



High precision metrology tester for solar modules



Moritz Meixner

Moritz Meixner, the general manager at h.a.l.m. elektronik gmbh, came back to PES to catch us up on the developments in their high quality range of testers. He is also enthusiastic about the need for R&D and training – both for staff and the customer.

PES: Welcome back to PES Solar/PV magazine. Thanks for talking with us. For our new readers you like to begin by explaining a little about the background of your organisation and how you currently serve the solar/PV industry?

Moritz Meixner: h.a.l.m. elektronik gmbh is a family owned business with high ethical standards and a strong belief in the future of renewable energies. Established in 1984 in Frankfurt am Main / Germany, h.a.l.m.

has worked for numerous industrial sectors like material testing, chemical, pharmaceutical, and automotive, before turning the focus on the photovoltaic industry 15 years ago.

Today, we provide complete measurement systems for the characterisation of solar cells and solar modules. Our PV product range offers cell testers, module testers for production and for R&D use as well as outdoor testers for solar systems.

PES: h.a.l.m is well known for delivering high-end measuring systems for photovoltaic technologies. Can you give us more information about your tools for the measurement of solar modules?

MM: h.a.l.m.'s product portfolio includes a large variety of measurement equipment covering a wide range of applications. Our module production systems are available in different system designs depending on the technical requirements of our customers.

The so-called cetisPV-IUCT-M is a flexible module production system, which can be utilised either as tunnel or tower flasher. Optional features, like the electroluminescence image capturing, can be integrated in this flasher type, providing a more enhanced quality control of the manufacturing process.

Our cetisPV-IUCT-Q represents a more advanced module production solution. This system type comes in a table flasher design intended for sunny side down solar module measurement. The compact unit does not need to be integrated in an additional dark chamber and the small footprint makes the system perfectly suitable for workshops with little space.

The simplified integration principle, into any kind of automation line, eliminates the need for additional module handling, thus making the system a cost and time saving solution for manufacturers.

Besides the mentioned production system, we also offer measurement equipment for R&D purposes. Our cetisPV-Moduletest3 is a one-of-a-kind measurement system especially developed for high-end R&D applications.

Its uniqueness is based on the numerous possibilities to retrofit the system, with various options, e.g. extension of flash duration, performance of dark IV measurements, temperature-controlled measurements, power rating, electroluminescence imaging, hysteresis measurement with smart averaging evaluation and class A+ spectral mismatch at low irradiance measurement.

PES: What are the advantages of the h.a.l.m. tools for R&D use? We are especially interested in the flasher-integrated electroluminescence image capturing and the temperature-controlled measurement.

MM: The cetisPV-Moduletest3 is an offline system designed to match the demands of modern R&D laboratories and institutes. The system is equipped with a pulsed sun simulator, the corresponding IV measurement electronics and an optimised dark chamber. The freely programmable simulator provides a highly stable irradiance output over long flash times from a single light source.



Combined with the h.a.l.m. state-of-the-art IV curve tracer and our unique measurement method for high-efficiency solar cells, the 'Advanced Hysteresis' measurement, this system is capable of meeting the requirements of current and up-coming solar cell technologies.

In addition, the system is based on an innovative modular design which allows the easy retrofitting of the standard base package with additional hardware and software options such as electroluminescence image capturing, temperature-controlled measurements and standard compliant low irradiance IV measurements.

Our cetisPV-EL-package-M comprises a completely flasher-integrated inspection system that complements the standard IV tester with a high-resolution electroluminescence imaging solution. It is a flexible tool for the visualisation of a wide range of defects and can be implemented

in production lines as well as R&D systems.

Thus, the tool offers additional benefits for advanced in-line quality control and research applications. The option is fully integrated into h.a.l.m.'s standard operating software, allowing seamless data handling and analysis in one system.

The cetisPV-Therm-package-M is an optional package for our offline system which means it's possible to take irradiance- and temperature-dependent performance measurements of solar cells and modules. This enables research laboratories and R&D centres to determine temperature coefficients as well as to perform power rating measurements according to IEC 61853-1 standard.

The option features a thermally insulated test chamber with a high-precision temperature regulating device. The control is completely embedded into the h.a.l.m. software PVControl, allowing a fully automated electrical performance measurement.



PES: With regards to the varying module types being produced, where are you seeing the most interest and/or demand at this time?

MM: Market trends are going in the direction of high efficiency cells/modules, which intrinsically have high capacitive effects and high throughputs. This requires advanced measurement methods which are capable of performing reliable IV-measurement of these cell/module types and comply with the throughput requirements.

PES: We are interested to know more about your software feature the single-flash advanced hysteresis for high-efficiency modules. How big an advancement is this and why is it important?

MM: The Advanced Hysteresis is a unique evaluation procedure that was introduced by h.a.l.m. in 2014. The measurement method is based on a “hysteresis measurement” in which the IV-curve is measured from Isc to Voc and from Voc to Isc within a single light pulse.

The two individual measurements are each strongly affected by the capacitive effects of the solar cell capacitances. However, using an extended diode model, we are able to extract the steady-state equivalent IV-curve from the two measurements without the need to adjust any additional parameters.

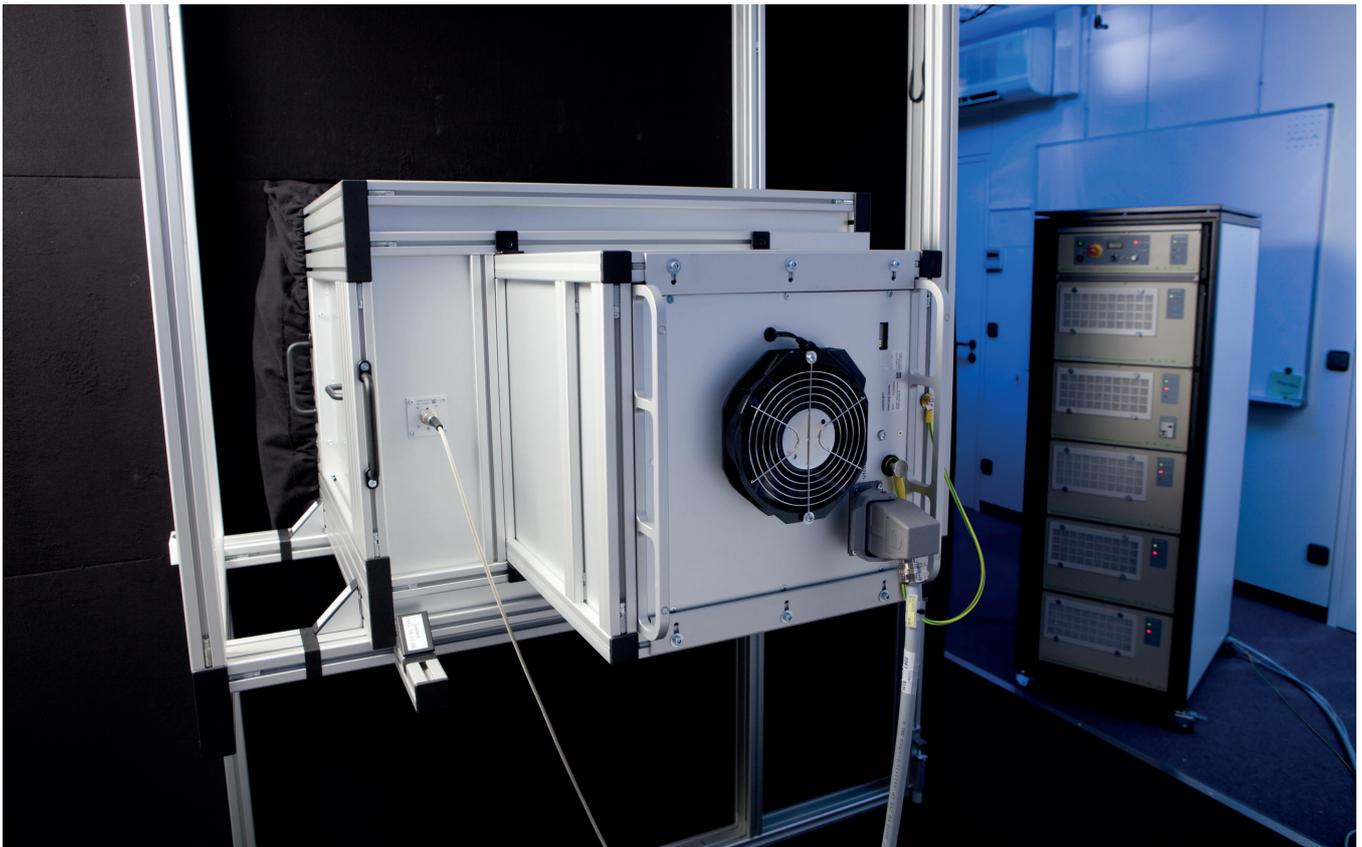
Our new method allows for extremely accurate IV-curve measurements of highest efficiency silicon solar cells and modules, in measurement times as short as 60 ms, without any effect on the cells capacitance on the measurement result. This way, we are able to provide a solution that is capable of complying with the current and up-coming high throughput demands of the market.

PES: Please can you tell us why and how h.a.l.m.’s solutions differ from those of others and what are the advantages for manufacturers?

MM: Over the past 15 years h.a.l.m.’s reputation and experience in the PV market has become well-known and recognised. The outstanding performance of our standard IV measurement equipment has been approved by many market leading manufactures in the industry.

With our standard IV system as a solid basis and our additional fully integrated add-on features, we can offer our customers a unique and complete solution for quality and process control that can be combined in one measurement station and matching the current and upcoming throughputs of the PV industry.

PES: How important is R&D to h.a.l.m? What new projects/products are you currently working on?



MM: h.a.l.m. focuses very much on the development of new products and solution. For this reason, we have established a close relationship and cooperation network with leading manufacturers and research institutes worldwide, giving us a good view of the current market situation and future market trends.

Currently, we are co-working on a pilot project, with one of the leading institutes, to develop an in-line system for the measurement of bifacial solar cells.

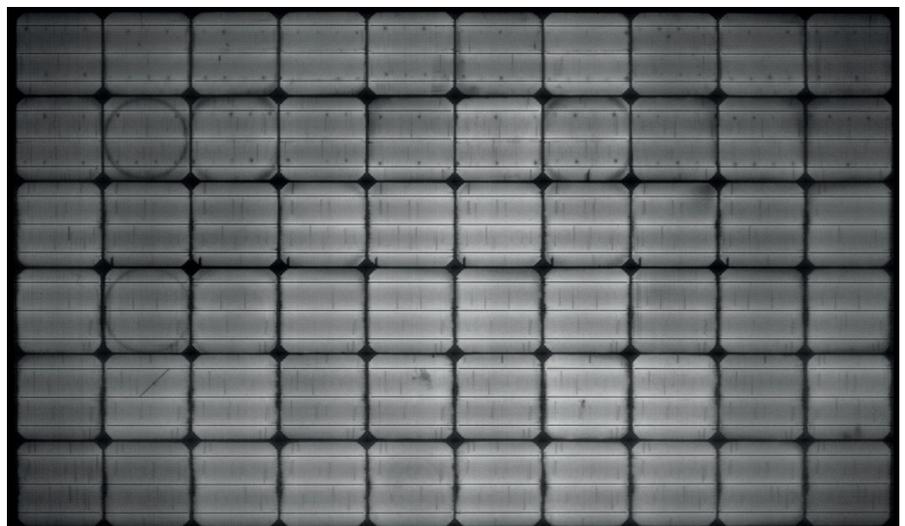
This new system will open new possibilities for manufacturers in regards to quality assurance for this new cell technology. Additionally, we recently integrated a specially adapted module production system in a manufacturing line for bifacial solar modules.

PES: I would suggest that the role of training has huge importance to you. Do you provide regular training both to your technicians and to your customers?

MM: Absolutely, this is extremely important to h.a.l.m. We train our customers regularly and repeatedly to ensure the best use of our equipment.

Alongside our customers, we put a lot effort in training our engineers. Personnel training is ongoing because we are continually developing new features. We know only too well that only qualified operators and engineers will do their job successfully.

Our success is based on our commitment



to create solutions. Just selling hardware is no solution for h.a.l.m. at all. We are interested in combining know-how with the best possible usage and the best possible handling of our high quality systems for the sake of our customers and their products.

PES: Speaking from a global standpoint, which geographical regions do you anticipate being key for h.a.l.m as we move into 2017?

MM: Key markets in 2017 are of course in Asia with a focus on China, Taiwan, and Korea. But Southeast Asia, Thailand, Malaysia and Vietnam are of high interest, as well. This year we see the ongoing

growing demand in India. h.a.l.m. observes new emerging markets closely and regularly evaluates new possibilities.

PES: There have been significant changes in the political landscape, with BREXIT and Donald Trump in the White House. How do you think these will affect the current trade agreements?

MM: Most than likely there will be no effect, since PV is seen more and more as one of the major energy generation sources worldwide. We do not expect a significant effect on the global PV market.

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