Instrument Systems
KONICA MINOLTA Group

LumiTop Series

Spectrally enhanced imaging colorimeter for advanced display testing

We bring quality to light.

Product highlights

- 2D measurements with unprecedented accuracy due to high-end reference spectroradiometer
- All-in-one display testing solution saves space and time
- Fastest measurement times for highest throughput
- Efficient audit concept: no golden samples required
- Easy integration in production lines

LumiTop 4000 with 29 mm objective lens and CAS 140D.

01 \\ LumiTop – Our solutions for comprehensive display testing

Fast measurements and high color accuracy

Instrument Systems has optimized the LumiTop imaging colorimeter series specifically for inline display testing. As the industry's fastest, most reliable and color accurate imaging colorimeter, LumiTop has become the standard for high-performance display testing.
The LumiTop design unites a high-resolution camera, a photometrically characterized flicker diode and an extremely accurate spectroradiometer of our CAS series. This combination renders the LumiTop system an exceptionally fast and powerful tool for display quality assurance in 24/7 operation. It solves even the most demanding optical testing challenges under the constraints of production takt times and harsh conditions with highest reliability.

LumiTop systems are easy to integrate via Software Development Kit into production lines, offer unparalleled performance and save valuable time and costs. They are industry proven, based on a huge, world-wide installation base, and they come with first-class global service, on-site auditing tools, and support. All measurement results are traceable to reference standards from national metrology institutes and therefore independently comparable, i.e. between different production sites. Therefore, LumiTop systems are often used as reference equipment worldwide.

Flexible hardware and comprehensive software

For all test requirements, our LumiTop systems together with the comprehensive LumiSuite software package can be perfectly tailored to customer-specific quality control tasks.

Thanks to the traceable measurement results, LumiTop systems also excel in R&D laboratories at all stages of the display supply chain.
The latest generation – the LumiTop X series – provides improved flexibility for use in technological research and production applications. A high-precision electronic focus and switchable internal ND filters easily align to different DUT sizes and luminance values.

The adequate solution for your individual measurement task

The constantly extended LumiTop portfolio covers the whole range of measurement applications, as smart phones, tablets and TVs to microdisplays, µLED-wafers and AR/VR near-eye displays. It enables display manufacturers to guarantee perfect true color displays at consistently high quality across globally spread production sites and associated R&D labs.

02 \\ LumiTop technology

The LumiTop design combines a camera with a high-end array-spectroradiometer, which acts as a live reference to ensure true color measurement. Camera image and reference spectrum are taken within one image acquisition, and the spectral information is used to perform an instant fine correction of the measured color values.

Customized for lab and production demands

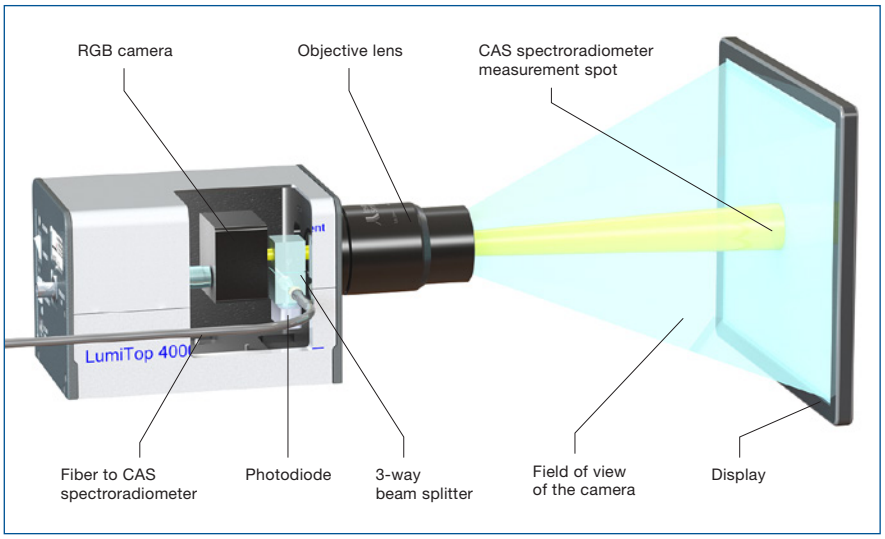
Within the LumiTop and LumiTop X series, various models offer diverse options for customization:

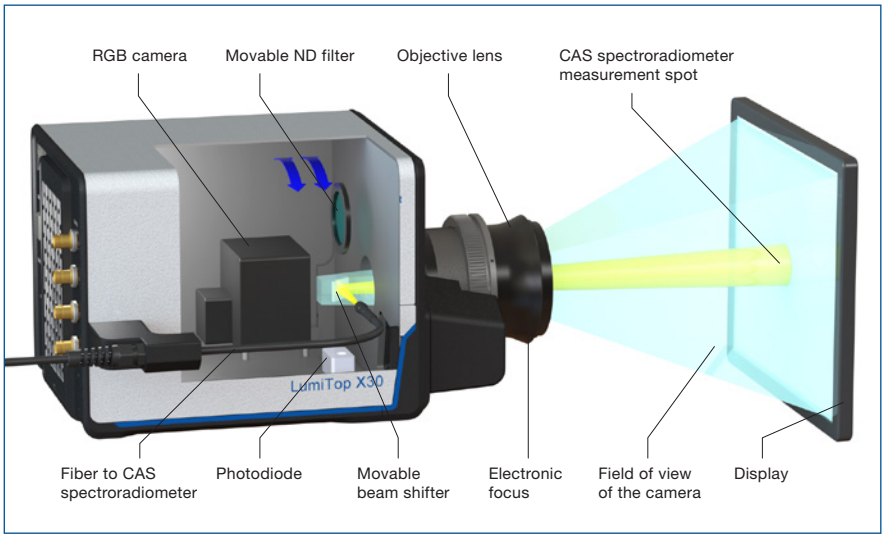
- High dynamic and low-noise CMOS RGB-cameras can be offered with sensors from 12 MP up to 150 MP for ultra-high resolution.
- Sensors with up to 81 dB dynamic range provide a huge measurement range for low and high luminance applications. Optionally, external filters can be used to extend the measurement range for extremely bright light sources.
- A variety of industry grade objective lenses serve customer-specific measurement needs for any device, be it a microdisplay, a flat panel display or a near-eye display in AR/VR devices.

For a perfect fit, different models of our high-class CAS spectroradiometer are available and complete the LumiTop system.

Especially LumiTop X20 and X30 provide maximum sensitivity for exceptional low luminance performance and offer the highest grade in flexibility. A switchable internal neutral density filter features enhanced dynamic range. They also provide a very precise, externally driven electronic focus, which offers a flexible focus setting with outstanding accuracy and repeatability.

LumiTop X150 is optimized for the highest possible resolution and single pixel metrology. An integrated pixel shifter is used for images up to 600 MP per color channel. This enables sub-pixel resolution of entire 4k high-definition displays.



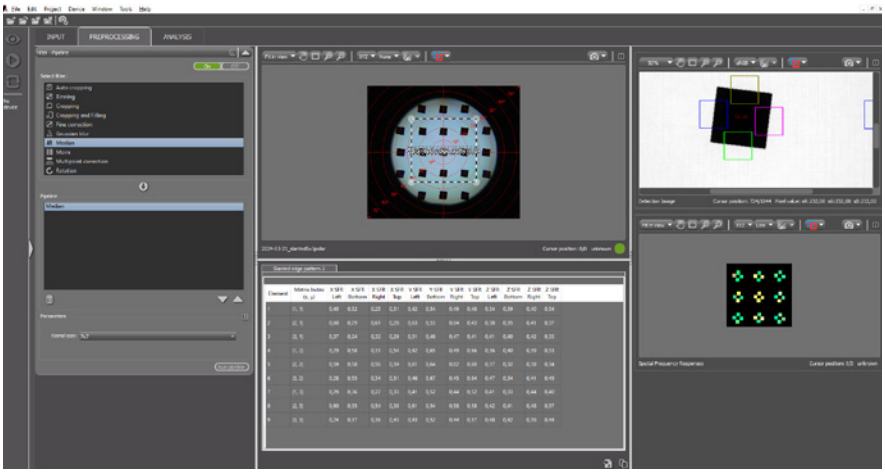


Optical design concepts of the LumiTop 4000 and LumiTop X30.

03 \\ LumiSuite – Powerful solution for 2D image capturing and evaluation

LumiSuite

LumiSuite is a paramount software platform to capture and evaluate spatially resolved radio- and photometric DUT information with Instrument Systems' photometers, colorimeters and infrared cameras.



Example of the LumiSuite GUI with image view, table of results and graphical representation of results.

LumiSuite GUI

LumiSuite's user-friendly graphical user interface (GUI) guides an operator intuitively through the individual steps of a workflow for data evaluation. The workflow of the LumiSuite Smart Analysis is organized in an easy 3-step logical sequence. With its diverse image analysis functions, LumiSuite SmartAnalysis is ideally suited for the comprehensive characterization of modules, displays, and cluster instruments.

SmartAnalysis

Data acquisition

- Settings camera sensor
- Settings spectrometer
- Flicker
- DC user correction
- ...

Image processing

- Cropping
- Binning
- Color correction
- Smoothing
- Moire filtering
- Multipoint correction
- Rotation
- ...

Image analysis

- Spotmeter
- (Poly-)Line profile
- Grid analysis
- Histograms
- Uniformity
- Slanted edge
- Statistics
- Defect pixel analysis
- Single pixel evaluation
- Defect region analysis
- ...

Additional plug-ins for dedicated applications

BlackMura

The Black Mura plug-in for LumiSuite analyses the 2D luminance homogeneity in accordance with the official standard (Uniformity Measurement Standard for Displays) of the German Automotive Industry.

MultiPoint Correction

The MultiPoint Correction plug-in for LumiSuite generates a spectral reference image to correct an image for a DUT-specific view direction dependence of luminance and color.

LumiSuite SDK

Besides the clear and comprehensible GUI, our LumiSuite software is equipped with an extensive and industry-proven software development kit (SDK) in C and .NET.

This allows a straightforward implementation of our LumiSuite solutions into automated systems in laboratory and production environments.

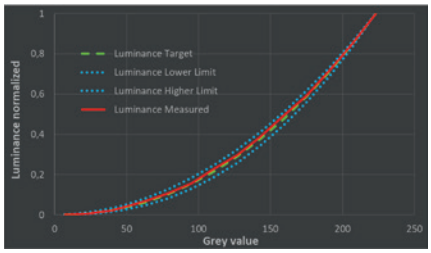
More information can be found in our LumiSuite software brochure:

04 \\ Flat panel display testing

State-of-the-art flat panel displays (FPDs) must meet the growing demands across a variety of applications. Different sizes and resolutions call for more flexible display testing solutions. Stronger requirements for low luminance conditions or high peak brightness increase the need for extremely sensitive measurement equipment that also provides a large dynamic range. To ensure superior quality for flat panel displays of all sizes, geometries, and technologies, the analysis with LumiTop is supported by our comprehensive LumiSuite software package. This package includes extensive standard and advanced display tests such as luminance and color uniformity, defect detection, and chromaticity. It covers applications such as Gamma correction, uniformity, Mura, low & high luminance, and OLED measurement.

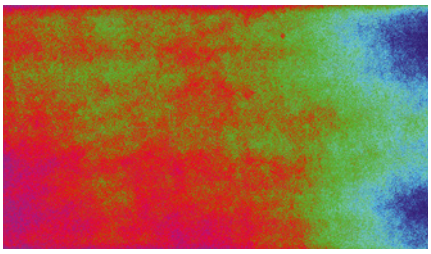
Variety of FPD testing applications using LumiTop and LumiSuite:

- Gamma
- Uniformity
- Mura
- Low luminance
- High luminance
- Artefact-free OLED testing



Gamma test with LumiTop 4000

Gamma correction is important to adapt the display luminance curve to the non-linear (intensity) perception of the human eye. All LumiTop systems provide customizable gamma tests, enabling even faster one-shot gamma measurements.

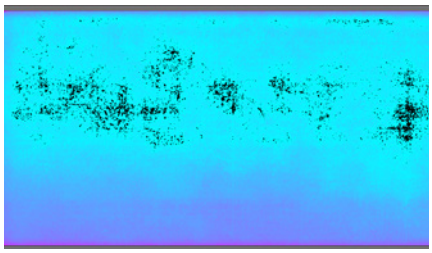


Uniformity test with LumiTop 4000

Uniformity of color and luminance is essential for any display, and assures a correct representation of the image. Due to the high accuracy in luminance and color, LumiTop systems detect even the smallest non-uniformities and prevent distorted image content and unsatisfactory visual experience.

Mura test with LumiTop 4000

The Mura effect generally refers to a non-uniform display, caused by variations in the display's light sources. Appearing as darker or lighter areas, low-contrast areas, or individual image points, lines or blobs, Mura generates disturbing deviations from the desired image impression. Instrument Systems provides tests for different Mura effects, including the DFF standard Black Mura test of the automotive OEM workgroup.



Low luminance test with LumiTop X30

Low luminance measurements are of increasing importance. In dark environments, displays are typically operated at luminance values smaller than 20 cd/m². In order to guarantee sufficient contrast and uniformity, tests are often performed at much lower luminance.
The LumiTop X series accurately measures luminance and color with high signal-to-noise ratios down to 0.001 cd/m².

High luminance test with LumiTop X20/X30

High Luminance displays are required when operation in a daylight environment is essential. LumiTop X20 and X30 support tests of bright light sources up to 1 Mcd/m² or 5000 cd/m² for 60 Hz modulated displays. Also, even brighter sources can be measured by applying external neutral density filters.

Artefact-free OLED testing with LumiTop 4000

OLED and other modulated light sources may produce measurement artefacts due to a mismatch of exposure time and refresh rate. Test routines with LumiTop systems avoid such artefacts. The integrated flicker diode determines the exact modulation frequency and synchronizes the camera measurement. In LumiTop 4000, an integrated hardware trigger also allows synchronization to external driver logic. This enables precise timing of the measurement for perfectly reproducible test conditions.

Our LumiTop portfolio for flat panel display analysis


LumiTop 4000


LumiTop X20


LumiTop X30


LumiTop X150


LumiSuite

05 \\ Augmented and virtual reality (AR/VR) testing

The spectrally corrected LumiTop AR/VR system brings speed and absolute radiometric accuracy to near-eye displays (NED).

The Instrument Systems AR/VR lens for LumiTop imaging colorimeters is specifically designed for production testing of NEDs in headsets and optical modules. The optical design mimics the human eye and measures color and luminance exactly as seen by the observer. A large field of view, various pupil sizes and adjustable focus distance enable a wide range of testing applications. For more flexibility, a periscopic and straight design is possible to provide the best solution.

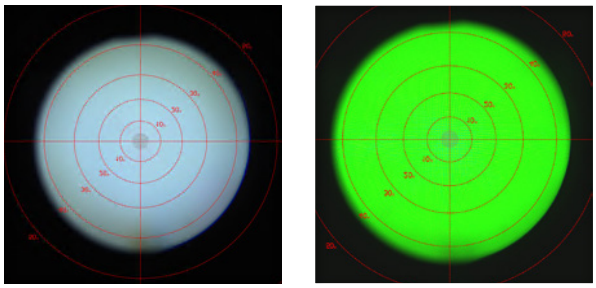
LumiTop 4000 AR/VR with 12 MPx resolution and a field of view of 120° x 85°

LumiTop 5300 AR/VR with 24 MPx resolution and a field of view of 120° x 105°

* Both LumiTop models are available with periscopic or straight lens design.

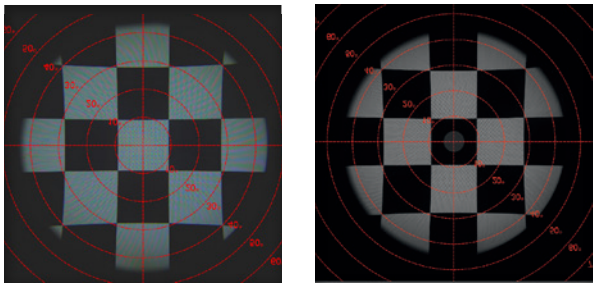
Variety of possible measurements using a LumiTop AR/VR system & LumiSuite software:

- Luminance and color uniformity
- Distortion
- Chromatic aberration
- Field of view
- Eye box scans
- Contrast ratio
- Michelson contrast
- Slanted edge analysis
- Virtual image distance



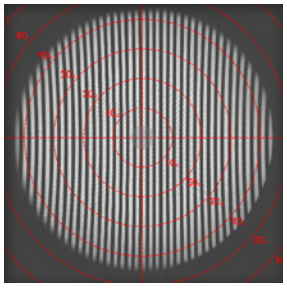
Luminance and color measurement of a NED for a VR headset

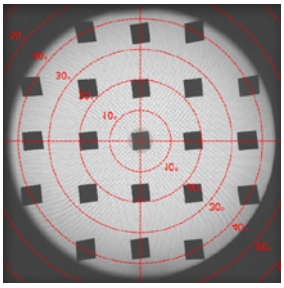
Luminance and color measurements are basic measurements to characterize and optimize NEDs, AR or VR devices. With one image measurement, the total field of view can be quantified within a second.



Contrast ratio measurement of a NED for a VR headset

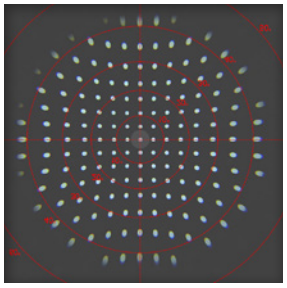
Contrast ratio measurements are needed to guarantee a brilliant image. A high ratio between white and black is the desire of every display. With the LumiSuite ARVR the contrast ratio of the image is measurable over the complete field of view.

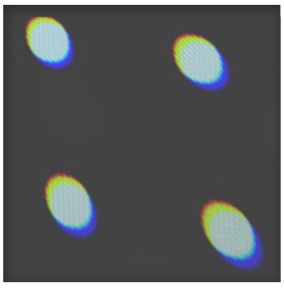




Sharpness analysis based on the Michelson contrast or slanted edge analysis

Sharpness evaluation using the Michelson contrast or slanted edge method is also supported by the LumiSuite. The sharpness varies over the field of view and is a sensitive indicator of the quality of the optics used for the NED.

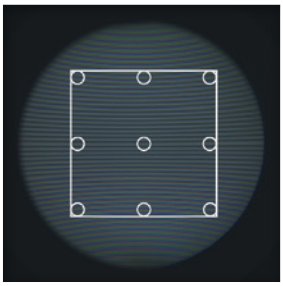




Distortion and chromatic aberration

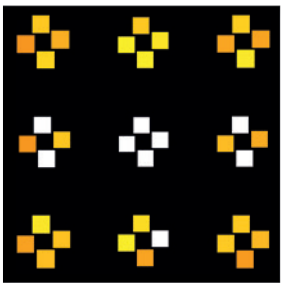
Distortion and chromatic aberration describes the properties of the optics used in the NED display. LumiTop ARVR together with LumiSuite allows a quick characterization of both properties.

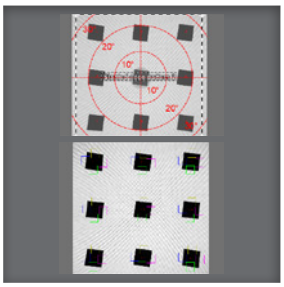
LumiSuite supports several analysis methods suitable for AR/VR applications including a test pattern generator.



Michelson contrast evaluation using LumiSuite methods

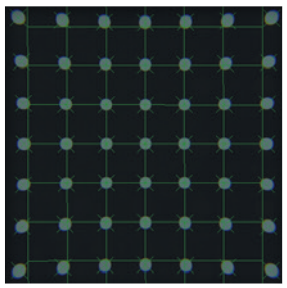
Michelson contrast evaluation allows to define a pattern of spots over the image. As shown with a striped pattern (left), the Michelson contrast values are evaluated for each spot (right).





Slanted edge analysis using LumiSuite GUI

Slanted edge evaluation in LumiSuite uses tilted squares for the measurement and allows a quick sharpness analysis in all directions.



Distortion and chromatic aberration

Distortion and chromatic aberration can be quantified using LumiSuite functions. A NED is recorded using a LumiTop ARVR (left). The blobs are detected and the distortion is evaluated. The corresponding chromatic aberration is shown on the right.

Our LumiTop portfolio for AR/VR tesing

06 \\ µLED and pixel metrology

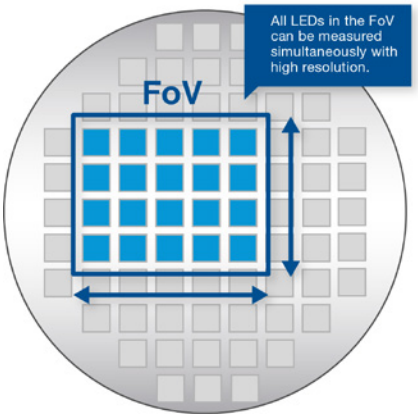
LED-based light sources have largely superseded conventional light sources, and due to their technical advantages, they have given rise to many new exciting applications. In particular, upcoming µLED technologies are expected to drive displays in head-mounted devices for augmented and virtual reality applications and other mobile devices.

LumiTop 4000, 29mm and 100 mm, optionally with periscope.

However, each of the millions of LEDs on a display or wafer is an individual light source with individual variations in color and luminance. To assure fast and accurate quality tests for each LED under the constraints of economical production takt times, we provide fast high-resolution camera sensors with up to 150 MP per color channel, high optical magnification with macro and microscope lenses along with a traceable reference spectrometer and live calibration for highly reliable pass/fail and binning decisions.

µLED/µOLED applications using LumiTop and LumiSuite:

- Wafer testing (photo-/ electroluminescence)
- Microdisplay testing
- Pixel demura
- Single pixel evaluation
- High luminance µLED module testing
- Low luminance pixel calibration
- Defect detection

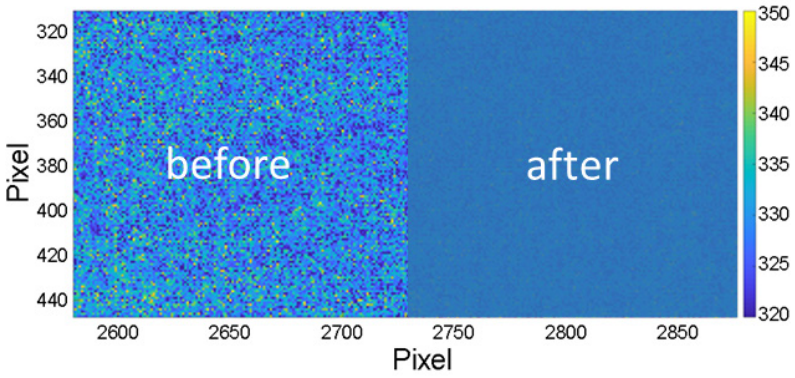


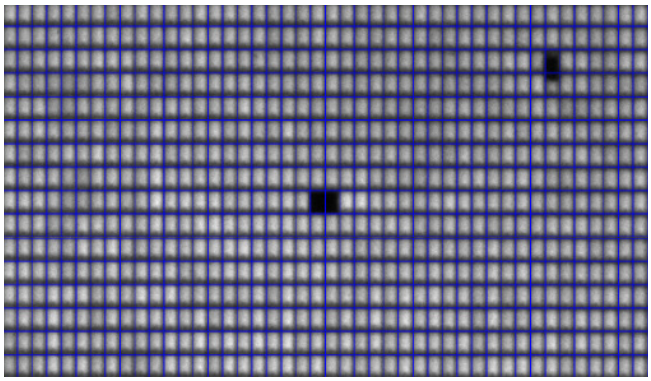
Wafer testing using fast and accurate imaging colorimeter

Wafer testing using LumiSuite SPE analysis for accurate binning and defect detection. Optics for < 3 µm resolution.

Demura on pixel level

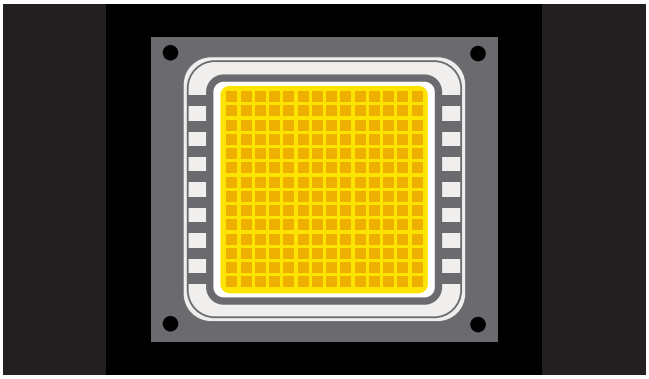
Pixel calibration at low luminance for perfectly uniform displays in all ambient lighting conditions.





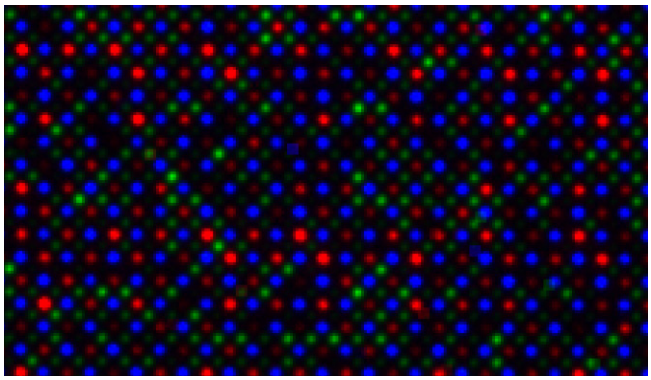
Comprehensive analysis of each LED/pixel on wafer or display

Single pixel evaluation (SPE) is a very fast analysis of each individual pixel or LED on a display or wafer. Luminance, color, dominant wavelength, purity and pixel size and location, as well as emitting area are given for every LED.



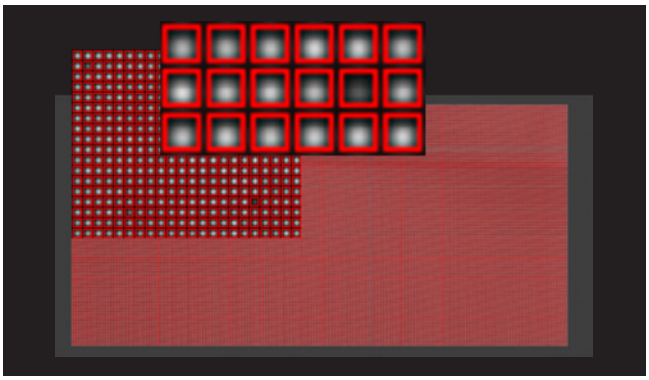
High luminance µLED module testing

µLED module testing at high luminance (100 Mcd/m^2) Accurate calibrations also for very bright light sources.



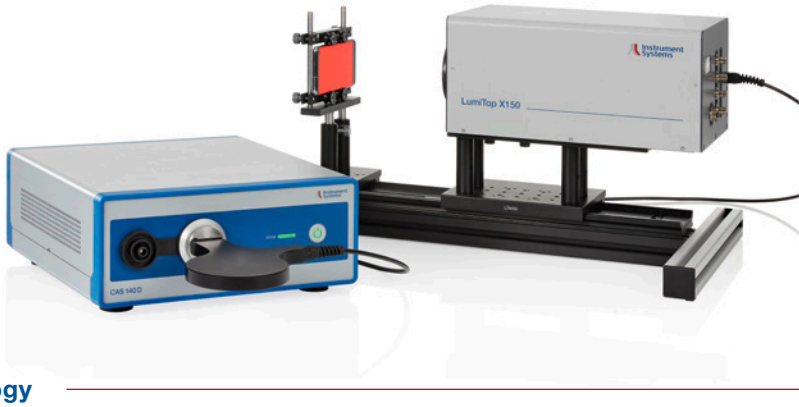
Low luminance measurements for display calibration

Pixel calibration at low luminance for perfectly uniform displays in all ambient lighting conditions



One-shot acquisition of millions of emitters

Defect detection with high resolution and mass production ready speed and accuracy.



LumiTop X150 with CAS 140D

Our LumiTop portfolio for µLED and pixel metrology

LumiTop 4000 | LumiTop 5300 | LumiTop X150 | LumiSuite

07 \\ Automotive lighting measurement

Whether they are for displays, ambient illumination or exterior lighting – light modules in the automotive area ensure safety, aesthetics and user-friendliness. Their purpose is the visual transmission of information, and they are exposed to a wide range of temperature and ambient lighting conditions and require wide viewing angles.

LumiTop system for µLED array measurement in adaptive front lighting systems (AFS) application.

Interior lighting

Displays are becoming more and more prevalent in the automotive sector and must serve a variety of functions in a challenging environment. Large pillar-to-pillar displays and requirements such as high peak brightness and contrast ratios demand for flexible light measurement devices with high resolution and dynamic range. Specialized analysis to measure effects such as Black Mura must be conducted according to established standards; this enables meaningful comparison between supplier and manufacturer. The automotive OEM software features of the LumiSuite contain tools specially developed for the evaluation of automotive displays and conforming to the standards of the DFF automotive OEM working group. Light guides and other ambient lighting components must be balanced to each other in terms of color and luminance uniformity in order to assure an elegant appearance. Large sizes and aspect ratios require high resolution measurement equipment with a flexible field of view, such as our LumiTop X20 and X30.

Exterior lighting

Vehicle headlights or backlights must guarantee the safety of traffic participants. They are therefore subject to strict legal requirements in terms of their photometric properties and must be tested extremely carefully and reliably. State-of-the-art light sources such as LED matrix headlights for adaptive driving beams combine these challenges with the requirement of measuring thousands of individual LEDs or µLEDs accurately in color and luminance. This can be easily achieved with our LumiTops equipped with suitable neutral density filters and magnifying lenses. The LumiTop X150 in combination with our single pixel evaluation in LumiSuite is capable of simultaneously measuring several thousands of individual µLEDs within a very short time in order to meet takt time requirements in production.

Our LumiTop portfolio for automotive lighting measurement

08 \\ Metrology, auditing and service

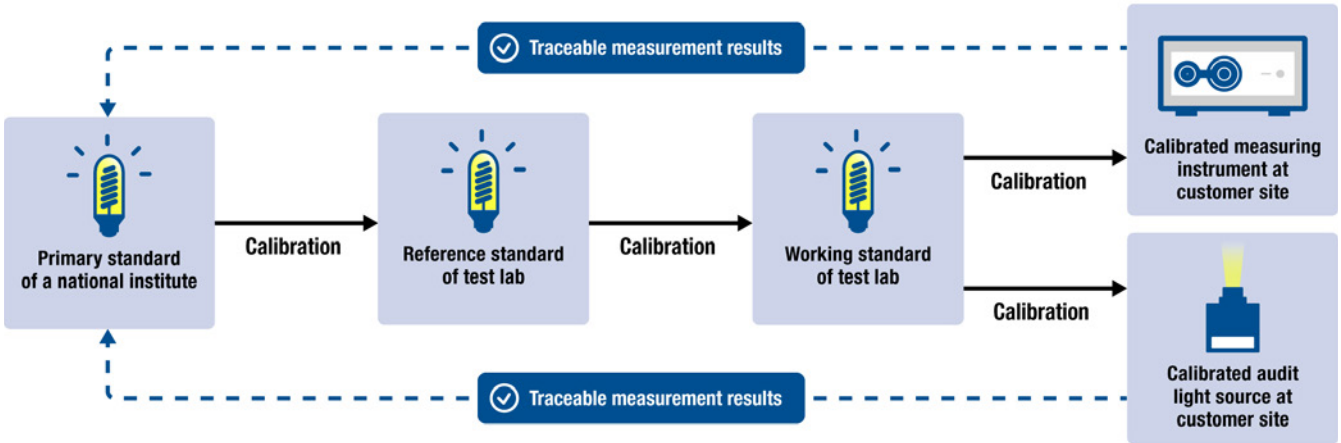
Accredited test lab

As a leading manufacturer of light measurement technology, measurement quality takes top priority at Instrument Systems. To this end, we operate an accredited testing laboratory at our facilities in Munich and Berlin. All measuring instruments produced by us are subjected to a detailed quality check, and their results are documented in test certificates. Accreditation to DIN EN ISO / IEC 17025:2018 is carried out by DAkkS (German Accreditation Body). The latter is a full member of ILAC (International Laboratory Accreditation Cooperation), ensuring the international validity and recognition of the accreditation. The underlying standard lays down the requirements to be met by the test lab, whereby particular emphasis is placed on technical details, e.g. choice of test procedure, validation, metrological traceability and measurement uncertainty.

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-19052-01-00

Traceability to national standards

Our accredited test lab guarantees independent, reliable and comparable readings, directly traceable to the reference standards of the National Metrological Institute PTB (Germany) and NIST (USA) for any measuring instrument purchased. A direct comparison of your own measurement results is thus always possible, regardless of the specific metrological implementation and locations of measuring stations or production lines. Since the number and service life of reference standards from the metrology institutes are limited, for daily lab operations Instrument Systems regularly creates so-called working standards. These are used routinely in the test lab for the calibration and testing of our products (e.g. spectroradiometers and light sources).

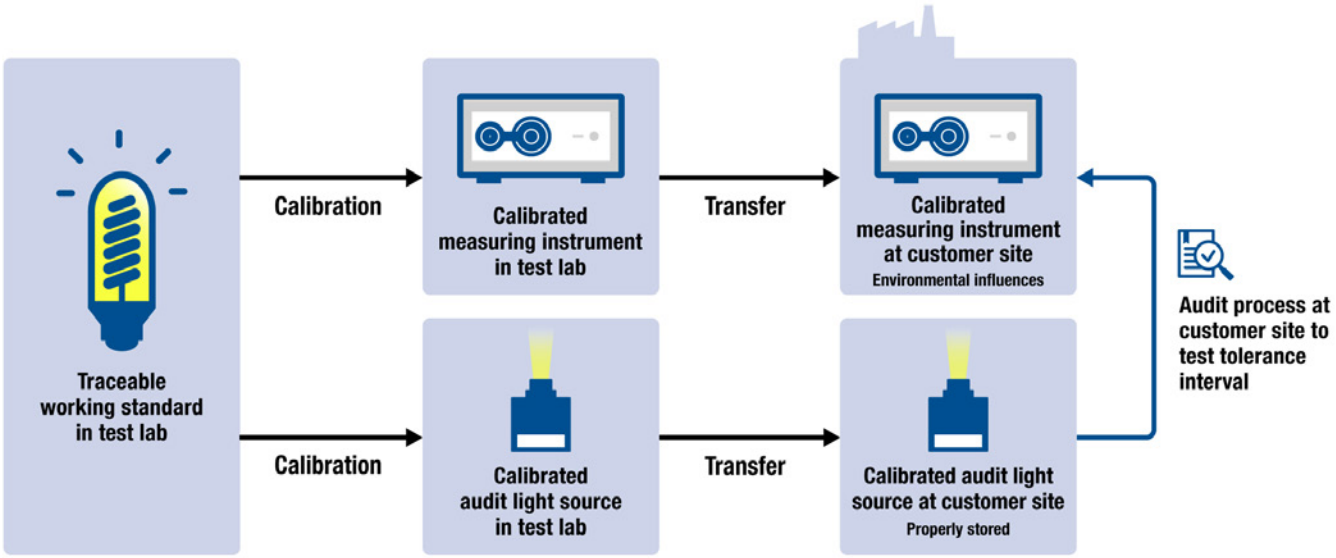


Traceable calibration chain from the national Institute to the customer.

Auditing and service

An efficient auditing process, the robust design and highly accurate calibration of the LumiTop systems guarantee exceptional long-term stability and accuracy. Our coordinated auditing, calibration and service strategy further improves testing limits and reduces factory downtimes. Reliability and accuracy arise from a mix of excellent hardware, dedicated calibration, live referencing and traceable auditing.

Our auditing light sources, named ACS, are very accurately defined light sources, traceable to national metrology institutes. Regular auditing of LumiTop measurement instruments against those light sources guarantees absolute measurement accuracy at any time and at any production site throughout the supply chain. This assures the same high display quality of the product, no matter where and when it is produced. Moreover, our auditing tools are optimized for quick inline instrument checks that minimize factory downtimes. Local partners and service subsidiaries ensure swift response and provide rapid recalibration, instrument repair and technical support. Auditing and service is the key to high yields and cost-efficient display production testing.



Regular audits with, e.g., audit light sources ensure that the measurements keep within with the specified tolerance.

09 \\ Technical specifications

LumiTop 4000 with 29 mm lens

LumiTop 4000 with 29 mm lens (f/2.8)		
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Dimensions incl. lens (l x w x h)	286 mm x 190 mm x 121 mm	
Effective resolution (h x v)	4096 x 3000 pixels (12 megapixels, CMOS)	
Pixel size	3.45 µm x 3.45 µm	
Measurement range (without external ND filter)	L = 0.02 cd/m² – 270,000 cd/m²	
Accuracy of CAS	Luminance ±3.0 %	Color ±0.0015
Accuracy of camera (rel. to CAS)	Luminance ±0.4 %	Color ±0.002
Minimum measurement time	0.7 s	
Field of view at selected working distances		
Working distance [mm]	385	1200
Field of view [mm]	156 x 114	546 x 400
Field of view diagonal [in]	7.6	26.6

Instrument Systems is continually working on the further development of its products. Technical changes, errors and misprints do not justify claims for damages. For all other purposes, our Terms and Conditions of Business shall be applicable.

LumiTop 4000 with 100 mm macro lens

LumiTop 4000 with 100 mm macro lens (f/2.8)		
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Dimensions incl. lens (l x w x h)	335 mm x 190 mm x 121 mm	
Effective resolution (h x v)	4096 x 3000 pixels (12 megapixels, CMOS)	
Pixel size	3.45 µm x 3.45 µm	
Measurement range (without external ND filter)	L = 0.06 cd/m² – 800,000 cd/m²	
Accuracy of CAS	Luminance ±3.0 %	Color ±0.0015
Accuracy of camera (rel. to CAS)	Luminance ±0.4 %	Color ±0.002
Minimum measurement time	0.7 s	
Field of view at selected working distances		
Working distance [mm]	257	550
Field of view [mm]	14.4 x 10.5	61.6 x 45.1
Field of view diagonal [in]	0.7	3.0

Instrument Systems is continually working on the further development of its products. Technical changes, errors and misprints do not justify claims for damages. For all other purposes, our Terms and Conditions of Business shall be applicable.

LumiTop X150

LumiTop X150		
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Dimensions incl. lens (l x w x h)	365 mm x 230 mm x 160 mm	
Effective resolution (h x v)	14,192 x 10,640 (151 megapixels, CMOS)	
Pixel size	3.76 µm x 3.76 µm	
Measurement range (without external ND filter)	L = 0.003 cd/m² – 50,000 cd/m²	
Accuracy of CAS	Luminance ±3.0 %	Color ±0.0015
Accuracy of camera (rel. to CAS)	Luminance ±0.2 %	Color ±0.001
Minimum measurement time	1.7 s	
Field of view for available lenses		
Focal length and magnification β	**FOV size**	**FOV diagonal**
97 mm f/3.2 β = 1.35 – 1.54	max. 40 mm x 30 mm	1.9"
	min. 35 mm x 26 mm	1.7"
104 mm f/4 β = 0.28 – 0.38	max. 193 mm x 145 mm	9.5"
	min. 137 mm x 103 mm	6.7"
100 mm f/4.1 β = 0.05 – 0.2	max. 847 mm x 635 mm	41.7"
	min. 276 mm x 207 mm	13.6"
92 mm f/3.3 β = 0.16 – 0.24	max. 331 mm x 248 mm	16.3"
	min. 226 mm x 170 mm	11.1"

LumiTop X20/X30

LumiTop X20		
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Dimensions incl. lens (l x w x h)	360 mm x 280 mm x 190 mm	
Effective resolution (h x v)	5496 x 3672 pixels (20 megapixels, CMOS)	
Pixel size	2.4 µm x 2.4 µm	
Measurement range (without external ND filter)	0.0005 cd/m² – 700,000 cd/m²	
Accuracy of CAS	Luminance ±3.0 %	Color ±0.0015
Accuracy of camera (rel. to CAS)	Luminance ±0.4 %	Color ±0.0025
Minimum measurement time	0.6 s	
Field of view for available lenses		
Focal length	**FOV size vs. Working distance WD**	**FOV diagonal**
25 mm f/1.4	185 mm x 139 mm @WD 300 mm	9.1"
	1146 mm x 861 mm @WD 1400 mm	56.4"
35 mm f/1.4	148 mm x 111 mm @WD 300 mm	7.3"
	869 mm x 652 mm @WD 1500 mm	42.8"

LumiTop X30		
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Dimensions incl. lens (l x w x h)	360 mm x 280 mm x 190 mm	
Effective resolution (h x v)	6464 x 4852 pixels (31 megapixels, CMOS)	
Pixel size	3.45 µm x 3.45 µm	
Measurement range (without external ND filter)	0.0005 cd/m² – 2,000,000 cd/m²	
Accuracy of CAS	Luminance ±3.0 %	Color ±0.0015
Accuracy of camera (rel. to CAS)	Luminance ±0.4 %	Color ±0.0015
Minimum measurement time	0.5 s	
Field of view for available lenses		
Focal length	**FOV size vs. Working distance WD**	**FOV diagonal**
25 mm f/1.4	185 mm x 139 mm @WD 300 mm	9.1"
	1069mm x 795 mm @WD 1300 mm	52.1"
35 mm f/1.4	148mm x 111 mm @WD 300 mm	7.3"
	934 mm x 701 mm @WD 1500 mm	46.0"

LumiTop AR/VR

LumiTop AR/VR	LumiTop 4000 (preliminary)	LumiTop 5300 (preliminary)
Measurement quantities		
2D	Luminance, color	
Spot	Spectrum, luminance, color, flicker	
General specifications		
Camera resolution	4096 x 3000 pixels	5312 x 4600 pixels
Field of view (FOV) (H x V)	120° x 85°	120° x 105°
Angular resolutions	> 30 px/deg (average over FOV)	> 40 px/deg (average over FOV)
Adjustable focus distance	0.5 m – 1.5 m (other on request)	
Entrance pupil	1 mm – 3.6 mm	
Measurement range 2D	L = 0.012 cd/m^2 – 170 000 cd/m^2	
Accuracy of camera (rel. to CAS)	Luminance ±0.4 % Color ±0.002	
Instrumental precision camera	Luminance ±0.03 % Color ±0.0001	
Accuracy of CAS	Luminance ±3.0 % Color ±0.0015	
Instrumental precision CAS	Luminance ±0.1 % Color ±0.0001	

Detailed specifications

LumiTop X20

LumiTop X30

LumiTop X150

LumiTop 4000

LumiTop AR/VR

LumiTop Low Luminance

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