

CAS 140D

High-precision luminous color measurement
for automotive lighting



01 \\ Importance of color for exterior automotive lighting

The human eye is extremely sensitive for luminous color. Even slight chromatic deviations may cause irritations and disturb driving or reflex actions. Headlamps and signal sources in vehicles must therefore satisfy stringent requirements regarding the precise color locus. ECE Regulation 48 defines the light colors permitted in exterior automotive lighting for white, yellow, amber, red and blue luminaires. They must be within the narrow borders of specific color polygons in CIE chromaticity diagram 1931.

However, small deviations in color may decide whether a lamp satisfies the regulations, otherwise an expensive redesign may be necessary. For this reason, the GTB Photometry Accuracy Guidelines provide recommendations for test equipment suitable for the type approval of automotive lamps. They specify a color deviation of only 0.005 compared to the reference values of a certified test laboratory as permissible for luminous color test equipment. This means:

- ▲ Headlamps and signal sources in vehicles should be measured with certified, highly precise measurement systems.
- ▲ State-of-the-art light sources such as narrow bandwidth LED and OLED with peaks in their spectral power distribution call for test equipment with high spectral resolution to achieve similarly accurate test results as halogen or discharge lamps.

02 \\ Our turnkey solution: Combined high-class goniometric and spectral measurement!

To meet the requirements of color measurement deviation in automotive lighting, we have complemented the AMS far-field goniometer system with a high-class CAS 140D spectroradiometer.

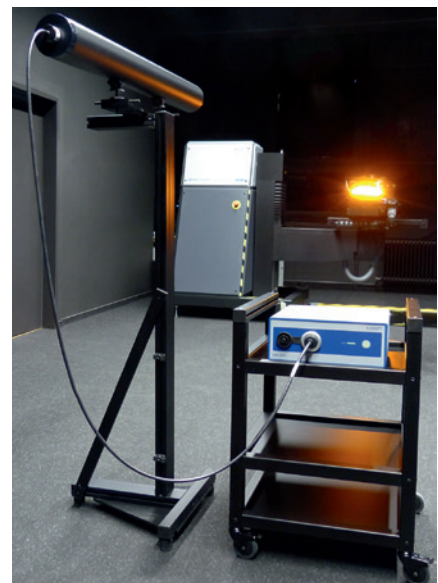
The combination of two world-wide approved measurement systems guarantees highly reliable product approval tests, including all desired spectral analysis.

CAS 140D spectroradiometer

- ▲ High-resolution spectroradiometer with maximum stray light suppression
- ▲ High-precision measurement of color coordinates and correlated color temperature (CCT)
- ▲ Proven reference instrument for luminous color measurement worldwide

AMS Series goniometer

- ▲ CIE Type A goniometer for headlamps and signal sources in vehicles
- ▲ Highest position accuracy and repeatability for measurement of photometric and colorimetric characteristics in the far field
- ▲ Automated set-up mode and sequential measuring procedure



Automotive light lab set-up with AMS 5000 goniometer and CAS 140D spectrometer

03 \ Your application: Color measurement of modern LED based vehicle lamps

LED technology in headlamps and signal lamps with high energy efficiency, color rendering and long lifetime are rapidly replacing traditional light sources. White and red light are mainly used for front and rear lighting, and must be precisely tested in accordance with national and international vehicle regulations. Figure 1 shows the spectra of a state-of-the-art headlamp and a red signal source based on LED technique.

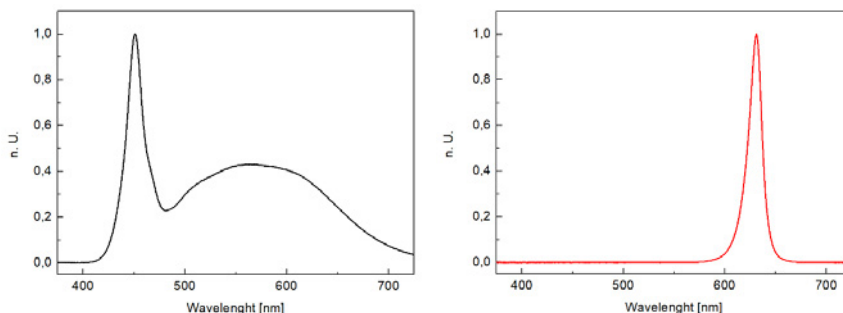


Figure 1: Spectra of LED headlamp (left) and red signal source (right) measured with CAS 140D from Instrument Systems.

The color coordinates CIE-x and CIE-y of the white and red luminous sources were determined at two different distances of 3 and 10 meters, typically used in the laboratory for type approval, using a CAS 140D spectroradiometer. Results are compared with the reference values measured in the ISO 17025 accredited test laboratory

of Instrument Systems in Munich (Tables 1 and 2).

For both LED sources, the CAS 140D spectroradiometer delivers highly accurate color coordinates CIE-x and CIE-y. The deviations between the measured CIE-x and CIE-y and reference values are < 0.001 for both light colors,

even at a distance of 10 meters. This is significantly better than the 0.005 limit required by the GTB Photometry Accuracy Guidelines for luminous color measurement for filter-based colorimeters. Furthermore, the spectroradiometer delivers information about UV or red spectral contents in the white light of headlamps.

Table 1: Deviation in CIE-x and CIE-y of the LED headlamp at different distances

	3 m		10 m	
	CIE-x	CIE-y	CIE-x	CIE-y
CAS 140D	0.32212	0.32061	0.32195	0.32033
Reference ¹⁾	0.32232	0.32049	0.32232	0.32049
Deviation	-0.0002	0.00012	-0.00037	-0.00016

Table 2: Deviation in CIE-x and CIE-y of the red LED signal source at different distances

	3 m		10 m	
	CIE-x	CIE-y	CIE-x	CIE-y
CAS 140D	0.69511	0.30443	0.69438	0.30431
Reference ¹⁾	0.69529	0.30453	0.69529	0.30453
Deviation	-0.00018	-0.0001	-0.00091	-0.00022

¹⁾ Reference values traceable to PTB standards in conformity with DIN ISO 17025

Summary

The CAS 140D spectroradiometer offers higher accuracy for luminous color measurement than filter-based measurement systems, which are still typically used in automotive exterior lighting applications. It is especially suitable for meeting the GTB requirements of state-of-the-art LED headlamps and signal sources. Together with its comprehensive and easy-to-use spectral software package, the CAS 140D is the ideal extension to the AMS goniophotometer system for sensitive and demanding applications in automotive lighting.

04 \ Ordering information

Order number	Description			
Spectrometer	Model	Interface	Slit	Filter wheel
CAS140D[Model][Interface] [Slit][Filter wheel]	[151] VIS (360 - 830 nm) [153] VIS/NIR (380 - 1040 nm) [154] UV/VIS/NIR (220 - 1020 nm) [156] UV/VIS/NIR (300 - 1100 nm) [157] UV/VIS (200 - 830 nm)	[U] USB [P] PCIe [E] Ethernet	[1] 100 µm [2] 50 µm [3] 250 µm	[A] . . [J] (OD 0.5 to OD 4; max. 7 filters)
Options				
CAS140D-422	Active USB extension			
Spare parts				
SPR-03-10	PCIe plug-in for PC			
SPR-03-11	PCIe plug-in modul			
SPR-03-12	3 m PCIe cable			
SPR-03-13	5 m PCIe cable			
SPR-03-20	USB plug-in modul			
SPR-03-30	Ethernet plug-in modul			
Software				
SW-120	SpecWin Light spectral software for Windows. Features emission-, transmission-, reflexion- and LED/display-measurements			
SW-130	SpecWin Pro spectral software for Windows. Including all modules and measurement modes			
SW-135	SpecWin Pro/Light language pack for Chinese (traditional und simplified) and Japanese			
SW-136	Calaris calibration software for array spectrometers; plug-in for SpecWin Pro			
SW-140	SpecWin Pro plug-in for Keithley 24xx/26xx sourcemeter			
SW-141	SpecWin Light plug-in for Keithley 24xx/26xx sourcemeter			
SW-150	SpecWin Pro plug-in for AC-sources and powermeter			
SW-160	SpecWin Pro MultiTrack plug-in for fast acquisition of spectra			
SW-231	Software development kit (SDK); DLL software for customized programs			
SW-233	LabVIEW driver software; requires SW-231			
AMS 5000 Goniometer				
AMS5000-110	Five-axis goniometer, CIE Type A, with angle measurement system and control cabinet, 33 height units with laser adjustment and lamp multiplexer with 4+4+2 channels, including RecoCAN-LX operating unit with touchscreen on the sample stage			
AMS5000-300	Optional 115 VAC power supply			
AMS5000-400	Safety pressure-sensitive mats for AMS 5000			
AMS5000-402	Safety light barrier around the danger area			
AMS5000-404	2 safety laser scanners			
AMS 3000 Goniometer				
AMS3000-100	Five-axis goniometer, CIE Type A, with angle measurement system and control cabinet, 33 height units with laser adjustment and lamp multiplexer with 4+4+1 channels			
AMS3000-300	Optional 115 VAC power supply			
AMS3000-400	Pressure-sensitive safety mats for AMS 3000			
AMS3000-402	Safety light barrier around the danger area			
AMS3000-404	2 safety laser scanners			

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We bring quality to light.