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Filling in the gaps: The evolution of high-density module design

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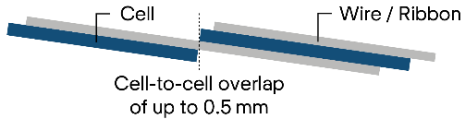
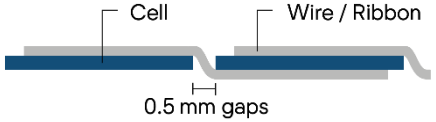
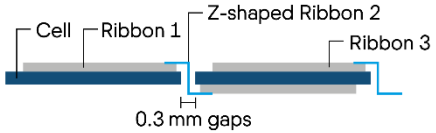
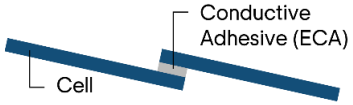
Filling in the gaps: The evolution of high-density module design

Introducing the Q.PEAK DUO-G9 series

Jürgen Steinberger
pv magazine webinar | June 25, 2020

Q CELLS
Engineered in Germany

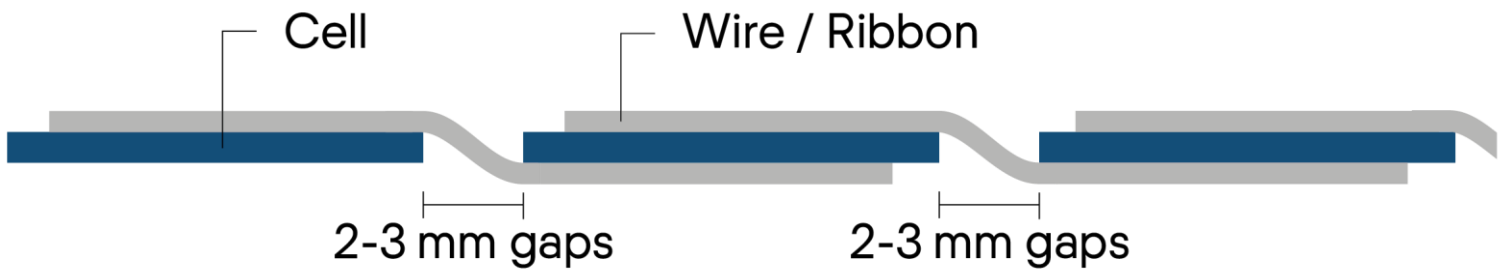
Assessing Zero-Gap Technology & Potential Alternatives

Assessment of High-Density Technologies	Zero-Gap	Small gaps	Paving	Shingling
				
Compatibility with existing production methods	Yes	Yes	No	No
Continuity of Q.ANTUM DUO Half-Cell Module Technology	Yes	Yes	Partially	No
Challenges for performance & reliability	• Well understood • Considered in qualification tests • Monitored in production line	Same as Zero-Gap	• Increased number of parts • Solder joints of 3-part ribbons critical	• Unknown durability of ECA in PV modules • No redundancy for cell breakage
Module efficiency for white backsheet modules	Optimal	Similar to Zero-Gap	Similar to Zero-Gap	Similar to Zero-Gap
Module efficiency for black backsheet modules	Optimal	Slightly lower than Zero-Gap	Slightly lower than Zero-Gap	Similar to Zero-Gap
Module size & weight vs. standard design	• 65 mm shorter • 730 grams lighter	• 50 mm shorter • 570 grams lighter	• 55 mm shorter • 640 grams lighter	*Not comparable due to use of 1/6-cells*
Appearance	New, distinct	Similar to standard	Similar to standard	New, distinct

Explaining Zero-Gap Technology

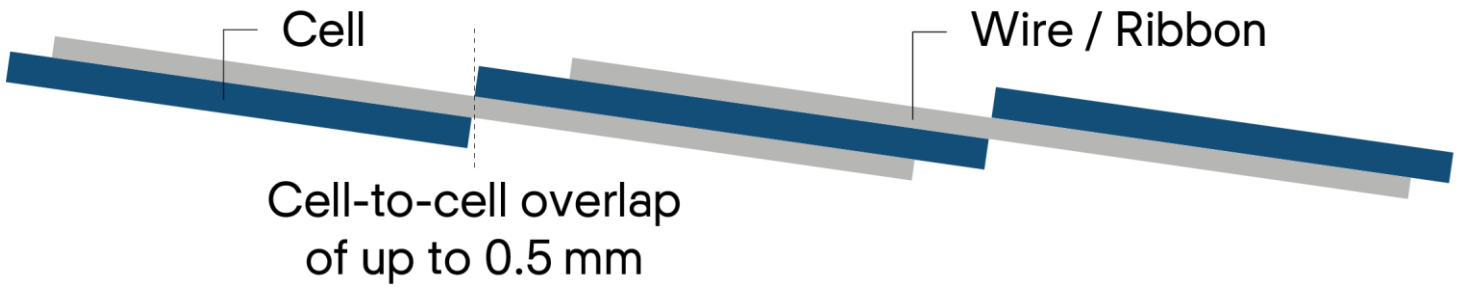
Current industry standard

Gaps of 2-3 mm between cells resulting in lower density of cells;
wire bends to connect front side of one cell to rear side of next cell



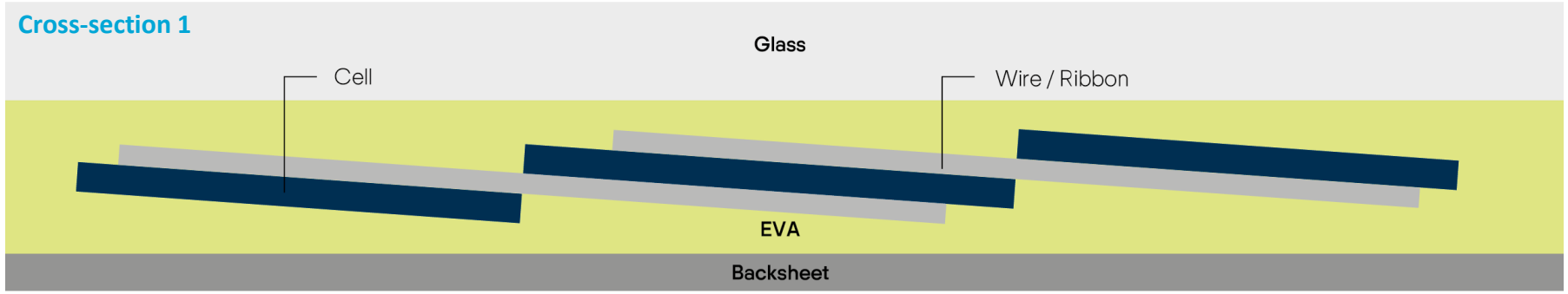
Zero-Gap Technology

No gap between cells for higher density; straight wire, cells marginally tilted (up to 0.3 degrees); no impact on solar energy harvest



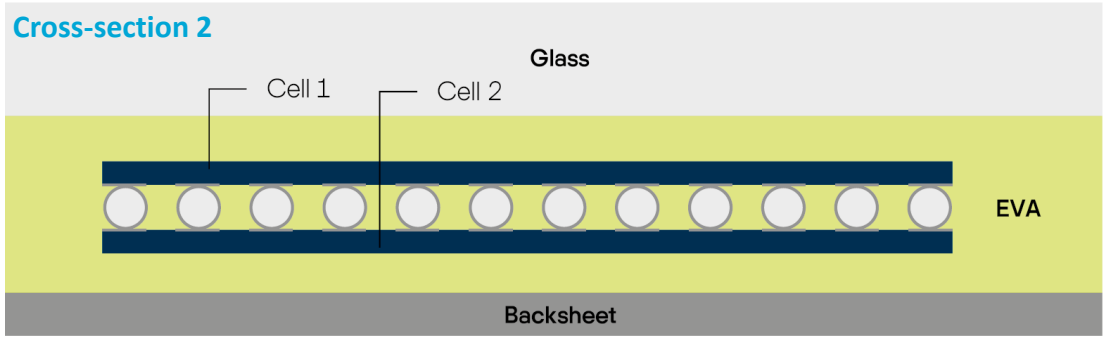
Explaining Zero-Gap Technology

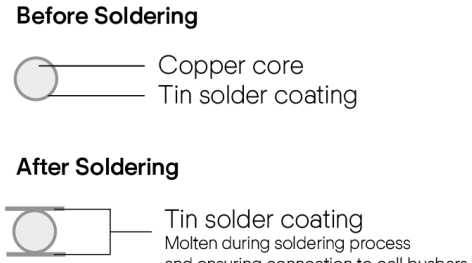
At a wire connecting cells: cells & wires are embedded in EVA and protected by glass and backsheet



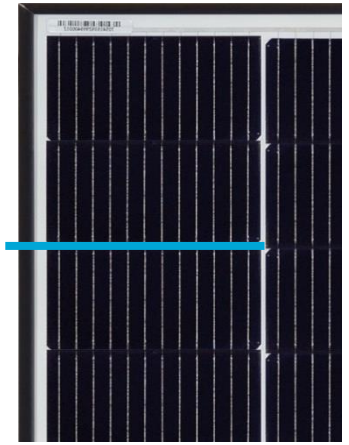
Cross-section 1
at a wire connecting cells

At an overlap of 2 cells: wires & EVA in between the cells provide support & cushioning





Cross-section 2
at an overlap
of 2 cells



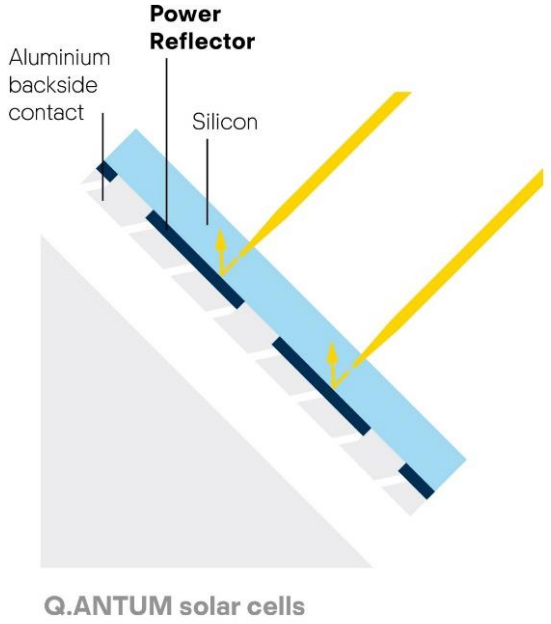
Q.ANTUM DUO Z: Innovation Building on Proven Technology

powered by Q.ANTUM

Solar Cells

+7 %

- 12+ years of R&D
- Commercialized 7+ years ago
- Over 4 billion Q.ANTUM cells
- More than 23 GW of Q.ANTUM solar modules



Q.ANTUM solar cells

+

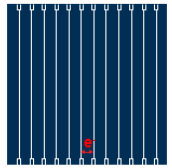
powered by Q.ANTUM DUO

Module Technology

+7.5 %

- 7 years of R&D
- More than 7 GW of Q.ANTUM DUO modules produced
- Won Intersolar PV Award 2018
- PVEL Top Performer 2019/2020 for DUO

1) 12 busbars



Shorter distance reduces effect of resistance on electrons → +2.0% Power

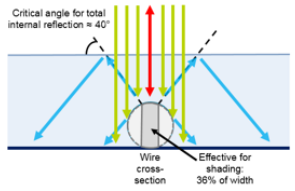
2) Half-cells

1× full cell → 1× half cell

~10 Amps ~0.7 Volts → ~5 Amps ~0.7 Volts

+3.0% Power

3) Round wires



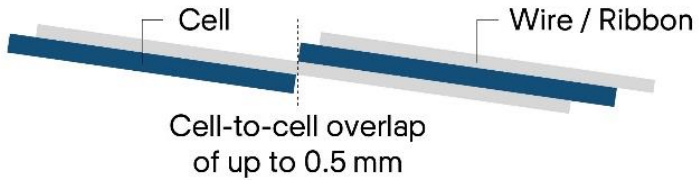
+2.5% Power

+

powered by Q.ANTUM DUO Z

Zero-Gap Technology

+4 %

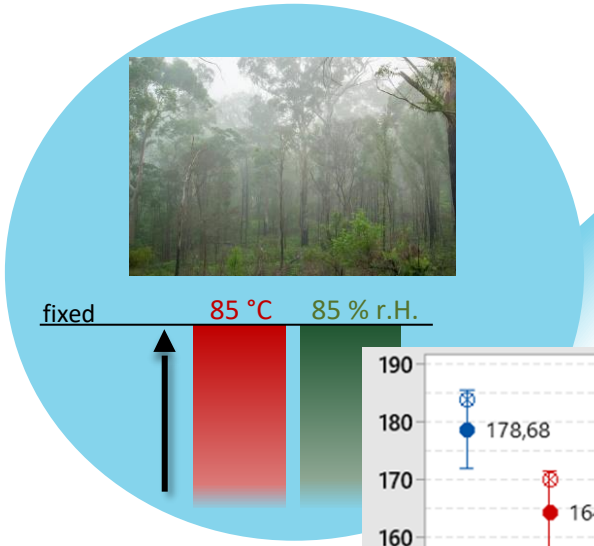


Cell-to-cell overlap of up to 0.5 mm

Q.ANTUM DUO Z: Tested to Q CELLS Outstanding Standards

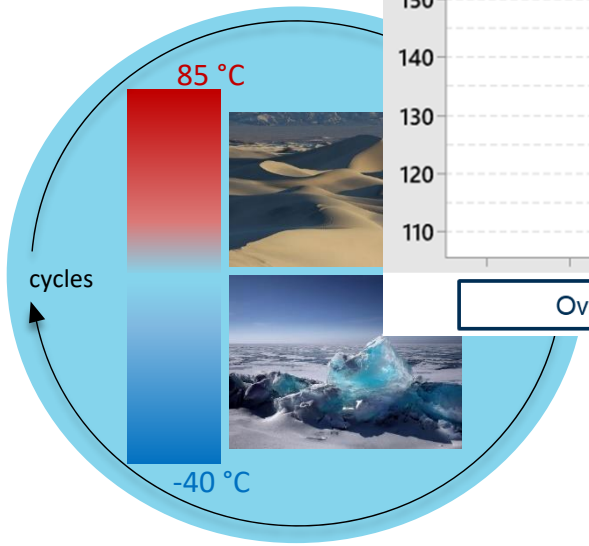
Damp Heat [DH]
(tropical stress)

3000 hours
(3 * IEC) tested!

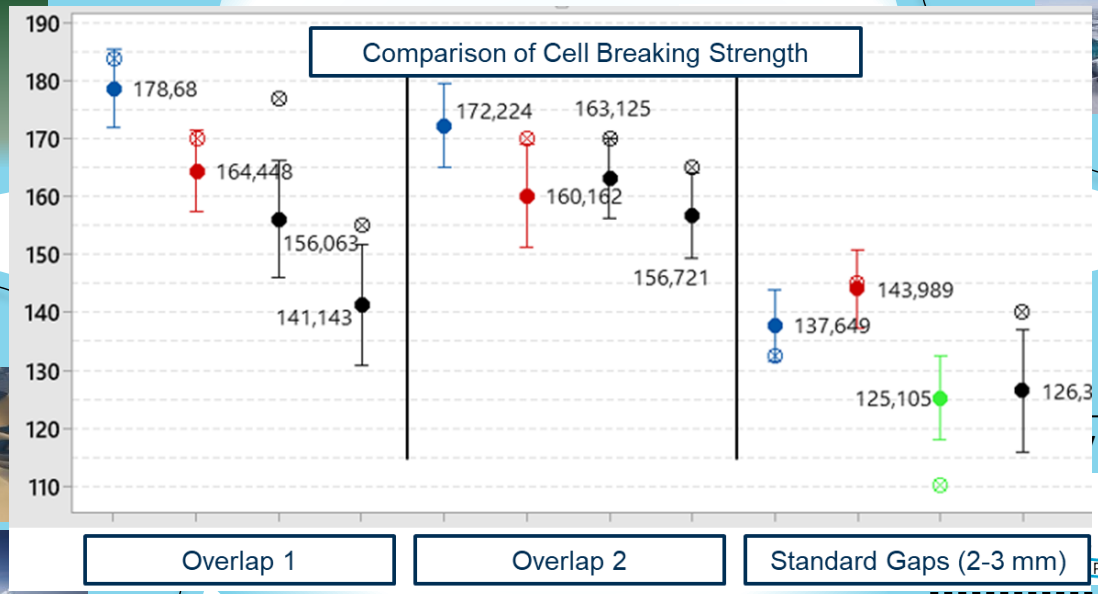


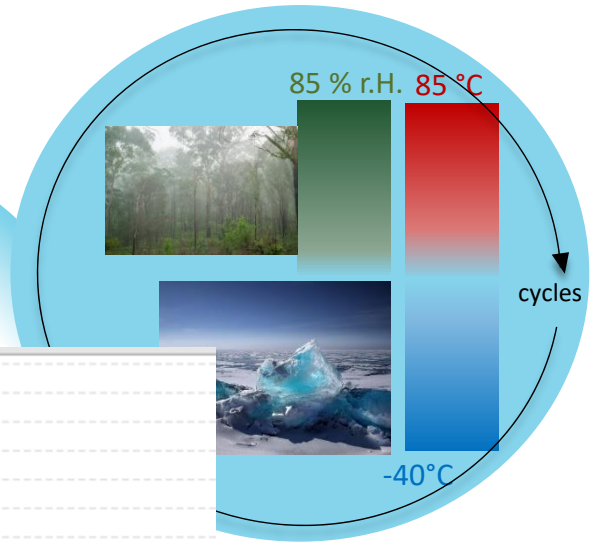
Thermal Cycling [TC]
(desert stress)

600 cycles
(3 * IEC) tested!



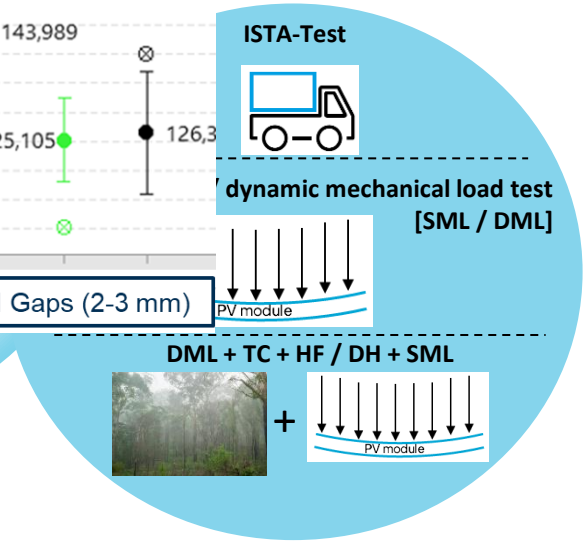
Q.PEAK DUO-G9 Series





Humidity Freeze [HF]

30 cycles
(3 * IEC) tested!



Transportation & mechanical load tests

Q.ANTUM DUO Z: Enabling the Q.PEAK DUO-G9 Modules Series

	White Backsheet		Black Backsheet		
	Q.PEAK DUO-G8	Q.PEAK DUO ML-G9	Q.PEAK DUO BLK-G8	Q.PEAK DUO BLK ML-G9	Characteristics of New Generation
Number of Half-Cells	120	**132**	120	**132**	• **12 half-cells more**
Power (Wp)	360	**390 (+30)**	345	**380 (+35)**	• **30 to 35 watts higher power**
Efficiency	20.09%	**20.58 % (+0.49 %)**	19.25 %	**20.05 % (+0.80 %)**	• **Efficiency increase up to 0.8 %p via higher cell density of Zero-Gap**
Length (mm)	1740	**1840**	1740	**1840**	• **Only 10 cm longer**
Width (mm)	1030	1030	1030	1030	• Same width
Frame height (mm)	32	32	32	32	• Same frame height
Weight (kg)	19.9	**19.5**	19.9	**19.5**	• **Lower weight due to thinner glass**

Q.ANTUM DUO Z: Enabling the Q.PEAK DUO-G9 Modules Series

Q.PEAK DUO-G8

- Standard Q.PEAK DUO appearance
  - Black frame, white backsheet
  - Silver cross-connectors
  - 12-wire technology
- Module power up to 360 Wp
- Module efficiency up to 20.1 %

Q.PEAK DUO ML-G9

- Distinct Zero-Gap appearance
  - Black frame, white backsheet
  - Silver cross-connectors
  - 12-wire technology
- Module power up to 390 Wp
- Module efficiency up to 20.6 % (+0.5 %p)

Q.PEAK DUO BLK ML-G9

- All-black design
  - Black frame, black backsheet
  - Black cross-connectors
  - Almost invisible thin round wires
- Module power up to 380 Wp
- Module efficiency up to 20.1 % (+0.8 %p)

Q.ANTUM DUO Z: Use Case of Q.PEAK DUO BLK ML-G9

Module	Q.PEAK DUO BLK-G8	Q.PEAK DUO BLK ML-G9
Power (Wp)	345	**380**
Efficiency	19.25%	**20.05%**
Length (mm)	1740	**1840**
Width (mm)	1030	1030
Weight (kg)	19.9	**19.5**

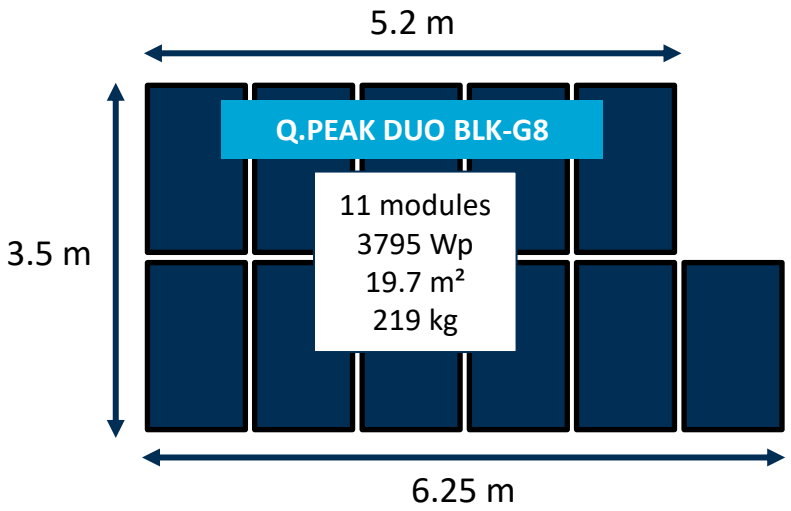
System	Q.PEAK DUO BLK-G8	Q.PEAK DUO BLK ML-G9	Absolute advantage	Relative advantage
System Power (Wp)	3795	**3800**		
Number of Modules	11	**10**	**1**	**9%**
Required Area (m²)	19.7	**19.0**	**0.76**	**4%**
Total Module Weight (kg)	219	**195**	**24**	**11%**

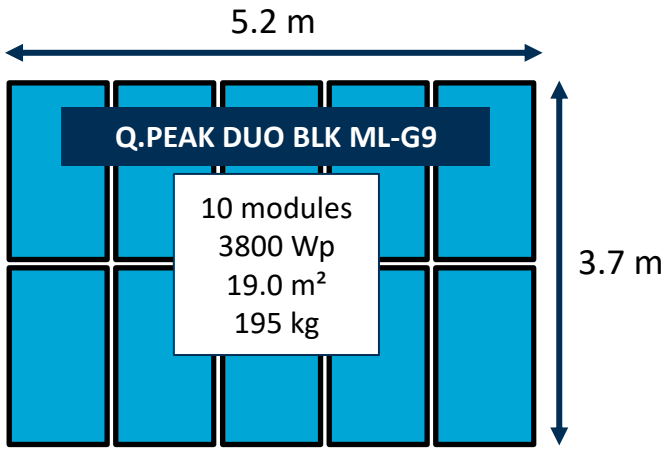
Superior Mounting Options

Q.PEAK DUO (BLK) ML-G9
5400 Pa push, 4000 Pa pull
300 mm wide clamping range

Previous Q CELLS standard
5400 Pa push, 4000 Pa pull
200 mm wide clamping range

Industry standard
5400 Pa push, 2400 Pa pull
80-100 mm wide clamping range





Q.ANTUM DUO Z: Enabling the Q.PEAK DUO-G9 Modules Series

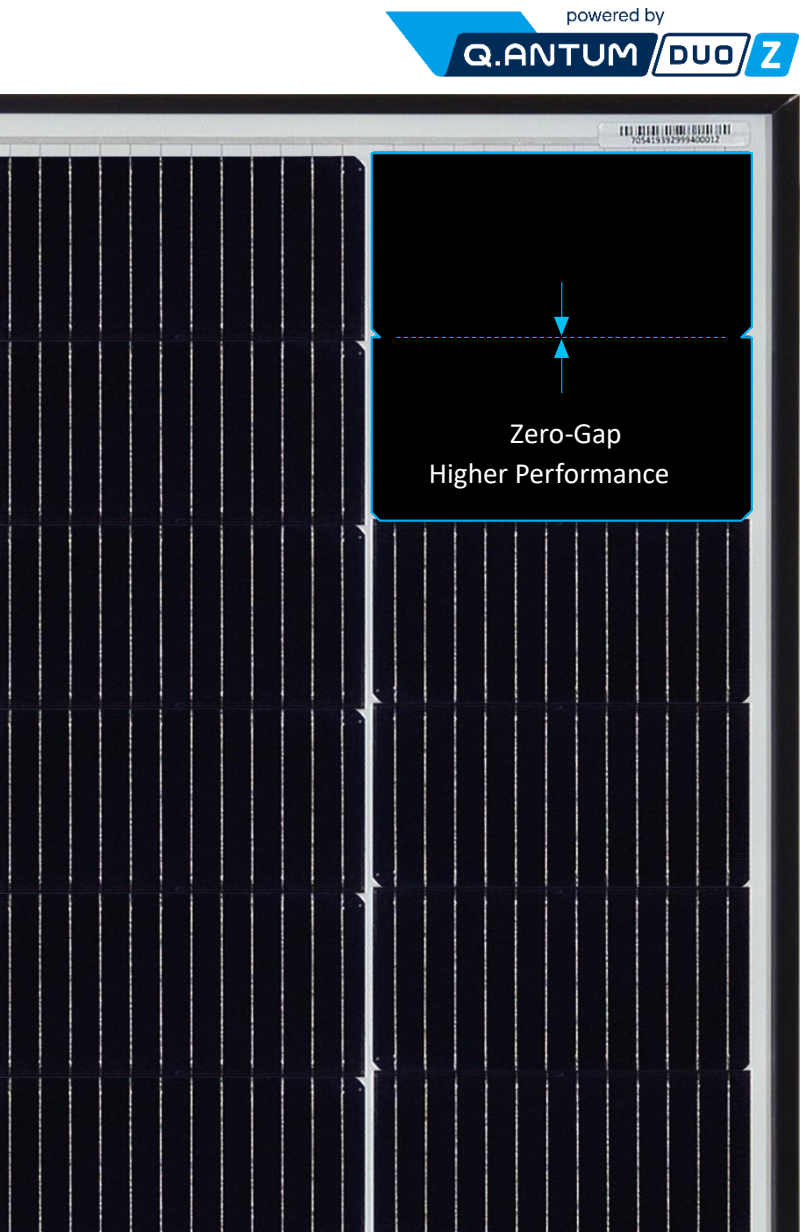
	Q.PEAK DUO L-G8	Q.PEAK DUO XL-G9
Number of Half-Cells	144	**156**
Power (Wp)	430	**460 (+30)**
Efficiency	20.07 %	**20.65 % (+0.58 %)**
Length (mm)	2080	**2163**
Width (mm)	1030	1030
Frame height (mm)	35	35
Weight (kg)	24.5	**25.5**

Characteristics of New Generation
• **12 half-cells more**
• **30 watts higher power**
• **Efficiency increase up to 0.6 %p via higher cell density of Zero-Gap**
• **Only 8.3 cm longer**
• Same width
• Same frame height
• **1 kg heavier**

THE IDEAL SOLUTION FOR:

Rooftop arrays on commercial / industrial buildings

Ground-mounted solar power plants



Extreme Performance with
Q.ANTUM DUO Z Technology

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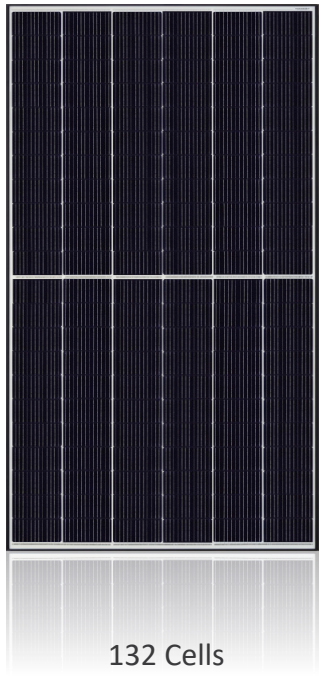
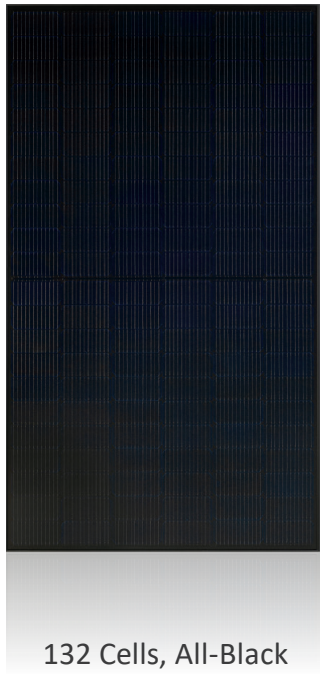
Q.PEAK DUO-G9 SERIES



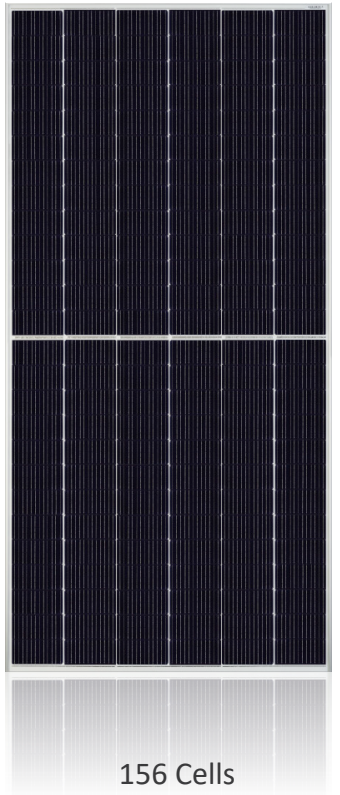
132 Cells
Q.PEAK DUO ML-G9

390 Wp / 20.6 %



132 Cells, All-Black
Q.PEAK DUO BLK ML-G9

380 Wp / 20.1 %



156 Cells
Q.PEAK DUO XL-G9

460Wp / 20.6 %