We bring quality to light.

LGS 1000
Goniophotometer

Instrument Systems

KONICA MINOLTA Group

Key features at a glance

- Goniophotometer with C,γ coordinate system for large LED modules, lamps and luminaires
- For samples up to 2 m in diameter and 50 kg weight
- Accessible steps facilitate mounting of samples
- Precise determination of photometric, spectro-radiometric, and colorimetric quantities
- Innovative correction procedure for position-sensitive samples

Light measurement – on a large scale

The LGS 1000 is ideal for the analysis of angle-dependent spatial radiation characteristics of large LED modules, solid-state lighting (SSL) products and conventional lamps and luminaires. It can be operated together with a photometer as a conventional goniophotometer or with a spectrometer as a high-quality goniospectroradiometer. This allows all important performance characteristics such as luminous intensity distribution curves, luminous flux, color coordinates and even color rendering index to be measured with maximum precision.

In combination with a photometer, fast “on the fly” measurements allow the spatial light distribution of the test specimen to be determined within a very short space of time.

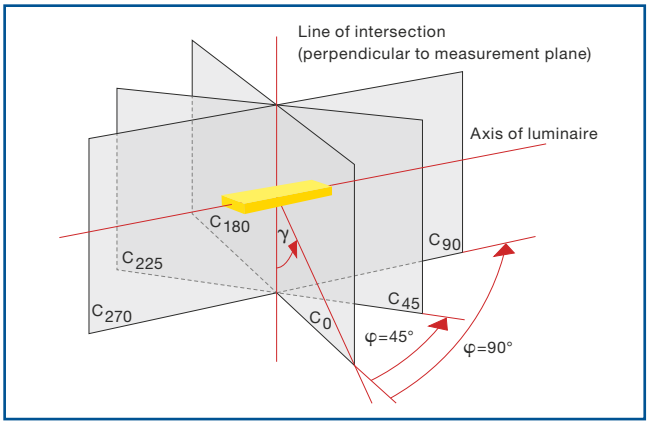
A comprehensive software package facilitates easy evaluation and reporting of the measured data.

The goniometer unit

The construction with horizontal optical axis in conformity with the C,γ coordinate system (CIE 121-1996) makes the LGS 1000 a very compact test station for angle-dependent characteristics. Although the instrument has impressive dimensions, it can be accommodated in a laboratory with a standard ceiling height. This is a distinct advantage compared with large-scale and complex rotating-mirror goniophotometers. The LGS 1000 rotates the test specimens in the gamma and C axes. The angular range of the fully rotatable C axis is from -90° to +270°. The gamma axis can be rotated by +/-165°.

Two synchronously controlled servo motors with precision angle encoders permit a very fine angular resolution of 0.01° and they ensure simultaneous and low-vibration movement of both axes. The reproducibility of the sample positioning is better than 0.1° at nominal load.

The complete goniophotometer unit is coated in black in order to avoid surface reflections.



Definition of the C,γ coordinate system

Sample table and electrical connection

The LGS 1000 accommodates samples up to a diameter of 2 m and a maximum weight of 50 kg. The sample table measures 210 mm x 210 mm and can easily be reached using accessible steps on the goniometer. It is fitted with 3 x 3 size 6 grooves. Different thread inserts and fitting bushes facilitate reproducible and safe fixing of the test specimen. This allows easy and quick mounting of customer-specific sample holders.

Adequate connection options are provided for electrical contact with the test samples, as well as for separate probe lines and a temperature sensor. An additional sub-D socket serves as a digital interface for intelligent light management, e.g. DALI or DMX control.

Mounting plate with sample connection

The mount with the connections is rotated together with the sample during measurement. Short connecting cables can therefore be used for unobstructed test runs. This prevents the cables from being ripped out while the axes of the goniometer are moving.

Positioning of the test sample

The adjustable Z axis is used to position the test specimen precisely at the goniometric center. A smooth-running hand crank and integrated alignment lasers at the center of rotation of the gamma and C axis allow precise and easy positioning of the test sample.

The RecoCAN optional remote control can be used for easier positioning and fast alignment of the goniometer on the optical axis of the test specimen.

LGS Controller and rack

The LGS Controller is integrated in a separate 19” rack and serves as driver of the goniometer. It controls the automated sequences as well as the manual positioning of the goniometer axes. The current angle position, the operating status of the axes, and the current measured value from the photometer are displayed in lux or candela. The rack offers adequate space for the necessary power supply and other measurement and control units.

Rack with control unit, power supply for the test specimen and power meter

The Safety Controller is also integrated in the rack and guarantees the necessary safety for operating the LGS 1000. It is used to activate the drives and to toggle between automatic and manual mode. In addition, the Safety Controller operates the optional optical safety system, comprising two laser scanners integrated in the steps of the goniometer. The scanners allow individual adjustment of the protected area to match the customer’s specific environment.

The entire world of measurement options

The goniometer unit can be used with a spectroradiometer or a photometer to suit the specific measurement task to be performed. This combination is recommended by the relevant guidelines for precise measurements of solid-state lighting products.

Spectroradiometric measurements

A spectroradiometer is essential for spectral characteristics such as CRI and color coordinates. The large dynamic range makes the array spectrometers in the CAS series ideal for this purpose. The measurement system is supplemented with optical probes from the EOP series. They are calibrated together with the spectrometer in the ISO 17025 certified laboratories of Instrument Systems.

CAS 140CT spectroradiometer with optical probe from the EOP series

Spectroradiometers offer the distinct advantage that all the characteristics – radiometric, colorimetric and photometric – can be determined with maximum precision.

Photometric measurements

Instrument Systems also supplies very fast photometers for performing integral measurements. They are recommended for pure photometric measurements and for time critical test sequences. The photometers are compliant with the highest class of accuracy in conformity

Photometer with DSP 10 measurement amplifier

with DIN 5032-7 (class L) and feature outstanding V(λ) correction (f_1' <1.5 %) and very high linearity. Combined with the LGS 1000, the photometers allow “on-the-fly” measurements, meaning the measuring system records the light distribution while the goniometer is moving. The digital signal processing of the measurement amplifier ensures optimum adjustment of the integration and filter parameters during the recording. Thus, the overall measuring time is significantly reduced even at a high angular resolution. This saves valuable time in the daily laboratory routine.

Accessories for test setups

Instrument Systems supplies a separate stand with a holder for a stray light tube in order to arrange flexibly configurable test setups. The tube minimizes undesired extraneous light and is supplied in two different versions.

A tube with ±4.5° viewing angle was developed for measurements of the luminous intensity distribution curve in the far field. A version with a ±30° opening angle is supplied for luminous flux measurements in the near field. The tube can be easily aligned and correctly positioned on the optical axis of the test specimen with the assistance of the alignment laser along the C axis of the goniometer. It can be fitted with an optical probe for use with a spectroradiometer and with a photometer head.

Stray light tube on stand

Power supply and control of samples

Instrument Systems has developed a turnkey solution to drive and measure the samples. A high-quality measurement device for recording electrical characteristics is supplied as well as AC power supplies in different classes. The LGS SwitchBox connects the instruments integrated in the rack with the test specimen connector terminal on the sample plate. It also allows the connection of customer-owned power supplies and power meters to the goniometer and additionally offers various options for switching between different units.

LGS SwitchBox for connecting to the sample supply terminal

The LGS SwitchBox offers the following functions:

- Connection of system-integrated and customer-supplied AC power supply units and power meters
- Switching between the two sample terminals at the sample plate
- Switching to the sample terminal of the optional luminous flux integrator
- Connection options for user-specific control signals (e.g. DALI or DMX) and a temperature sensor for monitoring the test specimen

Correction of the burning position

The LGS 1000 also supports the measurement of samples that are position sensitive with respect to their required burning orientation. Instrument Systems has developed an optional accessory for this purpose. A special adapter is fixed to the mounting plate and permits correction data to be determined using the auxiliary photometer method, in conformity with the EN 13032-4 standard. If a low-maintenance goniophotometer system with a compact footprint is a top priority, the LSG 1000 together with correction of the burning position provides a genuine alternative to a large and expensive rotating-mirror goniophotometer.

The special design of the adapter permits a change in the burning position of the sample even when it is switched on. The corresponding correction measurements can then be carried out without interruption. This approach achieves a high level of accuracy for the measurements and cuts down valuable measuring time because a renewed burn-in period for the test specimen is not required.

Easy operation is facilitated by a special application in the SpecWin Pro software controlling the correction process. The storable correction files can be reused at any time for test specimens of the same design with a similar spatial radiation pattern.

Measurement of photometric and colorimetric spatial radiation patterns

The angle-dependent measurement of photometric parameters is extremely important for the lighting industry. Comprehensive optical characterization of SSL products in particular include measurements of luminous intensity and illuminance distributions, as well as analyzing any potential angular variation in the correlated color temperature or color coordinates.

Instrument Systems supplies a wide range of accessories with the LGS 1000 and comprehensive software for this application. The system is ideal for the specification and classification of solid-state lighting products. In particular, this applies to characterizations of position-sensitive samples with the possibility of correcting the measurement results according to a fixed burning position.

Measurement setup and photometric distance

The photometric distance must be maintained when measurements of luminous intensity distributions are made. The required distance changes with the size of the test specimen. A variable adjustment of the length of the measuring path is achieved using the separate stand with a stray light tube. The stand is set up at an appropriate distance from the goniometer unit and can be anchored to the laboratory floor when necessary.

The stray light tube for measurements of angle-dependent distributions in the far field has an opening angle of ±4.5°. It covers the full size of the sample when the photometric distance is maintained and minimizes any undesired stray light. This guarantees maximum user friendliness and reduces the risk of maloperation.

The photometric distance

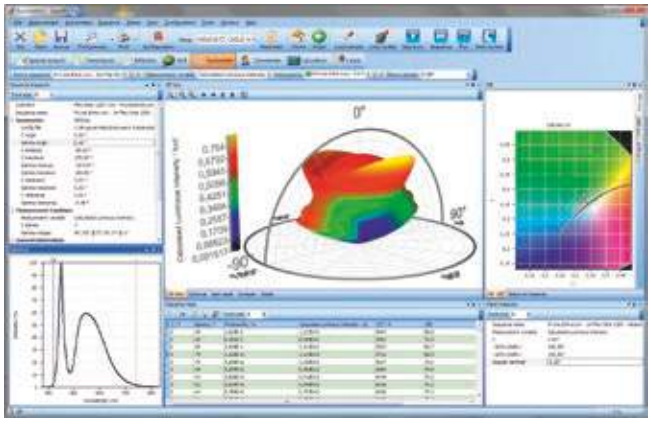
- According to the definition, the distribution of luminous intensity must be measured at a distance where the sample can be considered as an approximated point light source. The distance of the detector from the test specimen required for conformity with this criterion is known as the photometric distance. It varies with the size of the light source to be measured.
- The minimum factor, given by the ratio of the distance to the detector and the maximum extent of the test object, varies between 5 and 15 depending on the applied standard and the prevailing spatial radiation pattern.

Control and evaluation with SpecWin Pro

The LGS 1000 is operated via the goniometer module of the SpecWin Pro software. Two measurement processes are available, the sequence mode and the measurement series mode.

In the sequence mode, the spatial radiation pattern of the test specimen is recorded at specific angular increments on both axes (gamma and C). The angular range and the increments can be independently determined. However, the complete measurement is always carried out at the same intervals.

The measuring series mode, on the other hand, permits measurements to be carried out in any definable angle sequence. Larger and smaller intervals can be selected within a specified angular range.

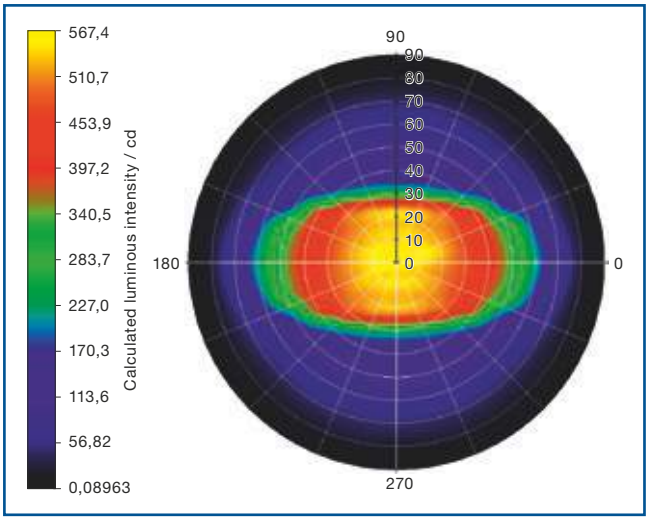


Goniometer module of the SpecWin Pro software

In both cases, the software controls the power supply to the test specimen and records electrical data. Voltage, current, switch-on and burn-in procedure as well as the sequencing are storable presets and can be retrieved for repeat measurement functions, for example the test in conformity with the European Ecodesign Directive and energy labelling.

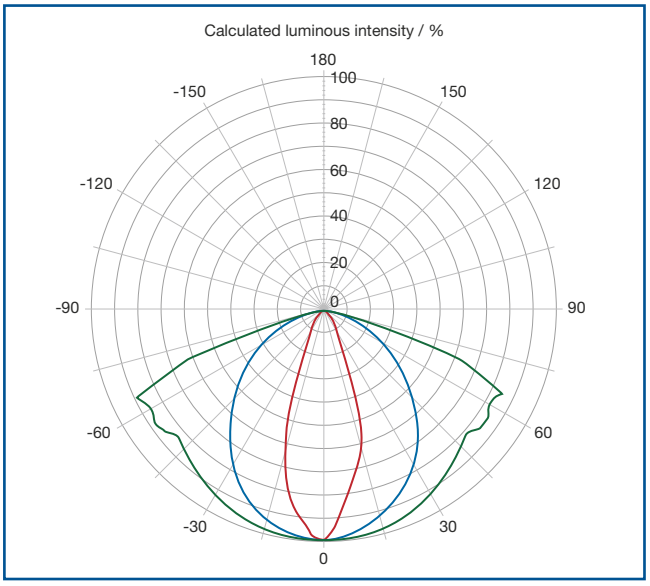
Display options for measurement values and output formats

The SpecWin Pro software offers five different display options for spatial radiation patterns: radial, semi-radial, Cartesian, spherical and 3-D. All photometric, radiometric, colorimetric and spectral measurement data can be presented in each display format.



Luminous intensity distribution in spherical display

The evaluation and processing of the measured data is exceptionally flexible and versatile. Apart from the option of adjusting the graphical user interface to the relevant application, an export manager is also available for preparing custom test reports. The test reports can be configured to match the user's requirements. Most importantly, the relevant formats for the lighting industry, such as IES and EULUMDAT, can be generated for use in simulation programs.



Luminous intensity distribution curves for different LED modules

Goniophotometric luminous flux integration – versatile and very precise

The most precise method for measuring radiant power or luminous flux is provided by integration of radiant intensity or luminous intensity using a goniophotometer. This is the method of choice for the leading national metrology institutes. It is the baseline for calibrating luminous flux standard lamps which provide the reference values for other test procedures.

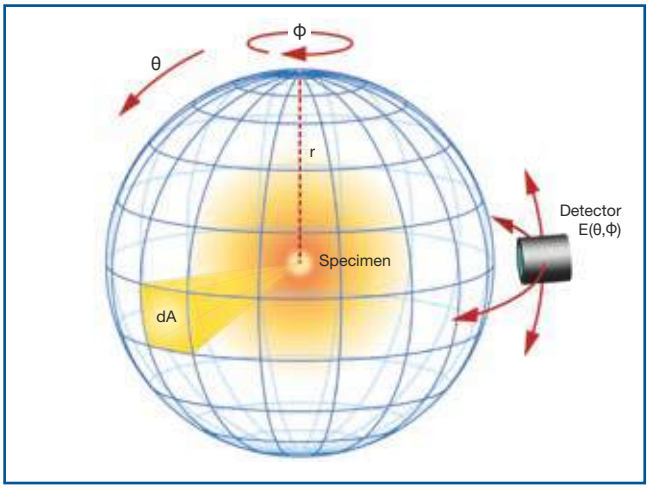
Goniophotometry

Although measuring luminous flux with a goniophotometer is more time-consuming compared to using integrating spheres, it is much more precise. This method aggregates the individual spectra of all angle positions of the distribution. It provides genuine integration of the entire spectral radiant power and therefore also guarantees exact calculation of colorimetric characteristics. The absolute measuring procedure does not require luminous flux standard lamps as a reference value as it is the case when integrating spheres are used.

$$\Phi = \int_A E \, dA = r^2 \int_{\Phi=0}^{2\pi} \int_{\theta=0}^{\pi} E(\theta,\Phi) \sin\theta \, d\theta \, d\Phi$$

E(θ,Φ): measured illuminance, Φ: luminous flux, r: distance of sample to detector

A goniophotometer is cost-effective if the characteristic luminous intensity distribution and luminous flux are equally important, for example in general lighting scenarios. It is also an advantage if lamps with different luminous intensity distributions have to be measured or even calibrated.



Measurement of luminous flux by integration over illuminance E

It is indeed absolutely essential if characteristics such as partial luminous flux or angle of half intensity need to be determined at light sources, as is the case when measuring the characteristics relating to energy efficiency.

Measurement of luminous flux in standard configuration

The LGS 1000 can be used to measure the luminous flux even in standard configuration. The luminous flux is calculated from any measured sequence. An additional near-field stray light tube is supplied that permits fast measurements for applications where only luminous flux is important. The tube has a field of view of ±30° and can therefore be positioned very close to the goniometer while also guaranteeing full coverage even for large test specimens. In addition, it ensures efficient suppression of undesired stray light.

Luminous flux integrator

The luminous flux integrator is an optional accessory that offers the possibility of determining the total luminous flux of lamps and modules in their required burning position within a compact setup. The position of the sample remains unchanged during the measurement and the detector moves around the test specimen on a spherical envelope surface.

LGS 1000 with luminous flux integrator

The luminous flux integrator offers an array of advantages. It makes the measurement of luminous flux faster, easier, and takes the prescribed burning position into account.

Where small light sources are being analyzed, luminous intensity distribution curves, as well as photometric and colorimetric spatial radiation patterns can also be measured in independently configurable burning positions.

Luminous flux integrator with photometer and spectroradiometer

Two alternative versions of the luminous flux integrator can be supplied to match the specific measurement task.

The first version uses a fast operating photometer as a detector and is cost-effective. The second version combines photometer and spectrometer to offer the full range of options. It provides the speed of the photometer while also enabling the extremely precise spectroradiometric calculation of all characteristics.

Similar to the standard configuration, the test specimen can be supplied from an AC current source and electrical characteristics can be measured with an integrated power meter when the luminous flux integrator is used.

Technical specifications

Specification	Description
Goniometer	
CIE goniometer type	C,γ coordinate system with horizontal optical axis
Drivers	Synchronous servo motors with angular encoders
Angular range C axis	-90° to +270°, protection with end switches
Angular range γ axis	±165°, protection with end switches
Resolution of the angle encoder	0.01°
Reproducibility C axis	≤0.1° (at rated load) ; ≤0.2° (under max. load)
Reproducibility γ axis	≤0.1° (at rated load); ≤0.1° (under max. load)
Angular speed C axis	3.1°/s to 50°/s selectable (16 speeds)
Angular speed γ axis	1.8°/s to 30°/s selectable (16 speeds)
Travel range Z axis	50 to 500 mm via hand crank (integrated measuring scale in mm)
Clear height	1005 mm
Dimensions (H x W x D); weight	1852.5 x 1492 x 1798 mm; 660 kg
Height of work area for mounting	421.5 mm (height of second step above the floor)
Height adjustability	±25 mm above adjustable feet
Radius of action	2000 mm
Minimum room height for operation of system	3000 x 3000 mm (minimum safety area); 2700 mm room height
Alignment laser	Integrated in the center of rotation of the γ and C axis, 1 mW, laser class 2
Machine safety	Emergency stop switch on goniometer/LGS Controller; optional safety laser scanner
Power supply; power consumption	230 V AC / 50 Hz; max. 1000 VA
Height for operation	0 - 2000 m
Sample table	
Mounting plate	210 mm x 210 mm with 3 x 3 grooves size 6; also various inserts with tapped threads
Maximum sample size	1000 mm maximum extension from the center point of the mounting plate
Rated and maximum load range	to 30 kg / to 50 kg
Electrical sample connection	2 x 2 safety banana sockets 4 mm for specimen power supply; max. 600 V, 10 A 2 x 2 safety banana sockets 2 mm for probe cable; max. 600 V, 0.5 A 2 safety banana sockets 4 mm for protective conductor Safety banana socket for thermal probe connection (Force/Sense and Screen); max. 50 V 9 pole Sub-D socket; data line for control signals (e.g. DALI, DMX, CAN); max. 50 V
LGS Controller	
Functions	Driving the servo motors of the goniometer; display of the angle positions; optional display of measured values for the photometer
Interfaces	RS232-C for connecting a PC; CAN Bus for DSP photometer and remote control RecoCAN
Power supply and consumption	230 V AC / 50 Hz; 120 W
Dimensions (H x W x D); weight	approx. 133 x 482 x 370 mm plus 130 mm for rear-panel connections; approx. 7 kg
Safety Controller	
Functions	Main switch, enabling of the motors, Emergency Stop switch, changeover of operating modes
Interfaces	CAN Bus for goniometer and LGS Controller, power supply goniometer, 15 pole Sub-D for Emergency Stop, 25 pole Sub-D for safety, 2 power sockets
Power supply and consumption	230 V; max. 2000 VA
Dimensions (H x W x D); weight	133 x 482 x 370 mm plus 130 mm for rear-panel connections; approx. 7 kg
Control cabinet	
Functions	19” control cabinet for Safety and LGS Controller, and option test specimen power supply
Dimensions (H x W x D)	Approx. 1700 x 550 x 600 mm
Weight	approx. 50 kg
Miscellaneous	
Valid standards	EN 61326-1, EN 61000-3-2, EN 61000-3-3, EN 60204-1, EN 61010-1
Ambient conditions	+10°C to +40°C; 70 % rF not condensing

Ordering information

Order no.	Description
Goniometer	
LGS1000-100	LGS 1000 Goniometer based on C,γ coordinate system with horizontal optical axis; separate 19” rack with control and monitor modules; without photometer or spectroradiometer
Options	
LGS1000-150	Safety system for CE conformity of the LGS1000-100; comprising two laser scanners integrated in the base unit
LGS1000-300	Optional 100 - 127 V AC power supply for LGS1000-100
LGS1000-320	RecoCAN remote control for manual angle positioning
LGS1000-330	Optional module LGS SwitchBox for electrical supply and taking measurements of the test specimen
LGS1000-580	Sample holder for measurements with correction of burning position
LGS1000-700	Sample holder for luminous flux integrator
LGS1000-710	Luminous flux integrator version for photometer
LGS1000-720	Luminous flux integrator version for photometer and spectroradiometer
Accessories	
LGS-415	Stand with mount for a stray light tube; height of the optical axis 1695 mm
LGS-440	Stray light tube with ±4.5° opening angle for measurement of luminous intensity distribution curves in the far field; for EOP 120 or photometer head
LGS-450	Stray light tube with ±30° opening angle for the measurement of luminous flux in the near field; for EOP 120 or photometer head
LGS-470	Rack for spectroradiometer CAS 140CT
AC current sources and power meters	
W-301	100 V / 115 V mains voltage for AC current sources with 250, 500 and 1000 W
W-302	240 V mains voltage for AC current sources with 250, 500 and 1000 W
W-310	AC current source 250 VA
W-310-1	AC current source 250 VA and expanded voltage range 0-500 V AC
W-320	AC current source 500 VA
W-320-1	AC current source 500 VA and expanded voltage range 0-500 V AC
W-330	AC current source 1000 VA
W-330-1	AC current source 1000 VA and expanded voltage range 0-500 V AC
W-410	Measuring unit for determining electrical quantities
Photometer	
LGS-610	Photometer comprising photometer head (10 x 10 mm detector aperture), class L in conformity with DIN5032-7, EN-DIN13032-1, CIE69; DSP measuring amplifier with digital signal processor for connecting to the LGS Controller; incl. mounting plate for stand
LGS-620	Cosine corrected photometer comprising photometer head (detector aperture 12 mm diameter), class L in conformity with DIN5032-7, EN-DIN13032-1, CIE69; DSP measuring amplifier with digital signal processor for connecting to the LGS Controller; incl. mounting plate for stand
CAL-630	Calibration in illuminance; incl. factory calibration certificate and verification of spectral correction of the detector
Spectroradiometer with optical probe	
CAS140CT-151	CAS 140CT Compact Array Spectrometer; Model VIS; 360 - 830 nm; 1024 pixel back-illuminated CCD detector; spectral resolution 2.2 nm (100 µm slit); 0.5 nm/pixel data point interval
EOP-120	Optical probe for irradiance; medium light throughput and cosine correction from 190 - 1700 nm; adapter for fiber bundle
OFG-414	Fiber bundle with ferrule; 1.5 mm ø; 2 m length; 380 - 1600 nm
PLG-410	Fiber bundle adapter; 300 - 2200 nm, optimized for VIS
CAL-100	Calibration of irradiance; wavelength range UV, VIS or IR
Software	
SW-130	SpecWin Pro spectral software; supports the spectrometers MAS 40, CAS 120, CAS 140CT/CTS, Spectro 320

Instrument Systems is continually working to develop and improve products. Any technical changes, errors or misprints do not form grounds for compensation. The company’s Terms of Delivery and Payment apply in all other respects.

We bring quality to light.

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KONICA MINOLTA Group

Instrument Systems GmbH
Kastenbauerstr. 2
81677 Munich, Germany
Tel.: +49 89/45 49 43-0
Fax: +49 89/45 49 43-11
Email: info@instrumentsystems.com
www.instrumentsystems.com

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