

RiGO801 - LED

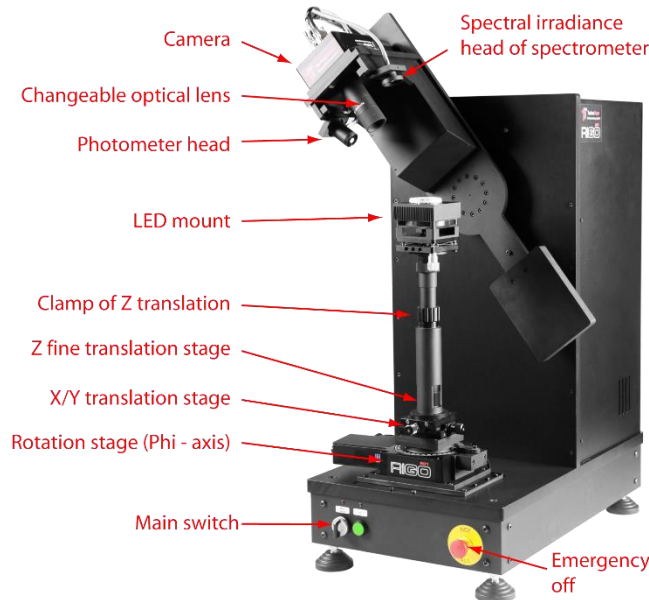


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1 RiGO801 – LED

The Goniophotometer series type RiGO801 utilizes a new image-resolving CCD measuring technique for determining ray data and luminous intensity distributions. The correct determination of the luminous intensity distributions (LID) of LEDs, lamps and luminaires is performed far within their photometric limiting distance on the basis of image-resolved measurements of luminous intensity distributions.



Our LED goniophotometer is especially designed to measure high precision ray data but also the far-field LID. The DUT is mounted on top of the vertical Phi – Axis that rotates 360 degree. The camera and photometer move on an arc bow.

The DUT position can be adjusted by precise x/y/z stages. The electrical interface between DUT mount socket and Phi-Axis is a 12-pin socket that offers also customer specific DUT mount sockets.

The goniophotometer is a compact self-standing device that can operate in a small room or a small black cabin.

Figure 1: Near-field goniophotometer RiGO801 for LEDs/OLEDs and modules, equipped with spectrometer (option)

1.1 Specifications

Goniometer mechanic	
Maximum size of test object:	≤ 200 mm (diameter of luminous area)
Space required:	WxDxH = approx. 900 x 700 x 1000 mm ³
Movement:	The measuring camera and the illuminance meter are moved on a circular path around the lamp (horizontal ϑ -axis). The lamp/LED itself is turned around a vertical φ -axis.
Measuring position of the test object:	Test object upstanding, rotated around vertical axis.
Measuring distance:	~160 mm
Travel path:	$\varphi = 0^\circ \dots 360^\circ, \delta = -143^\circ \dots 143^\circ$
Positioning accuracy:	$\varphi < 0.02^\circ, \delta < 0.05^\circ$
Repetitive accuracy:	$\varphi < 0.01^\circ, \delta < 0.02^\circ$
Ray data accuracy:	< 0.01 mm
Material	Aluminium, black anodised
Drives and Gears	High precision HarmonicDrive and Newport units

1.2 LED mount

The LED mount consists of a fan cooled heat sink, a leveling element and a fixable plug connection. The heat sink has a grid of threads for the fixing of the DUT, e.g. a LED-board. A 1-wire temperature sensor is situated in the center of the heat sink. The plug provides contacts for the DUT power, the sense lines, the fan supply, the 1-wire signal and USB interface for future purpose. All signals can be contacted at the back panel of the goniophotometer.

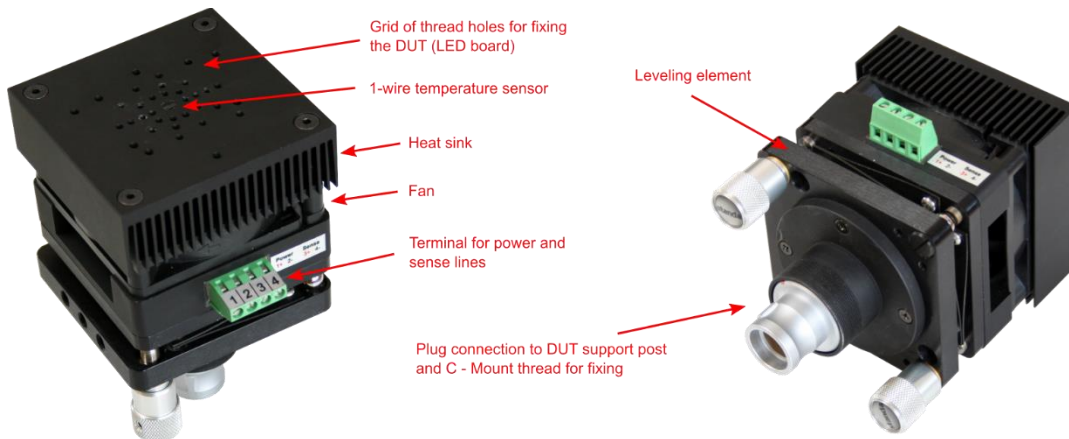


Figure 2: LED mount

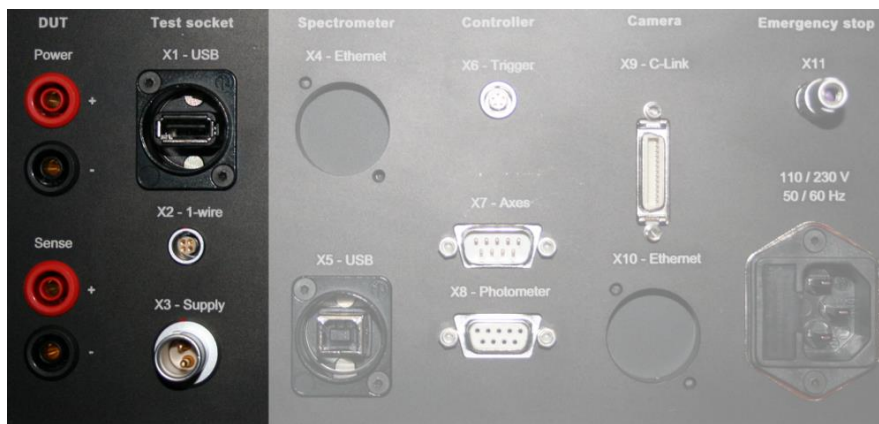


Figure 3: Back panel connections to LED mount plug

1.2.1 Heat sink and fan

Dimension	75 x 75 x 25 mm
Fan	ebm-papst 712F, 12V DC, air flow 44 m ³ /h
Temperature max.	60 °C

1.2.2 Thread grid

The inner thread pattern (M2 and M2.5 threads) has been designed to fit for all common LED boards. They are arranged as opposing pairs so that at least two screws can be used for fixing the board. Please refer to Figure 4 for details of the thread positions.

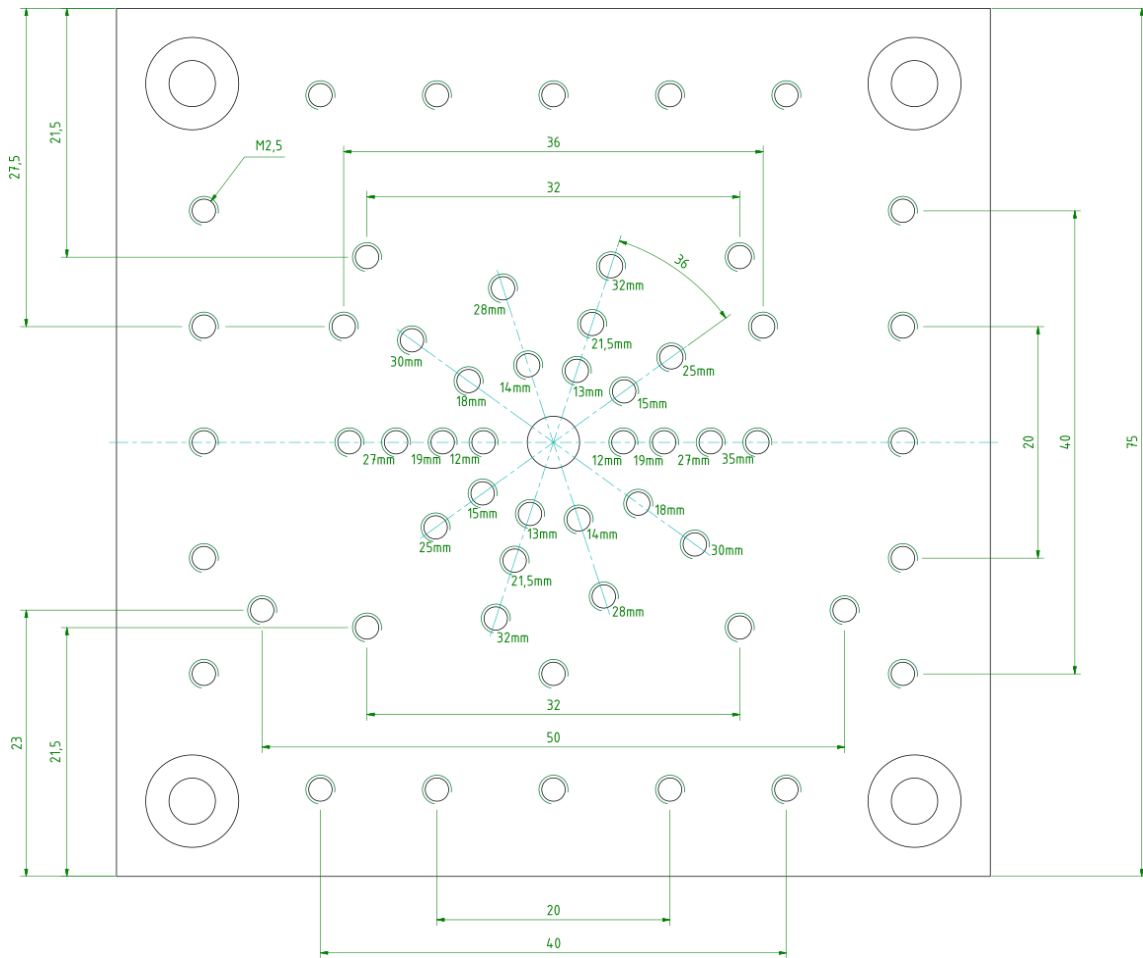


Figure 4: Grid of thread holes for fixing the LED board

1.2.3 Temperature sensor

Article description	18B20 (Dallas Semiconductor)	
Description	Digital thermometer sensor in T092 housing, communication via 1-wire Bus	
Temperature range:	-55°C to +125°C	
Resolution:	9 to 12 Bit	
Accuracy:	+/- 0,5°C (-10°C to 85°C)	

1.2.4 Plug

Type	12 pins, Lemo FAG.4B.312.CLA
Power lines	Maximum 60 V AC/DC / 12 A

1.2.5 1-wire USB adapter

Manufacturer: Eclo (<http://www.eclo.pt>)

Type: PN10000500011

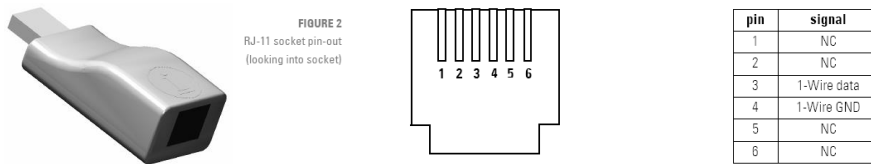



Figure 5: 1-wire USB adapter

1.2.6 Connector Pin assignment

	Socket (Goniometer): Lemo EGG.4B.312.CLL	Plug: Lemo FAG.4B.312.CLA
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Pin	Funktion	
1	Power +	Max. 60V / 12A
2	Power -	
3	Sense +	
4	Sense -	
5	Power Messfassung (+)	1-wire
6	Power Messfassung (-)	
7	1-wire Data	USB
8	1-wire GND	
9	USB VCC	
10	USB Data +	
11	USB Data -	
12	USB GND	
Earthing at plug housing		

1.3 Evaluation computer

- Advantech ASMB-787 ATX Motherboard, Rackmount 19"
- Intel® Core™ i7-10700E Processor
- 16 GB DDR4 2666MHz
- DVD-RW drive
- HDD WD RED 1TB
- SSD 512GB 3D NAND TLC
- Windows 11 Pro

2 Measuring components

2.1 LMK6 – 5 Image-resolving luminance measuring camera

The LMK 6-5 is a high quality luminance measuring camera with a 5 Megapixel CMOS image sensor. Each camera has a unique filter glass made for it, which ensures a high-quality $V(\lambda)$ -adaptation. The LMK 6-5 is robust in construction, lightweight and has compact dimensions. So, it can be used in almost every process for a wide range of lighting measurement tasks.

For RiGO801 measurements, the camera is used in different resolution modes for a flexible adaption of the field of view and pixel resolution. Real-time triggering enables precise positioning of the image recording.



Figure 6: LMK6 - 5

2.1.1 Base specifications:

Type	TechnoTeam LMK6-5
Sensor	Sony-CMOS [IMX 250 (2/3"); 12 Bit digital]
Resolution	2464 x 2056 Pixel
Interface	Gigabit Ethernet Interface(GigE ®)
Measurement quantities	Luminance: L (cd/m ²)
Metrological specification ¹	$V(\lambda)$ [f1' typical < 4 %]
Calibration uncertainty ²	ΔL [< 3% (for standard illuminant A)]
Repeatability ³	ΔL [< 0.1%]
Uniformity	ΔL [< 2%]

More information available on <http://www.technoteam.de>

¹ Measurements according to DIN 5032 Part 6/CIE Pub. 69

² Calibration according to DIN 5032 Part 6 using a luminance standard led back from the Physical-Technical Federal Institute

³ Measurement performed on a stabilized white LED light source L=100 cd/m². Mean value over 100 Pixel; repeatability as variability of the mean value

2.2 LMK6 – 5 color

The LMK6-5 color is equipped with a filter wheel for colour measurement, adapted to the CIE colour matching functions of the 2° standard observer (CIE 1931). Thus, luminances and colour coordinates can be measured in a spatially resolved way. The filter wheel permits a total of 6 filters to be incorporated, with 4 filters being necessary for colour measurement. In addition, the measuring system can also be equipped with filters for the scotopic luminance $V'(\lambda)$, the circadian function of action $C(\lambda)$, an IR-filter (measurements in the NIR range 780-1000 nm), a BLH (blue light hazard), or a clear glass filter .

For RiGO801 measurements, the filter wheel position can be selected by software for each measurement (ray data or (luminous) intensity distribution).



Figure 7: LMK6-5 color camera

2.2.1 Specifications

Basic specifications	Please refer to the base specification of the LMK6-5 above.
Measuring quantities	Luminance: L (cd/m ²), chromaticity coordinates: x,y, Supported colour spaces: RGB, XYZ, sRGB, EBU-RGB, User, Lxy, Luv, Lu'v', L*u*v*, C*h*s*uv, L*a*b*, C*h*ab, HIS, HSV, HSL, WST ⁴
Filter wheel	6 positions (x1, x2, y, z, glass, user defined)
Metrological specification ⁵	$V(\lambda)$ [f1' < 4 %], $X(\lambda)$ [f1' < 4 %], $Z(\lambda)$ [f1' < 6 %]

More information available on <http://www.technoteam.de>

2.3 Optical Lenses

2.3.1 Lens TT 6.5

- Focal length: 6.5 mm
- Aperture angle: ~54 deg
- Photometrically corrected (shading / flat-field)
- Distortion-corrected

2.3.2 Lens TT 35

- Focal length: 35 mm
- Aperture angle: ~8.2 deg
- Photometrically corrected (shading / flat-field)
- Distortion-corrected

⁴ Dominant wavelength, saturation, correlated color temperature

⁵ Measurements according to DIN 5032 Part 6/CIE Pub. 69

- This optical lens is used for the adaption to smaller test objects

2.3.3 Lens TT 60

- Focal length: 60 mm
- Field of view: 12x16mm (Goniophotometer RiGO801 – LED)
- Photometrically corrected (shading / flat-field)
- Distortion-corrected
- This optical lens is used for the adaption to smaller test objects

2.4 ND Filter set

- 6 ND Filters with transmissions from ~25 % ... ~0.02 %
- Filter thread 35.5 x 0.5 mm (RiGO – 300/600 and RiGO – LED)
- For RiGO – L: Special mount, Filter thread 49 x 0.75 mm

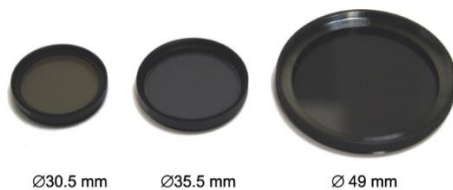


Figure 8: ND filter diameters

2.5 Photometer

2.5.1 Photo current amplifier MB13

- Manufacturer: Czibula & Grundmann GmbH (<http://www.photo-meter.de>)
- Current range: 0.1 pA to 1 mA
- Illuminance range (RiGO801 configuration): 0.7 ... 690000 lx
- Integration time: 10ms to 400ms
- Number of ranges: 13
- Linearity: < 0.1 %



Figure 9: Photo current amplifier

2.5.2 Photometer head VL-M2

- Manufacturer: Czibula & Grundmann GmbH (<http://www.photo-meter.de>)
- $V(\lambda)$ -calibrated $f1' < 1,5 \%$
- Cosine - adaptation $f2 < 1,5 \%$



Figure 10: Photometer head

2.6 Spectrometer JETI Specbos 1211E-2-LAN

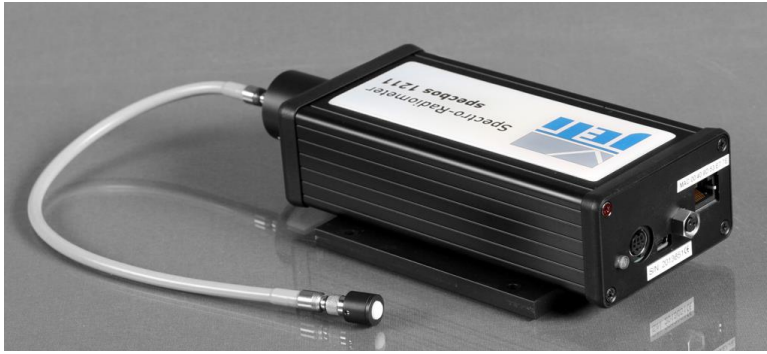


Figure 11: Spectrometer Specbos 1211E-2-LAN

2.6.1 Short specifications

Optical Parameters	
Spectral range:	350 nm - 1000 nm
Optical bandwidth:	4.5 nm
Wavelength resolution:	1 nm
Digital electronic resolution:	16 Bit ADC (15 Bit used)
Measuring values:	<ul style="list-style-type: none"> • Spectral irradiance⁶ • Chromaticity coordinates $x, y; u', v'$ • Correlated Color Temperature, color purity • CRI, TM30 • Circadian metrics, Photosynthetically Active Radiation
Measuring uncertainties (according to CIE TN 009:2019)	
Chromaticity accuracy	$\pm 0.002 x, y$ (Illuminant A, $k=2$)
Color reproducibility	$\pm 0.0005 x, y$ (Illuminant A)
CCT reproducibility	± 20 K (Illuminant A)
Wavelength accuracy	± 0.5 nm (HgAr line source)
Other technical data	
Interface:	Ethernet / USB
Dimensions	180 mm * 82 mm * 53 mm
Dispersive element	Imaging grating (flat field)

For the detailed technical specification, please refer to the web site:
<https://www.jeti.com/Products/Spectroradiometer/specbos1211-2>

⁶ For goniospectrometric application only spectral irradiance measuring head is used

2.6.2 *Cosine-corrected Irradiance Probe ACC 015*

The cosine-corrected irradiance probe ACC 015 is adapted to the spectrometer through a 300 mm optical fibre.

Diffusor diameter	7 mm
Barrel diameter:	12 mm



Figure 12: Irradiance Probe ACC 015

3 Software

3.1 RiGO801 base software



The measuring program RiGO801 offers the operator a comfortable setup and execution of the measurement.

3.1.1 Feature list

- Fast on-the-fly measurement
- Angular step sizes $0.1^\circ \dots 2.5^\circ$ (camera), $0.1^\circ \dots 90^\circ$ (photometer)
- Measurement of luminous intensity distributions with the camera in the case of large measurement objects in relation to the sensor distance (near-field mode) or with the photometer in the case of small objects to be measured (far-field mode)
- Easy alignment of the objects to be measured by means of the measuring camera. Image grid which can be activated, and metric coordinate system
- Saving in the TechnoTeam – format (.TTL), conversion into various standard formats (LDT, IES). Further processing of LID data by using LUMCat⁷.
- Capturing ray data, saving in the TechnoTeam – format (.TTR). Conversion into various standard formats using the Converter801 program.
- Protocolling the pole illuminances for stability monitoring (pole monitoring)
- Protocolling the stabilizing process and automatic start of the measurement
- Controlling the filter wheel of a color measuring camera (option)
- multi-channel measurements for colorimetric evaluations
- spectral ray file generation
- Data acquisition of external devices (e.g. power analyser, temperature sensors or data loggers)
- Synchronisation of external data acquisition software to the measurement by triggering
- Batch processing of several measurements
- Available languages: German, English

⁷ LUMCat is a software from the company Czibula&Grundmann (<http://www.photo-meter.de/index.php/de/>)

3.2 Goniospectrometer add-on for RiGO801 base software



Add-on for goniospectrometric measurements⁸ according to IES-LM-79-19, CIE S 024 / EN 13032-4

3.2.1 Feature list

- Measurements
- spectral flux (relative)
- xy and u'v' coordinates, Dominate wavelength, CCT, CRI, TM30
- color uniformity delta u'v'
- Export to various file formats (.csv, ASCII, .spectrum, ...)

3.3 Converter801 ray data generation software



The program Converter801 is used to process the TechnoTeam ray data files (.TTR). The conversion into various file formats with ray tracing on different target geometries is supported.

This software is free of license fees and can be used without any restrictions and transferred to any ray data users.

3.3.1 Feature list

- Generation of various ray data formats (TM25, ASAP, Optis, LightTools, LucidShape, Zemax, TracePro, Photopia)
- Generation of spectral ray files
- Visualization of all data contained in TechnoTeam ray files (ray data, luminous intensity distribution, luminance images, alignment of the object to be measured, stabilization protocol as well as the logged measurement data of external devices such as power analyser and temperature logger)
- Preparation of a universal TTR exchange files (Specification of conversion parameters, delete and edit internal information, integrating data sheets, reports or other data)
- Raytracing to basic geometries (sphere, cylinder, cuboid)
- Rotation and displacement of the ray data
- Integration of spectral information possible (spectral ray files)
- Recalculation of the luminous intensity distribution in other angular resolutions
- Calculation of near-field distributions
- Calculation of the virtual focus point of a ray file
- Output of the luminous intensity distribution in various formats (EULUMDAT, IES)
- Provision of customized formats possible
- Batch processing of conversion processes
- API for accessing the TechnoTeam ray data format
- Available languages: German, English

⁸ Option available in combination with spectroradiometer

4 Contact

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