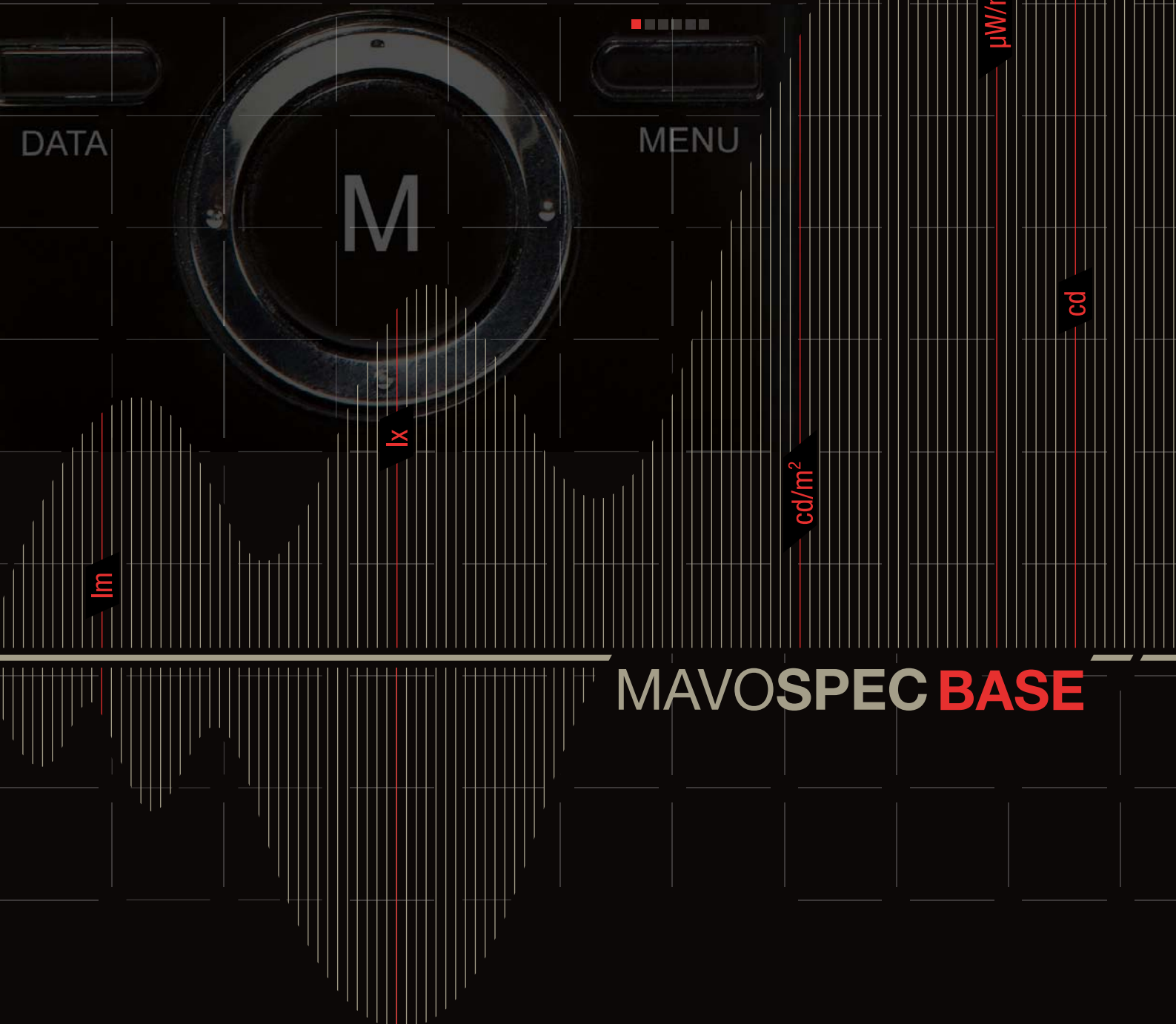


GOSSEN

Spectral Light Measuring



DATA

MENU

M

lm

lx

cd/m²

μW/m²/nm

cd

MAVOSPEC **BASE**

PRECISION

GOSSEN Foto- und Lichtmesstechnik – Your Guarantee for Precision and Quality MADE IN GERMANY

GOSSEN Foto- und Lichtmesstechnik is specialized in the measurement of light and has decades of experience in its chosen field. Continuous innovation is the answer to rapidly changing technologies, regulations and markets. Outstanding product quality is assured by means of a certified quality management system in accordance with ISO 9001.

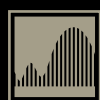
LED – Light of the Future

In the field of lighting technology, a decisive change has taken place in recent years from the conventional light bulb to the modern LED. This development has been driven by the Europe-wide ban on conventional light bulbs with low energy efficiency, as well as an ever increasing energy-saving mentality and environmental awareness.

LED technology has experienced rapid growth in recent years thanks to the development of LEDs with very high light output and thus outstanding energy efficiency. In combination with a long service life, impact resistance, minimal heat generation, the absence of an infrared component and fully non-toxic materials, this new technology has fully convinced the users.

The long service life makes it possible to install lamps permanently into light fixtures for the first time ever, and opens up entirely new levels of design freedom. This new generation of light fixtures is laid out in a targeted fashion for the radiant characteristics and the cooling requirements of LEDs. In place of the reflectors used as light guides with conventional round spotlights, optical systems made of plastic are frequently positioned in front of the LED today in order to direct the light efficiently. Because it's easy to control brightness and color, this artificial light can be adapted to changing sunlight during the course of the day, thus increasing one's sense of wellbeing and improving one's performance. This biological effect of light is now being correctly understood for the first time.

LEDs have thus long since gone beyond their previous status as effects lighting and are being used for display illumination, LED displays and light fixtures. Modern means of transportation, signal systems and street lights, as well as indoor and outdoor lighting, are no longer conceivable without them.



Spectral Power Distribution

(abbreviation: SPD, unit of measure: mW/m²/nm)

SPD represents the radiant power of a light source for a wavelength or a waveband in the visible range. It provides us with information about the color characteristics of a light source, and can be used to compare the color temperature of different light sources. Information can be inferred from this regarding color rendering properties. The color of an object results from partial reflection of the spectrum emitted by the illuminating light source. If certain ranges are missing from this spectrum, the corresponding color components cannot be reflected or seen. If intensity is not uniform over the entire spectral range, color components with greater intensity are amplified, and those with lower intensity are attenuated.

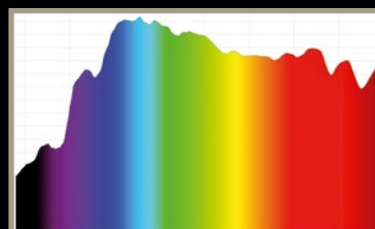
New Challenges for Measuring Technology

Whereas with conventional lighting technology it was sufficient to check illuminance and luminance, today it's also necessary to take spectrum, chromaticity, color temperature, color rendering index and flicker into consideration. The brightness and color of LEDs vary due to manufacturing processes, for which reason they have to be tested, classified and characterized during production and in their final applications.

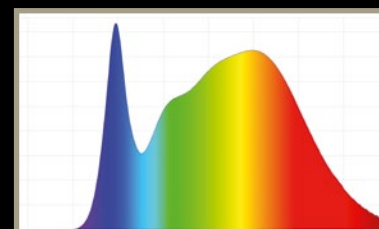
Daylight, incandescent lightbulbs and halogen lamps all have one thing in common: excellent color rendering with the highest possible index of 100. Due to their spectra, LEDs and fluorescent tubes don't fare as well in this respect. Individual spectral ranges dominate in the case of fluorescent light, or certain spectral ranges are missing, which influences color vision.

The component manufacturers have tackled these new challenges and miniaturized spectral sensors to such a degree that these MOEMS (micro-opto-electro-mechanical systems) are permitting the development of easy-to-handle, and above all affordable spectral photometers.

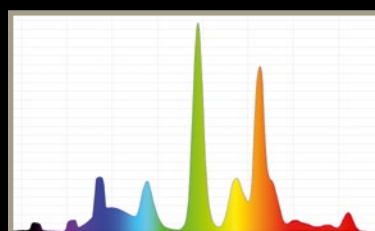
GOSSEN Foto- und Lichtmesstechnik GmbH offers a complete range of luxmeters and luminance meters, as well as spectrometers. As a calibration laboratory, GOSSEN also issues factory calibration certificates for illuminance and luminance, as well as DAkkS calibration certificates for illuminance.



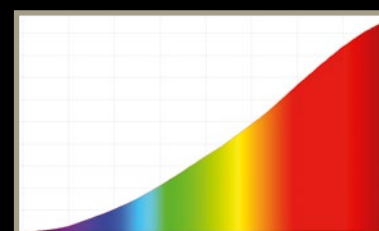
Afternoon daylight, CCT = 5319 K, Ra = 99,2



LED neutral white, CCT = 4362 K, Ra = 89,9



TL8 840, CCT = 3781 K, Ra = 82,9



Halogen, CCT = 2714 K, Ra = 99,0

QUALITY

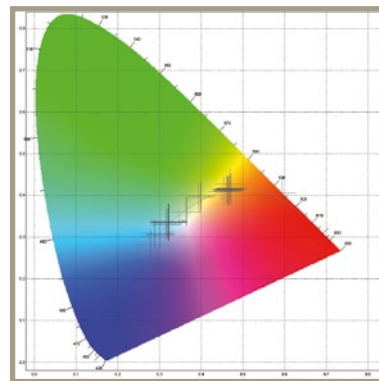


Color Coordinates

(abbreviation: x,y [CIE 1931] / u,v [CIE 1960] / u',v' [CIE 1976])

Color coordinates are a means of precisely defining a color, i.e. a color's chromaticity as specified by the coordinates of the CIE diagram. The human eye is equipped with sensory cells for the perception of the three primary colors, namely red, green and blue. The photopic curve for the standard observer was ascertained in 1931 by the CIE and indicates sensitivity for the individual wavelength ranges.

On the basis of this spectral value function, the CIE defined the standard XYZ color value system, by means of which each color is described by its standard color components x, y and z. Colors are represented in a two-dimensional diagram via the X and Y coordinates. The third component, Z, can be calculated by means of the relationship $z = 1 - x - y$. Various CIE color systems include CIE 1931 (x,y), CIE 1960 (u,v) and CIE 1976 (u',v').





MEASUREMENTS



Color Temperature

(abbreviation: CCT, unit of measure: Kelvin [K])

CCT is used to quantitatively specify the respective color impression of a light source. It's defined as the temperature of a black object, the so-called planckian radiator, which belongs to a certain color of the light which is emitted by the source of radiation. In concrete terms, it's the temperature whose light effect is most similar to the color to be described at uniform brightness under specified observation conditions.

Light color	Correlated color temperature
Warm white (ww)	< 3300 K
Neutral white (nw)	3300 to 5300 K
Daylight white (dw)	> 5300 K



Color Rendering Index

(abbreviation: Ra)

Ra is a measure of the color rendering properties of lamps and has a theoretical maximum value of 100. The higher the color rendering index, the better the color rendering properties of the lamp. Color rendering which is as natural as possible is achieved through the use of lamps with an Ra value of greater than 90.

Ra is the arithmetic mean value of the color deviation demonstrated by test colors 1 through 8 in accordance with DIN 6169. DIN EN 12464 specifies the color rendering properties of lamps used to illuminate various types of rooms and activities. Where LED lamps are concerned, color rendering index R9 for saturated red is also frequently taken into consideration, because white LEDs demonstrate weaknesses within this spectrum.

Ra	Color Rendering	Lamp Examples	Applications
≥ 90	Excellent	Halogen metal vapor lamps, deluxe fluorescent lamps, tungsten halogen lamps, high-quality LEDs	Graphics trade, museums, textile and leather goods showrooms, hair styling and cosmetics salons, dental treatment facilities
80 ... 89	Good	Halogen metal vapor lamps, fluorescent lamps, LEDs	Administration buildings, schools, industrial and sports facilities
70 ... 79	Medium	LEDs	
60 ... 69	Medium	Halogen metal vapor lamps for street lighting	Street lighting
40 ... 59	Inadequate	High pressure mercury lamps	Rough industrial work
20 ... 39	Inadequate	High pressure sodium vapor lamps	Indoor areas in exceptional cases only



Illuminance

(abbreviation: E, unit of measure: lux)

Illuminance indicates with how much intensity a surface is illuminated. It amounts to one lux when a luminous flux of one lumen illuminates a surface of one square meter. This corresponds roughly to a normal candle flame at a distance of one meter. Luxmeters are used to measure illuminance at horizontal and vertical surfaces. However, illuminance does not indicate the brightness impression of a room, because this depends to a great extent on the room's reflective characteristics. A white room gives a much brighter impression than a dark room. As a rule, uniform light distribution is not achieved with normal lighting, for which reason specifications in the standards usually make reference to mean illuminance. This value is calculated as the weighted arithmetic mean of all illuminance values in the room.



Flicker

(abbreviation: F%)

Flicker is caused by supply voltage deviations which result in fluctuations in the brightness of the light. These fluctuations influence human health and may trigger epileptic seizures, migraine headaches, tiredness, constrained vision, distraction and impaired vision.

A good LED driver smooths out voltage fluctuation and prevents flicker. The flicker value is a measure for the quality of the lamp or light fixture, and should be as low as possible.

APPLICATIONS



Development and manufacturing of lamps and light fixtures – incorporation into test systems via open interfaces for process monitoring and quality assurance by means of random samples and storage to memory for evaluation.

Wholesale and retail sale of lamps and light fixtures – inspection, verification, comparison and evaluation of the light and color quality of various sources of light from various suppliers.

Medical technology – checking of illuminance according to room classifications, as well as the great demands placed on color rendering in examination, operation and autopsy rooms, as well as in dental treatment facilities and laboratories due to the required color evaluation.

Shop lighting – specific selection of light fixtures for an attractive presentation of the respective goods such as fruit, vegetables, meats and sausages, or true-color presentation of textiles and leather goods.

Workplace lighting – great demands placed on color rendering with regard to color selection and color control for haircare and cosmetics, the graphics and chemicals industries, as well as for processing wood, ceramics, textiles, leather goods and jewelry.

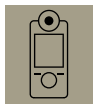
Interior design, lighting design – selection and coordination of various light sources, verification of the results of planning programs such as DIALux.

Exhibitions, museums, libraries – checking for adequate lighting and color rendering. Evaluation of the spectrum with regard to spectral components which can cause damage.

Studio, stage and film lighting – coordination of light sources, white balancing, evaluation of color rendering.

Human centric lighting research – adjustment and examination of brightness and color temperature during the course of the day in order to determine their biological influence on people.

Monitors, projectors, large-format screens – examination and calibration of color rendering, determination of displayable color space, color coordination for replacement parts should servicing become necessary.



MAVOSPEC BASE

The MAVOSPEC BASE is a high-quality, miniaturized spectrometer for routine daily measurement of all conventional and modern light sources such as LEDs and OLEDs. All characteristic measured quantities such as illuminance, correlated color temperature, color rendering index, color coordinates in accordance with various CIE standards, flicker, spectral power distribution, peak wavelength and dominant wavelength are determined for the measured spectrum and displayed such that they can be understood by experts as well as laypersons.

This results in an extensive range of possible applications and a broad spectrum of uses in planning, installation and maintenance of illumination systems, R&D, production and quality assurance for display panels, lamps and light fixtures, as well as for evaluation of ambient light parameters in psychological experiments.

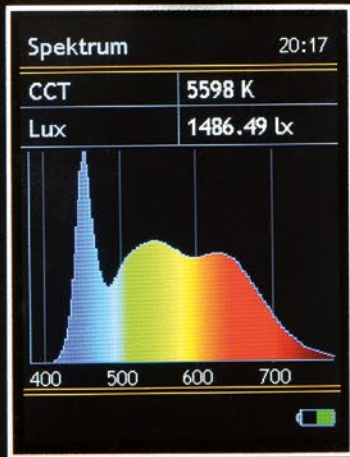


The user-friendly measuring instrument is operated intuitively via the ring controller and separate function keys, and is equipped with an extremely easy-to-read color display. The ecological power supply concept with rechargeable lithium-ion battery is in keeping with the application. Battery capacity allowing for 8 hours of continuous operation can be extended even further by reducing display brightness and with the help of automatic display and device shutdown. Electrical power for charging and continuous operation is supplied via the USB port and the mains power pack.

Sustainability is assured by the replaceable lithium-ion battery, which can be replaced by the user if necessary, and by the ability to install software updates via the USB port. The device software is thus open to an expanded range of functions in the future and changes to the current standards. A one-time investment in this device provides the user with a long service life.

Measured values can be saved in CSV format to the 8 GB microSD memory card integrated into the battery compartment either automatically for each measurement or manually by pressing a key. A new folder is created for each date and the filenames are based on the time of day. If the MAVOSPEC BASE is connected to the USB port at a PC, it appears as a disk drive and the measurement data can be transferred. CSV files can be read in to Excel directly, and can be further processed by the user in order to generate reports. A sample report is included in the scope of delivery and is located on the memory card.

Diverse communication capabilities via USB support data transmission and control with external software, as well as integration into stationary measuring systems. The open communication protocol and an Excel application sample are also included on the memory card or can be downloaded from GOSSEN's website.



MAVOSPEC **BASE**

DATA

M

MENU

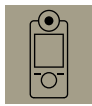
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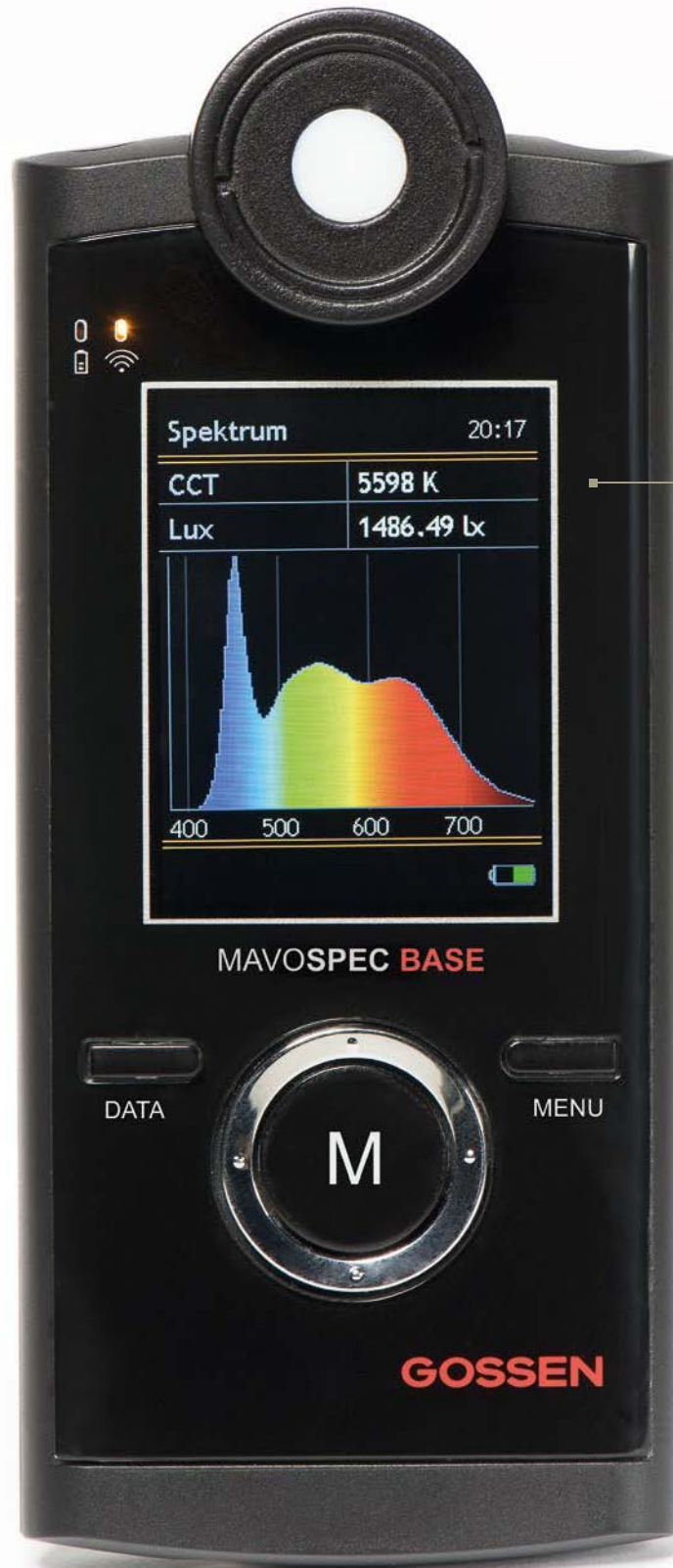
DATA

M

MENU



MAVOSPEC **BASE**



Specifications

Illuminance – Calculation of illuminance based on spectral data. Cosine-corrected measuring probe in accordance with class C per DIN 5032-7.

Large dynamic range – The meter is capable of measuring values from 10 to 100,000 lx, thus covering a broad range of applications.

Spectral power distribution – Measurement of spectral power distribution over a large spectral range of 340 to 750 nm with determination of the peak wavelength and dominant wavelength.

Chromaticity, color coordinates – Measurement of color coordinates in accordance with CIE 1931 [x,y], CIE 1960 [u,v] and CIE 1976 [u', v'], and display of the CIE standard color table.

Light quality – Measurement of the correlated color temperature and color rendering index Ra, as well as individual indices R1 through R15.

Flicker value – Measurement of flicker as an index and as a percentage.

Outstanding measured value stability – The integrated temperature sensor and automatic temperature compensation of the dark stream assure outstanding measurement results over a large temperature range.

Individual calibration – Each spectrometer is subjected to photometric and radiometric calibration prior to shipment. A simple calibration report is included in the scope of delivery.

Convenient daily use – Highly practical one-hand operation with the ring controller and just a few keys, easily legible color display with high resolution, compact design, protected transport in a high-quality aluminum case.

Automatic measured value storage – Thousands of light measurements can be automatically or manually saved in CSV format to the 8 GB microSD card which is integrated into the battery compartment where it's well protected.

Easy data transfer – The integrated USB port permits easy data exchange with the PC. The data, which are saved in CSV format, can be imported to any desired programs.

Individual system integration – The open protocol for device control and data communication permits incorporation into the user's own applications.

Sustainable device concept – The ability to update the device via the USB port keeps it open for future expansions and standards.

Ecological power supply – Replaceable, rechargeable lithium-ion battery, charging via USB port with external mains power pack, display of charging status and battery level, approximately 8 hours of continuous operation without shutdown.

Extremely long rechargeable battery operating time – Can be extended by reducing display brightness, with automatic display and device shutdown.

3-year guarantee

Reliable Measured Values through Calibration at Regular Intervals

The MAVOSPEC BASE with intuitive user interface is one of the most accurate and reliable spectrometers in its class, and reflects the most up-to-date technology available on the market. Like all other precision light meters, this product also requires regular maintenance, recalibration and software updates in order to continuously fulfil performance capabilities within the tolerances and specifications stipulated by the manufacturer. GOSSEN recommends a calibration interval of once every 12 months.

When do measuring instruments have to be calibrated?

As a standard for quality management systems, DIN EN ISO 9001:2008 stipulates essential requirements for monitoring measuring instruments in section 7.6, insofar as they are used to assure compliant results, and thus uniform product quality as well. Measuring instruments must be re-traced to national standards at regular intervals by means of calibration, and if necessary adjusted, and plainly labeled with their calibration status. If it is determined during calibration that the measuring instrument does not

fulfill the specified requirements, the operating company must evaluate the validity of previously obtained measurement results and implement appropriate measures with regard to the measuring instrument itself, as well as all affected products.

Consequently, calibration at regular intervals assures the quality of the respective product or service on the basis of internationally comparable measurement results. This provides for legal security with respect to product liability, as well as for approval tests and audits.



Strictest Standards for the GOSSEN Light Lab

The GOSSEN Light Lab is equipped with a tested and monitored optical table, whose traceability to the national standard maintained by the PTB (German Federal Institute of Physics and Metrology) is assured by means of a Wi41G standard lamp. The lab is subject to test equipment monitoring in accordance with DIN EN ISO 9001-9004, and is additionally accredited for illuminance by

DAkkS in accordance with DIN EN ISO/IEC 17025 under registration number D-K-15080-01-01. And thus you can count on product quality, the competence of our employees, continuous external monitoring and international recognition of our calibration services. In addition to factory calibration, GOSSEN also offers DAkkS calibration for illuminance.

TECHNICAL DATA



Model

MAVOSPEC BASE

Article number M521G

Photometry

Application	Daylight, LEDs, halogen and more
Illuminance [lux]	10 lx ... 100 000 lx
Error limit – cos like rating (f2')	3,00 %
Distance, diffuser to surface to be measured	25 mm
CRI – color rendering index per CIE 13,3	Ra, R1 - R15
CCT – correlated color temperature	■
Peak wavelength	■
Dominant wavelength per CIE 15	■
Purity per CIE 15	■
Chromaticity coordinates [x,y] per CIE 1931	■
Chromaticity coordinates [u',v'] per CIE 1976	■
Chromaticity coordinates [u, v] per CIE 1960	■
Configurable measured values display	■
Flicker measurement [F% / frequency]	■

Technical Data

Spectral range	380 to 750 nm (VIS)
Sensor	CMOS image sensor
Number of pixels	256
Physical resolution	~ 1.8 nm
Wavelength reproducibility	± 0.5 nm
Integration time	10 ms to 2000 ms
A-D converter	16 bit
Signal-to-noise ratio	1000:1
Spurious light	-25 dB
Full width at half maximum (FWHM)	15 nm
Radiometric accuracy	4%
Flicker compensation	■

Operation, Interfaces and Memory

Display	2.1" color TFT, 320 x 240
Operation	3 keys, ring controller
Interface	USB 2.0
Interface protocol	Disclosed
Memory	Micro SD, 8 GB
Memory mode	Manual, auto
Data format	CSV

Miscellaneous

Mains power pack	100 to 240 V (50/60 Hz), 0.15 A 5 V, 1 A (DC)
Power supply via USB port	■
Rechargeable battery	Li-Ion 3,7 V - 890 mAh
Automatic shutdown	Programmable, display and device
Rechargeable battery life	≥ 8 h continuous operation
Charging time with charger	1.5 h
Operating temperature	5 to 40 °C
Dimensions [H x W x D]	139 x 60 x 30 mm
Weight	200 g
Scope of Delivery	Case, wallet, rechargeable battery, USB cable, power pack, carrying strap, 8 GB micro SD card
Optional Accessories	
Replacement rechargeable battery	Li-Ion 3,7 V - 890 mAh Article number V070A

Specifications subject to change without notice

GOSSEN Foto- und Lichtmesstechnik GmbH | Lina-Ammon-Str. 22 | 90471 Nürnberg | Germany
Tel: + 49 (0) 911 8602 - 181 | Fax: +49 (0) 911 8602 - 142

www.gossen-photo.de