MICRO-EPSILON

SCIENCE GATE
Your Automation Partner


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# More Precision

## colorCONTROL ACS7000 // Inline Photospectrometer

# colorCONTROL ACS7000


- *Inline color measurement: 25Hz – 2,000Hz*
- *Measurement without touching the sample*
- *Measurement precision ΔE ≤ 0.08*
- *Inline color measurement: 25Hz – 2,000Hz*
- *Ethernet/EtherCAT, RS 422, digital I/O*
- *Web browser operation*

- Light source: Adjustable “standard illuminant” and “standard observers”
- Color space: XYZ; L*a*b*; L* u* v*; L*c*h°; adjustable
- Color recognition from a taught reference list
- White/black reference comparison (via browser and buttons on the device)
- Inline quality assurance and continuous monitoring
- Options: measuring head geometries for different technical surfaces

The colorCONTROL ACS7000 inline color measurement system not only recognises reference colors by comparison, but identifies individual colors clearly from their coordinates in the color space. With its very high measurement speeds, the colorCONTROL ACS7000 is suitable for applications where colors and shades have to be examined on-the-fly and to very high accuracies. Because of its high measurement accuracy, the system is also used in laboratory tasks.

**Measuring principle**

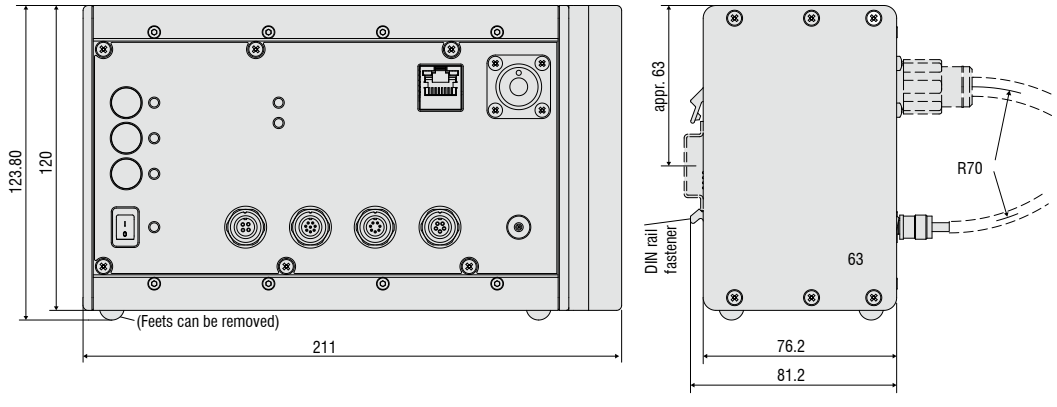
The spectral procedure is the most accurate method of color measurement. First, the sample is illuminated with a homogeneous white LED light. The spectrum of the reflected light is then calculated with a white reference. Then the coordinates in the CIE-XYZ color system are determined for all wavelengths of visible light (390 to 780nm) 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**

Three operating modes are possible with the colorCONTROL ACS7000: In the first mode, the color distance ΔE is measured for reference. The system operates with up to 15 taught values. In the second mode, the reflectivity spectrum of the sample is determined and output. In the third mode, color coordinates are determined and displayed in the desired color space. For quality inspection purposes, a trend analysis can be carried out over any time period via the L*a*b*; XYZ or L*c*h° color values.Measurements can be performed in all modes at speeds of up to 2kHz. Operation and display is via a Web interface. Light/dark correction can also be carried out using buttons on the controller or 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 |
| Illuminant | 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*),<br>with individual tolerance parameters for every color taught |
| Color resolution | 0.01 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 [1] | <0.03 (mean); <0.08 (max) ΔE |
| Housing dimensions | 210x120x90mm (WxHxD) |
| 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<br>(4 individual colors or 15 colors binary or {ΔE, ΔL* Δa*, Δb*} for one color)<br>1 Switching output, synchronisation<br>1 Switching input, synchronisation<br>1 Switching output, measurement error |
| Interfaces | Ethernet/EtherCAT (DHCP-enabled)<br>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)<br>Measuring: DIN fiber connector |
| Connection cables | To power supply: Art. No. 11234222 / to PLC: Art. No. 11234223 / to synchronisation: Art. No. 11234091 /<br>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,<br>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<br>Visualisation of spectral characteristics and temporal sequence of the color values and color differences |
| Power supply | 24VDC +/- 15%<br>1000mA |
| Service life of the light source | >20,000h when operated at 25°C |

[1] 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

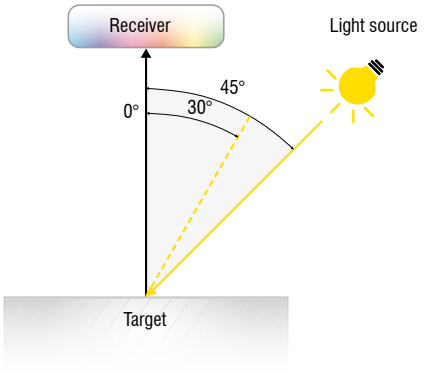



- *For common measuring tasks*
- *Measurement distance: 38 or 50 mm*
- *Measurement geometry: 45°x:0°; 30°x:0°°*
- *Measurement spot: ø9mm*

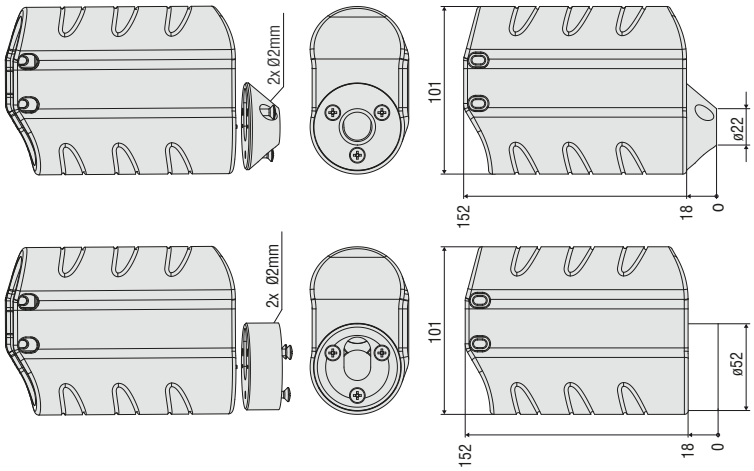
The standard sensor ACS1 is used for common measuring tasks. The transmitter and the receiver inside the sensor are arranged at an angle of 45°x:0° or 30°x:0° to each other, producing a working distance of 38mm or 50mm.

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

**Measurement geometry:**
Angular sensor model: 45°x:0°; 30°x:0°

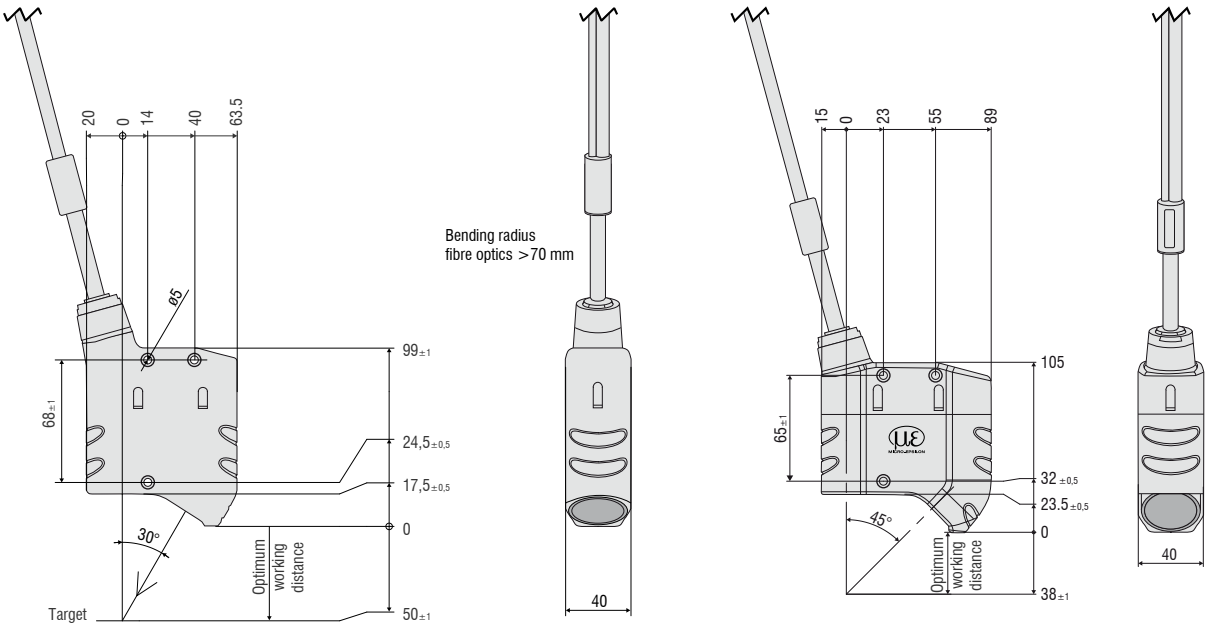



**FCS-ACS1-30/0 adapter tactile**
Article number 10824338



| Fiber-optic sensor FCS-T- | ACS1-30/0-50-1200 | ACS1-45/0-38-1200 |
|---|---|---|
| Article number | 10824175 | 10824371 |
| Geometry (illumination : receiver) | 30°x:0° | 45°x:0° |
| Measuring spot diameter | 9mm | 9mm |
| Optimal measurement distance | 50mm | 38mm |
| Working range | ±2mm of optimal working distance (ΔE<1) | ±1mm of optimal working distance (ΔE<1) |
| Distance tolerance | 0.5 ΔE/mm | 1 ΔE/mm |
| Tilt angular tolerance | <0.3 ΔE/° | <1.33 ΔE/° |
| Ambient light tolerance at max. LED-performance [1)] | <0.5 ΔE/1000lux | <0.6 ΔE/1000lux |
| Dimensions | 85x120x40mm | 106x125x40mm |
| Weight (sensor incl. optical fiber) | 420g | 500g |
| Length of the optical fiber/sensor cable (optical-fiber cable) | 1.2m (max 1.8m) | 1.2m (max 1.8m) |
| Bending radius sensor cable | 70mm | 70mm |
| Protection class | IP64 | IP64 |
| Operating temperature | -20°C ... +50°C | -20°C ... +50°C |
| Storage temperature | -20°C ... +50°C | -20°C ... +50°C |
| Shock resistance | DIN EN 60068-2-29; 15g, 6ms | DIN EN 60068-2-29; 15g, 6ms |
| Vibration resistance | DIN EN 60068-2-6; 2g / 10Hz…500Hz | DIN EN 60068-2-6; 2g / 10Hz…500Hz |

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



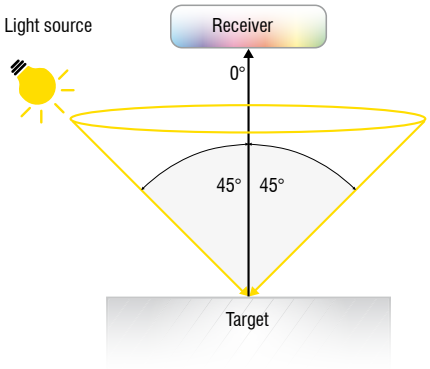

- *Color measurement of structured, highly reflective surfaces and lustrous metals*
- *Measurement distance: 28mm / 27.5mm*
- *Measurement geometry: Circular sensor 45°c:0°*
- *Measurement spot: ø5mm / 3x2mm*

The circular sensor ACS2 is used for color measurement of structured and highly reflective surfaces as well as lustrous metals.

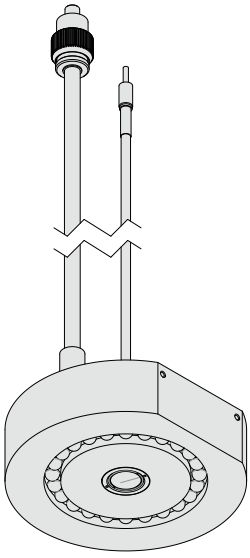
In the sensor, 24 lighting optics are circularly arranged around the receiving optics and provide a constant homogeneous lighting permitting that the measurement can be executed independently from the angular position of the measurement object.

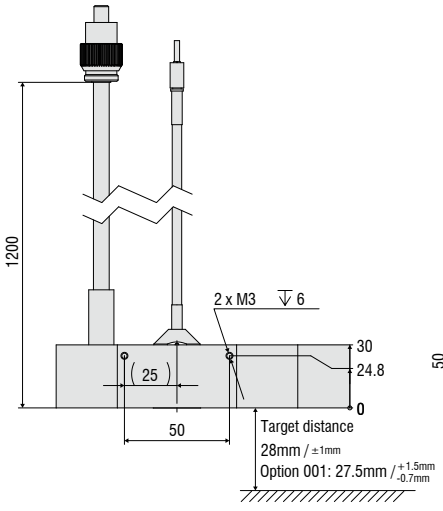
This sensor enables as well to measure small measurement objects and curved surfaces.

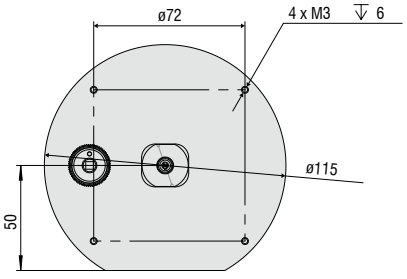
**Measurement geometry:**
Circular sensor 45°c:0°



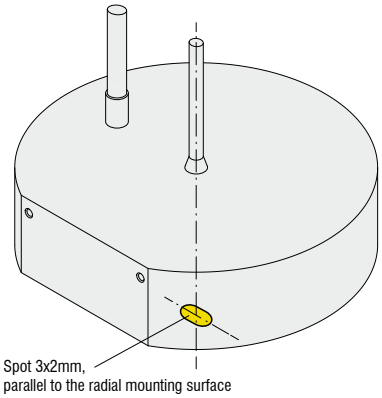
| Fiber-optic sensor FCS-T- | ACS2-R45/0-28-1200 | ACS2-R45/0-28-1200(001) |
|---|---|---|
| Article number | 10824370 | 10824370.001 |
| Measurement geometry (illumination : receiver) | 45°c:0° (circular) | 45°c:0° (circular) |
| Measurement spot diameter | 5mm (optional 9mm) | 3 x 2mm |
| Optimal measurement distance | 28mm | 27.5mm |
| Permissible measurement distance | ±1mm of optimal measurement distance (ΔE<1) | +1,5mm / -0.7mm |
| Distance tolerance | 1 ΔE/mm | 1 ΔE/mm |
| Tilt angular tolerance | <0.3 ΔE/° | <0.3 ΔE/° |
| Ambient light tolerance at max. LED-performance | <0.3 ΔE/1000lux | <0.3 ΔE/1000lux |
| Dimensions | Ø115x65mm | Ø115x65mm |
| Weight (sensor incl. optical fiber) | 822g | 822g |
| Length of the optical fiber/sensor cable (optical-fiber cable) | 1.2m (max 1.8m) | 1.2m (max 1.8m) |
| Bending radius sensor cable | 70mm | 70mm |
| Protection class | IP64 | IP64 |
| Operating temperature | -20 °C ... +50 °C | -20 °C ... +50 °C |
| Storage temperature | -20 °C ... +50 °C | -20 °C ... +50 °C |
| Shock resistance | DIN EN 60068-2-29; 15g, 6ms | DIN EN 60068-2-29; 15g, 6ms |
| Vibration resistance | DIN EN 60068-2-6; 2g / 10Hz…500Hz | DIN EN 60068-2-6; 2g / 10Hz…500Hz |

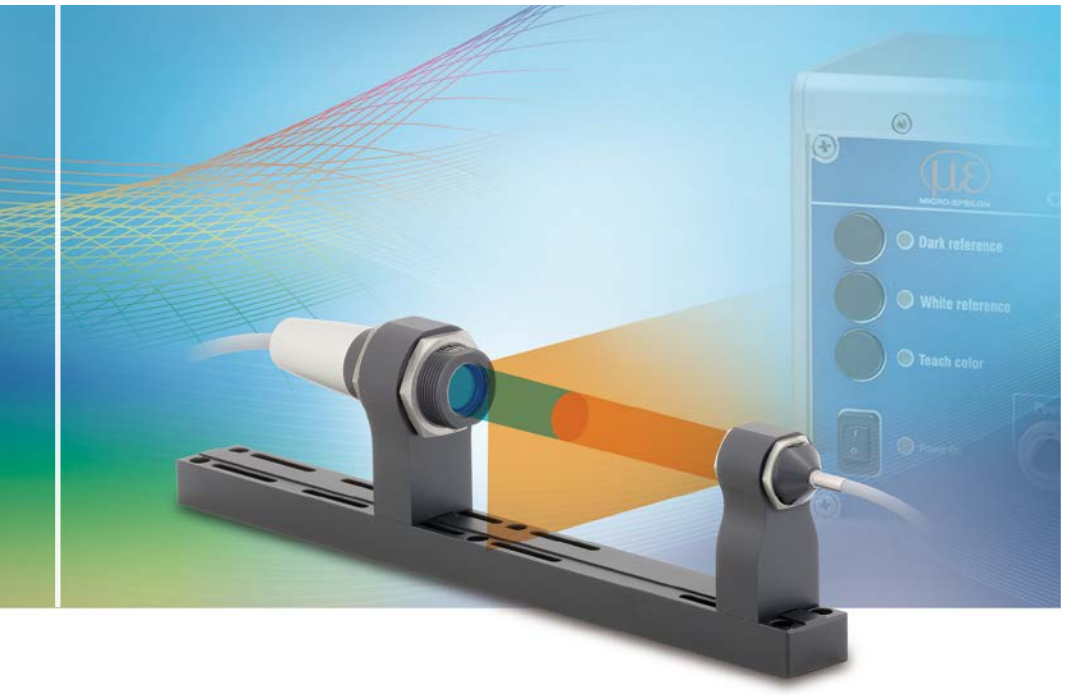





**ACS2-R45/0-28-1200(001)**

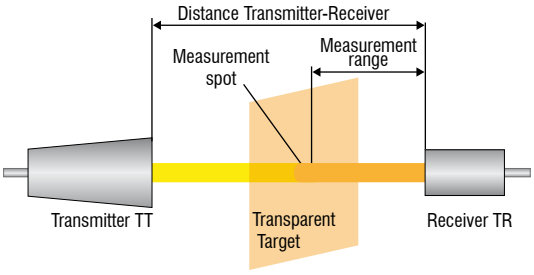





- *Measurement of self-luminous and transparent objects*
- *Measurement distance: max 300mm*
- *Measurement geometry: transmission*
- *Measurement spot: ø5/ø9mm (at a measurement distance up to 200mm)*

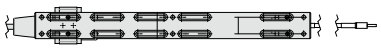
The transmission sensor ACS3 is used to measure self-luminous and transparent objects like foil, glass and Plexiglas. For the color measurement of selfluminous objects, only a receiver unit is required. Measuring transparent objects requires transmitter (TT) and receiver unit (TR) which can be installed with a mounting set.

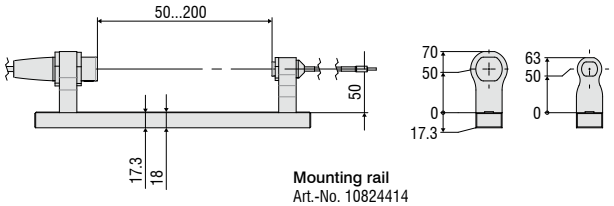
**Measurement geometry:**
Transmission



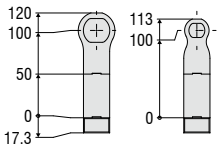

Transmission sensor with transmitter (TT) and receiver (TR) 0°:180°

**FCS-ACS3-200 mounting rail**

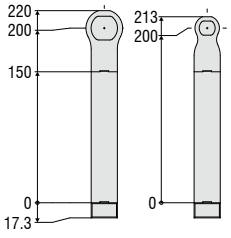





Mounting rail
Art.-No. 10824414



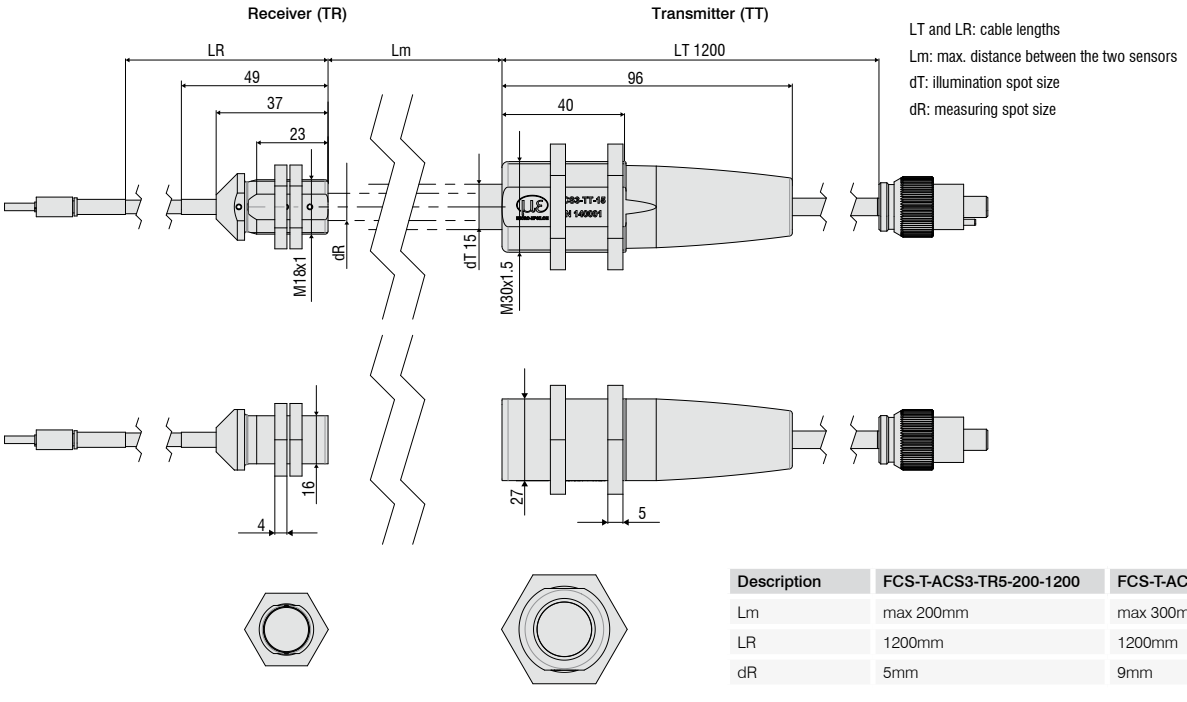

FCS-ACS3 mounting adapter 50mm
Art.-No. 10824423




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

| Fiber-optic sensor FCS-T- | ACS3-TR5-200-1200 | ACS3-TR9-200-1200 | ACS3-TT15-200-1200 |
|---|---|---|---|
| Article number | 10824411 | 10824412 | 10824413 |
| Measurement geometry (illumination : receiver) | Receiver | Receiver | Transmitter |
| Measurement spot diameter | 5mm for <100mm [1] | 9 mm for <200mm [1] | 15mm for 200mm [5] |
| Optimal measurement distance | 10 ... 100mm [2] [3] | 10 ... 200mm [2] [3] | 10 ... 200mm |
| Working range | 10 ... 200mm [2] [3] | 10 ... 300mm [2] [3] | 10 ... 300mm |
| Distance tolerance [4] | <0.01 ΔE/mm [6]<br><0.005 ΔE/mm [2] | <0.01 ΔE/mm [6]<br><0.005 ΔE/mm [2] | - |
| Tilt angular tolerance [4] | <0.05 ΔE/° | <0.05 ΔE/° | - |
| Ambient light tolerance at max. LED-performance | <0.05 ΔE/1000lux | <0.05 ΔE/1000lux | - |
| Dimensions | Ø22x40mm | Ø22x40mm | Ø30x96mm |
| Weight (sensor incl. optical fiber) | 70g | 70g | 220g |
| Length of the optical fiber/sensor cable (optical-fiber cable) | 1.2m (max. 30m) | 1.2m (max. 30m) | 1.2m (max. 1.8m) |
| Bending radius sensor cable | 70mm | 70mm | 70mm |
| Protection class | IP 64 | IP 64 | IP 64 |
| 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, 6ms | | |
| Vibration resistance | DIN EN 60068-2-6; 2g / 10Hz…500Hz | | |

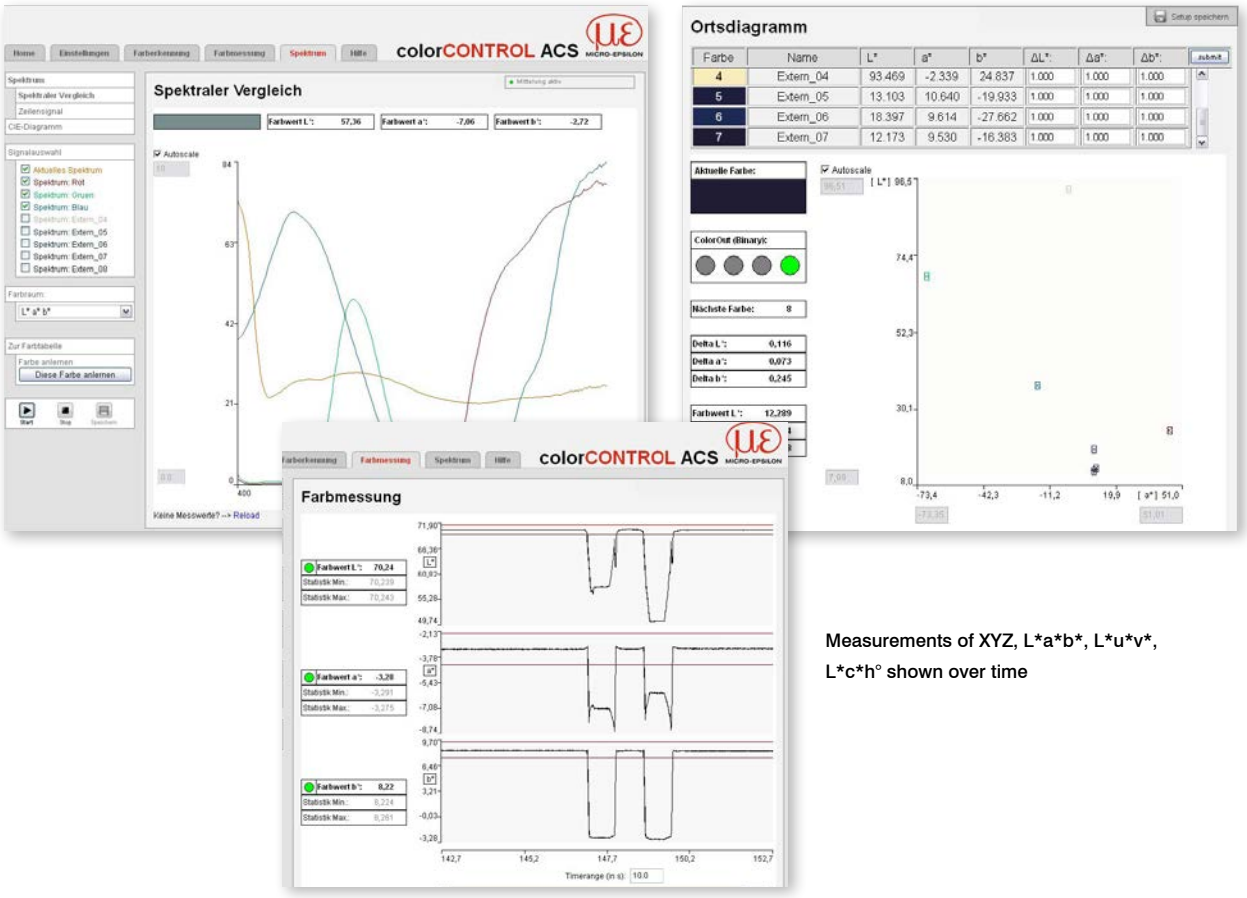
[1] Measurement spot diverges with growing distance between receiver and target
[2] Valid in combination with ACS3-TT15-200 for the transmission measurement (transmitted light)
[3] When measuring the transmission, the “optimal measurement distance” and the “working range” refer to the distance between transmitter and receiver. The sample can be at any position within the light curtain between transmitter and receiver.
[4] Tilt angular tolerance and distance tolerance were determined in transmission with different color glass filters (thickness 2.5 mm, refraction index 1.5). When measuring the illumination (only receiver), these were determined with uniformly illuminated (Lambertian) diffuser by tilting the transmitter towards the receiver.
[5] Illumination spot diameter
[6] When using it as receiver sensor for illumination measurement




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

Spectrum and color coordinate in the 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, 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

Inline mesurement of the color gradient of glass, Plexiglas, PET and PVC foils, paper.

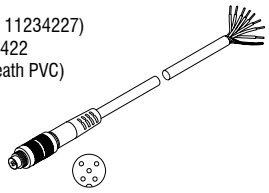
Measurement of the zinc sheet color.

Interior and attachment parts in the automotive industry.

| colorCONTROL ACS accessories | | |
|---|---|---|
| Art. no. | Description | suitable for: |
| 11234274 | Reflectance standard 30mm Zenith | colorSENSOR and colorCONTROL |
| 11234695 | Reflectance standard 30mm Zenith | colorSENSOR and colorCONTROL |
| 11234696 | Reflectance standard 5x5cm Zenith | colorSENSOR and colorCONTROL |
| 11234697 | Reflectance standard 5x5cm Zenith calibrated | colorSENSOR and colorCONTROL |
| 11234222 | CAB-M9-4P-co-straight; 2m-PUR; open ends | colorCONTROL ACS7000 (power) |
| 11234225 | CAB-M9-4P-co-straight; 5m-PUR; open ends | colorCONTROL ACS7000 (power) |
| 11234091 | CAB-M9-8P-co-straight; 2m-PUR; open ends | colorCONTROL ACS7000 (digital I/O, Sync.) |
| 11234099 | CAB-M9-8P-co-straight; 5m-PUR; open ends | colorCONTROL ACS7000 (digital I/O, Sync.) |
| 11234223 | CAB-M9-7P-co-straight; 2m-PUR; open ends | colorCONTROL ACS7000 (color Out) |
| 11234226 | CAB-M9-7P-co-straight; 5m-PUR; open ends | colorCONTROL ACS7000 (color Out) |
| 11294232 | CAB-RJ45-Eth; 2m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS7000 (Ether-net/-CAT) |
| 11293257 | CAB-RJ45-Eth; 5m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS7000 (Ether-net/-CAT) |
| 11294277 | CAB-RJ45-Eth-Cross; 3m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS7000 (Ether-net/-CAT) |
| 11293258 | CAB-RJ45-Eth-Cross; 5m-PVC-Cat5e; RJ45-Eth | colorCONTROL ACS7000 (Ether-net/-CAT) |
| 11234224 | CAB-M9-5P-co-straight; 2m-PVC-RS422; open ends | colorCONTROL ACS7000 (RS422) |
| 11234227 | CAB-M9-5P-co-straight; 5m-PVC-RS422; open ends | colorCONTROL ACS7000 (RS422) |
| 11234230 | CAB-M9-5P-co-straight; 2m-PVC-RS422; Sub-D-15P-co-straight | colorCONTROL ACS7000 (IF2008) |
| 11234231 | CAB-M9-5P-co-straight; 5m-PVC-RS422; Sub-D-15P-co-straight | colorCONTROL ACS7000 (IF2008) |
| 2213017 | IF2008 Interface card RS422 / PCI-card | colorCONTROL ACS7000 (RS422/PC) |
| 2213025 | IF2001/USB single channel RS422/USB converter | colorCONTROL ACS7000 |
| 10824338 | FCS-ACS1-30/0 adapter tactile | FCS-X-ACS1-30/0-50-XXXX |
| 10824424 | FCS-ACS adapter TT-TR | all ACS sensor heads (connection illumination into receiving fibers) |
| 10824414 | FCS-ACS3-200 mounting rail | FCS-X-ACS3 |
| 10824423 | FCS-ACS3 mounting adapter 50mm | FCS-ACS3-200 mounting rail |
| 10824422 | FCS-ACS3 mounting adapter 150mm | FCS-ACS3-200 mounting rail |
| 10824708 | FCS-ACS1/ILD1420 mounting adapter angled | FCS-X-ACS1 for distance measurement with ILD1420 |
| 10824709 | FCS-ACS2/ILD1420 mounting adapter angled | FCS-X-ACS2 for distance measurement with ILD1420 |
| 10824710 | FCS-ACS2/ILD1420 mounting adapter straight | FCS-X-ACS2 for distance measurement with ILD1420 |
| 2420065 | PS2030 power supply 24V/24W/ 1A; 2m-PVC; terminal-2P-co-fm-straight | CAB-M9-4P-co-straight; Xm-PUR; open ends (Power) |

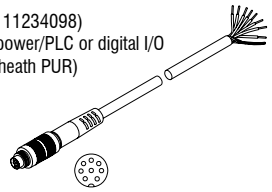
## Pin assignment

**CAB-M9-5P-co-straight; Xm-PVC-RS422; open ends**
(Art. no.: 11234224; 11234227)
Connection cable RS422
(max. length 5m, sheath PVC)



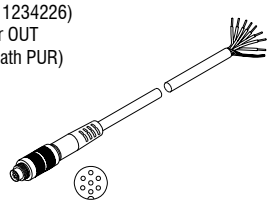
| Pin | Color | ACS7000 | 15 PIN IF2008 | 10 PIN IF2001 |
|---|---|---|---|---|
| 1 | white | TX | 3 | 3 |
| 2 | brown | /TX | 4 | 4 |
| 3 | green | /RX | 2 | 2 |
| 4 | yellow | RX | 1 | 1 |
| 5 | grey | GND RS422 DC-isolated | 15 | 9 |

**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)



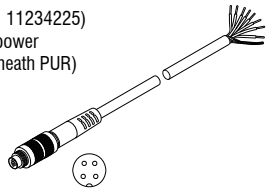
| Pin | Color | ACS7000 |
|---|---|---|
| 1 | white | Error |
| 2 | brown | GND Error |
| 3 | green | Sync. OUT |
| 4 | yellow | GND Sync. OUT |
| 5 | grey | Sync. IN |
| 6 | pink | GND Sync. IN |
| 7 | blue | LLL/HLL |
| 8 | red | LLL/HLL |

**CAB-M9-7P-co-straight; Xm-PUR; open ends**
(Art. no.: 11234223; 11234226)
Connection cable color OUT
(max. length 10m, sheath PUR)



| Pin | Color | ACS7000 |
|---|---|---|
| 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-M9-4P-co-straight; Xm-PUR; open ends**
(Art. no.: 11234222; 11234225)
Connection cable to power
(max. length. 10m, sheath PUR)



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

## High performance sensors made by Micro-Epsilon

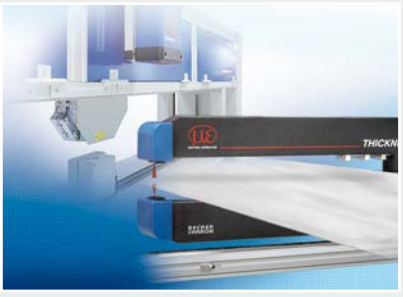
Sensors and systems for displacement and position

Sensors and measurement devices for non-contact temperature measurement


2D/3D profile sensors (laser scanner)

Optical micrometers, fiber optic sensors and fiber optics

Color recognition sensors, LED analyzers and color online spectrometer



Measurement and inspection systems



MICRO-EPSILON

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