



# 445-460 W

High Efficiency Bifacial Single Glass PERC Module

**TS-BB60** All Black



Bifacial technology allows for the harvesting of up to an additional 25% energy from the rear side of the module.



Excellent low irradiance performance.



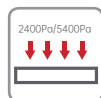
Enhanced light trapping and optimized current collection contribute to the improvement of both module power output and reliability.



Industry leading lowest thermal coefficient of power.



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

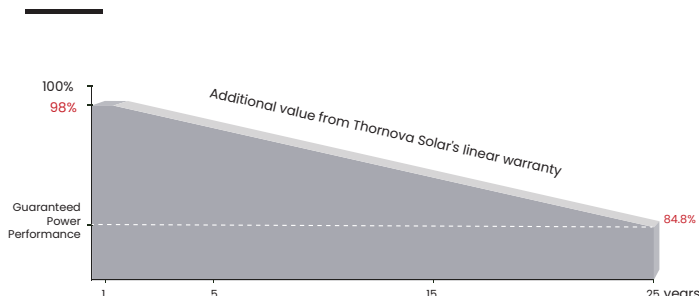


Certified to withstand: wind load (2400 Pa) and snow load (5400 Pa).



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

## LINEAR PERFORMANCE WARRANTY



**15** years

Product quality & process guarantee

**25** years

Linear power guarantee

**0.55** %

Annual degradation Over 25 years

## COMPREHENSIVE CERTIFICATES



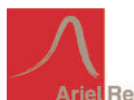
ISO 9001: Quality Management System

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



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

**ELECTRIC CHARACTERISTICS**

Model of modules	TS-BB60(445)		TS-BB60(450)		TS-BB60(455)		TS-BB60(460)	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Peak power - $P_{mp}$ (W)	445	332	450	336	455	339	460	343
Open circuit voltage - $V_{oc}$ (V)	41.27	38.96	41.46	39.14	41.65	39.32	41.78	39.44
Short circuit current - $I_{sc}$ (A)	13.42	10.84	13.47	10.88	13.54	10.94	13.63	11.01
MPP voltage - $V_{mp}$ (V)	34.46	32.26	34.62	32.41	34.78	32.56	34.89	32.66
MPP current - $I_{mp}$ (A)	12.92	10.28	13.01	10.35	13.09	10.42	13.19	10.50
Module efficiency - $\eta_m$ (%)	20.62 %		20.85 %		21.08 %		21.32 %	

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

**NOCT** (Nominal Operating Cell 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)	487	493	498	504
Open circuit voltage - $V_{oc}$ (V)	41.27	41.46	41.65	41.78
Short circuit current - $I_{sc}$ (A)	14.69	14.74	14.82	14.92
MPP voltage - $V_{mp}$ (V)	34.46	34.62	34.78	34.89
MPP current - $I_{mp}$ (A)	14.14	14.24	14.33	14.44
Irradiance ratio (rear/front)	13.5 %			

**STRUCTURAL CHARACTERISTICS**

Module dimension (L*W*H)	1903 x 1134 x 35 mm (74.92 x 44.65 x 1.38 inch)
Weight	24 kg (52.91 lbs)
Number of cells	120 cells
Cell	PERC monocrystalline 182x91 mm (7.17 x 3.58 inch)
Glass	Tempered, 3.2 mm AR, High transmittance, Low iron
Backsheet	Transparent black mesh backsheet
Frame	Anodized aluminum alloy
Junction box	IP68
Output wire	4.0 mm <sup>2</sup>
Wire length	1200 mm
Connector	MC4 - EVO2
Packing specification	31 pcs/Pallet; 744 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~+85 °C
Bifaciality	70±5%

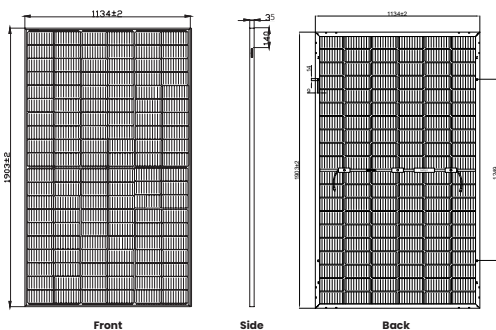
**MECHANICAL LOADING**

Front side maximum static loading (Pa)	5400
Rear side maximum static loading (Pa)	2400
Hailstone test (mm)	40

**TEMPERATURE RATINGS**

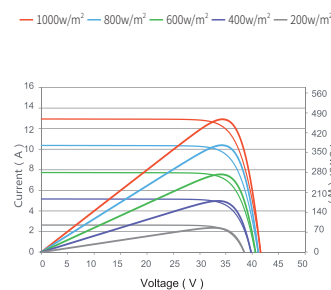
Temperature coefficient ( $P_{max}$ )	-0.33 %/°C
Temperature coefficient ( $V_{oc}$ )	-0.26 %/°C
Temperature coefficient ( $I_{sc}$ )	+0.06 %/°C
Nominal operating cell temperature	45±2 °C

**MODULE DIMENSIONS (MM)**

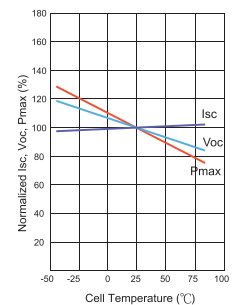


\* The unmarked tolerance is ±1 mm  
Length shown in mm

Current-Voltage & Power-Voltage Curves (460 W)



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



Scan the QR code to get more information

Web: [www.thornovasolar.com](http://www.thornovasolar.com)

E-mail: [info@thornovasolar.com](mailto:info@thornovasolar.com)

\* The parameters delineated within this datasheet, both technical and monetary, may exhibit variations contingent upon the region. Thornova Solar provides no warranty as to their absolute accuracy. Owing to our unceasing commitment to innovation, research, development, and product enhancement, Thornova Solar retains the discretion to amend any information encapsulated in this datasheet without any preceding notification. Clients are urged to procure the most recent iteration of this datasheet and incorporate it as an intrinsic component of the legally binding agreement ratified by both parties. The English rendition of this datasheet serves purely as a point of reference. Should discrepancies arise between the English text and versions rendered in other languages, the stipulations of the English version shall take precedence.

