MICRO-EPSILON

More Precision

colorCONTROL ACS7000 // Inline color measuring system

Inline color measuring system
colorCONTROL ACS7000

- Inline color measurement
- Non-contact measurement
- Measurement accuracy ΔE ≤ 0.08 (sample-related)
- Measurement frequency: 25 Hz up to 2000 Hz
- Ethernet/EtherCAT, RS422, Digital I/O
- Web browser operation

- *Light source: adjustable standard illuminant and observer*
- *Color spaces (adjustable): XYZ; L*a*b*; L* u* v*; L*c*h°*
- *Color recognition from a taught reference list*
- *White/black reference adjustment (via browser and keys on the device)*
- *Inline quality assurance and continuous documentation*
- *Optional measuring heads for different technical surfaces*

The colorCONTROL ACS7000 inline color measuring system recognizes colors not just by comparing them to reference values, but also by using their coordinates in the respective color space to ensure unique identification. Due to its very high measurement speeds, the colorCONTROL ACS7000 is suitable for applications where colors and shades have to be inspected on-the-fly and to very high accuracies. Due to its high measuring accuracy, the system is also used in laboratories.

Measuring principle

The spectral method is the most accurate method of color measurement. First, the sample is illuminated with a homogeneous white LED light. The spectrum of the reflected light is then calculated with a white reference. Then the coordinates in the CIE-XYZ color system are determined for all wavelengths of visible light (390 to 780 nm) and output in the desired color space. The controller takes into account different observation conditions such as the type of light (illuminant) and standard observer.

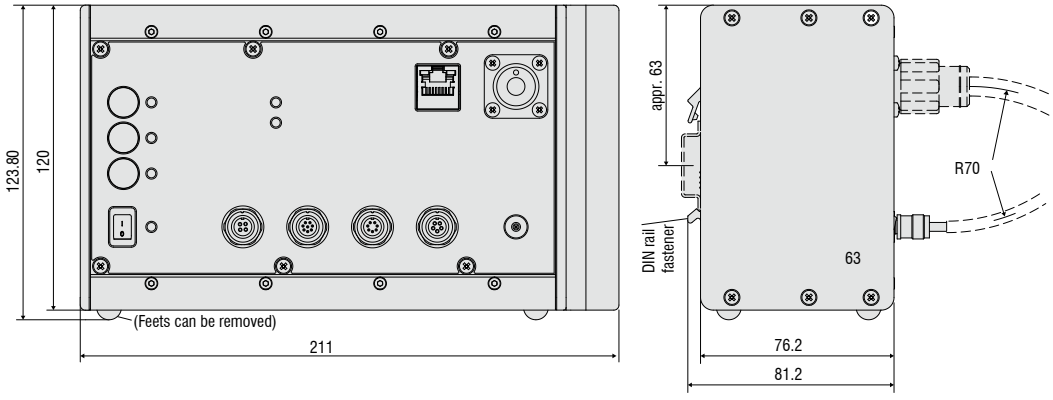
Function

colorCONTROL ACS7000 supports three operating modes. In the first mode, the color distance ΔE to the reference is measured. The system operates with up to 15 taught values. The second mode determines and outputs the reflectivity spectrum of the sample. The third mode determines color coordinates and displays these in the desired color space. For quality inspection purposes, a trend analysis can be performed over any time period via L*a*b*; XYZ or L*c*h° color values.

All modes support measurement speeds up to 2 kHz. Operation and display are performed via a web interface. Light/dark correction can also be carried out using buttons on the controller or through the user interface. Ethernet/EtherCAT, RS422 and digital I/Os are available for data output.

Controller, colorCONTROL ACS7000	
Article number	11104174
Spectral measuring range	390 ... 780 nm
Measuring range reflectivity	0 - 200 %R
Output values	L*a*b*, L*u*v*, L*c*h°, XYZ, ΔE, spectrum
Illuminants	A, C, D65, D50, D75, E, F4, F7, F11, Off
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	0.01 ΔE
Spectral resolution	5 nm
Measurement frequency	25 - 2000 Hz (internal spectrum, signal averaging and data reduction are possible)
Temperature stability	<0.1 ΔE/°C
Light source	LED, 390 - 780 nm
Repeatability of the measurements of a device [1]	<0.03 (mean); <0.08 (max) ΔE
Housing dimensions	210 x 120 x 90 mm (WxHxD)
Weight	1.8 kg
Protection class	IP40
Operating temperature	0 °C up to 45 °C
Storage temperature	-20 °C up to 70 °C
Inputs / outputs	4 color detection switching outputs (4 individual colors or 15 colors binary or {ΔE, ΔL* Δa*, Δb*} for one color) 1 switching output, synchronization 1 switching input, synchronization 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) Measurement: DIN fiber connector
Connection cables	to power supply: art. no. 11234222 / to PLC: art. no. 11234223 / to synchronization: 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 Visualization of spectral characteristics and temporal sequence of the color values and color differences
Power supply	24 V DC +/- 15 % 1000 mA
Service life of the light source	>20000 h when operated at 25 °C

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



Dimensions in mm,
not to scale.

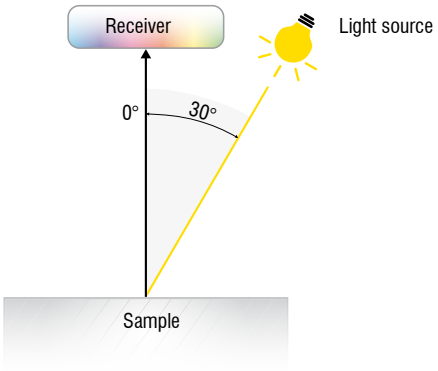
Standard sensor
colorCONTROL ACS1

- For common measurement tasks
- Measurement distance: 38 mm or 50 mm
- Measurement geometry: standard sensor 30°x:0°
- Measurement spot: ø9 mm

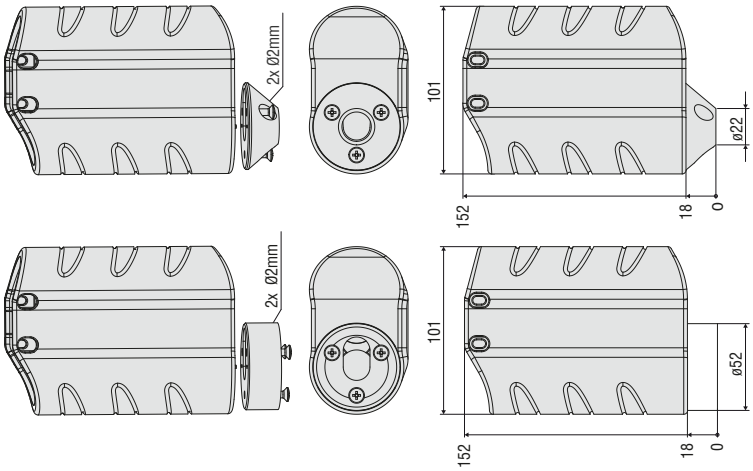
The standard sensor ACS1 is used for common measurement tasks. The transmitter and the receiver inside the sensor are arranged at an angle of 30°x:0° to each other, producing a working distance of 50 mm.

An optionally available adapter permits applying the 30°x:0° sensor even in tactile measurements.

Measurement geometry:
Standard sensor 30°x:0°

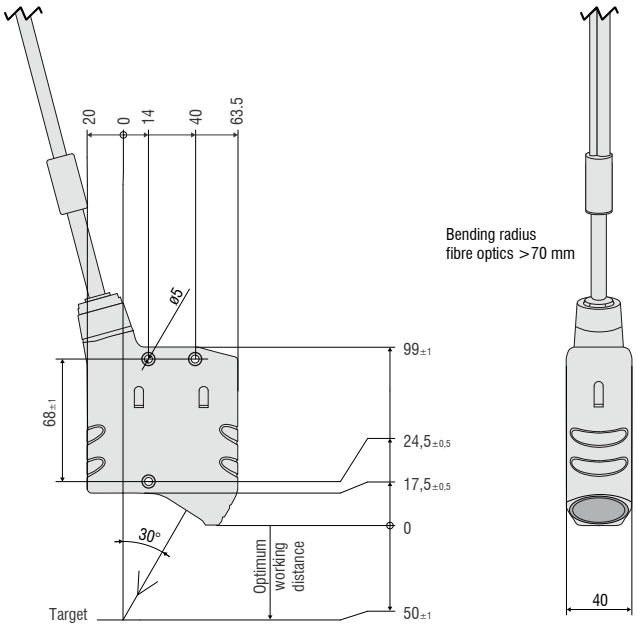


FCS-ACS1-30/0 tactile adapter
Art. no. 10824338



Fiber-optic sensor FCS-T-	ACS1-30/0-50-1200
Article number	10824175
Measurement geometry (illumination: receiver)	30°x:0°
Measurement spot diameter	9 mm
Optimal measurement distance [1]	50 mm ±1 mm
Permissible measurement distance	+2.0 / -1.75 mm from the optimal measurement distance (ΔE<1)
Distance tolerance	0.5 ΔE/mm
Tilt angle tolerance	<0.3 ΔE/°
Ambient light tolerance at max. LED power [2]	<0.5 ΔE / 1000 lux
Dimensions	85x120x40 mm
Weight (sensor incl. fiber optics)	420 g
Length of the fiber optics/sensor cable (optical fiber)	1.2 m (max 1.8 m)
Bending radius sensor cable	70 mm
Protection class	IP64
Operating temperature	-20 °C ... +50 °C
Storage temperature	-20 °C ... +50 °C
Shock resistance	DIN EN 60068-2-29; 15g, 6 ms
Vibration resistance	DIN EN 60068-2-6; 2g / 10 Hz…500 Hz

[1] See acceptance report
[2] Measured at maximum illumination for reference tile (R = 61 %) light gray with warm white external LED light source



Dimensions in mm,
not to scale.

Circular sensor
colorCONTROL ACS2

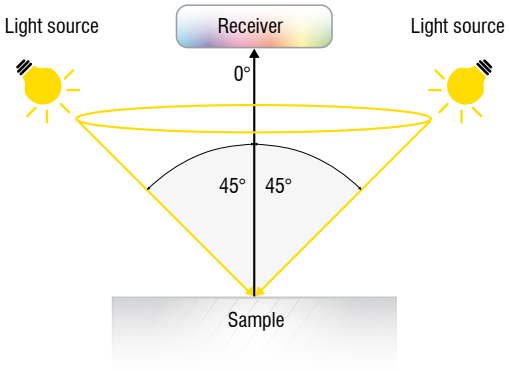
- Measurement of structured, highly reflective and shiny metallic surfaces
- Measurement distance: 28 mm / 27.5 mm
- Measurement geometry: circular sensor 45°c:0°
- Measurement spot: ø 5 mm / 3x2 mm / 9 mm

The ACS2 circular sensor is used for measurement of structured, highly reflective and shiny metallic surfaces.

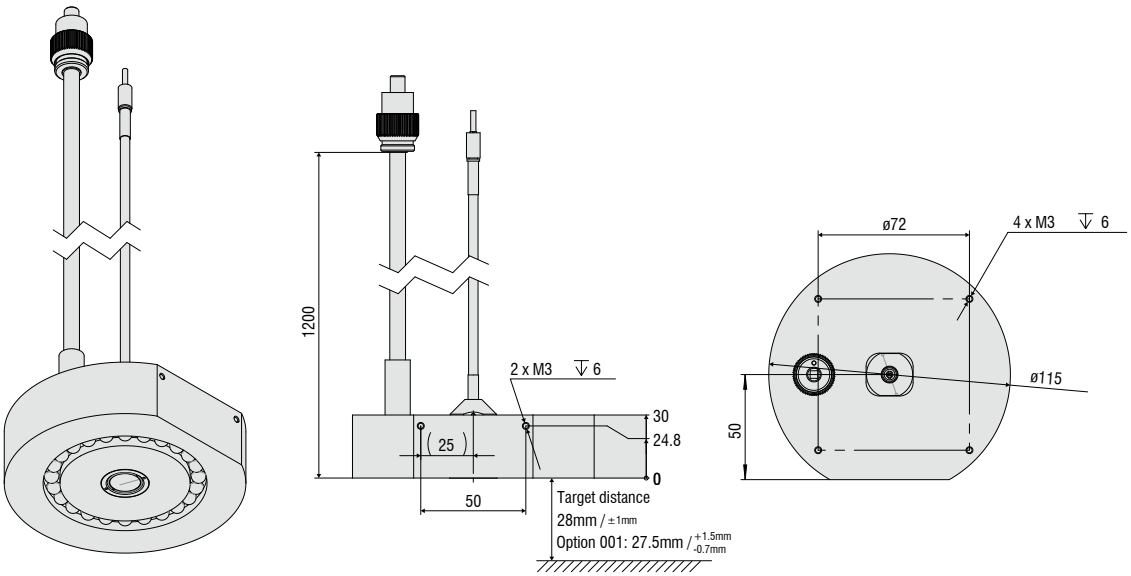
In the sensor, 24 lighting optics are arranged in a circular fashion around the receiving optics, providing continuous lighting that allows measurements to be carried out regardless of the angular position of the target object.

The sensor is also suitable for detecting small measuring objects and curved surfaces.

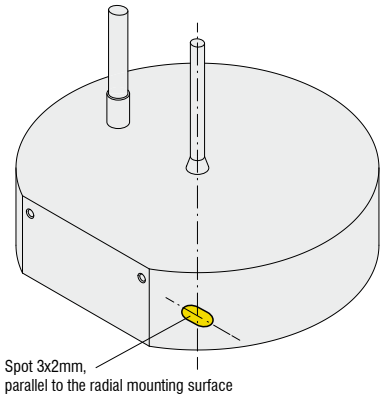
Measurement geometry:
Circular sensor 45°c:0°



Fiber-optic sensor FCS-T-	ACS2-R45/0-28-1200	ACS2-R45/0-28-1200(001)	ACS2-R45/0-28-1200(002)
Article number	10824370	10824370.001	10824370.002
Measurement geometry (illumination: receiver)	45°c:0° (circular)	45°c:0° (circular)	45°c:0° (circular)
Measurement spot diameter	5 mm	3x2 mm	9 mm
Optimal measurement distance	28 mm	27.5 mm	28.5 mm ±0.5 mm
Permissible measurement distance	±1 mm from the optimal measurement distance (ΔE<1)	+1.5 mm / -0.7 mm	±0.75 mm
Distance tolerance	1 ΔE/mm	1 ΔE/mm	1 ΔE/mm
Tilt angle tolerance	<0.3 ΔE/°	<0.3 ΔE/°	<0.3 ΔE/°
Ambient light tolerance at max. LED power	<0.3 ΔE/1000 lux	<0.3 ΔE/1000 lux	<0.3 ΔE/1000 lux
Dimensions	Ø115 x 65 mm	Ø115 x 65 mm	Ø115 x 65 mm
Weight (sensor incl. fiber optics)	822 g	822 g	822 g
Length of the fiber optics/sensor cable (optical fiber)	1.2 m (max 1.8 m)	1.2 m (max 1.8 m)	1.2 m (max 1.8 m)
Bending radius sensor cable	70 mm	70 mm	70 mm
Protection class	IP64	IP64	IP64
Operating temperature	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C
Storage temperature	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C
Shock resistance	DIN EN 60068-2-29; 15g, 6 ms		
Vibration resistance	DIN EN 60068-2-6; 2g / 10 Hz…500 Hz		



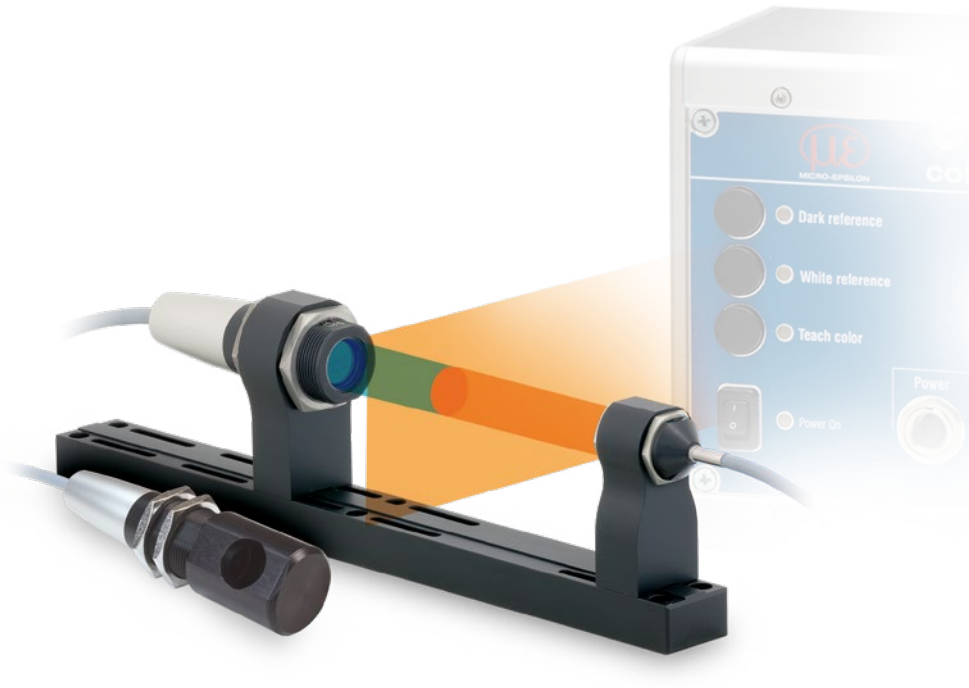
ACS2-R45/0-28-1200(001)



Dimensions in mm,
not to scale.

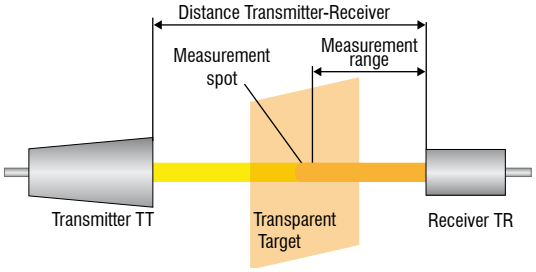
Transmission sensor
colorCONTROL ACS3

- Measurement of transparent and self-luminous objects
- Measurement distance: max. 300 mm
- Measurement geometry: transmitted light
- Measurement spot: ø5 / ø9 mm (at a measurement distance up to 200 mm)



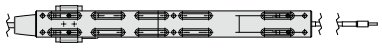
The ACS3 transmission sensor is applied for measurements of self-luminous objects and transparent objects such as film, glass and Plexiglas®. Only the receiver unit is required to measure the color of self-luminous objects. Measuring transparent objects requires a transmitter (TT) and receiver unit (TR) which are easily installed by using a mounting set.

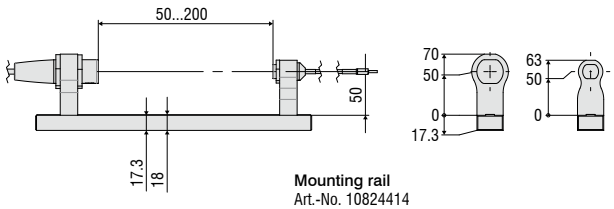
Measurement geometry:
Transmission



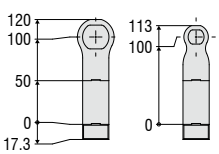
Transmission sensor with transmitter (TT) and receiver (TR) 0°:180°

FCS-ACS3-200 mounting rail

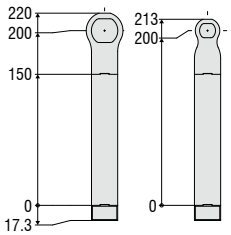




Mounting rail
Art.-No. 10824414



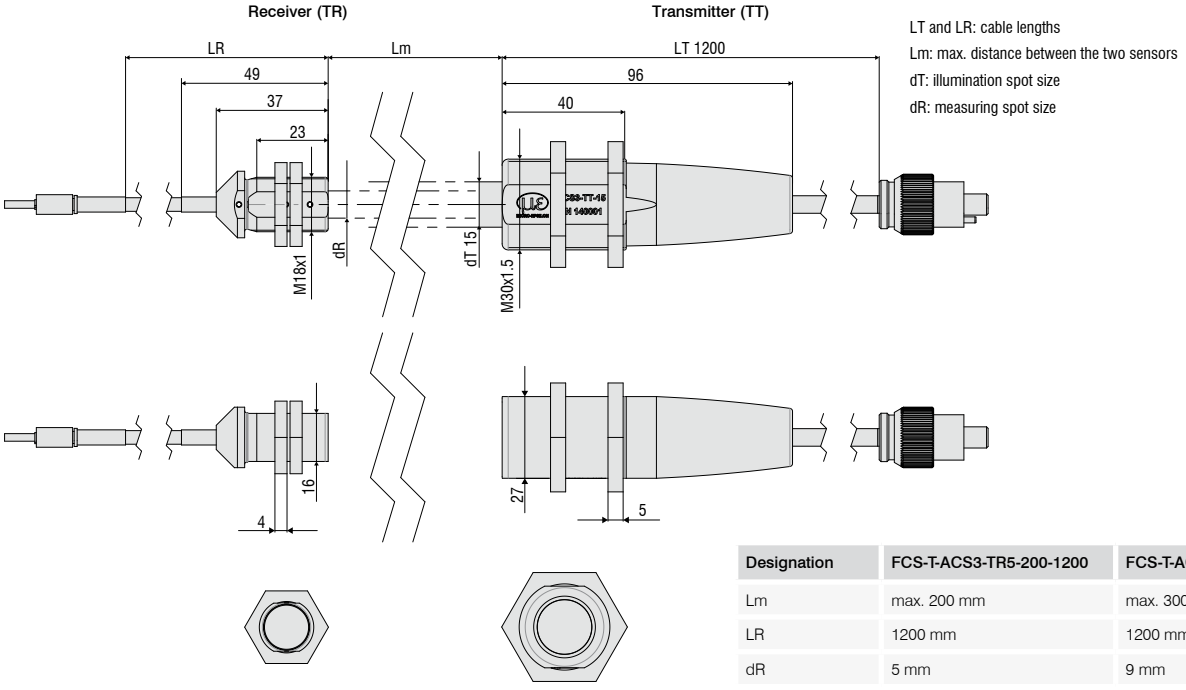
FCS-ACS3 mounting adapter 50mm
Art.-No. 10824423



FCS-ACS3 mounting adapter 150mm
Art.-No. 10824422

Fiber-optic sensor FCS-T- [1]	ACS3-TR5-200-1200	ACS3-TR9-200-1200	ACS3-TR3x2-28-1200	ACS3-TT15-200-1200
Article number	10824411	10824412	10824809	10824413
Measurement geometry (illumination : receiver)	Receiver	Receiver	Receiver	Transmitter
Measurement spot diameter	5 mm with <100 mm [2]	9 mm with <200 mm [2]	3x2 mm at 27.5 mm [2]	15 mm at 200 mm [6]
Optimal measurement distance	10 ... 100 mm [3] [4]	10 ... 200 mm [3] [4]	10 ... 28.5 mm [3] [4]	10 ... 200 mm
Permissible measurement distance	10 ... 200 mm [3] [4]	10 ... 300 mm [3] [4]	10 ... 55 mm [3] [4]	10 ... 300 mm
Distance tolerance [5]	<0.01 ΔE/mm [7] <0.005 ΔE/mm [3]	<0.01 ΔE/mm [7] <0.005 ΔE/mm [3]	<0.01 ΔE/mm [7] <0.005 ΔE/mm [3]	-
Tilt angle tolerance [5]	<0.05 ΔE/°	<0.05 ΔE/°	<0.05 ΔE/°	-
Ambient light tolerance at max. LED power	<0.05 ΔE/1000 lux	<0.05 ΔE/1000 lux	<0.05 ΔE/1000 lux	-
Dimensions	Ø22 x 40 mm	Ø22 x 40 mm	Ø22 x 40 mm	Ø30 x 96 mm
Weight (sensor head incl. fiber optics)	70 g	70 g	70 g	220 g
Length of the fiber optics/sensor cable (optical fiber)	1.2 m (max 30 m)	1.2 m (max 30 m)	1.2 m (max 30 m)	1.2 m (max 1.8 m)
Bending radius sensor cable	70 mm	70 mm	70 mm	70 mm
Protection class	IP64	IP64	IP64	IP64
Operating temperature	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C
Storage temperature	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C	-20 °C ... +50 °C
Shock resistance	DIN EN 60068-2-29; 15g, 6 ms			
Vibration resistance	DIN EN 60068-2-6; 2g / 10 Hz…500 Hz			

[1] Also available with an MA cladding designed for use with drag chains and radius limitation
[2] Measurement spot diverges with increasing distance between receiver and target
[3] Valid in combination with ACS3-TT15-200 for the transmission measurement (transmitted light)
[4] When measuring the transmission, the “optimal measurement distance” and the “permissible measurement distance” refer to the distance between transmitter and receiver. The sample can be at any position between transmitter and receiver.
[5] Tilt angle tolerance and distance tolerance were determined in transmission with different color glass filters (thickness 2.5 mm, refractive index 1.5). When measuring the illumination (only receiver), these were determined with uniformly illuminated (Lambertian) diffuser by tilting the transmitter towards the receiver.
[6] Illumination spot diameter
[7] When using it as receiver sensor for illumination measurement

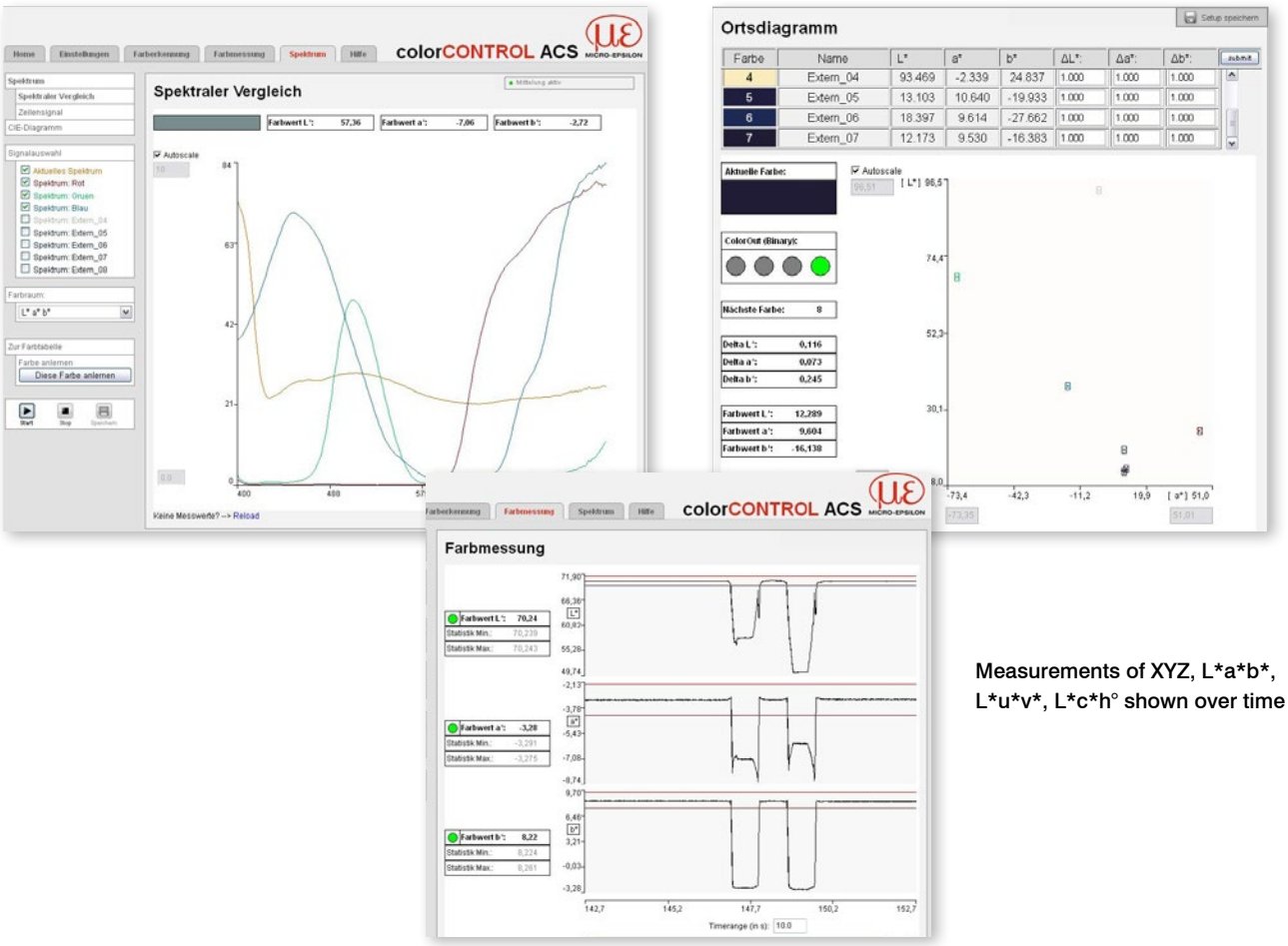


Designation	FCS-T-ACS3-TR5-200-1200	FCS-T-ACS3-TR9-200-1200
Lm	max. 200 mm	max. 300 mm
LR	1200 mm	1200 mm
dR	5 mm	9 mm

Software // Applications
colorCONTROL ACS7000

Spectrum and color location in user interface

Depiction of color values in the color space



Measurements of XYZ, L*a*b*, L*u*v*, L*c*h° shown over time

Applications:

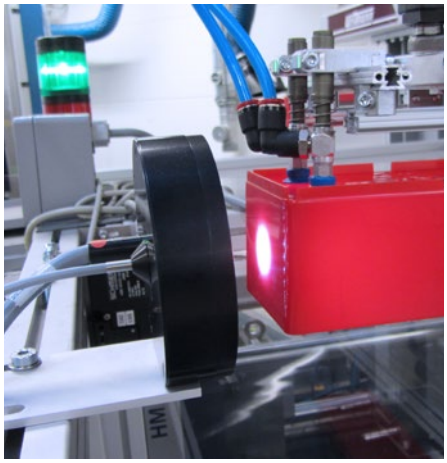
- Inline measurement in production lines, all industries: plastics, wood, paper, glass, films, injection molding, textiles and medical technology
- Color measurement of interior parts
- Inspection of car paint

Advantages:

- Continuous process measurement to ensure consistent product quality
- Direct influence on the production process is possible
- Economical production
- Waste reduction

Inline measurement of the color gradient of glass, Plexiglas®, PET and PVC films and paper

Measuring the zinc strip color in production



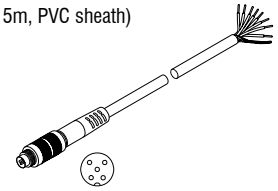
Inline color measurement of injection-molded plastic parts

Cables and other accessories

colorCONTROL ACS accessories		
Art. no.	Designation	suitable for
11234694	White standard 30 mm Zenith	colorSENSOR and colorCONTROL
11234695	White standard 30 mm Zenith, calibrated	colorSENSOR and colorCONTROL
11234696	White standard 5x5 cm Zenith	colorSENSOR and colorCONTROL
11234697	White standard 5x5 cm Zenith, calibrated	colorSENSOR and colorCONTROL
11234222	CAB-M9-4P-St-ge; 2m PUR; open	colorCONTROL ACS7000 (Power)
11234225	CAB-M9-4P-St-ge; 5m PUR; open	colorCONTROL ACS7000 (Power)
11234091	CAB-M9-8P-St-ge; 2m PUR; open	colorCONTROL ACS7000 (Digital I/O, Sync.)
11234099	CAB-M9-8P-St-ge; 5m PUR; open	colorCONTROL ACS7000 (Digital I/O, Sync.)
11234223	CAB-M9-7P-St-ge; 2m PUR; open	colorCONTROL ACS7000 (Color Out)
11234226	CAB-M9-7P-St-ge; 5m PUR; open	colorCONTROL ACS7000 (Color Out)
11294232	CAB-RJ45-Eth; 2m-PVC-Cat5e; RJ45-Eth	colorCONTROL ACS7000 (Ethernet/-CAT)
11293257	CAB-RJ45-Eth; 5m-PVC-Cat5e; RJ45-Eth	colorCONTROL ACS7000 (Ethernet/-CAT)
11234224	CAB-M9-5P-St-ge; 2m-PVC-RS422; open	colorCONTROL ACS7000 (RS422)
11234227	CAB-M9-5P-St-ge; 5m-PVC-RS422; open	colorCONTROL ACS7000 (RS422)
11234230	CAB-M9-5P-St-ge; 2m-PVC-RS422; Sub-D-15P-St-ge	colorCONTROL ACS7000 (IF2008)
11234231	CAB-M9-5P-St-ge; 5m-PVC-RS422; Sub-D-15P-St-ge	colorCONTROL ACS7000 (IF2008)
2213017	IF2008 Interface card RS422 / PCI card	colorCONTROL ACS7000 (RS422/PC)
2213025	IF2001/USB 1-channel RS422/USB converter	colorCONTROL ACS7000
10824338	FCS-ACS1-30/0 tactile adapter	FCS-X-ACS1-30/0-50-XXXX
10824424	FCS-ACS adapter TT-TR	All ACS sensor heads (coupling of illumination into receiving fibers)
10824804	FCS-ACS3 90° attachment	FCS-X-ACS3 TT and TR
10824414	FCS-ACS3-200 mounting rail	FCS-X-ACS3
10824423	FCS-ACS3 mounting bracket 50 mm	FCS-ACS3-200 mounting rail
10824422	FCS-ACS3 mounting bracket 150 mm	FCS-ACS3-200 mounting rail
10824708	FCS-ACS1/ILD1420 adapter plate gw	FCS-X-ACS1 for distance readjustment using the ILD1420
10824709	FCS-ACS2/ILD1420 adapter plate gw	FCS-X-ACS2 for distance readjustment using the ILD1420
10824710	FCS-ACS2/ILD1420 adapter plate ge	FCS-X-ACS2 for distance readjustment using the ILD1420
2420065	PS2030 power supply unit 24V/24W/ 1A; 2m-PVC; terminal 2P-BU-ge	CAB-M9-4P-St-ge; Xm-PUR; open (power)

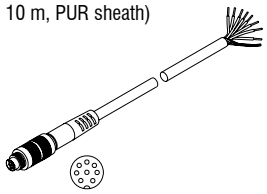
Pin assignment:

CAB-M9-5P-St-ge; Xm-PVC-RS422; open ends
(Art.-No.: 11234224; 11234227)
Connection cable RS422
(max. length 5m, PVC sheath)



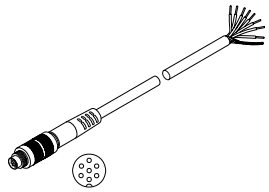
Pin	Color	ACS7000	15 PIN IF2008	10 PIN IF2001
1	white	TX	3	3
2	brown	/TX	4	4
3	green	/RX	2	2
4	yellow	RX	1	1
5	gray	GND RS422 (galvanically isolated)	15	9

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



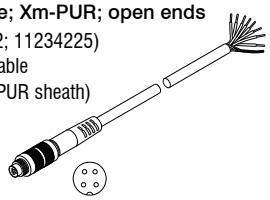
Pin	Color	ACS7000
1	white	Error
2	brown	GND Error
3	green	Sync. out
4	yellow	GND Sync. out
5	gray	Sync. in
6	pink	GND Sync. in
7	blue	LLL/HLL
8	red	LLL/HLL

CAB-M9-7P-St-ge; Xm-PUR; open ends
(Art.-No.: 11234223; 11234226)
Connection cable color OUT
(max. length 10 m, PUR sheath)



Pin	Color	ACS7000
1	white	OUT0
2	brown	OUT1
3	green	OUT2
4	yellow	OUT3
5	gray	GND
6	pink	n.c.
7	blue	n.c.

CAB-M9-4P-St-ge; Xm-PUR; open ends
(Art.-No.: 11234222; 11234225)
Power connection cable
(max. length 10 m, PUR sheath)

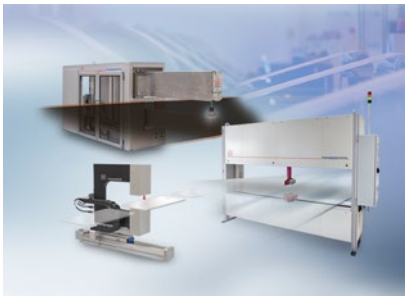


Pin	Color	ACS7000
1	white	n.c.
2	brown	+24V DC (±15%)
3	black	n.c.
4	blue	GND (0 V)

Sensors and Systems from Micro-Epsilon

Sensors and systems for displacement, distance and position

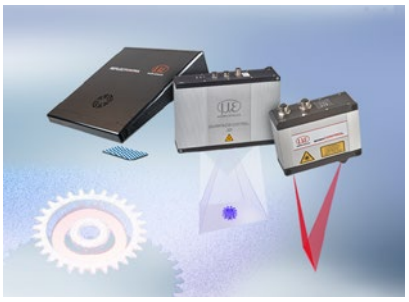
Sensors and measurement devices for non-contact temperature measurement



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

MICRO-EPSILON

MICRO-EPSILON Headquarters
Koenigbacher Str. 15 · 94496 Ortenburg / Germany
Tel. +49 (0) 8542 / 168-0 · Fax +49 (0) 8542 / 168-90
info@micro-epsilon.com · **www.micro-epsilon.com**