



SunPower® P Series Residential Panel Introduction and Overview

Performance Series (P-Series) Solar Panels

SunPower P Series Residential Fundamentals

Module	P19-310-335 watt
Country of Origin	China
Cells	Mono PERC, tiled cells
Efficiencies	18.4-19.9%
Size	1690 x 998mm, 46mm frame
Frame	Black anodized
Junction box	IP67, 3 bypass diodes
Connectors	MC4
Cables	1000mm
Warranty	25 product & performance



SunPower is Different, and Better

Robust shingled cells and advanced encapsulant are highly resistant to thermal stresses, humidity, and PID

Unique parallel circuitry mitigates hotspots and increases energy production in shade or soiling

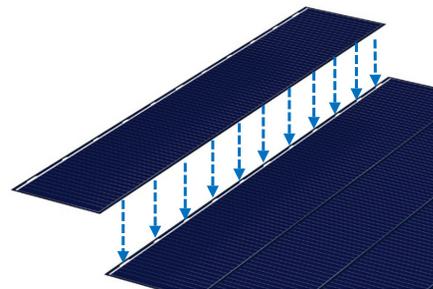
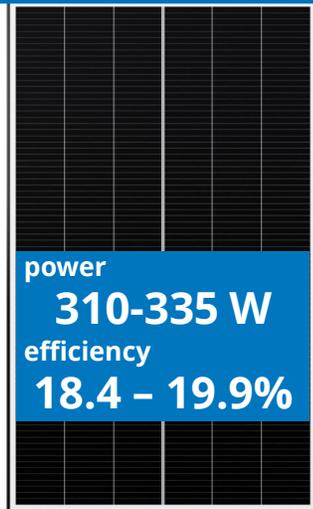
Minimal whitespace and no ribbons maximize efficiency, lowering balance of systems costs and increasing flexibility

Conventional ribbons and low quality encapsulants drive failure modes in the field¹

Serial wiring means that one shaded or cracked cell drops power by 33%

Shiny metal ribbons block incoming light, lowering efficiency

SunPower® Performance Series



P-Series panels use shingled cells with flexible and redundant electrical connections, ensuring reliable performance high stress

Conventional Tier 1 Residential Panel²



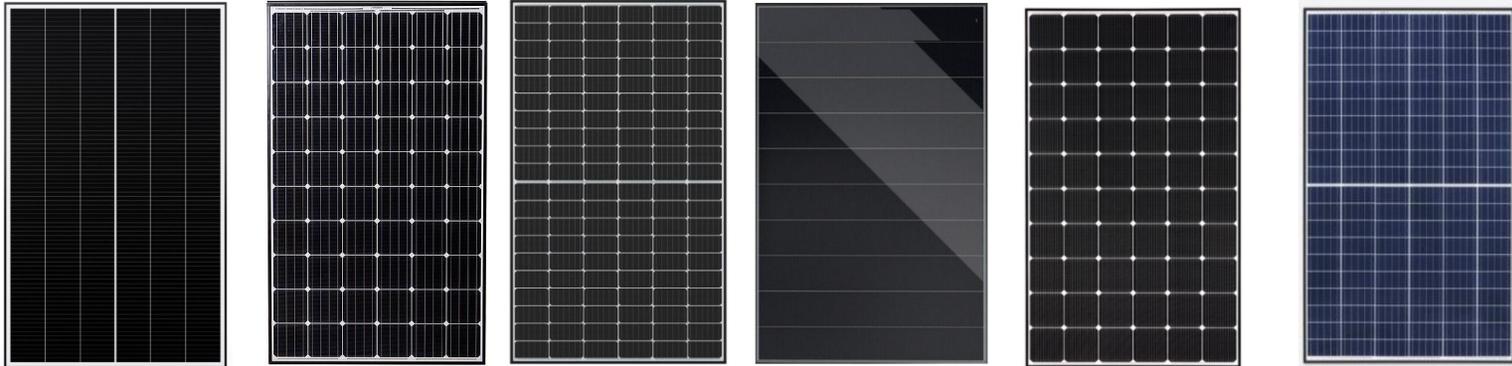
Conventional panels connect cells with soldered ribbons - these fatigue, causing hotspots and power loss

¹ TUV Quality Monitor, 2015.

² Definitions generally used throughout presentation: "Conventional Panel" is a 260W panel, 16% efficient, approx. 1.6 m², made with Conventional Cells.

"Conventional Cells" are silicon cells that have many thin metal lines on the front and interconnect ribbons soldered along the front and back.

“Premium Tier “ Residential Competition

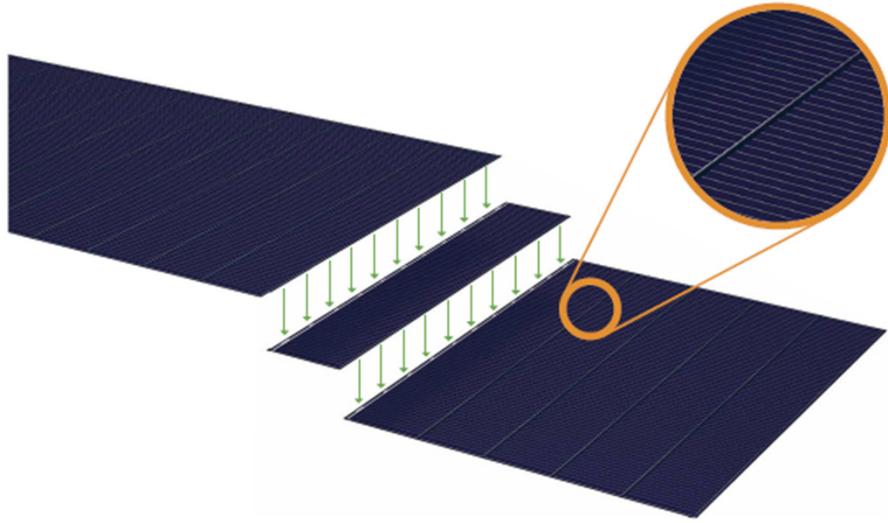


Module	SunPower P19 RES	Winaico WSP-M6	Q Cells Duo G5	Seraphim Eclipse	LG Neon 2	REC Twin Peak 2 Series
Avg. Power (W)	315 – 325	270-290	315-330	310	325	275-300
Efficiency	18.8 – 19.4%	16.24 – 17.46%	18.7 – 19.6%	19.1%	19.0%	16.5-18.0%
Length (mm)	1690	1665	1685	1623	1686	1675+-2.5
Width (mm)	998	999	1000	1048	1016	997 +- 2.5
Power Warranty	97%, -0.6%	97%, -0.7%	98%, -0.54%	97.5%, -0.7%	98%, -0.5%	97%, -0.7%
Product Warranty	25 yrs	12 yrs	12 yrs	10 yrs	25 yrs	10yrs

Data collected from published websites, data sheets & brochures. Collected July 2018.
 “Premium” as described by Solarquotes in a graph published June 6, 2016. Seraphim not “Premium Tier 1”. Added for comparison.

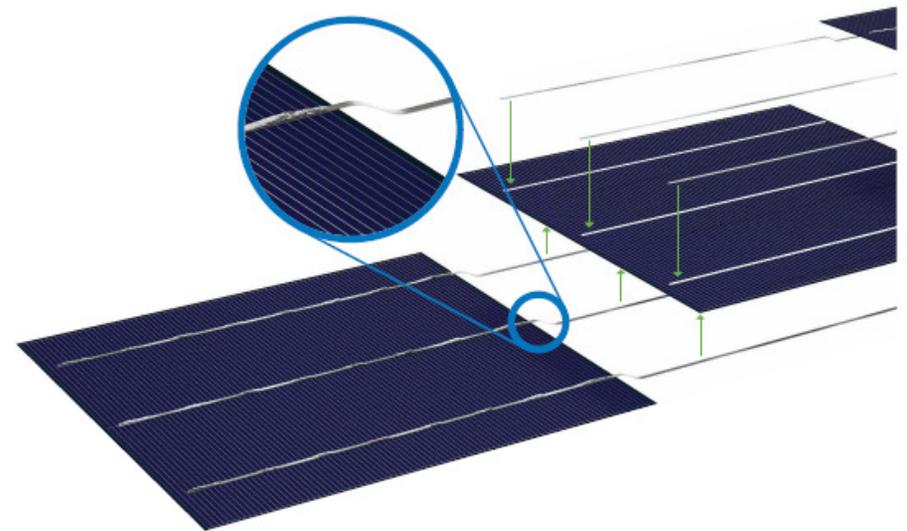
Shingled Cell vs. Conventional Cell

Shingled Solar Cells



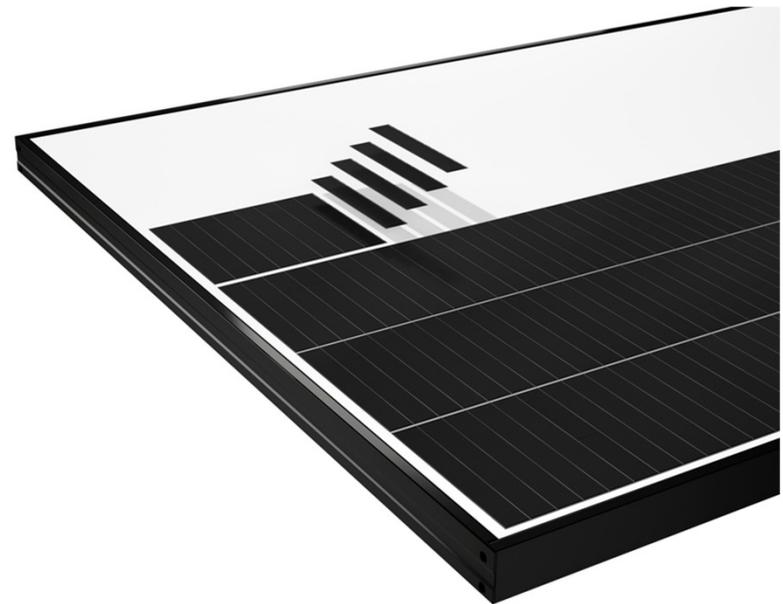
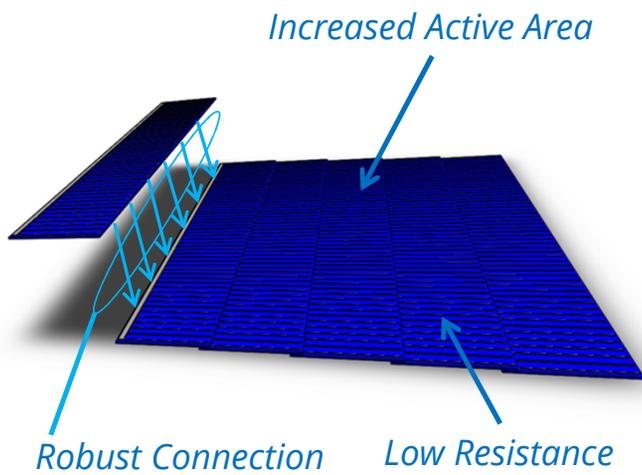
1. Thin screen-printed metal lines on the front of the cells are protected from corrosion by SunPower's specially engineered encapsulant
2. No soldered ribbons along the length of the cell – one of the major failure modes of using traditional cells has been designed out of the panel.
3. Cells are connected across their length, creating many redundant paths for electricity, and no single point of failure.

Conventional Solar Cell



1. High-stress solder joints between the long copper ribbons and crystal solar cell
 - As the panels get hot in the day and cold at night the copper expands but the silicon cell does not.
 - Over time, this repeated stress causes cells to crack and solder bonds to break.
2. Single points of failure on copper ribbons between cells.
3. Very thin screen-printed metal lines on the front of the cell are susceptible to corrosion over time

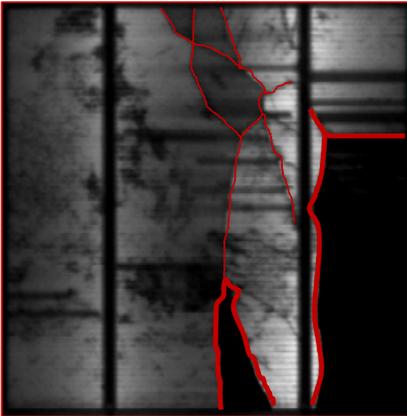
Shingled Cells Provide Excellent Strength



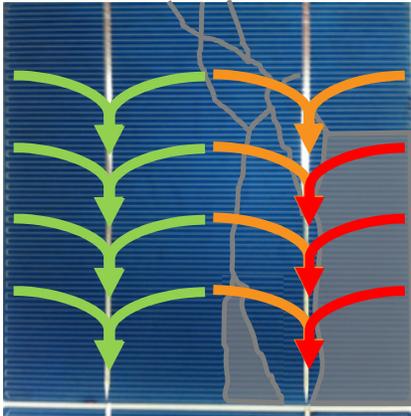
Shingled cells provide flexible and redundant electrical connections

Cell Cracking in P-Series

Conventional Cell¹

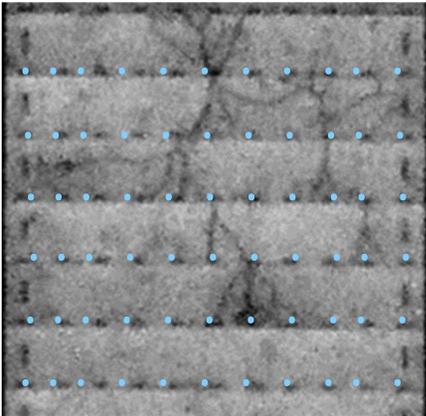


Cracks propagate until they encounter a ribbon or the edge of the cell

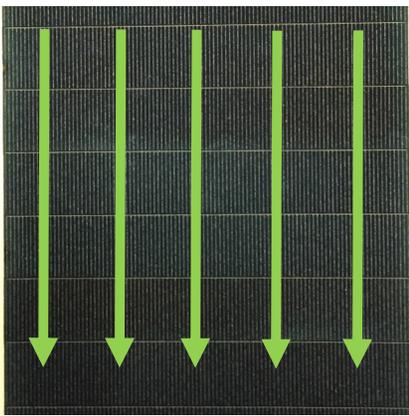


Current flows along silver lines to the ribbon so cracks prevent current from reaching the ribbon

SunPower® Performance Series



Short cell length, 1 inch, limits crack propagation, mitigating isolation of cracked cell areas



Highly redundant conductive adhesive connections act as a "mesh" to contain cracks and maintain current flow

Redundant connections limit power loss from cracks in P-Series

¹ Kontges, et. al. "Performance and Reliability of Photovoltaic Systems, Subtask 3.2: Review of Failures of Photovoltaic Modules." 2014.

Summarizing Key Features & Benefits

Feature	Benefit
SunPower the Brand	SunPower's Pedigree gained over 30 years leading the solar industry. A solid reputation for quality and innovation
Cell Construction	Mono PERC, tiled cells are efficient and strong. They are designed to last the distance
Warranty	SunPower back the P series with a 25 year product and performance warranty. Most competitors have a 10 or 12 year product warranty
Price Point	The P19 provides has the backing of SunPower and the performance of Mono PERC at a price point comparable to premium tier 1 panels
SunPower's encapsulate	SunPower's specially engineered encapsulant protects against water ingress, humidity and corrosion
11 cell connections	The proprietary conductive adhesive that is used on the cells to connect them is more flexible than bus bars and reduces the strain of expansion and contraction
Improved Shading Performance	The three Bypass diodes and parallel circuitry provides better performance in partial shade
Can be used with DC optimizers & Enphase Micro inverters	Allows for more flexibility - DC optimizers, string inverter or micro inverter for AC

SUNPOWER®

Thank You

Let's change the way our world is powered.