



LEADING THE WAY  
Structural Engineering Firm  
NC License No. C-2499

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Mr. Rob Smith, PV Project Manager  
**Yes! Solar Solutions of the Triangle**  
E-mail: [rsmith@yessolarsolutions.com](mailto:rsmith@yessolarsolutions.com)

September 29, 2018

Subject: Proposed roof solar panels – Dawkins Workshop  
5267 NC 27 E.  
Coats, North Carolina 27521

File No.: RB-185488

Dear Rob:

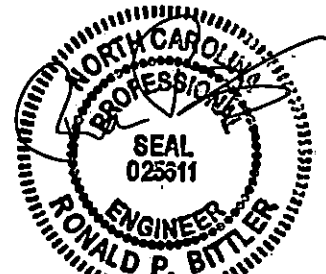
RB Engineering, Inc. is pleased to provide the following summary engineering letter concerning the subject project. The existing roof system is constructed with timber trusses at 24 inches on center, an OSB roof deck and a composition asphalt shingle roof. We have reviewed the proposed solar layout and have structurally evaluated the additional proposed roof loading with the following conclusions:

- The total surface area of the proposed solar array (36 PV modules) is approximately 650 SF. The solar panel installation has been evaluated for a maximum design wind loading of 110 mph.
- The subject roof mounted PV system attachment method is structurally adequate to transfer the design uplift loads in accordance with the current North Carolina residential building code.
- The existing roof system is structurally adequate to transfer the applicable design loads - including the additional design loading (dead load and wind load) due to the proposed solar panel installation - in accordance with the current North Carolina residential building code.

Our services were provided in accordance with the standard of practice for structural engineering and within the limits imposed by scope, schedule, and budget. If you have any questions or if I can be of further assistance to you on this project, please contact me at (919) 677-9662.

Respectfully submitted,

Ron Bittler, PE  
President / Structural Engineer  
RB Engineering, Inc.



9.29.2018

<b>Project Name</b>	Dawkins Residence
<b>Customer Name</b>	Ray Dawkins
<b>Project Address</b>	5267 NC 27 E. Coats, NC 27521
<b>Phone Number</b>	919-413-2250
<b>System Size</b>	10.62 kW DC

### Inverter Schedule

Inverter	Brand	Model	String(s)	Modules Per String	Total Modules
#1	SolarEdge	10000H-US	2	18 & 18	36

### Module Schedule

Brand	Model	Dimensions (Inch)	Amount	Rated Power
Mission	SQ5T	65.51 x 39.33 x 1.57	36	295W

### Array 1

Array 1		Array 2	
True Azimuth	180 degrees	True Azimuth	
Magnetic Azimuth	189 degrees	Magnetic Azimuth	
Tilt Angle	43 degrees	Tilt Angle	

### Sheet Index

PV 1	Cover
PV 2	Module & String
PV 3	Penetrations, Grounding, & Layout
PV 4	Load Calculations
PV 5	Single Line Diagram
PV 6	Labels and Signage

### Appendix

Module Spec Sheet
Inverter #1 Spec Sheet
Module Optimizer Spec Sheet

### Scope of Work

Install 36 PV modules on roof of workshop building to produce 10,620 Wp DC. Connect each PV module to it's own module optimizer. Connect 36 module optimizers to inverter through DC disconnect. Connect AC lines from inverter to Generation panel. Connect AC lines from generation panel and workshop panel to Backup Gateway. Connect AC lines from gateway to AC disconnect on main building. Connect AC from disconnect to main power supply of building through load-side connection in CT cabinet.

Comply with: 2017 NEC, 2012 NCBC  
Occupancy Group Division: Residential

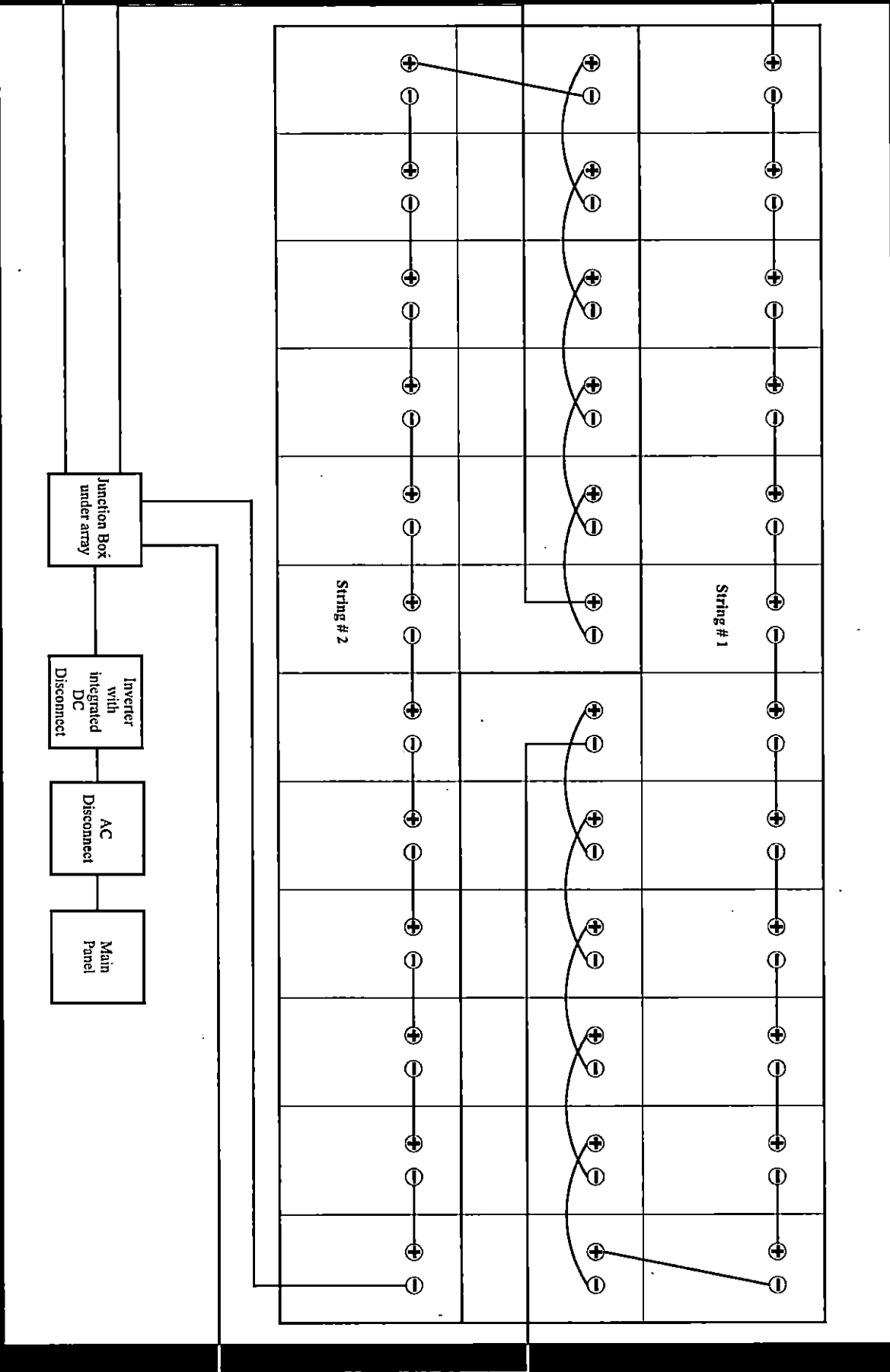
### PV 1 Cover

Drawn By: Darren Q  
Approved By: Rob Smith  
Date: 10/2/2018  
Rev. Date:  
Rev. Number:  
Scale: NTS

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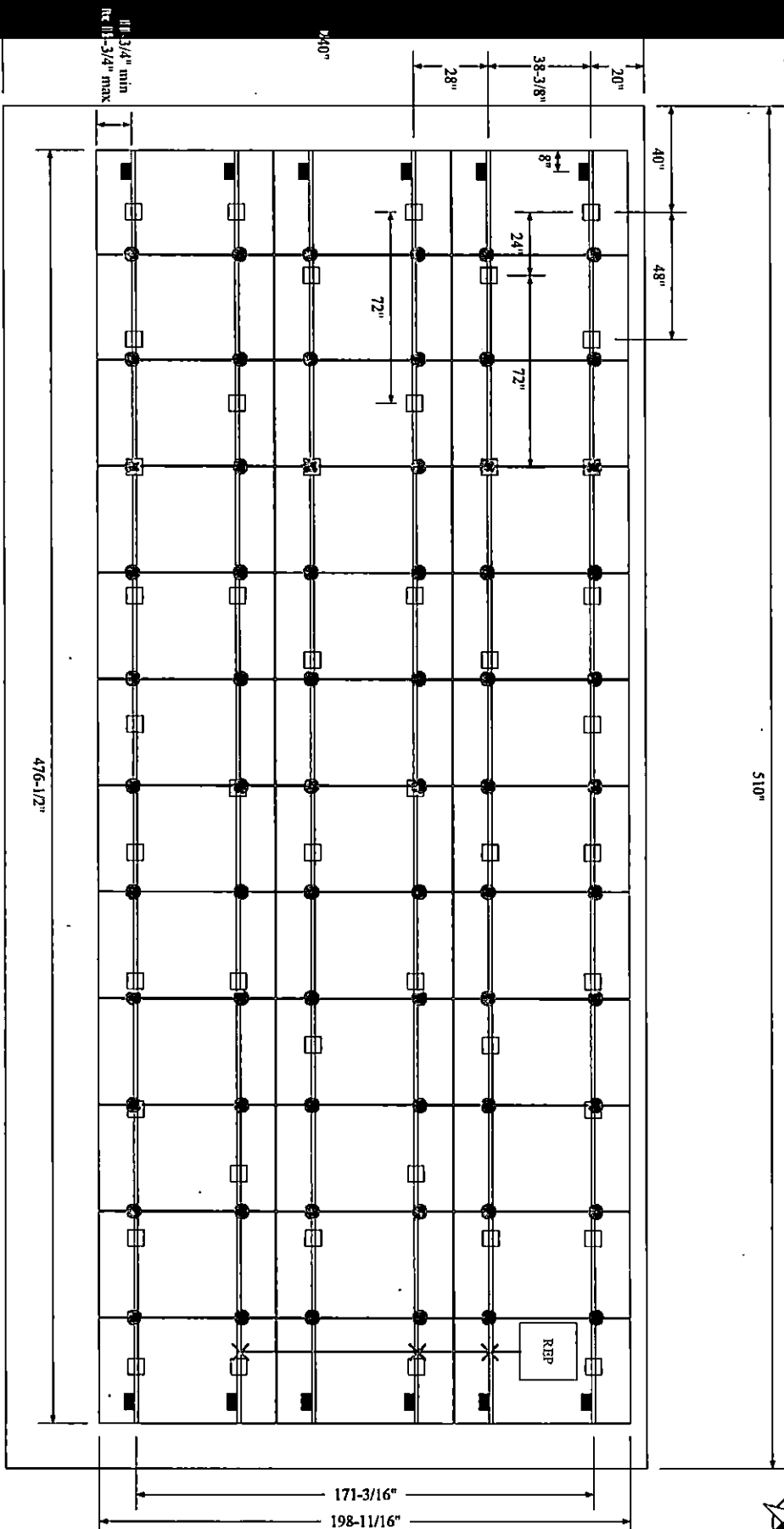
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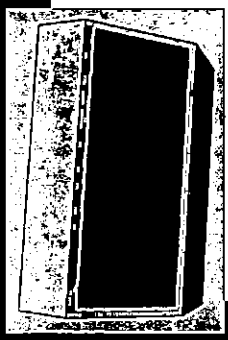
**PV 2**  
 Modules  
 &  
 Strings

degrees



- - Bonding End Clamp
  - - Bonding Mid Clamp
  - × - Ground Lug
  - - Rail
- Racked L-Post Rafter  
Kirschbaum  
- 12x12x3 steel rafter  
Aluminum

Criffen Guards



Ray Dawkins  
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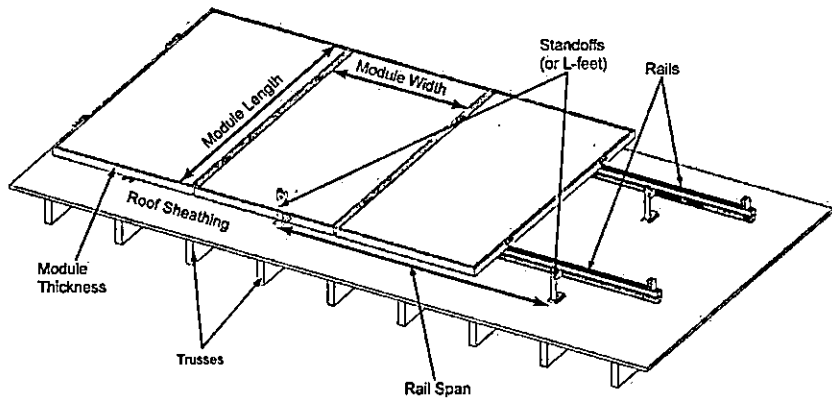
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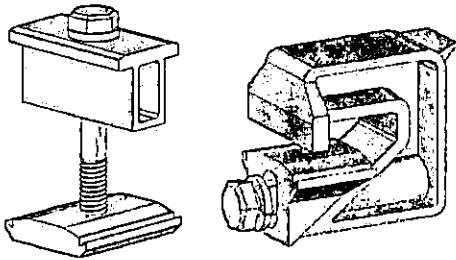
Drawn By: Darren Q  
Approved By: Rob Smith  
Date: 9/28/2018  
Rev. Date:  
Rev. Number:  
Scale: 5/16" = 1'

**PV 3**  
Penetrations & Grounding

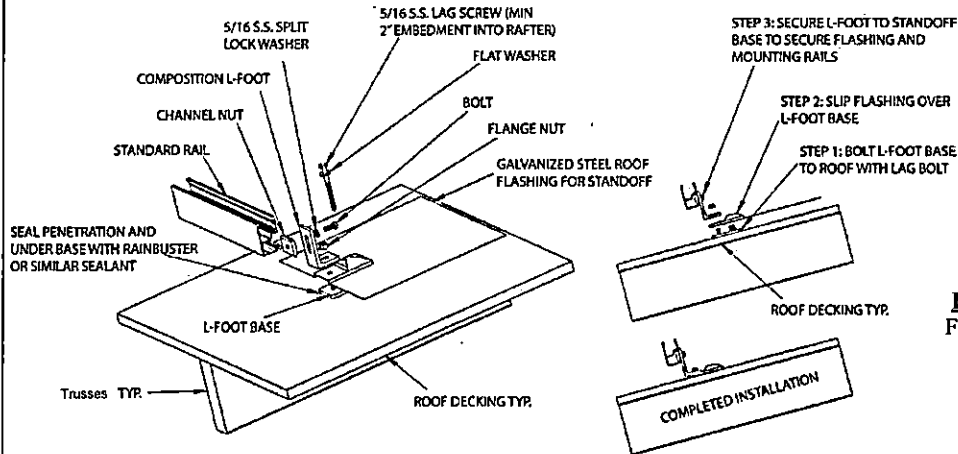
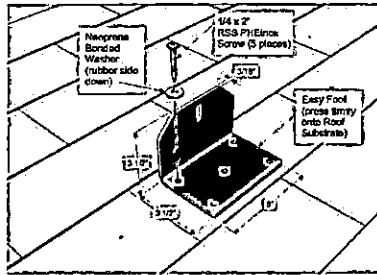


**DIAGRAM 1**  
Layout of PV  
modules showing rail  
span

**DIAGRAM 2**  
Universal End Clamp  
and Mid Clamp

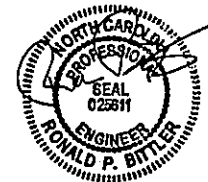


**DIAGRAM 4:**  
EZ feet mounting  
assembly



**DIAGRAM 3**  
Flashed L Foot  
assembly

Load Calculations for Snap-N-Rack & Misson Solar Modules	
Quantity of Modules	36.00 pcs
Module Weight	40.10 lbs
Module Area	17.89 SF
Weight per System	1443.60 lbs
Area per System	644.04 SF
Quantity of Optimizers	36.00 pcs
Each Weight	1.70 lbs
Weight per System	61.20 lbs
Quantity of 162" Rails	18.00 pcs
Each Weight	14.30 lbs
Weight per System	257.40 lbs
Quantity of 122" Rails	0.00 pcs
Each Weight	10.64 lbs
Weight per System	0.00 lbs
Quantity of Mid Clamps	66.00 pcs
Each Weight	0.16 lbs
Weight per System	10.56 lbs
Quantity of End Clamps	12.00 pcs
Each Weight	0.30 lbs
Weight per System	3.60 lbs
Quantity of Splices	12.00 pcs
Each Weight	0.65 lbs
Weight per System	7.80 lbs
Quantity of Flashed L Feet	46.00 pcs
Each Weight	1.25 lbs
Weight per System	57.50 lbs
Quantity of EZ Feet	12.00 pcs
Each Weight	3.00 lbs
Weight per System	138.00 lbs
Total Weight of System	1979.66 lbs
System Weight per SF	3.07 lbs/SF
Weight per footing	34.13 lbs/footing



9.29.2018

STRUCTURAL REVIEW PROVIDED BY:  
RONALD P. BITTLER, PE  
RB ENGINEERING, INC. (C-2499)  
168 QUADE DRIVE  
CARY, NC 27513  
919-677-9662  
PROJECT #RB-185488

**PV 4**  
SnapTrack  
Load  
Calculations

Drawn By: Darren Q  
Approved By: Rob Smith  
Date: 9/28/2018  
Rev. Date:  
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Scale: NTS

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5267 NC 27 E.  
Coats, NC 27521



NEC 690.31 (C)(3)(4)  
 PLACE ON ALL JUNCTION BOXES, EXPOSED RACEWAYS  
 EVERY 10' AND 1' FROM BENDS AND PENETRATIONS,  
 ADJACENT TO THE MAIN SERVICE DISCONNECT \*REFLECTIVE\*

**WARNING: PHOTOVOLTAIC  
 POWER SOURCE**

NEC 690.15 & 690.13 (B)  
 PLACE ON MAIN UTILITY DISCONNECT FOR PHOTOVOLTAIC  
 SYSTEM

**MAIN PHOTOVOLTAIC  
 SYSTEM DISCONNECT**

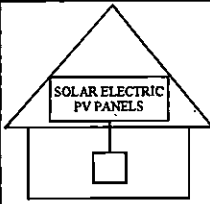
NEC 690.56 (C)  
 PLACE ON RAPID SHUTDOWN DISCONNECT OR INVERTER  
 WITH INTEGRATED RAPID SHUTDOWN \*REFLECTIVE\*

**RAPID SHUTDOWN SWITCH  
 FOR SOLAR PV SYSTEM**

NEC 690.56 (C)  
 PLACE WITHIN 3FT OF SERVICE DISCONNECTING MEANS TO  
 WHICH THE PV SYSTEMS ARE CONNECTED AND SHALL  
 INDICATE THE LOCATIONS OF RAPID SHUTDOWN SWITCHES

**SOLAR PV SYSTEM EQUIPPED  
 WITH RAPID SHUTDOWN**

TURN RAPID SHUTDOWN  
 SWITCH TO THE  
 \*OFF\* POSITION TO  
 SHUT DOWN PV SYSTEM  
 AND REDUCE  
 SHOCK HAZARD  
 IN THE ARRAY



NEC 705.12 (D)(3) & 690.64  
 PLACE AT POINT OF CONNECTION TO SERVICE DISTRIBUTION  
 EQUIPMENT (I.E. - MAIN PANEL (AND SUBPANEL IF APPLICABLE)  
 AND METER)

**WARNING: DUAL POWER SOURCE  
 SECOND SOURCE IS PHOTOVOLTAIC SYSTEM**

NEC 705.12 (D)(3)(B)  
 PLACE AT POINT OF CONNECTION TO SERVICE DISTRIBUTION  
 EQUIPMENT (I.E. - MAIN PANEL (AND SUBPANEL IF APPLICABLE))

**WARNING  
 INVERTER OUTPUT CONNECTION DO NOT  
 RELOCATE THIS OVERCURRENT DEVICE**

NEC 690.5 (C)  
 PLACE ON ALL SERVICE DISTRIBUTION EQUIPMENT  
 THAT THE PHOTOVOLTAIC SYSTEM IS FEEDING

**WARNING**  
 TURN OFF PHOTOVOLTAIC  
 AC DISCONNECT PRIOR TO  
 WORKING INSIDE PANEL

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

**WARNING**  
 ELECTRICAL SHOCK HAZARD  
 DO NOT TOUCH TERMINALS.  
 TERMINALS ON BOTH LINE AND  
 LOAD SIDES MAY BE ENERGIZED  
 IN THE OPEN POSITION

NEC 690.54  
 PLACE ON ALL AC DISCONNECTING MEANS AFTER THE INVERTER

**PHOTOVOLTAIC AC DISCONNECT**  
 RATED AC OUTPUT CURRENT: 42 A  
 NOMINAL OPERATING AC VOLTAGE: 240 V

NEC 690.53  
 PLACE ON ALL DC DISCONNECTING MEANS

**PV SYSTEM DC DISCONNECT**  
 MAXIMUM VOLTAGE: 480 V  
 MAXIMUM CIRCUIT CURRENT: 26.6 A  
 MAXIMUM RATED OUTPUT CURRENT OF  
 THE DC-DC CONVERTER (2 STRINGS): 30 A


All work shall comply with the 2017 National  
 Electrical Code (NEC) and all applicable local  
 electrical code requirements.

Labeling  
 Contractor will supply labels per NEC Article  
 110, 690, and 705.

**PV 6  
 Labels**

Drawn By: Darren Q  
 Approved By: Rob Smith  
 Date: 10/2/2018  
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 5267 NC 27 E.  
 Coats, NC 27521**

## ELECTRICAL SPECIFICATIONS

Electrical parameters at Standard Test Condition (STC)

Module Type			MSE290SQ5T	MSE295SQ5T	MSE300SQ5T
Power Output	P <sub>max</sub>	Wp	290	295	300
Module Efficiency		%	17.45	17.75	18.05
Tolerance			0 <sup>-</sup> +3%		
Short-Circuit Current	I <sub>sc</sub>	A	9.44	9.52	9.61
Open Circuit Voltage	V <sub>oc</sub>	V	39.81	40.11	40.18
Rated Current	I <sub>mp</sub>	A	8.95	9.03	9.17
Rated Voltage	V <sub>mp</sub>	V	32.54	32.72	32.80

STC: Irradiance 1000 W/m<sup>2</sup>, Cell temperature of 25°C, AM 1.5

## TEMPERATURE COEFFICIENTS

Normal Operating Cell Temperature (NOCT)	44°C (±2°C)
Temperature Coefficient of P <sub>max</sub>	-0.427%/°C
Temperature Coefficient of V <sub>oc</sub>	-0.318%/°C
Temperature Coefficient of I <sub>sc</sub>	0.042%/°C

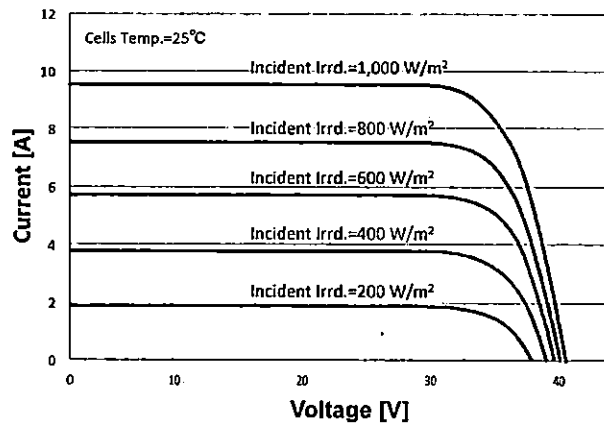
## OPERATING CONDITIONS

Maximum System Voltage	1,000VDC
Operating Temperature Range	-40°C (-40°F) to +90°C (194°F)
Maximum Series Fuse Rating	15A
Fire Safety Classification	Type 1, Class C
Front & Back Load (UL standard)	5600 Pa (117 psf) <b>New!</b>
Hail Safety Impact Velocity	25mm at 23 m/s

## MECHANICAL DATA

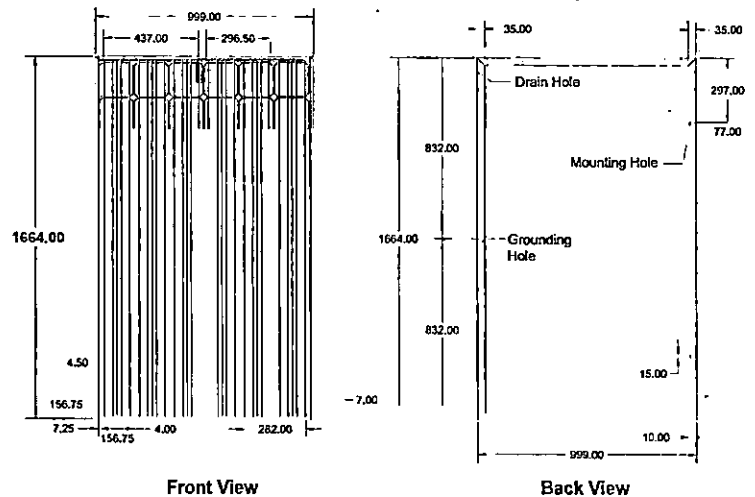
Solar Cells	P-type Mono-crystalline Silicon (156.75mm)
Cell orientation	60 cells (6x10), 4 busbar
Module dimension	1664mm x 999mm x 40mm (65.51 in. x 39.33 in. x 1.57 in.)
Weight	18.2 kg (40.1 lb)
Front Glass	3.2mm (0.126 in.) tempered, Low-iron, Anti-reflective coating
Frame	Anodized aluminum alloy
Encapsulant	Ethylene vinyl acetate (EVA)
J-Box	Protection class IP67 with 3 bypass-diodes
Cables	PV wire, 1m (39.37 in.), 4mm <sup>2</sup> / 12 AWG
Connector	MC4 or compatible

## MSE295SQ5T: 295WP, 60CELL SOLAR MODULE CURRENT-VOLTAGE CURVE



Current-voltage characteristics with dependence on irradiance and module temperature

## BASIC DESIGN (UNITS: mm)



MISSION SOLAR ENERGY



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DOCUMENT #: C-SA2-MKTG-0006 REVISION DATE: -- REVISION #:





# Single Phase Inverter

with HD-Wave Technology for North America  
 SE3000H-US / SE3800H-US / SE5000H-US /  
 SE6000H-US / SE7600H-US / SE10000H-US / SE11400H-US

	SE3000H-US	SE3800H-US	SE5000H-US	SE6000H-US	SE7600H-US	SE10000H-US	SE11400H-US		
<b>OUTPUT</b>									
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA	
Max. AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400	VA	
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	-	Vac	
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac	
AC Frequency (Nominal)	59.3 - 60 - 60.5 <sup>(1)</sup>							Hz	
Maximum Continuous Output Current 208V	-	16	-	24	-	-	-	A	
Maximum Continuous Output Current @ 240V	12.5	16	21	25	32	42	47.5	A	
GFDI Threshold	1							A	
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes								
<b>INPUT</b>									
Maximum DC Power @ 240V	4650	5900	7750	9300	11800	15500	17650	W	
Maximum DC Power @ 208V	-	5100	-	7750	-	-	-		
Transformer-less, Ungrounded	Yes								
Maximum Input Voltage	480							Vdc	
Nominal DC Input Voltage	380							Vdc	
Maximum Input Current 208V	-	9	-	13.5	-	-	-		
Maximum Input Current @ 240V	8.5	10.5	13.5	16.5	20	27	30.5	Adc	
Max. Input Short Circuit Current	45							Adc	
Reverse-Polarity Protection	Yes								
Ground-Fault Isolation Detection	600ka Sensitivity								
Maximum Inverter Efficiency	99			99.2				%	
CEC Weighted Efficiency	99							%	
Nighttime Power Consumption	< 2.5							W	
<b>ADDITIONAL FEATURES</b>									
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)								
Revenue Grade Data, ANSI C12.20	Optional <sup>(2)</sup>								
Rapid Shutdown - NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect								
<b>STANDARD COMPLIANCE</b>									
Safety	UL1741, UL1741 SA, UL1699B, CSA C22.2, Canadian AFCI according to T.I.L. M-07								
Grid Connection Standards	IEEE1547, Rule 21, Rule 14 (H)								
Emissions	FCC Part 15 Class B								
<b>INSTALLATION SPECIFICATIONS</b>									
AC Output Conduit Size / AWG Range	3/4" minimum / 14-6 AWG					3/4" minimum / 14-4 AWG			
DC Input Conduit Size / # of Strings / AWG Range	3/4" minimum / 1-2 strings / 14-6 AWG					3/4" minimum / 1-3 strings / 14-6 AWG			
Dimensions with Safety Switch (HxWxD)	17.7 x 14.6 x 6.8 / 450 x 370 x 174					21.3 x 14.6 x 7.3 / 540 x 370 x 185			in / mm
Weight with Safety Switch	22 / 10	25.1 / 11.4	26.2 / 11.9	38.8 / 17.6					lb / kg
Noise	< 25							dBA	
Cooling	Natural Convection				Natural convection				
Operating Temperature Range	-13 to +140 / -25 to +60 <sup>(3)</sup> (-40°F / -40°C option) <sup>(4)</sup>							°F / °C	
Protection Rating	NEMA 3R (Inverter with Safety Switch)								

<sup>(1)</sup> For other regional settings please contact SolarEdge support  
<sup>(2)</sup> Revenue grade inverter P/N: SExxxxH-US000NNC2  
<sup>(3)</sup> For power de-rating information refer to: <https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf>  
<sup>(4)</sup> -40 version P/N: SExxxxH-US000NNU4





# Power Optimizer

P320 / P370 / P400 / P405 / P505

OPTIMIZER MODEL (typical module compatibility)	P320 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	P505 (for higher current modules)	
<b>INPUT</b>						
Rated Input DC Power <sup>(1)</sup>	320	370	400	405	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48	60	80	125	83	Vdc
MPPT Operating Range	8 - 48	8 - 60	8 - 80	12.5 - 105	12.5 - 83	Vdc
Maximum Short Circuit Current (Isc)	11		10.1		14	Adc
Maximum DC Input Current	13.75		12.63		17.5	Adc
Maximum Efficiency	99.5					%
Weighted Efficiency	98.8				98.6	%
Overvoltage Category	II					
<b>OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)</b>						
Maximum Output Current	15					Adc
Maximum Output Voltage	60		85			Vdc
<b>OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)</b>						
Safety Output Voltage per Power Optimizer	1 ± 0.1					Vdc
<b>STANDARD COMPLIANCE</b>						
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3					
Safety	IEC62109-1 (class II safety), UL1741					
RoHS	Yes					
<b>INSTALLATION SPECIFICATIONS</b>						
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 28 / 5 x 5.97 x 1.1	128 x 152 x 36 / 5 x 5.97 x 1.42	128 x 152 x 50 / 5 x 5.97 x 1.96	128 x 152 x 59 / 5 x 5.97 x 2.32		mm / in
Weight (including cables)	630 / 1.4	750 / 1.7	845 / 1.9	1064 / 2.3		gr / lb
Input Connector	MC4 <sup>(2)</sup>					
Output Wire Type / Connector	Double Insulated; MC4					
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					%

<sup>(1)</sup> Rated STC power of the module. Module of up to +5% power tolerance allowed.

<sup>(2)</sup> For other connector types please contact SolarEdge

PV SYSTEM DESIGN USING A SOLAREDGE INVERTER <sup>(3)(4)</sup>		SINGLE PHASE HD-WAVE	SINGLE PHASE	THREE PHASE 208V	THREE PHASE 480V	
		Minimum String Length (Power Optimizers)	P320, P370, P400 P405 / P505	8 6		
Maximum String Length (Power Optimizers)		25		25	50 <sup>(5)</sup>	
Maximum Power per String		5700 (6000 with SE7600-US - SE11400- US)	5250	6000	12750	W
Parallel Strings of Different Lengths or Orientations		Yes				

<sup>(3)</sup> For detailed string sizing information refer to: [http://www.solaredge.com/sites/default/files/string\\_sizing\\_na.pdf](http://www.solaredge.com/sites/default/files/string_sizing_na.pdf).

<sup>(4)</sup> It is not allowed to mix P405/P505 with P320/P370/P400/P600/P700/P800 in one string.

<sup>(5)</sup> A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement

