TechnoTeam
Bildverarbeitung GmbH

801

RIGO

NEAR-FIELD
GONIOPHOTOMETER

Introduction

The near-field goniophotometers of the series **RIGO** 801 measure luminous intensity distributions, ray data, luminance distributions and spectral data of LEDs up to large luminaires. The measurements are enabled through a camera-based measuring technique in the case of which a luminance measuring camera is moved around the object to be measured, with the measuring distance being small. Thus, particularly compact measuring systems can be realized.

The luminance images recorded by the measuring camera are transformed into ray data widely used in optical simulation. The ray data are also transformed into the far-field luminous intensity distribution. Thus, the **RIGO** 801 goniophotometers perform the measurement tasks of classical far-field goniophotometers as well.

NEAR-FIELD GONIOPHOTOMETER

Advantages

- type C goniometer according to LM79
- object to be measured remains stationary and in its position of use*
- not linked to far-field condition
- high measuring speed due to on-the-fly measurement
- complete description of light radiation on the basis of the ray data
- luminous flux measurement with integrated photometer through integration of the illuminances (according to CIE87 and EN 13032-1, ...)
- direct luminous intensity measurement of small objects to be measured with the photometer in the far-field mode
- measurement of luminance distributions
- compact and light design
- export of ray data free of license fees

Result data

- luminous intensity distributions (LID) in all common formats (IES, EULUMDAT, TM14, Calculux, ...)
- luminous flux, light output ratio
- burn-in protocol, monitoring, power consumption, temperature profile
- processing and archiving of the LID data in a photometric database (LumCAT)
- ray data available in different formats (e.g. ASAP, Optis, LucidShape, LightTools, Zemax, TracePro, SimuLux, Photopia)
- acquisition of spectral data (color measuring camera and spectrometer)
- luminance and color images (option color measuring camera)

* except **RIGO** 801 **LED**

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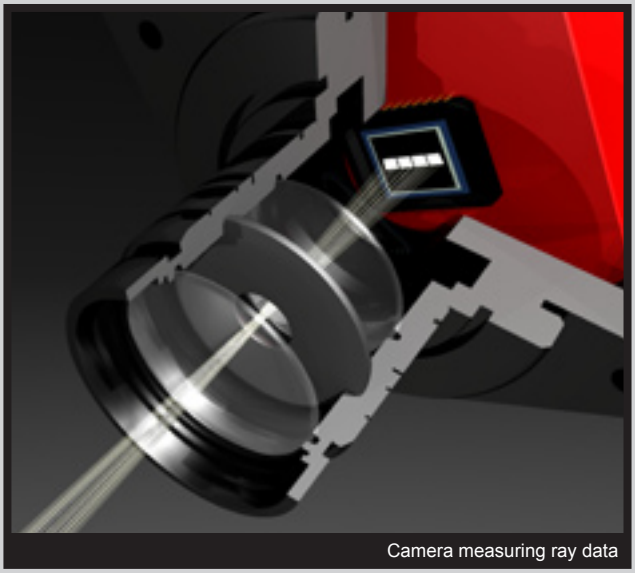
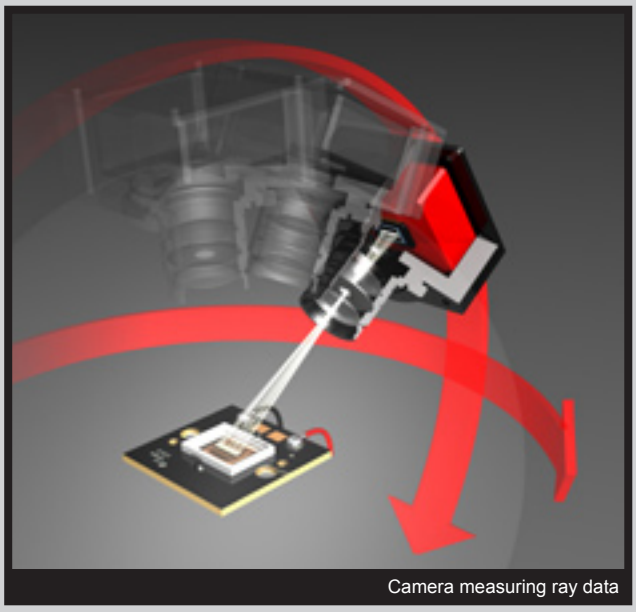
INTRODUCTION



Camera measuring ray data



Camera measuring ray data

Its place in photometry

For measuring photometric data, various goniophotometer systems are used. Fundamentally, a distinction is made between far-field and near-field goniophotometers. In the case of far-field goniophotometers, the photometric receiver/s is/are positioned at a large measuring distance beyond the photometric limiting distance. Near-field goniophotometers like the **RIGO** 801 series use a measuring camera positioned at a short measuring distance. They measure ray data and luminous intensity distributions (far-field data).

Concerning the structure of the goniometer units, the standards (CIE 121-1996, LM-75-01) differ between the following types:

1. Moving luminaire devices which rotate the object to be measured around two axes.
2. Goniophotometers which rotate the object to be measured around only one axis (e.g. moving mirror goniophotometer)
3. Goniophotometers which do not move the object to be measured, and which implement the positioning of the detector around the test item by means of two axes bedded one inside the other.

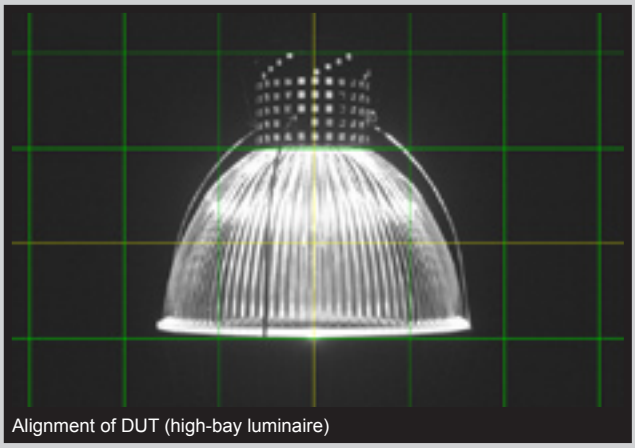
Concerning the luminaire reversing devices, the standard LM-75-01 differs – depending on the axis configuration - between two types (type A and type B) by combining type 2 and type 3 to type C goniometer. In the standard LM79, which is relevant for the LED lighting technology, a goniometer according to type C is required, i.e., no kinds of two axes moving luminaire devices at all are allowed.

Due to its vertical rotary axis with attached object to be measured, the **RIGO** 801 LED goniophotometer is of type 2., all other goniophotometers of the **RIGO** 801 series are of type 3. (stationary measurement object). All **RIGO** 801 goniophotometers correspond to the goniometer type C according to LM-75-01 and LM-79.

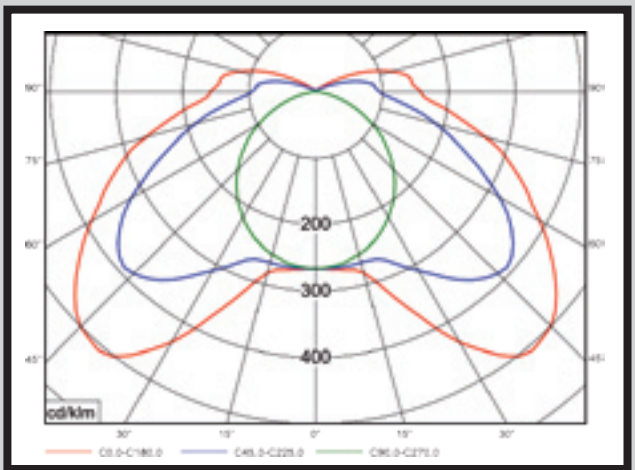
Luminaire and lamp measurement

For measuring large luminaires, the series of our type-C luminaire goniophotometers have been designed. Due to a maximum size of the measurement object (diameter) of 2000 mm, the **RIGO** 801 **2000** goniophotometers allow all common types of luminaires, lamps and LEDs to be measured.

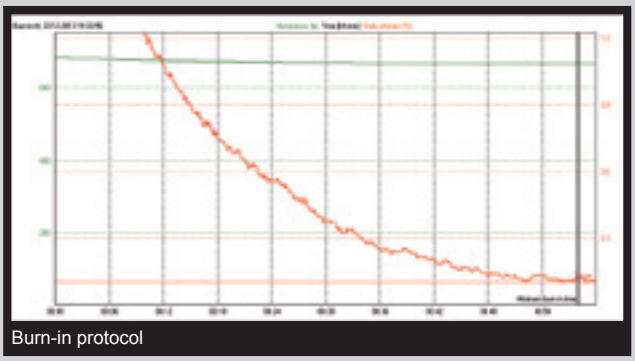
- Measurement of luminous intensity distributions and luminous fluxes of small lamps/LEDs up to large luminaires in one goniophotometer
- User-friendly alignment by means of the measuring camera
- Short measuring times and high angular resolutions (typical measuring times and angular resolutions 15min …1h, 2.5°… 0.5°)
- Automatic burn-in procedure
- Measurement of spectral parameters (option spectrometer)
- Evaluation, export, report generation and archiving using a photometric database



Alignment of DUT (high-bay luminaire)



LID polar diagram (office luminaire)



Burn-in protocol

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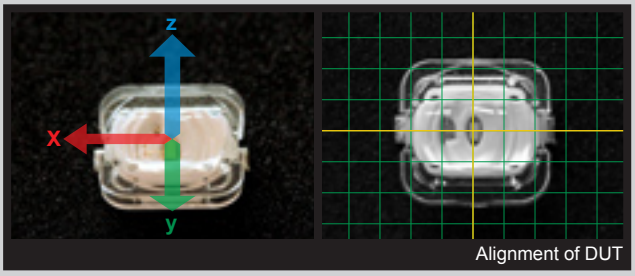
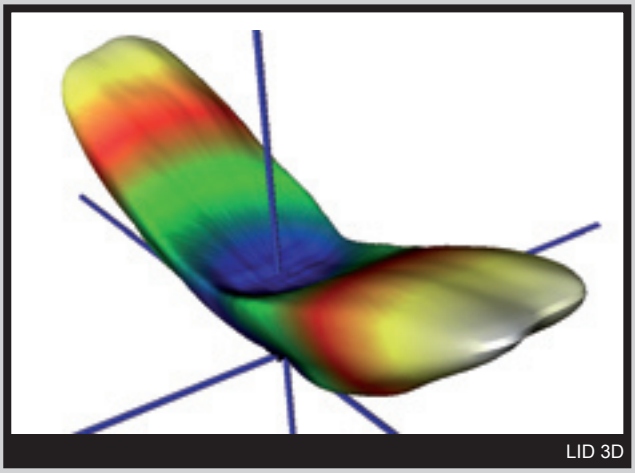
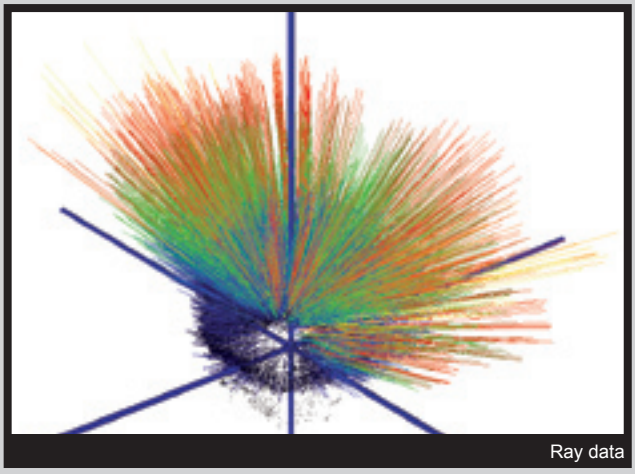
APPLICATIONS



Alignment of DUT


LID 3D


Ray data

Measurement of ray data

Ray data describe the complete radiation characteristic of a light source and are often used for simulating optical components. In many cases, ray data derived from mathematical / physical models describe the real light sources insufficiently, which makes measured ray data indispensable for the realistic simulation of optical components.

For measuring the ray data of LEDs and lamps, the smaller goniophotometer models have been designed. The result data can be output in all common ray data formats by means of a conversion program free of charge.

- Alignment of the objects to be measured by means of the camera and coordinate system displayed
- Measurement of high-resolution ray data at high measuring speeds (typical measuring times between 1h ... 4h, 1°...0.5°)
- Measurement using different spectral filters for generating spectrally resolved ray data
- Conversion of the compact **Techno**Team ray file format into various formats (ASAP, Optis, LightTools, LucidShape, Zemax, TracePro, SimuLux, Photopia)

Measurements according to the Zhaga standard

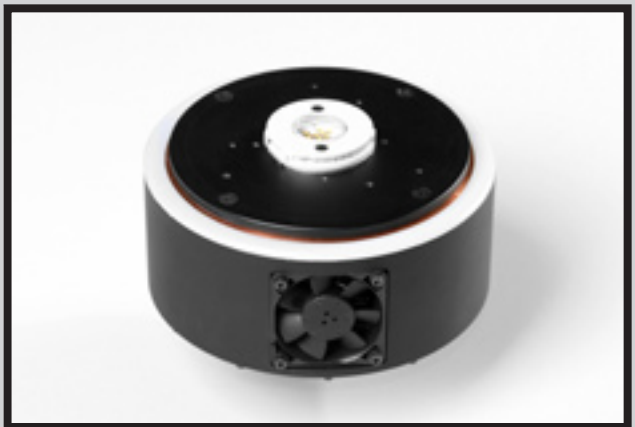
TechnoTeam Bildverarbeitung GmbH is

Zhaga

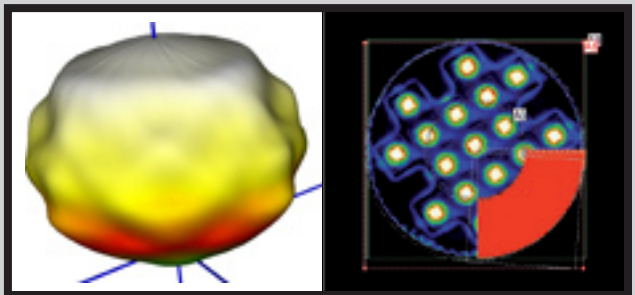
Associate Member

The Zhaga consortium develops specifications for the mechanical, photometric, thermal and electrical compatibility of interchangeable LED modules and ballasts. The photometric specifications also require the evaluation of image-resolved luminances. Thus, it can be said that the **RIGO** 801 near-field goniophotometers are ideally suited for this purpose.

- Measurement of the luminous intensity distribution and of the luminous flux of Zhaga modules
- Evaluation of the luminous intensity distribution
- Evaluation of the luminance distribution by means of a special **LMK** LabSoft macro and report generation



Zhaga module mounted on test socket



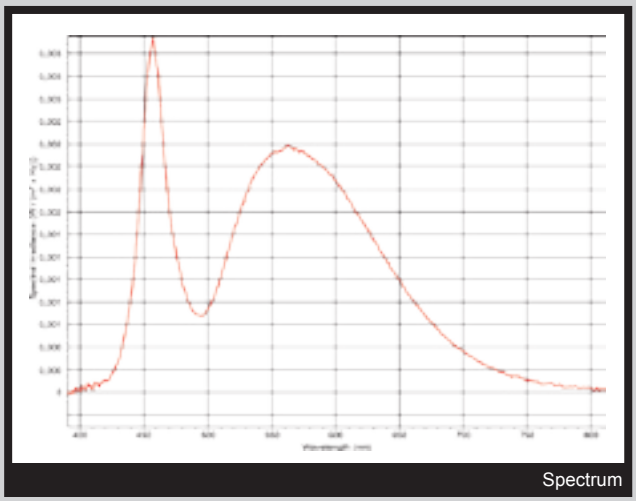
LID 3D / luminance evaluation

CIE Zone	Area	Measure	Min	Max	Result	MinBorder
FC1	0°-41,4°	48%	39%	56%	OK	7,7%
FC2	41,4°-60°	35%	31%	37%	OK	2,5%
FC3	60°-75,5°	16%	11%	22%	OK	5,0%
FC4	75,5°-90°	1%	0%	7%	OK	1,2%

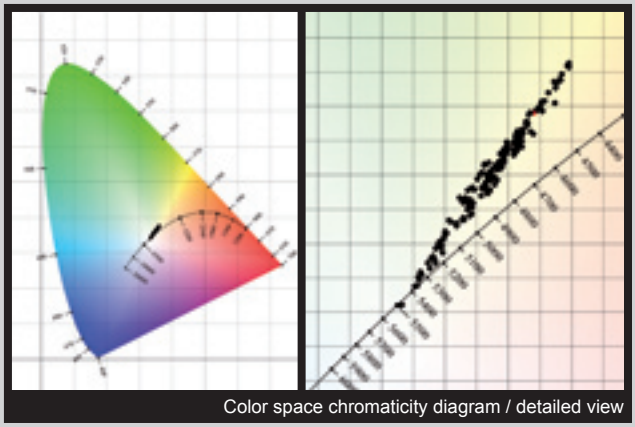
LID evaluation

APPLICATIONS

Spectrometer detector head mounted on RIGO 801 LED



Spectrum



Color space chromaticity diagram / detailed view

Spectrometer measurements

Particularly in the context of the increasing application of LED luminaires, spectral measurements are becoming more and more important. Standards concerning the measurement of LEDs (LM79, EN13032-4), include the measurement of spectral characteristics.

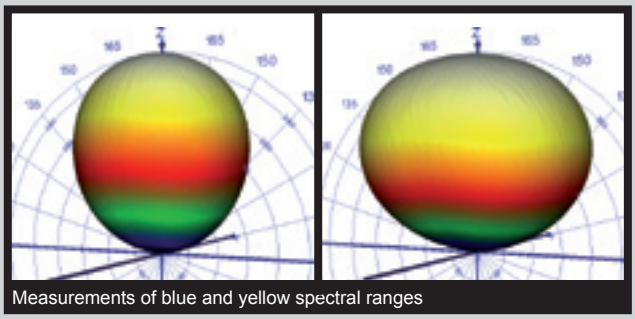
All RIGO 801 goniophotometer models can be equipped with a spectrometer so as to fit the measurement of spectral characteristics. In such a case, the RIGO 801 measurement program will be upgraded by a spectrometer software module.

- spectrometer software module for RIGO 801 measuring software
- automatic measurement of spectra on a configurable position list
- calculation of spectral characteristics according to LM79 and EN13032-4
- visualization of the spectra
- visualization in the CIE 1931 color space chromaticity diagram
- output in various file formats

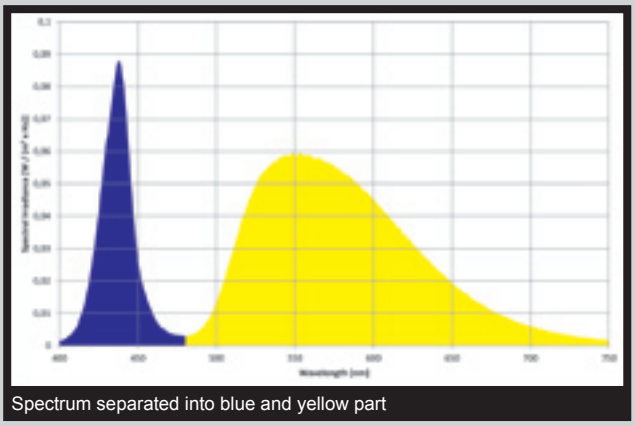
RIGO 801

Spectral ray data

For the physically correct simulation of dispersion effects, ray data must be spectrally resolved. As it is not possible to acquire image-resolved spectral data at reasonable expense (hyperspectral camera), the whole spectral range is split up into some few ranges by means of suitable spectral filters. For these ranges, ray data are measured separately, and spectral ray functions are assigned. This approach has proved to be successful particularly in the case of white LEDs. **RIGO** 801 goniophotometers can be equipped with a filter wheel camera (equipment with color filter set or according to customer requirements), thus making sure that the multichannel measurement runs automatically. Otherwise, externally mounted filters can be used.



Measurements of blue and yellow spectral ranges



Spectrum separated into blue and yellow part

GONIOMETERMODELS

RIGO 801 LED

RIGO 801 LED

Type C goniophotometer for LEDs and modules of a diameter up to 200 mm

The smallest goniophotomter of our product range is a compact desktop unit designed especially for measuring the ray data of small light sources, in particular of LEDs and LED modules of a diameter up to 200 mm. The object to be measured is mounted on a vertical rotary axis (phi). The camera and the other sensors, which are mounted on an arm, move around the measurement object on a circular arc (theta axis).

The light source is positioned by an x/y/z translation stage which displaces the upper rotary axis. The rotary axis is provided with a universal plug-in connector to which various measurement fixtures can be linked.

Due to the extremely high mechanical precision of the measured ray data, this goniophotometer is well suited for the ray data measurement of LEDs. Besides the ray data, also the luminous intensity distribution, the luminous flux and – optionally – some spectral data are measured as it is the case with all types of RIGO 801 goniophotometers.

Size of the device under test:

≤ 200 mm (diameter)

Required space:

LxBxH = approx. 700 x 700 x 1000 mm³

Movement:

The sensors are moved around the measurement object on a circular path (horizontal axis, theta). The object to be measured being in an upright position is rotated on a vertical rotary axis (phi).

Measuring position:

upright and vertically rotating

Position accuracy of the ray data:

< 0.01 mm

For detailed information about any components, please refer to the device specification: www.technoteam.de.

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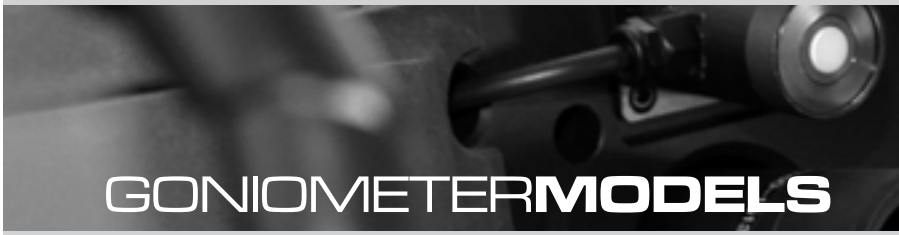


RIGO 801 300

Type C goniophotometer for LEDs, lamps and small luminaires of a diameter up to 300 mm

This free-standing type C goniophotometer has a maximum measuring volume of a diameter of 300 mm, and is well suited for measurement objects ranging from LEDs up to small luminaires. The measuring camera and the other sensors being mounted on two axes linked with each other are moved on a spherical surface around the stationary object to be measured.

The goniometer is mounted in an external frame in an entirely pivotable manner so that vertical just as horizontal burning positions can be set. This is particularly important for measuring automotive lamps as a stable horizontal burning position is urgently necessary here.

The high accuracy of the ray data measured allows the ray data measurement of light sources from the size of a power LED on (chip surface area from approx. 1x1 mm² on). The luminous intensity distribution and the luminous flux of much smaller light sources can still be measured as the measurement will then be carried out by the photometer in the far-field mode.

Size of the device under test:

≤ 280 mm (diameter of light-emitting surface)
≤ 300 mm (outside diameter)

Required space:

LxBxH = approx. 2000 x 1600 x 2200 mm³

Movement:

goniometer with two coupled axes

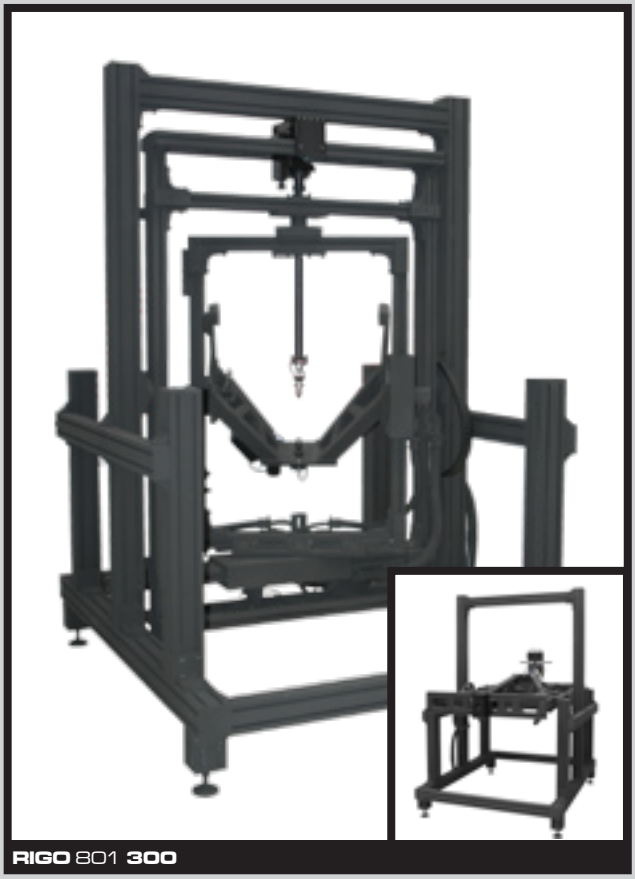
Measuring position:

stationary, burning position hanging, upright or horizontal

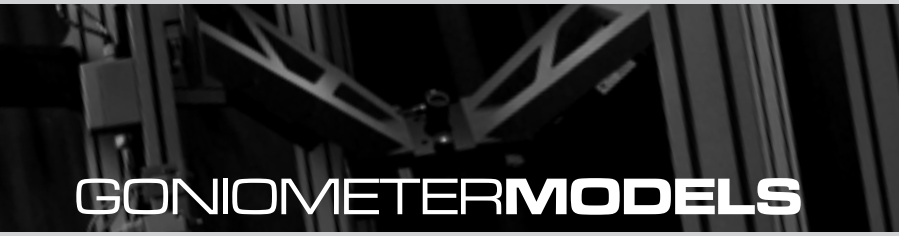
Positioning accuracy of the ray data:

< 0.05 mm

For detailed information about any components, please refer to the device specification: www.technoteam.de.



801 RIGO



GONIOMETER**MODELS**

RIGO 801 600

Type C goniophotometer for LEDs, lamps and small luminaires of a diameter up to 600 mm

This free-standing type C goniophotometer has a maximum measuring volume of a diameter of 600 mm and is well suited for measurement objects ranging from LEDs to small luminaires. The measuring camera and the other sensors mounted on two axes linked with each other are moved on a spherical surface around the stationary object to be measured.

The high accuracy of the ray data measured (< 0.1 mm) allows the ray data measurement of light sources of a size from a power LED on (chip surface area from approx. 2x2 mm² on). The luminous intensity distribution and the luminous flux of smaller light sources can still be measured as the measurement will be carried out by the photometer in the far-field mode.

Size of the device under test:

≤ 550 mm (diameter of light-emitting surface)
≤ 600 mm (outside diameter)

Dimensions:

LxBxH = approx. 2000 x 1600 x 2200 mm³

Movement:

goniometer with two coupled axes

Measuring position:

stationary, burning position hanging

Position accuracy of the ray data:

< 0.1 mm

For detailed information about any components, please refer to the device specification: www.technoteam.de.

RIGO 801 luminaires

Type C goniophotometer series for measurement objects of a diameter up to 2000 mm

The large goniophotometers can be employed for measuring LEDs up to large luminaires. They are available in different designs. The currently available standard designs (diameter of measuring volume) are 1400 mm, 1500 mm, 1800 mm and 2000 mm. The kind of device to be chosen mainly depends on the product range to be measured and on the size of the available laboratory room. Customized designs are possible at corresponding additional costs.

The goniometer mechanics includes an external, vertically rotating frame (phi – axis), in which a horizontally rotating arm is mounted (theta – axis). At the end of the internal arm, the measuring sensors are mounted. During the measurement, the object to be measured – which can be mounted either in a hanging or upright position - remains stationary.

In the case of these systems - as opposed to the smaller, self-standing goniophotometers - the external rotating frame must be fixed to a ceiling construction. For detailed information, please refer to our laboratory specification.

Size of the device under test:

depending on the model, between 1200 and 2000 mm, cf. specification

Required space:

depending on the model, required room height between 2800 mm and 4055 mm

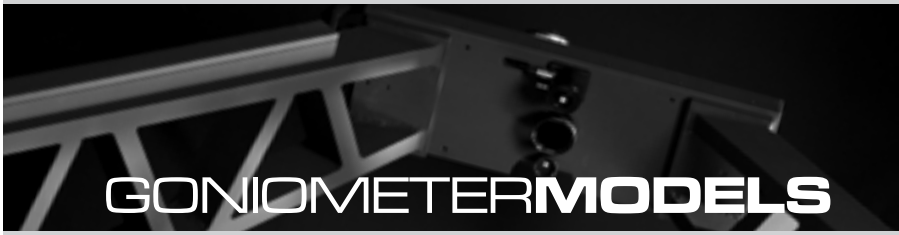
Movement:

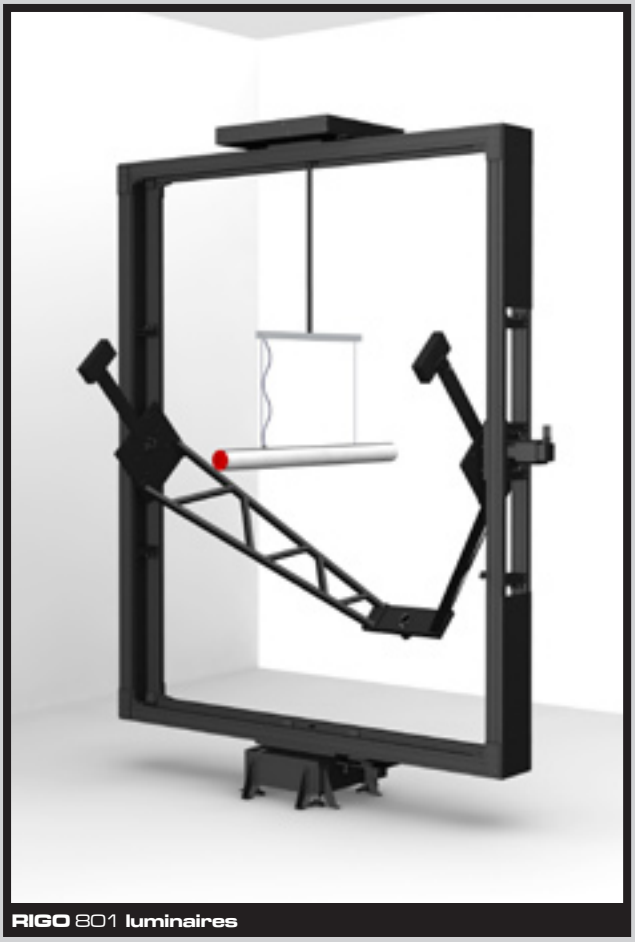
goniometer with two coupled axes

Measuring position:

stationary, burning position hanging or upright

For detailed information about any components, please refer to the device specification: www.technoteam.de.





RIGO 801 luminaires

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ACCESSOIRES

LMK / LMK color

Lense and filter case

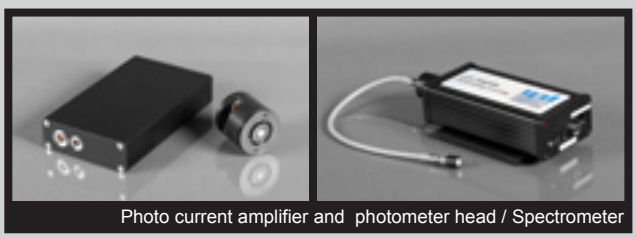


Photo current amplifier and photometer head / Spectrometer

Sensors

Measuring camera

- Luminance measuring camera **LMK** 98-4
- Optionally, color measuring camera (filter wheel)
- Interchangeable lenses, photometrically corrected, distortion corrected
- ND filter set

Photocurrent amplifier

- Czibula & Grundmann
- 13 measuring ranges
- Photocurrent 0.1 pA to 1 mA
- Linearity < 0.1%

Photometer head

- Czibula & Grundmann
- Class L
- f1' < 1,5 %, f2 < 1,5 %
- Illuminance range 0.7 … 690000 lx

Spectrometer

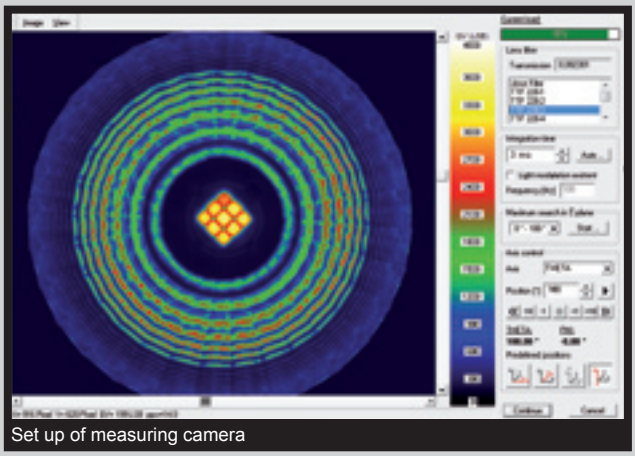
- JETI Specbos 1211-LAN
- Spectral range: 350 nm - 1000 nm
- Optical bandwidth: 4.5 nm
- Wavelength resolution: 1 nm

RIGO 801
Measuring program

Basic software for operating the goniophotometer

- Easy alignment of the objects to be measured by means of the measuring camera. Image grid which can be activated, and metric coordinate system
- 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)
- Saving in the **Techno**Team – format (.TTL), conversion into various standard formats (LDT, IES). The measurements will be evaluated using LumCAT.
- Angular step sizes 0.1° ... 2.5° (camera), 0.1° ... 90° (photometer)
- Capturing ray data, saving in the **Techno**Team – format (.TTR). Conversion into various standard formats using the Converter801 program.
- Spectrometer measurement (option)
- Protocolling the pole illuminances for stability monitoring (pole monitoring)
- Protocolling the burn-in process and automatic start of the measurement
- Controlling the filter wheel of a color measuring camera (option)
- Data acquisition of external devices (e.g. power analyzer or data logger)
- Synchronisation of external data acquisition software to the measurement by triggering
- Batch processing of several measurements


Guided measurement setup steps / setup of angular range and resolution


Set up of measuring camera

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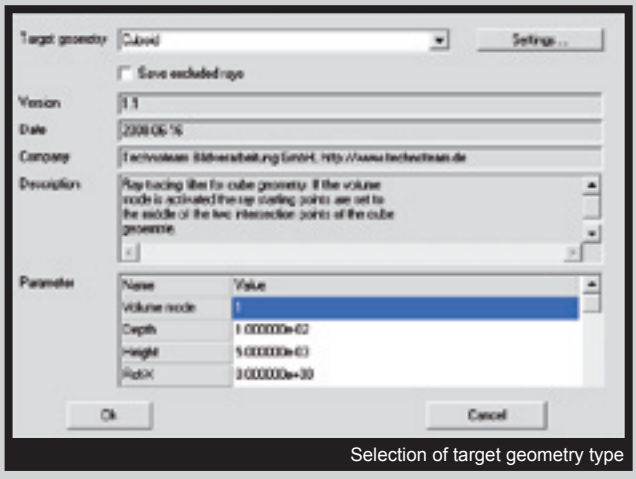
RIGO

CONVERTER 801

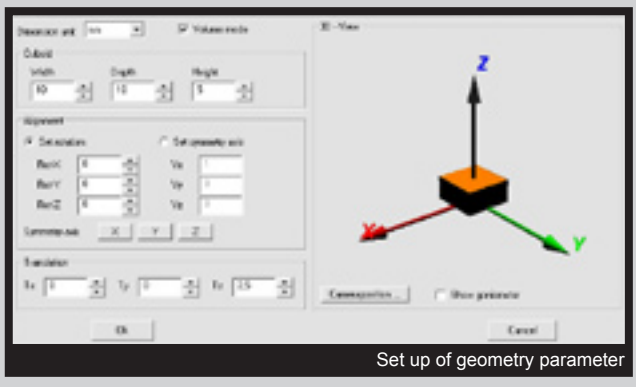
Generating ray data

- Visualization of all data (ray data, luminous intensity distribution, luminance images, alignment of the object to be measured, burn-in protocol as well as the logged measurement data of external devices such as power analyzer) contained in **Techno**Team ray files (.TTR).
- Generation of various ray data formats (ASAP, Optis, LightTools, LucidShape, Zemax, TracePro, SimuLux)
- Raytracing to basic geometries (sphere, cylinder, cuboid)
- Rotation and displacement of the ray data
- New calculation of the luminous intensity distribution in other angular resolutions
- 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

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



Selection of target geometry type



Set up of geometry parameter

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LMK LabSoft

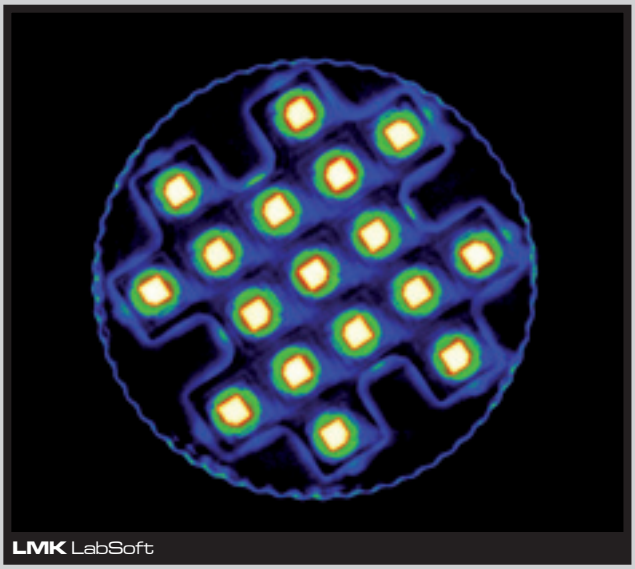
Measuring and evaluating luminance and color images

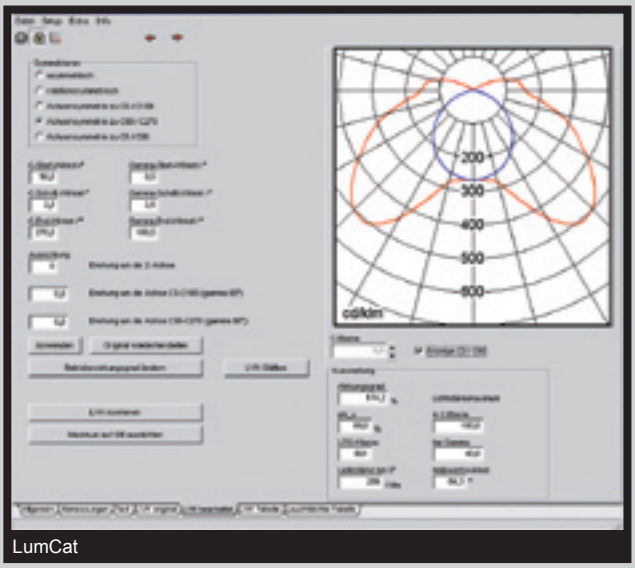
- Measurement of luminance images
- Measurement of color images (option color measuring camera)
- Control of goniometer axes, measurement series and position lists
- Extensive statistical evaluations
- Various visualization functions
- Script control and optional supplementary modules (display measurement, Zhaga, …)
- Report generation
- Programming interface (option)

LumCat

Photometry datenbase from Czibula & Grundmann GbR

- Conversion oft he LID data from the TechnoTeam format into other formats (IES, EULUMDAT, TM14, Calculux, …)
- System for managing and processing luminaire data (data base)
- Modification of all product information
- Different operations on the LID (rotation, symmetry, resolution)
- Graphs and analyses
- Report


LMK LabSoft



LumCat

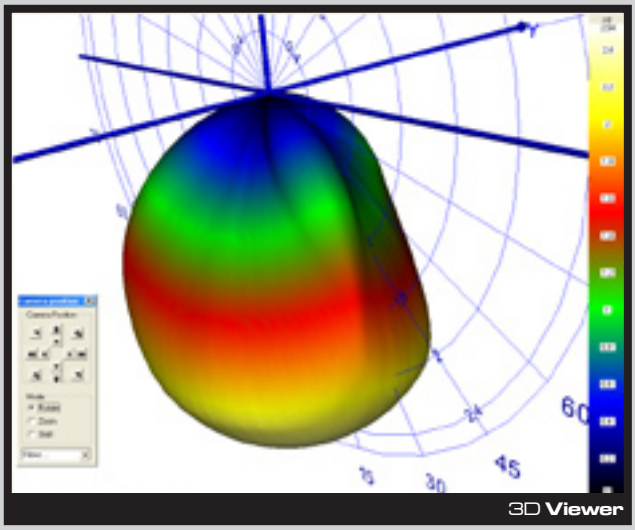
3D VIEWER

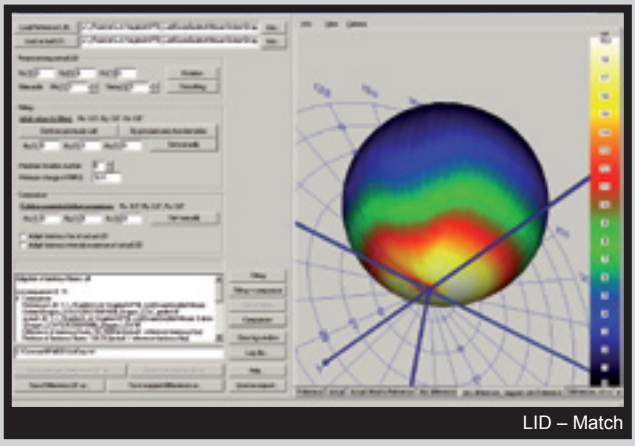
Program free of charge for the 3D visualization of luminous intensity distributions.

LID – Match

Software for the numerical and visual comparison of luminous intensity distribution curves

- numerical and visual comparison of luminous intensity distribution curves
- objective comparison independent from the user, from the measurement system generating LIDs and its parameterization
- quantifying the differences between LIDs by local and global distance measures
- optional preprocessing operations (smoothing, rotation)
- semi-automatic coordinate alignment of the reference- and the actual LID
- optional adaption of the luminous fluxes or the luminous intensities
- 3D-visualization of the LIDs and the LID-differences
- several variants of the color coding of the light intensity differences (surface mapping of differences)
- logging of the results


3D Viewer


LID – Match

Power supply and metrological equipment

For operating the light sources, power supply units (AC / DC) and the corresponding metrological equipment (power analyzer) are necessary. These devices can be integrated in the control cabinet already by the TechnoTeam staff and linked with the measuring software. In the following, a list of current choices is proposed which can be extended according to customers' wishes:

Power supply units

- AC power units types Elgar CW2501P / CW1251P / CW801P
- DC power unit type Delta Electronica SM 70-22-P183-P220

Power analyzers

- Yokogawa WT310 / WT500 / WT3000
- Fluke Norma4000
- ZES Zimmer LMG95

Other components

- Ahlborn Almemo System (data logger for temperatures, air humidity, air flow, …)
- 1-wire temperature sensors

Control cabinet

ACCESSOIRES

Lumiunous flux standard lamp

E27 test socket

L³ standard

Luminous flux measuring devices

- incandescent lamp type E27 24V 100W, shock-resistant, TechnoTeam version
- blackened glass bulb on base
- traceability to national standard

E27 4-pole test socket

- 4-pole E27 socket with hard gold plated contacts
- separate contacts for power supply and sensing

Half-space – luminous flux standard

- luminous flux standard on the basis of a halogen lamp
- half-space radiation with diffusor plate
- mechanical interface and plug-in connector compatible with **RIGO** 801 **300 / 600 / LED**

L³ standard

LED-based standards for luminance, luminous intensity (distribution) and luminous flux

- high stability of the luminance (<1%/100h)
- high stability of the dominant wavelength / color (<1nm/100h)
- stable function independent of the room temperature (15°C to 30°C)
- homogeneous luminance over the outlet opening (<2% inhomogeneity)
- standard equipment (in red, green, blue, yellow, orange, white)
- USB interface for reading the current operation status (serial number, working hours, temperature, …)

References (abstract)

AE Schreder GmbH, Austria | Ansorg GmbH Lichttechnik | Audi AG | Auer Lighting GmbH | BEGA Gantenbrink-Leuchten KG | D. Swarovski KG, Austria Diehl Aerospace GmbH | Fraunhofer Institut Solare Energiesysteme | FH Ravensburg/ Weingarten Goodrich Lighting Systems |Heraeus Noblelight Ilexa GmbH | IPT Instituto de Pesquisas Tecnológicas do Estado de São Paulo, Brasil | IREC, Spain| KaHo Sint-Lieven, Belgium | Karlsruher Institut für Technologie, LTI | KPU, Korea Polytechnic University, South Korea | Lehner Werkmetall GmbH | LG, South Korea LICHT Design Management | LIGHTING TECHNOLOGIES, RYAZAN, Russia | L-Lab | LTS Licht & Leuchten GmbH | Magistrat der Stadt Wien, MA 39, Austria | National Lighting Test Centre China (NLTC), China | OMS Ltd., Senica, Slovakia | OSRAM GmbH Philips Technologie GmbH | Regent Beleuchtungskörper AG, Basel Switzerland | Riegens A/S, Denmark | RZB Leuchten | Seoul Semiconductor, South Korea | SGS Fimko Ltd, Finland | SITECO Sun Yat-sen University, China | Spittler Lichttechnik GmbH | Systemtechnik International Lighting Service Technische Universität Berlin | Technische Universität Ilmenau | Technical University of Denmark TRILUX GmbH & Co. KG | Tsinghua University, China | TULUX AG, Switzerland | University of Tehran VNISI, Russian Lighting Research Institute VYRTYCH a.s., Czech Republic | XAL GmbH, Austria YAMAGIWA Corporation, Japan | Zumtobel GmbH & Co. KG

801 RIGÖ
NEAR-FIELD GONIOPHOTOMETER

Presented by:

Werner-von-Siemens-Str. 5
98693 Ilmenau
GERMANY

Tel. +49 3677 4624 0
Fax +49 3677 4624 10

info@TechnoTeam.de

www.TechnoTeam.de