# MICRO-EPSILON

# More Precision

**colorSENSOR** // Colour Sensors, LED Analyzers

Micro-Epsilon Eltrotec has 40 year´s experience in the development and use of colour recognition sensors and fibre optic technology.
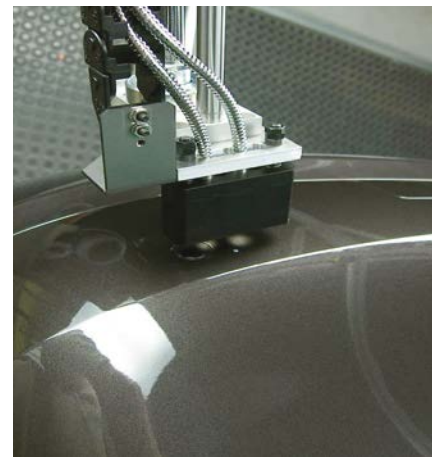
In production and quality assurance, a number of very different types of colour sensor are responsible for high productivity and cost reduction.

The sensors record colour values, intensities and functions, and do so on various surfaces and selfluminous objects.

The very latest colour sensors and high quality fibre optics are combined in a comprehensive product range.

They are used where high efficiency and effectiveness are called for.

Numerous renowned customers worldwide rely on accurate colour recognition sensors from Micro-Epsilon Eltrotec and their production.

## Basics and selection criteria

## Universal colour sensors

## Colour sensors for special measurement targets

## Quality inspection of LEDs and illumination

## Accessories

## Standard colour space CIE 1931 (xy colour space)

This colour space corresponds to the human colour perception (very large green and small blues/red sector).
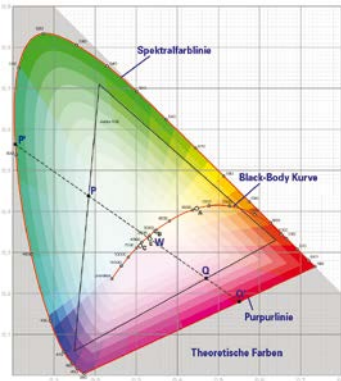


CIE – Commission internationale de l'éclairage
CIE standardised theoretical primary colours
x = red; y = green; z = blue (x+y+z = 1)
Colour spectrum = „pure" colours
W = whitepoint (x=y=z=1/3)
Black body curve = colour as the temperature of
an ideal black radiator
Suitable for green and active light (LED) test

## Standard colour space CIE Lab

Ideal colour space for colour test, as each colour range is the same size.
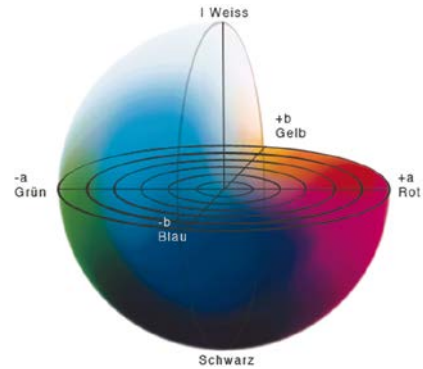


Each colour is defined by the colour location (L*; a*;b*)
L* = Luminosity value (black = 0; white = 100)
a* = Green / red value (green = -100; red = +100)
b* = Blue / yellow value (blue = -100; yellow = +100)

## HSV / HSI colour space

Ideal colour space for LED inspection.
Is used primarily with the colorCONTROL MFA series.
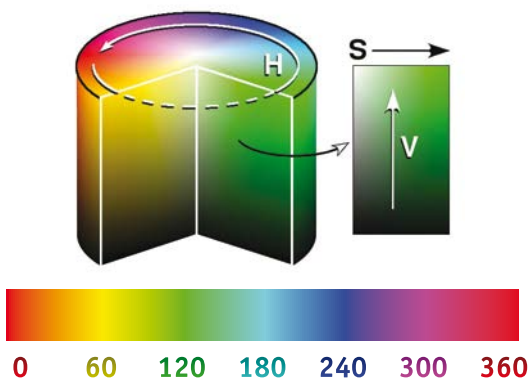


Each colour is defined by the colour location (H; S; V)
H= Hue (red = 0°; green = 120°; blue = 240°)
S= Saturation
    (neutral grey = 0%; "pure" colour = 100 %)
V= Value of luminosity
I = Intensity (light intensity)
    (dark = 0%; totally light = 100%)

## What is meant by Delta E?

Delta E; ΔE; dE = a measure of the perceived colour difference between two colours (DIN 5033)
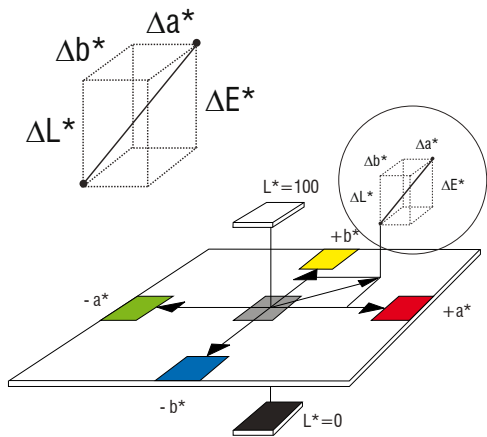


$$\Delta E = \sqrt{(L^*_p - L^*_v)^2 + (a^*_p - a^*_v)^2 + (b^*_p - b^*_v)^2} = 5$$

A ΔE of 5 corresponds roughly to the difference grey 50% ■ und grey 55% ■.

**Selection criteria colorSENSOR**

| colorSENSOR with fibre optics | | LT-1-LC-10 | LT-1-LC-20 | LT-1-ST | WLCS-M-41 | LT-2-ST | LT-2-DU | LT-3-HE | LT-3-LU |
|---|---|---|---|---|---|---|---|---|---|
| Number of colour memories | | 3 | 31 | 15 (255) | 4 | 255 | 255 (2x15) | 31 | 31 |
| Colour difference | | $\Delta E \geq 1.5$ | $\Delta E \geq 1.5$ | $\Delta E \geq 1.5$ | $\Delta E \geq 1.5$ | $\Delta E \geq 0.8$ | $\Delta E \geq 0.8$ | $\Delta E \geq 0.5$ | $\Delta E \geq 0.5$ |
| Detection distance | | 2-100mm | 2-100mm | 2-100mm | 2-150mm | 2-200mm | 2-200mm | 2-200mm | 2-200mm |
| Light spot Ø | | 0.6-20mm | 0.6-20mm | 0.6-20mm | 0.6-30mm | 0.6-30mm | 0.6-30mm | 0.6-30mm | 0.6-30mm |
| Fibre optic + lens | | • | • | • | • | • | • | • | • |
| Teach-in | | • | | • | • | | • | • | • |
| Button teach | | 3 | | 3 | 4 | | 8 (2x4) | 31 | 31 |
| Software | | | • | • | | • | • | • | • |
| Software teach | | | 31 | 15 (255) | | 255 | 255 | 31 | 31 |
| RS 232 interface | | | | • | • | • | • | • | • |
| USB interface | | | | | | • | • | | |
| Characteristics of the application | Matt surface | • | • | • | • | • | • | • | • |
| | Shiny surface | [1] | [1] | [1] | [1] | [1] | [1] | [1] | |
| | Reflective surface | | | | | | | | |
| | Textured surface | | | | | | | | |
| | High temperature to 400 °C | • | • | • | • | • | • | • | |
| | Fluorescent surfaces | | | | | | | | • |
| | Large working distance | | | | | | | | |
| | LED test | | | | | • | • | • | |
| Page | | 6-7 | 8-9 | 10-11 | 12-13 | 14-15 | 16-17 | 18-19 | 20-21 |

[1] with reservations in connection with KL-D-XX focus lens

| colorSENSOR with fixed lenses | | OT-3-MA | OT-3-GL | OT-3-HR | OT-3-LD | OT-3-LU | | | |
|---|---|---|---|---|---|---|---|---|---|
| Number of colour memories | | 31 | 31 | 31 | 31 | 31 | | | |
| Colour difference $\Delta E$ | | $\geq 0.5$ | $\geq 0.5$ | $\geq 0.5$ | $\geq 1.5$ | $\geq 0.5$ | | | |
| Detection distance | | 10-400mm | 10-300mm | 10-300mm | 200-800mm | 10-100mm | | | |
| Light spot Ø | | 4-50mm | 4-50mm | 4-50mm | 20-80mm | 8-40mm | | | |
| Fibre optic + lens | | | | | | | | | |
| Teach-in | | • | • | • | • | • | | | |
| Button teach (colours) | | 31 | 31 | 31 | 31 | 31 | | | |
| Software | | • | • | • | • | • | | | |
| Software teach (colours) | | 31 | 31 | 31 | 31 | 31 | | | |
| RS 232 interface | | • | • | • | • | • | | | |
| USB interface | | | | | | | | | |
| Characteristics of the application | Matt surface | • | • | • | • | | | | |
| | Shiny surface | | • | • | | | | | |
| | Reflective surface | | | • | | | | | |
| | Textured surface | | • | • | | | | | |
| | High temperature to 400 °C | | | | | | | | |
| | Fluorescent surfaces | | | | | • | | | |
| | Large working distance | | | | • | | | | |
| | LED test | • | • | • | • | | | | |
| Page | | 22-23 | 24-25 | 26-27 | 28-29 | 30-31 | | | |

# colorSENSOR LT-1-LC-10

*- Compact colour sensor*

*- 3 colours via Teach-in*

*- 5-fold tolerance adjustment*

*- Fibre optic with focus lenses*

## Features:
- Colour memory : 3 (via Teach-in)
- White light LED
- L*a*b* transformation
- True color colour chip
- Several TEACH possibilities (via PC or external)
- Adaption of fibre optic and focus lens
- Robust aluminium housing
- Switching frequency up to 1kHz

## Application examples:
- Detection of colour rings on metallic and plastic sleeves
- Reading out and statistically evaluating colour values
- Recognising colour markings in the printing industry
- Colour and grey-scale detection
- Inspection of packaging
- Sorting tasks on the basis of colour (e.g. checking O-rings, closures, crown corks, and labels)
- Colour recognition on interior components (e.g. head supports, ...)

With the aid of a modulated white light LED, a spot of white light is projected directly through an fibre optic to the surface being inspected. Part of the light back-scattered from the object being measured is now focused by fibre optic onto a perceptive True-Colour detector element, sub-divided according to RGB colour values and transformed into L*a*b*.

With the LC-10, up to 3 colours can be taught easily via the Teach-in or external teach functions. I f a colour that has been taught is recognised by the sensor, a change in switching condition is made via the 3 encoded digital outputs.

## Dimensions:
Dimensions in mm, not to scale
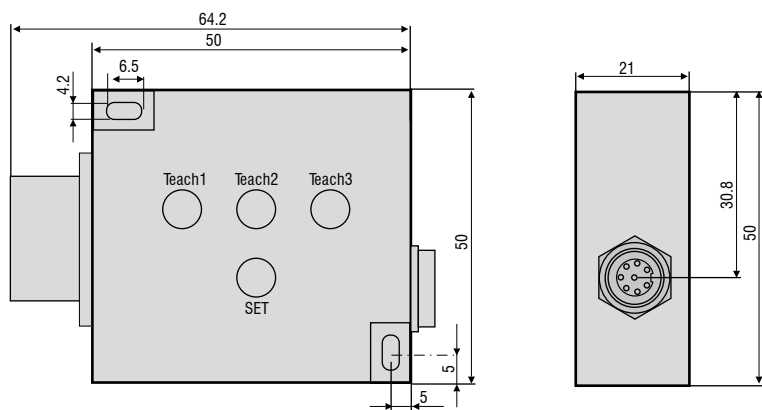
| Type | LT-1-LC-10 |
| --- | --- |
| Article number | 10234059 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables typically 2mm-15mm with lens, typically 5mm-100mm1) |
| Light spot diameter | dependent on the fibre optics used and the optical heads Ø 0,6mm-20mm 1) |
| Colour difference | ΔE ≥1.5 |
| Colour spaces | L*a*b* |
| Averaging | - |
| Size of the colour memory | max. 4 colours in non-volatile EEPROM with tolerance level |
| Switching frequency | max. 1kHz |
| Reproducibility | 3x12-Bit-A/D conversion |
| Temperature drift X,Y | 0.2% /K |
| Light source | white light LED, AC mode |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibility |
| Ambient light | up to 5000 Lux |
| Intermittent light operation | AC: typ. 10kHz |
| Power supply | +18 - 28VDC |
| Current consumption | typ. 100mA |
| Max. switching current | 100mA |
| TEACH button/inputs | 4 buttons, Set and IN0 - IN2 for external teaching of the colour reference and tolerance level |
| Outputs | OUT 0 - OUT 2, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | visualisation by means of 3 yellow LEDs |
| Interface | - |
| Type of connector | to PLC: 8-pole flange socket (binder series 712) |
| Connection cable | to Power/PLC: art. no. 11234091 |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | - |
| Pulse extension | 10ms |
| Signal amplification | - |
| Housing material | aluminium, black anodised |
| Operating temperature | -10°C - +55°C |
| Storage temperature | -10°C - +85°C |
| Protection class | IP54 |
| Fibre optic | page 34 onwards |

1) Type: FAR-T-A2.0-2,5-1200-67° reflex type
   Type: FAD-T-A2.0-2.5-1200-67° transmitted light  (p.36 onwards)

*- Compact colour sensor*

*- 31 colours via software*

*- 5-fold tolerance adjustment*

*- Fibre optic with focus lenses*

## Features:

- Colour memory: 31 (via software)
- RS232 interface
- White light LED
- Colour spaces: X/Y INT; s/i M (Lab)
- True color colour chip
- Several TEACH possibilities
  (via PC or external)
- A variety of evaluation algorithms can be
  activated
- Colour grouping
- Adaption of fibre optic and focus lens
- Robust aluminium housing
- Switching frequency up to 35kHz
- colorCONTROL S software

## Application examples:

- Detection of colour rings on metallic and
  plastic sleeves
- Reading out and statistically evaluating
  colour values
- Recognising colour markings in the printing
  industry
- Colour and grey-scale detection
- Inspection of packaging
- Sorting tasks on the basis of colour (e.g.
  checking O-rings, closures, crown corks,
  and labels)
- Colour recognition on interior components
  (e.g. head supports, ...)
- LED tests of function, colour and intensity

With the aid of a modulated white light LED, a spot of white light is projected directly through an fibre optic to the surface being inspected. Part of the light back-scattered from the object being measured is now focused by fibre optic onto a perceptive True-Colour detector element, sub-divided according to RGB colour values and transformed into L*a*b*.

With the LC-20, 31 colours can be taught using the colorCONTROL S software. If a colour that has been taught is recognised by the sensor, a change in switching condition is made via the 5 encoded digital outputs.

## Dimensions:
Dimensions in mm, not to scale
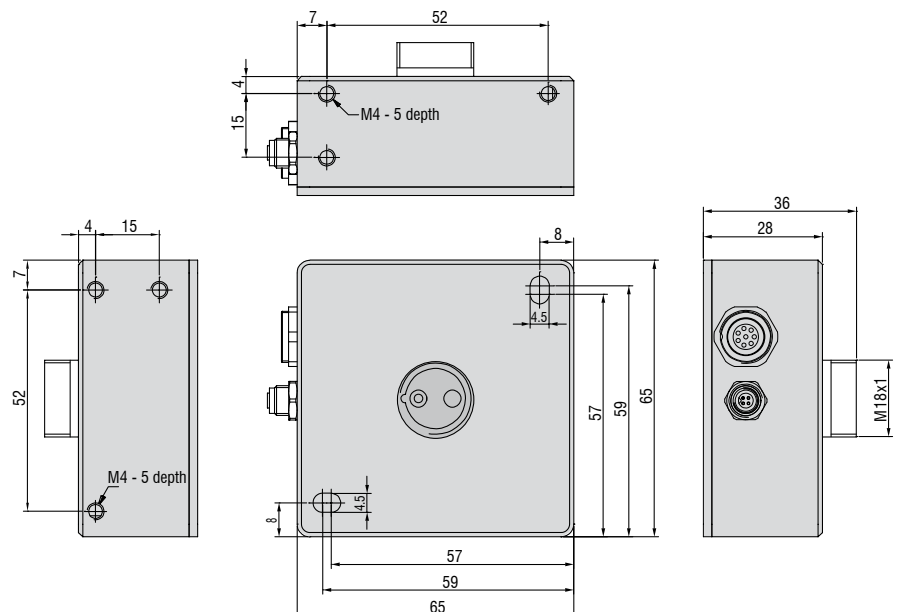
| Type | LT-1-LC-20 |
|---|---|
| Article number | 10234060 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables typically 2mm-15mm with lens, typically 5mm-100mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads reflex mode fibre optical cables, typically Ø 0.6mm-20mm [1] |
| Colour difference | ΔE ≥1.5 |
| Colour spaces | X/Y INT; s/i M (Lab) |
| Averaging | more than max. 32768 values |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 35kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | in the x,y colour 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 or PULSE mode (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibility |
| Ambient light | up to 5000Lux (in AC and PULSE mode) |
| Intermittent light operation | AC: typ. to 20kHz  (depending on amplification level AMP1 to AMP8)<br>DC: typ. to 35kHz PULSE mode: typ. to 5kHz |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof |
| Current consumption | < 160mA |
| Max. switching current | 100mA, short-circuit protected |
| TEACH button/inputs | no button for external teaching of the colour references apart from IN0 |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100 mA max. switching current npn-, pnp-capable<br>(bright or dark switching, switchable) |
| Switching state display | - |
| Interface | RS232 |
| Type of connector | to PLC: 8-pole flange socket (binder series 712)<br>to PC: 8-pole flange socket (binder series 712) |
| Connection cable | to power/PLC: art. no. 11234091 / to PC: 11234095 (RS232); 11234096 (USB) |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL S |
| Pulse extension | adjustable 0ms-100ms |
| 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 | IP54 |
| EMC test according | DIN EN 60947-5-2 |
| Fibre optic | page 34 onwards |

[1] Typ: FAR-T-A2.0-2,5-1200-67˚ reflex
Typ: FAD-T-A2.0-2,5-1200-67˚ transmitted light  (p. 36 onwards)

*- Compact True color recognition sensor*

*- 255 colours can be saved*

*- Teach-in (3 colours)*

*- PC programmable via RS232*

*- Fibre optic with focus lenses*

*- Adjustable illumination*

### Features:
- Colour memory:
  3 (Teach-In buttons), 255 (software)
- max. 4 colour channels (15 with binary coding)
- RS232 interface
- White light LED
- L*a*b* / L*u*v* transformation
- A variety of evaluation algorithms can be activated
- 15 colour grouping are possible
- Adaption of fibre optic and focus lens
- Robust aluminium housing
- Switching frequency to 10kHz
- colorCONTROL LT software
- Recording of colour values by means of Colour Watcher software

### Application examples:
- Detection of colour rings on metallic and plastic sleeves
- Reading out and statistically evaluating colour values
- Recognising colour markings in the printing industry
- Colour and grey-scale detection
- Inspection of packaging
- Sorting tasks on the basis of colour (e.g. checking O-rings, closures, crown corks, and labels)
- Colour recognition on interior components (e.g. head supports, ...)

### Dimensions:
Dimensions in mm, not to scale
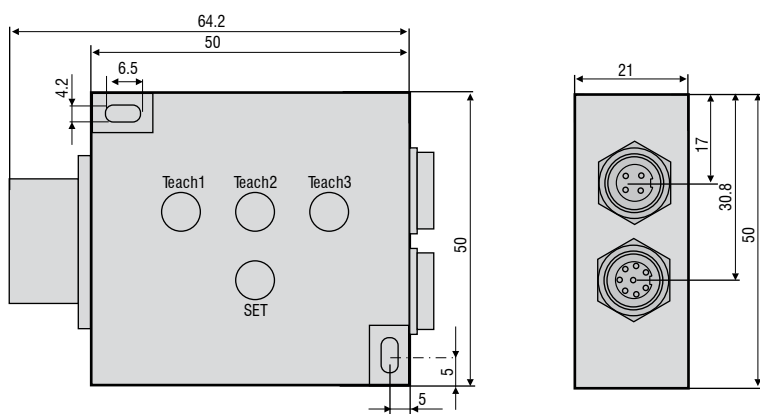
| Typ | LT-1-ST |
|---|---|
| Article number | 10234061 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables typically 2mm-25mm with lens, typically 5mm-100mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables, typically 0.6mm-20mm [1] |
| Colour difference | $\Delta E \geq 1.5$ |
| Colour spaces | XYZ, xyY, $L_{99}a_{99}b_{99}$, L*a*b*, L*u*v*, u'v'L* |
| Averaging | more than max. 57600 values |
| Size of the colour memory | max. 255 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 10kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | 3x12-Bit-A/D conversion |
| Temperature drift X,Y | 0.2%/K |
| Light source | white light LED, AC mode (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | via fibre optics |
| Effect through illumination | suitable for flexibility |
| Ambient light | up to 5000 Lux |
| Intermittent light operation | AC: typ. to 10kHz |
| Power supply | +18 - 28VDC |
| Current consumption | typ. 100mA |
| Max. switching current | 100mA |
| TEACH button/inputs | 4 buttons, Set and IN0 - IN2 for external teaching of the colour reference and tolerance level |
| Outputs | OUT 0 - OUT 2, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | visualisation by means of 3 yellow LEDs |
| Interface | RS232 |
| Type of connector | to PLC: 8-pole flange socket (binder series 712)<br>to PC: 4-pole flange socket (binder series 712) |
| Connection cable | to power/PLC: art. no. 11234091 / to PC: art. no. 11234093 (RS232) |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse extension | adjustable 0ms-100ms |
| Signal amplification | - |
| Housing material | aluminium, black anodised |
| Operating temperature | -10°C - +55°C |
| Storage temperature | -10°C - +85°C |
| Protection class | IP54 |
| Fibre optic | 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.36 onwards)

# colorSENSOR WLCS-M-41

*- The all-round talent for colour recognition*

*- 4 colour memory „Teach-in"*

*- Fibre optic with focus lenses to 100mm*

*- Colour and intensity evaluation*

*- High colour resolution*

*- „Plug & Play" operating concept*

## Features:
- Multi-Teach by buttons on the sensor
- Separation of sensor and sampling point (explosion-protected for hazardous areas)
- Switch Output, 4x potential-free
- Adaption of fibre optics for every application
- Working distance 2-100mm, depending on fibre optic and lens
- Protection class IP65
- Solid enclosure concept for rugged industrial applications
- Independent of distance due to colour and intensity evaluation (C and C+ I )
- Resolution
  Colour ≤ 12bit
  Intensity ≤ 12bit
- External teaching
- - Perceptive colour processing
- White light LED as light source
- RS232 interface
- 4 colour grouping can be saved
- Four-stage signal amplification
- Colour spaces: C, C+I

## Advantages:
- Application-oriented teaching of tolerances through „multiple teaching" per channel
- Separate tolerance setting via potentiometer for each colour memory is also possible
- Genuine three sector device
- Fibre optic adaption
- Universal operation
- No selectivity gaps in the colour range

## Application examples:
- Colour sorting and inspection
- Recognising similar colours
- Recording colour codes
- Recognising positions
- Recognising locking compounds
- All colour recognition tasks (between 390 and 750nm)
- Recognition of intensity

## Dimensions:
Dimensions in mm, not to scale



106
40
87.5
71
63
Ø 4.2
4
Ø 4.2
POWER
> max
in range
< min
OUT
TEACH
1  2  3  4

① El. connection M23
② Serial port (M9 3-pin)
③ FASOP optical adapter (FA) for fiber optic connection standard reflex type: see 1
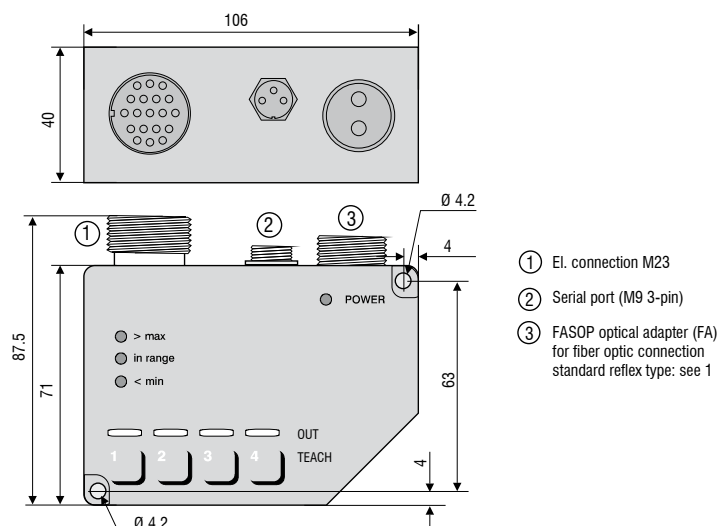
| Type | WLCS-M-41 |
|---|---|
| Article number | 10234062 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables typically 2mm-25mm with lens, typically 5mm-150mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables, typically Ø 0.6mm-30mm [1] |
| Colour difference | ΔE ≥1.5 |
| Colour spaces | C, C+I |
| Averaging | more than 32 values |
| Size of the colour memory | max. 4 colours in non-volatile EEPROM with tolerance level via potentiometer |
| Switching frequency | 1kHz, 32Hz with averaging |
| Reproducibility | in the C+I colour range ≤ 12 Bit-A/D conversion |
| Temperature drift X,Y | 0.1% / K |
| Light source | white light LED, AC mode |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibility |
| Ambient light | up to 5000Lux |
| Intermittent light operation | AC: typ. 20kHz |
| Power supply | +18 - 30VDC |
| Current consumption | typ. 240mA |
| Max. switching current | 240mA |
| TEACH button/inputs | 4 buttons and IN1 - IN4 for external teaching of the colour reference |
| Outputs | OUT 1-OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current |
| Switching state display | visualisation by means of 4 yellow LEDs |
| Interface | RS232 |
| Type of connector | to PLC: 19-pole flange socket (Harting)<br>to PC: 3-pole flange socket |
| Connection cable | to power/PLC: art no. 11234089 / to PC: art. no. 11234090 (RS232) |
| Receiver | 3-PIN photodiodes with colour filter |
| Software | - |
| Pulse extension | - |
| Signal amplification | - |
| Housing material | aluminium, black anodised |
| Operating temperature | 0°C - +50°C |
| Storage temperature | 0°C - +80°C |
| Protection class | IP65 |
| Fibre optic | p. 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. 36 onwards)

*- Standard colour sensor*

*- 255 colours can be saved*

*- Perceptive colour sensor system*

*- PC programmable via RS232 / USB*

*- Fibre optic with focus lenses*

*- Distinguishing colours like the human eye*

## Features:

- Colour memory: up to 255 colours
- RS232/ USB interface
- White light LED
- L*a*b* / L*u*v* / DIN99 transformation
- Can be re-calibrated
- Switchable for LED recognition
- Several TEACH possibilities (via PC or external)
- A variety of evaluation algorithms can be activated
- Colour grouping
- Adaption of FASOP fibre optic and focus lenses
- Robust aluminium housing
- Switching frequency up to 15kHz
- colorCONTROL LT software

## Application examples:

- Quality assurance
- Reading out and statistically evaluating colour values
- Recognising colour markings in the printing industry
- Colour and grey-scale detection
- Recognising the degree of browning with bakery products
- Inspection of packaging
- Sorting tasks on the basis of colour (e.g. checking O-rings, closures, crown corks, and labels)
- Colour recognition on vehicle body parts, bumpers, doors, etc.
- LED tests of function, colour and intensity

## Dimensions:

Dimensions in mm, not to scale
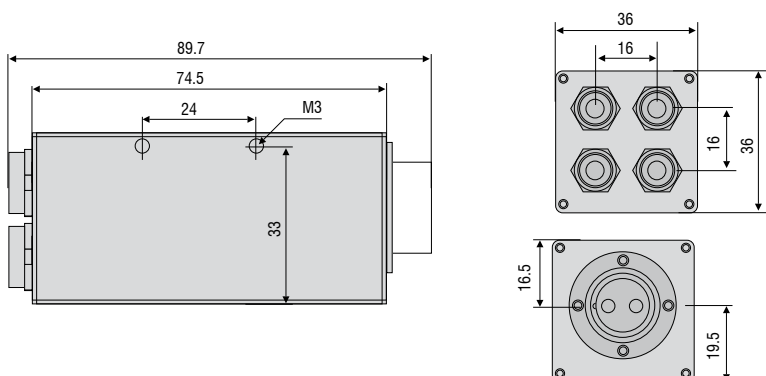
| Type | LT-2-ST |
|---|---|
| Article number | 10234063 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex optics fibre typ. 2mm-25mm with lens, typ. 5mm-200mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads<br>reflex fibre optic typ. Ø 0.6mm-30mm [1] |
| Colour difference | $\Delta E \geq 0.8$ |
| Colour spaces | XYZ, xyY, $L_{99}a_{99}b_{99}$, L*a*b*, L*u*v*, u'v'L* |
| Averaging | more than max. 57600 values |
| Size of the colour memory | max. 255 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 15kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | 3x12-Bit-A/D conversion |
| Temperature drift X,Y | 0.2% /K |
| Light source | 2x white light LED, AC mode (adjustable or OFF for self-luminous objects, software-switchable) [2] |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibility |
| Ambient light | to 5000Lux |
| Intermittent light operation | AC: typically to 15kHz (depending on 4 amplification levels) |
| Power supply | +18 - 28VDC |
| Current consumption | typ. 500mA |
| Max. switching current | 100mA |
| TEACH button/inputs | no button for external teaching of the colour references apart from IN0 - IN1 |
| Outputs | OUT 0 - OUT 7, digital (0V/+Ub), 100 mA max. switching current |
| Switching state display | - |
| Interface | RS232, USB 2.0 |
| Type of connector | to PLC: 8-pole flange socket (binder series 712)<br>to PC: 4-pole flange socket (binder series 712) |
| Connection cable | to power/PLC: 2 x art. no. 11234091 / to PC: art. no. 11234093 (RS232); 11234094 (USB) |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse extension | adjustable 0ms-100ms |
| Signal amplification | 4 levels (1, 5, 25, and 100) |
| Housing material | aluminium, black anodised |
| Operating temperature | -10 °C - +55°C |
| Storage temperature | -10 °C - +85°C |
| Protection class | IP65 |
| Fibre optic | p. 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. 36 onwards)
[2] suitable for LED testing

- *2-channel colour sensor*

- *255 colours can be saved*

- *Teach-in (8 colours)*

- *PC programmable via RS232 / USB*

- *Fibre optic with focus lenses*

- *Distinguishing colours like the human eye*

**Features:**
- Colour memory: 8 (Teach-in) 255 (software)
- 2x White light LED
- RS232 and USB 2.0 interface
- Colour spaces: XYZ, xyY, $L_{99}a_{99}b_{99}$, L*a*b*, L*u*v*, u'v'L*
- Switchable for LED recognition
- Several TEACH possibilities (via PC or external)
- Difference / reference / 2-channel mode
- Adaption of FASOP fibre optic and focus lens
- Logical link, deviation mode
- Switching frequency to 15kHz
- Perceptive colour processing
- Six teach buttons on the housing
- 4 stage signal amplification
- colorCONTROL LT software

**Application examples:**
- Quality assurance
- Reading out and statistically evaluating colour values
- Detection of colour rings on metallic and plastic sleeves
- Recognising colour markings in the printing industry
- Colour and grey-scale detection
- Checking colour gradients
- Checking colour transitions
- Checking colour deviations
- Inspection of packaging
- Colour recognition on vehicle body parts, bumpers, doors, etc.
- LED tests of function, colour and intensity

**Dimensions:**
Dimensions in mm, not to scale



110
100
4.2
6.5
28
70
73.7
Height: 30mm
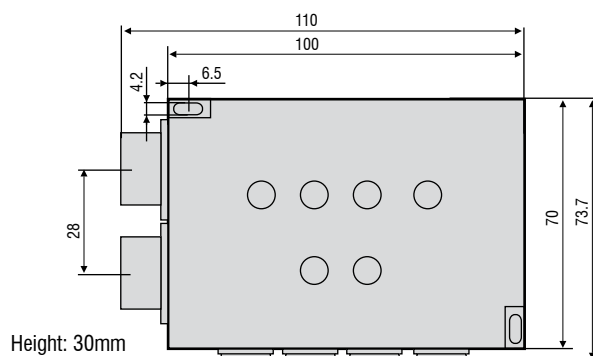
| Type | LT-2-DU |
|---|---|
| Article number | 10234064 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex mode fibre optical cables typically 2mm-25mm with lens, typically 5mm-200 mm[1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads<br>reflex fibre optic typ. Ø 0.6mm-30mm [1] |
| Colour difference | $\Delta E \geq 0.8$ |
| Colour spaces | XYZ, xyY, $L_{99}a_{99}b_{99}$, L*a*b*, L*u*v*, u'v'L* |
| Averaging | more than max. 57600 values |
| Size of the colour memory | max. 255 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 15kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | 3x12-Bit-A/D conversion |
| Temperature drift X,Y | 0.2% /K |
| Light source | 2x white light LED, 2x white light LED, AC mode (adjustable or OFF for self-luminous objects, software-switchable) [2] |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable in flexibility |
| Ambient light | to 5000Lux |
| Intermittent light operation | AC: typically to 15kHz (depending on 4 amplification levels) |
| Power supply | +18 - 28VDC |
| Current consumption | typ. 500mA |
| Max. switching current | 100mA |
| TEACH button/inputs | 6 buttons, Tol, Lo/Hi and IN0/4 - IN3/8 for external teaching of the colour reference and tolerance level |
| Outputs | OUT 0 - OUT 7, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | visualisation by means of 3 yellow LEDs |
| Interface | RS232, USB 2.0 |
| Type of connector | to PLC: 8-pole flange socket (binder series 712)<br>to PC: 4-pole flange socket (binder series 712) |
| Connection cable | to power/PLC: 2 x art no. 11234091 / to PC: art no. 11234093 (RS232); 11234094 (USB) |
| Receiver | 2x3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse extension | adjustable 0ms-100ms |
| Signal amplification | 4 levels (1, 5, 25 and 100) |
| Housing material | aluminium, black anodised |
| Operating temperature | -10 °C - +55°C |
| Storage temperature | -10 °C - +85°C |
| Protection class | IP54 |
| Fibre optic | p. 34 onwards |

[1] Type: FAR - T - A 2.0 - 2,5 - 1200 - 67˚ reflex
   Type: FAD - T - A 2.0 - 2,5 - 1200 - 67˚ transmitted light  (p. 36 onwards)
[2] suitable for LED testing

*- High-end colour sensor*

*- 31 colours can be saved*

*- Fibre optic adaption*

*- Colour and grey scale evaluation*

*- PC programmable via RS232 / USB*

### Features:
- Colour memory: 31 colours per Teach-in and software
- RS232 interface (USB adapter optional)
- Modulated white light LED (can be connected for external super-bright white light source)
- Switchable brightness readjustment
- Colour and grey-scale detection
- Switchable averaging
- A variety of evaluation algorithms can be activated
- Switching frequency max. 30kHz
- Switching state display
- Temperature compensation <0.01%/K
- Eight-stage signal amplification, adjustable
- Colour spaces: X/Y INT; s/i M (Lab)

### Application examples:
- Detection of colour rings
- Recognising colour markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of colour
- Colour recognition on interior components
- Colour control of self-luminous objects (LEDs, displays, etc.)

### Dimensions:
Dimensions in mm, not to scale

Ø52

25

115

60

M34x1.5

Ø32
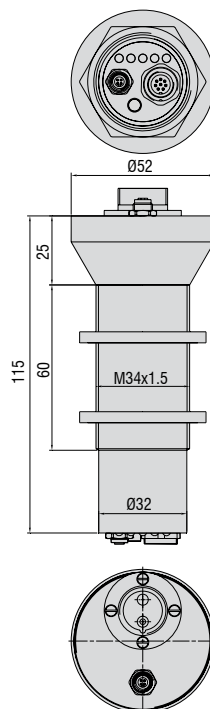
| Type | LT-3-HE |
|---|---|
| Article number | 10234065 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex fibre optic typ. 2mm-25mm with lens typ. 5mm-200mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads<br>reflex fibre optic typ. Ø 0.6mm-30mm [1] |
| Colour difference | ΔE ≥0.5 |
| Colour spaces | X/Y INT; s/i M (Lab) |
| Averaging | more than max. 32768 values |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | In the x,y colour 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,<br>(adjustable or OFF for self-luminous objects, software-switchable) [2] |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibility |
| Ambient light | to 5000Lux (AC-mode) |
| Intermittent light operation | AC: typ. 10kHz to 40kHz (depending on amplification level AMP1 to AMP8)<br>DC: switchable by PC software |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof |
| Current consumption | typ. 320mA |
| Max. switching current | 100mA, short-circuit protected |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current<br>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-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL S |
| Pulse extension | adjustable 0ms-100ms |
| 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 | IP67 (lens), IP64 (electronics) |
| EMC test according | DIN EN 60947-5-2 |
| Fibre optic | p. 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. 36 onwards)
[2] suitable for LED testing

# colorSENSOR LT-3-LU

*- High-end colour sensor*
  *for fluorescent objects*

*- 31 colours can be saved*

*- Adaption of UV-light capable*
  *fibre optics*

*- Colour and grey scale evaluation*

*- Detection of luminescent colours*

*- PC programmable via RS232 / USB*

## Features:

- Colour memory: 31 colours per Teach-in
  and software
- RS232 interface (USB adapter optional)
- Modulated white light LED (385nm)
  (can be connected for external super-bright
  white light source)
- Switchable brightness readjustment
- Colour and grey-scale detection
- Switchable averaging
- A variety of evaluation algorithms can be
  activated
- Switching frequency max. 30kHz
- Switching state display
- UV fibre optic available
- colorCONTROL S software

## Application examples:

- Detection of luminescent colours
- Recognising colour markings
  in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of colour

## Dimensions:

Dimensions in mm, not to scale

Ø52

25

115    60    M34x1.5

Ø32
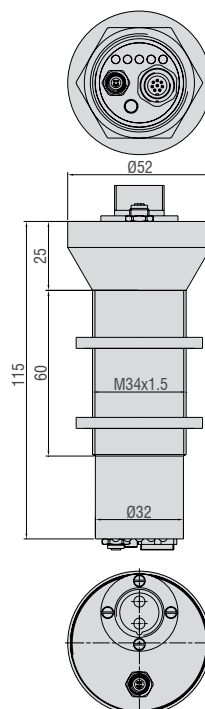
| Type | LT-3-LU |
|---|---|
| Article number | 10234066 |
| Object distance | dependent on the fibre optics used and the optical heads<br>reflex fibre optic typ. 2mm-25mm with lens typ. 5mm-50mm [1] |
| Light spot diameter | dependent on the fibre optics used and the optical heads [1] |
| Colour difference | ΔE ≥0.5 |
| Colour spaces | X/Y INT; s/i M (Lab) |
| Averaging | more than max. 32768 values |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) |
| Reproducibility | in the x,y colour range, 1 digit each with 12-Bit-A/D conversion |
| Temperature drift X,Y | < 0.01% /K |
| Light source | super-bright UV LED, 385nm, AC-, DC mode, (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | via fibre optic |
| Effect through illumination | suitable for flexibly recognising luminescent colours |
| Ambient light | to 5000 Lux (AC mode) |
| Intermittent light operation | AC: typ. 10kHz to 40kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof |
| Current consumption | typ. 320mA |
| Max. switching current | 100mA, short-circuit protected |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current<br>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-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) |
| Software | colorCONTROL S |
| Pulse extension | adjustable 0ms-100ms |
| 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 | IP67 (lens), IP64 (electronics) |
| EMC test according | DIN EN 60947-5-2 |
| Fibre optic | p. 34 onwards |

[1] Type: FAR - T - A 2.0 - 2,5 - 1200 - 67° - UV reflex
    FAD - T - A 2.0 - 2,5 - 1200 - 67° - UV transmitted light

- *Colour sensor for large distances and matt surfaces*

- *31 colours can be saved*

- *Focused illumination for rapidly changing object distances*

- *Colour and grey scale evaluation*

- *PC programmable via RS232*

**Features:**
- White light LED ring, focused, with clear glass covering
- Object distance typ. 10mm - 400mm
- Large dynamic range through focused white light operation
- Colour memory: 31 colours per Teach-in and software
- RS232 interface (USB adapter optional)
- Switchable brightness readjustment
- Switching frequency max. 30kHz
- A variety of evaluation algorithms can be activated,e.g. „BEST HIT" mode
- Switching state display via 5 yellow LEDs
- Switchable averaging
- Colour control of self-luminous objects

**Application examples:**
- Colour recognition of matt surfaces at a distance of up to 400mm
- Detection of colour rings
- Recognising colour markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of colour
- Colour control of self-luminous objects (LEDs, displays, etc.)
- Illumination recognition as per colour and intensity

colorSENSOR OT colour sensors are fixed lens sensors with True-Colour detection. The sensor automatically illuminates the surface with white light and records the reflected colour values. Aside from the optics, the models are almost identical. The illumination can be disabled by software. OT sensors are then suitable for the colour detection of self-luminous sources.

**Dimensions:**
Dimensions in mm, not to scale
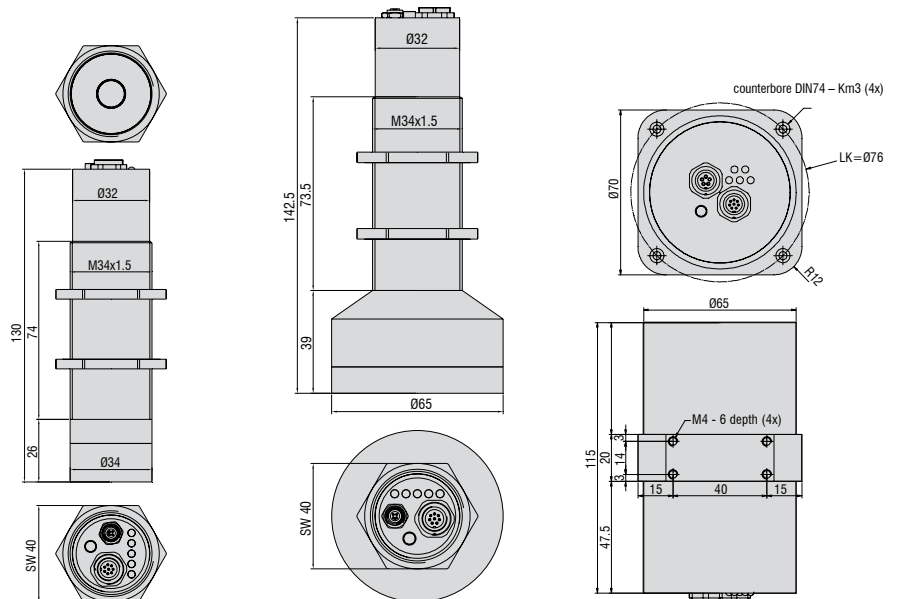
OT-3-MA-30-8/OT-3-MA-30-16
OT-3-MA-50-12.5/OT-3-MA-50-25

OT-3-MA-80-36

OT-3-MA-200-20

| Type | OT-3-MA-30-8 | OT-3-MA-30-16 | OT-3-MA-50-12.5 | OT-3-MA-50-25 | OT-3-MA-80-36 | OT-3-MA-200-20 |
|---|---|---|---|---|---|---|
| Article number | 10234067 | 10234068 | 10234069 | 10234070 | 10234071 | 10234072 |
| Object distance | typ. 10mm-100mm ideal distance 30mm | | typ. 20mm-120mm ideal distance 50mm | | typ. 40mm-150mm ideal distance 80mm | typ. 50mm-400mm ideal distance 200mm |
| Light spot | Ø 5-16mm | Ø 10-31mm | Ø 4-24mm | Ø 8-48mm | Ø 30-48mm | Ø 5-40mm |
| Light spot diameter | Ø 8mm at 30mm | Ø 16mm at 30mm | Ø 12.5mm at 50mm | Ø 25mm at 50mm | Ø 36mm at 80mm | Ø 20mm at 200mm |
| Colour difference | ΔE ≥0.5 | | | | | ΔE ≥1.5 |
| Colour spaces | X/Y INT; s/i M (Lab) | | | | | |
| Averaging | more than max. 32768 values | | | | | |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets | | | | | |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) | | | | | |
| Reproducibility | in the x,y colour range, 1 digit each with 12-Bit-A/D conversion | | | | | |
| Temperature drift X,Y | < 0.01% /K | | | | | |
| Light source | 8x white light LED, AC-, DC mode [1] (adjustable or OFF for self-luminous objects, software-switchable) | | | | 12x white light LED, AC-, DC mode [1] (adjustable bzw. OFF for self-luminous objects, software-switchable | 10x white light LED, modulated 30kHz |
| Type of illumination | focused | | | | | |
| Effect through illumination | large dynamic range for matt/dark surfaces | | | | | |
| Ambient light | to 5000Lux (AC mode) | | | | | to 5000Lux |
| Intermittent light operation | AC: typ. 10kHz to 40kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software | | | | | 30kHz |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof | | | | | |
| Current consumption | typ. 320mA | | | | | |
| Max. switching current | 100mA, short-circuit protected | | | | | |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references | | | | | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA 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) | | | | | to PLC: 8-pole flange socket (binder 712) to PC: 5-pole flange socket (binder 712) |
| Connection cable | to power/PLC: art. no. 11234091 / to PC: art. no 11234095 (RS232); 11234096 (USB). | | | | | to power/PLC: art. no. 11234091 to PC: art. no. 11234092 |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) | | | | | |
| Software | colorCONTROL S | | | | | colorCONTROL C4 |
| Pulse extension | adjustable 0ms-100ms | | | | | |
| 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 | IP67 (lens), IP64 (electronics) | | | | | IP64 |
| EMC test according | DIN EN 60947-5-2 | | | | | |

[1] suitable for illumination testing

*- Colour sensor for non-homogeneous surfaces and shine suppression*

*- 31 colours can be saved*

*- Diffuse illumination for the reduction of the shine effect*

*- Colour and grey scale evaluation*

*- PC programmable via RS232 / USB*

**Features:**
- White light LED ring with diffusor and clear glass covering
- Object distance typ. 10mm - 300mm
- Suppression of the shine effect through diffuse illumination
- Colour memory: 31 colours via Teach-in and software
- RS232 interface (USB adapter optional)
- Insensitive to external light up to 5000Lux
- Switchable brightness readjustment
- Switching frequency max. 30kHz
- A variety of evaluation algorithms can be activated, e.g. „BEST HIT" mode
- Switching state display via 5 yellow LEDs
- Switchable averaging
- Colour control of self-luminous objects

**Application examples:**
- Colour recognition of textured and/or shiny surfaces
- Detection of colour rings
- Recognising colour markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of colour
- Colour control of self-luminous objects (LEDs, displays, etc.)

**Dimensions:**
Dimensions in mm, not to scale
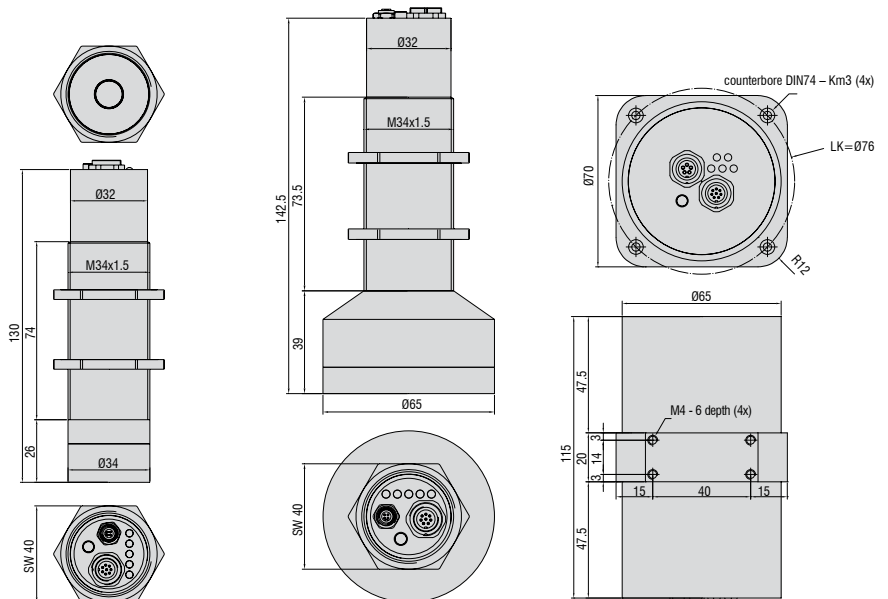
OT-3-GL-30-8/OT-3a-GL-30-16
OT-3-GL-50-12.5/OT-3-GL-50-25

OT-3-GL-80-36

OT-3-GL-200-20

| Type | OT-3-GL-30-8 | OT-3-GL-30-16 | OT-3-GL-50-12.5 | OT-3-GL-50-25 | OT-3-GL-80-36 | OT-3-GL-200-20 |
|---|---|---|---|---|---|---|
| Article number | 10234073 | 10234074 | 10234075 | 10234076 | 10234077 | 10234078 |
| Object distance | typ. 10mm-60mm ideal distance 30mm | | typ. 20mm-80mm ideal distance 50mm | | typ. 40mm-100mm ideal distance 80mm | typ. 50mm-300mm ideal distance 200mm |
| Light spot | Ø 4-14mm | Ø 8-28mm | Ø 5-20mm | Ø 10-40mm | Ø 30-40mm | Ø 5-30mm |
| Light spot diameter | Ø 8mm at 30mm | Ø 16mm at 30mm | Ø 12.5mm at 50mm | Ø 25mm at 50mm | Ø 36mm at 80mm | Ø 20mm at 200mm |
| Colour difference | ΔE ≥0.5 | | | | | ΔE ≥1.5 |
| Colour spaces | X/Y INT; s/i M (Lab) | | | | | |
| Averaging | more than max. 32768 values | | | | | |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets | | | | | |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) | | | | | |
| Reproducibility | in the x,y colour range, 1 digit each with 12-Bit-A/D conversion | | | | | |
| Temperature drift X,Y | < 0.01% /K | | | | | |
| Light source | 8x white light LED, AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) | | | | 12x white light LED, AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) | 10x white light LED, modulated 30kHz |
| Type of illumination | diffuse | | | | | |
| Effect through illumination | suppression of the shine effect | | | | | |
| Ambient light | to 5000Lux (AC mode) | | | | | to 5000Lux |
| Intermittent light operation | AC: typ. 10kHz to 40kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software | | | | | 30kHz |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof | | | | | |
| Current consumption | typ. 320mA | | | | | |
| Max. switching current | 100mA, short-circuit protected | | | | | |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references | | | | | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA 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) | | | | | to PLC: 8-pole flange socket (binder 712) to PC: 5-pole flange socket (binder 712) |
| Connection cable | to power/PLC: art. no. 11234091 to PC: 11234095 (RS232); art. no. 11234096 (USB) | | | | | to power/PLC: 11234091 to PC: art. no. 11234092 |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) | | | | | |
| Software | colorCONTROL S | | | | | colorCONTROL C4 |
| Pulse extension | adjustable 0ms-100ms | | | | | |
| Signal amplification | 8 stage (AMP1 - AMP8), adjustable | | | | | - |
| Housing material | aluminium, black anodised | | | | | |
| Operating temperature | -20℃ - +55℃ | | | | | |
| Storage temperature | -20℃ - +85℃ | | | | | |
| Protection class | IP67 (lens), IP64 (electronics) | | | | | IP64 |
| EMC test according | DIN EN 60947-5-2 | | | | | |

*- Colour sensor for reflective and textured surfaces*

*- 31 colours can be saved*

*- Polarised illumination for highly reflective surfaces*

*- Colour and grey scale evaluation*

*- PC programmable via RS232*

## Features:

- White light LED ring with polarisation filter and clear glass covering
- Object distance typ. 10mm - 300mm
- Polarisation filter (significant reduction of the shine effect)
- Colour memory: 31 colours via Teach-in and software
- RS232 interface (USB adapter optional)
- Insensitive to external light up to 5000Lux
- Switchable brightness readjustment
- Switching frequency max. 30kHz
- A variety of evaluation algorithms can be activated, e.g. „BEST HIT" mode
- Switching state display via 5 yellow LEDs
- Switchable averaging
- Colour control of self-luminous objects

## Application examples:

- Colour recognition of highly reflective and/or highly textured surfaces
- Detection of colour rings
- Recognising colour markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of colour
- Colour control of self-luminous objects (LEDs, displays, etc.)

## Dimensions:
Dimensions in mm, not to scale
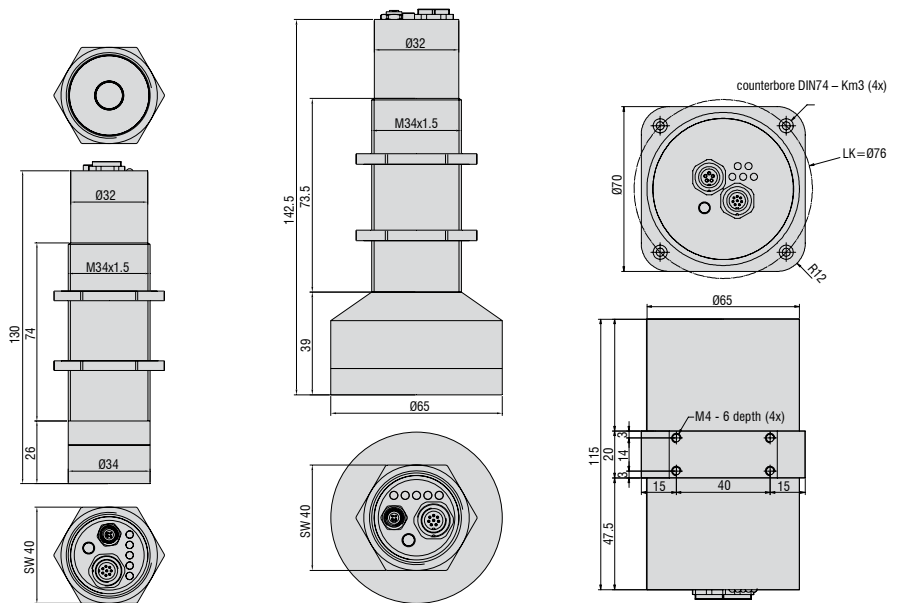


OT-3-HR-30-8/OT-3-HR-30-16
OT-3-HR-50-12.5/OT-3-HR-50-25

OT-3-HR-80-36

OT-3-aHR-200-20

| Type | OT-3-HR-30-8 | OT-3-HR-30-16 | OT-3-HR-50-12.5 | OT-3-HR-50-25 | OT-3-HR-80-36 | OT-3-HR-200-20 |
|---|---|---|---|---|---|---|
| Article number | 10234079 | 10234080 | 10234081 | 10234082 | 10234083 | 10234084 |
| Object distance | typ. 10mm-40mm ideal distance 30mm | | typ. 20mm-80mm ideal distance 50mm | | typ. 40mm-100mm ideal distance 80mm | typ. 50mm-300mm ideal distance 200mm |
| Light spot | Ø 4-10mm | Ø 8-20mm | Ø 5-20mm | Ø 10-40mm | Ø 30-40mm | Ø 5-30mm |
| Light spot diameter | Ø 8mm at 30mm | Ø 16mm at 30mm | Ø 12.5mm at 50mm | Ø 25mm at 50mm | Ø 36mm at 80mm | Ø 20mm at 200mm |
| Colour difference | ΔE ≥0.5 | | | | | ΔE ≥1.5 |
| Colour spaces | X/Y INT; s/i M (Lab) | | | | | |
| Averaging | more than max. 32768 values | | | | | |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets | | | | | |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) | | | | | |
| Reproducibility | In the x,y colour range, 1 digit each with 12-Bit-A/D conversion | | | | | |
| Temperature drift X,Y | < 0.01% /K | | | | | |
| Light source | 8x white light LED | 8x white light LED | 8x white light LED | 8x white light LED | 12x white light LED | 10x white light LED modulated 30kHz |
| | AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) | | | | | |
| Type of illumination | Polarisation filter, focused | | | | | |
| Effect through illumination | great reduction of the shine effect, ideal for highly reflecting surfaces | | | | | |
| Ambient light | to 5000Lux (AC mode) | | | | | to 5000Lux |
| Intermittent light operation | AC: typ. 10kHz bis 40kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software | | | | | 30kHz |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof | | | | | |
| Current consumption | typ. 320mA | | | | | |
| Max. switching current | 100mA, short-circuit protected | | | | | |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references | | | | | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current npn-, pnp-capable (bright or dark switching, switchable) | | | | | |
| Switching state display | visualisation by means of 5 yellow LEDs | | | | | |
| Interface | RS232 (USB optional) | | | | | |
| Type of connector | to PLC: 8-pole flange socket (binder series 712) to PC: 4-pole flange socket (binder series 707) | | | | | to PLC: 8-pole flange socket (binder series 712) to PC: 5-pole flange socket (binder series 712) |
| Connection cable | to power/PLC: art. no. 11234091 to PC: art. no. 11234095 (RS232); 11234096 (USB) | | | | | to power/PLC: art. no. 11234091 to PC: art. no. 11234092 |
| Receiver | 3-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) | | | | | |
| Software | colorCONTROL S | | | | | colorCONTROL C4 |
| Pulse extension | adjustable 0ms-100ms | | | | | |
| Signal amplification | 8 stage (AMP1 - AMP8), adjustable | | | | | |
| Housing material | aluminium, black anodised | | | | | |
| Operating temperature | -20℃ - +55℃ | | | | | |
| Storage temperature | -20℃ - +85℃ | | | | | |
| Protection class | IP67 (lens), IP64 (electronics) | | | | | IP64 |
| EMC test according | DIN EN 60947-5-2 | | | | | |

- *- Colour sensor for large distances*

- *- 31 colours can be saved*

- *- Coaxial optics for large working distance up to 900mm*

- *- Colour and grey scale evaluation*

- *- PC programmable via RS232*

## Features:

- Object distance typ. 50mm - 900mm
- Integrated receiver and transmitter optics (coaxial)
- Colour memory: 31 colours via Teach-in and software
- RS232 interface (USB adapter optional)
- Super-bright white light LED
- Colour, contrast and grey-scale detection
- Insensitive to external light up to 5000Lux
- Switchable brightness readjustment
- Switching frequency max. 35kHz
- A variety of evaluation algorithms can be activated e.g. „BEST HIT" mode
- Switching state display via 5 yellow LEDs
- Temperature compensated (< 0.01% /K)
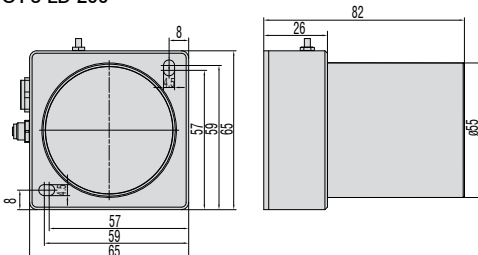- Switchable averaging
- Colour control of self-luminous objects

## Application examples:

- Colour recognition from long distances up to 900mm
- Correct insertion of poduct in production machinery
- Inspection of packaging
- Sorting tasks on the basis of colour
- Colour assignment on automobiles
- Detecting drink crates
- Paper, recycling recognition
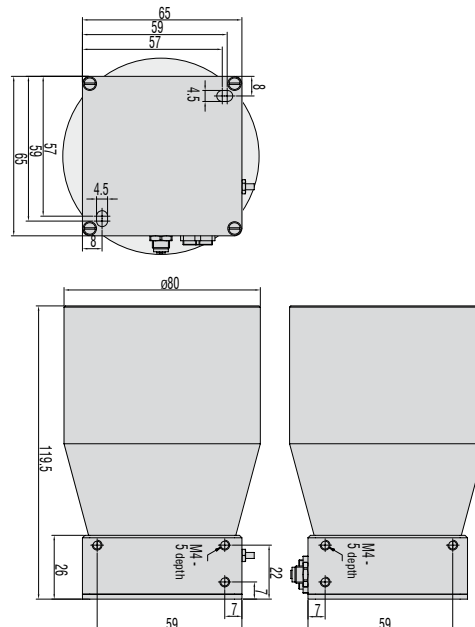- Illumination recognition as per colour and intensity

**OT-3-LD-500**

## Dimensions:

Dimensions in mm, not to scale

**OT-3-LD-200**

| Typ | OT-3-LD-200-6 | OT-3-LD-200-12 | OT-3-LD-200-26 | OT-3-LD-500-23 | OT-3-LD-500-50 |
|---|---|---|---|---|---|
| Article number | 10234434 | 10234437 | 10234438 | 10234085 | 10234086 |
| Object distance | typ. 100-700mm ideal distance 200mm | typ. 50-500mm ideal distance 200mm | typ. 50-500mm ideal distance 200mm | typ. 100-900mm ideal distance 500mm | typ. 100-900mm ideal distance 500mm |
| Light spot | Ø 4-28mm | Ø 4-32mm | Ø 6-70mm | Ø 6-46mm | Ø 8-105mm |
| Light spot diameter | Ø 6mm at 200mm | Ø 12mm at 200mm | Ø 26mm at 200mm | Ø 25mm at 500mm | Ø 58mm at 500mm |
| Colour difference | ΔE ≥ 1 | ΔE ≥ 1 | ΔE ≥ 1 | ΔE ≥1,5 | |
| Colour spaces | X/Y INT; s/i M (Lab) | | | | |
| Averaging | more than max. 32768 values | | | | |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets | | | | |
| Switching frequency | max. 35kHz (depending on number of colours being taught and the setting for the averaging) | | | | |
| Reproducibility | in the x,y colour range, 1 digit each with 12-Bit-A/D conversion | | | | |
| Temperature drift X,Y | < 0,0% / K | | | | |
| Light source | super-bright white light LED; AC-, DC- oder PULSE mode (adjustable or OFF for self-luminous objects, software-switchable) [1] | | | | |
| Type of illumination | coaxial | | | | |
| Effect through illumination | large object distance | | | | |
| Ambient light | to 5000Lux (in AC and PULSE mode) | | | | |
| Intermittent light operation | AC: typ. to 20kHz (depending on amplification level AMP1 to AMP8) DC: typ. to 35kHz PULSE: typ. to 5kHz switchable by PC software | | | | |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof | | | | |
| Current consumption | typ. 160mA | | | | |
| Max. switching current | 100mA, short-circuit protected | | | | |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references | | | | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA 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-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) | | | | |
| Software | colorCONTROL S | | | | |
| Pulse extension | adjustable 0ms-100ms | | | | |
| Signal amplification | 8 steps (AMP1 - AMP8), adjustable | | | | |
| Housing material | aluminium, black anodised | | | | |
| Operating temperature | -20°C - +55°C | | | | |
| Storage temperature | -20°C - +85°C | | | | |
| Protection class | IP67 (lens), IP64 (electronics) | | | | |
| EMC test according | DIN EN 60947-5-2 | | | | |

[1] suitable for illumination testing

- *Colour sensor for fluorescent objects*

- *31 colours can be saved*

- *UV illumination to detect luminescent colours*

- *Colour and grey scale evaluation*

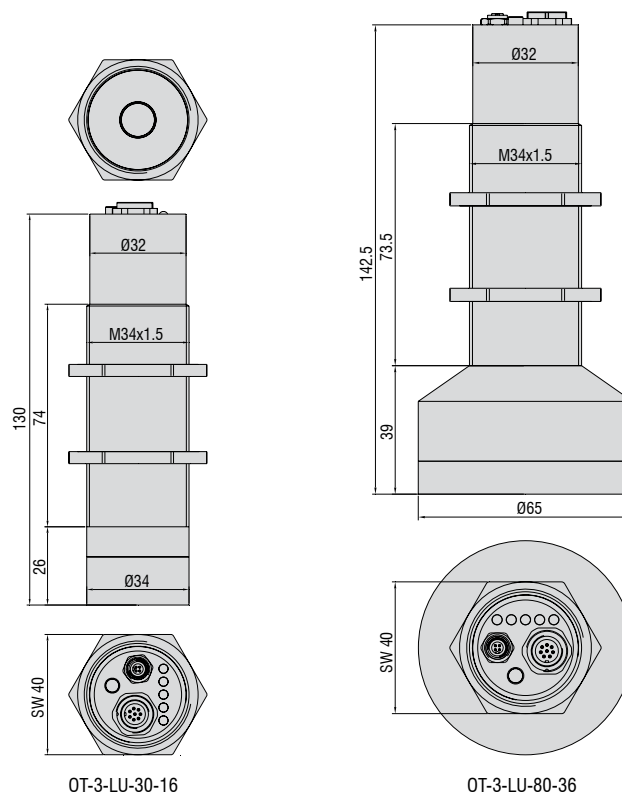- *PC programmable via RS232*

**Features:**
- UV-LED ring with black glass cover, 385nm
- Object distance typ. 10mm - 100mm
- Colour memory: 31 colours via Teach-in and software
- RS232 interface (USB adapter optional)
- Recognition of different luminescent colours
- Insensitive to external light up to 5000Lux
- Switchable brightness readjustment
- Switching frequency max. 30kHz
- A variety of evaluation algorithms can be activated, e.g. „BEST HIT" mode
- Switching state display via 5 yellow LEDs
- Switchable averaging

**Application examples:**
- Presence of the applied adhesive
- Detection of safeguarding thread
- Turbidity of liquids

**Dimensions:**
Dimensions in mm, not to scale

Ø32

M34x1.5

130

74

26

Ø34

SW 40

OT-3-LU-30-16

Ø32

M34x1.5

142.5

73.5

39

Ø65

SW 40

OT-3-LU-80-36

| Type | OT-3-LU-30-16 | OT-3-LU-80-36 |
|---|---|---|
| Article number | 10234087 | 10234088 |
| Object distance | typ. 10mm-40mm ideal distance 30mm | typ. 40mm-100mm ideal distance 80mm |
| Light spot | Ø 8-20mm | Ø 30-40mm |
| Light spot diameter | Ø 16mm at 30mm | Ø 36mm at 80mm |
| Colour difference | ΔE ≥0.5 | |
| Colour spaces | X/Y INT; s/i M (Lab) | |
| Averaging | more than max. 32768 values | |
| Size of the colour memory | max. 31 colours in non-volatile EEPROM with parameter sets | |
| Switching frequency | max. 30kHz (depending on number of colours being taught and the setting for the averaging) | |
| Reproducibility | in the x,y colour range, 1 digit each with 12-Bit-A/D conversion | |
| Temperature drift X,Y | $< 0.01\%$ /K | |
| Light source | 8x UV-LED, 385nm<br>AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) | 12x UV-LED, 385nm<br>AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | UV 385nm, focused | |
| Effect through illumination | luminescent colours | |
| Ambient light | to 5000Lux (AC mode) | |
| Intermittent light operation | AC: typ. 10kHz to 40kHz (depending on amplification level AMP1 to AMP8) DC: switchable by PC software | |
| Power supply | +24VDC (± 10%), inverse polarity protected, overload-proof | |
| Current consumption | typ. 320mA | |
| Max. switching current | 100mA, short-circuit protected | |
| TEACH button/inputs | 1 button and IN0 for external teaching of the colour references | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current<br>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-colour filter detector (TRUE COLOR detector, colour filter curve as per CIE 1931) | |
| Software | colorCONTROL S | |
| Pulse extension | adjustable 0ms-100ms | |
| 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 | IP67 (lens), IP64 (electronics) | |
| EMC test according | DIN EN 60947-5-2 | |

- *Multiple-point colour testing system*

- *Optionally with up to 20 channels*

- *Colour testing in HSI and RGB colour space*

- *Colour differentiation/intensity test*

### Features:
- Universal connection of fibre optics
- Individual adaptation of the fibre optic configuration
- Each measuring point can be freely configured to colour, intensity and function
- Integration in test sequence
- Good/poor evaluation
- Output of HSI, RGB and XY values via RS232 or USB
- External trigger
- Replaceable fibre optic adapter
- Suitable for POF (2m) and glass fibre optics up to 5m
- Up to 20 testing points using different assembly kits

### Anwendungen:
- Self-luminous object inspection
- LED test (binning)
- Indication test
- Display test
- 7 segment display inspection
- Checking up to 20 colours parallel and simultaneously ≤1s
- Frontpanel test
- With external illumination, multiple-point colour testing is possible

### Function:
The colour, intensity and light information is fed directly from the measuring object to the MFA via single fibre bundles and evaluated at up to 20 points at the same time.
The inspection of inaccessible and/or remote systems is not difficult with the MFA series, because the information is transmitted to the intelligent evaluation system via fibre optics.

The colorCONTROL MFA-5 can be enlarged up to 20 testing points using the module colorCONTROL MFA-5-M. Additionally, one of the assembly kits is required depending on the construction depths (see accessories).
For example: 20 inspection tests require: 1x colorCONTROL MFA-5 + 3x colorCONTROL MFA-5-M + 1x assembly kit MFA-20.

### Dimensions:
Dimensions in mm, not to scale
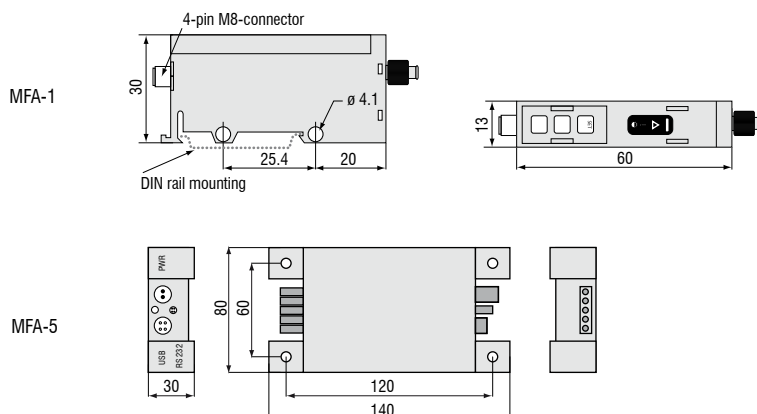
| Type | MFA-1 | MFA-5 | MFA-5-M[1] | MFA-5-P |
|---|---|---|---|---|
| Article number | 11094302 | 11094050 | 11094051 | 11094052 |
| Measuring points | 1 | 5 | extension of MFA-5 up to 10/15 or 20 | 5 |
| Test spectrum | 480 - 1000nm | 450 - 650nm | | |
| Power supply | 10 - 30VDC | 24VDC +/- 10% residual ripple | 24VDC via MFA-5 | 5VDC |
| Current consumption | 100mA | 80mA-320mA | 160-320mA | 80mA |
| Interface | - | RS232, USB, daisy chain | daisy chain | RS232, USB, daisy chain |
| Inputs | 1 external teach input | - | - | - |
| Outputs | 1 switching output npn/pnp | - | - | - |
| | - | - | - | - |
| | - | - | - | - |
| Photo Receiver | 1x black and white photodiode | 5x TRUE COLOR photochip | | |
| Accuracy | ±5% | ±4nm | | |
| Resolution | - | 9-81 pixels per measuring point | | |
| Data memory | EEPROM | - | - | - |
| Object distance | typ. 1-5mm | | | |
| Fibre optic | incl. POF 1m; max. POF 2m / glass 5m | incl. POF 0.5m; max. POF 2m / glass 5m | | |
| Colour space | - | HSI, RGB, XY + colour temperature in K | | |
| Dynamic range | 200lx - 4000lx | | | |
| Testing frequency | ≤5Hz | ≤1Hz (20 measuring points ≤1s) | | |
| Operating temperature | 0 to +60°C | 0 to +50°C | | |
| Humidity | 20% to 80% rel. humidity (non-condensing) | | | |
| Protection class | IP 65 | IP 50 | IP 50 | IP 0 |

[1] Modular extension to 10/15/20 measuring points

*- For colorSENSOR*

*- High-quality fibre optics with polished and ground end-faces*

*- Fibres for visible, ultraviolet and infrared light*

*- For wavelengths from 190 – 2500nm*

**Features:**
- Temperature stability from –40°C to +400°C (special bonding)
- Various aperture angles available 68° (NA0.86), 22° (NA0.21), 121° (NA0.87)
- Maximum cable lengths of 30m available; default lengths: 600, 1200, 1800 or 2400mm
- Large selection of sensor mechanisms for different tasks

## Standard versions

Micro-Epsilon fibre optics for colour sensors and fibre optic sensors for measurements and testing feature a high build and transmission quality.

Ground and polished end-faces ensure excellent optical integration with adapted sensors. A large selection of sensor mechanisms provides optimum flexibility for a great variety of tasks.

## Special versions

### Fibre optics with increased vibration protection

Fibre optics can be manufactured to include increased vibration protection for use with high mechanical loads, such as shock, acceleration, and movement. This special treatment minimises friction between fibres and reduces shocks.

### Fibre optics with special bonding for high temperatures

Standard bonding is suitable for maximum temperatures of 80°C.
Special adhesives allow for temperatures of up to 250°C, even 400°C. These higher temperature ranges require the use of Type E stainless steel sheathing. Temperatures of up to 600°C can be reached with metallized fibres and with sapphire optics installed.
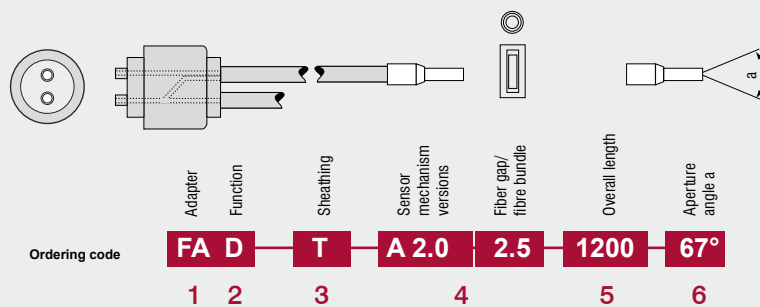
### Customer-specific designs

One of the advantages of Micro-Epsilon fibre optic manufacturing is the production of customer-specific designs for various complex sensor mechanisms.

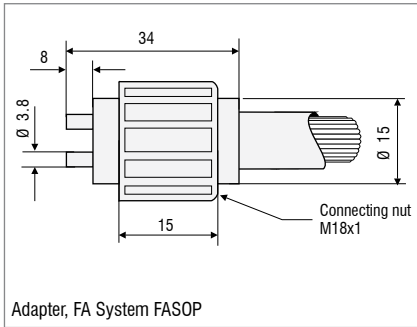| Technical data | | | |
|---|---|---|---|
| Single fibre diameter | 20, 30, 50, 70µm standard fibre (depending on structure) | | |
| Aperture angle | standard fibres | 67° (NA 0.56) | |
| | special fibres | 22° (NA 0.21)<br>121° (NA 0.87 / wide angle)<br>22° UV (80/100µm)<br>22° IR (80/100/150µm) | |
| Material | optical glass (e.g. for UV / IR / in quartz glass) | | |
| Dielectric strength | 50kV/m with PVC protective sheath | | |
| Sensor mechanism – temperature range, fibre bonding | standard | -20°C to + 80°C | |
| | T250 | 0°C to + 250°C | |
| | T400 | -40°C to + 400°C | |
| | T600 | 0°C to + 600°C | |
| Permissible temperature range with sheathing that has appropriate fibre bonding | PVC | -20°C to +80°C | (P) (Z) |
| | metal | +40°C to +180°C | (M) |
| | metal with special bonding | -40°C to +400°C | (E) |
| | metal/silicone | -40°C to +180°C | (T) |
| Fibre transmission | usable for wavelengths from 190-2500nm of different types (we can provide the most suitable solution depending on the requirements) Transmission curves on request! | | |

## Order code for fibre optics

You can see an overview of the Fasop fibre optic range on the following pages.

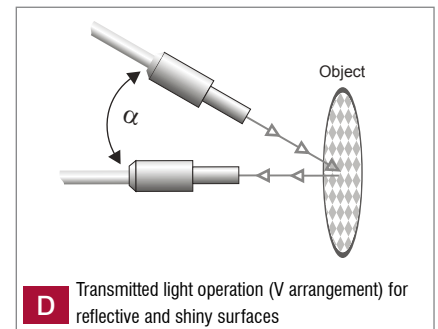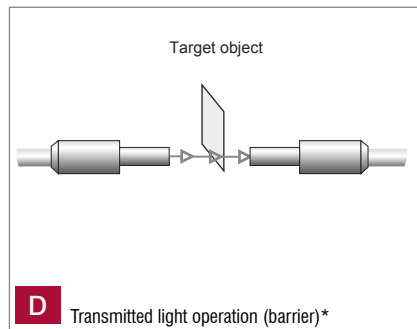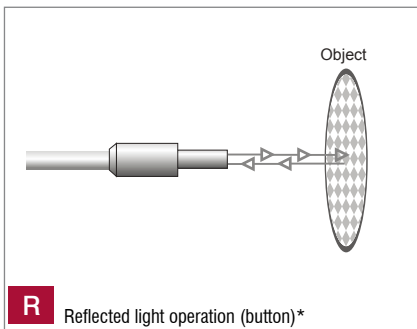You can define your own individual fibre optic from the various components using the order key.



| | Adapter | Function | Sheathing | Sensor mechanism versions | Fiber gap/ fibre bundle | Overall length | Aperture angle a |
|---|---|---|---|---|---|---|---|
| Ordering code | FA | D | T | A 2.0 | 2.5 | 1200 | 67° |
| | 1 | 2 | 3 | 4 | | 5 | 6 |

**1**   Adaption to FA-adapter

**2**   Function of the fibre optic (D = transmitted light mode, R = reflex mode)

**3**   Sheathing e.g. silicone-metal sheath (T)

**4**   Sensor mechanism type, e.g. A2.0
Fibre bundle e.g. 2.5mm dia.

**5**   Overall length of e.g. 1200mm (standard length / bearing types)

**6**   Aperture angle of the fibre, e.g. 67 °

# 1 Adapter version



Adapter, FA System FASOP

# 2 Functions



**R**   Reflected light operation (button)＊



**D**   Transmitted light operation (barrier)＊



**D**   Transmitted light operation (V arrangement) for reflective and shiny surfaces

＊ All functions can also be performed as mutliple reflex and transmitted light functions

# 3 Sheathing

**Silicone metal sheath**
Metal wire-spiral-reinforced hose with glass fibre braiding and silicone rubber sheathing



**T**   Very flexible, highly resistant to bending, tension and torsion; temperature-stable to 180°C, liquid-tight

**Stainless-steel sheath**
Flexible stainless steel wire-spiral-reinforced hose[1]



**E**   Flexible, protection against mechanical stress, temperature-stable to 400°C

**Metal sheath**
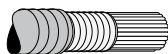Flexible brass wire-spiral-reinforced hose [1]



**M**   Flexible, protection against mechanical stress, temperature-stable to 180°C

**PVC-metal sheath**
Flexible brass spiral-reinforced hose coated with PVC sheathing [1]



**Z**   Flexible, protection against mechanical stress, temperature-stable to 80°C

**PVC special sheath**
Highly flexible plastic hose [2]



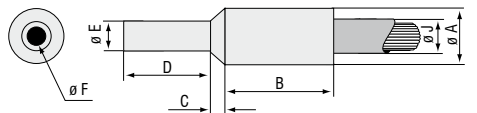**P**   Highly flexible, small sheath diameter, temperature-stable to 80°C

[1] Bending radius corrresponds to three times the external diameter of the sheath.
[2] Bending radius corrresponds to twice the external diameter of the sheath.

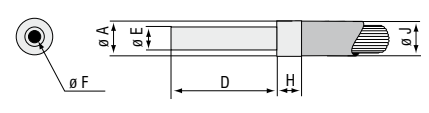Details of sheath diameters can be found in Section 4:

**Please note:** Every version can be supplied with increased vibration protection (VS).
See the „Special versions" section for more information
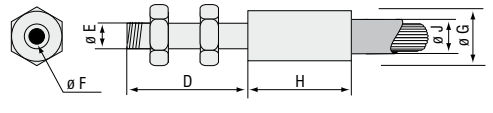
# 4 Sensor mechanism variants and fibre bundles



| Type | A Ø | B | C | D | E Ø | F Ø | P | Ø J M | T |
|---|---|---|---|---|---|---|---|---|---|
| A 1.0 | 4.6 | 8 | 2 | 11 | 2.5 | 1.5 | 4 | 4 | – |
| A 1.1 | 6.6 | 8 | 2 | 11 | 2.5 | 1.5 | – | 5 | 4.4 |
| A 2.0 | 6.6 | 10 | 2 | 12 | 4.5 | 2.5 | 6 | 6 | 5.8 |
| A 3.0 | 8.5 | 11 | 2 | 15 | 6 | 3 | 7 | 7 | 7.5 |

**A** Type A ferrule, stainless steel



| Type | A Ø | D | E Ø | F Ø | H | Ø J P | Ferrule |
|---|---|---|---|---|---|---|---|
| B 1.1 | 2 | 30 | 1 | 0.6 | 2 | 2 | stainless steel |
| B 1.2 | 2 | 10 | 1 | 0.6 | 2 | 2 | stainless steel |
| B 2.0 | 3 | 10 | 2 | 1 | 2 | 3 | alu |
| B 3.0 | 5 | 12 | 4 | 2.5 | 2 | 5 | alu |
| B 4.0 | 8 | 12 | 6 | 3 | 2 | 8 | alu |

**B** Type B ferrule
(only suitable for PVC sheathing)
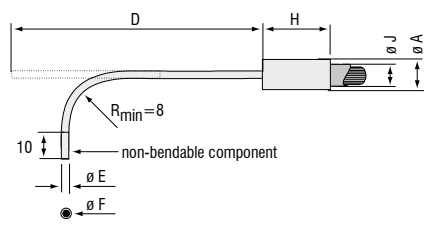


| Type | D | E | F Ø | G Ø | H | P | Ø J M | T |
|---|---|---|---|---|---|---|---|---|
| C 1.0 | 30 | M4 | 1.0 | 6 | 13 | 5 | 5 | 4.4 |
| C 2.0 | 30 | M6 | 2.5 | 8 | 15 | 6 | 6 | 5.8 |
| C 3.0 | 30 | M10 | 3 | 11 | 12 | 7 | 7 | 7.5 |

**C** Type C ferrule, stainless steel

Standard sensor mechanism, bonding
for -20°C to +80°C
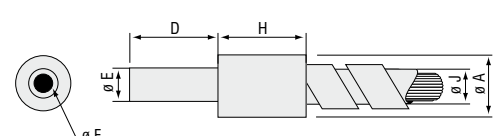Special designs available (T250, T400, T600)

All details in mm
Tolerances: typ. +/- 0.1mm
Al ferrule, black anodised

Different sizes are possible by arrangement,
please ask our product specialists.
(see also the „Special versions" section)



| Type | A Ø | D | E Ø | F Ø | H . | P | Ø J M | T |
|---|---|---|---|---|---|---|---|---|
| O 1.0 | 2 | 100 | 1 | 0.6 | 10 | 2 | – | – |
| O 1.1 | 7 | 100 | 1 | 0.6 | 20 | – | 5 | 4.4 |
| O 2.0 | 3 | 100 | 1.3 | 1 | 10 | 3 | – | – |
| O 2.1 | 7 | 100 | 1.3 | 1 | 20 | – | 5 | 4.4 |

**O** Type O ferrule, bendable, to an extent



| Type | A Ø | D | E Ø | F Ø | H | Ø J | | Ferrule |
|---|---|---|---|---|---|---|---|---|
| | | | | | | M | T | |
| M 1.1 | 6 | 30 | 1 | 0.6 | 10 | 5 | 4.4 | stainless steel |
| M 1.2 | 6 | 10 | 1 | 0.6 | 10 | 5 | 4.4 | stainless steel |
| M 2.0 | 6 | 10 | 2 | 1 | 10 | 5 | 4.4 | alu |
| M 3.0 | 7 | 12 | 4 | 2.5 | 12 | 6 | 5.8 | alu |
| M 4.0 | 9 | 12 | 6 | 3.5 | 12 | 7 | 7.5 | alu |
| M 5.0 | 12 | 16 | 7 | 5 | 16 | 9 | 9 | alu |
| M 6.0 | 13 | 16 | 8 | 6 | 18 | 10 | 11.5 | alu |
| M 8.0 | 16 | 20 | 10 | 8 | 20 | 13 | 13.5 | alu |
| M10.0 | 18 | 20 | 12 | 10 | 20 | 15 | – | alu |

**M** Type M ferrule

# 4 Sensor mechanism variants and fibre bundles
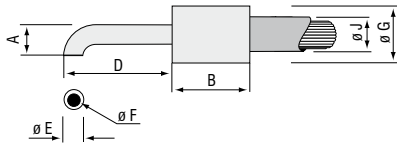


| Type | A Ø | B | D | E Ø | F Ø | G Ø | r | P | Ø J M | T |
|------|-----|---|---|-----|-----|-----|---|---|-------|---|
| D 1.0 | 2.5 | 10 | 20 | 1 | 0.6 | 3 | 1.5 | 2 | – | – |
| D 1.1 | 2.5 | 13 | 20 | 1 | 0.6 | 6 | 1.5 | – | – | 4.4 |
| D 2.0 | 6 | 13 | 20 | 2 | 1.5 | 6 | 4 | 5 | 5 | 4.4 |
| D 3.0 | 15 | 17 | 20 | 5 | 2.5 | 9 | 10 | 7 | 7 | 6.5 |

**D**  Type D ferrule, stainless steel
(* D1.0 only suitable for PVC sheathing)
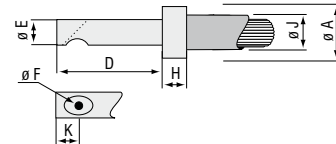


| Type | A Ø | D | E Ø | F Ø | H | K | P | Ø J M | T |
|------|-----|---|-----|-----|---|---|---|-------|---|
| E 1.0 | 4 | 20 | 3 | 1.5 | 1.5 | 4 | 4 | – | – |
| E 2.0 | 5 | 20 | 4 | 2.5 | 1.5 | 4 | 5 | 5 | – |
| E 2.1 | 7 | 20 | 4 | 2.5 | 10 | 4 | – | – | 5.8 |
| E 3.0 | 8 | 20 | 6 | 3 | 1.5 | 5 | 7 | 7 | – |

**E**  Type E ferrule, stainless steel
(* E1.0 only suitable for PVC sheathing)
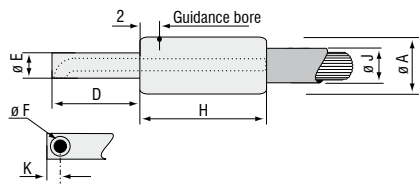


| Type | A Ø | D | E Ø | F Ø | H | K | P | Ø J M | T |
|------|-----|---|-----|-----|---|---|---|-------|---|
| F 1.0 | 8 | 20 | 6 | 1.5 | 9 | 3 | 5 | 5 | 5.8 |
| F 2.0 | 10 | 20 | 8 | 2.5 | 10 | 4 | 6 | 6 | 6.5 |
| F 3.0 | 12 | 20 | 10 | 3 | 10 | 5 | 7 | 7 | 7.5 |

**F**  Type F ferrule, stainless steel
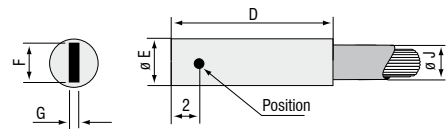


| Type | D | E Ø | F | G max. | P | Ø J M | T |
|------|---|-----|---|--------|---|-------|---|
| R 1.0 | 25 | 4 | 3 | 0.5 | 3 | – | – |
| R 1.1 | 30 | 7 | 3 | 0.5 | 6 | 6 | 5.8 |
| R 2.0 | 25 | 7 | 6 | 1 | 6 | 6 | 5.8** |
| R 2.1 | 30 | 10 | 6 | 1 | – | 7 | 7.5 |

**R**  Type R ferrule, aluminium
* R1.0 only suitable for PVC sheathing
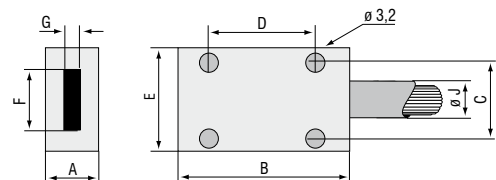** at 6x1 mm², can be made to a length of 1200
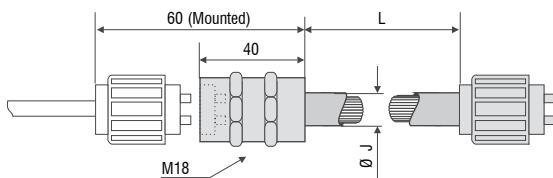


| Fibre bundle Ø | P | Ø J M | T | L |
|----------------|---|-------|---|---|
| (3mm)/ channel | 12 | 13 | 13.5 | variable |

**LV**  Type LV ferrule
Fibre optic extension / feed-through

All details in mm
Attention: With angular sensor mechanism versions, a reduction in range can be expected compared to axially emerging versions.



| Type | A | B | C | D | E | F | G | Ø J |
|------|---|---|---|---|---|---|---|-----|
| Q1 | 12 | 25 | 9 | 15 | 15 | 5 | 0.5 | |
| Q2 | 12 | 30 | 14 | 20 | 20 | 10 | 0.3 | |
| Q3 | 12 | 35 | 24 | 25 | 30 | 18 | 0.3 | |
| Q4 | 12 | 55 | 34 | 40 | 40 | 28 | 0.2 | |
| Q5 | 12 | 55 | 44 | 40 | 50 | 38 | 0.15 | dependent on fibre cross-section |
| Q6 | 12 | 55 | 54 | 40 | 60 | 48 | 0.15 | |
| Q7 | 16 | 75 | 64 | 60 | 70 | 58 | * | |
| Q8 | 16 | 75 | 74 | 60 | 80 | 68 | * | |
| Q9 | 20 | 90 | 84 | 75 | 90 | 78 | * | |
| Q10 | 20 | 90 | 94 | 75 | 100 | 88 | * | |

(F x G 3.5 mm² for CLS and IFA applications with FA adapter)

**Q**  Type Q, aluminium
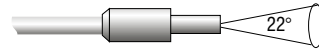Also available in stainless steel

## 5 + 6 Length and aperture angle

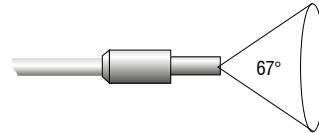Standard lengths are: 600*, 1200*, 1800 and 2400mm.
* Bearing types
Length tolerance type: +/- 4%
Cable lengths of up to 30m can be supplied on request!

**5**

22°

67°

Dependent on the glass fibre material used the following aperture angles are included in the standard range: 22°, 67°, 121°

**6**

## Detection areas, various sensor mechanisms

| Fibre bundle ØF mm | Working distance mm | Light spot for 67° fibre approx. Ø mm | Light spot for 22° fibre approx. Ø mm |
|---|---|---|---|
| 0.6 | 5 | 3 | 3 |
| | 10 | 5 | 4 |
| | 15 | 8[1] | 6 |
| | 20 | 12[1] | 8 |
| 1 | 5 | 3 | 3 |
| | 10 | 7 | 5 |
| | 15 | 11 | 8[1] |
| | 20 | 15[1] | 11[1] |
| 1.5 | 5 | 4 | 3 |
| | 10 | 7 | 5 |
| | 15 | 11 | 8 |
| | 20 | 19[1] | 11 |
| 2.5 | 5 | 5 | 4 |
| | 10 | 10 | 8 |
| | 15 | 13 | 10 |
| | 20 | 19[1] | 13 |
| 3 | 5 | 8 | 5 |
| | 10 | 12 | 7 |
| | 15 | 15 | 10 |
| | 20 | 18[1] | 13 |

Typical values were determined using colorSENSOR LT-2-ST
[1] Can be realised only in certain conditions

*- Focussing of colour and fibre optic sensors*

*- Improving the efficiency of the application*

*- Many possible applications*

**Features:**

- Working distances from 8mm to 200mm
- Scratch-resistant glass lens
- Robust aluminium housing
  (black anodised)
- Bundling to a small light spot
- Increasing the range
- Minimum colour change when the distance
  is altered
- High luminous efficiency
- Special designs possible, according to
  customer requirements
- Colour measurement on small objects at a
  relatively large distance (Kl-3, KL-4)
- Recognising highly absorbent objects
  (KL-5, KL-14, KL-17)

| Type LWL FASOP | Article number | Object distance (typ.) | Detection range (typ.)* | Dimensions |
|---|---|---|---|---|
| KL-3-A2.0 [3] | 10823012 | 8mm - 20mm | Ø 1mm - 5mm<br>Ø 1mm at 10mm | L x Ø<br>ap. 60mm x 15mm |
| KL-M18-A2.0 [1] | 10823020 | 20mm - 50mm | Ø 3mm - 10mm<br>Ø 3mm at 20mm | L x Ø<br>ap. 51mm x M18 x 1 |
| KL-M18-XL-A2.0 [1] | 10824358 | Pos1 50 - 120mm<br>Pos2 10 - 180mm<br>Pos3 10 - 160mm | Pos1 Ø 4-7mm  Ø 4mm at 80mm<br>Pos2 Ø 7-11mm  Ø 7mm at 110mm<br>Pos3 Ø 7-11mm  Ø 7mm at 120mm | L x Ø<br>ap. 90mm x M18x1<br>(L=50mm) |
| KL-M34-A2.0 [1] | 10823278 | 100mm - 180mm | Ø 15mm - 18mm<br>Ø 15mm at 100mm | L x Ø<br>ap.  85mm x M34 x 1,5 |
| KL-M34/62-A2.0 [1] | 10824196 | 80mm - 200mm | Ø 3mm - 5mm<br>Ø 3mm at 120mm | L x Ø<br>ap. 170mm x 62mm |
| KL-4-A1.1 [1] | 10823262 | 8mm - 20mm | Ø 0,6mm - 3mm<br>Ø 0,6mm at 10mm | L x Ø<br>ap. 60mm x 15mm |
| KL-M18-A1.1 [1] | 10824140 | 10mm - 50mm | Ø 2mm - 7mm<br>Ø 2mm at 10mm | L x Ø<br>ap. 51mm x M18 x 1 |
| KL-D-40-A2.0 [2] | 10824143 | 15mm - 25mm | Ø 3mm - 6mm<br>Ø 3mm at 15mm | L x B x H<br>ap. 43.4 x 49.5 x 12mm |
| KL-D-28-A2.0 [2] | 10824197 | 20mm - 30mm | Ø 5mm - 8mm<br>Ø 5mm at 20mm | L x B x H<br>ap. 31.7 x 40.5 x 15mm |
| KL-D-20-A2.0 [2] | 10823021 | 10mm - 50mm | Ø 4mm - 10mm<br>Ø 4mm at 10mm | L x B x H<br>ap. 21.4 x 33 x 12mm |
| KL-D-17-A2.0 [2] | 10823220 | 30mm - 80mm | Ø 8mm - 25mm<br>Ø 8mm at 30mm | L x B x H<br>ap. 36.5 x 25.5 x 15mm |
| KL-D-14-A2.0 [2] | 10823022 | 60mm - 120mm | Ø 10mm - 20mm<br>Ø 10mm at 60mm | L x B x H<br>ap. 37 x 50 x 20mm |
| KL-D-6-A2.0 [2] | 10823409 | 100mm - 200mm | Ø 15mm - 30mm<br>Ø 15mm at 100mm | L x B x H<br>ap. 31.1 x 45.1 x 20mm |
| KL-5-R1.1 [1] | 10824198 | 8mm - 20mm | Ø 2mm x 0,3mm<br>to 15mm x 3mm<br>2x0.3mm at 10mm | L x Ø<br>ap. 60mm x 15mm |
| KL-8-R2.1 [1] | 10823920 | 8mm - 20mm | Ø 4mm x 0,7mm<br>to 30mm x 5mm<br>4x0.7mm at 10mm | L x Ø<br>ap. 60mm x 15mm |

\* The smallest figure in the table relates to the smallest typical optical diameter that is generated.
  This corrresponds to roughly the smallest detection area for colour or fibre optic sensors.
[1] Reflex fibre optic (FAR)
[2] Transmitted light mode fibre optic cables (FAD)
[3] Can be realised in conjunction with FAR-X-A2.0-0.6-XXXX-67° reflex mode fibre optical cable (FAR) measurement spot of approx. 0.2mm

**colorSENSOR accessories**

| Art. no. | description | suitable for: |
|---|---|---|
| 11234089 | CAB-M23-19P-co-fm-straight; 2m-PUR; open ends | colorSENSOR WLCS M-41 (power and PLC) |
| 11234097 | CAB-M23-19P-co-fm-straight; 5m-PUR; open ends | colorSENSOR WLCS M-41 (power and PLC) |
| 11234090 | CAB-M9-3P-co-straight; 2m-PUR; RS232 | colorSENSOR WLCS M-41 (RS232) |
| 11234098 | CAB-M9-3P-co-straight; 5m-PUR; RS232 | colorSENSOR WLCS M-41 (RS232) |
| 11234091 | CAB-M9-8P-co-straight; 2m-PUR; open ends | colorSENSOR LT and OT series (power and PLC) |
| 11234099 | CAB-M9-8P-co-straight; 5m-PUR; open ends | colorSENSOR LT and OT series (power and PLC) |
| 11234092 | CAB-M9-5P-co-straight; 2m-PUR; RS232 | colorSENSOR OT-3-XX-200 (RS232) |
| 11234100 | CAB-M9-5P-co-straight; 5m-PUR; RS232 | colorSENSOR OT-3-XX-200 (RS232) |
| 11234093 | CAB-M9-4P-co-straight; 2m-PVC; RS232 | colorSENSOR LT-1-ST; LT-2-XX (RS232) |
| 11234101 | CAB-M9-4P-co-straight; 5m-PVC; RS232 | colorSENSOR LT-1-ST; LT-2-XX (RS232) |
| 11234094 | CAB-M9-4P-co-straight; 2m-PVC; USB | colorSENSOR LT-2-XX (USB) |
| 11234102 | CAB-M9-4P-co-straight; 5m-PVC; USB | colorSENSOR LT-2-XX (USB) |
| 11234095 | CAB-M5-4P-co-straight; 2m-PUR; RS232 | colorSENSOR LT-1-LC-20; LT-3; OT-3 series (RS232) |
| 11234103 | CAB-M5-4P-co-straight; 5m-PUR; RS232 | colorSENSOR LT-1-LC-20; LT-3; OT-3 series (RS232) |
| 11234096 | CAB-M5-4P--co-straight; 2m-PVC; USB | incl. RS232 to USB adapter suitable for: colorSENSOR LT-1-LC-20; LT-3; OT-3 series (USB) |
| 11234104 | CAB-M5-4P-co-straight; 5m-PVC; USB | incl. RS232 to USB adapter suitable for: colorSENSOR LT-1-LC-20; LT-3; OT-3 series (USB) |
| 11234368 | CAB-M5-4P-co-straight; 2m-PVC; RJ45-co-fm-Eth | incl. RS232 to Ethernet adapter suitable for: colorSensor LT-1-LC-20; LT-3; OT-3 series (Ethernet) |
| 11234274 | reflectance standard 1.25" Fluorilon | colorSENSOR and colorCONTROL |
| 11233482 | white reference modul | colorSENSOR LT-2-DU |
| 2420065 | PS2030 power supply 24V/24W/ 1A; 2m-PVC; terminal-2P-co-fm-straight | Power supply of all sensors with 24 V DC |

**colorCONTROL MFA accessories**

| Art. no. | description | suitable for: |
|---|---|---|
| 10814105 | POF-2.2mm plastic fibre optic cable | colorCONTROL MFA |
| 11251112 | thread fitting; LWL; M4 | POF-2.2 |
| 11251113 | lens optic 6mm | thread fitting; LWL; M4 |
| 11253931 | thread fitting; 3mm lens; LWL; M4 | POF-2.2 |
| 11254108 | thread fitting; 90° optics; LWL; M5 | POF-2.2 |
| 11253959 | reducer sleeve 2.2/1mm POF; 2 pcs. | colorCONTROL MFA for use of POF-1mm |
| 10813842 | POF-1mm fibre optic cable | colorCONTROL MFA in connection with the reducer sleeve 2.2/1mm POF |
| 11253906 | guide sleeve 1mm | POF-1mm |
| 10824431 | guide sleeve 1 mm x 50 mm | POF-1mm |
| 11234305 | CAB-M8-4P-co-fm-straight; 2m-PUR; open ends | colorCONTROL MFA-1 (power and PLC) |
| 11234306 | CAB-M8-4P-co-fm-straight; 5m-PUR; open ends | colorCONTROL MFA-1 (power and PLC) |
| 11294205 | CAB-M9-2P-co-fm-straight; 2m-PUR; open ends | colorCONTROL MFA-5 (power) |
| 11294206 | CAB-M9-2P-co-fm-straight; 5m-PUR; open ends | colorCONTROL MFA-5 (power) |
| 11234094 | CAB-M9-4P-co-straight; 2m-PVC; USB | colorCONTROL MFA-5 (USB) |
| 11234102 | CAB-M9-4P-co-straight; 5m-PVC; USB | colorCONTROL MFA-5 (USB) |
| 11234095 | CAB-M5-4P-co-straight; 2m-PUR; RS232 | colorCONTROL MFA-5 (RS232) |
| 11234103 | CAB-M5-4P-co-straight; 5m-PUR; RS232 | colorCONTROL MFA-5 (RS232) |
| 11294243 | assembly kit MFA-10 | colorCONTROL MFA-5 + MFA-5-M |
| 11294244 | assembly kit MFA-15 | colorCONTROL MFA-5 + 2 x MFA-5-M |
| 11294245 | assembly kit MFA-20 | colorCONTROL MFA-5 + 3 x MFA-5-M |
| 11294203 | CAB-socket board-6P-co-fm-straight; 2m-PVC; 2P-open ends | colorCONTROL MFA-5-P (power) |
| 11294054 | CAB-socket board-6P-co-fm-straight; 1m-PVC; USB | colorCONTROL MFA-5-P (USB and power) |
| 11294204 | CAB-socket board-4P-co-fm-straight; 2.5m-PVC; RS232 | colorCONTROL MFA-5-P (RS232) |

## Pin assignment

### CAB-M23-19P-co-fm-straight; Xm-PUR; open ends
(Art. no.: 11234089; 11234097)
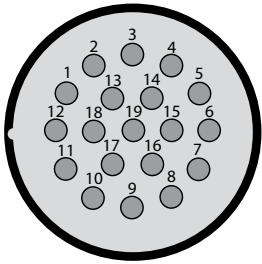


| Pin | Colour | WLCS-M-41 |
|---|---|---|
| 1 | green | IN TF |
| 2 | grey | OUT Int. OK |
| 3 | pink | n.c. |
| 4 | red | OUT 4 |
| 5 | white | OUT 2 |
| 6 | blue | GND (0V) |
| 7 | violet | n.c. |
| 8 | grey/pink | n.c. |
| 9 | red/blue | IN HOLD |
| 10 | white/green | IN 1 |
| 11 | brown/green | IN 2 |
| 12 | yellow | PE |
| 13 | white/yellow | Common |
| 14 | - | - |
| 15 | black | OUT 1 |
| 16 | yellow/brown | OUT 3 |
| 17 | white/grey | IN 3 |
| 18 | grey/brown | IN 4 |
| 19 | brown | +24V DC (±10%) |

### CAB-M9-8P-co-straight; Xm-PUR; open ends
(Art. no.: 11234091; 11234098)
Connection cable to power/PLC or digital I/O
(max. length. 10m, sheath PUR)
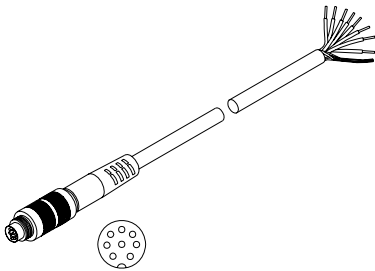


| Pin | Colour | LT-1- LC-10 / ST | SB1 LT-2- ST/DU | SB2 LT-2- ST/DU | LT-1-LC-20 LT-3-XX/OT-3-XX |
|---|---|---|---|---|---|
| 1 | white | OUT 0 | OUT 0 / OUT A 0 | OUT 1 | GND (0V) |
| 2 | brown | OUT 1 | OUT 1 / OUT A 1 | OUT 2 | +24V DC (±10%) |
| 3 | green | IN 1 | IN 1 | OUT 3 | IN 0 |
| 4 | yellow | IN 0 | IN 0 | OUT 4 | OUT 0 |
| 5 | grey | n.c. / OUT 4 | CLK (OUT K) | OUT 5 | OUT 1 |
| 6 | pink | OUT 3 | OUT 2 / OUT A 2 | OUT 6 | OUT 2 |
| 7 | blue | GND (0V) | GND (0V) | OUT 7 | OUT 3 |
| 8 | red | +24V DC (±10%) | +24V DC (±10%) | OUT 0 | OUT 4 |

### CAB-M8-4P-co-fm-straight; Xm-PUR; open ends
(Art. no.: 11234305; 11234306)
Connection cable to to power/PLC
(max. length 5m, sheath PUR)
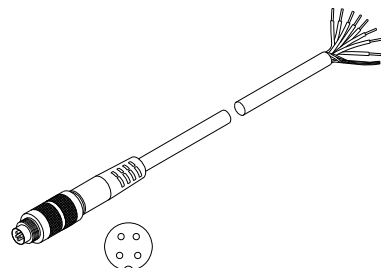


| Pin | Colour | MFA-1 |
|---|---|---|
| 1 | brown | + 24V DC |
| 2 | white | Extern Teach |
| 3 | blue | GND |
| 4 | black | NPN/PNP |

### CAB-M9-2P-co-fm-straight; Xm-PUR; open ends
(Art. no.: 11294205; 11294206)
Connection cable to power
(max. length. 10m, sheath PUR)
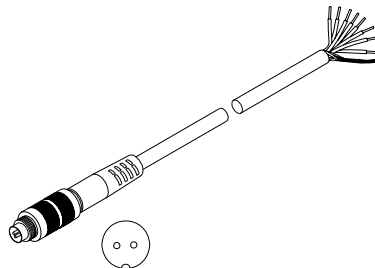


| Pin | Colour | MFA-5 |
|---|---|---|
| 1 | white | +24V DC |
| 2 | brown | GND |

# High performance sensors made by Micro-Epsilon



Sensors and systems for displacement and position



Sensors and measurement devices for non-contact temperature measurement



2D/3D profile sensors (laser scanner)



Optical micrometers, fibre optic sensors and fibre optics



Colour recognition sensors, LED analyzers and colour online spectrometer



Measurement and inspection systems