

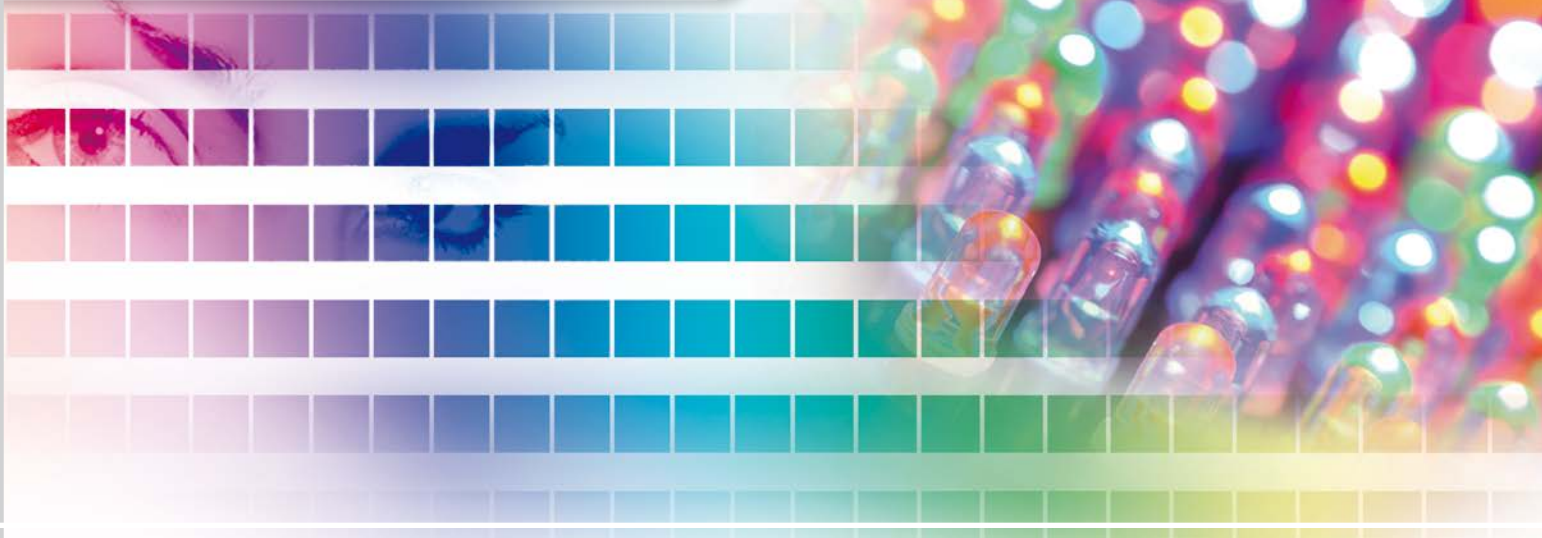


More Precision

Color sensors colorSENSOR
Color measurement colorCONTROL
LED Analyzers colorCONTROL



COLOR SENSORS / LED ANALYZERS



MICRO-EPSILON Eltrotec has over 40 year's experience in the development and use of color detection sensors and fiber optic technology.

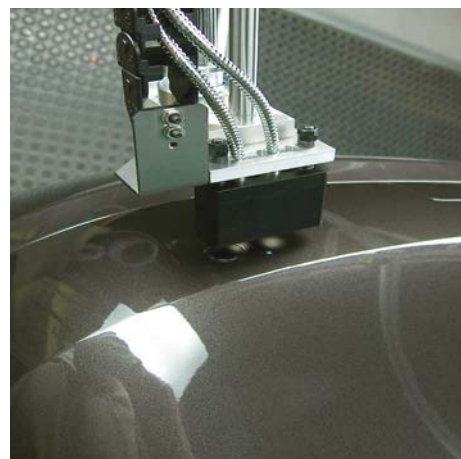
A number of different types of color sensor are responsible for high productivity and cost reduction in production and quality assurance applications.

The sensors detect different color values, and intensities on various surfaces and self-luminous objects.

The very latest color sensor technology and high quality fiber optics are combined in a comprehensive product portfolio.

They are implemented where high efficiency and effectiveness are needed.

Numerous customers worldwide rely on accurate color sensors from Micro-Epsilon Eltrotec to solve their most difficult and demanding applications.



Overview

Page

Fiber color sensors

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| <i>Model</i> | <i>Teach-in button</i> | <i>Software Teach-in</i> | <i>Color delta</i> | <i>Page</i> |
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| colorSENSOR LT-1-LC-10 | 3 | - | $\Delta E \geq 1.5$ | 6 - 7 |
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| colorSENSOR LT-1-ST | 3 | 15 colors | $\Delta E \geq 1.5$ | 10 - 11 |
| colorSENSOR WLCS-M-41 | 4 | - | $\Delta E \geq 1.5$ | 12 - 13 |
| colorSENSOR LT-2-ST | - | 255 colors | $\Delta E \geq 0.8$ | 14 - 15 |
| colorSENSOR LT-2-DU | 8 | 255 colors | $\Delta E \geq 0.8$ | 16 - 17 |
| colorSENSOR LT-3-HE | 31 | 31 colors | $\Delta E \geq 0.5$ | 18 - 19 |
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Fixed lens color sensors

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| colorSENSOR OT-3-MA | Color control with large standoff for matt surfaces | $\Delta E \geq 0.5$ | 22 - 23 |
| colorSENSOR OT-3-GL | Color control on non-homogeneous and shiny surfaces | $\Delta E \geq 0.5$ | 24 - 25 |
| colorSENSOR OT-3-HR | Color control on reflective and textured surfaces | $\Delta E \geq 0.5$ | 26 - 27 |
| colorSENSOR OT-3-LD | Color control at a extra long standoff | $\Delta E \geq 1.5$ | 28 - 29 |
| colorSENSOR OT-3-LU | Color control of fluorescent objects | $\Delta E \geq 0.5$ | 30 - 31 |

Online Photospectrometer

| <i>Model</i> | <i>Description</i> | <i>Color delta</i> | <i>Page</i> |
|-----------------------|--------------------------|----------------------|-------------|
| colorCONTROL ACS 7000 | Online Photospectrometer | $\Delta E \geq 0,08$ | 32 - 33 |

LED analyzers

| <i>Model</i> | <i>Description</i> | <i>Measuring points</i> | <i>Page</i> |
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| colorSENSOR LT-3-HE | LED tests of function, color, and intensity with high precision | 1 | 18 - 19 |
| colorSENSOR OT-3-MA | LED lamp and illumination test of function, color, and intensity | 1 | 22 - 23 |
| colorSENSOR OT-3-LD | LED lamp and illumination test of function, color, and intensity with large standoff | 1 | 28 - 29 |
| colorCONTROL MFA | LED tests of function, color and intensity | 5/10/15/20 | 34 - 35 |

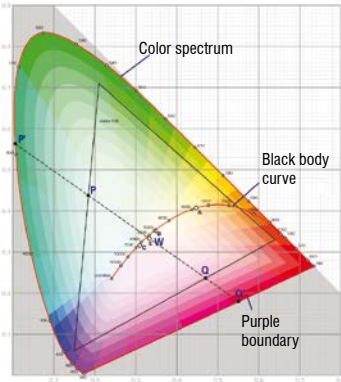
Accessories

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| Fiber optics | 36 - 43 |
| Cable | 44 - 45 |
| Pin assignment of cables (power supply) | 46 - 47 |

BASICS AND SELECTION CRITERIA

Standard color space CIE 1931 (xy color space)

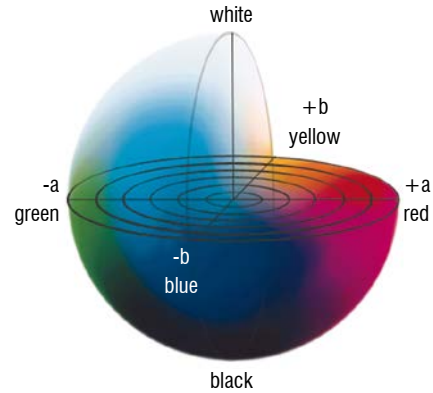
This color space corresponds to the human color perception (very large green and small blue/red sector).



CIE – Commission internationale de l'éclairage
 CIE standardized theoretical primary colors
 $x = \text{red}; y = \text{green}; z = \text{blue} (x+y+z = 1)$
 Color spectrum = "true" colors
 $W = \text{whitepoint} (x=y=z=1/3)$
 Black body curve = color as the temperature of an ideal black radiator
 Suitable for green and active light (LED) test

Standard color space CIE Lab

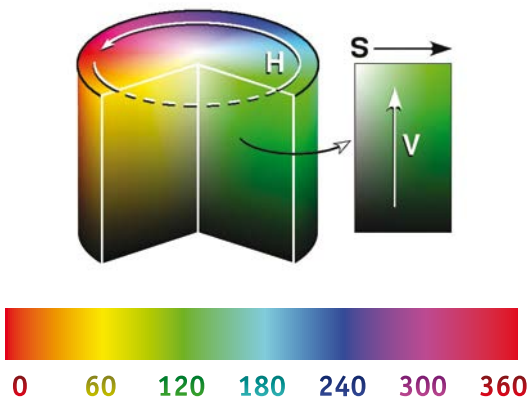
Ideal color space for color test, as each color range is the same size.



Each color is defined by the color location ($L^*; a^*; b^*$)
 $L^* = \text{Luminosity value} (\text{black} = 0; \text{white} = 100)$
 $a^* = \text{Green / red value} (\text{green} = -100; \text{red} = +100)$
 $b^* = \text{Blue / yellow value} (\text{blue} = -100; \text{yellow} = +100)$

HSV / HSI color space

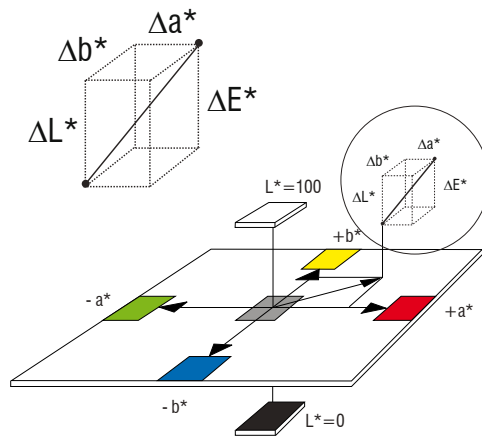
Ideal color space for LED inspection.
 Is used primarily with the colorCONTROL MFA series.



Each color is defined by the color location ($H; S; V$)
 $H = \text{Hue} (\text{red} = 0^\circ; \text{green} = 120^\circ; \text{blue} = 240^\circ)$
 $S = \text{Saturation}$
 (neutral grey = 0%; "pure" color = 100 %)
 $V = \text{Value of luminosity}$
 $I = \text{Intensity (light intensity)}$
 (dark = 0%; totally light = 100%)

What is meant by Delta E?

Delta E; $\Delta E; dE = \text{a measure of the perceived color difference between two colors (DIN 5033)}$



$$\Delta E = \sqrt{(L_p^* - L_v^*)^2 + (a_p^* - a_v^*)^2 + (b_p^* - b_v^*)^2} = 5$$

A ΔE of 5 corresponds roughly to the difference grey 50% and grey 55%

Selection criteria for choosing colorSENSOR type

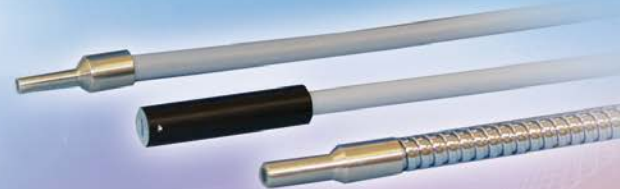
| Tasks / colorSENSOR | | LT-1-LC-10 | LT-1-LC-20 | LT-1-ST | WLCS-M-41 | LT-2-ST | LT-2-DU | LT-3-HE | LT-3-LU |
|------------------------------------|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Number of color memories | | 3 | 31 | 15 (255) | 4 | 255 | 255 (2x15) | 31 | 31 |
| Color 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 |
| Fiber optic + lens | | x | x | x | x | x | x | x | x |
| Button teach | | 3 | | 3 | 4 | | 8 (2x4) | 31 | 31 |
| Software teach | | | 31 | 15 (255) | | 255 | 255 | 31 | 31 |
| RS 232 interface | | | | x | x | x | x | x | x |
| USB interface | | | | | | x | x | | |
| Characteristics of the application | Matt surface | x | x | x | x | x | x | x | x |
| | Shiny surface | 1) | 1) | 1) | 1) | 1) | 1) | 1) | |
| | Reflective surface | | | | | | | | |
| | Textured surface | | | | | | | | |
| | High temperature to 400 °C | x | x | x | x | x | x | x | |
| | Fluorescent surfaces | | | | | | | | x |
| | Large working distance | | | | | | | | |
| LED test | | | | | | x | x | x | |
| Page | | 4-5 | 6-7 | 8-9 | 10-11 | 12-13 | 14-15 | 16-17 | 18-19 |

1) with reservations in connection with KL-D-XX focus lens

| Tech. specifications / colorSENSOR | | OT-3-MA | OT-3-GL | OT-3-HR | OT-3-LD | OT-3-LU | | |
|------------------------------------|----------------------------|------------|------------|------------|------------|------------|---|--|
| Number of color memories | | 31 | 31 | 31 | 31 | 31 | | |
| Color difference ΔE | | ≥ 0.5 | ≥ 0.5 | ≥ 0.5 | ≥ 1.5 | ≥ 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 | | |
| Fiber optic + lens | | | | | | | | |
| Button teach (Colors) | | 31 | 31 | 31 | 31 | 31 | | |
| Software | | x | x | x | x | x | | |
| Software teach (Colors) | | 31 | 31 | 31 | 31 | 31 | | |
| RS 232 interface | | x | x | x | x | x | | |
| USB interface | | | | | | | | |
| Characteristics of the application | Matt surface | x | x | x | x | | | |
| | Shiny surface | | x | x | | | | |
| | Reflective surface | | | x | | | | |
| | Textured surface | | x | x | | | | |
| | High temperature to 400 °C | | | | | | | |
| | Fluorescent surfaces | | | | | | x | |
| | Large working distance | | | | | x | | |
| LED test | | | | | | | | |
| Page | | 20-21 | 22-23 | 24-25 | 26-27 | 28-29 | | |

colorSENSOR LT-1-LC-10

Compact color sensor



- ▶ 3 color detection via Teach-in button
- ▶ 5 adjustable threshold levels
- ▶ Fiber optic with focus lenses

Features:

- 3 Color memory (via Teach-in)
- White light LED
- $L^*a^*b^*$ transformation
- True Color color chip
- Teach-in via PC or push button
- Selection of fiber optic and focus lens
- Robust aluminium housing
- Switching frequency up to 1kHz

Application examples:

- Detection of color rings on metallic and plastic sleeves
- Reading out and statistically evaluating color values
- Recognizing color markings in the printing industry
- Color and grey-scale detection
- Inspection of packaging
- Sorting tasks based on color (e.g. checking O-rings, closures, crown corks, and labels)
- Color recognition on interior components (e.g. head supports, ...)

By using a modulated white light LED, a spot is projected directly on the inspection target through a fiber optic. Part of the light back-scattered from the target is now focused by fiber optic onto a True-Color detector element, sub-divided according to RGB color values and converted into $L^*a^*b^*$.

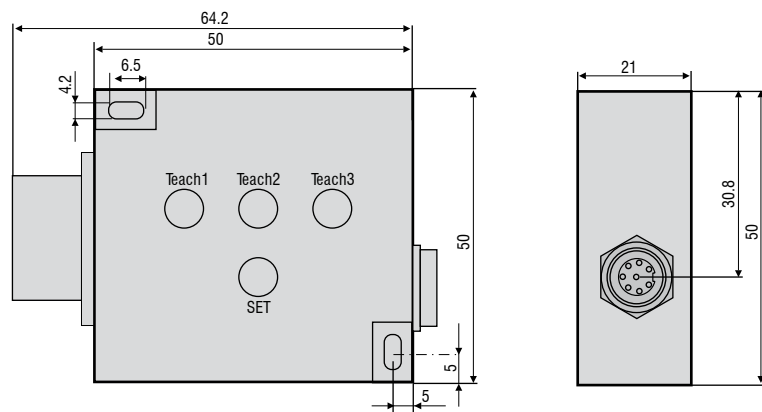
With the LC-10, up to 3 colors can be taught easily via the PC Teach-in or externally. If a color that has been taught is recognized by the sensor, a change in switching condition is made via the 3 encoded digital outputs and visual indication on the button.

| Type | LT-1-LC-10 |
|------------------------------|--|
| Article number | 10234059 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex mode fiber optic cables typically 2mm-15mm with lens, typically 5mm-100mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads \varnothing 0,6mm-20mm ¹⁾ |
| Color difference | $\Delta E \geq 1.5$ |
| Color domain | $L^*a^*b^*$ |
| Averaging | - |
| Color memory | max. 4 colors in non-volatile EEPROM with tolerance level |
| Switching frequency | max. 1kHz |
| Repeatability | 3x12-Bit-A/D conversion |
| Temperature drift X,Y | 0.2% /K |
| Light source | White light LED, AC mode |
| Type of illumination | via fiber optic |
| 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 color reference and tolerance level |
| Outputs | OUT 0 - OUT 2, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | Visualization 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) |
| Software | - |
| Pulse hold | 10ms |
| Signal amplification | - |
| Housing material | Aluminium, black anodized |
| Operating temperature | -10°C - +55°C |
| Storage temperature | -10°C - +85°C |
| Protection class | IP54 |
| Fiber optic | Page 36 |

1) Type: FAR - T - A 2.0 - 2,5 - 1200 - 67° reflex type
Type: FAD - T - A 2.0 - 2,5 - 1200 - 67° transmitted light (p.36)

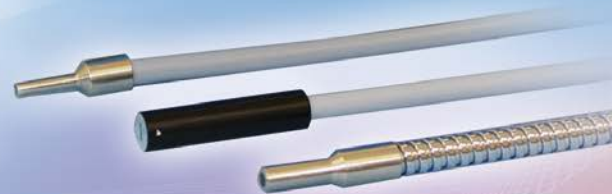
Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-1-LC-20

Compact color sensor



- ▶ 31 Colors via configuration software
- ▶ Fiber optic with focus lenses
- ▶ 5 adjustable threshold levels

Features:

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

Application examples:

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

By using a modulated white light LED, a spot is projected directly on the inspection target through a fiber optic. Part of the light back-scattered from the target is now focused by fiber optic onto a True-Color detector element, sub-divided according to RGB color values and converted into $L^*a^*b^*$.

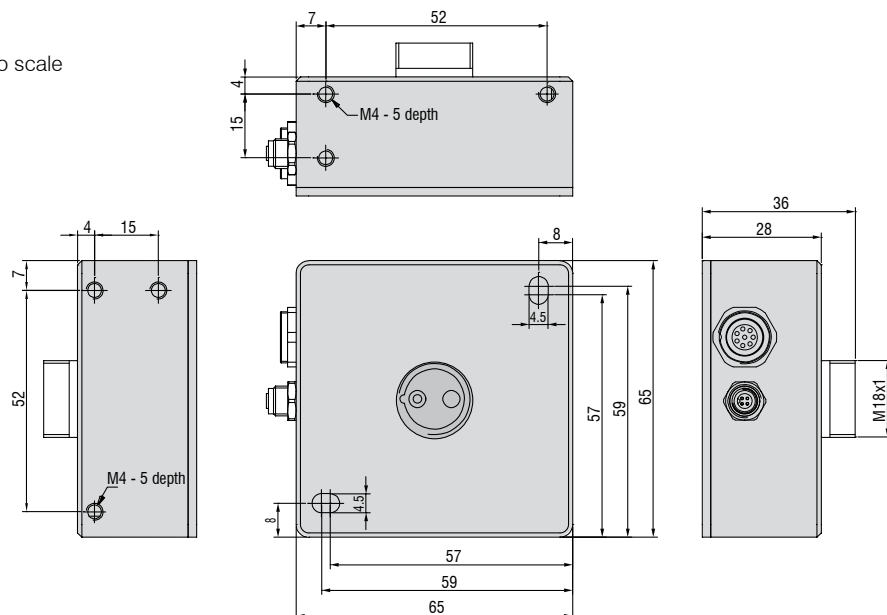
With the LC-20, 31 colors can be taught using the colorCONTROL S software. If a color that has been taught is recognized by the sensor, a change in switching condition is made via the 5 encoded digital outputs.

| Type | LT-1-LC-20 |
|------------------------------|--|
| Article number | 10234060 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex mode fiber optical cables typically 2mm-15mm with lens, typically 5mm-100mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the heads used Reflex mode fiber optical cables, typically Ø 0.6mm-20mm ¹⁾ |
| Color difference | $\Delta E \geq 1.5$ |
| Color domain | X/Y INT; s/i M (Lab) |
| Averaging | max. 32768 |
| Color Memory | Max. 31 colors in non-volatile EEPROM with parameter sets |
| Switching frequency | Max. 35kHz (depending on number of colors being taught and the setting for the averaging) |
| Repeatability | In the x,y color range, 1 digit each with 12-Bit-A/D conversion |
| Temperature drift X,Y | < 0.01% K |
| Light source | High-power white light LED, AC or DC or PULSE mode (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | Via fiber optic |
| Ambient light | Up 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 mode: typ. to 5kHz |
| Power supply | +24VDC ($\pm 10\%$), 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 color references apart from IN0 |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100 mA max. switching current npn-, pnp-capable (bright or dark switching, switchable) |
| Switching state display | - |
| Interface | RS232 |
| Type of connector | to PLC: 8-pole flange socket (Binder series 712) 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) |
| Software | colorCONTROL S |
| Pulse hold | Adjustable 0ms-100ms |
| Signal amplification | 8 stage (AMP1 - AMP8), adjustable |
| Housing material | Aluminium, black anodized |
| Operating temperature | -20°C - +55°C |
| Storage temperature | -20°C - +85°C |
| Protection class | IP54 |
| EMC test according | DIN EN 60947-5-2 |
| Fiber optic | Page 36 |

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

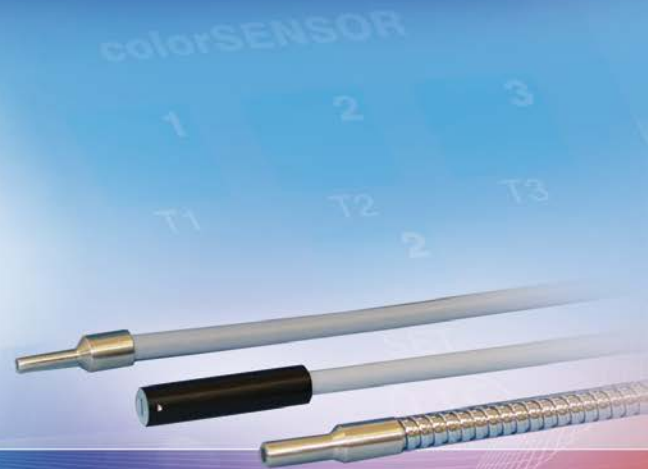
Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-1-ST

Compact True Color color recognition sensor



- ▶ 255 Colors can be recognized
- ▶ Teach-in (3 colors)
- ▶ PC programmable via RS232
- ▶ Fiber optic with focus lenses
- ▶ Auto Gain Control for illumination

Features:

- Memory: 3 (Teach-In buttons), 255 (software)
max. 4 color channels (15 with binary coding)
- RS232 interface
- White light LED
- $L^*a^*b^*$ / $L^*u^*v^*$ transformation
- Switchable for LED recognition
- A variety of evaluation algorithms can be activated
- 15 color groupings are possible
- Interchangeable fiber optic and focus lens
- Robust aluminium housing
- Switching frequency to 10kHz
- colorCONTROL LT software
- Recording of color values by use of
Color monitoring software

Application examples:

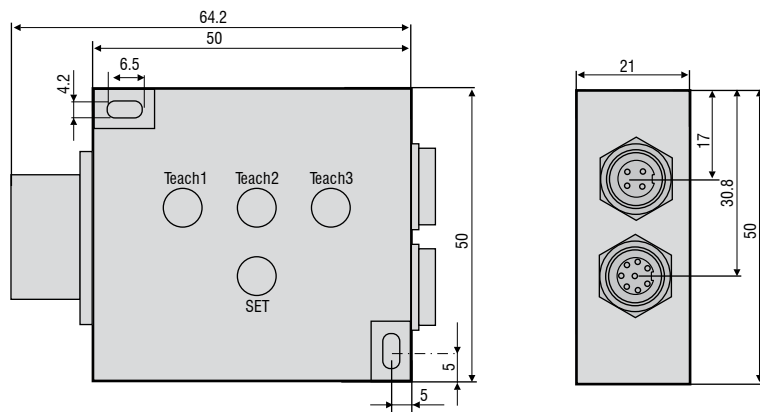
- Detection of color rings on metallic and plastic sleeves
- Reading out and statistically evaluating color values
- Recognizing color markings in the printing industry
- Color and grey-scale detection
- Inspection of packaging
- Sorting tasks on the basis of color
(e.g. checking O-rings, closures, crown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

| Typ | LT-1-ST |
|------------------------------|--|
| Article number | 10234061 |
| Object distance | Dependent on the fiber optics used and the optical heads reflex mode fiber optical cables typically 2mm-25mm with lens, typically 5mm-100mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads reflex mode fiber optical cables, typically 0.6mm-20mm ¹⁾ |
| Color difference | $\Delta E \geq 1.5$ |
| Color domain | Selectable: XYZ, xyY, L99a99b99, L*a*b*, L*u*v*, u'vL* |
| Averaging | Max. 57600 |
| Color Memory | max. 255 colors in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 10kHz (depending on number of colors being taught and the setting for the averaging) |
| Repeatability | 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 fiber optics |
| 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 color reference and tolerance level |
| Outputs | OUT 0 - OUT 2, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | 3 yellow LEDs |
| Interface | RS232 |
| Type of connector | to PLC: 8-pole flange socket (Binder series 712) 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse hold | adjustable 0ms-100ms |
| Signal amplification | - |
| Housing material | Aluminium, black anodized |
| Operating temperature | -10°C - +55°C |
| Storage temperature | -10°C - +85°C |
| Protection class | IP54 |
| Fiber optic | page 36 |

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)

Dimensions:

Dimensions in mm, not to scale



colorSENSOR WLCS-M-41

The multi-purpose sensor for color recognition



- ▶ 4 color memory “Teach-in”
- ▶ Fiber optic with focus lenses to 100mm
- ▶ Color and intensity evaluation
- ▶ High color resolution
- ▶ “Plug & Play” operation

Features:

- Multi-Teach by buttons on the sensor
- Separation of electronic and sensor head (explosion-protected for hazardous areas)
- Switching Output, 4x potential-free
- Wide assortment of fiber optics for every application
- Working distance 2-100mm, depending on fiber optic and lens selection
- Protection class IP65
- Solid enclosure concept for rugged industrial applications
- Independent of distance due to color and intensity evaluation (C and C+ I)
- Resolution Color ≤ 12 bit; Intensity ≤ 12 bit
- External teaching
- Perceptive color processing
- White light LED as light source
- RS232 interface
- Color grouping for advanced control
- Four-stage signal amplification
- Color domain: C, C+I

Advantages:

- Smart teach in of tolerances through “multiple teachings” per channel
- Separate threshold setting via potentiometer for each color memory is also possible
- True Color Device
- Selection of fiber optic
- No gaps in the color spectrum

Application examples:

- Color sorting and inspection
- Recognizing similar colors
- Recording color codes
- Recognizing positions
- Recognizing various epoxies
- All color recognition spectrum (between 390 and 750nm)
- Recognition of intensity

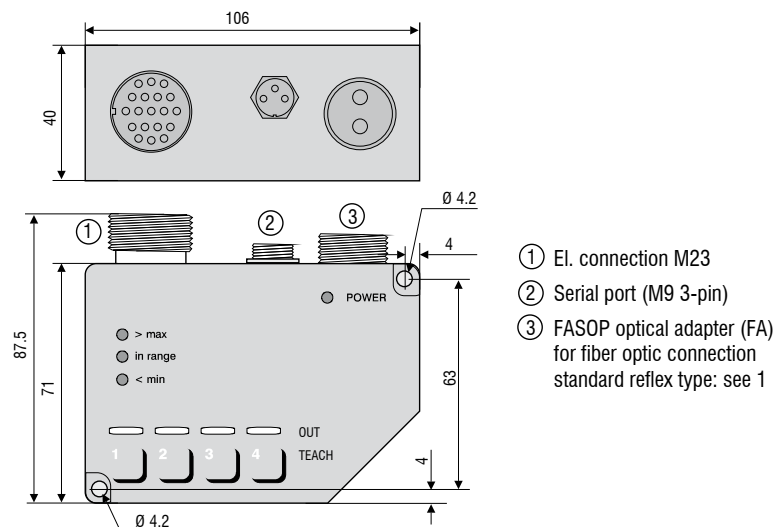
| Type | WLCS-M-41 |
|------------------------------|--|
| Article number | 10234062 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex mode fiber optical cables typically 2mm-25mm with lens, typically 5mm-100mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads Reflex mode fiber optical cables, typically Ø 0.6mm-30mm ¹⁾ |
| Color difference | $\Delta E \geq 1.5$ |
| Color domain | C, C+I |
| Averaging | more than 32 values |
| Color Memory | max. 4 colors in non-volatile EEPROM with tolerance level via potentiometer |
| Switching frequency | 1kHz, 32Hz with averaging |
| Repeatability | in the C+I color range ≤ 12 Bit-A/D conversion |
| Temperature drift X,Y | 0.1% / K |
| Light source | White light LED, AC mode |
| Type of illumination | via fiber optic |
| 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 color reference |
| Outputs | OUT 1-OUT 4, digital (0V/+Ub), short-circuit protected, 100mA max. switching current |
| Switching state display | Visualization by means of 4 yellow LEDs |
| Interface | RS232 |
| Type of connector | to PLC: 19-pole flange socket (Harting) 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 color filter |
| Software | - |
| Pulse hold | - |
| Signal amplification | - |
| Housing material | Aluminium, black anodized |
| Operating temperature | 0°C - +50°C |
| Storage temperature | 0°C - +80°C |
| Protection class | IP65 |
| Fiber optic | p. 36 |

¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

Type: FAD-T-A2.0-2.5-1200-67° transmitted light (p. 36)

Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-2-ST

Advanced color sensor



- ▶ 255 colors can be programmed
- ▶ Hi-Res ($\Delta E \geq 0.8$) True Color sensor system
- ▶ PC programmable via RS232 / USB
- ▶ Fiber optic with focus lenses
- ▶ Distinguishes colors similar to the human eye

Features:

- Color memory: up to 255 colors
- RS232/ USB interface
- White light LED
- $L^*a^*b^*$ / $L^*u^*v^*$ / DIN99 transformation
- On-site re-calibration
- Switchable for LED recognition
- Several TEACH possibilities (via PC or external)
- A variety of evaluation algorithms can be activated
- Color grouping for advanced control
- Selection of FASOP fiber optic and focus lenses
- Robust aluminium housing
- Switching frequency up to 15kHz
- colorCONTROL LT software

Application examples:

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

| Type | LT-2-ST |
|------------------------------|---|
| Article number | 10234063 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex optics fiber typ. 2mm-25mm with lens, typ. 5mm-200mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads Reflex fiber optic typ. Ø 0.6mm-30mm ¹⁾ |
| Color difference | $\Delta E \geq 0.8$ |
| Color space | XYZ, xyY, $L_{99}^*a_{99}^*b_{99}^*$, $L^*a^*b^*$, $L^*u^*v^*$, u ^v L [*] |
| Averaging | max. 57600 |
| Color Memory | max. 255 colors in non-volatile EEPROM with parameter sets |
| Switching frequency | max. 15kHz (depending on number of colors 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 fiber optic |
| 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 color 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) 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse hold | adjustable 0ms-100ms |
| Signal amplification | 4 levels (1, 5, 25, and 100) |
| Housing material | Aluminium, black anodized |
| Operating temperature | -10 °C - +55°C |
| Storage temperature | -10 °C - +85°C |
| Protection class | IP65 |
| Fiber optic | p. 36 |

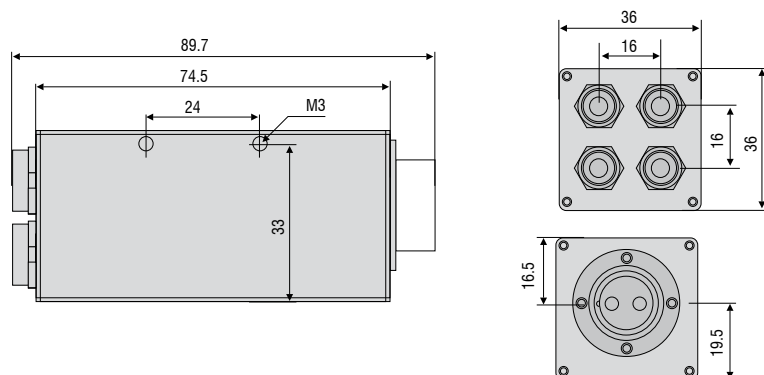
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

Type: FAD-T-A2.0-2.5-1200-67° transmitted light (p. 36)

²⁾ suitable for LED testing

Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-2-DU

2-channel color sensor



- ▶ 2-channel color sensor
- ▶ 255 colors can be saved in sensor
- ▶ Visual teach-in (8 colors)
- ▶ PC programmable via RS232 / USB
- ▶ Fiber optic with focus lenses
- ▶ Distinguishes color similar to the human eye

Features:

- Color memory: 8 (Teach-in) 255 (software)
- 2x White light LED
- RS232 and USB 2.0 interface
- Color domain: XYZ, xyY, $L_{99}a_{99}b_{99}$, $L^*a^*b^*$, $L^*u^*v^*$, $u'v'L^*$
- Switchable for LED evaluation
- Several TEACH Options (via PC or external)
- Difference / reference / 2-channel mode
- Selection of FASOP fiber optic and focus lens
- Boolean analysis or differential mode
- Switching frequency to 15kHz
- Perceptive color processing
- Six teach buttons on the controller
- 4 stage signal amplification
- colorCONTROL LT software

Application examples:

- Quality control
- Statistically evaluating and outputting color values
- Detection of color rings on metallic and plastic sleeves
- Recognizing color markings in the printing industry
- Color and grey-scale detection
- Checking color gradients
- Checking color transitions
- Checking color deviations
- Inspection of packaging
- Color recognition on vehicle body parts, bumpers, doors, etc.
- LED tests of function, color and intensity

| Type | LT-2-DU |
|------------------------------|---|
| Article number | 10234064 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex mode fiber optical cables typically 2mm-25mm with lens, typically 5mm-200 mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads Reflex fiber optic typ. Ø 0.6mm-30mm ¹⁾ |
| Color difference | $\Delta E \geq 0.8$ |
| Color domain | XYZ, xyY, $L_{99}a_{99}b_{99}$, $L^*a^*b^*$, $L^*u^*v^*$, $u^*v^*L^*$ |
| Averaging | more than max. 57600 values |
| Color Memory | max. 255 |
| Switching frequency | max. 15kHz (depending on number of colors being taught and the setting for the averaging) |
| Repeatability | 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 fiber optic |
| 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 color reference and tolerance level |
| Outputs | OUT 0 - OUT 7, digital (0V/+Ub), 100mA max. switching current |
| Switching state display | Visualization by means of 3 yellow LEDs |
| Interface | RS232, USB 2.0 |
| Type of connector | to PLC: 8-pole flange socket (Binder series 712) 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) |
| Software | colorCONTROL LT |
| Pulse hold | adjustable 0ms-100ms |
| Signal amplification | 4 levels (1, 5, 25 and 100) |
| Housing material | Aluminium, black anodized |
| Operating temperature | -10 °C - +55°C |
| Storage temperature | -10 °C - +85°C |
| Protection class | IP54 |
| Fiber optic | p. 36 |

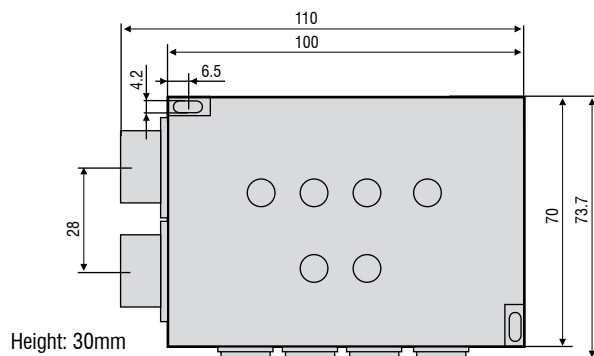
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

Type: FAD-T-A2.0-2.5-1200-67° transmitted light (p. 36)

²⁾ suitable for LED testing

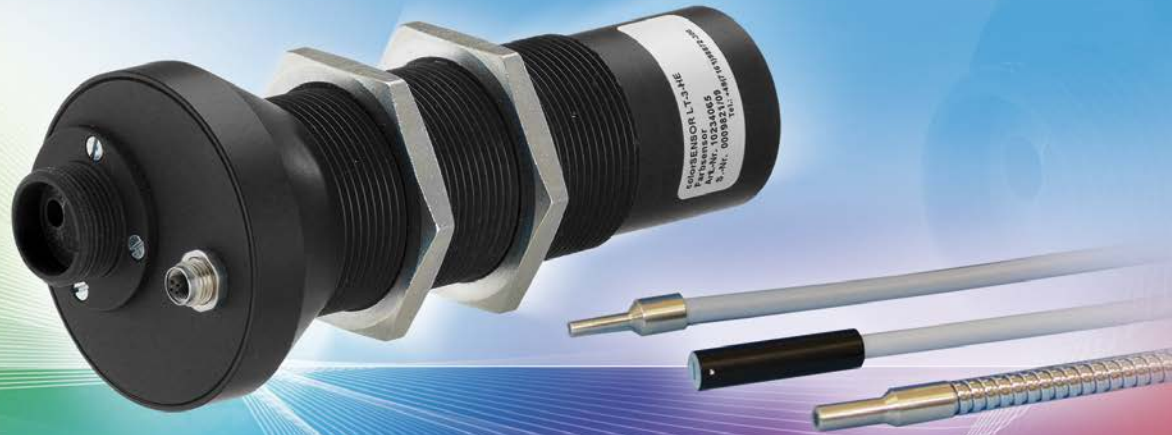
Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-3-HE

High-end color sensor



- ▶ 31 colors can be saved
- ▶ Fiber optic Selection
- ▶ Color and grey scale evaluation
- ▶ PC programmable via RS232 / USB
- ▶ Highest Res ($\Delta E \geq 0.5$); Large Standoff

Features:

- Color memory: 31 Colors with Teach-in and software
- RS232 interface (USB adapter optional)
- Modulated white light LED (can be connected for external high-power white light source)
- Switchable brightness readjustment
- Color and grey-scale detection
- Adjustable averaging
- A variety of evaluation algorithms can be activated
- Switching frequency max. 30kHz
- Switching state display
- Temperature compensation $<0.01\%/K$
- Eight-stage adjustable amplification
- Color domain: X/Y INT; s/i M (Lab)

Application examples:

- Detection of color rings
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color
- Color recognition on interior components
- Color control of self-luminous objects (LEDs, displays, etc.)

| Type | LT-3-HE |
|------------------------------|--|
| Article number | 10234065 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex fiber optic typ. 2mm-25mm with lens typ. 5mm-200mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads Reflex fiber optic typ. Ø 0.6mm-30mm ¹⁾ |
| Color difference | $\Delta E \geq 0.5$ |
| Color domain | X/Y INT; s/i M (Lab) |
| Averaging | more than max. 32768 values |
| Color Memory | max. 31 |
| Switching frequency | max. 30kHz (depending on number of colors being taught and the setting for the averaging) |
| Repeatability | In the x,y color range, 1 digit each with 12-Bit-A/D conversion |
| Temperature drift X,Y | < 0.01% /K |
| Light source | high-power white light LED, AC or DC, (adjustable or OFF for self-luminous objects, software-switchable) ²⁾ |
| Type of illumination | via fiber optic |
| 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 ($\pm 10\%$), 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 color 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 | Visualization 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 hold | adjustable 0ms-100ms |
| Signal amplification | 8 stage (AMP1 - AMP8), adjustable |
| Housing material | Aluminium, black anodized |
| 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 |
| Fiber optic | p. 36 |

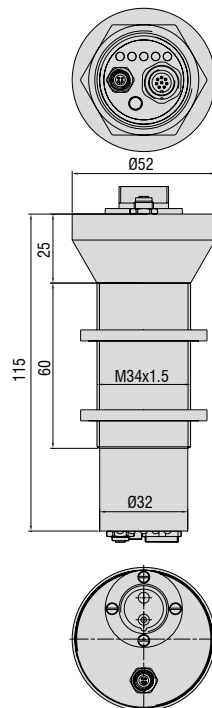
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

Type: FAD-T-A2.0-2.5-1200-67° transmitted light (p. 36)

²⁾ suitable for LED testing

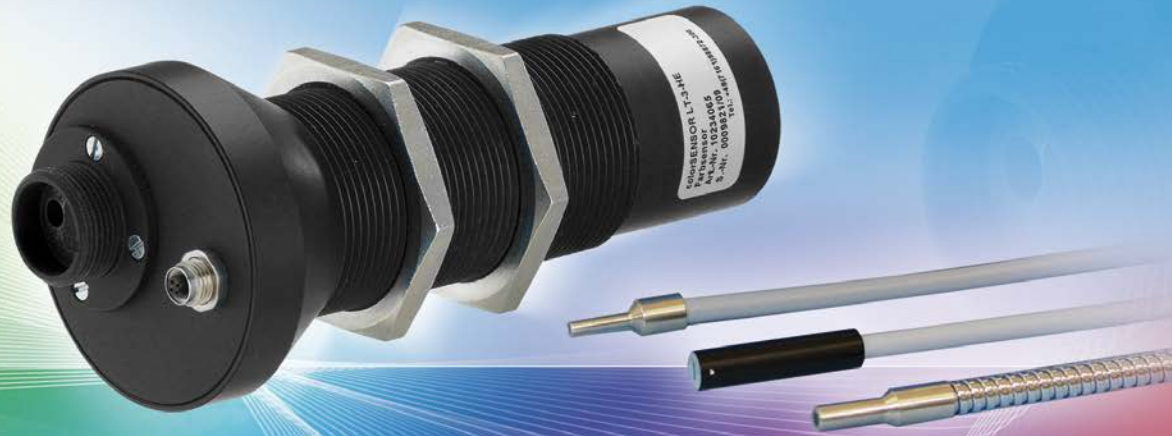
Dimensions:

Dimensions in mm, not to scale



colorSENSOR LT-3-LU

High-end color sensor for fluorescent objects



- ▶ 31 colors can be saved
- ▶ Selection of UV-light capable fiber optics
- ▶ Color and grey scale evaluation of luminescent colors
- ▶ PC programmable via RS232 / USB

Features:

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

Application examples:

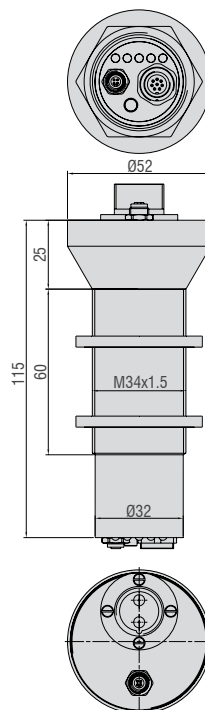
- Detection of luminescent colors
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color

| Type | LT-3-LU |
|------------------------------|--|
| Article number | 10234066 |
| Object distance | Dependent on the fiber optics used and the optical heads Reflex fiber optic typ. 2mm-25mm with lens typ. 5mm-50mm ¹⁾ |
| Light spot diameter | Dependent on the fiber optics used and the optical heads ¹⁾ |
| Color difference | $\Delta E \geq 0.5$ |
| Color domain | X/Y INT; s/i M (Lab) |
| Averaging | more than max. 32768 values |
| Color Memory | max. 31 |
| Switching frequency | max. 30kHz (depending on number of colors being taught and the setting for the averaging) |
| Repeatability | In the x,y color range, 1 digit each with 12-Bit-A/D conversion |
| Temperature drift X,Y | < 0.01% /K |
| Light source | high-power UV LED, 385nm, AC-, DC mode, (adjustable or OFF for self-luminous objects, software-switchable) |
| Type of illumination | via fiber optic |
| 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 ($\pm 10\%$), 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 color 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 | Visualization 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 hold | adjustable 0ms-100ms |
| Signal amplification | 8 stage (AMP1 - AMP8), adjustable |
| Housing material | Aluminium, black anodized |
| 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 |
| Fiber optic | p. 36 |

¹⁾ Type: FAR - T - A2.0 - 2.5 - 1200 - 67° - UV reflex
FAD - T - A2.0 - 2.5 - 1200 - 67° - UV transmitted light

Dimensions:

Dimensions in mm, not to scale



colorSENSOR OT-3-MA

Fixed lens color sensor for large distances
and matt targets



- ▶ 31 colors can be saved
- ▶ Focused illumination for rapidly changing distances to measurement objects
- ▶ Color and grey scale evaluation
- ▶ PC programmable via RS232 / USB

Features:

- White light LED ring, focused, with clear glass covering
- Object distance typ. 10mm - 400mm
- Variable range through focused white light operation
- Color memory: 31 colors 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
- Adjustable averaging
- Color control of self-luminous objects

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

Application examples:

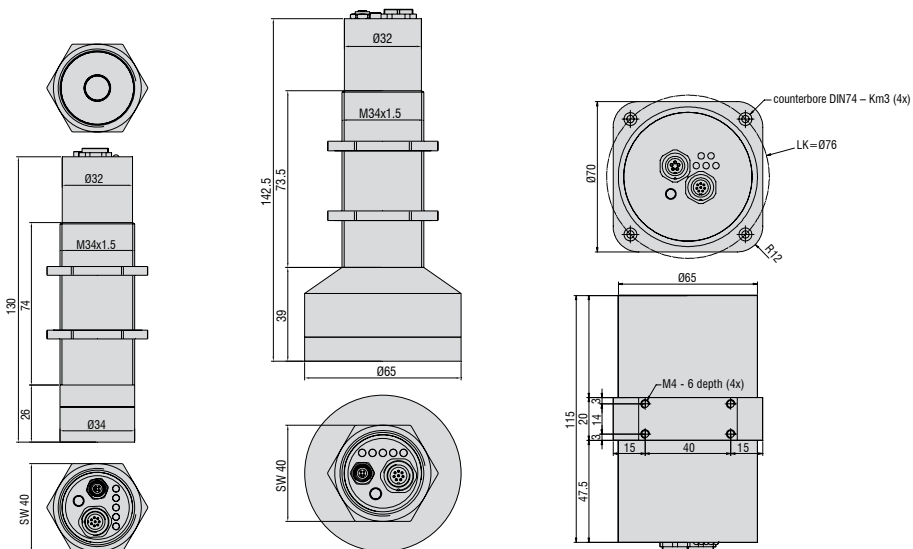
- Color recognition of matt surfaces at a distance of up to 400mm
- Detection of color rings
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color
- Color control of self-luminous objects (LEDs, displays, etc.)
- Illumination recognition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

| 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 |
| Color difference | | | ΔE ≥ 0.5 | | | ΔE ≥ 1.5 |
| Color domain | | | X/Y INT; s/i M (Lab) | | | |
| Averaging | | | more than max. 32768 values | | | |
| Color Memory | | | max. 31 | | | |
| Switching frequency | | max. 30kHz (depending on number of colors being taught and the setting for the averaging) | | | | |
| Repeatability | | In the x,y color 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 | | | | |
| 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 color 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 | | Visualization 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) to power/PLC: art. no. 11234091 to PC: art. no. 11234092 |
| 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 | | | | colorCONTROL C4 |
| Pulse hold | | 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

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

colorSENSOR OT-3-GL

Color control on non-homogeneous targets
and glossy targets



- ▶ 31 colors can be saved
- ▶ Diffuse illumination for the reduction of glaring
- ▶ Color 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
- Color memory: 31 colors via Teach-in and software
- RS232 interface (USB adapter optional)
- Not effected by 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
- Color control of self-luminous objects

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

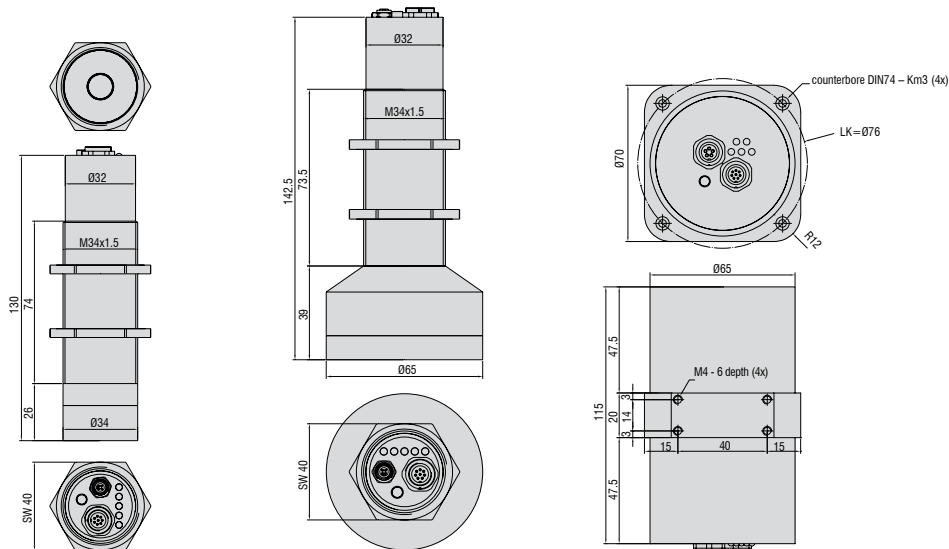
Application examples:

- Color recognition of textured and/or shiny surfaces
- Detection of color rings
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color
- Color control of self-luminous objects (LEDs, displays, etc.)

| 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 |
| Color difference | ΔE ≥ 0.5 | | | | | ΔE ≥ 1.5 |
| Color domain | X/Y INT; s/i M (Lab) | | | | | |
| Averaging | more than max. 32768 values | | | | | |
| Color Memory | max. 31 | | | | | |
| Switching frequency | max. 30kHz (depending on number of colors being taught and the setting for the averaging) | | | | | |
| Repeatability | In the x,y color 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 | | | | | |
| 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 color 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 | Visualization 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) | | | | | |
| Software | colorCONTROL S | | | | | colorCONTROL C4 |
| Pulse hold | 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 | | | | | |

Dimensions:

Dimensions in mm, not to scale



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

colorSENSOR OT-3-HR

Color sensor for highly reflective and textured targets



- ▶ 31 colors can be saved
- ▶ Polarized illumination for highly reflective surfaces
- ▶ Color and grey scale evaluation
- ▶ PC programmable via RS232 / USB

Features:

- White light LED ring with polarization filter and clear glass covering
- Object distance typ. 10mm - 300mm
- Polarization filter (significant reduction of the shine effect)
- Color memory: 31 colors via Teach-in software
- RS232 interface (USB optional)
- Not effected by 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
- Color control of self-luminous objects

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

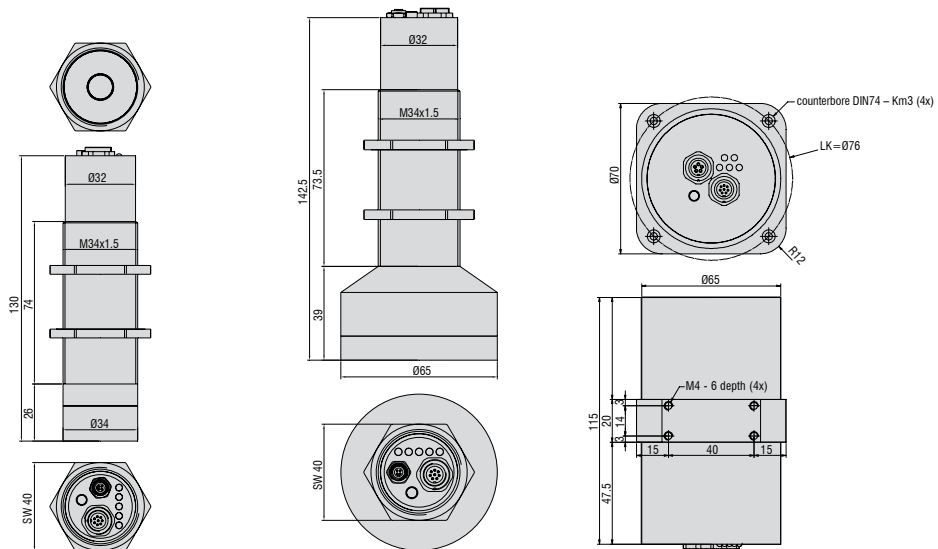
Application examples:

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

| 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 |
| Color difference | ΔE ≥ 0.5 | | | | | ΔE ≥ 1.5 |
| Color domain | X/Y INT; s/i M (Lab) | | | | | |
| Averaging | max. 32768 values | | | | | |
| Color Memory | max. 31 | | | | | |
| Switching frequency | max. 30kHz (depending on number of colors being taught and the setting for the averaging) | | | | | |
| Repeatability | In the x,y color 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 |
| Type of illumination | AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable) | | | | | |
| Ambient light | Polarization filter, focused 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 color 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 | Visualization 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-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) | | | | | |
| Software | colorCONTROL S | | | | | colorCONTROL C4 |
| Pulse hold | 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 | | | | | |

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-HR-200-20

colorSENSOR OT-3-LD

Color sensor for large distances



- ▶ 31 colors can be saved
- ▶ Coaxial optics for very large working distance up to 800mm
- ▶ Color and grey scale evaluation
- ▶ PC programmable via RS232 / USB

Features:

- Object distance typ. 50mm - 800mm
- Integrated receiver and transmitter optics (coaxial)
- Color memory: 31 colors via Teach-in software
- RS232 interface (USB adapter optional)
- High-power white light LED
- Color, contrast and grey-scale detection
- Not effected by 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
- Color control of self-luminous objects

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

Application examples:

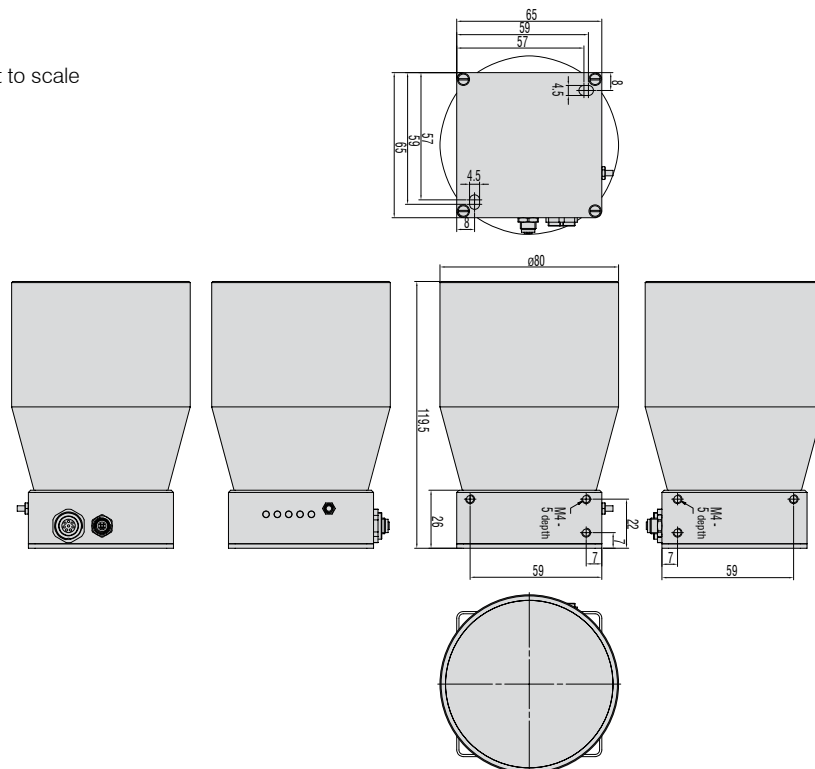
- Color recognition from long distances up to 800mm
- Correct insertion of product in production machinery
- Inspection of packaging
- Sorting tasks on the basis of color
- Color assignment on automobiles
- Detecting drink crates
- Paper, recycling recognition
- Illumination recognition as per color and intensity

| Type | OT-3-LD-500-23 | OT-3-LD-500-50 |
|------------------------------|---|---|
| Article number | 10234085 | 10234086 |
| Object distance | typ. 200mm-600mm ideal distance at 500mm | typ. 50mm-800mm ideal distance at 500mm |
| Light spot | Ø 9-27mm | Ø 5-80mm |
| Light spot diameter | Ø 23mm at 500mm | Ø 50mm at 500mm |
| Color difference | | $\Delta E \geq 1.5$ |
| Color domain | | X/Y INT; s/i M (Lab) |
| Averaging | | max. 32768 |
| Color Memory | | max. 31 |
| Switching frequency | max. 35kHz (depending on number of colors being taught and the setting for the averaging) | |
| Repeatability | In the x,y color range, 1 digit each with 12-Bit-A/D conversion | |
| Temperature drift X,Y | < 0.01% /K | |
| Light source | high-power white light LED; AC-, DC- oder PULSE mode (adjustable or OFF for self-luminous objects, software-switchable) ¹⁾ | |
| Type of illumination | Coaxial | |
| 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 ($\pm 10\%$), 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 color references | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA Max. switching current npn-, pnp-capable | |
| Switching state display | (bright or dark switching, switchable) | |
| Interface | Visualization by means of 5 yellow LEDs | |
| Type of connector | RS232 (optional USB) | |
| Connection cable | to PLC: 8-pole flange socket (Binder series 712) to PC: 4-pole flange socket (Binder series 707) | |
| Receiver | to power/PLC: art. no. 11234091 / to PC: art. no. 11234095 (RS232); 11234096 (USB) | |
| Software | 3-color filter detector (TRUE COLOR detector, color filter curve as per CIE 1931) | |
| Pulse hold | colorCONTROL S | |
| Signal amplification | adjustable 0ms-100ms | |
| Housing material | - | |
| Operating temperature | Aluminium, black anodized | |
| Storage temperature | -20°C - +55°C | |
| Protection class | -20°C - +85°C | |
| EMC test according | IP67 (lens), IP64 (electronics) | |
| EMC test according | DIN EN 60947-5-2 | |

¹⁾ suitable for illumination testing

Dimensions:

Dimensions in mm, not to scale



colorSENSOR OT-3-LU

Color sensor for fluorescent targets



- ▶ 31 colors can be saved
- ▶ UV illumination to detect luminescent colors
- ▶ Color and grey scale evaluation
- ▶ PC programmable via RS232 / USB

Features:

- UV-LED ring with black glass cover, 385nm
- Object distance typ. 10mm - 100mm
- Color memory: 31 colors via Teach-in and software
- RS232 interface (USB adapter optional)
- Recognition of different luminescent colors
- Not effected by 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
- Adjustable averaging

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

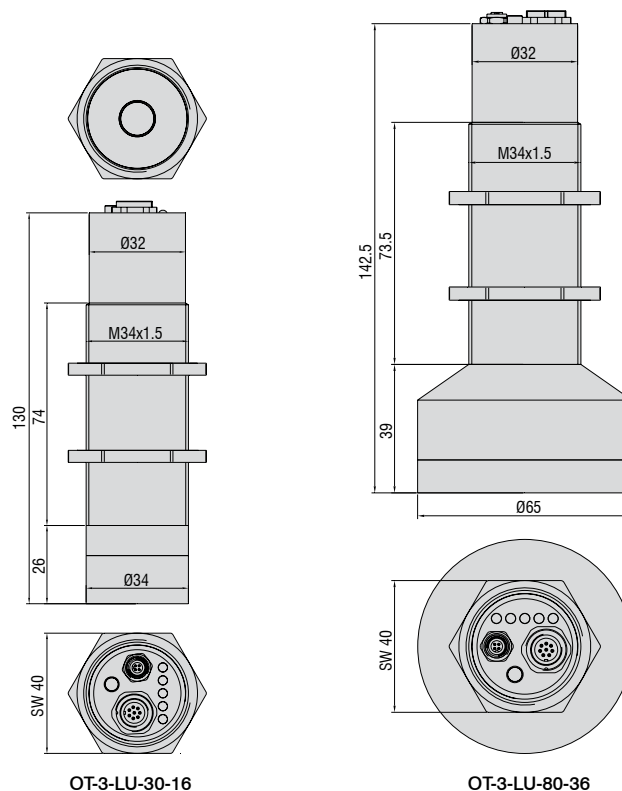
Application examples:

- Presence of the applied adhesive
- Detection of safeguarding thread
- Turbidity of liquids

| 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 |
| Color difference | $\Delta E \geq 0.5$ | |
| Color domain | X/Y INT; s/i M (Lab) | |
| Averaging | more than max. 32768 values | |
| Color Memory | max. 31 | |
| Switching frequency | max. 30kHz (depending on number of colors being taught and the setting for the averaging) | |
| Repeatability | In the x,y color range, 1 digit each with 12-Bit-A/D conversion | |
| Temperature drift X,Y | < 0.01% /K | |
| Light source | 8x UV-LED, 385nm <small>AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable)</small> | 12x UV-LED, 385nm <small>AC-, DC mode (adjustable or OFF for self-luminous objects, software-switchable)</small> |
| Type of illumination | UV 385nm, focused | |
| 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 ($\pm 10\%$), 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 color references | |
| Outputs | OUT 0 - OUT 4, digital (0V/+Ub), short-circuit protected, 100mA Max. switching current nnp-, pnp-capable (bright or dark switching, switchable) | |
| Switching state display | Visualization 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 hold | 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 | |

Dimensions:

Dimensions in mm, not to scale



OT-3-LU-30-16

OT-3-LU-80-36

colorCONTROL ACS 7000

Online Photospectrometer (390 - 780nm)



- ▶ Online color measurement:
25Hz – 2,000Hz
- ▶ Non-contact color measurement
- ▶ Measurement precision $\Delta E \leq 0.08$
- ▶ Ethernet/EtherCAT, RS 422, digital I/O

Features:

- Measurement distance 50mm
- Measurement geometry: 30°/0°
- 9mm measuring range
- Measurement precision $\Delta E \leq 0.08$ sample-related
- Adjustable color space: XYZ; L*a*b*; L*c*h*; L* u* v*; RGB
- Adjustable light source: "standard illuminant" and "standard observers"
- Color recognition from a saved reference list
- White/black reference comparison (via browser and buttons on the device)
- Web browser operation
- Online quality assurance and continuous monitoring
- Options: measuring head geometries for different target surfaces

Applications:

- Online measurement in production lines, all industries: Plastics, wood, paper, film and foil, injection moulding, textiles and pharmaceuticals
- Interior color measurement
- Inspection of car paint

Benefits:

- Continuous process measurement to ensure consistent product quality
- Direct feedback to the production process is possible
- Lower production costs
- Minimisation of waste and rejects

FCS-T-ACS1-30/0-50-1200 fiber optical sensor

| | |
|--|--|
| Article number | 10824175 |
| Working distance | 50mm |
| Geometry (illumination / receiver) | 30°/ 0° |
| Measuring spot diameter | 9mm |
| Working range | ± 2mm from the optimal working distance ($\Delta E < 1$) |
| Distance error | 0.5 ΔE /mm |
| Tilt angular error | < 0.3 ΔE /° |
| External light tolerance at max. LED power ¹⁾ | < 0.5 ΔE / 1000Lux |
| Dimensions | 85x120x40mm |
| Weight (sensor head, incl. fiber optics) | 420g |
| Length of the fiber optics | 1.2m (max 1.8m) |
| Protection class | IP64 |

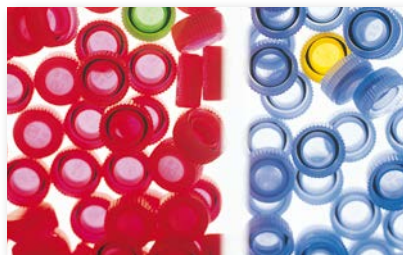
Controller colorCONTROL ACS 7000

| | |
|---|---|
| Article number | 11104174 |
| Spectral measuring range | 390 - 780nm |
| Measuring range reflectivity | 0 - 200%R |
| Output values | L*a*b*, L*u*v*, XYZ, ΔE , spectrum |
| Types of light | types of light: A, C, D65, D50, D75, E, F4, F7, F11, user |
| Standard observer | 2°, 10° |
| Distance models for color recognition | sphere (ΔE), cylinder (ΔL^* , Δa^*b^*), box (ΔL^* , Δa^* , Δb^*), with individual tolerance parameters for every color taught |
| Color resolution | 0.08 ΔE |
| Spectral resolution | 5nm |
| Measuring frequency | 25 - 2,000Hz (internal spectrum, signal averaging and data reduction are possible) |
| Temperature stability | < 0.1 ΔE /°C |
| Light source | LED, 390 - 780nm |
| Reproducibility of the measurements of a device ²⁾ | $\Delta E < 0.03$ (mean); < 0.08 (max) |
| Housing dimensions | 210x120x90 mm (Wx Hx D) |
| Weight | 1.8kg |
| Protection class | IP40 |
| Operating temperature | 0°C to 45°C |
| Storage temperature | -20°C to 70°C |
| Inputs / Outputs: | four color detection switching outputs (4 individual colors or 15 colors binary or { ΔE , ΔL^* , Δa^* , Δb^* } for one color) 1 switching output, synchronisation 1 switching input, synchronisation 1 switching output, measurement error |
| Interfaces | Ethernet/EtherCAT (DHCP-enabled) RS422 (USB via RS422 adapter is possible) |
| Connection for fiber optics | illumination: 7mm ferrule with M18 cap (union) nut (analogous to MICRO-EPSILON Eltrotec Fasop system) measuring: DIN fiber connector |
| Connection cables | to power supply: art. no. 11234222 / to PLC: art. no. 11234223 / to synchronisation: art. no. 11234091 / to PC: art. no. 11294232 (Ethernet/EtherCAT); 11234224 or 11234230 (RS422) |
| Additional data processing | internal calculation of spectral characteristics, color valence calculations, color space transformations, ΔE calculations, and tolerance settings of the upper and lower thresholds for the color values |
| Connection to software | control and configuration via integrated web server or via terminal with commands visualisation of spectral characteristics and temporal sequence of the color values and color differences |
| Power supply | 24VDC +/- 15% 1000mA |
| Service life of the light source | > 20,000h when operated at 25°C |

¹⁾ Measured at maximum illumination for reference tile (R = 61%) light grey with warm white external LED light source

²⁾ Medium or maximum color distance ΔE of 1000 successive measurements of the color value (mean) of a light grey reference tile (R = 61%), measured with sensor FCS-T-ACS1-30/0-50-1200 at 200Hz and maximum illumination brightness

Applications



colorCONTROL MFA

Multi-point color testing system



- ▶ Measures up to 20 channels
- ▶ Color testing in HSI and RGB color space
- ▶ Color differentiation/intensity test

Features:

- Universal connection of fiber optics
- Individual selection of the fiber optic configuration
- Each measuring point can be individually configured to color, intensity and function
- Integration in test sequence
- Pass/Fail evaluation
- Output of HSI, RGB and XY values via RS232 or USB
- External trigger
- Replaceable fiber optic adapter
- Suitable for POF (2m) and glass fiber optics up to 5m
- Up to 20 testing points using different assembly kits

Applications:

- Self-luminous object inspection
- LED test (binning)
- Status test
- Display test
- 7 segment display inspection
- Checking up to 20 colors parallel and simultaneously $\leq 1s$
- Frontpanel test
- With external illumination, multiple-point Color testing is possible

Function:

The color, intensity, and light information is fed directly from the measuring object to the MFA via single fiber 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 fiber optics.

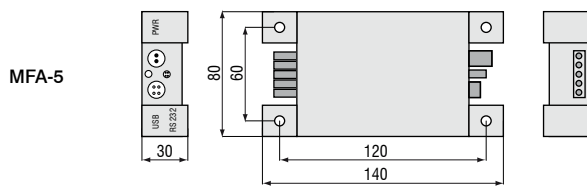
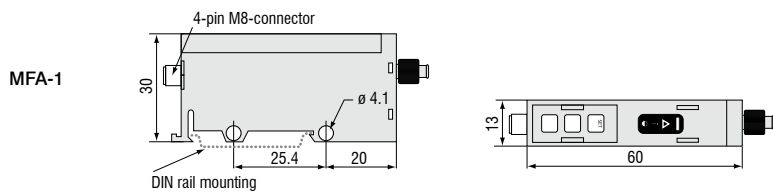
The colorCONTROL MFA-5 can be enlarged up to 20 testing points using the module colorCONTROL MFA-5-M. Additionally, one of the assembly kits is required depending on the construction depths (see accessories). For example: 20 inspection tests require: 1x colorCONTROL MFA-5 + 3x colorCONTROL MFA-5-M +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

| 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 |
| 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 | - |
| Fiber optic | incl. POF 1m; max. POF 2m / glass 5m | - | incl. POF 0.5m; max. POF 2m / glass 5m | - |
| Color domain | - | - | HSI, RGB, XY + color 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

Dimensions:

Dimensions in mm, not to scale



Fiber optics for colorSENSOR



- ▶ High-quality fiber optics with polished and ground end-faces
- ▶ Fibers for visible, ultraviolet and infrared light
- ▶ For wavelengths from 190 – 2500nm

Features:

- Temperature stability from -40°C to $+400^{\circ}\text{C}$ (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 fiber optics for color sensors and fiber 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

Fiber optics with increased vibration protection

Fiber 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 fibers and reduces shocks

Fiber 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 fibers and with sapphire optics installed.

Customer-specific designs

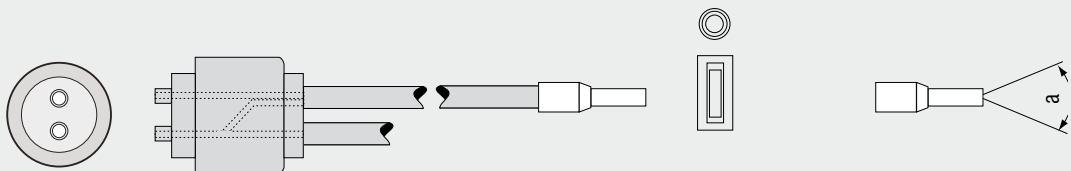
One of the advantages of Micro-Epsilon fiber optic manufacturing is the production of customer-specific designs for various complex sensor mechanisms.

Technical data for FASOP fiber optics

| | | |
|--|--|--|
| Single fiber diameter | 20, 30, 50, 70 μ m standard fiber (depending on structure) | |
| Aperture angle | Standard fibers | 67° (NA 0,56) |
| | Special fibers | 22° (NA 0.21) 121° (NA 0.87 / wide angle) 22° UV (80/100 μ m) 22° IR (80/100/150 μ m) |
| Material | Optical glass (e.g. for UV / IR / in quartz glass) | |
| Dielectric strength | 50kV/m with PVC protective sheath | |
| Sensor mechanism – temperature range, fiber bonding | standard | -20°C to + 80°C |
| | T250 | 0°C to + 250°C |
| | T400 | 0°C to + 400°C |
| | T600 | 0°C to + 600°C |
| Permissible temperature range with sheathing that has appropriate fiber 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) |
| Fiber 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 fiber optics

Individual fiber optics can be defined by specifying the various components in the ordering key below.

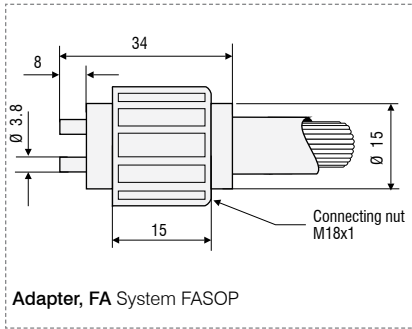


Ordering code

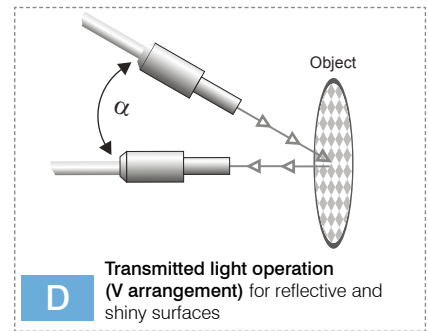
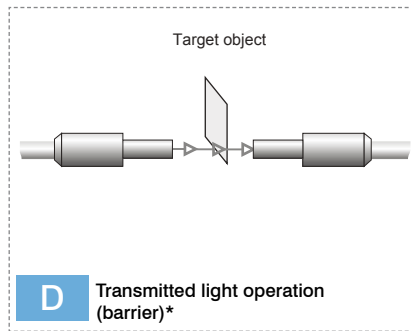
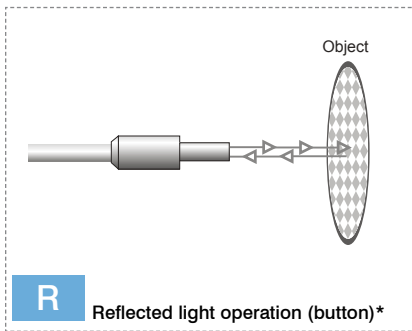
| | | | | | | |
|-----------|----------|----------|--------------|------------|-------------|------------|
| FA | D | T | A 2.0 | 2.5 | 1200 | 67° |
| 1 | 2 | 3 | 4 | | 5 | 6 |

- 1** Adaption to FA-Adapter
- 2** Function of the fiber optic (D = transmitted light mode, R = reflex mode)
- 3** Sheathing e.g. silicone-metal sheath (T)
- 4** Sensor mechanism type, e.g. A2.0
Fiber bundle e.g. 2.5mm dia.
- 5** Overall length of e.g. 1200mm (standard length / bearing types)
- 6** Aperture angle of the fiber, e.g. 67 °

1 Adapter version



2 Functions

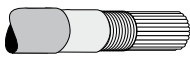


* All functions can also be performed as multiple reflex and transmitted light functions

3 Sheathing

Silicone metal sheath

Metal wire-spiral-reinforced hose with glass fiber braiding and silicone rubber sheathing



Characteristics

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

T

Stainless-steel sheath

Flexible stainless steel wire-spiral-reinforced hose ¹⁾



Characteristics

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

E

Metal sheath

Flexible brass wire-spiral-reinforced hose ¹⁾



Characteristics

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

M

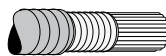
- ¹⁾ Bending radius corresponds to three times the external diameter of the sheath.
²⁾ Bending radius corresponds to twice the external diameter of the sheath.

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

PVC-metal sheath

Flexible brass spiral-reinforced hose coated with PVC sheathing ¹⁾



Characteristics

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

Z

PVC special sheath

Highly flexible plastic hose ²⁾

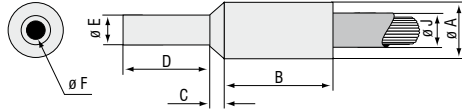


Characteristics

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

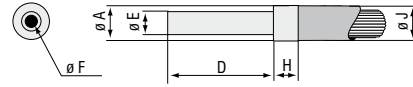
P

4 Sensor mechanism variants and fiber bundles



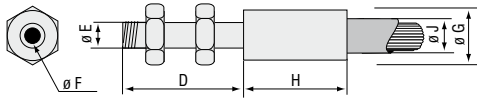
| Type | A Ø | B | C | D | E Ø | F Ø | P | ØJ | M | T |
|-------|-----|----|---|----|-----|-----|---|----|---|-----|
| A 1.0 | 4.6 | 8 | 2 | 11 | 2.5 | 1.5 | 4 | 4 | 4 | - |
| A 1.1 | 6.6 | 8 | 2 | 11 | 2.5 | 1.5 | - | 5 | 5 | 4.4 |
| A 2.0 | 6.6 | 10 | 2 | 12 | 4.5 | 2.5 | 6 | 6 | 6 | 5.8 |
| A 3.0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

A Type A ferrule, stainless steel



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

B Type B ferrule
(only suitable for PVC sheathing)



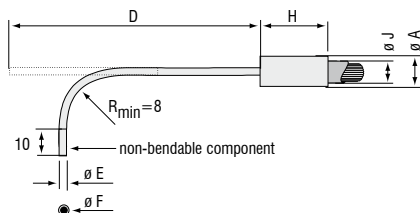
| Type | D | E | F Ø | G Ø | H | P | ØJ | M | T |
|-------|----|-----|-----|-----|----|---|----|---|-----|
| C 1.0 | 30 | M4 | 1.0 | 6 | 13 | 5 | 5 | 5 | 4.4 |
| C 2.0 | 30 | M6 | 2.5 | 8 | 15 | 6 | 6 | 6 | 5.8 |
| C 3.0 | 30 | M10 | 3 | 11 | 12 | 7 | 7 | 7 | 7.5 |

C Type C ferrule, stainless steel

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

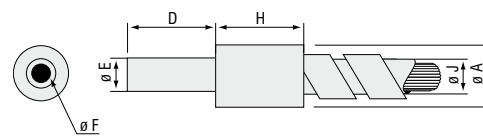
All details in mm
Tolerances: typ. +/- 0.1mm
All ferrule, black anodized

**Different sizes are possible by request, please
ask our technical team.**
(see also the "Special versions" section)



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

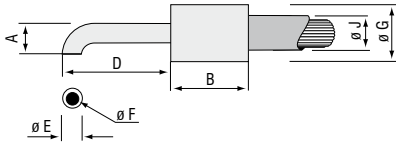
O Type O ferrule
Bendable, to an extent



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

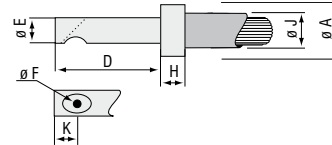
M Type M ferrule

4 Sensor mechanism variants and fiber bundles



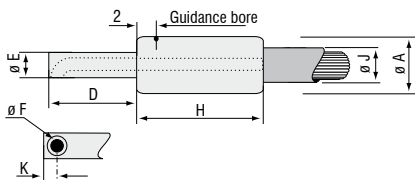
| Type | A Ø | B | D | E Ø | F Ø | G Ø | r | P | ØJ M | T |
|-------|--------|----|----|--------|--------|--------|-----|---|---------|-----|
| D 1.0 | 2.5 | 10 | 20 | 1 | 0.6 | 3 | 1.5 | 2 | - | - |
| D 1.1 | 2.5 | 13 | 20 | 1 | 0.6 | 6 | 1.5 | - | - | 4.4 |
| D 2.0 | 6 | 13 | 20 | 2 | 1.5 | 6 | 4 | 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)



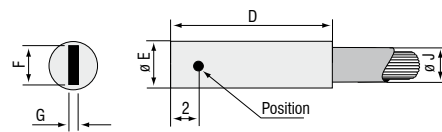
| Type | A Ø | D | E Ø | F Ø | H | K | P | ØJ M | T |
|-------|--------|----|--------|--------|-----|---|---|---------|-----|
| E 1.0 | 4 | 20 | 3 | 1.5 | 1.5 | 4 | 4 | - | - |
| E 2.0 | 5 | 20 | 4 | 2.5 | 1.5 | 4 | 5 | 5 | - |
| E 2.1 | 7 | 20 | 4 | 2.5 | 10 | 4 | - | - | 5.8 |
| E 3.0 | 8 | 20 | 6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

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



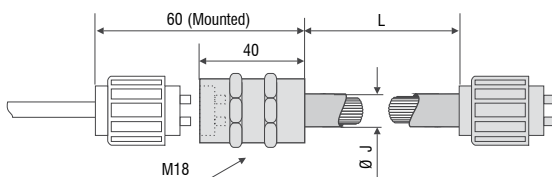
| Type | A Ø | D | E Ø | F Ø | H | K | P | ØJ M | T |
|-------|--------|----|--------|--------|----|---|---|---------|-----|
| F 1.0 | 8 | 20 | 6 | 1.5 | 9 | 3 | 5 | 5 | 5.8 |
| F 2.0 | 10 | 20 | 8 | 2.5 | 10 | 4 | 6 | 6 | 6.5 |
| F 3.0 | 12 | 20 | 10 | 3 | 10 | 5 | 7 | 7 | 7.5 |

F Type F ferrule, stainless steel



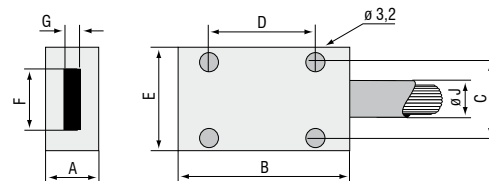
| Type | D | E Ø | F | G max. | P | ØJ M | T |
|-------|----|--------|---|-----------|---|---------|-------|
| R 1.0 | 25 | 4 | 3 | 0.5 | 3 | - | - |
| R 1.1 | 30 | 7 | 3 | 0.5 | 6 | 6 | 5.8 |
| R 2.0 | 25 | 7 | 6 | 1 | 6 | 6 | 5.8** |
| R 2.1 | 30 | 10 | 6 | 1 | - | 7 | 7.5 |

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



| Fiber bundle Ø | P | ØJ M | T | L |
|----------------|----|---------|------|---|
| (3mm)/ channel | 12 | 13 | 13.5 | |

LV Type LV ferrule
Fiber optic hold / feed-through



| Typ | A | B | C | D | E | F | G | ØJ |
|-----|----|----|----|----|-----|----|------|-------------------------------------|
| Q1 | 12 | 25 | 9 | 15 | 15 | 5 | 0.5 | dependent on fiber cross-section |
| 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 | |
| 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

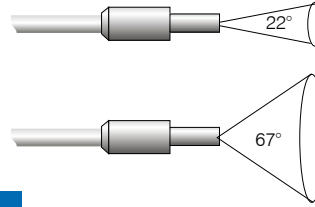
All details in mm
Attention: With angular sensor mechanism versions, a reduction in range can be expected compared to axially emerging versions.

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



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

6

Detection areas, various sensor mechanisms

| Fiber bundle ØF mm | Working distance mm | Light spot for 67° fiber approx. Ø mm | Light spot for 22° fiber 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

Series KL-xx/xx



- ▶ Focussing of color and fiber optic sensors
- ▶ Allowing for extreme customization of the mounting of the fiber
- ▶ Many possible applications

Features:

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

| | 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 ³⁾ |
|  | 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. 85mm 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⁾ |
|  | KI-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 fiber optic sensors.

¹⁾ Reflex fiber optic (FAR)

²⁾ Transmitted light fiber optics (FAD)

³⁾ Can be realised in conjunction with FAR-X-A2.0-0.6-XXXX-67* reflex mode fiber optical cable (FAR) measurement spot of approx. 0.2mm

Cables and other accessories

colorSENSOR accessories

| Art. no. | description | suitable for: |
|----------|--|---|
| 11234089 | CAB-M23-19P-co-straight; 2m-PUR; open ends | colorSENSOR WLCS M-41 (power and PLC) |
| 11234097 | CAB-M23-19P-co-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) |

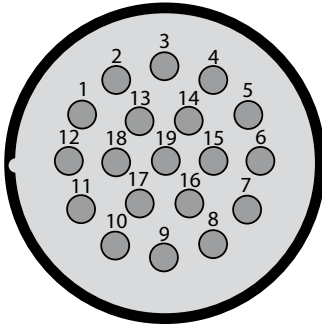
colorCONTROL ACS accessories

| Art. no. | description | suitable for: |
|----------|--|--|
| 11234274 | reflectance standard 1.25" Fluorilon | colorSENSOR and colorCONTROL |
| 11234222 | CAB-M9-4P-co-straight; 2m-PUR; open ends | colorCONTROL ACS 7000 (power) |
| 11234225 | CAB-M9-4P-co-straight; 5m-PUR; open ends | colorCONTROL ACS 7000 (power) |
| 11234091 | CAB-M9-8P-co-straight; 2m-PUR; open ends | colorCONTROL ACS 7000 (digital I/O, Sync.) |
| 11234099 | CAB-M9-8P-co-straight; 5m-PUR; open ends | colorCONTROL ACS 7000 (digital I/O, Sync.) |
| 11234223 | CAB-M9-7P-co-straight; 2m-PUR; open ends | colorCONTROL ACS 7000 (colour OUT) |
| 11234226 | CAB-M9-7P-co-straight; 5m-PUR; open ends | colorCONTROL ACS 7000 (colour OUT) |
| 11294232 | CAB-RJ45-Eth; 2m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS 7000 (Ether-net/-CAT) |
| 11293257 | CAB-RJ45-Eth; 5m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS 7000 (Ether-net/-CAT) |
| 11294277 | CAB-RJ45-Eth-Cross; 3m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS 7000 (Ether-net/-CAT) |
| 11293258 | CAB-RJ45-Eth-Cross; 5m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS 7000 (Ether-net/-CAT) |
| 11234224 | CAB-M9-5P-co-straight; 2m-PVC-RS422; open ends | colorCONTROL ACS 7000 (RS422) |
| 11234227 | CAB-M9-5P-co-straight; 5m-PVC-RS422; open ends | colorCONTROL ACS 7000 (RS422) |
| 11234230 | CAB-M9-5P-co-straight; 2m-PVC-RS422; Sub-D-15P-co-straight | colorCONTROL ACS 7000 (IF2008) |
| 11234231 | CAB-M9-5P-co-straight; 5m-PVC-RS422; Sub-D-15P-co-straight | colorCONTROL ACS 7000 (IF2008) |
| 2213017 | IF2008 Interface card RS422 / PCI-card | colorCONTROL ACS 7000 (RS422/PC) |

| colorCONTROL MFA accessories | | |
|------------------------------|--|--------------------------------------|
| Art. no. | description | suitable for: |
| 10814105 | POF-2,2 mm 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 |
| 11234305 | CAB-M8-4P-co-straight; 2m-PUR; open ends | colorCONTROL MFA-1 (power and PLC) |
| 11234306 | CAB-M8-4P-co-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) |

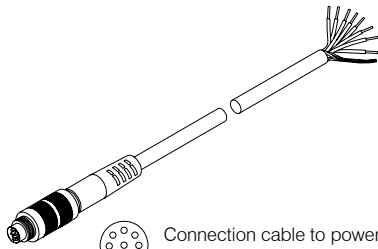
Pin assignment

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



| Pin | Color | 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 ($\pm 10\%$) |

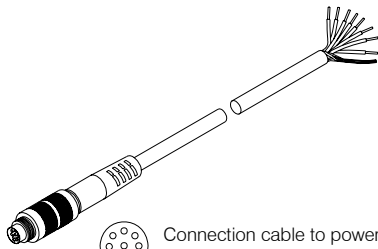
CAB-M9-8P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234091; 11234098)



Connection cable to power/PLC or digital I/O
(max. length. 10m, sheath PUR)

| Pin | Color | 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 | ACS 7000 |
|-----|--------|------------------------|------------------------|--------------------|-------------------------------|---------------|
| 1 | white | OUT 0 | OUT 0 / OUT A 0 | OUT 1 | GND (0V) | Error |
| 2 | brown | OUT 1 | OUT 1 / OUT A 1 | OUT 2 | +24V DC ($\pm 10\%$) | GND Error |
| 3 | green | IN 1 | IN 1 | OUT 3 | IN 0 | Sync. OUT |
| 4 | yellow | IN 0 | IN 0 | OUT 4 | OUT 0 | GND Sync. OUT |
| 5 | grey | n.c. / OUT 4 | CLK (OUT K) | OUT 5 | OUT 1 | Sync. IN |
| 6 | pink | OUT 3 | OUT 2 / OUT A 2 | OUT 6 | OUT 2 | GND Sync. IN |
| 7 | blue | GND (0V) | GND (0V) | OUT 7 | OUT 3 | LLL/HLL |
| 8 | red | +24V DC ($\pm 10\%$) | +24V DC ($\pm 10\%$) | OUT 0 | OUT 4 | LLL/HLL |

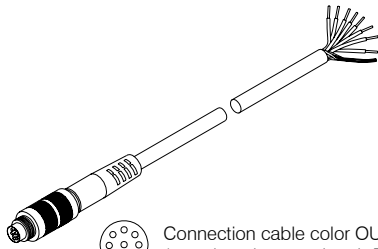
CAB-M9-4P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234222; 11234225)



Connection cable to power
(max. length. 10m, sheath PUR)

| Pin | Color | ACS 7000 |
|-----|-------|------------------------|
| 1 | white | n.c. |
| 2 | brown | +24V DC ($\pm 15\%$) |
| 3 | black | n.c. |
| 4 | blue | GND (0V) |

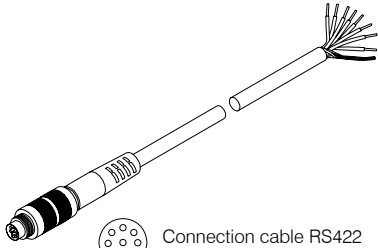
CAB-M9-7P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234223; 11234226)




Connection cable color OUT
(max. length 10m, sheath PUR)

| Pin | Color | ACS 7000 |
|-----|--------|----------|
| 1 | white | OUT 0 |
| 2 | brown | OUT 1 |
| 3 | green | OUT 2 |
| 4 | yellow | OUT 3 |
| 5 | grey | GND |
| 6 | pink | n.c. |
| 7 | blue | n.c. |

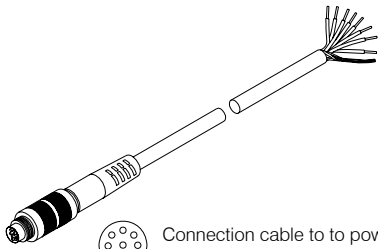
CAB-M9-5P-co-straight; Xm-PVC-RS422;
open ends
(Art. no.: 11234224; 11234227)




 Connection cable RS422
(max. length 5m, sheath PVC)

| Pin | Color | ACS 7000 |
|-----|--------|-----------------------|
| 1 | white | TX |
| 2 | brown | /TX |
| 3 | green | /RX |
| 4 | yellow | RX |
| 5 | grey | GND RS422 DC-isolated |

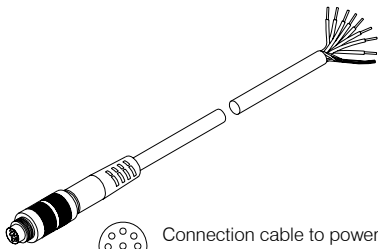
CAB-M8-4P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234305; 11234306)




 Connection cable to to power/PLC
(max. length 5m, sheath PUR)

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

High performance sensors made by Micro-Epsilon



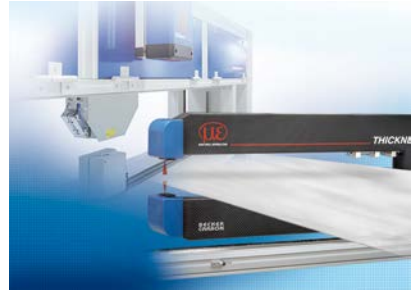
Sensors and systems for displacement and position



Sensors and measurement devices for non-contact temperature measurement



2D/3D profile sensors (laser scanner)



Measurement and inspection systems for quality assurance



Optical micrometers, fibre optic sensors and fiber optics



Color recognition sensors, LED analyzers and color online spectrometer

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