

HISTORIC AND DESIGN REVIEW COMMISSION

December 02, 2015

Agenda Item No: 16

HDRC CASE NO: 2015-468
ADDRESS: 134 ARMOUR
LEGAL DESCRIPTION: NCB 6203 BLK 4 LOT 9 & W 25 FT OF 10
ZONING: R4-CD H RIO-1
CITY COUNCIL DIST.: 1
DISTRICT: River Road Historic District
APPLICANT: Daniel Hudson/Texas Solar Systems
OWNER: Bill Aylor
TYPE OF WORK: Solar panel installation
REQUEST:

The applicant is requesting a Certificate of Appropriateness for approval to install twelve, black Axitec Solar Panels on the rear (southern) roof slope as well as the front (northern) roof slope.

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 applicant has proposed to mount a solar photovoltaic system on the rear (southern) roof slope as well as the front, street facing (northern) roof slope of the structure located at 134 Armour. According to the Guidelines for Additions 6.C.i., solar collectors should be located on the side of rear roof pitch of the primary historic structure to minimize visibility from the public right of way. The applicant's proposal to mount a portion of the proposed system on the rear roof slope is consistent with the Guidelines, however, the applicant's proposal to mount solar panels to the front, street facing roof slope is not.
- b. Staff finds that the relocation of the panels that are currently proposed to be located on the front roof slope would be more appropriately placed on the southwest roof slope where they would not be seen from the public right of way.

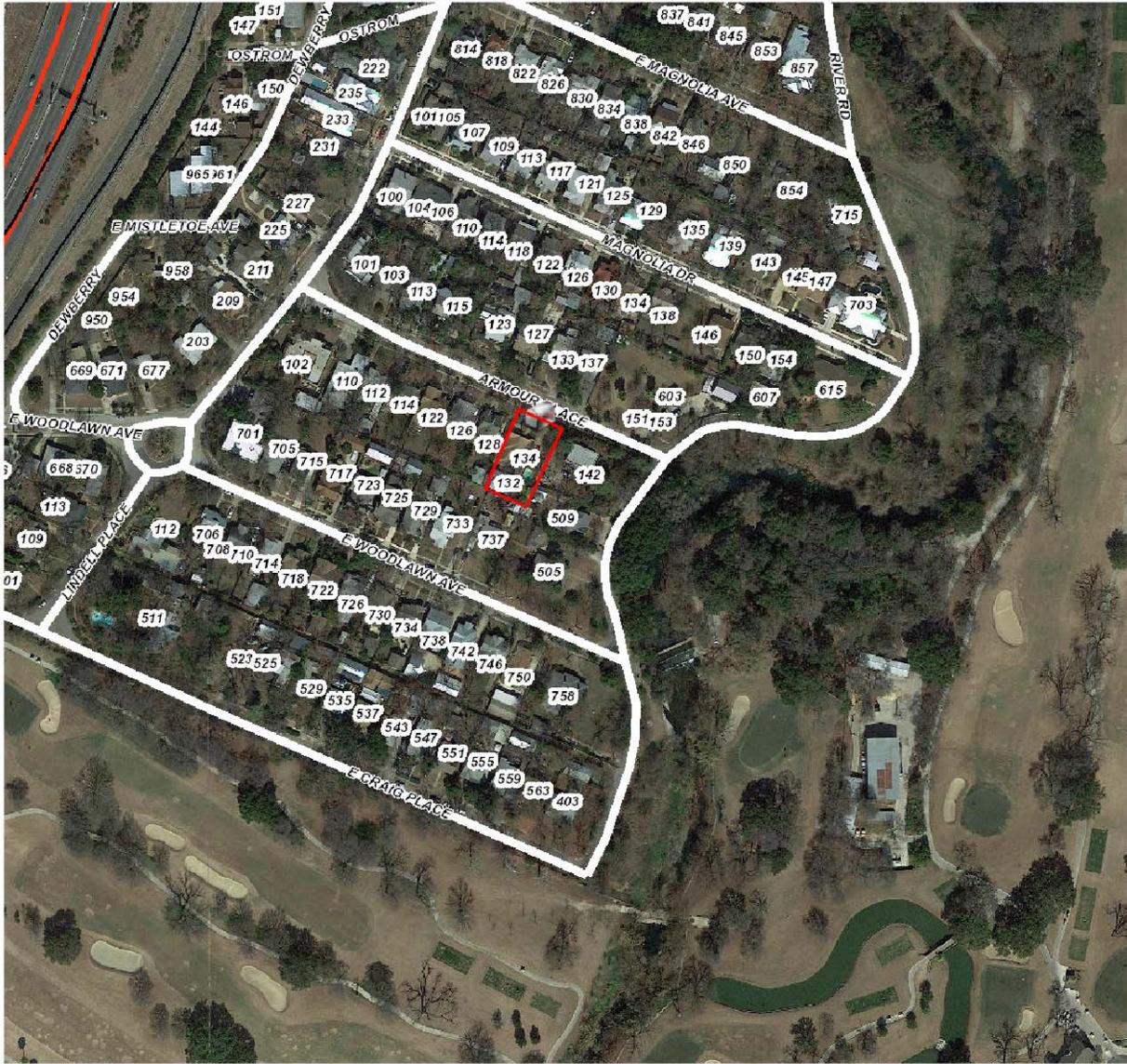
RECOMMENDATION:

Staff recommends approval of the proposed panels to be placed on the southern roof slope.

Staff does not recommend approval of the proposed panels to be placed on the northern roof slope. Staff recommends that those panels be relocated to the southwestern roof slope where they would not be seen from the public right of way.

CASE MANAGER:

Edward Hall





N

Flex Viewer

Powered by ArcGIS Server

Printed: Nov 23, 2015

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**Preliminary Array
Location & Layout**



10203 Kotzebue St
Suite 226
San Antonio, TX 78217

Array Orientation
Azimuth: 205°
Elevation: 45°



LAYOUT
PROJECT REF: Bill Aylor
SITE ADDRESS: 134 Armour Place, San Antonio, TX 78212
SYSTEM SIZE: 3.0 kW
1 String of 12 Modules/Optimizers (Axitec 250W, SolarEdge P300)
Sheet 3 of 9 Date: September 14, 2015



Location of current temporary power



Locatiof
CPS Meter

Ac disco

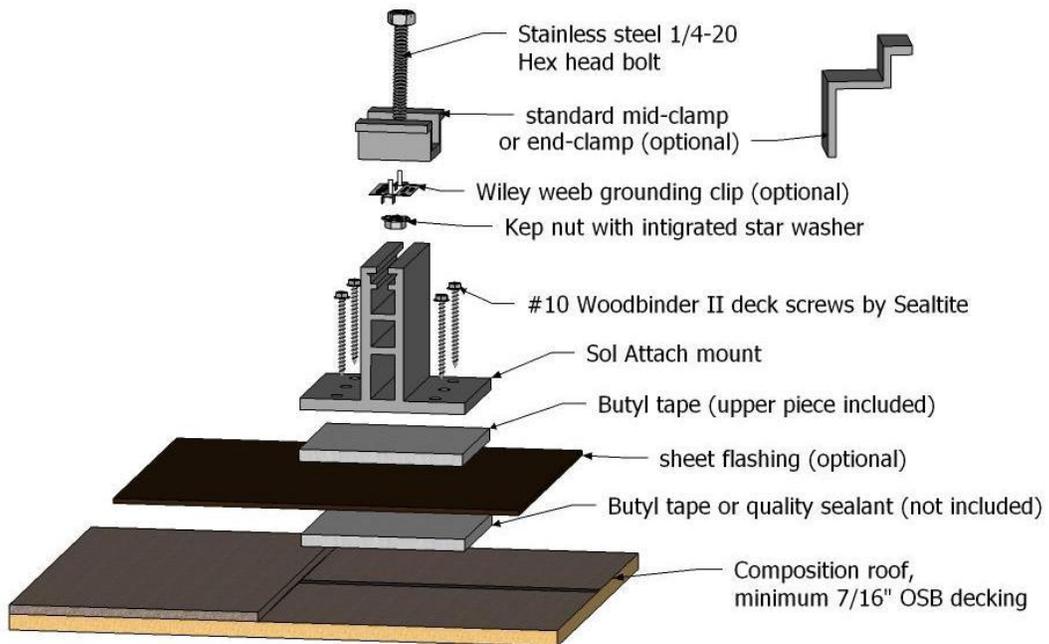
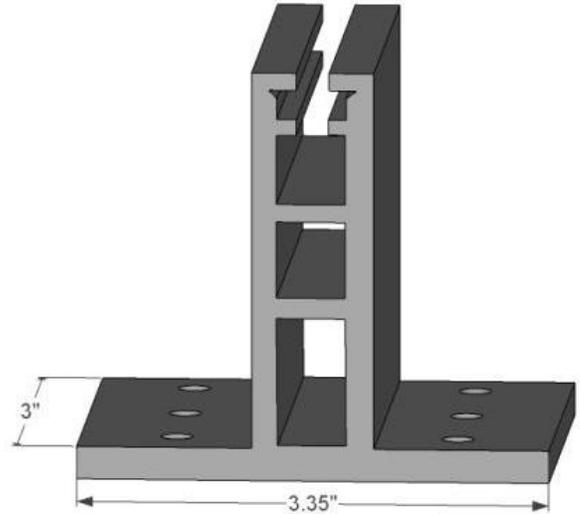
inverter

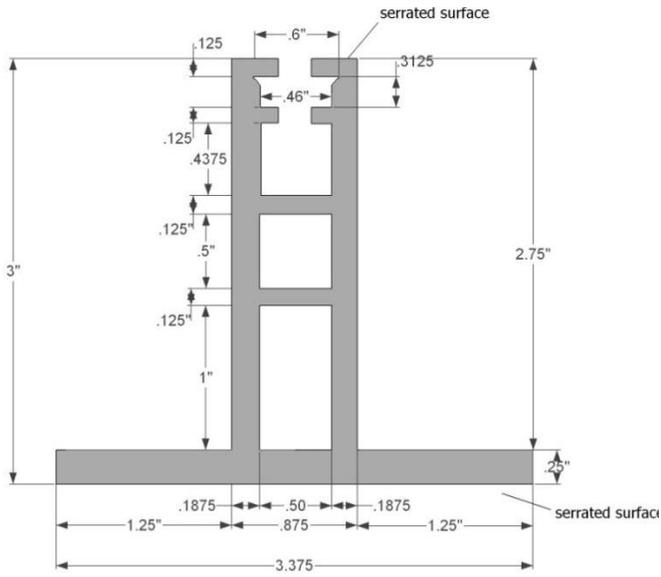
SM

New 200 amp main
New 200 amp service

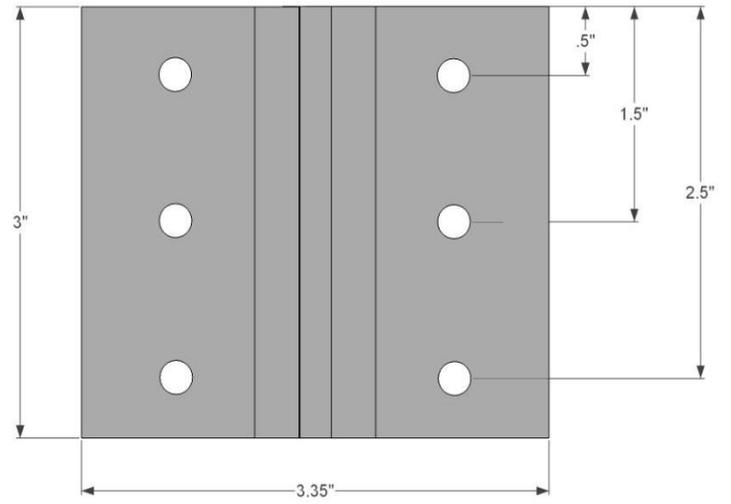
SOL ATTACH

Sol Attach, LLC
Composition roof mounting foot
Extrusions made of 6061-T6 alloy
Patent Pending



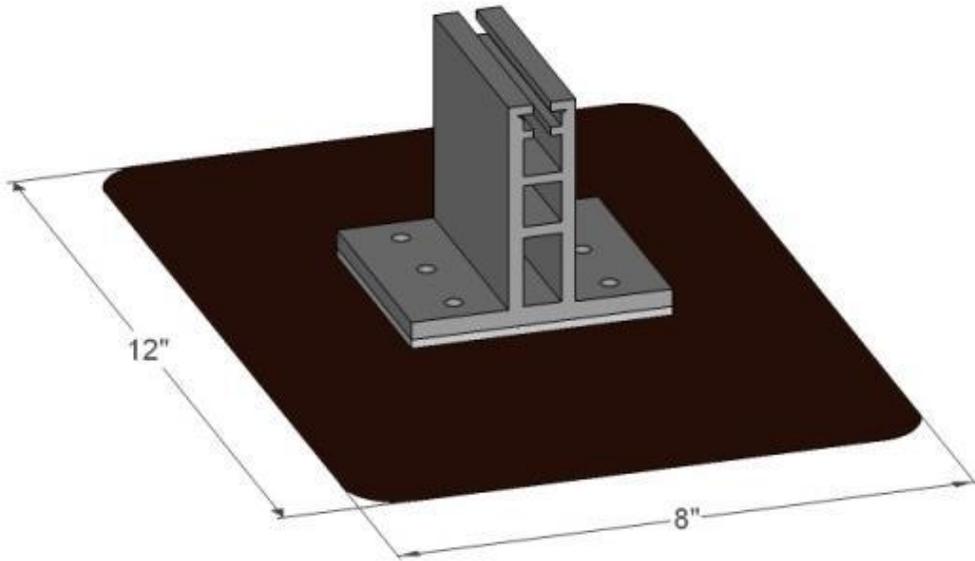


Front View



Top View

Flat flashing

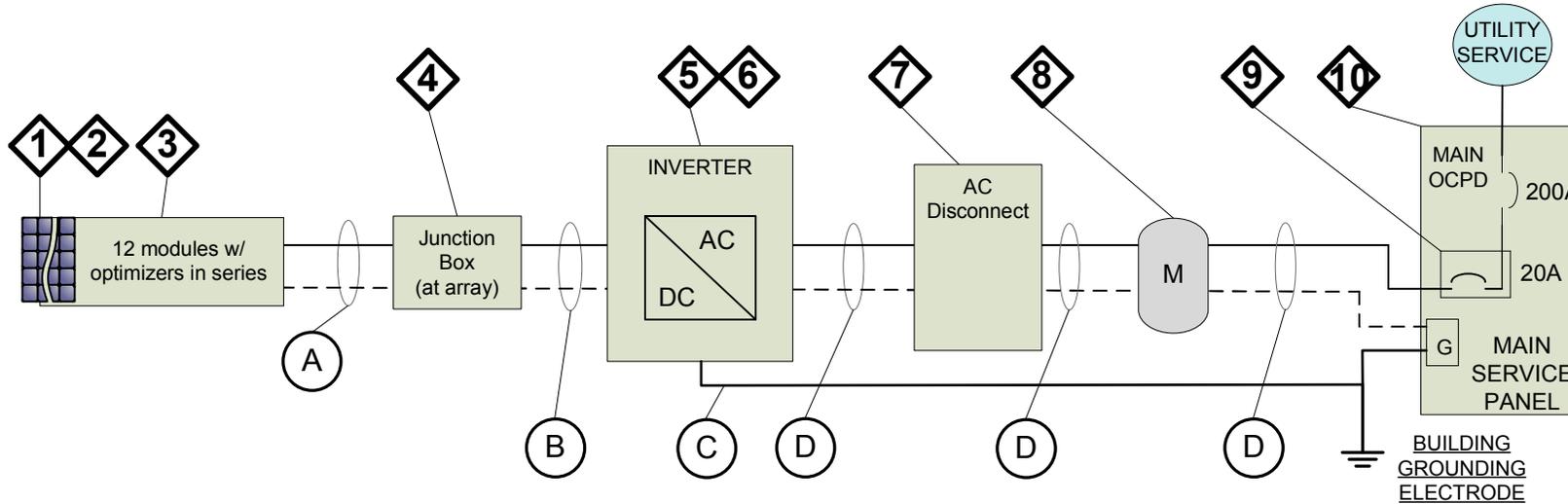


System Information			
PV Module Ratings		Inverter Ratings	
Module Make	Axitec Solar	Inverter Make	SolarEdge
Module Model	AC-250P	Inverter Model	SE3000A-US
Max Power	= 250 W	Max. Output Power	= 3300 W
Open Circuit Voltage	= 37.8 V	Max. DC Voltage	= 500 V
Max Power Point Voltage	= 30.7 V	Normal AC Voltage	= 240 V
Short Circuit Current	= 8.71 A	Max. AC Current	= 12.5 A
Max Power Point Current	= 8.18 A	CEC Inverter Efficiency	= 97.5%

Labels	
Photovoltaic DC Disconnect	
Rated MPP Current	= 8.6 A
Rated MPP Voltage	= 350.0 V
Max. System Voltage	= 500.0 V
Max. System Current	= 15.0 A
Photovoltaic AC Disconnect	
AC Output Current	= 12.5 A
Nominal AC Voltage	= 240 V



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PV System meets requirements for Rapid Shutdown as defined in 690.12.

EQUIPMENT SCHEDULE			
REF	DESCRIPTION	PN	NOTES
1	SOLAR PV MODULE	AC-250P/156-60S	AXITEC 250W POLYCRYSTALLINE MODULE
2	PV MODULE OPTIMIZER	P300	SOLAREGE 300W PV MODULE OPTIMIZER
3	ARRAY MOUNTING HARDWARE	TBD	PRO SOLAR FLUSH ROOF MOUNTING SYSTEM
4	JUNCTION BOX	TBD	
5	AC/DC INVERTER	SE3000A-US	SOLAREGE 3.0KW INVERTER W/ AC/DC DISCONNECT
6	WIRELESS COMM	SE1000-ZBGW	SOLAREGE ZIGBEE WIRELESS COMMUNICATIONS - MASTER
7	MAIN AC DISCONNECT	DU221NRB	SQUARE D, SAFETY SWITCH, 240V, 30A 2-POLE UNFUSED
8	GENERATION METER	TBD	
9	SOLAR OCPD	TBD	20A, 240V, 2-POLE BACK-FED CIRCUIT BREAKER
10	SERVICE PANEL	NA	200A BUS & 200A MAIN BREAKER, 240V (PENDING UPGRADE)

CONDUIT & CONDUCTOR SCHEDULE					
REF	DESCRIP. /CONDUCTOR TYPE	CONDUCTOR GAUGE	NUMBER OF CONDUCTORS	CONDUIT TYPE	CONDUIT SIZE
A	PV-WIRE & BARE GROUND	#12 / #6	2 / 1		
B	THWN-2	#10 / #6	2 / 1	EMT	1"
C	BARE GROUND	#6	1		
D	THWN-2	#12 / #12	3 / 1	EMT	3/4"

Notes:

- All equipment, conductors and conduit as listed or equivalent.
- Expected nominal string voltage: 350Vdc.
- Expected nominal optimizer output voltage: 29.2Vdc

ONE-LINE STANDARD ELECTRICAL DIAGRAM
PROJECT REF: Bill Aylor
SITE ADDRESS: 134 Armour Place, San Antonio, TX 78212
SYSTEM SIZE: 3.0 kW
1 String of 12 Modules/Optimizers (Axitec 250W, SolarEdge P300)

Sheet 1 of 9
Date: September 14, 2015

NOT TO SCALE

SAN ANTONIO INTL AP



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Elev.	High Temp		Distance above roof			Extreme
	0.4%	2% Avg.	0.5"	3.5"	12"	
247 m	38 °C	36 °C	58 °C	53 °C	50 °C	-6 °C

Correction Temperatures

$\Delta T_{cold} = -6^{\circ}C - 25^{\circ}C = -31^{\circ}C$ $\Delta T_{hot} = (36^{\circ}C + 35^{\circ}C) - 25^{\circ}C = 46^{\circ}C$
Flush roof mount

Module Voltage Calculations

Axitec 250W Poly
Voc = 37.8V Vmp = 30.7V Voc Temp Coefficient = -0.33%/°C
Isc = 8.71A Imp = 8.18A Pmax Temp Coefficient = -0.44%/°C

Cold Voc = $37.8V + (37.8V \times -0.33\%/^{\circ}C \times -31^{\circ}C) = 37.8V + 3.87V = 41.7V$
Hot Vmp = $30.7V + (30.7V \times -0.44\%/^{\circ}C \times 46^{\circ}C) = 30.7V - 6.21V = 24.5V$

SolarEdge P300 Optimizer
Max Input DC Power: 300W
MPPT Operating Range: 8-48V
Maximum DC Output: 15A
Maximum Power per String: 5250

Max Input DC Voltage: 48V
Max Input Isc Current: 10A
Min/Max Input String Length: 8/25

String Sizing

12 x 250W = 3000W

SolarEdge SE3000A-US Inverter
Max DC Input (V): 500V
Nominal DC Input: 350V
Output voltage: 240Vac

Max DC Input (A): 9.5A
Max Output current: 12.5A

Label Calculations

MPPT DC Current:
 $250W \times 12 \div 350V = 8.6A$

Conductor Ampacity

PV Source Circuit (Optimizer Output):
 $15A \times 125\% = 18.8A$ (continuous duty)
 $18.8A \div 1.00 = 18.8$ (PV Wire in free air)
#12 AWG (rated for 25A into 75° terminals)
 $18.8A \div 0.71 = 26.5A$ (conditions of use – temp and conduit fill)
#10 AWG (rated for 35A into 75° terminals)

Inverter Output Circuit:
 $12.5A \times 125\% = 15.6A$
#12 AWG (rated for 25A into 75° terminals and required OCPD)

OCPD & Disconnects

DC fusing not required for a single string.

DC/AC Disconnect functions integral to inverter.

Inverter OCPD and Disconnect:
 $12.5A \times 125\% = 15.6A \rightarrow 20A, 240V, 2-Pole$ Back Fed Breaker
30A, 2-Pole, 240V Unfused Disconnect

Voltage Drop calculations:

Worst Case String
PV Nominal String Voltage: 350Vdc
PV MPPT String Current: $250W \times 12 \div 350V = 8.6A$
Approximate DC wire distance is 75 ft (estimated)
DC Voltage Drop
 $(2 \times 75ft \times 8.6A \times 1.24\Omega/kft \times 100) / (1000ft/kft \times 350V) = 0.46\%$

Inverter Output is 240Vac, 12.5A
Approximate worst case AC wire distance is 15 ft (estimated)
AC Voltage Drop
 $(2 \times 15ft \times 12.5A \times 1.98\Omega/kft \times 100) / (1000ft/kft \times 240V) = 0.31\%$

ELECTRICAL CALCULATIONS

PROJECT REF: Bill Aylor
SITE ADDRESS: 134 Armour Place, San Antonio, TX 78212
SYSTEM SIZE: 3.0 kW
1 String of 12 Modules/Optimizers (Axitec 250W, SolarEdge P300)

Notes:

- PV System meets requirements for Rapid Shutdown as defined in 690.12.
- Each PV module is connected to a dedicated optimizer. The voltage generated by a string of modules/optimizers is controlled to 350Vdc at the inverter DC inputs.
- Calculations for the System Labeling based on SolarEdge Tech Note, *PV Power Source Labeling in a SolarEdge system*.
- Inverter, AC Disconnect and REC Meter located near the service entrance. Due to ongoing construction at the residence, the exact location of the service entrance is TBD. It will be near the front of the residence. Main Service Panel to be upgraded to a 200A Main Bus with 200A Main Breaker.
- Ensure clearances around the inverter comply with Chapter 3 of the Solar Edge Installation Guide. The inverter should be installed to minimize exposure to sunlight, rainfall and direct water spray.
- Each module/optimizer string is run to a separate input on the inverter.
- Interconnection to the main service via a back-fed breaker in the Main Service Panel. Per 705.12, maximum back-fed solar breaker calculated to be 40A.
- Layout/location of array may be adjusted to avoid vent stacks, skylights and other roof protrusions. Adequate clearances should be maintained from roof eaves and ridge to allow for safe access. Minimum spacing between module rows should be 1/4 inch to allow for thermal expansion of module frames.
- Conductor sizing listed is minimum required based on NEC ampacity calculations and a conduit fill of not more than 2 current carrying conductors. Minimum conductor size required for REC meter base typically #6 AWG.
- Conduit sizing is based upon NABCEP recommended maximum conduit fill of 25%. Conduit sizing may be decreased to comply with Annex C of NEC.
- Voltage drop calculations should be verified on-site based on actual wire run lengths. Recommended worst case system voltage drop – 2% total.
- All electrical work must be made in accordance with the local and applicable *National Electrical Code ANSI/NFPA 70*.
- PV System to be installed and labeled per National Electric Code 2014. Specifically:
 - 690.4(B)(1),(2) and (3)
 - 690.4(H)
 - 690.5
 - 690.17
 - 690.31
 - 690.35(C) and (F)
- Inverter listed to UL-1741 for grid-interactive use and GFDI protection.
- All equipment used UL listed.
- Equipment, conductors and conduit as listed or equivalent.



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Suite 226
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SPECIAL NOTES

PROJECT REF: Bill Aylor

SITE ADDRESS: 134 Armour Place, San Antonio,
TX 78212

SYSTEM SIZE: 3.0 kW

1 String of 12 Modules/Optimizers (Axitec 250W,
SolarEdge P300)

Sheet 4 of 9

Date: September 14, 2015



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SolarEdge Single Phase Inverters For North America

SE3000A-US / SE3800A-US / SE5000A-US / SE6000A-US /
SE7600A-US / SE10000A-US / SE11400A-US



INVERTERS



Single Phase Inverters for North America

SE3000A-US / SE3800A-US / SE5000A-US / SE6000A-US /
SE7600A-US / SE10000A-US / SE11400A-US

	SE3000A-US	SE3800A-US	SE5000A-US	SE6000A-US	SE7600A-US	SE10000A-US	SE11400A-US	
OUTPUT								
Nominal AC Power Output	3000	3800	5000	6000	7600	9980 @ 208V 10000 @ 240V	11400	VA
Max. AC Power Output	3300	4100	5400 @ 208V 5400 @ 240V	6000	8350	10800 @ 208V 10950 @ 240V	12000	VA
AC Output Voltage Min-Nom-Max ⁽¹⁾	-	-	✓	-	-	✓	-	
AC Output Voltage Min-Nom-Max ⁽²⁾	✓	✓	✓	✓	✓	✓	✓	
AC Frequency Min-Nom-Max ⁽³⁾	59.3 - 60 - 60.3	59.3 - 60 - 60.3	59.3 - 60 - 60.3	59.3 - 60 - 60.3	59.3 - 60 - 60.3	59.3 - 60 - 60.3	59.3 - 60 - 60.3	Hz
Max. Continuous Output Current	12.5	16	21 @ 240V	25	32	42 @ 240V	47.5	A
GFDI Threshold						1		A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds						Yes		Yes
INPUT								
Maximum DC Power (STC)	4000	5100	6750	8100	10250	13500	15500	W
Transformer-less, Ungrounded						Yes		
Max. Input Voltage						500		Vdc
Nom. DC Input Voltage						325 @ 208V / 350 @ 240V		Vdc
Max. Input Current ⁽⁴⁾	9.5	13	15.5 @ 208V 15.7 @ 240V	18	23	33 @ 208V 33.5 @ 240V	34.5	Adc
Max. Input Short Circuit Current						45		Adc
Reverse-Polarity Protection						Yes		
Ground-Fault Isolation Detection						600µg Sensitivity		
Minimum Inverter Efficiency	97.7	98.2	98.3	98.3	98	98	98	%
CEC Weighted Efficiency	97.5	98	98 @ 208V 98 @ 240V	97.5	97.5	97 @ 208V 97.5 @ 240V	97.5	%
Nighttime Power Consumption						< 2.5		W
ADDITIONAL FEATURES								
Supported Communication Interfaces						RS485, RS232, Ethernet, ZigBee (optional)		
Revenue Grade Data, ANSI C12.1						Optional ⁽⁵⁾		
Rapid Shutdown - NEC 2014 690.12						Functionality enabled when SolarEdge rapid shutdown kit is installed ⁽⁶⁾		
STANDARD COMPLIANCE								
Safety						UL1741, UL1699B, UL1998, CSA 22.2		
Grid Connection Standards						IEEE1547		
Emissions						FCC part15 class B		
INSTALLATION SPECIFICATIONS								
AC output conduit size / AWG range						3/4" minimum / 16-6 AWG	3/4" minimum / 8-3 AWG	
DC input conduit size / # of strings / AWG range						3/4" minimum / 1-2 strings / 16-6 AWG	3/4" minimum / 1-2 strings / 14-6 AWG	
Dimensions with Safety Switch (HxWxD)						30.3 x 12.5 x 10.5 / 11.9" x 5.0" x 4.1"	27.3 x 31.5 x 26.0 / 10.7" x 12.4" x 10.2"	
Weight with Safety Switch						51.2 / 23.2 lb / kg	54.7 / 24.7 lb / kg	
Cooling						Natural Convection	Natural convection and internal fan (user replaceable)	
Noise						< 25 dBA	< 30 dBA	
Min-Max. Operating Temperature						-13 to +140 / -25 to +60 (-40 to +60 version available ⁽⁷⁾)		°F / °C
Protection Rating						NEMA 3R		

The best choice for SolarEdge enabled systems

- Integrated arc fault protection (Type 1) for NEC 2011 690.11 compliance
- 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

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SPECIFICATIONS

PROJECT REF: Bill Aylor

SITE ADDRESS: 134 Armour Place, San Antonio, TX 78212

SYSTEM SIZE: 3.0 kW

1 String of 12 Modules/Optimizers (Axitec 250W, SolarEdge P300)

Sheet 6 of 9
Date: September 14, 2015



10203 Kotzebue St
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San Antonio, TX 78217



SolarEdge Power Optimizer

Module Add-On For North America

P300 / P400 / P405



POWER OPTIMIZER



SolarEdge Power Optimizer

Module Add-On for North America

P300 / P400 / P405

	P300 (for 60-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	
INPUT				
Rated Input DC Power ⁽¹⁾	300	400	405	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48	80	125	Vdc
MPPT Operating Range	8 - 48	8 - 80	12.5 - 105	Vdc
Maximum Short-Circuit Current (Isc)	10	10	10	Adc
Maximum DC Input Current	12.5	12.5	12.5	Adc
Maximum Efficiency	99.5	99.5	99.5	%
Weighted Efficiency ⁽¹⁾	99.6	99.6	99.6	%
Overvoltage Category	II	II	II	
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREEDGE INVERTER)				
Maximum Output Current		15		Adc
Maximum Output Voltage		60	85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREEDGE INVERTER OR SOLAREEDGE INVERTER OFF)				
Safety Output Voltage per Power Optimizer		1		Vdc
STANDARD COMPLIANCE				
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3			
Safety	IEC62109-1 (class II safety), UL1741			
RoHS	Yes			
INSTALLATION SPECIFICATIONS				
Maximum Allowed System Voltage	1000			Vdc
Dimensions (W x L x H)	Pxxx-2 series 128 x 152 x 27.5 / 5 x 5.97 x 1.08	Pxxx-5 series 141 x 212 x 40.5 / 5.55 x 8.34 x 1.59 128 x 152 x 35 / 5 x 5.97 x 1.37	Pxxx-5 series 128 x 152 x 48 / 5 x 5.97 x 1.89	mm / in mm / in
Weight (including cables)	Pxxx-2 series 770 / 1.7	Pxxx-5 series 930 / 2.05	Pxxx-5 series 930 / 2.05	Rt / lb Rt / lb
Input Connector	MC4 Compatible			
Output Wire Type / Connector	Double Insulated, Amphenol			
Output Wire Length	0.95 / 3.0	1.2 / 3.9	1.2 / 3.9	m / ft m / ft
Operating Temperature Range	-40 +85 / -40 +135			
Protection Rating	Pxxx-2 series IP68 / NEMA4	IP68 / NEMA4		
Relative Humidity	0 - 100			

⁽¹⁾ Rated STC power of the module. Module of up to 45% power tolerance allowed.

PV SYSTEM DESIGN USING A SOLAREEDGE INVERTER ⁽¹⁾	SINGLE PHASE	THREE PHASE 208V	THREE PHASE 480V	
Minimum String Length (Power Optimizers)	8	10	18	
Maximum String Length (Power Optimizers)	25	25	50	
Maximum Power per String	5250	6000	12750	W
Parallel Strings of Different Lengths or Orientations	Yes			

⁽¹⁾ It is not allowed to mix P405 with P300/P400/P300/P700 in one string.

PV power optimization at the module-level

- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module-level monitoring
- Module-level voltage shutdown for installer and firefighter safety

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10203 Kotzebue St
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Project:

Bill Aylor
Tuesday, September 15, 2015 1:53 PM
134 Armour Place
San Antonio, TX 78212

Location:

San Antonio, Texas, United States

System data:

Installed power: 3.00 kWp
Max achieved DC power: 2.99 kW
Inverter active power: 3.00 kW
Maximum apparent power: 3.00 kVA

PV Array # 1: PV Array # 1

Tilt	Azimuth	Mounting
45°	205°	Co-planar with roof
Axitec, AC-250P/156-60S, 250.00 W		

Inverter design

Inverter 1: SE3000A-US
String 1: PV Array # 1: 12 x P300

Power optimizer extreme operating conditions

P300			
	Calculated	Limit	
Max input power	250 W	300 W	✓
Min input voltage	31 V	8 V	✓
Max input voltage	42 V	48 V	✓
Max input current	9 A	10 A	✓
Max output current	9 A	15 A	✓

* Calculated values are the absolute min/max of all arrays using this power optimizer configuration.

STRING SIZING TOOL REPORT

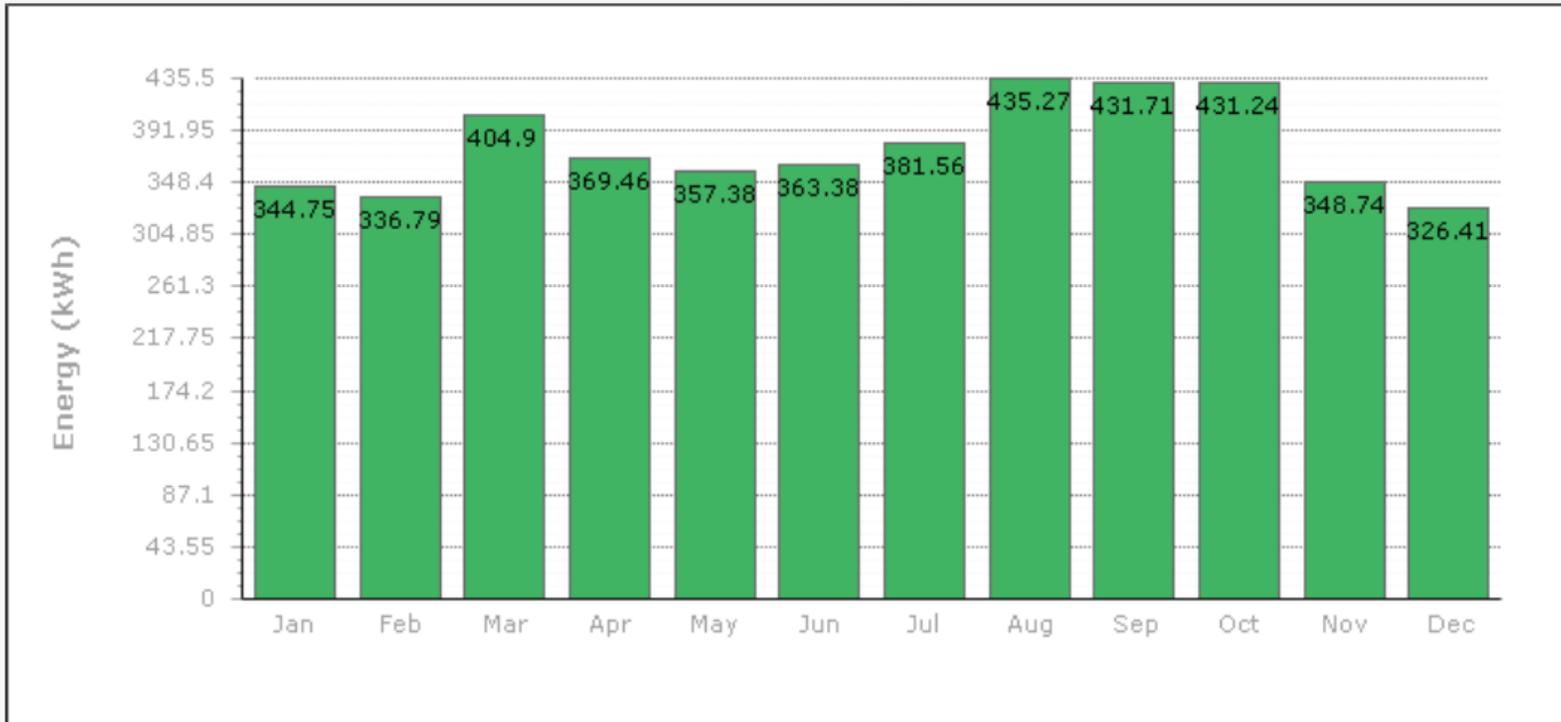
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Energy estimation

Estimated monthly energy



Estimated yearly energy: 4.532 MWh

Energy yields are an approximation; they are not guaranteed by SolarEdge.

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Sheet 9 of 9

Date: September 14, 2015