Vertex S+

DUAL GLASS N type i-TOPCon MODULE

PRODUCT: TSM-NEG9R.28

POWER RANGE: 430-460 W

460 W
MAXIMUM POWER OUTPUT

0/+5 W
POSITIVE POWER TOLERANCE

23.0 %
MAXIMUM EFFICIENCY



Small in size, bigger on power

- Generates up to 460 W, 23.0 % module efficiency with high density interconnect technology
- Multi-busbar technology for better light trapping, lower series resistance, improved current collection and enhanced reliability
- Reduces installation cost with higher power bin and efficiency

Dual-glass Design, High Reliability

- Excellent fire rating and resistance to harsh environmental conditions
- 5,400 Pa snow load and 4,000 Pa wind load (test loads)

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

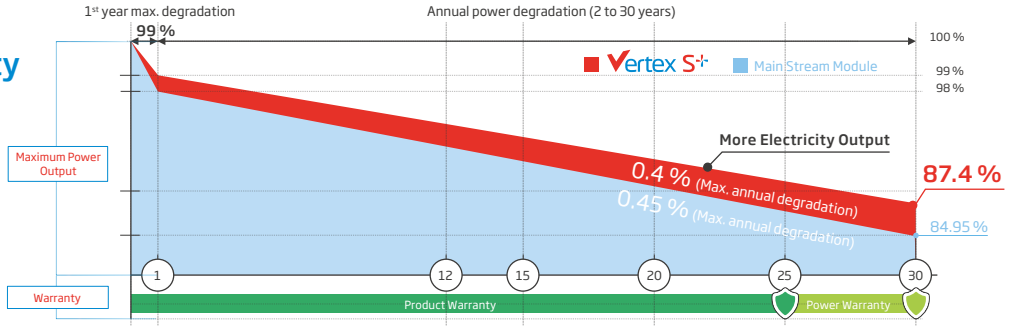
- Designed for compatibility with existing mainstream inverters, optimizers and mounting systems
- Perfect size and low weight for easy handling. Optimized transportation cost
- Flexible installation solutions for system deployment

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

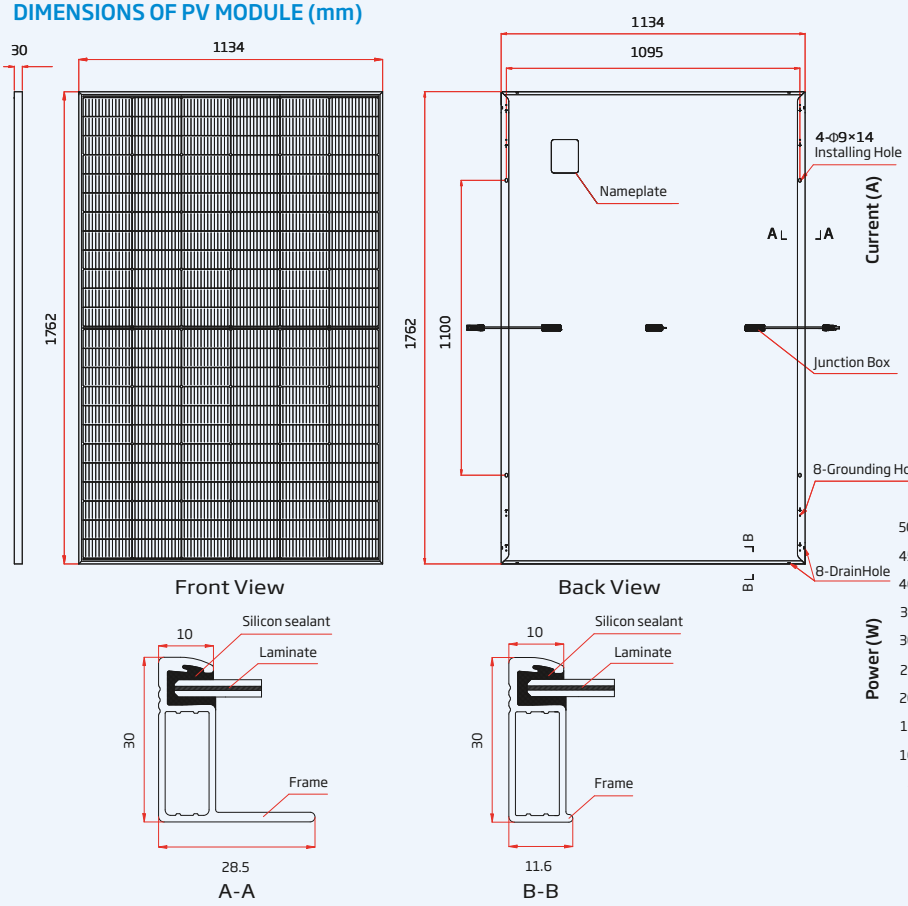
IEC61215/IEC61730/IEC61701/IEC62716
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System
ISO14067: Product Carbon Footprint Limited Assurance
ISO14025: Environmental Product Declaration

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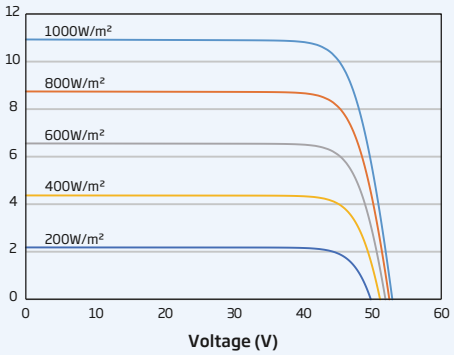
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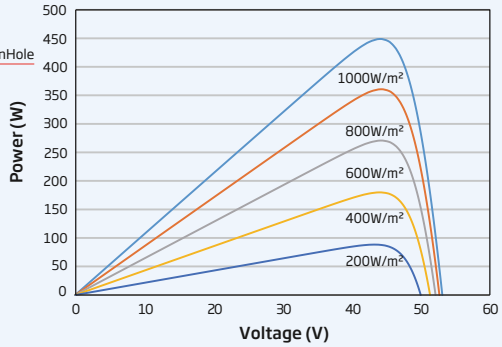
DIMENSIONS OF PV MODULE (mm)



I-V CURVES OF PV MODULE (450 W)



P-V CURVES OF PV MODULE (450 W)



ELECTRICAL DATA (STC)

	TSM-430 NEG9R.28	TSM-435 NEG9R.28	TSM-440 NEG9R.28	TSM-445 NEG9R.28	TSM-450 NEG9R.28	TSM-455 NEG9R.28	TSM-460 NEG9R.28
Peak Power Watts-P_{MAX} (Wp)*	430	435	440	445	450	455	460
Power Tolerance-P_{MAX} (W)				0/+5			
Maximum Power Voltage-V_{MPP} (V)	43.2	43.6	44.0	44.3	44.6	45.0	45.4
Maximum Power Current-I_{MPP} (A)	9.96	9.99	10.01	10.05	10.09	10.11	10.14
Open Circuit Voltage-V_{OC} (V)	51.4	51.8	52.2	52.6	52.9	53.4	53.8
Short Circuit Current-I_{SC} (A)	10.59	10.64	10.67	10.71	10.74	10.77	10.81
Module Efficiency η m (%)	21.5	21.8	22.0	22.3	22.5	22.8	23.0

STC: Irrdiance 1000 W/m², Cell Temperature 25 °C, Air Mass AM 1.5. *Measuring tolerance: ±3 %.

ELECTRICAL DATA (NOCT)

	TSM-430 NEG9R.28	TSM-435 NEG9R.28	TSM-440 NEG9R.28	TSM-445 NEG9R.28	TSM-450 NEG9R.28	TSM-455 NEG9R.28	TSM-460 NEG9R.28
Maximum Power-P_{MAX} (Wp)	329	333	337	341	344	348	352
Maximum Power Voltage-V_{MPP} (V)	40.7	41.0	41.4	41.7	42.0	42.3	42.7
Maximum Power Current-I_{MPP} (A)	8.08	8.12	8.14	8.17	8.19	8.22	8.25
Open Circuit Voltage-V_{OC} (V)	48.7	49.1	49.5	49.9	50.2	50.6	51.0
Short Circuit Current-I_{SC} (A)	8.54	8.58	8.60	8.63	8.66	8.68	8.71

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	21.0 kg
Front Glass	1.6 mm, AR Coated Heat Strengthened Glass
Back Glass	1.6 mm, Heat Strengthened Glass
Frame	30 mm Anodized Aluminium Alloy, Black
J-Box	IP 68 rated
Cables	Photovoltaic Technology Cable 4.0 mm² Landscape: 1100/1100 mm Portrait: 280/350 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 +85 °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:	936 pieces

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

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