

# Technical Information

## Indumax CLS50D/CLS50

Inductive conductivity sensor for standard, Ex and high-temperature applications



Digital sensor with Memosens protocol or analog sensor

### Application

Indumax CLS50D or CLS50 sensor is particularly suitable for use in the chemical and process technology sectors. The six-decade measuring range and the excellent chemical resistance properties of the materials in contact with the medium (PFA or PEEK) make it possible to use this sensor in a wide range of applications, such as:

- Concentration measurement of acids and bases
- Quality monitoring of chemical products in tanks and pipes
- Phase separation of product/product mixtures

The digital sensor CLS50D is used in conjunction with the Liquiline CM44x/R or Liquiline M CM42, while the analog sensor CLS50 is used with the Liquiline M CM42 or Liquisys CLM223/253.

### Your benefits

- High durability
  - High chemical resistance thanks to PFA coating
  - PEEK version for temperatures up to 180 °C (356 °F)
- Low risk of soiling
  - Dirt-repellent PFA surface
  - Large sensor opening
- Easy installation
  - Can be installed in pipes  $\geq$  DN 80
  - Total cable length up to 55 m (180 ft)
- Large measuring range from 2  $\mu$ S/cm to 2000 mS/cm
- Integrated, coated Pt 100 temperature sensor, error class A
- Ex approval Ex ia IIC T4/T6

### Other advantages of Memosens technology

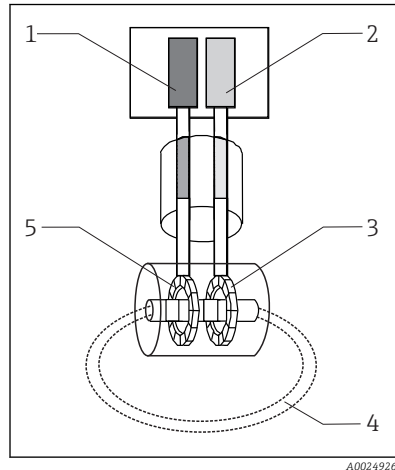
- Maximum process safety
- Data security thanks to digital data transmission
- Very easy to use as sensor data saved in the sensor
- Recording of sensor load data in the sensor enables predictive maintenance

## Function and system design

### Measuring principle

#### Inductive conductivity measurement

An oscillator (1) generates an alternating magnetic field in the primary coil (5), which induces a current flow (4) in the medium. The strength of the current depends on the conductivity and thus on the ion concentration in the medium. The current flow in the medium, in turn, generates a magnetic field in the secondary coil (3). The resulting induced current is measured by the receiver (2) and used to determine the conductivity.



- 1 Oscillator
- 2 Receiver
- 3 Secondary coil
- 4 Current flow in the medium
- 5 Primary coil

#### Advantages of inductive conductivity measurement:

- No electrodes and therefore no polarization effects
- Accurate measurement in media with a high degree of pollution and a tendency to form buildup
- Complete galvanic isolation of the measurement and the medium

### Measuring system

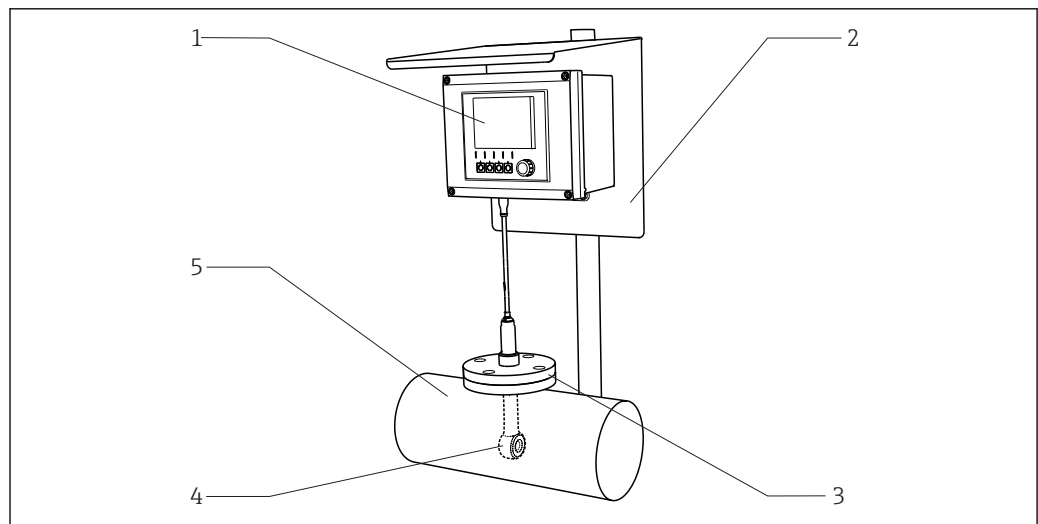
#### CLS50D

A complete measuring system comprises:

- A CLS50D inductively measuring conductivity sensor with fixed cable
- A transmitter, e.g. Liquiline CM44x

Optional:

- Weather protection for the field installation of the transmitter
- Assembly to install the sensor in vessels or pipes, e.g. CLA111



1 Example of a measuring system

- 1 Liquiline CM44x transmitter
- 2 Protective cover
- 3 Pipe nozzle with flange DN50 PN16
- 4 CLS50D sensor, version with flange DN50 PN16 and fixed cable with M12 connector
- 5 Pipe

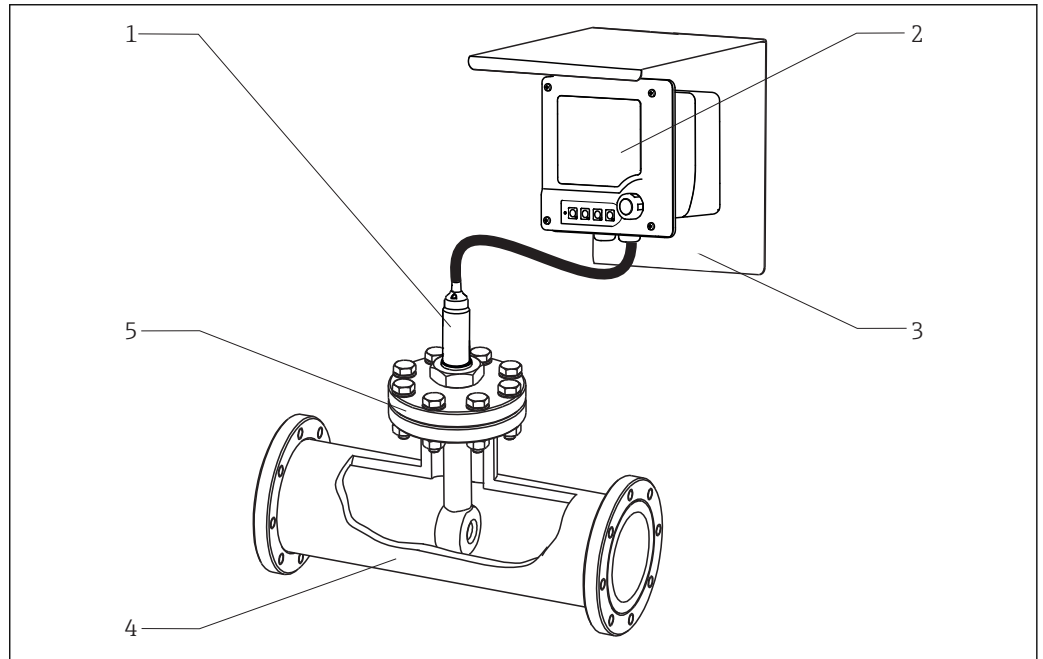
### CLS50

A complete measuring system comprises:

- A CLS50 inductively measuring conductivity sensor with fixed cable
- A transmitter, e.g. Liquiline M CM42

Optional:

- Weather protection for the field installation of the transmitter
- Assembly to install the sensor in vessels or pipes, e.g. CLA111




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2 Example of a measuring system

- 1 CLS50 sensor, version with lap joint flange and fixed cable with ferrules
- 2 Liquiline CM42 transmitter
- 3 Protective cover
- 4 Pipe
- 5 Pipe nozzle with flange connection

## Communication and data processing (CLS50D only)

### Communication with the transmitter

 Always connect digital sensors with Memosens technology to a transmitter with Memosens technology. Data transmission to a transmitter for analog sensors is not possible.

Digital sensors can store measuring system data in the sensor. These include the following:

- Manufacturer data
  - Serial number
  - Order code
  - Date of manufacture
- Calibration data
  - Calibration date
  - Cell constant
  - Delta cell constant
  - Number of calibrations
  - Serial number of the transmitter used to perform the last calibration
- Operating data
  - Temperature application range
  - Conductivity application range
  - Date of initial commissioning
  - Maximum temperature value
  - Hours of operation at high temperatures

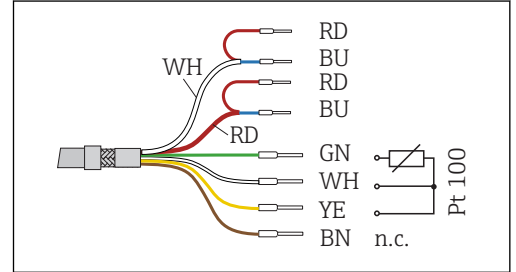
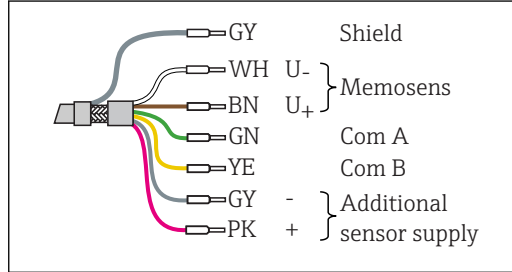
## Input

<b>Measured variables</b>	<ul style="list-style-type: none"> <li>▪ Conductivity</li> <li>▪ Temperature</li> </ul>				
<b>Measuring ranges</b>	<table> <tr> <td>Conductivity</td> <td>2 µS/cm to 2000 mS/cm (uncompensated)</td> </tr> <tr> <td>Temperature</td> <td>-20 to +180 °C (-4 to +350 °F)</td> </tr> </table>	Conductivity	2 µS/cm to 2000 mS/cm (uncompensated)	Temperature	-20 to +180 °C (-4 to +350 °F)
Conductivity	2 µS/cm to 2000 mS/cm (uncompensated)				
Temperature	-20 to +180 °C (-4 to +350 °F)				
<b>Cell constant</b>	$k = 1.98 \text{ cm}^{-1}$				
<b>Measuring frequency</b>	2 kHz				
<b>Temperature measurement</b>	<p><b>CLS50D</b> Pt1000 (Class A according to IEC 60751)</p> <p><b>CLS50</b> Pt100 (Class A according to IEC 60751)</p>				

## Power supply

### Electrical connection

The sensor is supplied with a fixed cable. The cable between the sensor and transmitter can be extended using the CYK11 (CLS50D) or CLK6 (CLS50) measuring cable (does not apply for use in a hazardous environment).



3 CYK11 for extension of CLS50D

4 CLK6 for extension of CLS50

Total cable length (max.): 100 m (330 ft)

Total cable length (max.): 55 m (180 ft)



CLS50 only:

The residual coupling of the sensor increases when the fixed cable is extended.

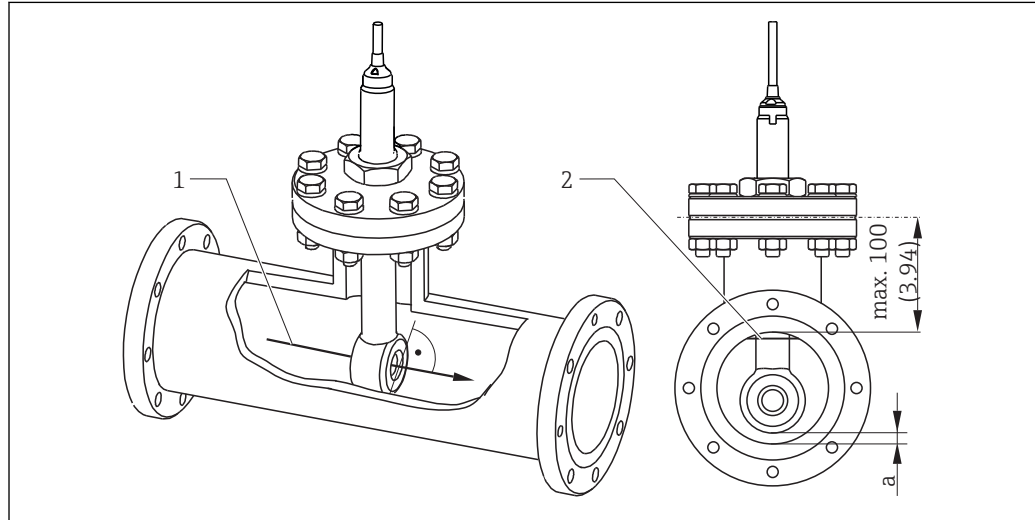
## Performance characteristics

<b>Conductivity response time</b>	$t_{95} \leq 2 \text{ s}$	
<b>Temperature response time</b>	PEEK version:	$t_{90} \leq 7 \text{ min}$
	PFA version:	$t_{90} \leq 11 \text{ min}$
<b>Maximum measured error</b>	-20 to 100 °C (-4 to 212 °F):	$\pm(5 \mu\text{S/cm} + 0.5 \% \text{ of reading})$
	> 100 °C (212 °F):	$\pm(10 \mu\text{S/cm} + 0.5 \% \text{ of reading})$
<b>Repeatability</b>	0.2% of reading	
<b>Linearity</b>	1.9 % (only applies in the 1 to 20 mS/cm measuring range)	

## Installation

### Orientation

- ▶ When installing, align the sensor in such a way that the medium flows through the flow opening of the sensor in the direction of medium flow.
  - ↳ The sensor head must be completely immersed in the medium.



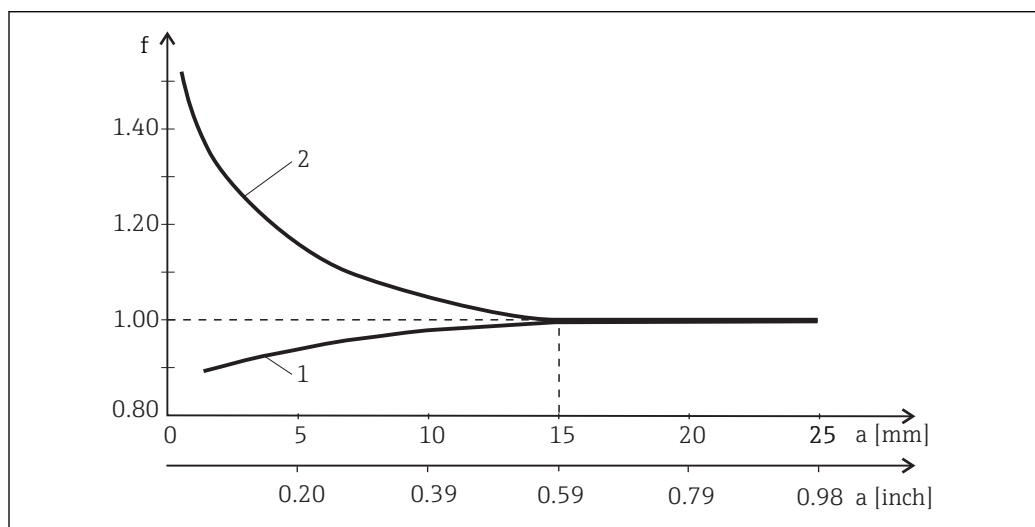
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5 Sensor orientation, dimensions in mm (in)

- 1 Direction of medium flow
- 2 Minimum water level in the pipe
- a Distance from pipe wall

### Installation factor

In confined installation conditions, the conductivity measurement is affected by the pipe walls. The installation factor compensates for this effect. The transmitter corrects the cell constant by multiplying by the installation factor. The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the sensor's distance to the wall. The installation factor  $f$  can be disregarded ( $f = 1.00$ ) if the distance to the wall is sufficient ( $a > 15 \text{ mm}$  (0.59")), from DN 80). If the distance to the wall is smaller, the installation factor increases for electrically insulating pipes ( $f > 1$ ) and decreases for electrically conductive pipes ( $f < 1$ ). It can be measured using calibration solutions, or a close approximation determined from the following diagram.



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6 Relationship between installation factor  $f$  and wall distance

- 1 Electrically conductive pipe wall
- 2 Electrically insulating pipe wall

**Air set**

**CLS50D**

The digital sensor has already been adjusted at the factory. Onsite compensation is not required.

**CLS50**

To compensate residual coupling in the cable and between the two sensor coils, zero adjustment in air ("air set") must be performed before installing the sensor. Follow the instructions provided in the Operating Instructions of the transmitter used.

**Installation with flange**

The sensor is suitable for installation in T-pieces  $\geq$  DN 80, with the outgoing diameter reduced to  $\geq$  DN 50.

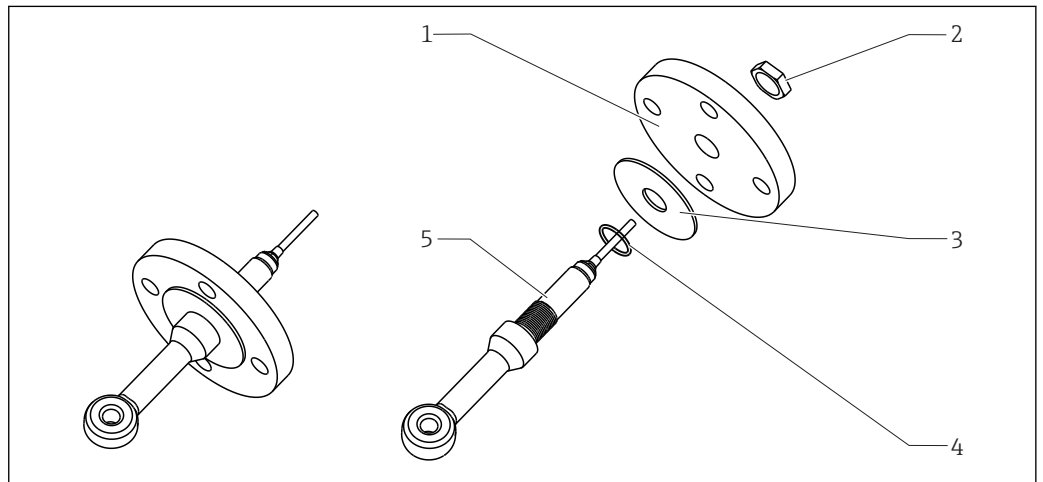
**⚠ WARNING**

**Leakage**

Risk of injury if medium escapes!

- ▶ Tighten sensor nut using a torque of 20 Nm.
- ▶ To avoid leakages, regularly check the tightness of the nut.

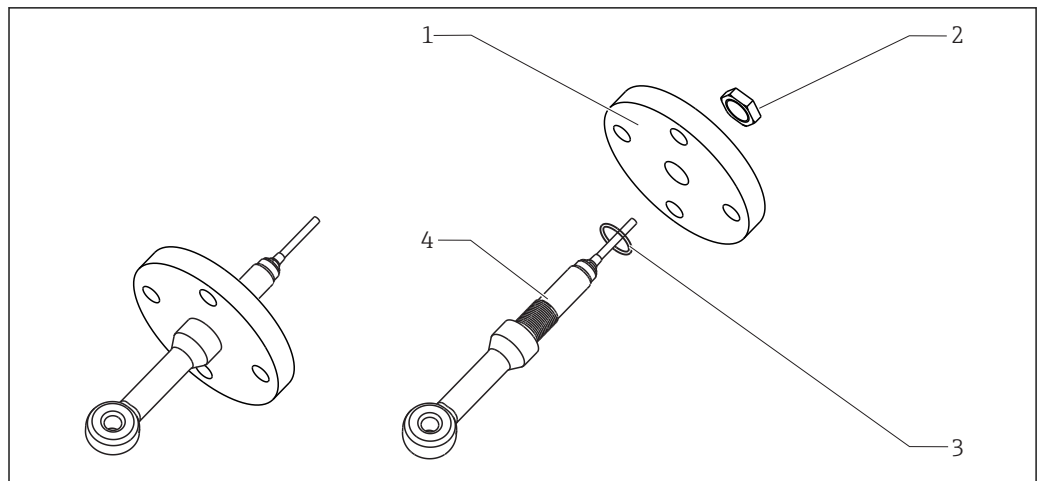
**Flange, not in contact with medium**



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7 Fixed flange, not in contact with medium (for order option: "Process connection" = 5, 6, 7)

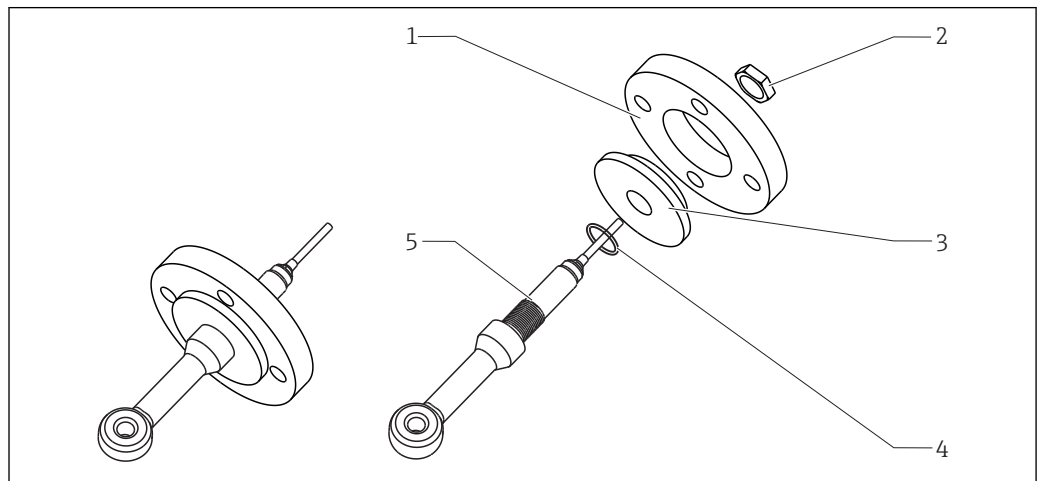
- 1 Flange (stainless steel)
- 2 Nut
- 3 Sealing disk (GYLON)
- 4 O-ring
- 5 Sensor

**Flange, in contact with medium**

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▣ 8 Fixed flange, in contact with medium (for order option: "Process connection" = 3, 4)

- 1 Flange (stainless steel)
- 2 Nut
- 3 O-ring
- 4 Sensor

**Lap joint flange, not in contact with medium**

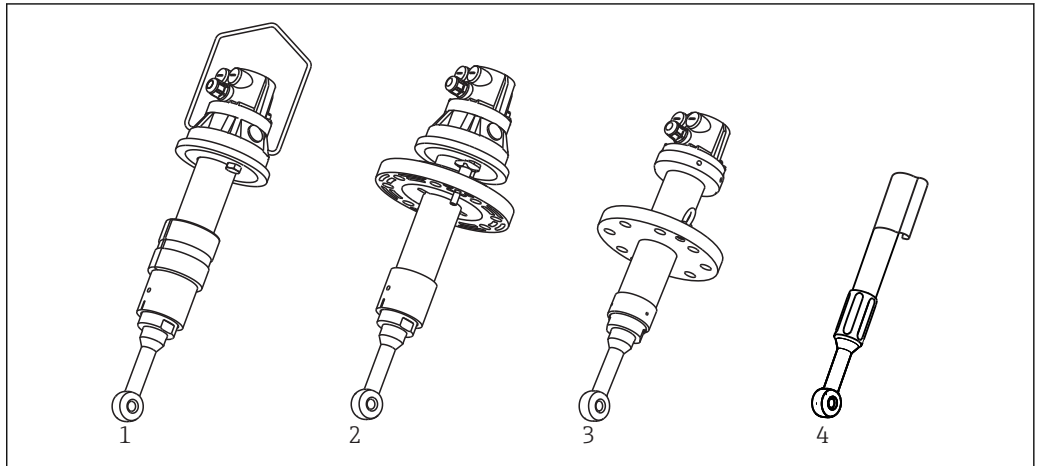
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▣ 9 Lap joint flange, not in contact with medium (for order option: "Process connection" = A, B, C)

- 1 Lap joint flange (PP-GF)
- 2 Nut (stainless steel)
- 3 Flange (PVDF)
- 4 O-ring
- 5 Sensor



**Installation in assembly**



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10 Installation of sensor with assembly

- 1 CLA111 with suspension bracket
- 2 CLA111 with flange connection
- 3 CLA140 with flange connection
- 4 CYA112

**Environment**

**Ambient temperature range**    **CLS50D**  
 -10 to +60 °C (+10 to +140 °F)

**CLS50**  
 -10 to +70 °C (+10 to +160 °F)

**Storage temperature**                    -20 to +80 °C (0 to +180 °F)

**Degree of protection**                    IP 68 / NEMA type 6 (sensor in installed state with genuine seal)

**Process**

**Process temperature**

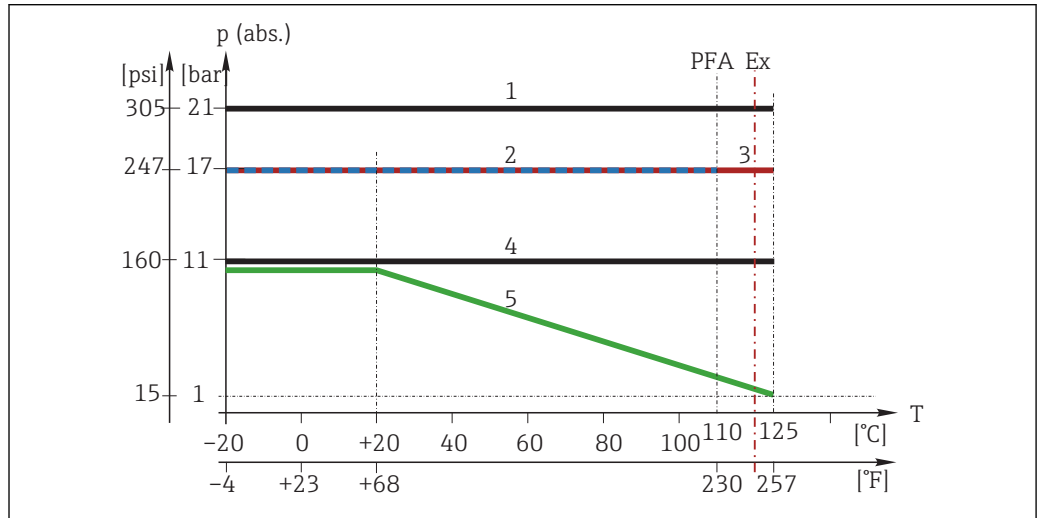
Sensor material	CLS50D-*1/2 Without flange	CLS50D-*3/4/5/6/8 DN50, ANSI 2"	CLS50D-*7 JIS	CLS50D-*A/B/C PVDF lap joint flange
PEEK	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)
PFA	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)	-20 to 110 °C (-4 to 230 °F)

*CLS50*

Sensor material	CLS50-*1/2 Without flange	CLS50-*3/4/5/6/8 DN50, ANSI 2"	CLS50-*7 JIS	CLS50-*A/B/C PVDF lap joint flange
PEEK	-20 to 180 °C (-4 to 360 °F)	-20 to 180 °C (-4 to 360 °F)	-20 to 180 °C (-4 to 360 °F)	-20 to 125 °C (-4 to 260 °F)
PFA	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)	-20 to 125 °C (-4 to 260 °F)

**Process pressure (absolute)** Max. 21 bar (305 psi), depending on the sensor version, see pressure-temperature ratings

**Temperature/pressure ratings** **CLS50D**

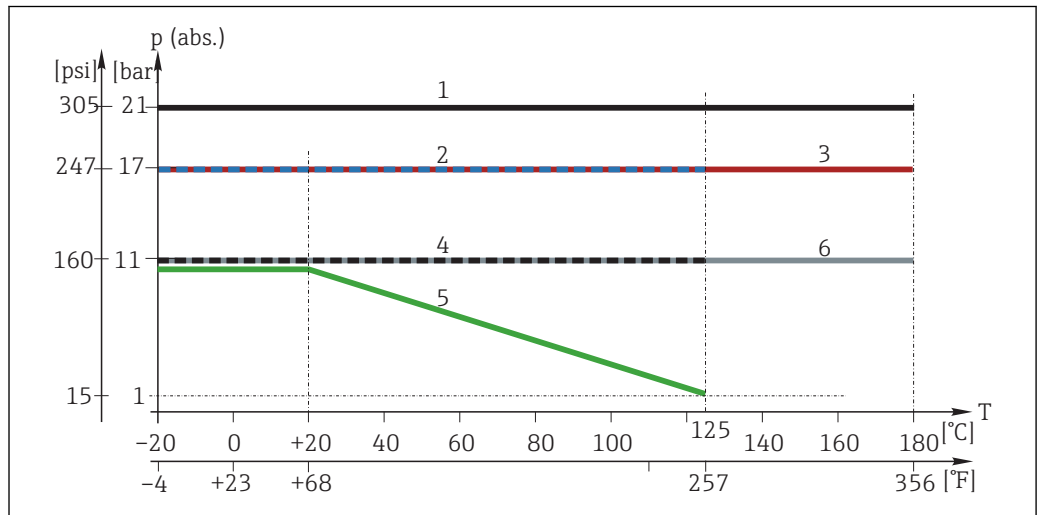


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11 Pressure temperature ratings CLS50D

- 1 PEEK sensor, without a flange
- 2 PFA sensor, without a flange (blue line)
- 3 PEEK or PFA sensor, with DN50/ANSI 2" flange (red line)
- 4 PEEK or PFA sensor, with JIS flange
- 5 PEEK or PFA sensor, with PVDF lap joint flange (green line)

**CLS50**



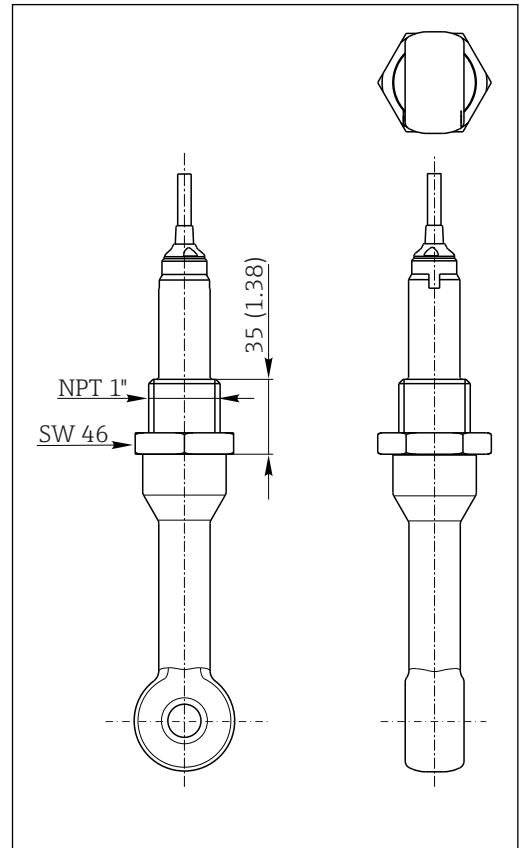
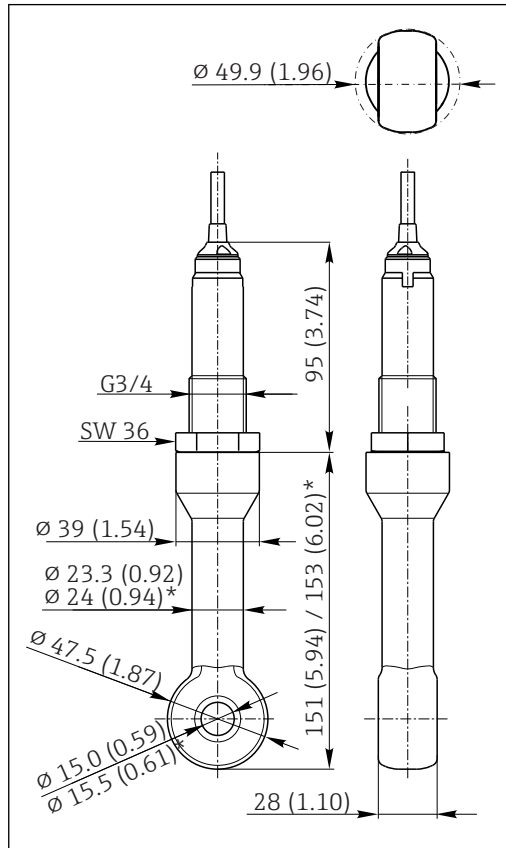
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12 Pressure-temperature ratings for CLS50

- 1 PEEK sensor, without a flange
- 2 PFA sensor, without a flange or with DN50/ANSI 2" flange (blue line)
- 3 PEEK sensor, with DN50/ANSI 2" flange (red line)
- 4 PFA sensor, with JIS flange (black line)
- 5 PEEK or PFA sensor, with PVDF lap joint flange (green line)
- 6 PEEK sensor, with JIS flange (gray line)

## Mechanical construction

### Dimensions



13 Version with G $\frac{3}{4}$  thread, dimensions in mm (inch)

14 Version with NPT 1" thread, dimensions in mm (inch)

\* Dimension for PEEK version

### Weight

Approx. 0.65 kg (1.43 lbs)

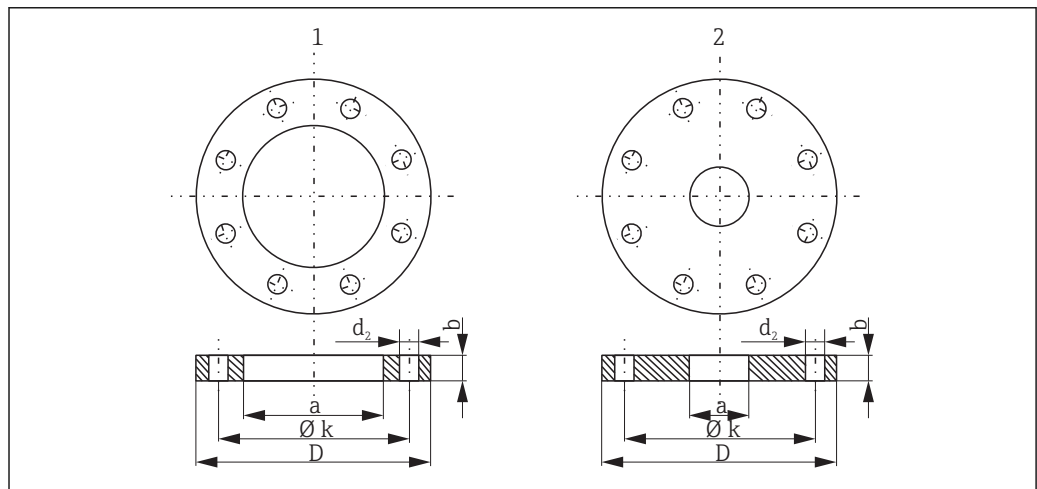
### Materials

Sensor	PEEK, PFA (depending on version)
Sensor seal	VITON, CHEMRAZ (depending on version)
Process connections	
G $\frac{3}{4}$	CLS50D-*1B/C** : PEEK GF30 CLS50D-*1D** : stainless steel (AISI 316Ti) CLS50-*1A* : stainless steel 1.4571 (AISI 316Ti) CLS50-*1B/C/1/2/3 : PEEK GF30 CLS50-*1B/C5/6 : stainless steel 1.4571 (AISI 316Ti)
NPT 1"	PEEK
Fixed flange	Stainless steel 1.4404 (AISI 316L)
Sealing disk	GYLON (PTFE ceramic-filled)
Lap joint flange	PP-GF
Flange combined with lap joint flange	PVDF

**Process connections**

- G<sup>3</sup>/<sub>4</sub> thread
- NPT 1" thread
- Lap joint flange EN 1092 DN50 PN10
- Lap joint flange ANSI 2" 150 lbs
- Lap joint flange JIS 10K 50A
- Flange EN 1092-1 DN50 PN16
- Flange ANSI 2" 300 lbs
- Flange JIS 10K 50A

**Flange dimensions**



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15 Flange dimensions

- 1 Lap joint flange (PP-GF)
- 2 Fixed flange (stainless steel)

*Dimensions in mm*

Lap joint flange PP-GF	DN50 PN10	ANSI 2" 150 lbs	JIS 10K 50A
D	165	165	152
Ø k	125	121	120
d <sub>2</sub>	4 x 18	8 x 19	4 x 19
b	18	18	18
a	78	78	78
Screws	M16	M16	M16

*Dimensions in mm*

Fixed flange SS 316 L	DN50 PN10	ANSI 2" 300 lbs	JIS 10K 50A
D	165	165.1	155
Ø k	125	127	120
d <sub>2</sub>	4 x 18	8 x 19	4 x 19
b	18	22.2	16
a	27	27	27
Screws	M16	M16	M16

## Chemical resistance

Medium	Concentration	PEEK	PFA	CHEMRAZ	VITON
Sodium hydroxide solution NaOH	0 to 50 %	20 to 100 °C (68 to 212 °F)	20 to 50 °C (68 to 122 °F)	0 to 150 °C (32 to 302 °F)	Not suitable
Nitric acid HNO <sub>3</sub>	0 to 10 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 40 %	20 °C (68 °F)	20 to 60 °C (68 to 140 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Phosphoric acid H <sub>3</sub> PO <sub>4</sub>	0 to 80 %	20 to 100 °C (68 to 212 °F)	20 to 60 °C (68 to 140 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Sulfuric acid H <sub>2</sub> SO <sub>4</sub>	0 to 2.5 %	20 to 80 °C (68 to 176 °F)	20 to 100 °C (68 to 212 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 30 %	20 °C (68 °F)	20 to 100 °C (68 to 212 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
Hydrochloric acid HCl	0 to 5 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)
	0 to 10 %	20 to 100 °C (68 to 212 °F)	20 to 80 °C (68 to 176 °F)	0 to 150 °C (32 to 302 °F)	0 to 120 °C (32 to 248 °F)

## Certificates and approvals

## CE mark

## Declaration of Conformity

The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EU directives. The manufacturer confirms successful testing of the product by affixing to it the CE mark.

## Ex approvals

## CLS50D-BA\*\*\*\* and CLS50-G\*\*\*\*

ATEX II 1G Ex ia IIC T4/T6 Ga

## CLS50D-BV\*\*\*\*

ATEX II 3G Ex ic IIC T4/T6 Gc

## CLS50D-IA\*\*\*\*

IECEx Ex ia IIC T4/T6 Ga

## CLS50-V\*\*\*\*

ATEX II 3G Ex ic IIC T4/T6 Gc + NEPSI Ex ic IIC T4/T6 Gc

## CLS50D-NA\*\*\*\* and CLS50-H\*\*\*\*

NEPSI Ex ia IIC T4/T6 Ga

## CLS50D-FB\*\*\*\* and CLS50-O\*\*\*\*

FM IS NI Cl.I Div.1&2, G. A-D

## CLS50D-C2\*\*\*\* and CLS50-S\*\*\*\*

CSA IS NI Cl.I Div.1&2, Gr. A-D

## CLS50D-TA\*\*\*\* and CLS50-T\*\*\*\*

TIIS Ex ib IIC T4 Gb

## CLS50D-GB\*\*\*\* and CLS50-K\*\*\*\*

■ EAC Ex, 0Ex ia IIC T6/T4 Ga X

■ Zone 0

■ Certificate number: TC RU C-DE.AA87.B.00088 and TC RU C-DE.ГB05.B.00172 (only CLS50-K\*\*\*\*)

■ The product has been certified in accordance with Directive TR CU 012/2011 which applies in the European Economic Area (EEA). The EAC conformity mark has been affixed to the product.

## Ordering information

### Product page

[www.endress.com/cls50d](http://www.endress.com/cls50d)

[www.endress.com/cls50](http://www.endress.com/cls50)

### Product Configurator

On the product page there is a **Configure** button to the right of the product image.

1. Click this button.
  - ↳ The Configurator opens in a separate window.
2. Select all the options to configure the device in line with your requirements.
  - ↳ In this way, you receive a valid and complete order code for the device.
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.



For many products you also have the option of downloading CAD or 2D drawings of the selected product version. Click the **CAD** tab for this and select the desired file type using picklists.

## 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 Center.

### Measuring cable

#### For CLS50D

##### Memosens data cable CYK11

- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: [www.endress.com/cyk11](http://www.endress.com/cyk11)



Technical Information TI00118C

#### For CLS50

##### Measuring cable CLK6

- Extension cable for inductive conductivity sensors, for extension via VBM junction box
- Sold by the meter, order number: 71183688

##### VBM

- Junction box for cable extension
- 10 terminal strips
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"
- Material: aluminum
- Degree of protection: IP 65
- Order numbers
  - Cable entries Pg 13.5 : 50003987
  - Cable entries NPT ½": 51500177

### Assemblies

#### Dipfit CLA111

- Immersion assembly for open and closed vessels with flange DN 100
- Product Configurator on the product page: [www.products.endress.com/cla111](http://www.products.endress.com/cla111)



Technical Information TI00135C

#### Dipfit CLA140

- For the CLS50/CLS50D inductive sensor
- Immersion assembly with flange connection for very demanding processes
- Product Configurator on the product page: [www.products.endress.com/cla140](http://www.products.endress.com/cla140)



Technical Information TI00196C

**FlexdipCYA112**

- Immersion assembly for water and wastewater
- Modular assembly system for sensors in open basins, channels and tanks
- Material: PVC or stainless steel
- Product Configurator on the product page: [www.endress.com/cya112](http://www.endress.com/cya112)



Technical Information TI00432C

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**Calibration solutions**

**Conductivity calibration solutions CLY11**

Precision solutions referenced to SRM (Standard Reference Material) by NIST for qualified calibration of conductivity measuring systems in accordance with ISO 9000

- CLY11-B, 149.6  $\mu\text{S}/\text{cm}$  (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)  
Order No. 50081903
- CLY11-C, 1.406 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)  
Order No. 50081904
- CLY11-D, 12.64 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)  
Order No. 50081905
- CLY11-E, 107.00 mS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)  
Order No. 50081906



Technical Information TI00162C

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

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