

Introduction

This manual contains information about electrical and mechanical installation of the solar panels: DNA-108 and DNA-120 Series

Disclaimer of Liability

Installation techniques and methods of this product is beyond Aptos Solar Technology's control. AST does not assume responsibility of loss or damage resulting from improper installation, handling or use. AST disclaims liability for damage, loss, expense arising out of, or in any way connected with installation, use or maintenance by using this manual.

Regulation Information

This certified product meets the UL61730 standard for maximum system voltage of 1500V with maximum overcurrent protection rating of 25A. The installer or system integrator is assumed the responsibility to ensure compliance with all local electrical codes which may be applicable. **Warnings & Safety**

Solar panels generate electricity when exposed to light, which can cause lethal shock and burn hazards.

Only authorized, qualified and trained installers should handle these solar panels. Do not touch live terminals with bare hands. Work only in dry weather with dry solar panels and tools.

Do not make connections while under load. Do not disconnect under load. Use insulated tools for electrical connections. Do not step or stand on the solar panel. Do not disassemble the solar panel or junction box.

Carry panel with two or more person. Do not carry by its wires or junction box. Wear non-slip, suitable gloves and protective clothing.

Do not install the solar panel where flammable vapors or gases are present. Do not install in corrosive environment.

Do not direct artificially concentrated sunlight on solar panel.

Under normal conditions, a photovoltaic module is likely to experience conditions that produce higher current and/or voltage than reported at standard test conditions. Accordingly, the values of I_{sc} and V_{oc} marked on this PV module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor current ratings, and size of controls (e.g., inverter) connected to the PV output.

The module is considered to be in compliance with this standard only when the module is either mounted in the manner specified by the mounting instructions, or when the mounting means has been evaluated with this PV module to UL 2703. A module with exposed conductive parts is considered to be in compliance with this standard only when it is either electrically grounded in accordance with the manufacturer's instructions and the requirements of the National Electrical Code, ANSI/NFPA 70 (2014-2017), or when the bonding means has been evaluated with this PV module to UL 2703.

Fire Rating

If mounted over a roof, the solar panel shall be mounted over a fire-resistant roof covering rated for the application. Refer to local authority for guidelines and regulations for building fire protection and required slope. The module fire performance rating is Type I.

Installing the Panel

Aptos Solar Technology panels may be installed in various applications. The particular mounting is to be defined by the system designer. Installer must handle and mount the modules to prevent any impact on front surface, back surface, and frames as this could result in damage.

Support structures used to support AST DNA panels should be wind rated and approved for use by the appropriate codes prior to installation. In addition, they must be designed from materials that retain structural integrity over the 25 years lifespan of the panels they support.

AST DNA panels may be installed in portraits or landscape orientation.

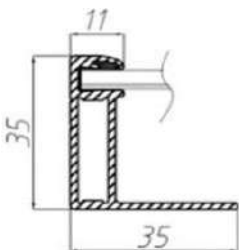
A minimum of tilt angle of 5 degrees is required to ensure drainage and enable rainwater.

The junction box edge should be at the top when mounted in portrait orientation.

Specific rails and frame clips approved by AST are listed in Table 1. Alternative rails and frame clips/fasteners need to be approved by AST to ensure compliance to UL61730 safety standard.

De-rating factors must be applied if installed above 2000m.

Frame Cross Section



Module Wiring

AST DNA panels are pre-wired and terminated with MC4 compatible connectors.

Connections to other panels should use compatible connectors that comply with Code requirements. AST recommends that all wiring be double insulated with a minimum rating of 90 C, and wiring should use flexible copper conductors where minimum size should be determined by the applicable codes.

The cables and connectors are UV and weather resistant from -40 C to +90 C and rated for 1500VDC.

Panels may be wired in series or parallel to obtain desired voltages and current but must not exceed the system rating for voltage and current.

AST panels may produce up to 20% more power than STC rating, depending on system design and albedo.

The additional power gain should be taken into consideration when determining optimum system sizing, string length, and selecting system components and wiring.

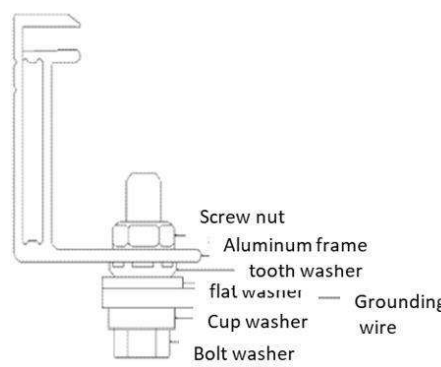
Overcurrent protection devices should be employed.

25A current rating for series or parallel. Please comply with all code and design requirements.

Grounding

NEC, article 250 governs grounding method. Grounding method must follow local electric codes. Use bolt, M4, cup washer, grounding wires, flat washer, tooth washer, screw nut, M4 and install as shown in the diagram below.

Torque specification is 2 to 3 Nm. Grounding materials is evaluated under UL1703.



cup washer: SS $\Phi 9 \Phi 4.3$ h8

grounding wires: single conductor, the cross section of conductor is no less than 4mm^2

flat washer: SS $\Phi 9 \Phi 4.3$ h8

tooth washer: SS $\Phi 7.8 \Phi 4.3$ Thickness: 0.5 number of gears: 11

screw nut M4: SS

Specifications

The electrical characteristics are within $\pm 10\%$ of the indicated values of I_{sc} , I_{mp} , V_{mp} , and V_{oc} and $\pm 3\%$ of the indicated value P_{max} under standard testing conditions (irradiance of 1000W/m^2 , AM 1.5 spectrum, and a cell temperature of 25C)

Under normal conditions, solar panels are likely to experience conditions that produce more current and/or voltage than stated at standard test conditions.

Accordingly, the values of I_{sc} and V_{oc} , inclusive of bifacial gain, should be multiplied by a factor of 1.25, or more, when determining component voltage ratings, and size of controls connected to the PV output. (Refer to code and design requirements).

AST DNA panels have a maximum system voltage of 1500 VDC. Some grid-tied systems operate or near this voltage rating. The V_{oc} increases as the ambient temperature decreases.

Maximum system voltage is computed as the sum of the open-circuit voltage of the series-connected panels for the lowest expected ambient temperature.

Temperature coefficients can be used to provide the most accurate prediction of the panel voltage under temperature extremes.

Maintenance

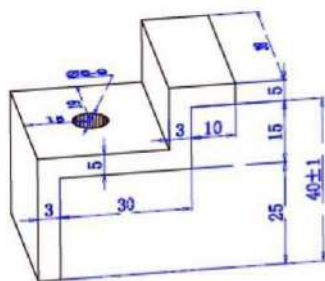
ASTDNA panels are designed to require little to no maintenance. Depending on local conditions, panels may need periodic cleaning to remove dirt build-up and soiling. Panels should be washed with water to remove dirt and soiling. Frequency of cleaning will depend on local weather conditions and panel tilt. Once a year, have qualified service professional check the general condition of wiring and check to be sure that mounting hardware is at the correct torque. Loose connections may result in damaged panels.

Panels generate electricity when there is sunlight, and cleaning/maintenance personnel must take proper precautions.

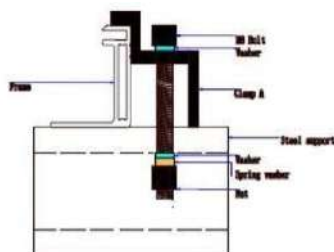
Mechanical Drawings

Installers must use pre-drilled mounting holes on the frame.

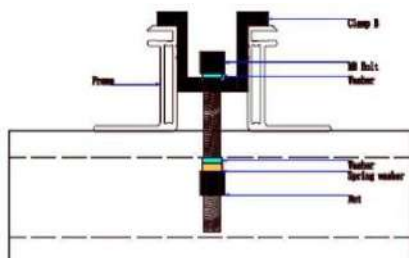
Frame clip must have minimum height dimension as shown.



End Frame Clip



Mid Frame Clip



Mounting Methods

Mounting holes are 14mm by 9mm. M8 bolt and fasteners.

Torque value is 12.5 Nm – 18 Nm.

Rails can run perpendicular or parallel to panel length. (See figure 1)

Fasteners

Bolt: M8 Stainless steel, abbreviated as ss

Flat washer : $\Phi 16-\Phi 8.4$ H1.6 ss

Spring washer: $\Phi 12.6-\Phi 8.4$ H4.7 ss

General Information

Slope should be less than 5 in/ft (127 mm/305mm) required to maintain a fire class rating. Any roof penetration required to mount the module must be properly sealed to prevent leaks. The modules are rated fire class C and are suitable for mounting over class A roof.

Pole Mount

When installing a module on a pole, choose a pole and module mounting structure that will withstand anticipated winds for the area.

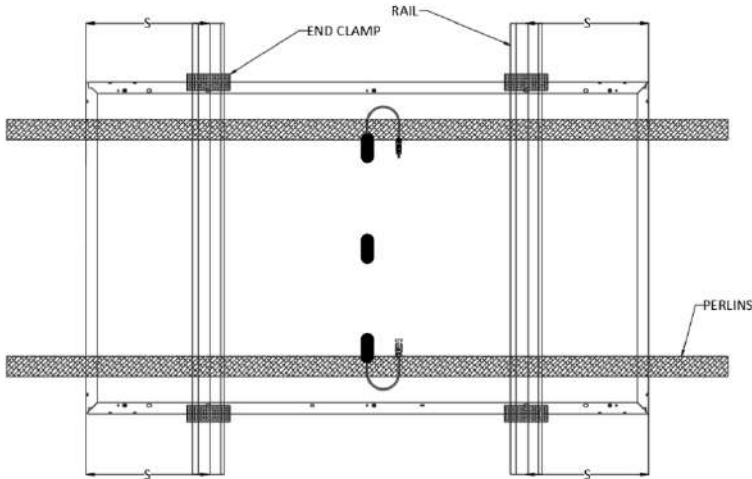
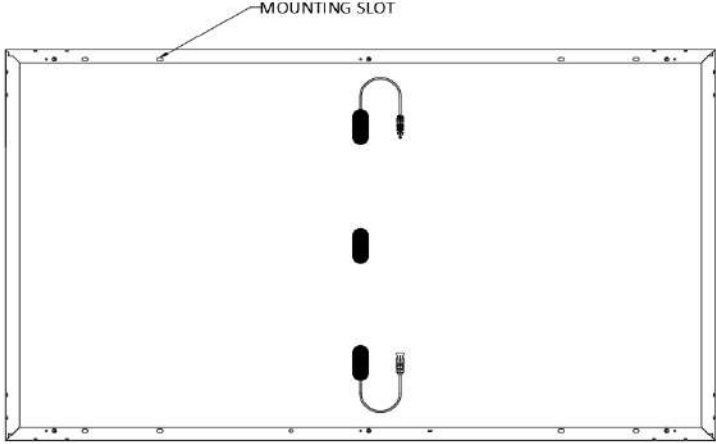
Modules Installed with Mounting Holes

Modules should be bolted with M8 to the support structures through mounting holes located in the frame in the back flanges. See table in the following page. Torque should be 12.5-18 Nm for tightening the M8 bolt.

Modules Installed with Clamping

Modules should be bolted to the support structures rail by metal clamps. It is recommended to use clamp under the following conditions or Approved by system installation. Clamping distance is quarter of the module length. See table in the following page.

Clamp materials: Aluminum, Bolt torque: 12.5 – 18 NM, clamp must not contact the front glass, bolt: M8 SS, flat washer: diameter 16-8.4 mm H1.6 ss, spring washer: diameter 12.6-8.4 mm H4.7 ss.

	High level loading condition (Apply to harsher environment conditions, such as storm.) Test load* is 5400Pa (Front and Back), safety factor is 1.5.
Clamping System	Permissible range of clamp $(1/4L) < S \leq (1/4L)$ 
Mounting System	

*Testing Setup for MLT (Mechanical Load Testing)			
Model Name	Model No.	Model Name	Model No.
SnapNrack Rail PN	015-10198	K2 End clamps	4005270
SnapNrack Mid clamp PN	242-02051	K2 Rails	CR80
SnapNrack End clamp PN	242-02065		
SnapNrack L-foot PN	242-01223		

DNA 108-BF10-400W, 405W, 410W, 415W

Electrical Specifications	DNA-108-BF10-400W		DNA-108-BF10-405W		DNA-108-BF10-410W		DNA-108-BF10-415W	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Rated Output P _{mp} (W)	400W	299W	405W	303W	410W	307W	415W	311W
Open Circuit Voltage V _{oc} (V)	37.18	35.14	37.27	35.22	37.36	35.31	37.45	35.39
Short Circuit Current I _{sc} (A)	13.50	11.98	13.63	12.10	13.77	12.22	13.90	12.34
Rated Voltage V _{mp} (V)	32.01	28.81	32.11	28.88	32.21	28.95	32.30	29.02
Rated Voltage I _{mp} (A)	12.49	10.39	12.61	10.49	12.72	10.60	12.84	10.70
Module Efficiency	20.48%		20.74%		20.99%		21.25%	
STC for front-face of panel: 1000 W/m², 25°C, measurement uncertainty ≤3% NOCT for front-face of panel: 800W/m², 45°C, Wind speed 1 m/s								

Bifacial Output-Rearside Power Gain

5%-Maximum Power (Pmax)	400W	425W	431W	435W
5%-Module Efficiency STC(%)	21.51%	21.78%	22.05%	22.31%
15%-Maximum Power (Pmax)	460W	467W	472W	477W
15%-Module Efficiency STC(%)	23.56%	23.85%	24.15%	24.44%
25%-Maximum Power (Pmax)	500W	506W	513W	518W
25%-Module Efficiency STC(%)	25.60%	25.93%	26.25%	26.57%

Test Operating Conditions

Maximum Series Fuse	30A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 5400 Pa Wind Load
Fire Performance Type	Type 1



DNA 108-MF10-400W, 405W, 410W, 415W

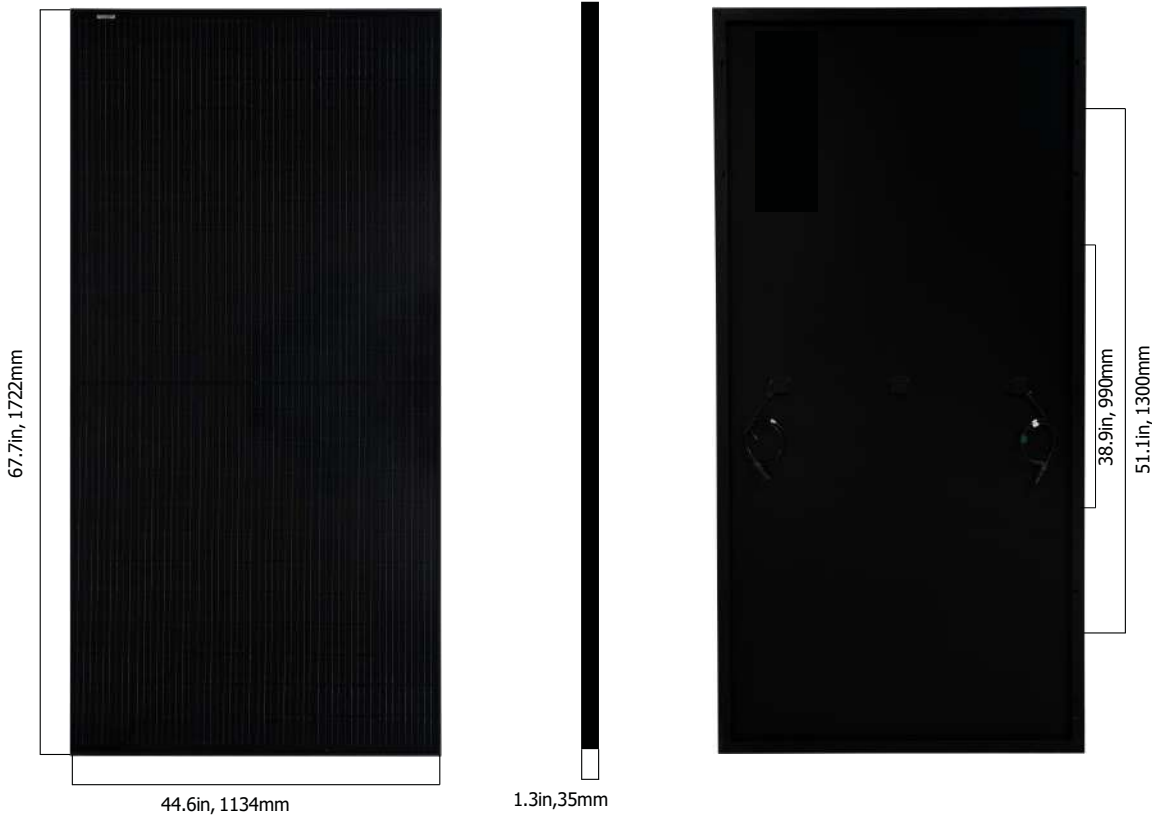
Electrical Specifications	DNA-108-MF10-400W		DNA-108-MF10-405W		DNA-108-MF10-410W		DNA-108-MF10-415W	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Rated Output P _{mp} (W)	400W	299W	405W	303W	410W	307W	415W	311W
Open Circuit Voltage V _{oc} (V)	37.14	35.11	37.23	35.19	37.32	35.27	37.41	35.36
Short Circuit Current I _{sc} (A)	13.40	12.11	13.65	12.11	13.78	12.23	13.92	12.35
Rated Voltage V _{mp} (V)	32.33	28.78	32.42	28.85	32.51	28.92	32.60	28.99
Rated Current I _{max} (A)	12.37	10.39	12.49	10.50	12.61	10.61	12.73	10.71
Module Efficiency	20.47%		20.78%		20.99%		21.25%	
STC for front-face of panel: 1000 W/m², 25°C, measurement uncertainty ≤3% NOCT for front-face of panel: 800W/m²,45°C, Wind speed 1 m/s								

Temperature Coefficients

Temperature Coefficients P_{mpp}	-0.32%/°C
Temperature Coefficients I_{sc}	+0.045%/°C
Temperature Coefficients V_{oc}	-0.27%/°C
Nominal Operating Cell Temperature (NOCT)	45°C

Test Operating Conditions

Maximum Series Fuse	25A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 5400 Pa Wind Load
Fire Performance Type	Type 1



DNA-120-BF10-445W, 450W, 455W, 460W

Electrical Specifications	DNA-120-BF10-445W		DNA-120-BF10-450W		DNA-120-BF10-455W		DNA-120-BF10-460W	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
STC Rated Output P _{mpp} (W)	445W	333W	450W	337W	455W	341W	460W	344W
Open Circuit Voltage V _{voc} (V)	41.61	39.32	41.70	39.41	41.09	39.50	41.18	38.92
Short Circuit Current I _{sc} (A)	13.42	11.90	13.54	12.01	13.66	12.12	14.01	12.43
Rated Voltage V _{mp} (V)	35.11	32.25	35.20	32.32	35.29	32.39	35.40	32.44
Rated Voltage I _{mp} (A)	12.67	10.33	12.78	10.42	12.89	10.51	12.99	10.60
Module Efficiency	20.57%		20.79%		21.03%		21.26%	
STC for front-face of panel: 1000 W/m², 25°C, measurement uncertainty ≤3% NOCT for front-face of panel: 800W/m², 45°C, Wind speed 1 m/s								

Bifacial Output-Rearside Power Gain

5%-Maximum Power (Pmax)	467W	473W	478W	483W
5%-Module Efficiency STC(%)	21.60%	21.84%	22.08%	22.32%
15%-Maximum Power (Pmax)	512W	518W	523W	529W
15%-Module Efficiency STC(%)	23.65%	23.92%	24.18%	24.45%
25%-Maximum Power (Pmax)	556W	563W	569W	575W
25%-Module Efficiency STC(%)	25.71%	26.00%	26.29%	26.58%

Test Operating Conditions

Maximum Series Fuse	30A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 5400 Pa Wind Load
Fire Performance Type	Type 1



DNA-120-MF10-445W, 450W, 455W, 460W

Electrical Specifications	DNA-120-MF10-445W		DNA-120-MF10-450W		DNA-120-MF10-455W		DNA-120-MF10-460W	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
STC Rated Output P _{mp} (W)	445W	331W	450W	336W	455W	341W	460W	344W
Open Circuit Voltage V _{oc} (V)	41.15	39.31	41.26	39.50	41.37	39.55	41.48	39.67
Short Circuit Current I _{sc} (A)	13.77	11.96	13.85	11.99	13.93	12.12	14.01	12.20
Rated Voltage V _{mp} (V)	33.72	32.02	33.88	32.39	34.04	32.36	34.20	32.53
Rated Voltage I _{mp} (A)	13.21	10.34	13.29	10.40	13.37	10.50	13.45	10.58
Module Efficiency	20.57%		20.79%		21.03%		21.26%	
STC for front-face of panel: 1000 W/m², 25°C, measurement uncertainty ≤3% NOCT for front-face of panel: 800W/m², 45°C, Wind speed 1 m/s								

Temperature Coefficients

Temperature Coefficients P_{mp}	-0.35%/°C
Temperature Coefficients I_{sc}	+0.054%/°C
Temperature Coefficients V_{oc}	-0.27%/°C
Nominal Operating Cell Temperature (NOCT)	45±2°C

Test Operating Conditions

Maximum Series Fuse	25A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 5400 Pa Wind Load
Fire Performance Type	Type 1



DNA-132-BF10-490W, 495W, 500W

Electrical Specifications	DNA-132-BF10-490W	DNA-132-BF10-495W	DNA-132-BF10-500W
STC Rated Output P_{mpp} (W)	490W	495W	500W
Module Efficiency	20.63%	20.84%	21.05%
Open Circuit Voltage V_{voc} (V)	45.33	45.45	45.59
Short Circuit Current I_{sc} (A)	13.24	13.31	13.38
Rated Voltage V_{mp} (V)	37.99	38.17	38.35
Rated Voltage I_{mp} (A)	12.90	12.97	13.04
Standard Test Conditions for front-face of panel: 1000 W/m ² , 25°C, measurement uncertainty $\leq 3\%$			

Bifacial Output-Rearside Power Gain			
5%-Maximum Power (Pmax)	515W	520W	525W
5%-Module Efficiency STC(%)	21.66%	21.88%	22.10%
15%-Maximum Power (Pmax)	564W	570W	575W
15%-Module Efficiency STC(%)	23.73%	23.97%	24.21%
25%-Maximum Power (Pmax)	613W	619W	625W
25%-Module Efficiency STC(%)	25.79%	26.05%	26.32%

Test Operating Conditions		
Maximum Series Fuse		30A
Maximum System Voltage		1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	2400 PA Snow Load / 2400 Pa Wind Load	
Fire Performance Class		Class C/Type 1

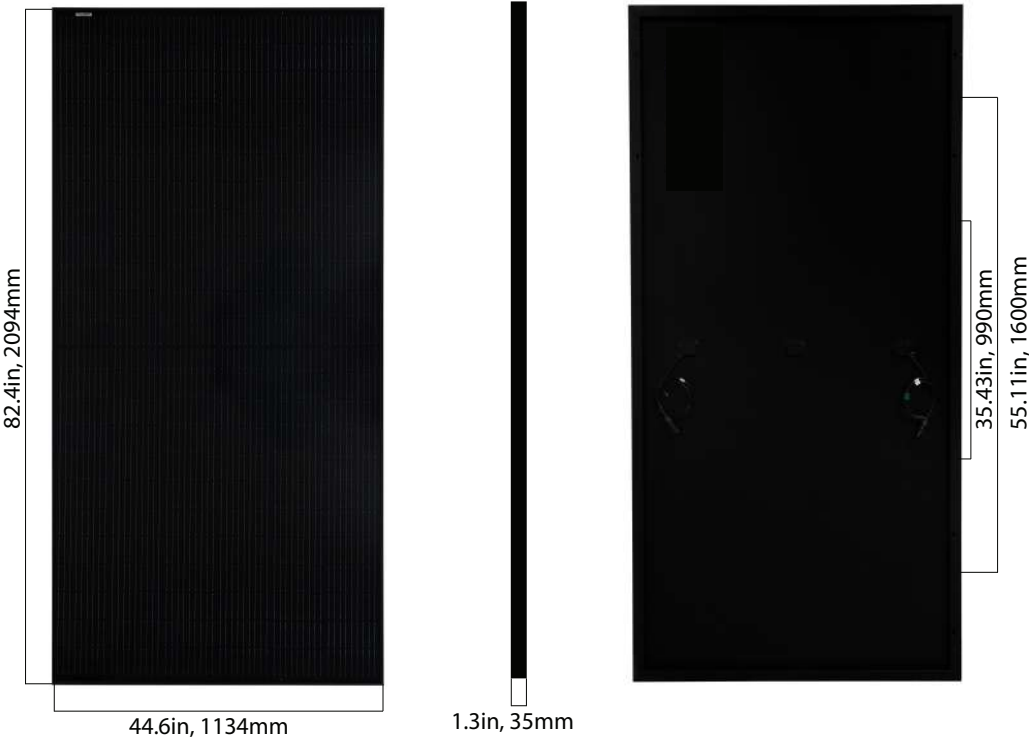


DNA-132-MF10-480W, 485W, 490W

Electrical Specifications	DNA-132-MF10-480W	DNA-120-MF10-485W	DNA-120-MF10-490W
STC rated Output P_{mpp} (W)	480W	485W	440W
Module Efficiency	19.92%	20.15%	20.38%
Open Circuit Voltage V_{OC} (V)	44.95	45.10	45.25
Short Circuit Current I_{SC} (A)	13.59	13.67	13.74
Rated Voltage V_{mpp} (V)	37.78	37.93	38.08
Rated Current I_{max} (A)	12.71	12.79	12.87
Standard Test Conditions for front-face of panel: 1000 W/m ² , 25°C, measurement uncertainty $\leq 3\%$			

Temperature Coefficients	
Temperature Coefficients P_{mpp}	-0.35%/°C
Temperature Coefficients I_{SC}	+0.054%/°C
Temperature Coefficients V_{OC}	-0.27%/°C
Nominal Operating Cell Temperature (NOCT)	45°C

Test Operating Conditions	
Maximum Series Fuse	25A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	2400 PA Snow Load / 2400 Pa Wind Load
Fire Performance Class	Class C/Type 1



DNA-144-BF10-540W, 545W, 550W

Electrical Specifications	DNA-144-BF10-540W	DNA-144-BF10-545W	DNA-144-BF10-550W
STC Rated Output P_{mpp} (W)	540W	545W	550W
Module Efficiency	20.90%	21.09%	21.29%
Open Circuit Voltage V_{voc} (V)	49.50	49.65	49.80
Short Circuit Current I_{sc} (A)	13.30	13.37	13.44
Rated Voltage V_{mp} (V)	41.65	41.80	41.95
Rated Voltage I_{mp} (A)	12.97	13.04	13.11
Standard Test Conditions for front-face of panel: 1000 W/m ² , 25°C, measurement uncertainty $\leq 3\%$			

Bifacial Output-Rearside Power Gain			
5%-Maximum Power (Pmax)	567W	572W	578W
5%-Module Efficiency STC(%)	21.94%	22.14%	22.35%
15%-Maximum Power (Pmax)	621W	627W	633W
15%-Module Efficiency STC(%)	24.03%	24.27%	24.50%
25%-Maximum Power (Pmax)	675W	682W	688W
25%-Module Efficiency STC(%)	26.12%	26.40%	26.63%

Test Operating Conditions		
Maximum Series Fuse		30A
Maximum System Voltage		1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	2400 PA Snow Load / 2400 Pa Wind Load	
Fire Performance Class		Class C/Type 29

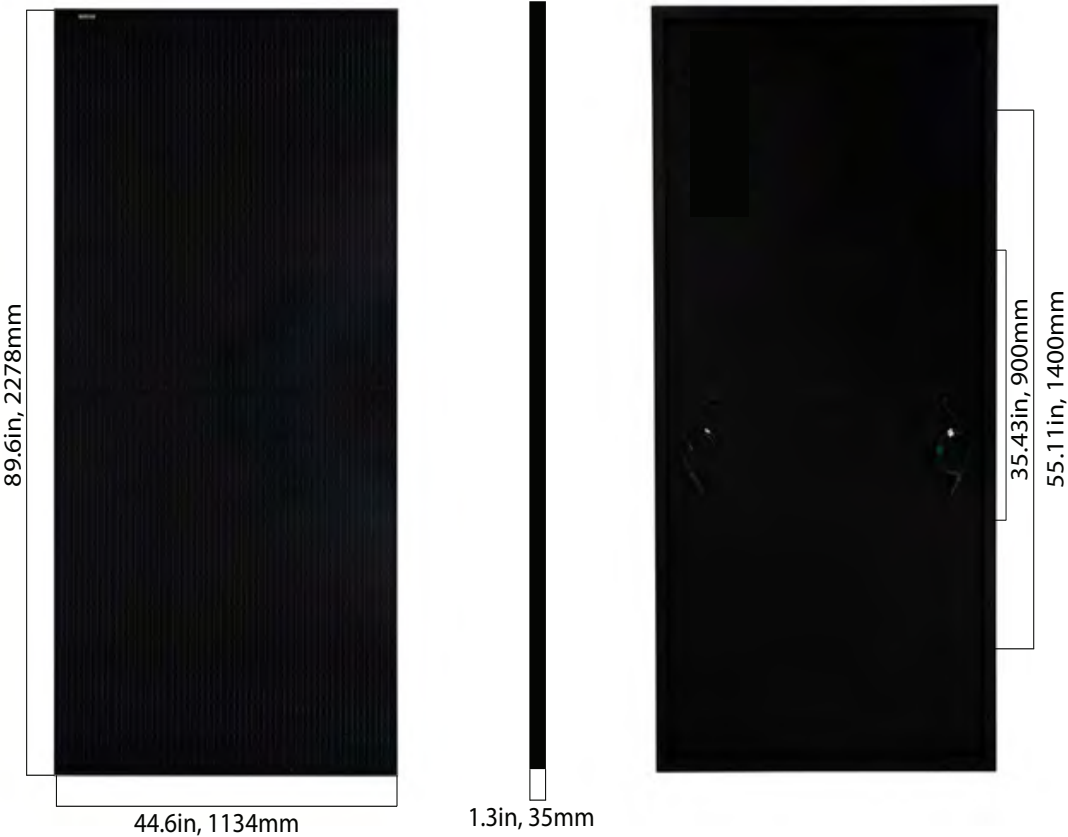


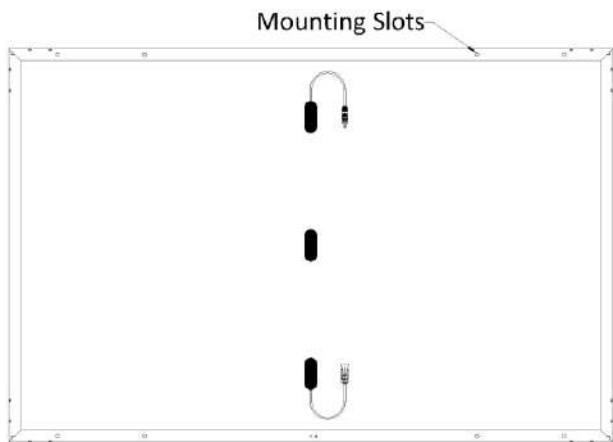
DNA-144-MF10-540W, 545W, 550W

Electrical Specifications	DNA-144-MF10 -540W	DNA-144-MF10 -545W	DNA-144-MF10 -550W
STC rated Output P_{mpp} (W)	540W	545W	550W
Module Efficiency	20.90%	21.09%	21.29%
Open Circuit Voltage V_{oc} (V)	49.50	49.65	49.50
Short Circuit Current I_{sc} (A)	13.30	13.37	13.44
Rated Voltage V_{mmp} (V)	41.65	41.80	41.95
Rated Current I_{max} (A)	12.97	13.04	13.11
Standard Test Conditions for front-face of panel: 1000 W/m ² , 25°C, measurement uncertainty ≤3%			

Temperature Coefficients	
Temperature Coefficients P_{mmp}	-0.35%/°C
Temperature Coefficients I_{sc}	+0.054%/°C
Temperature Coefficients V_{oc}	-0.27%/°C
Nominal Operating Cell Temperature (NOCT)	45°C

Test Operating Conditions	
Maximum Series Fuse	25A
Maximum System Voltage	1,500 VDC (UL&IEC)
Maximum Load Capacity (Per UL 1703)	5400 PA Snow Load / 4000 Pa Wind Load
Fire Performance Class	Class C/Type 1





Junction Box Information

Overcurrent protection type: none

of bypass diodes: 3

Diameter of cables: every module has 2 cables whose diameter is 4mm² for any one of them, and it can endure 90°C insulation and can be exposed under sun light.

Ways of connecting

Every module with 2 connectors that are positive electrode and negative electrode. When modules are installed in series, the first positive connector should connect with the negative connector of the next module.

The modules are equipped with PV wiring connectors that comply with the Standard for Connectors for use in photovoltaic systems, UL 61730, the specific allowable mating connector manufacturer and model number are listed as below.

Electrical Connectors
PV-KBT4-EVO2
PV-KST4-EVO2