From:
Solar Design Associates
Stephen Coffrin
280 Ayer Rd.
Harvard, MA 01451

To:
Boxford Conservation Commission
Attn: Peter Delaney
7A Spofford Rd
Boxford, MA 01921

Re: Langer Residence Solar PV array

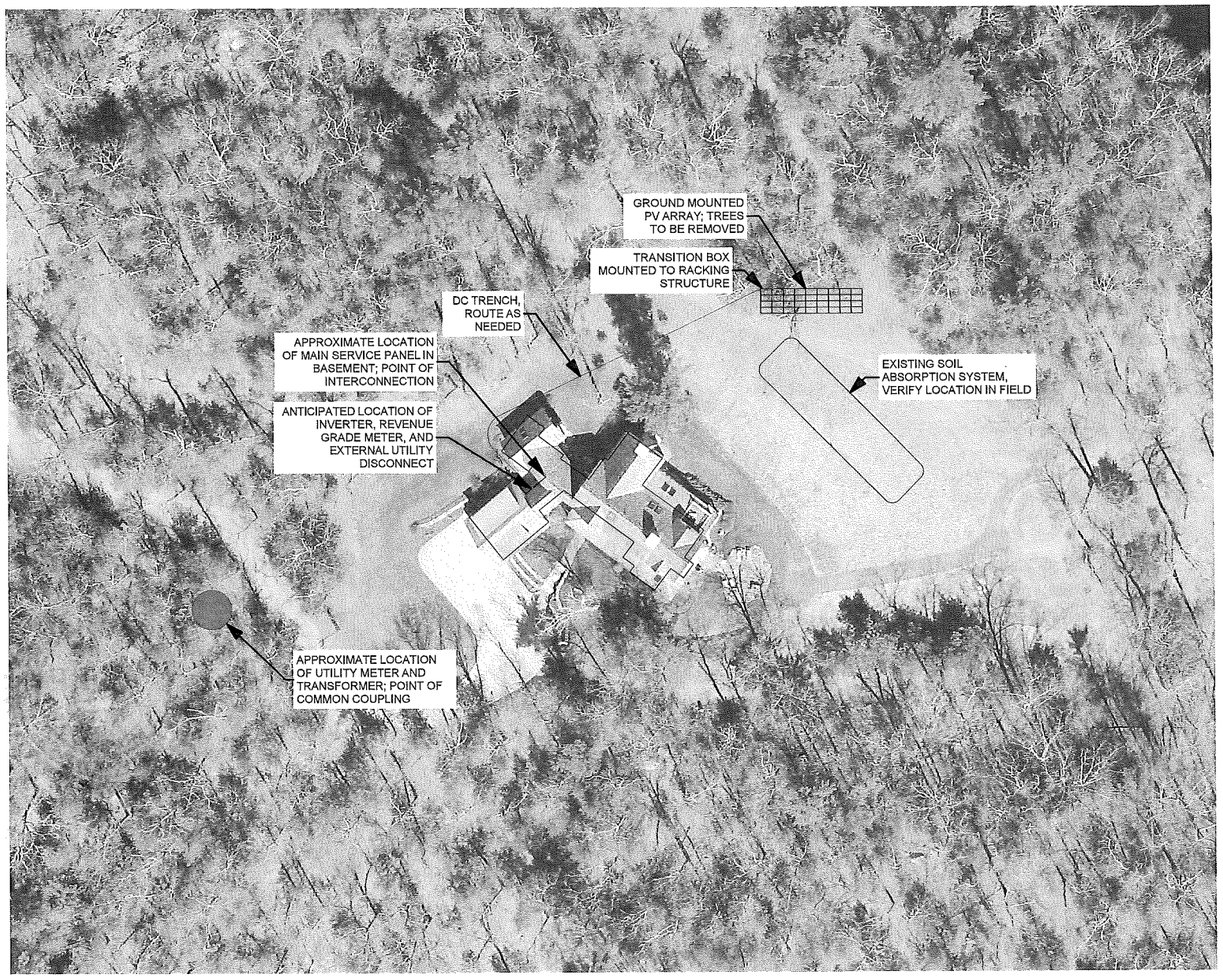
Solar Design Associates has been contracted by Holly Langer of 146 Middleton Rd. to construct a 36 module, 9 kW, ground mounted PV array for supplying electricity to her primary residence. The PV array has been determined to be within the 200' buffer zone of Fish Brook, and therefore requires a hearing in front of the Boxford Conservation Commission. This letter is a formal request for a Determination Of Negligible Impact for the solar project.

Sincerely:

Stephen Coffrin, Project Engineer
For Solar Design Associates, Inc.

PHOTOVOLTAIC SYSTEM FOR LANGER RESIDENCE

146 MIDDLETON ROAD, BOXFORD, MA 01921



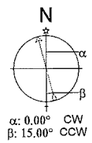
1 9.18 KW DC (10 KW AC) PV ARRAY WITH (36) 255W MODULES AT FIXED 25 DEGREE TILT

0 16' 32' 64'

2 SITE LOCUS

0 1000' 2000'

3 SIMILAR GROUND MOUNT ARRAY



α: 0.00° CW
β: 15.00° CCW

25° FIXED TILT PV ARRAY AZIMUTH: 0.00° E OF S			
MODULES	DC POWER	AC POWER	ANNUAL AC ENERGY
36/ 255W	9.18 kWdc	10 kWac	10,865 kWhr/yr

solar design associates inc
HARVARD, MA 01451-0242 tel: 978-456-6855
www.solardesign.com fax: 978-772-9715

NOT FOR CONSTRUCTION

THIS DRAWING IS FOR INFORMATION PURPOSES ONLY. CERTIFICATION OR VALIDATION IS TO BE DONE BY A PROFESSIONAL WITH EXPERTISE IN THE REQUIRED FIELD AND A LICENSE IN THE STATE THAT THE INSTALLATION WILL RESIDE. CERTIFICATION OR VALIDATION TO BE INCLUDED AS PART OF THE SUBMITTALS FOR PERMITTING OF THE OVERALL PROJECT.

LANGER RESIDENCE

SUBMISSION: PERMIT SET — Thursday, July 02, 2015

PROFESSIONAL STAMP: 7/2/2015 — COMMONWEALTH OF MASSACHUSETTS — CHRISTOPHER P. O'NEIL 37643 — REGISTERED PROFESSIONAL ENGINEER

ORIGINAL

NOT FOR CONSTRUCTION

REVISION NOTES

MARK	DATE	DESCRIPTION
0	06/26/15	PERMIT SET
0	05/27/15	INTERCONNECTION SET

CONTRACTOR

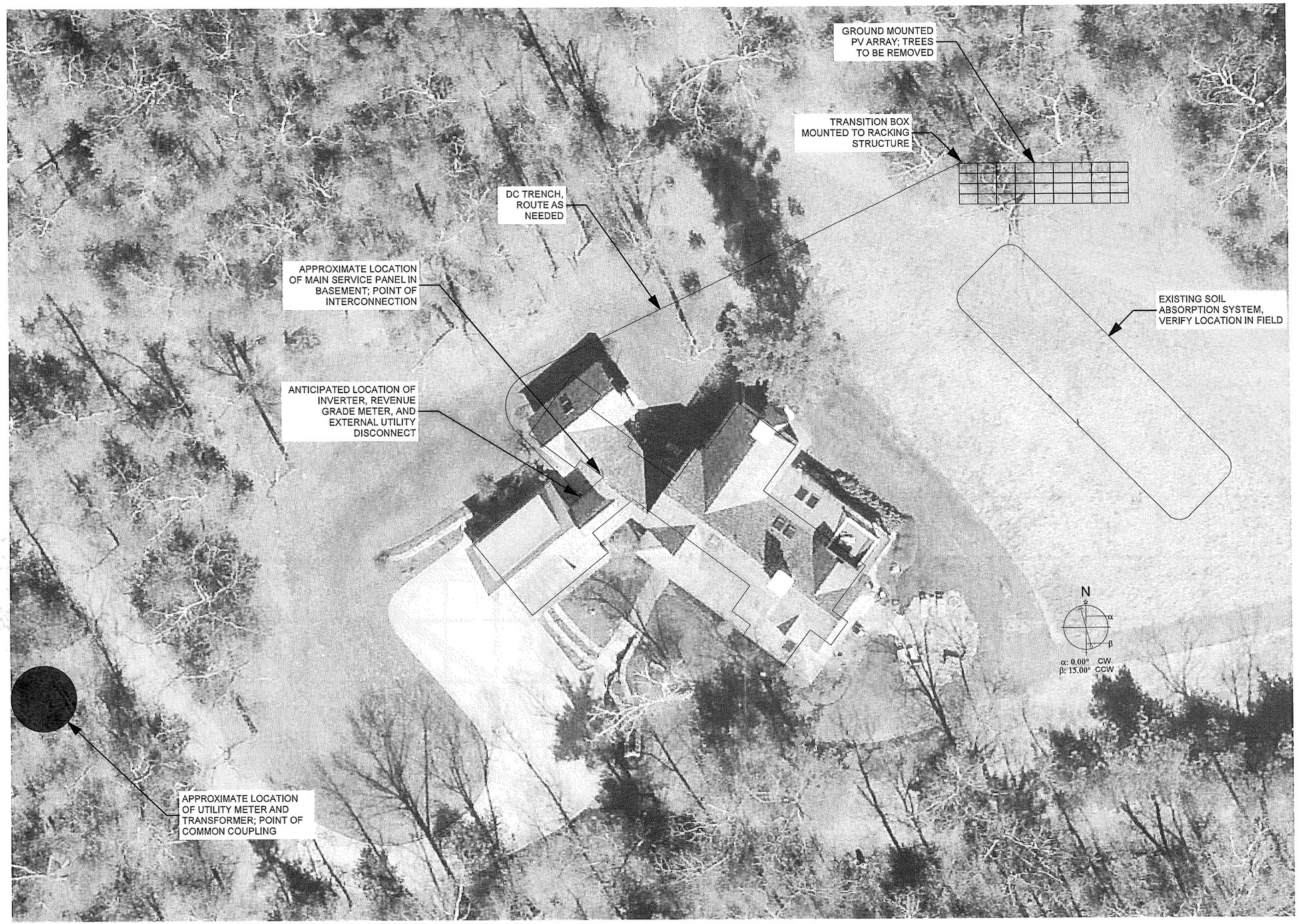
NAME	
STREET	
CITY/ST/ZIP	
NOTES	

BUILDING

NAME	
STREET	146 MIDDLETON ROAD
CITY/ST/ZIP	BOXFORD, MA 01921
NOTES	

DRAWING

FILE NAME	2015-0611 Langer Residence.pln
SCALE	AS NOTED
DRAWN BY	NL — DATE DRAFTED: 7/2/2015
CHECKED BY	SMC — SHEET SIZE: ARCH D
DRAWING NO.	PV001
DRAWING TITLE	PV SITE PLAN



1 GROUND MOUNT PV ARRAY IN BOXFORD, MA

solar design associates inc
HARVARD, MA 01451-0242 tel 978-456-6855
www.sdainc.com fax 978-772-9715

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LANGER RESIDENCE

SUBMISSION: PERMIT SET
Thursday, July 02, 2015

PROFESSIONAL STAMP: COMMONWEALTH OF MASSACHUSETTS — CHRISTOPHER P. O'NEIL 37843 REGISTERED PROFESSIONAL ENGINEER

ORIGINAL
NOT FOR CONSTRUCTION

REVISION NOTES

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CONTRACTOR

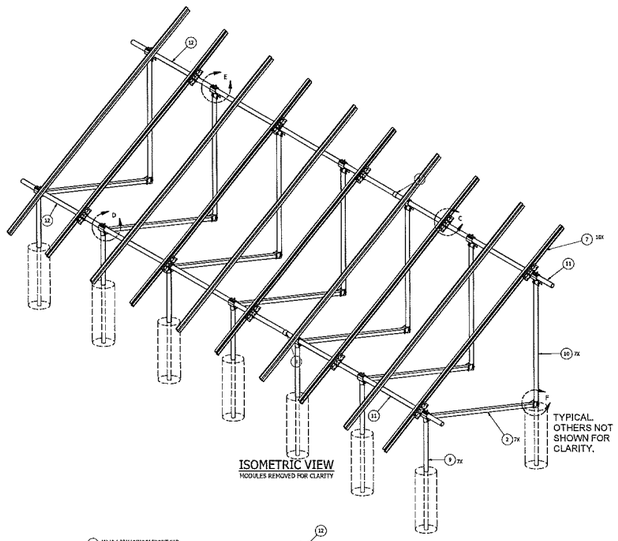
NAME	
STREET	
CITY/ST/ZIP	
NOTES	

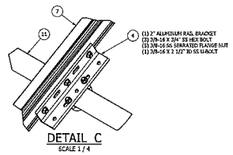
BUILDING

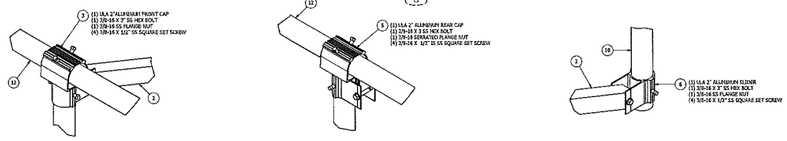
NAME	
STREET	146 MIDDLETON ROAD
CITY/ST/ZIP	BOXFORD, MA 01921
NOTES	

DRAWING

FILE NAME	2015-0611 Langer Residence.pln	
SCALE	AS NOTED	
DRAWN BY	NL	DATE DRAFTED: 7/2/2015
CHECKED BY	SMC	SHEET SIZE: ARCH D
DRAWING NO.	PV101	
DRAWING TITLE	PV LAYOUT	

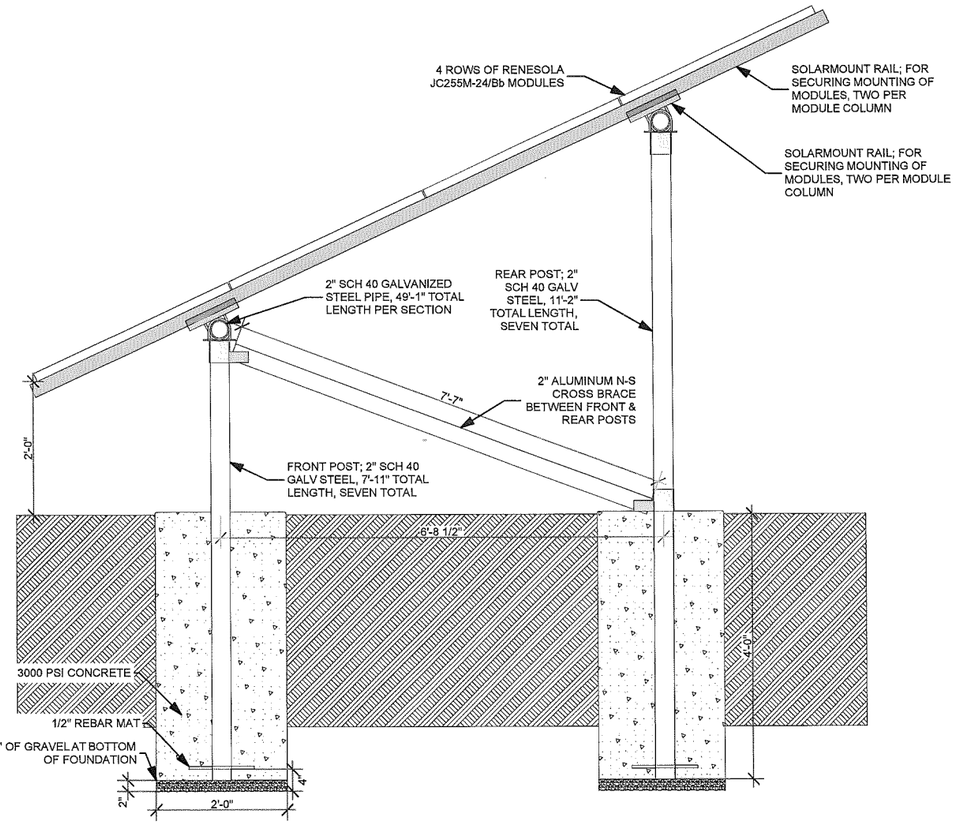






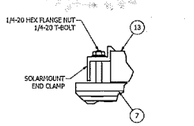
1 UNIRAC ULA ISO VIEW

NOTES:
1. ISOMETRIC VIEW IS FROM A SAMPLE UNIRAC ULA MOUNTING SYSTEM AND IS FOR ILLUSTRATIVE PURPOSES ONLY.
2. RACKING DETAILS (2) AND (4) REPRESENT ACTUAL DIMENSIONS OF PROPOSED RACKING SYSTEM.
2. RACKING SYSTEM WILL UTILIZE TOP DOWN CLAMPS AND WEEB WASHERS FOR BONDING AND GROUNDING.

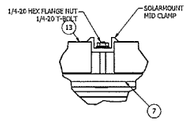


2 FOOTING DETAILS

0 6" 1' 2'

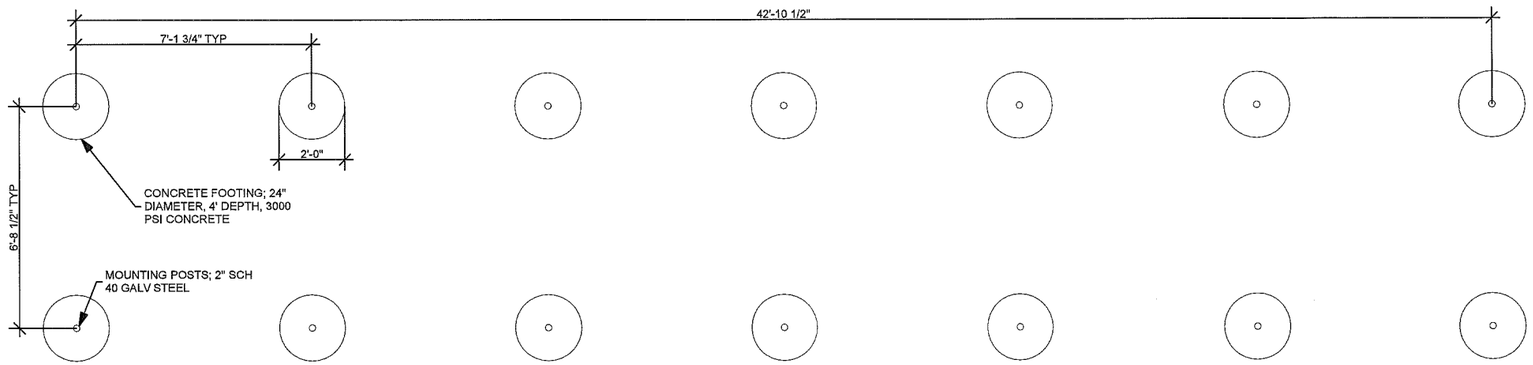


TOP MOUNT END CLAMP
TYPICAL MODULE MOUNTING



TOP MOUNT MID CLAMP
TYPICAL MODULE MOUNTING

3 SAMPLE RACKING DETAILS



4 FOOTING LAYOUT

0 1' 2' 4'

solar design associates Inc
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LANGER RESIDENCE

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Thursday, July 02, 2015

PROFESSIONAL STAMP: COMMONWEALTH OF MASSACHUSETTS — CHRISTOPHER P. O'NEIL 37843 REGISTERED PROFESSIONAL ENGINEER

NOT FOR CONSTRUCTION
ORIGINAL

REVISION NOTES

MARK	DATE	DESCRIPTION
0	06/26/15	PERMIT SET
0	05/27/15	INTERCONNECTION SET

CONTRACTOR

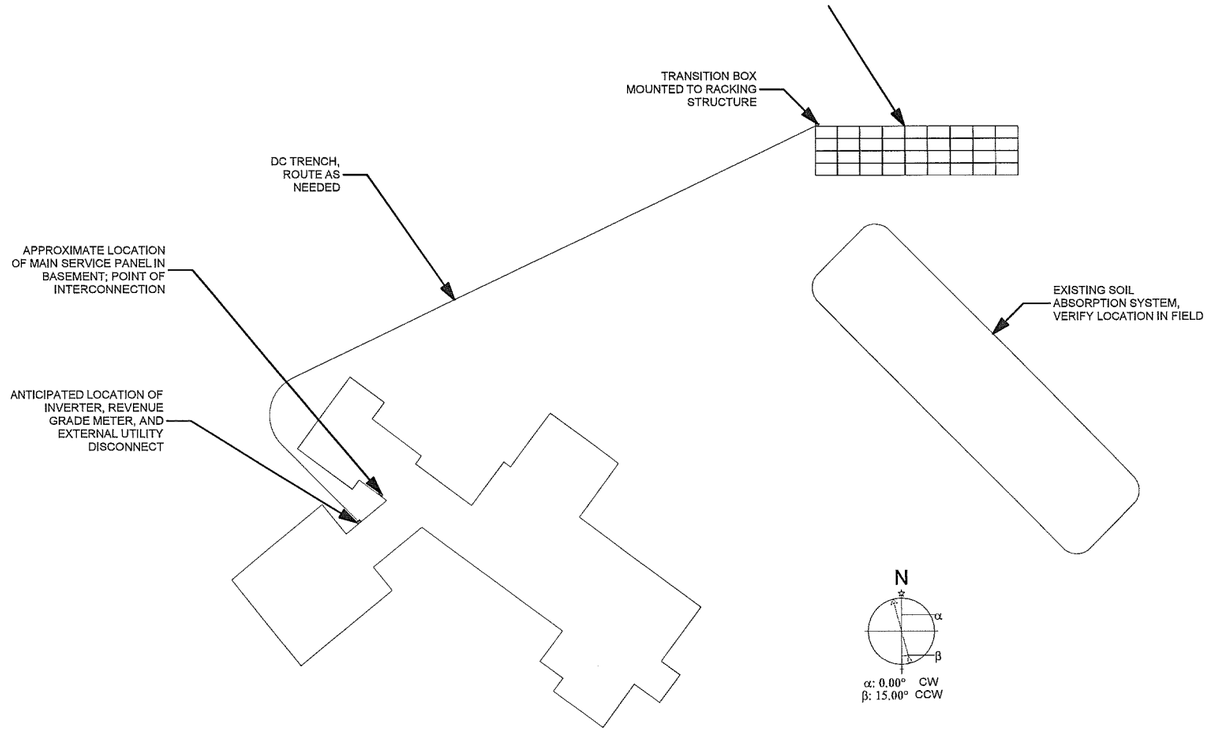
NAME	
STREET	
CITY/ST/ZIP	
NOTES	

BUILDING

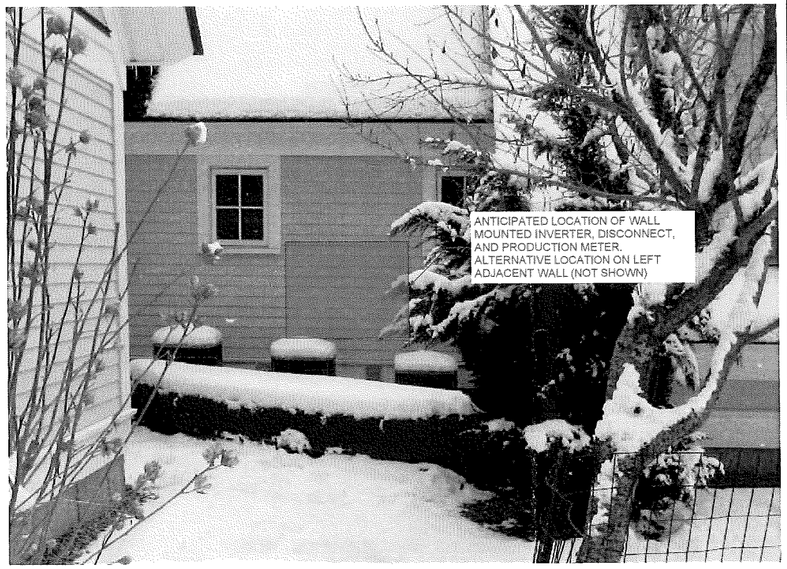
NAME	
STREET	146 MIDDLETON ROAD
CITY/ST/ZIP	BOXFORD, MA 01921
NOTES	

DRAWING

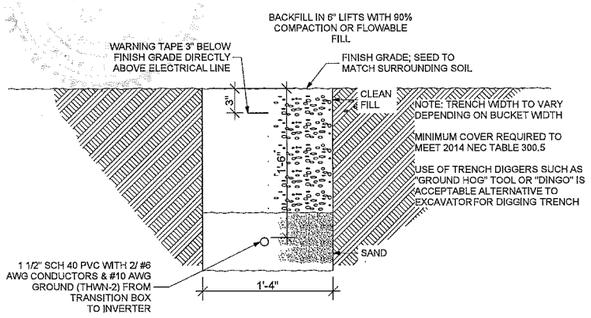
FILE NAME	2015-0611 Langer Residence.pln
SCALE	AS NOTED
DRAWN BY	NL DATE DRAFTED: 7/2/2015
CHECKED BY	SMC SHEET SIZE: ARCH D
DRAWING NO.	PV103
DRAWING TITLE	MOUNTING DETAILS



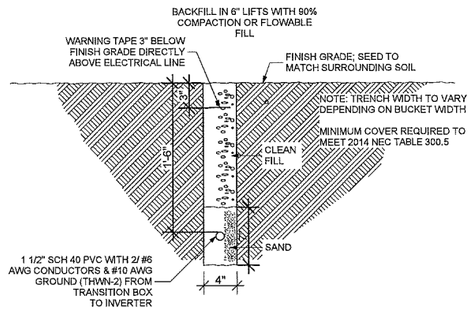
1 CONDUIT LAYOUT 0 8' 16' 32'



2 EQUIPMENT LOCATION 0 8' 16' 32'

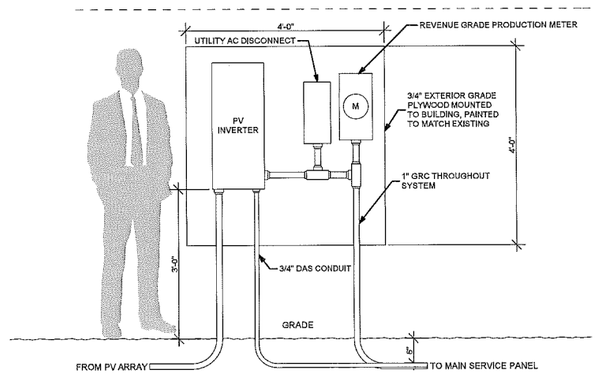


3 TRENCH PROFILE 0 6" 12" 18"



5 ALTERNATE TRENCH PROFILE 0 6" 12" 18"

NOTE: ALL DIMENSIONS ARE APPROXIMATE AND FOR REFERENCE ONLY.



4 EQUIPMENT ELEVATION 0 1' 2' 3'

solar design associates inc
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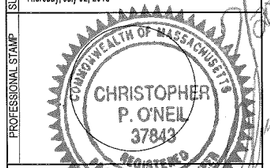
LANGER RESIDENCE

SUBMISSION: PERMIT SET
Thursday, July 02, 2015

PROFESSIONAL STAMP:


ORIGINAL
NOT FOR CONSTRUCTION

REVISION NOTES

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NAME	
STREET	146 MIDDLETON ROAD
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NOTES	

DRAWING

FILE NAME	2015-0611 Langer Residence.pln
SCALE	AS NOTED
DRAWN BY	NL DATE DRAFTED: 7/2/2015
CHECKED BY	SMC SHEET SIZE: ARCH D
DRAWING NO.	PV301
DRAWING TITLE	CONDUIT LAYOUT

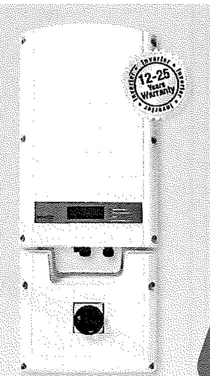
solaredge

SolarEdge Single Phase Inverters

For North America

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

INVERTERS



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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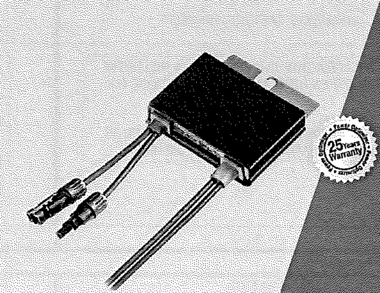
SolarEdge Power Optimizer

Module Add-On For North America

P300 / P320 / P400 / P405

POWER OPTIMIZER



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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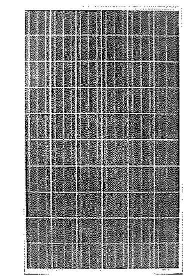
ReneSola

Virtus II

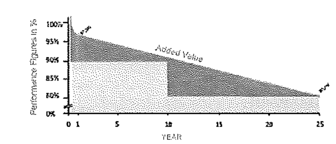
Virtus®II Module

250W, 255W, 260W,265W

- High Module Conversion Efficiencies
- Easy Installation and Handling for Various Applications
- Mechanical Load Capability of up to 5400 Pa
- Conforms with IEC 61215:2005, IEC 61730:2004, UL 1703 PV Standards
- ISO9001, OHSAS18001, ISO14001 Certified
- Application Class A, Safety Class II, Fire Rating C



Also Applicable For Module With Black Frame



10-year material & workmanship

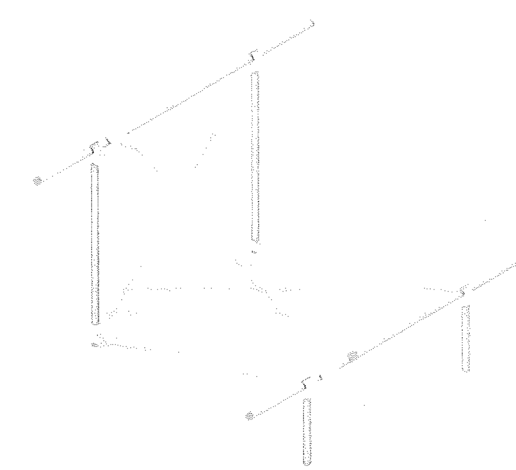
25-year linear power output

ReneSola.com

ULA UNIRAC LARGE ARRAY

UNIRAC A HILTI GROUP COMPANY

UNIRAC LARGE ARRAY will support a wider range of site and climatic challenges than any other PV structure on the market. ULA aluminum components merge with SOLARMOUNT rails and installer-supplied steel pipe to form durable, rigid truss structures.



GROUND MOUNT SYSTEMS | MODULAR FLEXIBILITY

MODULAR DESIGN • FLEXIBILITY • AVAILABILITY • QUALITY PROVIDER

solaredge

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	4150	5400 @ 208V 5450 @240V	6000	8350	10800 @ 208V 10950 @240V	12000	VA
AC Output Voltage Min.-Nom.-Max.[1] 183 - 208 - 229 Vac	-	-	✓	-	-	✓	-	
AC Output Voltage Min.-Nom.-Max.[1] 211 - 240 - 264 Vac	✓	✓	✓	✓	✓	✓	✓	
AC Frequency Min.-Nom.-Max.[1]	59.3 - 60 - 60.5 (with HI country setting 57 - 60 - 60.5)							Hz
Max. Continuous Output Current	12.5	16	24 @ 208V 21 @ 240V	25	32	48 @ 208V 42 @ 240V	47.5	A
GFDI Threshold	1							A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes							Yes
INPUT								
Maximum DC Power (STC)	4050	5100	6750	8100	10250	13500	15350	W
Transformer-less, Ungrounded	Yes							
Max. Input Voltage	500							Vdc
Nom. DC Input Voltage	325 @ 208V / 350 @ 240V							Vdc
Max. Input Current[2]	9.5	13	16.5 @ 208V 15.5 @ 240V	18	23	33 @ 208V 30.5 @ 240V	34.5	Adc
Max. Input Short Circuit Current	45							Adc
Reverse-Polarity Protection	Yes							
Ground-Fault Isolation Detection	600kΩ Sensitivity							
Maximum Inverter Efficiency	97.7	98.2	98.3	98.3	98	98	98	%
CEC Weighted Efficiency	97.5	98	97.5 @ 208V 98 @ 240V	97.5	97.5	97 @ 208V 97.5 @ 240V	97.5	%
Nighttime Power Consumption	< 2.5					< 4		W
ADDITIONAL FEATURES								
Supported Communication Interfaces	RS485, RS232, Ethernet, ZigBee (optional)							
Revenue Grade Data, ANSI C12.1	Optional[3]							
Rapid Shutdown – NEC 2014 690.12	Functionality enabled when SolarEdge rapid shutdown kit is installed[4]							
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)	30.5 x 12.5 x 7.2 / 775 x 315 x 184					30.5 x 12.5 x 10.5 / 775 x 315 x 260		in / mm
Weight with Safety Switch	51.2 / 23.2		54.7 / 24.7			88.4 / 40.1		lb / kg
Cooling	Natural Convection				Natural convection and internal fan (user replaceable)	Fans (user replaceable)		
Noise	< 25					< 50		dBA
Min.-Max. Operating Temperature Range	-13 to +140 / -25 to +60 (-40 to +60 version available[5])							°F / °C
Protection Rating	NEMA 3R							

RoHS

solaredge

SolarEdge Power Optimizer

Module Add-On for North America

P300 / P320 / P400 / P405

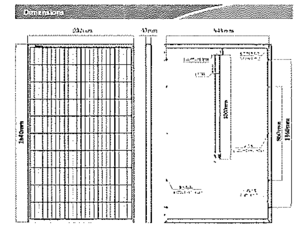
	P300 (for 60-cell modules)	P320 (for high-power 60-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	
INPUT					
Rated Input DC Power[1]	300	320	400	405	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		80	125	Vdc
MPPT Operating Range	8 - 48		8 - 80	12.5 - 105	Vdc
Maximum Short Circuit Current (Isc)	10	11	10		Adc
Maximum DC Input Current	12.5	13.75	12.5		Adc
Maximum Efficiency	99.5				%
Weighted Efficiency	98.8				%
Overvoltage Category	II				
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)					
Maximum Output Current	15				Adc
Maximum Output Voltage	60			85	Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE 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
Compatible Inverters	All SolarEdge Single Phase and Three Phase Inverters				
Dimensions (W x L x H)	128 x 152 x 27.5 / 5 x 5.97 x 1.08		128 x 152 x 35 / 5 x 5.97 x 1.37	128 x 152 x 48 / 5 x 5.97 x 1.89	mm / in
Weight (including cables)	770 / 1.7		930 / 2.05	930 / 2.05	gr / lb
Input Connector	MC4 Compatible				
Output Wire Type / Connector	Double Insulated; MC4 Compatible				
Output Wire Length	0.95 / 3.0		1.2 / 3.9		m / ft
Operating Temperature Range	-40 - +85 / -40 - +185				°C / °F
Protection Rating	IP68 / NEMA6P				
Relative Humidity	0 - 100				%

PV SYSTEM DESIGN USING A SOLAREDGE INVERTER[2]	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			

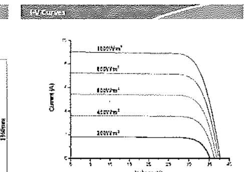
ReneSola

Virtus®II Module

250W, 255W, 260W,265W



Drawing Only for Reference



Varied Irradiation Efficiencies

Irradiance	200W/m²	400W/m²	600W/m²	800W/m²	1000W/m²
Efficiency	16.1%	16.5%	16.5%	16.4%	16.3%

Electrical Characteristics STC	JC250M-24/Bb	JC255M-24/Bb	JC260M-24/Bb	JC265M-24/Bb
Maximum Power (Pmax)	250W	255W	260W	265W
Power Tolerance	0~+5W	0~+5W	0~+5W	0~+5W
Module Efficiency	15.4%	15.7%	16.0%	16.3%
Maximum Power Current (Imp)	8.25A	8.39A	8.53A	8.66A
Maximum Power Voltage (Vmp)	30.3V	30.4V	30.5V	30.6V
Short Circuit Current (Isc)	8.83A	8.85A	8.95A	9.03A
Open Circuit Voltage (Voc)	37.3V	37.5V	37.6V	37.7V

Values at Standard Test Conditions STC (AM1.5, Irradiance 1000W/m², Cell Temperature 25°C)

Electrical Characteristics NOCT	JC250M-24/Bb	JC255M-24/Bb	JC260M-24/Bb	JC265M-24/Bb
Maximum Power (Pmax)	185W	189W	193W	196W
Maximum Power Current (Imp)	6.57A	6.63A	6.74A	6.81A
Maximum Power Voltage (Vmp)	28.2V	28.5V	28.6V	28.7V
Short Circuit Current (Isc)	7.12A	7.20A	7.27A	7.31A
Open Circuit Voltage (Voc)	35.0V	35.1V	35.2V	35.3V

Values at Normal Operating Cell Temperature, Irradiance of 800W/m², AM1.5, Ambient Temperature 20°C, Wind Speed 1m/s

Mechanical Characteristics

Cell Type	Virtus II (Polycrystalline) 156x156 mm, 60 (6x10) pcs in series
Glass	High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminum Alloy
Junction Box	IP65/IP67 Rated, With Bypass Diodes
Dimension	1640 x 992 x 40 mm
Output Cable	4 mm² (EU)/12 AWG (US), 1000 mm
Weight	19 kg
Installation Hole Location	See Drawing Above

Characteristics

Temperature Coefficient of Voc	-0.31%/°C
Temperature Coefficient of Isc	0.04%/°C
Temperature Coefficient of Pmax	-0.40%/°C
Nominal Operating Cell Temperature (NOCT)	45°C±2°C

Packing Information

Container	20' GP	40' GP	40' HQ
Pallets per Container	12	26	28
Pieces per Container	330	700	728

Maximum Ratings

Operating Temperature	-40°C~+85°C
Maximum System Voltage	1000VDC (EU) / 600VDC (US)
Maximum Series Fuse Rating	20A (EU) / 16A (US)

ReneSola.com

ULA UNIRAC LARGE ARRAY

UNIRAC A HILTI GROUP COMPANY

FLEXIBILITY

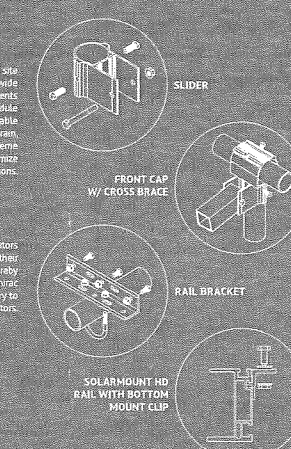
MADE TO MEET YOUR NEEDS

The size of a ULA is limited only by the size of your ground site or the structural strength of your flat roof. ULA supports a wide range of site and climatic challenges. Aluminum components merge with SOLARMOUNT rails and installer-supplied Schedule 40 or 80 steel pipe (available anywhere) to create a durable structure that can accommodate uneven, rocky, sloping terrain, and is capable of withstanding Zone 4 seismic events or extreme wind or snow loads. Increase your leading edge height or optimize your tilt angle to clear rooftop equipment or ground obstructions.

AVAILABILITY

NATION WIDE NETWORK

Unirac maintains the largest network of stocking distributors for our racking solutions. Our partners have distinguished their level of customer support, availability, and overall value thereby providing the highest level of service to the users of Unirac products. Count on our partners for fast and accurate delivery to meet your project needs. Visit Unirac.com for a list of distributors.



UNIRAC CUSTOMER SERVICE MEANS THE HIGHEST LEVEL OF PRODUCT SUPPORT

UNMATCHED EXPERIENCE · CERTIFIED QUALITY · ENGINEERING EXCELLENCE · BANKABLE WARRANTY · DESIGN TOOLS · PERMIT DOCUMENTATION

TECHNICAL SUPPORT

Unirac's technical support team is dedicated to answering questions & addressing issues in real time. An online library of documents including engineering reports, stamped letters and technical datasheets greatly simplifies your permitting and project planning process.

CERTIFIED QUALITY PROVIDER

Unirac is the only PV mounting vendor with ISO certifications for 9001:2008, 14001:2004 and OHSAS 18001:2007, which means we deliver the highest standards for fit, form, and function. These certifications demonstrate our excellence and our commitment to first class business practices.

BANKABLE WARRANTY

As a Hilti Group Company, Unirac has the financial strength to back our products and reduce your risk. Have peace of mind knowing you are receiving products of exceptional quality. ULA is covered by a 10-year limited product warranty.

(1) EQUIPMENT DATASHEETS

solar design associates
HARVARD, MA 01451-0242 tel: 978-456-6855
www.solardesign.com fax: 978-772-9715

NOT FOR CONSTRUCTION

LANGER RESIDENCE

SUBMISSION: PERMIT SET — Thursday, July 02, 2015

PROFESSIONAL STAMP: COMMONWEALTH OF MASSACHUSETTS — CHRISTOPHER P. O'NEIL 37843 — REGISTERED PROFESSIONAL ENGINEER

ORIGINAL — NOT FOR CONSTRUCTION

MARK	DATE	DESCRIPTION
0	06/26/15	PERMIT SET
0	05/27/15	INTERCONNECTION SET

CONTRACTOR	
NAME	
STREET	
CITY/ST/ZIP	
NOTES	

BUILDING	
NAME	
STREET	146 MIDDLETON ROAD
CITY/ST/ZIP	BOXFORD, MA 01921
NOTES	

DRAWING	
FILE NAME	2015-0611 Langer Residence.pln
SCALE	AS NOTED
DRAWN BY	NL — DATE DRAFTED: 7/2/2015
CHECKED BY	SMC — SHEET SIZE: ARCH D
DRAWING NO.	PV403
DRAWING TITLE	DATA SHEETS