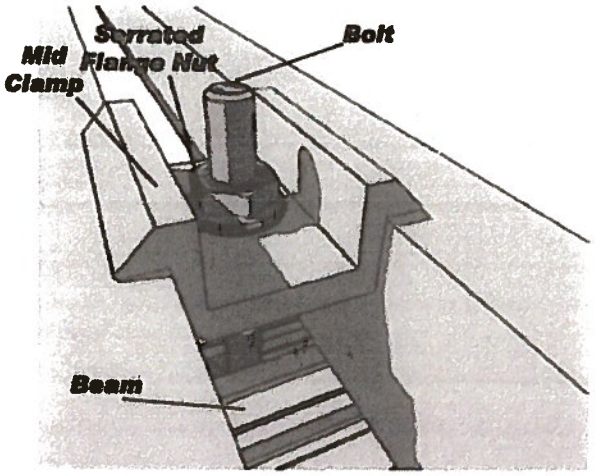


Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Load lbs (N)	Resistance Factor, Φ
Tension, Y+	1566 (6967)	686 (3052)	2.28	1038 (4615)	0.662
Transverse, X±	1128 (5019)	329 (1463)	3.43	497 (2213)	0.441
Sliding, Z±	66 (292)	27 (119)	2.44	41 (181)	0.619

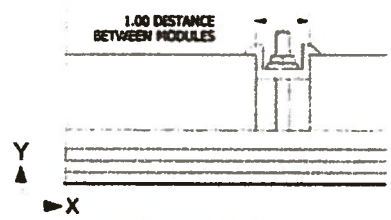
Dimensions specified in inches unless noted

SOLARMOUNT Mid Clamp

Part No. 302101C, 302101D, 302103C, 302104D, 302105D, 302106D



- **Mid clamp material:** One of the following extruded aluminum alloys: 6005-T5, 6105-T5, 6061-T6
- **Ultimate tensile:** 38ksi, Yield: 35 ksi
- **Finish:** Clear or Dark Anodized
- **Mid clamp weight:** 0.050 lbs (23g)
- Allowable and design loads are valid when components are assembled according to authorized UNIRAC documents
- Values represent the allowable and design load capacity of a single mid clamp assembly when used with a SOLARMOUNT series beam to retain a module in the direction indicated
- Assemble mid clamp with one Unirac ¼"-20 T-bolt and one ¼"-20 ASTM F594 serrated flange nut
- Use anti-seize and tighten to 10 ft-lbs of torque
- Resistance factors and safety factors are determined according to part 1 section 9 of the 2005 Aluminum Design Manual and third-party test results from an IAS accredited laboratory

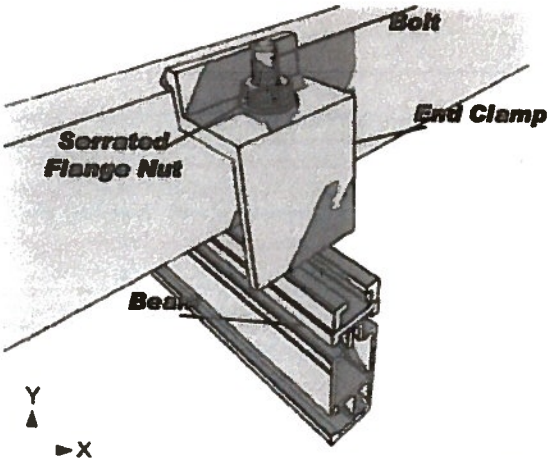


Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Load lbs (N)	Resistance Factor, Φ
Tension, Y+	2020 (8987)	891 (3963)	2.27	1348 (5994)	0.667
Transverse, Z±	520 (2313)	229 (1017)	2.27	346 (1539)	0.665
Sliding, X±	1194 (5312)	490 (2179)	2.44	741 (3295)	0.620

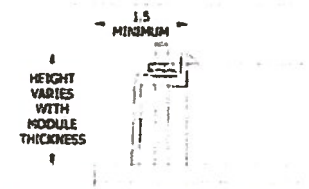
Dimensions specified in inches unless noted

SOLARMOUNT End Clamp

Part No. 302001C, 302002C, 302002D, 302003C, 302003D, 302004C, 302004D, 302005C, 302005D, 302006C, 302006D, 302007D, 302008C, 302008D, 302009C, 302009D, 302010C, 302011C, 302012C



- **End clamp material:** One of the following extruded aluminum alloys: 6005-T5, 6105-T5, 6061-T6
- **Ultimate tensile:** 38ksi, Yield: 35 ksi
- **Finish:** Clear or Dark Anodized
- **End clamp weight:** varies based on height: ~0.058 lbs (26g)
- Allowable and design loads are valid when components are assembled according to authorized UNIRAC documents
- Values represent the allowable and design load capacity of a single end clamp assembly when used with a SOLARMOUNT series beam to retain a module in the direction indicated
- Assemble with one Unirac ¼"-20 T-bolt and one ¼"-20 ASTM F594 serrated flange nut
- Use anti-seize and tighten to 10 ft-lbs of torque
- Resistance factors and safety factors are determined according to part 1 section 9 of the 2005 Aluminum Design Manual and third-party test results from an IAS accredited laboratory
- Modules must be installed at least 1.5 in from either end of a beam

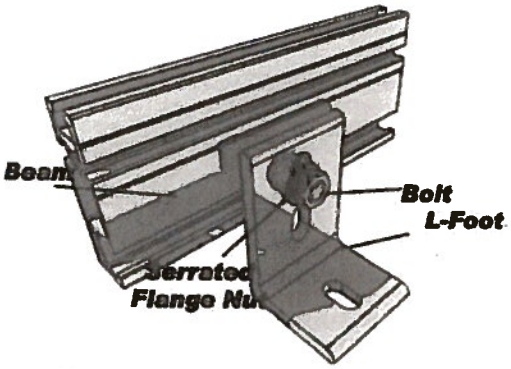


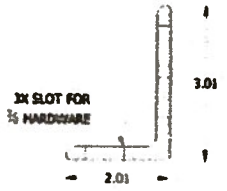
Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Loads lbs (N)	Resistance Factor, Φ
Tension, Y+	1321 (5876)	529 (2352)	2.50	800 (3557)	0.605
Transverse, Z±	63 (279)	14 (61)	4.58	21 (92)	0.330
Sliding, X±	142 (630)	52 (231)	2.72	79 (349)	0.555

Dimensions specified in inches unless noted

SOLARMOUNT Beam Connection Hardware

SOLARMOUNT L-Foot
Part No. 304000C, 304000D





Dimensions specified in inches unless noted

- **L-Foot material:** One of the following extruded aluminum alloys: 6005-T5, 6105-T5, 6061-T6
- **Ultimate tensile:** 38ksi, Yield: 35 ksi
- **Finish:** Clear or Dark Anodized
- **L-Foot weight:** 0.215 lbs (98g)
- Allowable and design loads are valid when components are assembled with SOLARMOUNT series beams according to authorized UNIRAC documents
- **For the beam to L-Foot connection:**
  - Assemble with one ASTM F593 ⅜"-16 hex head screw and one ASTM F594 ⅜"serrated flange nut
  - Use anti-seize and tighten to 30 ft-lbs of torque
- Resistance factors and safety factors are determined according to part 1 section 9 of the 2005 Aluminum Design Manual and third-party test results from an IAS accredited laboratory

NOTE: Loads are given for the L-Foot to beam connection only; be sure to check load limits for standoff, lag screw, or other attachment method

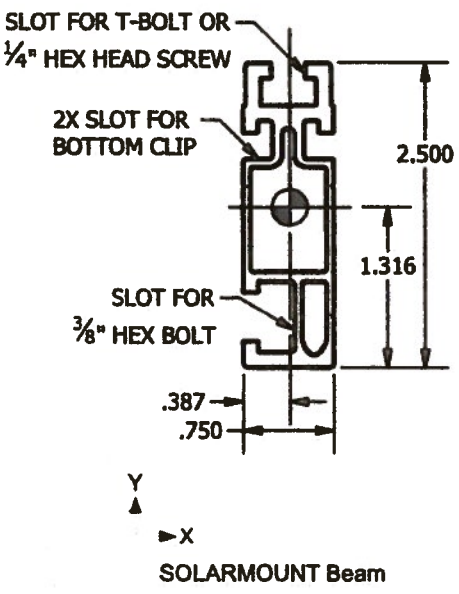
Applied Load Direction	Average Ultimate lbs (N)	Allowable Load lbs (N)	Safety Factor, FS	Design Load lbs (N)	Resistance Factor, Φ
Sliding, Z±	1766 (7856)	755 (3356)	2.34	1141 (5077)	0.646
Tension, Y+	1859 (8269)	707 (3144)	2.63	1069 (4755)	0.575
Compression, Y-	3258 (14492)	1325 (5893)	2.46	2004 (8913)	0.615
Traverse, X±	486 (2162)	213 (949)	2.28	323 (1436)	0.664

SOLARMOUNT Beams

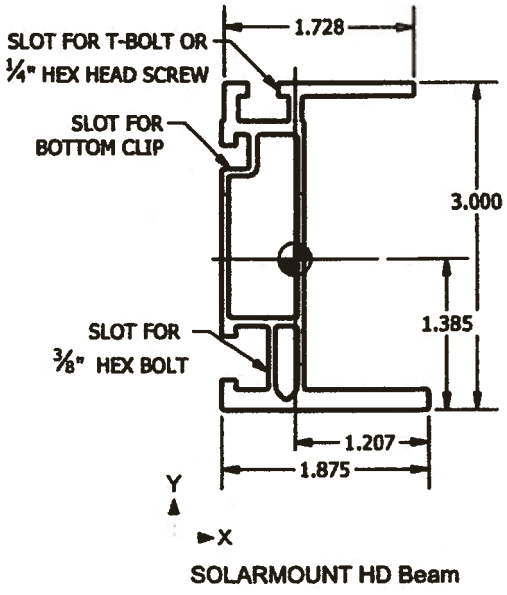
Part No. 310132C, 310132C-B, 310168C, 310168C-B, 310168D 310208C, 310208C-B, 310240C, 310240C-B, 310240D, 410144M, 410168M, 410204M, 410240M

Properties	Units	SOLARMOUNT	SOLARMOUNT HD
Beam Height	in	2.5	3.0
Approximate Weight (per linear ft)	plf	0.811	1.271
Total Cross Sectional Area	in^2	0.676	1.059
Section Modulus (X-Axis)	in^3	0.353	0.898
Section Modulus (Y-Axis)	in^3	0.113	0.221
Moment of Inertia (X-Axis)	in^4	0.464	1.450
Moment of Inertia (Y-Axis)	in^4	0.044	0.267
Radius of Gyration (X-Axis)	in	0.289	1.170
Radius of Gyration (Y-Axis)	in	0.254	0.502

**Rails are extruded using these aluminum alloys: 6005-T5, 6105-T5, 6061-T6*



SOLARMOUNT Beam



SOLARMOUNT HD Beam

Dimensions specified in inches unless noted

SERIES 100 UL FLASHED L FOOT KIT

SnapNrack Solar Mounting Solutions

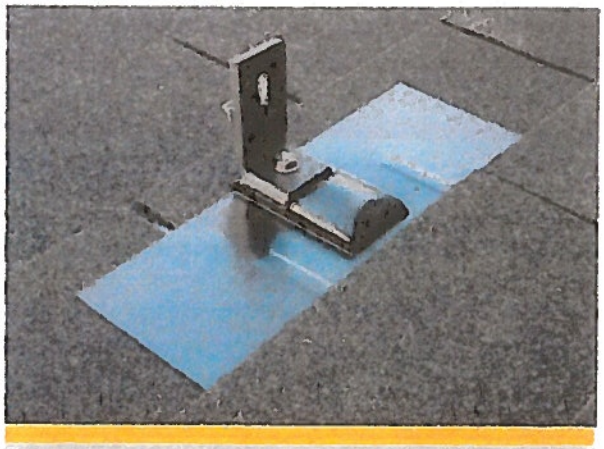
The SnapNrack line of solar mounting solutions is designed to reduce total installation costs. The system's technical innovations have been proven to drive down costs and improve installation quality on more than 350 MW of solar installations.

Flashed L Foot Simplified

SnapNrack Series 100 Flashed L Foot Kit is an innovative solution to provide a long lasting watertight seal over the life of the system. The Flashed L Foot provides a fully flashed roof fastener for attachment to composition roof with no required cutting of shingles. The L Foot is engineered for maximum adjustability for a clean level installation.

- 1" slotted bolt connection
- 1" spacers available for increased adjustability
- Clear or Black anodized aluminum components (both available with black flashing)
- No Cutting of shingles

Patent Pending



Flashed L Foot in 4 Simple Steps:

1) Locate a rafter in the roof using a pilot drill

2) Install base to the roof on top of the composition shingle

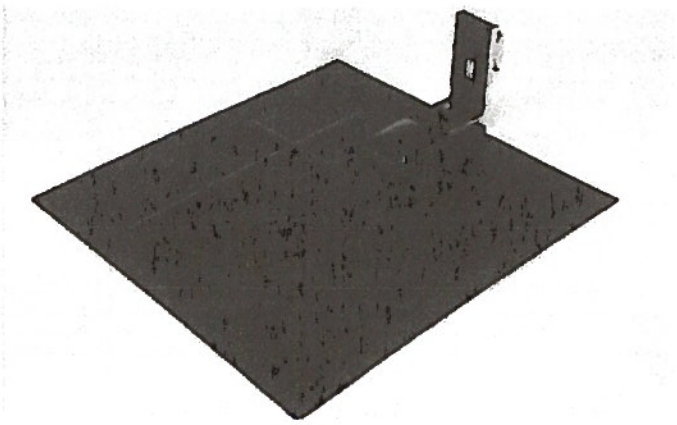
3) Use a breaker bar to separate the composition shingles above the base, and install the flashing

4) Attach the L foot on top and proceed with rail installation and leveling

Place order with your distributor. Purchase material for a single project or order in bulk for additional savings

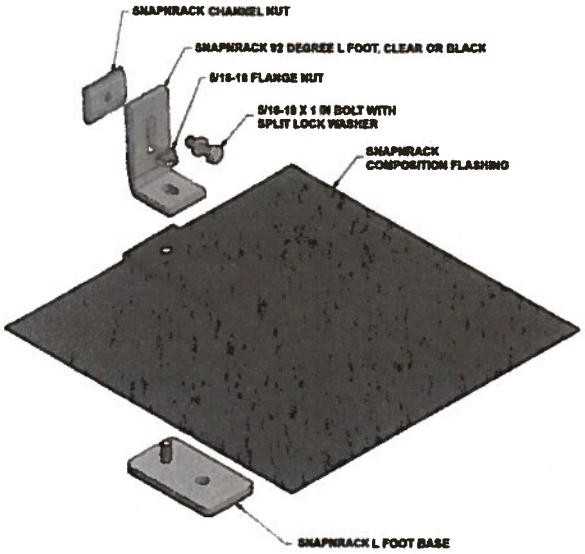
UL LISTED
PV Mounting System
2703

Flashed L Foot Kit Parts

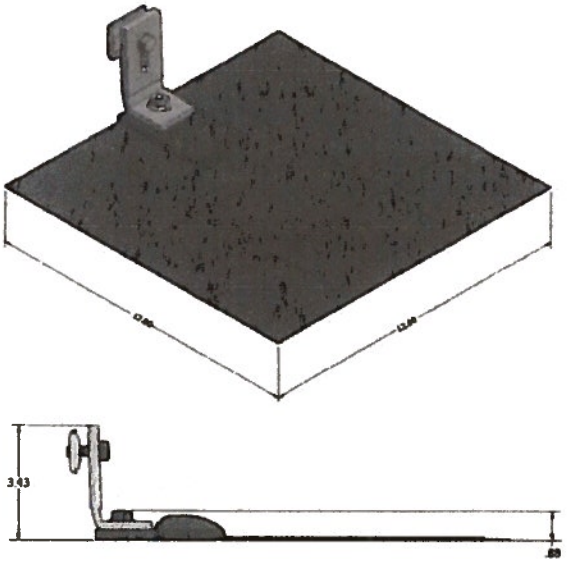


Flashed L Foot Kit Assembled

Flashed L Foot Kit Assembly



Flashed L Foot Kit Dimensions



SnapNrack Flashed L Foot Technical Data Patent Pending	
Materials	• 6000 Series Aluminum L Foot & Base • Stainless Steel Hardware • Galvanized Steel Flashing w/ black all weather coating
Material Finish	• Clear and black anodized aluminum
Weight	• 1.3 lbs
Design Uplift Load	• 350 lbs Uplift
Design Ultimate Load	• 1,000 lbs Uplift
Warranty	• 10 Year material and worksmanship

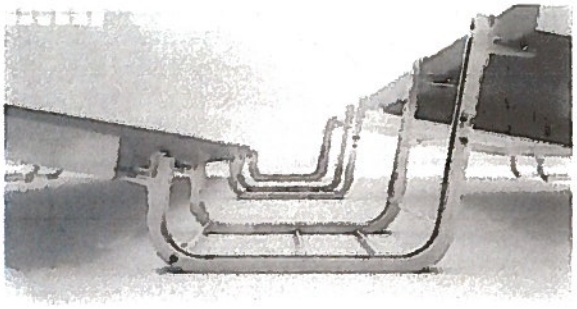
SnapNrack™

Solar Mounting Solutions

(877) 732-2860 www.SnapNrack.com

Printed on recycled paper using soy based inks.

RM ROOF MOUNT



THE POWER OF SIMPLICITY

ROOF MOUNT introduces the Power of Simplicity to the ballasted flat roof solar industry. The system consists of only two major components, minimizing preparation work and installation time. Seamlessly design around roof obstacles, support most framed modules and bond the system with just the turn of a wrench.

www.unirac.com

PROJECT CHARACTERISTICS

Allowable Roof Slope:	3 Degrees
Unevenness:	+/- 3.5 Degrees
Max Building Height:	100 ft
Wind Speed:	Up to 120 mph
Wind Exposure:	Categories B and C. (D Upon Request)
PSF on Roof:	As low as 3.5 PSF
Surfaces:	EPDM, PVC & TPO Membranes, Bitumen & Concrete
Min. Local Contact Area:	38 in^2 per Module (57 in^2 with Roof Pad)
Module Orientation:	Landscape
Nominal Module Tilt Angle:	10 Degrees (Nominal)
Row Spacing:	19 in (Nominal)

COMPONENTS MATERIALS

Ballast Bay	Aluminum 6063-T5
Module Clamp	Aluminum 6005A-T61
Locking 3/8" Hex Bolt	Stainless Steel 300 Series
Roof Pad	TPE 70 Shore A

BALLAST BAY GEOMETRY

Width:	21 in
Length:	17 in
Height:	13 in
Weight:	3.5 lbs
Roof Pad:	3 in x 10 in

MODULE COMPATIBILITY

Standard 60 and 72 Cell Framed Modules
Module Clamp w/ Integrated Bonding to UL2703
Cable Management — Compatible w/ Strut Accessories

WARRANTY & CERTIFICATIONS

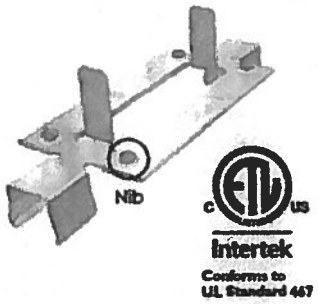
20 Year Manufacturing
UL 2703 Certification

UNIRAC

SOLARMOUNT™

Top Mounting UniRac Grounding Clips and WEEBLugs - 225.6

UGC-1



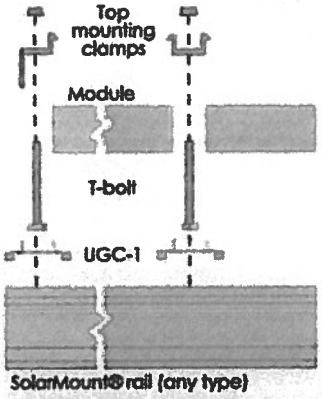


Figure 26. Slide UGC-1 grounding clip into top mounting slot of rail. Torque modules in place on top of clip. Nibs will penetrate rail anodization and create grounding path through rail (see Fig. 3, reverse side).

WEEBLug

Clips and lugs are sold separately.

Figure 27. Insert a bolt in the aluminum rail or through the clearance hole in the stainless steel flat washer. Place the stainless steel flat washer on the bolt, oriented so the dimples will contact the aluminum rail. Place the lug portion on the bolt and stainless steel flat washer. Install stainless steel flat washer, lock washer and nut. Tighten the nut until the dimples are completely embedded into the rail and lug. The embedded dimples make a gas-tight mechanical connection and ensure good electrical connection between the aluminum rail and the lug through the WEEB.

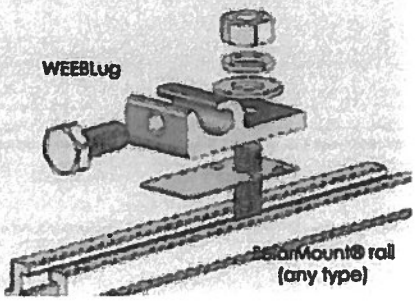
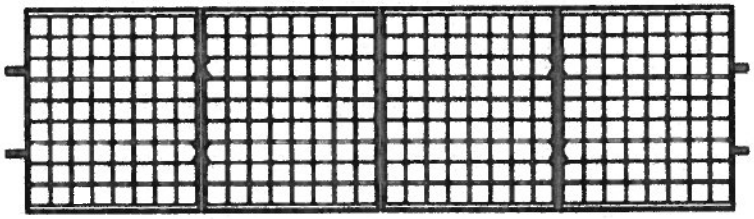
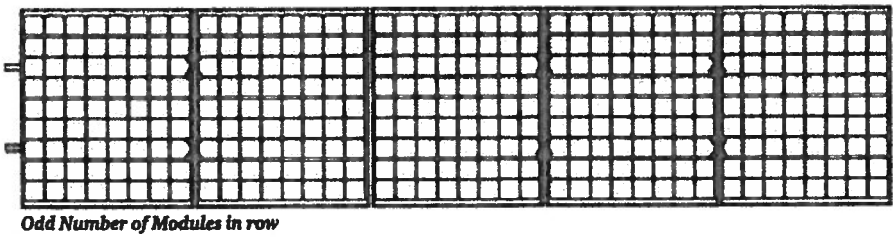


Figure 28. UGC-1 layout for even and odd number of modules in row. "X" denotes places to install UGC-1.



Even Number of Modules in row



Odd Number of Modules in row

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