# 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

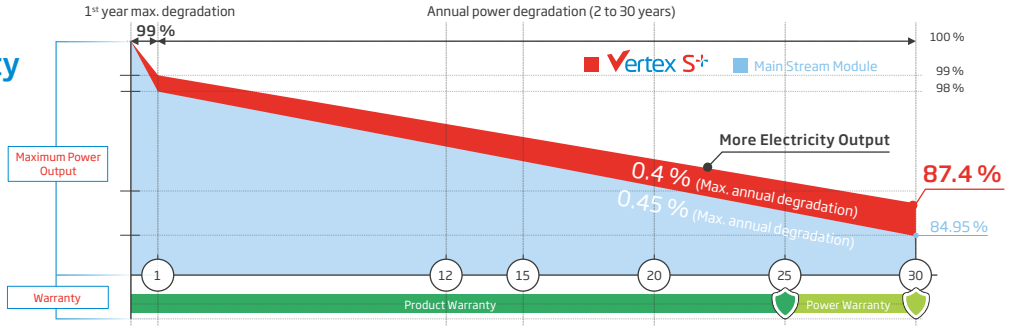
- Designed for compatibility with existing mainstream inverters, optimizers and mounting systems
- Perfect size and low weight for easy handling. Optimized transportation cost
- Flexible installation solutions for system deployment

## 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

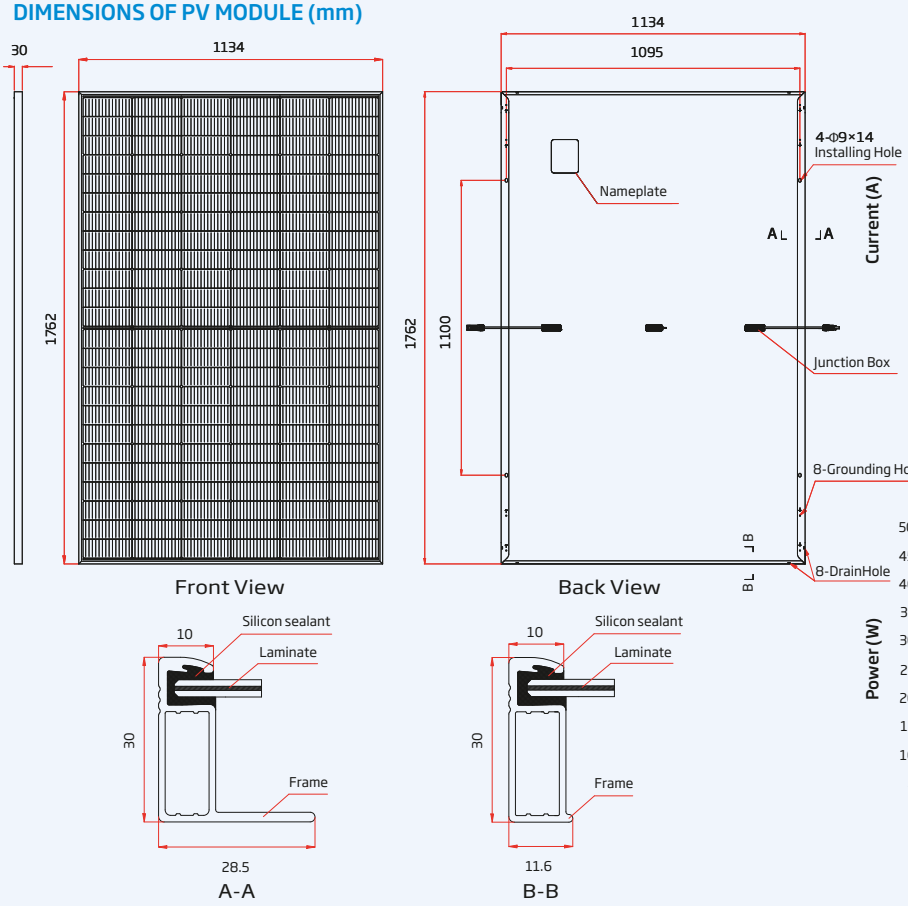
IEC61215/IEC61730/IEC61701/IEC62716
ISO 9001: Quality Management System
ISO 14001: Environmental Management System
ISO14064: Greenhouse Gases Emissions Verification
ISO45001: Occupational Health and Safety Management System
ISO14067: Product Carbon Footprint Limited Assurance
ISO14025: Environmental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

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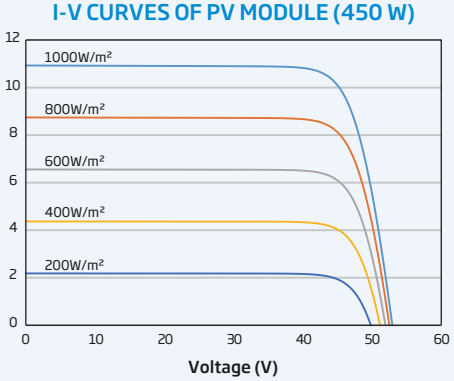
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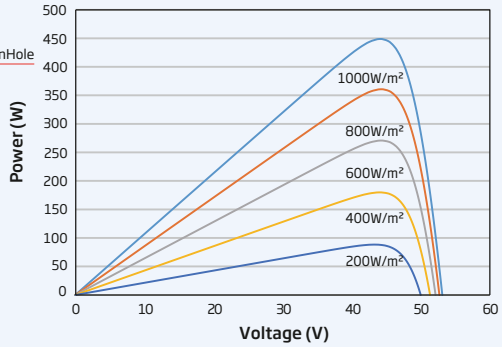
### DIMENSIONS OF PV MODULE (mm)




### 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-PMAX (Wp)* | 430 | 435 | 440 | 445 | 450 | 455 | 460 |
| Power Tolerance-PMAX (W) | | | | 0/+5 | | | |
| Maximum Power Voltage-VMPP (V) | 43.2 | 43.6 | 44.0 | 44.3 | 44.6 | 45.0 | 45.4 |
| Maximum Power Current-IMPP (A) | 9.96 | 9.99 | 10.01 | 10.05 | 10.09 | 10.11 | 10.14 |
| Open Circuit Voltage-VOC (V) | 51.4 | 51.8 | 52.2 | 52.6 | 52.9 | 53.4 | 53.8 |
| Short Circuit Current-ISC (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-PMAX (Wp) | 329 | 333 | 337 | 341 | 344 | 348 | 352 |
| Maximum Power Voltage-VMPP (V) | 40.7 | 41.0 | 41.4 | 41.7 | 42.0 | 42.3 | 42.7 |
| Maximum Power Current-IMPP (A) | 8.08 | 8.12 | 8.14 | 8.17 | 8.19 | 8.22 | 8.25 |
| Open Circuit Voltage-VOC (V) | 48.7 | 49.1 | 49.5 | 49.9 | 50.2 | 50.6 | 51.0 |
| Short Circuit Current-ISC (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<br>Landscape: 1100/1100 mm<br>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 PMAX | -0.29 %/°C |
| Temperature Coefficient of VOC | -0.24 %/°C |
| Temperature Coefficient of ISC | 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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