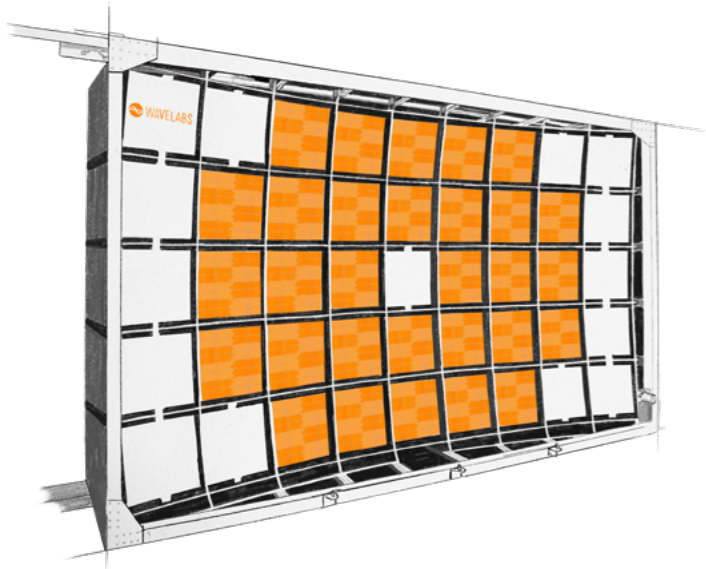# LED´s MEASURE SOLAR MODULES

LED SOLAR SIMULATOR
SINUS-3000 ADVANCED

The **SINUS-3000 ADVANCED** is the ideal solar simulator for the research and certification of solar modules. Its nearly perfect simulation of the sun's spectrum enables highly accurate solar cell efficiency measurement.

The intelligent LED-based light source is what makes this exceptional accuracy possible.

LED's present the new benchmark:
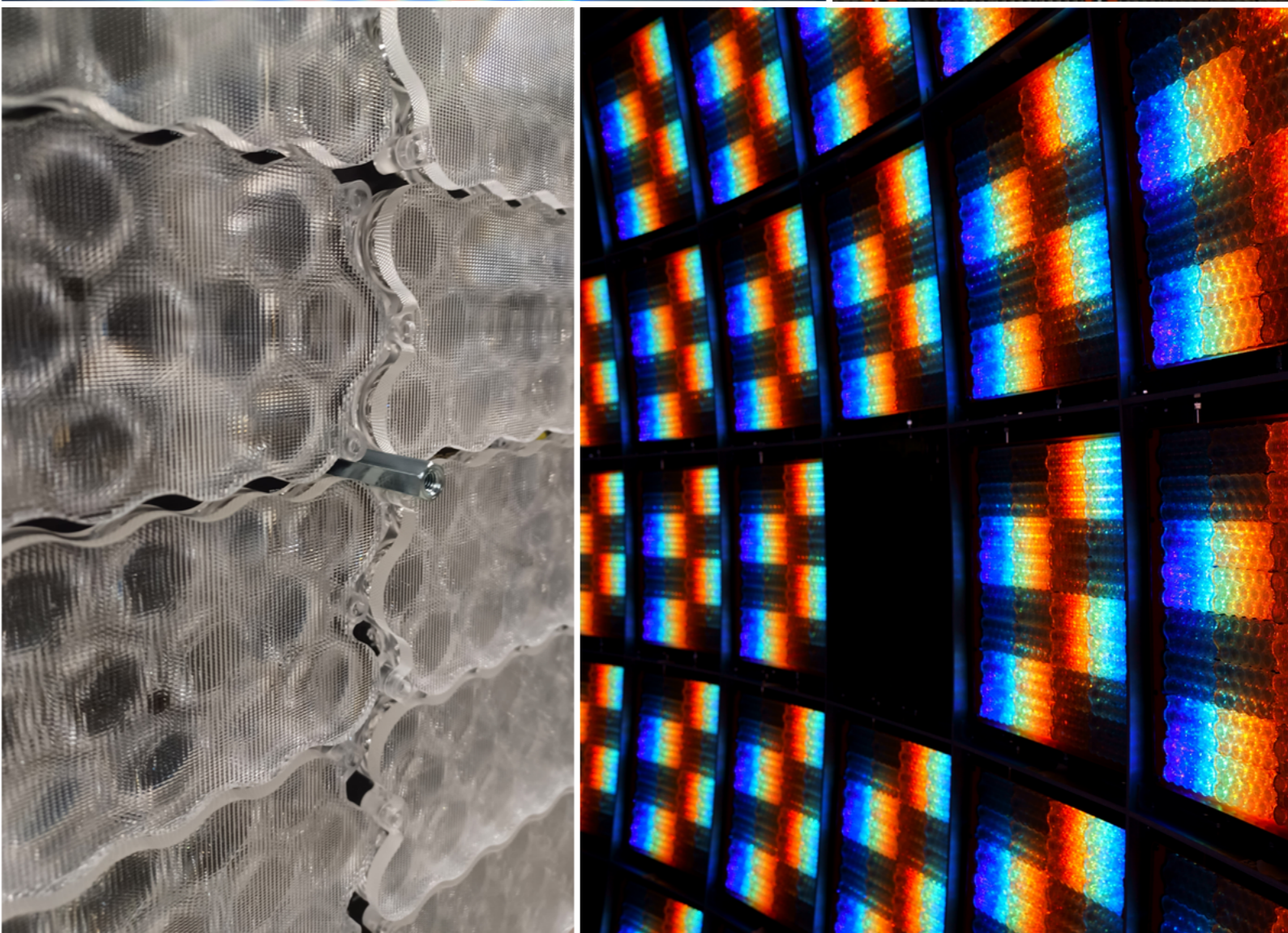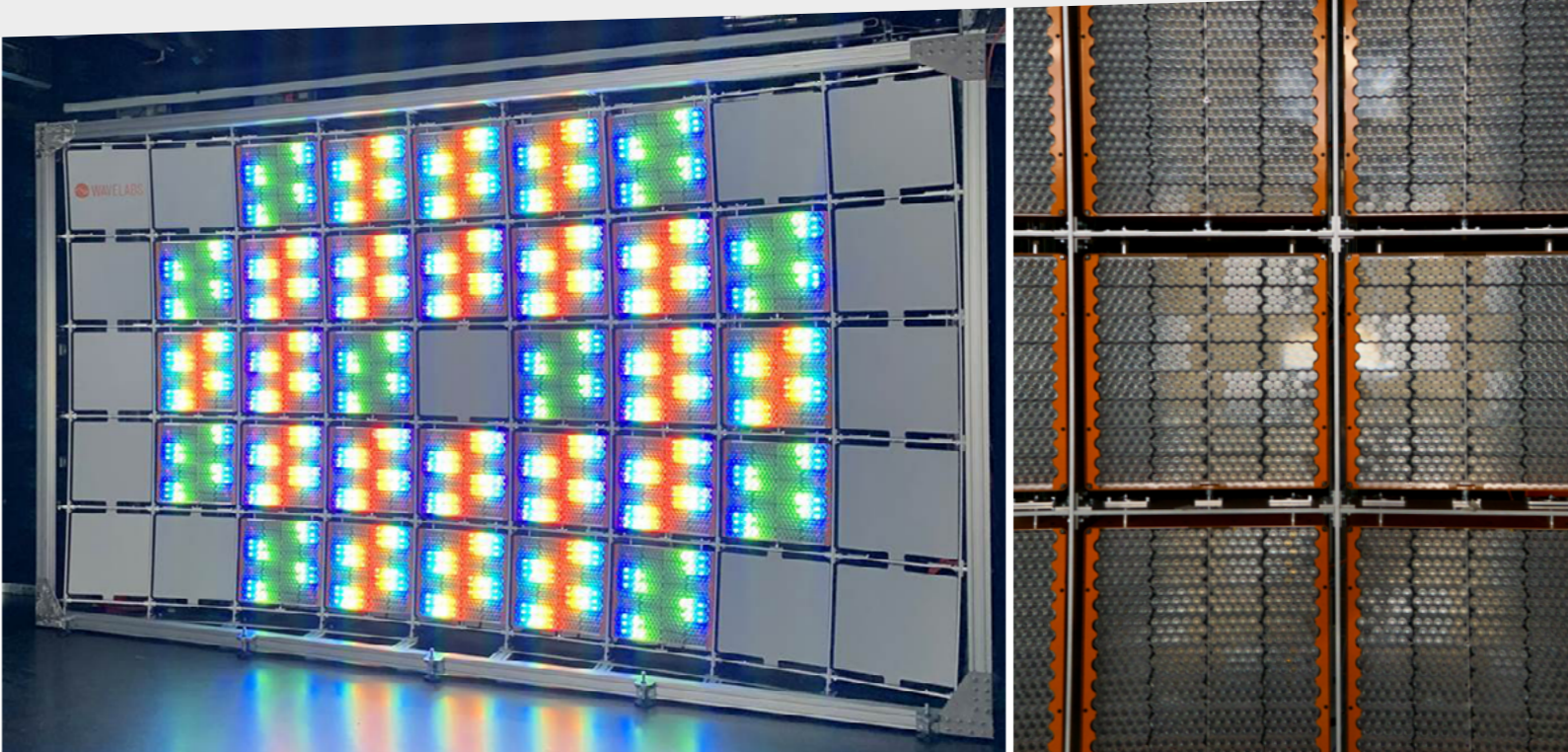
HIGHLIGHTS

Multicolor LED-based light source
for a perfect copy of the sun

All LEDs can be tuned separately
for customised spectra

Special optical lens system
for perfect color mixing

Fully integrated electro-luminescence camera
(optional)

Second LED light source
for bifacial testing (optional)

Exceeds class A+A+A+ criteria
(IEC 60904-9 ed.3) for spectral match, non-uniformity and temporal stability

Wide range of exposure times
from flashes up to continuous illumination

Built-in spectrometer
spectrum monitoring for every flash

Reference intensity sensor
in combination with fast feedback loop for automatic intensity correction

Fully integrated climate chamber
(optional)

LED SOLAR SIMULATOR
## SINUS-3000 ADVANCED

CLASSIFICATION

|	SINUS-3000 ADVANCED		Class A+A+A+ requirements (IEC 60904-9 Ed. 3)
Spectral match	Class A+	0.875 - 1.125	0.875 - 1.125
Nonuniformity of irradiance	Class A+	< 1%	< 1%
Short-term instability (STI)	Class A+	Synchronized	Synchronized
Long-term instability (LTI) flash length < 0.3 s	Class A+++	< 0.25%	< 1%
Long-term instability (LTI) flash length > 0.3 s	Class A+	< 1%	< 1%

Validity of classification: WPVS cell ISE021/030-2014, 1 sun, AM1.5g, 100 ms, 7,000 mm distance between light engine and solar module

SPECTRAL QUALITY

> **Typical spectrum of LED solar simulator SINUS-3000 ADVANCED**
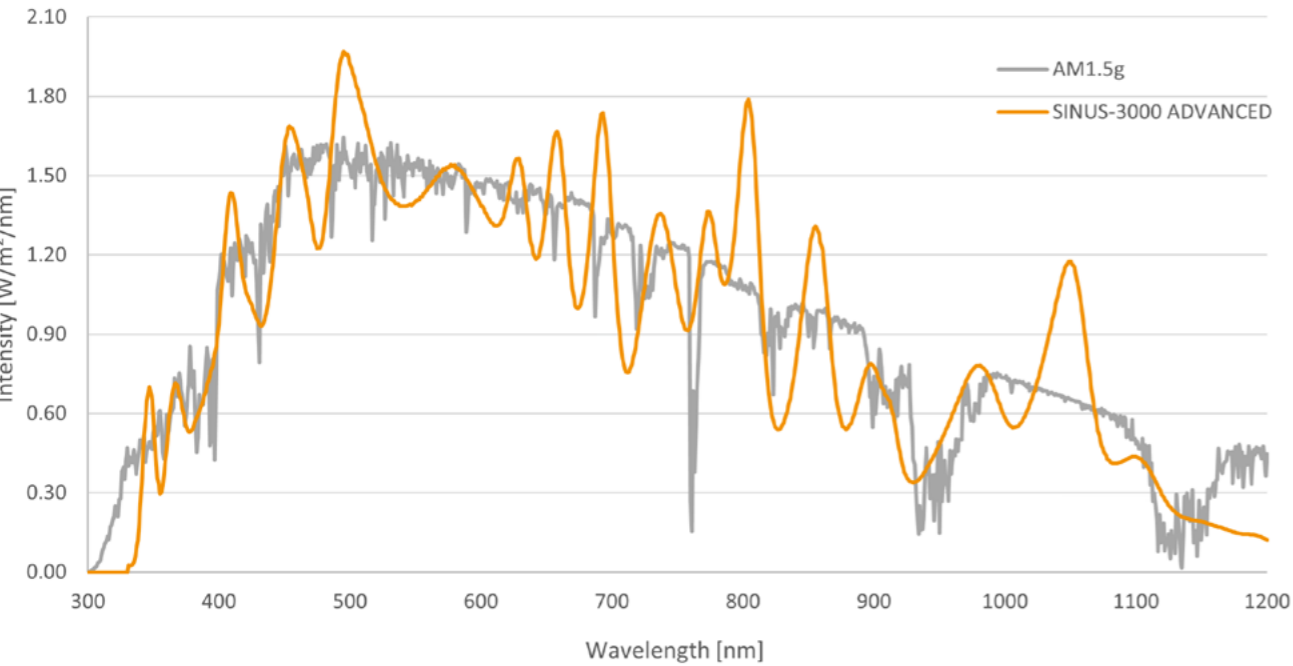
> **Typical spectral deviation**
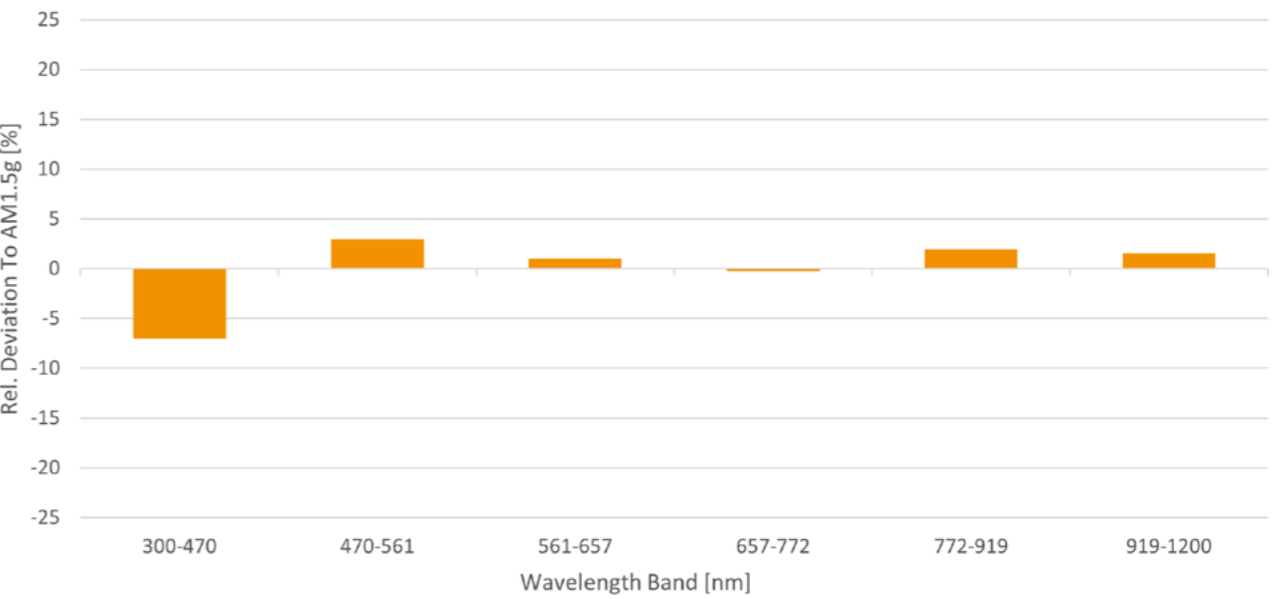
FUNCTIONALITY

I-V curve measurement	Under illumination, optional dark I-V measurement
Solar cell parameter analytics	Voc, Isc, FF, P_{MPP} and conversion efficiency
Temperature correction	Solar cell parameters are adjusted according to IEC 60904-5, IEC 60891
User-defined analytics	Open software interface allows for export of all measured data for analysis and import of classification criteria
Visual inspection	Fully integrated electroluminescence camera (optional)
Bifacial testing	Additional AM1.5g LED light source for rear side illumination (optional)
Climate chamber	Temperature variation between 15°C and 75°C (optional)
IR extension	Wavelengths range can be extended to 1,650 nm (optional)

LED SOLAR SIMULATOR
SINUS-3000 ADVANCED

PRODUCT FEATURES

Spectrum	AM1.5g, AM0 or other customer-defined spectrum including illumination by single colors
SPD	≤ 25%
SPC	≥ 98%
Irradiance time	Adjustable from 50 ms up to continuous illumination
Flash-to-flash time interval	2 s
Intensity	Qualified intensities (flash mode): 0.3 suns, 0.5 suns, 1 sun, 1.3 suns Qualified intensities (continuous illumination): 0.3 suns, 0.5 suns, 1 sun, 1.1 suns Intermediate intensities can be set individually Maximum intensity can be increased by integrating more LED boxes
Voltage/Current resolution	0.025%
I-V measurement up to	80 V, 24 A, 750 W or customized
I-V curve measurement duration	As required: 10 ms and longer
Distance light engine – test area	7,000 mm
Test area	2,300 x 1,400 mm² or customized

TECHNOLOGIES AND COMPONENTS

Light source	Multiple individually controlled LEDs with different peak wavelengths. Cooling via recirculation chiller
Feedback system	Spectrum and intensity are monitored during each single measurement. Intensity adjustments, if necessary, are made on the fly
I-V measurement	Active electronic load for 4-quadrant measurement capability with 14-bit calibrated analog-digital converter and calibrated shunt resistor

System control	Integrated PC runs application software and controls hardware
User interface	Monitor, keyboard and mouse

PRODUCT DIMENSION AND REQUIREMENTS

Light engine	(L x D x H) 4,600 x 2,900 x 1,150 mm³, approx. 1,800 kg or customized
Power	Max 72 kW (max 3 x 130 A @ 400 V), 50/60 Hz
Environment	Non-condensing ambient with relative humidity less than 70%
Cooling power	Max. 50 kW (depends on cycle time)
Maintenance area	1 m free area around light engine required

SCOPE OF DELIVERY

- Light engine
- I-V electronics
- Cables
- User manuals
- Power supply and control cabinet
- Industrial PC, monitor, keyboard & trackball/mouse
- Rack for light engine and other hardware
- Chiller