



Level



Pressure



Flow



Temperature

Liquid  
Analysis

Registration

Systems  
Components

Services



Solutions

## Technical Information

# Condumax CLS16 and CLS16D

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



74-03



### 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 CM42
- 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
- 3-A certificate
- 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

TI227C/07/EN/04.10  
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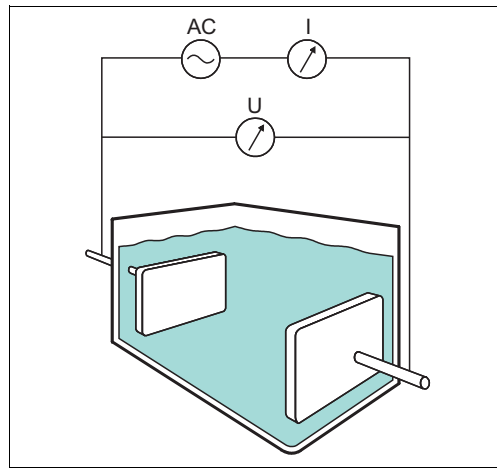
Endress+Hauser

People for Process Automation

## 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

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).

### Important properties CLS16D

#### Maximum process safety

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.

#### Data safety through digital data transfer

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.

### **Easy handling**

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.

### **Communication with the transmitter**

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

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### **Data storage of CLS16D**

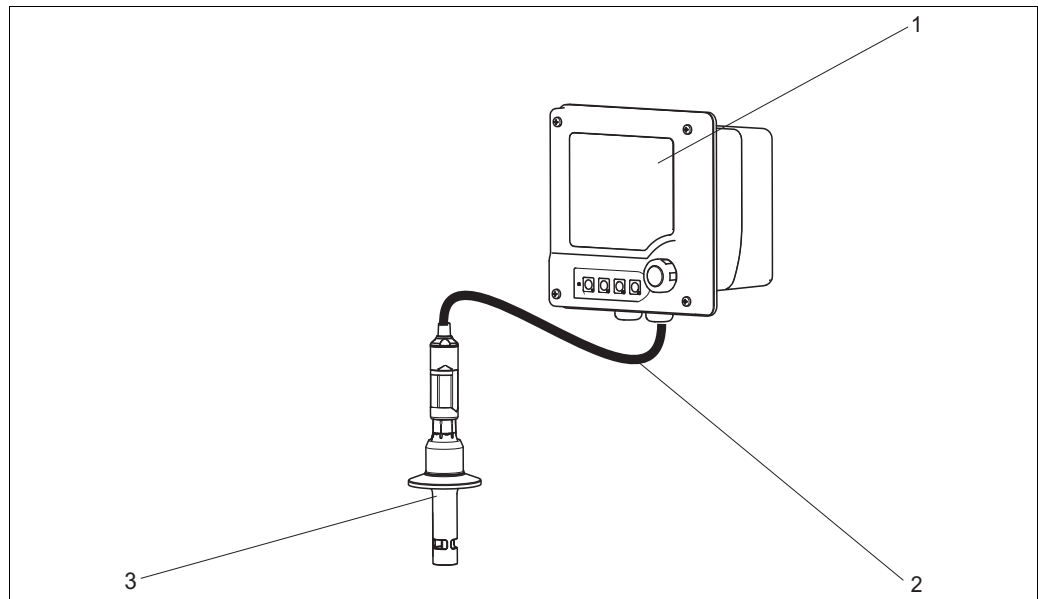
Digital sensors are able to store the following system data in the sensor:

- 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

**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**

**Measured values**

Conductivity  
Temperature

**Cell constant k**

$k = 0.1 \text{ cm}^{-1}$

**Measuring ranges**

Conductivity measurement (referenced to water at 25 °C (77 °F))  
 0.04  $\mu\text{S}/\text{cm}$  to 500  $\mu\text{S}/\text{cm}$   
 in the following temperature range  
 CLS16: -5 to 150 °C (23 to 302 °F)  
 CLS16D: -5 to 100 °C (23 to 212 °F)  
 (spec. measuring accuracy up to 100 °C (212 °F), communication up to 130 °C (266 °F))

Temperature measurement  
 CLS16: -5 to 150 °C (23 to 302 °F)  
 CLS16D: -5 to 100 °C (23 to 212 °F)  
 (spec. measuring accuracy up to 100 °C (212 °F), communication up to 130 °C (266 °F))

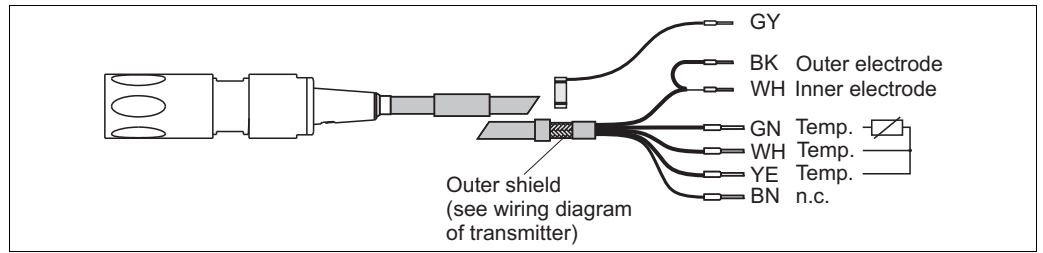
**Temperature compensation**

CLS16: Pt 100, Pt 1000 Class A  
 CLS16D: NTC

**Cable specification**

**CLS16**

CLS16 is connected to the transmitter using the CPK9 measuring cable (see Accessories) or the fixed cable.

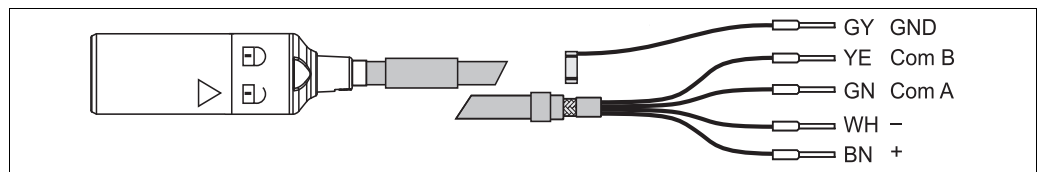


*CPK9 measuring cable or fixed cable*

a0005301-en

**CLS16D**

CLS16D is connected to the transmitter using the Memosens data cable CYK10.



*CYK10 Memosens data cable*

a0003350

**Performance characteristics**

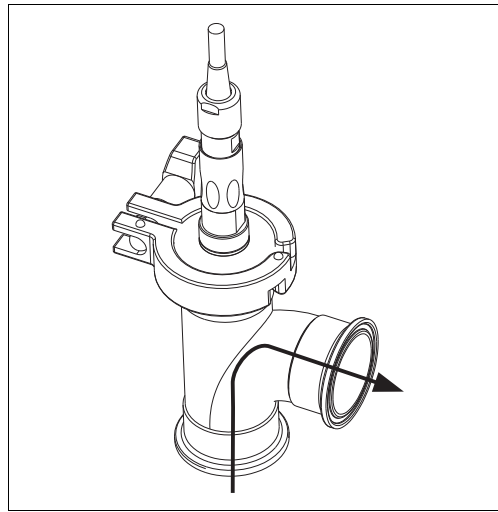
**Measured error**

Each individual sensor is factory-measured in a solution of approx. 5 µS/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 %.

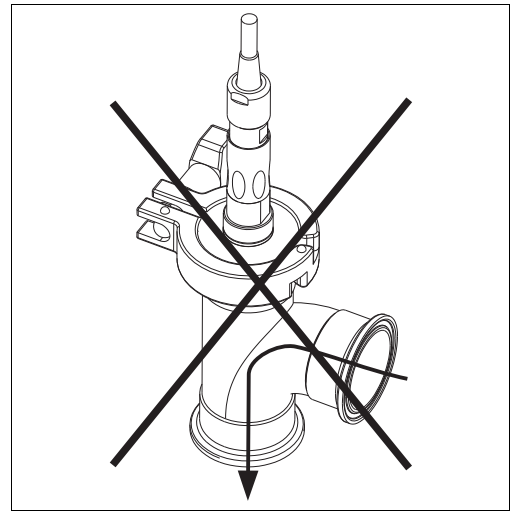
## Installation

### Installation instructions

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



Non-permissible flow direction

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 CO<sub>2</sub>, may increase conductivity by up to 3 μS/cm.

## Environment

### Ingress protection

CLS16	
Fixed cable:	IP 67 (≅ NEMA 6)
TOP68 plug-in system:	IP 68 (≅ NEMA 6)
CLS16D:	IP 68 (≅ NEMA 6)

## Process

### Process temperature

Normal operation:	-5 to 120 °C (23 to 248 °F)
Sterilization (max. 45 min):	max. 150 °C @ 5 bar (302 °F @ 72.5 psi)

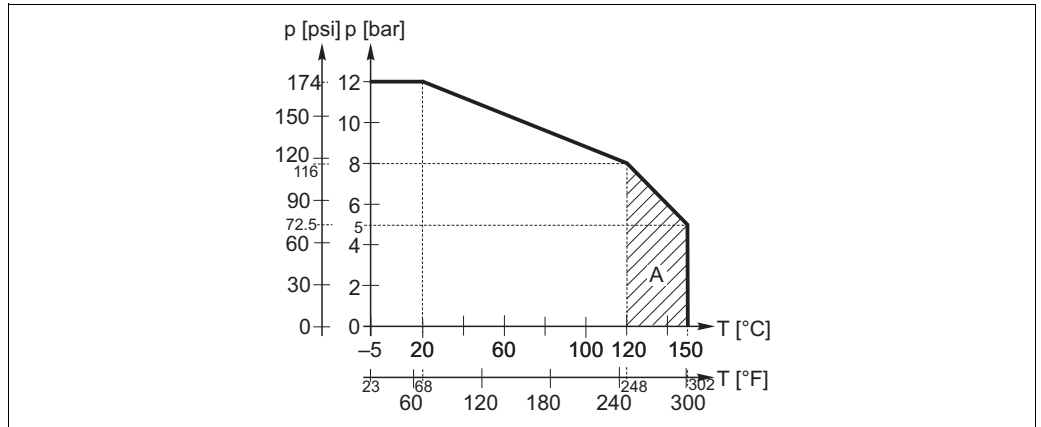
#### Note!

For CLS16D, the maximum temperature for communication with the transmitter is 130 °C (266 °F).

### Process pressure

12 bar @ 20 °C (174 psi @ 68 °F)
8 bar @ 120 °C (116 psi @ 248 °F)
0.1 bar abs. @ 20 °C (1.5 psi abs. @ 68 °F) (underpressure)

**Pressure/temperature load curve**

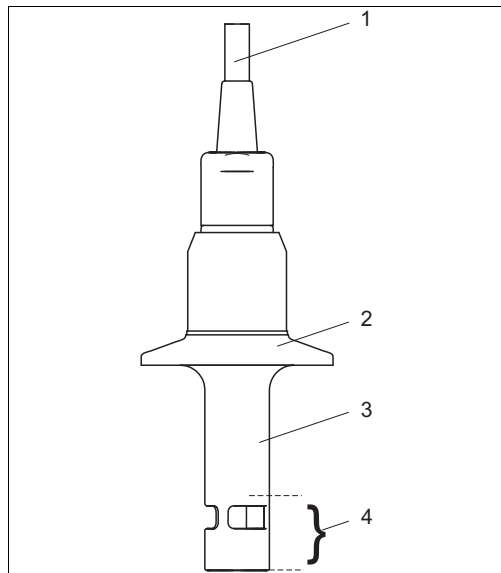


Mechanical pressure-temperature stability of the sensor

A short-time sterilizable (45 min)

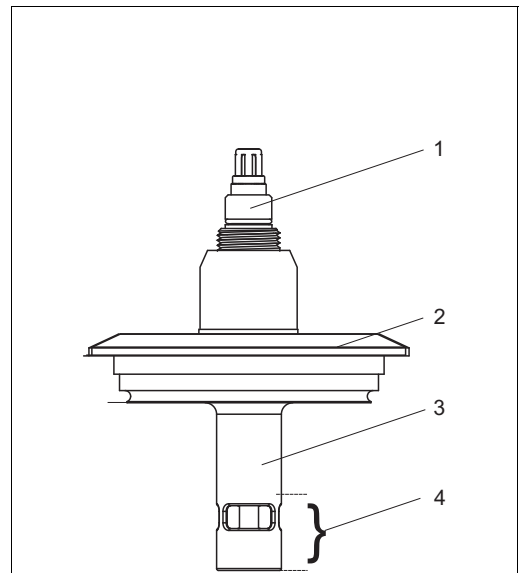
**Mechanical construction**

**Design, dimensions**



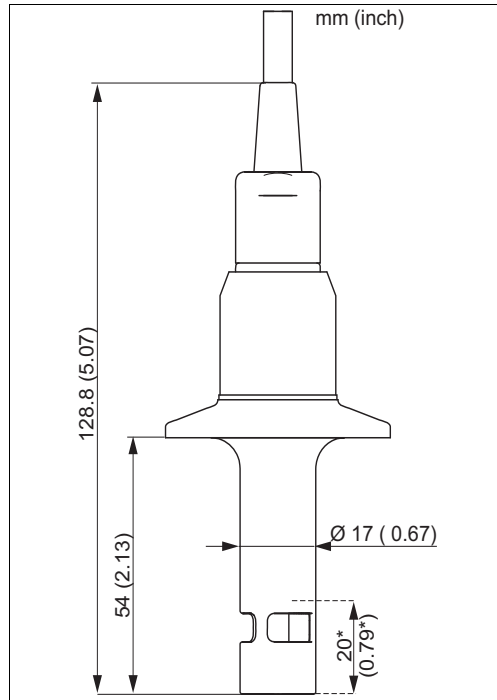
Fixed-cable version

- 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

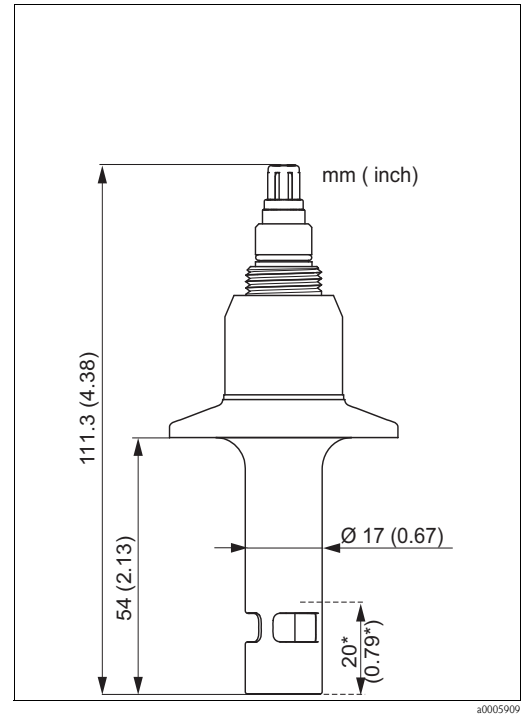


Plug-in head version

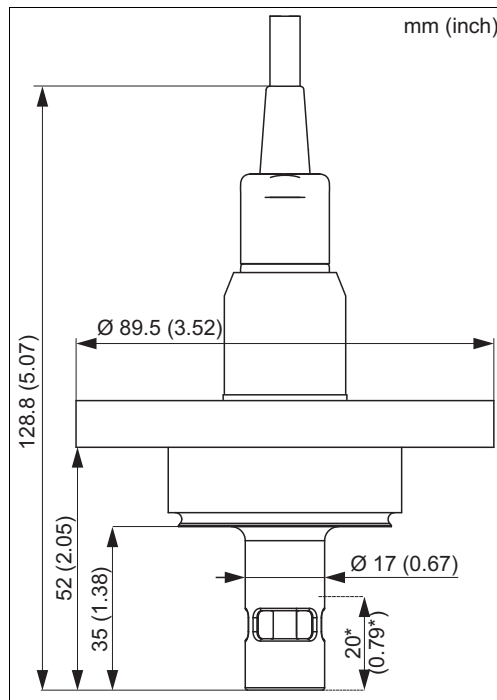
- 1 TOP68 plug-in head
- 2 Process connection (clamp, Varivent, BioControl)
- 3 Coaxial measuring electrode made of electro-polished, stainless steel 1.4435 (AISI 316L)
- 4 Minimum immersion depth



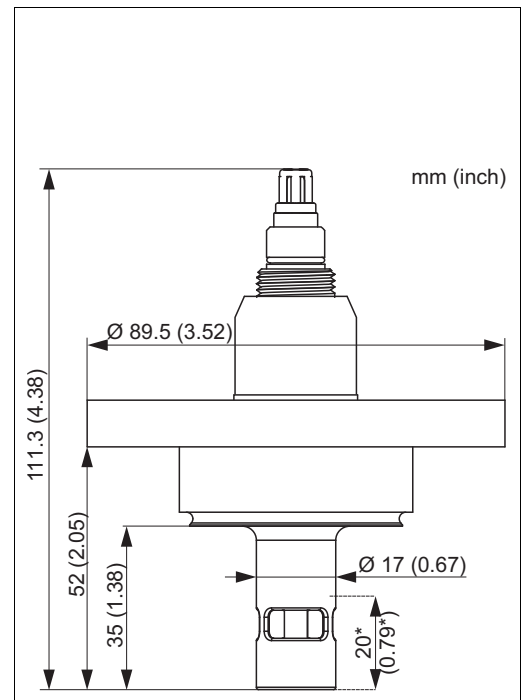
Dimensions of clamp connection, fixed-cable version  
\*minimum immersion depth



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

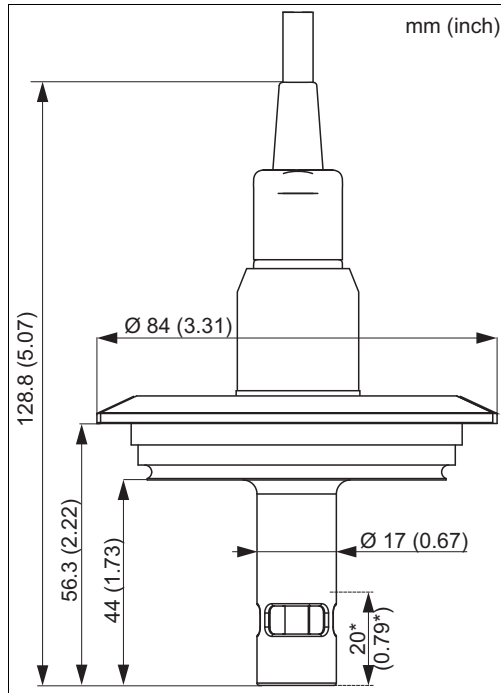


Dimensions of BioControl connection, fixed-cable version  
\*minimum immersion depth

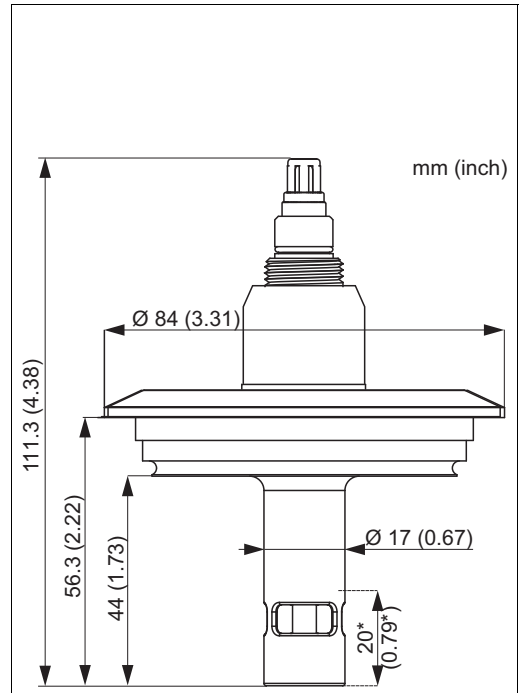


Dimensions of BioControl connection, plug-in head version  
\*minimum immersion depth



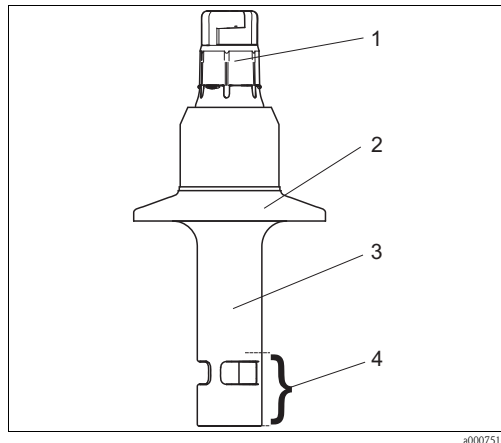


Dimensions of Varivent connection, fixed-cable version  
\*minimum immersion depth



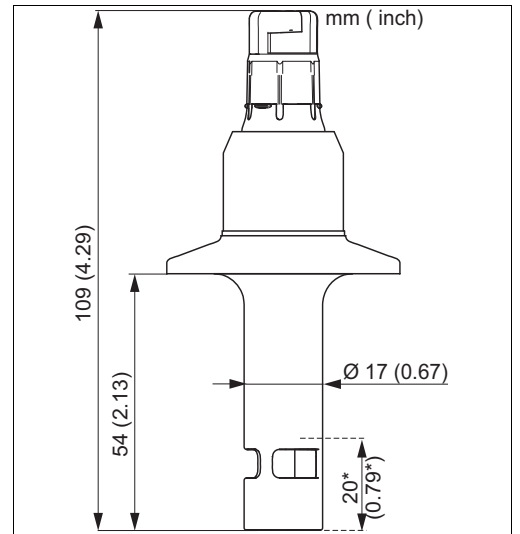
Dimensions of Varivent connection, plug-in head version  
\*minimum immersion depth

**Design, dimensions CLS16D**

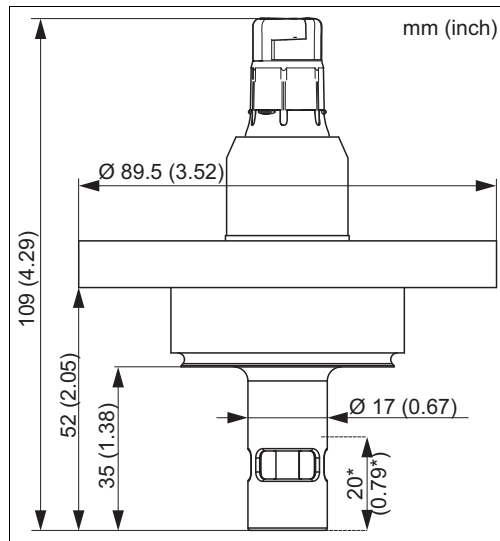


Design

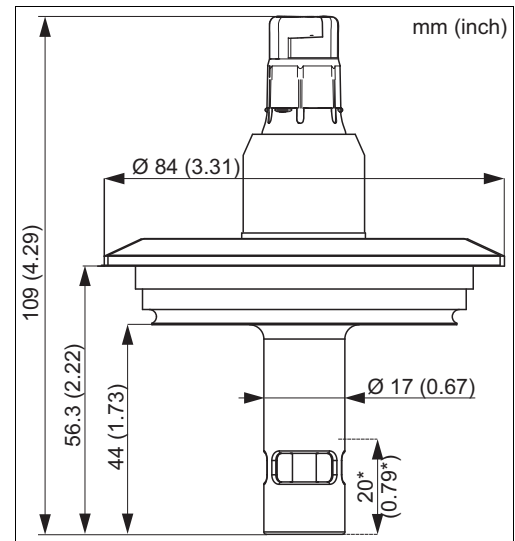
- 1 Memosens plug-in head
- 2 Process connection (clamp, Varivent, BioControl)
- 3 Coaxial measuring electrode, electro-polished stainless steel 1.4435 (AISI 316 L)
- 4 Minimum immersion depth



Dimensions of clamp connection  
\*minimum immersion depth



Dimensions of BioControl connection



Dimensions of Varivent connection

**Weight**

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

**Materials in contact with medium**

 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 connection**

 Clamp 1", 1½", 2" according to ISO 2852 (also suitable for TriClamp®, DIN 32676)  
 Tuchenhagen Varivent® N DN 50 to 125  
 Neumo BioControl® D50

## Maintenance

**Checking the sensors**

Intact seals are a prerequisite for safe and accurate measurement.

To ensure highest operational reliability and complete hygiene of the sensor according to 3-A Standard 74-, the seal should be replaced at regular intervals.

The actual maintenance intervals can only be determined by the operator since they strongly depend on the operating conditions such as:

- type and temperature of the medium
- type and temperature of the cleaning solution
- number of cleanings
- number of sterilizations
- ambient conditions

**Recommended intervals for seal replacement**

Application	Seal replacement (recommended interval)
Medium temperature between 50 to 100 °C (122 to 212 °F)	approx. every 18 months
Medium temperature below 50 °C (122 °F)	approx. every 36 months
Sterilization cycles, max. 145 °C (293 °F), 30 min	approx. 400 cycles

**Replacement of seals and recalibration**

If the sensor is exposed to very high loads, you can have it regenerated at the Endress+Hauser Service (see Accessories). Regeneration includes replacement of seals and recalibration of the sensor. Send the sensor to the responsible Endress+Hauser sales center.

**Cleaning the sensors**

To ensure accurate measurement, clean the sensor regularly:

- Use appropriate cleaning solutions (e.g. Isopropanol) to remove light soilings and coatings of the sensor parts in contact with medium.
- After cleaning the sensor, rinse it with distilled or ultrapure water. Remnants of cleaning solutions might distort the measurement.

**Certificates and approvals**

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**Ex approval**

- ATEX II 1G Ex ia IIC T3 / T4 / T6
- NEPSI Ex ia IIC T3 / T4 / T6 (CLS16D)
- FM/CSA IS/NI CL I Div. 1 & 2 GP A - D in combination with the Liquiline CM42 and Mycom CLM153 transmitters (CLS16)

for all product versions listed in the product structure (see Ordering Information)

**Note!**

Ex versions of digital sensors with Memosens technology are indicated by an orange-red ring in the plug-in head.

**EHEDG**

Certified according to EHEDG Document 8

Validated for:

- sterilizability according to EHEDG Document 5
- cleanability according to EHEDG Document 2
- bacteria tightness according to EHEDG Document 7

**3-A**

Certified according to 3-A Standard Number 74-

**FDA**

All materials in contact with medium are listed with FDA.

**Quality certificate**

With statement of the individual cell constant

**Biological reactivity test (USP Class VI, optional)**

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

**Inspection certificate acc. to EN 10204-3.1 (optional)**

Available for all process connections

**ASME BPE-2002**

Designed according to ASME BPE-2002 criteria (American Society of Mechanical Engineers)

## Ordering information

### Product structure CLS16

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		
O	FM/CSA IS/NI Cl I Div. 1 & 2 GP A - D		
1	Non-hazardous areas		
CLS16D-			<b>complete order code</b>

## Accessories

### Connection

#### Measuring cables

CPK9 special measuring cable

- For sensors with TOP68 plug-in head, for high-temperature and high-pressure applications, IP 68
- Ordering acc. to product structure, see Technical Information (TI118C/07/en)

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: 51506616

CYK10 Memosens data cable

- For digital sensors with Memosens technology
- Ordering according to product structure, see below

Certificates	
A	Standard, non-Ex
G	ATEX II 1G Ex ia IIC T6/T4/T3, FM/CSA IS/NI Cl I DIV 1&2 GP A-D
L	LABS free, non-Ex
O	FM IS/NI Cl I DIV 1&2 GP A-D
S	CSA IS/NI Cl I DIV 1&2 GP A-D
T	TIIS
V	ATEX/NEPSI II 3G Ex nL IIC
Cable length	
03	Cable length: 3 m (9.8 ft)
05	Cable length: 5 m (16 ft)
10	Cable length: 10 m (33 ft)
15	Cable length: 15 m (49 ft)
20	Cable length: 20 m (66 ft)
25	Cable length: 25 m (82 ft)
88	... m length
89	... ft length
Ready-made	
1	Wire terminals
2	M12 plug
<b>CYK10-</b>	complete order code

CYK81 measuring cable

- Non-terminated measuring cable for extension of sensor cables of e.g. Memosens sensors, CUS31/CUS41
- 2 wires, twisted pair with shield and PVC-sheath (2 x 2 x 0.5 mm<sup>2</sup> + shield)
- Sold by the meter, order no.: 51502543

#### Junction box

Junction box VBM

- For cable extension
- 10 terminals
- Cable entries: 2 x Pg 13.5 or 2 x NPT 1/2"
- Material: aluminum
- Ingress protection: IP 65 (≅ NEMA 4X)
- Order numbers:
  - cable entries Pg 13.5: 50003987
  - cable entries NPT 1/2": 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

- Junction box RM
- For cable extension (e.g. for Memosens sensors)
  - 5 terminals
  - Cable entries: 2 x Pg 13.5
  - Material: PC
  - Ingress protection: IP 65
  - Order no.: 51500832

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**Transmitters**

- Liquiline CM42 (for analog conductivity sensors and digital conductivity sensors with Memosens technology)
- Modular two-wire transmitter for Ex and non-Ex areas
  - Hart®, PROFIBUS or FOUNDATION Fieldbus available
  - Ordering acc. to product structure, see Technical Information (TI381C/07/en)
- Liquisys CLM223/253 (for analog conductivity sensors)
- Transmitter for conductivity, field or panel-mounted housing,
  - Hart® or PROFIBUS available
  - Ordering acc. to product structure, see Technical Information (TI193C/07/en)
- Mycom CLM153 (for analog conductivity sensors)
- Transmitter for conductivity, one or two channel version, Ex or Non-Ex,
  - Hart® or PROFIBUS available
  - Ordering acc. to product structure, see Technical Information (TI234C/07/en)

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**Sensor regeneration**

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

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**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

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**Calibration sets**

- Concal calibration set
- 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. 10 µS/cm
- Recalibration Concal
- factory recalibration and new issue of calibration certificate, traceable to SRM of NIST and DKD
  - factory calibration procedure according to ASTM D-5391-93
  - order no. 51502486



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## Instruments International

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