LED'S COPY THE SUN

The SINUS-270 is the ideal solar simulator for production, research and certification. Its nearly perfect simulation of the sun's spectrum enables highly accurate and precise solar cells efficiency measurement. The intelligent LED-based light source is what makes this exceptional accuracy possible. LED's present the new benchmark:

FEATURES

- Light engine with multiple LEDs
- Spectral match of class A++ acc. IEC 60904-9 ed. 2 (400-1,100nm)
- All LEDs can be separately tuned for user defined spectra
- Unique special optical lens system for perfect color mixing
- Built-in intensity sensor and spectrometer in combination with fast feedback loop for automatic intensity and spectral correction.
- Exceeds class A++AA+ (IEC 60904-9, JIS C8912, ASTM E 927-10) criteria for spectral match, non-uniformity and temporal stability.
- Electroluminescence and infrared imaging can be integrated
- Second LED light engine to flash from the rear for upgrading to bifacial cell testing
- Allows storage of user-defined spectra
- Easy-to-use, intuitive, ergonomic user interface
- Typical lifetime of up to 20,000 hrs

WAVELABS is proud partner of

CLASSIFICATION

	SINUS-270		Class AAA requirements (IEC 60904-9)
Spectral Match	Class A++	0,95-1,05	0.75 - 1.25
Non-uniformity of irradiance	Class A	< 1%	2%
Long term instability (LTI)	Class A+	< 0.2%	2%
Short term instability (STI)	Class A	synchronized	synchronized

Validity of classification:
WPVS cell ISE021/030-2014, 1 sun, AM1.5, 250 ms, 185x185mm²

SPECTRAL QUALITY
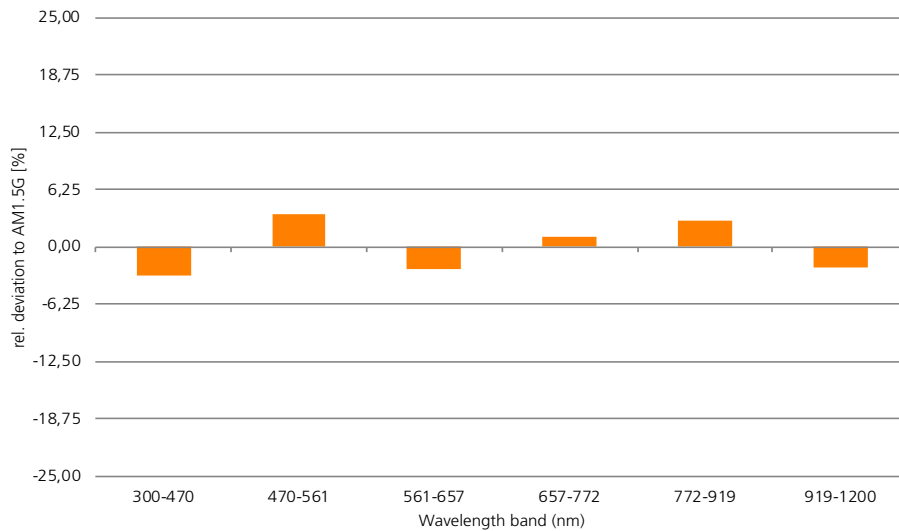
Typical spectral deviation per wavelength according to new code IEC60904-9 ed.3
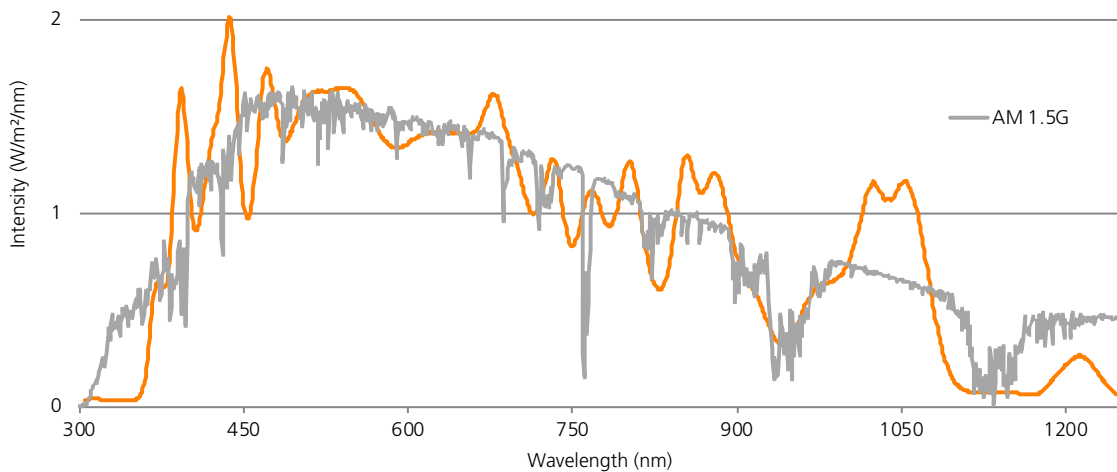
Typical spectrum of LED solar simulator SINUS-270

SPECTRAL QUALITY

Wavelength range (nm)	SINUS-270	AM1.5
400 - 500	18.4%	18.4%
500 - 600	19.9%	19.9%
600 - 700	18.4%	18.4%
700 - 800	14.9%	14.9%
800 - 900	12.5%	12.5%
900 -1,100	15.9%	15.9%
400 – 1,100	100%	100%

Typical spectral intensity ratio for different wavelength ranges according to IEC60904-9 ed.2

FUNCTIONALITY

IV curve measurement	Dark and under illumination, from −20 V to 8 V, from −30 A to 30 A
Solar cell parameter analytics	Voc, Isc, FF, Pmpp and efficiency
Temperature correction	Solar cell parameters are adjusted according to IEC 60904-5, IEC 60891
Series resistance analytics	Based on IEC 60891 with IV curves measured at two irradiance levels
Shunt resistance analytics	Based on reverse dark current
IV curve fitting	Based on two diode model
Fully integrated and synchronized infrared (IR) camera	IR camera and IV electronics are synchronized so that current measurement and IR image are recorded at the same time.
Fully integrated electroluminescence (EL) camera with image processing software	Micro-crack detection and wafer inspection based on artificial intelligence or grey scale image analysis.
Red-blue routine	Illumination with only blue and red light (or other colors) allows the fast detection of process instabilities
Variable spectrum	User can easily define spectra other than AM1.5 for yield tests under non-standard operating conditions
SunsVoc	Fast inline method for measurement of ideal FF without impact from series resistance. LED light engine reduces change of mismatch factor during measurement
User defined analytics	Open software interface allows export of all measured data for analysis and import of classification criteria
User defined measurement recipes	SINUS-270 is shipped with standard measurement recipes. User can easily define new recipes via GUI

LIGHT ENGINE FEATURES

The light engine consists of individually controlled LEDs with different peak wavelengths. A special optical lens system ensures perfect color mixing for each spot on the solar cell. Built-in spectrometer and reference solar cell in combination with automatic on-the-fly correction within milliseconds make daily re-calibration redundant.

Light source	Multiple individually controlled sets of LEDs with different peak wavelengths.
Special optical lens system	The multi-level special optical lens system ensures that all LEDs/colors are perfectly mixed so that each spot in the test plane is illuminated with the identical spectrum.
Feedback system	Monitor cell and spectrometer measure intensity and spectrum during each single measurement multiple times. Adjustments, if necessary, are made on-the-fly within <2 ms.
Spectrum	AM1.5, AM0 or customer defined spectrum including illumination by single colors
Spectral control	Built-in spectrometer in combination with automatic feedback loop ensures highly stable spectrum and total intensity for any flash length. Actual spectrum is displayed on GUI for each flash.
Intensity range for AM1.5	As required: from 0.1 up to 1.6 suns
Intensity range for each single color	As required: from 10 % up to 100 %
Irradiance time	As required: from 10 ms up to 250ms
Test area	185 mm x 185 mm at non-uniformity of <1%
Cooling	Water cooling for high stability and large life span
Expected LED box life span	More than 2 years under standard inline operating conditions

IV ELECTRONICS FEATURES

The very fast active electronic load allows 4 quadrant measurements. A 14 bit calibrated analog-digital converter and a calibrated, traceable shunt resistor fulfill the highest demands for accuracy and precision.

Voltage resolution	0.025 % of 2 V or 20 V
Current resolution	0.025 % of 3A / 30 A
Repeatability	$< \pm 0.15$ % for Isc, Voc $< \pm 0.2$% for FF and efficiency
IV curve measurement time	As required: from 2 ms up to 600 s

SYSTEM FEATURES

SINUS-270 is designed for high precision and low maintenance operation in high speed production lines. Alternatively, it can also be used offline in R+D laboratories or for certification.

Throughput	Up to 4,000 solar cells per hour (limited by automation). Faster measurement possible because LED light engine does not require time for re-charging.
Sorting	As required: up to 256 classes
Communication for inline integration	Via hardware signals, RS232, TCPIP, ProfiNET (others on request)
Control levels	Operator/Service/Admin level
User interface	Screen, keyboard, mouse
Industrial PC	OS Windows
Cell temperature measurement	Pyrometer
Infrared camera	See separate data sheet
Electroluminescence camera	See separate data sheet
Rear side LED flasher	See separate data sheet
Required environment	17°C < T < 28°C, less than 60 % humidity, non-condensing. Maximum change of humidity 10%/h

SCOPE OF DELIVERY AND DIMENSIONS

Light engine	564 mm (740 mm with both cameras) x 688 mm x 477 mm, 55 kg
Power supply	19" rack mount chassis, 3U
IV electronics and amplifier	19" rack mount chassis, 4U
Industrial PC	19" rack mount chassis, 3U
Screen and keyboard, mouse	
Chiller	
Hardware options	› Fully integrated infrared camera
	› Fully integrated electroluminescence camera
	› Fully integrated rear side LED flasher
	› Pyrometer for inline temperature measurement
	› UPS
	› Rack for installation

Specifications subject to technical changes, SINUS-270 2020_04_02

CONTACT