TechnoTeam
Bildverarbeitung GmbH

VIDEO PHOTOMETER

IMAGING LIGHT AND COLOUR
MEASURING DEVICES

LMK6

Seven Good Reasons to Consider the Techno**Team LMK** Family of Imaging Light and Color Measuring Devices

1 All CCD and CMOS based **LMK** systems are measured individually in-house for its spectral responsivity. This gives an accurate measure for the spectral matching of the sensitivity curves of the 2° standard observer define by the CIE. The measurement is done for every configurated lens of the delivered **LMK** system. The results are stated in the calibration certificate.

2 A high transmission of the CIE matching filters is a parameter for the optimization of each CCD. This allows using much shorter exposure times for capturing low light levels. This specific optimization is made unique for the **LMK** system.

3 The accuracy of fine spectral matching is almost in the level of other high-accuracy photometers. This allows to minimized the uncertainty due to spectral mismatch even for saturated LED colors.

4 Electronic components are manufactured in-house designed especially for **LMK** systems.

5 A supplier-independent optimization considering the influence for radiometric signal detection is being possible due to this.

6 Special measurement features like High-Dynamic measurements are supported from hardware point of view in a very unique way.

7 Serveral different measuring options with one system e.g.

- Luminance distributions in measuring images L(x,y)
- Derived lighting-engineering parameters such as illuminance distribution E(x,y) and Luminous intensity distribution (LID) I(x,y)
- Color and chromaticity data
- Human vision based metrology data like glare, visibility and contrast sensitivity, visual perception based ratings

Automotive lighting

- Exterior: head/tail lamps - luminance, color, luminous intensity distribution (LID)
- Interior: ambient and dashboard illumination - visibility, contrasts, visual and color appearance rating
- Display design - visual perception, glare sensation, contrast sensitivity

Architectural/Outdoor lighting

- Luminance - Brightness level light pollution, glare sensation, visual perception
- Color - CRI, color appearance
- Luminous intensity distribution (LID), ray-data, BRTF data
- Non visual effect - blue light hazard, human melatonin suppressionMelatonin suppression

Automotive interior lighting

- Luminance
- Color – CRI
- Luminous intensity distribution (LID) – ray data
- Non visuals – Blue light hazard

Display industry/metrology

- Luminance - brightness, uniformity, contrast ratio, image sticking, angular performance
- Color – color reproduction, color rendering, color homogeneity
- Pixel defects and crosstalk
- Gamma determination and rating

LMK6

The **LMK** 6 is the center-piece of the entire **LMK** product family and equipped with colored full glass filter to adapt the system to the V(λ)-function or a set of full filter glasses to realize the matching for the 2° CIE standard observer.

Its robust construction, compact dimensions and lightweight means that it can be used in almost every process for a wide range of lighting measurement tasks.

In conjunction with the supplied system and measuring software, their areas of application lies in a lot of tasks in which the imaging determination and evaluation of luminances is required.

A large selection of high-quality standard lenses and special imaging systems in combination with an interchangeable lens mount further increase the flexibility of the **LMK** 6. As a result, the **LMK** 6 is able to meet a wide range of requirements and to combine a wide variety of measuring devices in one system.

Modulation detection (e.g. flicker)

With the use of a CMOS image sensor arrays, it is not necessary to transfer a complete image during image acquisition. Rather, the CMOS technology makes it possible to partially read the image data. For example, individual image pixels or image lines can be recorded.

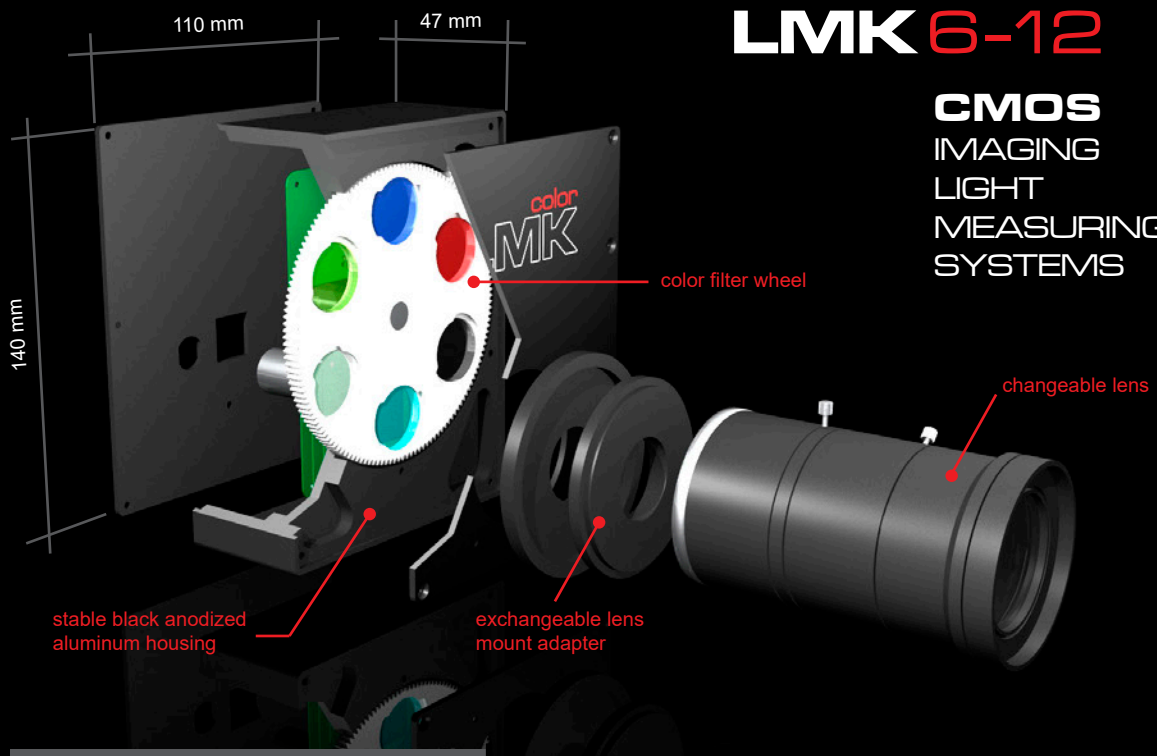
With a special modulation measurement the **LMK** 6 is able to measure the modulation frequency of the light source. Using this information the influence of the modulation frequency to the measurement result can be minimized.

Trigger function

The **LMK** 6 series has an external and an internal trigger function to communicate with the surrounding. Thus the **LMK** 6 is able to state the integration time to an external signal.
Additionally the image capture can be controlled from an external trigger source. Also an external source can be controlled by the **LMK** 6 itself.
For both cases time delays before and after the image integration are possible. This saves the need of expensive power supplies.

LMK 6-12

CMOS IMAGING LIGHT MEASURING SYSTEMS



SYSTEM

Standard resolution LMK 6-5 color	2464 x 2056 Pixel | Sony-CMOS [IMX 250 (2/3"); 12 Bit digital]
High resolution LMK 6-12 color	4112 x 3008 Pixel | Sony-CMOS [IMX 253 (1,1"); 12 Bit digital]
Measurement time	starting with 1 sec. up to 15 sec. depending on luminance level, adjusted lens and exposure/integration time
Dynamic range	[1:10000000 (~140 dB)]
Data interface	Gigabit Ethernet Interface(GigE®)
Spectral matching	using V(λ)-function matched full glas filter for luminance measures adapted with full glass filters to the X(λ)-, V(λ)- and Z(λ)-function to measure color values further full glass filters for the functions V'(λ)-, S_{mel}(λ) and BLH (blue light hazard) as well as NIR filters are available

METROLOGICAL DATA

Metrological specifications	V(λ) [f´1 < 4 %[1]]; X(λ) [f*1 < 4 %] Z(λ) [f*1 < 6 %]; V´(λ) [f*1 < 6 %]
Measuring quantities	Luminance: L (cd/m²)
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
Measuring range (integration time)	100 µsec. ...15 sec.
Measuring range[2] depending on lens aperture value (F) mono	1 msec. ...appr. 1800 cd/m² & 3 sec. ... appr. 0.6 cd/m² (F = min.) 1 msec. ...appr. 60000 cd/m² & 3 sec. ... appr. 20 cd/m² (F = max.)
Measuring range depending on lens aperture value (F) color	1 msec. ...appr. 7500 cd/m² & 3 sec. ... appr. 2.5 cd/m² (F = min.) 1 msec. ...appr. 60000 cd/m² & 3 sec. ... appr. 20 cd/m² (F = max.)
Measuring range for the preset f-number (F/4)	1 msec. ... ca. 10000 cd/m² & 3 sec. ... ca. 3.3 cd/m²
Calibration uncertainty[3]	fix focused lenses ΔL [< 2 %] focusable lenses ΔL [< 2.5 %]
Repeatability[4]	ΔL [< 0.1 %]
Measuring accuracy	ΔL [< 3 % (for standard illuminant A)]
Uniformity	ΔL [< 2 %]

DIMENSIONS AND WEIGHT

	housing dimensions (HxWxD)	weight (without lens)	available lens
LMK 6 mono	80 mm x 80 mm x 47 mm	600 g	120 g - 800 g
LMK 6-5 color	117 mm x 90 mm x 47 mm	800 g	120 g - 600 g
LMK 6-12 color	140 mm x 110 mm x 47 mm	1300 g	200 g - 800 g

1 Measurements according to DIN 5032 Part 6/CIE Pub. 69 | 2 The given values representig the highest luminance values with the given setting. | 3 Calibration according to DIN 5032 Part 6 using a luminance standard led back from the Physical-Technical Federal Institute | 4 Measurement performed on a stabilized white LED light source L=100 cd/m². Mean value over 100 Pixel; repeatability

References LMK video photometer (extract)

Adam Opel AG
ALPINE ELECTRONICS GmbH
ALPINE Japan
Behr-Hella Thermocontrol GmbH
Blaupunkt GmbH
BMW AG
Bosch-Gruppe Motometer GmbH
Braun GmbH
Cherry GmbH
Continental AG
D. Swarovski & Co.
Daimler AG
Delphi Packard Deutschland GmbH
Diehl Aerospace GmbH
Dr. -Ing. h.c. F. Porsche AG
ECOLUMY Korea
EFI, Trontheim Norwegen
ETH Zürich
EPFL Lausanne
GE, Hungary
Goodrich Hella Aerospace GmbH
Hella KG Hueck& Co.
KONKUK University Korea
KostalMexiko
Kostal, USA
Leopold Kostal GmbH
Marquardt GmbH
Matsushita Electric, (Panasonic)
METAS, Bern
OptrexEurope GmbH
OSRAM GmbH
OSRAM OS GmbH& Co. OHG
Philips Licht
PTB Braunschweig
Schréder Group GIE
Škoda Auto
Siteco Beleuchtungstechnik GmbH
Technische Universität Berlin
Technische Universität Dresden
Technische Universität Darmstadt
Technische Universität, Ilmenau
THALES VENDOME
TRW Automotive & Co. KG
Universität Dortmund
Valeo Auto-Electric Hungary LLC
VDO Car Communication
VISTEON Deutschland GmbH
Visteon Brasilien
VW AG
Zumtobel GmbH

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