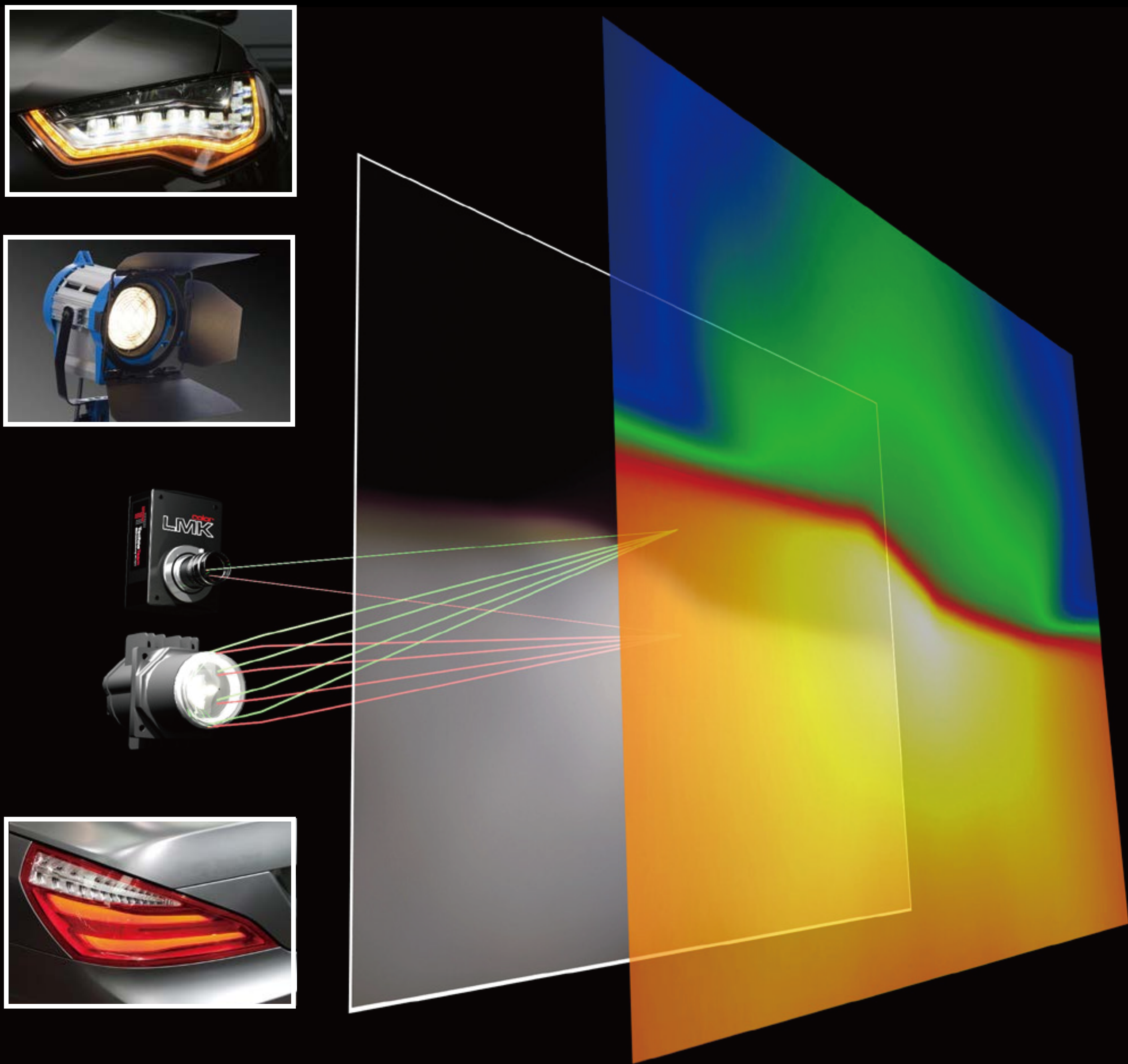
TechnoTeam
Bildverarbeitung GmbH



Measuring technique
for luminous intensity
distribution analysis

BV Room

LID Checker & **BV** Room

The spatially resolved measurement of luminous intensity distributions by means of the indirect light measurement technique allows the complex evaluation of numerous lighting-engineering devices:

- head- and rear lamps
- Signal lamps
- LED modules
- stage spot lights and reflector lamps

The imaging luminance measuring technology provides the acquisition of both photometric and geometrical data, thus allowing the user to determine important lighting-engineering quantities:

- luminance distribution L(x,y) on an illuminated surface
- derived parameters such as luminous intensity distribution I(ϑ,ϕ) and the illuminance distribution E(x,y) on an illuminated surface by means of the luminance distribution
- color distribution on an illuminated surface getting the chromaticity coordinates x,y
- Contrast
- Chromatic fringe
- Position and luminous intensity values of predefined measurement regions

All this information can be determined by using our imaging photometer **LMK** or imaging colorimeter **LMK** Color within seconds. In addition, the integrated software solution **LID** Checker provides automated image processing routines for customer related measuring tasks or the software solution **LMK** LabSoft enables the user to analyse the measuring data manually and flexible.

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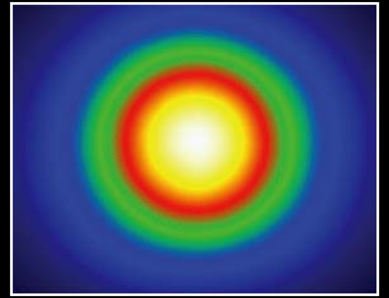
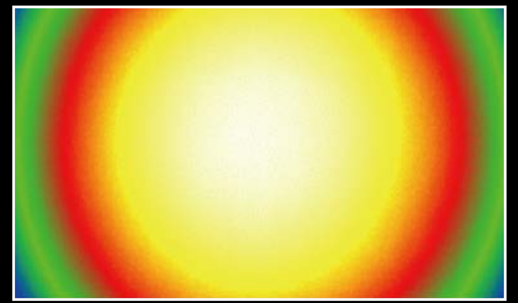
Lamp No.	Voltage U[V]	Current I[A]	Power P[W]	Axial luminous intensity I[cd]	Max luminous intensity I[cd]	Tilt angle horiz. [°]	Tilt angle vert. [°]	Half value angle left [°]	Half value anlge right [°]	Sum HVA horiz. [°]	Half value angle up [°]	Half value angle down [°]	Sum HVA vert. [°]
Mean	**5.91**	**6.60**	**38.97**	**11778.0**	**12080.0**	**-0.40**	**0,30**	**-4.35**	**4.40**	**8.75**	**-4.20**	**4.15**	**8.30**
StdDev.	**0.02**	**0.00**	**0.13**	**674.6**	**356.4**	**0.42**	**0,00**	**0.07**	**0.14**	**0.21**	**0.00**	**0.07**	**0.00**
1	5.89	6.60	38.88	12255	12332	-0.1	0,3	-4.3	4.3	8.6	-4.2	4.1	8.3
2	5.92	6.60	39.06	11301	11828	-0.7	0,3	-4.4	4.5	8.9	-4.2	4.2	8.3

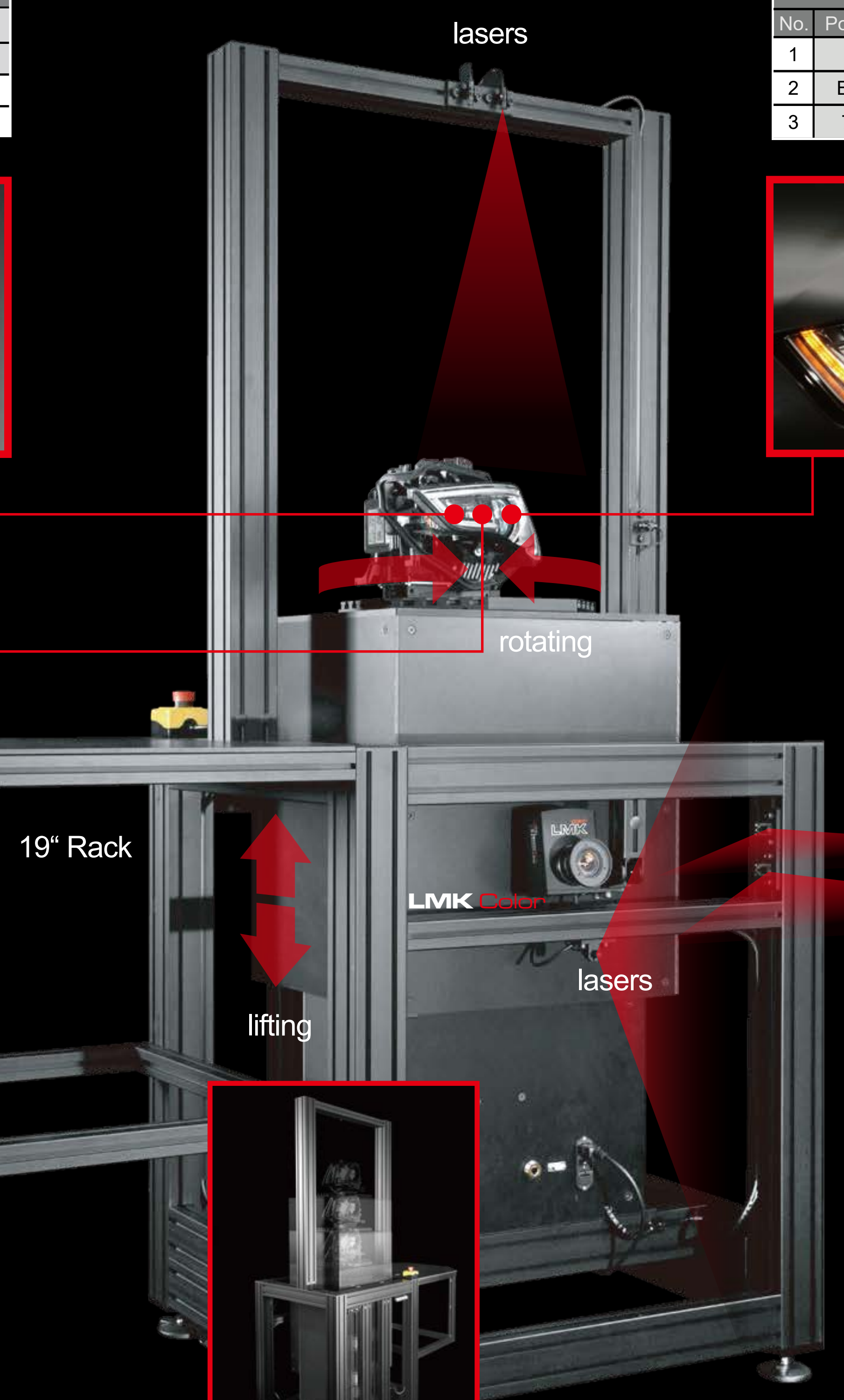
In the case of reflector lamps using the **LMK** within the **BV** Room including the **LID** Checker Software provides notable speed advantages, so that it can even be used during the production process.





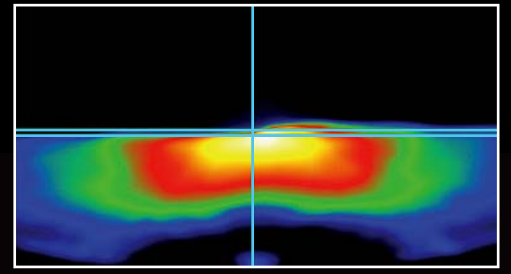
	x[°]	y[°]	Result	Luminous flux[lm]
Ref. Point	0.25	0.1	pass	225

Measuring				Set Val. [cd]		
No.	Position	x[°]	y[°]	Min[cd]	Max[cd]	I[cd]
1	15UH	0	15		260	210
2	10U5L	-5	10	12	260	223
3	10U5R	5	10	12	260	195

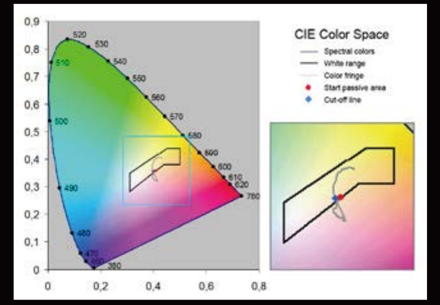


	x[°]	y[°]	Result	Luminous flux[lm]
Elbow Point	-0.42	0.05	pass	378

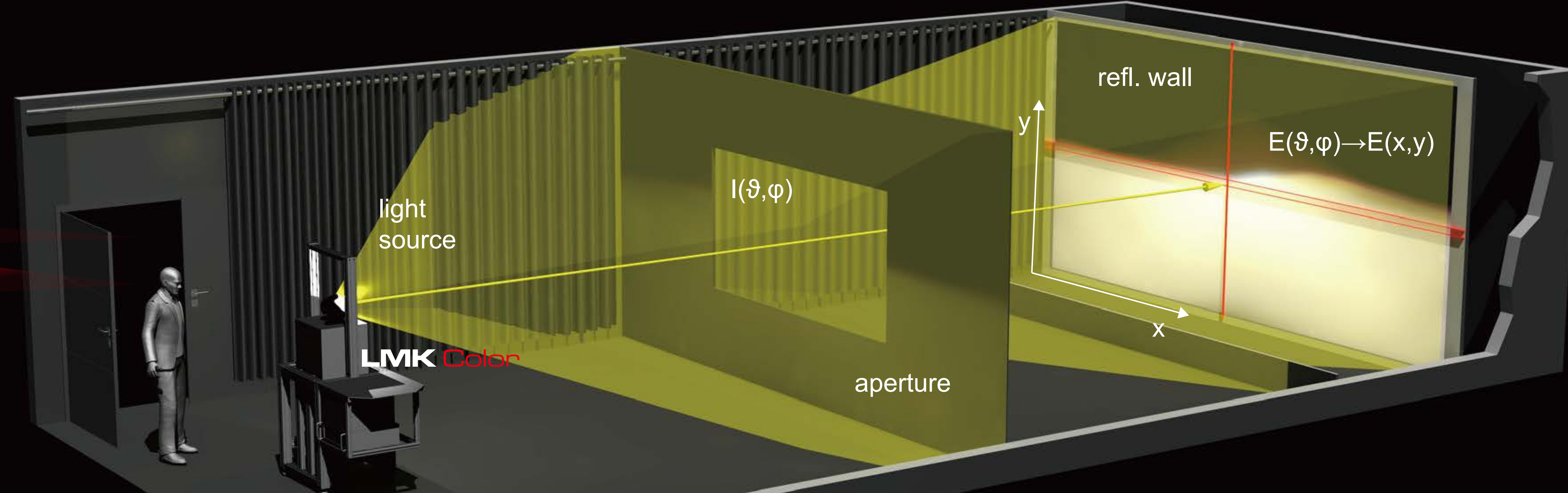
Measuring				Set Val. [cd]		
No.	Position	x[°]	y[°]	Min[cd]	Max[cd]	I[cd]
1	HV	0	0		500	496
2	B50L	-3.43	0.57		250	244
3	75R	1.15	-0.57	15000		19392



Measuring headlamp with the **LMK** or **LMK** Color is fast. Using **LID** Checker offers wide possibilities to define test specification in accordance to ECE, SAE and more. Therefore, a LID segment for example ±17°; ±8.5° can be captured in appr. 10s including elbow point detection an protocol generation.



Using the **LID** Checker with the **LMK** Color offers possibilities in the range of chromatic measurement. For example, analysing the chromatic values along a cross section is the basis for detailed cut-off line analysis.



Measuring Principle

The **BV** Room is a solution for the indirect light measurement. A measuring object positioned on a stable measuring table illuminates a reflective wall with lambertian characteristics, which is placed in a typical measuring distance of 10 m or more (in the case of headlamp measurements). Thus the projected luminance distribution or color distribution can be measured by using the **LMK** or **LMK** Color, which is mounted ideally on the measuring table or anywhere within the room, facing the measuring wall. The geometrical and photometric relations between the light source (in spherical coordinates) and the reflective wall (in camera coordinates) are well calibrated, so that the luminous intensity distribution I(ϑ,ϕ) can be calculated automatically from the image of the luminance L(x,y).

Measuring Table

To realize a stable and reproducible measurement of more and more complex luminous intensity distributions, it is necessary to position the measuring object precisely. Although it is important to compensate different measuring object dimensions, to sufficiently reach the reference point of the measuring setup. To help the customer to achieve these conditions, **Techno**Team provides an own design of a measuring table. Features are:

- Height-adjustable – ±25 cm
- Rotation unit full 360°
- Alignment lasers directed to the measuring object for positioning in the reference point
- Alignment lasers directed to the measuring wall for visual control and optional adjustment of the beam direction
- Optional x-y-table for horizontal adjustment of the measuring object
- Camera mounting
- Slot for 19" devices (power supply, PC, ...)

Technical Data

Geometrical dimension[1]
Depends on the room size and photometrical limiting distance

Size of the measurement object
any; depends on the photometrical limiting distance and the corresponding size of the measuring room

Interface
Gigabit Ethernet Interface (GigE ®)

Spectral mismatch
V(λ) [f_1' < 3.5%]; X(λ) [f_1^* < 4%]
Z(λ) [f_1^* < 6.0%]; V'(λ) [f_1^* < 6%]

Measuring range[2]
Adaptable by using different integration/ exposure times
100 µs - 15 s → approx. 1 Mcd down to 1 cd
Higher intensities can be measured using optional grey filters

Angular resolution[3]
0.01° to 0.1°

Typical Image field[4]
±17° hor.; by ±8.5° vert. for a 10 m room
±32° hor.; by ±17° vert. for a 3.16 m room
The horizontal image field can increased by using the motor unit of our measuring table.

Calibration uncertainty
Focusable lens ΔL [< 2.5%]

Repeatability
ΔI [< 0.1%]; Δx,y [< 0.0001]

Measuring accuracy[5]
ΔI [< 3%]; Δx,y [< 0.0020]

Uniformity
ΔI [< 3%]

Measurable contrast[6]
Common 1:1000 with measurement conditions according to CIE TC2-59 Draft characteristic f_{25}

Measurement period
< 1 min for a full field luminance intensity distribution (e.g. ±17° horizontal by ; ±8.5° vertical with resolution of ; 0.01°)

1 For headlamp measurements; for other measurements more compact dimensions are realizable | 2 upper range value according to the integration time | 3 Depending on the measuring task and the angular range | 4 For headlamp measurements; for other measurements greater fields of view are possible | 5 For standard illuminant A with homogenous illuminance | 6 Depending on the light distribution lower or higher contrasts are possible

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Software client

LID Checker

TechnoTeam provides an interactive user interface for applying test specifications in automated measurements. It is possible to define various measurement regions including their tolerance values. In the case of headlamp measurements, algorithms for automated elbow point detection and ReAim are included. In addition, the resulting measurement values can be summarized in individual protocols. The **LID** Checker also supports the TCP/IP interface for the communication with a process control system for fully automatic measurements.

Teach-In

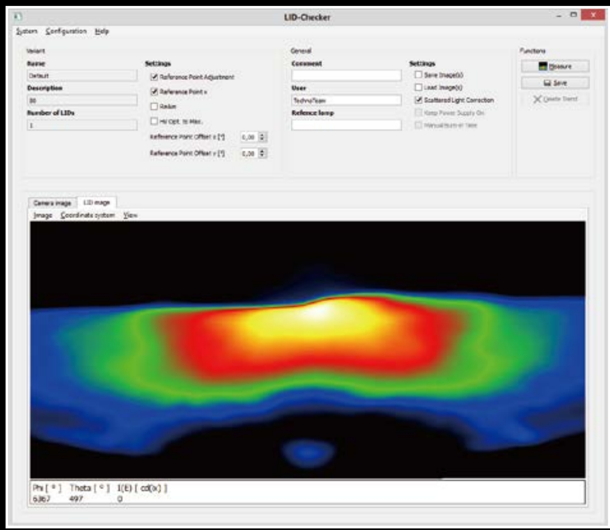
For the evaluation of lighting-engineering devices, it is often a point of interest to carry out more than just one single measurement task. For this purpose **LID** Checker includes a Teach-In interface to create different so called variants for each measurement task. Among other things it is possible to define variable rectangular regions e.g. concerning car headlamp measurements for searching E_{max} according to SAE or ECE regularities. All teached-in variants can easily be selected in the user interface of the **LID** Checker and run automatically.

Elbow Point Detection & ReAim

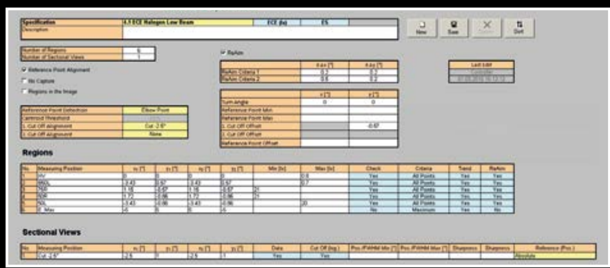
For measuring car headlamp LIDs, the **LID** Checker features the elbow point detection, based on the measured luminous intensity distribution data. This allows an automated adjustment of the predefined measurement regions to a reference point. In addition it is possible for all measuring tasks, to define a ReAim range to optimize the reference point, so that all measurement regions fulfil the official requirements.

Protocol design

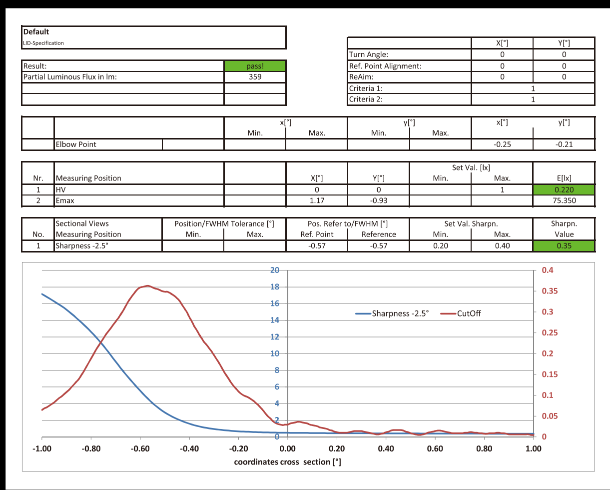
All results of selected variants are summarized in a tabular protocol (formatted Excel and corresponding none formatted csv file). This enables the user to evaluate the measurement values fast and neatly. Beside the current measured values, selected values of past measurements are stored to create comprehensible trend data. Additional colored formatting or diagrams can further enhance the result overview.



LID Checker

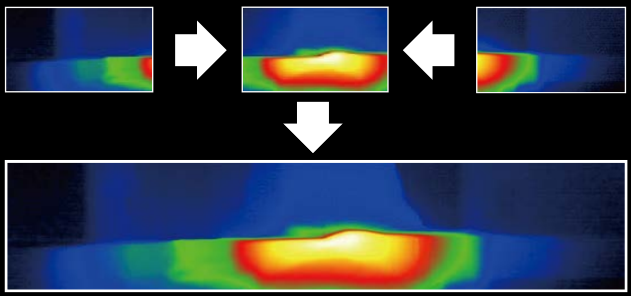


Teach-In LID specification



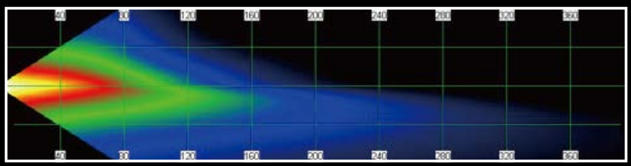
Protocol design

BV Room



Merging

- Single LIDs are combined into a LID of the desired solid angle
- Obstacles in the field of view can be eliminated (for example hole of the goniometer tube)



LID analysis

LMK LabSoft

Additionally to all camera systems of the **LMK** family, the **LMK** LabSoft can be supplied. The measuring software offers a big number of possible applications when using the luminance measuring systems, as well as for data evaluation and processing.
For the visualization of the measuring results, the user can choose, among other things, from a freely scalable pseudocolouring as well as several logarithmic representations. Pre-made and freely scalable point, line, circular and rectangular cursors permit the measuring data to be accessed in a quick and flexible way. The defining of measuring regions by means of geometrical basic shapes facilitates evaluation. In addition, they provide many auxiliary means for the statistical evaluation of the data (tables, sectional diagrams, histograms and photometric evaluation algorithms).
Furthermore, the software offers a function for an automatic detection of regions by means of intensities. This is both useful and advantageous for detecting complex geometrical structures.

LMK LabSoftAddOn user application software

LMK LID AddOn offers additional functionality for analysing luminous intensity distributions especially of headlamps. It enables the user to transform the measured luminance image into the corresponding luminous intensity or illuminance distribution. Here the illuminance can be determined either on a plane (e.g. on a projection wall located at a distance of 10 m) or on a hemisphere (e.g. 25 m radius for ECE). Also there are already implemented **LMK** LabSoft Macros for typical measurement routines:

- Gradient of the cut-off line: Transforming the LID image into an Gradient image
- Merging of multi-captures: LID images of horizontally turned measuring objects are merged to one wide-angle LID image.

Additionally to saving the image data according to the TechnoTeam Formats *.pf,*.pcf, there is the possibility to export this data to international standard formats like *.ldt or *.ies files supporting programs like LumCAT or others.

LMK Motor Control allows the control and automatisation of motor units. Especially for the offered measuring table by TechnoTeam, this AddOn enables the merging of several images of one light source to analyze and display a wider angle.

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