

# Vertex S<sup>+</sup> Shield

DUAL GLASS N type i-TOPCon Ultra MODULE

PRODUCT: TSM-NED9R.28

POWER RANGE: 445-470 W

## 470 W

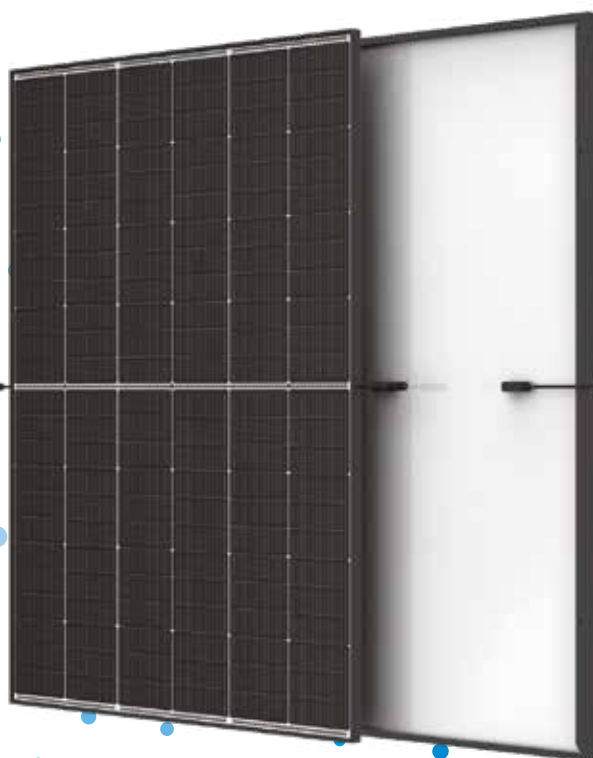
MAXIMUM POWER OUTPUT

## 0/+5 W

POSITIVE POWER TOLERANCE

## 23.5 %

MAXIMUM EFFICIENCY



### Small in size, bigger on power

- High module power: Up to 470 W, 23.5 % module efficiency with n type i-TOPCon technology
- Reduces installation cost with higher power bin and efficiency



### Dual-glass Design, High Reliability

- Excellent fire rating and resistance to harsh environmental conditions



### Key Features

- VKF HW4 Hail Test
- Standard load capacity: +7000/-5000 Pa,
- Fire rating (IEC 61730-2): Class A+A



### Maximize Energy Harvest

- Up to 25 years product warranty and 30 years power warranty
- 1 % first-year degradation and 0.4 % annual degradation enabled by N-type technology



### Universal solution for residential and C&I rooftops

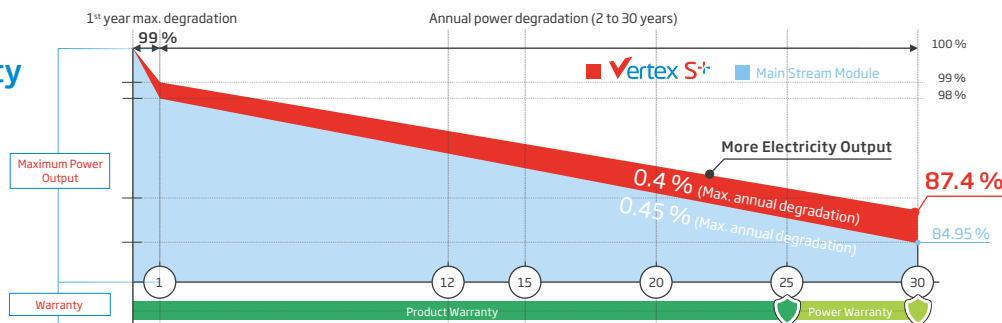
- Designed for compatibility with existing mainstream inverters, optimizers and mounting systems
- Flexible installation solutions for system deployment

## Extended Vertex S<sup>+</sup> Warranty

**1 %**  
1<sup>st</sup> year max. degradation

**0.4 %**  
Max. annual degradation from year 2 to 30

**25 Years**  
Product Workmanship Warranty

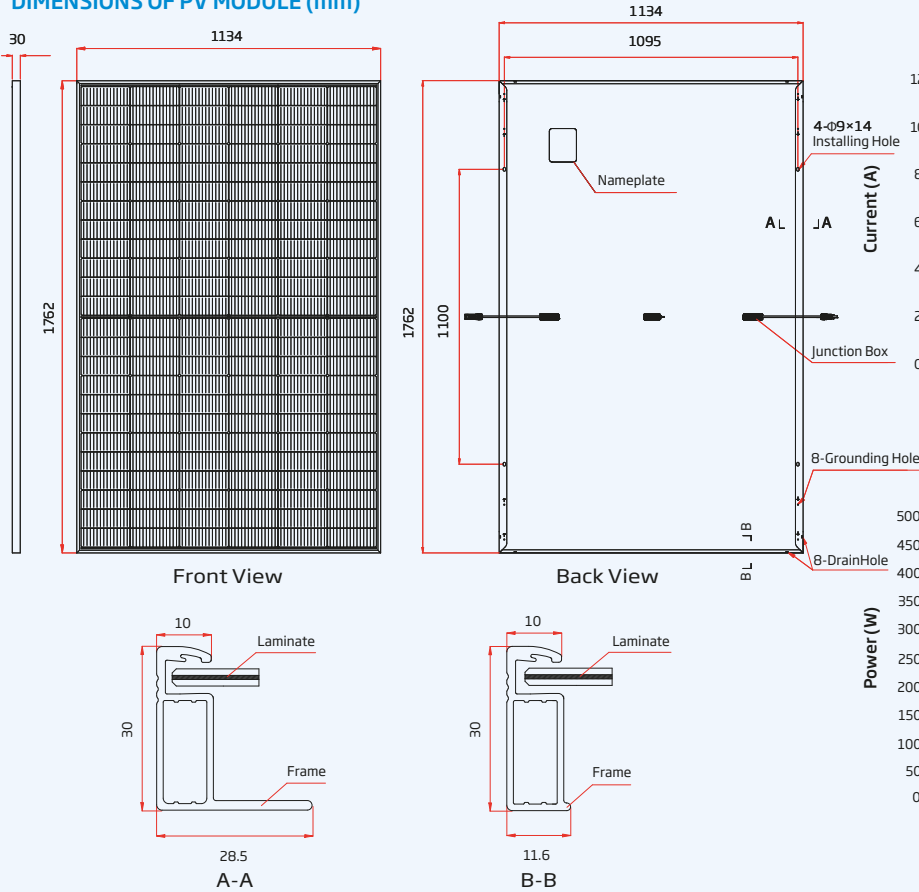


## Comprehensive Products and System Certificates

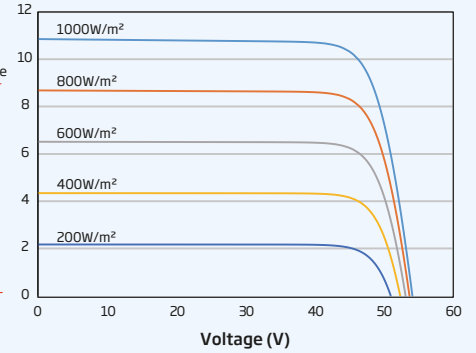


IEC61215/IEC61730/IEC61701/IEC62716  
ISO 9001: Quality Management System  
ISO 14001: Environmental Management System  
ISO14064: Greenhouse Gases Emissions Verification  
ISO45001: Occupational Health and Safety Management System

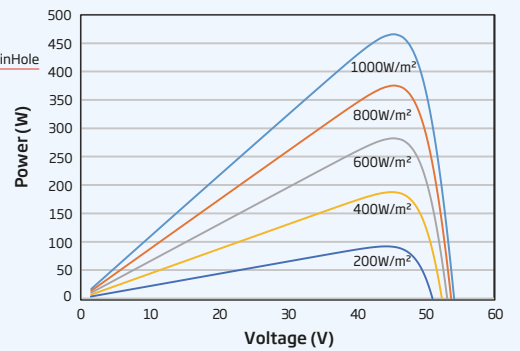
### DIMENSIONS OF PV MODULE (mm)



### I-V CURVES OF PV MODULE (465 W)



### P-V CURVES OF PV MODULE (465 W)



### ELECTRICAL DATA (STC)

	TSM-445 NED9R.28	TSM-450 NED9R.28	TSM-455 NED9R.28	TSM-460 NED9R.28	TSM-465 NED9R.28	TSM-470 NED9R.28
Peak Power Watts- $P_{MAX}$ (Wp)*	445	450	455	460	465	470
Power Selection (W)**			0/+5			
Maximum Power Voltage- $V_{MPP}$ (V)	44.3	44.6	45.0	45.4	45.7	46.1
Maximum Power Current- $I_{MPP}$ (A)	10.05	10.09	10.11	10.14	10.16	10.19
Open Circuit Voltage- $V_{OC}$ (V)	52.6	52.9	53.4	53.8	54.2	54.6
Short Circuit Current- $I_{SC}$ (A)	10.71	10.74	10.77	10.81	10.85	10.89
Module Efficiency $\eta_m$ (%)	22.3	22.5	22.8	23.0	23.3	23.5

STC: Irradiance 1000 W/m<sup>2</sup>, Cell Temperature 25 °C, Air Mass AM 1.5. \*Measuring tolerance: ±3%. \*\*Power Selection up to: +3%

### ELECTRICAL DATA (NOCT)

	TSM-445 NED9R.28	TSM-450 NED9R.28	TSM-455 NED9R.28	TSM-460 NED9R.28	TSM-465 NED9R.28	TSM-460 NED9R.28
Maximum Power- $P_{MAX}$ (Wp)	341	344	348	352	355	359
Maximum Power Voltage- $V_{MPP}$ (V)	41.7	42.0	42.3	42.7	42.8	43.2
Maximum Power Current- $I_{MPP}$ (A)	8.17	8.19	8.22	8.25	8.28	8.31
Open Circuit Voltage- $V_{OC}$ (V)	49.9	50.2	50.6	51.0	51.4	51.7
Short Circuit Current- $I_{SC}$ (A)	8.63	8.66	8.68	8.71	8.74	8.78

NOCT: Irradiance at 800 W/m<sup>2</sup>, Ambient Temperature 20 °C, Wind Speed 1 m/s.

### MECHANICAL DATA

Solar Cells	N-type i-TOPCon Monocrystalline
No. of cells	144 cells
Module Dimensions	1762×1134×30 mm
Weight	27 kg
Front Glass	2.5 mm AR Coating Heat Strengthened Glass
Back Glass	2.0 mm Heat Strengthened Glass
Frame	30 mm Anodized Aluminium Alloy, Black
J-Box	IP 68 rated, 3 bypass diodes
Cables	Photovoltaic Technology Cable 4.0 mm <sup>2</sup> Landscape: 1100/1100 mm Portrait: 200/320 mm*
Connector	TS4 Plus / TS4 / MC4 EVO2*

\*Special order only

### TEMPERATURE RATINGS

NOCT (Nominal Operating Cell Temperature)	43 °C (±2 °C)
Temperature Coefficient of $P_{MAX}$	-0.29 %/°C
Temperature Coefficient of $V_{OC}$	-0.24 %/°C
Temperature Coefficient of $I_{SC}$	0.04 %/°C

### MAXIMUM RATINGS

Operational Temperature	-40 to +70 °C
Maximum System Voltage	1500 V DC (IEC)
Max Series Fuse Rating	25 A

### WARRANTY

25 year Product Workmanship Warranty  
30 year Power Warranty  
1% first year degradation  
0.4% Annual Power Attenuation

(Please refer to product warranty for details)

### PACKAGING CONFIGURATION

Modules per box:	36 pieces
Modules per 40' container:	900 pieces

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

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