



Level



Pressure



Flow



Temperature



Liquid  
Analysis



Registration



Systems  
Components



Services



Solutions

## Technical Information

# Turbimax W CUS65

Turbidity and solids content sensor

Installation and immersion sensor for low, medium and high concentrations using the four-beam pulsed light method



### Application

The Turbimax W CUS65 sensor is used for optical turbidity and solids content measurement. Due to various sensor heads the sensor is suitable for use from low to high concentration ranges.

- Wastewater clarification / sludge treatment
- Boiler feedwater monitoring
- Condensate monitoring
- Service water monitoring

### Your benefits

- Four-beam pulsed light method for compensation of sensor soiling and wearing of optical components
- Sensor body made of stainless steel
- No mechanically moving parts, therefore no sensor blocking
- Measured value processing in sensor resulting in low signal transmission sensitivity
- Aeration systems do not affect measurement
- Plug system for quick commissioning

## Function and system design

### Measuring principle

#### Turbidity measurement

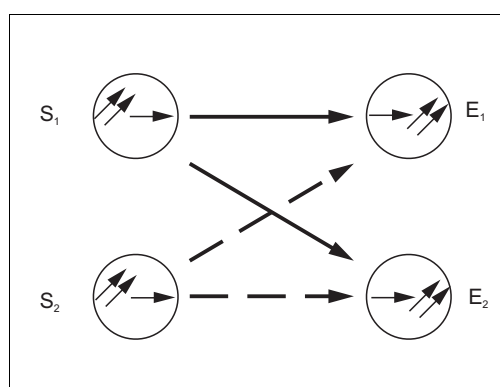
For turbidity measurement a light beam is sent through the medium and is diverted from its original direction by optically denser particles, e.g. solid matter particles.

#### Four-beam pulsed light method

The method is based on two light sources and two photo receivers. Long-life LEDs are used as monochromatic light sources. To eliminate interference from extraneous light sources, these LEDs are pulsed at a rate of several kHz.

Two measuring signals are detected at the two photo receivers. The four measuring signals are processed in the sensor and are converted into proportional frequencies. The transmitter assigns the frequencies to the appropriate turbidity units and solids concentrations.

The four-beam pulsed light method compensates the sensor soiling as well as the wearing of the optical components.



$S$  = Light source  
 $E$  = Light receiver

Four-beam pulsed light method

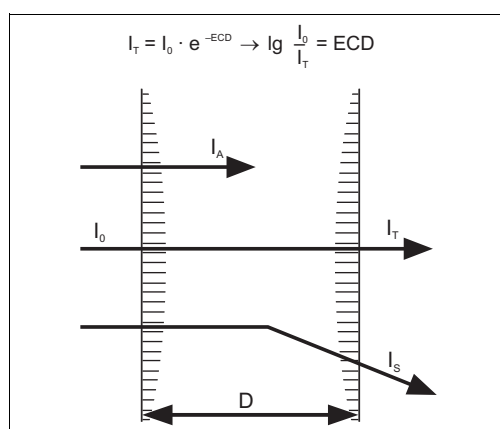
### Measuring methods

Depending on the version, the sensor uses the absorption light method (CUS65-A, -B, -C) or the scattered light method (CUS65-D, -E).

#### Absorption light method

The measuring principle is based on the Lambert-Beer law. The turbidity of the medium is determined by the weakening of the light beam.

The sensor LEDs send a directed light beam to the light receivers. The light beam intensity is weakened by the solid matter particles in the medium.



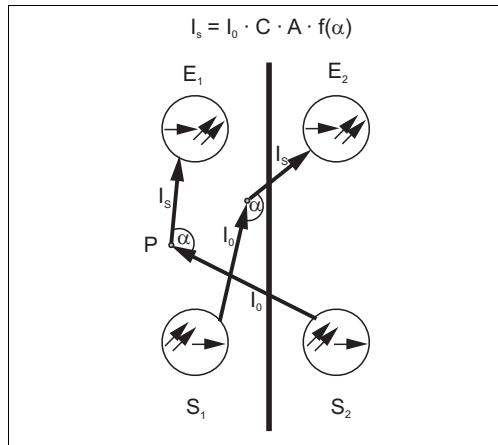
$I_0$  = Intensity of transmitted light  
 $I_A$  = Intensity of absorbed light  
 $I_T$  = Intensity of light transmitted  
 $I_S$  = Intensity of scattered light  
 $E$  = Extinction coefficient  
 $C$  = Concentration  
 $D$  = Optical path length

Absorption light method

#### 90° NIR scattered light method

The measurement uses the 90° scattered light method acc. to ISO 7027 / EN 27027.

The turbidity of the medium is determined by the amount of scattered light. The transmitted light beam with a wavelength in the near-infrared range is scattered by the solid matter particles in the medium. The scattered beams are detected by scattered light receivers which are arranged at an angle of 90° to the infrared light sources.



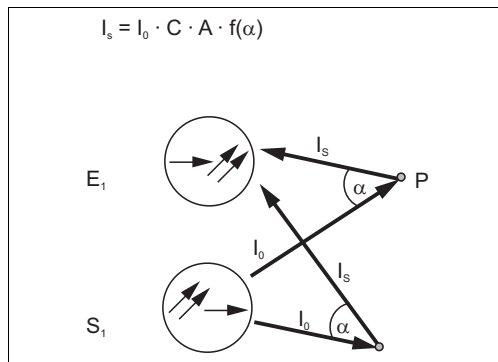
$I_0$  = Intensity of transmitted light  
 $I_S$  = Intensity of scattered light  
 $A$  = Geometrical factor  
 $C$  = Concentration  
 $P$  = Particle  
 $f(\alpha)$  = Angle correlation

90° scattered light method

**Backscattered light method**

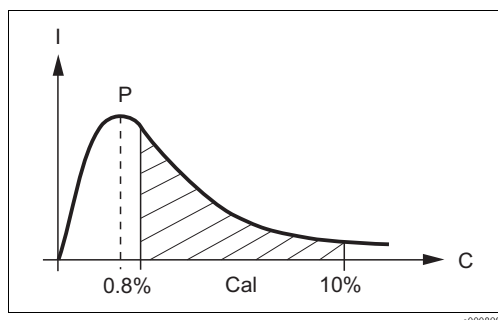
The measurement uses the backscattered light method.

The turbidity of the medium is determined by the amount of backscattered light. The transmitted light beam is scattered by the solid matter particles in the medium. The backscattered beams are detected by scattered light receivers, which are arranged next to the light sources.



$I_0$  = Intensity of transmitted light  
 $I_S$  = Intensity of scattered light  
 $A$  = Geometrical factor  
 $C$  = Concentration  
 $P$  = Particle  
 $f(\alpha)$  = Angle correlation

Backscattered light method



$I$  = Intensity of transmitted light  
 $C$  = Concentration  
 $P$  = Reversal point  
 $Cal$  = Calibration range



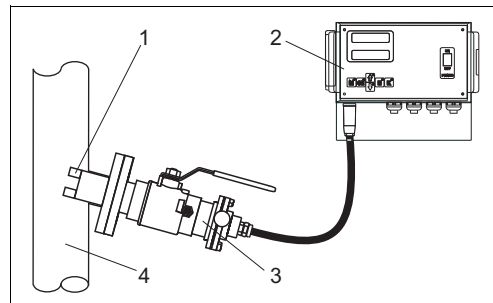
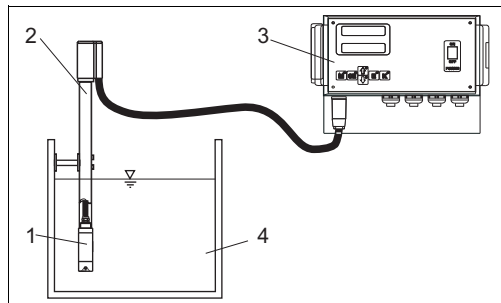
Note!

CUS65-E has a reversal point at approx. 0.8% of solid matter (as dry substance) and can thus not be calibrated with water. Therefore only use the sensor starting from a concentration >10 g/l.

**Measuring system**

A complete measuring system comprises:

- Turbidity transmitter CUM740
- Turbidity sensor Turbimax W CUS65
- Immersion pipe CYY105 or
- Retractable assembly Cleanfit CUA451
- Extension cable (optional)
- Junction box (optional)



Measuring system with immersion pipe

Measuring system with retractable assembly

- 1 Turbidity sensor Turbimax W CUS65-C
- 2 Immersion pipe CYY105
- 3 Turbidity transmitter CUM740
- 4 Basin or channel

- 1 Turbidity sensor Turbimax W CUS65-A
- 2 Turbidity transmitter CUM740
- 3 Retractable assembly Cleanfit CUA451
- 4 Pipe

**Input**

**Measured variable**

Turbidity  
Solids content

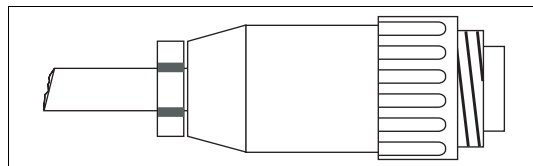
**Measuring range**

Version	Measuring range	Application
CUS65-A	0 to 12 g/l	Activated sludge, centrate
CUS65-B	0 to 40 g/l	Return sludge
CUS65-C	0 to 50 g/l	Primary sludge, digested sludge
CUS65-D	1 to 1000 FNU	Wastewater outlet, service water, condensate, boiler feedwater
CUS65-E	10 to 150 g/l	Centrifuge inlet, press inlet

**Power supply**

**Electrical connection**

Connect the sensor directly to the transmitter by using the special measuring cable with SXP plug.



SXP plug

**Cable specification**

Cable length	Cable cross section
up to 50 m (160 ft):	5 x 0.35 mm <sup>2</sup> (≅ 22 AWG)
up to 100 m (330 ft):	5 x 0.5 mm <sup>2</sup> (≅ 21 AWG)
up to 200 m (660 ft):	5 x 1.0 mm <sup>2</sup> (≅ 18 AWG)

## Performance characteristics

<b>Maximum measured error</b>	< 1% of measuring range end (system measured error related to the primary formazine standard / tracing according to ISO 5725 and ISO 7027 / EN 27027)	
<b>Wave length</b>	880 nm	
<b>Reference measurement</b>	by four-beam pulsed light method	
<b>Factory calibration</b>	CUS65-A, -B, -C, -E: CUS65-D:	SiO <sub>2</sub> Formazine acc. to ISO 7027 / EN 27027

## Installation

### Installation instructions

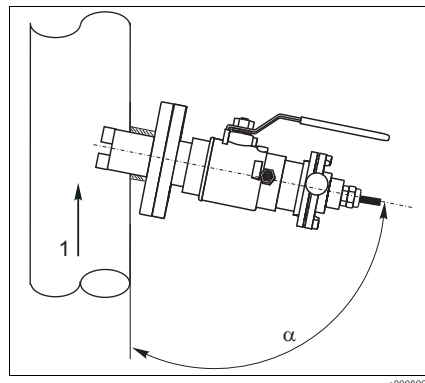
Installation options:

- with retractable assembly CUA451
- with immersion pipe CYY105



Note!

- Observe the required mounting clearance for the installation mode selected. Installing the sensor in pipes or close to a wall can lead to backscattering resulting in signal increase, mainly with measurements in low turbidity ranges (<100 FNU).
- Make sure the sensor is completely immersed at changing water levels.

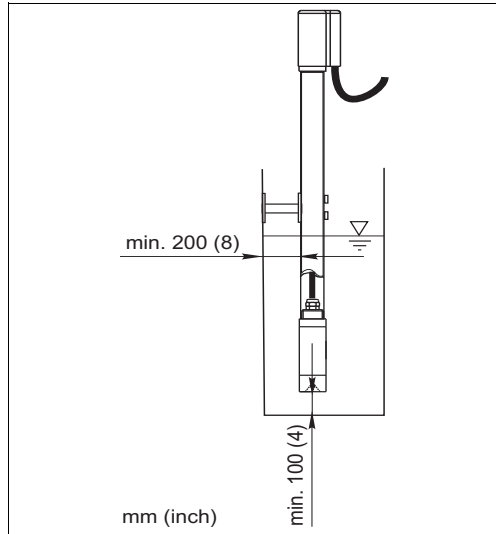


Installation with retractable assembly

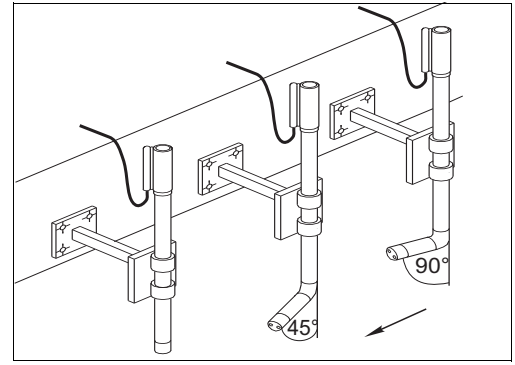
Arrow = flow direction of the medium

Installation angle  $\alpha$  dependent on sensor version:

- CUS65-A: 80°
- CUS65-B: 90°
- CUS65-C, E: 100°
- CUS65-D: 110°



Wall distance with immersion pipe



Immersion pipe angles

Arrow = flow direction of the medium

- CUS65-A: 45 °
- CUS65-D: 90 °
- CUS65-B, -C, -E: 180 ° (straight)

## Environment

**Ambient temperature range** -20 to 60 °C (0 to 140 °F)

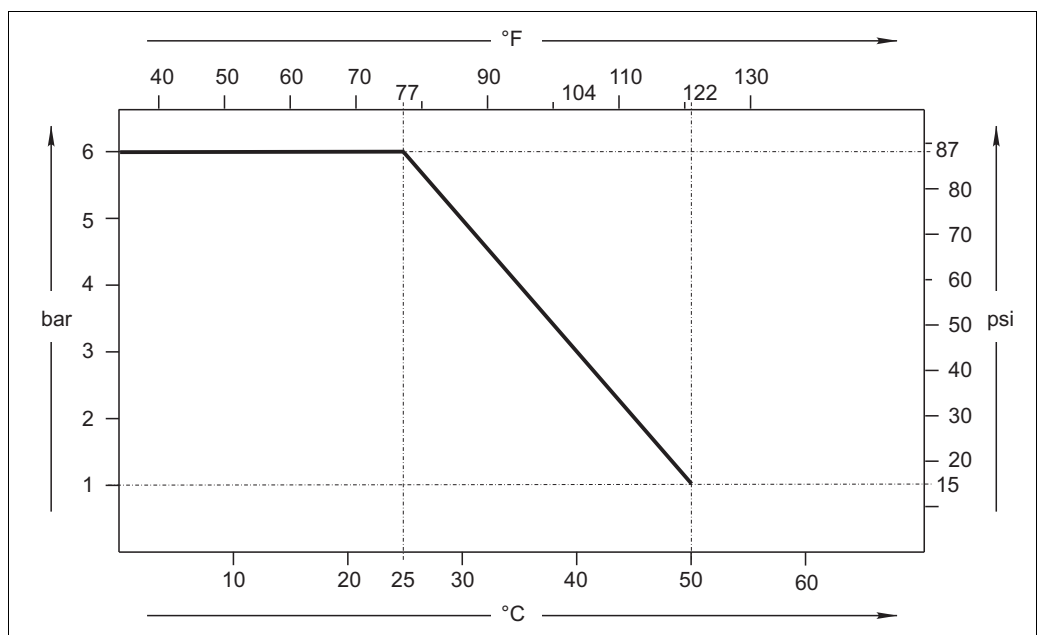
**Storage temperature** -20 to 60 °C (0 to 140 °F)

**Humidity** 5 to 95 %

**Ingress protection** IP 68

## Process

**Temperature pressure diagram**



Temperature pressure diagram

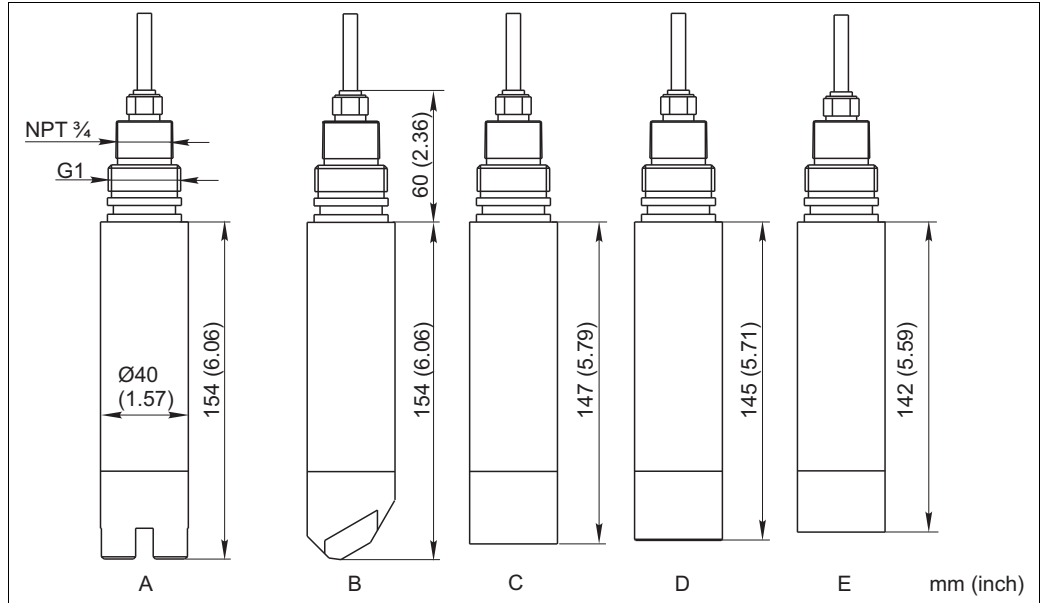
**Process temperature range** 0 to 50 °C (32 to 120 °F)

**Process pressure** 1 to 6 bar (15 to 87 psi)

**Minimum flow** No minimum flow required.  
Make sure that there is a sufficient turbulence for solids with a tendency to sedimentation.

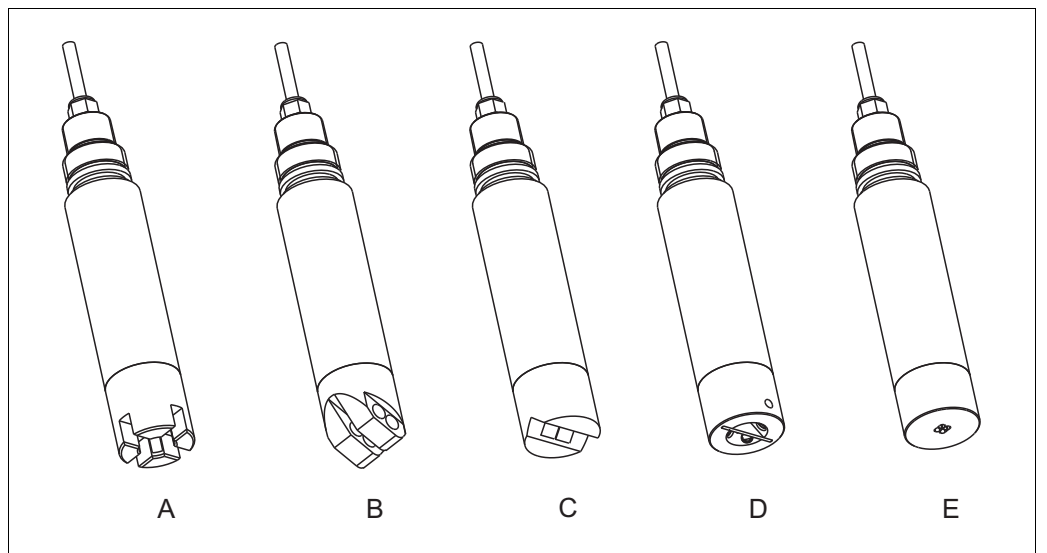
## Mechanical construction

### Design, dimensions



Dimensions depend on the sensor version (see ordering information)

a0008995



Sensor versions

a0008996

**Weight** approx. 1 kg (2.2 lbs)

**Materials**

Sensor	Stainless steel 1.4404 (AISI 316L)
Optical windows	CUS65-A, -C, -E: Epoxy resin CUS65-B, -D: Polyoxymethylene (POM)
O-rings	Viton®

## Ordering information

### Product structure TurbiMax W CUS 65

Measuring range, application	
A	0 to 12 g/l, activated sludge, centrate
B	0 to 40 g/l, return sludge
C	0 to 50 g/l, primary sludge, digested sludge
D	1 to 1000 FNU, wastewater effluent, service water, condensate, boiler feedwater
E	10 to 150 g/l, centrifuge inlet, press inlet
Certificates	
1	Factory calibration certificate
Process connection	
A	G1 + NPT 3/4 thread
Y	Special version acc. to customer specification
Connecting cable	
1	7 m (23 ft), SXP plug
2	15 m (49 ft), SXP plug
3	1 m (3.3 ft) + extension cable 10 m (32 ft), both with SXP plug
Seal	
A	Viton
Y	Special version acc. to customer specification
CUS65-	complete order code

### Scope of delivery

The scope of delivery comprises:

- 1 CUS65 sensor, cable length depending on version
- 1 extension cable (only version CUS65-xxx3)
- 1 Quality certificate
- 1 Operating Instructions BA370C/07/en



## Accessories

### Assemblies

Retractable assembly Cleanfit CUA451

- retractable assembly with ball valve; for turbidity sensors; material: stainless steel
- ordering acc. to product structure (Technical Information TI369C/07/en)

Immersion assembly CYY105

- for sensor immersion in basins, SS 1.4404 (AISI 316L) pipe, SS 1.4571 (AISI 316Ti) fitting
- Ordering acc. to product structure (Technical Information TI092C/07/en)

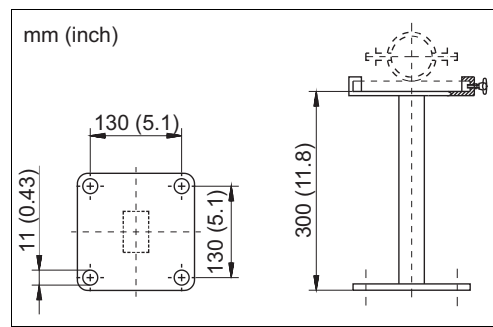
### Wall mounting

Wall attachment for immersion pipes

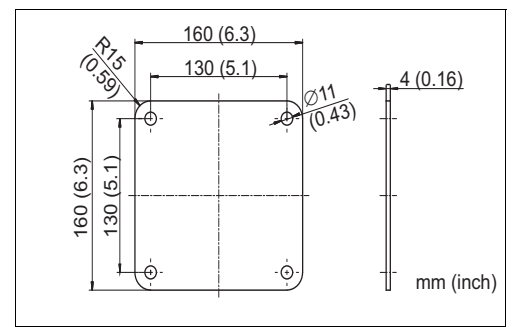
- Material: stainless steel 1.4301 (AISI 304)
- order no. 51503581

Counter plate

- Material: stainless steel 1.4301 (AISI 304)
- order no. 51512992



Wall mounting



Counter plate

### Transmitters

CUM740

- Transmitter for turbidity and solids content measurement
- see Technical Information (TI232C/07/en)

### Connection accessories

Extension cable

- Extension cable length 10m (32 ft)
- Shielded, with SXP plug and SXX coupling
- Ingress protection IP 67
- Order No.: 51503633

Plugs

- SXP plug
  - 7-pole
  - Order No.: 51504027
- SXX coupling
  - 7-pole
  - Order No.: 51504025

Junction box

- Junction box for extension of cable connection between sensor and instrument
- Sensor cable input SXB socket, cable output Pg 11 cable gland
- Material: Makrolon®
- Ingress protection IP 67
- Order No.: 51503632





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## Instruments International

Endress+Hauser  
Instruments International AG  
Kaegenstrasse 2  
4153 Reinach  
Switzerland

Tel.+41 61 715 81 00  
Fax+41 61 715 25 00  
[www.endress.com](http://www.endress.com)  
[info@ii.endress.com](mailto:info@ii.endress.com)

**Endress+Hauser**   
People for Process Automation