



BLUE RAVEN SOLAR, LLC.
Firm License No. D-0369
1220 S. 630 Ste. 430
American Fork, UT

August 6, 2018

To: Blue Raven Solar
1220 S. 630 E. Ste. 430
American Fork, UT. 84003

Subject: Certification Letter
Rowe Residence
105 Jarrett Bay Ln.
Fuquay Varina, NC. 27526



Digitally signed by John Calvert
Date: 2018.08.06 11:39:11 -06'00'

To Whom It May Concern,

A jobsite observation of the condition of the existing framing system was performed by an audit team of Blue Raven Solar. All attached structural calculations are based on these observations and the design criteria listed below.

On the above referenced project, the roof structural framing has been reviewed for additional loading due to the installation of the solar PV addition to the roof. The structural review, including the plans and calculations only apply to the section of the roof that is directly supporting the solar PV system and its supporting elements. The observed roof framing is described below.

The roof structure of (All MP's) consists of composition shingle on roof plywood that is supported by 2x8 rafters @ 16" o.c. paired with 2x8 ceiling joists @ 16" o.c.. The rafters have a max projected horizontal span of 16'-0", with a slope of 40 degrees. The rafters are connected at the ridge to a ridge board and are supported at the eave by a load bearing wall.

The existing roof framing system of (All MP's) are judged to be adequate to withstand the loading imposed by the installation of the solar panels. No reinforcement is necessary.

The spacing of the solar standoffs should be kept at 64" o.c. for landscape and 48" o.c. for portrait orientation, with a staggered pattern to ensure proper distribution of loads.

The scope of this report is strictly limited to an evaluation of the fastener attachment, underlying framing and supporting structure only. The attachment's to the existing structure are required to be in a staggered pattern to ensure proper distribution of loading. All panels, racking and hardware shall be installed per manufacturer specifications and within specified design limitations. All waterproofing shall be provided by the manufacturer. Domus Structural Engineering assumes no responsibility for misuse or improper installation of the solar PV panels or racking.

Design Criteria:

- Applicable Codes = 2012 North Carolina State Building Code (NCSBC), ASCE 7-05, and NDS-12
- Roof Dead Load = 9 psf (All MP's)
- Roof Live Load = 20 psf
- Wind Speed = 94 mph, Exposure B
- Ground Snow Load = 15 psf - Roof Snow Load = 10.5 psf
- Attachments: (1) 5/16" dia lag screw with 2.5" min embedment depth, at spacing shown above.

Please contact me with any further questions or concerns regarding this project.

Sincerely,

John Calvert, P.E.
Project Engineer



BLUE RAVEN
SOLAR

BLUE RAVEN SOLAR, LLC
Firm License No. D-0396
1220 S. 630 E. Ste. 430
American Fork, UT 84003

Address: 105 Jarrett Bay Ln., Fuquay Varina, NC. 27526
Exposure: B
Wind Speed: 94 mph

Aerial Image





Gravity Loading

Roof Snow Load Calculations		
p_g = Ground Snow Load =	15 psf	
$p_f = 0.7 C_e C_t I p_g$		(ASCE7 - Eq 7-1)
C_e = Exposure Factor =	1	(ASCE7 - Table 7-2)
C_t = Thermal Factor =	1	(ASCE7 - Table 7-3)
I = Importance Factor =	1	
p_f = Flat Roof Snow Load =	10.5 psf	
$p_s = C_s p_f$		(ASCE7 - Eq 7-2)
C_s = Slope Factor =	1	
p_s = Sloped Roof Snow Load =	10.5 psf	

PV Dead Load = 3 psf (Per Blue Raven Solar)

PV System Weight	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
X Standoff Spacing =	4.00 ft
Y Standoff Spacing =	5.50 ft
Standoff Tributary Area =	22.00 sft
Point Loads of Standoffs	66 lb

Note: PV standoffs are staggered to ensure proper distribution of loading

Roof Live Load = 20 psf

Note: Roof live load is removed in area's covered by PV array.

Roof Dead Load (All MP's)		
Composition Shingle	4.00	
Roof Plywood	2.00	
2x8 Rafters @ 16"o.c.	2.27	
Vaulted Ceiling	0.00	(Ceiling Not Vaulted)
Miscellaneous	0.73	
Total Roof DL (All MP's)	9.0 psf	
DL Adjusted to 40 Degree Slope	11.7 psf	



Wind Calculations

Per ASCE 7-05 Components and Cladding

Input Variables	
Wind Speed	94 mph
Exposure Category	B
Roof Shape	Gable/Hip
Roof Slope	40 degrees
Mean Roof Height	20 ft
Effective Wind Area	19.3 ft

Design Wind Pressure Calculations	
Wind Pressure $P = qh * G * C_n$	
$qh = 0.00256 * K_z * K_{zt} * K_d * V^2 * I$	(Eq_6-15)
K_z (Exposure Coefficient) = 0.7	(Table 6-3)
K_{zt} (topographic factor) = 1	(Fig. 6-4)
K_d (Wind Directionality Factor) = 0.85	(Table 6-4)
V (Design Wind Speed) = 94 mph	
Importance Factor = 1	(Table 6-1)
$qh = 13.46$	

Standoff Uplift Calculations-Portrait					
	Zone 1	Zone 2	Zone 3	Positive	
$G C_p =$	-0.92	-1.12	-1.12	0.86	(Fig. 6-11)
Uplift Pressure =	-12.44 psf	-15.13 psf	-15.13 psf	11.6 psf	
X Standoff Spacing =	4.00	4.00	2.67		
Y Standoff Spacing =	5.50	2.75	2.75		
Tributary Area =	22.00	11.00	7.33		
Footing Uplift =	-274 lb	-166 lb	-111 lb		

Standoff Uplift Calculations-Landscape					
	Zone 1	Zone 2	Zone 3	Positive	
$G C_p =$	-0.92	-1.12	-1.12	0.86	(Fig. 30.4-1)
Uplift Pressure =	-12.44 psf	-15.13 psf	-15.13 psf	10.0 psf	(Minimum)
X Standoff Spacing =	5.33	5.33	3.56		
Y Standoff Spacing =	3.50	1.75	1.75		
Tributary Area =	18.67	9.33	6.22		
Footing Uplift =	-232 lb	-141 lb	-94 lb		

Standoff Uplift Check	
Maximum Design Uplift =	-274 lb
Standoff Uplift Capacity =	450 lb
450 lb capacity > 274 lb demand Therefore, OK	

Fastener Capacity Check	
Fastener = 1 - 5/16" dia Lag	
Number of Fasteners =	1
Embedment Depth =	2.5
Pullout Capacity Per Inch =	250 lb
Fastener Capacity =	625 lb
w/ F.S. of 1.5 & DOL of 1.6=	667 lb
667.2 lb capacity > 274 lb demand Therefore, OK	



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Framing Information & Site Specific Pictures





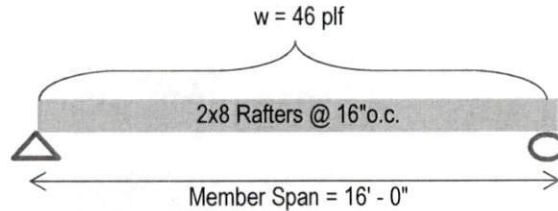
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Framing Check

(All MP's)

PASS

Dead Load 11.7 psf
 PV Load 3.0 psf
 Live Load 20.0 psf



Governing Load Combo = DL + LL
Total Load 34.7 psf

Member Properties				
Member Size	S (in ³)	I (in ⁴)	Lumber Sp/Gr	Member Spacing
2x8	13.14	47.63	DF#2	@ 16" o.c.

Check Bending Stress								
Fb (psi) =	f _b	x	C _d	x	C _f	x	C _r	(NDS Table 4.3.1)
	900	x	1.25	x	1.2	x	1.15	

Allowed Bending Stress = 1552.5 psi

Maximum Moment = $(wL^2) / 8$
 = 1482.61 ft#
 = 17791.32 in#

Actual Bending Stress = (Maximum Moment) / S
 = 1354 psi

Allowed > Actual -- 87.3% Stressed -- Therefore, OK

Check Deflection

Allowed Deflection (Total Load) = $L/180$ (E = 1600000 psi Per NDS)
 = 1.066 in

Deflection Criteria Based on = Simple Span
 Actual Deflection (Total Load) = $(5 * w * L^4) / (384 * E * I)$
 = 0.897 in
 = L/215 > L/180 Therefore OK

Allowed Deflection (Live Load) = $L/240$
 = 0.8 in
 Actual Deflection (Live Load) = $(5 * w * L^4) / (384 * E * I)$
 = 0.517 in
 = L/372 > L/240 Therefore OK

Check Shear

Member Area = 10.9 in² F_v (psi) = 180 psi (NDS Table 4A)
 Allowed Shear = F_v * A = 1958 lb Max Shear (V) = w * L / 2 = 371 lb

Allowed > Actual -- 19% Stressed -- Therefore, OK



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Lateral Check

Per 2009 IBC Chapter 34

Existing Weight of Effected Building			
Level	Area	Weight (psf)	Weight (lb)
Roof	2700 sf	11.7 psf	31721 lb
Ceiling	2700 sf	6.0 psf	16200 lb
Wood Siding	100 ft	5.0 psf	2000 lb
Int. Walls	100 ft	6.4 psf	2560 lb
Existing Weight of Effected Building			52481 lb

(8'-0" Wall Height)

Proposed Weight of PV System	
Weight of PV System (Per Blue Raven Solar)	3.0 psf
Approx. Area of Proposed PV System	539 sf
Approximate Total Weight of PV System	1617 lb

10% Comparison	
10% of Existing Building Weight (Allowed)	5248 lb
Approximate Weight of PV System (Actual)	1617 lb
Percent Increase	3.1%
5248 lb > 1617 lb, Therefore OK	

GENERAL NOTES

1. ALL WORK SHALL COMPLY WITH 2014 NATIONAL ELECTRIC CODE (NEC), 2015 INTERNATIONAL RESIDENTIAL CODE (IRC), 2014 NATIONAL BUILDING CODE (NBC), 2009 INTERNATIONAL BUILDING CODE (IBC), 2015 INTERNATIONAL PLUMBING CODE (IPC), AND ALL STATE AND LOCAL BUILDING, ELECTRICAL, AND PLUMBING CODES.
2. DRAWINGS HAVE BEEN DETAILED ACCORDING TO UL LISTING REQUIREMENTS.

SITE NOTES

1. A LADDER SHALL BE IN PLACE FOR INSPECTION IN COMPLIANCE WITH OSHA REGULATIONS.
2. THE PV MODULES ARE CONSIDERED NON-COMBUSTIBLE AND THIS SYSTEM IS AN UTILITY INTERACTIVE SYSTEM WITH NO STORAGE BATTERIES.
3. THE SOLAR PV INSTALLATION SHALL NOT OBSTRUCT ANY PLUMBING, MECHANICAL, OR BUILDING ROOF VENTS.
4. PROPER ACCESS AND WORKING CLEARANCE AROUND EXISTING AND PROPOSED ELECTRICAL EQUIPMENT WILL BE PROVIDED AS PER SECTION [NEC 110.26].
5. THE GROUNDING ELECTRODE CONDUCTOR SHALL BE PROTECTED FROM PHYSICAL DAMAGE BETWEEN THE GROUNDING ELECTRODE AND THE PANEL (OR INVERTER) IF SMALLER THAN #6 AWG COPPER WIRE PER NEC 250-64B. THE GROUNDING ELECTRODE CONDUCTOR WILL BE CONTINUOUS, EXCEPT FOR SPLICES OR JOINTS AT BUSBARS WITHIN LISTED EQUIPMENT PER [NEC 250.64C].
6. ROOF COVERINGS SHALL BE DESIGNED, INSTALLED, AND MAINTAINED IN ACCORDANCE WITH THIS CODE AND THE APPROVED MANUFACTURER'S INSTRUCTIONS SUCH THAT THE ROOF COVERING SHALL SERVE TO PROTECT THE BUILDING OR STRUCTURE.
7. RIGID CONDUIT (AND/OR NIPPLES) MUST HAVE A PULL BUSHING TO PROTECT WIRES.
8. BOLTED CONNECTION REQUIRED IN DC DISCONNECTS ON THE WHITE GROUNDED CONDUCTOR (USE POLARIS BLOCK OR NEUTRAL BAR).
9. ANY CONNECTION ABOVE LIVE PARTS MUST BE WATERTIGHT. REDUCING WASHERS DISALLOWED ABOVE LIVE PARTS. MEYERS HUBS RECOMMENDED.
10. UV RESISTANT CABLE TIES (NOT ZIP TIES) USED FOR PERMANENT WIRE MANAGEMENT OFF THE ROOF SURFACE IN ACCORDANCE WITH NEC 110.2.110.3(A-B), 300.4.
11. SOLADECK JUNCTION BOXES MOUNTED FLUSH W/ROOF SURFACE TO BE USED FOR WIRE MANAGEMENT AND AS FLASHED ROOF PENETRATIONS FOR INTERIOR CONDUIT RUNS.

SOLAR CONTRACTOR

1. MODULE CERTIFICATIONS WILL INCLUDE UL1703, IEC61646, IEC61730.
2. IF APPLICABLE, MODULE GROUNDING LUGS MUST BE INSTALLED AT THE MARKED GROUNDING LUG HOLES PER THE MANUFACTURER'S INSTALLATION REQUIREMENTS.
3. AS INDICATED BY DESIGN, OTHER NRTL LISTED MODULE GROUNDING DEVICES MAY BE USED IN PLACE OF STANDARD GROUNDING LUGS AS SHOWN IN MANUFACTURER DOCUMENTATION AND APPROVED BY THE AHJ.
4. CONDUIT AND WIRE SPECIFICATIONS ARE BASED ON MINIMUM CODE REQUIREMENTS AND ARE NOT MEANT TO LIMIT UP-SIZING AS REQUIRED BY FIELD CONDITIONS.
5. CONDUIT POINT OF PENETRATION FROM EXTERIOR TO INTERIOR TO BE INSTALLED AND SEALED WITH A SUITABLE SEALING COMPOUND.
6. DC WIRING LIMITED TO MODULE FOOTPRINT W/ ENPHASE AC SYSTEM.
7. ENPHASE WIRING SYSTEMS SHALL BE LOCATED AND SECURED UNDER THE ARRAY W/ SUITABLE WIRING CLIPS.
8. MAX DC VOLTAGE CALCULATED USING MANUFACTURER PROVIDED TEMP COEFFICIENT FOR VOC UNLESS NOT AVAILABLE.
9. ALL INVERTERS, MOTOR GENERATORS, PHOTOVOLTAIC MODULES, PHOTOVOLTAIC PANELS, AC PHOTOVOLTAIC MODULES, DC COMBINERS, DC-TO-DC CONVERTERS, SOURCE CIRCUIT COMBINERS, AND CHARGE CONTROLLERS INTENDED FOR USE IN A PHOTOVOLTAIC POWER SYSTEM WILL BE IDENTIFIED AND LISTED FOR THE APPLICATION PER 690.4 (B).
10. ALL SIGNAGE TO BE PLACED IN ACCORDANCE WITH LOCAL BUILDING CODE.

EQUIPMENT LOCATIONS

1. ALL EQUIPMENT SHALL MEET MINIMUM SETBACKS AS REQUIRED BY [NEC 110.26].
2. EQUIPMENT INSTALLED IN DIRECT SUNLIGHT MUST BE RATED FOR EXPECTED OPERATING TEMPERATURE AS SPECIFIED BY [NEC 690.31 (A)-(B)] AND [NEC TABLE 310.15 (B)].
3. ADDITIONAL AC DISCONNECTS SHALL BE PROVIDED WHERE THE INVERTER IS NOT ADJACENT TO THE UTILITY AC DISCONNECT, OR NOT WITHIN SIGHT OF THE UTILITY AC DISCONNECT.
4. ALL EQUIPMENT SHALL BE INSTALLED ACCESSIBLE TO QUALIFIED PERSONNEL ACCORDING TO NEC APPLICABLE CODES.
5. ALL COMPONENTS ARE LISTED FOR THEIR PURPOSE AND RATED FOR OUTDOOR USAGE WHEN APPROPRIATE.

AERIAL VIEW



ASCE 7-05 WIND SPEED: 94 MPH
 GROUND SNOW LOAD: 15 PSF
 EXPOSURE CATEGORY: B
 SEISMIC DESIGN CATEGORY: D

OCCUPANCY - R3
 CONSTRUCTION - V-B
 ZONING: RESIDENTIAL

SCOPE OF WORK

DC SYSTEM SIZE: 8.4 kW DC
 ROOF TYPE: Comp Shingle
 MODULES: (28) Trinasolar 300 TSM-DD05A.08(II)
 INVERTER(S): Enphase IQ7-60-2-US, ---
 RACKING: Unirac Sunframe Microrail Mounting & Racking System

ANCHORED ON MAX 64 INCH CENTERS USING UL LISTED RACKING SYSTEM TO SPEC.

SHEET INDEX

- PV1 - COVER SHEET
- PV2 - PROPERTY PLAN
- PV3 - SITE PLAN
- PV4 - EQUIPMENT & ATTACHMENT DETAIL
- PV5 - ELECTRICAL SINGLE LINE DIAGRAM & STRING DIAGRAM
- PV6 - ELECTRICAL CALCULATIONS
- PV7 - MBD CALCS. (IF NEEDED)
- PV8 - LABELS & LOCATIONS
- PV9 - STRING & SE OPTIMIZER
- PV10 - PLACARD (IF NEEDED - NEC 690.56(B))



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PROJECT MANAGER:
 SCOTT GURNEY
 385-498-4401

CONTRACTOR:
 BRS FIELD OPS
 800.377.4480

SITE INFORMATION:

Lynette Rowe
 105 Jarrett Bay Ln
 Fuquay Varina, North Carolina 27526

DC SYSTEM SIZE:
 8.4 kW DC

DRAWING BY:

Marcelo Correa

DATE:

August 6, 2018

PROJECT NUMBER:

53447666

SHEET NAME:

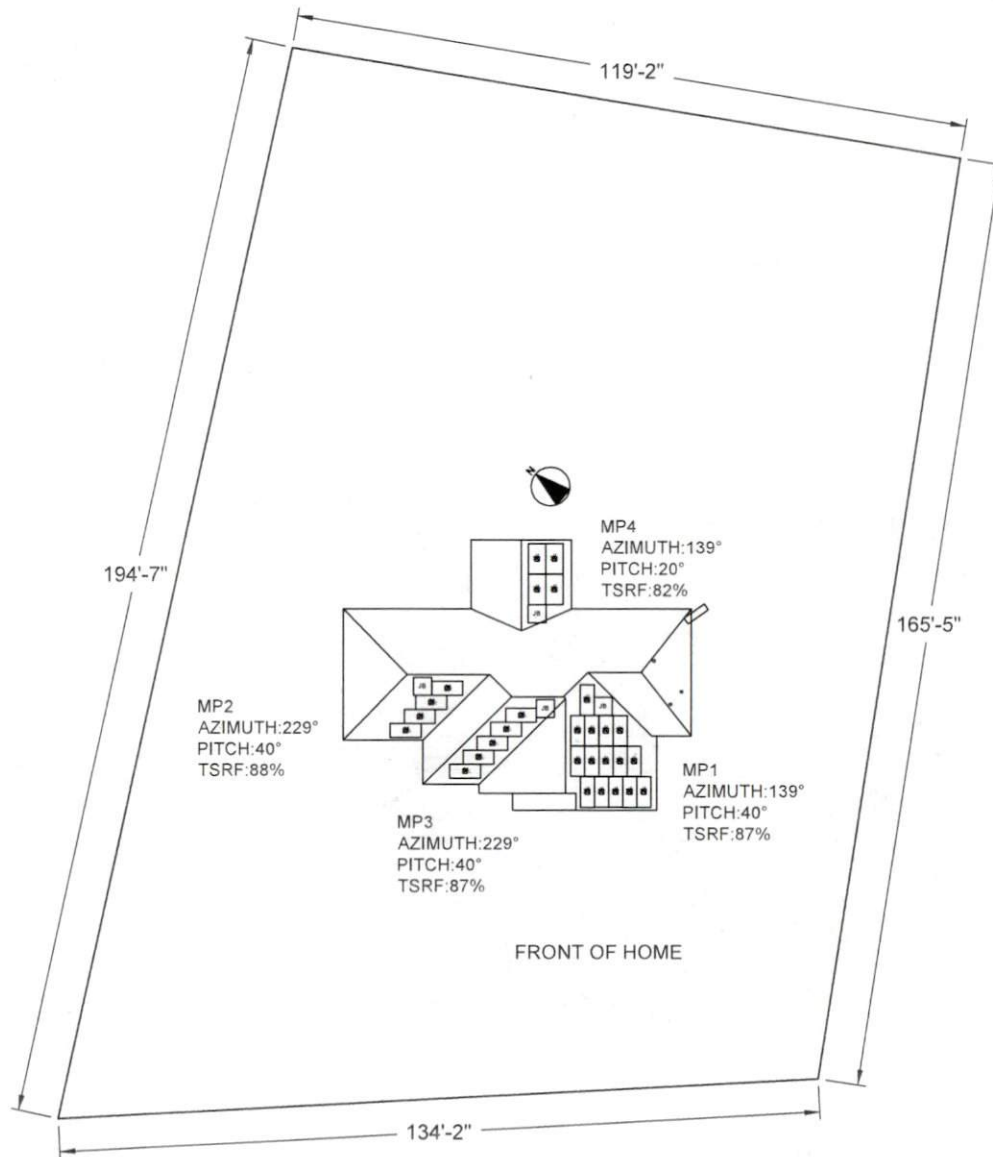
COVER SHEET

PAGE NUMBER:

PV1

REVISION:

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DC SYSTEM SIZE: 8.4 kW DC
 ROOF TYPE: Comp Shingle

(28) Trinasolar 300 TSM-DD05A.08(II)
 Enphase IQ7-60-2-US, ---INVERTER

105 Jarrett Bay Ln

LEGEND

- INV INVERTER & DC DISCONNECT
- SUB (E) SUBPANEL
- LC (N) LOAD CENTER
- AC AC DISCONNECT
- M UTILITY METER / SERVICE PANEL
- JB JUNCTION BOX
- C COMBINER BOX
- PV PV REVENUE METER
- FIRE SETBACK
- EMT CONDUIT RUN
(TO BE DETERMINED IN FIELD)
- PV WIRE STRING
- PROPERTY LINE

SCALE: 3/64" = 1'-0"



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 Lynette Rowe
 105 Jarrett Bay Ln
 Fuquay Varina, North Carolina 27526
 DC SYSTEM SIZE:
 8.4 kW DC

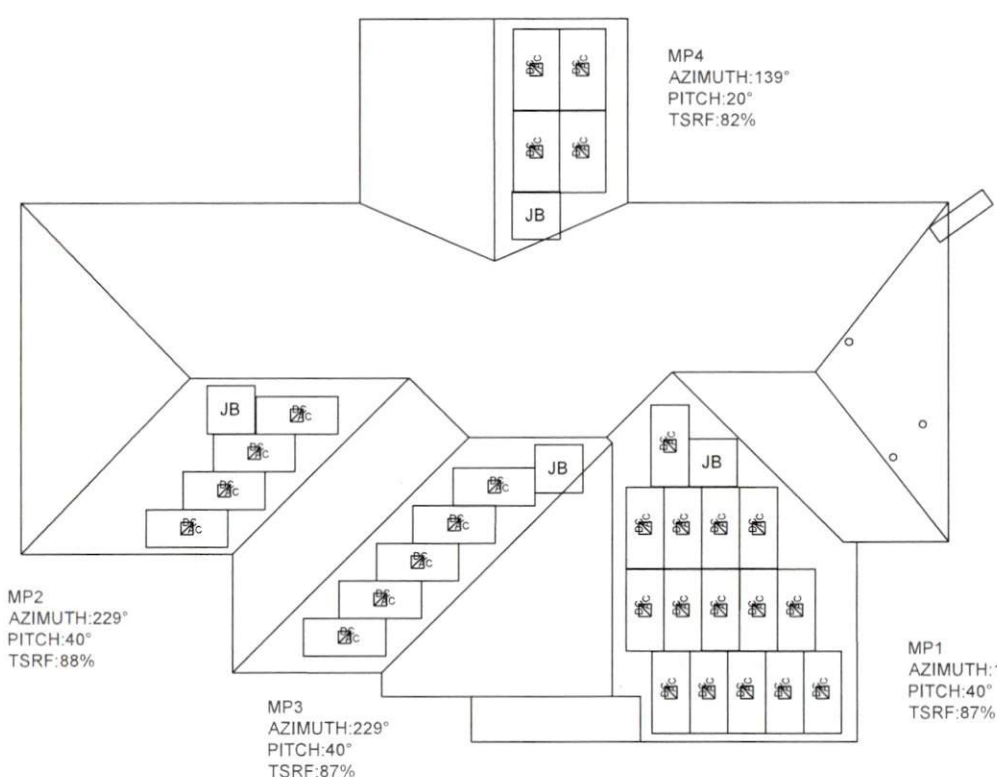
DRAWING BY
 Marcelo Correa

DATE
 August 6, 2018

PROJECT NUMBER
 53447666

SHEET NAME
PROPERTY PLAN

PAGE NUMBER PV2	REVISION: 0
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LEGEND

- INV INVERTER & DC DISCONNECT
- SUB (E) SUBPANEL
- LC (N) LOAD CENTER
- AC AC DISCONNECT
- M UTILITY METER / SERVICE PANEL
- JB JUNCTION BOX
- C COMBINER BOX
- PV PV REVENUE METER
- FIRE SETBACK
- EMT CONDUIT RUN (TO BE DETERMINED IN FIELD)
- PV WIRE STRING
- - - PROPERTY LINE

SCALE: 1/8" = 1'-0"



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PROJECT MANAGER:
SCOTT GURNEY
 385-498-4401

CONTRACTOR:
BRS FIELD OPS
 800.377.4480

Sealed For
 Existing Roof &
 Attachment Only



Digitally signed by John Calvert
 Date: 2018.08.06 11:41:31 -06'00'

Firm No. : D-0369

DC SYSTEM SIZE: 8.4 kW DC
 ROOF TYPE: Comp Shingle

(28) Trinasolar 300 TSM-DD05A.08(II)
 Enphase IQ7-60-2-US,—INVERTER

FRONT OF HOME

SITE INFORMATION:
 Lynette Rowe
 105 Jarrett Bay Ln
 Fuquay Varina, North Carolina 27526

DC SYSTEM SIZE:
 8.4 kW DC

DRAWING BY Marcelo Correa	
DATE August 6, 2018	
PROJECT NUMBER 53447666	
SHEET NAME SITE PLAN	
PAGE NUMBER PV3	REVISION 0

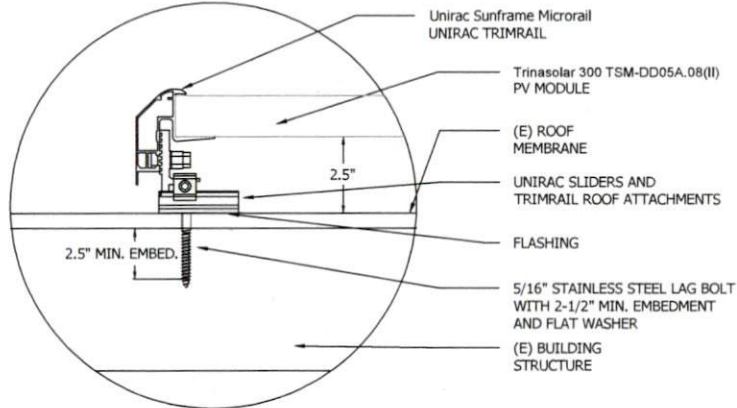
PV ARRAY STRUCTURAL CRITERIA

PV MODULE COUNT:	28 MODULES
# OF ATTACHMENT POINTS:	85
ARRAY AREA:	Module Count X 17.51ft ² = 490.3ft ²
ROOF AREA:	2730.9ft ²
% OF ARRAY/ROOF:	18.0%
ARRAY WEIGHT:	Module Count x 50lbs = 1400.0lbs
DISTRIBUTED LOAD:	Array Weight ÷ Array Area = 2.86 lbs/ft ²
POINT LOAD:	Array Weight ÷ Attachments = 16.5lbs/attachment

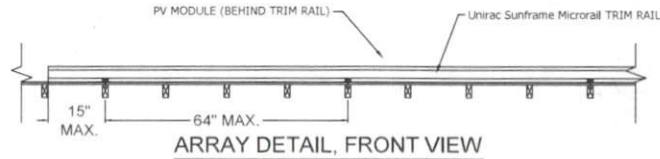
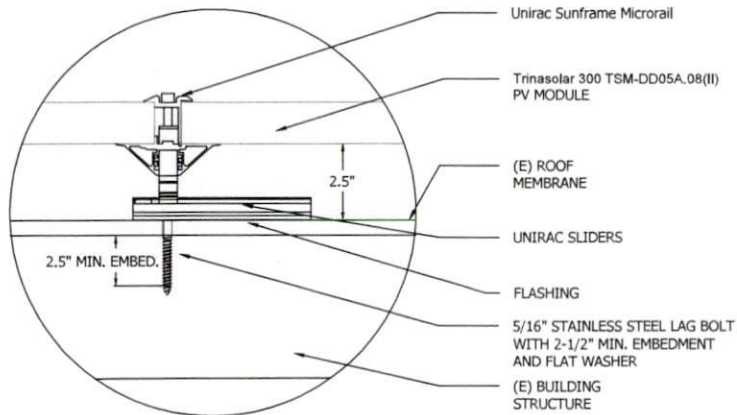
SITE CRITERIA

ASCE 7-05 WIND SPEED: 94 MPH	EXPOSURE CATEGORY: B
GROUND SNOW LOAD: 15 PSF	SEISMIC DESIGN CATEGORY: D

G
DETAIL - BOTTOM STANDOFF
Scale: 3" = 1'-0"



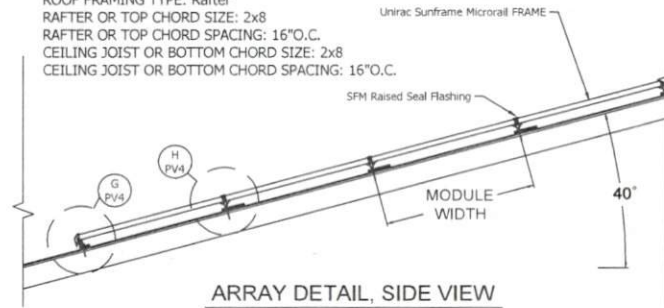
H
DETAIL - MIDDLE/TOP STANDOFF
Scale: 3" = 1'-0"



ARRAY DETAIL, FRONT VIEW

Scale: 3/8" = 1'-0"

ROOF TYPE: Comp Shingle
 ROOF FRAMING TYPE: Rafter
 RAFTER OR TOP CHORD SIZE: 2x8
 RAFTER OR TOP CHORD SPACING: 16"O.C.
 CEILING JOIST OR BOTTOM CHORD SIZE: 2x8
 CEILING JOIST OR BOTTOM CHORD SPACING: 16"O.C.



ARRAY DETAIL, SIDE VIEW

Scale: 3/8" = 1'-0"

Sealed For
Existing Roof &
Attachment Only



Firm No. : D-0369

Digitally signed by John Calvert
Date: 2018.08.06 11:42:18 -06'00'



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SITE INFORMATION:
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DC SYSTEM SIZE:
8.4 kW DC

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SHEET NAME
EQUIP. DETAIL

PAGE NUMBER
PV4

REVISION
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15	(1) 8 AWG THWN-2, COPPER, BLACK (LINE 1)	3	(2) 10 AWG THWN-2, COPPER, BLACK (LINE 1)	MAX 14.0 A AC 240 V AC	2	(1) 12-2 UF-B W/G, SOLID COPPER	MAX 14.0 A AC 240 V AC	1	(1) 12-2 TC-ER, THWN-2, COPPER	MAX 14.0 A AC 240 V AC
	(1) 8 AWG THWN-2, COPPER, RED (LINE 2)		(2) 10 AWG THWN-2, COPPER, RED (LINE 2)			(1) 6 AWG BARE, COPPER (EGC)				
	(1) 10 AWG THWN-2, COPPER, WHITE (NEUTRAL)									
	(1) 10 AWG THWN-2, COPPER, GREEN (GROUND)		(1) 10 AWG THWN-2, COPPER, GREEN (EGC)							
	(1) 3/4 INCH EMT CONDUIT		(1) 3/4 INCH EMT CONDUIT							



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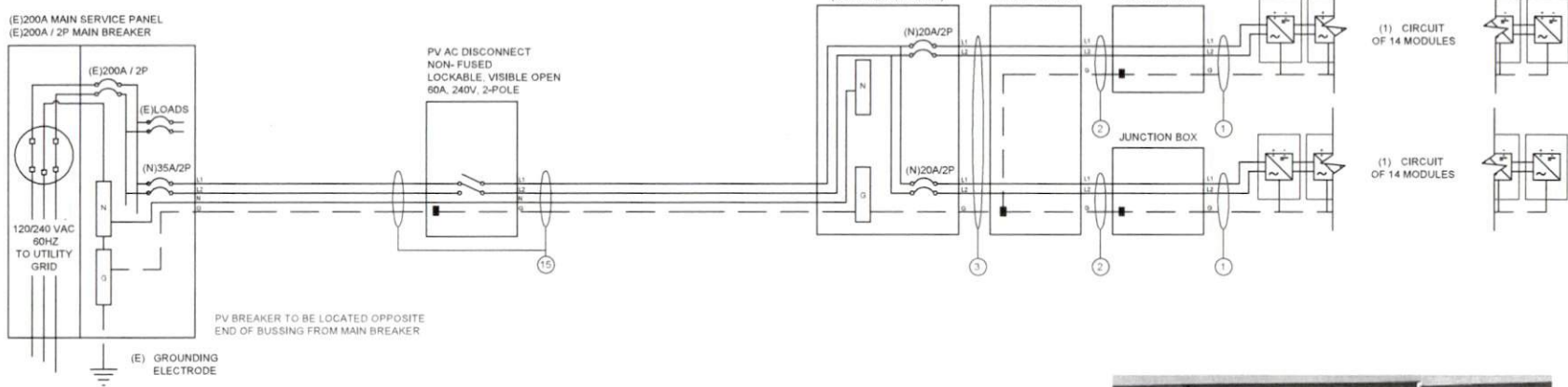
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Fuquay Varina, North Carolina 27526
DC SYSTEM SIZE:
8.4 kW DC

DRAWING BY:
Marcelo Correa
DATE:
August 6, 2018
PROJECT NUMBER:
53447666
SHEET NAME:
ELEC. 3 LINE DIAG.
PAGE NUMBER:
PV5
REVISION:
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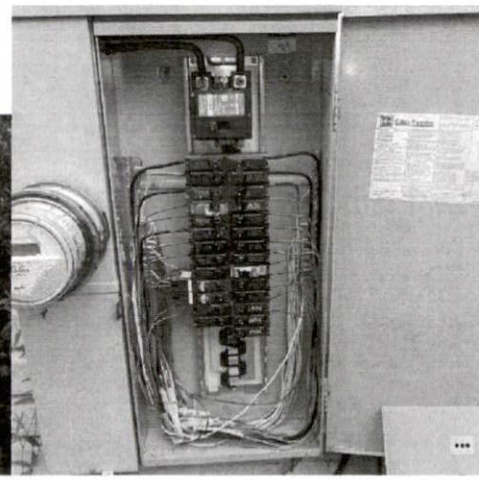
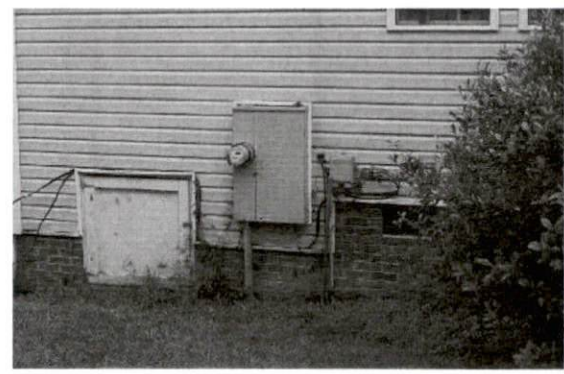
(28) Trinasolar 300 TSM-DD05A.08(II)
UL 1703 COMPLIANT
(28) Enphase IQ7-60-2-US MICRO INVERTERS
UL 1741 COMPLIANT
8 MODULES MAX FOR ALL SUB-BRANCH
CIRCUIT(S) TO COMPLY WITH VRISE CALCS

INTERCONNECTION NOTES

- ONE OF THE METHODS THAT FOLLOWS SHALL BE USED TO DETERMINE THE RATINGS OF BUSBARS AND PANELBOARDS. (a) THE SUM OF 125 PERCENT OF THE INVERTER(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUSBAR SHALL NOT EXCEED THE AMPACITY OF THE BUS BAR. (b) WHERE TWO SOURCES, ONE THE UTILITY AND THE OTHER AN INVERTER ARE LOCATED AT OPPOSITE ENDS OF A BUSBAR THAT CONTAINS LOADS, THE SUM OF 125 PERCENT OF THE INVERTER(S) OUTPUT CIRCUIT CURRENT AND THE RATING OF THE OVERCURRENT DEVICE PROTECTING THE BUSBAR SHALL NOT EXCEED 120 PERCENT OF THE AMPACITY OF THE BUSBAR [NEC 705.12(D)(3)].
- GROUND FAULT PROTECTION IN ACCORDANCE WITH [NEC 215.9] & [NEC 230.95]
- ALL EQUIPMENT TO BE RATED FOR BACKFEEDING.

DISCONNECT NOTES

- DISCONNECTING SWITCHES SHALL BE WIRED SUCH THAT WHEN THE SWITCH IS OPENED THE CONDUCTORS REMAINING LIVE ARE CONNECTED TO THE TERMINALS MARKED "LINE SIDE" (TYPICALLY THE UPPER TERMINALS)
- AC DISCONNECT MUST BE ACCESSIBLE TO QUALIFIED UTILITY PERSONNEL. BE LOCKABLE, AND BE A VISIBLE-BREAK SWITCH
- DC CURRENT CONDUCTORS ARE TO REMAIN OUTSIDE OF BUILDING PRIOR TO EITHER A FUSEABLE SOURCE CIRCUIT



MODULE SPECIFICATIONS	Trinasolar 300 TSM-DD05A.08(II)
RATED POWER (STC)	300 W
MODULE VOC	40 V DC
MODULE VMP	33 V DC
MODULE IMP	9.2 A DC
MODULE ISC	9.8 A DC
VOC CORRECTION (%/°C)	-0.3 °C
VMP CORRECTION (%/°C)	-0.4 °C
SERIES FUSE RATING	15 A DC
ADJ. MODULE VOC @ ASHRAE LOW TEMP	44.1 V DC
ADJ. MODULE VMP @ ASHRAE 2% AVG. HIGH TEMP	27.4 V DC

MICROINVERTER SPECIFICATIONS	Enphase IQ7-60-2-US
POWER POINT TRACKING (MPPT) MIN/MAX	22 - 48 V DC
MAXIMUM INPUT VOLTAGE	48 V DC
MAXIMUM DC SHORT CIRCUIT CURRENT	15 A DC
MAXIMUM USABLE DC INPUT POWER	350 W
MAXIMUM OUTPUT CURRENT	1 A AC
AC OVERCURRENT PROTECTION	20 A
MAXIMUM OUTPUT POWER	250 W
CEC WEIGHTED EFFICIENCY	97 %

AC PHOTOVOLTAIC MODULE MARKING (NEC 690.52)	
NOMINAL OPERATING AC VOLTAGE	240 V AC
NOMINAL OPERATING AC FREQUENCY	47 - 68 HZ AC
MAXIMUM AC POWER	240 VA AC
MAXIMUM AC CURRENT	14.0 A AC
MAXIMUM OCPD RATING PER CIRCUIT	20 A AC

DESIGN LOCATION AND TEMPERATURES

TEMPERATURE DATA SOURCE	ASHRAE 2% AVG. HIGH TEMP
STATE	North Carolina
CITY	Fuquay Varina
WEATHER STATION	RALEIGH DURHAM INTERNATIONAL
ASHRAE EXTREME LOW TEMP (°C)	-12
ASHRAE 2% AVG. HIGH TEMP (°C)	34

SYSTEM ELECTRICAL SPECIFICATIONS	CIR 1	CIR 2	CIR 3	CIR 4	CIR 5	CIR 6
NUMBER OF MODULES PER MPPT	14	14				
DC POWER RATING PER CIRCUIT (STC)	4200	4200				
TOTAL MODULE NUMBER	28 MODULES					
STC RATING OF ARRAY	8400W DC					
AC CURRENT @ MAX POWER POINT (IMP)	14.0	14.0				
MAX. CURRENT (IMP X 1.25)	17.5	17.5				
OCPD CURRENT RATING PER CIRCUIT	20	20				
MAX. COMB. ARRAY AC CURRENT (IMP)	28.0					
MAX. ARRAY AC POWER	6720W AC					

AC VOLTAGE RISE CALCULATIONS	DIST (FT)	RISE(V)	VEND(V)	%VRISE	IQ7-8
VRISE SEC. 1 (MICRO TO JBOX)	28.8	0.93	240.93	0.39%	
VRISE SEC. 2 (JBOX TO COMBINER BOX)	35	1.24	241.24	0.52%	
VRISE SEC. 3 (COMBINER BOX TO POI)	10	0.44	240.44	0.18%	
TOTAL VRISE				1.09%	

PHOTOVOLTAIC AC DISCONNECT OUTPUT LABEL (NEC 690.54)	
AC OUTPUT CURRENT	28.0 A AC
NOMINAL AC VOLTAGE	240 V AC

CONDUCTOR SIZE CALCULATIONS

MICROINVERTER TO JUNCTION BOX	MAX. SHORT CIRCUIT CURRENT (ISC) =	14.0 A DC
	MAX. CURRENT (ISC X1.25) =	17.5 A DC
	CONDUCTOR (TC-ER, COPPER (90°C)) =	12 AWG
	CONDUCTOR RATING =	30 A
	AMB. TEMP. AMP. CORRECTION =	0.96
	ADJUSTED AMP. =	28.8 > 17.5
JUNCTION BOX TO COMBINER BOX	MAX. SHORT CIRCUIT CURRENT (ISC) =	14.0 A DC
	MAX. CURRENT (ISC X1.25) =	17.5 A DC
	CONDUCTOR (THWN-2, COPPER (90°C)) =	10 AWG
	CONDUCTOR RATING =	35 A
	CONDUIT FILL DERATE =	1
	AMB. TEMP. AMP. CORRECTION =	0.96
	ADJUSTED AMP. =	33.6 > 17.5
EGC	ISC =	14.0 A DC
	MAX. CHANNEL ISC =	17.5 A DC
	CONDUCTOR (THWN-2, COPPER (90°C)) =	12 AWG
	EGC CONDUCTOR RATING =	20 A
	CONDUIT FILL DERATE =	1
	AMB. TEMP. AMP. CORRECTION =	0.96
	ADJUSTED AMP. =	19.2 > 17.5
COMBINER BOX TO MAIN PV OCPD	INVERTER RATED AMPS =	28.0 A AC
	MAX. CURRENT (RATED AMPS X1.25) =	35 A AC
	CONDUCTOR (THWN-2, COPPER (75°C)) =	8 AWG
	CONDUCTOR RATING =	50 A
	CONDUIT FILL DERATE =	1
	AMB. TEMP. AMP. CORRECTION =	0.96
	ADJUSTED AMP. =	48 > 35.0

GROUNDING NOTES

- A GROUNDING ELECTRODE SYSTEM IN ACCORDANCE WITH [NEC 690.47] AND [NEC 250-50] THROUGH [NEC 250-60] SHALL BE PROVIDED, PER NEC. GROUNDING ELECTRODE SYSTEM OF EXISTING BUILDING MAY BE USED AND BONDED TO AT THE SERVICE ENTRANCE, IF EXISTING SYSTEM IS INACCESSIBLE, OR INADEQUATE, OR IS ONLY METALLIC WATER PIPING, A SUPPLEMENTAL GROUNDING ELECTRODE WILL BE USED AT THE INVERTER LOCATION CONSISTING OF A UL LISTED 8 FT GROUND ROD WITH ACORN CLAMP.
- GROUNDING ELECTRODE CONDUCTORS SHALL BE NO LESS THAN #8 AWG AND NO GREATER THAN #6 AWG COPPER AND BONDED TO THE EXISTING GROUNDING ELECTRODE TO PROVIDE FOR A COMPLETE SYSTEM.
- PV SYSTEM SHALL BE GROUNDED IN ACCORDANCE TO [NEC 250.21], [NEC TABLE 250.122], AND ALL METAL PARTS OR MODULE FRAMES ACCORDING TO [NEC 690.46].
- MODULE SOURCE CIRCUITS SHALL BE GROUNDED IN ACCORDANCE TO [NEC 690.42].
- THE GROUNDING CONNECTION TO A MODULE SHALL BE ARRANGED SUCH THAT THE REMOVAL OF A MODULE DOES NOT INTERRUPT A GROUNDED CONDUCTOR TO ANOTHER MODULE.
- EACH MODULE WILL BE GROUNDED USING THE SUPPLIED CONNECTIONS POINTS IDENTIFIED IN THE MANUFACTURER'S INSTALLATION INSTRUCTIONS.
- ENCLOSURES SHALL BE PROPERLY PREPARED WITH REMOVAL OF PAINT/FINISH AS APPROPRIATE WHEN GROUNDING EQUIPMENT WITH TERMINATION GROUNDING LUGS.
- GROUNDING SYSTEM COMPONENTS SHALL BE LISTED FOR THEIR PURPOSE, AND GROUNDING DEVICES EXPOSED TO THE ELEMENTS SHALL BE RATED FOR DIRECT BURIAL.
- GROUNDING AND BONDING CONDUCTORS SHALL BE COPPER, SOLID OR STRANDED, AND BARE WHEN EXPOSED.

- EQUIPMENT GROUNDING CONDUCTORS SHALL BE SIZE ACCORDING TO [NEC 690.45] AND BE A MINIMUM OF #10AWG WHEN NOT EXPOSED TO DAMAGE (#6AWG SHALL BE USED WHEN EXPOSED TO DAMAGE).
- GROUNDING AND BONDING CONDUCTORS, IF INSULATED, SHALL BE COLOR CODED GREEN (OR MARKED GREEN IF #4 AWG OR LARGER)
- ALL CONDUIT BETWEEN THE UTILITY AC DISCONNECT AND THE POINT OF CONNECTION SHALL HAVE GROUNDED BUSHINGS AT BOTH ENDS.
- SYSTEM GEC SIZED ACCORDING TO [NEC 690.47], [NEC TABLE 250.66], DC SYSTEM GEC SIZED ACCORDING TO [NEC 250.166], MINIMUM #8AWG WHEN INSULATED, #6AWG WHEN EXPOSED TO DAMAGE.
- EXPOSED NON-CURRENT CARRYING METAL PARTS OF MODULE FRAMES, EQUIPMENTS, AND CONDUCTOR ENCLOSURES SHALL BE GROUNDED IN ACCORDANCE WITH 250.134 OR 250.136(A) REGARDLESS OF VOLTAGE.

WIRING & CONDUIT NOTES

- ALL CONDUIT SIZES AND TYPES, SHALL BE LISTED FOR ITS PURPOSE AND APPROVED FOR THE SITE APPLICATIONS
- ALL PV CABLES AND HOMERUN WIRES BE TYPE USE-2, AND SINGLE-CONDUCTOR CABLE LISTED AND IDENTIFIED AS PV WIRE, TYPE TC-ER, OR EQUIVALENT; ROUTED TO SOURCE CIRCUIT COMBINER BOXES AS REQUIRED
- ALL CONDUCTORS AND OCPD SIZES AND TYPES SPECIFIED ACCORDING TO [NEC 690.8] FOR MULTIPLE CONDUCTORS
- ALL PV DC CONDUCTORS IN CONDUIT EXPOSED TO SUNLIGHT SHALL BE INSTALLED AT LEAST 7/8" ABOVE THE ROOF SURFACE AND DERATED ACCORDING TO [NEC TABLE 310.15 (B)(2)(a), NEC TABLE 310.15(B)(3)(a), & NEC 310.15(B)(3)(c)].
- EXPOSED ROOF PV DC CONDUCTORS SHALL BE USE-2, 90°C RATED, WET AND UV RESISTANT, AND UL LISTED RATED FOR 600V. UV RATED SPIRAL WRAP SHALL BE USED TO PROTECT WIRE FROM SHARP EDGES

- PHASE AND NEUTRAL CONDUCTORS SHALL BE DUAL RATED THHN/THWN-2 INSULATED, 90°C RATED, WET AND UV RESISTANT, RATED FOR 600V
- 4-WIRE DELTA CONNECTED SYSTEMS HAVE THE PHASE WITH THE HIGHER VOLTAGE TO GROUND MARKED ORANGE OR IDENTIFIED BY OTHER EFFECTIVE MEANS.
- ALL SOURCE CIRCUITS SHALL HAVE INDIVIDUAL SOURCE CIRCUIT PROTECTION
- VOLTAGE DROP LIMITED TO 2% FOR DC CIRCUITS AND 3% FOR AC CIRCUITS
- NEGATIVE GROUNDED SYSTEMS DC CONDUCTORS SHALL BE COLOR CODED AS FOLLOWS: DC POSITIVE- RED (OR MARKED RED), DC NEGATIVE- GREY (OR MARKED GREY)
- POSITIVE GROUNDED SYSTEMS DC CONDUCTORS COLOR CODED: DC POSITIVE- GREY (OR MARKED GREY), DC NEGATIVE- BLACK (OR MARKED BLACK)
- AC CONDUCTORS >4AWG COLOR CODED OR MARKED: PHASE A OR L1- BLACK, PHASE B OR L2- RED, PHASE C OR L3- BLUE, NEUTRAL- WHITE/GRAY
- USE-2 IS NOT INDOOR RATED BUT PV CABLE IS RATED THWN/THWN-2 AND MAY BE USED INSIDE
- USE-2 IS AVAILABLE AS UV WHITE
- IF CONDUIT DETERMINED TO BE RAN THROUGH ATTIC IN FIELD THEN CONDUIT WILL BE EITHER EMT, FMC, OR MC CABLE IF DC CURRENT COMPLYING WITH NEC 690.31, NEC 250.118(10), DISCONNECTING MEANS SHALL COMPLY WITH 690.13 AND 690.15
- CONDUIT RAN THROUGH ATTIC WILL BE AT LEAST 18" BELOW ROOF SURFACE COMPLYING WITH NEC 230.6(4) AND SECURED NO GREATER THAN 6' APART PER NEC 330.30(B).



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PROJECT MANAGER:
SCOTT GURNEY
385-498-4401

CONTRACTOR:
BRS FIELD OPS
800.377.4480

SITE INFORMATION:

Lynette Rowe
105 Jarrett Bay Ln
Fuquay Varina, North Carolina 27526

DC SYSTEM SIZE:
8.4 KW DC

DRAWING BY
Marcelo Correa

DATE
August 6, 2018

PROJECT NUMBER
53447666

SHEET NAME
ELEC. CALCS.

PAGE NUMBER
PV6

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SITE INFORMATION:
Lynette Rowe
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Fuquay Varina, North Carolina 27526
DC SYSTEM SIZE:
8.4 kW DC

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DATE
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SHEET NAME
LABELS

PAGE NUMBER
PV8

REVISION
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WARNING
ELECTRIC SHOCK HAZARD
THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED

WARNING
ELECTRIC SHOCK HAZARD
TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION

PHOTOVOLTAIC SYSTEM
DC DISCONNECT
RATED MPP CURRENT AMPS
RATED MPP VOLTAGE VOLTS
MAX SYSTEM VOLTAGE VDC
MAX CIRCUIT CURRENT AMPS

PHOTOVOLTAIC SYSTEM
AC DISCONNECT
RATED AC OUTPUT CURRENT A
NOMINAL OPERATING AC VOLTAGE V

WARNING
DUAL POWER SUPPLY
SOURCES: UTILITY GRID AND PV SOLAR ELECTRIC SYSTEM

WARNING
THIS EQUIPMENT FED BY MULTIPLE SOURCES. TOTAL RATING OF ALL OVERCURRENT DEVICES, EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE, SHALL NOT EXCEED AMPACITY OF BUSBAR.

LABEL 1
AT EACH DIRECT CURRENT JUNCTION BOX, COMBINER BOX, DISCONNECT, AND DEVICE WHERE ENERGIZED UNGROUNDED CONDUCTORS MAY BE EXPOSED DURING SERVICE.
[NEC 690.35(F)]

LABEL 2
FOR PV DISCONNECTING MEANS WHERE ALL TERMINALS OF THE DISCONNECTING MEANS MAY BE ENERGIZED IN THE OPEN POSITION.
[NEC 690.17(E), NEC 705.22]

LABEL 3
AT EACH DC DISCONNECTING MEANS, INCLUDING THE DC DISCONNECT AT THE INVERTER.
[NEC 690.53, NEC 690.13(B)]

LABEL 4
AT POINT OF INTERCONNECTION, MARKED AT AC DISCONNECTING MEANS.
[NEC 690.54, NEC 690.13 (B)]

LABEL 5
AT POINT OF INTERCONNECTION FOR EQUIPMENT CONTAINING OVERCURRENT DEVICES IN CIRCUITS SUPPLYING POWER TO A BUSBAR OR CONDUCTOR SUPPLIED FROM MULTIPLE SOURCES, EACH SERVICE EQUIPMENT AND ALL ELECTRIC POWER PRODUCTION SOURCE LOCATIONS.
[NEC 705.12(D)(3)]

LABEL 9 (ONLY IF 3 OR MORE SUPPLY SOURCES TO A BUSBAR)
SIGN LOCATED AT LOAD CENTER IF CONTAINS 3 OR MORE POWER SOURCES.
[NEC 705.12(D)(3)(C)]

WARNING: PHOTOVOLTAIC POWER SOURCE

WARNING
INVERTER OUTPUT CONNECTION
DO NOT RELOCATE THIS OVERCURRENT DEVICE

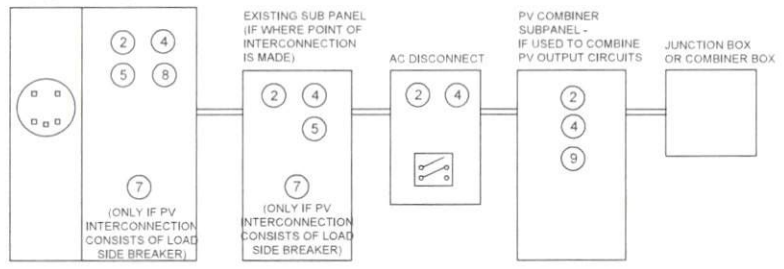
PHOTOVOLTAIC SYSTEM
EQUIPPED WITH RAPID SHUTDOWN

LABEL 6
AT DIRECT-CURRENT EXPOSED RACEWAYS, CABLE TRAYS, COVERS AND ENCLOSURES OF JUNCTION BOXES, AND OTHER WIRING METHODS, SPACED AT MAXIMUM 10FT SECTION OR WHERE SEPARATED BY ENCLOSURES, WALLS, PARTITIONS, CEILINGS, OR FLOORS.
[NEC 690.31(G)(3&4)]

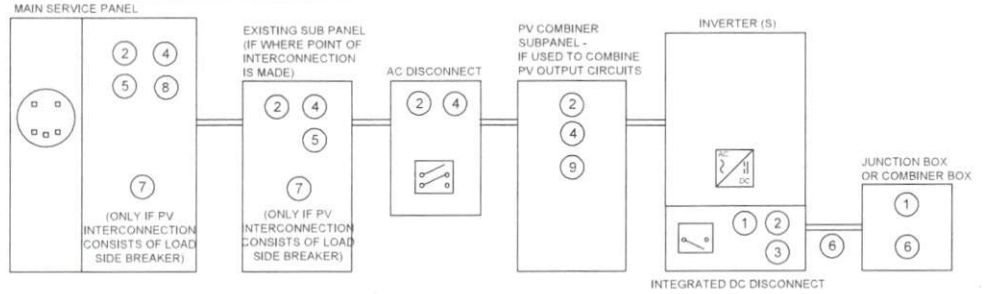
LABEL 7
PLACED ADJACENT TO THE BACK-FED BREAKER FROM THE INVERTER IF TIE IN CONSISTS OF LOAD SIDE CONNECTION TO BUSBAR.
[NEC 705.12(D)(2)(3)(b)]

LABEL 8
SIGN LOCATED AT UTILITY SERVICE EQUIPMENT.
[NEC 690.56(C)]

LABELING DIAGRAM FOR MICRO INV.



LABELING DIAGRAM FOR STRING INV. / DC OPTIMIZER INV.



*ELECTRICAL DIAGRAMS SHOWN ABOVE ARE FOR LABELING PURPOSES ONLY. NOT AN ACTUAL REPRESENTATION OF EQUIPMENT AND CONNECTIONS TO BE INSTALLED. LABEL LOCATIONS PRESENTED MAY VARY DEPENDING ON TYPE OF INTERCONNECTION METHOD AND LOCATION PRESENTED ON PV5 OF 3 LINE DIAGRAM. PV5 LINE DIAGRAM TO REFLECT ACTUAL REPRESENTATION OF PROPOSED SCOPE OF WORK.

LABELING NOTES:

1. LABELS CALLED OUT ACCORDING TO ALL COMMON CONFIGURATIONS. ELECTRICIAN TO DETERMINE EXACT REQUIREMENTS IN THE FIELD PER CURRENT NEC AND LOCAL CODES AND MAKE APPROPRIATE ADJUSTMENTS.
2. LABELING REQUIREMENTS BASED ON THE 2014 NATIONAL ELECTRIC CODE, OSHA STANDARD 19010.145, ANSI Z535.
3. MATERIAL BASED ON THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION.
4. LABELS TO BE OF SUFFICIENT DURABILITY TO WITHSTAND THE ENVIRONMENT INVOLVED [NEC 110.21]
5. LABELS TO BE A MINIMUM LETTER HEIGHT OF 3/8", WHITE ON RED BACKGROUND, REFLECTIVE, AND PERMANENTLY AFFIXED [IFC 605.11.1.1]

Enphase IQ 7 and IQ 7+ Microinverters

The high-powered smart grid-ready Enphase IQ 7 Micro™ and Enphase IQ 7+ Micro™ dramatically simplify the installation process while achieving the highest system efficiency.

Part of the Enphase IQ System, the IQ 7 and IQ 7+ Microinverters integrate with the Enphase IQ Envoy™, Enphase IQ Battery™, and the Enphase Enlighten™ monitoring and analysis software.

IQ Series Microinverters extend the reliability standards set forth by previous generations and undergo over a million hours of power-on testing, enabling Enphase to provide an industry-leading warranty of up to 25 years.

Easy to Install

- Lightweight and simple
- Faster installation with improved, lighter two-wire cabling
- Built-in rapid shutdown compliant (NEC 2014 & 2017)

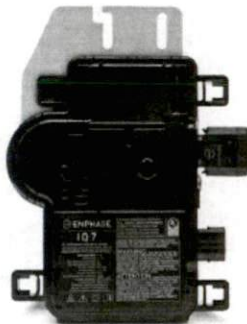
Productive and Reliable

- Optimized for high powered 60-cell and 72-cell* modules
- More than a million hours of testing
- Class II double-insulated enclosure
- UL listed

Smart Grid Ready

- Complies with advanced grid support, voltage and frequency ride-through requirements
- Remotely updates to respond to changing grid requirements
- Configurable for varying grid profiles
- Meets CA Rule 21 (UL 1741-SA)

* The IQ 7+ Micro is required to support 72-cell modules.



To learn more about Enphase offerings, visit enphase.com



Enphase IQ 7 and IQ 7+ Microinverters

INPUT DATA (DC)	IQ7-60-2-US / IQ7-60-B-US	IQ7PLUS-72-2-US / IQ7PLUS-72-B-US
Commonly used module pairings ¹	235 W - 350 W +	235 W - 440 W +
Module compatibility	60-cell PV modules only	60-cell and 72-cell PV modules
Maximum input DC voltage	48 V	60 V
Peak power tracking voltage	27 V - 37 V	27 V - 45 V
Operating range	16 V - 48 V	16 V - 60 V
Min/Max start voltage	22 V / 48 V	22 V / 60 V
Max DC short circuit current (module Isc)	15 A	15 A
Overvoltage class DC port	II	II
DC port backfeed current	0 A	0 A
PV array configuration	1 x 1 ungrounded array. No additional DC side protection required; AC side protection requires max 20A per branch circuit	
OUTPUT DATA (AC)	IQ 7 Microinverter	IQ 7+ Microinverter
Peak output power	250 VA	295 VA
Maximum continuous output power	240 VA	290 VA
Nominal (L-L) voltage/range ²	240 V / 208 V / 211-264 V	240 V / 208 V / 211-264 V
Maximum continuous output current	1.0 A (240 V) 1.15 A (208 V)	1.21 A (240 V) 1.39 A (208 V)
Nominal frequency	60 Hz	60 Hz
Extended frequency range	47 - 68 Hz	47 - 68 Hz
AC short circuit fault current over 3 cycles	5.6 Arms	5.6 Arms
Maximum units per 20 A (L-L) branch circuit ³	16 (240 VAC) 13 (208 VAC)	13 (240 VAC) 11 (208 VAC)
Overvoltage class AC port	III	III
AC port backfeed current	0 A	0 A
Power factor setting	1.0	1.0
Power factor (adjustable)	0.7 leading ... 0.7 lagging	0.7 leading ... 0.7 lagging
EFFICIENCY @240 V @208 V @240 V @208 V		
Peak CEC efficiency	97.6 %	97.6 %
CEC weighted efficiency	97.0 %	97.0 %
MECHANICAL DATA		
Ambient temperature range	-40°C to +65°C	
Relative humidity range	4% to 100% (condensing)	
Connector type (IQ7-60-2-US & IQ7PLUS-72-2-US)	MC4 (or Amphenol H4 UTX with additional Q-DCC-5 adapter)	
Connector type (IQ7-60-B-US & IQ7PLUS-72-B-US)	Friends PV2 (MC4 intermateable)	
	Adaptors for modules with MC4 or UTX connectors: - PV2 to MC4: order ECA-S20-S22 - PV2 to UTX: order ECA-S20-S25	
Dimensions (WxHxD)	212 mm x 175 mm x 30.2 mm (without bracket)	
Weight	1.08 kg (2.38 lbs)	
Cooling	Natural convection - No fans	
Approved for wet locations	Yes	
Pollution degree	PD3	
Enclosure	Class II double-insulated, corrosion resistant polymeric enclosure	
Environmental category / UV exposure rating	NEMA Type 6 / outdoor	
FEATURES		
Communication	Power Line Communication (PLC)	
Monitoring	Enlighten Manager and MyEnlighten monitoring options. Both options require installation of an Enphase IQ Envoy.	
Disconnecting means	The AC and DC connectors have been evaluated and approved by UL for use as the load-break disconnect required by NEC 690.	
Compliance	CA Rule 21 (UL 1741-SA) UL 62109-1, UL 1741/IEEE1547, FCC Part 15 Class B, ICES-0003 Class B, CAN/CSA-C22.2 NO. 107.1-01 This product is UL Listed as PV Rapid Shut Down Equipment and conforms with NEC-2014 and NEC-2017 section 690.12 and C22.1-2015 Rule 64-218 Rapid Shutdown of PV Systems, for AC and DC conductors, when installed according manufacturer's instructions.	

1. No enforced DC/AC ratio. See the compatibility calculator at <https://enphase.com/en-us/support/module-compatibility>
 2. Nominal voltage range can be extended beyond nominal if required by the utility
 3. Limits may vary. Refer to local requirements to define the number of microinverters per branch in your area.

To learn more about Enphase offerings, visit enphase.com

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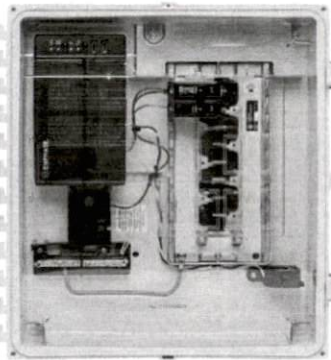
CONTRACTOR:
 BLUE RAVEN SOLAR
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SHEET NAME
 DATA SHEET

PAGE NUMBER REVISION
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Enphase IQ Combiner+ (X-IQ-AM1-240-2)

The Enphase IQ Combiner+™ with Enphase IQ Envoy™ consolidates interconnection equipment into a single enclosure and streamlines PV and storage installations by providing a consistent, pre-wired solution for residential applications. It offers up to four 2-pole input circuits and Eaton BR series busbar assembly.



Smart

- Includes IQ Envoy for communication and control
- Flexible networking supports Wi-Fi, Ethernet, or cellular
- Provides production metering and optional consumption monitoring
- Supports installation of the Enphase Q Aggregator™

Simple

- Eaton BR series panelboard interior
- Up to four 2-pole branch circuits for 240 VAC plug-in breakers (not included)
- 80 A total PV or storage branch circuits

Reliable

- Durable NRTL-certified NEMA type 3R enclosure
- Five-year warranty
- UL listed



To learn more about Enphase offerings, visit enphase.com



Enphase IQ Combiner+

MODEL NUMBER	
IQ Combiner+ X-IQ-AM1-240-2	IQ Combiner+ with Enphase IQ Envoy™ for integrated revenue grade PV production metering (ANSI C12.20 +/- 0.5%) and optional* consumption monitoring (+/- 2.5%).
ACCESSORIES (order separately)	
Enphase Mobile Connect™ CELLMODEM-03 (4G / 12-year data plan) CELLMODEM-01 (3G / 5-year data plan) CELLMODEM-M1 (4G LTE CAT-M1 / 5-year data plan)	Plug and play industrial grade cellular modem with data plan for systems up to 60 microinverters. (Available in the US, Canada, Mexico, Puerto Rico, and the US Virgin Islands, where there is adequate cellular service in the installation area.)
Consumption Monitoring CT CT-200-SPLIT	Split core current transformers enable whole home consumption metering* (+/- 2.5%).
Circuit Breakers BRK-15A-2-240 BRK-20A-2-240	Breaker, 2 pole, 15A, Eaton BR215 Breaker, 2 pole, 20A, Eaton BR220
ELECTRICAL SPECIFICATIONS	
Rating	Continuous duty
System voltage	240 VAC, 60 HZ
Eaton BR series busbar rating	125 A
Max. continuous current rating (output to grid)	65 A
Max. fuse/circuit rating (output)	90 A
Branch circuits (solar and/or storage)	Up to four 2-pole Eaton BR series Distributed Generation (DG) breakers only (not included)
Max. continuous current rating (input from PV)	64 A
Max. total branch circuit breaker rating (input)	80 A (any combination)
Production Metering CT	200 A solid core pre-installed and wired to IQ Envoy
MECHANICAL DATA	
Dimensions (WxHxD)	49.3 x 46.5 x 16.0 cm (19.4" x 18.3" x 6.3")
Weight	7.5 kg (16.5 lbs)
Ambient temperature range	-40° C to +46° C (-40° to 115° F)
Cooling	Natural convection, plus heat shield
Enclosure environmental rating	Outdoor, NRTL-certified, NEMA type 3R, polycarbonate construction
Wire sizes	<ul style="list-style-type: none"> • 20 A to 50 A breaker inputs: 14 to 4 AWG copper conductors • 60 A breaker branch input: 3 to 1/0 AWG copper conductors • Main lug combined output: 10 to 2/0 AWG copper conductors • Neutral and ground: 14 to 1/0 copper conductors Always follow local code requirements for conductor sizing.
Altitude	To 2000 meters (6,560 feet)
INTERNET CONNECTION OPTIONS	
Integrated Wi-Fi	802.11b/g/n
Ethernet	802.3, Cat5E (or Cat 6) UTP Ethernet cable - not included
Cellular	Optional, CELLMODEM-01 (3G) or CELLMODEM-03 (4G) (not included)
COMPLIANCE	
Compliance, Combiner	UL 1741 CAN/CSA C22.2 No. 107.1 47 CFR, Part 15, Class B, ICES 003 Production metering: ANSI C12.20 accuracy class 0.5 (PV production)
Compliance, IQ Envoy	UL 916 CAN/CSA C22.2 No. 61010-1

* Consumption monitoring is required for Enphase Storage Systems.

To learn more about Enphase offerings, visit enphase.com

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Mono Multi Solutions

THE ALLMAX^M plus⁺

FRAMED 60-CELL MODULE

60 CELL
MONOCRYSTALLINE MODULE

275-315W
POWER OUTPUT RANGE

19.2%
MAXIMUM EFFICIENCY

0~+5W
POSITIVE POWER TOLERANCE

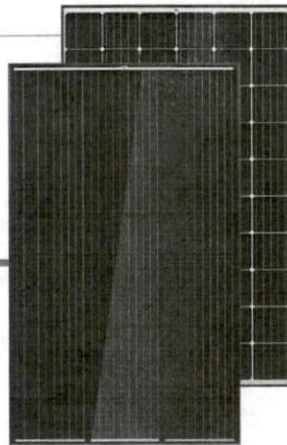
Founded in 1997, Trina Solar is the world's leading comprehensive solutions provider for solar energy. We believe close cooperation with our partners is critical to success. Trina Solar now distributes 25 PV products to over 60 countries all over the world. Trina is able to provide exceptional service to each customer in each market and supplement our innovative, reliable products with the backing of Trina as a strong, beneficial partner. We are committed to building strategic, mutually beneficial collaboration with installers, developers, distributors and other partners.

Comprehensive Products And System Certificates

IEC61215/IEC61730/UL1709/IEC61730/UL1709/IEC61730
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse gases Emissions, Verification
OHSAS 18001: Occupational Health and Safety Management Systems



TrinaSolar



Maximize limited space with top-end efficiency

- Up to 192W/m² power density
- Low thermal coefficients for greater energy production at high operating temperatures



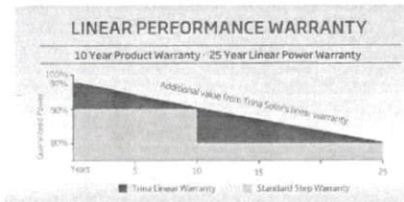
Highly reliable due to stringent quality control

- Over 30 In-house tests (UV, TC, HF, and many more)
- In-house testing goes well beyond certification requirements
- PID resistant
- 100% EL double inspection
- Selective emitter, advanced surface texturing



Certified to withstand the most challenging environmental conditions

- 2400 Pa wind load
- 5400 Pa snow load
- 35 mm hail stones at 97 km/h

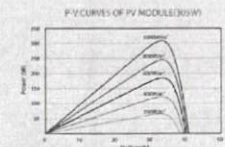
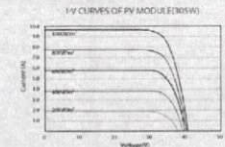
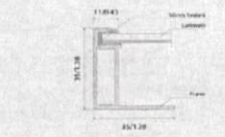
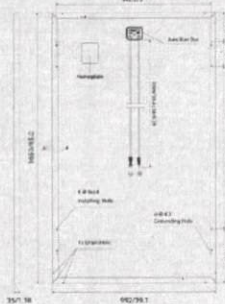


ALLMAX^{plus}

FRAMED 60-CELL MODULE

PRODUCTS: TSM DD05A.0B(II) 290-315W
TSM DD05A.05(II) 275-310W

DIMENSIONS OF PV MODULE (mm/inches)



ELECTRICAL DATA (STC)

	275	290	295	295	300	305	310	315
Peak Power Watts (P _{max})	275	290	295	295	300	305	310	315
Power Output Tolerance (P _{tol})	0 ~ +5							
Maximum Power Voltage (V _{mp})	31.4	31.7	31.8	32.2	32.5	32.9	33.1	33.3
Maximum Power Current (I _{mp})	8.76	8.84	8.97	9.01	9.09	9.20	9.37	9.46
Open Circuit Voltage (V _{oc})	38.4	38.4	38.5	38.9	39.5	39.8	40.0	40.5
Short Circuit Current (I _{sc})	9.24	9.42	9.51	9.66	9.77	9.95	9.94	10.0
Module Efficiency (%)	16.8	17.1	17.4	17.7	18.0	18.3	18.5	18.9

ELECTRICAL DATA (NOCT)

	205	209	212	216	220	223	227	231	235
Maximum Power (P _{max})	205	209	212	216	220	223	227	231	235
Maximum Power Voltage (V _{mp})	29.1	29.4	29.5	29.9	30.1	30.2	30.5	30.7	30.9
Maximum Power Current (I _{mp})	7.04	7.10	7.21	7.24	7.30	7.38	7.46	7.53	7.60
Open Circuit Voltage (V _{oc})	35.7	35.7	35.8	36.2	36.8	37.0	37.2	37.4	37.6
Short Circuit Current (I _{sc})	7.45	7.61	7.60	7.80	7.82	7.89	7.95	8.03	8.10

MECHANICAL DATA

Solar Cells	Monocrystalline 156.75 × 156.75 mm (6 inches)
Cell Orientation	60 cells (6 × 10)
Module Dimensions	1650 × 992 × 35 mm (65.0 × 39.1 × 1.38 inches)
Weight	18.6 kg (41.0 lb)
Glass	3.2 mm (0.13 inches), High Transmission, AR Coated / Tempered Glass
Backsheet	White [DD05A.0B(II)] Black [DD05A.05(II)]
Frame	Black Anodized Aluminum Alloy [DD05A.0B(II), DD05A.05(II)]
J-Box	IP 67 of IP 68 rated
Cables	Photovoltaic Technology Cable 4.0mm ² (0.006 inches ²), 1000 mm (39.4 inches)
Connector	Trina T54
Fire Type	Type 1 or Type 2

TEMPERATURE RATINGS

NOCT (nominal operating cell temperature)	44°C (±2°C)
Temperature Coefficient of P _{max}	-0.39%/°C
Temperature Coefficient of V _{oc}	-0.29%/°C
Temperature Coefficient of I _{sc}	0.05%/°C

MAXIMUM RATINGS

Operational Temperature	-40 ~ +85°C
Maximum System Voltage	1000V DC (IEC)
Maximum DC (UL)	1000V DC (UL)
Max Series Fuse Rating	15A (Power < 285W) 20A (Power > 290W)

DO NOT connect fuse in Combiner Box with two or more strings in parallel connection.

WARRANTY

10 Year Product Workmanship Warranty
25 Year Linear Power Warranty

Please refer to product warranty for details.

PACKAGING CONFIGURATION

Modules per box: 30 pieces
Modules per 40' container: 840 pieces

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

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SolaDeck

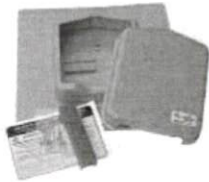
FLASHED PV ROOF-MOUNT COMBINER/ENCLOSURE

Basic Features

- Stamped Seamless Construction
- 18 Gauge Galvanized Steel
- Powder Coated Surfaces
- Flashes into the roof deck
- 3 Roof deck knockouts .5", .75", 1"
- 5 Centering dimples for entry/exit fittings or conduit
- 2 Position Ground lug installed
- Mounting Hardware Included



SolaDeck Model SD 0783



SolaDeck UL50 Type 3R Enclosures

Available Models:

- Model SD 0783 - (3" fixed Din Rail)
- Model SD 0786 - (6" slotted Din Rail)



SolaDeck UL 1741 Combiner/Enclosures

Models SD 0783-41 and SD 0786-41 are labeled and ETL listed UL STD 1741 according to the UL STD 1741 for photovoltaic combiner enclosures.

Max Rated - 600VDC, 120AMPS

Model SD 0783-41 3" Fixed Din Rail fastened using Norlock System

**Typical System Configuration

- 4- Din Rail Mounted Fuse Holders 600VDC 30 AMP
- 1- Power Distribution Block 600VDC 175AMP
- 1- Bus Bar with UL lug

Model SD 0786-41 6" Slotted Din Rail fastened using steel studs

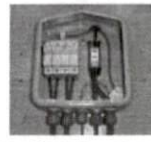
**Typical System Configuration

- 4- Din Rail Mounted Fuse Holders 600VDC 30 AMP
- 4- Din Rail Mounted Terminal Blocks
- Bus Bars with UL lug

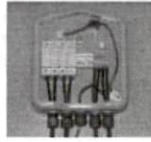
**Fuse holders and terminal blocks added in the field must be UL listed or recognized and meet 600 VDC 30 AMP 110C for fuse holders, 600V 50 AMP 90C for rail mounted terminal blocks and 600 V 175 AMP 90C for Power Distribution Blocks. Use Copper Wire Conductors.



Cover is trimmed to allow conduit or fittings, base is center dimpled for fitting locations.



Model SD 0783-41, wired with Din Rail mounted fuse holders, bus bar and power distribution block.



Model SD 0786-41, wired with Din Rail mounted fuse holders, terminal blocks and bus bars.

RSTC Enterprises, Inc • 2219 Heimstead Road • Eau Claire, WI 54703
For product information call 1(866) 367-7782



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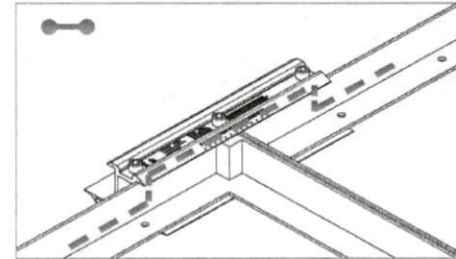
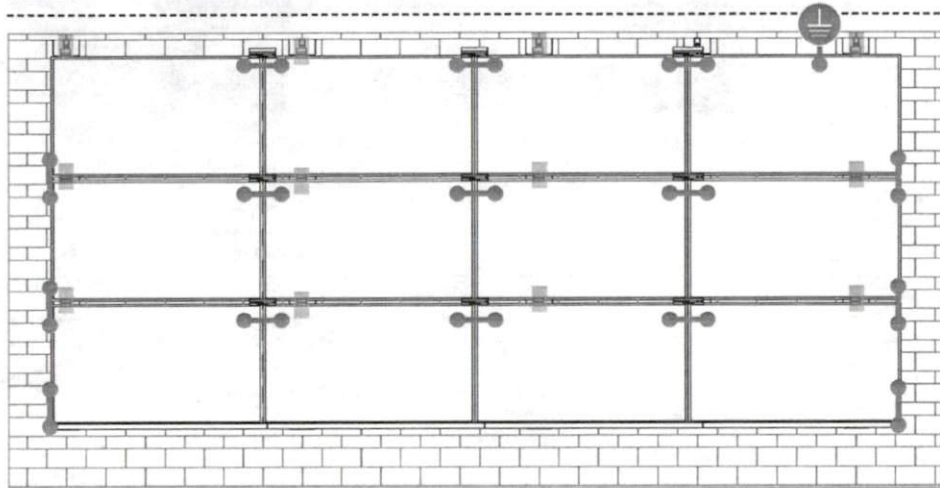
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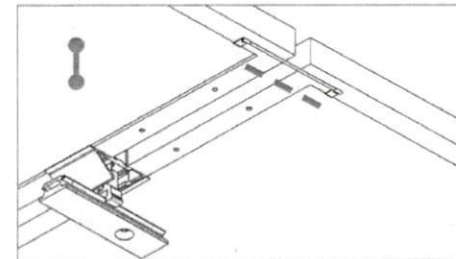
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E-W BONDING PATH: E-W module to module bonding is accomplished with 2 pre-installed bonding clips which engage on the secure side of the Microrail™ and splice.



N-S BONDING PATH: N-S system bonding is accomplished through a N-S bonding clip. Insert each end of the N-S bonding clip onto a module frame flange. System is bonded with a single array edge, however it is recommended that N-S bonding clips be installed on both edges for ease of maintenance (see also: Maintenance Page 5)

Star Washer is Single Use Only



TERMINAL TORQUE,
Install Conductor and torque to the following:
4-6 AWG: 35in-lbs
8 AWG: 25 in-lbs
10-14 AWG: 20 in-lbs

LUG DETAIL & TORQUE INFO
Ilsc Lay-In Lug (GBL-4DBT)

- 10-32 mounting hardware
- Torque = 5 ft-lb
- AWG 4-14- Solid or Stranded

TERMINAL TORQUE,
Install Conductor and torque to the following:
4-14 AWG: 35in-lbs

LUG DETAIL & TORQUE INFO
Ilsc Flange Lug(SGB-4)

- 1/4" mounting hardware
- Torque = 75 in-lb
- AWG 4-14- Solid or Stranded

WEEBLUG Single Use Only



TERMINAL TORQUE,
Install Conductor and torque to the following:
6-14 AWG: 7ft-lbs

LUG DETAIL & TORQUE INFO
Wiley WEEBLug (6.7)

- 1/4" mounting hardware
- Torque = 10 ft-lb
- AWG 6-14- Solid or Stranded

NOTE: ISOLATE COPPER FROM ALUMINUM CONTACT TO PREVENT CORROSION

System bonding is accomplished through modules. System grounding accomplished by attaching a ground lug to any module at a location on the module specified by the module manufacturer.

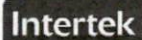
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Country: USA	Country: China
Contact: Klaus Nicolaedis Jason Mayfield	Contact: Lili Zeng George Huang
Phone: 505-482-2190 505-400-2949	Phone: 510-979-1920 650-799-7627
FAX: NA	FAX: NA
Email: klaus.nicolaedis@unirac.com jasonm@unirac.com	Email: lzeng@ccmfg.com george@ccmfg.com

Party Authorized To Apply Mark: Same as Manufacturer
Report Issuing Office: Lake Forest, CA

Control Number: 5003278 **Authorized by:** *Robert Martin*
for Dean Davidson, Certification Manager



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545 East Algonquin Road, Arlington Heights, IL 60005
Telephone 800-345-3851 or 847-438-5667 Fax 312-283-1672

Standard(s):	UL 2703 Issued: 2015/01/28 Ed: 1 Mounting Systems, Mounting Devices, Clamping/Retention Devices, and Ground Lugs for Use with Flat-Plate Photovoltaic Modules and Panels
Product:	Photovoltaic Mounting System, Sun Frame Micro Rail- Installed Using Unirac Installation Manual, Rev PUB2017FEB16
Brand Name:	Unirac
Models:	Unirac SFM

ATM for Report 102393982LAX-002

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ATM Issued: 2-Mar-2017
ED 16.3.15 (1-Jul-16) Mandatory



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SUNFRAME MICRORAIL RAISED SEAL FLASHING INSTALLATION GUIDE

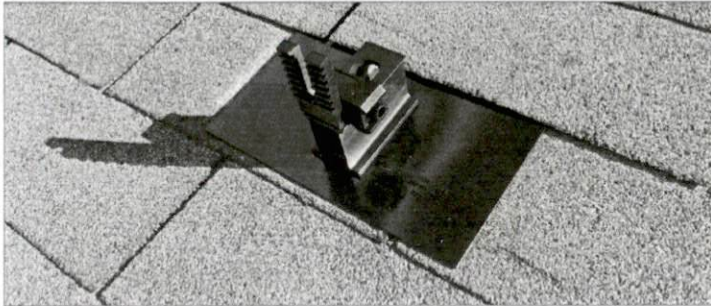


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Quick Steps for Installation	2

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SUNFRAME MICRORAIL RAISED SEAL FLASHING

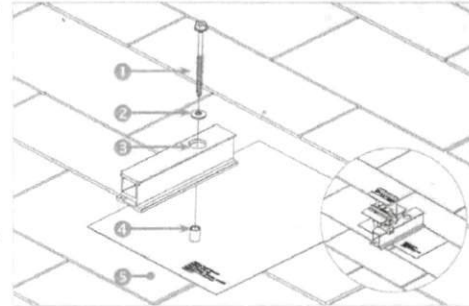
TOOLS & ASSEMBLY DETAILS 1 TECHNICAL DATA SHEET PAGE

TOOLS REQUIRED OR RECOMMENDED FOR LAYOUT & INSTALLATION:

- TAPE MEASURE
- CHALK LINE
- ROOFING CRAYON
- HAMMER
- COMPATIBLE SEALANT AND DISPENSER
- DRILL WITH EITHER 1/8" BIT FOR GRK AND 7/32" BIT FOR LAG BOLT
- UNIRAC CUSTOM STRUCTURAL SCREW OR 7/32" BIT FOR LAG BOLT
- IMPACT DRIVER WITH 1/2" SOCKET (OPTIONAL 3/4" HEX DRIVER FOR UNIRAC CUSTOM STRUCTURAL SCREW)

SFM RAISED SEAL FLASHING COMPONENTS:

1. FASTENER:
 - LAG BOLT 5/16"
 - UNIRAC CUSTOM STRUCTURAL SCREW 5/16"
 - GRK STRUCTURAL SCREW 5/16"
2. 5/16" ID EDPH SEALING WASHER
3. SFM MOUNT ASSEMBLY (VARIOUS) WITH SLIDER
4. SFM RAISED SEAL FLASHING
5. COMP SHINGLE ROOF



INSTALLATION NOTES:

- It is not necessary or advisable to use nails or other fasteners to secure the perimeter of the flashing.
- The SFM Raised Seal Flashing is made to work with standard and high-definition composition/asphalt and wood shingle roofs with 5" to 5-5/8" courses.
- Mounts should not be installed in areas of the roof susceptible to ice damming. Ponding water can travel upward under shingles and reach the bolt penetration.
- Fastener length specification and capacity verification are the responsibility of the installer.

SUNFRAME MICRORAIL RAISED SEAL FLASHING

QUICK INSTALLATION STEPS 2 INSTALLATION GUIDE PAGE



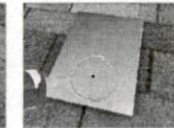
PREPARING SHINGLES: Use roofing bar to break seals between 1st and 2nd, and 2nd and 3rd shingle courses. Be sure to remove all nails to allow correct placement of flashing. See SFM installation guide for proper flashing placement.



DRILL PILOT HOLES: Holding the drill square to the rafter, drill 3" deep pilot hole into center of rafter using 5/16" alk-a-ll extension bit for 5/16" GRK or Unirac Custom Structural Screw or 7/32" alk-a-ll extension bit for 5/16" lag.



ROOF SEALANT: Fill pilot hole with appropriate sealant.



OPTIONAL SEALANT ON FLASHING: Apply a circle-shaped bead of sealant around the attachment hardware hole of the flashing before insertion. Do not use excessive sealant.



POSITION FLASHING: Slide the flashing up underneath the 2nd course of shingles, so that the bottom edge of the flashing does not overhang the downslope edge of the 1st course of shingles.



PLACE SLIDER: Place slider with assembly over the flashing flange, ensuring that the slider sits flat on the flashing surface.



INSTALL FASTENER & TIGHTEN: Install fastener with sealing washer. Swivel the slider to gauge proper torque when driving the fastener. Tighten until slider stops swiveling easily.



COMPLETE FLASHING INSTALLATION: Repeat previous steps to install all mounts.



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