

7.93 KW DC ROOF MOUNTED PHOTOVOLTAIC SYSTEM

EQUIPMENT SUMMARY

19 NO'S - APTOS SOLAR DNA-144-BF23 - 400W MODULES
01 NO - APTOS SOLAR DNA-120-MF23 - 330W MODULES
01 NO'S - SOLAREEDGE SE7600H-US INVERTER WITH
19 NO'S OF P400 DC POWER OPTIMIZERS AND
01 NO OF P340 DC POWER OPTIMIZER

SHEET INDEX

- T-001 COVER SHEET
- G-001 ELECTRICAL CONSTRUCTION GENERAL NOTES
- P-001 PROPERTY MAP & PROPERTY LAYOUT
- P-002 PV LAYOUT
- P-003 STRING LAYOUT
- P-004 ATTACHMENT LAYOUT
- P-005 ELECTRICAL THREE LINE DIAGRAM
- P-006 ELECTRICAL CALCULATION
- P-007 SYSTEM LABELING DETAILS
- P-008 MODULE DATA SHEET-1
- P-009 MODULE DATA SHEET-2
- P-010 POWER OPTIMIZER DATA SHEET
- P-011 INVERTER DATA SHEET
- P-012 MOUNTING ATTACHMENT DATA SHEET-1
- P-013 MOUNTING ATTACHMENT DATA SHEET-2

GOVERNING CODES

GOVERNING CODES :
ALL WORK TO COMPLY WITH THE FOLLOWING CODES
UNDERWRITERS LABORATORIES (UL) STANDARDS
2017 FLORIDA BUILDING CODE (6TH EDITION)
2017 FLORIDA ENERGY CONSERVATION CODE (6TH EDITION)
2017 FLORIDA MECHANICAL CODE (6TH EDITION)
2017 FLORIDA PLUMBING CODE (6TH EDITION)
2017 FLORIDA RESIDENTIAL CODE (6TH EDITION)
2017 FLORIDA FIRE CODE (6TH EDITION)
2014 NATIONAL ELECTRICAL CODE (6TH EDITION)



SITE VICINITY MAP



SITE AERIAL MAP

PROPERTY ADDRESS:

ANYTOWN
FLORIDA-PR,USA

DESIGNER:

Eduardo Bas, Florida PE 77463,
PR PE 17485

Rev	Designed By	Checked By	Date	Sheet No	BASEL ENGINEERING SERVICES
				Page No	
				01	
				Package ID / R	

ELECTRICAL CONSTRUCTION GENERAL NOTES:

1.1 Site Notes

- 1.2 A ladder shall be in place for inspection in compliance with OSHA regulations.
- 1.3 The PV modules are considered non-combustible and this system is a utility interactive system with no storage batteries.
- 1.4 The solar PV installation shall not obstruct any plumbing, mechanical, or building roof vents.
- 1.5 Proper access and working clearance around existing and proposed electrical equipment will be provided as per section [NEC 110.26].
- 1.6 Alternative power source placard shall be plastic, engraved in a contrasting color to the plaque. This plaque will be attached using an approved method. If exposed to sunlight, it shall be UV resistant. All plaques and signage will be installed as required by the NEC.
- 1.7 The grounding electrode conductor shall be protected from physical damage between the grounding electrodes and the panel (or inverter) if smaller than #6 AWG copper wire per NEC 250-64B. The grounding electrode conductor will be continuous, expect for splices or joints at bus bars within listed equipment per [NEC250.64C.]
- 1.8 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.
- 1.9 Rigid conduit (and/or nipples) must have a pull bushing to project wires.
- 1.10 Bolted connection required in dc disconnects on the white grounded conductor (use Polaris block or neutral bar)
- 1.11 Any connection above live parts must be watertight. Reducing washers disallowed above live parts, Meyers hubs recommended.

2.1 Solar Contractor

- 2.2 Module certifications will include UL1703, IEC61646, and IEC61730.
- 2.3 If applicable, module grounding lugs must be installed at the marked grounding lug holes per the manufactures installation requirements.
- 2.4 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.
- 2.5 Conduit and wire specifications are based on minimum code requirements and are not meant to limit up-sizing as required by field conditions.
- 2.6 Conduit point of penetration from to interior to be installed and sealed with a suitable sealing compound.
- 2.7 Dc wiring limited to module footprint w/ Enphase ac system.
- 2.8 Enphase wiring systems shall be located and secured under the array w/suitable wiring clips.
- 2.9 Max dc voltage calculated using manufacturer provided temp coefficient for Voc unless not available.
- 2.10 All inverters, motor generators, photovoltaic modules, photovoltaic panels, ac photovoltaic modules, source circuit combiners, and charge controllers intended for use in a photovoltaic power system will be identified and listed for the application per690.4(d).
- 2.11 All signage to be placed in accordance with local building code.

3.1 Equipment Locations

- 3.2 All equipment shall meet minimum setbacks as required by [NEC 110.26].
- 3.3 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) (2) (c)].
- 3.4 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.
- 3.5 All equipment shall be installed accessible to qualified personal according to NEC applicable codes.
- 3.6 All components are listed for their purpose and rated for outdoor usage when appropriate.

4.1 Wiring & Conduit Notes

- 4.2 All conduit sizes and types, shall be listed for its purpose and approved for the site applications.
- 4.3 All PV cables and home run wires be #10AWG *USE-2, PV wire, or proprietary solar cabling specified by MFR, or equivalent; routed to source circuit combiner boxes as required
- 4.4 All conductors and OCPD sizes and types specified according to [NEC 690.8(a) (1) & (b) (1)], [NEC 240] [NEC690.7] for multiple conductors.
- 4.5 All PV dc conductors in conduit exposed to sunlight shall be de rated according to [NEC table 310.15(b) (2) (c) block only**
- 4.6 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.
- 4.7 Phase and neutral conductors shall be dual rated THHN/THWN-2 insulated, 90° C rated, wet and UV resistant, rated for 600V per NEC 2008 or 1000V per NEC 2011.
- 4.8 4-wire delta connected systems have the phase with the higher voltage to ground marked orange or identified by other effective means
- 4.9 All source circuits shall have individual source circuit protection
- 4.10 Voltage drop limited to 2% for dc circuits and 1% for ac circuits
- 4.11 Negative grounded systems dc conductors shall be color coded as follows: dc positive -red (or marked red), dc negative - grey (or marked grey)
- 4.12 Positive grounded systems dc conductors color coded: dc positive -grey (or marked grey), dc negative- black (or marked black)
- 4.13 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

5.1 Structural Notes:

- 5.2 Racking system & PV array shall be installed according to code-compliant installation manual.
- 5.3 Roof mounted standard rail requires one thermal expansion gap for every run of rail greater than 40'.
- 5.4 Array shall be a min. Height of 3” above the composition roof.
- 5.5 Junction box shall be installed per manufacturer's specifications.it shall be flashed &sealed per local requirements.
- 5.6 Rooftop penetrations permitting to solar racking will be completed and sealed w/approved chemical sealant per code by a licensed contractor.
- 5.7 All PV related racking attachments will be spaced no greater than the span distance specified by the racking manufacturer, O.C. final attachment locations may be adjusted in the field as necessary.
- 5.8 All PV related racking attachments shall be staggered by row amongst the roof framing members.

6.1 Grounding Notes

- 6.2 A grounding electrode system in accordance with [nec690-47] and [nec250-50] through [NEC 60 250-166] 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 supplement grounding electrode will be used at the inverter location consisting of a UL listed 8ft ground rod with acorn clamp.
- 6.3 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.
- 6.4 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 690.43].
- 6.5 Module source circuits shall be grounded in accordance to [NEC 690.42].
- 6.6 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.
- 6.7 Each module will be grounded using the supplied connections points identified in the manufacturer's installation instructions.
- 6.8 Enclosures shall be properly prepared with removal of paint/finish as appropriate when grounding equipment with termination grounding lugs.
- 6.9 Grounding system components shall be listed for their purpose, and grounding devises exposed to the elements shall be rated for direct burial.
- 6.10 Grounding and bonding conductors shall be copper, solid or stranded, and bare when exposed.
- 6.11 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).
- 6.12 Grounding and bonding conductors, if insulated, shall be color coded green (or marked green if #4awg or larger)
- 6.13 All conduit between the utility ac disconnect and the point of connection shall have grounded bushings at both ends.
- 6.14 AC 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.
- 6.15 Exposed non-current carrying metal parts of module frames, equipment's, and conductor enclosures shall be grounded in accordance with 250.134 or 250.136(a) regardless of voltage.

7.1 Interconnection Notes

- 7.2 PV provided back feed breakers must be located at the opposite end of the bus from the main service breaker or transformer input feeder in accordance with [NEC 690.64(b) (7)]
- 7.3 Sum of breaker ratings supplying the bus may not exceed 120% of the bus bar rating per [NEC 690.64(b) (2)] and/or [nec705.12 (d) (1)].
- 7.4 Ground fault protection in accordance with [nec215.9] & [NEC 230.95].all equipment to be rated for back feeding.
- 7.5 Supply side interconnection according to [NEC 690.64(a) and/or [NEC 705.12(a)] with service entrance conductors in accordance with [NEC 230.42(b)]
- 7.6 Micro inverter branches shall be connected to a single breaker OCPD in accordance with [NEC 110.3(b)].

8.1 Disconnect Notes

- 8.2 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).
- 8.3 AC disconnect must be accessible to qualified utility personnel, be lockable, and be a visible- break switch.
- 8.4 DC current conductors are to remain outside of building prior to either a fuse able source circuit combiner box or a load-break disconnecting device.

9.1 Storm Water Prevention

- 9.2 Storm water pollution prevention devices and practices shall be installed and/or instituted as necessary to ensure compliance with the city water quality standards contained in local regulations, federal regulations and any erosion control plan associated with this project. all such devices and practices shall be maintained, inspected and/or monitored to ensure adequacy and proper function throughout the duration of the construction project.
- Compliance with the water quality standards and any erosion control plan associated with this project includes, but is not limited to the following:
- 9.3 All pollutants shall be retained on site until properly disposed of, and may not be transported from the site via sheet flow, swales, area drains, natural drainage courses or wind.
- 9.4 Stockpiles of construction-related materials shall be protected from being transported from the site by forces of wind or water flow.
- 9.5 Trash and construction solid wastes shall be deposited into covered receptacle to prevent contamination of rainwater and dispersal by wind.

10.1 Visibility From Adjacent Property : The solar panels may be visible from adjacent properties. Paint all structural elements to match the existing roofing.

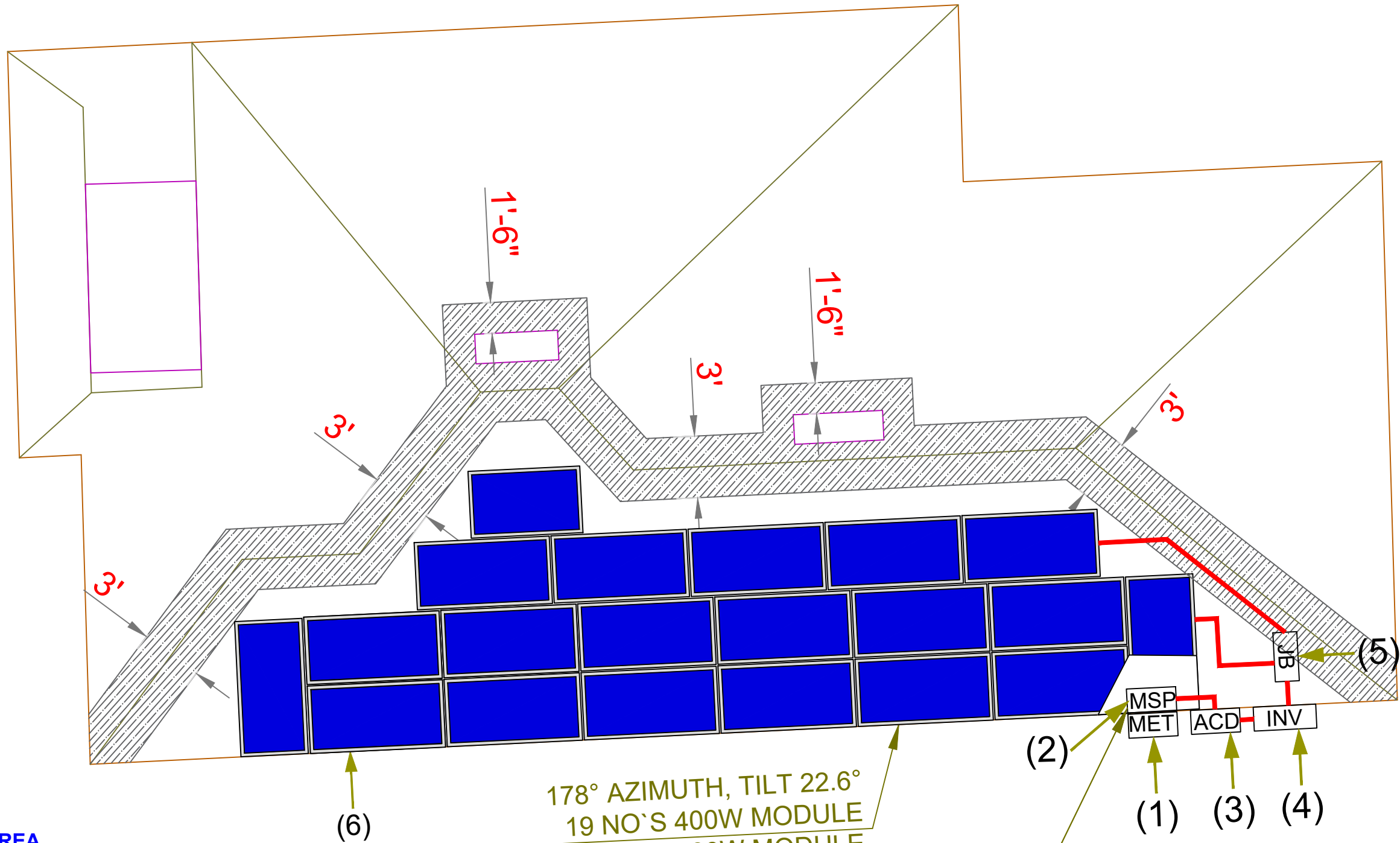
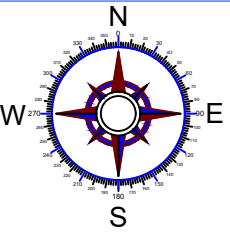
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DESIGNER:

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				Page No	
				01	
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ROOF COVERAGE AREA

Roof Area in SQ.FT : 1823
Array Area in SQ.FT : 433
Array Area in % : 23.7%

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PV LAYOUT

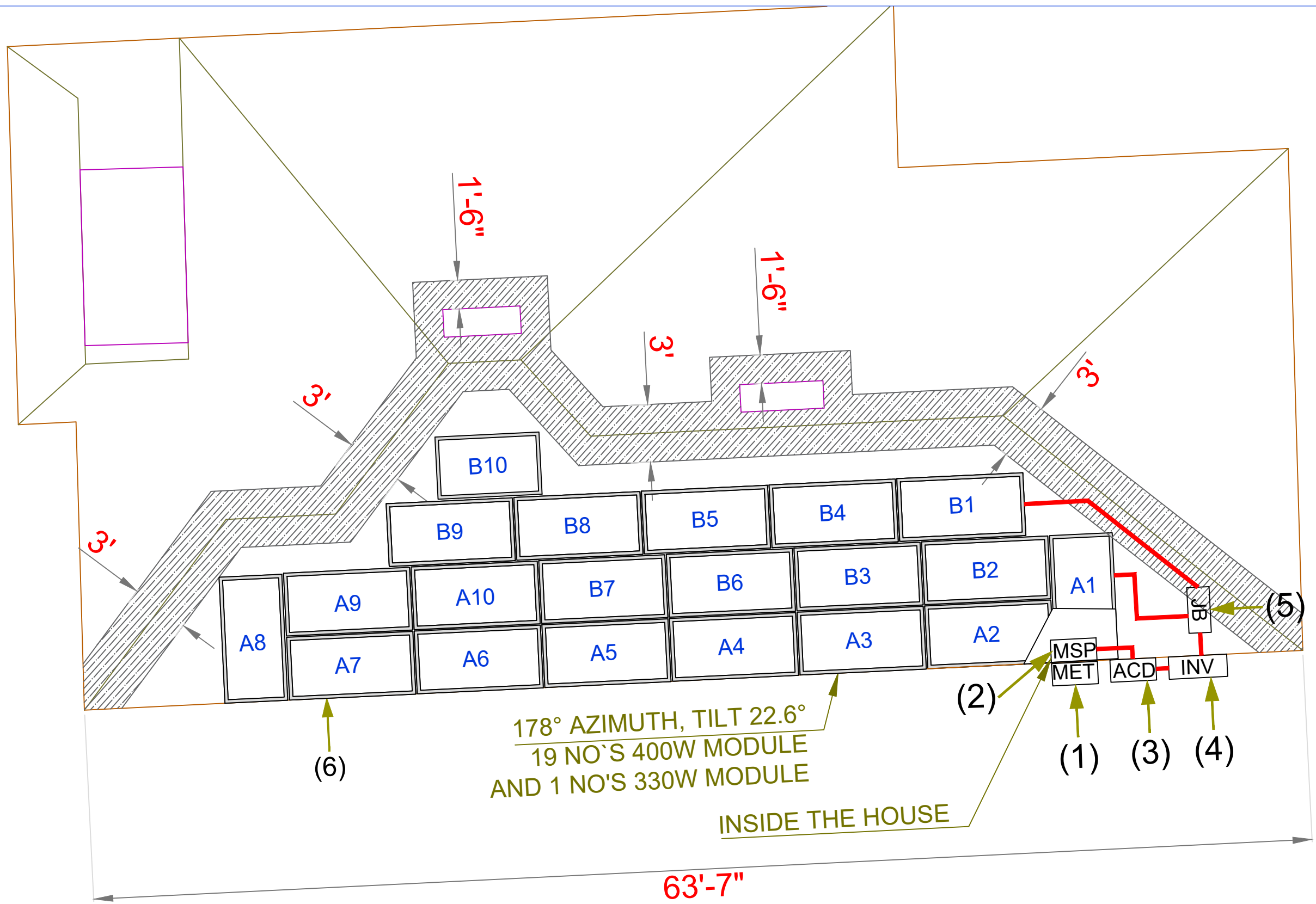
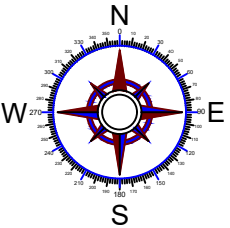
178° AZIMUTH, TILT 22.6°
19 NO`S 400W MODULE
AND 1 NO`S 330W MODULE
INSIDE THE HOUSE

DESCRIPTION

1. UTILITY METER
 2. MAIN SERVICE PANEL
 3. AC DISCONNECT
 4. INVERTER
 5. JUNCTION BOX
 6. PV MODULES
- FIRE SETBACK

Rev	Designed By	Checked By	Date	Sheet No
				Page No
				01
				Package ID / R

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DESCRIPTION
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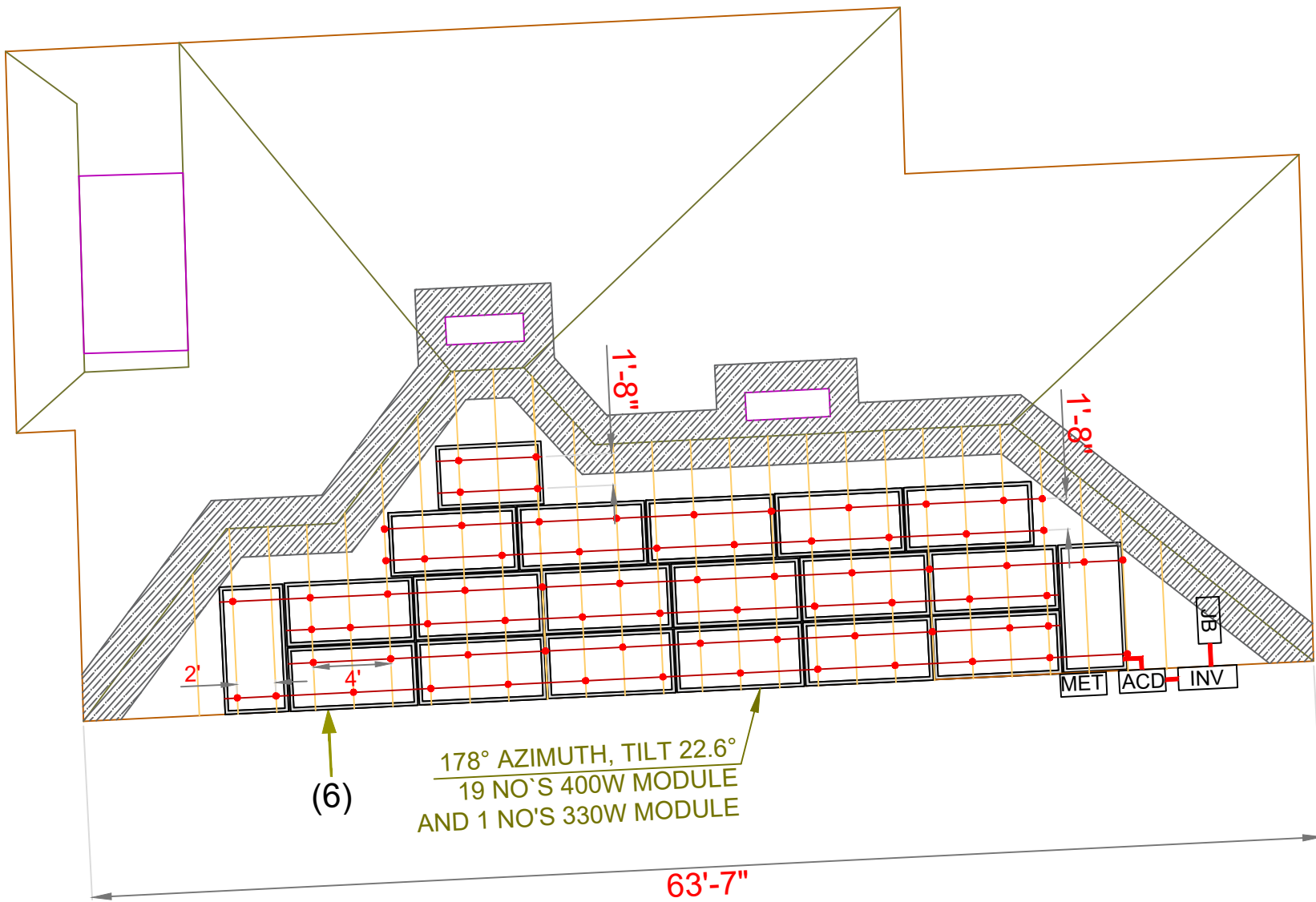
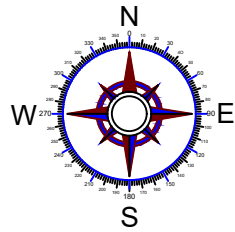
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STRING LAYOUT

Rev	Designed By	Checked By	Date	Sheet No
				Page No
				01
				Package ID / R

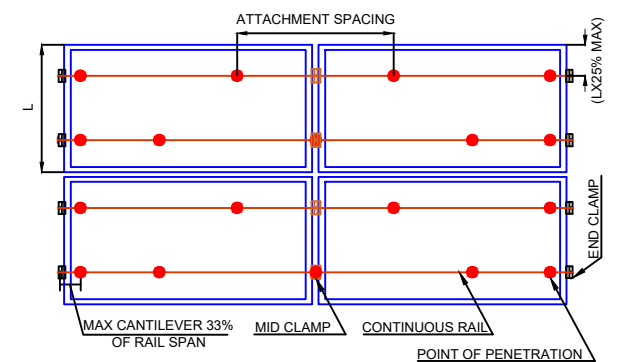
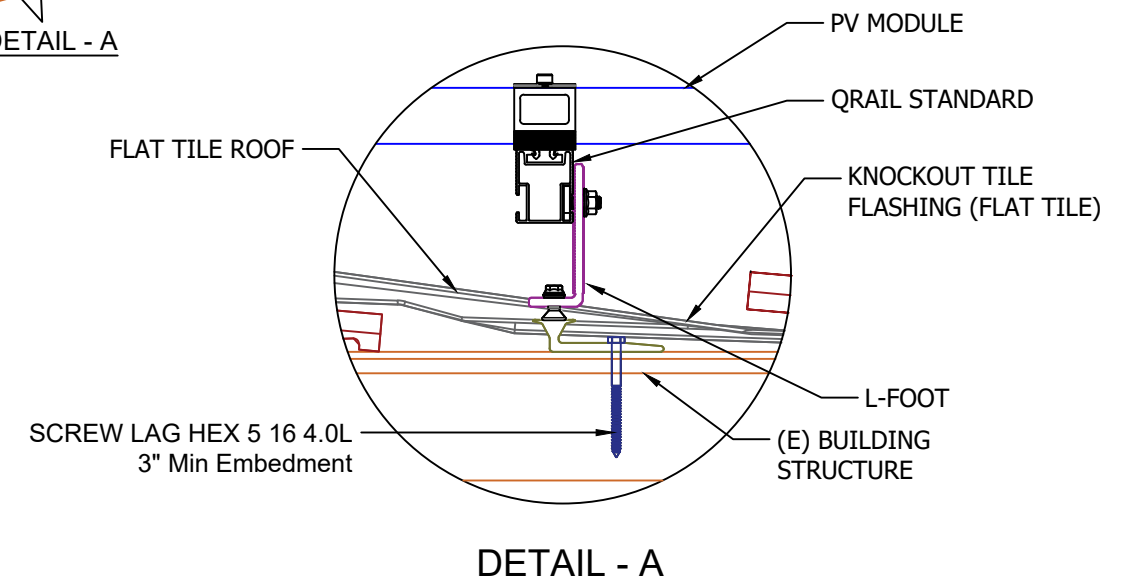
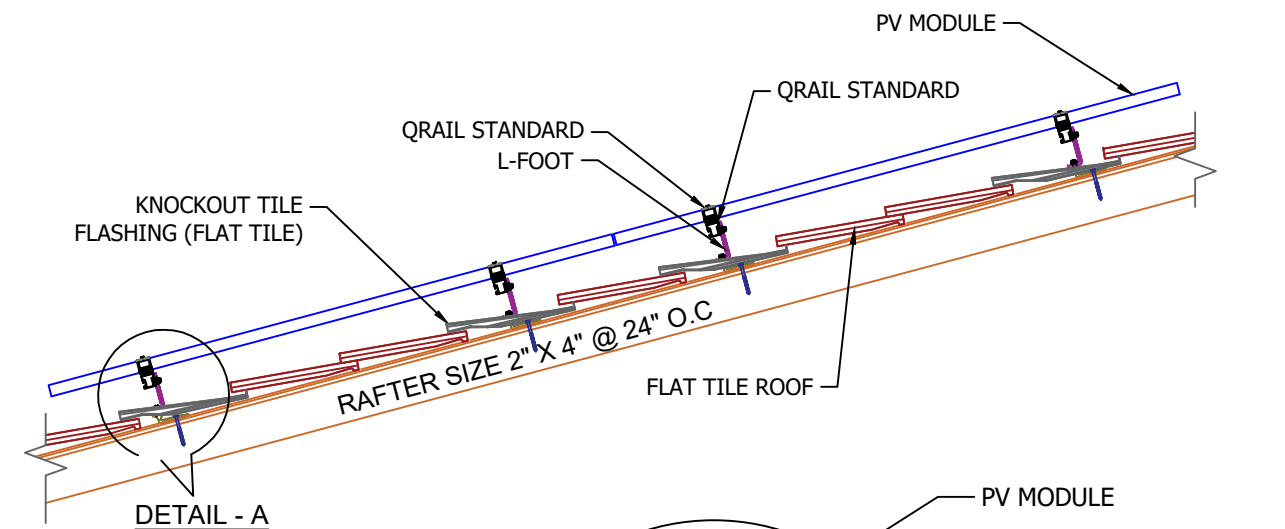
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- PV MODULES
- ROOF PENETRATION POINTS
- RAILS
- RAFTER

Roof Cover Type : Flat Tile Roof
Rafter Size with O.C : 2" X 4" @ 24"
Attachment Spacing : 4'
No. of Attachment Points : 73
Attachment Type : Staggered

ATTACHMENT DETAILS



ATTACHMENT LAYOUT

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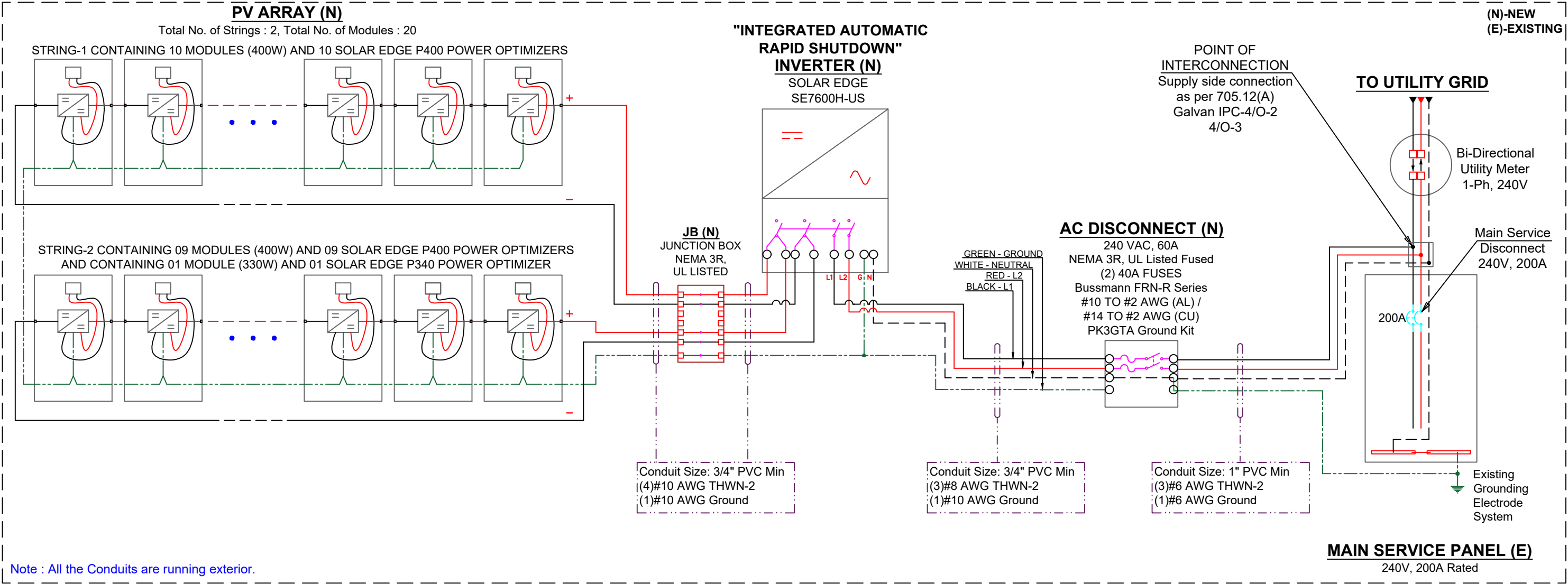
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Rev	Designed By	Checked By	Date	Sheet No
				Page No
				01
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7.93 KW DC PROPOSED PV SYSTEM THREE LINE DIAGRAM



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				Page No
				01
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ELECTRICAL CALCULATION

WIRING AND CONDUIT SCHEDULE																											
DC SCHEDULE																											
ITEM		DESCRIPTION	ID	QTY	Voc (V)	Vmpp (V) STC	Imp (A) STC	ISC (A) STC	Max Circuit Current (A)	Nominal Power	Minimum Ampacity (A)	Adjusted Ampacity (A)	OCPD Rating (A)	Multiple Conductor Derate	Temperature Derate	Max One Way Length (ft)	Wire Size	Wire Ampacity (A)	Derated Ampacity (A)	Ground	Wire Type	R/1000FT	V Loss%	Temp Max	Total No Of Conductors	No. Of Current Carrying Conductors	Conduit
1	MODULE	APTOS SOLAR		19	48.35	40.01	10	10.32	12.90	400	16.1	17.2	20	1.00	0.76	3.5	#12 AWG	30	22.8	#6 Bare	PV	1.98	0.03%	52 C	2	2	N/A
2		APTOS SOLAR		1	40.27	32.91	10.02	10.51	13.14	330	16.4	17.5	20	1.00	0.76	3.5	#12 AWG	30	22.8	#6 Bare	PV	1.98	0.03%	52 C	2	2	N/A
3	STRING WIRING	MODULE TO POWER OPTIMIZERS (e.g: PV MODULES CONNECTED IN SERIES FOR ONE STRING)	A	2	483.5	400.1	10	10.32	12.90	4000	16.1	21.4	20	0.80	0.76	5	#10 AWG	40	24.32	#10 AWG	THWN-2	1.24	0.06%	52 C	5	4	3/4" PVC Min
4		POWER OPTIMIZER TO JUNCTION BOX TO INVERTER	B	2	483.5	400.1	10	10.32	12.90	4000	16.1	21.4	20	0.80	0.76	60	#10 AWG	40	24.32	#10 AWG	THWN-2	1.24	0.74%	52 C	5	4	3/4" PVC Min
							Total Nominal Power			7930												DC DROP	0.88%				
AC SCHEDULE																											
ITEM		DESCRIPTION	ID	QTY	Voltage (V)		Max Circuit Current (A)		Power	Minimum Ampacity (A)	Adjusted Ampacity (A)	OCPD Rating (A)	Multiple Conductor Derate	Temperature Derate	Max One Way Length (ft)	Wire Size	Wire Ampacity (A)	Derated Ampacity (A)	Ground	Wire Type	R/1000FT	V Loss%	Temp Max	Total No Of Conductors	No. Of Current Carrying Conductors	Conduit	
5	AC WIRING	INVERTER TO AC DISCONNECT	C	1	240		32		7600	40.0	42.6	40	1.00	0.96	5	#8 AWG	55	52.8	#10 AWG	THWN-2	0.78	0.05%	30 C	4	2	3/4" PVC Min	
6		AC DISCONNECT TO MAIN SERVICE PANEL	D	1	240		32		7600	40.0	42.6	40	1.00	0.96	50	#6 AWG	75	72	#6 AWG	THWN-2	0.491	0.33%	30 C	4	2	1"PVC Min	
							Total Nominal Power		7600													AC DROP	0.38%				

BILL OF MATERIAL													
REF. DES.	QTY.	MANUFACTURER	MODEL NUMBER	DESCRIPTION									
SOLAR MODULE	19	APTOS SOLAR	DNA-144-BF23-400W	SOLAR PANEL				400	W	1500	V (UL)		
		NOTES: 1. TYPE-1 UL 1703 class C											
SOLAR MODULE	1	APTOS SOLAR	DNA-120-MF23-330W	SOLAR PANEL				330	W	1500	V (UL)		
		NOTES: 1. TYPE-1 UL 1703 class C											
INVERTER	1	SOLAREEDGE	SE7600H-US	INVERTER				7.6	Kw	NEMA 4X		240	V AC
		NOTES: 1. DC INPUT WIRE RANGE (2) #12 to #2; AC OUTPUT WIRE RANGE (3) #12											
MSP	1	TBD	TBD	MAIN SERVICE PANEL, NEMA 3R ENCLOSURE				200	A	1	Ph	240	V AC
AC DISCONNECT	1	SQUARE D	TBD	AC DISCONNECT				60	A				
		NOTES: 1. USED AS PV UTILITY/SERVICE DISCONNECT 2. LOCKABLE HEAVY DUTY SWITCH WITH VISIBLE CONTACTS, UL LISTED											
AC JUNCTION BOX	1	TBD	TBD	AC JUNCTION BOX				600	V				
AC COMBINER PANEL	1	TBD	COMBINER PANEL	NEMA 3R ENCLOSURE				150	A	1	Ph	240	V AC

Module Rating Specs			Module Rating Specs		
APTOS SOLAR			APTOS SOLAR		
DNA-144-BF23-400W			DNA-120-MF23-330W		
Pmax -	400	Wp	Pmax -	330	Wp
Vmp -	40.01	V	Vmp -	32.91	V
Imp -	10	A	Imp -	10.02	A
Voc -	48.35	V	Voc -	40.27	V
Isc -	10.32	A	Isc -	10.51	A

System Configuration		
Number of strings	2	No's
Number of Modules	20	No's
Modules Per string	2 X 10	
Number of Inverter	1	No's
Module Model	DNA-144-BF23-400W & DNA-120-MF23-330W	
Inverter Model	SE7600H-US	
PV Service Disconnect	-	A
DC Watts STC	7930	W
Max AC output Current	32	A
Operating AC Voltage	240	V

Inverter Rating Specs		
	SOLAREEDGE	SE7600H-US
Nominal Input	20	A DC
Max.Short Circuit I/P	45	A DC
Output Voltage	240	V AC
Imax	32	A AC
Inec	40	A (@125%)
	Outdoor	NEMA 4X Enclosure
UL1741 / IEEE 1547		

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				Page No
				01
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SIGNAGE REQUIREMENT :

RED BACKGROUND .WHITE LETTERING. ("WARNING"-3/8" LETTERS).ALL CAPITAL LETTERS.ARIAL OR SIMILAR FONT . WEATHER - RESISTANT MATERIAL,UL 969.

JUNCTION BOX & CONDUIT RACEWAYS	DC DISCONNECT	AC DISCONNECT	BUILDING / STRUCTURE	MAIN SERVICE PANEL
WARNING PHOTOVOLTAIC POWER SOURCE NEC 690.31(E)(3) - CONDUIT/ALL JUNCTION BOXES WARNING ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION NEC 690.13(B) - UNGROUNDED SYSTEM JUNCTION BOXES PLACE ON : Inverter PHOTOVOLTAIC POWER EQUIPPED WITH RAPID SHUTDOWN Label NEC 690.56(C)	PHOTOVOLTAIC SYSTEM DC DISCONNECT RATED MAX POWER-POINT CURRENT: 19.82A RATED MAX POWER-POINT VOLTAGE : 480V MAXIMUM SYSTEM VOLTAGE : 400V MAXIMUM SYSTEM CURRENT : 30A NEC 690.53 WARNING ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION. DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT. NEC 690.17(4) - GROUNDED SYSTEMS	PHOTOVOLTAIC SYSTEM AC DISCONNECT RATED AC OUTPUT CURRENT : 32A NOMINAL OPERATING AC VOLTAGE : 240V PER NEC 690.54 WARNING ELECTRIC SHOCK HAZARD TERMINALS ON THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION. DC VOLTAGE IS ALWAYS PRESENT WHEN SOLAR MODULES ARE EXPOSED TO SUNLIGHT. NEC 690.17(4) - GROUNDED SYSTEMS PLACE ON:All DC Source Markings and System Output Conductor Raceways WARNING DUAL POWER SOURCE SECOND SOURCE IS PV SYSTEM "Photovoltaic Power Source" Label NEC 690.31 place on conduit every 10 feet "NFPA1" *MUST BE REFLECTIVE IF Indoors OR IN ATTIC PHOTOVOLTAIC AC DISCONNECT NEC 690.13(B)	CAUTION SOLAR ELECTRICAL SYSTEM CONNECTED WITH SOURCE AND DISCONNECTS AS SHOWN Must show drawing of the property and equipment layout. NEC 705.10 & NEC 690.56(B)	PLACE ON: Inverter Breaker Panel if sum of breaker exceeds panel rating WARNING INVERTER OUTPUT CONNECTION DO NOT RELOCATE THIS OVERCURRENT PROTECTION DEVICE NEC 705.12(D)(7) - NEAR PV BREAKER MAIN PV SYSTEM AC DISCONNECT PER NEC 690.13(B) WARNING DUAL POWER SOURCE SOURCE: UTILITY GRID AND PV SOLAR ELECTRICAL SYSTEM NEC 705.12(D)(4), 690.56(B) - ON PANEL COVER WARNING TURN OFF PHOTOVOLTAIC AC DISCONNECT PRIOR TO WORKING INSIDE PANEL PER NEC 110.27(C) & OSHA 1910.145(f)(7) CAUTION: SOLAR ELECTRICAL SYSTEM CONNECTED PER NEC 690.14(C)(2), IFC 605.11.1, IFC 605.11.1.4, NEC 690.15 & NEC 690.53 SOLAR PV BREAKER BREAKERS BACKFED DO NOT RELOCATE PLACE ON : Next to inverter interconnection Breaker, Load center, & Service Panel
INVERTER WARNING THE DISCONNECTION OF THE GROUNDED CONDUCTOR(S) MAY RESULT IN OVER-VOLTAGE ON THE EQUIPMENT NEC 690.31(I) - GROUNDED SYSTEMS WARNING ELECTRIC SHOCK HAZARD THE DC CONDUCTORS OF THIS PHOTOVOLTAIC SYSTEM ARE UNGROUNDED AND MAY BE ENERGIZED. NEC 690.35(F) - GROUNDED SYSTEMS	NET METER (Bi-directional) WARNING DUAL POWER SOURCE SECOND SOURCE IS PV SYSTEM NEC 705.12(D)(3) & NEC 690.59	WARNING ELECTRIC SHOCK HAZARD IF A GROUND FAULT IS INDICATED, NORMALLY GROUNDED CONDUCTORS MAY BE UNGROUNDED AND ENERGIZED. NEC 690.5(C)	PLACE ON : Inverter PHOTOVOLTAIC SYSTEM EQUIPPED WITH RAPID SHUTDOWN Label NEC 690.56(C) THIS ELECTRIC SYSTEM IS ALSO SERVED BY A PHOTOVOLTAIC SYSTEM	

Note:

All Plaques and signage required by the 2014 edition of NEC will be installed as required. Placards consist of white lettering on red background with text written in capitol lettering a minimum of 3/8" in height on plastic Engraved placards. Alternate Power Source Placard shall be metallic or plastic with engraved or machine printed letters in a contrasting color to the plaque, include the location of meter, disconnects, inverter, the array and a footprint of the entire building and site. This plaque will be attached by pop rivets, screws or other approved fasteners. If exposed to sunlight, shall be UV resistant.

Photovoltaic DC conductors entering the building shall be installed in a metallic raceway and shall be identified every 5 feet -- and within 1 foot of turns or bends and within 1 foot above and below penetrations of roof/ceiling assemblies, walls, or barriers labeled "Caution Solar Circuit" or equivalent. Examples of all required warning labels per NEC and CEC 690 below:

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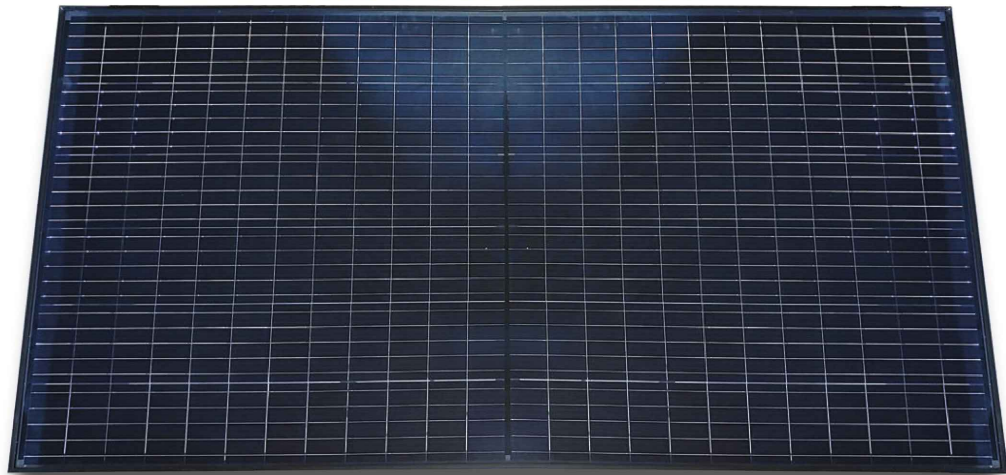
DESIGNER:

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PR PE 17485

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BASEL
ENGINEERING SERVICES

DNA-144
ALL-BLACK BI-FACIAL DESIGN
400W | 395W | 390W



Maximize Energy Production
High-efficiency, Bi-facial half-cut cell panel

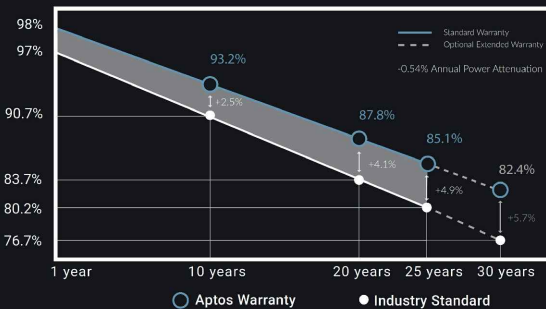
- Produce up to 30% more energy with rear-side generation
- Resilient in extreme weather conditions
5400 Pa snow load
175 mph wind load
- Ideal solution for applications affected by shading
- 25 year extended product warranty*
30 year extended peak power warranty*

Our DNA Half-cut Cell Series impressively combines advanced technologies to maximize performance. Produce up to 30% more energy with the bi-facial rear side generation. Our patented DNA, Dual Nano Absorber, technology allows for panel to harvest energy from all directions and operate exceptionally in high heat temperatures.

*Aptos Solar Technology solar panels come with a standard 15 product warranty and 25 year peak power warranty. Customers must select optional warranty upgrade package to qualify extended 25 year product warranty and extended 30 year peak power warranty.

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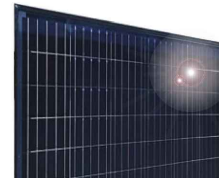
Linear Peak Power Warranty



Factory Certifications



Product Certifications



DNA-144
BLACK FRAME, BLACK BACKSHEET
HIGH EFFICIENCY, BI-FACIAL, HALF-CUT CELL PANEL



ELECTRICAL SPECIFICATIONS (+3%/0%)

	DNA-144-BF23-390W	DNA-144-MB23-395W	DNA-144-BF23-400W
STCrated output P_{mpp} (W)	390	395	400
Module Efficiency	19.28%	19.52%	19.77%
Open Circuit Voltage V_{oc} (V)	48.17	48.26	48.35
Short Circuit Current I_{sc} (A)	10.14	10.23	10.32
Rated Voltage V_{mpp} (V)	39.65	39.83	40.01
Rated Current I_{mpp} (A)	9.84	9.92	10.00

Standard Test Conditions for front-face of panel:
1000 W/m², 25 °C, measurement uncertainty $\leq 3\%$

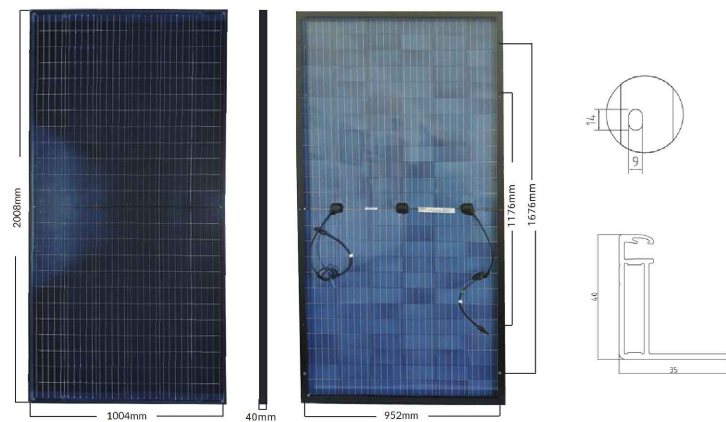
TEMPERATURE COEFFICIENTS

Temperature Coefficients P_{mpp}	-0.36%/°C
Temperature Coefficients I_{sc}	+0.046%/°C
Temperature Coefficients V_{oc}	-0.306%/°C
Normal Operating Cell Temperature (NOCT)	45°C

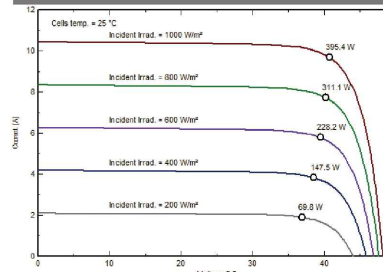
TEST OPERATING CONDITIONS

Maximum Series Fuse	20A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL1703)	5,400PA Snow Load 175mph Wind Rating
Fire Performance Class	Class C/Type 1

MODULE DIMENSIONS



I-V CURVE



BI-FACIAL OUTPUT

P_{mpp} (W) at STC	390	395	400
Bi-facial Boost 5%	404	409	414
Bi-facial Boost 10%	418	423	428
Bi-facial Boost 15%	430	436	442

MECHANICAL PROPERTIES

Cell Type	Monocrystalline
Glass	Low Iron, Tempered
Frame	Anodized Aluminum Alloy
Junction Box	IP67
Dimension	2008 x 1008 x 40mm
Output Cable	4mm ² (EU)12AWG, 39.37in(1200mm)
Weight	51.4lbs.(23.3kg)
Cable Length	1200mm

PACKAGING CONFIGURATION

Number of Modules per Pallet	27
Number of Pallets per 40ft HQ Container	22
Pallet Dimensions (mm)	2050 X 1140 X 1140
Pallet weight (kg)	680
Container weight (kg)	14960

Aptos Solar Technology reserves the right to make specification changes without notice

3140 De La Cruz Blvd., Ste. 200
Santa Clara, CA 95054
www.aptosolar.com | info@aptosolar.com

DNA-144-BF23-XXXW

RESIDENTIAL | COMMERCIAL | UTILITY

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DESIGNER:

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PR PE 17485

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				Page No 01
				Package ID / R

BASEL
ENGINEERING SERVICES

DNA-120
ALL-BLACK DESIGN
330W | 325W | 320W



Maximize Energy Production
High-efficiency, Half-cut cell panel

Advanced technology boosts power generation

Designed & engineered for extreme weather
5400 Pa snow load
5400 Pa (210 mph) wind load

All-black design for pristine aesthetics

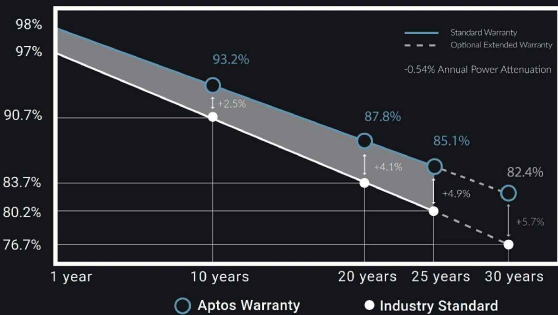
25 year extended product warranty*
30 year extended peak power warranty*

Our DNA Half-cut Cell Series impressively combines advanced technologies to maximize performance. Our patented DNA, Dual Nano Absorber, technology allows for panel operate at high efficiencies with excellent performance in high temperature environments.

*Aptos Solar Technology solar panels come with a standard 15 product warranty and 25 year peak power warranty. Customers must select optional warranty upgrade package to qualify extended 25 year product warranty and extended 30 year peak power warranty.

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Linear Performance Warranty



Factory Certifications



Product Certifications



DNA-120
BLACK FRAME, BLACK BACK-
HIGH EFFICIENCY, HALF-CUT CELL PANEL



ELECTRICAL SPECIFICATIONS (+3%/-0%)

	DNA-120-MF23-320W	DNA-120-MF23-325W	DNA-120-MF23-330W
STCrated output P _{mpp} (W)	320	325	330
Module Efficiency	18.96%	19.25%	19.54%
Open Circuit Voltage V _{oc} (V)	39.92	40.10	40.27
Short Circuit Current I _{sc} (A)	10.35	10.43	10.51
Rated Voltage V _{mpp} (V)	32.51	32.71	32.91
Rated Current I _{mpp} (A)	9.84	9.93	10.02

Standard Test Conditions for front-face of panel:
1000 W/m², 25 °C, measurement uncertainty ≤3%

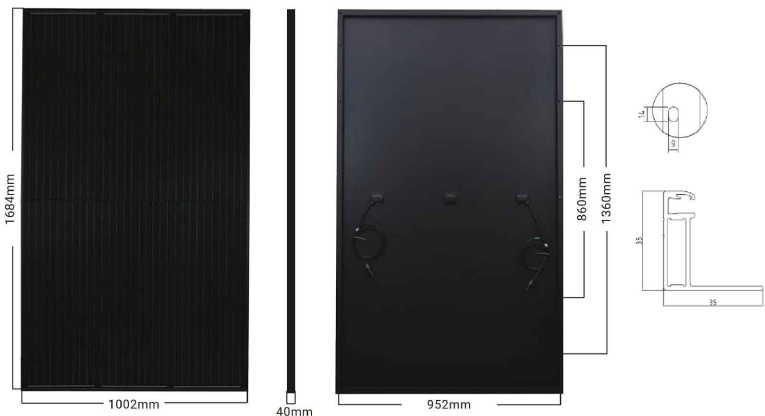
TEMPERATURE COEFFICIENTS

Temperature Coefficients P _{mpp}	-0.40%/°C
Temperature Coefficients I _{sc}	+0.046%/°C
Temperature Coefficients V _{oc}	-0.306%/°C
Normal Operating Cell Temperature (NOCT)	45 °C

TEST OPERATING CONDITIONS

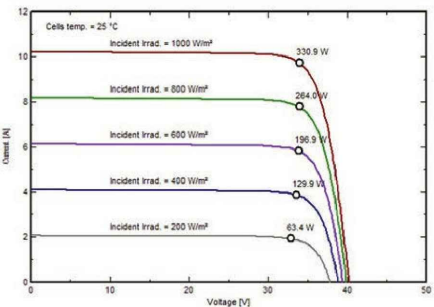
Maximum Series Fuse	20A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL1703)	Front Load: 5400 PA Snow load / 113 PSF / 2052 lbs. Rated Load Rear Load: 5400 PA Wind load / 113 PSF / 210 MPH Rated Load
Fire Performance Class	Class C/Type 1

MODULE DIMENSIONS



Aptos Solar Technology reserves the right to make specification changes without notice

I-V CURVE



MECHANICAL PROPERTIES

Cell Type	Monocrystalline
Glass	Low Iron, Tempered
Frame	Anodized Aluminum Alloy
Junction Box	IP67
Dimension	1684 x 1002 x 35mm
Output Cable	4mm ² (EU)12AWG, 39.37in(1000mm)
Weight	41.9lbs.(19kg)
Cable Length	1200mm

PACKAGING CONFIGURATION

Number of Modules per Pallet	30
Number of Pallets per 40ft HQ Container	26
Pallet Dimensions (mm)	1720X 1140 X 1140
Pallet weight (kg)	620
Container weight (kg)	16120

PRODUCT CERTIFICATIONS



3140 De La Cruz Blvd., Ste. 200
Santa Clara, CA 95054
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DNA-120-MF23-XXXW
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BASEL
ENGINEERING SERVICES

Power Optimizer

For North America

P320 / P340 / P370 / P400 / P401 / P405 / P485 / P505



POWER OPTIMIZER

PV power optimization at the module-level

- Specifically designed to work with SolarEdge inverters
- 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
- Meets NEC requirements for arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)
- Module-level voltage shutdown for installer and firefighter safety

solaredge.com



Power Optimizer
For North America

P320 / P340 / P370 / P400 / P401 / P405 / P485 / P505

Optimizer model (typical module compatibility)	P320 (for 60-cell modules)	P340 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P401 (for high power 60 and 72 cell modules)	P405 (for high-voltage modules)	P485 (for high-voltage modules)	P505 (for higher current modules)	
INPUT									
Rated Input DC Power ⁽¹⁾	320	340	370	400	405	485	505		W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		60	80	60	125 ⁽²⁾	83 ⁽²⁾		Vdc
MPPT Operating Range	8 - 48		8 - 60	8 - 80	8-60	12.5 - 105	12.5 - 83		Vdc
Maximum Short Circuit Current (Isc)	11			10.1	11.75	11	14		Adc
Maximum Efficiency				99.5					%
Weighted Efficiency				98.8			98.6		%
Overvoltage Category				II					
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREEDGE INVERTER)									
Maximum Output Current				15					Adc
Maximum Output Voltage			60			85			Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREEDGE INVERTER OR SOLAREEDGE INVERTER OFF)									
Safety Output Voltage per Power Optimizer				1 ± 0.1					Vdc
STANDARD COMPLIANCE									
EMC				FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3					
Safety				IEC62109-1 (class II safety), UL1741					
Material				UL94 V-0, UV Resistant					
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)	129 x 153 x 27.5 / 5.1 x 6 x 1.1	129 x 153 x 33.5 / 5.1 x 6 x 1.3	129 x 153 x 29.5 / 5.1 x 6 x 1.16	129 x 159 x 49.5 / 5.1 x 6.3 x 1.9	129 x 162 x 59 / 5.1 x 6.4 x 2.3				mm / in
Weight (including cables)	630 / 1.4	750 / 1.7	655 / 1.5	845 / 1.9	1064 / 2.3				gr / lb
Input Connector			MC4 ⁽³⁾		Single or dual MC4 ⁽⁴⁾	MC4 ⁽⁵⁾			
Input Wire Length			0.16 / 0.52						m / ft
Output Wire Type / Connector			Double Insulated / MC4						
Output Wire Length	0.9 / 2.95		1.2 / 3.9						m / ft
Operating Temperature Range ⁽⁶⁾			-40 - +85 / -40 - +185						°C / °F
Protection Rating			IP68 / NEMA6P						
Relative Humidity			0 - 100						%

(1) Rated power of the module at STC will not exceed the optimizer "Rated Input DC Power". Modules with up to +5% power tolerance are allowed
(2) NEC 2017 requires max input voltage be not more than 80V
(3) For other connector types please contact SolarEdge
(4) For dual version for parallel connection of two modules use P485-4NMDVRM. In the case of an odd number of PV modules in one string, installing one P485 dual version power optimizer connected to one PV module. When connecting a single module seal the unused input connectors with the supplied pair of seals
(5) For ambient temperature above +85°C / +185°F power de-rating is applied. Refer to Power Optimizers Temperature De-Rating Technical Note for more details.

PV System Design Using a SolarEdge Inverter ⁽⁶⁾⁽⁷⁾	Single Phase HD-Wave	Single phase	Three Phase for 208V grid	Three Phase for 277/480V grid	
Minimum String Length (Power Optimizers)	P320, P340, P370, P400, P401	8	10	18	
	P405, P485, P505	6	8	14	
Maximum String Length (Power Optimizers)		25	25	50 ⁽⁸⁾	
Maximum Power per String	5700 (6000 with SE7600-US - SE1400-US)	5250	6000 ⁽⁹⁾	12750 ⁽¹⁰⁾	W
Parallel Strings of Different Lengths or Orientations		Yes			

(6) For detailed string sizing information refer to: http://www.solaredge.com/sites/default/files/string_sizing_na.pdf
(7) It is not allowed to mix P405/P485/P505 with P320/P340/P370/P400/P401 in one string
(8) A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement
(9) For 208V grid: it is allowed to install up to 7,200W per string when the maximum power difference between each string is 1,000W
(10) For 277/480V grid: it is allowed to install up to 15,000W per string when the maximum power difference between each string is 2,000W

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BASEL
ENGINEERING SERVICES

Single Phase Inverter with HD-Wave Technology

for North America

SE3000H-US / SE3800H-US / SE5000H-US / SE6000H-US /
SE7600H-US / SE10000H-US / SE11400H-US



Optimized installation with HD-Wave technology

- Specifically designed to work with power optimizers
- Record-breaking efficiency
- Fixed voltage inverter for longer strings
- Integrated arc fault protection and rapid shutdown for NEC 2014 and 2017, per article 690.11 and 690.12
- UL1741 SA certified, for CPUC Rule 21 grid compliance
- Extremely small
- Built-in module-level monitoring
- Outdoor and indoor installation
- Optional: Revenue grade data, ANSI C12.20 Class 0.5 (0.5% accuracy)

solaredge.com

solaredge

INVERTERS

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-USSE3800H-USSE5000H-USSE6000H-USSE7600H-USSE10000H-USSE11400H-US									
OUTPUT									
Rated AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA	
Maximum AC Power Output	3000	3800 @ 240V 3300 @ 208V	5000	6000 @ 240V 5000 @ 208V	7600	10000	11400 @ 240V 10000 @ 208V	VA	
AC Output Voltage Min.-Nom.-Max. (211 - 240 - 264)	✓	✓	✓	✓	✓	✓	✓	Vac	
AC Output Voltage Min.-Nom.-Max. (183 - 208 - 229)	-	✓	-	✓	-	-	✓	Vac	
AC Frequency (Nominal)	59.3 - 60 - 60.5 ⁽¹⁾							Hz	
Maximum Continuous Output Current @240V	12.5	16	21	25	32	42	47.5	A	
Maximum Continuous Output Current @208V	-	16	-	24	-	-	48.5	A	
GFDI Threshold	1							A	
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes								
INPUT									
Maximum DC Power @240V	4650	5900	7750	9300	11800	15500	17650	W	
Maximum DC Power @208V	-	5100	-	7750	-	-	15500	W	
Transformer-less, Ungrounded	Yes								
Maximum Input Voltage	480							Vdc	
Nominal DC Input Voltage	380				400			Vdc	
Maximum Input Current @240V ⁽²⁾	8.5	10.5	13.5	16.5	20	27	30.5	Adc	
Maximum Input Current @208V ⁽²⁾	-	9	-	13.5	-	-	27	Adc	
Max. Input Short Circuit Current	45							Adc	
Reverse-Polarity Protection	Yes								
Ground-Fault Isolation Detection	600k Ω Sensitivity								
Maximum Inverter Efficiency	99	99.2						%	
CEC Weighted Efficiency	99						99 @ 240V 98.5 @ 208V	%	
Nighttime Power Consumption	< 2.5							W	
ADDITIONAL FEATURES									
Supported Communication Interfaces	RS485, Ethernet, ZigBee (optional), Cellular (optional)								
Revenue Grade Data, ANSI C12.20	Optional ⁽³⁾								
Rapid Shutdown - NEC 2014 and 2017 690.12	Automatic Rapid Shutdown upon AC Grid Disconnect								
STANDARD COMPLIANCE									
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-I)								
Emissions	FCC Part 15 Class B								
INSTALLATION SPECIFICATIONS									
AC Output Conduit Size / AWG Range	1" Maximum / 14-6 AWG					1" Maximum /14-4 AWG			
DC Input Conduit Size / # of Strings / AWG Range	1" Maximum / 1-2 strings / 14-6 AWG					1" Maximum / 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				<50				dBA
Cooling	Natural Convection								
Operating Temperature Range	-13 to +140 / -25 to +60 ⁽⁴⁾ (-40°F / -40°C option) ⁽⁵⁾							°F / °C	
Protection Rating	NEMA 4X (Inverter with Safety Switch)								

⁽¹⁾ For other regional settings please contact SolarEdge support

⁽²⁾ A higher current source may be used; the inverter will limit its input current to the values stated

⁽³⁾ Revenue grade inverter P/N: SExxxxH-US000NNG2

⁽⁴⁾ For power de-rating information refer to: <https://www.solaredge.com/sites/default/files/se-temperature-derating-note-na.pdf>

⁽⁵⁾ -40 version P/N: SExxxxH-US000NNU4

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BASEL
ENGINEERING SERVICES

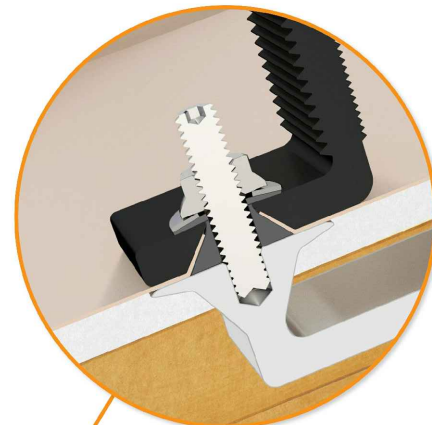


Knockout Tile

A Breakthrough Tile Solution

Solar installs on tile roofs can be messy and complicated. These jobs often require tile grinding to ensure fit, a struggle to align mounting components, and extensive searches to find the replacements for broken tiles.

Knockout Tile is the solution. The replacement mount rapidly and reliably integrates into the existing roof system. With the strike of a hammer, you create a solid stack of high-performance, form-fitting components which fully encases the waterproof seal. The result? Unprecedented speed and flexibility during installation.



Form-Fit Waterproofing

Knockout Tile keeps water down and out with its unique compression seal technology formed by joining the flashing, gasket, and L-foot through a single strike of the hammer.



Triple Certified to Protect the Roof

Listed to UL 2703 for bonding and mechanical loading, and passed both the UL 441 Section 27 rain test and TAS 100(A)-95 wind-driven rain test.

Universal Base

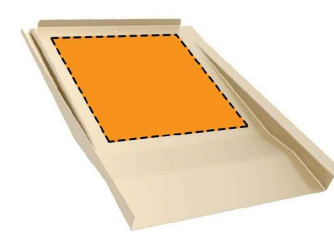
Strong, yet light with a compact footprint, Knockout Tile base can be placed anywhere along the rafter in any orientation. The universal base is used with Flat, S, and W flashings.

Concentric Loading

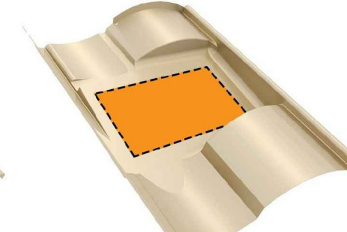
Minimal offset between the lag bolt and L-foot improves structural performance, and makes possible the use of a single lag. That translates into a 40% higher loading capacity and half the number of roof penetrations.

No Struggling to Align Components

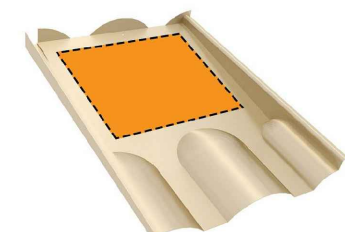
Punch through the flashing anywhere in these zones.



Flat Tile

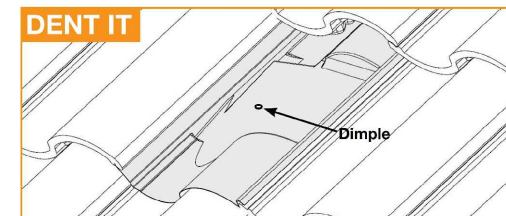


S-Tile



W-Tile

DENT IT



Deliver a Knockout in Record Time

Remove the tile and mark the rafter. Use the base as guide to drill 1/4" pilot hole and fill with roofing manufacturer's approved sealant.

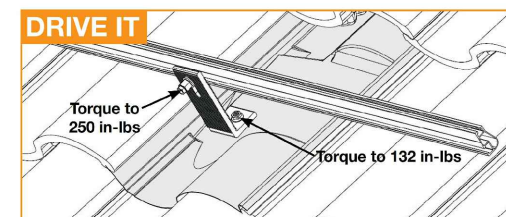
STRIKE IT



Insert the lag bolt with bonded washer through the base into the pilot hole. The base can be installed parallel or perpendicular to the rafter.

Press the Tile Replacement Flashing onto the base until a dent forms over the post. Form the edges of the flashing to quickly create a tight fit.

DRIVE IT



Place the L-Foot over the top of the dent and strike with the hammer to punch the threaded post through the flashing.

Once the L-Foot is positioned, torque the hardware to 132 in-lbs and attach the rail to either side of the L-Foot and torque hardware to 250 in-lbs.

25-Year Warranty

When using Knockout Tile with XR Rail, the entire assembly is covered by IronRidge's 25-year warranty. To learn more about IronRidge's product warranty, visit the IronRidge website at www.ironridge.com.

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BASEL
ENGINEERING SERVICES

QRail® System

QClick Technology®
Rail Mounting System



Quick Mount PV®
RESPECT THE ROOF

2.2 QRail System Components

Components	Product Rendering	Torque Value
QRail options: Standard in various lengths Light in various lengths Mill or Black finish		
Internal QSplice: For Standard & Light QRail sizes		
Fixed Size End Clamps w/ QClick Technology®: For modules from 31-50mm thick Mill or Black finish		96 in-lbs (11N-m)
Universal End Clamps w/ QClick Technology®: 2 clamps for modules from 30-45mm or 38-50mm thick Mill or Black finish		96 in-lbs (11N-m)
Hidden End Clamps		108 in-lbs (12N-m)
Universal Bonding Mid Clamps w/ QClick Technology®: 2 clamps for modules from 30-45mm or 38-50mm thick Mill or Black finish		144 in-lbs (16N-m)
QMR-GLQ-A-50 Grounding Lug: Can be installed in any rail channel		T-bolt: 192 in-lbs (22N-m) Wire capture bolt: 6-8 AWG: 60 in-lbs (7N-m) 10-12 AWG: 36 in-lbs (4N-m)
T-Bolt: For attaching roof attachments, MLPEs, and grounding lugs to the rail		192 in-lbs (22N-m)
End Cap options: For Standard & Light QRail sizes Black finish		

BI 7.2.3-46

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Aug-2020, Rev 11

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