

# Tangra™ S HD Black

N-Type High efficiency Bifacial Single Glass Module

**TS-BBT48(440-460)-G11**



Bifacial technology allows for the harvesting of up to an additional 30% energy from the rear side of the module.



30 years lifespan brings 10-30% additional power generation comparing with conventional P-type module.



N-type solar cell has no LID naturally which can increase power generation.



Excellent low irradiance performance.



Enhanced light trapping and optimized current collection contribute to the improvement of both module power output and reliability.



Industry leading lowest thermal coefficient of power.



Design optimized for lower operating current, resulting in minimized hot spot loss and improved temperature coefficient.

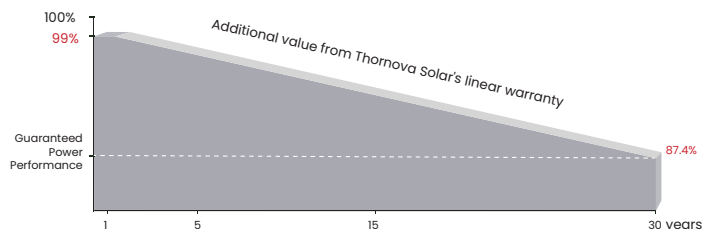


Certified to withstand: wind load (2400 Pa) and snow load (5400 Pa).



100% triple EL test enables remarkable reduction of module hidden crack rate.

## LINEAR PERFORMANCE WARRANTY



up to **25** years  
Product quality & process warranty

**30** years  
Linear power guarantee

**0.40** %  
Annual degradation Over 30 years

## COMPREHENSIVE CERTIFICATES

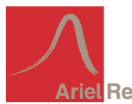


- ISO 9001: Quality Management System
- ISO 14001: Environmental Management System Standard
- ISO 45001: International Occupational Health and Safety Assessment System Standard

\* Different markets have different certification requirements. Also, the products are under rapid innovation. Please confirm the certification status with regional sales representatives.

## RE INSURANCE

Warranty partner



\* Optional performance warranty insurance. Please contact our local sales staff for more information.

## ELECTRICAL CHARACTERISTICS

2x48 cells

Model of modules	TS-BBT48(440)-G11		TS-BBT48(445)-G11		TS-BBT48(450)-G11		TS-BBT48(455)-G11		TS-BBT48(460)-G11	
	STC	NMOT	STC	NMOT	STC	NMOT	STC	NMOT	STC	NMOT
Peak power - $P_{mp}$ (W)	440	331	445	335	450	338	455	342	460	346
Open circuit voltage - $V_{oc}$ (V)	34.67	32.94	34.85	33.11	35.03	33.28	35.21	33.45	35.39	33.62
Short circuit current - $I_{sc}$ (A)	15.95	12.88	16.00	12.92	16.05	12.96	16.10	13.00	16.15	13.04
MPP voltage - $V_{mp}$ (V)	29.72	27.68	29.90	27.88	30.08	27.96	30.26	28.18	30.44	28.40
MPP current - $I_{mp}$ (A)	14.81	11.96	14.89	12.02	14.97	12.09	15.04	12.14	15.11	12.19
Module efficiency - $\eta_m$ (%)	22.0		22.3		22.5		22.8		23.0	

**STC** (Standard Testing Conditions): Irradiance 1000W/m<sup>2</sup>, Cell Temperature 25 °C, Spectra at AM1.5

**NMOT** (Nominal Module Operating Temperature): Irradiance 800W/m<sup>2</sup>, Ambient Temperature 20 °C, Spectra at AM1.5, Wind at 1m/s

## ELECTRICAL CHARACTERISTICS WITH DIFFERENT POWER BIN (REFERENCE TO 13.5% IRRADIANCE RATIO)

Peak power - $P_{mp}$ (W)	488	493	499	504	510
Open circuit voltage - $V_{oc}$ (V)	34.67	34.85	35.03	35.21	35.39
Short circuit current - $I_{sc}$ (A)	17.67	17.73	17.78	17.84	17.89
MPP voltage - $V_{mp}$ (V)	29.72	29.90	30.08	30.26	30.44
MPP current - $I_{mp}$ (A)	16.41	16.50	16.59	16.66	16.74
Irradiance ratio (rear/front)	13.5 %				

## STRUCTURAL CHARACTERISTICS

Module dimension (L*W*H)	69.37 x 44.65 x 1.18 inch (1762 x 1134 x 30 mm)
Weight	46.96 lbs (21.3 kg)
Number of cells	96 cells
Cell	N-type monocrystalline (7.17 X 8.27 inch (182X210 mm))
Glass	Tempered, 3.2 mm AR, High transmittance, Low iron
Backsheet	Transparent black mesh backsheet
Frame	Anodized aluminum alloy
Junction box	IP68 rated (3 diodes)
Output wire	4mm <sup>2</sup> (IEC), 12 AWG (UL)
Wire length (Including Connector)	+400/-200mm (+15.75/-7.87in.) or customized
Connector	MC4 Compatible
Pieces per Pallet	36 pcs/Pallet
Pieces per Container (Normal/Weight-limited area)	936/828 pcs/40'HQ

## OPERATING PARAMETERS

Power tolerance (W)	(0,+5)
Maximum system voltage (V)	1500
Maximum rated fuse current (A)	30
Current operating temperature (°C)	-40~+185 °F (-40~+85 °C)
Bifaciality	80±10 %
Fire performance	Type 1

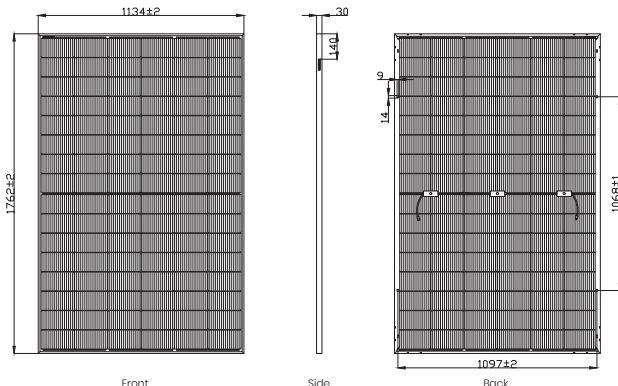
## MECHANICAL LOADING

Front side maximum static loading (Pa)	5400
Rear side maximum static loading (Pa)	2400
Hailstone test (mm)	35

## TEMPERATURE RATINGS

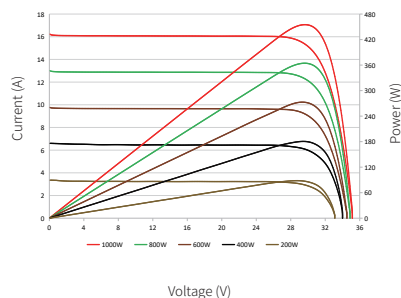
Temperature coefficient ( $P_{max}$ )	-0.29 %/K
Temperature coefficient ( $V_{oc}$ )	-0.28 %/K
Temperature coefficient ( $I_{sc}$ )	+0.04 %/K
Nominal Module Operating Temperature	109.4±35.6 °F (43±2 °C)

## MODULE DIMENSIONS (MM)

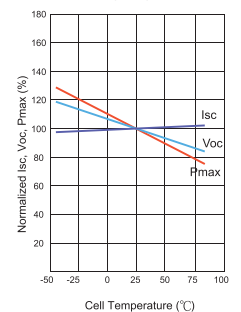


\* The unmarked tolerance is ±1 mm  
Length shown in mm

Characteristic curves (450W)



Temperature Dependence of  $I_{sc}$ ,  $V_{oc}$ ,  $P_{max}$



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