



2023, Warsaw

Delivery of components for PV installations

Leading technology



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Photovoltaic modules

RISEN ENERGY



risen



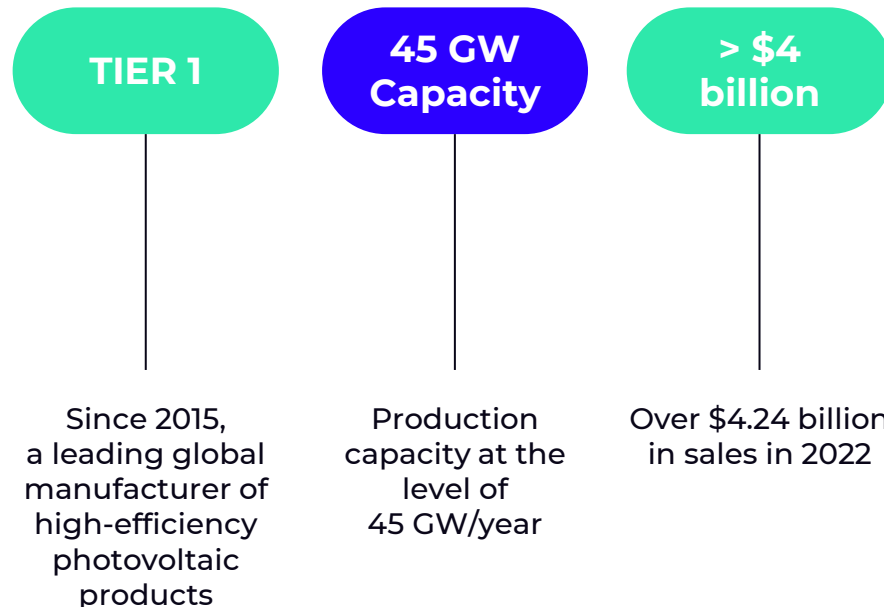
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Photovoltaic modules RISEN ENERGY

Provider of comprehensive business solutions for electricity generation on residential, commercial and industrial scales.

Risen Energy specializes in developing the most powerful PV cells and modules within the latest available technologies.



Global compatibility

Module parameters

RISEN modules are compatible with leading brands of inverters

With the commercialization of G12 half-cut modules, inverter manufacturers have introduced dedicated inverters and solutions in which a single MPPT current is increased to 40A+, which perfectly adapts to the 210 series modules.

SUNGROW
Clean power for all

SOFAR
SOLAR



KSTAR
Powering Green Future



GROWATT



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Offered products



PERC

Titan
560Wp+

560W+
Power
21.4%
Efficiency

2384×1096
Size

Titan
670Wp+

670W+
Power
21.6%
Efficiency

2384×1303
Size

TOPCon

TOPCon
600Wp+

600W+
Power
22.2%
Efficiency

2384×1134
Size

TOPCon
625Wp+

625W+
Power
22.4%
Efficiency

2465×1134
Size

HJT

Hyper-ion
585Wp+

585W+
Power
22.4%
Efficiency

2384×1096
Size

Hyper-ion
700Wp+

700W+
Power
22.5%
Efficiency

2384×1303
Size



Offered products



PERC

Titan
560Wp+

Titan
670Wp+

560W+
Power
21.4%
Efficiency

2384 × 1096
Size

670W+
Power
21.6%
Efficiency

2384 × 1303
Size

Type	Titan 560Wp+		Titan 670Wp+	
Type	Mono-facial	Bifacial	Mono-facial	Bifacial
Cells	PERC (110 cells)	PERC (110 cells)	PERC (132 cells)	PERC (132 cells)
Module Power [Wp]	535 - 560	535 - 560	650 - 670	650 - 670
Maximum system voltage [V]	1500	1500	1500	1500
Efficiency [%]	21,4	21,4	21,6	21,6
Temperature coefficient of Voc [%/°C]	-0,25	-0,25	-0,25	-0,25
Temperature coefficient of Pmax [%/°C]	-0,34	-0,34	-0,34	-0,34
Module Dimensions [mm]	2384x1096x30/35	2384x1096x30	2384x1303x35	2384x1303x33/35
Weight (aluminum frame) [kg]	29,0	33 +/- 0,5	34,0	38,3
Weight (steel frame) [kg]	30,5	34,0	35,5	41,0



Offered products



TOPCon

TOPCon
600Wp+

TOPCon
625Wp+

600W+
Power
22.2%
Efficiency

2384×1134
Size

625W+
Power
22.4%
Efficiency

2465×1134
Size

Type	TOPCon 600Wp+	TOPCon 625Wp+
Type	Bifacial	Bifacial
Cells	n-type (144 cells)	n-type (156 cells)
Module Power [Wp]	575 - 600	605 - 625
Maximum system voltage [V]	1500	1500
Efficiency [%]	22,2	22,4
Temperature coefficient of Voc [%/°C]	-0,25	-0,25
Temperature coefficient of Pmax [%/°C]	-0,30	-0,30
Module Dimensions [mm]	2384x1134x30	2465x1134x30
Weight (aluminum frame) [kg]	33,5	34,5



Offered products



HJT

Hyper-ion
585Wp+

Hyper-ion
700Wp+

585W+
Power
22.4%
Efficiency

2384 × 1096
Size

700W+
Power
22.5%
Efficiency

2384 × 1303
Size

Type	Hyper-ion 585Wp+	Hyper-ion 700Wp+
Type	Bifacial	Bifacial
Cells	HJT (110 cells)	HJT (132 cells)
Module Power [Wp]	565 – 585	680 – 700
Maximum system voltage [V]	1500	1500
Efficiency [%]	22,4	22,5
Temperature coefficient of Voc [%/°C]	-0,22	-0,22
Temperature coefficient of Pmax [%/°C]	-0,24	-0,24
Module Dimensions [mm]	2384x1096x30	2384x1303x33/35
Weight (aluminum frame) [kg]	33,0 +/- 0,5	38,3
Weight (steel frame) [kg]	34,0	41,0



Bifacial Factor

The ratio of the efficiency of the rear part to the efficiency of the front at the same radiation intensity. If the bifacial factor is 90%, and the rated power of the front side is 100W, the output power of the back side at the same radiation intensity is $100W * 90\% = 90W$.

The higher the albedo and bifacial coefficient, the greater the gain of energy generation by HJT photovoltaic modules.

	PERC	TOPCon	HJT
Bifacial coefficient of the cell	~75%	~85%	>90%
Bifacial coefficient of the module	~70%	~80%	~85%

Example

Rated power = 100W

Operation environment (STC)

Temperature =
25°C

Irradiance =
1000W/m²

Albedo = 10%

Air mass = 1,5

Output power including rear side

$$P = 100 + 100 * 70\% * 10\% = 107,0W$$

$$P = 100 + 100 * 80\% * 10\% = 108,0W$$

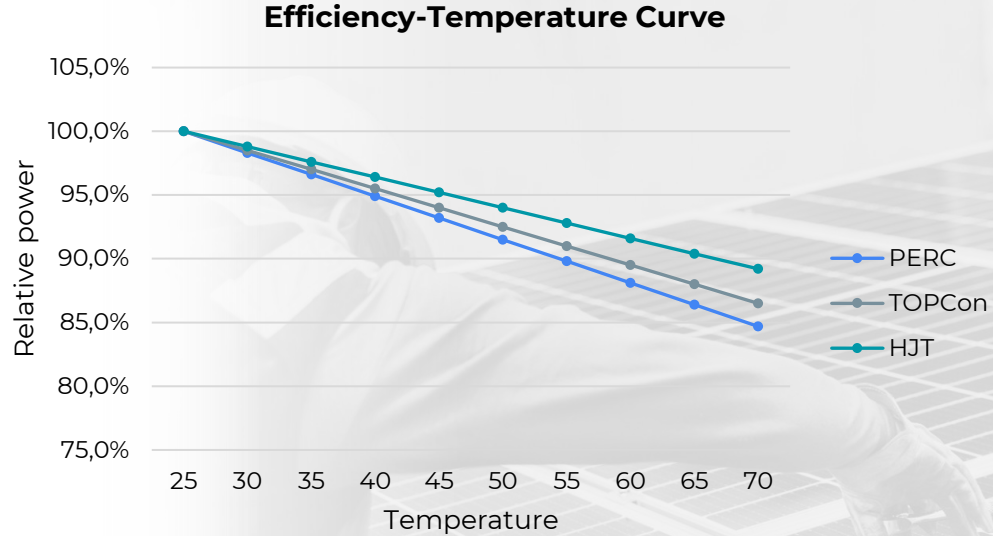
$$P = 100 + 100 * 85\% * 10\% = 108,5W$$



Power temperature coefficient

The most stable power temperature coefficient leads to higher efficiency. Producing energy in high temperature conditions will be more beneficial.

HJT cell power temperature coefficient = $-0.24\%/^{\circ}\text{C}$



Comparison of typical power temperature coefficients for different cell technologies

PERC

$-0,34\%/^{\circ}\text{C}$

TOPCon

$-0,30\%/^{\circ}\text{C}$

HJT

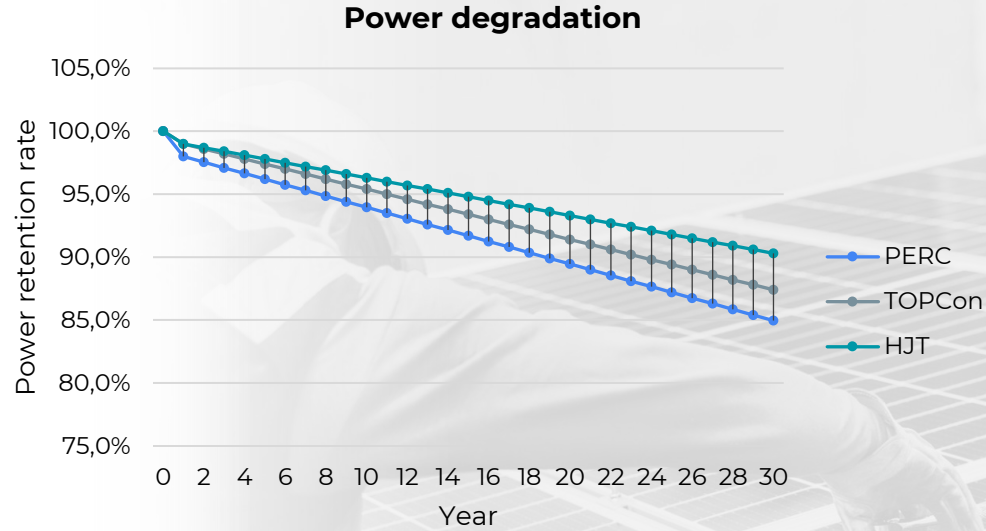
$-0,24\%/^{\circ}\text{C}$



Long-term power degradation

- The power retention of HJT product is much better than PERC and TOPCon
- By the end of the 30th year of use, only the Hyperion HJT product has a power conservation factor above 90%

Power degradation in the first year
PERC – 2%, TOPCon – 1%, HJT – 1%



Annual power degradation

0,45%

Bifacial PERC
650Wp

0,40%

Bifacial TOPCon
570Wp

0,30%

Bifacial HJT
690Wp



Investment indicators

BOS and LCOE

BOS and LCOE are related to the system design and for different types of modules there are different optimal system fitting solutions. BOS and LCOE cannot be calculated and compared without special restrictions (e.g. specific inverter or mounting structure).

The Hyper-ion series is a product that offers a significant reduction of BOS and LCOE

Type	Power (Wp)	BOS	LCOE	IRR
182-72 PERC	550	Baseline	Baseline	Baseline
182-72 TOPCon	570	-1,77%	-4,42%	+10,99%
182-78 TOPCon	610	-2,17%	-4,37%	+10,84%
210-66 PERC	660	-2,57%	-3,19%	+7,97%
210-66 Hyper-ion	695	-4,45%	-5,40%	+12,95%



Additional Information

The advantages of HAS in a nutshell:

- 1.3x higher tear resistance of mounting holes and screws
- 1/3 of production energy consumption
- Lifetime carbon emissions reduced by 77%
- stable supplies and prices of raw materials
- Excellent corrosion resistance

	Risen HJT	PERC	TOPCon	Traditional HJT
Cell efficiency	25,50%	23,40%	25,00%	25,30%
Thickness of silicon wafer	100µm	150µm	130µm	130µm
Silver Paste Unit Consumption	10mg/W	9,6mg/W	12,1mg/W	17,5mg/W
Carbon footprint data	<400 CO ₂ /W	550 CO ₂ /W	480 CO ₂ /W	420 CO ₂ /W
Frame type	stal	Steel/aluminum	Steel/aluminum	aluminum

Carbon emissions comparison 1GW, 650W modules, sea transport over a distance of over 10,000 km

	Carbon emissions in all aspects of the whole life [ton]				
	Mining	Production	Shipping	Recycle	Life cycle CO ₂ emissions
Steel (1GW PV)	931	14 891	165	1 015	17 002
Aluminum (1GW PV)	53	77 376	93	159	77 691

All new RISEN modules will also be offered in the steel alloy (HAS) version.





Mounting structures

ANTAI

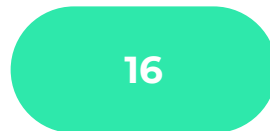


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Mounting structures ANTAI

Supplier of comprehensive mounting solutions for photovoltaic installations.

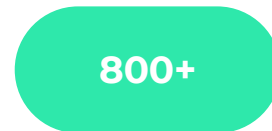
ANTAISOLAR focuses on providing convenient, reliable and innovative solar installation and tracking systems.



Years of experience



Production capacity over 25 GW/year



People employed, including more than 120 technical in the R&D sector

Comprehensive solutions

ANTAISOLAR offers comprehensive solutions, adapted to the surface on which they are to be mounted and the customer's expectations.

The offer includes standard and tracking systems.

Offered types of mounting structures:

Trackers

Roof

Ground

Carport

Greenhouse

Floating

The solar tracking system is designed to meet the needs of different scenarios, for both 1 modular and 2 module layout, which can achieve higher manufacturing efficiency and lower LCOE.

ANTAISOLAR offers a comprehensive portfolio that covers various application scenarios for photovoltaic projects with aluminum, steel or steel MAC construction.





Ultralight photovoltaic modules

Custom solutions



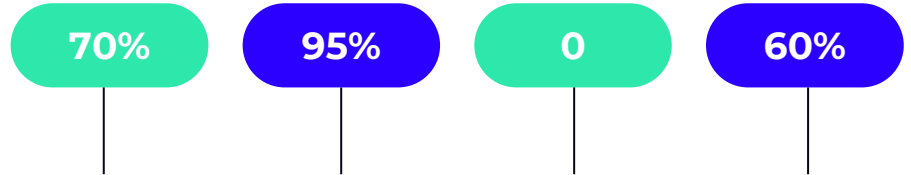
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Lightweight, flexible photovoltaic modules

Supplier of lightweight, flexible, glass-free photovoltaic modules.

An innovation that combines proven crystalline silicon solar cells with a patented composite material that has the same durability and strength as conventional glass modules.



70% lighter

up to 95% thinner

construction equipment during installation, reducing on-site time by 40%

up to 60% more kW per pallet



Aimed at various applications where glass modules cannot be used.



Application of the product

The product is used in markets where glass modules do not meet the requirements, including roofs with poor load capacity, waterproof membrane roofs, photovoltaics integrated into vehicles and off-grid.

The weight of the module is $<3 \text{ kg/m}^2$. The frameless design also eliminates the need to ground the frame.

The solution is suitable for:

Low load-bearing roofs

Waterproof membranes

Curved roofs

Balcony

Building facades

Transport

The product is ideally suited for large-area roofs with poor load capacity, for which standard solutions do not meet the criteria of additional roof load.



Offered products



Type	Ultra-light 430	Ultra-light 520
Maximum Power [Wp]	430	520
Maximum Power Voltage [V]	1500	1500
Module Efficiency [%]	19,4	19,3
Temperature coefficient Voc [%/°C]	-0,28	-0,26
Temperature coefficient Pmax [%/°C]	-0,38	-0,34
Module Dimensions [mm]	2054x1084x2	2246x1197x2
Weight [kg]	6,3	7,6
Product Warranty [Year]	12	12
Linear Power Warranty [Year]	84,8% after 25 years	84,8% after 25 years

Unlike conventional glass modules, the installation of the offered product does not involve penetration or violation of the waterproofing of the roof membrane. Installation is carried out using adhesives. The product is perfect for sheet metal roofs, glass and polymer roofs.



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