



Level



Pressure



Flow



Temperature



Analytics



Registration

Systems  
Components

Services



Solutions

## Technical Information

# Condumax CLS16 and CLS16D

Hygienic conductivity sensor, analog or digital with Memosens technology, cell constant  $k = 0.1 \text{ cm}^{-1}$



### Application

Measurement in pure and ultrapure water:

- Monitoring ion exchangers
- Reverse osmosis
- Distillation
- Electro-deionizing
- WFI (Water for Injection) in the pharmaceutical industry

The cell constant  $k$  of the sensor is  $0.1 \text{ cm}^{-1}$ . The measuring range reaches from 0.04 to 500  $\mu\text{S}/\text{cm}$ .

Sensors with integrated temperature sensors are used with transmitters with automatic temperature compensation:

- Liquiline CM442 / CM444 / CM448 (CLS16D only)
- Liquiline CM42
- Liquiline CM14 (CLS16D only)
- Mycom CLM153
- Liquisys CLM223/253

For measurement of resistivity,  $\text{M}\Omega \cdot \text{cm}$  measuring ranges are available in the menus of these transmitters.

### Your benefits

- High measuring accuracy as cell constant is individually measured
- Hygienic process connections for installation in pipes or flow chambers
- Plug-in head (IP 68) / fixed cable (IP 67)
- Easy to clean thanks to electro-polished measuring surfaces
- Can be sterilized up to 150 °C (302 °F)
- Stainless steel 1.4435 (AISI 316L), meets the highest demands of the pharmaceutical industry
- Quality certificate stating the individual cell constant
- Certified according to EHEDG Document 8
- Available with biological reactivity test certificate according to USP (United States Pharmacopeia) Part 87 and 88 Class VI
- Available with inspection certificate according to EN 10204-3.1

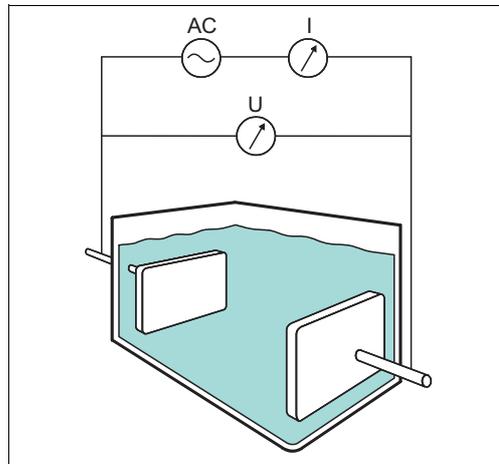
### Further benefits offered by Memosens technology

- Maximum process safety through contactless inductive signal transmission
- Data safety through digital data transmission
- Easy handling thanks to storage of sensor-specific data in the sensor
- Predictive maintenance possible thanks to registration of sensor load data in the sensor

## Function and system design

### Measuring principle

### Conductive measurement of conductivity



The conductivity of liquids is measured with the following measurement setup: Two electrodes are immersed in the medium. An AC voltage is applied to these electrodes which generates a current in the medium.

The electric resistance or its reciprocal value, the conductance  $G$ , is calculated according to Ohm's law. The specific conductivity  $\kappa$  is determined using the cell constant  $k$  that is dependent on the sensor geometry.

Conductive measurement of conductivity

»0003416

AC Power supply  
I Current meter  
U Voltage meter

### General properties

#### ■ Electrodes

The sensor has coaxially arranged measuring electrodes made of electro-polished, stainless steel 1.4435 (AISI 316L).

#### ■ Temperature measurement

A temperature sensor is installed in the inside electrode to measure the medium temperature.

#### ■ Durable and sterilizable

- The sensors are pressure-proof up to 12 bar at 20 °C (180 psi at 68 °F).
- They are underpressure-proof down to 0.1 bar at 20 °C (1.5 psi at 68 °F).
- They are suitable for continuous operation up to 120 °C at 8 bar (248 °F at 116 psi)
- The sensors are sterilizable up to 150 °C at 5 bar (302 °F at 72.5 psi), 45 min.
- For CLS16D, the maximum temperature for communication with the transmitter is 130 °C (266 °F).

### Communication and data processing with CLS16D

Digital sensors are able to store the following system data in the sensor:

#### ■ Manufacturing data

- Serial number
- Order code
- Date of manufacture

#### ■ Calibration data

- Calibration date
- Cell constant
- Change in cell constant
- Number of calibrations
- Serial number of the transmitter used for the last calibration

#### ■ Application data

- Temperature application range
- Conductivity application range
- Date of first commissioning
- Maximum temperature value
- Operating hours at high temperatures

**Dependability with CLS16D**

**Reliability**

The Memosens technology digitalizes the measured values in the sensor and transfers them to the transmitter contactlessly and free from interference potential. The result:

- An automatic error message is generated if the sensor fails or the connection between sensor and transmitter is interrupted.
- The availability of the measuring point is dramatically increased by immediate error detection.

**Maintainability**

Sensors with Memosens technology have integrated electronics that allow for saving calibration data and further information such as total hours of operation and operating hours under extreme measuring conditions. When the sensor is connected, the calibration data are automatically transferred to the transmitter and used to calculate the current measured value. Storing the calibration data in the sensor allows for calibration and adjustment away from the measuring point. The result:

- Sensors can be calibrated under optimum external conditions in the measuring lab. Wind and weather do neither affect the calibration quality nor the operator.
- The measuring point availability is dramatically increased by the quick and easy replacement of precalibrated sensors.
- Maintenance intervals can be defined based on all stored sensor load and calibration data and predictive maintenance is possible.
- The sensor history can be documented on external data carriers and evaluation programs at any time. Thus, the current application of the sensors can be made to depend on their previous history.

**Integrity**

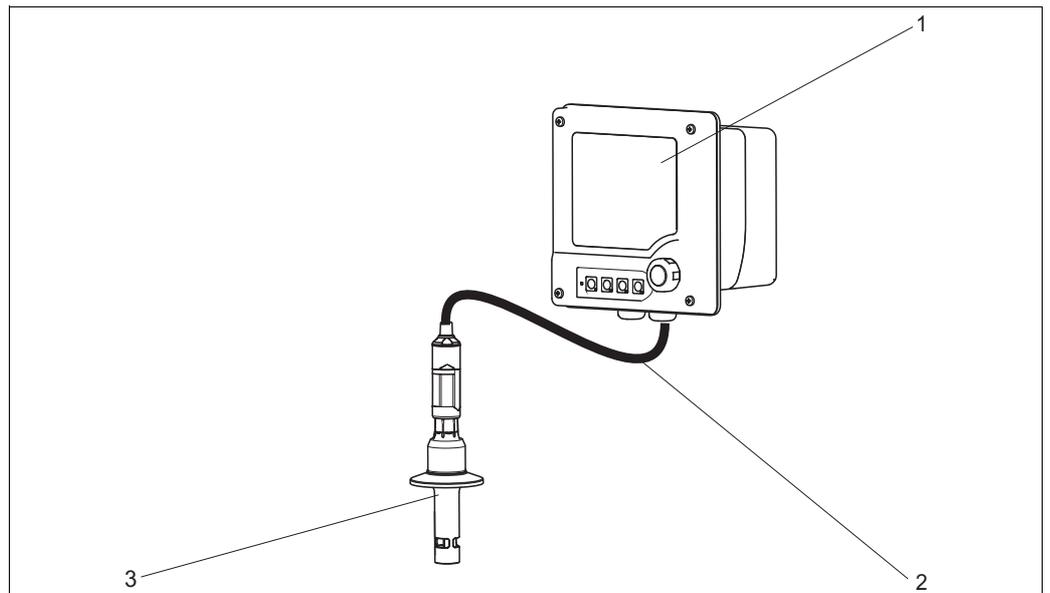
The inductive and non-contacting measured value transmission of Memosens guarantees maximum process safety and offers the following benefits:

- All problems caused by moisture are eliminated.
  - The plug-in connection is free from corrosion.
  - Measured value distortion from moisture is not possible.
  - The plug-in system can even be connected under water.
- The transmitter is galvanically decoupled from the medium.
- EMC safety is guaranteed by screening measures for the digital measured value transmission.

**Measuring system**

A complete measuring system comprises:

- a CLS16 or CLS16D conductivity sensor
- a transmitter, e.g. Liquiline CM42
- a measuring cable, e.g. CPK9 or CYK10 Memosens data cable



Measuring system example

- 1 Liquiline CM42 transmitter
- 2 CYK10 Memosens data cable
- 3 Condumax CLS16D

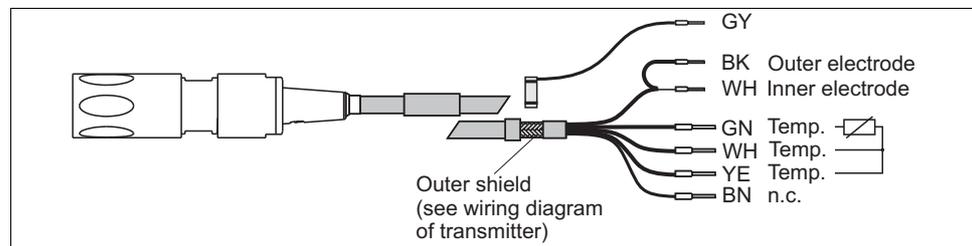
## Input

<b>Measured variable</b>	<ul style="list-style-type: none"> <li>■ Conductivity</li> <li>■ Temperature</li> </ul>
<b>Measuring range</b>	<p>Conductivity (referenced to water at 25 °C (77 °F))  <b>CLS16D and CLS16</b> 0.04 to 500 µS/cm                      valid in the specified temperature range                      specified measuring accuracy up to 100 °C (212 °F)</p> <p>Temperature  <b>CLS16D</b> -5 to 100 °C (23 to 212 °F)  <b>CLS16</b> -5 to 150 °C (23 to 300 °F)                      specified measuring accuracy up to 100 °C (212 °F)</p>
<b>Cell constant</b>	k = 0.1 cm <sup>-1</sup>
<b>Temperature compensation</b>	<p><b>CLS16D</b> NTC</p> <p><b>CLS16</b> Pt 100, PT1000 (class A acc. to IEC 60751)</p>

## Power supply

**Electrical connection** **CLS16**

The sensor is connected via the CPK9 measuring cable. For the wiring diagram, refer to the Operating Instructions of the transmitter used.

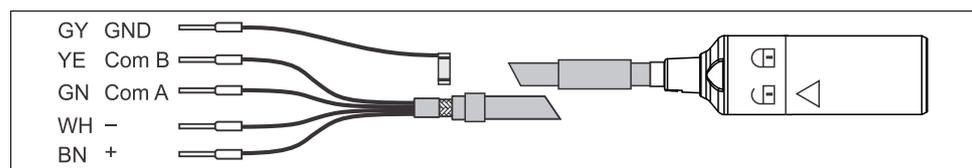


CPK9 measuring cable

To extend the cable, a VBM junction box and a CYK71 extension cable is required.

**CLS16D**

The sensor is connected to the transmitter via the measuring cable CYK10.



Measuring cable CYK10

## Performance characteristics, in general

### Measured error

Each individual sensor is factory-measured in a solution of approx. 5  $\mu\text{S}/\text{cm}$  with a reference system traceable to NIST or DKD. The exact cell constant is entered into the supplied quality certificate. The maximum measured error in cell constant determination is 1.0 %.

## Performance characteristics, CLS16D only

### Conductivity response time

$t_{95} \leq 3 \text{ s}$

### Temperature response time

$t_{90} \leq 13 \text{ s}$

### Maximum measured error

2 % of the measured value up to 200  $\mu\text{S}/\text{cm}$   
 3 % of the measured value from 200 to 500  $\mu\text{S}/\text{cm}$

### Repeatability

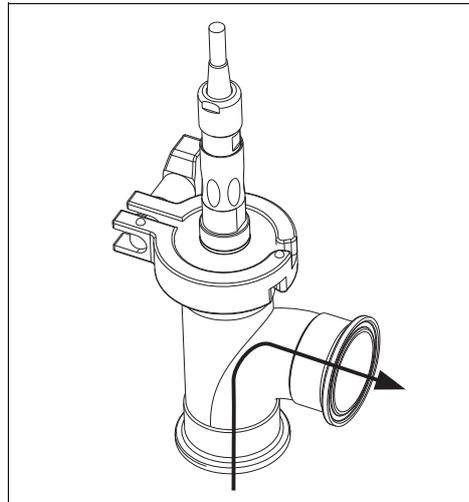
0.2 % of the measured value + 3  $\text{nS}/\text{cm}$

## Installation

### Installation conditions

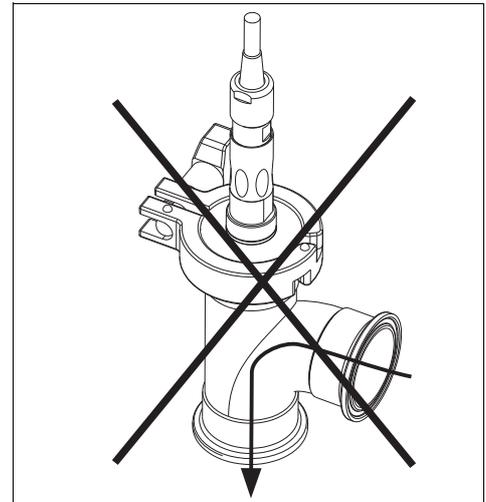
The sensors are mounted directly via the process connection.

When installing the sensor in pipes, note the flow direction of the medium (see figure below).



Permissible flow direction

a0005885



Non-permissible flow direction

a0005886

**i** The measuring surfaces must be completely immersed in the medium during operation. When working in ultrapure water, ingress of air must be prevented since dissolved air, particularly  $\text{CO}_2$ , may increase conductivity by up to 3  $\mu\text{S}/\text{cm}$ .

## Environment

**Ambient temperature** -20 to +60 °C (-4 to +140 °F)

**Storage temperature** -25 to +80 °C (-10 to +180 °F)

**Humidity** 5 to 95%

**Protection degree**

<b>CLS16</b>	Fixed cable version	IP 67 / NEMA 6
	TOP68 plug system	IP 68 / NEMA 6
<b>CLS16D</b>		IP 68 / NEMA Type 6P (10 m water column, 25 °C, 168 h)

## Process

**Process temperature**

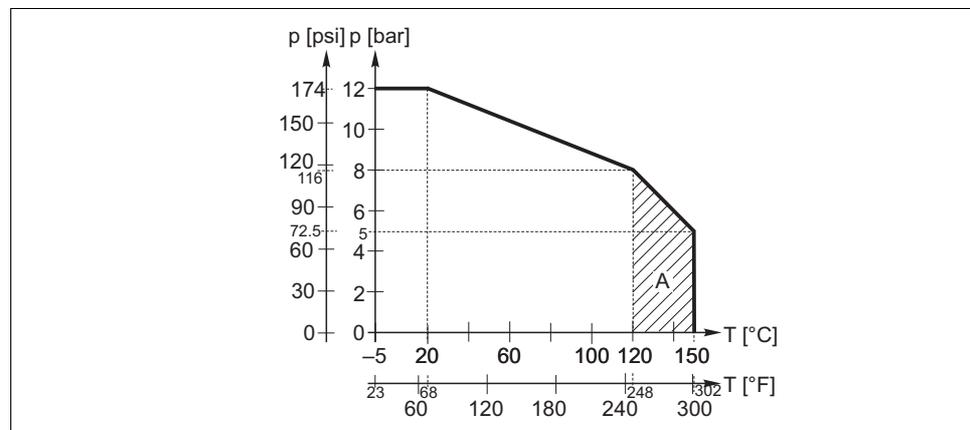
Normal operation:	-5 to 120 °C (23 to 248 °F)
Sterilization (max. 45 min):	max. 150 °C (302 °F) at 5 bar (73 psi)

**i** The maximum temperature for communication between Memosens sensors and the transmitter is 130 °C (266 °F).

**Process pressure**

12 bar (170 psi) at 20 °C (68 °F)
8 bar (120 psi) at 120 °C (248 °F)
0.1 bar abs. (1.5 psi abs. (depression)) at 20 °C (68 °F)

### Pressure/temperature load curves

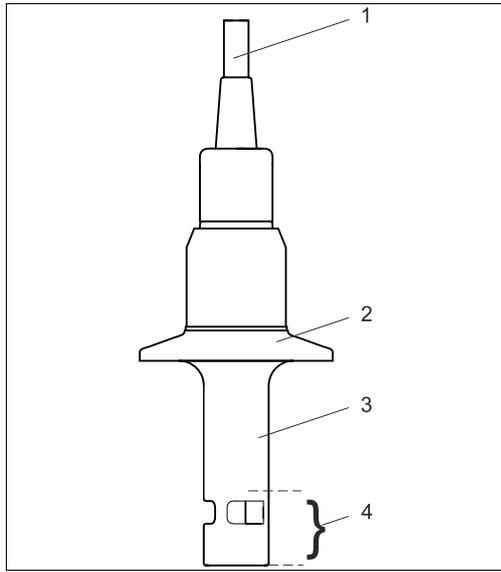


Mechanical pressure-temperature stability of

A Short-time sterilizable (45 min)

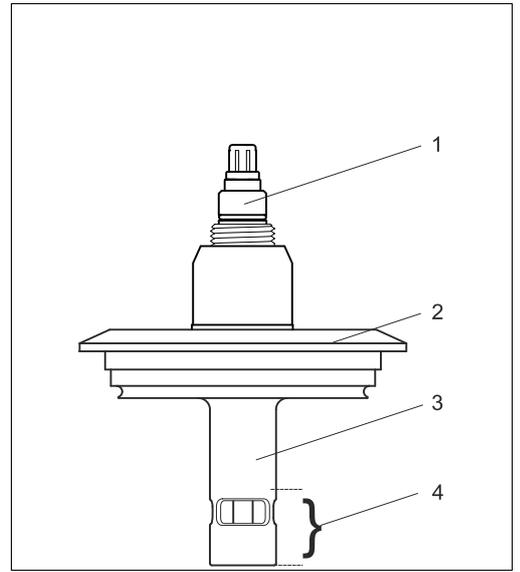
## Mechanical construction

### Design, dimensions of CLS16



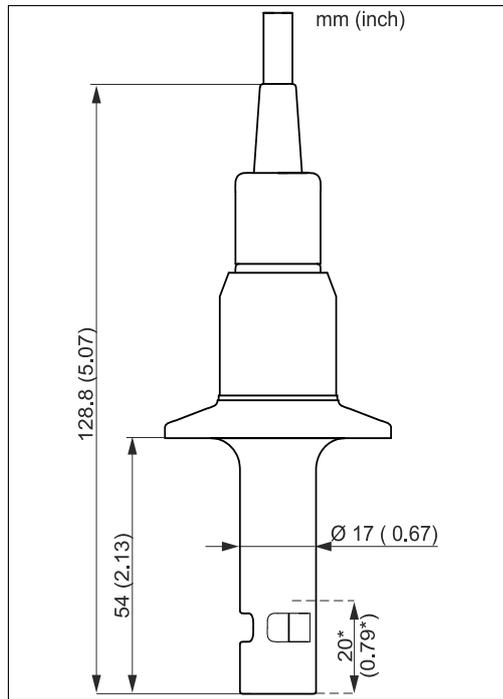
Fixed cable version

- 1 Fixed cable
- 2 Process connection (clamp, Varivent, BioControl)
- 3 Coaxial measuring electrode, electro-polished, stainless steel 1.4435 (AISI 316L)
- 4 Minimum immersion depth

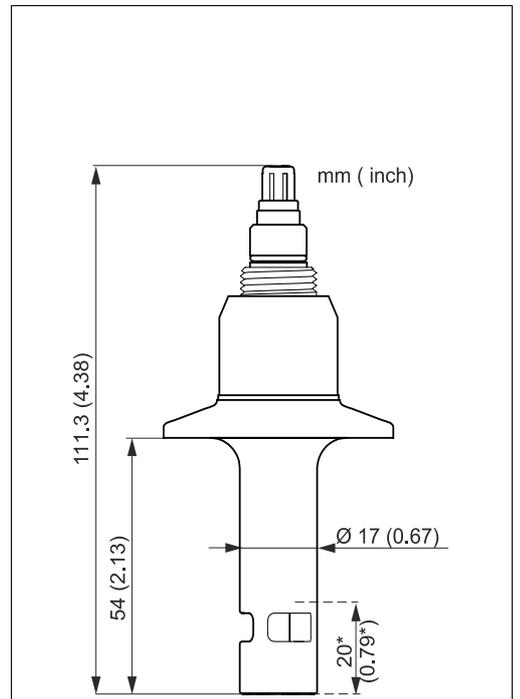


Plug-in head version

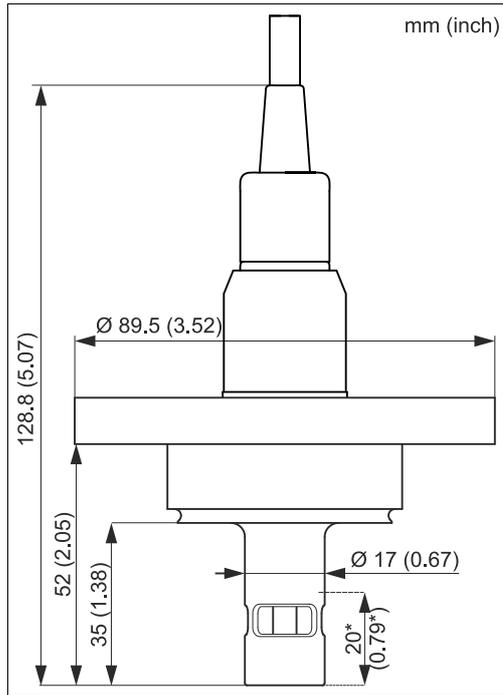
- 1 TOP68 plug-in head
- 2 Process connection (clamp, Varivent, BioControl)
- 3 Coaxial measuring electrode made of electro-polished, stainless steel 1.4435 (AISI 316L)
- 4 Minimum immersion depth



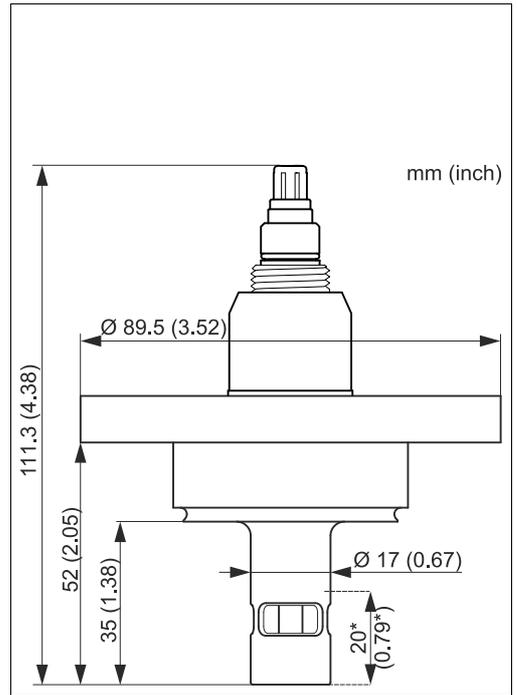
Dimensions of clamp connection, fixed-cable version  
\*minimum immersion depth



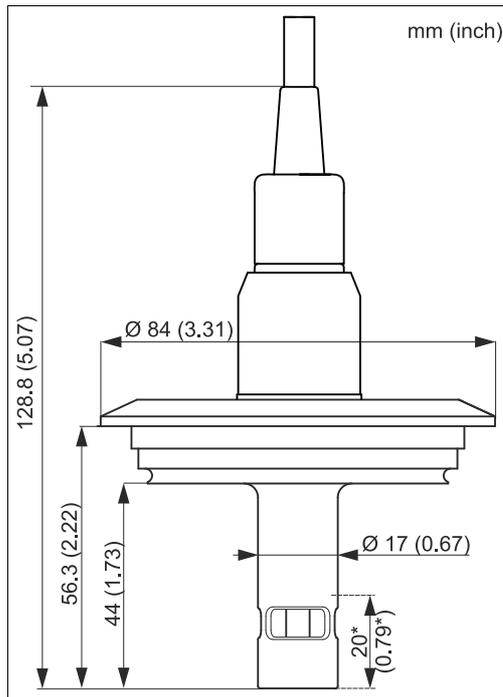
Dimensions of clamp connection, plug-in head version  
\*minimum immersion depth



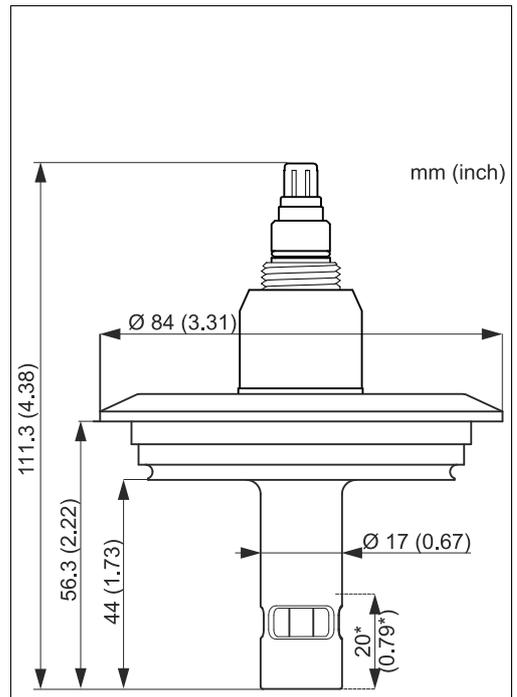
Dimensions of BioControl connection, fixed-cable version  
\*minimum immersion depth



Dimensions of BioControl connection, plug-in head  
\*minimum immersion depth

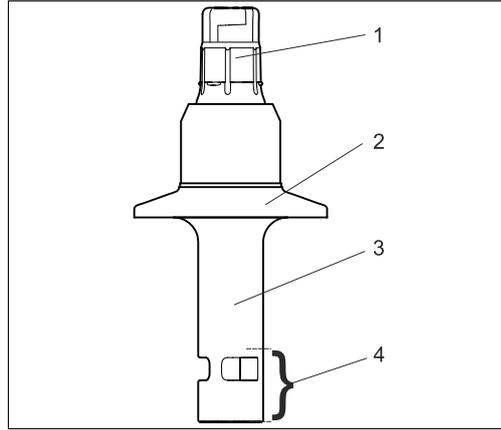


Dimensions of Varivent connection, fixed-cable version  
\*minimum immersion depth



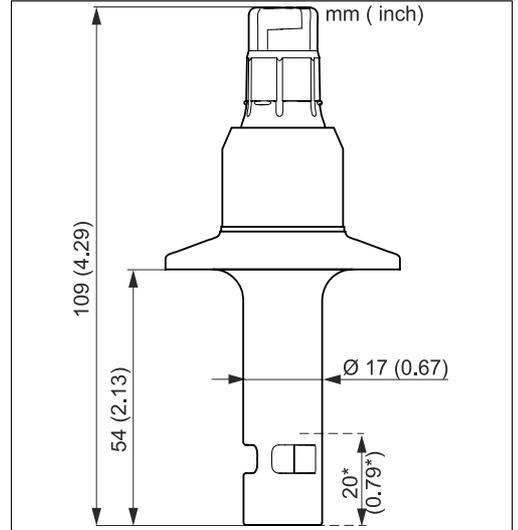
Dimensions of Varivent connection, plug-in head version  
\*minimum immersion depth

**Dimensions of CLS16D**

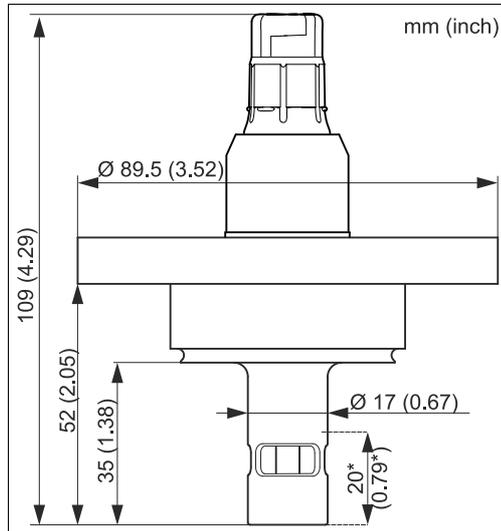


Design

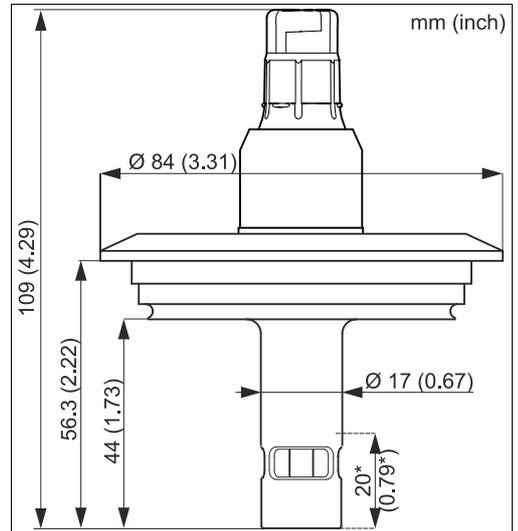
- 1 Memosens plug-in head
- 2 Process connection (clamp, Varivent, BioControl)
- 3 Coaxial measuring electrode, electro-polished stainless steel 1.4435 (AISI 316 L)
- 4 Minimum immersion depth



Dimensions of clamp connection  
\*minimum immersion depth



Dimensions of BioControl connection  
\*minimum immersion depth



Dimensions of Varivent connection  
\*minimum immersion depth

**Weight**

Depending on version, approx. 0.13 to 0.75 kg (0.3 to 1.7 lb.)

**Material**

Electrodes: electro-polished, stainless steel 1.4435 (AISI 316L)  
Seal: molded seal ISOLAST (FFKM), listed with FDA

**Surface roughness**

$R_a \leq 0.8 \mu\text{m}$ , electro-polished  
 $R_a \leq 0.4 \mu\text{m}$ , electro-polished, optional

**Process connections**

Clamp 1", 1½", 2" acc. to ISO 2852 (also suitable for TRI-CLAMP, DIN 32676)  
Tuchenhagen VARIVENT N DN 50 to 125  
NEUMO BioControl D50

**Clamp connection:**

Sensors with clamp connections can be fixed using sheet metal brackets or solid brackets. Sheet metal brackets have a lower dimensional stability, uneven bearing surfaces causing point loads and sometimes sharp edges that can damage the clamp. We strongly recommend to always use solid brackets because of their higher dimensional stability. Solid brackets may be applied over the total pressure-temperature range (see temperature-pressure load curve).

## Certificates and approvals

<b>Ex approval</b>	<p><b>CLS16</b></p> <ul style="list-style-type: none"> <li>■ ATEX II 1G Ex ia IIC T3 / T4 / T6</li> <li>■ FM/CSA IS/NI CL I Div. 1 &amp; 2 GP A - D in combination with the Liquiline CM42 and Mycom CLM153 transmitters</li> </ul> <p><b>CLS16D-**G</b></p> <ul style="list-style-type: none"> <li>■ ATEX /NEPSI II 1G Ex ia IIC T3 / T4 / T6, IECEx Ex ia IIC T6 Ga</li> </ul> <p><b>CLS16D-**O</b></p> <ul style="list-style-type: none"> <li>■ FM/CSA IS/NI CL I Div. 1 &amp; 2 GP A - D in combination with the Liquiline CM42 transmitter</li> </ul> <p><b>CLS16D-**V</b></p> <ul style="list-style-type: none"> <li>■ ATEX/NEPSI II 3G Ex nL IIC T3 / T4 / T6 for the use in Zone 2 with transmitter Liquiline CM42-KV***</li> </ul> <p> ATEX and FM/CSA versions of digital sensors with Memosens technology are indicated by an orange-red ring in the plug-in head.</p>
<b>EHEDG</b>	<p>Certified according to EHEDG Document 8</p> <p>Validated for:</p> <ul style="list-style-type: none"> <li>■ sterilizability according to EHEDG Document 5</li> <li>■ cleanability according to EHEDG Document 2</li> <li>■ bacteria tightness according to EHEDG Document 7</li> </ul>
<b>FDA</b>	All materials in contact with medium are listed with FDA.
<b>Quality certificate</b>	With statement of the individual cell constant
<b>Biological reactivity test (USP Class VI, optional)</b>	Certificate on biological reactivity test according to USP (United States Pharmacopeia) Part <87> and Part <88> Class VI with lot traceability of the materials in contact with medium
<b>Inspection certificate acc. to EN 10204-3.1 (optional)</b>	Available for all process connections
<b>ASME BPE-2002</b>	Designed according to ASME BPE-2002 criteria (American Society of Mechanical Engineers)

## Ordering information

<b>Product pages</b>	<p><a href="http://www.products.endress.com/cls16">www.products.endress.com/cls16</a>  <a href="http://www.products.endress.com/cls16d">www.products.endress.com/cls16d</a></p>
<b>Product configurator</b>	<ol style="list-style-type: none"> <li>You can choose from the following options on the product page located on the right: <div data-bbox="464 1563 807 1733" data-label="Image"> </div> </li> <li>Click "Configure this product".</li> <li>The configurator opens in a separate window. You can now configure your device and receive the complete order code that applies for the device.</li> <li>Afterwards, export the order code as a PDF or Excel file. To do so, click the appropriate button at the top of the page.</li> </ol>

**Product structure CLS16**

**i** The following product structure represents the status of printing. You can create a complete and valid order code on the Internet using the configurator tool.

Process connection and materials	
3C	Clamp ISO 2852 1", stainless steel 1.4435 (AISI 316L)
3D	Clamp ISO 2852 1½", stainless steel 1.4435 (AISI 316L)
3E	Clamp ISO 2852 2", stainless steel 1.4435 (AISI 316L)
3F	Varivent N DN 50 to 125
3G	Neumo BioControl D50
4C	Clamp ISO 2852 1", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4D	Clamp ISO 2852 1½", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4E	Clamp ISO 2852 2", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4F	Varivent N DN 50 to 125, with inspection certificate acc. to EN 10204-3.1
4G	Neumo BioControl D50, with inspection certificate acc. to EN 10204-3.1
Measuring cable connection	
1	with TOP68, without cable
2	with 5 m (15 ft) fixed cable
3	with 10 m (30 ft) fixed cable
Temperature sensor	
A	Integrated Pt 100 temperature sensor
B	Integrated Pt 1000 temperature sensor
Additional option	
1P	Basic version
1R	Ra < 0.4 µm with inspection certificate acc. to EN 10204-3.1
1S	Certificate on biological reactivity test acc. to USP Class VI and Ra < 0.4 µm with inspection certificate acc. to EN 10204-3.1
1U	Certificate on biological reactivity test acc. to USP Class VI
CLS16-	<b>complete order code</b>

**Product structure CLS16D**

Process connection and materials	
3C	Clamp ISO 2852 1", stainless steel 1.4435 (AISI 316L)
3D	Clamp ISO 2852 1½", stainless steel 1.4435 (AISI 316L)
3E	Clamp ISO 2852 2", stainless steel 1.4435 (AISI 316L)
3F	Varivent N DN 50 to 125
3G	Neumo BioControl D50
4C	Clamp ISO 2852 1", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4D	Clamp ISO 2852 1½", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4E	Clamp ISO 2852 2", stainless steel 1.4435 (AISI 316L), with inspection certificate acc. to EN 10204-3.1
4F	Varivent N DN 50 to 125, with inspection certificate acc. to EN 10204-3.1
4G	Neumo BioControl D50, with inspection certificate acc. to EN 10204-3.1
Additional option	
1P	Basic version
1R	Ra < 0.4 µm with inspection certificate acc. to EN 10204-3.1
1S	Certificate on biological reactivity test acc. to USP Class VI and Ra < 0.4 µm with inspection certificate acc. to EN 10204-3.1
1U	Certificate on biological reactivity test acc. to USP Class VI
Approval	
G	ATEX/NEPSI II 1G Ex ia IIC T3/T4/T6 Ga, IECEx Ex ia IIC T6 Ga
O	FM/CSA IS/NI Cl I Div. 1 & 2 GP A - D
1	Non-hazardous areas
CLS16D-	<b>complete order code</b>

## Accessories

-  In the following sections, you find the accessories available at the time of issue of this documentation. For information on accessories that are not listed here, please contact your local service or sales center.

### Connection

#### Measuring cables

CYK71 measuring cable

- Non-terminated cable for the connection of sensors (e.g. conductivity sensors) or the extension of sensor cables
- Sold by the meter, order numbers:
  - non-Ex version, black: 50085333
  - Ex version, blue: 50085673

CYK10 Memosens data cable

- For digital sensors with Memosens technology  
pH, redox, oxygen (amperometric), chlorine, conductivity (conductive)
- Ordering as per product structure (-> online Configurator, [www.products.endress.com/cyk10](http://www.products.endress.com/cyk10))

CYK11 Memosens data cable

- Extension cable for digital sensors with Memosens protocol
- Ordering as per product structure (-> Online configurator, [www.products.endress.com/cyk11](http://www.products.endress.com/cyk11))

#### Junction box

Junction box VBM

- For cable extension
- 10 terminals
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"
- Material: aluminum
- Ingress protection: IP 65 (≅ NEMA 4X)
- Order numbers:
  - cable entries Pg 13.5: 50003987
  - cable entries NPT ½": 51500177

Junction box VBM-Ex

- For cable extension in hazardous areas
- 10 terminals (blue)
- Cable entries: 2 x Pg 13.5
- Material: aluminum
- Ingress protection: IP 65 (≅ NEMA 4X)
- Order no.: 50003991

### Calibration solutions

Precision solutions referred to SRM (Standard Reference Material) of NIST for qualified calibration of conductivity measuring systems according to ISO, with temperature table,

- CLY11-A  
74 µS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz);  
Order no. 50081902
- CLY11-B  
149.6 µS/cm (reference temperature 25 °C (77°F)), 500 ml (16.9 fl.oz);  
Order no. 50081903

### Sensor regeneration

- Factory replacement of seals and factory recalibration of sensors;  
order no. 51505585

**Calibration sets**

Conducal CLY421

- Conductivity calibration set for ultrapure water applications
- Complete, factory-calibrated measuring set with certificate, traceable to SRM of NIST and DKD
- For comparative measurement in ultrapure water applications up to max. 20  $\mu\text{S}/\text{cm}$
- Product page: [www.products.endress.com/cly421](http://www.products.endress.com/cly421)
- Technical Information TI00496C/07/EN

Recalibration

- Depending on its operating hours and conditions ConduCal has to be recalibrated at the factory at regular intervals.
- Recommended recalibration interval: 1 year

## Instruments International

Endress+Hauser  
Instruments International AG  
Kaegenstrasse 2  
4153 Reinach  
Switzerland

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[www.endress.com](http://www.endress.com)  
[info@ii.endress.com](mailto:info@ii.endress.com)

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People for Process Automation