

# Technical Information

## OUSAF21

Optical sensor for the measurement of low color concentrations



### Application

The sensor is used to measure color concentrations in the low measuring range of the visible electromagnetic spectrum.

- Color scale measurement
  - APHA/Hazen, potassium permanganate in water
- Measurement of color concentration
  - Outgoing goods inspection/purity monitoring
  - Color assurance
  - Discoloration control
  - Distillation monitoring

### Your benefits

- As slightest color changes are detected, production quality is guaranteed
  - Measuring range up to 2.5 AU or 50 OD (depending on optical path length)
  - Can be configured to measure color concentration at discrete wavelengths in the visible region
  - Outstanding filter properties for highest linearity
  - Direct concurrence with laboratory values
  - Integrated reference detector for the compensation of particles, bubbles and lamp aging
  - Incandescent lamp for long service life and stable measured values
- Cost-effective, time-efficient verification (liquid-free)
- FM- and ATEX-approved lamps for applications in the hazardous area
- Broad variety of window materials and seals for resistance to a wide range of process media
- Optional air purge ports to prevent the formation of condensate on the optical windows

## Function and system design

### Measuring principle

#### Light absorption

The measuring principle is based on the Lambert-Beer law.

There is a linear dependency between the absorption of light and the concentration of the absorbing substance:

$$A = -\log A_m = \epsilon \cdot c \cdot OPL$$

$A$  ... absorption,  $A_m$  ... absorption measured by detector

$\epsilon$  ... Extinction coefficient

$c$  ... Concentration

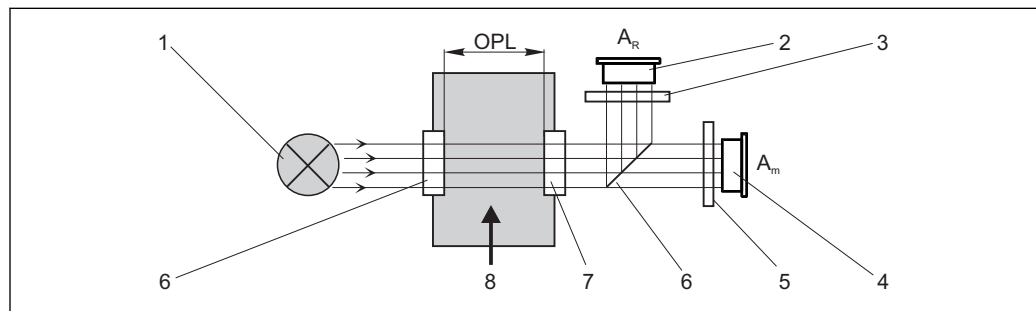
$OPL$  ... Optical path length

A light source emits radiation through the medium and the incident radiation is measured on the detector side.

A beam splitter splits the light into two beams. One beam is used for measuring while the other acts as a reference to compensate for particles, bubbles and lamp aging.

Once the light has passed through a filter for wavelength selection, the intensity of the light is determined by a photodiode and converted to a photocurrent.

The subsequent conversion to absorbance units (AU, OD) is performed in the associated transmitter.



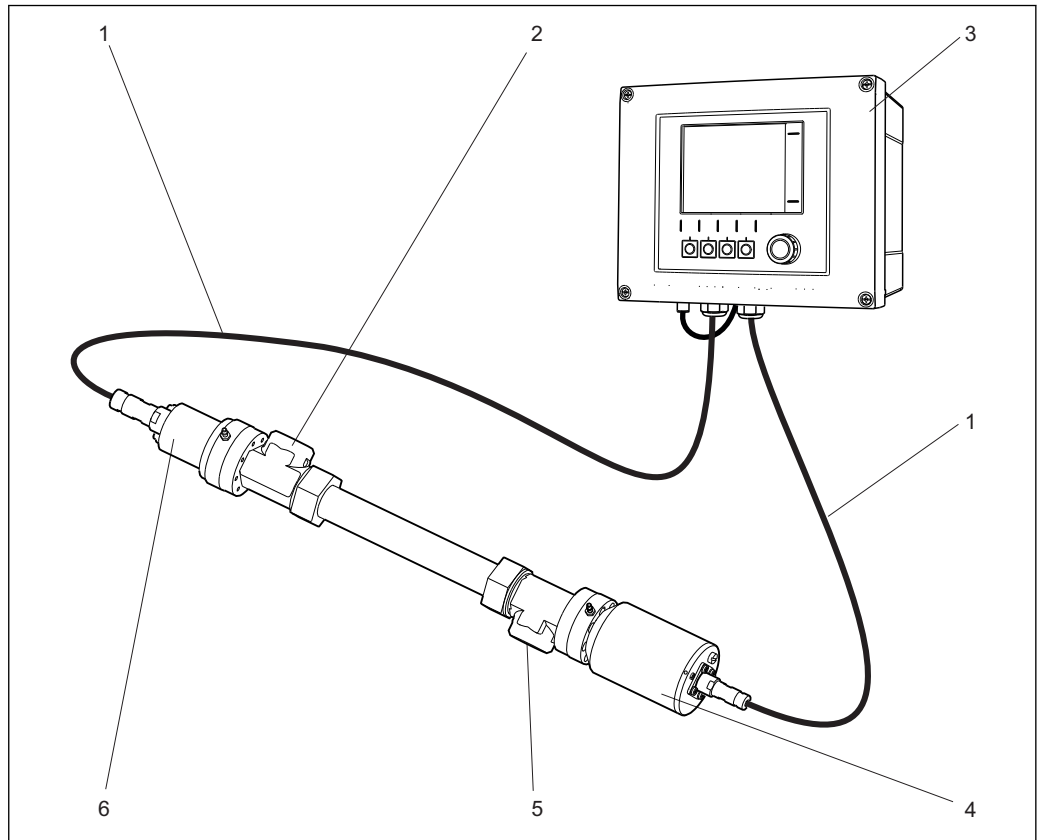
1 Absorption measurement (double wavelength) with reference

- 1 Light source
- 2 Reference detector
- 3 Reference filter
- 4 Measuring detector
- 5 Measurement filter
- 6 Beam splitter
- 7 Optical windows
- 8 Medium flow

### Measuring system

An optical measuring system comprises:

- OUSA21 sensor (photometer) with flow assembly
- Liquiline CM44P transmitter
- CUK80 cable set



2 Example of a measuring system with OUSAF21

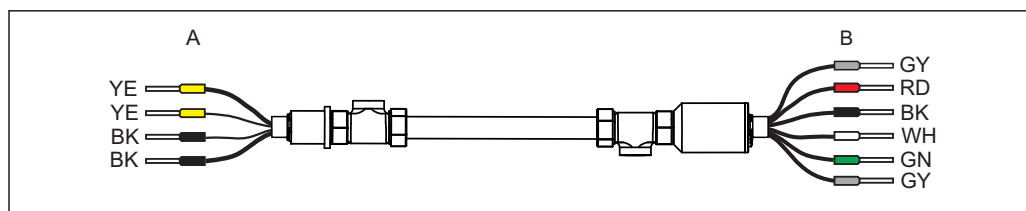
- |   |                              |   |                           |
|---|------------------------------|---|---------------------------|
| 1 | CUK80 cable set              | 4 | OUSAF21 detector unit     |
| 2 | Medium outflow from assembly | 5 | Medium inflow to assembly |
| 3 | CM44P transmitter            | 6 | OUSAF21 lamp unit         |

## Input

<b>Measured variable</b>	process absorption
<b>Measuring range</b>	<ul style="list-style-type: none"> <li>■ 0 to 2.5 AU</li> <li>■ Max. 50 OD (depending on the optical path length)</li> </ul>
<b>Wavelength</b>	Measurement 400 nm, 420 nm, 520 nm Reference 720 nm

## Power supply

<b>Electrical connection</b>	The sensor is connected to the transmitter using the pre-terminated or labeled cable set CUK80 (for connection to CM44P) or OUK20 (for connection to CVM40). The terminals and labeling may vary depending on the transmitter in use. The cable set must be ordered separately.
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3 OUSAF21 connecting cable

A Light source (lamp) power supply

B Signals of detector

CM44P terminal	CVM40 terminal	Cable color	Assignment
P+	V1.1	YE (thick)	Lamp voltage +
S+	V1.3	YE (thin)	Detection of lamp voltage +
P-	V1.2	BK (thick)	Lamp voltage -
S-	V1.4	BK (thin)	Detection of lamp voltage -
A (1)	S1.1	RD	Measuring detector sensor +
C(1)	S1.2	BK	Measuring detector sensor -
SH (1)	S1.S	GY	Shield
A (2)	S2.1	WH	Sensor reference +
C(2)	S2.2	GN	Sensor reference -
SH (2)	S2.S	GY	Shield

**Cable length** Maximum 100 m (330 ft)

**Lamp voltage**

Sensor version	Lamp type	Lamp voltage [V]
OUSAF21-xxxxx	Dual beam, high-luminescence or gas-filled high-performance lamp	4.9 ± 0.1

**Versions for use in hazardous areas**

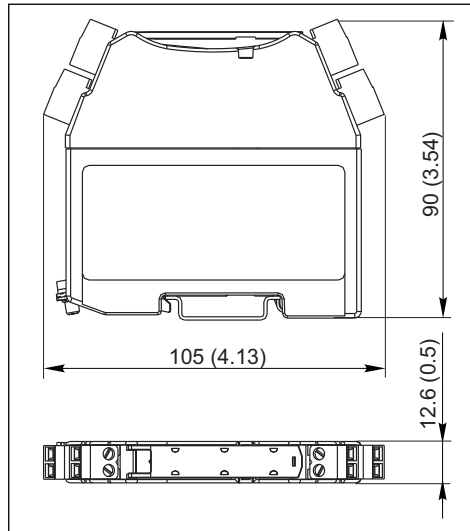


Safety instructions for electrical apparatus in explosion-hazardous areas, XA01403C

**Connecting the detector using a safety barrier**

The photometer sensors use silicon photovoltaic cells as detectors which are operated in the current mode. The detectors are intrinsically safe and can be deployed in Zone 1 environments.

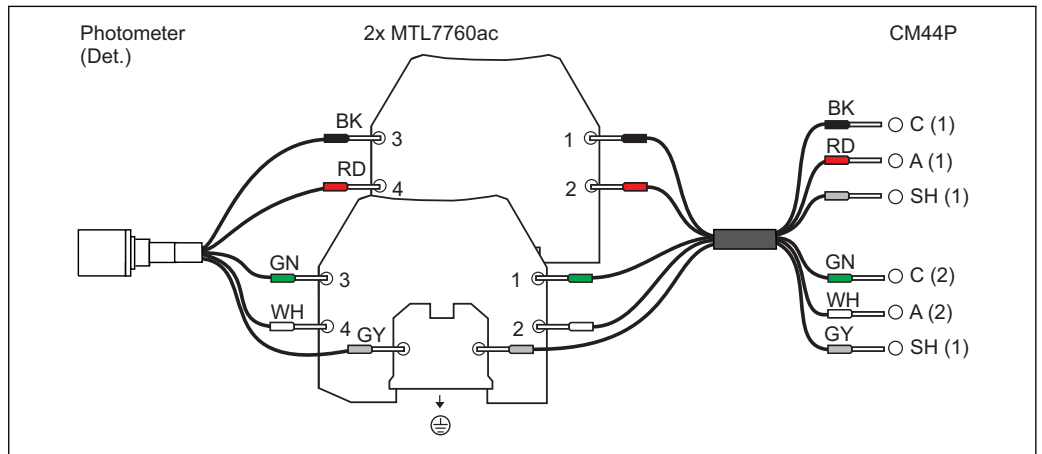
The safe area is separated from the hazardous area by two safety barriers MTL7760AC.



4 Safety barrier, dimensions in mm (inch)

**i** The safety barrier may only have a very low leak current since the optical signals from the sensor can be in the nanoampere range. Therefore, the sensor cable shield is connected to the ground terminal of the barrier.

On delivery, the CUK80 detector cable is permanently wired to the safety barriers. All you have to do is simply connect the individual cable ends to the detector and transmitter.

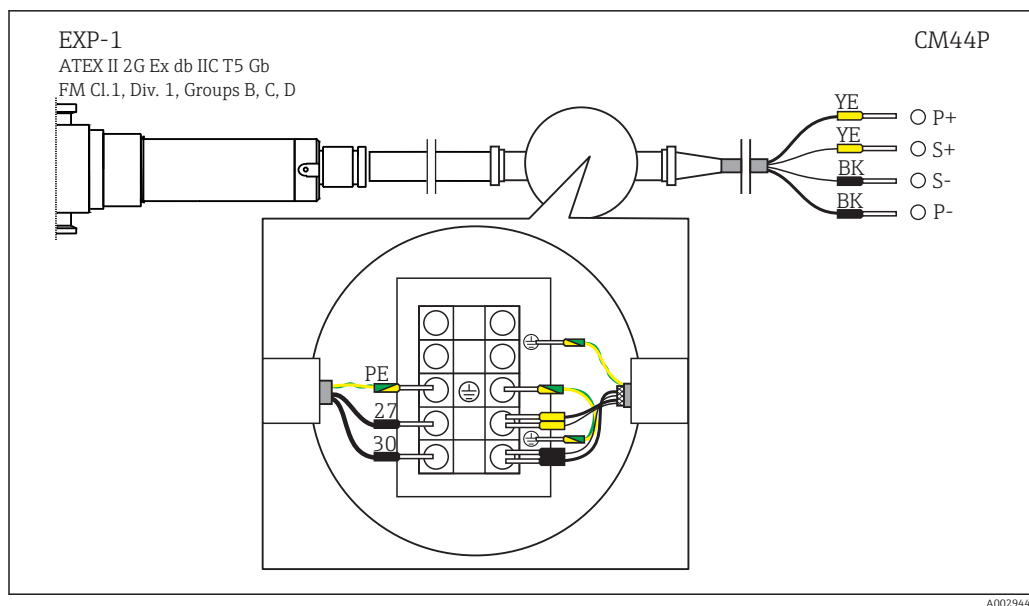


**Connecting the hazardous area lamp using a junction box**

The hazardous area lamp (EXP-1) must be connected to the transmitter using a certified junction box.

**i** For versions with FM approval, the junction box is included in the delivery and already pre-terminated on the lamp side. You simply have to connect the cable of the transmitter (CUK80) to the terminals of the junction box.

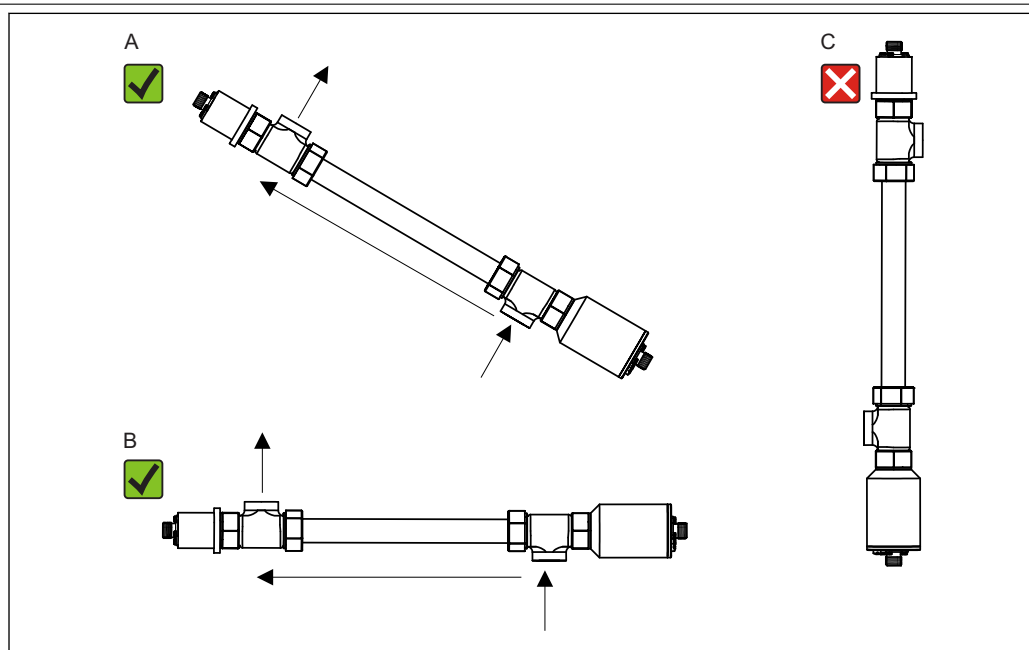
For versions with ATEX approval, the junction box is not included in the delivery and it and the cable glands required must be provided by the customer at the place of installation. You must connect the cables entirely on your own (CUK80 of transmitter and lamp cable of photometer sensor).



5 Connecting the hazardous area lamp to CM44P using a junction box

## Installation

### Installation instructions



6 Mounting angles. The arrows indicate the direction of medium flow through the assembly.

## Environment

Ambient temperature range 0 to 55 °C (32 to 130 °F)

Storage temperature -10 to +70 °C (+10 to +160 °F)

Humidity 5 to 95 %

**Degree of protection** IP 65 (NEMA 4) for all optical parts

## Process

**Process temperature** 0 to 90 °C (32 to 194 °F) continuous  
 Max. 130 °C (266 °F) for 2 hours

**Process pressure** Max. 6 bar (84 psi) absolute, depending on the material, pipe size and process connection of the flow assembly

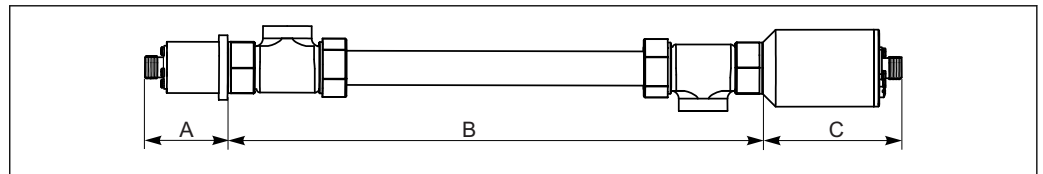
## Mechanical construction

**Design, dimensions**


<b>Lamp type</b>	<b>Dimension A in mm (inch)</b>
<b>Detector type</b>	<b>Dimension B in mm (inch)</b>

 The total length of the sensor module is derived from the lengths of the lamp, the detector and the assembly.

The dimensions of the OUA260 assembly are provided in Technical Information, TI00418C.



A0029245

 7 Dimensions, see table

- A Lamp module
- B Flow assembly
- C Detector module

Lamp module	Dimension A in mm (inch)
High-luminescence lamp and standard incandescent lamp	33.78 (1.33)
Gas-filled lamp	33.78 (1.33)
Flow assembly	Dimension B in mm (inch)
Path length 100 mm	150 (5.9)
Path length 150 mm	200 (7.9)
Path length 200 mm	250 (9.8)
Path length 250 mm	300 (11.8)
Detector module	Dimension C in mm (inch)
Standard version	101.6 (4.0)

- ▶ When connecting the sensor cable, make sure you maintain an additional distance of 5 cm (2") on both the lamp side and the detector side of the sensor.


**Weight** 1.225 kg (2.7 lbs.), without flow assembly

<b>Materials</b>	Sensor housing	Stainless steel 316L
	Cable connection ends	Nickel-plated brass
<b>Light source</b>	High-luminescence lamp (wavelength filter 450 nm and above) Gas-filled high-performance lamp (wavelength filter below 450 nm) Lamp operating life: typically 10 000 h	
<b>Detector</b>	UV silicon detectors, hermetically sealed	
<b>Filter</b>	Multilayer narrow-band interference filter	

## Certificates and approvals


<b>CE mark</b>	<p><b>Declaration of Conformity</b></p> <p>The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.</p>
<b>Ex approvals</b>	<ul style="list-style-type: none"> <li>▪ ATEX II 2G Ex db IIC T5 Gb</li> <li>▪ FM Cl.1, Div. 1, Groups B, C, D</li> </ul>

## Ordering information

<b>Product page</b>	<a href="http://www.endress.com/ousaf21">www.endress.com/ousaf21</a>
<b>Product Configurator</b>	<p>On the product page there is a "Configuration" button to the right of the product image.</p> <ol style="list-style-type: none"> <li>1. Click this button. <ul style="list-style-type: none"> <li>↳ The Configurator opens in a separate window.</li> </ul> </li> <li>2. Select all the options to configure the device in line with your requirements. <ul style="list-style-type: none"> <li>↳ In this way, you receive a valid and complete order code for the device.</li> </ul> </li> <li>3. Export the order code as a PDF or Excel file. To do so, click the appropriate button on the right above the selection window.</li> </ol> <p> For many products you also have the option of downloading CAD or 2D drawings of the selected product version. To do so, click the "CAD" tab and select the desired file type using drop-down lists.</p>

<b>Scope of delivery</b>	<p>The scope of delivery consists of the following :</p> <ul style="list-style-type: none"> <li>▪ sensor</li> <li>▪ Detector and lamp module mounted on OUA260 flow assembly</li> <li>▪ Operating Instructions</li> </ul> <p>If the sensor is ordered with a transmitter, the complete measuring system is factory-calibrated and shipped as one package.</p> <p>If you have any questions, please contact your supplier or your local sales center.</p>
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## Accessories

 The following are the most important accessories available at the time this documentation was issued. For accessories not listed here, please contact your service or sales office.



**Cable**

**CUK80 cable set**

- Pre-terminated and labeled cables for connecting analog photometer sensors
- Product Configurator on the product page: [www.endress.com/cuk80](http://www.endress.com/cuk80)

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[www.addresses.endress.com](http://www.addresses.endress.com)

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