

### Introduction

This manual contains information about electrical and mechanical installation of the solar panels: DNA-144-XXXW-DG

### 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 30A. 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 29.

### 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.

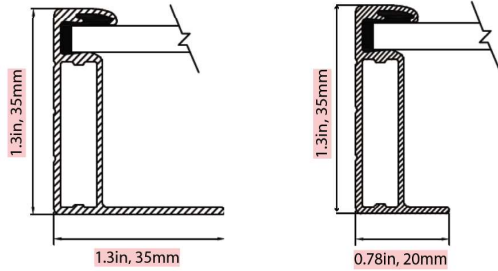
A minimum of tilt angle of 5 degrees is required to ensure drainage and enable rainwater.

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.

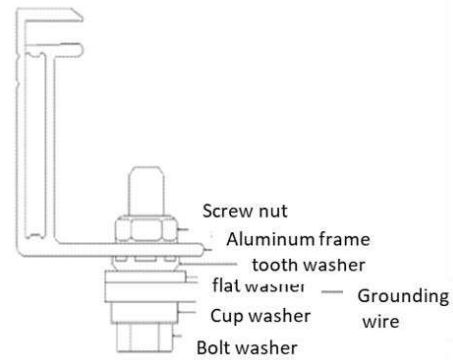
Overcurrent protection devices should be employed.

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  $4\text{mm}^2$

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  $1000/\text{m}^2$ , AM 1.5 spectrum, and a cell temperature of  $25\text{C}$ )

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

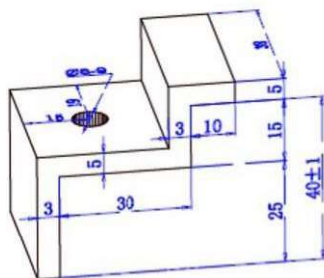
AST DNA panels are designed to require little to no maintenance. Depending on local conditions, panels may need periodic cleaning to remove dirt build-up and soiling. Panels should be washed with water to remove dirt and soiling. Frequency of cleaning will depend on local weather conditions and panel 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.

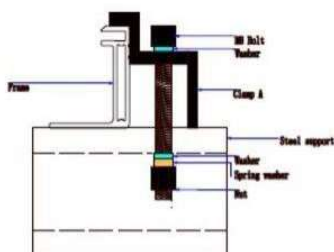
### Mechanical Drawings

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

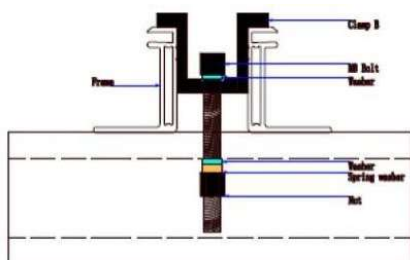
Frame clip must have minimum height dimension as shown.



### 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.

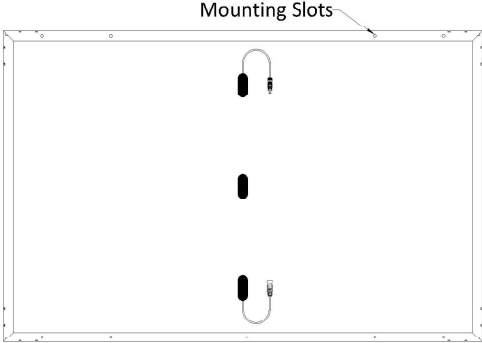
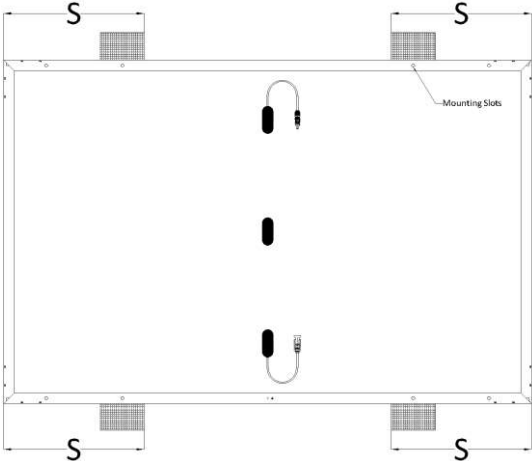
### Modules Installed with Mounting Holes

Modules should be bolted with M8 and M6 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, the torque should be 9-15 Nm for tightening the M6 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.

	<p>High level loading condition (Apply to harsher environment conditions, such as storm. Test load is 4000Pa, safety factor is 1.5)</p>
<p>Mounting System</p>	
	<p>Permissible range of clamp  <math>(1/4L) &lt; S \leq (1/4L)</math> [For modules whose length is less than 1966mm]</p> 

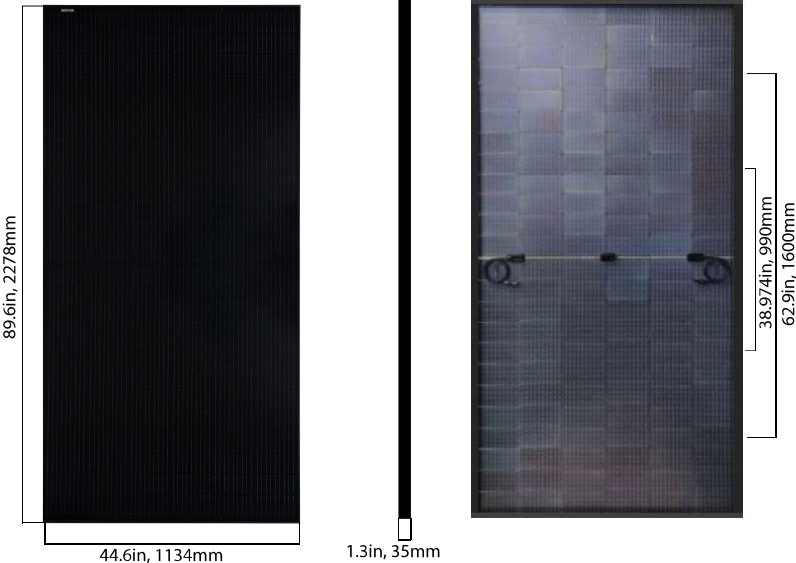
### DNA-144-BF10-540W,545W and 550W-DG

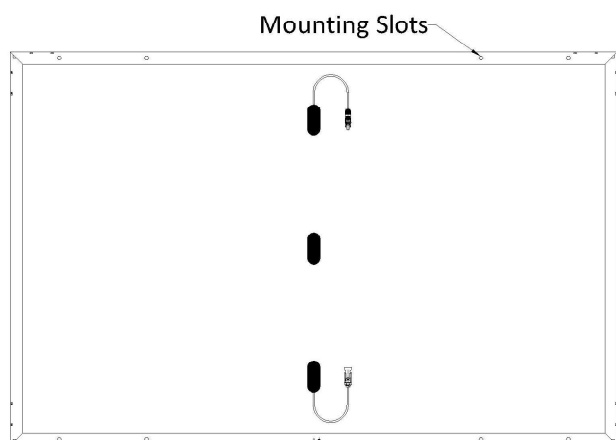
Electrical Specifications	DNA-144-BF10-540W-DG	DNA-144-BF10-545W-DG	DNA-144-BF10-550W-DG
STC Rated Output $P_{mpp}$ (W)	540W	545W	550W
Module Efficiency	20.90%	21.09%	21.29%
Open Circuit Voltage $V_{VOC}$ (V)	49.50	49.65	49.80
Short Circuit Current $I_{SC}$ (A)	13.85	13.92	13.99
Rated Voltage $V_{mp}$ (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<sup>2</sup>, 25°C, measurement uncertainty ≤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)		5400 PA Snow Load / 4000 Pa Wind Load	
Fire Performance Class			Class C/Type 29





### Junction Box Information

Overcurrent protection type: none

# of bypass diodes: 3

Diameter of cables: every module has 2 cables whose diameter is  $4\text{mm}^2$  for any one of them, and it can endure  $90^\circ\text{C}$  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