

16 percent: Manz achieves new world record for efficiency of CIGS thin-film solar modules

- **High-tech equipment manufacturer sets new benchmark for efficiency of CIGS modules on mass production line in Schwäbisch Hall**
- **Impressive transfer of the 21.7% world record for laboratory cells of technology partner ZSW Stuttgart to mass production**
- **CEO Dieter Manz: 16 percent world record in module format is an important milestone, but immense potential of CIGS technology not nearly exhausted**

Reutlingen, April 27, 2015. With a module efficiency of 16 percent, Manz AG is presenting an impressive new efficiency world record for CIGS thin-film solar modules today at SNEC in Shanghai, the world's leading trade fair for the photovoltaics industry. In doing so, Manz is pushing forward into a new dimension and closing the efficiency gap that has previously existed in the multi-crystalline technology that is still prevalent today.

In the fall of 2014, the Center for Solar Energy and Hydrogen Research of Baden-Württemberg (ZSW), Manz's exclusive development partner, was able to demonstrate the superiority of CIGS technology in comparison to crystalline solar cells in the laboratory, with a world-record efficiency of 21.7% in cell format. With Manz's new world record for module size, this superiority has now been impressively proven in production. The significance of this result is all the greater since the high-tech equipment manufacturer produced the world record module on its innovative production line for CIGS technology at its location in Schwäbisch Hall, on equipment for mass production.

The significant increase in performance was achieved mainly by the next generation of CIGS semiconductor material, which Manz applies to a glass substrate in the so-called co-evaporation process. Additional technological innovation is a new module design for increasing the active module surface. In addition, Manz engineers were able to sustainably reduce optical losses.

Dieter Manz, founder and CEO of Manz AG, is extremely satisfied with the consistent, continued development of CIGS thin-film technology by his engineers: "Our performance parameters are world-class. With significantly lower production costs compared to crystalline solar cells, CIGS technology will play a large role in the coming investment cycle of the photovoltaics industry," Dieter Manz is convinced. Today, CIGS modules from Manz already offer the lowest electricity generation costs in comparison to the still prevailing crystalline silicon technology.

As a technological leader, Manz offers a secure investment option with maximum profitability

With Manz CIGS*fab*, the Reutlingen equipment manufacturer is currently the only supplier of turnkey CIGS production lines in the world, with a scalable production capacity of 50 to 350 Megawatts per year. With an internal rate of return of more than 15 percent, an investment in a fully integrated CIGS line from Manz is one of the most profitable in the entire energy sector. "As a high-tech equipment manufacturer with unique process know-how, we offer an unbeatable combination of arguments in favor of investment in a CIGS production line," explains Dieter Manz: "A lower total investment in comparison to crystalline systems, significantly shorter implementation time for the plant, as well as the unrivaled low production costs. An investor in Manz CIGS technology is guaranteed absolute investment security, with the highest margins in the entire energy sector – in the future, and even today. The future potential of CIGS technology is enormous and will lead to further cost reductions."

Manz's 16 percent efficiency world record is the impressive result of a long-term development partnership with the Stuttgart Center for Solar Energy and Hydrogen Research of Baden-Württemberg (ZSW). Following the presentation of 21.7 percent cell efficiency in the laboratory by the globally leading research institute for CIGS thin-film technology in the fall of 2014, Manz was able to transfer the essential insights of the technology that was used to mass production. "This great success demonstrates the future potential of CIGS thin-film technology and emphasizes nothing less than our claim to technology leadership," says Dieter Manz.

"Building on the know-how of ZSW and our own experts, it is thus absolutely realistic that we will already be able to present module efficiencies of significantly higher than 17 percent in the near future, produced on our innovative production line in Schwäbisch Hall. We have

already mastered the necessary processes in the lab, such as the after-treatment of CIGS coatings. The goal of our joint efforts is the further reduction of electricity costs – around the world, under all climatic conditions."

Manz's world record with 16 percent efficiency was certified last week by the testing organization TÜV Rheinland. Manz AG offers potential investors in CIGS production systems a long-term road map for further efficiency increases, whose milestones have always been achieved ahead of schedule in recent years.



Photo: Team members of the CIGS innovation line of Manz in Schwäbisch Hall celebrate the new 16percent world record module.

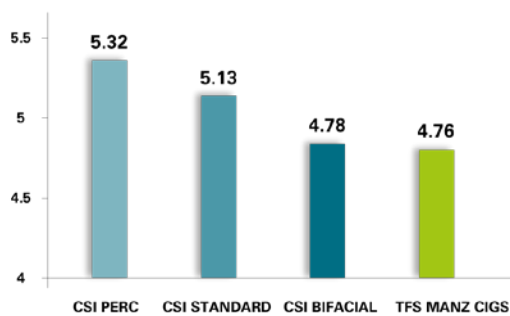


Photo: Dieter Manz (right) with CIGS development manager Dr. Kay Orgassa at a CIGS thin-film module.



Photo: CIGS thin-film solar module with world record efficiency of 16 %.

LCOE OF DIFFERENT PV TECHNOLOGIES [in €ct/kwh]
Source: Fraunhofer ISE/IFA 2013, data calculated for 0.5 GWp/a



Graphic: The electricity generation costs with Manz CIGS technology are significantly lower in comparison to other solar technologies.



Link to the video:

<http://www.manz.com/de/media/downloads/videos/tfs-prozessschritte-21/>

Photos in print resolution are available from Stefan Richter, Storymaker GmbH:

s.richter@storymaker.de, Tel.: +49 (0)7071 – 93872-213.

Company profile:

Manz AG – passion for efficiency

As one of the world's leading high-tech equipment manufacturers, Manz AG, based in Reutlingen, Germany, is a pioneer for innovative products in fast-growing markets. The company, founded in 1987, has expertise in seven technology sectors: Automation, laser processing, vacuum coating, screen printing, measurement technology, wet chemical processes and roll-to-roll processes. Manz deploys and further develops these technologies in three strategic business segments: "Display," "Solar" and "Battery."

The company, led by founder Dieter Manz and listed on the stock exchange in Germany since 2006, currently develops and produces in Germany, China, Taiwan, Slovakia, Hungary and Italy. It also has sales and service branches in the USA and India. At the end of 2014, Manz AG had approximately 1,900 employees, around half of which work in Asia. With its claim "passion for efficiency," Manz gives its clients, who are active in dynamic industries of the future, its performance promise: to provide production systems with the highest level of efficiency and innovation. Thanks to its extensive expertise in the development of new production technologies and the required equipment, Manz AG contributes substantially to lowering the production costs of end products and making them available to large buyer groups worldwide.

Public relations contact

Manz AG

Axel Bartmann

Tel.: +49 (0)7121 – 9000-395

Fax: +49 (0)7121 – 9000-99

Email: abartmann@manz.com

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