

ENERGIZING LIFE TOGETHER

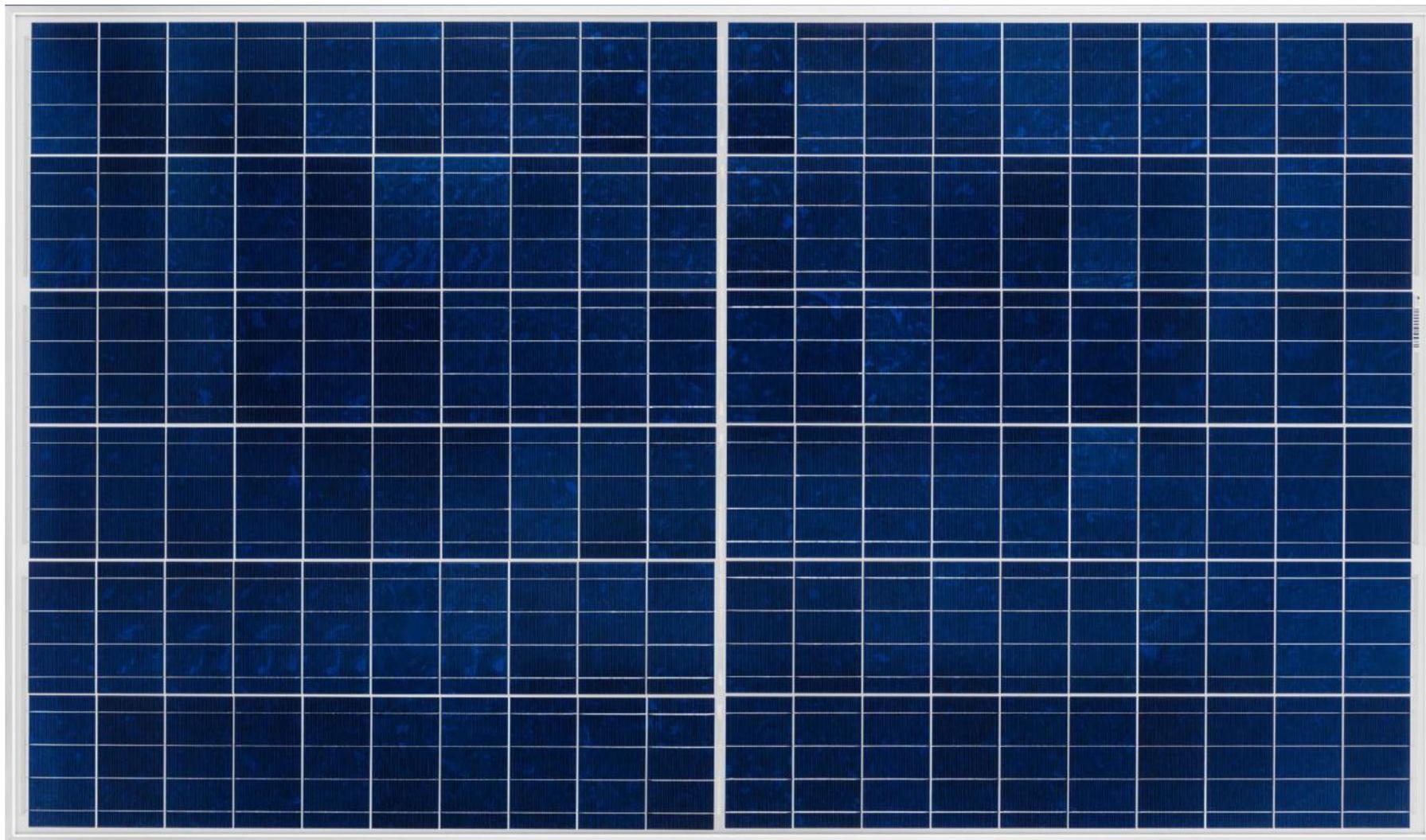


REC TWINPEAK SERIES ENABLERS AND ADVANTAGES

A closer look at the new technology inherent in the REC TwinPeak Series solar panel and what makes it unique on the market.



REC TwinPeak Series



REC TwinPeak Series (60 cell format)



Target segment: Residential / C&I

SOP: February 2015

REC TwinPeak Series

Dimensions:

1665 x 991 x 38 mm

Area:

1.65 m²

Weight:

18 kg

Cables:

0.9 + 1.2 m

Frame:

Anodized aluminum silver

Connectors:

Multi Contact MC4-EVO2

Certifications:

IEC 61215/61730 (1000V)

UL 1703 (1000V)

JET

PID-free*

Packaging:

25 panels/pallet (Double stack)

Watt-classes 2015:

265 Wp – 280 Wp



Product advantages

Half-cut cells:



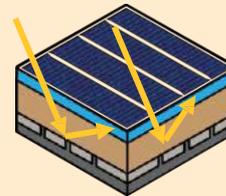
- Reduces current per cell by 50%
- Gives better performance in shade
- Reduced series resistance
- Gain of +4 Wp per panel

4 bus bar cells:



- Reduced resistance in cell
- Reduced finger width for more cell area
- Higher fill factor
- Gain of +2 Wp per panel

Passivated Emitter Rear Cell (PERC):



- Increases light capture in cell & current
- More output at higher temperatures
- More output in low light conditions
- Gain of +4 Wp per panel

Split junction box:



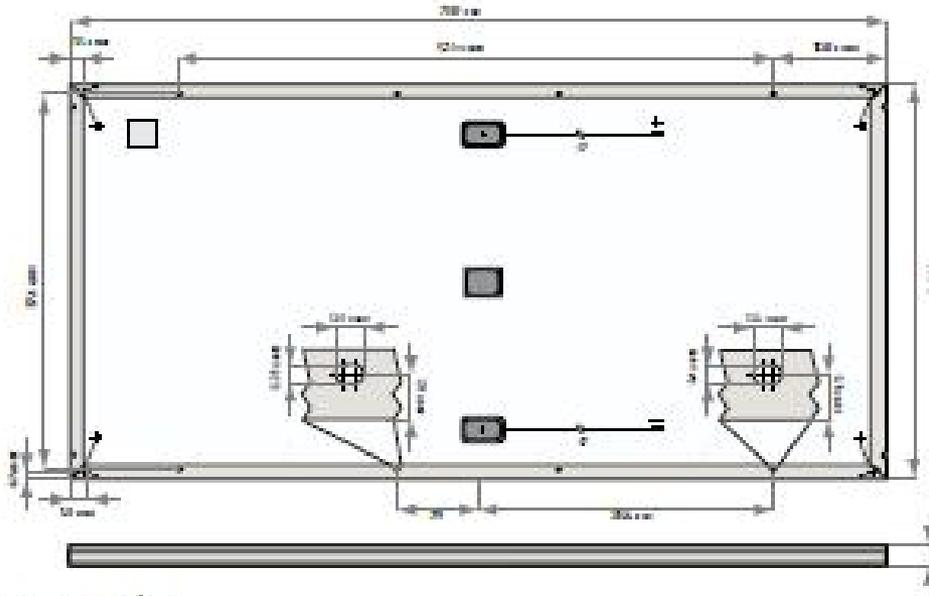
- Enables improved cell layout
- Increased internal reflection
- Reduced heat build up behind JB
- Gain of +1 Wp per panel

REC TwinPeak 72 Series

Higher Watt Classes



REC TWINPEAK 72 SERIES



- 17.1%** EFFICIENCY
- 10** YEAR PRODUCT WARRANTY
- 25** YEAR LINEAR POWER OUTPUT WARRANTY
- DUTY-FREE** US IMPORT DUTY FREE

TEMPERATURE RATINGS

Nominal Operating Cell Temperature (NOCT)	44.6°C (±2°C)
Temperature Coefficient of P_{max}	-0.39 %/°C
Temperature Coefficient of V_{oc}	-0.31 %/°C
Temperature Coefficient of I_{sc}	0.045 %/°C

GENERAL DATA

Cell Type:	144 multicrystalline 6 strings of 24 cells (6" x 3")
Glass:	0.36" (4 mm) solar glass with anti-reflection surface treatment
Back Sheet:	Double layer highly resistant polyester
Frame:	Anodized aluminum (silver)
Junction Box:	IP67 rated with bypass diodes 12 AWG (4 mm ²) solar cable 4.7" x 4.7" (1.2 m x 1.2 m)
Connectors:	Multi-Contact MC4 (12 AWG, 4 mm ²)

Minimum order quantities:

ELECTRICAL DATA @ STC

	REC330TP72	REC335TP72	REC340TP72
Nominal Power - P_{max} (Wp)	330	335	340
Watt Class Sorting - (W)	0/+5	0/+5	0/+5
Nominal Power Voltage - V_{mp} (V)	38.1	38.3	38.5
Nominal Power Current - I_{mp} (A)	8.66	8.75	8.84
Open Circuit Voltage - V_{oc} (V)	46.0	46.2	46.3
Short Circuit Current - I_{sc} (A)	9.22	9.27	9.32
Panel Efficiency (%)	16.6	16.9	17.1

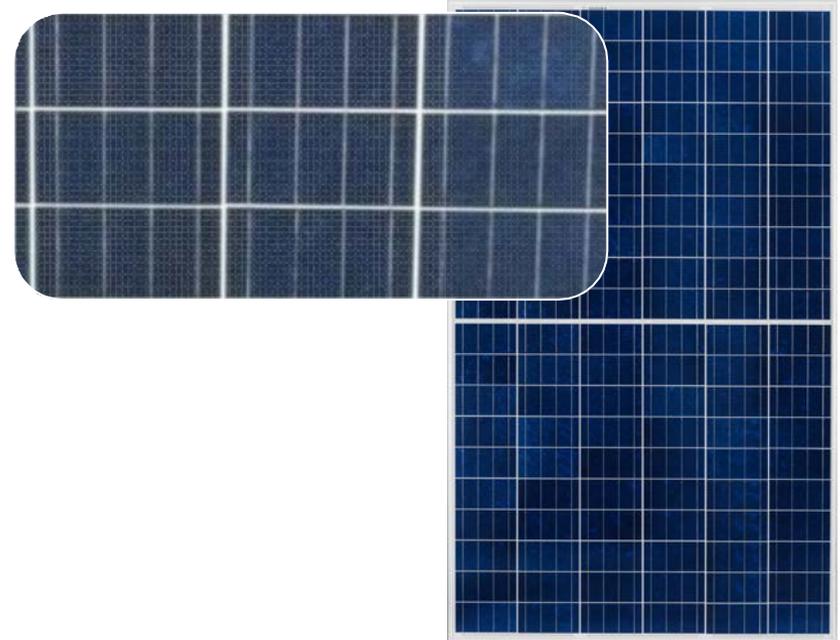
Analysed data demonstrates that 100% of modules produced have current and voltage tolerance of ±3% from nominal values. Values at standard test conditions STC (air mass AM1.5, irradiance 1000 W/m², cell temperature 77°F (25°C). At low irradiance of 200 W/m² (AM1.5) and cell temperature 77°F (25°C) at least 94% of the STC module efficiency will be achieved.

REC TwinPeak Enablers: Half-Cut Cells



What it is:

- Using the same cell production process as for standard cells, the cells in the REC TwinPeak Series have been cut in half to reduce internal cell resistance, give higher yields and increased reliability
- Higher energy yield through lower cell resistance
 - Resistive losses are strongest loss mechanism in current design
 - Half cut cells produce have a higher fill factor and higher efficiency
- Power loss in cell reduced by x 4
 - Cutting cells in half cuts the current per cell by half.
 - Panel power loss reduced by a factor of four as power loss is proportional to the square of the current
- Improved shading performance
 - New twin cell sections ensure that when bottom row is shaded, 50% of the panel is still producing power
- No changes at wafer level



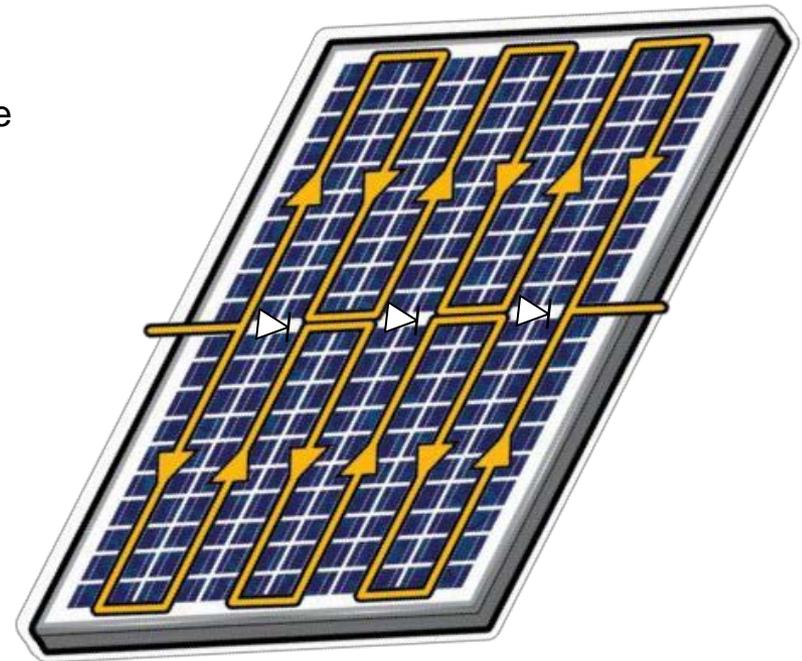
Highlights:

- Increase in energy yield
- Reduced power loss
- Improved performance when shaded
- **Total gain of 4 Wp per panel**

REC TwinPeak Enablers: How the half-cut design works



- Current splits into two panel sections
- Current per cell reduced by half
 - Current reduction gives a reduction in resistance and power lost internal to the cell
 - Power loss in the TwinPeak is reduced by a factor of four, as loss is generally proportional to the square of the current ($P_{loss} = R \cdot I^2$, where R is the resistance and I is the current)
- Three bypass diodes
 - Split junction box placed in center of panel
 - Switch on or off for each half of the panel
- Reduced loss gives a higher fill factor and efficiency, resulting in better energy yields
 - Especially at times of high irradiance.
 - Panels with a higher fill factor have lower series resistance meaning reduced loss of current internally

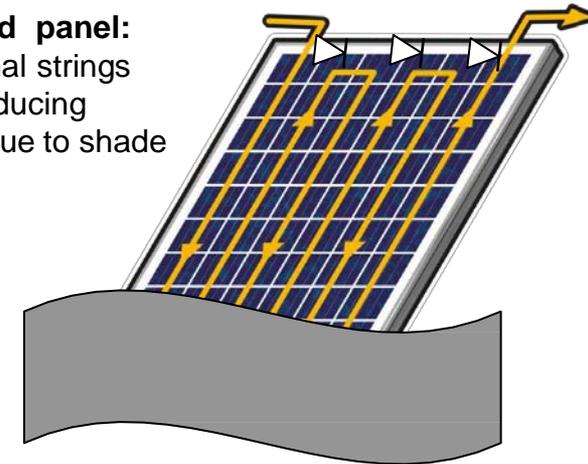


REC TwinPeak Enablers: Offering an advantage in shaded conditions

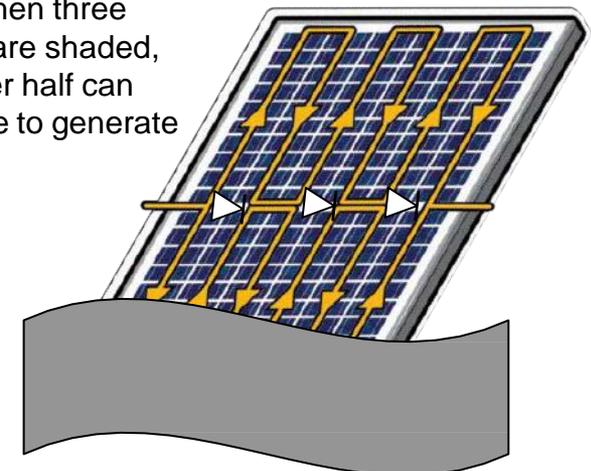


- Due to the two separate sections the REC TwinPeak Series offers improved performance in certain shading conditions
- Depending on how shade covers the panel, when the one part of the panel is shaded, the other half will still generate electricity
- Shaded darker string produces less energy. Bypass diodes remain closed and the shaded string does not contribute to output, while the 'opposite' string continues to function
- Dependent on system design, this can help ensure the REC TwinPeak Series starts to produce energy earlier than a standard panel and continues to produce energy later in the day when a standard panel may be shaded
 - Free field with even shading = Large benefit
 - Roof with uneven shading = Benefit depends on system design

Standard panel:
All internal strings stop producing energy due to shade



REC TwinPeak Series panel:
Even when three strings are shaded, the other half can continue to generate energy

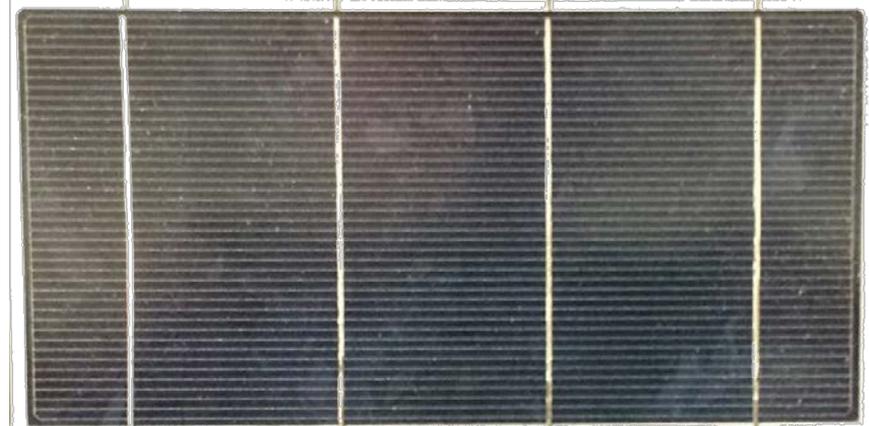


REC TwinPeak Enablers: 4 bus bar cells



What it is:

- An additional bus bar shortens the distance electrons travel to the ribbon, vastly improving the flow and the reliability performance of the panel
- 4 bus bars decrease the distance electrons have to travel
 - Improves flow of current in the cell due to reduced resistance
 - Improves the reliability performance of the panel
- More surface area exposed through reduced finger width
 - Generates more current
 - Keeps the fill factor high
- More mechanically stable than standard cells
 - Lower cross section of ribbon creates less stress on the cell
 - Proven by REC's extensive qualification testing



Highlights:

- Reduced resistance
- Increased cell surface area exposed to sunlight for higher I_{sc}
- Better reliability
- **Total gain of +2 Wp per panel**

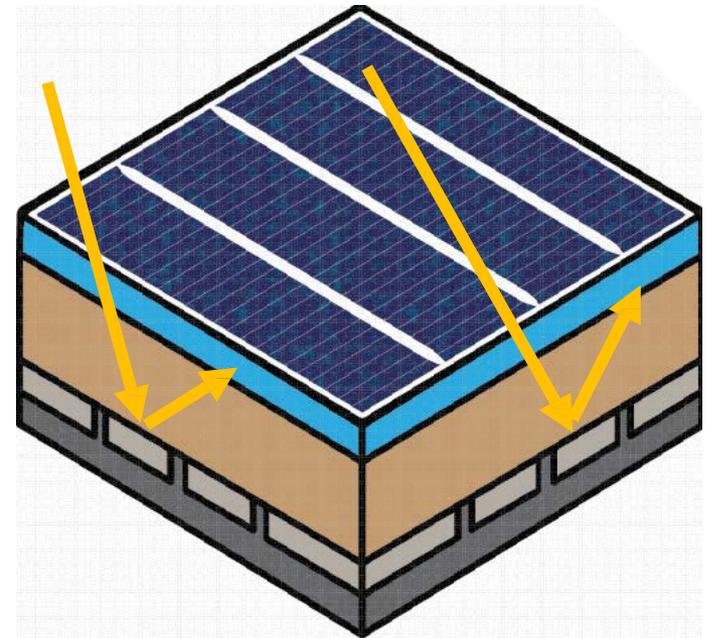
REC TwinPeak Enablers: Passivated Emitter Rear Cell (PERC)



What it is:

→ A dielectric layer between the silicon wafer and the aluminum metallization at the rear of the cell improves yield and reduces heat build up. REC is the first company to bring PERC to production level for multicrystalline cells

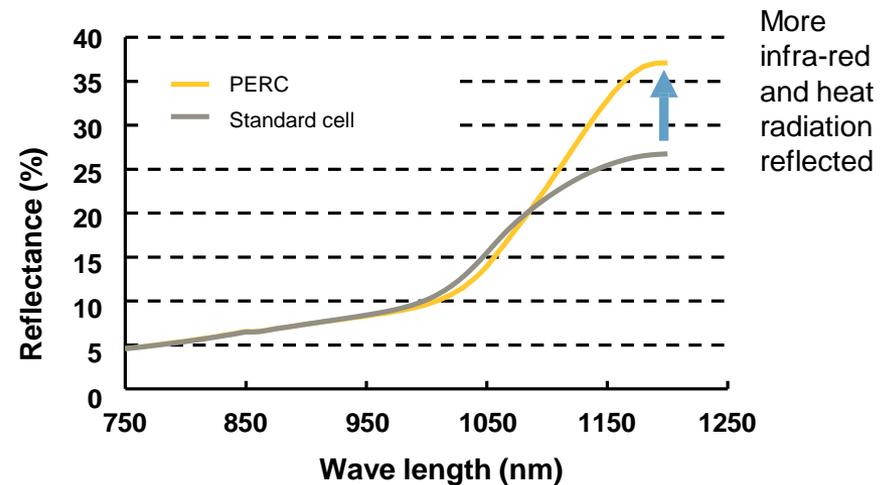
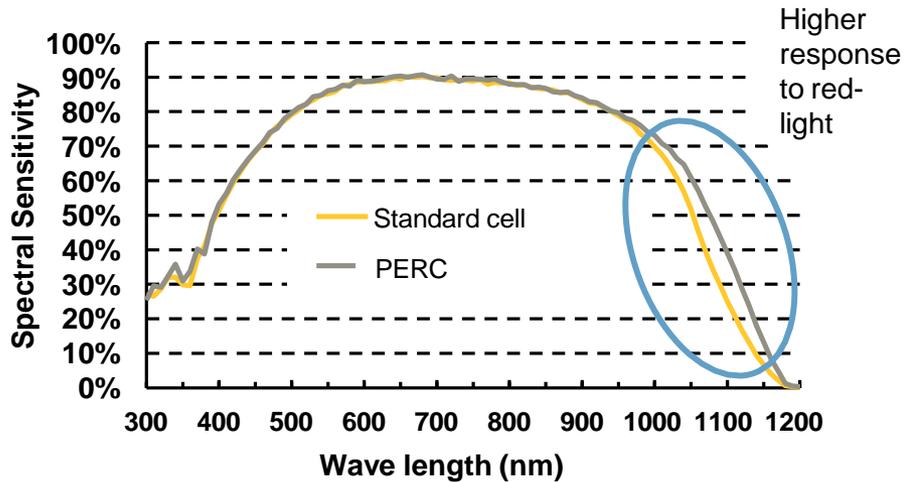
- PERC reflects light that has penetrated through the cell
 - Gives it a 2nd chance to be converted into current
 - Reduces build up of heat at rear of cell
- Rear surface is passivated
 - Electrons generated close to the rear surface can travel back through the cell layers to the emitter
 - This is seen as an increase in voltage of the cell
- Lower cell temperatures allow more efficient operation
 - Capture more light in higher temperatures
- Increased red light absorption
 - Capture more light in low light conditions (dawn/dusk)



Highlights:

- Increased energy yield
- Reduced heat build up for better efficiency
- Increased absorption at low light levels
- **Total gain of +4 Wp per panel**

REC TwinPeak Enablers: Improved energy yield through increased light capture



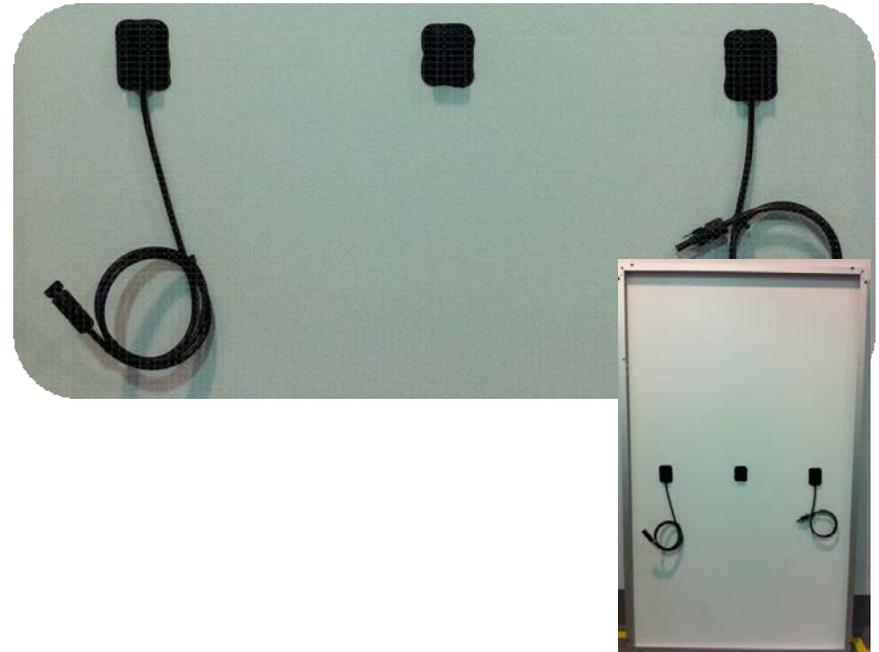
- ➔ It is mostly infra-red light (longer wavelengths) that penetrates to the bottom of the cell.
- ➔ Improving the cell's response to red-light improves the performance during early and late hours of the day and in hazy conditions
- ➔ Improved reflection of infra-red light and heat radiation internal to the cell reduces the heating up of the panel and allows higher yield

REC TwinPeak Enablers: Split junction box



What it is:

- The use of three separate, smaller boxes, each containing one bypass diode reduces internal resistance and enables the new layout design for increased output
- The three smaller parts use one less cross-connector
 - This reduces resistance in the panel
- Enables an improved cell layout design for increased power output
 - Saves space which can be used to increase internal reflection and light capture
- Reduction in heat build up behind JB
 - Around 15°C cooler than a standard panel
 - Helps increase panel reliability



Highlights:

- Enables more powerful cell layout
- Reduces heat build up by ~15°
- Cable lengths as of today
- **Total gain of +1 Wp per panel**

REC TwinPeak Series: Premium Solar Panels



REC TwinPeak Series solar panels feature an innovative design with high panel efficiency and power output, enabling customers to get the most out of the space used for the installation.

Combined with industry-leading product quality and the reliability of a strong and established European brand, REC TwinPeak panels are ideal for residential and commercial rooftops worldwide.

REC TWINPEAK SERIES

PREMIUM SOLAR PANELS WITH SUPERIOR PERFORMANCE

REC TwinPeak Series solar panels feature an innovative design with high panel efficiency and power output, enabling customers to get the most out of the space used for the installation.

Combined with industry-leading product quality and the reliability of a strong and established European brand, REC panels are ideal for residential and commercial rooftops worldwide.

- Anti-reflection
- High efficiency
- High power
- High durability

The new REC TwinPeak Series:
The combination of different technologies maximizes the power from a polycrystalline platform and optimizes long term panel performance

What are the REC TwinPeak Series?
The REC TwinPeak Series is a brand new solar panel development that features innovative design with high panel efficiency, i.e. higher watt classes. Based on a polycrystalline platform, the REC TwinPeak Series incorporates a number of new and innovative technologies that ensure the panels can compare favorably with mono-crystalline and heterojunction products on the market.

What advantages do half-cut cells offer?
An inherent benefit of half-cut cell technology is that the electrical resistance of the cell is reduced by 50%. This results in a lower series resistance, which in turn leads to a higher fill factor and higher efficiency. Additionally, the lower series resistance also results in a higher short-circuit current, which is beneficial for the system's performance in low light conditions.

What is PERC technology?
The reduction of power loss in half-cut cells produces a higher fill factor and higher efficiency, resulting in higher power output, especially in low light conditions. This is achieved by higher fill factor, lower series resistance resulting in reduced power loss and improved efficiency.

For which markets is the new panel suitable?
The new panel is suitable for all markets where polycrystalline panels are used. It is particularly well suited for residential and commercial rooftops where space is limited and high power output is required.

Maximizing cell performance
How REC's use of Passivated Emitter Rear Cell Technology increases light capture and optimizes performance

REC has introduced an innovative cell design into production that utilizes Passivated Emitter Rear Cell technology (PERC). This technology has been developed for silicon polycrystalline platform in REC and is used if it is used in a wide range of polycrystalline solar cell efficiency of 19.5 percent.

When is PERC technology?
PERC is a variation of the PERC technology that is used in the production of solar cells. It is a variation of the PERC technology that is used in the production of solar cells. It is a variation of the PERC technology that is used in the production of solar cells.

How does REC technology improve performance?
REC technology improves performance by increasing light capture and optimizing performance. This is achieved by higher fill factor, lower series resistance resulting in reduced power loss and improved efficiency.

MORE POWER OUTPUT PER M²

HIGHER ENERGY YIELD

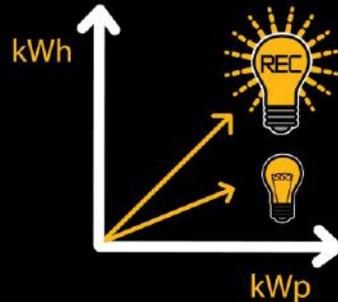
100% PID FREE

REDUCES BALANCE OF SYSTEM COSTS

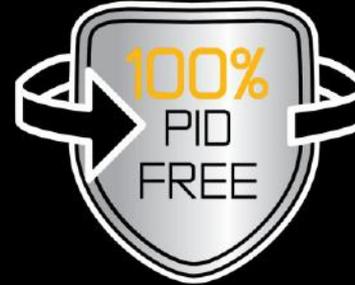
REC TwinPeak Series: USPs



**MORE POWER
OUTPUT PER M²**



**HIGHER
ENERGY YIELD**



**100%
PID FREE**



**REDUCES BALANCE OF
SYSTEM COSTS**

→ Higher Wp gives higher power

→ Higher Wp produces more energy

→ New technology captures more light and works at a lower temp to produce more energy

→ REC's unique cell and panel treatment ensures 100% of REC production is PID-free

→ Higher power over the same surface area means fewer panels required

→ Increases output for smaller surface areas, meaning improved finances

ENERGIZING LIFE TOGETHER



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