

Our Ref: B070320/nc/40/240726

Your Ref: EPA Licence P0358-01

Environmental Protection Agency (EPA),
Johnstown Castle Estate,
Co. Wexford,
Y35 W821.

24 July 2026

BY EMAIL

To whom it may concern,

SUBJECT: WOODFAB CONCEPT DESIGN POLLUTION MONITORING SYSTEM – TECHNICAL DETAILS

This Technical Note (TN) is intended to provide additional details on the real-time pollution monitoring system that has been proposed as part of the Detailed Drainage Design for the Woodfab Timber Ltd ("Woodfab") site and is to be submitted to the Environmental Protection Agency (EPA) for review and agreement.

Tetra Tech (TT) have significant experience in designing and overseeing the installation of pollution monitoring systems for wastewater and industrial sites. Based on this experience and our understanding of the site we have recommended that the Endress and Hauser monitoring system¹ or equivalent be installed.

Figure 1 and Figure 2 are provided as a real-world example of this monitoring system which has been designed and installed at a wastewater treatment site by TT.



Figure 1 – Example monitoring sensors



Figure 2 – Example monitoring enclosure

¹ [Monitoring systems for municipal wastewater treatment plants | Endress+Hauser](#)

TT have undertaken a detailed review of the required monitoring needs and have recommended this system based on the following:

- Continuous, reliable detection of changes in water quality that indicate pollution events – The proposed system offers a range of available sensors to choose from as evidenced in Figure 1. By combining specific sensors, this ensures it can be designed and calibrated to reliably, and continuously, monitor established parameters based on the target chemical(s) used on site.
- Hardware designed for harsh, outdoor and wet environments – The recommended system is to have instruments housed in a weatherproof, UV resistant enclosure rated for outdoor environments. Depending on requirements, this system can also be fitted with a sensor cleaning system, wipers and other technologies to reduce maintenance frequency and improve data quality.
- Robust data handling and remote monitoring – The systems devices support standard industrial outputs enabling straightforward integration with existing monitoring/alert systems on site. Its compatibility with remote monitoring platforms allows operators to view data, receive alarms and manage devices off-site ensuring real-time alerts can be received outside of working hours. Storage of historical data also helps support analysis of long-term trends and show regulatory compliance.
- Low maintenance overheads – The design of the system including appropriate enclosure, automatic cleaning technologies and diagnostic capabilities reduces the need for maintenance field visits and frequency of replacement of damaged parts therefore lowering the overall lifecycle costs.
- Endress and Hauser, as a global leader in process and laboratory measurement technology have decades of experience in designing and delivering reliable monitoring systems. This includes the monitoring of surface water for a variety of clients and needs. Appendix A provides a case study example of real-time surface water monitoring installed on the River Baltschieder in Switzerland.

Tanalith E Chemical Composition Review:

A review of the Tanalith E 8000, Tanagard 3755 and Tanatone 3999 composition ingredients was first undertaken to narrow down the potential list of parameters that could be measured by the proposed monitoring system (Refer to Appendix A for relevant Chemical Safety Data Sheets).

There are a number of notable ingredients found within Tanalith E 8000 (e.g. 2-Aminoethanol, Copper Carbonate, Organic Acid and Cationic Surfactant), Tanagard 3755 (e.g. OIT and Copper Nitrate), and Tanatone 3999 (e.g. Azo dyestuff). The potential physico-chemical impacts that these are most likely to cause should they be released in concentrated volumes to surface water are:

- Immediate depletion of Dissolved Oxygen (DO) – Due to organic chemicals found in all three:
 - o Polluting discharges rich in organic matter or chemicals will consume oxygen and reduce DO; low DO is a principal metric for ecological harm;
 - o Continuous DO monitoring detects progressive oxygen depletion and acute events that can cause ecological impact and regulatory noncompliance.
- Immediate and significant spike in Conductivity – Due to dissolved copper salts and/or other ionic components found in all three:
 - o Conductivity measures the water's ability to conduct electrical current, which correlates with dissolved ionic content (e.g. Copper);

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- Conductivity is a robust and reliable monitoring parameter which responds quickly to concentration changes making it an excellent early-warning parameter for pollution affecting surface water near discharge points and receiving bodies.
- Immediate and significant localised spike or decrease in pH - Based on high pH level of Tanalith E, and lowered pH levels of Tanagard and Tanatone:
 - Changes in pH within surface water can be dependent on the scale of the spill and low levels of contamination may not be detected by pH alone. Increases the importance of a multi-detection approach.
- Rapid increase in heavy metal toxicity – Due to presence of Copper Carbonate/nitrate in Tanalith E and Tanagard:
 - Electrochemical stripping or Voltammetry sensors are commonly used to monitor for the presence of heavy metals down to trace levels.

Other potential impacts that should be considered further are:

- Spike in Total Organic Carbon (TOC)
- Increase in UV absorption
- Decrease in Oxidation-Reduction Potential (ORP)

The above list establishes a preliminary range of parameters that can be tested to ensure the most reliable monitoring sensors are included as part of the proposed monitoring system.

Baseline Environmental Data Review:

Environmental monitoring at Woodfab was undertaken by TT between January 2025 and January 2026 and included Surface Water, Ground Water and Soil sampling across the site.

To better establish the suitability of the preliminary monitoring parameters identified, a review of the existing screened water and soil sampling data was undertaken. This included assessing the baseline environmental levels of those parameters identified, with particular focus on those samples taken at:

- SW2 and SWA, i.e. surface water discharges from the catchment where existing treatment activities occur);
- SW12 and SW14, i.e. surface water discharges from the catchment where the 2024 spill event occurred; and,
- SS08 and SS119 – SS128, i.e. Soil sample taken in the vicinity of where the 2024 spill event occurred.

This review found a number of notable findings in respect to the potential monitoring parameters including:

- DO levels within surface water were fairly consistent across samples when measured, however these were above guideline values;

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- Limited fluctuation was noted in Conductivity across surface water samples, however, for the identified sampling locations the conductivity levels remained below guideline values;
- pH levels in all surface water samples remained within a consistent range at all sampling locations noted above, and within guideline values;
- There were no significant levels of Copper detected within any surface water samples, this is not unexpected given the low solubility of Copper. It was noted that other heavy metals were present in elevated level (e.g. Arsenic, Iron and Manganese) which will need to be accounted for when establishing monitoring parameters;
- In soil samples with elevated levels of Propiconazole and Tebuconazole, there was a notable correlation in elevated levels of Copper which would be expected given Copper Carbonate is known to easily accumulate within soils; and,
- TOC levels were fairly consistent across surface water and soil samples when measured, and remained within guideline values.

Following a review of the existing surface water and soil screening results, it was determined that the preliminary monitoring parameters established have suitable potential given the consistent baseline values detected across surface water samples.

Whilst the impact of additional heavy metals found within surface water samples will need to be examined in detail when conducting jar testing, the potential remains for a significant spike in Copper within surface water that could well exceed the baseline environmental levels of these other heavy metals. Therefore, those monitoring parameters linked to the presence of heavy metals should remain on the list.

Proposed Sampling and Jar Testing:

To establish the final monitoring parameters and allow for the installation of the proposed monitoring system, raw water samples are to be taken at SW2 and used for jar testing.

Given the significant alterations to the surface water regime expected as a result of the detailed drainage design works, it was determined that raw water samples should only be taken:

- Once the existing tanks at SW2 have been fully desludged and cleaned out;
- Once drainage upgrades up-stream of SW2 have been completed; and,
- Following the second heavy storm event that occurs post-construction of the up-stream network upgrades.

This is necessary to ensure the raw water samples accurately represent the new baseline surface water environment following remediation and drainage upgrade works. This also allows for any debris or material associated with these construction works to be flushed out of the system before samples are taken.

Once raw water samples have been collected, jar testing will be undertaken as follows:

- A raw water sample will be analysed to confirm the baseline levels for the identified parameters;

- Samples of Tanalith E, Tanagard and Tanatone used within the treatment process on site will be analysed to determine the significance of effect this may have on the identified parameters, this will help reaffirm their suitability;
- Raw water samples will be dosed with Tanalith E, Tanagard and Tanatone chemicals individually and in varying, progressively larger doses. These will then be analysed to determine the impact these concentrations have on the identified parameters;
- The outputs of this analysis will be assessed alongside the established environmental guideline values for all parameters to determine the suitable trigger levels for each. Activation of the shut-down alarm can then be configured based on multiple trigger levels being exceeded concurrently, which is indicative a pollution event.

Proposed Monitoring System:

Preliminary discussions are currently underway with Endress and Hauser to confirm the viability of the proposed parameters and to compile more detailed information on the proposed sensors and monitoring system that would be installed.

Endress and Hauser have provided technical specifications relating to the most suitable sensors that would be installed to measure DO, conductivity and pH (refer to Appendix B). These sensors would be connected to a transmitter (refer to Appendix B) that integrates into the existing operation systems. This will then be configured to allow for the automatic closure of the proposed penstock at the lagoon outfall in the event that sensor limit exceedances indicate a pollution event may have occurred.

Should you wish to discuss any aspects of this TN further, please do not hesitate to contact the undersigned.

Yours sincerely



Niamh Cassidy

Principal Engineer

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APPENDIX A – SURFACE WATER MONITORING CASE STUDY

Monitoring surface water

Netilion Smart System in the municipality of Baltschieder



The municipality of Baltschieder lies adjacent to the municipality of Visp in the northeast of the Swiss canton of Valais. The village currently has a population of 1,200. The centre of the village is located at the end of the Baltschieder valley with its eponymous River Baltschieder.

"We opted to use the new Smart System for surface water for the purpose of temporarily recording analytical measured values for the River Baltschieder. The system records key analytical parameters for us. Its main advantage is that the measured values are continuously transmitted to the Netilion Cloud and can be called up easily from a workstation."

Philipp Kalbermatten
Municipality of Baltschieder
Dorfplatz, Baltschieder, Switzerland



Philipp Kalbermatten



Measuring water quality in the River Baltschieder

Recording pH, conductivity, turbidity and temperature in a reliable manner means that the surface water of the River Baltschieder can be analyzed for the purpose of ensuring that any contamination is detected and tracked.

The challenge facing the customer

Up until now, the municipality of Baltschieder has not had access to consistent information on certain parameters relating to the water quality of the River Baltschieder. This meant that contamination or natural effects were not detected and dealt with in a timely manner. What was needed was a reliable monitoring system that required little effort to install and maintain.

Our solution

The Netilion Smart System for surface water ensures reliable detection of the quality parameters required by the municipality:

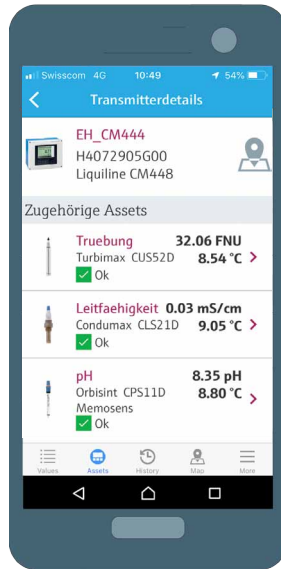
- **Turbidity:** The smart Turbimax CUS52D sensor measures turbidity with laboratory-grade accuracy and enables low-maintenance operation.
- **Conductivity:** The Condumax CLS21D is a robust and accurate conductivity sensor for all process and environmental applications.
- **pH:** The Orbisint CPS11D is the digital all-rounder for process and environmental technology. This durable device provides reliable measurements and requires little maintenance.
- The multi-channel Liquiline CM444 transmitter collects the measurement information.
- The Modbus Edge Device transmits the measured data to the Netilion Cloud.
- A smartphone application delivers the measurement, diagnostic and alarm information directly into the hands of the customer.

Result

The result is that the measured variables from the River Baltschieder are continuously recorded at 15-minute intervals and displayed online to municipal employees on their smartphones. Instrument status information provides indications regarding maintenance requirements and underlines the reliability of the measured values displayed. To analyze the data, the measured values can be downloaded from the Netilion Cloud using the CSV Export function, and documented.

Features and benefits

- Continuous monitoring of water quality
- Measured values displayed via smartphone app
- Trend indicator on smartphone for previous 24 hours
- Diagnostic information relating to instrument status
- Data export to Excel for analysis and documentation



Netilion Smart Systems App



Liquiline transmitter

www.addresses.endress.com

APPENDIX B – MONITORING SYSTEM SPECIFICATIONS

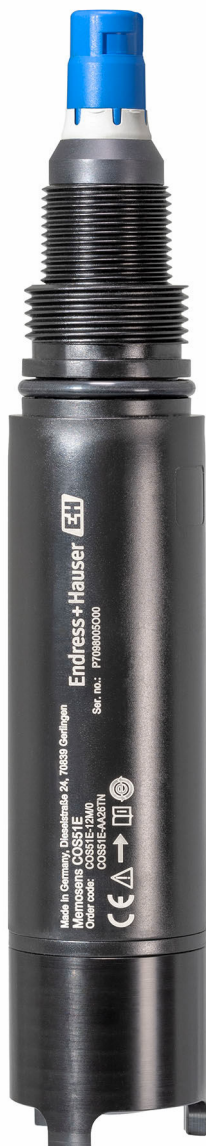
APPENDIX B.1 – OXYGEN SENSOR SPECIFICATION

Technical Information

Memosens COS51E

Amperometric oxygen sensor for water, wastewater and utilities

Digital with Memosens 2.0 technology



Application

Typical applications include:

- Wastewater treatment plants:
 - Oxygen control in activated sludge basins
 - Treatment and monitoring of process water
- Water treatment plants:
 - Status monitoring of drinking water
 - Monitoring of water quality in rivers, lakes or oceans
- All industrial utilities:
 - Oxygen control in biological treatment phase
 - Treatment and monitoring of process water

With ATEX, IECEx, CSA C/US, NEPSI, Korea Ex, Japan Ex and INMETRO certificates for use in hazardous areas Zone 0, Zone 1 and Zone 2. With CSA C/US approval also in hazardous areas Class I Division 1 in explosive gas atmospheres. Also suitable for Class I Division 2.

Your benefits

- Maximum measurement reliability with long maintenance intervals
- Intelligent, self-monitoring sensor
 - Sensor data stored in the sensor
 - Integrated electrolyte counter
- Minimal calibration effort thanks to straightforward air calibration

Function and system design

Measuring principle

During amperometric oxygen measurement, oxygen molecules diffuse through the membrane and are reduced to hydroxide ions (OH⁻) at the working electrode. At the counter-electrode, silver is oxidized to silver ions (Ag⁺) (this forms a silver halide layer). The associated release of electrons at the working electrode and absorption of electrons at the counter-electrode causes a current to flow. Under constant conditions, this current flow is proportional to the oxygen content of the medium. The current is converted in the transmitter and indicated on the display as an oxygen concentration in mg/l, µg/l, ppm, ppb or Vol%, ppmVol, raw value nA, as a saturation index in % SAT or as an oxygen partial pressure in hPa.

Potentiostatic three-electrode system

The high-impedance, current-free reference electrode plays an important role. The formation of the silver bromide or silver chloride layer at the anode causes the electrolyte's bromide or chloride ions to be depleted. With conventional membrane-covered sensors with a two-electrode system, this results in increased signal drift.

Not so with the three-electrode system:

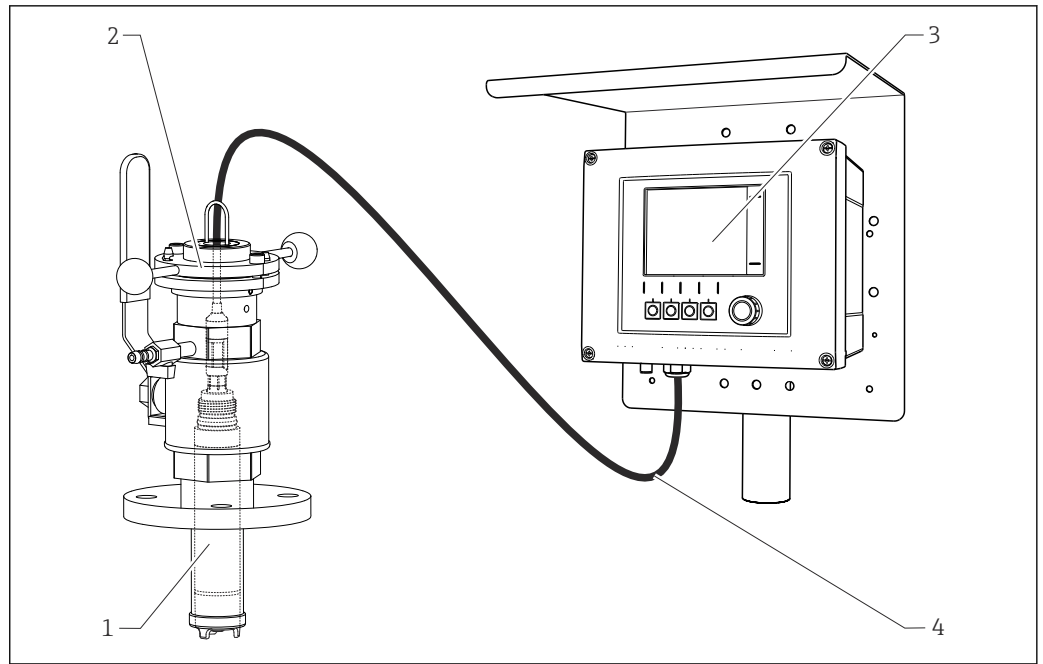
The change in the bromide or chloride concentration is recorded by the reference electrode and an internal regulator circuit keeps the working electrode at a constant potential. The advantages are a much higher signal accuracy and significantly extended calibration intervals.

Measuring system

A complete measuring system comprises:

- a Memosens COS51E oxygen sensor
- a transmitter, see Table
- a measuring cable e.g. CYK10
- Optional: an assembly, e.g. CYA112 immersion assembly or COA451 retractable assembly
- Optional: a CYH112 assembly holder
- Optional: a cleaning unit with compressed air system
- Optional: other protection cages (71096199)

Transmitter	Memosens COS22E- standard, trace
Liquiline CM44x	Cable: CYK10
Liquiline CM42	Cable: CYK10
Liquiline Compact CM72	Cable: CYK10
Liquiline Compact CM82	Cable: CYK10
Liquiline Mobile CML18	Cable: CYK20
Third-party provider	Memosens partner



1 Example of a measuring system with Memosens COS51E digital oxygen sensor

- 1 Memosens COS51E oxygen sensor
- 2 COA451 retractable assembly
- 3 Liquiline CM44
- 4 CYK10 measuring cable

Dependability

Reliability

Memosens technology digitizes the measured values in the sensor and transmits the data to the transmitter via a . The result:

- If the sensor fails or there is an interruption in the connection between the sensor and transmitter, this is reliably detected and reported.
- The availability of the measuring point is reliably detected and reported.

Maintainability

Easy handling

Sensors with Memosens technology have integrated electronics that store calibration data and other information (e.g. total operating hours or operating hours under extreme measuring conditions). Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the current measured value. As the calibration data are stored in the sensor, the sensor can be calibrated and adjusted independently of the measuring point. The result:

- Easy calibration in the measuring lab under optimum external conditions increases the quality of the calibration.
- Pre-calibrated sensors can be replaced quickly and easily, resulting in a dramatic increase in the availability of the measuring point.
- The availability of sensor data means that maintenance intervals can be accurately defined and predictive maintenance is possible.
- The sensor history can be documented with external storage media and evaluation programs.
- The application range of the sensor can be determined based on its previous history.

Integrity

With inductive transmission of the measured value using a non-contact connection, Memosens guarantees maximum process safety and offers the following benefits:

- All problems caused by moisture are eliminated.
 - Plug-in connection remains 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 transmission of measured values.

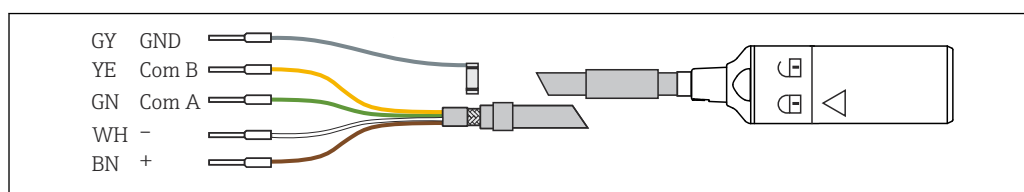
Input

Measured variables	Dissolved oxygen [mg/l, µg/l, ppm, ppb, %SAT, %Vol, ppmVol]
	Temperature [°C, °F]

Measuring ranges	■ 0 to 100 mg/l ■ 0 to 2000 hPa ■ 0.00 to 1000 % SAT
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Power supply

Electrical connection	The electrical connection of the sensor to the transmitter is established using measuring cable CYK10.
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2 Measuring cable CYK10

Performance characteristics

Response time ¹⁾	At 20 °C (68 °F):	
	■ COS51E-****TN (black membrane cap for standard response time): ■ t₉₀ : 3 minutes ■ t₉₈ : 8 minutes ■ COS51E-****TF (white membrane cap for rapid response time): ■ t₉₀ : 30 seconds ■ t₉₈ : 90 seconds	
Reference operating conditions	Reference temperature:	20 °C (68 °F)
	Reference pressure:	1013 hPa (15 psi)
	Reference application:	Air-saturated water
Signal current in air	COS51E-****TN (black membrane cap)	approx. 300 nA
	COS51E-****TF (white membrane cap)	approx. 1100 nA
Zero current	< 0.1 % of the signal current in air	
Measurement error ²⁾	COS51E-****TN (black membrane cap):	≤ ±1 % of the measured value
	COS51E-****TF (white membrane cap):	≤ ±1 % of the measured value
Limit of detection (LOD) ³⁾	COS51E-****TN (black membrane cap):	10 ppb
	COS51E-****TF (white membrane cap):	5 ppb

1) Average of all sensors that have undergone a final inspection

2) In accordance with IEC 60746-1 under rated operating conditions

3) According to DIN EN ISO 15839. The measurement error contains all the uncertainties of the sensor and transmitter (measuring chain). It does not contain all the uncertainties caused by the reference material and adjustments that may have been performed.

Limit of quantification (LOQ) ³⁾	COS51E-****TN (black membrane cap):	20 ppb
	COS51E-****TF (white membrane cap):	10 ppb
Repeatability	COS51E-****TN (black membrane cap):	20 ppb
	COS51E-****TF (white membrane cap):	100 ppb
Long-term drift ⁴⁾	Zero-point drift:	< 0.1 % per week
	Measuring range drift:	< 0.1 % per week
Polarization time	< 60 minutes	
Intrinsic oxygen consumption	■ COS51E-****TN: approx. 90 ng/h in air at 25 °C (77 °F) ■ COS51E-****TF: approx. 270 ng/h in air at 25 °C (77 °F)	
Electrolyte	Alkaline saline solution	

Installation

Installation instructions	NOTICE Installing the unit without an assembly carries the risk of cable breakage or sensor loss! ► Do not install the sensor freely suspended from the cable!
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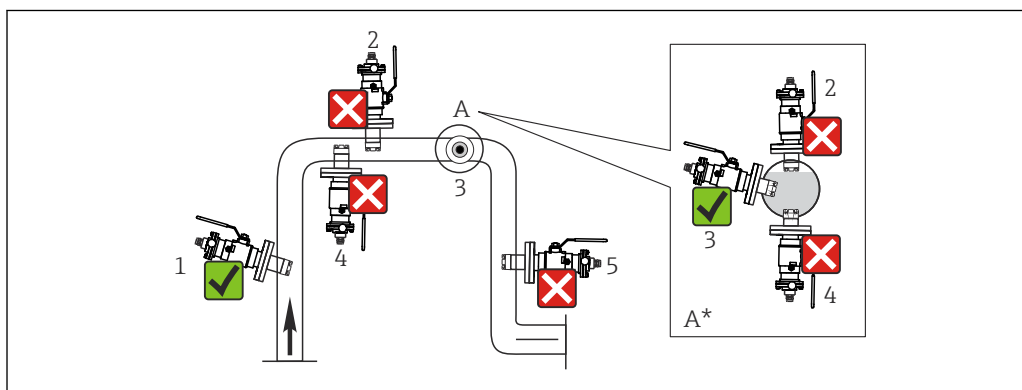
Orientation

Installation examples

Retractable assembly COA451	The assembly is designed for installation on vessels and pipes. This requires the availability of suitable process connections.
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⁴⁾ Under constant conditions

Install the assembly in a place with uniform flow conditions. The pipe diameter must be at least DN 80.



A0045980

3 Permissible and impermissible sensor installation positions with retractable assembly

- 1 Ascending pipe, best position
- 2 Horizontal pipe, sensor top down, impermissible due to air cushion or foam bubble forming
- 3 Horizontal pipe, lateral installation with permissible installation angle (acc. to sensor version)
- 4 Upside-down installation, unsuitable
- 5 Down pipe, impermissible
- A Detail A (top view)
- A* Detail A, turned by 90° (side view)
- ✓ Possible installation angle
- ✗ Inadmissible installation angle

NOTICE

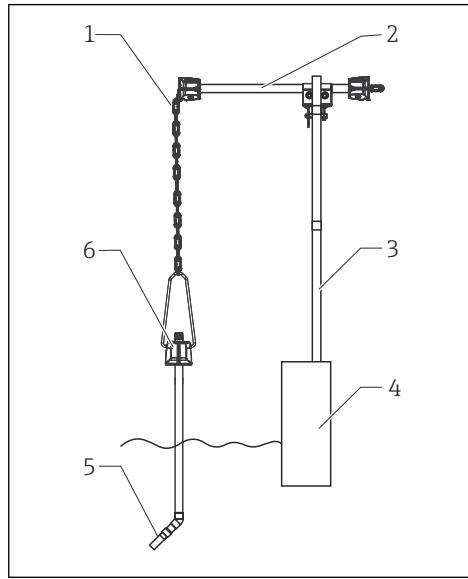
Sensor not fully immersed in the medium, buildup, upside-down installation

These can all cause incorrect measurements!

- Do not install assembly at points where air pockets or bubbles may form.
- Avoid buildup on the sensor membrane or remove it at regular intervals.
- Do not install sensor upside down.

Immersion operation

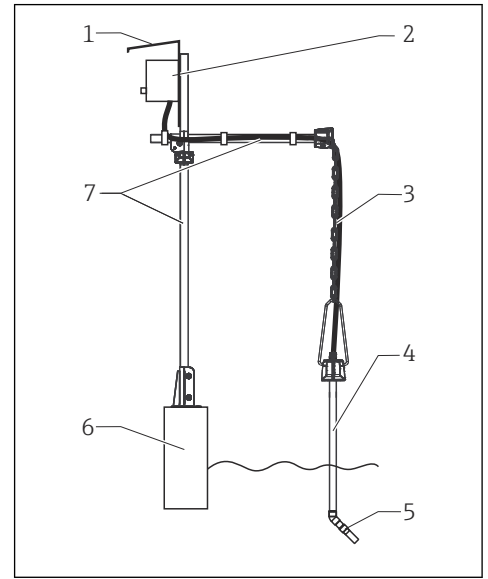
Universal holder and chain assembly



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4 Chain holder on railing

- 1 Chain
- 2 Holder Flexdip CYH112
- 3 Rail
- 4 Basin rim
- 5 Oxygen sensor
- 6 Wastewater assembly Flexdip CYA112

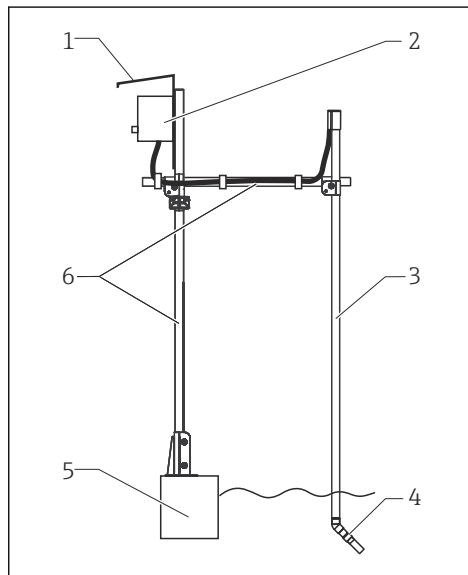


A0042858

5 Chain holder on upright post

- 1 Weather protection cover CYY101
- 2 Transmitter
- 3 Chain
- 4 Wastewater assembly Flexdip CYA112
- 5 Oxygen sensor
- 6 Basin rim
- 7 Holder Flexdip CYH112

Universal holder and fixed immersion tube

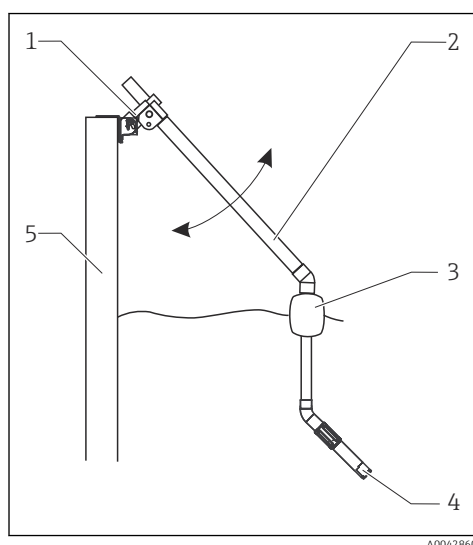


A0042859

6 Assembly holder with immersion tube

- 1 Protective cover
- 2 Transmitter
- 3 Flexdip CYA112 immersion assembly
- 4 Oxygen sensor
- 5 Basin rim
- 6 Assembly holder Flexdip CYH112

Basin rim mounting with immersion tube

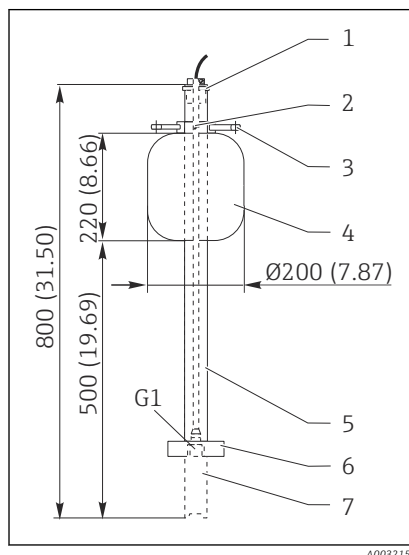


7 Basin rim mounting

- 1 Pendulum holder CYH112
- 2 Assembly Flexdip CYA112
- 3 Assembly float
- 4 Oxygen sensor
- 5 Basin rim

Float

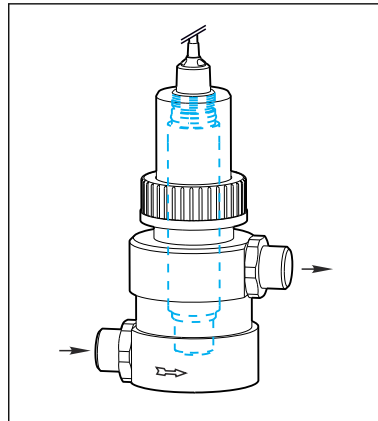
The CYA112 float is for use in the case of large fluctuations in water level, for example in rivers or lakes.



8 Dimensions in mm (inch)

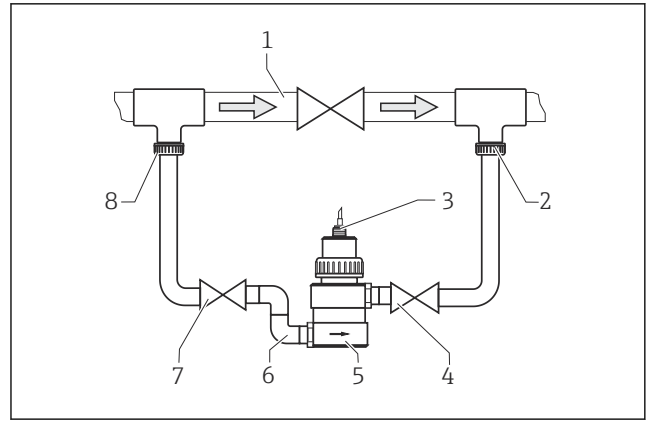
Flow assembly COA250

The COA250 flow assembly with automatic self-venting is suitable for use in pipelines or at hose connections. The inlet is at the bottom of the assembly and the outlet is at the top (G $\frac{3}{4}$ connection thread). It is installed in a pipe using two 90° pipe brackets at the inlet of assembly (item 6).



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9 COA250

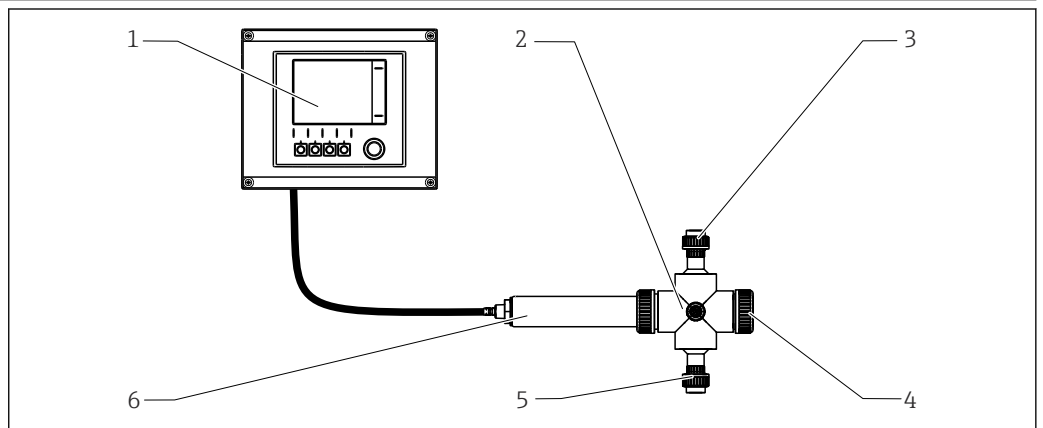


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10 Bypass installation with manually actuated valves or solenoid valves

- 1 Main pipe
- 2 Medium return
- 3 Oxygen sensor
- 4, 7 Manually actuated or solenoid valves
- 5 Flow assembly COA250-A
- 6 90° pipe elbow
- 8 Medium removal

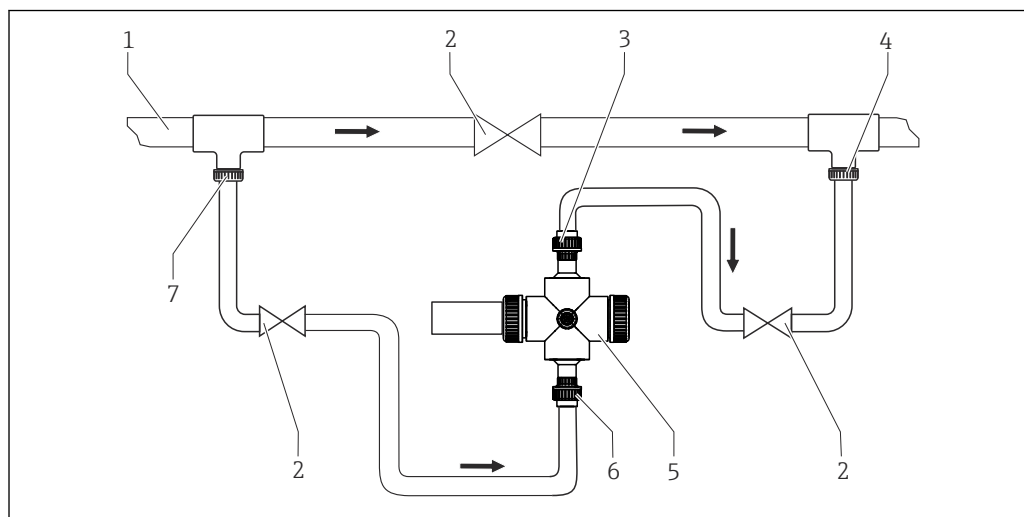
Universal flow assembly Flowfit CYA251



A0032917

11 Measuring system with CYA251

- 1 Transmitter
- 2 Flow assembly
- 3 Medium outlet
- 4 Cap
- 5 Medium inflow
- 6 Memosens COS51E



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12 Connection diagram

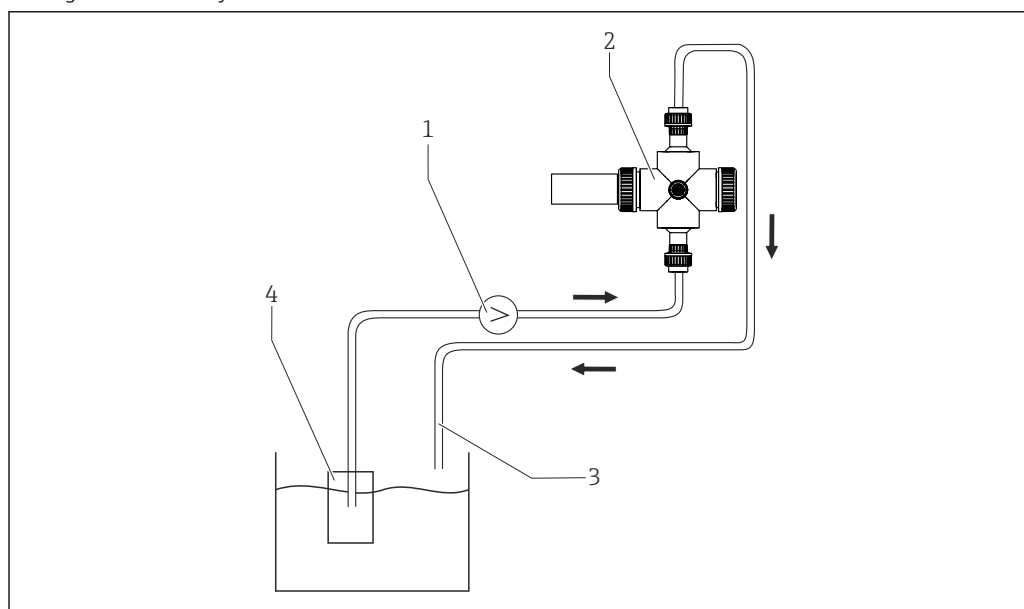
- | | |
|--|------------------|
| 1 Main pipe | 5 Medium inflow |
| 2 Manually actuated or solenoid valves | 6 Flow assembly |
| 3 Medium outlet | 7 Medium removal |
| 4 Medium return | |

Mount the sensor in the assembly in accordance with the Operating Instructions (BA00495C).

There must be a minimum flow rate of 100 ml/h (0.026 gal/h).

► Take increased response times into account.

As an alternative to bypass operation, direct the sample flow from a filter unit with an open outlet through the assembly:



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13 Flow assembly with open outlet

- | |
|---------------|
| 1 Pump |
| 2 Assembly |
| 3 Open outlet |
| 3 Filter unit |

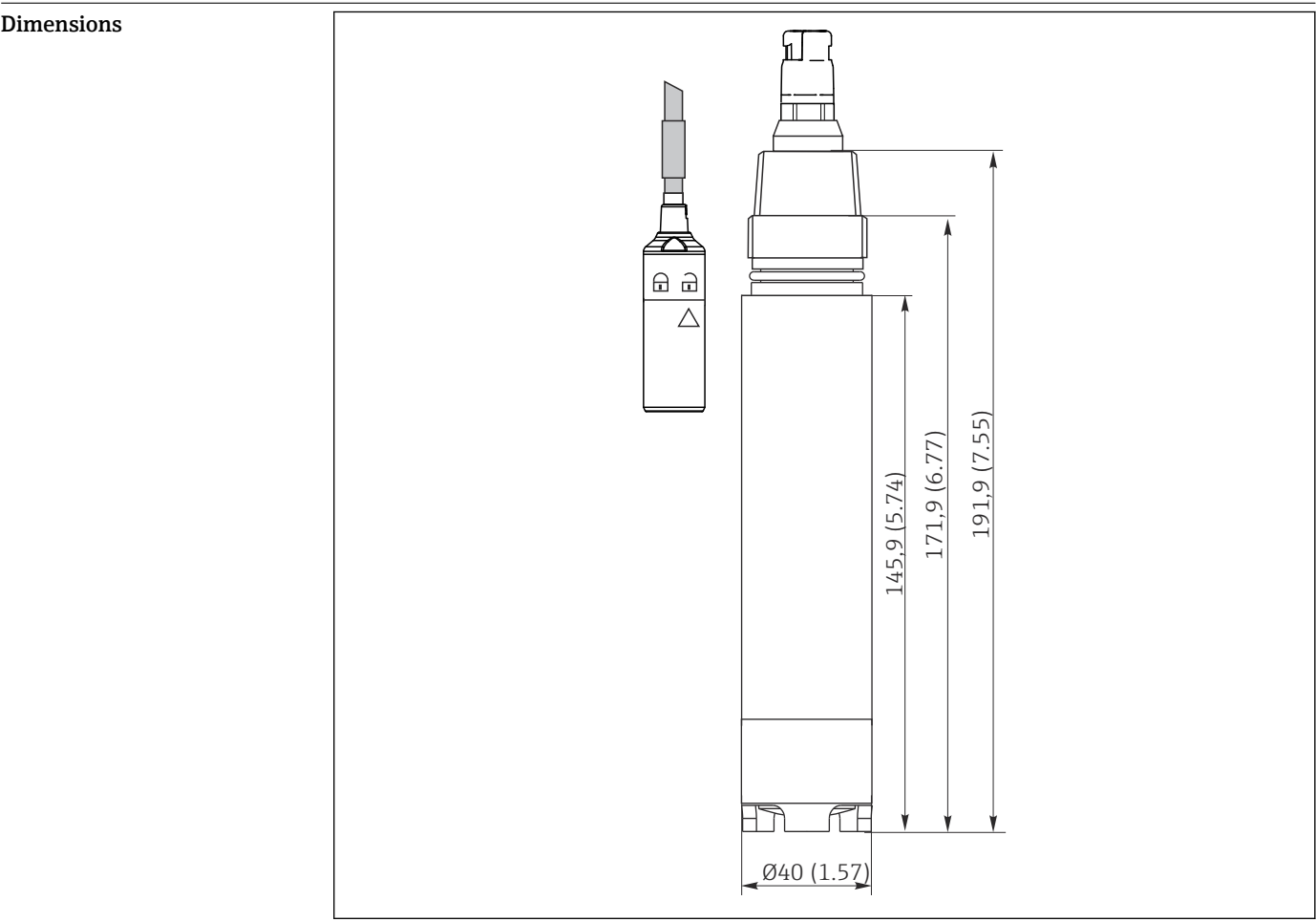
Environment

Ambient temperature range	−5 to 60 °C (23 to 140 °F)
Storage temperature range	■ Filled with electrolyte: −5 to 60 °C (20 to 140 °F) ■ Without electrolyte: −20 to 60 °C (0 to 140 °F)
Degree of protection	IP68 (2 m (6.5 ft) water column, 21 °C (70 °F), 24 hours)

Process

Process temperature range	−5 to 60 °C (41 to 140 °F)
Process pressure range	5 bar (72.5 psi) abs.

Mechanical construction



14 Dimensions in mm (inch)

Weight	0.3 kg (0.7 lbs)
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Materials	Parts in contact with medium	
	Sensor shaft	POM
	Membrane cap	POM
	Working electrode	Gold
	Counter-electrode and reference electrode	Silver/Silver halide
	Membrane	ETFE (COS51-****TN) FEP (COS51-****TF)
Process connection	G1, NPT 3/4"	
Membrane thickness	■ COS51D-***0*: Approx. 50 µm ■ COS51D-***1*: Approx. 25 µm	
Temperature sensor	NTC 30KΩ	

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ex certification	ATEX
	II 1G Ex ia IIC T6 Ga
	CSA C/US
	■ IS Class I Division 1 Groups A, B, C and D T6 ■ Ex ia IIC T6 Ga ■ IS Class I Zone 0 AEx ia IIC T6 Ga
	EAC Ex
	0Ex ia IIC T6 Ga X
	INMETRO
	Ex ia IIC T6 Ga
	IECEX
	Ex ia IIC T6 Ga
	Japan Ex
	Ex ia IIC T6 Ga
	Korea Ex
	Ex ia IIC T6 Ga
	NEPSI
	Ex ia IIC T6 Ga
	UK Ex
	Ex ia IIC T6 Ga
Additional certifications and declarations	EAC
	The product has been certified according to Directive TP TC 020/2011 applicable in the Eurasian Economic Union (EAEU). The product bears the EAC mark of conformity.

Ordering information

Product page	www.endress.com/cos51e
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.
Scope of delivery	The scope of delivery comprises: ▪ Ordered version of the sensor with protective cap (filled with tap water) to protect the membrane ▪ Accessories set with the following contents: ▪ 2 replacement membrane caps ▪ Electrolyte, 1 bottle, 10 ml (0.34 fl.oz.) ▪ Seal set with 3 O-rings ▪ 6 polishing foils in 2 grit sizes ▪ Safety instructions for the hazardous area (for sensors with Ex approval) ▪ Brief Operating Instruction ▪ Optional: cleaning unit ▪ Optional: replacement caps If you have any questions, please do not hesitate to contact the the Endress+Hauser sales team.

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.

Device-specific accessories	Assemblies (selection) Flowfit CYA251 ▪ Connection: See product structure ▪ Material: PVC-U ▪ Product Configurator on the product page: www.endress.com/cya251  Technical Information TI00495C Flowfit COA250 ▪ Flow assembly for oxygen measurement ▪ Product Configurator on the product page: www.endress.com/coa250  Technical Information TI00111C Cleanfit COA451 ▪ Manual retractable assembly made of stainless steel with ball valve shutoff ▪ For oxygen sensors ▪ Product Configurator on the product page: www.endress.com/coa451  Technical Information TI00368C
------------------------------------	--

Flexdip CYH112

- Modular holder system for sensors and assemblies in open basins, channels and tanks
- For Flexdip CYA112 water and wastewater assemblies
- Can be affixed anywhere: on the ground, on the capstone, on the wall or directly onto railings.
- Plastic or stainless steel version
- Product Configurator on the product page: www.endress.com/cyh112



Technical Information TI00430C

Flexdip CYA112

- 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



Technical Information TI00432C

Membrane protection guard

- For using the sensor in fish farming tanks
- Order No.: 50081787

Measuring cables

Memosens data cable CYK10

- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10



Technical Information TI00118C

Memosens laboratory cable CYK20

- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk20

Memosens data cable CYK11

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



Technical Information TI00118C

Transmitter

Liquiline CM44

- Modular multi-channel transmitter for hazardous and non-hazardous areas
- HART®, PROFIBUS, Modbus or EtherNet/IP is possible
- Order according to product structure



Technical Information TI00444C

Liquiline CM42

- Modular two-wire transmitter for hazardous and non-hazardous areas
- HART®, PROFIBUS or FOUNDATION Fieldbus is possible
- Order according to product structure



Technical Information TI00381C

Liquiline Mobile CML18

- Multiparameter mobile device for laboratory and field
- Reliable transmitter with display and app connection
- Product Configurator on the product page: www.endress.com/CML18



Operating Instructions BA02002C

Liquiline Compact CM82

- Configurable 1-channel multiparameter transmitter for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM82



Technical Information TI01397C

Liquiline Compact CM72

- 1-channel single parameter field device for Memosens sensors
- Ex- and non-ex applications possible in all industries
- Product Configurator on the product page: www.endress.com/CM72



Technical Information TI01409C

Memosens analog converter CYM17

- Converter for Memosens sensors
- Enables the simple use of digital Memosens sensors in fermentation applications in the laboratory
- Product Configurator on the product page: www.endress.com/cym17



Operating Instructions BA01833C

Memobase Plus CYZ71D

- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d



Technical Information TI00502C

Maintenance kit

COV45 maintenance kits for COS41/COS51X

- Maintenance kit for COS51D and COS51E
 - Scope of supply of maintenance kit COV45 is based on the configuration:
 - Maintenance kit, complete
 - with 10x sensor electrolyte
 - with 2x membrane cap
 - with seal set
 - with polishing foil
 - Or each can be ordered individually
- Ordering information: www.endress.com/cos51e under "Accessories/Spare parts"



www.addresses.endress.com

APPENDIX B.2 – CONDUCTIVITY SENSOR SPECIFICATION

Technical Information

Memosens CLS21E

Digital conductivity sensor with Memosens technology

Cell constant $k = 1.0 \text{ cm}^{-1}$

Application

Measurements in media with medium or high conductivity

Typical applications include:

- Separation of media with high conductivity (alkali/water)
- Drinking water treatment
- Wastewater treatment
- Cleaning of ballast water on ships
- Cleaning of water in a ship's wake

Sensors with temperature probes are used in conjunction with conductivity measuring devices that support automatic temperature compensation:

- Liquiline CM442/CM444/CM448
- Liquiline CM42
- Liquiline CM14

The resistivity in $\text{M}\Omega \cdot \text{cm}$ can also be measured using these transmitters.

Your benefits

- Manufacturer inspection certificate stating the individual cell constant
- Different designs for optimum adaptation to the process or mounting location
- Installation in pipe or flow assembly
- Compact design
- High chemical, thermal and mechanical resistance

Other advantages provided by Memosens technology

- Maximum process safety
- Data security thanks to digital data transmission
- Very easy to use as sensor data are saved in the sensor
- Predictive maintenance can be performed by recording sensor load data in the sensor

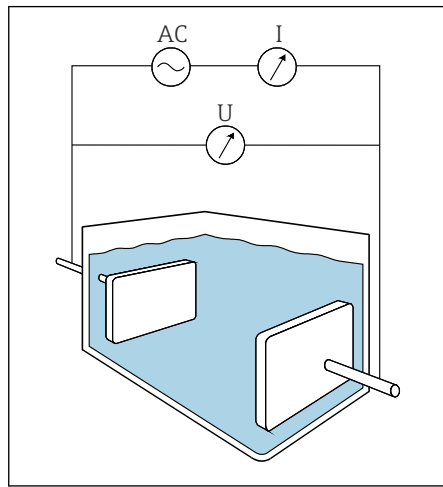


Table of contents

Function and system design	3	Ordering information	10
Measuring principle	3	Product page	10
Measuring system	3	Product Configurator	10
		Scope of delivery	10
Communication and data processing	4		
		Accessories	10
Dependability	4	Assemblies	10
Reliability	4	Measuring cable	11
Maintainability	4	Calibration solutions	11
Integrity	4		
Input	5		
Measured variables	5		
Measuring ranges	5		
Cell constant	5		
Temperature compensation	5		
Power supply	5		
Electrical connection	5		
Performance characteristics	5		
Uncertainty of measurement	5		
Response time	5		
Measured error	5		
Repeatability	5		
Installation	6		
Installation instructions	6		
Environment	6		
Ambient temperature	6		
Storage temperature	7		
Degree of protection	7		
Process	7		
Process temperature	7		
Process pressure	7		
Temperature/pressure ratings	7		
Mechanical construction	8		
Design	8		
Dimensions in mm (in)	8		
Weight	8		
Materials (in contact with medium)	9		
Materials (not in contact with medium)	9		
Process connection	9		
Certificates and approvals	9		
CE mark	9		
Hazardous area approvals	9		
Marine approvals	9		
Test reports	9		
Additional certification	9		
Other standards and guidelines	9		

Function and system design

Measuring principle



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1 Conductive measurement of conductivity

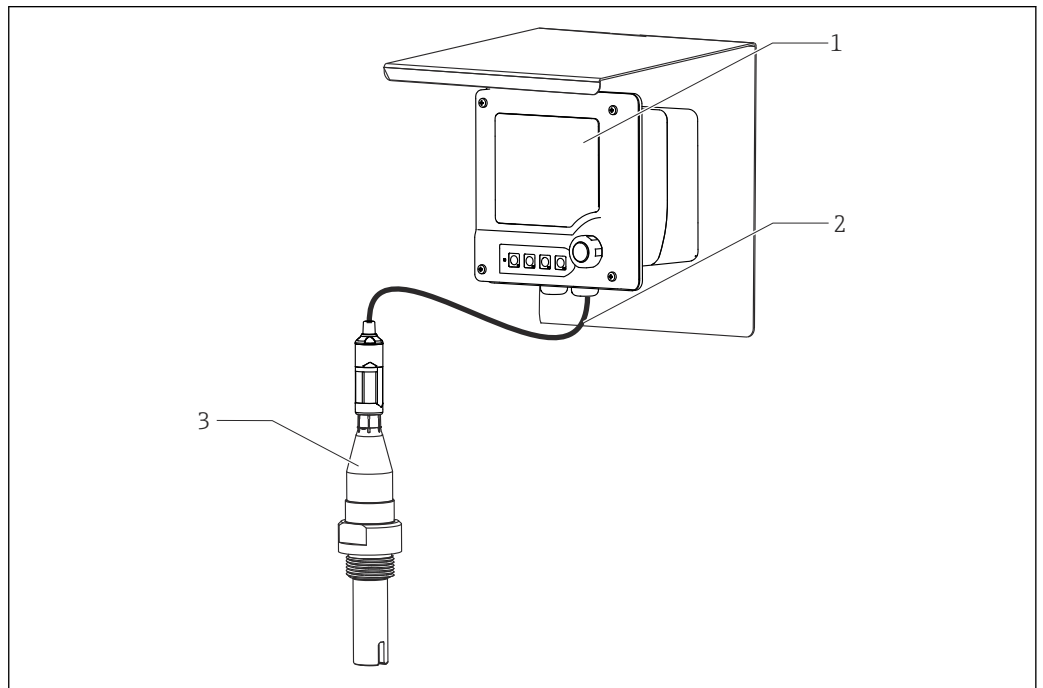
AC Alternating voltage source
I Current intensity measurement
U Voltage measurement

Conductivity of liquids is determined with a measuring arrangement where two electrodes are located in the medium. An alternating voltage that causes a current to flow through the medium is applied at these electrodes. The electrical resistance, or its reciprocal value - conductance G - is calculated based on Ohm's law. The specific conductance κ is determined from the conductance value using the cell constant k , which depends on the sensor geometry.

Measuring system

A complete measuring system comprises at least:

- Conductivity sensor Memosens CLS21E
- Transmitter, e.g. Liquiline M CM42
- Measuring cable, e.g. Memosens data cable CYK10



A0024376

2 Example of a measuring system (with Memosens sensor)

- 1 Liquiline M CM42 transmitter
2 Memosens data cable
3 Memosens CLS21E

Communication and data processing

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 or adjustment
- Operating data
 - Temperature application range
 - Conductivity application range
 - Date of initial commissioning
 - Maximum temperature value
 - Hours of operation at high temperatures

Dependability

Reliability

Memosens technology digitizes the measured values in the sensor and transmits the data to the transmitter via a . The result:

- If the sensor fails or there is an interruption in the connection between the sensor and transmitter, this is reliably detected and reported.
- The availability of the measuring point is reliably detected and reported.

Maintainability

Easy handling

Sensors with Memosens technology have integrated electronics that store calibration data and other information (e.g. total hours of operation or operating hours under extreme measuring conditions). Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the current measured value. As the calibration data are stored in the sensor, the sensor can be calibrated and adjusted independently of the measuring point. The result:

- Easy calibration in the measuring lab under optimum external conditions increases the quality of the calibration.
- Pre-calibrated sensors can be replaced quickly and easily, resulting in a dramatic increase in the availability of the measuring point.
- Thanks to the availability of the sensor data, maintenance intervals can be accurately defined and predictive maintenance is possible.
- The sensor history can be documented with external data carriers and evaluation programs.
- Thus, the current application of the sensors can be made to depend on their previous history.

Integrity

With inductive transmission of the measured value using a non-contact connection, Memosens guarantees maximum process safety and offers the following benefits:

- All problems caused by moisture are eliminated.
 - Plug-in connection remains 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 transmission of measured values.

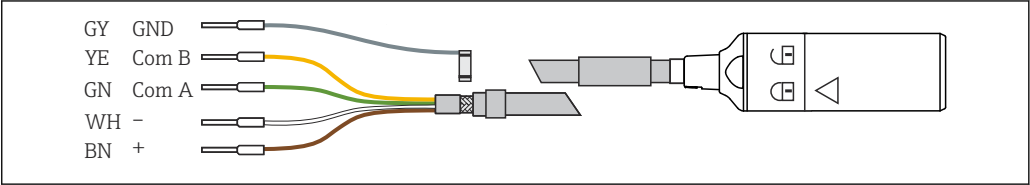
Input

Measured variables	■ Conductivity ■ Temperature	
Measuring ranges	Conductivity ¹⁾	10 µS/cm to 20 mS/cm
	1) In relation to water at 25 °C (77 °F)	
	Temperature	-20 to 135 °C (-4 to 275 °F)
Cell constant	k = 1.0 cm ⁻¹ , nominal	
Temperature compensation	Pt1000 (Class A according to IEC 60751)	

Power supply

Electrical connection

The electrical connection of the sensor to the transmitter is established using the measuring cable CYK10.



 3

Measuring cable CYK10

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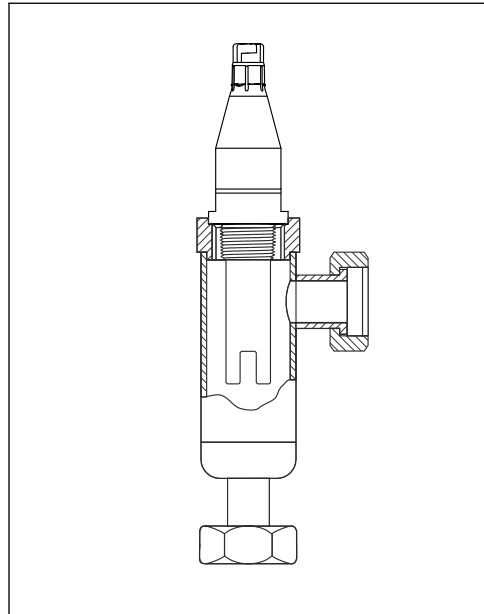
Performance characteristics

Uncertainty of measurement	Each individual sensor is factory-measured in a solution with approx. 5 mS/cm using a reference measuring system traceable to NIST or PTB. The exact cell constant is entered into the manufacturer inspection certificate supplied. The uncertainty of measurement in determining the cell constant is 1.0 %.	
Response time	Conductivity	t ₉₅ ≤ 2 s
	Temperature ¹⁾	t ₉₀ ≤ 30 s ²⁾
	1) DIN VDI/VDE 3522-2 (0.3 m/s laminar)	
	2) With temperature prediction activated as standard	
Measured error	Conductivity	≤ 5 % of reading, in specified measuring range
	Temperature	≤ 2.5 K, in measuring range -20 to 100 °C (-4 to 212 °F) ≤ 3.5 K, in measuring range 100 to 135 °C (212 to 275 °F)
Repeatability	Conductivity	≤ 0.2 % of reading, in specified measuring range
	Temperature	≤ 0.05 K

Installation

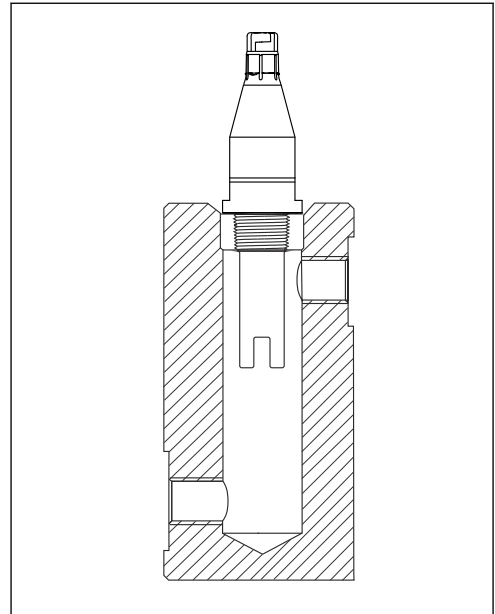
Installation instructions

The sensors are installed directly via the process connection. As an option, the sensor can also be installed via a flow or immersion assembly (see "Accessories").



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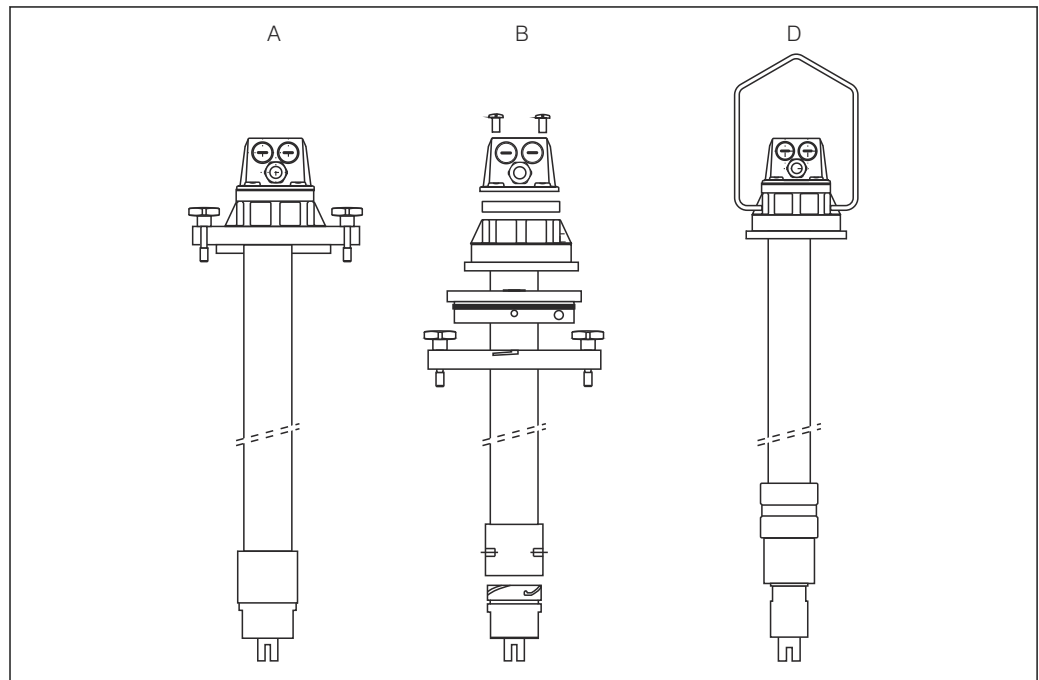
4 Installation in flow assembly CLA751



A0035650

5 Installation in flow assembly CLA752

For the installation of sensors with a G1 thread in vessels: immersion assembly Dipfit CLA111 (see Accessories).



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6 Installation in immersion assembly, mounting versions A, B and D

Environment

Ambient temperature

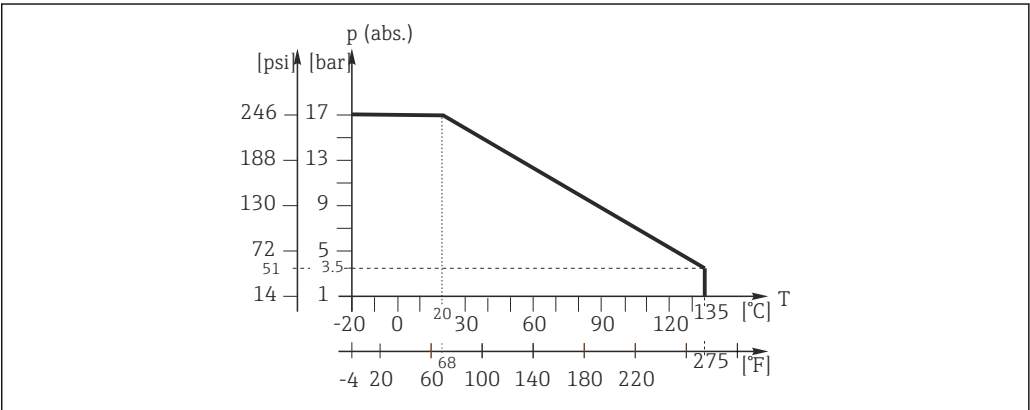
-20 to 60 °C (-4 to 140 °F)

Storage temperature	-25 to +80 °C (-10 to +180 °F)
Degree of protection	IP 68 / NEMA type 6P (1 m water column, 25 °C, 24 h)

Process

Process temperature	-20 to 135 °C (-4 to 275 °F) at 3.5 bar (50 psi) absolute
Process pressure	17 bar (247 psi) absolute, at 20 °C (68 °F)

Temperature/pressure ratings

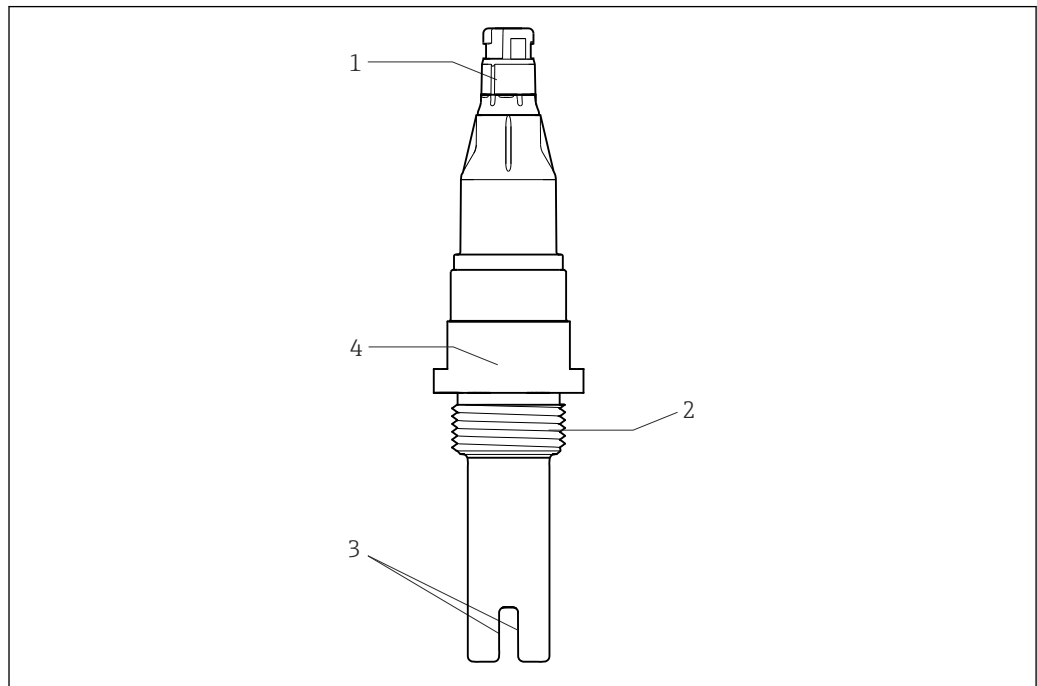


A0044757

7 Mechanical pressure-temperature resistance

Mechanical construction

Design

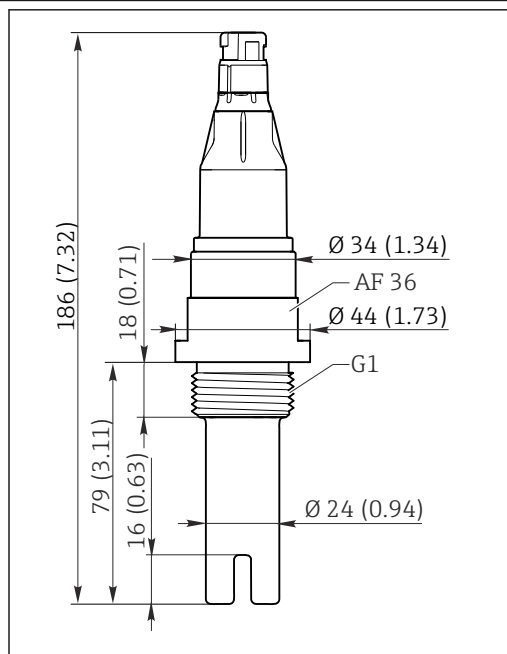


A0024381

8 Sensor

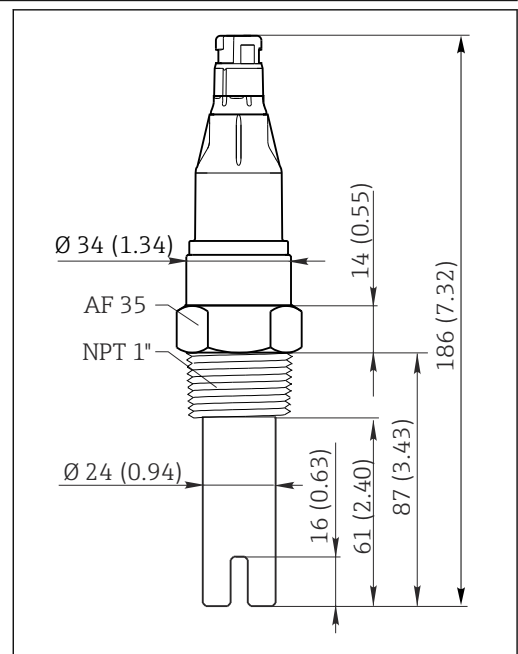
- 1 Memosens plug-in head
- 2 Process connection (here G1)
- 3 Coaxial measuring electrodes made of graphite
- 4 Wrench flats for mounting

Dimensions in mm (in)



A0024382

9 Version with thread G1



A0024394

10 Version with thread NPT 1"

Weight

Approx. 0.3 kg (0.66 lbs) depending on version

Materials (in contact with medium)	Electrodes Sensor shaft Thermal conductivity socket for temperature probe	Graphite Polyethersulfone (PES-GF20) Titanium 3.7035
Materials (not in contact with medium)	Information according to REACH Regulation (EC) 1907/2006 Art. 33(1) An internal connector contains the SVHC substance lead (CAS number 7439-92-1) with over 0.1 % (w/w). The product does not present a hazard if it is used as designated.	
Process connection	G1 thread NPT 1" thread	

Certificates and approvals



Certificates and approvals are optional, i.e. they depend on the product version.

CE mark	EU 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.
Hazardous area approvals	CLS21E-BA II 1 G Ex ia IIC T3/T4/T6 Ga CLS21E-CI CSA C/US IS Cl. I Div. 1 GP A-D T3/T4/T6 + CSA C/US IS Cl. I Zone 0 AEx ia IIC T3/T4/T6 CLS21E-GA EAC Ex, 0Ex ia IIC T3/T4/T6 Ga X CLS21E-IA Ex ia IIC T3/T4/T6 Ga CLS21E-NA NEPSI Ex ia IIC T3/T4/T6 Ga
Marine approvals	A selection of the devices and sensors have type approval for marine applications, issued by the following classification societies: ABS (American Bureau of Shipping), BV (Bureau Veritas), DNV-GL (Det Norske Veritas-Germanischer Lloyd) and LR (Lloyd's Register). Details of the order codes of the approved devices and sensors, and the installation and ambient conditions, are provided in the relevant certificates for marine applications on the product page on the Internet.
Test reports	Manufacturer inspection certificate Stating the individual cell constant
Additional certification	Inspection certificate in accordance with EN 10204 3.1 A test certificate 3.1 in accordance with EN 10204 is supplied depending on the version (→ Product Configurator on the product page).
Other standards and guidelines	EAC The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.

Ordering information

Product page

www.endress.com/cls21e

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.

Scope of delivery

The scope of delivery includes:

- Sensor in the version ordered
- Operating Instructions

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.

Assemblies

Dipfit CLA111

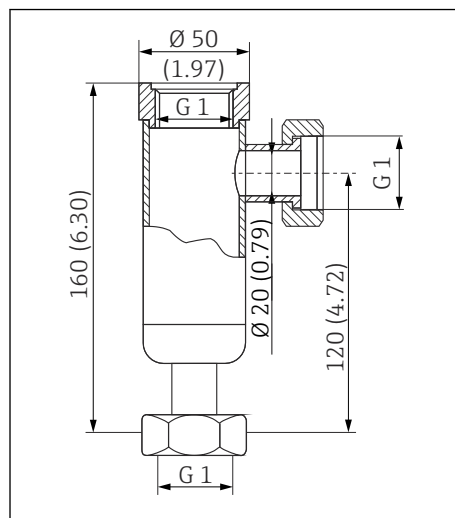
- Immersion assembly for open and closed vessels with flange DN 100
- Product Configurator on the product page: www.products.endress.com/cla111



Technical Information TI00135C

Flow assembly CLA751

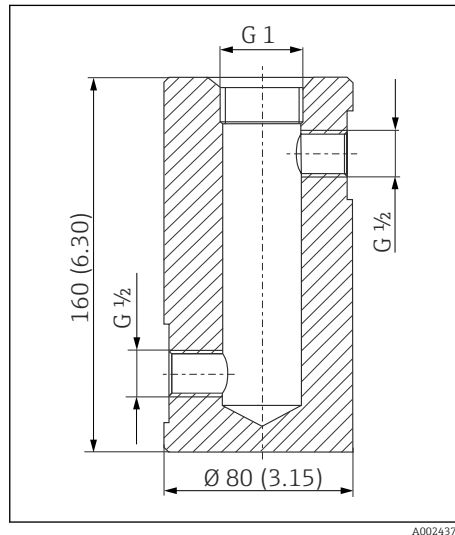
- For installing conductivity sensors with G1 thread (CLS12, CLS13, CLS21, CLS30)
- Inlet (below) and outlet (lateral) DN 20 with G1 thread adapter nut
- Stainless steel 1.4571 (AISI 316Ti)
- Max. temperature 160 °C (320 °F), max. pressure 12 bar (174 psi)
- Order No. 50004201



11 Dimensions in mm (inch)

Flow assembly CLA752

- For installing conductivity sensors with G1 thread (CLS12, CLS13, CLS21, CLS30)
- Inlet (lateral) and outlet (lateral) DN 20 with G½ internal thread
- Polypropylene (PP)
- Max. temperature 90 °C (194 °F), max. pressure 6 bar (87 psi)
- Order No. 50033772



A0024378

12 Dimensions in mm (inch)

Measuring cable

Memosens data cable CYK10

- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10



Technical Information TI00118C

Memosens data cable CYK11

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



Technical Information TI00118C

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-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
- 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



Technical Information TI00162C



www.addresses.endress.com

APPENDIX B.3 – PH SENSOR SPECIFICATION

Technical Information

Memosens CPF81E

pH sensor for mining operations, industrial water and wastewater treatment

Digital with Memosens 2.0 technology

Application

- Flotation
- Leaching
- Neutralization
- Outlet monitoring
- Inlet and outlet monitoring

Your benefits

- With proven KNO_3 electrolyte bridge for improved protection against electrode poisons such as S^{2-} or CN^- ions
- Optionally available with flat membrane for improved wear resistance
- Threaded connection NPT $\frac{3}{4}$ " top and bottom for easy installation at user end
- Suitable for measurements in the 0 to 14 pH range and in the 0 to 110 °C (32 to 230 °F) temperature range (application L)
- Integrated NTC 30K temperature sensor for effective temperature compensation
- Protection guard against damage

Other advantages provided by Memosens technology

- Maximum process safety thanks to non-contact, inductive signal transmission
- Data security thanks to digital data transmission
- Very easy to use as sensor data are saved in the sensor
- Predictive maintenance can be performed by recording sensor load data in the sensor



Function and system design

Measuring principle

pH measurement

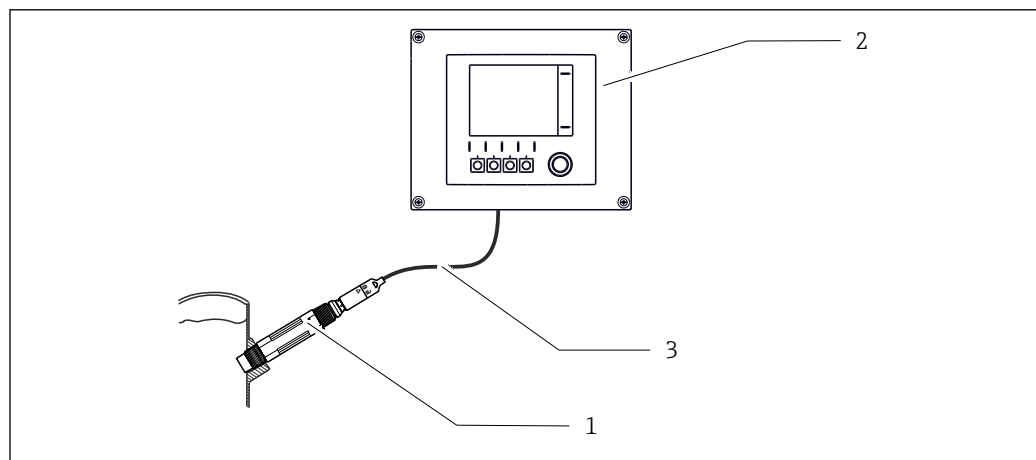
The pH value is used as a unit of measurement for the acidity or alkalinity of a medium. The membrane glass of the electrode delivers an electrochemical potential that depends on the pH value of the medium. This potential is generated by the selective accumulation of H^+ ions on the outer layer of the membrane. As a result, an electrochemical boundary layer with an electrical potential difference forms at this point. An integrated Ag/AgCl reference system serves as the required reference electrode.

The measured voltage is converted to the corresponding pH value using the Nernst equation.

Measuring system

A complete measuring system comprises:

- Sensor CPF81E
- Transmitter, e.g. Liquiline CM44x/R or Liquiline M CM42
- Memosens data cable , e.g. CYK10



A0024721

1 Example of a measuring system

- 1 Sensor CPF81E
- 2 Transmitter Liquiline CM44x
- 3 Memosens data cable CYK10

Communication and data processing

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:

- Manufacturing data
 - Serial number
 - Order code
 - Date of manufacture
- Calibration data
 - Calibration date
 - Slope at 25 °C (77 °F)
 - Zero point at 25 °C (77 °F)
 - Offset of integrated temperature sensor
 - Number of calibrations
 - Calibration history
 - Serial number of the transmitter used to perform the last calibration or adjustment
- Application data
 - Temperature application range
 - pH application range
 - Date of first commissioning
 - Maximum temperature value
 - Hours of operation under extreme conditions
 - Sensor load

The data listed above can be displayed with Liquiline CM42, CM44x, and Memobase Plus CYZ71D.

Dependability

Reliability

Easy handling

Sensors with Memosens technology have an integrated electronics unit that stores calibration data and other information (e.g. total hours of operation or operating hours under extreme measuring conditions). Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the current measured value. As the calibration data are stored in the sensor, the sensor can be calibrated and adjusted independently of the measuring point. The result:

- Easy calibration in the measuring lab under optimum external conditions increases the quality of the calibration.
- Pre-calibrated sensors can be replaced quickly and easily, resulting in a dramatic increase in the availability of the measuring point.
- Thanks to the availability of the sensor data, maintenance intervals can be accurately defined and predictive maintenance is possible.
- The sensor history can be documented on external data carriers and evaluation programs.
- The saved application data of the sensor can be used to determine the continued use of the sensor in a targeted manner.

Integrity

Data security thanks to digital data transmission

Memosens technology digitizes the measured values in the sensor and transmits the data to the transmitter via a non-contact connection that is free from potential interference. The result:

- If the sensor fails or there is an interruption in the connection between the sensor and transmitter, this is reliably detected and reported.
- The availability of the measuring point is reliably detected and reported.

Security

Maximum process safety

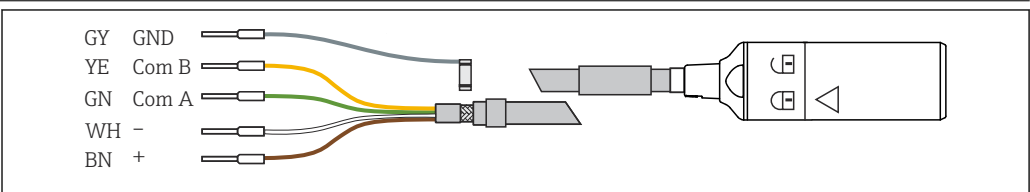
With inductive transmission of the measured value using a non-contact connection, Memosens guarantees maximum process safety and offers the following benefits:

- All problems caused by moisture are eliminated:
 - No corrosion at the connection
 - Measured values cannot be distorted by moisture
- The transmitter is galvanically decoupled from the medium. Issues concerning "symmetrical high-impedance" or "asymmetry" or the type of impedance converter are a thing of the past.
- Electromagnetic compatibility (EMC) is guaranteed by screening measures for the digital transmission of measured values.
- Intrinsically safe electronics mean operation in hazardous areas is not a problem. Complete flexibility thanks to individual Ex approvals for all components, such as sensors, cables and transmitters.

Input

Measured variables	pH value Temperature
Measuring range	Application L ■ pH: 0 to 14 ■ Temperature: 0 to 110 °C (32 to 230 °F) Application N ■ pH: 0 to 11 ■ Temperature: 0 to 80 °C (32 to 176 °F)

Power supply

Electrical connection	
-----------------------	--

2 Measuring cable CYK10 or CYK20

- Connect the Memosens measuring cable, e.g. CYK10 or CYK20 to the sensor.

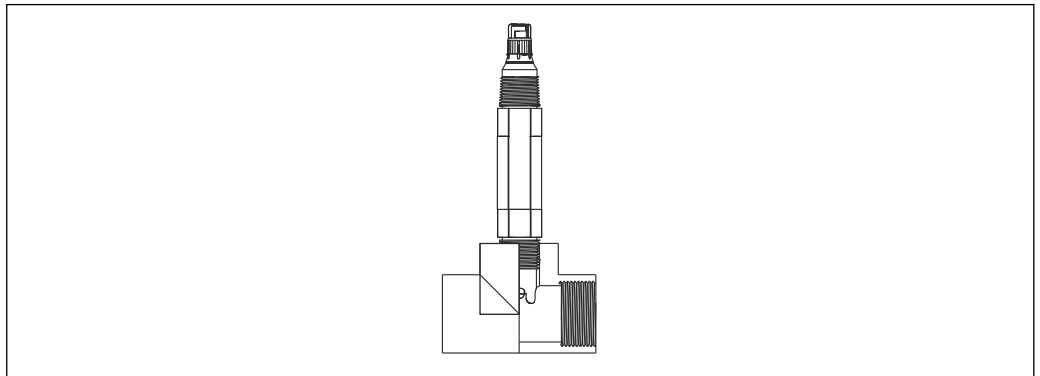
 For further information on cable CYK10, see BA00118C

Performance characteristics

Reference system	Double chamber reference system ■ 1st chamber: bridging electrolyte: gel - 3 MKNO₃ ■ 2nd chamber: Ag/AgCl reference lead, bridging electrolyte: gel KCl, 3M
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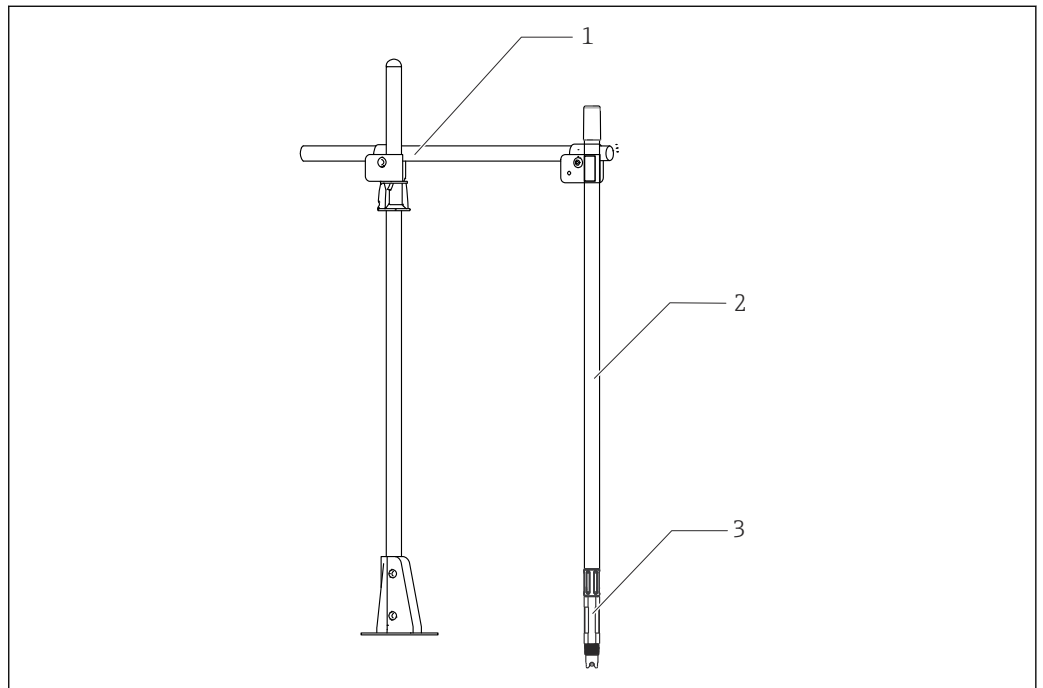
Installation

Installation instructions



A0024681

 3 *Flow installation*



A0024690

 4 *Installation with immersion assembly with Flexdip CYA112*

- 1 *CYH112 holder*
- 2 *CYA112 assembly*
- 3 *Sensor*

- Before screwing in the sensor, make sure the assembly thread, the O-rings and the sealing surface are clean and undamaged and that the thread runs smoothly.
- Pay attention to the installation instructions provided in the Operating Instructions of the assembly used.
- ▶ Screw in the sensor and tighten by hand with a torque of 3 Nm (2.21 lbf ft) (specifications only apply if installing in Endress+Hauser assemblies).



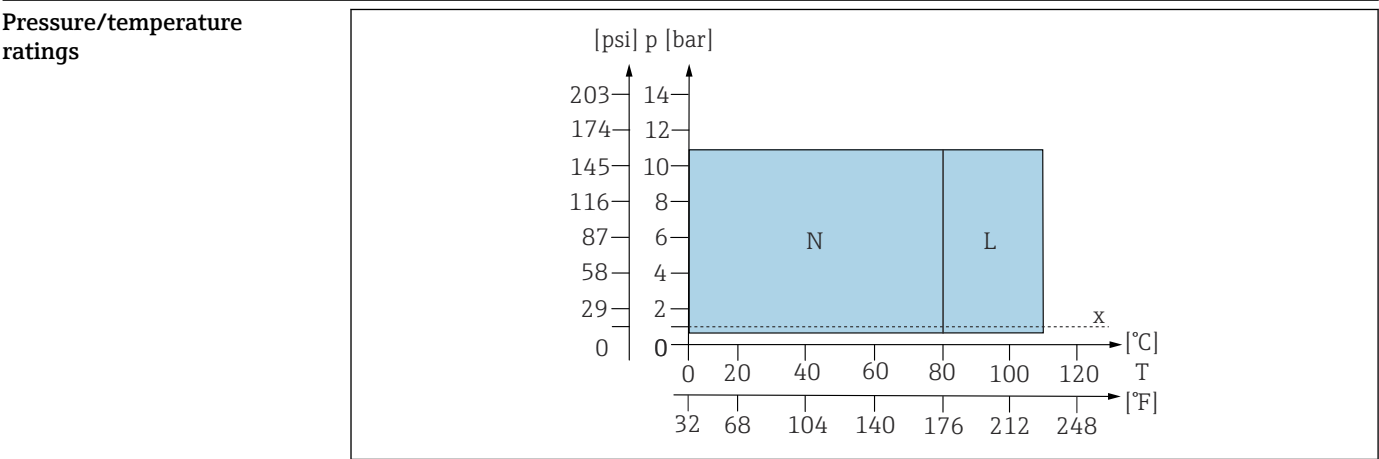
For detailed information on removing the moistening cap, see BA01988C

Environment

Ambient temperature range	NOTICE Risk of damage from frost! ▶ Do not use the sensor at temperatures below .
Storage temperature	0 to 50 °C (32 to 122 °F)
Degree of protection	IP 68 (10 m (33 ft) water column, 25 °C (77 °F), 45 days, 1 M KCl)
Electromagnetic compatibility (EMC)	Interference emission and interference immunity as per: ■ EN 61326-1:2013 ■ EN 61326-2-3:2013 For ESD > 2 kV to 8 kV: reduced accuracy ± 1.5 pH

Process

Process temperature range	■ Application L: 0 to 110 °C (32 to 230 °F) ■ Application N: 0 to 80 °C (32 to 176 °F)
Process pressure range	0.8 to 11 bar (11.6 to 159.5 psi) (absolute) ⚠ CAUTION Pressurization of sensor due to prolonged use under increased process pressure Possibility of sudden rupture and injury from glass splinters! ▶ Avoid fast heating of these pressurized sensors if they are used under reduced process pressure or under atmospheric pressure. ▶ When handling these sensors, always wear protective goggles and appropriate protective gloves.
Conductivity	50 µS/cm (at atmospheric pressure, without flow) (minimized flow; pressure and temperature must remain constant)



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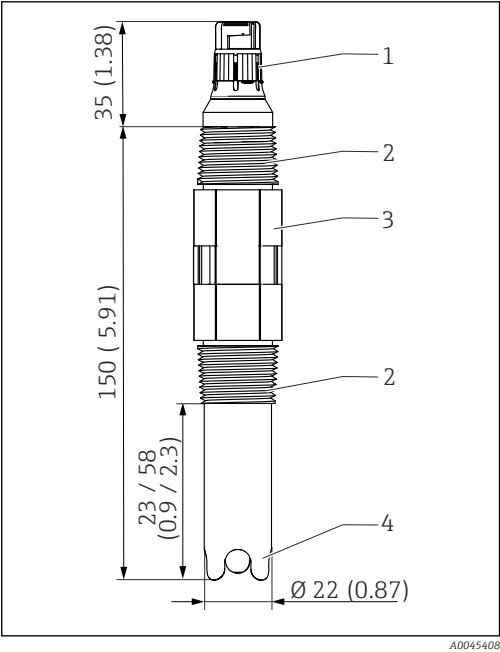
5 Pressure/temperature ratings

- N Application N
- L Application L
- x Atmospheric pressure

Mechanical construction

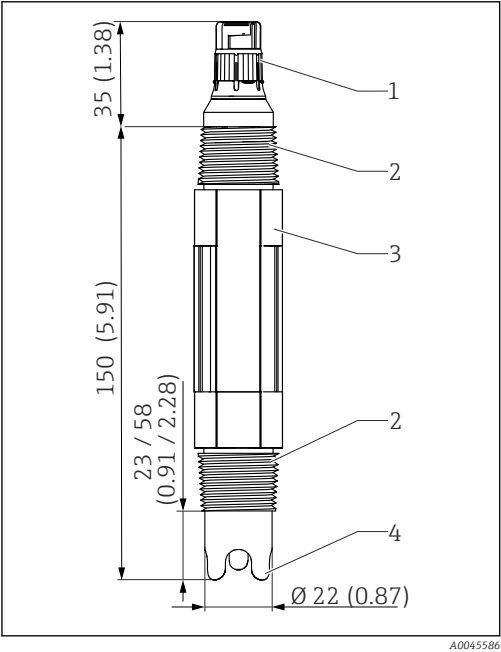
Design, dimensions	Integrated preamplifier (optional)	
Structure	cast in sensor body	
Power supply	via integrated coin cells	
Reference potential:	reference electrode	
 With preamplifier versions, the sensor check function (SCS) of the transmitter is ineffective and should be turned off.		

Dimensions



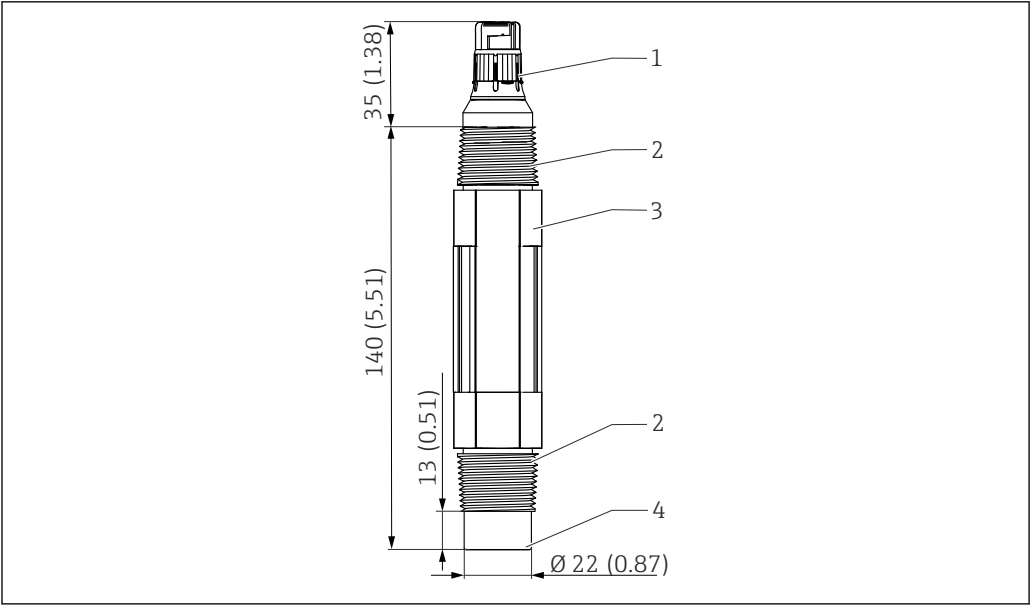
 6 CPF81E with spherical membrane
58 mm (2.3 in). Engineering unit: mm (in)

- 1 Memosens plug-in head
- 2 NPT 3/4" thread
- 3 Width across flats 26
- 4 Protection guard



 7 CPF81E with spherical membrane
23 mm (0.9 in). Engineering unit: mm (in)

- 1 Memosens plug-in head
- 2 NPT 3/4" thread
- 3 Width across flats 26
- 4 Protection guard



8 CPF81E with flat membrane. Engineering unit: mm (in)

- 1 Memosens plug-in head
- 2 NPT 3/4" thread
- 3 Width across flats 26
- 4 Flat membrane

Weight	0.12 to 0.15 kg (0.26 to 0.33 lb), depending on the version and excluding a cable	
Materials	Housing, sensor shaft	PPS
	pH sensor (in contact with medium)	Lead-free membrane glass, suitable for process applications
	Double chamber reference system	KNO ₃ and KCl/AgCl
Plug-in head	Memosens plug-in head for digital, non-contact data transmission, pressure resistance 16 bar (232 psi) (relative)	
Process connections	NPT 3/4"	

Certificates and approvals

CE mark	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.	
Additional certification	TÜV certificate for Memosens plug-in head	
	Pressure resistance 16 bar (232 psi) relative, minimum three times the safety pressure	
	EAC	
	The product has been certified according to guidelines TP TC 004/2011 and TP TC 020/2011 which apply in the European Economic Area (EEA). The EAC conformity mark is affixed to the product.	

Ordering information

Product page	www.endress.com/cpf81e
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.
Scope of delivery	The delivery comprises: ■ Sensor in the version ordered ■ Operating Instructions

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.

Assembly	Flexdip CYA112 ■ 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  Technical Information TI00432C
Measuring cable	Memosens data cable CYK10 ■ For digital sensors with Memosens technology ■ Product Configurator on the product page: www.endress.com/cyk10  Technical Information TI00118C Measuring cable CPK9 ■ Terminated measuring cable for connecting analog sensors with TOP68 plug-in head ■ Selection in accordance with product structure ■ Product Configurator on the product page: www.endress.com/cpk9  Technical Information TI00118C
Buffer solutions	High-quality buffer solutions from Endress+Hauser - CPY20 The secondary buffer solutions have been referenced to primary reference material of the PTB (German Federal Physico-technical Institute) or to standard reference material of NIST (National Institute of Standards and Technology) according to DIN 19266 by a laboratory accredited by the DAkkS (German accreditation body) according to DIN 17025. Product Configurator on the product page: www.endress.com/cpy20



www.addresses.endress.com

APPENDIX B.4 – TRANSMITTER SPECIFICATION

Technical Information

Liquiline CM442/CM444/CM448

Multiparameter transmitter with a maximum of eight measuring channels based on digital Memosens technology



For monitoring and controlling processes in industry and the environmental sector

Applications

- Food and beverages
- Life sciences
- Water and wastewater
- Chemical industry
- Power plants
- Other industrial applications

Your benefits

- Highly flexible:
 - Able to connect up to 8 Memosens sensors
 - Mathematics functions calculate new measured values
- Digital fieldbuses (HART, PROFIBUS, Modbus, Ethernet/IP, PROFINET) and integrated web server
- Choice of cleaning function, controller and alarm relay
- Optional digital or analog inputs/outputs
- Maximum process safety thanks to standardized operating concept across all devices in the Liquiline, sampler and analyzer platform
- Fast commissioning thanks to:
 - Memosens: lab-calibrated sensors & hot plug-and-play
 - Preconfigured Liquiline transmitters
 - Easy extension and adaptation

[Continued from front page]

- Minimum inventory:
 - Cross-platform, modular concept (e.g. identical modules irrespective of parameters)
 - Integration into FieldCare and W@M facilitates effective asset management

Table of contents

Function and system design	5	External power supply	27
Measuring system	5	PFM function	27
Application example	6	Auxiliary voltage	27
		Test voltage	27
		Cable specification	27
Equipment architecture	7	Current outputs, active	28
Slot and port assignment	7	Span	28
Order of the modules	7	Signal characterization	28
Basic rule for hardware upgrades	8	Electrical specification	28
Determining the hardware delivery status	8	Cable specification	28
Terminal diagram	8		
Device configuration using the example of a CM442- **M1A1F0*	10	Relay outputs	28
Block circuit diagram CM442	11	Electrical specification	28
Device configuration using the example of a CM444- **M42A1FA*	12	Cable specification	29
Block circuit diagram CM444	14		
Device configuration using the example of a CM448- **26A1*	16	Protocol-specific data	29
Block circuit diagram CM448	17	HART	29
		PROFIBUS DP	29
Communication and data processing	19	Modbus RS485	29
		Modbus TCP	29
Reliability	19	Ethernet/IP	30
Dependability	19	PROFINET	31
Maintainability	21	Web server	32
Safety	24		
		Power supply	32
Input	25	Supply voltage	32
Measured variables	25	Power consumption	32
Measuring ranges	25	Fuse	32
Types of input	25	Overvoltage protection	32
Input signal	25	Cable entries	33
Cable specification	25	Cable specification	34
		Electrical connection	34
Digital inputs, passive	25	Connecting optional modules	36
Electrical specification	25	Protective ground connection	38
Span	25	Sensor connection	39
Nominal input current	25		
PFM function	25	Performance characteristics	42
Test voltage	25	Response time	42
Cable specification	25	Reference temperature	42
		Measurement error for sensor inputs	42
Current input, passive	25	Measurement error for current inputs and outputs	42
Span	25	Frequency tolerance of digital inputs and outputs	42
Signal characterization	25	Resolution of current inputs and outputs	42
Internal resistance	25	Repeatability	42
Test voltage	26		
		Installation	42
Output	26	Installation requirements	42
Output signal	26	Installation	43
Signal on alarm	27		
Load	27	Environment	44
Linearization/transmission behavior	27	Ambient temperature	44
		Storage temperature	46
Digital outputs, passive	27	Relative humidity	46
Electrical specification	27	Degree of protection	46
		Vibration resistance	46
		Electromagnetic compatibility	47

Electrical safety	47
Pollution degree	47
Pressure compensation to environment	47

Mechanical construction 47

Dimensions	47
Weight	47
Materials	48

Operability 48

display	48
Operation concept	48
Local operation	49
Remote operation	49
Language packages	49

Certificates and approvals 50

Ordering information 50

Product page	50
Product Configurator	50
Scope of delivery	50

Accessories 50

Device-specific accessories	51
Communication-specific accessory	56
Service-specific accessories	56
System components	58
Other accessories	58

Function and system design

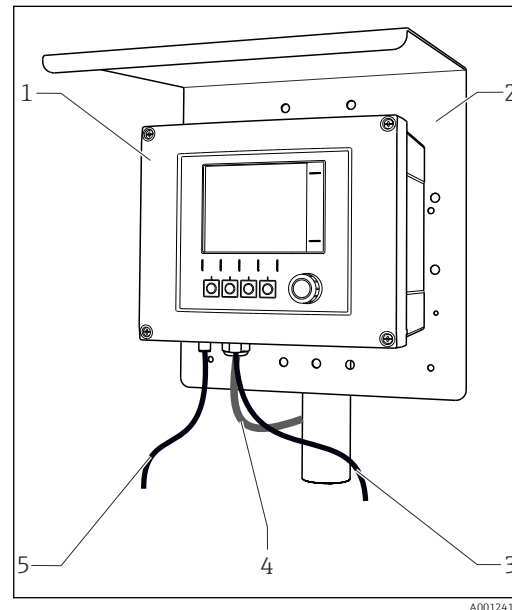
Measuring system

The overview shows examples of measuring systems. Other sensors and assemblies can be ordered for conditions specific to your application (www.endress.com/products).

Measuring point

A complete measuring system comprises:

- Liquiline transmitter
- Sensors with Memosens technology
- Assemblies to suit the sensors used
- Post retainer or railing (optional)
- Weather protection cover (optional)



 1 Measuring system (e.g. two-channel device)

- 1 Liquiline
- 2 Weather protection cover CYY101 (optional)
- 3, 5 Sensor cable CYK10 or fixed cable
- 4 Power supply cable (to be provided by the customer)

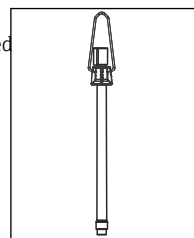
Nitrate and SAC

Nitrate in wastewater

- Sensor CAS51D-**A2 with fixed cable
- Dipfit CYA112 immersion assembly
- CYH112 holder

SAC in the wastewater treatment outlet

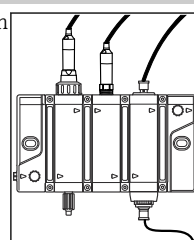
- Sensor CAS51D-**2C2 with fixed cable
- Dipfit CYA112 immersion assembly
- CYH112 holder



Disinfection

Free available chlorine (and pH) in drinking water

- CCS51D sensor
- Memosens CPS11E sensor
- Measuring cable CYK10
- CYA27 flow assembly



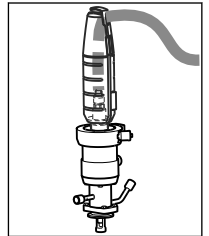
pH value or ORP

pH measurement in drinking water

- Cleanfit CPA871 retractable assembly
- Memosens CPS11E sensor
- Measuring cable CYK10

ORP in drinking water

- Dipfit CYA112 immersion assembly
- Memosens CPS12E sensor
- Measuring cable CYK10



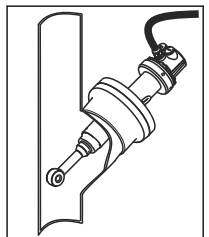
Conductivity

Inductive conductivity measurement in wastewater treatment

- Indumax CLS50D sensor
- Sensor fixed cable

Conductive conductivity measurement in power plant cooling water

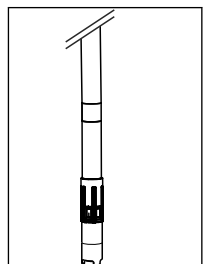
- Memosens CLS15E sensor
- Measuring cable CYK10



Oxygen

Oxygen in aeration basins

- Dipfit CYA112 immersion assembly
- CYH112 holder
- Sensor
 - COS61D (optical) with fixed cable
 - COS51E (amperometric), CYK10 cable



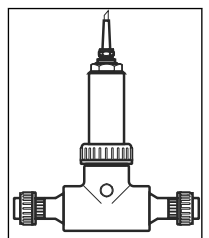
Turbidity and interface

Turbidity in industrial water

- Turbimax CUS51D sensor with fixed cable
- Flowfit CUA250 assembly
- CUR3 spray head (optional)

Interface in the primary clarifier

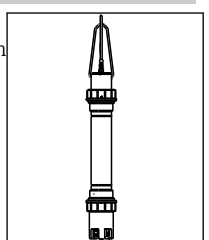
- Turbimax CUS71D sensor
- CYA112 assembly
- CYH112 holder



Ion-selective electrodes

Ammonium and nitrate measurement in the aeration basin

- CAS40D sensor with fixed cable
- CYH112 holder

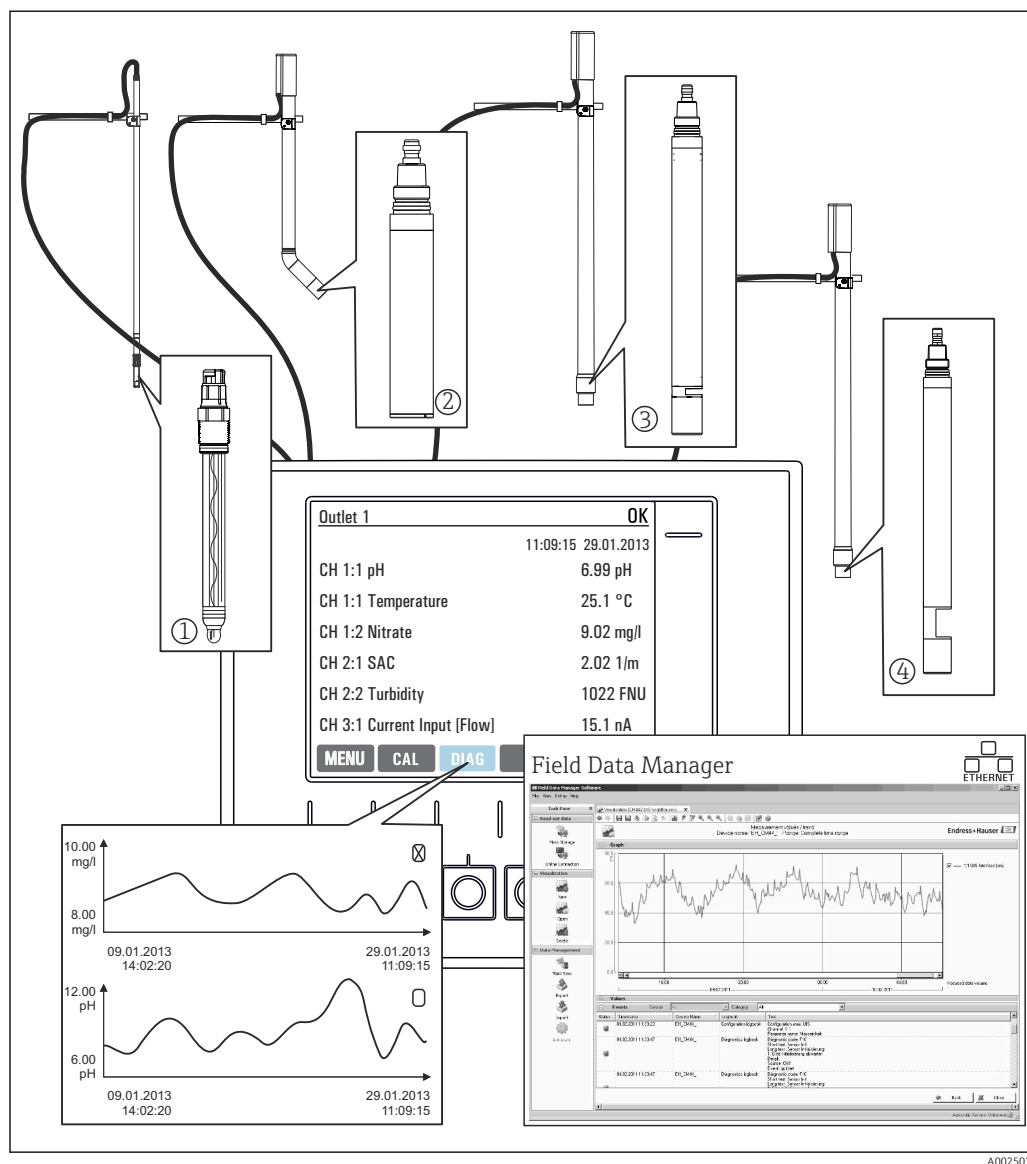


i If mounting outdoors, always use the weather protection cover (see "Accessories") to protect the transmitter against weather conditions.

Application example

Measuring point at wastewater treatment plant outlet (open channel)

- Transmitter CM444-AAM44A0FF with:
 - 4 x Memosens, Modbus TCP, 4 x relays for cleaning/limit value, 2 x analog current input
- pH and temperature with CPS11E, item 1 (www.endress.com/cps11e)
- Turbidity with CUS51D, item 2 (www.endress.com/cus51d)
- Nitrate with CAS51D, item 3 (www.endress.com/cas51d)
- Spectral absorption coefficient with CAS51D, item 4 (www.endress.com/cas51d)
- Flow from external measurement via current input
- Assembly holder CYH112 with assemblies CYA112 (www.endress.com/cyh112)



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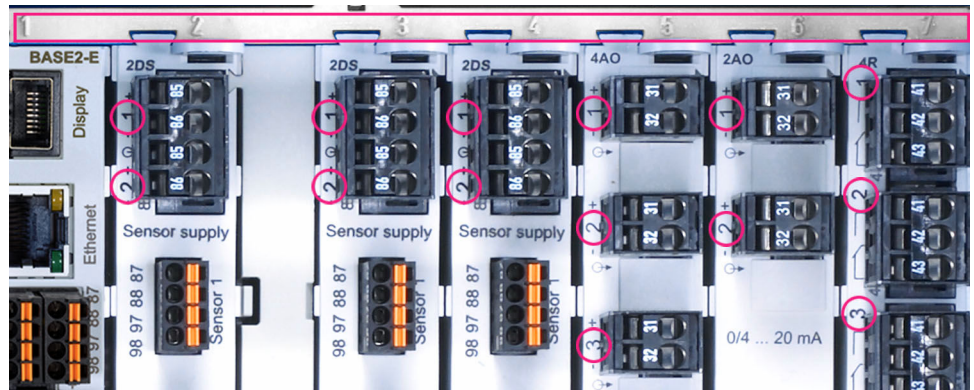
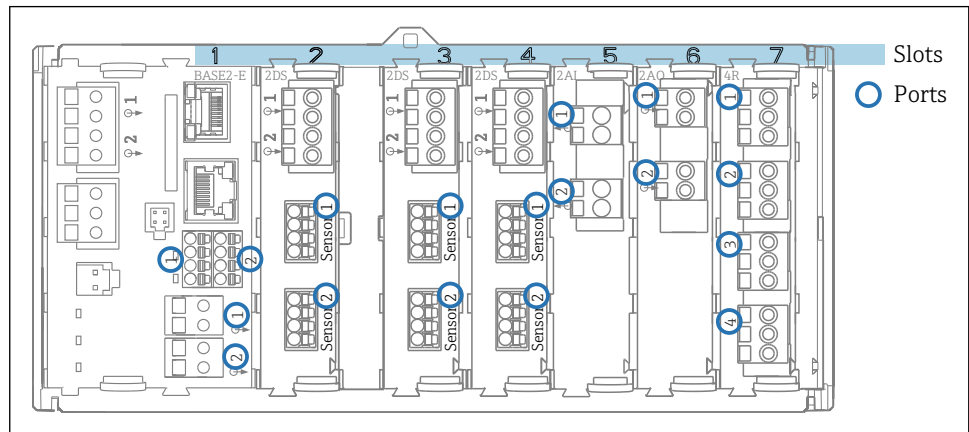
2 Measuring point at wastewater treatment plant outlet

Data retention

- Storage of all measured values, incl. values of external sources, in the non-volatile memory (data logbook)
- Data called up on site via user-defined measuring menu and load curve display of the data logbook
- Transmission of data by Ethernet, CDI interface or SD card and storage in a tamper-proof database (Field Data Manager)
- Data export to CSV file (for Microsoft Excel)

Equipment architecture

Slot and port assignment



3 Slot and port assignment of the hardware modules

Outlet 1	OK
CH1: 1:1 pH Glass ATC 6.95 pH	Port
CH2: 1:2 TU/TS 500.0 g/l	Slot
CH3: 5:1 SAC 500.0 1/m	
CH4: 5:2 Cond i ATC 2.62 mS/cm	
CH5: 6:1 Chlorine 28.33 mg/l	
CH6: 6:2 Redox $\pm$ 51 mV	
CH7: 7:1 Oxygen (am... 32.86 mg/l	
CH8: 7:2 Cond c ATC 131.1 pS/cm	
MENU CAL DIAG HOLD	

4 Slot and port assignment on the display

- Inputs are assigned to measuring channels in the ascending order of the slots and ports. Adjacent example: "CH1: 1:1 pH glass" means: Channel 1 (CH1) is slot 1 (basic module) : Port 1 (input 1), pH glass sensor
- Outputs and relays are named according to their function, e.g. "current output", and are displayed in ascending order with the slot and port numbers

Order of the modules

Depending on the version ordered, the device is supplied with a number of electronic modules, which are assigned in a specific sequence in ascending order to slots 0 to 7. If you do not have a particular module, the next moves up automatically:

- The basic module (which is always present) always occupies slots 0 and 1
- Fieldbus module 485DP or 485MB
- Memosens input module 2DS (DS = digital sensor)
- Extension module for digital inputs and outputs DIO (DIO = digital input and output)
- Current input module 2AI (AI = analog input)
- Current output modules 4AO or 2AO (AO = analog output)
- Relay modules AOR, 4R or 2R (AOR = analog output + relay, R = relay)

With intrinsically safe sensor communication module 2DS Ex-i:

- CM442/CM442R: always in slot 2
- CM444/CM444R: always in slot 7 (two channel) and slot 6 (four channel)
- CM448/CM448: slot 7, 6, 5



Modules with 4 ports are connected before modules of the same type with 2 ports.

Basic rule for hardware upgrades**Please note the following if upgrading the device:**

- Upgrade only to 1x 4 AO module possible
- A maximum of two "DIO" modules may be used.

Determining the hardware delivery status

You must be aware of the type of modules and the number of them supplied with the device you have ordered to determine the delivery status of your Liquiline.

- Basic module
One basic module in all versions. Always occupies slots 0 and 1.
- Fieldbus module
Optional, and only one fieldbus module is possible.
- Input modules
 - Must be clearly assigned to the number of optional inputs ordered.
 - Examples:
2 current inputs = module 2AI
4 Memosens inputs = 2 inputs with basic module + module 2DS with 2 further inputs
- Current outputs and relays
Various module combinations can exist.
The following table will help you determine which modules your device has, depending on the type and number of outputs.

Current outputs	Relays		
	0	2	4
2	-	1 x 2R	1 x 4R
4	1 x 2AO	1 x AOR	1 x 2AO + 1 x 4R
6	1 x 4AO	1 x 4AO + 1 x 2R	1 x 4AO + 1 x 4R
8	1 x 4AO + 1 x 2AO	1 x 4AO + 1 x 2AO + 1 x 2R	1 x 4AO + 1 x 2AO + 1 x 4R

- Sum up the number of modules and sort them according to the specified sequence → 7.
↳ This will give you the slot assignment for your device.

Terminal diagram

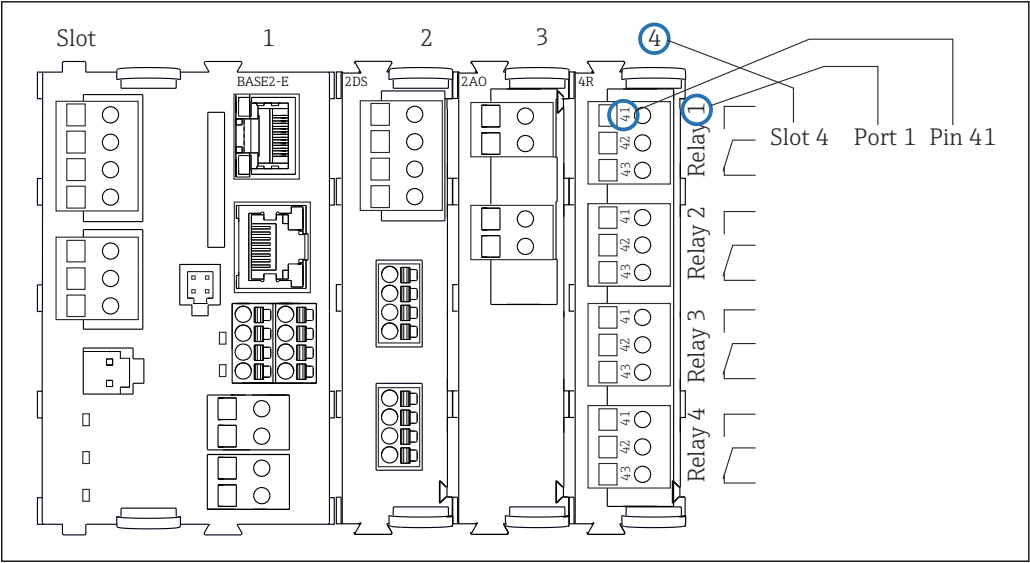
The unique terminal name is derived from:

Slot no. : Port no. : Terminal

Example, NO contact of a relay

Device with 4 inputs for digital sensors, 4 current outputs and 4 relays

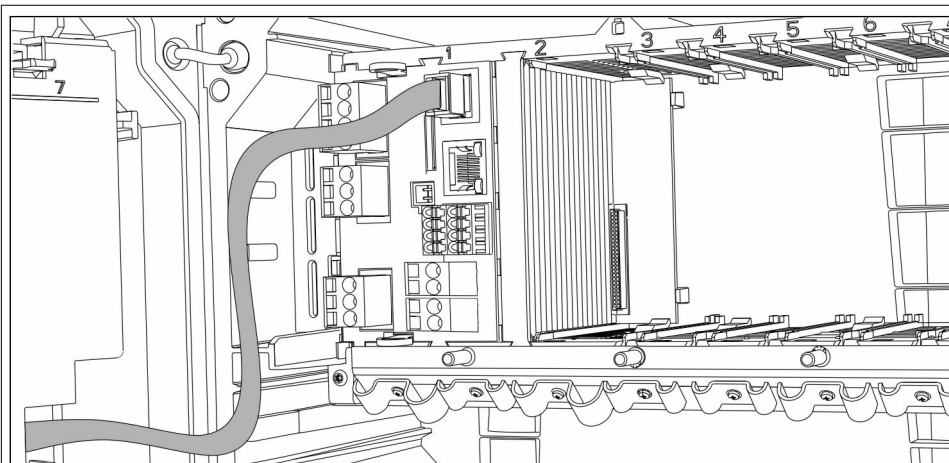
- Base module BASE2-E (contains 2 sensor inputs, 2 current outputs)
- 2DS module (2 sensor inputs)
- 2AO module (2 current outputs)
- 4R module (4 relays)



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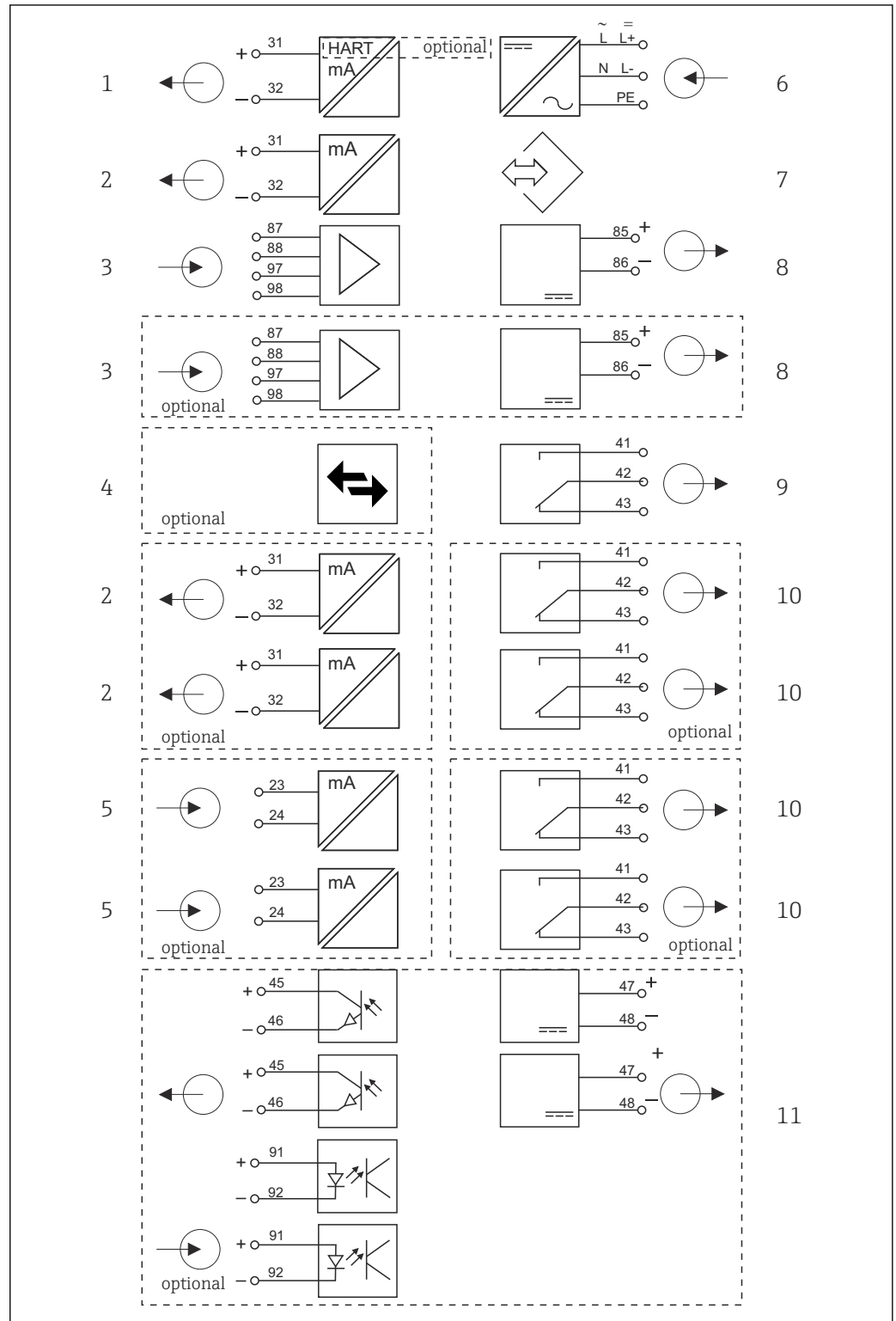
5 Creating a terminal diagram using the example of the NO contact (terminal 41) of a relay

Device configuration using
the example of a CM442-
**M1A1F0*



Ordered basic device (example)	- Order code CM442-**M1A1F0* - Functionality: 1 x Memosens, 2 current outputs without HART
Extension options without additional modules	Activation with activation code: - Second Memosens input (71114663) - HART (71128428) - EtherNet/IP + web server (71449914) - Modbus TCP + web server (71449915) - PROFINET + web server (71449901) - Web server (71449918)
Extension options by using an extension module in free slot 2	PROFIBUS DP with module 485DP or Modbus RS485 with module 485MB: - PROFIBUS DP Module 485DP (71575177) - Modbus RS485 Module 485MB (71575178) i If module 485DP or 485MB is retrofitted, any existing current outputs are disabled! Additional inputs or outputs, relays: - Module 2AI (71135639): 2 current inputs - Module 2AO (71135632): 2 current outputs - Module AOR (71111053): 2 current outputs, 2 relays - Module 2R (71125375) or 4R (71125376): 2 or 4 relays - Module DIO (71135638): 2 digital inputs and 2 digital outputs
Device upgrade to CM444 or CM448	- Upgrade kit 71470973 (100 to 230 V AC) or 71470975 (24 V DC) - Extension power supply unit and backplane - Basic module BASE2-E (Memosens inputs same as for base device) 6 slots for extension modules - Extension options: - Second Memosens input (71114663), additional modules same as for CM442 - Up to 8 measuring channels by using an appropriate number of Memosens input modules 2DS (71135631)
Basic rule for extensions	The sum of all current inputs and outputs must not exceed 8.
Restrictions if using CUS71D sensors for interface measurement	- CM442: Only one CUS71D can be connected. The second Memosens input may not be used. - If extending to CM444: Every combination of CUS71D or other sensors is possible. All Memosens inputs (max. 4) can be used. - An extension to CM448 is not advisable as the maximum number of Memosens inputs remains limited to 4.
Product Configurator	www.endress.com/cm442

Block circuit diagram CM442

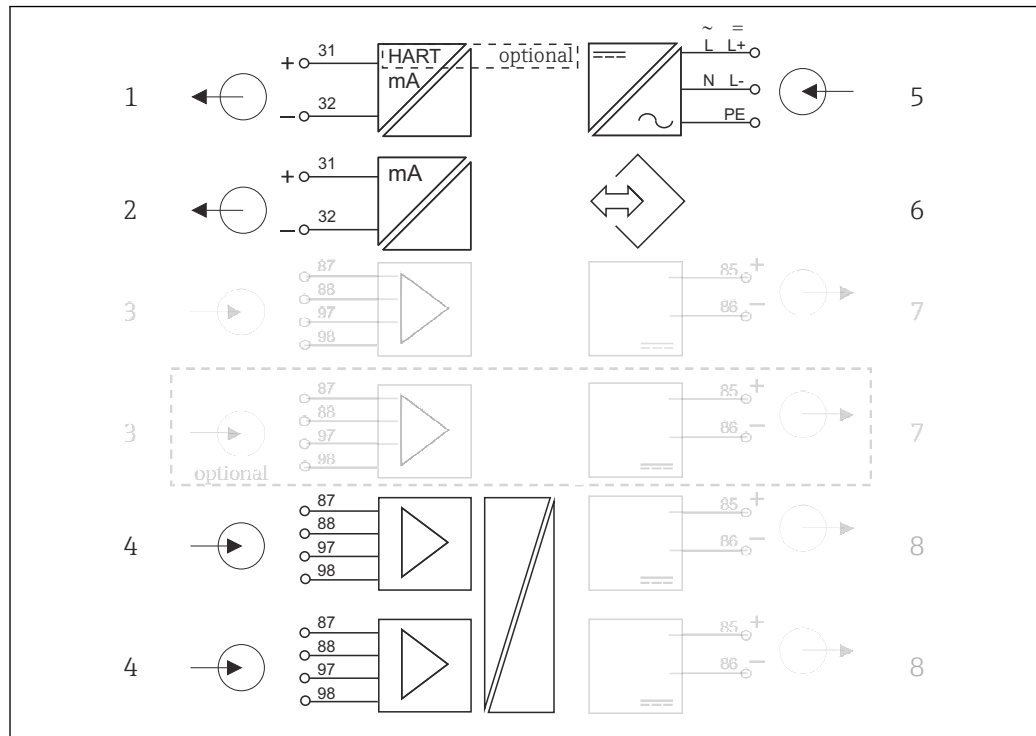


6 Function diagram CM442

- 1 Current output 1:1, + HART (optional)
- 2 Current outputs (2 x optional)
- 3 2 x Memosens input (1 x optional)
- 4 PROFIBUS DP/Modbus/Ethernet (optional)
- 5 2 x current input (optional)

- 6 Power supply
- 7 Service interface
- 8 Power supply, fixed cable sensors
- 9 Alarm relay
- 10 2 or 4 x relays (optional)
- 11 2 digital inputs and outputs (optional)

Block circuit diagram CM442 with sensor communication module 2DS Ex-i

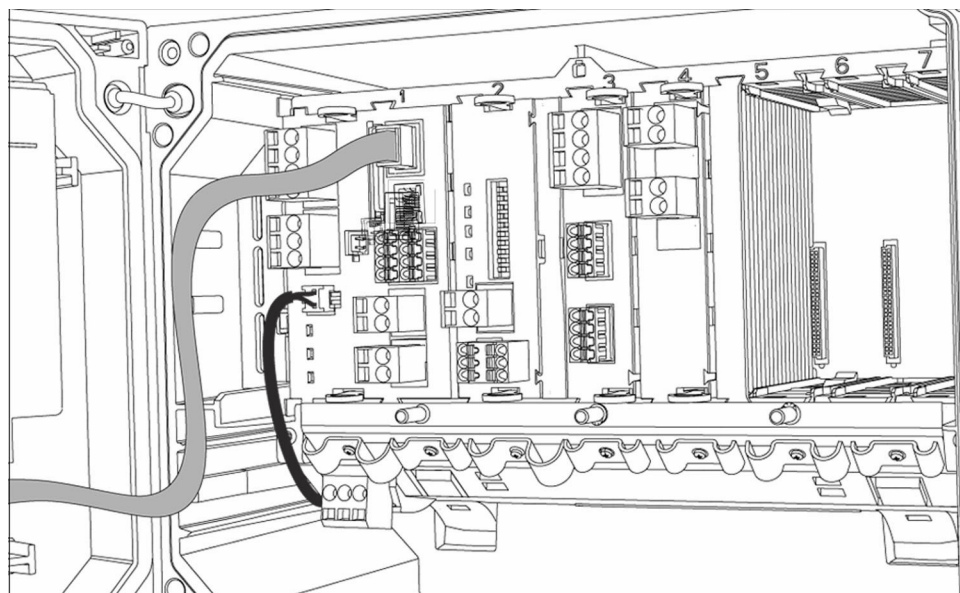


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7 Block circuit diagram CM442 with intrinsically safe sensor communication module 2DS Ex-i

- | | | | |
|---|---|---|--|
| 1 | Current output 1:1, + HART (optional) | 5 | Power supply |
| 2 | Current outputs (2 x optional) | 6 | Service interface |
| 3 | 2 x Memosens input BASE2 (disabled) | 7 | Power supply, fixed cable sensors BASE2 (disabled) |
| 4 | 2 x Memosens input 2DS Ex-i for intrinsically safe Memosens sensors | 8 | Power supply, fixed cable sensors |

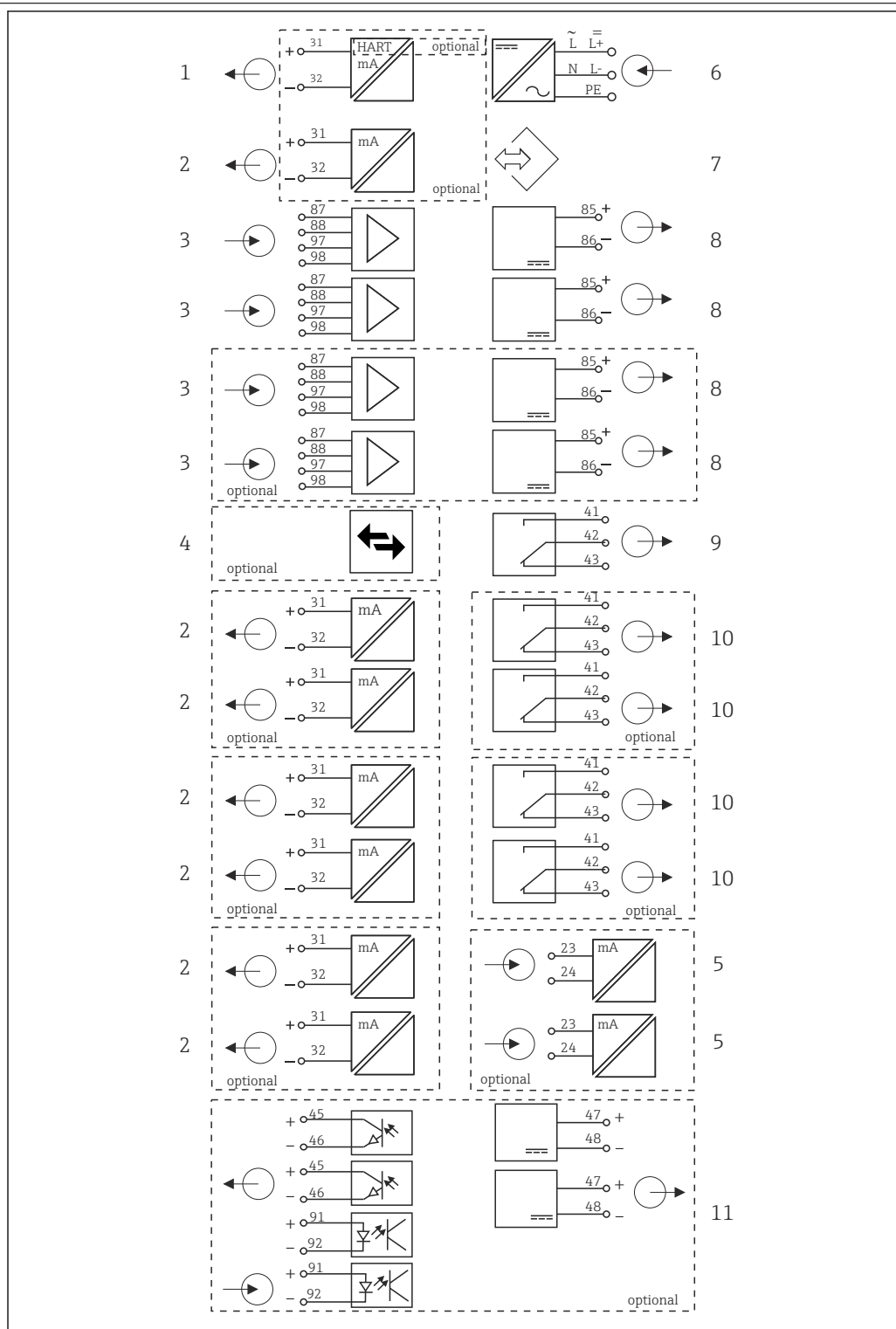
Device configuration using
the example of a CM444-
**M42A1FA*



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Ordered basic device (example)	- Order code CM444-**M42A1FA* - Functionality: 4 x Memosens (2 on BASE2-E module + 2 on an extension module 2DS) - PROFIBUS communication (module 485DP) - Web server (BASE2-E module) 2 current outputs without HART (on BASE2-E module) 2 current inputs (module 2AI) 3 slots are still free in this example. More or fewer slots can be free in other versions.
Extension options without additional modules	None
Modification options without additional modules	Retrofit by removing module 485DP and entering the activation code for: - Modbus TCP + web server (71449915) - EtherNet/IP + web server (71449914) - PROFINET + web server (71449901) - HART (71128428) - Web server (71449918)
Modification options by replacing existing modules	Change the communication type by replacing module 485DP with module 485MB. This disables the communication type used previously! Module 485MB: Modbus RS485 + web server (Order No. 71575178)
Extension options by using extension modules in free slots 5-7	Only the following is possible for the example above: - Module 2R (71125375) or 4R (71125376): 2 or 4 relays - Module DIO (71135638): 2 digital inputs and 2 digital outputs If extending to 8 measuring channels: Module 2DS (71135631): 2 Memosens inputs Additional inputs or outputs and relays if fieldbus module 485DP is removed: - Module 2AO (71135632): 2 current outputs - Module AOR (71111053): 2 current outputs, 2 relays - Module 2R (71125375) or 4R (71125376): 2 or 4 relays - Module DIO (71135638): 2 digital inputs and 2 digital outputs  If module 485DP is removed and an Ethernet-based fieldbus is used via BASE2-E module, a maximum of up to 6 current outputs can be operated in addition. Only two current outputs are possible with module 485DP.
Basic rule for extensions	The sum of all current inputs and outputs must not exceed 8.
Restrictions if using CUS71D sensors for interface measurement	- In the case of CM444, every combination of Memosens sensors (max. 4) is possible. - An extension to CM448 is not advisable as the maximum number of Memosens inputs when using CUS71D remains limited to 4.
Product Configurator	www.endress.com/cm444

Block circuit diagram CM444

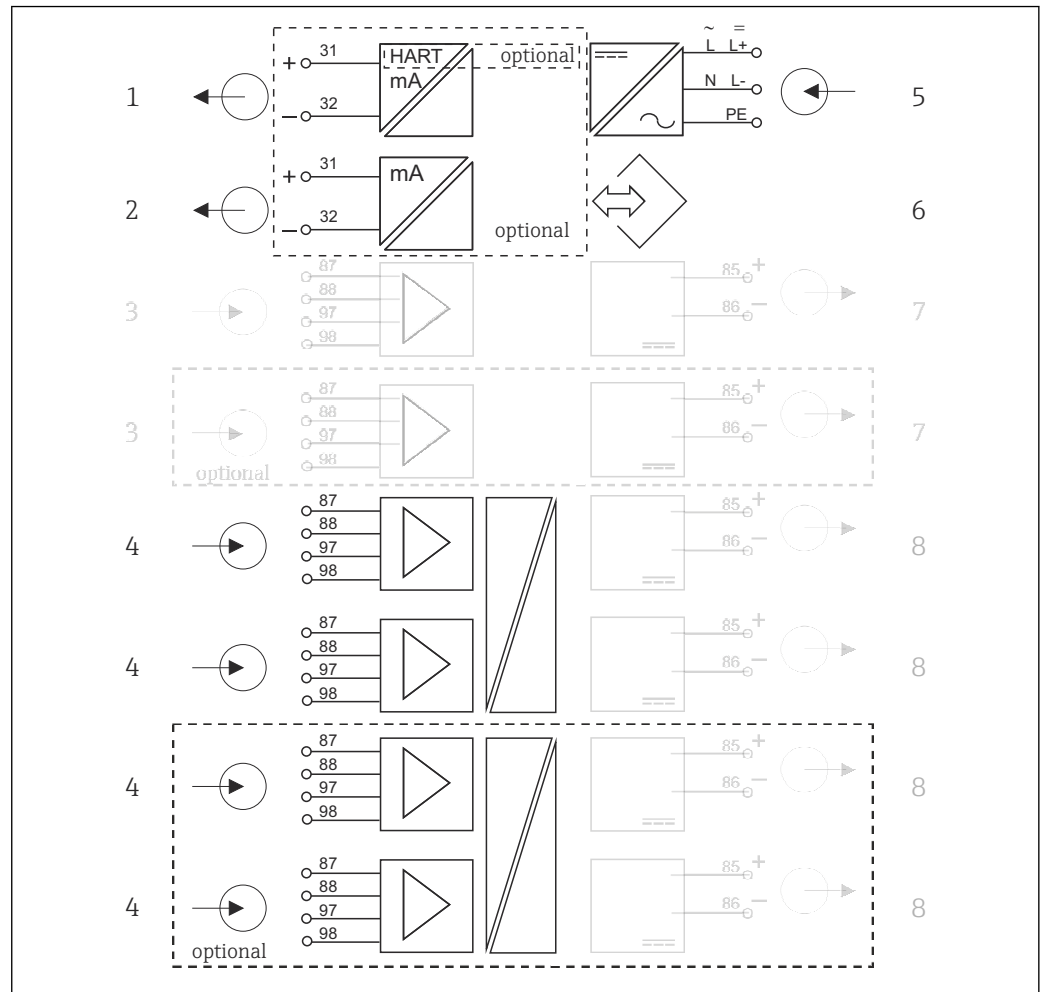


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8 Function diagram CM444

- | | | | |
|---|--|----|---|
| 1 | Current output 1:1, + HART (both optional) | 6 | Power supply |
| 2 | Max. 7 x current output (optional) | 7 | Service interface |
| 3 | Memosens input (2 x standard + 2 x optional) | 8 | Power supply, fixed cable sensors |
| 4 | PROFIBUS DP/Modbus/Ethernet (optional) | 9 | Alarm relay |
| 5 | 2 x current input (optional) | 10 | 2 or 4 x relays (optional) |
| | | 11 | 2 digital inputs and outputs (optional) |

Block circuit diagram CM444 with sensor communication module 2DS Ex-i

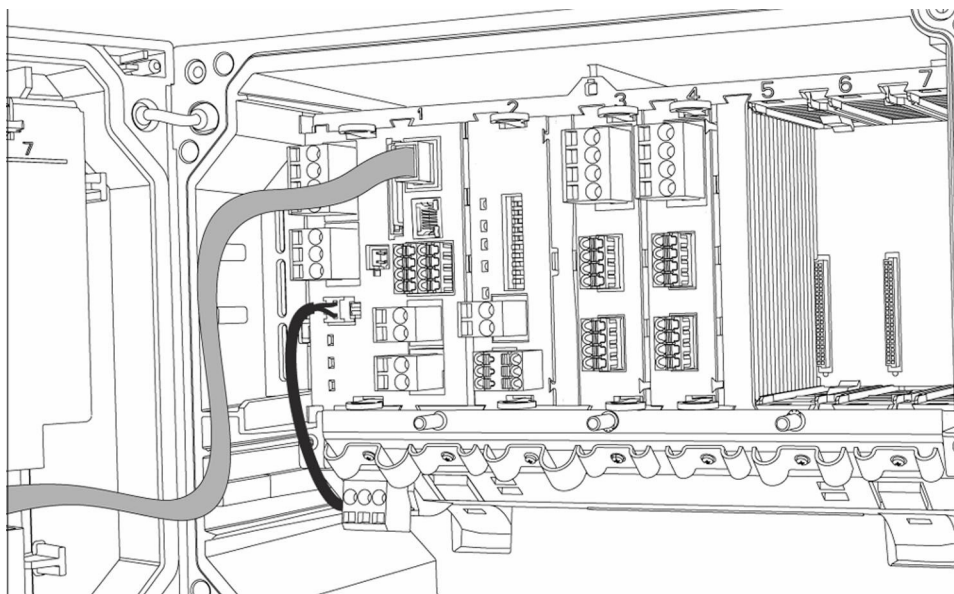


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9 Block circuit diagram CM444 with intrinsically safe sensor communication module 2DS Ex-i

- | | | | |
|---|---|---|--|
| 1 | Current output 1:1, + HART (optional) | 5 | Power supply |
| 2 | Current outputs (2 x optional) | 6 | Service interface |
| 3 | 2 x Memosens input BASE2 (disabled) | 7 | Power supply, fixed cable sensors BASE2 (disabled) |
| 4 | 2 x Memosens input 2DS Ex-i for intrinsically safe Memosens sensors | 8 | Power supply, fixed cable sensors |

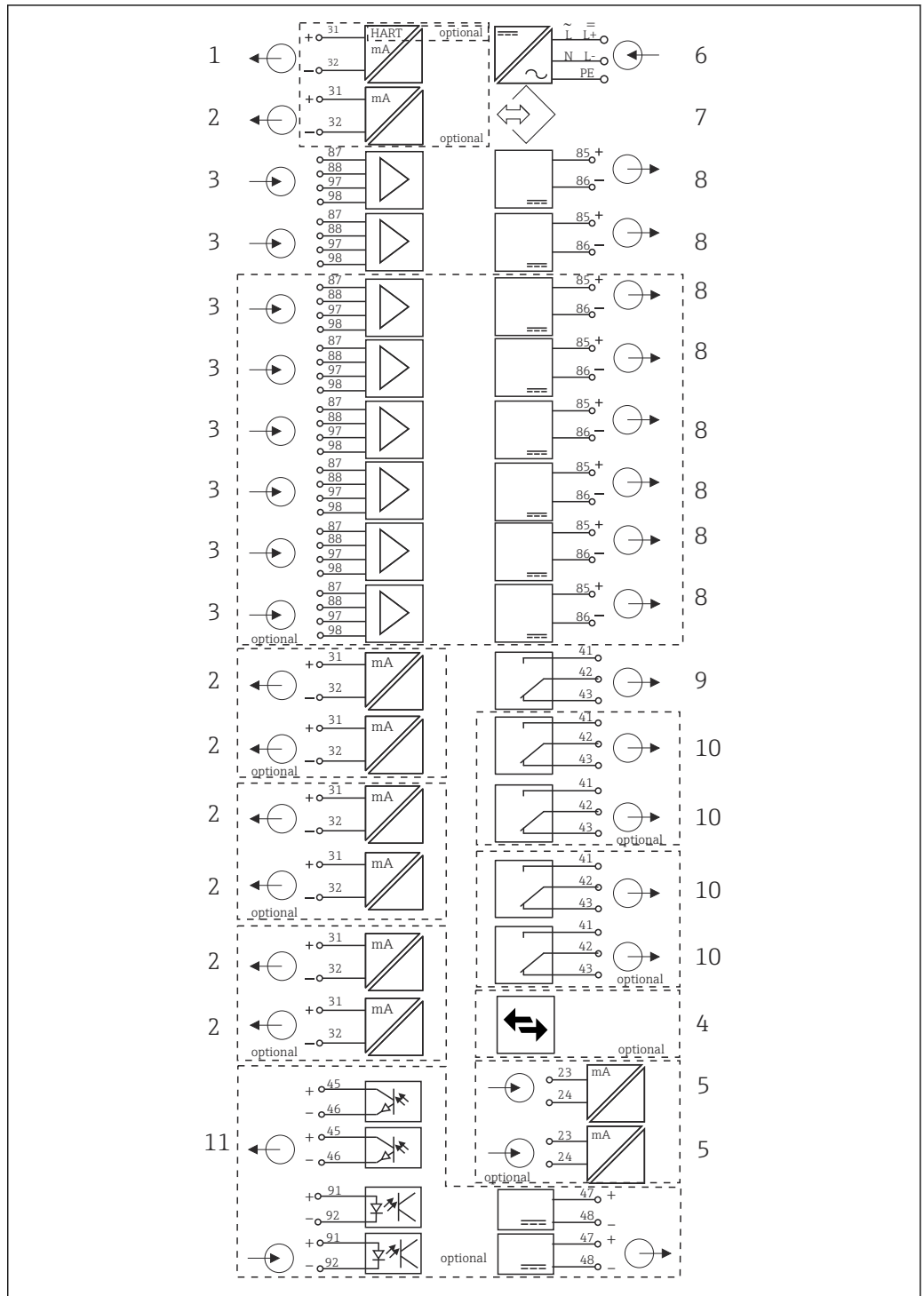
Device configuration using
the example of a CM448-
**26A1*



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Ordered basic device (example)	- Order code CM448-**26A1* - Functionality: 6 x Memosens (2 on BASE2-E module + 2 on two 2DS extension modules) - PROFIBUS communication (module 485DP) - Web server (BASE2-E module) 3 slots are still free in this example. More or fewer slots can be free in other versions.
Extension options without additional modules	Activation code for the use of current outputs of the basic module: 2 current outputs (71140891)
Modification options without additional modules	Retrofit by removing module 485DP and entering the activation code for communication via the BASE2 module: - Modbus TCP + web server (71449915) - EtherNet/IP + web server (71449914) - PROFINET + web server (71449901) - HART (71128428) - Web server (71449918)
Modification options by replacing existing modules	Change the communication type by replacing module 485DP with module 485MB. This disables the communication type used previously! Module 485MB: Modbus RS485 + web server (Order No. 71575178)
Extension options by using extension modules in free slots 5-7	If extending to 8 measuring channels: Module 2DS (71135631): 2 Memosens inputs Additional inputs or outputs, relays: - Module 2AO (71135632): 2 current outputs - Module 2AI (71135639): 2 current inputs - Module AOR (71111053): 2 current outputs, 2 relays - Module 2R (71125375) or 4R (71125376): 2 or 4 relays - Module DIO (71135638): 2 digital inputs and 2 digital outputs i If module 485DP is removed and an Ethernet-based fieldbus is used, a maximum of up to 6 current outputs can be operated in addition. Only two current outputs are possible with module 485DP.
Basic rule for extensions	The sum of all current inputs and outputs must not exceed 8.
Restrictions if using CUS71D sensors for interface measurement	The maximum number of Memosens inputs that can be used is limited to 4! Here, every combination of CUS71D and other Memosens sensors is then possible.
Product Configurator	www.endress.com/cm448

Block circuit diagram CM448

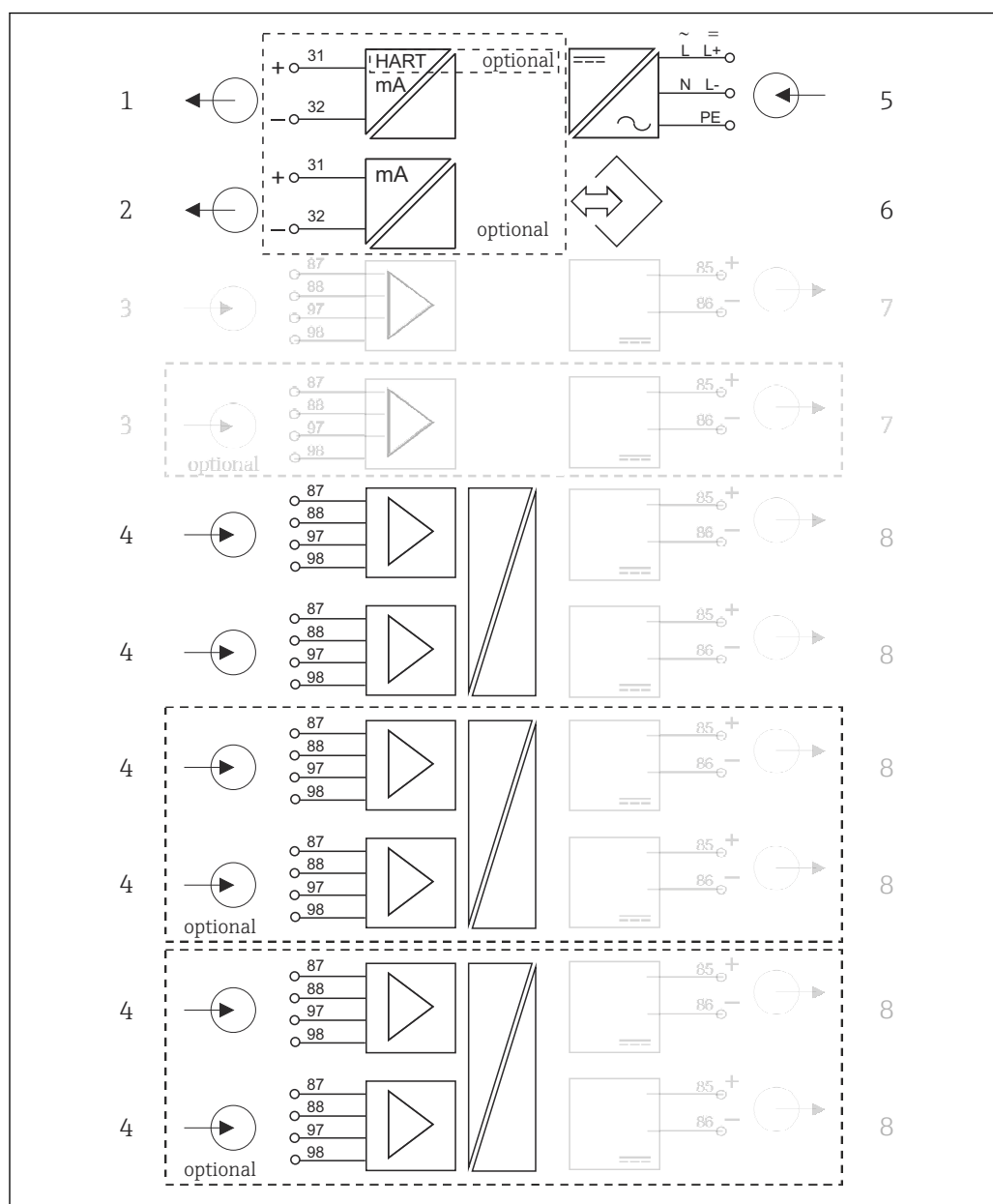


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10 Function diagram CM448

- | | | | |
|---|--|----|---|
| 1 | Current output 1:1, + HART (both optional) | 7 | Service interface |
| 2 | Max. 7 x current output (optional) | 8 | Power supply, fixed cable sensors |
| 3 | Max 8 x Memosens input (2 x of which are optional) | 9 | Alarm relay |
| 4 | PROFIBUS DP/Modbus/Ethernet (optional) | 10 | 2 or 4 x relays (optional) |
| 5 | 2 x current input (optional) | 11 | 2 digital inputs and outputs (optional) |
| 6 | Power supply | | |

Block circuit diagram CM448 with sensor communication module 2DS Ex-i



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11 Block circuit diagram CM448 with intrinsically safe sensor communication module 2DS Ex-i

- | | | | |
|---|---|---|--|
| 1 | Current output 1:1, + HART (optional) | 5 | Power supply |
| 2 | Current outputs (2 x optional) | 6 | Service interface |
| 3 | 2 x Memosens input BASE2 (disabled) | 7 | Power supply, fixed cable sensors BASE2 (disabled) |
| 4 | 2 x Memosens input 2DS Ex-i for intrinsically safe Memosens sensors | 8 | Power supply, fixed cable sensors |

Communication and data processing

Communication protocols:

Fieldbus systems

- HART
- PROFIBUS DP (Profile 3.02)
- Modbus TCP or RS485
- PROFINET
- EtherNet/IP



Only one type of fieldbus communication can ever be active. The last activation code entered decides which bus is used.

The device drivers available make it possible to perform a basic setup and display measured values and diagnostics information via the fieldbus. A full device configuration via the fieldbus is not possible.

Extension module 485DP/485MB and current outputs

For PROFIBUS DP and Modbus RS485 communication protocols:

- CM442
Current outputs cannot be used in parallel. Any existing current outputs are deactivated with the installation of 485DP/485MB.
PROFIBUS DP and Modbus RS485 are not possible in conjunction with the sensor communication module 2DS Ex-i.
- CM444/CM448
A maximum of 2 current outputs can be used in parallel.

Ethernet functionality via Base2 module and current outputs

- CM442
A maximum of 2 current outputs can be used in parallel.
- CM444 and CM448
A maximum of 6 current outputs can be used in parallel.

Bus termination on the device

- Via slide switch at bus module 485DP/485MB
- Displayed via LED "T" on bus module 485DP/485MB

Reliability

Dependability

Memosens

Memosens makes your measuring point safer and more reliable:

- Non-contact, digital signal transmission enables optimum galvanic isolation
- No contact corrosion
- Completely watertight
- Sensor can be calibrated in a lab, thus increasing the availability of the measuring point in the process
- Intrinsically safe electronics mean operation in hazardous areas is not a problem.
- Predictive maintenance thanks to recording of sensor data, e.g.:
 - Total hours of operation
 - Hours of operation with very high or very low measured values
 - Hours of operation at high temperatures
 - Number of steam sterilizations
 - Sensor condition

Heartbeat diagnostics

- Heartbeat diagnostics screen with graphic indicators for the health of the device and sensor and with a maintenance or (sensor-dependent) calibration timer
- Heartbeat status information on the health of the device and condition of the sensor
 - ☺: Sensor/device condition and maintenance timer > 20 %; no action is required
 - ☹: Sensor/device condition or maintenance timer > 5 ≤ 20 %, maintenance not yet urgent but should be scheduled
 - ☹: Sensor/device condition or maintenance timer < 5 %, maintenance is recommended
- The Heartbeat sensor condition is the assessment of the calibration results and the sensor diagnostic functions.

An unhappy smiley can be due to the calibration result, the measured value status or to the operating hours limit having been exceeded. These limits can be configured in the sensor setup in a way that adapts the Heartbeat diagnostics to the application.

Heartbeat and NAMUR category

The Heartbeat status indicates the sensor or device condition while the NAMUR categories (F, C, M, S) assess the reliability of the measured value. The two conditions can correlate but do not have to.

■ Example 1

- The number of remaining cleaning cycles for the sensor reaches 20% of the defined maximum number. The Heartbeat symbol changes from ☺ to ☹. The measured value is still reliable so the NAMUR status signal does not change.
- If the maximum number of cleaning cycles is exceeded, the Heartbeat symbol changes from ☹ to ☹. While the measured value can still be reliable, the NAMUR status signal changes to M (maintenance required).

■ Example 2

The sensor breaks. The Heartbeat status changes immediately from ☺ to ☹ and the NAMUR status signal also changes immediately to F (failure).

Heartbeat Monitoring

Sensor data from Memosens sensors are transmitted via the EtherNet/IP, PROFINET, PROFIBUS DP, HART, Modbus RTU and Modbus TCP fieldbus protocols. These data can be used for predictive maintenance, for instance.

Examples include:

- Total hours of operation
- Hours of operation with very high or very low measured values
- Hours of operation at high temperatures
- Number of steam sterilizations
- Sensor identification
- Calibration information

 For detailed information on "Ethernet/IP communication", see the product pages on the Internet (→ SD01293C).

 For detailed information on "Modbus communication", see the product pages on the Internet (→ SD01189C).

 For detailed information on "PROFINET communication", see the product pages on the internet (→ SD02490C).

 For detailed information on "PROFIBUS communication", see the product pages on the Internet (→ SD01188C).

 More detailed information on HART communication is provided on the product pages on the Internet (→ SD01187C).

Heartbeat Verification

Heartbeat Verification makes it possible to verify the correct operation of the measuring device without interrupting the process. This verification can be documented anytime.

Sensor Check System (SCS)

The Sensor Check System (SCS) monitors the high impedance of the pH glass. An alarm is issued if a minimum impedance value is undershot or a maximum impedance is exceeded.

- Glass breakage is the main reason for a drop in high impedance values
- The reasons for increasing impedance values include:
 - Dry sensor
 - Worn pH glass membrane

 For the SCS, upper and lower limit values can be enabled or disabled independently of one another.

Process Check System (PCS)

The process check system (PCS) checks the measuring signal for stagnation. An alarm is triggered if the measuring signal does not change over a specific period (several measured values).

The main causes of stagnating measured values are:

- Contaminated sensor, or sensor outside of medium
- Sensor defective
- Process error (e.g. through control system)

Self-monitoring functions

Current inputs are deactivated in the event of overcurrent and reactivated once the overcurrent stops. Board voltages are monitored and the board temperature is also measured.

USP and EP

The limit functions for pharmaceutical water in accordance with USP and EP specifications are implemented in the software for conductivity measurements:

- "Water for Injection" (WFI) as per USP <645> and EP
- "Highly Purified Water" (HPW) as per EP
- "Purified Water" (PW) as per EP

The uncompensated conductivity value and the temperature are measured for the USP/EP limit functions. The measured values are compared against the tables defined in the standards. An alarm is triggered if the limit value is exceeded. Furthermore, it is also possible to configure an early warning alarm that signals undesired operating states before they occur.

ChemocleanPlus

Freely programmable sequence control

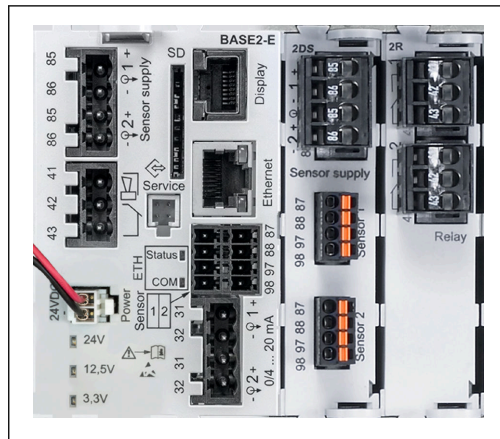
- e.g. for automatic sensor cleaning in retractable assemblies for reliable measurement results in processes with a high risk of contamination
- Individual, time-based activation of 4 outputs e.g. relays
- Starting, stopping or pausing of activities via digital input or fieldbus signals e.g. from limit position switches

Maintainability

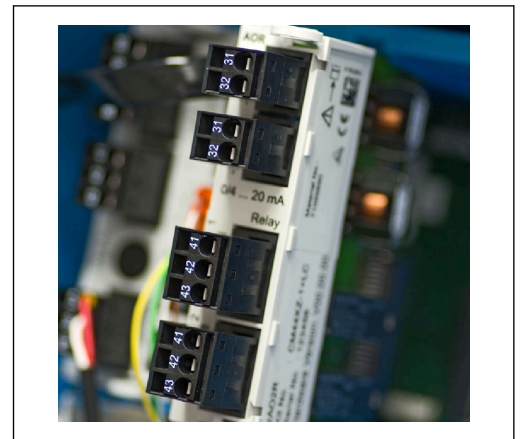
Modular design

The modular transmitter design means it can be easily adapted to suit your needs:

- Retrofit extension modules for new or extended range of functions, e.g. current outputs, relays and digital communication
- Upgrade to maximum eight-channel measurement
- Optional: M12 sensor connector for connecting any kind of Memosens sensor
- Optional: CDI connector for external access to the service interface (avoids having to unscrew the housing cover)



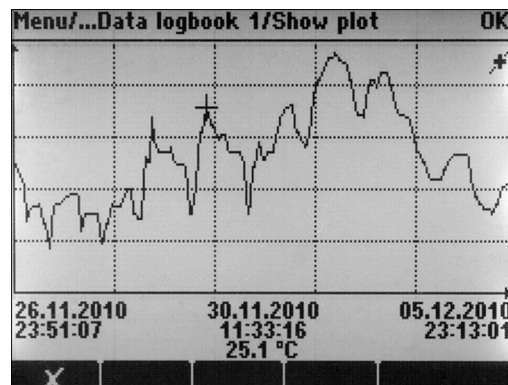
 12 *CM444: example*



13 *Extension module*

Data logger function

- Adjustable scan time: 1 to 3600 s (1 h)
- Data logbooks:
 - Max. 8 data logbooks
 - 150,000 entries per logbook
 - Graphic display (load curves) or numerical list
- Calibration logbook: max. 75 entries
- Hardware version logbook:
 - Hardware configuration and modifications
 - Max. 125 entries
- Version logbook:
 - E.g. software updates
 - Max. 50 entries
- Operation logbook: max. 250 entries
- Diagnostics logbook: max. 250 entries



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14 Data logbook: Graphic display



Logbooks remain unchanged even after a software update.

SD card

The exchangeable storage medium enables:

- Quick and easy software updates and upgrades
- Data storage of internal device memory (e.g. logbooks)
- Transfer of complete configurations to a device with an identical setup (backup function)
- Transfer of configurations without the TAG and bus address to devices with an identical setup (copy function)
- Saving of screenshots for documentation purposes

Endress+Hauser offers industry-approved SD cards as accessories. These memory cards provide maximum data security and integrity.

Other industrial quality SD cards, 1 to 32 GB and with a maximum weight of 5 g can also be used. However, Endress+Hauser does not accept any responsibility for the data security of such cards.

External signals for device control and for activating external devices

Hardware options, e.g. the "DIO" module with 2 digital inputs and 2 digital outputs or fieldbus module 485DP/485MB enable the following:

- via a digital input signal
 - measuring range switching for conductivity (upgrade code required, see accessories)
 - switching between different calibration datasets in the case of optical sensors
 - an external hold
 - a cleaning interval to be triggered
 - switching on and off a PID controller, e.g. via the proximity switch of the CCA250
 - the use of the input as an "analog input" for pulse-frequency modulation (PFM)
- via a digital output signal
 - the static transmission (similar to a relay) of diagnostic states, point level switch states etc.
 - the dynamic transmission (comparable to a non-wearing "analog output") of PFM signals, e.g. to control dosing pumps.

FieldCare and Field Data Manager

FieldCare

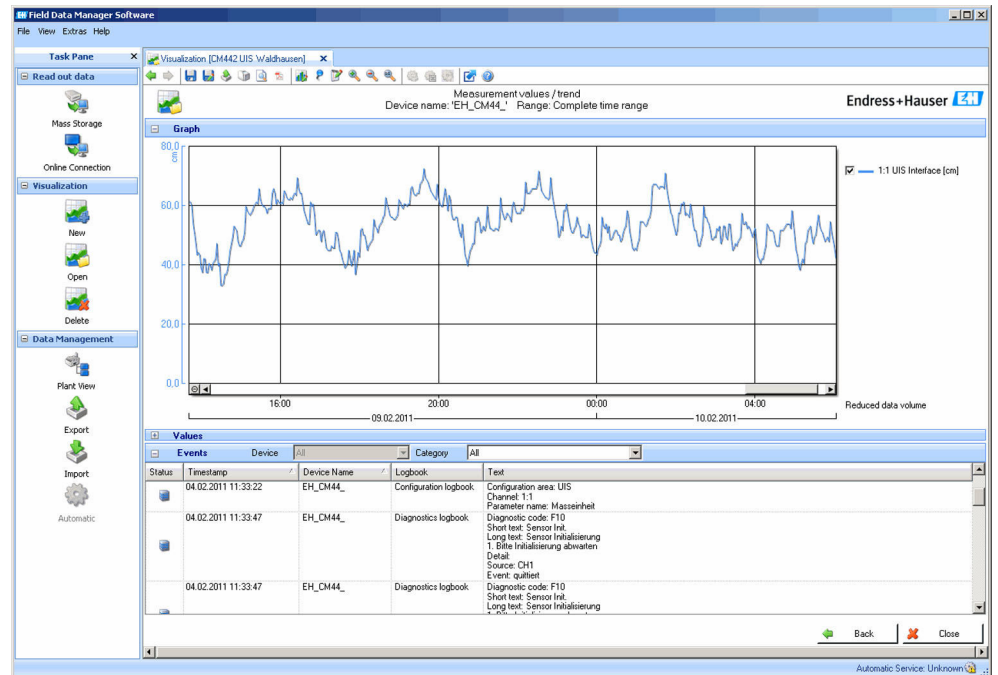
Configuration and asset management software based on FDT/DTM technology

- Complete device configuration when connected via FXA291 and service interface
- Access to a number of configuration parameters and identification, measuring and diagnostic data when connected via HART modem
- Logbooks can be downloaded in CSV format or binary format for "Field Data Manager" software

Field Data Manager

Visualization software and database for measuring, calibration and configuration data

- SQL database which is protected against manipulation
- Functions to import, save and print out logbooks
- Load curves to display measured values



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15 Field Data Manager: Load curves

Virtual process values (mathematical functions)

In addition to "real" process values, which are provided by connected physical sensors or analog inputs, mathematical functions can be used to calculate a maximum of 8 "virtual" process values.

The "virtual" process values can be:

- Output via a current output or a fieldbus
- Used as a controlled variable
- Assigned as a measured variable to a limit switch
- Used as a measured variable to trigger cleaning
- Displayed in user-defined measuring menus

The following mathematical functions are possible:

- Calculation of pH from two conductivity values according to VGB 405 RL, e.g. in boiler feedwater
- Difference between two measured values from different sources, e.g. for membrane monitoring
- Differential conductivity, e.g. for monitoring the efficiency of ion exchangers
- Degassed conductivity, e.g. for process controls in power plants
- Redundancy for monitoring two or three redundant sensors
- rH calculation from the measured values of a pH sensor and an ORP sensor
- Calculation of the remaining capacity of a cation exchanger
- Calculation of the combined chlorine concentration. This calculation involves subtracting the free chlorine concentration from the total chlorine concentration. This requires both a sensor for free chlorine CCS51E and a sensor for total chlorine CCS53E.
- Formula editor

Concentration tables

When the device is delivered from the factory, tables are saved in the device that allow inductive conductivity measurements to be converted to concentrations of certain substances. 4 user-defined tables are also possible.

The following factory concentration tables are available:

NaOH	0 to 15 %	0 to 100 °C (32 to 212 °F)
NaOH	25 to 50%	2 to 80 °C (36 to 176 °F)
HCl	0 to 20 %	0 to 65 °C (32 to 149 °F)
HNO ₃	0 to 30 %	2 to 80 °C (36 to 176 °F)
H ₂ SO ₄	0.5 to 27 % and 35 to 85 %	0 to 100 °C (32 to 212 °F)
H ₂ SO ₄	93 to 100 %	10 to 115 °C (50 to 239 °F)
H ₃ PO ₄	0 to 40 %	2 to 80 °C (36 to 176 °F)
NaCl	0 to 26 %	2 to 80 °C (36 to 176 °F)

Safety

Real-time clock

The device has a real-time clock, which is buffered by a button cell battery if the power supply fails.

This ensures that the device continues to keep the correct date and time when it is restarted and that the time stamp for the logbooks is correct.

Data security

All settings, logbooks etc. are stored in a non-volatile memory to ensure that the data are retained even in the event of a disruption to the power supply.

Measuring range switching for conductivity

- Can be used in CIP processes e.g. for safe monitoring of phase separations
- Switching between 4 complete parameter sets:
 - Conductivity operating mode
 - Concentration tables
 - Temperature compensation
 - Output signal range
 - Limit value switch
- Via digital inputs or fieldbus

Measured value compensation for oxygen and conductivity

- Pressure or temperature compensation
- Input signals from external sensors via current input or fieldbus
- Signals from connected temperature sensors

Password protection

Password-protected login

- For remote operation via web server
- For local operation

Process safety

Two independent PID controllers

- One- or two-sided control
- Limit switches
- 4 cleaning programs which can be programmed independently of each other

IT security

The manufacturer warranty is valid only if the product is installed and used as described in the Operating Instructions. The product is equipped with security mechanisms to protect it against any inadvertent changes to the settings.

IT security measures, which provide additional protection for the product and associated data transfer, must be implemented by the operators themselves in line with their security standards.

Input

Measured variables	→ Documentation of the connected sensor
Measuring ranges	→ Documentation of the connected sensor
Types of input	■ Digital sensor inputs for sensors with Memosens protocol ■ Analog current inputs (optional) ■ Digital inputs (optional) ■ Digital sensor inputs for intrinsically safe sensors with Memosens protocol and Ex approval (optional)
Input signal	Depending on version: ■ Without sensor communication module 2DS Ex-i: max. 8 x binary sensor signal ■ With sensor communication module 2DS Ex-i: max. 6 x binary sensor signal ■ 2 x 0/4 to 20 mA (optional), passive, potentially isolated from one another and from the sensor inputs ■ 0 to 30 V
Cable specification	Cable type ■ Without sensor communication module 2DS Ex-i: Memosens data cable CYK10 or sensor fixed cable, each with cable end sleeves or M12 circular plug (optional) ■ With sensor communication module 2DS Ex-i: Memosens data cable CYK10 or sensor fixed cable, each with cable end sleeves  Only Memosens data cables CYK10 with an appropriate approval may be connected to the intrinsically safe digital sensor inputs of the sensor communication module 2DS Ex-i. Cable length Max. 100 m (330 ft)

Digital inputs, passive

Electrical specification	■ Drawing power (passive) ■ Galvanically isolated
Span	■ High: 11 to 30 V DC ■ Low: 0 to 5 V DC
Nominal input current	max. 8 mA
PFM function	Minimum pulse width: 500 µs (1 kHz)
Test voltage	500 V
Cable specification	Max. 2.5 mm ² (14 AWG)

Current input, passive

Span	> 0 to 20 mA
Signal characterization	Linear
Internal resistance	Non-linear

Test voltage 500 V

Output

Output signal

Depending on version:

- 2 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 4 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 6 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- 8 x 0/4 to 20 mA, active, galvanically isolated from one another and from the sensor circuits
- Optional HART communication (only via current output 1:1)

HART	
Signal encoding	FSK $\pm$ 0.5 mA above current signal
Data transmission rate	1200 baud
Galvanic isolation	Yes
Load (communication resistor)	250 Ω

PROFIBUS DP/RS485	
Signal encoding	EIA/TIA-485, PROFIBUS DP-compliant acc. to IEC 61158
Data transmission rate	9.6 kBd, 19.2 kBd, 45.45kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd, 6 MBd, 12 MBd
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Modbus RS485	
Signal encoding	EIA/TIA-485
Data transmission rate	2,400, 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 baud
Galvanic isolation	Yes
Connectors	Spring terminal (max. 1.5 mm), bridged internally (T-function), optional M12
Bus termination	Internal slide switch with LED display

Ethernet and Modbus TCP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, optional M12
IP address	DHCP (default) or configuration via menu

Ethernet/IP	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	10/100 MBd
Galvanic isolation	Yes
Connection	RJ45, optional M12 (D-coded)
IP address	DHCP (default) or configuration via menu

PROFINET	
Signal encoding	IEEE 802.3 (Ethernet)
Data transmission rate	100 MBd
Galvanic isolation	Yes
Connection	RJ45, optional M12 (D-coded)
Name of station	Via DCP protocol by means of configuration tool (e.g. Siemens PRONETA)
IP address	Via DCP protocol by means of configuration tool (e.g. Siemens PRONETA)

Signal on alarm	Adjustable, as per NAMUR Recommendation NE 43 ■ In measuring range 0 to 20 mA (HART is not available with this measuring range): Failure current from 0 to 23 mA ■ In measuring range 4 to 20 mA: Failure current from 2.4 to 23 mA ■ Factory setting for failure current for both measuring ranges: 21.5 mA
------------------------	--

Load	Max. 500 Ω
-------------	------------

Linearization/transmission behavior	Linear
--	--------

Digital outputs, passive

Electrical specification	■ Passive ■ Open collector, max. 30 V, 15 mA ■ Maximum voltage drop 3 V
---------------------------------	---

External power supply	When using an onsite auxiliary voltage supply and an onsite digital input: Recommended minimum auxiliary voltage = $3\text{ V} + V_{IHmin}$ (V_{IHmin} = minimum input voltage required (high-level input voltage))
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PFM function	Minimum pulse width: 500 μs (1 kHz)
---------------------	-------------------------------------

Auxiliary voltage	Electrical specification ■ Galvanically isolated ■ Unregulated, 24 V DC ■ Max. 50 mA (per DIO module)
--------------------------	--

Test voltage	500 V
---------------------	-------

Cable specification	Max. 2.5 mm ² (14 AWG)
----------------------------	-----------------------------------

Current outputs, active

Span	0 to 23 mA 2.4 to 23 mA for HART communication
Signal characterization	Linear
Electrical specification	Output voltage Max. 24 V Test voltage 500 V
Cable specification	Cable type Recommended: shielded cable Cable specification Max. 2.5 mm ² (14 AWG)

Relay outputs

Electrical specification	Relay types ▪ 1 single-pin changeover contact (alarm relay) ▪ 2 or 4 single-pin changeover contacts (optional with extension modules) Maximum load ▪ Alarm relay: 0.5 A ▪ All other relays: 2.0 A Relay switching capacity
---------------------------------	---

Base module (Alarm relay)

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000

Extension modules

Switching voltage	Load (max.)	Switching cycles (min.)
230 V AC, cosΦ = 0.8 to 1	0.1 A	700,000
	0.5 A	450,000
	2 A	120,000
115 V AC, cosΦ = 0.8 to 1	0.1 A	1,000,000
	0.5 A	650,000
	2 A	170,000
24 V DC, L/R = 0 to 1 ms	0.1 A	500,000
	0.5 A	350,000
	2 A	150,000

Cable specificationMax. 2.5 mm² (14 AWG)**Protocol-specific data****HART**

Manufacturer ID	11 _h
Device type	155D _h
Device revision	001 _h
HART version	7.2
Device description files (DD/DTM)	www.endress.com/hart Device Integration Manager DIM
Device variables	16 user-definable and 16 predefined device variables, dynamic variables PV, SV, TV, QV
Supported features	PDM DD, AMS DD, DTM, Field Xpert DD

PROFIBUS DP

Manufacturer ID	11 _h
Device type	155D _h
Profile version	3.02
Device database files (GSD files)	www.endress.com/profibus Device Integration Manager DIM
Output variables	16 AI blocks, 8 DI blocks
Input variables	4 AO blocks, 8 DO blocks
Supported features	■ 1 MSCY0 connection (cyclical communication, master class 1 to slave) ■ 1 MSAC1 connection (acyclical communication, master class 1 to slave) ■ 2 MSAC2 connections (acyclical communication, master class 2 to slave) ■ Device lock: The device can be locked using the hardware or software. ■ Addressing using DIL switches or software ■ GSD, PDM DD, DTM

Modbus RS485

Protocol	RTU/ASCII
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)
Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using switch or software

Modbus TCP

TCP port	502
TCP connections	3
Protocol	TCP
Function codes	03, 04, 06, 08, 16, 23
Broadcast support for function codes	06, 16, 23
Output data	16 measured values (value, unit, status), 8 digital values (value, status)

Input data	4 setpoints (value, unit, status), 8 digital values (value, status), diagnostic information
Supported features	Address can be configured using DHCP or software

Ethernet/IP

Log	EtherNet/IP	
ODVA certification	Yes	
Device profile	Generic device (product type: 0x2B)	
Manufacturer ID	0x049E _h	
Device type ID	0x109C _h	
Polarity	Auto-MIDI-X	
Connections	CIP	12
	I/O	6
	Explicit message	6
	Multicast	3 consumers
Minimum RPI	100 ms (default)	
Maximum RPI	10000 ms	
System integration	EtherNet/IP	EDS
	Rockwell	Add-on-Profile Level 3, Faceplate for Factory Talk SE
IO data	Input (T → O)	Device status and diagnostic message with highest priority Measured values: 16 AI (analog input) + Status + Unit 8 DI (discrete input) + Status
	Output (O → T)	Actuating values: 4 AO (analog output) + status + unit 8 DO (discrete output) + Status

PROFINET

Protocol	"Application layer protocol for decentral device periphery and distributed automation", PNIO Version 2.34
Communication type	100 MBit/s
Conformance Class	Conformance Class B
Netload Class	Netload Class II
Baud rate	Automatic 100 Mbps with full-duplex detection
Cycle times	From 32 ms
Device profile	Application interface identifier 0xF600 Generic device
PROFINET interface	1 port, Realtime Class 1 (RT_CLASS_1)
Manufacturer ID	0x11 _h
Device type ID	0x859C D _h
Device description files (GSD)	Information and files under: ■ www.endress.com On the product page for the device: Documents/Software → Device drivers ■ www.profibus.com On the website under Products/Product Finder
Polarity	Auto-polarity for automatic correction of crossed TxD and RxD pairs
Supported connections	■ 1 x AR (IO Controller AR) ■ 1 x AR (IO-Supervisor Device AR connection allowed) ■ 1 x Input CR (Communication Relation) ■ 1 x Output CR (Communication Relation) ■ 1 x Alarm CR (Communication Relation)
Configuration options for measuring device	■ Web browser ■ Manufacturer-specific software (FieldCare, DeviceCare) ■ Device master file (GSD), can be read out via the integrated web server of the measuring device
Configuration of the device name	DCP protocol
Supported functions	■ Identification & maintenance Simple device identification via: ■ Process control system ■ Nameplate ■ Measured value status The process variables are communicated with a measured value status ■ Blinking feature (FLASH_ONCE) via the local display for simple device identification and assignment ■ Device operation via operating tools (e.g. FieldCare, DeviceCare)
System integration	For information on system integration, see the Operating Instructions ■ Cyclic data transmission ■ Overview and description of the modules ■ Status coding ■ Startup configuration ■ Factory setting

Web server

The web server enables full access to the device configuration, measured values, diagnostic messages, logbooks and service data via standard WiFi/WLAN/LAN/GSM or 3G routers with a user-defined IP address.

TCP port	80
Supported features	■ Remote-controlled device configuration(1 session) ■ Save/restore device configuration (via SD card) ■ Logbook export (file formats: CSV, FDM) ■ Access to web server via DTM or Internet Explorer ■ Login ■ Web server can be switched off

Power supply

Supply voltage**CM442**

Depending on version:

- 100 to 230 V AC, 50/60 Hz
Maximum permitted fluctuation of mains supply voltage: $\pm 15\%$ of nominal voltage
- 24 V AC/DC, 50/60 Hz
Maximum permitted fluctuation of mains supply voltage: $+20/-15\%$ of nominal voltage

CM444 and CM448

Depending on the version,:

- 100 to 230 V AC, 50/60 Hz
Maximum permitted fluctuation of mains supply voltage: $\pm 15\%$ of nominal voltage
- 24 V DC
Maximum permitted fluctuation of mains supply voltage: $+20/-15\%$ of nominal voltage

NOTICE**The device does not have a power switch!**

- Provide a protected circuit breaker in the vicinity of the device at the place of installation.
- The circuit breaker must be a switch or power switch, and must be labeled as the circuit breaker for the device.
- Secondary circuits must be separated from mains supply circuits by reinforced insulation or double insulation.

Power consumption**CM442**

Depending on supply voltage

- 100 to 230 V AC and 24 V AC:
Max. 55 VA
- 24 V DC:
Max. 22 W

CM444 and CM448

Depending on supply voltage

- 100 to 230 V AC:
Max. 73 VA
- 24 V DC:
Max. 68 W

Fuse

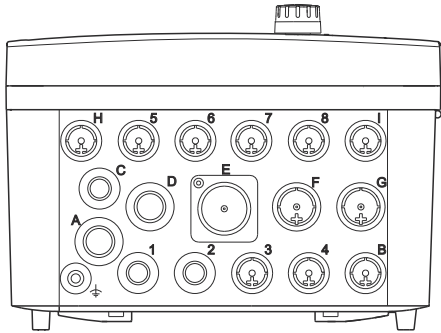
Fuse not exchangeable

Overvoltage protection

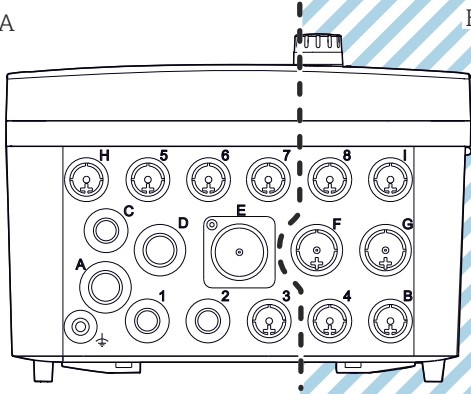
Overvoltage protection: integrated protection against transient overvoltages according to EN 61326-1 (Table 2, industrial environment)

Cable entries

Cable entries for transmitters for the non-hazardous area

Identification of the cable entry on housing base	Suitable gland
B, C, H, I, 1-8	M16x1.5 mm/NPT3/8"/G3/8
A, D, F, G	M20x1.5 mm/NPT1/2"/G1/2
E	-
$\perp$	M12x1.5 mm
	Recommended assignment 1-8 Sensors 1-8 A Power supply B Unrestricted use C RS485 Out or M12 Ethernet D,F,G Current outputs and inputs, relays H RS485 In or M12 DP/RS485 I Unrestricted use E Do not use

Cable entries for transmitters with sensor communication module 2DS Ex-i for the hazardous area

Identification of the cable entry on housing base	Suitable gland
B, C, H, I, 1-8	M16x1.5 mm/NPT3/8"/G3/8
A, D, F, G	M20x1.5 mm/NPT1/2"/G1/2
E	-
$\perp$	M12x1.5 mm
	Recommended assignment 1/2/3 Do not use 5/6/7 4/8 Intrinsically safe sensors B/F/G/I A Power supply C RS485 Out or M12 Ethernet D Current outputs and inputs, relays H RS485 In or M12 DP/RS485 E Do not use

16 A: Non-hazardous area, B: Hazardous area

 Do not cross cables for the non-hazardous area and the hazardous area in the housing. Select a suitable cable entry for the connection.

Cable specification

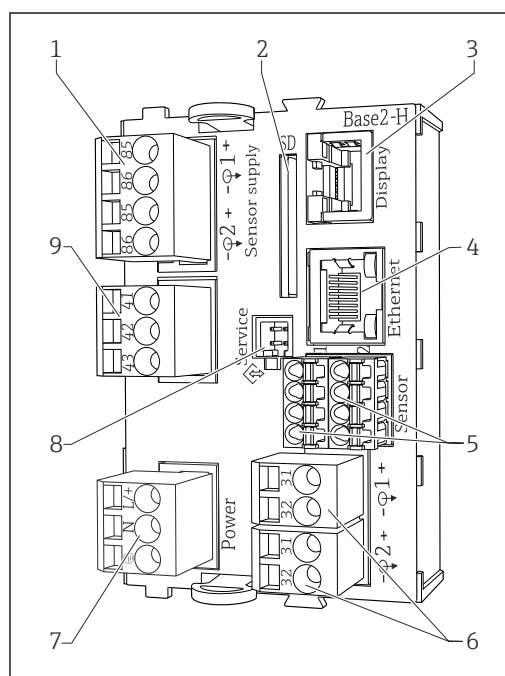
Cable gland	Permitted cable diameter
M16x1.5 mm	4 to 8 mm (0.16 to 0.32")
M12x1.5 mm	2 to 5 mm (0.08 to 0.20")
M20x1.5 mm	6 to 12 mm (0.24 to 0.48")
NPT3/8"	4 to 8 mm (0.16 to 0.32")
G3/8	4 to 8 mm (0.16 to 0.32")
NPT1/2"	6 to 12 mm (0.24 to 0.48")
G1/2	7 to 12 mm (0.28 to 0.48")



Cable glands mounted at the factory are tightened with 2 Nm.

Electrical connection

Basic module

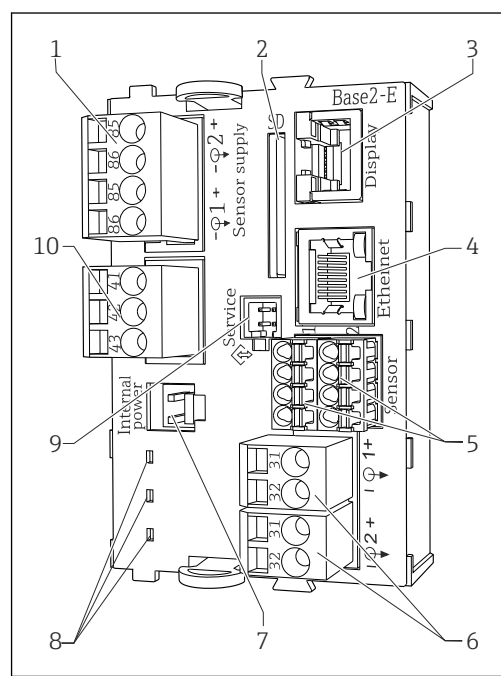


A0040639

17 Basic module BASE2-H or -L (two-channel device)

- 1 Power supply for digital fixed cable sensors with Memosens protocol
- 2 SD card slot
- 3 Slot for display cable ¹⁾
- 4 Ethernet interface
- 5 Connections for 2 Memosens sensors
- 6 Current outputs
- 7 Power connection
- 8 Service interface
- 9 Alarm relay connection

¹⁾ Internal device connection. Do not disconnect the plug!

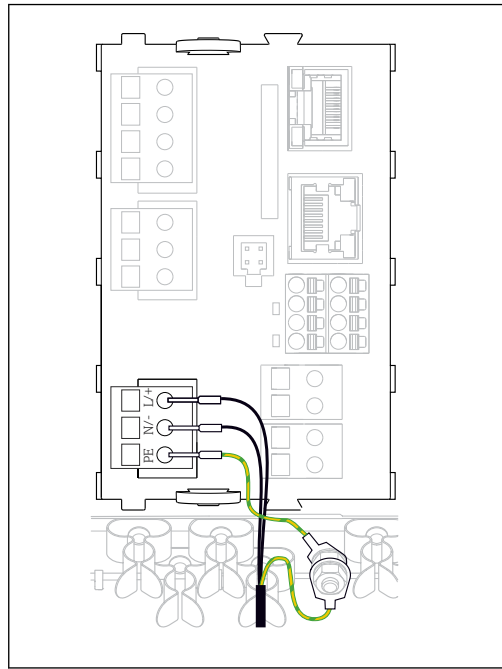


A0040640

18 Basic module BASE2-E (four- and eight-channel device)

- 1 Power supply for digital fixed cable sensors with Memosens protocol
- 2 SD card slot
- 3 Slot for display cable ¹⁾
- 4 Ethernet interface
- 5 Connections for 2 Memosens sensors
- 6 Current outputs
- 7 Socket for internal power supply cable ¹⁾
- 8 LEDs
- 9 Service interface
- 10 Alarm relay connection

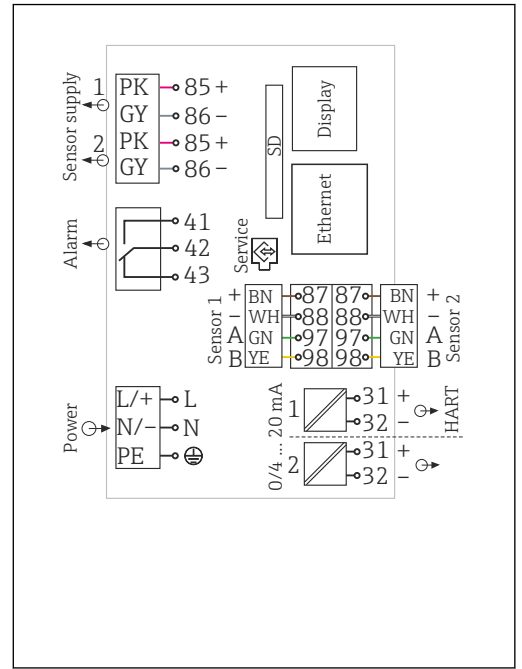
Connecting the supply voltage for CM442



A0039627

19 Connecting the power supply using the example of the BASE2-H or -L

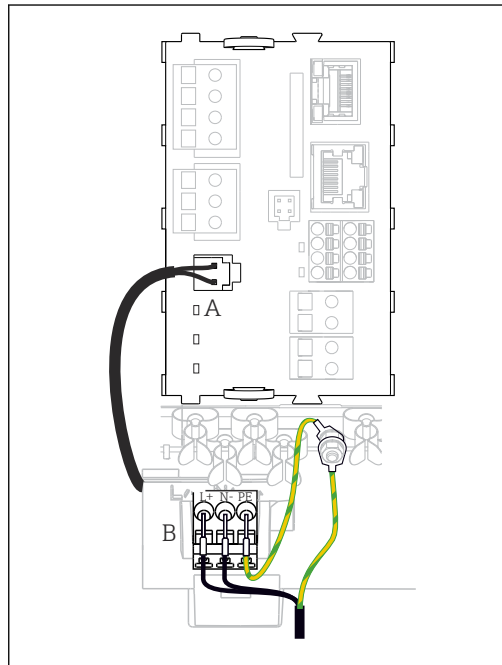
H Power unit 100 to 230 VAC
L Power unit 24 VAC or 24 VDC



A0039625

20 Complete wiring diagram using the example of the BASE2-H or -L

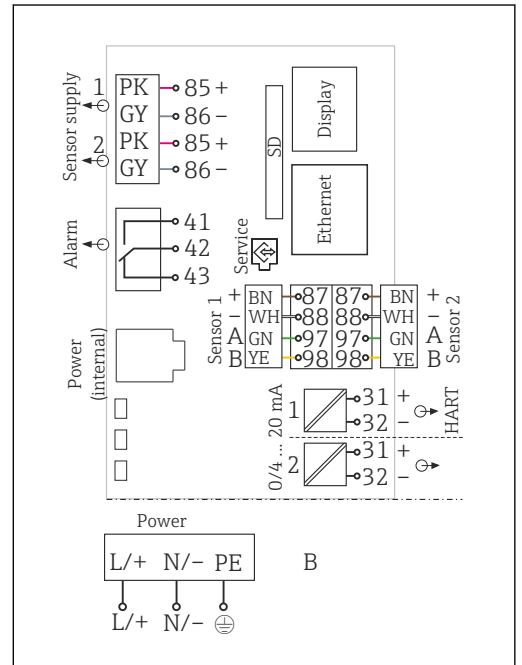
Connecting the supply voltage for CM444 and CM448



A0039626

21 Connecting the power supply using the example of the BASE2-E

A Internal power supply cable
B Extension power unit



A0039624

22 Complete wiring diagram using the example of the BASE2-E and extension power supply unit (B)

Connecting optional modules

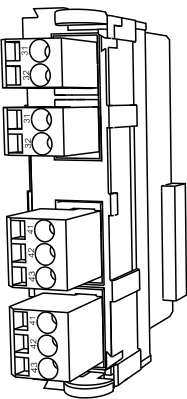
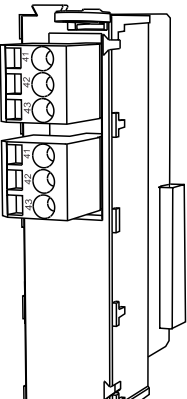
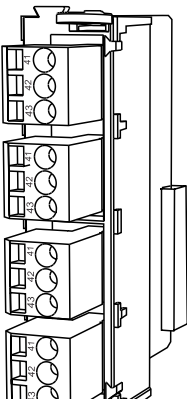
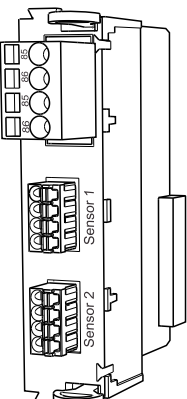
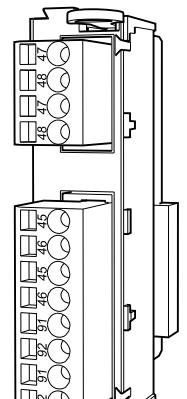
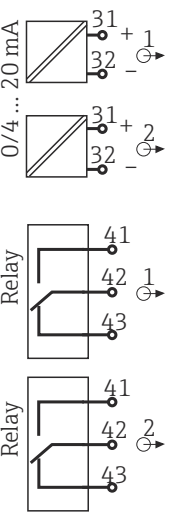
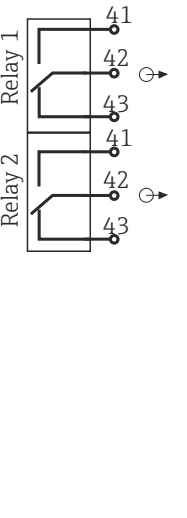
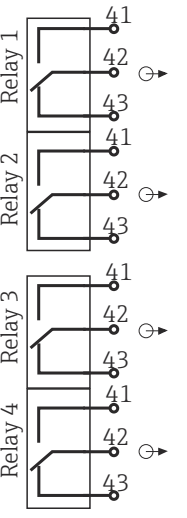
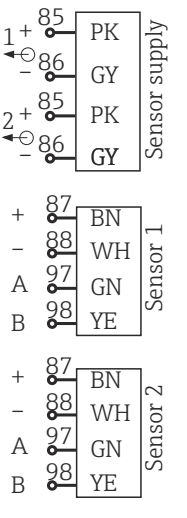
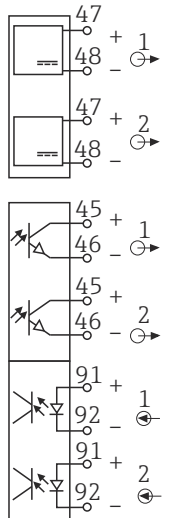
With extension modules you can purchase additional functions for your device.

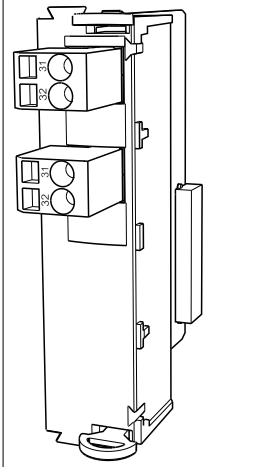
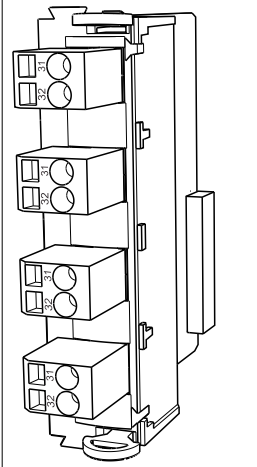
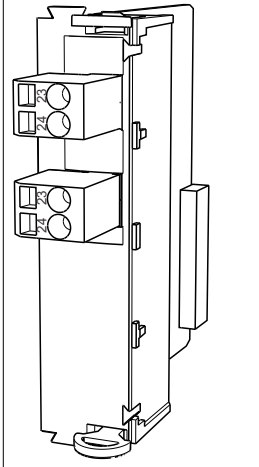
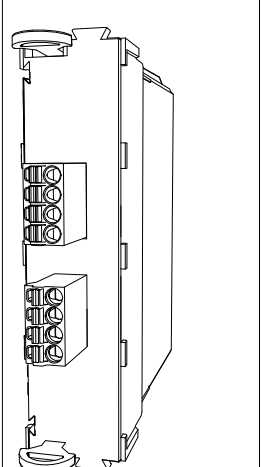
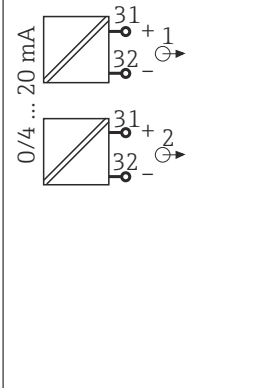
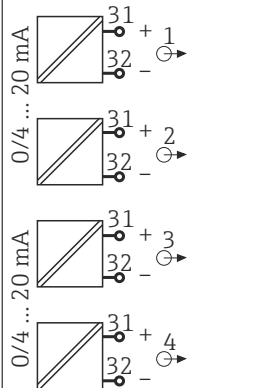
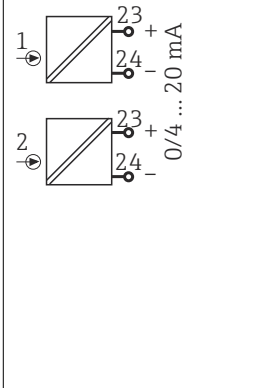
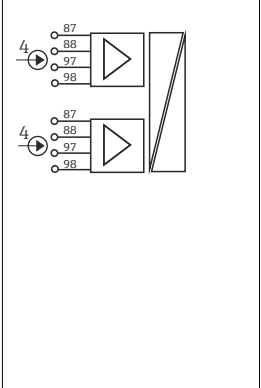
NOTICE**Unacceptable hardware combinations (due to conflicts in power supply)**

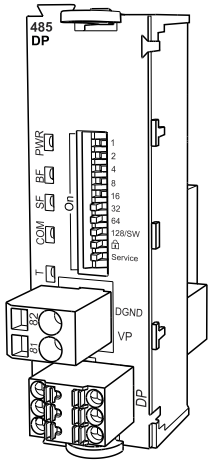
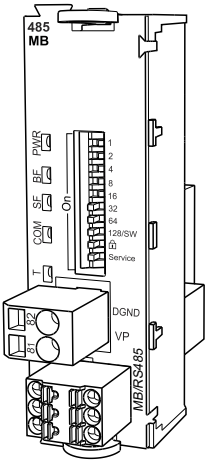
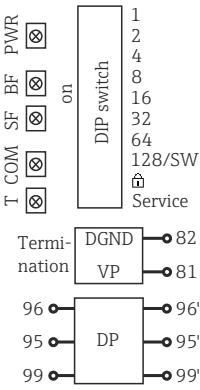
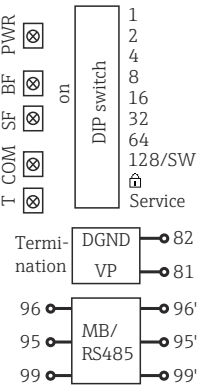
Incorrect measurements or total failure of the measuring point as a result of heat build-up or overloading

- Find out whether the planned extension for your transmitter results in a permitted hardware combination (Configurator at www.endress.com/CM442 or .../CM444 or .../CM448).
- Please note that if you are extending CM442 to CM444 or CM448, you must additionally fit an extension power supply unit and an extension backplane. You must then also use basic module BASE-E.
- Remember that the sum of all current inputs and outputs may not exceed 8.
- Make sure not to use more than 2 "DIO" modules. More "DIO" modules are not permitted.
- Please contact your Endress+Hauser sales center should you have any questions.

Overview of all the modules available

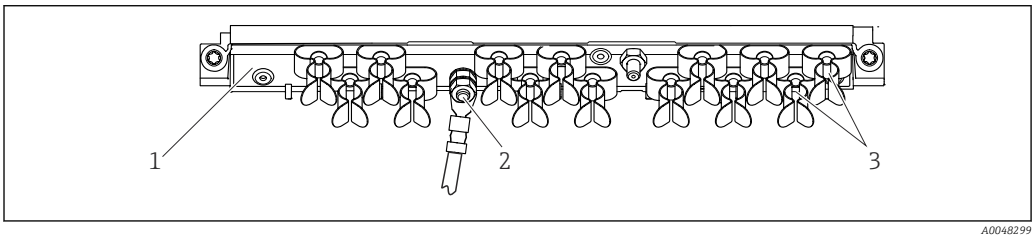
Module name				
AOR	2R	4R	2DS	DIO
 A0025110	 A0025111		 A0025113	 A0025114
■ 2 x 0/4 to 20 mA analog outputs ■ 2 relays ■ Order No. 71111053	■ 2 relays ■ Order No. 71125375	■ 4 relays ■ Order No. 71125376	■ 2 digital sensor inputs ■ 2 power supply systems for digital sensors ■ Order No. 71135631	■ 2 digital inputs ■ 2 digital outputs with auxiliary voltage ■ Order No. 71135638
 A0033234	 A0033235	 A0025125	 A0025128	 A0025129

Module name			
2AO	4AO	2AI	2DS Ex-i
 A0025132	 A0025133	 A0025135	 A0046513
2 x 0/4 to 20 mA analog outputs - Order No. 71135632	4 x 0/4 to 20 mA analog outputs - Order No. 71135633	2 x 0/4 to 20mA analog inputs - Order No. 71135639	2 intrinsically safe digital inputs for Memosens sensors with Ex approval - Inputs on BASE2 module are disabled - Module 2DS EX-i is equipped in the right slot of the device - Order No. 71477718
 A0025137	 A0025138	 A0025139	 A0046512

Module name	
485DP	485MB
 A0050399	 A0050401
■ 5V power supply for PROFIBUS DP termination ■ RS485 (PROFIBUS DP) ■ Order No. 71575177	■ RS485 (Modbus RS485) ■ Order No. 71575178
 A0050400	 A0050402

i PROFIBUS DP (module 485DP)
Contacts 95, 96 and 99 are bridged in the connector. This ensures that PROFIBUS communication is not interrupted if the connector is disconnected.

Protective ground connection



-  **23 Cable mounting rail and associated function**
- | | |
|---|---|
| 1 Cable mounting rail | 3 Cable clamps (fixing and grounding the sensor cables) |
| 2 Threaded bolt (protective ground connection, central grounding point) | |

Sensor connection

Sensor types with Memosens protocol for non-hazardous area

Sensors with Memosens protocol

Sensor types	Sensor cable	Sensors
Digital sensors without additional internal power supply	With plug-in connection and inductive signal transmission	■ pH sensors ■ ORP sensors ■ Combined sensors ■ Oxygen sensors (amperometric and optical) ■ Conductivity sensors with conductive measurement of conductivity ■ Chlorine sensors (disinfection)
	Fixed cable	Conductivity sensors with inductive measurement of conductivity
Digital sensors with additional internal power supply	Fixed cable	■ Turbidity sensors ■ Sensors for interface measurement ■ Sensors for measuring the spectral absorption coefficient (SAC) ■ Nitrate sensors ■ Optical oxygen sensors ■ Ion-sensitive sensors

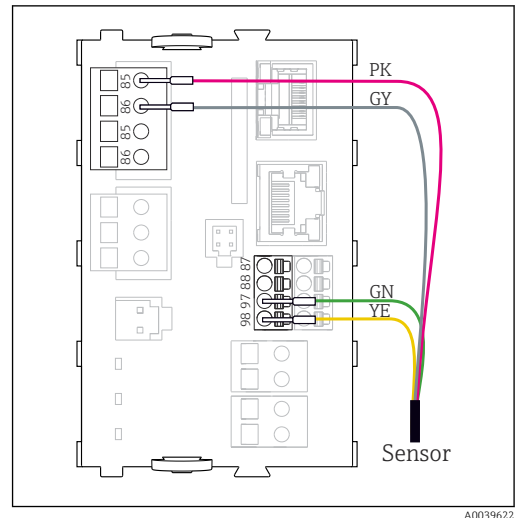
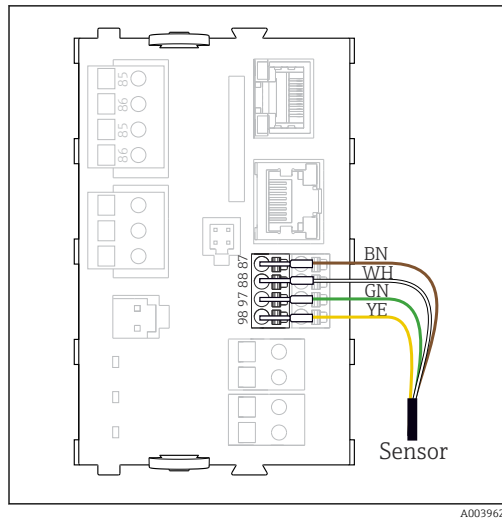
The following rule applies if connecting CUS71D sensors:

- CM442
 - Only one CUS71D is possible; an additional sensor is not permitted.
 - The second sensor input may also not be used for another type of sensor.
- CM444
 - No restrictions. All the sensor inputs can be used as required.
- CM448
 - If a CUS71D is connected, the number of sensor inputs that can be used is limited to a maximum of 4.
 - Of these, all 4 inputs can be used for CUS71D sensors.
 - Every combination of CUS71D and other sensors is possible, provided that the total number of connected sensors does not exceed 4.

Types of connection

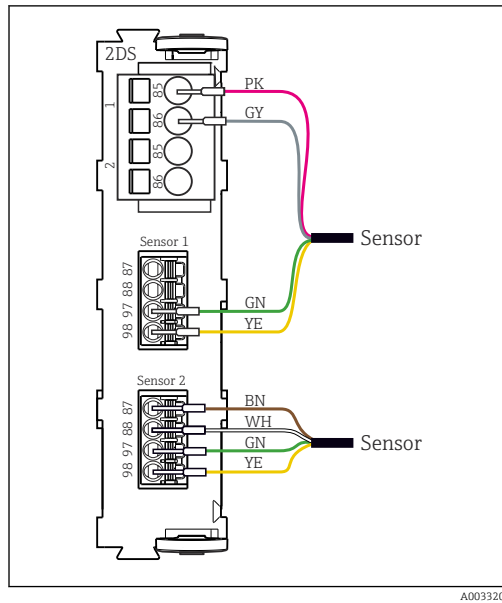
- Direct connection of the sensor cable to the terminal connector of the , basic module-L, -H or -E (→  24 ff.)
- Optional: Sensor cable plug connected to the M12 sensor socket on the underside of the device
With this type of connection, the device is already wired at the factory (→  27).

Sensor cable connected directly



24 sensors without additional supply voltage

25 sensors with additional supply voltage

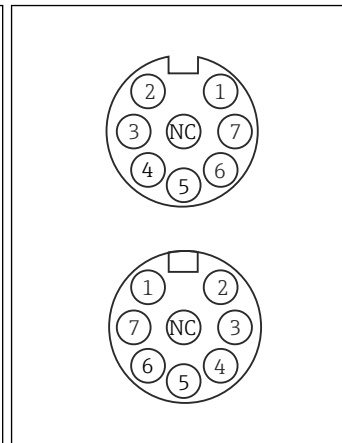
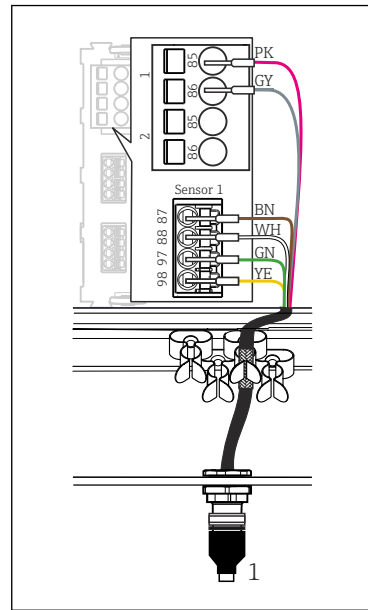


26 Sensors with and without additional supply voltage at sensor module 2DS

i In the case of a single-channel device:
The left-hand Memosens input on basic module must be used!

connection via M12 connection

Only for connection in non-hazardous area.



Device versions with a pre-installed M12 socket are ready-wired upon delivery.

Please note the following:

- The internal device wiring is always the same regardless of what kind of sensor you connect to the M12 socket (plug&play).
- The signal or power supply cables are assigned in the sensor head in such a way that the PK and GY power supply cables are either used (e.g. optical sensors) or not (e.g. pH or ORP sensors).

28 M12 assignment, top: socket, bottom: connector (top view in each case)

- | | |
|----|------------------|
| 1 | PK (24 V) |
| 2 | GY (Ground 24 V) |
| 3 | BN (3 V) |
| 4 | WH (Ground 3 V) |
| 5 | GN (Memosens) |
| 6 | YE (Memosens) |
| 7, | Not connected |
| | NC |

27 M12 connection (e.g. on sensor module)

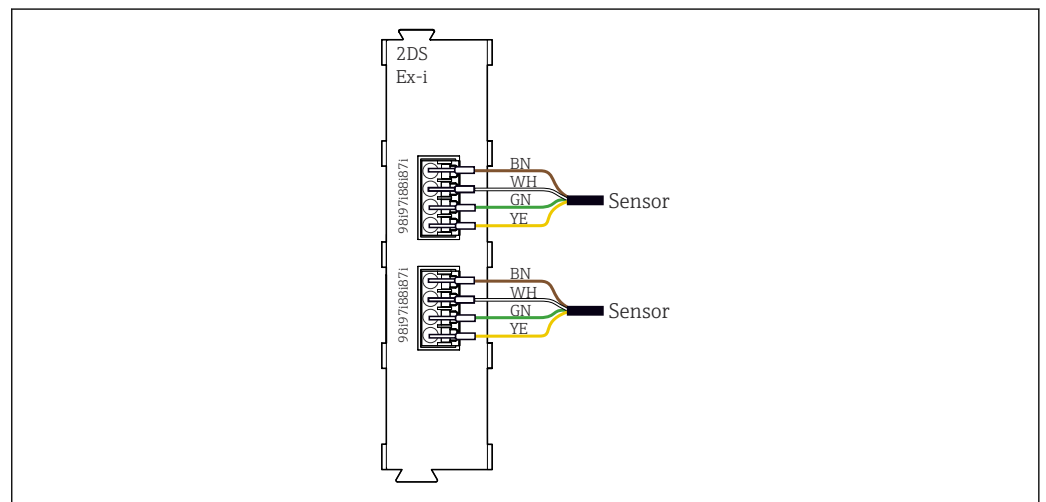
1 Sensor cable with M12 connector

i When connecting intrinsically safe sensors to transmitters with sensor communication module type 2DS Ex i, the M12 plug-in connector is **not** permitted.

Connecting intrinsically safe sensors to sensor communication module type 2DS Ex i

Sensor cable connected directly

- Connect the sensor cable to the terminal connector of the sensor communication module 2DS Ex-i.



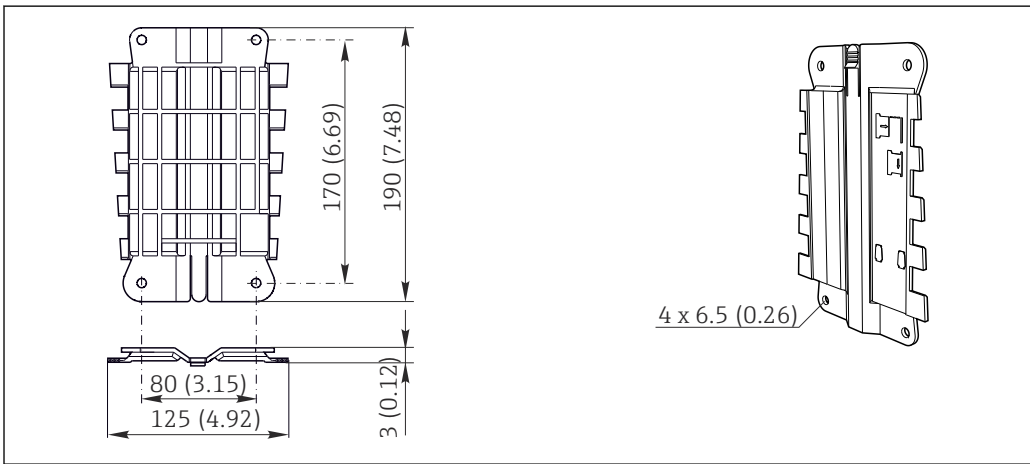
29 Sensors without additional supply voltage at sensor communication module type 2DS Ex-i

i Intrinsically safe sensors for use in explosive atmospheres may only be connected to the sensor communication module type 2DS Ex-i. Only the sensors covered by the certificates may be connected (see XA).

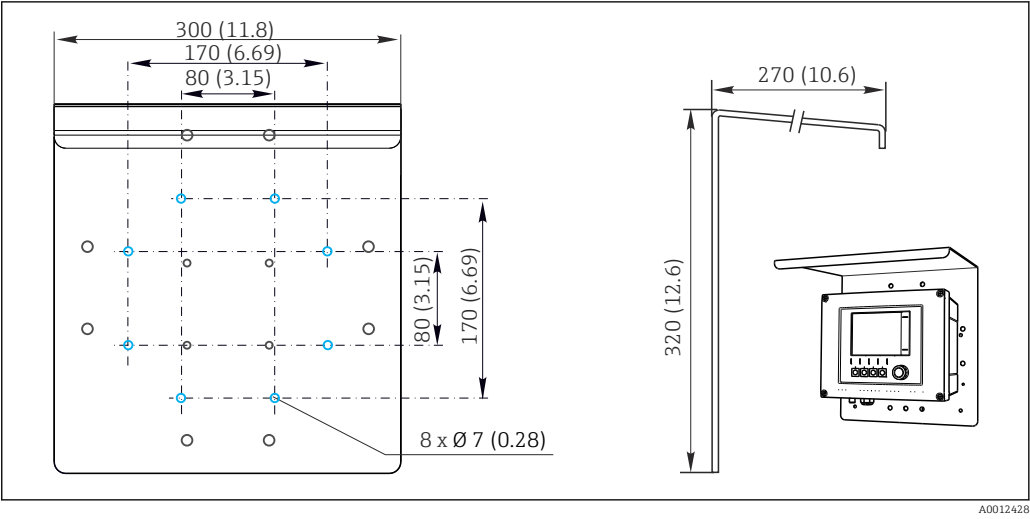
Performance characteristics

Response time	Current outputs t_{90} = max. 500 ms for an increase from 0 to 20 mA
	Current inputs t_{90} = max. 330 ms for an increase from 0 to 20 mA
	Digital inputs and outputs t_{90} = max. 330 ms for an increase from low to high
Reference temperature	25 °C (77 °F)
Measurement error for sensor inputs	→ Documentation of the connected sensor
Measurement error for current inputs and outputs	Typical measured errors: < 20 μ A (with current values < 4 mA) < 50 μ A (with current values 4 to 20 mA) at 25 °C (77 °F) each
	Additional measured error depending on the temperature: < 1.5 μ A/K
Frequency tolerance of digital inputs and outputs	$\leq 1\%$
Resolution of current inputs and outputs	< 5 μ A
Repeatability	→ Documentation of the connected sensor

Installation

Installation requirements	Mounting plate
 The technical drawing shows two views of the mounting plate. The front view (left) shows a rectangular plate with a grid of 16 terminals (4x4). Dimensions include a total width of 125 mm (4.92 in) and a terminal pitch of 80 mm (3.15 in). The side view (right) shows the plate's profile with a total height of 190 mm (7.48 in) and a terminal height of 170 mm (6.69 in). A detail of the terminal spacing is shown as 4 x 6.5 mm (0.26 in). A0012426	
30 Mounting plate. Engineering unit: mm (in)	

Weather protection cover

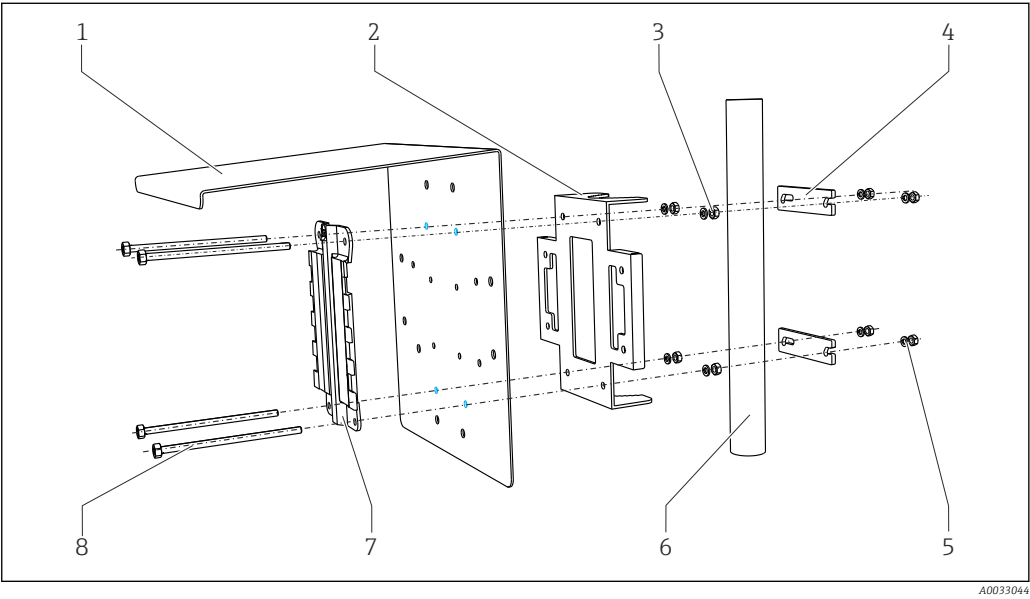


31 Dimensions in mm (in)

Installation

Post mounting

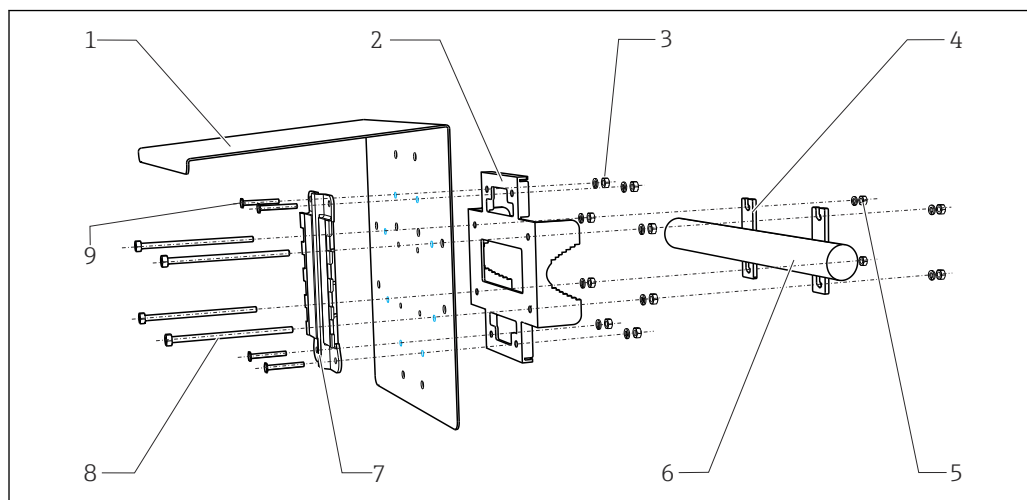
i You require the post mounting kit (optional) to mount the unit on a pipe, post or railing (square or circular, clamping range 20 to 61 mm (0.79 to 2.40")).



32 Post mounting

- | | | | |
|---|---|---|---|
| 1 | Weather protection cover (optional) | 5 | Spring washers and nuts (post mounting kit) |
| 2 | Post mounting plate (post mounting kit) | 6 | Pipe or railing (circular/square) |
| 3 | Spring washers and nuts (post mounting kit) | 7 | Mounting plate |
| 4 | Pipe clamps (post mounting kit) | 8 | Threaded rods (post mounting kit) |

Rail mounting

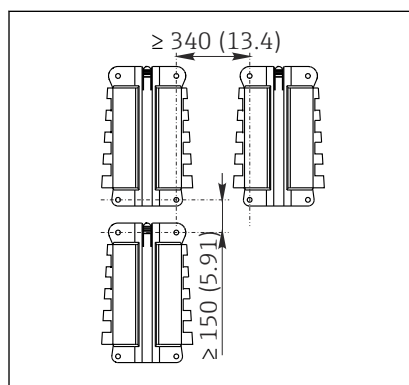


A0012668

33 Rail mounting

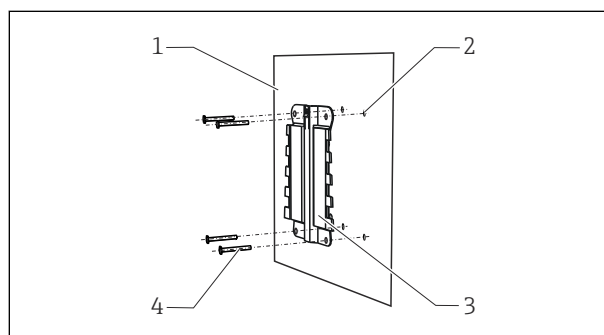
- | | | | |
|---|---|---|-----------------------------------|
| 1 | Weather protection cover (optional) | 6 | Pipe or railing (circular/square) |
| 2 | Post mounting plate (post mounting kit) | 7 | Mounting plate |
| 3 | Spring washers and nuts (post mounting kit) | 8 | Threaded rods (post mounting kit) |
| 4 | Pipe clamps (post mounting kit) | 9 | Screws (post mounting kit) |
| 5 | Spring washers and nuts (post mounting kit) | | |

Wall mounting



A0012686

34 Installation clearance in mm (in)



A0027798

35 Wall mounting

- | | |
|---|---|
| 1 | Wall |
| 2 | 4 drill holes ¹⁾ |
| 3 | Mounting plate |
| 4 | Screws Ø 6 mm (not part of scope of supply) |

¹⁾The size of the drill holes depends on the wall plugs used. The wall plugs and screws must be provided by the customer.

Environment

Ambient temperature

CM442

- -20 to 60 °C (-4 to 140 °F)
- -20 to 50 °C (-4 to 122 °F) for the following devices:
 - CM442-BM
 - CM442-IE
 - CM442-CL
 - CM442-UM

CM444

- Generally -20 to 55 °C (-4 to 131 °F), with the exception of packages under the second point in the list
- -20 to 50 °C (-4 to 122 °F) for the following packages:
 - CM444-**-M40A7FI*****+...
 - CM444-**-M40A7FK*****+...
 - CM444-**-N40A7FI*****+...
 - CM444-**-N40A7FK*****+...
 - CM444-**-M4AA5F4*****+...
 - CM444-**-M4AA5FF*****+...
 - CM444-**-M4AA5FH*****+...
 - CM444-**-M4AA5FI*****+...
 - CM444-**-M4AA5FK*****+...
 - CM444-**-M4AA5FM*****+...
 - CM444-**-M4BA5F4*****+...
 - CM444-**-M4BA5FF*****+...
 - CM444-**-M4BA5FH*****+...
 - CM444-**-M4BA5FI*****+...
 - CM444-**-M4BA5FK*****+...
 - CM444-**-M4BA5FM*****+...
 - CM444-**-M4DA5F4*****+...
 - CM444-**-M4DA5FF*****+...
 - CM444-**-M4DA5FH*****+...
 - CM444-**-M4DA5FI*****+...
 - CM444-**-M4DA5FK*****+...
 - CM444-**-M4DA5FM*****+...
 - CM444-BM
 - CM444-IE
 - CM444-CL
 - CM444-UM
 - CM444-CD

CM448

- Generally -20 to 55 °C (-4 to 131 °F), with the exception of packages under the second point in the list
- -20 to 50 °C (-4 to 122 °F) for the following packages:
 - CM448-***6AA*****+...
 - CM448-***8A4*****+...
 - CM448-***8A5*****+...
 - CM448-**28A3*****+...
 - CM448-**38A3*****+...
 - CM448-**48A3*****+...
 - CM448-**58A3*****+...
 - CM448-**68A3*****+...
 - CM448-**26A5*****+...
 - CM448-**36A5*****+...
 - CM448-**46A5*****+...
 - CM448-**56A5*****+...
 - CM448-**66A5*****+...
 - CM448-**22A7*****+...
 - CM448-**32A7*****+...
 - CM448-**42A7*****+...
 - CM448-**52A7*****+...
 - CM448-**62A7*****+...
 - CM448-**A6A5*****+...
 - CM448-**A6A7*****+...
 - CM448-**B6A5*****+...
 - CM448-**B6A7*****+...
 - CM448-**C6A5*****+...
 - CM448-**C6A7*****+...
 - CM448-**D6A5*****+...
 - CM448-**D6A7*****+...
 - CM448-BM
 - CM448-IE
 - CM448-CL
 - CM448-UM
 - CM448-CD

Storage temperature	-40 to +80 °C (-40 to 176 °F)
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Relative humidity	10 to 95 %, non-condensing
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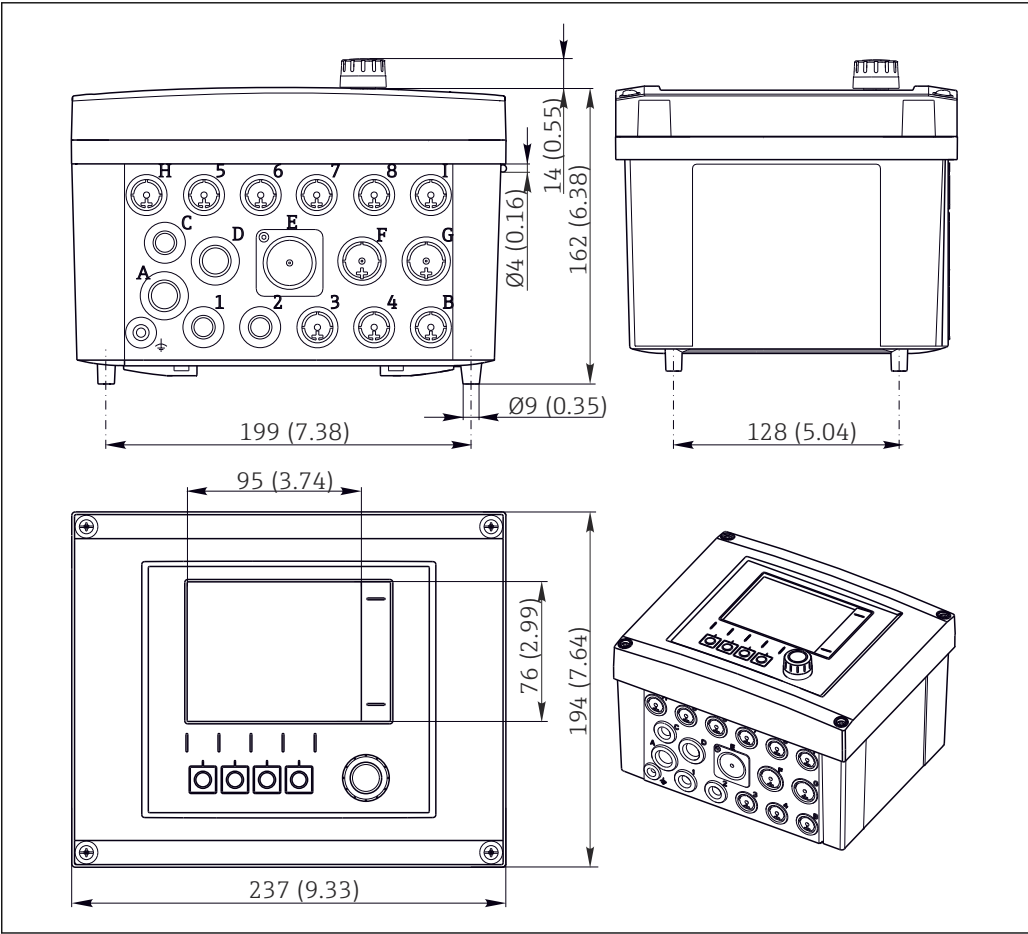
Degree of protection	IP66/67 as per IEC 60529 Housing protection rating NEMA Type 4X as per UL 50E
-----------------------------	--

Vibration resistance	Environmental tests Vibration test according to DIN EN 60068-2 Vibration test according to DIN EN 60654-3 Post or pipe mounting <table> <tr> <td>Frequency range</td> <td colspan="2">10 to 500 Hz (sinusoidal)</td> </tr> <tr> <td>Amplitude</td> <td>10 to 57.5 Hz:</td> <td>0.15 mm</td> </tr> <tr> <td></td> <td>57.5 to 500 Hz:</td> <td>2 g ¹⁾</td> </tr> <tr> <td>Test duration</td> <td colspan="2">10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)</td> </tr> </table> Wall mounting <table> <tr> <td>Frequency range</td> <td colspan="2">10 to 150 Hz (sinusoidal)</td> </tr> <tr> <td>Amplitude</td> <td>10 to 12.9 Hz:</td> <td>0.75 mm</td> </tr> <tr> <td></td> <td>12.9 to 150 Hz:</td> <td>0.5 g ¹⁾</td> </tr> <tr> <td>Test duration</td> <td colspan="2">10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)</td> </tr> </table> 1) g ... acceleration due to gravity (1 g ≈ 9.81 m/s²)	Frequency range	10 to 500 Hz (sinusoidal)		Amplitude	10 to 57.5 Hz:	0.15 mm		57.5 to 500 Hz:	2 g ¹⁾	Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)		Frequency range	10 to 150 Hz (sinusoidal)		Amplitude	10 to 12.9 Hz:	0.75 mm		12.9 to 150 Hz:	0.5 g ¹⁾	Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)	
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	12.9 to 150 Hz:	0.5 g ¹⁾																							
Test duration	10 frequency cycles/ spatial axis, in 3 spatial axes (1 oct./min)																								

Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326-1, class A for industrial areas
Electrical safety	IEC 61010-1, Class I equipment Low voltage: overvoltage category II Environment < 3000 m (< 9840 ft) above MSL
Pollution degree	The product is suitable for pollution degree 2.
Pressure compensation to environment	Filter made of GORE-TEX used as pressure compensation element Ensures pressure compensation to environment and guarantees IP protection.

Mechanical construction

Dimensions



A0012396

36 Dimensions of field housing in mm (in)

Weight	Complete device	Approx. 2.1 kg (4.63 lbs), depending on the version
	Individual module	Approx. 0.06 kg (0.13 lbs)

Materials

Housing base	PC-FR
Display cover	PC-FR
Display film and soft keys	PE
Housing seal	EPDM
Module side panels	PC-FR
Module housing 2DS Ex-i	PC-PBT
Module covers	PBT GF30 FR
Cable mounting rail	PBT GF30 FR, stainless steel 1.4301 (AISI304)
Clamps	Stainless steel 1.4301 (AISI304)
Screws	Stainless steel 1.4301 (AISI304)
Cable glands	Polyamide V0 as per UL94
Separation element	PC-PBT GF30

Operability

display

- Graphic display:
- Resolution: 240 x 160 pixel
 - Back light with switch-off function
 - Red display background for alarms alerts users to errors
 - Transflective display technology for maximum contrast even in bright environments

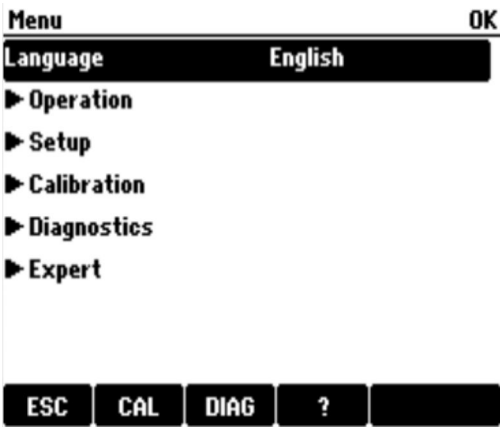
Operation concept

- The simple and structured operating concept sets new standards:
- Intuitive operation with the navigator and soft keys
 - Fast configuration of application-specific measurement options
 - Easy configuration and diagnosis thanks to plain-text display
 - All languages that can be ordered are available in every device



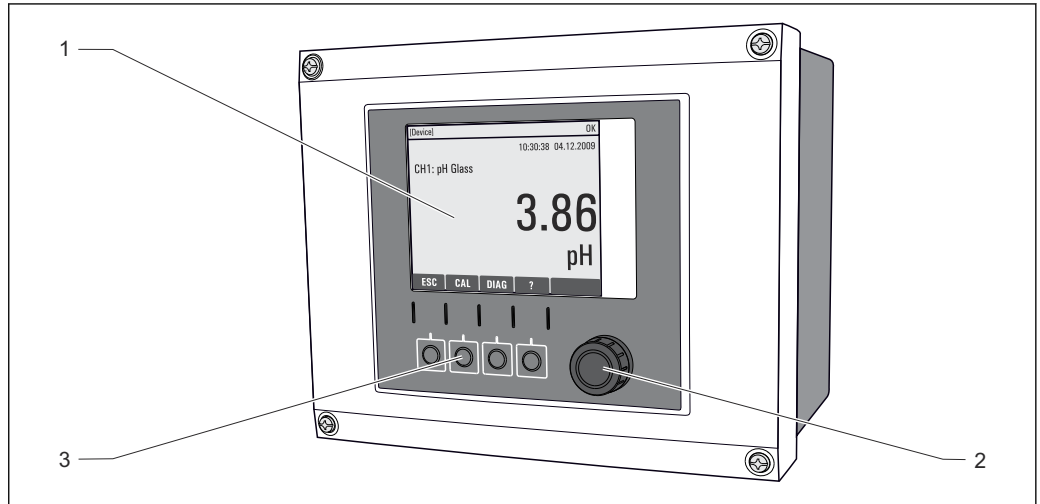
37 Easy operation

A0025228



38 Plain-text menu

Local operation



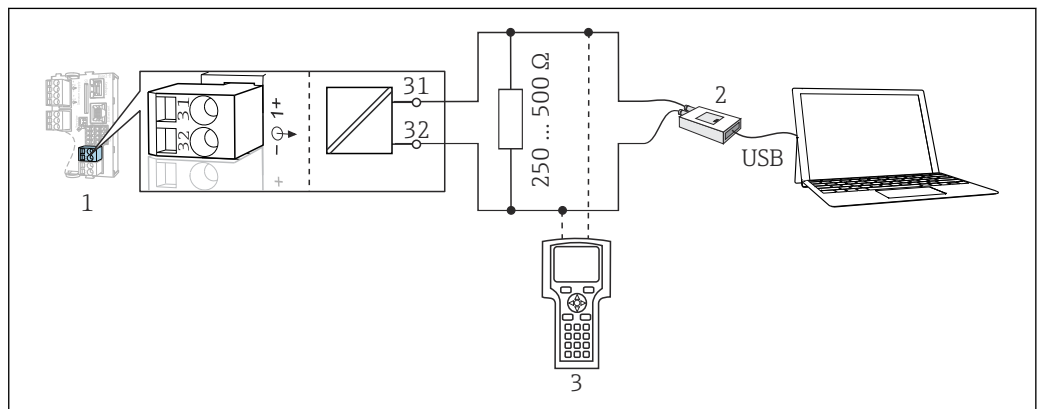
A0011764

39 Overview of operation

- 1 Display (with red display background in alarm condition)
- 2 Navigator (jog/shuttle and press/hold function)
- 3 Soft keys (function depends on menu)

Remote operation

Via HART (e.g. via HART modem and FieldCare)



A0039620

40 HART using modem

- 1 Device module Base2-L, -H or -E: current output 1 with HART
- 2 HART modem for connection to PC, e.g. Commubox FXA191 (RS232) or FXA195 ¹⁾ (USB)
- 3 HART handheld terminal

¹⁾ Switch position "on" (substitutes the resistor)

Language packages

The language selected in the product structure is the operating language preset at the factory. All other languages can be selected using the menu.

- English (US)
- German
- Chinese (Simplified, PR China)
- Czech
- Dutch
- French
- Italian
- Japanese
- Polish
- Portuguese
- Russian
- Spanish
- Swedish
- Turkish

- Hungarian
- Croatian
- Vietnamese

The availability of other languages can be checked via the product structure at www.endress.com/cm442 or [.../cm444](http://www.endress.com/cm444) or [.../cm448](http://www.endress.com/cm448).

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

Product page

www.endress.com/cm442
www.endress.com/cm444
www.endress.com/cm448

Product Configurator

1. **Configure:** Click this button on the product page.
 2. Select **Extended selection**.
 - ↳ The Configurator opens in a separate window.
 3. Configure the device according to your requirements by selecting the desired option for each feature.
 - ↳ In this way, you receive a valid and complete order code for the device.
 4. **Accept:** Add the configured product to the shopping cart.
-  For many products, you also have the option of downloading CAD or 2D drawings of the selected product version.
5. **CAD:** Open this tab.
 - ↳ The drawing window is displayed. You have a choice between different views. You can download these in selectable formats.

Scope of delivery

The scope of delivery comprises:

- 1 multichannel transmitter in the version ordered
- 1 mounting plate
- 1 wiring label (attached at the factory to the inside of the display cover)
- 1 printed copy of the Brief Operating Instructions in the language ordered
- Separation element (pre-installed on hazardous area version type 2DS Ex-i)
- Safety instructions for the hazardous area (for hazardous area version type 2DS Ex-i)

Accessories

The following are the most important accessories available at the time this documentation was issued.

Listed accessories are technically compatible with the product in the instructions.

1. Application-specific restrictions of the product combination are possible.
 Ensure conformity of the measuring point to the application. This is the responsibility of the operator of the measuring point.

2. Pay attention to the information in the instructions for all products, particularly the technical data.
3. For accessories not listed here, please contact your Service or Sales Center.

Device-specific accessories

Weather protection cover

CYY101

- Weather protection cover for field devices
- Absolutely essential for field installation
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY101-A

Post mounting kit

Post mounting kit CM44x

- For securing the field housing to horizontal and vertical posts and pipes
- Order No. 71096920

Measuring cables

Memosens data cable CYK10

- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10



Technical Information TI00118C

Memosens data cable CYK11

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



Technical Information TI00118C

Sensors

Glass electrodes

Memosens CPS11E

- pH sensor for standard applications in process and environmental engineering
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps11e



Technical Information TI01493C

Memosens CPS41E

- pH sensor for process technology
- With ceramic junction and KCl liquid electrolyte
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps41e



Technical Information TI01495C

Memosens CPS71E

- pH sensor for chemical process applications
- With ion trap for poison-resistant reference
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps71e



Technical Information TI01496C

Memosens CPS91E

- pH sensor for heavily polluted media
- With open aperture
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps91e



Technical Information TI01497C

Memosens CPS31E

- pH sensor for standard applications in drinking water and swimming pool water
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps31e



Technical Information TI01574C

Memosens CPS61E

- pH sensor for bioreactors in life sciences and for the food industry
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps61e



Technical Information TI01566C

Memosens CPF81E

- pH sensor for mining operations, industrial water and wastewater treatment
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cpf81e



Technical Information TI01594C

*Enamel pH electrodes***Ceramax CPS341D**

- pH electrode with pH-sensitive enamel
- Meets highest demands of measuring accuracy, pressure, temperature, sterility and durability
- Product Configurator on the product page: www.endress.com/cps341d



Technical Information TI00468C

*ORP sensors***Memosens CPS12E**

- ORP sensor for standard applications in process and environmental engineering
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps12e



Technical Information TI01494C

Memosens CPS42E

- ORP sensor for process technology
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps42e



Technical Information TI01575C

Memosens CPS72E

- ORP sensor for chemical process applications
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps72e



Technical Information TI01576C

Memosens CPF82E

- ORP sensor for mining operations, industrial water and wastewater treatment
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cpf82e



Technical Information TI01595C

Memosens CPS92E

- ORP sensor for use in heavily polluted media
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps92e



Technical Information TI01577C

Memosens CPS62E

- ORP sensor for hygienic and sterile applications
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps62e



Technical Information TI01604C

pH ISFET sensors

Memosens CPS47E

- ISFET sensor for pH measurement
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps47e



Technical Information TI01616C

Memosens CPS77E

- Sterilizable and autoclavable ISFET sensor for pH measurement
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps77e



Technical Information TI01396

Memosens CPS97E

- ISFET sensor for pH measurement
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps97e



Technical Information TI01618C

Combined pH/ORP sensors

Memosens CPS16E

- pH/ORP sensor for standard applications in process technology and environmental engineering
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps16e



Technical Information TI01600C

Memosens CPS76E

- pH/ORP sensor for process technology
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps76e



Technical Information TI01601C

Memosens CPS96E

- pH/ORP sensor for heavily polluted media and suspended solids
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cps96e



Technical Information TI01602C

Conductivity sensors with inductive measurement of conductivity

Indumax CLS50D

- High-durability inductive conductivity sensor
- For standard and hazardous area applications
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cls50d



Technical Information TI00182C

Indumax CLS54D

- Inductive conductivity sensor
- With certified, hygienic design for food, beverages, pharmaceuticals, and biotechnology
- Product configurator on the product page: www.endress.com/cls54d



Technical Information TI00508C

*Conductivity sensors with conductive measurement of conductivity***Memosens CLS15E**

- Digital conductivity sensor for measurements in pure and ultrapure water
- Conductive measurement
- With Memosens 2.0
- Product Configurator on the product page: www.endress.com/cls15e



Technical Information TI01526C

Memosens CLS16E

- Digital conductivity sensor for measurements in pure and ultrapure water
- Conductive measurement
- With Memosens 2.0
- Product Configurator on the product page: www.endress.com/cls16e



Technical Information TI01527C

Memosens CLS21E

- Digital conductivity sensor for media with medium or high conductivity
- Conductive measurement
- With Memosens 2.0
- Product Configurator on the product page: www.endress.com/cls21e



Technical Information TI01528C

Memosens CLS82E

- Hygienic conductivity sensor
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cls82e



Technical Information TI01529C

*Oxygen sensors***Memosens COS22E**

- Hygienic amperometric oxygen sensor with maximum measurement stability over multiple sterilization cycles
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cos22e



Technical Information TI01619C

Memosens COS51E

- Amperometric oxygen sensor for water, wastewater and utilities
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cos51e



Technical Information TI01620C

Oxymax COS61D

- Optical oxygen sensor for drinking water and industrial water measurement
- Measuring principle: quenching
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cos61d



Technical Information TI00387C

Memosens COS81E

- Hygienic optical oxygen sensor with maximum measurement stability over multiple sterilization cycles
- Digital with Memosens 2.0 technology
- Product Configurator on the product page: www.endress.com/cos81e

 Technical Information TI01558C

Disinfection sensors

Memosens CCS51D

- Sensor for measuring free available chlorine
- Product Configurator on the product page: www.endress.com/ccs51d

 Technical Information TI01423C

Ion-selective sensors

ISEmax CAS40D

- Ion selective sensors
- Product Configurator on the product page: www.endress.com/cas40d

 Technical Information TI00491C

Turbidity sensors

Turbimax CUS51D

- For nephelometric measurements of turbidity and solids in wastewater
- 4-beam scattered light method
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus51d

 Technical Information TI00461C

Turbimax CUS52D

- Hygienic Memosens sensor for turbidity measurement in drinking water, process water and in utilities
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cus52d

 Technical Information TI01136C

SAC and nitrate sensors

Viomax CAS51D

- SAC and nitrate measurement in drinking water and wastewater
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cas51d

 Technical Information TI00459C

Interface measurement

Turbimax CUS71D

- Immersion sensor for interface measurement
- Ultrasonic interface sensor
- Product Configurator on the product page: www.endress.com/cus71d

 Technical Information TI00490C

Spectrometer sensors

Memosens Wave CAS80E

- Measurement of various parameters in liquid media
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cas80e

 Technical Information TI01522C

*Fluorescence sensors***Memosens CFS51**

- Sensor for fluorescence measurement
- With Memosens technology
- Product Configurator on the product page: www.endress.com/cfs51



Technical Information TI01630C

Communication-specific accessory**Device Care SFE100**

- Configuration of Endress+Hauser devices
- Fast and easy installation, online application updates, one-click connection to devices
- Automatic hardware identification and driver catalog update
- Device configuration with DTMs



Technical Information Device Care SFE100, TI01134S

Commubox FXA195

Intrinsically safe HART communication with FieldCare via the USB port



Technical Information TI00404F

Commubox FXA291

Connects the CDI interface of measuring devices with the USB port of the computer or laptop



Technical Information TI00405C

Wireless HART adapter SWA70

- Wireless device connection
- Easily integrated, offers data protection and transmission safety, can be operated in parallel with other wireless networks, minimum cabling complexity



Technical Information TI00061S

Field Data Manager Software MS20/21

- PC software for central data management
- Visualization of series of measurements and logbook events
- SQL database for secure data storage

FieldCare SFE500

- Universal tool for field device configuration and management
- Supplied with a complete library of certified DTMs (Device Type Manager) for operation of Endress+Hauser field devices
- Order according to product order structure
- www.endress.com/sfe500

Memobase Plus CYZ71D

- PC software to support laboratory calibration
- Visualization and documentation of sensor management
- Sensor calibrations stored in database
- Product Configurator on the product page: www.endress.com/cyz71d



Technical Information TI00502C

Service-specific accessories**Additional functionality***Hardware extension modules***Kit, extension module AOR**

- 2 x relay, 2 x 0/4 to 20 mA analog output
- Order No. 71111053

Kit, extension module 2R

- 2 x relay
- Order No. 71125375

Kit, extension module 4R

- 4 x relay
- Order No. 71125376

Kit, extension module 2AO

- 2 x 0/4 to 20 mA analog output
- Order No. 71135632

Kit, extension module 4AO

- 4 x analog output 0/4 to 20 mA
- Order No. 71135633

Kit, extension module 2DS

- 2 x digital sensor, Memosens
- Order No. 71135631

Kit extension module 2DS Ex-i

- 2 x digital sensor, Memosens, Ex approval
- Order No. 71477718

Kit, extension module 2AI

- 2 x 0/4 to 20 mA analog input
- Order No. 71135639

Kit, extension module DIO

- 2 x digital input
- 2 x digital output
- Auxiliary voltage supply for digital output
- Order No. 71135638

Upgrade kit, extension module 485DP

- Extension module 485DP
- PROFIBUS DP
- Order No. 71575177

Upgrade kit, extension module 485MB

- Extension module 485MB
- Modbus RS485
- Order No. 71575178

Kit CM442: upgrade kit to CM444/CM448

- Extension power supply unit 100 to 230 V AC and extension backplane
- Base module BASE2-E
- You must quote the serial number of the device when ordering the kit.
- Order No. 71470973

Kit CM442: upgrade kit to CM444/CM448

- Extension power supply unit 24 V DC and extension backplane
- Base module BASE2-E
- You must quote the serial number of the device when ordering the kit.
- Order No. 71470975

Firmware and activation codes

SD card with Liquiline firmware

- Industrial Flash Drive, 1 GB
- Order No. 71127100



You must quote the serial number of the device when ordering the activation code.

Kit CM442: activation code for 2nd digital sensor input

Order No. 71114663

Activation code for feedforward control

- Requires current input or fieldbus communication
- Order No. 71211288

Activation code for measuring range switch

- Requires digital inputs or fieldbus communication
- Order No. 71211289

Activation code for ChemocleanPlus

- Requires relays or digital outputs or fieldbus communication and optional digital inputs
- Order No. 71239104

Activation code for Heartbeat Verification and Monitoring

Order No. 71367524

Activation code for mathematics

- Formula editor
- Order No. 71367541

Activation code for Ethernet/IP and web server

Order No. XPC0018

Activation code for Modbus TCP and web server

Order No. XPC0020

Activation code for web server for BASE2

Order No. XPC0021

Activation code for PROFINET and web server Base2

Order No. XPC0022

Activation code for HART

Order No. XPC0023

Activation code for Profibus DP for module 485

Order No. XPC0024

Activation code for module 485 Modbus RS485

Order No. XPC0025

Activation code for Liquiline inputs/outputs

Order No. XPC0026

Activation code for additional functions

Order No. XPC0027

System components**RIA14, RIA16**

- Field display unit for integration into 4-20 mA circuits
- RIA14 in flameproof metal enclosure



Technical Information TI00143R and TI00144R

RIA15

- Process display unit, Digital display unit for integration into 4-20 mA circuits
- Panel mounting
- With optional HART communication



Technical Information TI01043K

Other accessories**SD card**

- Industrial Flash Drive, 1 GB
- Order number: 71110815

Cable glands**Kit CM44x: gland M**

- Set, 6 pieces
- Order number: 71101768

Kit CM44x: gland NPT

- Set, 6 pieces
- Order number: 71101770

Kit CM44x: gland G

- Set, 6 pieces
- Order number: 71101771

Kit CM44x: dummy plug for cable gland

- Set, 6 pieces
- Order number: 71104942

M12 built-in socket and cable junction with Velcro strip**Kit CM442/CM444/CM448/CSF48: M12 built-in socket for digital sensors**

- Pre-terminated
- Order No. 71107456

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for PROFIBUS DP/Modbus RS485

- B-coded, pre-terminated
- Order No. 71140892

Kit CM442/CM444/CM448/CSF48: M12 built-in socket for Ethernet

- D-coded, pre-terminated
- Order No. 71140893

Kit: external CDI socket, complete

- Retrofit kit for CDI interface, with terminated connecting cables
- Order No. 51517507

Cable junction with Velcro strip

- 4 pieces, for sensor cable
- Order No. 71092051



www.addresses.endress.com
