WE BRING QUALITY TO LIGHT

CAS 140B
Array Spectrometer

LIGHTNING FAST LIGHT MEASUREMENTS

- Msec measurement times
- Back-illuminated CCD detector for superb sensitivity
- Flexible configurations using fiber-optic adapters
- Comprehensive laboratory software and DLLs

- Turnkey systems for testing LEDs and displays
- Spectroradiometry and spectrophotometry in the UV/VIS/IR range
- Flash lamp measurements
- Production testing and quality assurance

INSTRUMENT SYSTEMS
OPTISCHE MESSTECHNIK

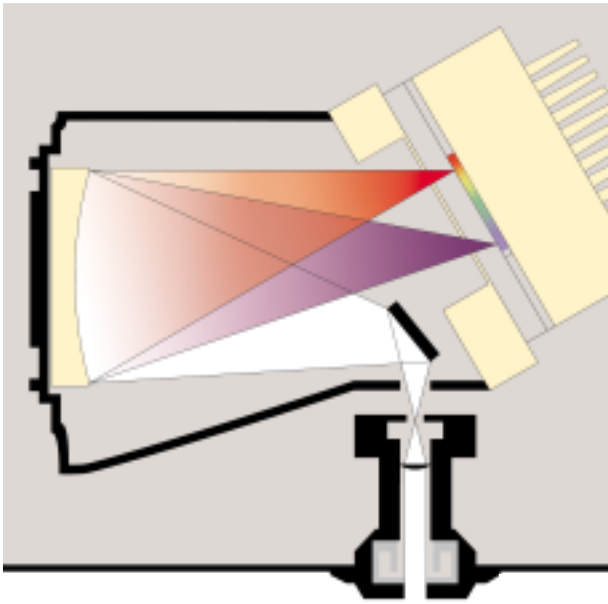
Fast, compact, and extremely sensitive

The CAS 140B Compact Array Spectrometer was designed to meet sophisticated light measurement requirements. Unlike scanning systems, an array spectrometer measures the entire spectrum simultaneously making very short measuring times a reality. An added benefit is the extremely robust and compact design due to the elimination of moving parts. Furthermore, the back-illuminated CCD detector yields precise results, even from very weak light sources.

The CAS 140B features a fiber-optic port for all measurement adapter accessories from INSTRUMENT SYSTEMS. This flexibility gives the CAS 140B the capability to carry out all spectroradiometric and spectrophotometric applications in quality control, production testing, and in lab settings.
There are two different PC interfaces for the CAS 140B: a high-speed version with PCI or ISA plug-in card that allows data acquisition times in the msec range and an alternative RS232 interface for data transfer within one second.

Functional design

The key component in the CAS 140B is a CCD or diode-array detector that captures all spectral components simultaneously. This results in a high measuring speed and robust mechanical design, which make the CAS 140B ideal for around-the-clock production control as well as for measuring pulsed sources, e.g. flash lamps. Signal sensitivity is controlled by the software-selected integration time during which the detector accumulates light.



Light enters through a choice of entrance slits of fixed width and it is reflected by a plane mirror onto a concave diffraction grating with flat-field correction. The diffraction grating spreads the spectrum horizontally and simultaneously focuses the individual spectral components onto the detector array

Back-illuminated CCDs: measure very weak light sources within msec

Photons do not need to penetrate deep into the chip in modern, back-illuminated CCD detectors. This design gives these detectors a sensitivity that is an order of magnitude better than that of conventional front-illuminated CCDs and a thousand times better than that of diode arrays. A much better relative response is also achieved in the blue region.
The CCD detector used in the CAS 140B is a two-dimensional array operated in a binning mode, i.e. all pixels in a column are summed electronically. This reduces noise significantly and delivers the precision required for spectroradiometry and photometry. Further noise reduction can be achieved where necessary by using the averaging feature of the software. CCD detectors are ideal for applications in which the emission intensity is low or short measurement times are important (e.g. in production, LED and display metrology).

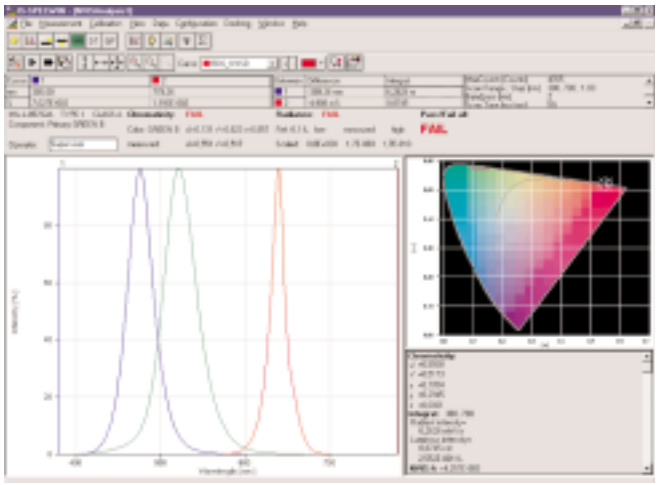
Diode Arrays: stable, low-noise, and very linear

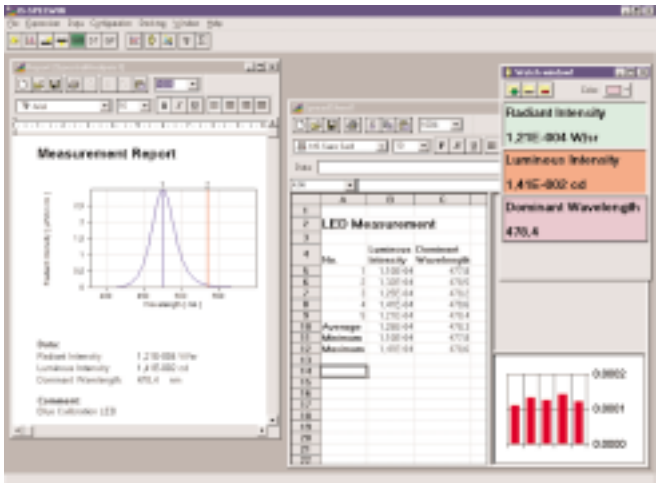
Low-noise spectra and a wide linearity range are the strengths of diode arrays – even with long integration times of up to 5 minutes without averaging. This makes them ideal for applications in which adequate intensity is available and extremely stable measurements are required (e.g. transmission and reflection measurements in spectrophotometry). Baseline stability and low baseline noise are particularly important here.
The CAS 140B uses NMOS diode arrays for the spectral range from 190 to 1070 nm and InGaAs diode arrays for 800 to 1650 nm.

Software for Windows 95/98 and NT

SpecWin: control, evaluation, and reporting – all in one package

SpecWin controls all CAS 140B measurement functions and also includes both an MS Word compatible report generator and an MS Excel compatible spreadsheet. This saves time when taking measurements and facilitates instant analysis and the documentation of results. Also included is a "watch window" with user-definable Pass/Fail evaluation and an integrated spectral analysis mode that displays all radiometric, photometric, and colorimetric results.





SpecWin Lite and instrument DLLs

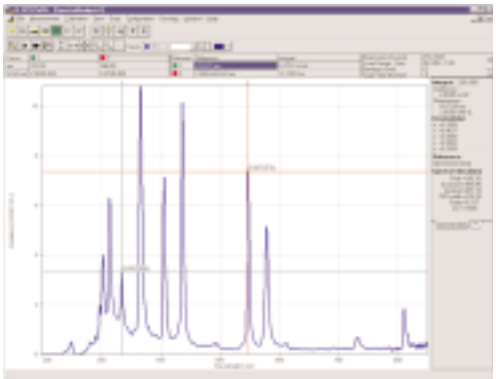
SpecWin Lite was developed specifically for quality-assurance applications. This software is easy to use and delivers results quickly. It can also be configured for a specific measurement task.
A Windows DLL is also available to create customer-specific programs. This DLL operates all the CAS 140B functions and features comprehensive analysis functions (i.e. colorimetric calculations).

Accessories for flexible, universal applications

A comprehensive range of fiber-based accessories supports many different applications. These include radiation measurements in general spectroradiometry and photometry as well as diffuse/specular transmission and reflection measurements.

Spectroradiometry and Photometry

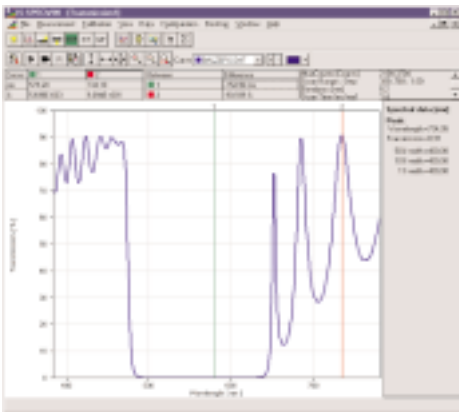
A variety of fiber-optic probes (including cosine-corrected versions) are available for determining irradiance and illuminance. The CAS 140B can also be easily connected to a large integrating sphere in order to obtain the total radiation emitted by a source (i.e. LED luminaires and lamps).



Precise analysis of radiation emitted by light sources using calibrated optical probes with cosine correction

Transmission and Reflection Measurements

Accessories are also available for this type of measurement. They include a sample compartment, sample mount, and light-source unit. The fiber-optic design facilitates measurements of large samples with diverse geometries. For example, the GON 360 Goniometer can be used to obtain specular transmission and reflection measurements at variable angles over the spectral range from 200 to 1700 nm. Compact integrating spheres in the ISP 80 and ISP 150 series are available for diffuse measurements.



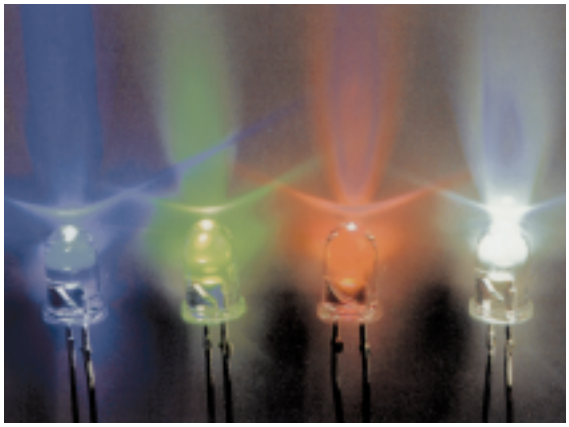
The GON 360 Goniometer tests optical coatings and special-effect paints at variable angles of measurement and illumination

Model	CAS140B-151/-152/-153	CAS140B-161/-162/-163	CAS140B-164
Detector	**CCD (back-illuminated)**	**NMOS Diode Array**	**InGaAs Diode Array**
Number of pixels	1024 x 128 (binning mode)	1024	256
Spectral range	190 - 1050 nm	190 - 1070 nm	800 - 1650 nm
Integration time	9 msec - 30 sec	20 msec - 5 min	20 msec - 10 sec
Cooling	-10° C ± 0.05° C	0° C ± 0.05° C	0° C ± 0.05° C
Linearity	± 2 %	± 0.5 %	± 2 %
Spectroradiometry			
Sensitivity range for irradiance *1	$2 \cdot 10^{-7}$ - 20 W/m²nm	$2 \cdot 10^{-6}$ - 1 W/m²nm	$5 \cdot 10^{-6}$ - 10^{-1} W/m²nm
Signal sensitivity at 1s integration time *1	$4 \cdot 10^{-6}$ W/m²nm	$1 \cdot 10^{-3}$ W/m²nm	$5 \cdot 10^{-5}$ W/m²nm
Spectroradiometric accuracy *2	± 5 %	± 5 %	± 7 %
Spectrophotometry			
Baseline noise *3	± 60 counts, or ± 0.4 %	± 15 counts, or ± 0.1 %	± 30 counts, or ± 0.2 %
Photometric transmission accuracy *4	± 0.5 % T or ± 0.02 A at 1 A	± 0.3 % T or ± 0.01 A at 1 A	± 0.5 % T or ± 0.02 A at 1 A
Baseline drift *4	0.15 %/h or ± 0.006 A/h	0.15 %/h or ± 0.006 A/h	0.3 %/h or ± 0.01 A/h

Spectrograph	VIS model	UV model	VIS-NIR model	IR model
Spectral range with CCD	380 - 780 nm	190 - 780 nm	380 - 1050 nm	N/a
Spectral range with diode array	380 - 780 nm	190 - 800 nm	360 - 1070 nm	800 - 1650 nm
Spectral resolution *5	2.5 nm	3 nm	3.5 nm	11 nm
Wavelength accuracy *6	± 0.3 nm	± 0.3 nm	± 0.3 nm	± 1 nm
Stray light (broadband with standard illuminant A) *7	$1 \cdot 10^{-3}$ at 400 nm	$2 \cdot 10^{-3}$ at 285 nm	$2 \cdot 10^{-3}$ at 400 nm	$1 \cdot 10^{-3}$ at 1000 nm
Stray light (for LED) *8	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$	$1 \cdot 10^{-4}$
Filter wheel	Standard in CCD models, optional in diode-array models Configuration of the filter wheel: OD1, OD2, OD3 and OD4 density filters and blue filter			
Focal length, grating	140 mm, f/2.0 / holographic grating with flat-field correction			
Slit	100 µm standard, optional 50 µm or 250 µm			
Electrical data				
AD converter	15 Bit resolution			
PC interface	Standard version: plug-in card for ISA bus; Optional: plug-in card for PCI bus or RS232 interface connection			
Trigger	One input and output each, 5 V TTL level (level or flank triggered)			
Miscellaneous				
Dimensions (H, W, D)	192 x 330 x 348 mm³			
Power consumption	approx. 40 watts			
Ambient temperature	15 - 35° C			
Weight	approx. 10 kg			

**1 Measured with EOP-120 optical probe and OFG-414 fiber bundle at 600 nm wavelength, a signal-to-noise ratio of 10 : 1, and without averaging (in CCD models incl. density filter)*
**2 Directly after calibration relative to the calibration standard and without density filter*
**3 This value is obtained at the shortest integration time, without averaging and at 15000 counts. The value improves with appropriate averaging (e.g. 9-fold averaging reduces noise 3-fold)*
**4 Applies to LS100-130 light source after 1 hour for warming up*
**5 Approximate values for 100 µm standard slit. Other values are obtained with optional 50 µm or 250µm slits*
**6 Applies to Penray lamp or laser*
**7 Measured with 320 nm (for 285 nm), 455 nm (for 400 nm) or 1200 nm (for 1000 nm) cut filter relative to the peak intensity of the unweighted spectral data*
**8 Measured at 100 nm distance to the left of the peak wavelength, relative to the peak intensity of the unweighted spectral data*

LED measurement



All spectral characteristics plus either luminous intensity or luminous flux can be obtained quickly and easily in a single measurement using the appropriate configuration of the CAS 140B. It is a particular advantage that the measuring adapter geometries are in exact conformance with CIE (International Commission on Illumination) specifications; measurement results therefore correlate precisely with CIE recommendations.

Lab testing: precise, CIE-compliant, easy to reconfigure

A complete LED test station includes a CAS 140B with CCD detector, an LED optical probe, LED test sockets, and constant-current source. The special design of the fiber-optic interface allows adapters to be changed quickly and easily without losing calibration. This saves time and extends the range of possible applications. The correct calibration file is simply selected in the software after changing the adapter. A single test system can therefore be used to determine luminous intensity, luminous flux, luminance, and all radiometric and colorimetric quantities.

Production testing: fast, compact and fully automated

The LED tester from INSTRUMENT SYSTEMS includes a CAS 140B CCD Array Spectrometer, a Keithley Model 2400 Source-Meter, and a WindowsNT computer. The complete system is housed in a 19″ rack and has been specifically designed for performing automated measurements in production testing (e.g. controlling mechanical sorting machines). All radiometric, photometric, and spectral characteristics can typically be measured within 20 msec. The current and forward voltage can also be determined and logged. The comprehensive test software allows LEDs to be classified into as many as 32 bin classes. All data are stored in a database and are then statistically analyzed.

Luminous intensity and radiant intensity: CIE-compliant

LED optical probes from INSTRUMENT SYSTEMS conform precisely to CIE recommendations. These probes have been specifically developed for use with spectroradiometers. Thus, in addition to luminous intensity, also all spectral parameters such as dominant wavelength are determined in conformance with CIE recommendations. Light from the adapter is launched into the CAS 140B through a fiber bundle that is made up of a large number of individual fibers. This setup ensures that measuring accuracy is not compromised by changing the orientation of the fiber.

LED OPTICAL PROBES, complete with fiber bundle and plug					
Model	CIE Condition	Solid angle	Distance between LED tip and sensor	Spectral range	Comment
LED430-15	B	0.01 sr	100 mm	350 - 1700 nm	standard version
LED432-15	B	0.01 sr	100 mm	200 - 1700 nm	UV version
LED433-15	B	0.01 sr	100 mm	350 - 1700 nm	shortened version for handling machines
LED434-15	B	0.01 sr	100 mm	200 - 1700 nm	shortened UV version for handling machines
LED440-15	A	0.001 sr	316 mm	350 - 1700 nm	for narrow-angled LEDs
LED445-15	A	0.001 sr	316 mm	350 - 1700 nm	for off-axis LEDs

Luminous flux and radiant power

INSTRUMENT SYSTEMS supplies two different integrating spheres with diameters of 80 mm and 150 mm. They are used for measuring luminous flux and radiant power. The spheres have a port for both the LED test socket and the fiber-bundle connection. The measurement geometry corresponds to the current CIE recommendation according to which the luminous flux from one entire hemisphere of an LED is measured.

LED test sockets: precise and repeatable fixturing

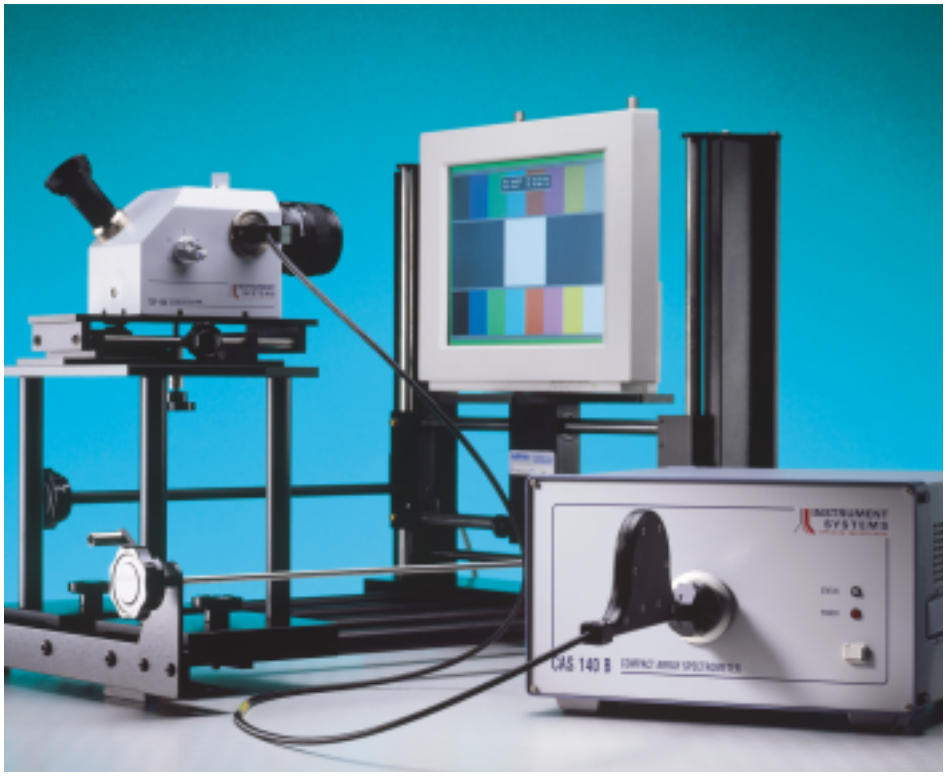
Standard and high-precision versions of these test sockets ensure proper alignment between the mechanical axis of the LED and the optical axis of the measurement accessory being used. All LED test sockets have a cable for connection to a constant-current source.

TECHNICAL SPECIFICATIONS FOR LED MEASUREMENTS			
Spectrometer	**CAS140B-151**	**CAS140B-152**	**CAS140B-153**
Spectral range	380 - 780 nm	190 - 780 nm	380 - 1050 nm
Spectral resolution *1	2.5 nm	3 nm	3.5 nm
Sensitivity			
Luminous intensity *2	0.02 mcd - 50 cd		
Luminous flux *3	0.04 mlm - 80 lm		
Accuracy			
Luminous intensity *4	± 5 %		
Luminous flux *4	± 6 %		
Dominant wavelength *5	± 0.5 nm		
Chromaticity (x, y) *5	± 0.002		

**1 Applies to 100 µm standard slit. Other values are obtained with optional 50 µm or 250µm slits*
**2 Specified for a signal-to-noise ratio of 10:1, for a yellow LED at 585 nm, and with LED430 adapter*
**3 Specified for a signal-to-noise ratio of 10:1, for a yellow LED at 585 nm, and with ISP80 adapter*
**4 Valid immediately after calibration with the calibration standard, for diffuse LEDs and without density filter*
**5 Assuming sufficient signal dynamic range and valid calibration. The specified errors apply a twofold standard deviation*

Display Measurement

The DTS 140 Display Test System includes a CAS 140B with CCD detector connected to the TOP 100 Telescope Optical Probe by fiber-optic cable. This calibrated turnkey system is supplied complete with SpecWin Windows software. The DTS 140 is ideal for testing LCDs and TFT displays, LED backlit panels, and for any measurements that require a high level of sensitivity due to small measurement spots or low light levels.

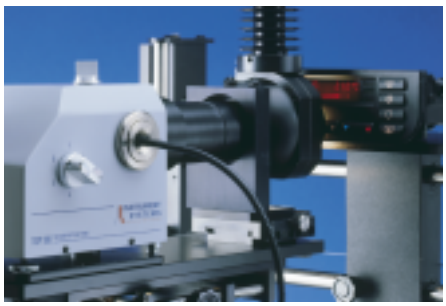


Special fiber-optic port

The flexible fiber-optic port includes "integrated mode mixing" and offers a wide range of advantages:
The test setup can be easily reconfigured for different measurement scenarios without loss of calibration.
The fiber-optic port acts as a polarization scrambler that makes the CAS 140B insensitive to polarization changes and permits precise measurements from LCDs and TFT displays.
The aperture baffles of the TOP100 do not affect the spectral bandwidth of the spectrometer. Unlike systems coupled directly with Pritchard optics, accurate and reproducible results can be taken for different measuring-spot sizes.
A non-uniform luminance and spectral distribution within the measurement aperture do not adversely affect measurement results.

An Eye for Detail: TOP 100 Telescope Optical Probe

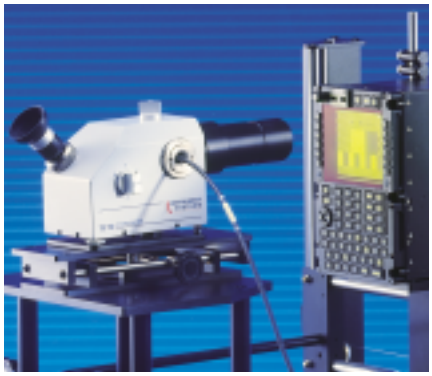
The DTSISP-100 accessory comprises an integrating sphere with light source which illuminates the test surface uniformly. High-spatial resolution is achieved with the TOP 100 that collects the reflected light.



The TOP 100 from INSTRUMENT SYSTEMS is used for determining luminance, radiance, and colorimetric values from light sources. The DTSISP-100 accessory was designed for determining the reflection characteristics of extremely small graphics. The measurement spot location is adjusted using the focusing eyepiece and different aperture baffles can be selected for different spot sizes.

DTS 140: DISPLAY MEASUREMENT

There are two different TOP 100 configurations for the DTS 140:
The DTS 140-111 and DTS 140-113 models have a 60 mm objective lens and are ideally suited for all standard applications including LCD and TFT displays. The distance from the test sample can be adjusted between 8 cm and infinity (usually calibrated at 50 cm).
The DTS 140-211 and DTS 140-213 models incorporate the HRL-90 high-resolution objective lens (the distance to the test sample is always 90 mm). This permits the measurement of graphics as small as 0.15 mm in diameter (0.006").
Other TOP 100 objective lenses are also available and can be attached to the base unit with a universal bayonet connector.



The DTS 140 can be combined with the DTS 500 motorized positioner for automated testing of displays.

TECHNICAL SPECIFICATIONS FOR DISPLAY MEASUREMENTS					
Spectrometer model		**DTS140-111**	**DTS140-113**	**DTS140-211**	**DTS140-213**
Spectral range		380 - 780 nm	380 - 1050 nm	380 - 780 nm	380 - 1050 nm
Spectral resolution *1		3 nm	3.5 nm	3 nm	3.5 nm
Data-point interval		0.6 nm	0.8 nm	0.6 nm	0.8 nm
TOP 100 Telescope Optical Probe					
Objective lens		60 mm	60 mm	HRL 90	HRL 90
Sample distance *2		8 cm to infinity	8 cm to infinity	9 cm	9 cm
Lens stray light (approx.) *3		1 %	1 %	0.1 %	0.1 %
Measuring-spot sizes *4	Aperture 1	0.25 mm at 8 cm 2.1 mm at 50 cm	0.25 mm at 8 cm 2.1 mm at 50 cm	0.15 mm	0.15 mm
	Aperture 2	0.5 mm at 8 cm 4.2 mm at 50 cm	0.5 mm at 8 cm 4.2 mm at 50 cm	0.3 mm	0.3 mm
	Aperture 3	1 mm at 8 cm 8.4 mm at 50 cm	1 mm at 8 cm 8.4 mm at 50 cm	0.6 mm	0.6 mm
Measuring sensitivity range *5	Aperture 1	1 - 60000 cd/m²	1 - 60000 cd/m²	3 -180000 cd/m²	3 -180000 cd/m²
	Aperture 2	0.3 - 20000 cd/m²	0.3 - 20000 cd/m²	1 - 60000 cd/m²	1 - 60000 cd/m²
	Aperture 3	0.1 - 6000 cd/m²	0.1 - 6000 cd/m²	0.3 -18000 cd/m²	0.3 -18000 cd/m²
Accuracy					
Luminance *6		± 5 %			
Radiance *6		± 5 %			
Chromaticity (x, y) *7		± 0.002			
Dominant wavelength *7		± 0.5 nm			
Polarization sensitivity		± 3 %			
General					
Detector		CCD back-illuminated, 1024 x 128 pixels, binning mode			
Fiber-optic cable		1 mm fiber with mode mixing, minimum bending radius is 20 cm			
Dimensions TOP100 (HxWxD)		150 x 150 x 95 mm			
Weight TOP100		2.5 kg			

**1 Applies to 100 µm standard slit. Other values are obtained with optional 50 µm or 250 µm slits*
**2 Calibration only applies at a distance of 50 cm to the test sample in models with the 60 mm objective lens*
**3 Measured at the minimum measuring spot in conformity with MIL-L-85672A*
**4 Measuring-spot diameter depends on distance from the test sample with the 60 mm objective lens*
**5 Specified for a signal-to-noise ratio of 10:1 in the spectrum, measured with standard illuminant A, without density filter. Measuring sensitivity improves up to tentimes when testing smallband radiation (e.g. LED displays)*
**6 Valid immediately after calibration with the calibration standard*
**7 Assuming sufficient signal dynamic range and valid calibration. The specified errors apply a twofold standard deviation.*

ORDERING INFORMATION

Order Number	Description			
Spectrometer				
Model	Detector	Spectral range	Spectral resolution	Data point interval
CAS140B-151	CCD (back-illuminated)	380 - 780 nm	2.5 nm	0.4 nm
CAS140B-152	CCD (back-illuminated)	190 - 780 nm	3 nm	0.6 nm
CAS140B-153	CCD (back-illuminated)	380 - 1050 nm	3.5 nm	0.8 nm
CAS140B-161	NMOS diode array	380 - 780 nm	2.5 nm	0.4 nm
CAS140B-162	NMOS diode array	190 - 800 nm	3 nm	0.6 nm
CAS140B-163	NMOS diode array	360 - 1070 nm	3.5 nm	0.8 nm
CAS140B-164	InGaAs diode array	800 - 1650 nm	11 nm	3.4 nm
Options for Spectrometer				
CAS140B-250	Filter wheel (standard in CCD models, optional in diode-array models)			
CAS140B-330	50 µm slit instead of standard 100 µm slit			
CAS140B-332	250 µm slit instead of standard 100 µm slit			
CAS140B-400	PC plug-in card for PCI bus instead of ISA bus			
CAS140B-402	RS232 interface connection instead of ISA bus (Note: the serial interface is not possible in addition to the PCI or ISA bus)			
Software				
SpecWin	Spectral acquisition and analysis software for MS Windows based operating systems; for more information on SpecWin see additional data sheet			
SW-231	DLL for CAS140B for MS Windows based operating systems; incl. radiometric, photometric and colorimetric calculations; supports Visual Basic, C++ and DELPHI 4			
LED Tester Models				
CAS140B-xxx	Information on our complete LED testers with software is available upon request			
DTS140 Models (complete for display measurements)				
DTS140-111	380 - 780 nm; 60 mm objective lens, 80 mm sample distance to infinity			
DTS140-113	380 - 1050 nm; 60 mm objective lens, 80 mm sample distance to infinity			
DTS140-211	380 - 780 nm; HRL 90 objective lens, fixed 90 mm sample distance			
DTS140-213	380 - 1050 nm; HRL 90 objective lens, fixed 90 mm sample distance			
Options for DTS140 Models				
DTSISP-101	Reflection measurement at small graphics comprising an integrating sphere with 80 mm internal diameter, halogen lamp, and power supply; complete with mount for TOP100 (Note: only suitable for the HRL90 objective lens)			

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