



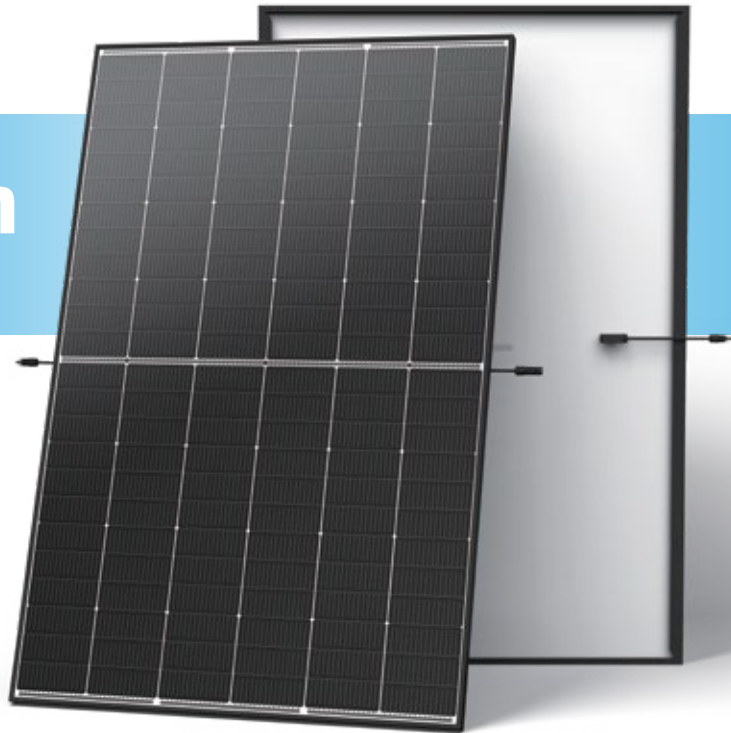
N-type i-TOPCon

DUAL GLASS MONOCRYSTALLINE MODULE

TSM-NEG9R.28 430-460W

460W / MAXIMUM POWER OUTPUT

23.0% / MAXIMUM EFFICIENCY



High Customer Value

- Suitable for residential and C&I rooftop
- Perfect size and low weight for handling and installation
- Compatible with mainstream inverters and diverse mounting systems
- Mechanical test load up to 5400 Pa front side and 4000 Pa back side
- Certified lifetime carbon footprint assessment



High reliability with light double glass

- Less prone to micro-cracks and scratches on the back side
- Excellent fire rating, weather resistance, sustainable in harsh environments and extreme weather conditions
- Certified resistance against salt spray, sand dust, ammonia, PID
- Up to 15/25 years product warranty and 30 years power warranty



High power up to 460W

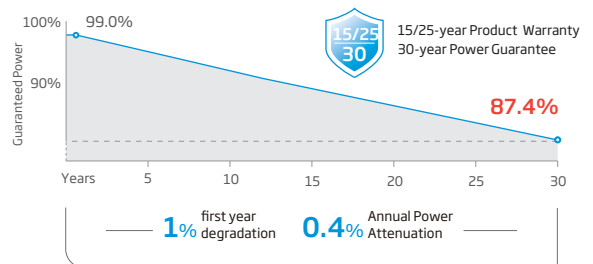
- Up to 23.0% module efficiency, on 210 innovative platform
- Patented i-TOPCon technology with continuous efficiency improvement, including contact resistance reduction, rear reflection enhancement and edge quality repairment



High energy yield

- Excellent low irradiation performance, validated by 3rd party
- Lower temperature efficient (-0.29%/°C) and lower working temperature

Performance Warranty



* Please refer to product warranty for details

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



ELECTRICAL DATA (STC)

| | | | | | | | |
|-------------------------------------|--------|-------|-------|-------|-------|-------|-------|
| Peak Power Watts- $P_{MAX}(Wp)^*$ | 430 | 435 | 440 | 445 | 450 | 455 | 460 |
| Power Selection (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 $\eta_m(\%)$ | 21.5 | 21.8 | 22.0 | 22.3 | 22.5 | 22.8 | 23.0 |

STC: Irradiance 1000W/m², Cell Temperature 25°C, Air Mass AM1.5. *Measuring tolerance: ±3%. **Power selection up to: +3%.

ELECTRICAL DATA (NOCT)

| | | | | | | | |
|-------------------------------------|------|------|------|------|------|------|------|
| Peak Power Watts- $P_{MAX}(Wp)$ | 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 800W/m², Ambient Temperature 20°C, Wind Speed 1m/s.

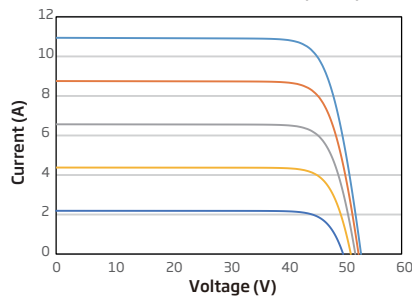
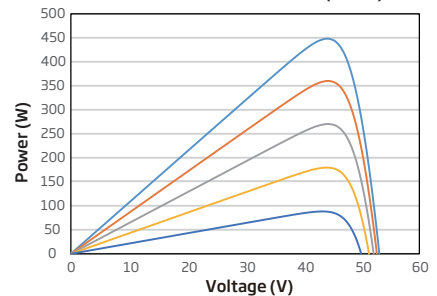
TEMPERATURE RATINGS

| | |
|---|-------------|
| 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 |

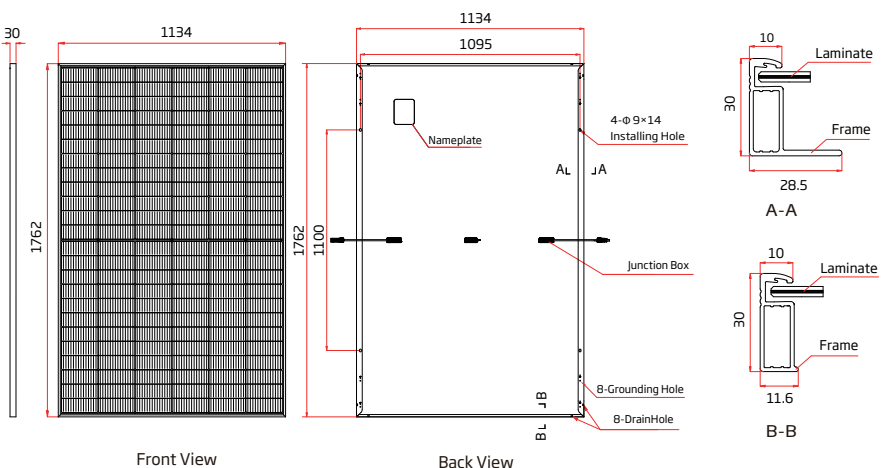
Due to different testing methods, the actual performances might differ from the declared specifications.

MAXIMUM RATINGS

| | |
|-------------------------|----------------|
| Operational Temperature | -40~+85°C |
| Maximum System Voltage | 1500V DC (IEC) |
| Max Series Fuse Rating | 25A |

CURVES OF PV MODULE
I-V CURVES OF PV MODULE (450W)

P-V CURVES OF PV MODULE (450W)

MECHANICAL DATA

| | |
|-------------------|---|
| Solar Cells | N-type i-TOPCon Monocrystalline |
| No. of cells | 144 cells |
| Module Dimensions | 1762×1134×30 mm (69.37×44.65×1.18 inches) |
| Weight | 21.0 kg (46.30lb) |
| Front Glass | 1.6 mm (0.06 inches) AR Coating Heat Strengthened Glass |
| Back Glass | 1.6 mm (0.06 inches), Heat Strengthened Glass |
| Frame | 30mm (1.18 inches) Anodized Aluminium Alloy, Black |
| J-Box | IP 68 rated |
| Cables | Photovoltaic Technology Cable 4.0mm ² (0.006 inches ²) Portrait: 350/280 mm (13.78/11.02 inches) Length can be customized |
| Connector | TS4 Plus / TS4 |
| Packaging | Modules per box: 36 pieces Modules per 40' container: 936 pieces |



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