Vertex S+ Shield

DUAL GLASS N type i-TOPCon MODULE

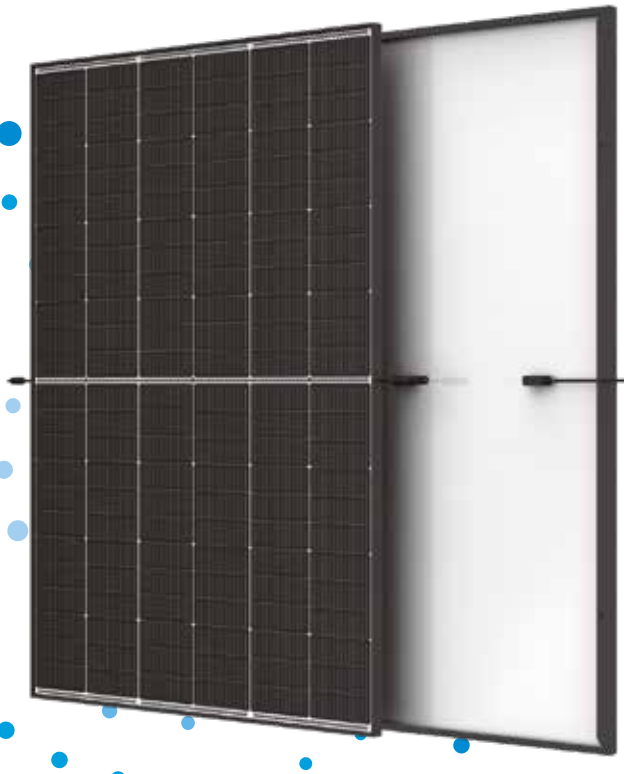
PRODUCT: TSM-NED9R.28

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,
- Special load capacity: +8000/-6000 Pa
- Fire rating (IEC 61730-2): Class A+B,
- Fire rating (EN13501-1): Class B
- Uneven snow load: 7000 Pa,
- Snow depth capacity: 2.2 m

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

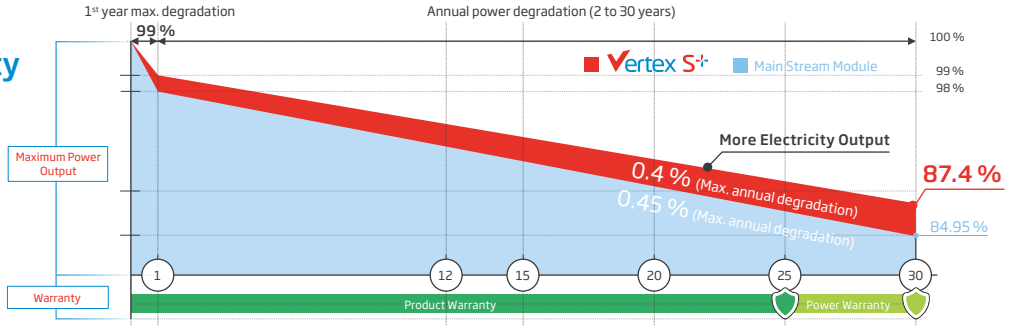
- Designed for compatibility with existing mainstream inverters, optimizers and mounting systems
- Flexible installation solutions for system deployment

Extended Vertex S+ Warranty

1 %
1st 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

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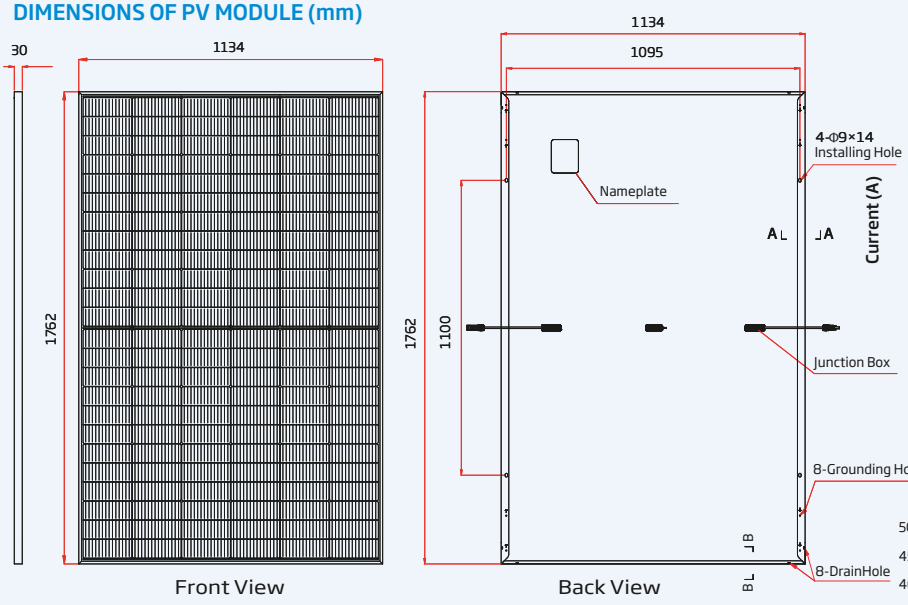
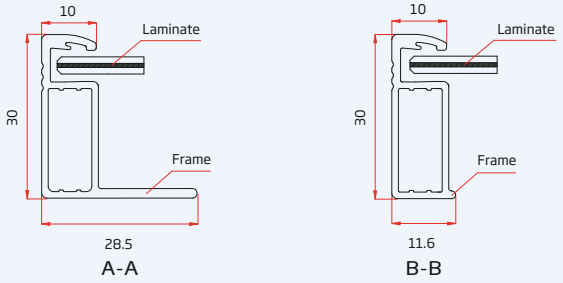
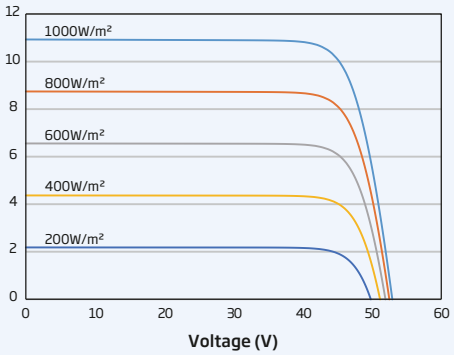
DIMENSIONS OF PV MODULE (mm)

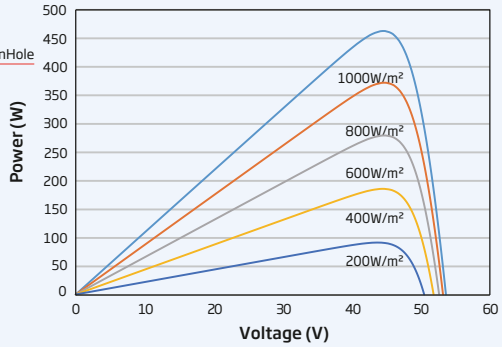




I-V CURVES OF PV MODULE (455 W)



P-V CURVES OF PV MODULE (455 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-PMAX (Wp)*	445	450	455	460	465	470
Power Tolerance-PMAX (W)			0/+5			
Power Selection (W)**	44.3	44.6	45.0	45.4	45.7	46.1
Maximum Power Current-IMPP (A)	10.05	10.09	10.11	10.14	10.16	10.19
Open Circuit Voltage-VOC (V)	52.6	52.9	53.4	53.8	54.2	54.5
Short Circuit Current-ISC (A)	10.71	10.74	10.77	10.81	10.85	10.89
Module Efficiency η m (%)	22.3	22.5	22.8	23.0	23.3	23.5

STC: Irradiance 1000 W/m², 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-PMAX (Wp)	341	344	348	352	355	359
Maximum Power Voltage-VMPP (V)	41.7	42.0	42.3	42.7	42.8	43.2
Maximum Power Current-IMPP (A)	8.17	8.19	8.22	8.25	8.28	8.31
Open Circuit Voltage-VOC (V)	49.9	50.2	50.6	51.0	51.4	51.7
Short Circuit Current-ISC (A)	8.63	8.66	8.68	8.71	8.74	8.78

NOCT: Irradiance at 800 W/m², 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	27.5 kg
Front Glass	AR Coating Heat Strengthened Glass
Back Glass	Heat Strengthened Glass
Frame	30 mm Anodized Aluminium Alloy, Black
J-Box	IP 68 rated, 3 bypass diodes
Cables	Photovoltaic Technology Cable 4.0 mm² Portrait: 280/350 mm* Landscape: 1100/1100 mm
Connector	TS4 Plus / TS4 / MC4 EVO2*

*Special order only

TEMPERATURE RATINGS

NOCT(Nominal Operating Cell Temperature)	43 °C (±2 °C)
Temperature Coefficient of PMAX	-0.29 %/°C
Temperature Coefficient of VOC	-0.24 %/°C
Temperature Coefficient of ISC	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

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

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