

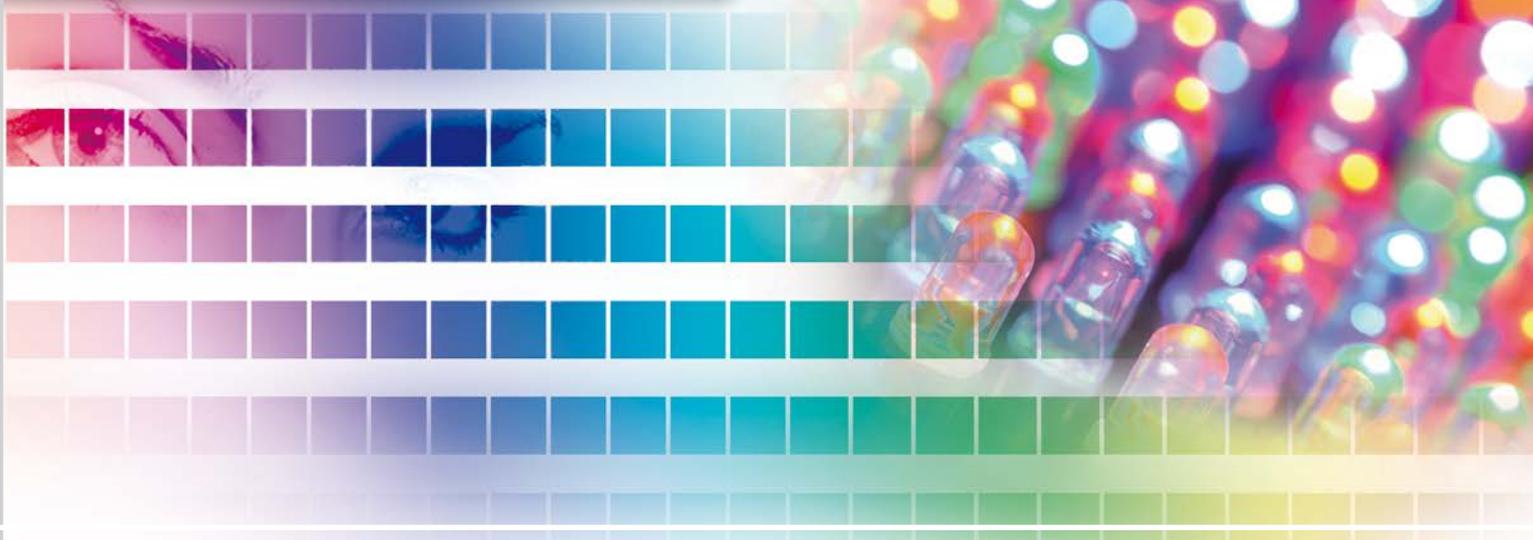


More Precision

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.

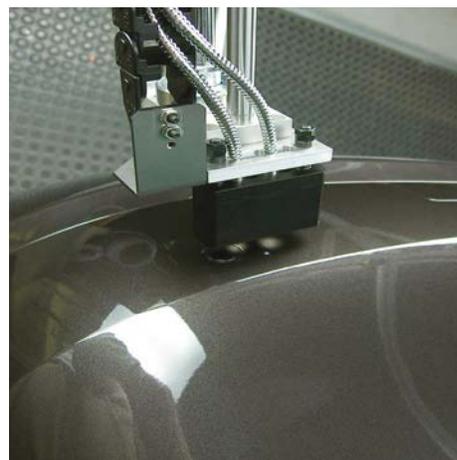
A number of different types of color sensor are responsible for high productivity and cost reduction in production and quality assurance applications.

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

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Fiber color sensors

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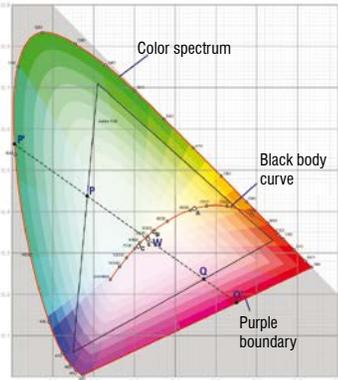
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BASICS AND SELECTION CRITERIA

Standard color space CIE 1931 (xy color space)

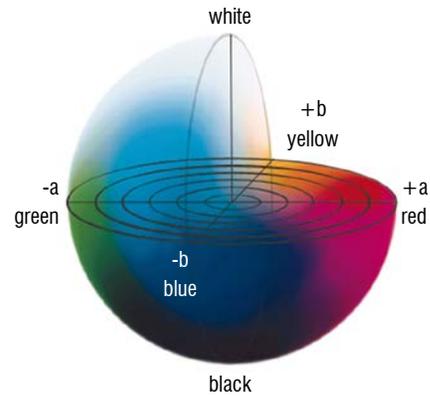
This color space corresponds to the human color perception (very large green and small blue/red sector).



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

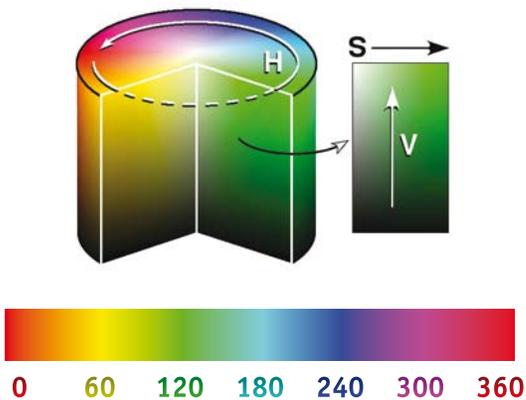
Ideal color space for color test, as each color range is the same size.



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

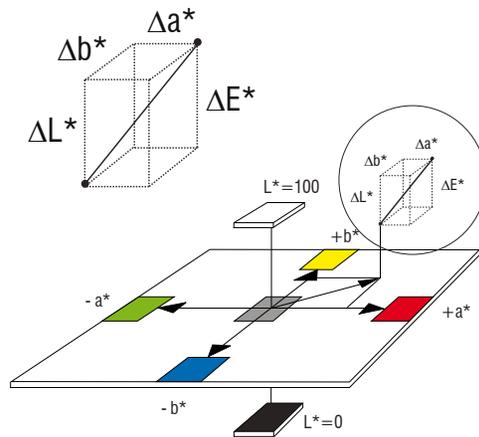
Ideal color space for LED inspection.
 Is used primarily with the colorCONTROL MFA series.



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; ΔE ; $dE =$ 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		$\Delta E \geq 1.5$	$\Delta E \geq 0.8$	$\Delta E \geq 0.8$	$\Delta E \geq 0.5$	$\Delta E \geq 0.5$			
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	
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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								
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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 $L^*a^*b^*$.

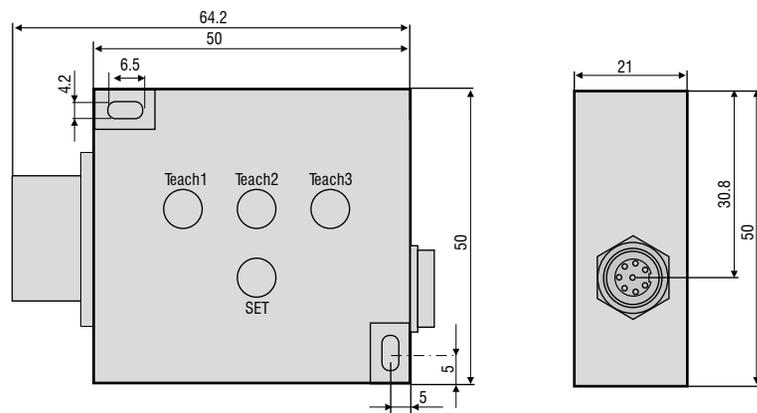
With the LC-10, up to 3 colors can be taught easily via the PC Teach-in or externally. If a color that has been taught is recognized by the sensor, a change in switching condition is made via the 3 encoded digital outputs and visual indication on the button.

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 $L^*a^*b^*$.

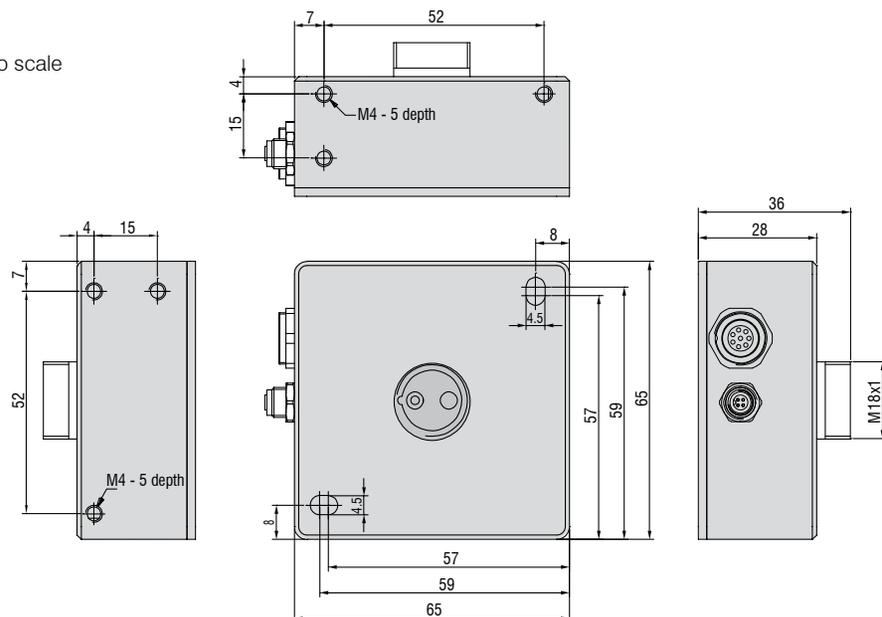
With the LC-20, 31 colors can be taught using the colorCONTROL S software. If a color that has been taught is recognized by the sensor, a change in switching condition is made via the 5 encoded digital outputs.

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)

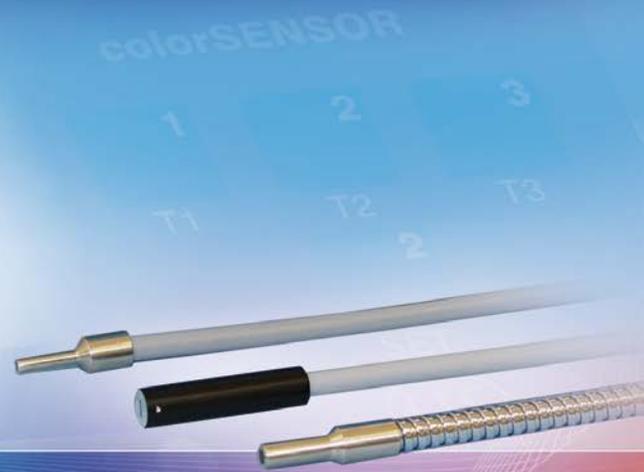
Dimensions:

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:

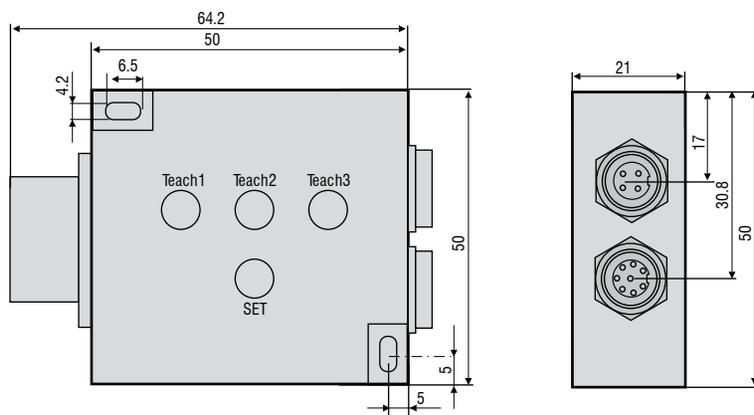
- Detection of color rings on metallic and plastic sleeves
- Reading out and statistically evaluating color values
- Recognizing color markings in the printing industry
- Color and grey-scale detection
- Inspection of packaging
- Sorting tasks on the basis of color
(e.g. checking O-rings, closures, crown 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

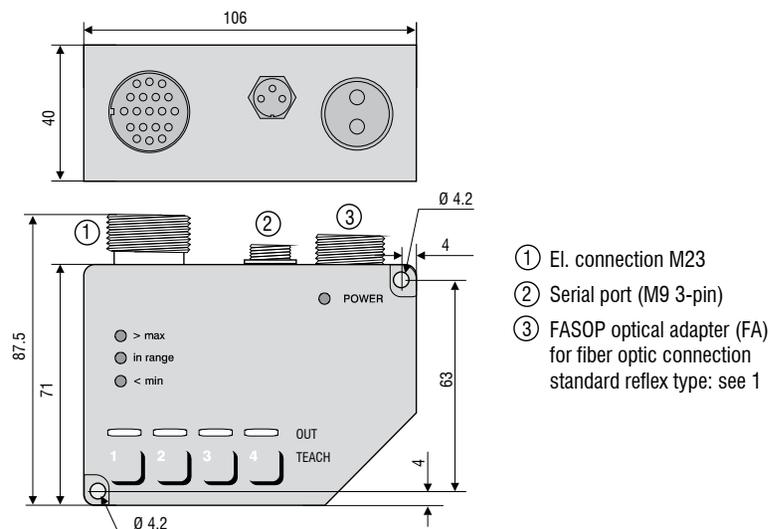
Type	WLCS-M-41
Article number	10234062
Object distance	Dependent on the fiber optics used and the optical heads Reflex mode fiber optical cables typically 2mm-25mm with lens, typically 5mm-100mm ¹⁾
Light spot diameter	Dependent on the fiber optics used and the optical heads Reflex mode fiber optical 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

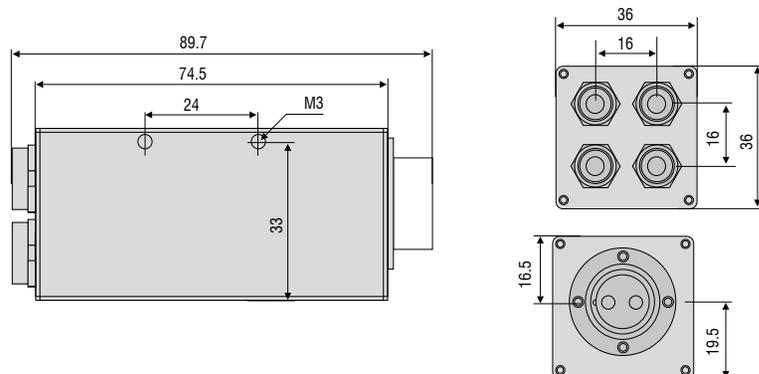
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

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

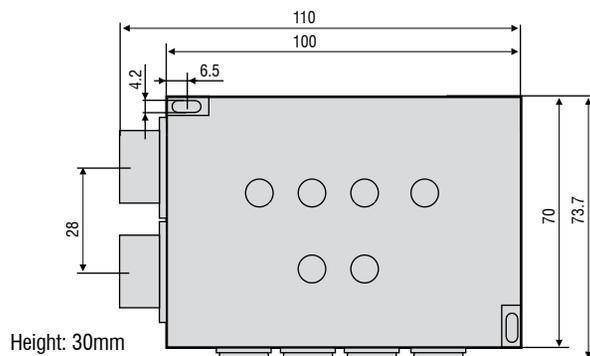
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

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

²⁾ suitable for LED testing

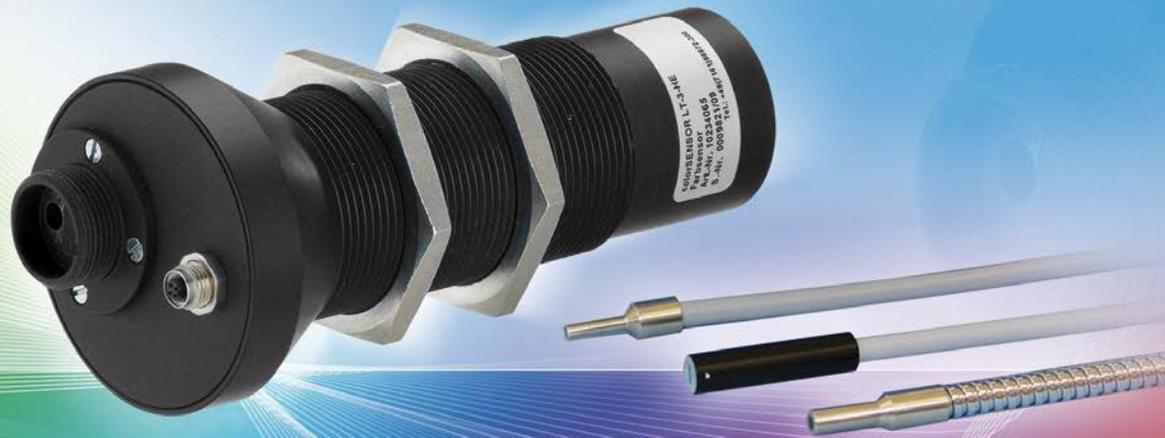
Dimensions:

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

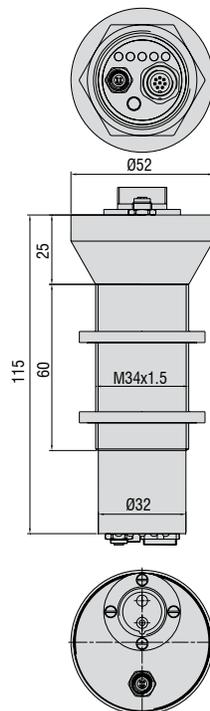
¹⁾ Type: FAR-T-A2.0-2.5-1200-67° reflex

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

²⁾ suitable for LED testing

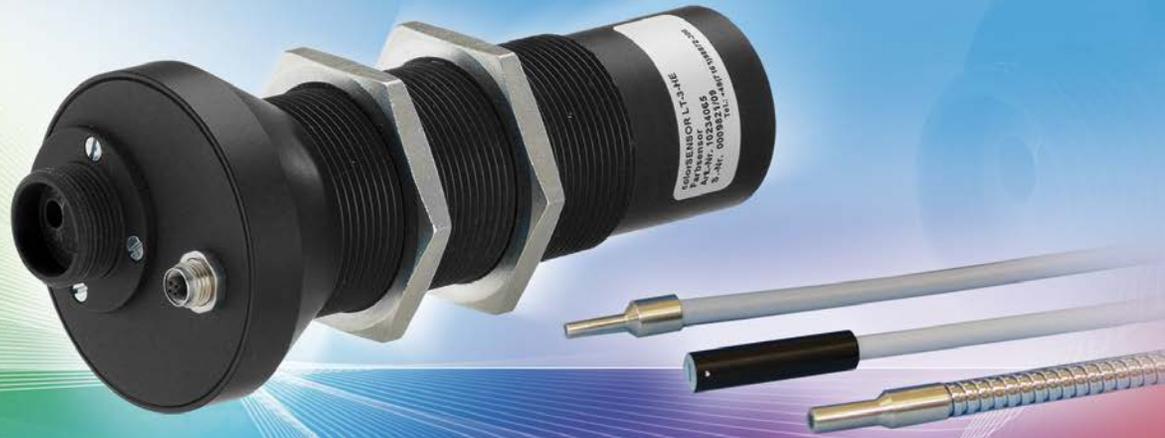
Dimensions:

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:

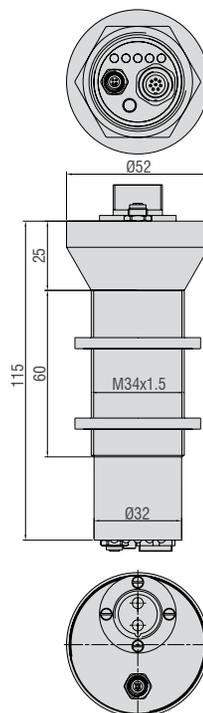
- Detection of luminescent colors
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color

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:

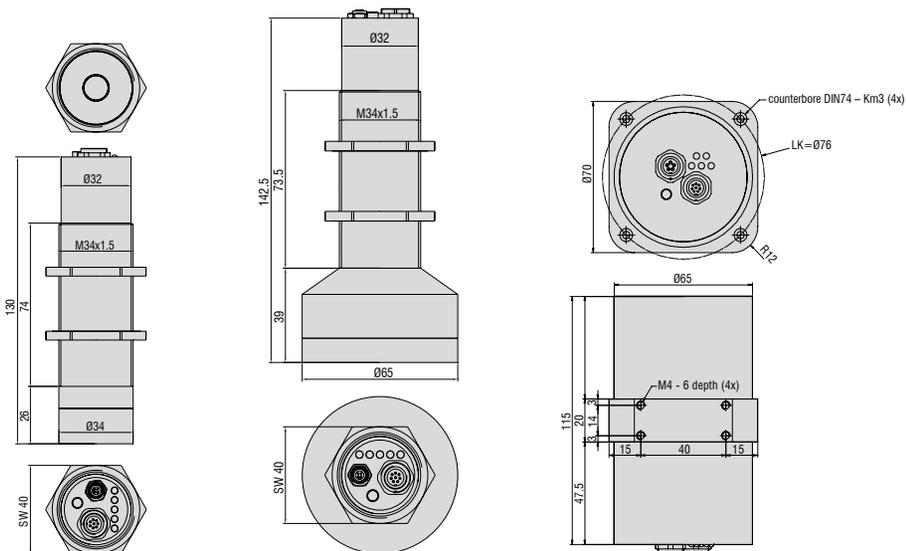
- Color recognition of matt surfaces at a distance of up to 400mm
- Detection of color rings
- Recognizing color markings in the printing industry
- Inspection of packaging
- Sorting tasks on the basis of color
- Color control of self-luminous objects (LEDs, displays, etc.)
- Illumination recognition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

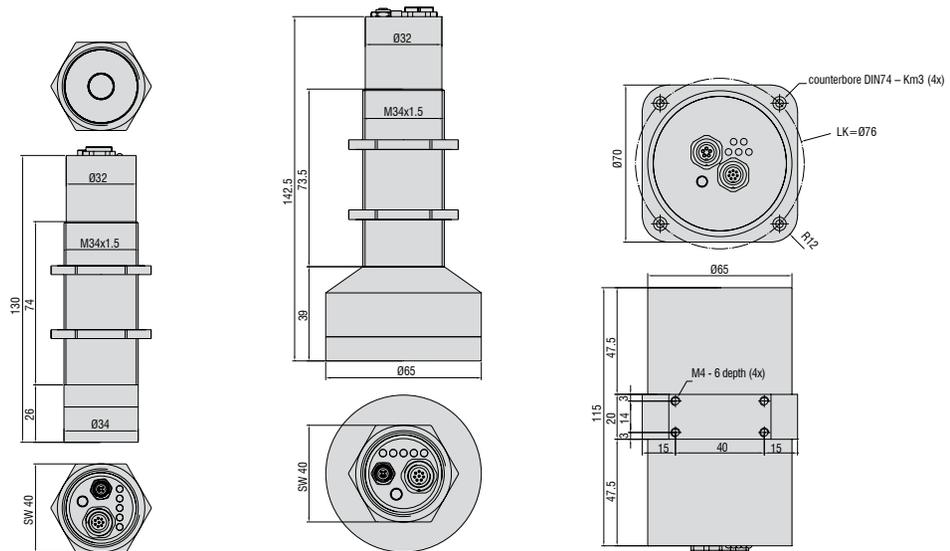
Application examples:

- 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.

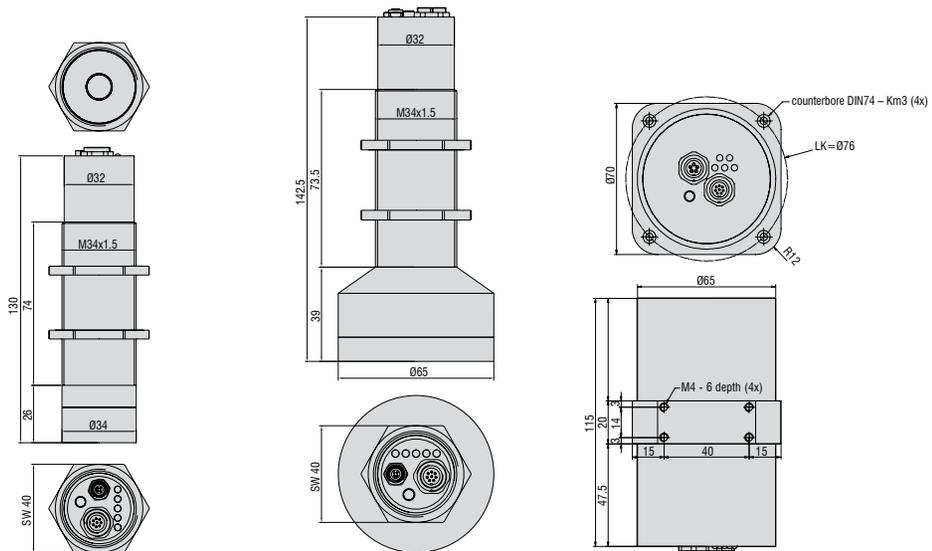
Application examples:

- 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:

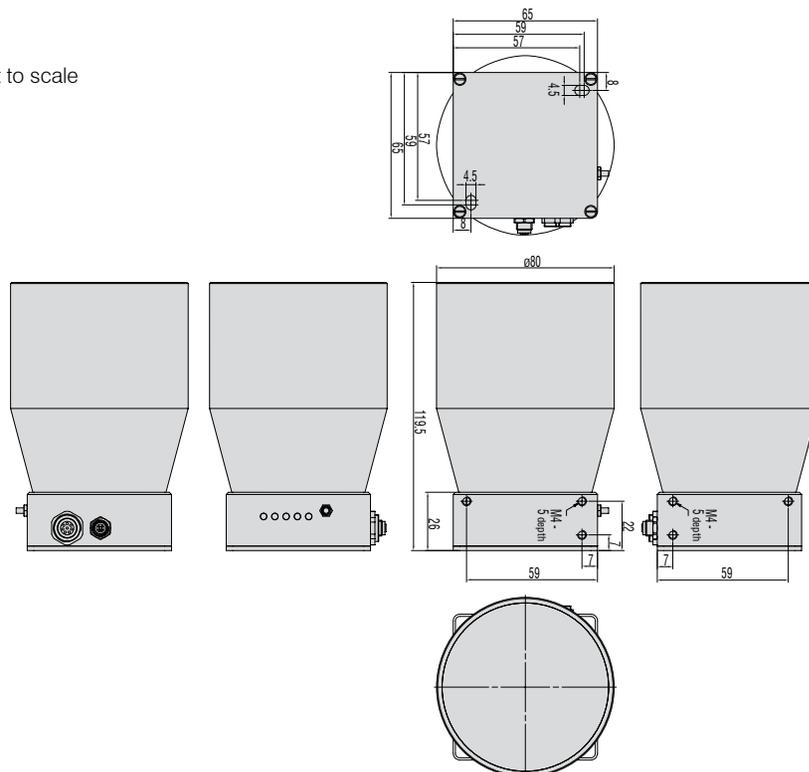
- Color recognition from long distances up to 800mm
- Correct insertion of product in production machinery
- Inspection of packaging
- Sorting tasks on the basis of color
- Color assignment on automobiles
- Detecting drink crates
- Paper, recycling recognition
- Illumination recognition as per color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

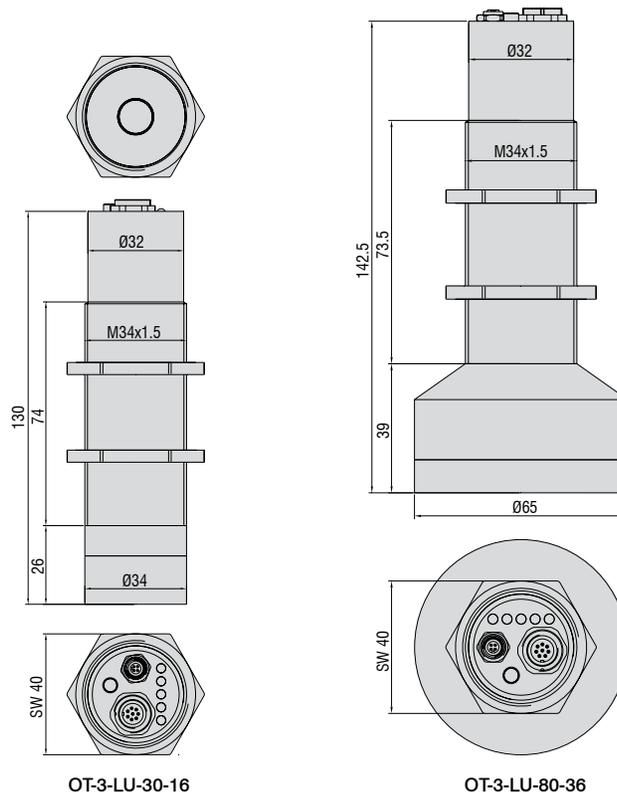
Application examples:

- 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

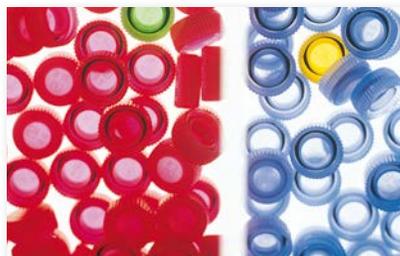
Controller colorCONTROL ACS 7000

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.

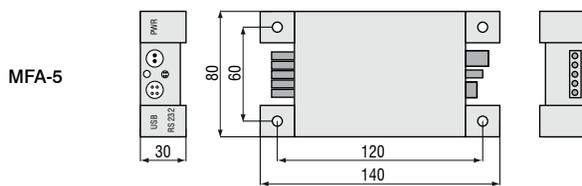
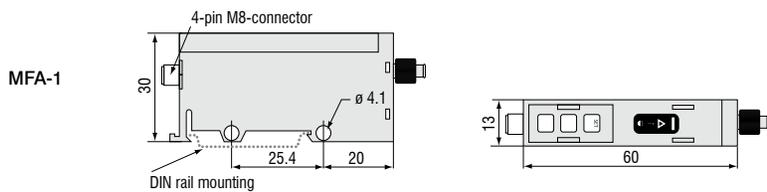
The colorCONTROL MFA-5 can be enlarged up to 20 testing points using the module colorCONTROL MFA-5-M. Additionally, one of the assembly kits is required depending on the construction depths (see accessories). For example: 20 inspection tests require: 1x colorCONTROL MFA-5 + 3x colorCONTROL MFA-5-M +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

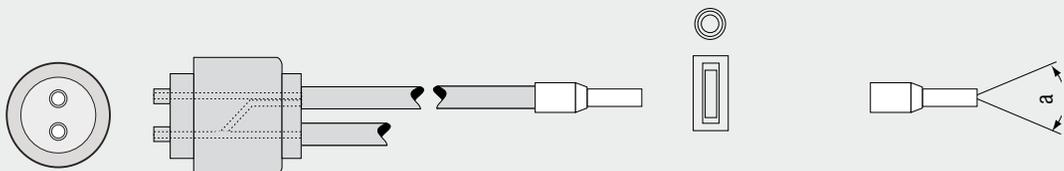
One of the advantages of Micro-Epsilon fiber optic manufacturing is the production of customer-specific designs for various complex sensor mechanisms.

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.



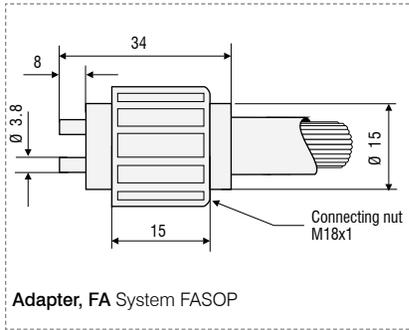
The diagram illustrates the components of a fiber optic system, each corresponding to a part of the ordering code. From left to right: an adapter with two ports, a fiber optic cable with a sensor mechanism, a cross-section of a fiber bundle, and a fiber optic cable with an aperture angle 'a'.

Ordering code

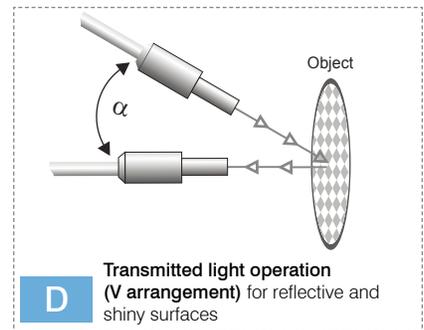
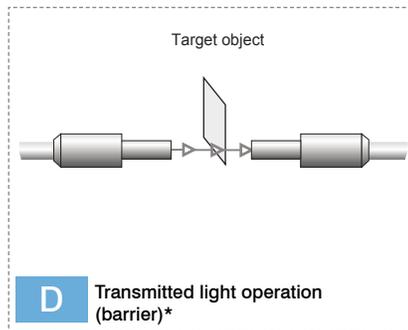
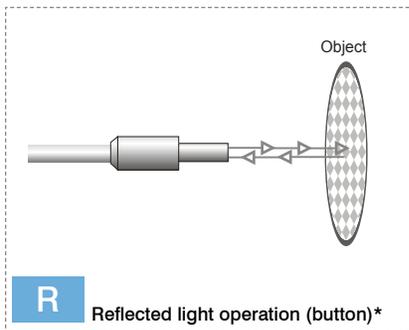
FA	D	T	A 2.0	2.5	1200	67°
1	2	3	4		5	6

- 1** Adaption to FA-Adapter
- 2** Function of the 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.

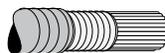
²⁾ Bending radius corresponds to twice the external diameter of the sheath.

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⁾

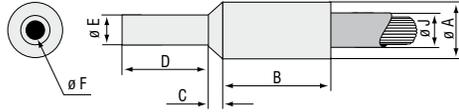


Characteristics

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

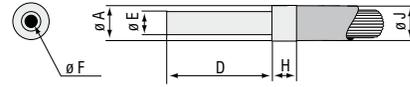
P

4 Sensor mechanism variants and fiber bundles



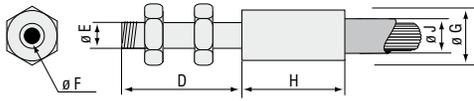
Type	A Ø	B	C	D	E Ø	F Ø	P	ØJ	M	T
A 1.0	4.6	8	2	11	2.5	1.5	4	4	4	-
A 1.1	6.6	8	2	11	2.5	1.5	-	5	5	4.4
A 2.0	6.6	10	2	12	4.5	2.5	6	6	6	5.8
A 3.0	8.5	11	2	15	6	3	7	7	7	7.5

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)



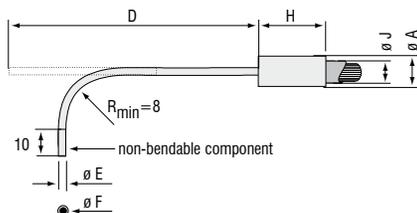
Type	D	E	F Ø	G Ø	H	P	ØJ	M	T
C 1.0	30	M4	1.0	6	13	5	5	5	4.4
C 2.0	30	M6	2.5	8	15	6	6	6	5.8
C 3.0	30	M10	3	11	12	7	7	7	7.5

C Type C ferrule, stainless steel

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

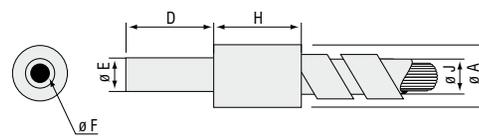
All details in mm
Tolerances: typ. +/- 0.1mm
All ferrule, black anodized

**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

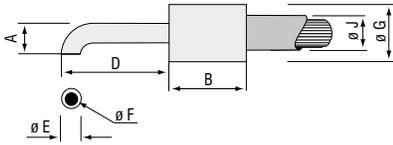
O Type O ferrule
Bendable, to an extent



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

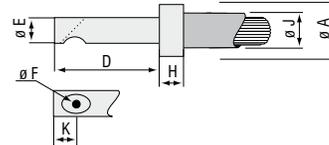
M Type M ferrule

4 Sensor mechanism variants and fiber bundles



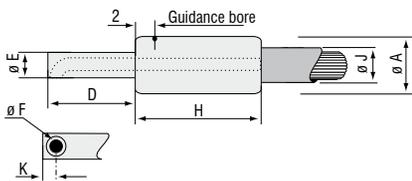
Type	A Ø	B	D	E Ø	F Ø	G Ø	r	P	ØJ M	T
D 1.0	2.5	10	20	1	0.6	3	1.5	2	-	-
D 1.1	2.5	13	20	1	0.6	6	1.5	-	-	4.4
D 2.0	6	13	20	2	1.5	6	4	5	5	4.4
D 3.0	15	17	20	5	2.5	9	10	7	7	6.5

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



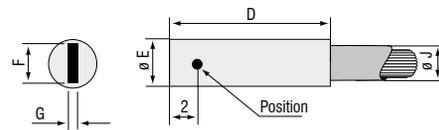
Type	A Ø	D	E Ø	F Ø	H	K	P	ØJ M	T
E 1.0	4	20	3	1.5	1.5	4	4	-	-
E 2.0	5	20	4	2.5	1.5	4	5	5	-
E 2.1	7	20	4	2.5	10	4	-	-	5.8
E 3.0	8	20	6	3	1.5	5	7	7	-

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



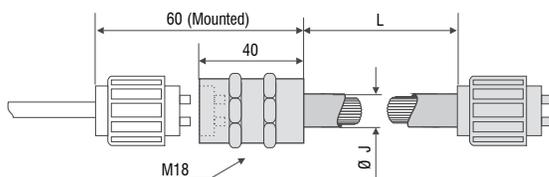
Type	A Ø	D	E Ø	F Ø	H	K	P	ØJ M	T
F 1.0	8	20	6	1.5	9	3	5	5	5.8
F 2.0	10	20	8	2.5	10	4	6	6	6.5
F 3.0	12	20	10	3	10	5	7	7	7.5

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

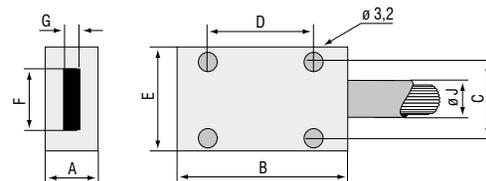
R Type R ferrule, aluminium
* R1.0 only suitable for PVC sheathing
** at 6x1 mm², can be made to a length of 1200



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

LV Type LV ferrule
Fiber optic hold / feed-through

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



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)

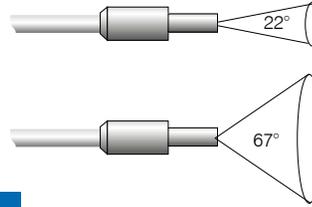
Q Type Q, aluminium
Also available in stainless steel

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)

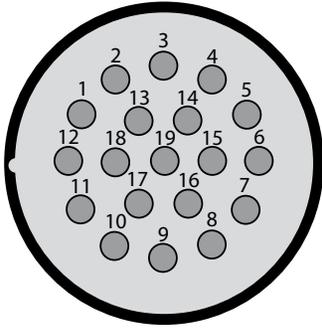
colorCONTROL ACS accessories

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)

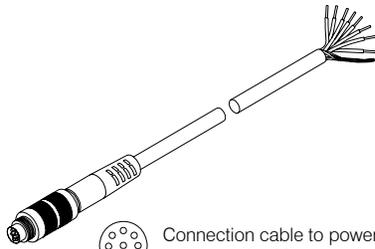
Pin assignment

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 ($\pm 10\%$)

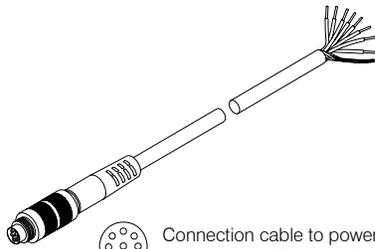
CAB-M9-8P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234091; 11234098)



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

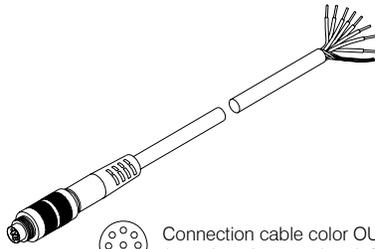
CAB-M9-4P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234222; 11234225)



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)

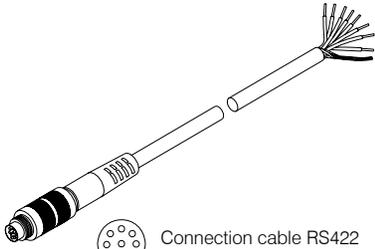
CAB-M9-7P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234223; 11234226)



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.

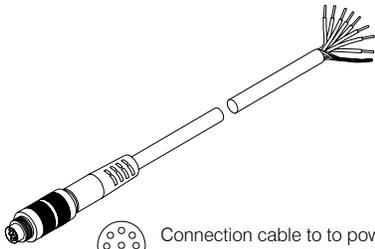
CAB-M9-5P-co-straight; Xm-PVC-RS422;
open ends
(Art. no.: 11234224; 11234227)



 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

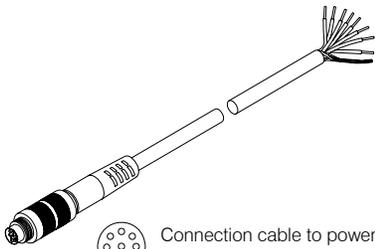
CAB-M8-4P-co-straight; Xm-PUR;
open ends
(Art. no.: 11234305; 11234306)



 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

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