CIGS SOLAR MODULES

Q.SMART
Sophisticated design for a broad range of applications
Solar energy is in limitless supply, conserves natural resources, and protects the climate. We have made it our mission to promote the development of solar power.

Shortly after the company was founded in 1999, Q-Cells developed into one of the world’s largest solar cell manufacturers. Since then it has shown a real pioneering spirit, innovation strength, and quality awareness in its work to establish photovoltaics as a sustainable and environmentally sound form of technology. Initially, Q-Cells was solely focused on its core competence: The production of solar cells. Today, Q-Cells offers a wide range of innovative photovoltaic solutions: From solar cells and modules to solar power plants.
Q-Cells leads the field when it comes to developing, producing, and marketing solar cells from mono- and multicrystalline silicon. The solar cells manufactured by Q-Cells are subjected to rigorous testing to achieve maximum efficiencies.

Q-Cells is one of the largest system integrators active in the global photovoltaic industry. We plan, build, and maintain large-scale solar power plants and roof-mounted systems worldwide, providing our customers with turnkey solutions from a one-stop supplier.

**Q-CELLS PRODUCT PORTFOLIO**

**OUTSTANDING QUALITY FOR RELIABLE ENERGY YIELDS**

**SOLAR MODULES**

With its crystalline and thin-film modules, Q-Cells supplies certified solutions for a wide range of requirements. Homeowners and commercial customers are equally impressed by the modules’ quality, attractive design, and reliable energy output.

<table>
<thead>
<tr>
<th>PRODUCT GROUP</th>
<th>APPLICATION</th>
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<tbody>
<tr>
<td><strong>SOLAR ARRAYS ON RESIDENTIAL ROOFTOPS</strong></td>
<td><strong>SOLAR ARRAYS ON COMMERCIAL AND INDUSTRIAL ROOFTOPS</strong></td>
</tr>
<tr>
<td><strong>Q.PRO</strong></td>
<td><strong>Q.SMART</strong></td>
</tr>
<tr>
<td>Multicrystalline solar modules</td>
<td>CIGS solar modules</td>
</tr>
<tr>
<td><strong>Excellent performance, reliable yields, the industry standard</strong></td>
<td><strong>Prime aesthetics, inclination angle-independent installation and good yields at each roof orientation</strong></td>
</tr>
</tbody>
</table>

**SOLAR ARRAYS ON RESIDENTIAL ROOFTOPS**

**SOLAR ARRAYS ON COMMERCIAL AND INDUSTRIAL ROOFTOPS**

**IN-HOUSE AND FACADE SOLAR ARRAYS**

**LARGE-SCALE SOLAR ARRAYS, SOLAR POWER PLANTS**

**SOLAR CELLS**

Q-Cells is one of the largest system integrators active in the global photovoltaic industry. We plan, build, and maintain large-scale solar power plants and roof-mounted systems worldwide, providing our customers with turnkey solutions from a one-stop supplier.
Instead of using individual cells, the CIGS technology applies an ultra-thin photovoltaic layer to a substrate. This so-called “thin-film technology” utilizes an energy and material reduced production. The CIGS technology, which uses copper indium gallium (di)selenide mixtures, stands for world best efficiencies.

Q-Cells manufactures its CIGS solar modules on highly automated production lines in “Solar Valley” in Bitterfeld-Wolfen, Germany. The CIGS layer is applied to a molybdenum-coated glass substrate. The thin-film cells are defined and connected in series by fine patterning lines on the glass substrate. In conjunction with a transparent zinc oxide layer, the cells produce a photovoltaic effect when exposed to the sun.

A comprehensive quality assurance program determines the production process, which is certified in accordance with ISO 9001. From the inspection of incoming goods through to performance measurement, each stage of the process is closely monitored, and every solar module can be traced back with respect to all the important production parameters.

100% testing of the electrical and visual characteristics of the modules guarantees reliable quality and an outstanding appearance for both installers and system operators.

The use of the Q-Cells module testing center in “Solar Valley” has made it possible to establish a comprehensive quality assurance system that exceeds the industry standards. We are continuously optimizing our production processes and the quality of our modules which, in turn, enables us to achieve very low breakage and complaint rates.
Highly automated production lines in “Solar Valley” in Bitterfeld-Wolfen.

CROSS SECTION OF A CIGS SOLAR MODULE

- Front contact (ZnO:Al)
- Absorber layer (CIGS)
- Back contact (Mo)
- Substrate glass
Q.SMART solar modules offer the world’s best efficiencies – of up to 13 % – for thin-film modules in mass production. The reliable “Made in Germany” quality and the superior design make them perfect for rooftop and building integrated installations where visual aesthetic is of prime importance.

Q.SMART 70–90 FRAMED CIGS SOLAR MODULE

PRODUCT BENEFITS

- Outstanding design with a homogeneous black surface and black aluminum frame
- Optimization of output due to positive sorting +5/-0 Wp
- Approved for increased snow and wind loads of up to 5400 Pa
- Wide clamping range for cost-efficient mounting on roof hooks

IDEAL FOR

- In-roff and rooftop arrays on residential buildings
- In-roof and rooftop arrays on small-sized commercial and industrial buildings
- Facade installations
**Q.SMART UF 70–90**
**UNFRAMED CIGS SOLAR MODULE**

**PRODUCT BENEFITS**
- Outstanding design with a homogeneous black surface and black edge sealing
- Optimization of output due to positive sorting +5/–0 Wp
- Mounting options for every inclination – from flat roofs to facades
- Efficient self-cleaning due to lack of raised edges

**IDEAL FOR**
- Rooftop arrays on residential buildings
- Rooftop arrays on small-sized commercial and industrial buildings
- Facade installations
- Roof-parallel flat roof installations

**Q.SMART UF L 90–110**
**UNFRAMED CIGS SOLAR MODULE**

**PRODUCT BENEFITS**
- Outstanding design with a homogeneous black surface
- Optimization of output due to positive sorting +5/–0 Wp
- Surface area of 0.94 m² for high output of up to 110 Wp
- Efficient self-cleaning due to lack of raised edges

**IDEAL FOR**
- Rooftop arrays on small-sized commercial and industrial buildings
- Roof-parallel flat roof installations
<table>
<thead>
<tr>
<th>PRODUCT LINE</th>
<th>Q.SMART 70–90</th>
<th>Q.SMART UF 70–90</th>
<th>Q.SMART UF L 90–110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal power</td>
<td>70–90 Wp</td>
<td>70–90 Wp</td>
<td>90–110 Wp</td>
</tr>
<tr>
<td>Positive sorting</td>
<td>+5/-0 Wp</td>
<td>+5/-0 Wp</td>
<td>+5/-0 Wp</td>
</tr>
<tr>
<td>Maximum nominal efficiency</td>
<td>11.8 %</td>
<td>12.0 %</td>
<td>11.7 %</td>
</tr>
<tr>
<td>Format</td>
<td>1196 mm×636 mm×36 mm</td>
<td>1190 mm×630 mm×7.3 mm</td>
<td>1190 mm×790 mm×7.3 mm</td>
</tr>
<tr>
<td>Surface area</td>
<td>0.76 m²</td>
<td>0.75 m²</td>
<td>0.94 m²</td>
</tr>
<tr>
<td>Thickness</td>
<td>36 mm</td>
<td>7.3 mm (22 mm including junction box)</td>
<td>7.3 mm (22 mm including junction box)</td>
</tr>
<tr>
<td>Weight</td>
<td>14.5 kg</td>
<td>13.2 kg</td>
<td>16.5 kg</td>
</tr>
<tr>
<td>Front cover</td>
<td>4 mm tempered low iron glass</td>
<td>4 mm tempered low iron glass</td>
<td>4 mm tempered low iron glass</td>
</tr>
<tr>
<td>Back cover</td>
<td>3 mm float glass</td>
<td>3 mm float glass</td>
<td>3 mm float glass</td>
</tr>
<tr>
<td>Frame</td>
<td>Black anodized aluminum</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Cell type</td>
<td>CIGS [Cu(In, Ga) Se₂]</td>
<td>CIGS [Cu(In, Ga) Se₂]</td>
<td>CIGS [Cu(In, Ga) Se₂]</td>
</tr>
<tr>
<td>Junction box</td>
<td>Protection class IP 65 with bypass diode</td>
<td>Protection class IP 65 with bypass diode</td>
<td>Protection class IP 65 with bypass diode</td>
</tr>
<tr>
<td>Cable length</td>
<td>855 mm (plus cable), 735 mm (minus cable)</td>
<td>855 mm (plus cable), 735 mm (minus cable)</td>
<td>855 mm (plus cable), 735 mm (minus cable)</td>
</tr>
<tr>
<td>Connector</td>
<td>MC4 (or equivalent)</td>
<td>MC4 (or equivalent)</td>
<td>MC4 (or equivalent)</td>
</tr>
<tr>
<td>System voltage</td>
<td>1000 V</td>
<td>1000 V</td>
<td>1000 V</td>
</tr>
<tr>
<td>Reverse current resistance</td>
<td>6.5</td>
<td>6.5</td>
<td>5.0</td>
</tr>
<tr>
<td>Inverters without transformers</td>
<td>Allowed according to the specifications of the installation manual.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow/wind load</td>
<td>Up to 5400 Pa</td>
<td>Up to 2400 Pa</td>
<td>Up to 2400 Pa</td>
</tr>
<tr>
<td>Certification</td>
<td>CE-Compliant; IEC 61646 (ed. 2); IEC 61730 (ed. 1), Application Class A; UL 1703</td>
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</tr>
</tbody>
</table>

For detailed information on the different power classes of Q.SMART solar modules, please refer to the respective data sheet.
Facade installation at the production facility in Bitterfeld-Wolfen.
Q.SMART solar modules achieve world record efficiencies of up to 13 %. No other thin-film modules in mass production currently offer higher energy yields. Furthermore, the new CIGS solar module Q.SMART UF L generates a power output of up to 110 Wp due to a 25 % increased surface area. This also reduces system costs for installers and operators.

The high yields of all Q.SMART modules are a result of the outstanding behavior in low and oblique light, the favorable temperature coefficients and a cell geometry advantageous in the case of partial shading. Q.SMART solar modules provide excellent output even on flat roofs or in locations that are unfavorably aligned.

Positive sorting of the power classes in +5 Wp increments further optimizes the output. Because of their optimal rain runoff characteristics, the unframed solar modules have the additional advantage of repeated self-cleaning and can thus achieve stable yields in the long term.
• World’s best efficiencies for thin-film modules in mass production
• High energy yields due to good temperature behavior and low-light performance
• Particularly efficient, even in cases of partial shading and unfavorable roof orientation, thanks to optimized cell geometry
• Long term weather resistance due to durable glass encapsulation
ATTRACTIVE AND AESTHETICAL VISUAL APPEARANCE

Q.SMART SOLAR MODULES BRING ELEGANCE AND STYLE TO EVERY BUILDING

With their uniform pure black surface, Q.SMART solar modules have an exceptionally attractive appearance. The black anodized aluminum surrounding the framed modules combine high visual aesthetics with excellent stability for in-roof, rooftop, and facade installations.

The particularly elegant appearance of the frameless modules makes them the ideal choice for high-quality rooftop projects, roof-parallel and facade installations, as well as for protected historic buildings. Developers and architects appreciate the combination of economic efficiency and elegant design that the Q.SMART product line offers.
• Outstanding design with homogeneous black surface
• Sophisticated aesthetics for rooftop and building integrated installations where visual appearance is of crucial importance
The advantages of the attractive Q.SMART thin-film modules are persuasive. The frameless models demonstrate their superiority in particular on slightly inclined roofs. The Q.SMART solar modules with frames are the preferred choice for steeper roofs, since they are adaptable and easy to handle. The increased reverse current resistance minimizes wiring efforts. High break resistance and precision design also facilitate installation.

Q.SMART SOLAR MODULES WITH FRAMES
The framed Q.SMART modules have a black aluminum frame. Thanks to the hollow profile and strong corner joints, the frame is especially stable and flex-resistant. It has been certified for increased snow and wind loads up to 5400 Pa. Installation is quick and inexpensive since the 26 cm wide clamping area allows the modules to be installed on roof hooks with just one layer of cross rails.

- Wide clamping range for cost-efficient mounting on roof hooks
- Approved for increased snow and wind loads of up to 5400 Pa

Q.SMART UF FRAMELESS SOLAR MODULES
The frameless Q.SMART modules are permanently protected from the elements by a stable glass encapsulation with proven edge sealing. With a front pane of 4 mm thick tempered safety glass (TSG), the laminate thickness is just 7.3 mm. This stable construction minimizes the breakage rate of the glass-glass modules during transport, assembly, and operation.

- A wide range of installation options – from flat roofs to facades
- Minimal system costs due to optimum format of the Q.SMART UF L modules
• Minimal wiring effort due to a high reverse current resistance up to 6.5 A
• 4 mm TSG front pane for increased breaking resistance
The ‘Q’ in the company name stands for quality and German engineering expertise. The reliability and high quality of Q.SMART solar modules are backed up by relevant certificates and long-term warranties.

Q-Cells offers a 10-year product warranty as well as a 25-year performance warranty*. This warranty applies in full even to the small solar installations – under 30 kWp – that are usually found on residential homes. Q.SMART solar modules are certified by the VDE (Association for Electrical, Electronic & Information Technologies) in accordance with IEC standards 61646 and 61730. UL 1703 certification for the North American market is obtained via CSA or UL.

An important aspect for the environment: Q.SMART solar modules contain no lead. The modules are classified as “non-hazardous waste” in accordance with the waste list regulations and can therefore be recycled with no special requirements via the usual PV Cycle recycling process. The membership in the PV Cycle Association ensures that our modules can be returned free of charge within Europe once a system has been dismantled**. For more information visit: www.pvcycle.com.

* 90% of the initial efficiency up to 10 years, 80% up to 25 years (according to the respective effective regional warranty terms)

** In PV Cycle member countries only
• 10-year product warranty
• 25-year performance warranty*
• Full warranty service also for solar arrays smaller than 30 kWp
• Free module recycling through membership in the PV Cycle Association**
THE FORECAST IS SUNNY

Q.SMART SOLAR MODULES DEMONSTRATE EFFICIENCY AND VISUAL APPEAL IN LONG-TERM USE

Rooftop array on a residential home in Leipzig, Germany
Module type: Q.SMART 75
Output: 4 kWp
Rooftop array on an industrial building (saw-tooth roof) in Gütersloh, Germany
Module type: Q.SMART UF 70
Output: 502 kWp
Rooftop array in Stein-Neukirch, Germany
Module type: Q.SMART 75
Output: 40 kWp
Rooftop array on an agricultural building in Schackenthal, Germany

Module type: Q.SMART UF 80
Output: 30 kWp
Q-Cells takes responsibility for the reliability of the solar modules before, during, and after you have taken delivery. Technical specialists are ready to help during the planning stage, on-site, and after the modules are installed.

With the constant changes in the PV sector, an ongoing knowledge transfer with our business partners is a high priority. Our experts are available for comprehensive training. Our telephone support is always available and staffed with technical experts. Our business partners value the personal contact and quality of advice we provide. Our service engineers are especially skilled in performance monitoring and advising on performance simulation. Together, we will find solutions to benefit us all.
• Proficient telephone support
• Application-oriented planning advice
• Reliable simulation of energy yields using PV-Sol and PV-Syst
• Reliable monitoring of energy yields and equipment
• Professional on-site service
• Practical product training
DO YOU HAVE ANY QUESTIONS ABOUT OUR Q.SMART SOLAR MODULES? WE ARE THERE FOR YOU, WHEREVER IN THE WORLD YOU ARE