MICRO-EPSILON

More Precision

colorSENSOR // True Color Measuring Systems

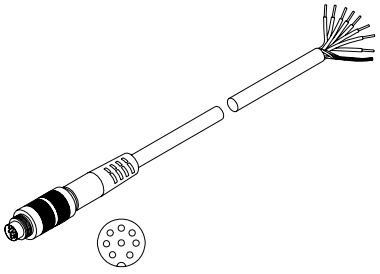


Connection cables & Accessories
colorSENSOR

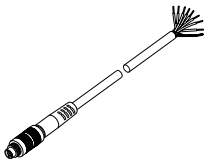
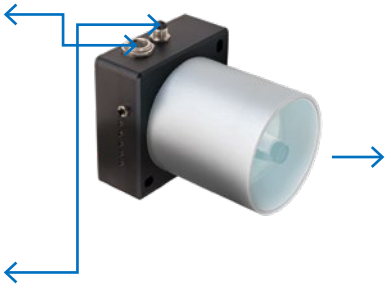
Connection cables		Mounting	Sensor	Accessories
Supply/RS232 Power supply unit PS2031 Art. no. 2420096 Connection PLC (I/O)	Art. no. 11234717 (2 m) 11234718 (5 m)		CFS1 CFS2 CFS3 CFS4	White standard Art. no. 11234694 11234695
Digital output/ Ethernet	Art. no. 11234735 (2 m) 11234736 (5 m)			Vacuum feed-through Art. no. 10811916
Connection PLC (I/O)	Art. no. 11234722 (2 m) 11234723 (5 m)			C-mount lens Art. no. 11293186 and others
Process interfaces (USB)	Art. no. 11234732 (2 m) 11234733 (5 m)	Mounting adapter Art. no. 11234713 11234762 11234763		

Pin assignment

CAB-M12-8P-co-fm-straight; Xm-PUR; open ends
(Art.-No.: 11234717; 11234718)
Connection cable SYS; Power and PLC
(max. length 10 m, PUR sheath)

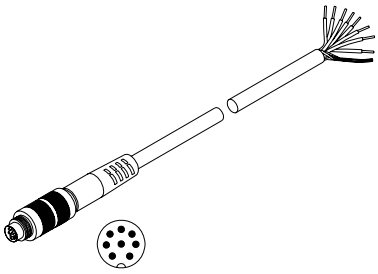


Pin	Color	CFO100/200
1	white	IN0
2	brown	+UB
3	green	TX
4	yellow	RX
5	gray	OUT0
6	pink	OUT1
7	blue	GND
8	red	OUT2

Connection cables		Mounting	Sensor	Accessories
Supply/PLC Power supply unit PS2031 Art. no. 2420096 	Art. no. 11234091 (2 m) 11234099 (5 m) 		No separate sensor or cable - integrated in sensor head	White standard Art. no. 11234694 11234695 
Digital output/ serial/Ethernet 	RS232 Art. no. 11234095 (2 m) 11234103 (5 m) USB Art. no. 11234096 (2 m) 11234104 (5 m) Ethernet Art. no. 11234910+11234735 (2.5 m) 11234910+11234736 (5.5 m)	Screw connection via integrated bore holes		

Pin assignment

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



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

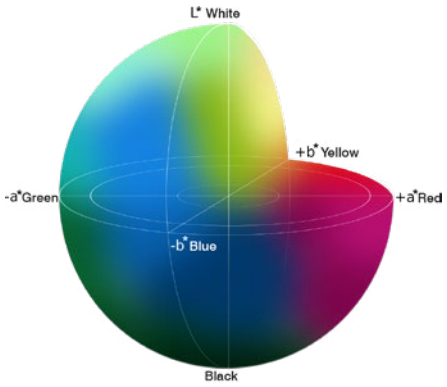
Basics and selection criteria
colorSENSOR

Standard color space CIELAB76

The L*a*b color space comprises all colors perceptible to the human eye. In this 3D color model, each hue is described with approximately the same volume of space. The L*a*b* color space has established itself in the industry and is used by device manufactures for color inspection.

Each color is described by the color location (L*; a*; b*).
L* = lightness (black = 0; white = 100)
a* = green/red colors (green = -100; red = +100)
b* = blue/yellow colors (blue = -100; yellow = +100)

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



L*a*b* Color space

Color distance ΔE

The larger the difference between the colors within the color space, the more clearly the difference can be perceived with the human eye. This is defined as ΔE color distance.
Delta E; ΔE; dE = is a metric for the perceived color distance between colors (DIN 5033)

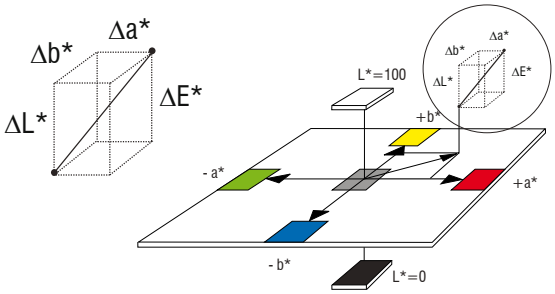
$$\Delta E = \sqrt{(L^*_p - L^*_v)^2 + (a^*_p - a^*_v)^2 + (b^*_p - b^*_v)^2}$$

ΔE of 11.61 corresponds to the difference between sample (p) and comparison (v)

$$\Delta E = \sqrt{(60^*_p - 55^*_v)^2 + (-38{,}6^*_p - (-30)^*_v)^2 + (-46^*_p - (-52)^*_v)^2} = 11{,}62$$

Interpretation:

ΔE > 5	Large color difference
ΔE 0.5 … 1	Limits of human perception
ΔE < 0.3	Required by the paper industry
ΔE < 0.1	Required by the automotive industry



Sample (p)

Comparison (v)

RGB Color space

It combines the colors red (R), green (G) and blue (B) into one. It is an additive color space, i.e. all three colors as one result in the color white. Black color is produced when R/G/B = 0/0/0.

The RGB color space has established itself in the display industry but is of no interest for industrial measurement technology since not every color can be displayed and measured.

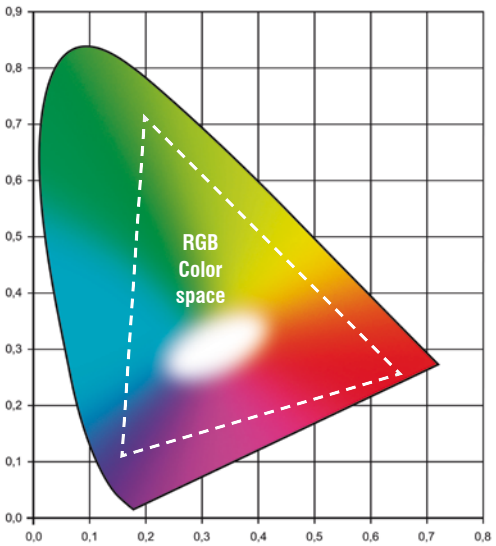
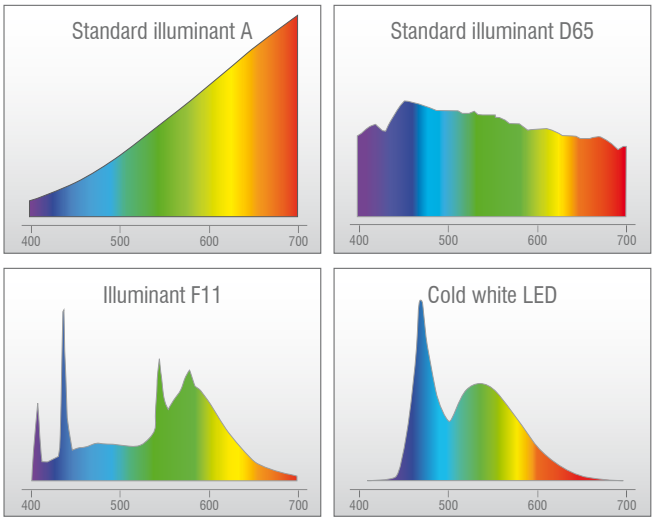


Image © Torso-Verlag

Standard illuminants and light sources

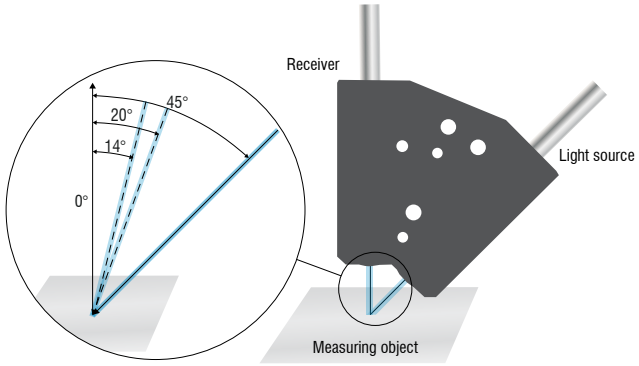
Standard illuminants are defined from 380 to 780 nm.

- **Illuminant A** = light bulb with 2865 k
- **Illuminant D65** = medium daylight with approx. 6500 k
- **Illuminant F11** = fluorescent lamp
- **Cold white LED**

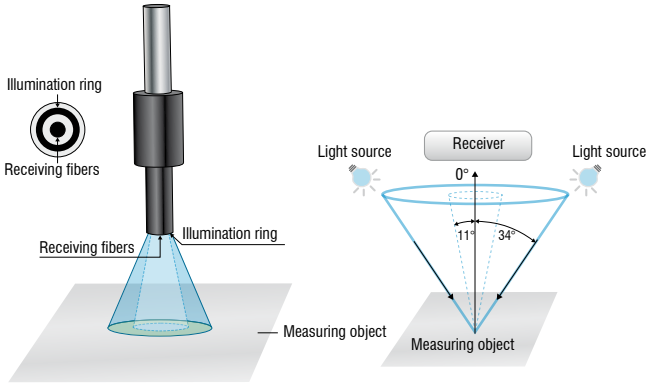


Measurement geometries

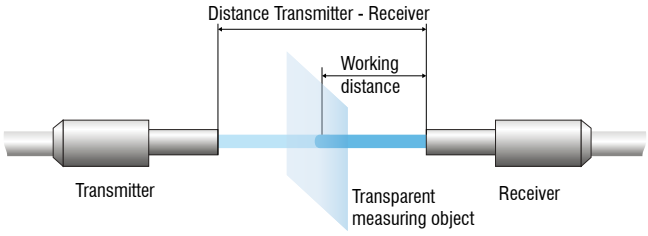
Standard sensor 45°x:0°, 20°x:0°, 14°x:0°



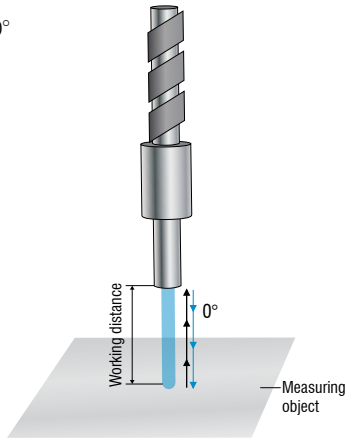
Circular sensor R34°c:0°, R11°c:0°



Transmission sensor 0°:180°



Reflex sensor 0°:0°



With structured surfaces, it is recommended to perform the inspection from all four directions (north, east, south, west on one side) and to calculate the average on different positions or to illuminate the specimen from all directions (ring illumination (R45°c:0°) and to measure only one position. With translucent samples, a defined background or folding the sample should provide sufficient layer thickness for the inspection. You can alternatively use some illumination as background in order to inspect in transmission (0°:180°) mode.

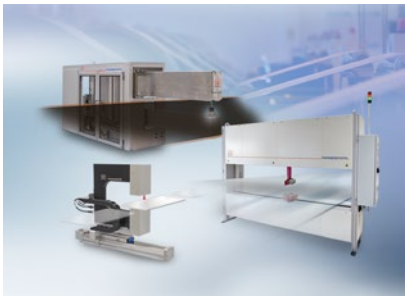
Sensors and Systems from Micro-Epsilon



Sensors and systems for displacement, distance and position



Sensors and measurement devices for non-contact temperature measurement



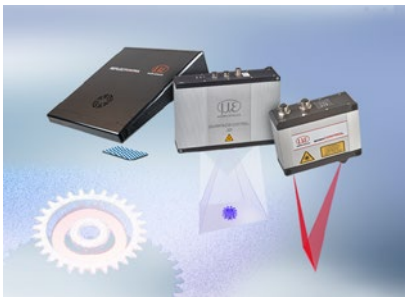
Measuring and inspection systems for metal strips, plastics and rubber



Optical micrometers and fiber optics, measuring and test amplifiers



Color recognition sensors, LED analyzers and inline color spectrometers



3D measurement technology for dimensional testing and surface inspection

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