



Instruction Manual
colorSENSOR LT-3-HE

High-end color sensor

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Certified acc. to DIN EN ISO 9001: 2008

colorSENSOR LT Series

colorSENSOR LT-3-HE

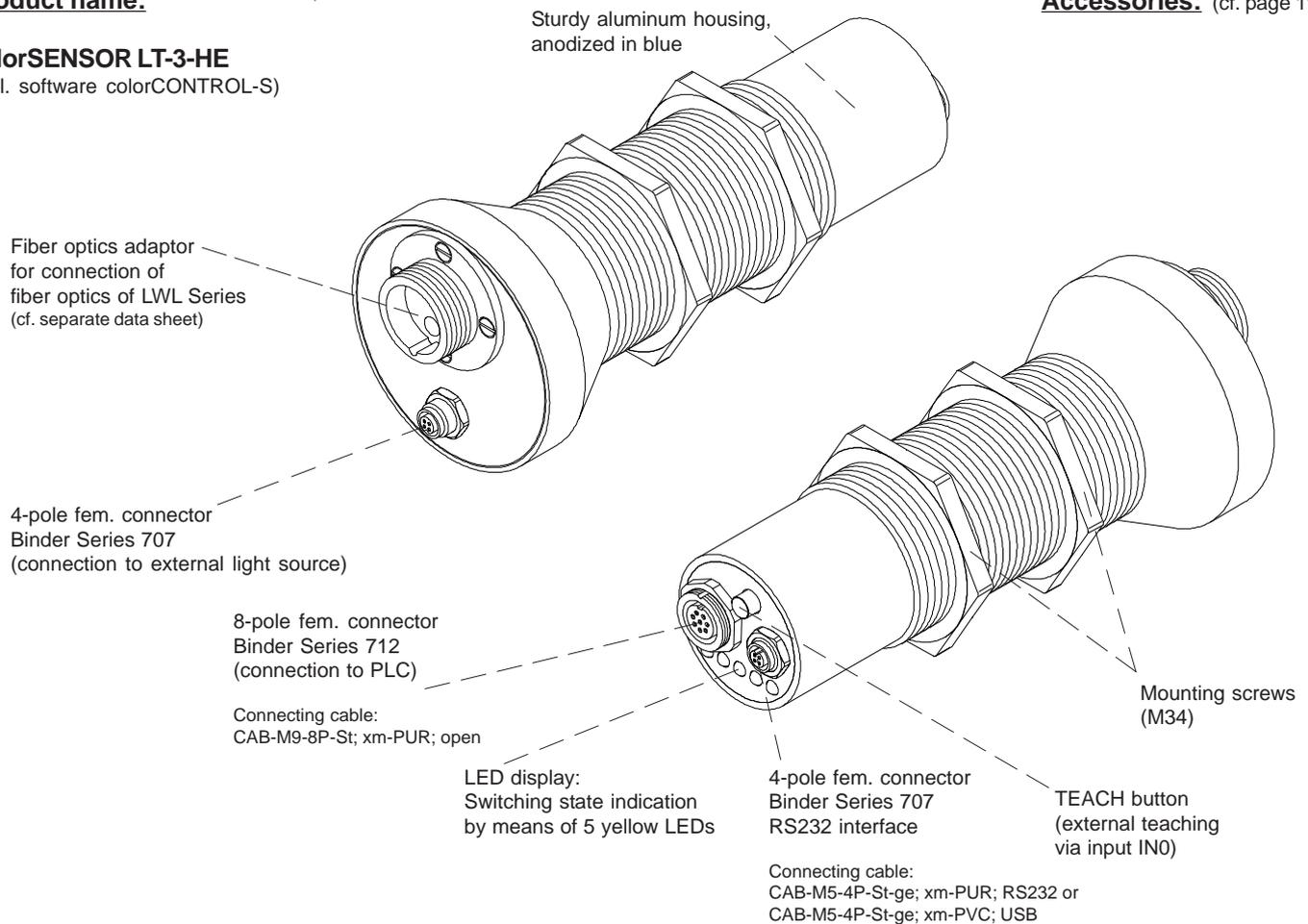
- Big working range: typ. 1 mm ... 500 mm (depends on the fiber optics used and attachment optics)
- Big assortment of fiber optics available (reflected light or transmitted light operation)
- Up to 31 colors can be stored
- RS232 interface (USB adapter is available)
- Super-bright white-light LED, modulated (AC-/DC-/PULSE-operation or OFF for luminous objects can be switched)
- Color detection, contrast detection, and gray scale detection
- Insensitive to outside light
- Brightness correction can be activated
- Switching frequency up to 35 kHz
- Several TEACH functions (via PC, PLC, or push button)
- Various evaluation algorithms can be activated
- "BEST HIT" mode ("human color assessment")
- Switching state display by means of 5 yellow LEDs
- Temperature compensated in climatic cabinet
- Averaging can be activated (from 1 up to over 32000 values)
- Color control of luminous objects (LEDs, halogen lamps, displays, ...)
- 3-color filter detector (true color detector: "human color perception")

Design

Product name:

colorSENSOR LT-3-HE
(incl. software colorCONTROL-S)

Accessories: (cf. page 11)



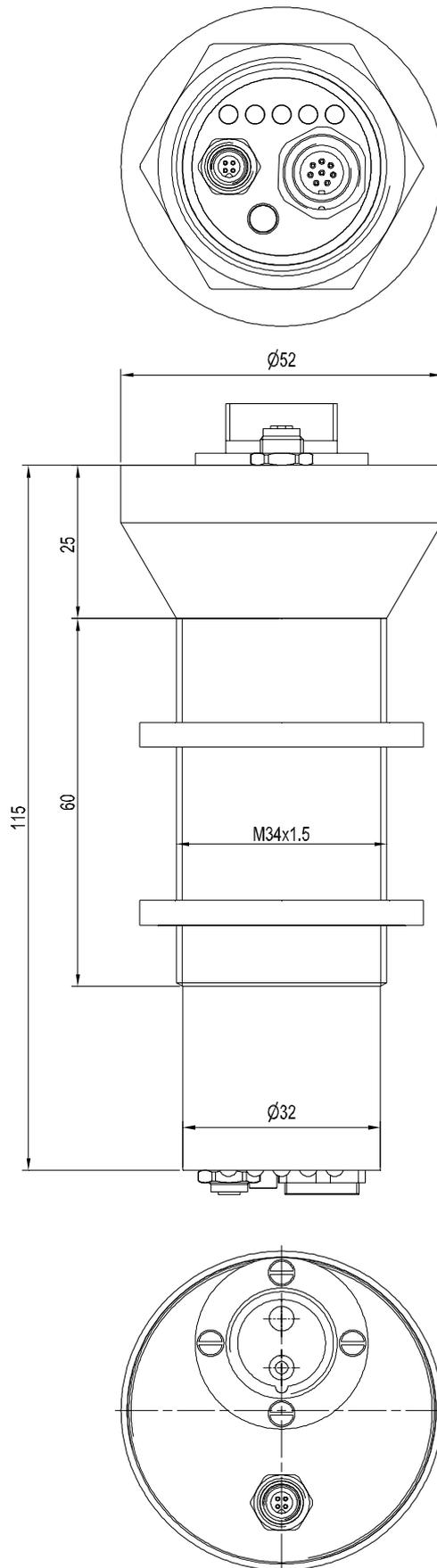
Technical Data

Type	LT-3-HE
Article number	10234065
Object distance	Dependent on the optical fibers used and the optical heads Reflex optical fiber typ. 2 mm-25 mm with lens typ. 5 mm-200 mm ¹⁾
Light spot diameter	Dependent on the optical fibers used and the optical heads Reflex optical fiber typ. Ø 0.6 mm-30 mm ¹⁾
Color difference	$\Delta E \geq 0.5$
Color spaces	X/Y INT; s/i M (Lab)
Averaging	more than max. 32768 values
Size of the color memory	max. 31 colors in non-volatile EEPROM with parameter sets
Switching frequency	max. 30 kHz (depending on number of colors being taught and the setting for the averaging)
Reproducibility	In the x,y color range, 1 digit each with 12-Bit-A/D conversion
Temperature drift X,Y	< 0.01 % /K
Light source	Super-bright white light LED, AC or DC, (adjustable or OFF for self-luminous objects, software-switchable) ²⁾
Type of illumination	via optical fiber
Effect through illumination	suitable for flexibility
Ambient light	to 5000 Lux (AC-mode)
Intermittent light operation	AC: typ. 10 kHz to 40 kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software
Power supply	+24 VDC ($\pm 10\%$), inverse polarity protected, overload-proof
Current consumption	typ. 320 mA
Max. switching current	100 mA, short-circuit protected
TEACH button/inputs	1 button and IN0 for external teaching of the color references
Outputs	OUT 0 - OUT 4, digital (0 V/+Ub), short-circuit protected, 100 mA max. switching current npn-, pnp-capable (bright or dark switching, switchable)
Switching state display	Visualisation by means of 5 yellow LEDs
Interface	RS232 (optional USB)
Type of connector	to PLC: 8-pole flange socket (Binder series 712) to PC: 4-pole flange socket (Binder series 707)
Connection cable	to power/PLC: art. no. 11234091 / to PC: art. no 11234095 (RS232); 11234096 (USB).
Receiver	3-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931)
Software	colorCONTROL S
Pulse extension	adjustable 0 ms-100 ms
Signal amplification	8 stage (AMP1 - AMP8), adjustable
Housing material	Aluminium, black anodised
Operating temperature	-20 °C - +55 °C
Storage temperature	-20 °C - +85 °C
Protection class	IP 67 (lens), IP 64 (electronics)
EMC test according	DIN EN 60947-5-2
Optical fiber	See color catalog page 34 onwards

¹⁾ Type: FAR-T-A2.0-2,5-1200-67° Reflex
Type: FAD-T-A2.0-2,5-1200-67° Transmitted light (p. 34 onwards)

²⁾ suitable for LED testing

Dimensions

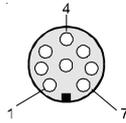


All dimensions in mm

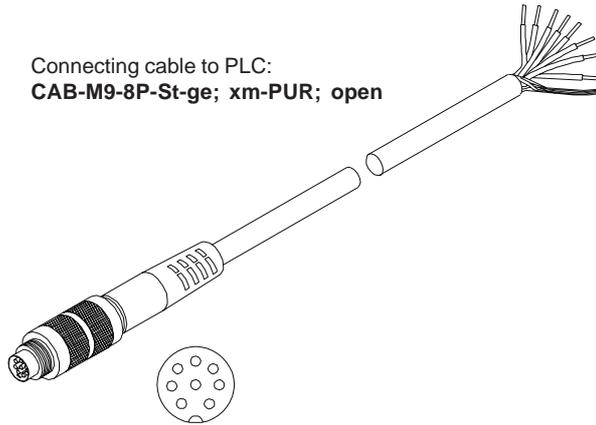
Connector Assignment

**Connection to PLC:
8-pole fem. connector Binder Series 712**

Pin:	Color:	Assignment:
1	white	GND (0V)
2	brown	+24VDC (±10%)
3	green	IN0
4	yellow	OUT0
5	grey	OUT1
6	pink	OUT2
7	blue	OUT3
8	red	OUT4



Connecting cable to PLC:
CAB-M9-8P-St-ge; xm-PUR; open



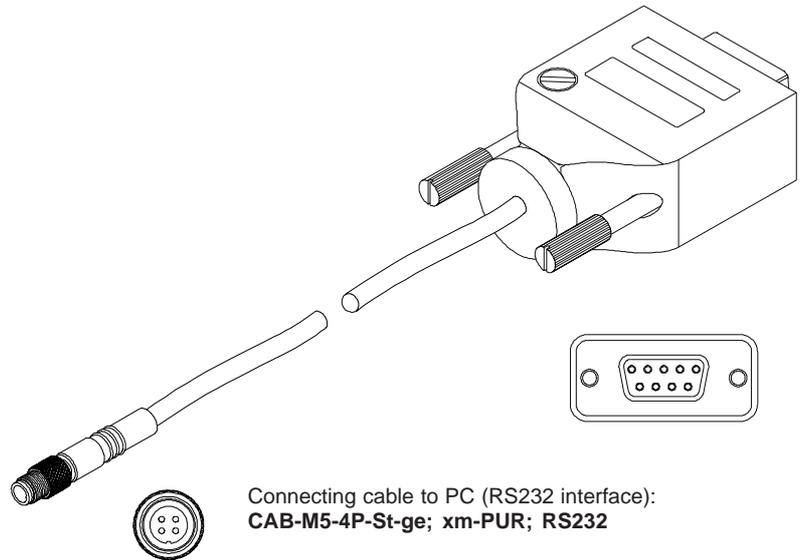
Connecting cable:
CAB-M9-8P-St-ge; 2m-PUR; open
CAB-M9-8P-St-ge; 5m-PUR; open
(Standard length 2 m)

**Connection to PC:
4-pole fem. connector Binder Series 707**

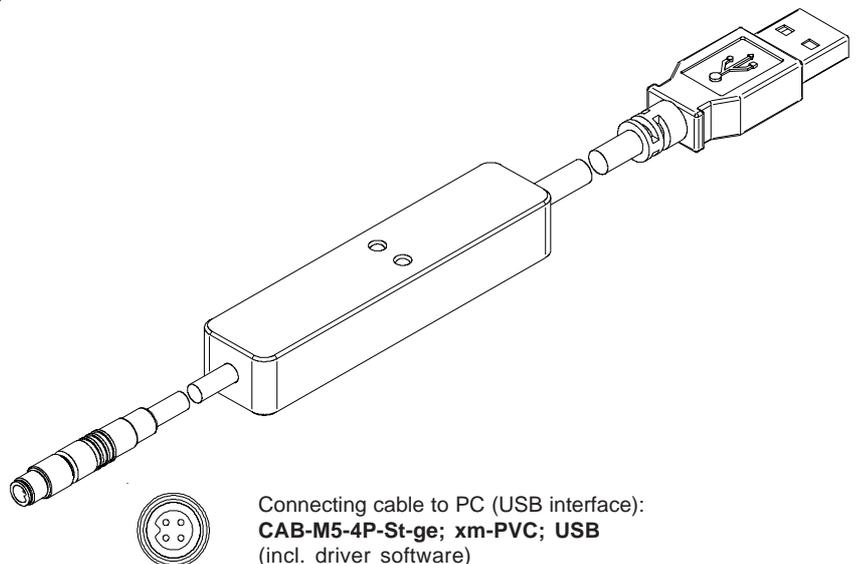
Pin:	Assignment:
1	+24VDC (+Ub, OUT)
2	GND (0V)
3	RxD
4	TxD

Connecting cable:
CAB-M5-4P-St-ge; 2m-PUR; RS232
CAB-M5-4P-St-ge; 5m-PUR; RS232
(Standard length 2 m)

alternatively:
Connecting cable (incl. driver software):
CAB-M5-4P-St-ge; 2-PVC; USB
CAB-M5-4P-St-ge; 5-PVC; USB
(Standard length 2 m)



Connecting cable to PC (RS232 interface):
CAB-M5-4P-St-ge; xm-PUR; RS232



Connecting cable to PC (USB interface):
CAB-M5-4P-St-ge; xm-PVC; USB
(incl. driver software)

Measuring Principle

Measuring principle of the color sensors of colorSENSOR LT-3 series:

The colorSENSOR LT-3 provides highly flexible signal acquisition. For example, the sensor can be operated in alternating-light mode (AC mode), which makes the sensor insensitive to extraneous light. It also can be set to constant-light mode (DC mode), which makes the sensor extremely fast and allows a scan-frequency of up to 35 kHz.

An OFF function turns off the integrated light source at the sensor and changes to DC operation. The sensor then can detect so-called "self-luminous objects". In PULSE operation extremely dark surfaces can be reliably detected. With the stepless adjustment of the integrated light source and the selectable gain of the receiver signal the sensor can be set to almost any surface or any "self-luminous object".

When the integrated light source of the colorSENSOR LT-3 color sensor is activated, the sensor detects the radiation that is diffusely reflected from the object. As a light source the colorSENSOR LT-3 color sensor uses a white-light LED with adjustable transmitter power. An integrated 3-fold receiver for the red, green, and blue content of the light that is reflected from the object, or the light that is emitted by a "self-luminous object", is used as a receiver. As mentioned above, a special feature here is that the gain of the receiver can be set in 8 steps. This makes it possible to optimally adjust the sensor to almost any surface and to different "self-luminous objects".

The colorSENSOR LT-3 color sensor can be "taught" up to 31 colors. For each of these taught colors it is possible to set tolerances.

In X/Y INT or s/i M mode these tolerances form a color cylinder in space. In X/Y/INT or s/i/M mode the tolerances form a color sphere in space. Color evaluation according to s/i M is based on the lab calculation method. All modes can be used in combination with several operating modes such as "FIRST HIT" and "BEST HIT". Raw data are represented with 12 bit resolution.

Color detection either operates continuously or is started through an external PLC trigger signal. The respective detected color either is provided as a binary code at the 5 digital outputs or can be sent directly to the outputs, if only up to 5 colors are to be detected. At the same time the detected color code is visualised by means of 5 LEDs at the housing of the colorSENSOR LT-3. [\[Please note: Visualisation by means of LEDs not available with colorSENSOR LT-1-LC-20 types.\]](#)

With a TEACH button at the sensor housing the color sensor can be taught up to 31 colors. For this purpose the corresponding evaluation mode must be set with the software. The TEACH button is connected in parallel to the input IN0 (green wire at cable CAB-M9-8P-St-ge; xm-PUR; open). [\[Please note: TEACH button not available with colorSENSOR LT-1-LC-20 types.\]](#)

Parameters and measurement values can be exchanged between a PC and the colorSENSOR LT-3 color sensor through the serial RS232 interface. All the parameters for color detection also can be saved to the non-volatile EEPROM of the colorSENSOR LT-3 color sensor through this serial RS232 interface. When parameterisation is finished, the color sensor continues to operate with the current parameters in STAND-ALONE mode without a PC.

The sensors of the colorSENSOR LT-3 series can be calibrated (white-light balancing). Balancing can be performed to any white surface. A ColorCheckerTM table with 24 color fields is available as an alternative.

Visualization

Visualization of the color code:

The color code is visualised by way of 5 yellow LEDs at the housing of the colorSENSOR LT-3 color sensor. At the same time in the binary mode (OUT BINARY) the color code indicated on the LED display is output as 5-bit binary information at the digital outputs OUT0 to OUT4 of the 8-pin colorSENSOR LT-3/PLC socket.

The colorSENSOR LT-3 color sensor is able to process a maximum of 31 colors (color code 0 ... 30) in accordance with the corresponding rows in the COLOR TEACH TABLE. An "error" respectively a "not detected color" is displayed by the lighting of all LED (OUT0 ... OUT4 digital outputs are set to HIGH-level).

In the DIRECT mode (OUT DIRECT HI or OUT DIRECT LO) the maximum numbers of colors to be taught is 5 (color no. 0, 1, 2, 3, 4). If DIRECT HI is activated, the specially digital output is set to HI, while the other 4 are set to LO. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to LOW (no LED is lighting).

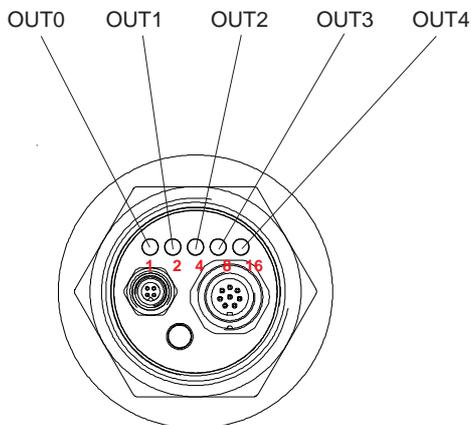
If DIRECT LO is activated, the specially digital output is set to LO, while the other 4 are set to HI. If the current color does not correspond with any of the teach-in colors, all digital outputs are set to HIGH (all LED are lighting).

LED Display

LED display:

The color code is visualized by means of 5 yellow LEDs at the housing of the color sensor. At the same time the color code indicated at the LED display is output as 5-bit binary information at the digital outputs OUT0 ... OUT4 of the 8-pole PLC connector.

In the DIRECT mode the maximum number of color codes to be taught is 5. These 5 color codes can be directly output at the 5 digital outputs. The respective detected color code is displayed by means of the 5 yellow LEDs at the color sensor housing.



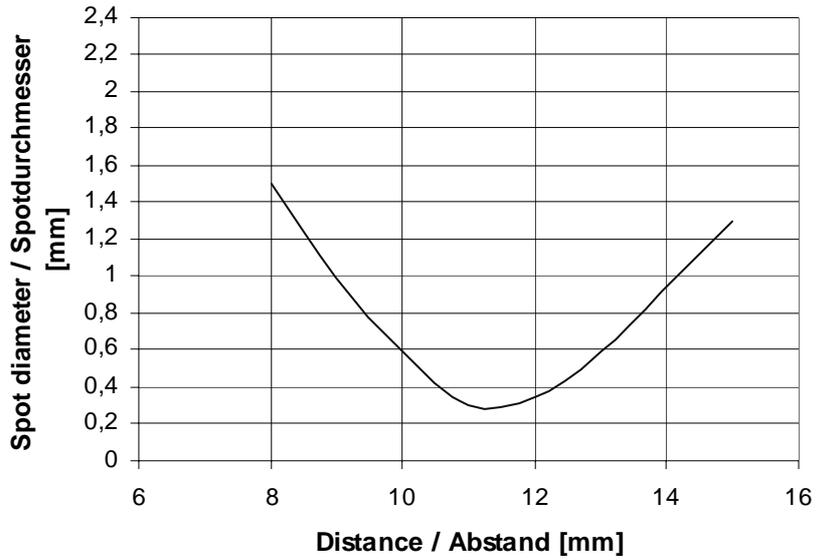
○ ○ ○ ○ ○	● ○ ○ ○ ○	○ ● ○ ○ ○
0	1	2
● ● ○ ○ ○	○ ○ ● ○ ○	● ○ ● ○ ○
3	4	5
○ ● ● ○ ○	● ● ● ○ ○	○ ○ ○ ● ○
6	7	8
● ○ ○ ● ○	○ ● ○ ● ○	● ● ○ ● ○
9	10	11
○ ○ ● ● ○	● ○ ● ● ○	○ ● ● ● ○
12	13	14
● ● ● ● ○	○ ○ ○ ○ ●	● ○ ○ ○ ●
15	16	17
○ ● ○ ○ ●	● ● ○ ○ ●	○ ○ ● ○ ●
18	19	20
● ○ ● ○ ●	○ ● ● ○ ●	● ● ● ○ ●
21	22	23
○ ○ ○ ● ●	● ○ ○ ● ●	○ ● ○ ● ●
24	25	26
● ● ○ ● ●	○ ○ ● ● ●	● ○ ● ● ●
27	28	29
○ ● ● ● ●	● ● ● ● ●	
30	Error or „not detected“	

Diagrams

Diagrams: SPOT DIAMETER depending on distance

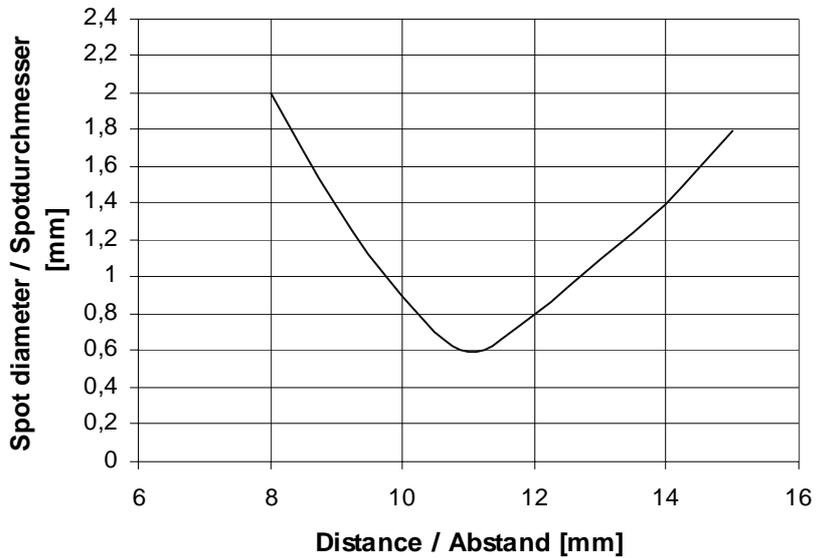
SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
 with fiber optics FAR-T-A1.1-0,6-1200-67°
 and attachment optics KL-4
 (fiber optics fixed at limit stop into attachment optics)



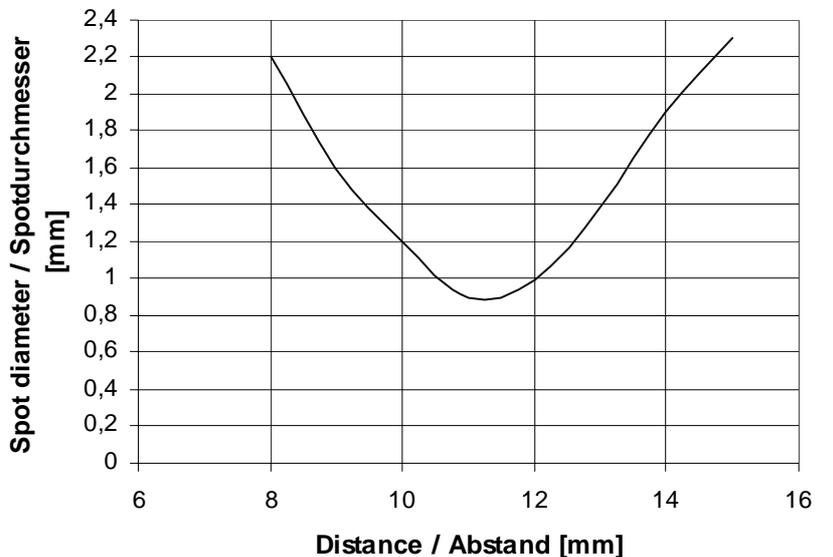
SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
 with fiber optics FAR-T-A1.1-1,1-1200-67°
 and attachment optics KL-4
 (fiber optics fixed at limit stop into attachment optics)



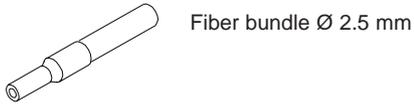
SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
 with fiber optics FAR-T-A1.1-1,5-1200-67°
 and attachment optics KL-4
 (fiber optics fixed at limit stop into attachment optics)



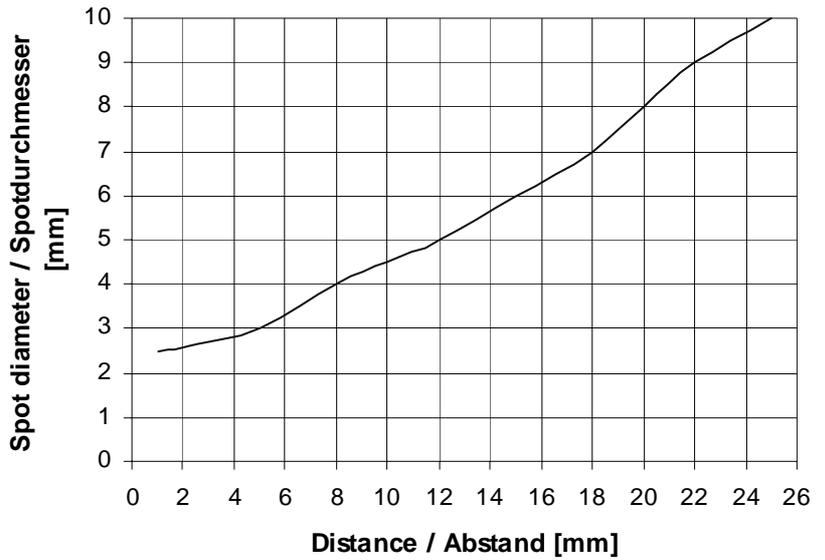
Diagrams

Diagrams: SPOT DIAMETER depending on distance



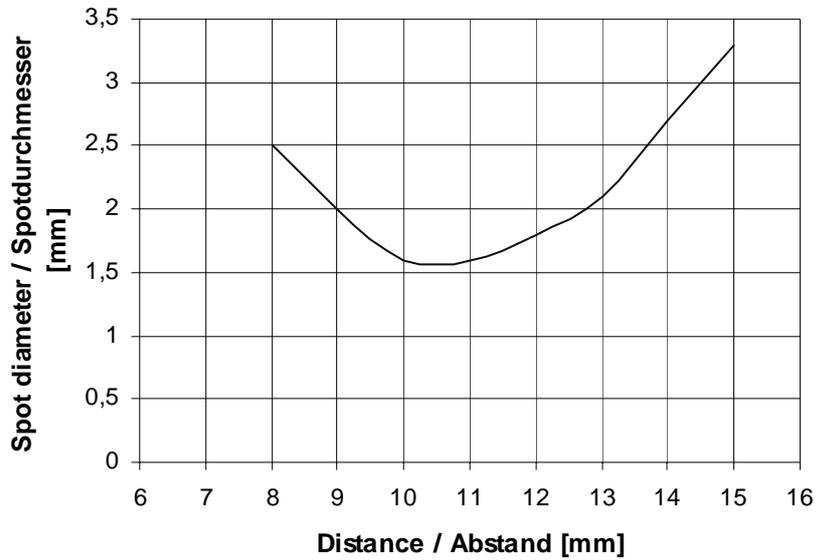
SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
with fiber optics FAR-T-A2.0-2,5-600-67°



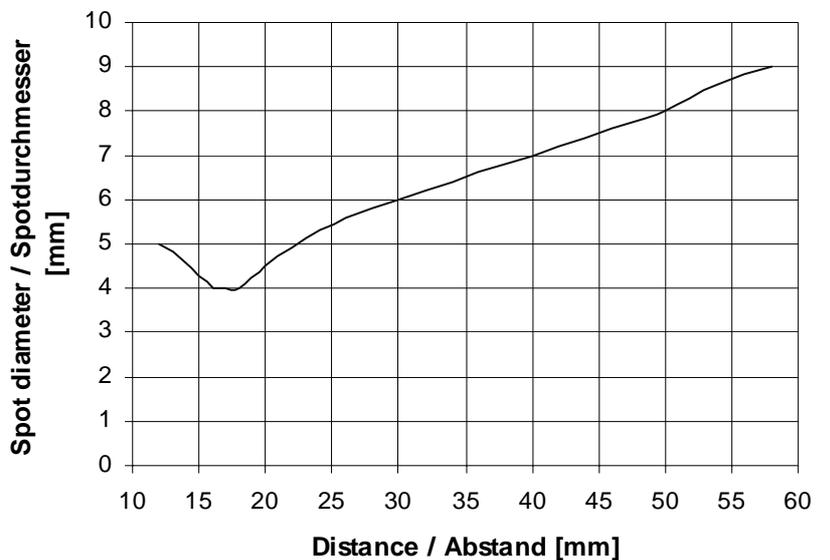
SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
with fiber optics FAR-T-A2.0-2,5-1200-67°
and attachment optics KL-3
(fiber optics fixed at limit stop into attachment optics)



SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
with fiber optics FAR-T-A2.0-2,5-1200-67°
and attachment optics KL-M18-A2.0
(fiber optics fixed at limit stop into attachment optics)

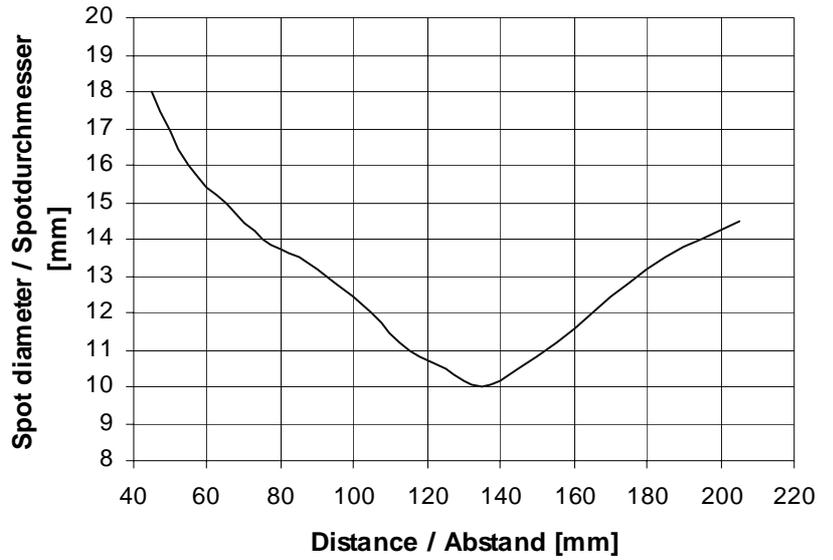


Diagrams

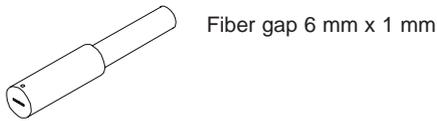
Diagrams: SPOT DIAMETER depending on distance

SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
with fiber optics FAR-T-A2.0-2,5-1200-67°
and attachment optics KL-M34-A2.0
(fiber optics fixed at limit stop into attachment optics)

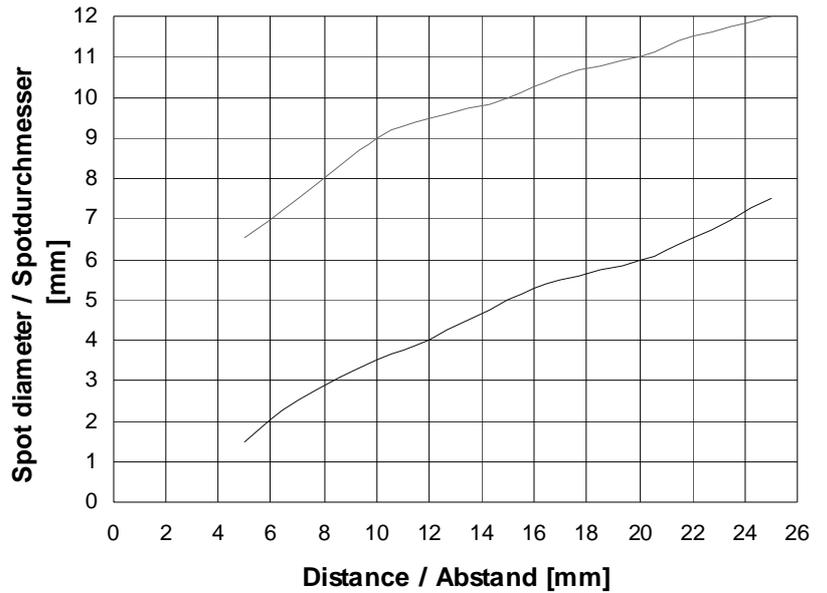


◆ short semiaxis
● long semiaxis



SPOT DIAMETER [distance], typ.

colorSENSOR LT-3-HE
with fiber optics FAR-T-R2.1-6x1-1200-67°



Attachment Optics

	Type	Article number	Object distance (typ.)	Detection range (typ.)*	Dimensions	LWL FASOP
	KL-3	10823012	8mm - 20mm	1mm - 5mm	L x Ø ap. 60mm x 15mm	A 2.0 ¹⁾
	KL-M18-A2.0	10823020	15mm - 50mm	2mm - 10mm	L x Ø ap. 51mm x M18 x 1	A 2.0 ¹⁾
	KL-M34	10823278	80mm - 150 mm	10mm - 20mm	L x Ø ap. 71mm x M34 x 1.5	A 2.0 ¹⁾
	KL-M34/62	10824196	80mm - 150 mm	2mm - 5mm	L x Ø ap. 170mm x 62mm	A 2.0 ¹⁾
	KL-4	10823262	8mm - 20mm	0.6mm - 3mm	L x Ø ap. 60mm x 15mm	A 1.1 ¹⁾
	KL-M18-A1.1	10824140	10mm - 50mm	2mm - 7mm	L x Ø ap. 51mm x M18 x 1	A 1.1 ¹⁾
	KL-D-40	10824143	15mm - 25mm	3mm - 5mm	L x W x H ap. 43.4 x 49.5 x 12mm	A 2.0 ²⁾
	KL-D-28	10824197	20mm - 30mm	5mm - 8mm	L x W x H ap. 31.7 x 40.5 x 15mm	A 2.0 ²⁾
	KL-D-20	10823021	20mm - 40mm	4mm - 10mm	L x W x H ap. 21.4 x 33 x 12mm	A 2.0 ²⁾
	KL-D-17	10823220	30mm - 80mm	8mm - 25mm	L x W x H ap. 36.5 x 25.5 x 15mm	A 2.0 ²⁾
	KL-D-14	10823022	60mm - 120mm	10mm - 20mm	L x W x H ap. 37 x 50 x 20mm	A 2.0 ²⁾
	KL-D-6	10823409	100mm - 200mm	15mm - 30mm	L x W x H ap. 31.1 x 45.1 x 20mm	A 2.0 ²⁾
	KL-5	10824198	8mm - 20mm	2mm x 0.3mm to 15mm x 3mm	L x Ø ap. 60mm x 15mm	R 1.1 ¹⁾
	KL-8	10823920	8mm - 20mm	4mm x 0.7mm to 30mm x 5mm	L x Ø ap. 60mm x 15mm	R 2.1 ¹⁾

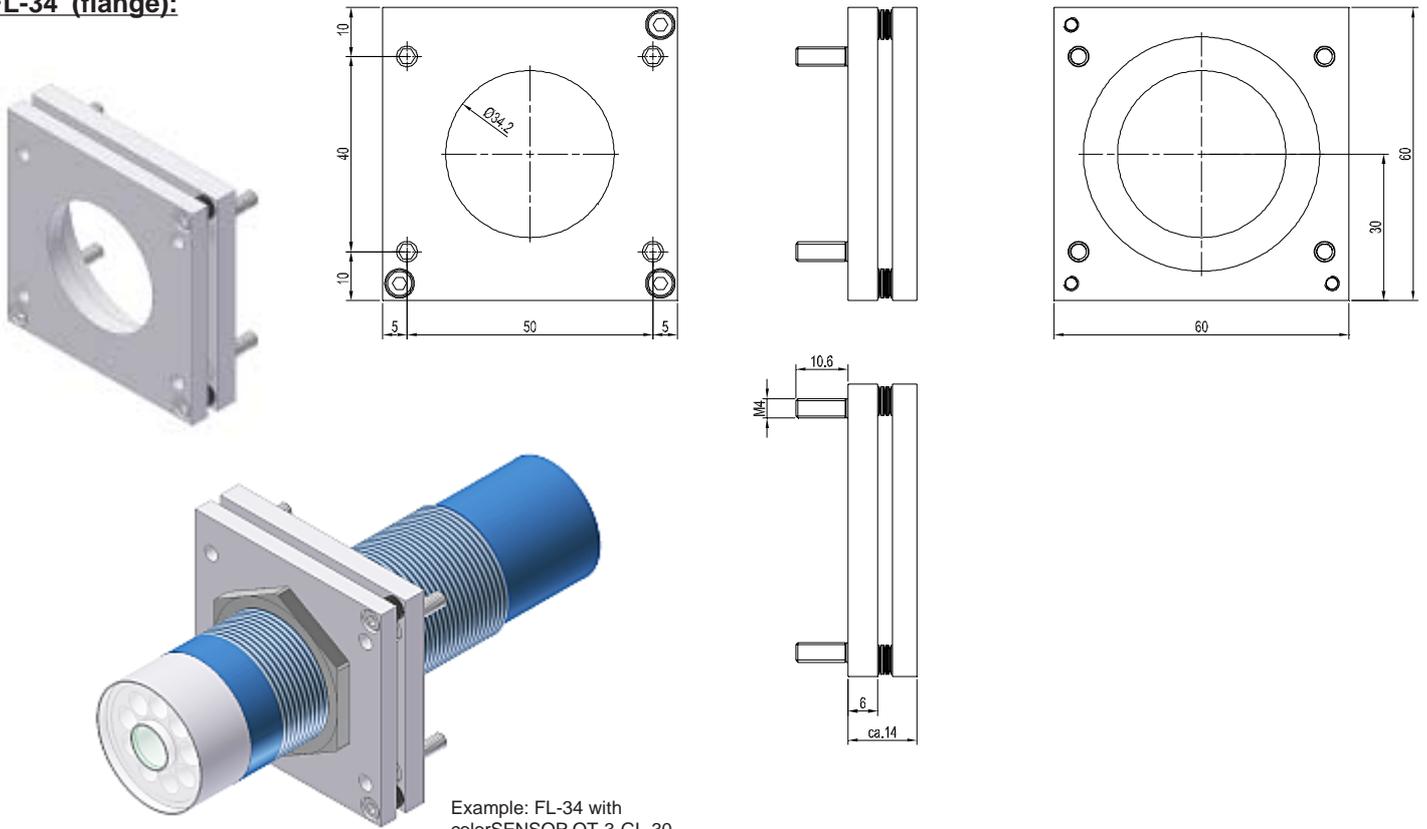
*The smallest figure in the table relates to the smallest typical optical diameter that is generated. This corresponds to roughly the smallest detection area for color or optical fiber sensors.

¹⁾ Reflex optical fiber (FAR)

²⁾ Transmitted light mode fiber optical cables (FAD)

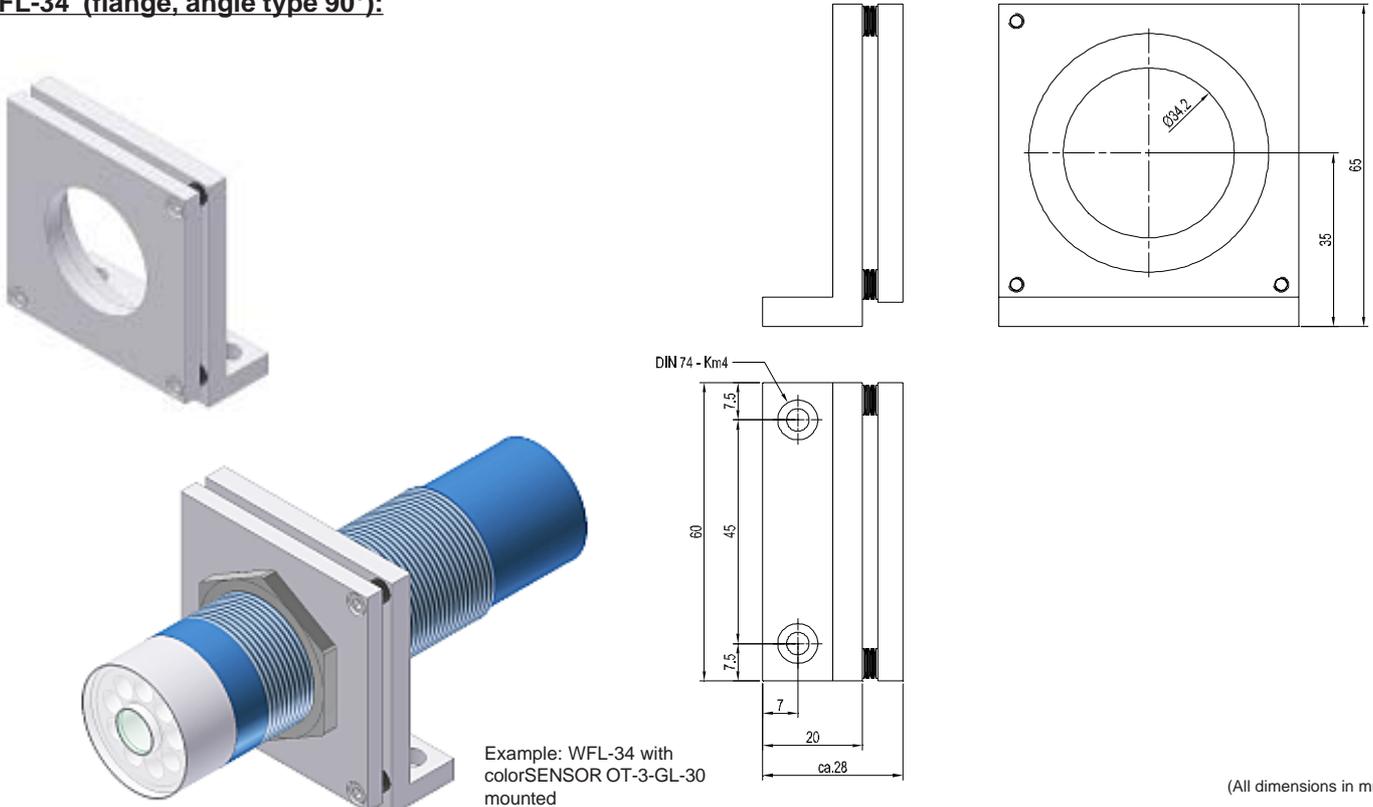
Mounting Accessories

FL-34 (flange):



Example: FL-34 with colorSENSOR OT-3-GL-30 mounted

WFL-34 (flange, angle type 90°):



Example: WFL-34 with colorSENSOR OT-3-GL-30 mounted

(All dimensions in mm)

Application Example

Color checking of LED lamps

Differently colored LED lamps should be detected. On the one hand the active color, caused by the LEDs in the lamps, should be checked, and on the other hand the passive color, here the colored or transparent plastic.

The test was performed with a colorSENSOR LT-3-HE in combination with a FAR-P-A2.0-2,5-600-67° optical fibre, because this series allows both the detection of passive and of active colors. Measurement was performed in DC operating mode, in BEST HIT mode with x/y INT setting.



(Bild 2) 3 different objects (LED)



(Bild 3) Test setup active colors (white)



(Bild 5) Test setup active colors (orange)



(Bild 4) Test setup active colors (red)



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