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01.12.01 (Device firmware)

Operating Instructions
Memosens

Sensor inputs with Memosens protocol
For all devices in the Liquiline family: CM44x, CM44xR, CM44P, CSFXX, CSP44, CA80XX

Endress+Hauser
People for Process Automation

Table of contents

1 Document information

1.1 Warnings

Structure of information	Meaning
⚠ DANGER **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **will** result in a fatal or serious injury.
⚠ WARNING **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid the dangerous situation **can** result in a fatal or serious injury.
⚠ CAUTION **Causes (/consequences)** If necessary, Consequences of non-compliance (if applicable) ▶ Corrective action	This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or more serious injuries.
NOTICE **Cause/situation** If necessary, Consequences of non-compliance (if applicable) ▶ Action/note	This symbol alerts you to situations which may result in damage to property.

1.2 Symbols

- Additional information, tips
- Permitted or recommended
- Not permitted or not recommended
- Reference to device documentation
- Reference to page
- Reference to graphic
- Result of a step

1.3 Documentation

The following manuals complement these Operating Instructions and are available on the product pages on the Internet:

- Operating Instructions
  - Liquiline CM44x, BA00444C
  - Liquiline CM44xR, BA01225C
  - Liquiline CM44P, BA01570C
  - Liquistation CSF48, BA00443C
  - Liquiport CSP44, BA00465C
  - Liquistation CSF34, BA00478C
  - Liquistation CSF39, BA01407C
  - Liquisystem CA80AM, BA01240C
  - Liquisystem CA80PH, BA01416C and BA01435C
  - Liquisystem CA80NO, BA01574C
  - Liquisystem CA80CR, BA01575C
  - Liquisystem CA80AL, BA001585C
  - Liquisystem CA80FE, BA01586C
  - Liquisystem CA80COD, BA01354C
  - Liquisystem CA80TP, BA01593C
  - Liquisystem CA80HA, BA01772C
  - Liquisystem CA80SI, BA01650C
- Brief Operating Instructions for the devices mentioned
- Technical Information for the devices mentioned
- Liquiline Operating Instructions for HART communication, BA00486C
  - Onsite settings and installation instructions for HART
  - Description of HART driver
- Guidelines for communication via fieldbus and web server
  - HART, SD01187C
  - PROFIBUS, SD01188C
  - Modbus, SD01189C
  - Web server, SD01190C
  - EtherNet/IP, SD01293C

2 Information on sensors with Memosens protocol

Sensors with Memosens protocol have an integrated electronics unit that stores calibration data and other information. Once the sensor has been connected, the sensor data are transferred automatically to the transmitter and used to calculate the measured value.

▶ Call up the sensor data via the corresponding DIAG menu.

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
  - Calibration values
  - Number of calibrations
  - Serial number of the transmitter used to perform the last calibration or adjustment
- Operating data
  - Temperature application range
  - Date of initial commissioning
  - Hours of operation under extreme conditions
  - Sensor monitoring data

Which exact data are recorded and communicated to the transmitter is dependent on the sensor. Even within a sensor type, differences may occur. This means that, depending on which sensor is connected, menu items may or may not be available. Please note the relevant information in this manual.

Example:
The amperometric oxygen sensor COS51D cannot be sterilized. For this reason, limit values for sterilization cannot be defined in the diagnostic settings for this sensor. However, these menu items are available for a sterilizable amperometric sensor, e.g. COS22D.

3 Electrical connection

⚠ WARNING

Device is live!

Incorrect connection may result in injury or death!

- ▶ The electrical connection may be performed only by an electrical technician.
- ▶ The electrical technician must have read and understood these Operating Instructions and must follow the instructions contained therein.
- ▶ **Prior** to commencing connection work, ensure that no voltage is present on any cable.

3.1 Sensor types with Memosens protocol

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:

- CM442R
  - 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.
- CM444R
  No restrictions. All the sensor inputs can be used as required.
- CM448R
  - 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.

3.2 Connecting sensors with Memosens protocol

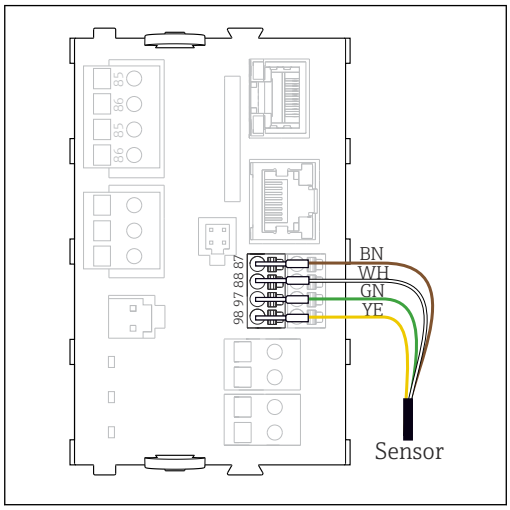
Connection Types of connection

- Direct connection of the sensor cable to the terminal connector of the , basic module-L, -H or -E (→ 🖼 1 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 (→ 🖼 4).

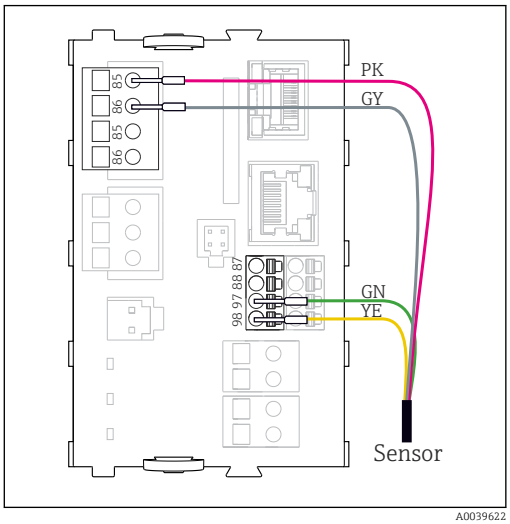
1. Sensor cable connected directly
   Connect the sensor cable to the Memosens terminal connector of the 2DS, or of the BASE2-L, -H or -E module.

2. If connected via M12 connector
Connect the sensor connector to an M12 sensor socket which has been previously installed or is supplied on delivery.

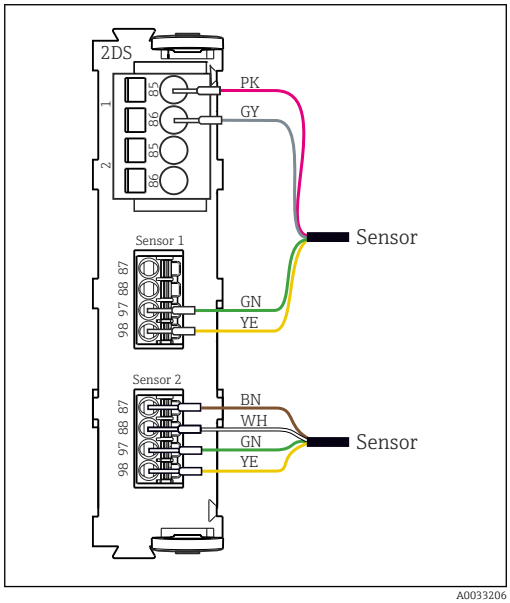
Sensor cable connected directly



1 *sensors without additional supply voltage*



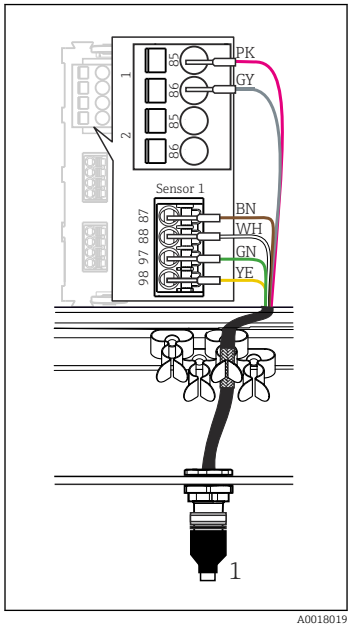
2 *sensors with additional supply voltage*



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

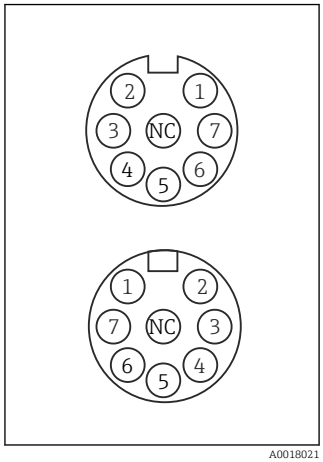
In the case of a single-cannel device:
The left-hand Memosens input on basic module must be used!

connection via M12 connection
Only for connection in non-hazardous area.



4 *M12 connection (e.g. on sensor module)*

1 Sensor cable with M12 connector



5 *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, NC Not connected

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

Version without a pre-installed M12 socket

1. Insert an M12 socket (accessory) into a suitable opening in the base of the housing.
2. Connect the cable to a Memosens terminal as per the wiring diagram.

Connecting the sensor

▶ Connect the sensor cable connector (→ 4item 1) directly to M12 socket.

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).

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

3.3 Sensor types with Memosens protocol for 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

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).

The sensor connections for non-Ex sensors on the base module are disabled.

4 Inputs: General

An input can be configured in one of two ways:
- Configuration where a sensor is not connected
- Configuration where a sensor is connected

Configuration where a sensor is not connected

Some settings require sensor communication. You cannot make these settings if a sensor is not connected.

It is also possible to save a setup and transfer it to another device (→ Operating Instructions for the device, → 7). This function might meet the requirements of your application better than a configuration when a sensor is not connected.

1. Select the relevant channel.
2. From the list, select the sensor type that you want to configure.
3. Configure the channel as explained in the following sections.
4. At a later point, connect a sensor of the selected type.
   ↳ The channel is ready for operation immediately.

Configuration where a sensor is connected

▶ Configure the channel as explained in the following sections.

5 Inputs:pH/ORP

5.1 Basic settings

5.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

5.1.2 Main value

Menu/Setup/Inputs/Channel: pH or ORP or pH/ORP		
Function	**Options**	**Info**
Main value	**Selection** ▪ pH [1] ▪ mV [2] ▪ ORP mV [3] ▪ ORP % [3] ▪ pH/ORP/rH [4] **Factory setting** ▪ pH [1] ▪ ORP mV [5]	Select how the main value should be displayed. Subsequent configuration options depend on the option selected here. You can display the main value of a pH sensor as a pH value or as a raw value in mV. If using an ORP sensor, here you decide which ORP mode to use: mV or %. If you have connected a combined sensor, you can also select the rH value. **Note the following for pH/ORP combined sensors** Select **pH/ORP/rH** as the main value if you want to calibrate pH and ORP.

1) pH sensor and pH/ORP combined sensor
2) pH sensor
3) ORP sensor and pH/ORP combined sensor
4) pH/ORP combined sensor
5) ORP sensor

5.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

5.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

5.2 Extended setup

5.2.1 Temperature and medium compensation (only pH and pH/ORP)

Menu/Setup/Inputs/Channel: pH or pH/ORP/▶ Extended setup		
Function	**Options**	**Info**
Temp. compensation	**Selection** ▪ Off ▪ Automatic ▪ Manual **Factory setting** Automatic	Determine compensation of fluid temperature: ▪ Automatically using the temperature sensor of your sensor (ATC) ▪ Manually by entering the medium temperature ▪ No compensation
Temperature **Temp. compensation** = **Manual**	-50 to 250 °C (-58 to 482 °F) **Factory setting** 25 °C (77 °F)	Specify the medium temperature.
This setting only refers to compensation during measurement. Enter the compensation for calibration in the calibration settings.		
Medium comp.	**Selection** ▪ Off ▪ 2-point calibration ▪ Table **Factory setting** Off	Take a sample of the medium and determine its pH value at different temperatures in the lab. Decide whether you want to compensate using two points or several points in a table.
The dissociation of water changes with increasing temperature. The balance shifts towards the protons; the pH value drops. It is possible to compensate for this effect with the **Medium comp.** function.		
Internal buffer	pH 0 to 14 **Factory setting** pH 7.00	Only change the value if you are using a sensor with an internal buffer other than pH 7.

5.2.2 Measured value formats

Menu/Setup/Inputs/Channel: pH or ORP or pH/ORP/▶ Extended setup		
Function	**Options**	**Info**
Main value format *Only* **pH** *and* **pH/ORP**	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places
Temperature format		

5.2.3 Customer ID (only for E-sensors)

You can enter an individual identifier for the sensor. This can then be found in the menu **DIAG/Sensor information**/Channel No. <Sensor type>/**General information**.

5.2.4 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▸ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

5.2.5 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

5.2.6 Sterilization settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Sterilization settings		
Function	**Options**	**Info**
Temperature threshold	120 to 150 °C **Factory setting** 121 °C	This temperature must be exceeded for the sterilization counter to start and a sterilization cycle to be counted.
Duration	1 to 250 min **Factory setting** 20 min	The set temperature must be reached during this time for a sterilization cycle to be counted.

5.2.7 CIP settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ CIP settings		
Function	**Options**	**Info**
Mode	**Selection** ▪ On ▪ Off **Factory setting** Off	Switch the counter for the CIP cycles on or off
Signal type	**Selection** ▪ Acidic ▪ Alkaline **Factory setting** Acidic	▶ Specify whether an acidic or alkaline CIP should be recognized.
pH threshold	pH 2.0 to 11.0 **Factory setting** pH 11.0	A CIP cycle is counted if the temperature threshold is exceeded and, simultaneously, the pH threshold is exceeded or undershot, depending on the selected type. ▪ **Signal type** = **Acidic** → The device counts when the pH threshold is undershot ▪ **Signal type** = **Alkaline** → The device counts when the pH threshold is exceeded
Upper temp. threshold	**Factory setting** 85 °C	A CIP cycle is taken into consideration within the temperature thresholds. ▪ **Upper temp. threshold**: If the temperature measured value exceeds this limit value, the CIP conditions are breached and a CIP cycle is not counted. ▪ **Lower temp. threshold**: A CIP cycle is counted if the temperature exceeds the lower temperature threshold and drops below the threshold again after the set minimum time at the very earliest.
Lower temp. threshold	**Factory setting** 75 °C	
Duration	1 to 250 min **Factory setting** 20 min	Minimum time period in which the temperature must be between the lower and upper temperature threshold for a CIP cycle to be counted.

5.2.8 Calibration settings

Stability criteria

Define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during the calibration. If the permitted difference is exceeded, the calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: pH or ORP or pH/ORP/Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta mV	1 to 10 mV **Factory setting** 1 mV	Permitted measured value fluctuation during calibration
Duration	10 to 60 s **Factory setting** 20 s	Timeframe within which the permitted measured value fluctuation must not be exceeded

Temperature compensation during calibration

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Temp. compensation	**Selection** ▪ Off ▪ Automatic ▪ Manual **Factory setting** Automatic	Specify the compensation of the buffer temperature: ▪ Automatically using the temperature sensor of the sensor (ATC) ▪ Manually by entering the medium temperature ▪ Not at all
Temperature **Temp. compensation** = **Manual**	-50 to 250 °C (-58 to 482 °F) **Factory setting** 25 °C (77 °F)	Specify the buffer temperature.
This setting only refers to compensation during calibration, not in measuring mode. Perform compensation in the measuring mode further up in the menu.		

Buffer recognition

Automatic buffer recognition
To ensure a buffer is detected correctly, the measuring signal may deviate by a maximum of 30 mV from the value stored in the buffer table. This is approx. 0.5 pH at a temperature of 25°C.
If both buffers - 9.00 and 9.20 - were used, this would cause the signal intervals to overlap and buffer recognition would not work. For this reason, the device would recognize a buffer with a pH of 9.00 as a pH of 9.20.
→ Do not use the buffer with pH 9.00 for automatic buffer recognition.

Menu/Setup/Inputs/Channel: pH or ORP or pH/ORP or (ISE/Electrode slot)/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Buffer recognition	**Selection** ▪ Fixed ▪ Automatic [1)] ▪ Manual **Factory setting** Fixed	**Fixed** Select values from a list. The list depends on the setting in **Buffer manufacturer**. **Automatic** The device recognizes the buffer automatically. The recognition depends on the setting in **Buffer manufacturer**. As their zero point is offset, CPS341D enamel pH sensors and CPS4xxD-ISFET sensors cannot be calibrated and adjusted with automatic buffer recognition. **Manual** Enter any two buffer values. These must differ in terms of their pH value.
Buffer manufacturer	**Selection** ▪ Endress+Hauser ▪ Ingold/Mettler ▪ DIN 19266 ▪ DIN 19267 ▪ Merck/Riedel ▪ Hamilton ▪ Special buffer **Factory setting** Endress+Hauser	Temperature tables are stored internally in the unit for the following pH values: ▪ **Endress+Hauser** 2.00 / 4.00 / 7.00 / (9.00) / 9.22 / 10.00 / 12.00 ▪ **Ingold/Mettler** 2.00 / 4.01 / 7.00 / 9.21 ▪ **DIN 19266** 1.68 / 4.01 / 6.86 / 9.18 ▪ **DIN 19267** 1.09 / 4.65 / 6.79 / 9.23 / 12.75 ▪ **Merck/Riedel** 2.00 / 4.01 / 6.98 / 8.95 / 12.00 ▪ **Hamilton** 1.09 / 1.68 / 2.00 / 3.06 / 4.01 / 5.00 / 6.00 7.00 / 8.00 / 9.21 / 10.01 / 11.00 / 12.00
With the **Special buffer** option, it is possible to define two buffers of your own. For this purpose, two tables are displayed in which pH value/temperature value pairs can be saved.		
Calibration buffer 1 … 2 **Buffer recognition** = **Fixed** *or* **Manual**	The options and factory setting depend on the **Buffer manufacturer**	
1 point adjustment	**Selection** ▪ Transmitter ▪ Sensor **Factory setting** Transmitter	**Function not in the ISE menu** Select whether the offset should be saved in the transmitter or in the sensor.

1) Only pH or pH/ORP combined sensor

Calibration monitoring

The calibration interval for the sensor can be specified here. Once the configured time elapses, the diagnostic message **Calibration validity** is shown on the display.

The timer is reset automatically if the sensor is recalibrated.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ During operation ▪ When connecting **Factory setting** Off	This function checks the time elapsed since the last sensor calibration. This may occur continuously during operation or just once while the calibration data are being read (sensor connection, device start, calibration kit replacement). 1. During operation During continuous operation, this function informs the user of the time elapsed since the last calibration. 2. When connecting During a batch process, this function ensures that only recently calibrated sensors are used. No error message is generated during the batch process.
▶ Calibration validity		
Warning limit	**Factory setting** 800 h	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 1000 h	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 20000 h Generally, the following applies: alarm limit > warning limit		

5.2.9 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Impedance monitoring, Sensor Check System (only pH glass and pH/ORP combined sensor)

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.

- Reasons for decreasing impedance values:
  - High temperatures
  - Glass breakage
- Reasons for increasing impedance values:
  - Dry sensor (sensor is in air)
  - Worn pH glass membrane or coating on the pH glass membrane
  - Low temperatures

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Glass impedance (SCS)		
Function	**Options**	**Info**
Upper limit	**Selection** ▪ Off ▪ On **Factory setting** On	**On** SCS operates with the following settings for the upper warning and alarm limits. **Off** Monitoring of the upper warning and alarm limits is switched off.
Upper alarm limit	0 to 10000 MΩ **Factory setting** 3000 MΩ	Diagnostics code and associated message text: 124 **Sensor glass**
Upper warning limit	0 to 10000 MΩ **Factory setting** 2500 MΩ	Diagnostics code and associated message text: 125 **Sensor glass**
Lower limit	**Selection** ▪ Off ▪ On **Factory setting** On	**On** SCS operates with the following settings for the lower warning and alarm limits. **Off** Monitoring of the lower warning and alarm limits is switched off.
Lower warning limit	0 to 10000 MΩ **Factory setting** 0.1 MΩ	Diagnostics code and associated message text: 123 **Sensor glass**
Lower alarm limit	0 to 10000 MΩ **Factory setting** 0 MΩ	Diagnostics code and associated message text: 122 **Sensor glass**

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

Slope (only pH)

The slope characterizes the sensor condition. The bigger the deviation from the ideal value (59 mV/pH) the poorer the condition of the sensor.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Slope		
Function	**Options**	**Info**
Warning limit	25.00 to 65.00 mV/pH **Factory setting** 35.16 mV/pH	Specify limit values for slope monitoring. Associated diagnostics code and message text: 509 **Sensor calibration**

Zero point (pH Glass) and Operating point (pH ISFET)

pH glass sensors
The zero point characterizes the condition of the sensor reference. The bigger the deviation from the ideal value (pH 7.00) the poorer the condition.
This can be caused by KCl dissolving away or reference contamination, for example.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Zero point or Operating point		
Function	**Options**	**Info**
Upper warning limit	**Lower warning limit** ... pH 12.00 [1] **Lower warning limit** ... 950 mV [2] **Factory setting** pH 8.00 / 300 mV	Associated diagnostics code and message text: 505 **Sensor calibration** [1] 515 **Sensor calibration** [2]
Lower warning limit	pH 2.00 to **Upper warning limit** [1] -950 mV to **Upper warning limit** [2] **Factory setting** pH 6.00 / -300 mV	Associated diagnostics code and message text: 507 **Sensor calibration** [1] 517 **Sensor calibration** [2]

1) **pH Glass**
2) **pH ISFET**

Sensor Condition Check (only pH Glass)

Sensor condition check (SCC) monitors the electrode status and the degree of electrode aging. The condition of the electrode is updated after every calibration.

The main reasons for a deteriorating electrode status are:
- Glass membrane blocked or dry
- Diaphragm (reference) blocked

Remedial action

1. Clean or regenerate sensor.
2. If this does not have the desired effect:
   Replace sensor.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Sensor condition check		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	The function can only be switched on or off. It uses internal limit values Diagnostics code and associated message text: 127 **SCC sufficient** 126 **SCC bad**

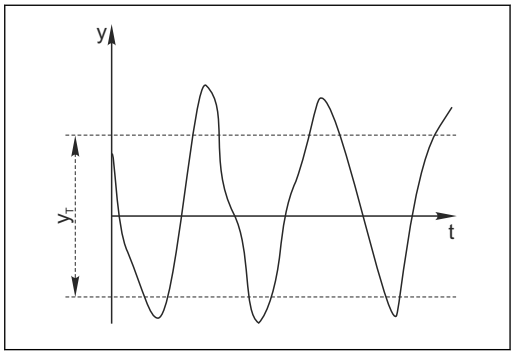
ORP meas. value (only ORP)

Specify the limit values to monitor the process. A diagnostics message is displayed if the limits are exceeded or undershot.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ ORP meas. value		
Function	**Options**	**Info**
Upper alarm limit	**Factory setting** 1000 mV	Diagnostics code and associated message text: 842 **Process value**
Upper warning limit	**Factory setting** 900 mV	Diagnostics code and associated message text: 942 **Process value**
Lower warning limit	**Factory setting** -900 mV	Diagnostics code and associated message text: 943 **Process value**
Lower alarm limit	**Factory setting** -1000 mV	Diagnostics code and associated message text: 843 **Process value**

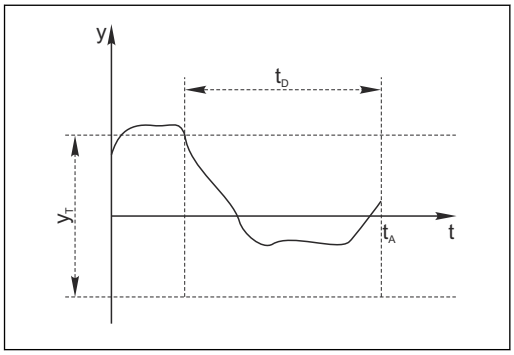
Process Check System (PCS)

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).



6 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



7 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation > 80 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 193 **Operating time**
▶ Operation > 100 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 194 **Operating time**
Operation < -300 mV		*Only pH sensor or pH/ORP combined sensor*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 180 **Operating time**
Operation > 300 mV		*Only pH sensor or pH/ORP combined sensor*
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 179 **Operating time**

Delta slope (only pH and pH/ORP combined sensor)

The device determines the difference in slope between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor. The greater the change, the greater the wear experienced by the pH-sensitive glass membrane as a result of chemical corrosion or abrasion.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Delta slope		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0.10 to 10.00 mV/pH **Factory setting** 5.00 mV/pH	Specify the limit values for monitoring the slope differential. Associated diagnostics code and message text: 518 **Sensor calibration**

Delta zero point (pH glass) or Delta operating point (ISFET)

The device determines the difference between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor.

The following applies to pH glass electrodes:
The greater the change, the greater the wear experienced by the reference as a result of contaminating ions or KCl dissolving away.

Menu/Setup/Inputs/Channel: pH or pH/ORP/Extended setup/Diagnostics settings/▶ Delta zero point or Delta operating point		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	pH 0.00 to 2.00 (pH glass) 0 to 950 mV (ISFET) **Factory setting** pH 0.50 / 25 mV	Specify the limit values for monitoring the slope differential. Associated diagnostics code and message text: ▪ 520 **Sensor calibration** (pH glass) ▪ 522 **Sensor calibration** (ISFET)

Sterilizations

The system counts the number of operating hours during which the sensor is exposed to a temperature that is typical for a sterilization. This temperature depends on the sensor.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/Diagnostics settings/▶ Sterilizations		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0 to 1000 **Factory setting** Depends on sensor [1)]	Specify the limit value for the number of sensor sterilizations. Diagnostics code and associated message text: 108 **SIP, CIP, autoclaving**

1) Every sensor type has its own factory setting. Can be viewed at: **DIAG**/**Sensor information**/Channel <Sensor type>/**Recommended diag. limit values**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

5.3 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

5.4 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

5.5 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

6 Inputs: Conductivity

6.1 Basic settings

6.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

6.1.2 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

6.1.3 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

6.1.4 Operating mode and cell constant

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Conductivity ▪ Resistance [1] ▪ Concentration [2] ▪ TDS **Factory setting** Conductivity	Instead of measuring conductivity, a **contacting conductivity sensor** can also be used to measure the resistivity and the Total Dissolved Solids (TDS) parameter. An **inductive conductivity sensor** or a conductive **four-pin sensor**, on the other hand, can be used to measure the concentration of the medium and the TDS parameter, as an alternative to measuring conductivity. **TDS** TDS stands for all the inorganic and organic substances in the water in ionic, molecular or microgranular (<2 µm) form. The conductivity is multiplied by a fixed factor of 0.5 for calculation purposes.
Cell constant	Read only (Only available if a sensor is connected)	The cell constant of the connected sensor is displayed (→ sensor certificate)

1) Only conductive sensor
2) Only inductive conductivity sensor and four-pin sensor (e.g. CLS82E)

6.1.5 Installation factor (only inductive conductivity sensors and four-pin sensors)

In confined installation conditions, the conductivity measurement is affected by the pipe walls.
The installation factor compensates for this effect. The transmitter corrects the cell constant by multiplying by the installation factor.
The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the sensor's distance to the wall.
If there is a sufficient distance between the wall and the sensor, the installation factor f does not have to be taken into consideration (f = 1.00). If the distance to the wall is smaller, the installation factor increases for electrically insulating pipes (f > 1) and decreases for electrically conductive pipes (f < 1).
The installation factor can be determined using calibration solutions. Approximate values for the sensor-specific installation factor are provided in the Operating Instructions of the sensor.

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Inst. factor	Read only (Only available if a sensor is connected)	Displays the current value. Only changes with a calibration.

6.1.6 Concentration table (only inductive conductivity sensors and four-pin sensors)

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Conc. table **Operating mode** = **Concentration**	**Selection** ▪ NaOH 0..15% ▪ NaOH 25..50% ▪ HCl 0..20% ▪ HNO3 0..24% ▪ HNO3 24..30% ▪ H2SO4 0.5..27% ▪ H2SO4 40..80% ▪ H2SO4 93..99% ▪ H3PO4 0..40% ▪ NaCl 0..26% ▪ User table 1 … 4 **Factory setting** NaOH 0..15%	Concentration tables saved at the factory: ▪ 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 24 %, 2 to 80 °C (36 to 176 °F) ▪ HNO_3: 24 to 30 %, 2 to 80 °C (36 to 176 °F) ▪ H_2SO_4: 0.5 to 27 %, 4 to 98 °C (39 to 208 °F) ▪ H_2SO_4: 40 to 80 %, 4 to 98 °C (39 to 208 °F) ▪ H_2SO_4: 93 to 99 %, 10 to 115 °C (50 to 239 °F) ▪ H_3PO_4: 0 to 40 %, 2 to 80 °C (36 to 176 °F) ▪ NaCl: 0 to 26 %, 2 to 80 °C (36 to 176 °F)
Temp. comp. mode **Conc. table** = **User table 1 … 4**	**Selection** ▪ with temp. comp ▪ without temp. comp **Factory setting** with temp. comp	Only select **without temp. comp** in very narrow temperature ranges. Select **with temp. comp** in all other cases.
Table name **Conc. table** = **User table 1 … 4**	Customized text, 16 characters	Assign a meaningful name to the selected table.
▶ Edit table **Conc. table** = **User table 1 … 4**	3-column table	Assign conductivity and concentration value pairs for a specific temperature.

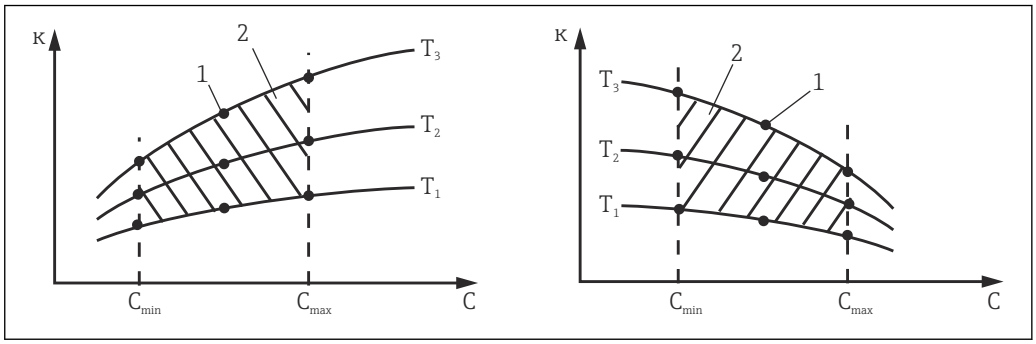
Data records for entering a concentration table

Given a defined medium composition, you can take data records for concentration tables from tables. Alternatively you can determine the data records experimentally.

To this end:

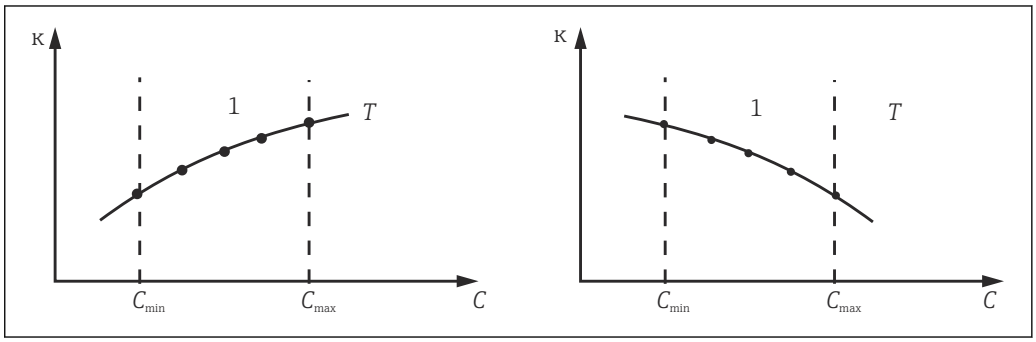
1. Create samples of the medium in the concentrations that occur in the process. Two samples of different concentrations are required at the very minimum.
2. Measure the uncompensated conductivity of these samples at a constant temperature.
   ↳ If the variable process temperature is to be taken into consideration, determine data records for at least two different temperatures (minimum 0.5 °C apart). The transmitter requires at least 4 support points. Ideally, measure the conductivity of two different concentrations at the minimum and maximum process temperature.

You should receive measured data which, from a qualitative perspective, are presented as illustrated in the following charts.



8 *Example of measured data for variable temperatures*

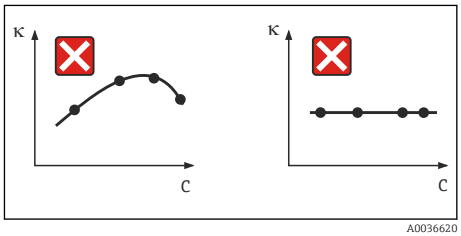
κ	*Conductivity*	*1*	*Measuring point*
c	*Concentration*	*2*	*Measuring range*
T	*Temperature*		



9 *Example of measured data for constant temperatures*

κ	*Conductivity*	*T*	*Constant temperature*
c	*Concentration*	*1*	*Measuring range*

The characteristic curves received from the measuring points must increase or decrease very monotonically in the range of the process conditions, this means that neither maximum points, nor minimum points, nor ranges with a constant behavior can occur. The curve profiles opposite are therefore not permitted.



10 *Impermissible curve profiles*

κ *Conductivity*
c *Concentration*

Example of a concentration table:

Conductivity (uncompensated) [mS/cm]	**Concentration [mg/l]**	**Temperature [°C (°F)]**
1.000	0.000	0.00 (32.00)
2.000	0.000	100.00 (212.00)
100.0	3.000	0.00 (32.00)
300.0	3.000	100.00 (212.00)

6.1.7 Unit and format

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Main value format	**Selection** ▪ Auto ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** Auto	Specify the number of decimal places. **Only four-pin sensors** The **#.###** format is not available for **Operating mode** = **Conductivity**.
Cond. unit	**Selection** ▪ Auto ▪ µS/cm ▪ mS/cm ▪ S/cm ▪ µS/m ▪ mS/m ▪ S/m **Factory setting** Auto	**Operating mode** = **Conductivity** All conductivity sensors
Unit	**Selection** ▪ Auto ▪ MΩm ▪ MΩcm ▪ kΩcm ▪ kΩm ▪ Ωm ▪ Ωcm **Factory setting** Auto	**Operating mode** = **Resistance** Contacting conductivity sensors
Conc. unit	**Selection** ▪ % ▪ mg/l [1)] **Factory setting** %	**Operating mode** = **Concentration** Inductive conductivity sensors and four-pin sensors
Unit	**Selection** ▪ ppm ▪ mg/l **Factory setting** ppm	**Operating mode** = **TDS** All conductivity sensors

1) Only with user table

6.1.8 Temperature compensation

Temperature coefficient α = change in the conductivity per degree of temperature change:
$\kappa(T) = \kappa(T_0)(1 + \alpha(T - T_0))$
$\kappa(T)$ ... conductivity at process temperature T
$\kappa(T_0)$ ... conductivity at reference temperature T_0

The temperature coefficient depends both on the chemical composition of the solution and the temperature itself.

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Temp. source	**Selection** ▪ Sensor ▪ Manual ▪ Measured value **Factory setting** Sensor	Decide how you want to compensate the medium temperature: ▪ Automatically using the temperature sensor of your sensor ▪ Manually by entering the medium temperature ▪ Using an external temperature sensor
Medium temperature **Temp. source** = **Manual**	-50.0 to 250.0 °C (-58.0 to 482.0 °F) **Factory setting** 25.0 °C (77 °F)	Enter the temperature of your medium.
Measured value **Temp. source** = **Measured value**	**Selection** ▪ Sensor input ▪ Fieldbus input with subsequent selection of the input signal	External temperature signals only in °C Select an input to which a temperature sensor is connected. Alternatively you can use a temperature signal via the fieldbus. In this case, you must select the fieldbus input afterwards.
Compensation **Operating mode** = **Conductivity**	**Selection** ▪ None ▪ Linear ▪ NaCl (IEC 746-3) ▪ Water ISO7888 (25°C) ▪ UPW HCl ▪ UPW NaCl ▪ User table 1 … 4 **Factory setting** Linear	Various methods are available to compensate for the temperature dependency. Depending on your process, decide which type of compensation you want to use. Alternatively, you can also select **None** and then measure the uncompensated conductivity.

Linear temperature compensation

The change between two temperature points is taken to be constant, i.e. α = const.

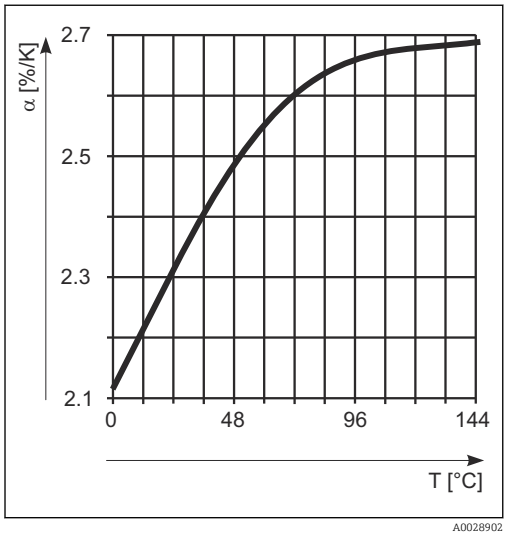
Reference temperature and alpha coefficient (only for linear temperature compensation)

The alpha coefficients and alpha reference temperatures of your process medium must be known. Typical alpha coefficients at a reference temperature of 25 °C are:

- Salts (e.g. NaCl): approx. 2.1 %/K
- Bases (e.g. NaOH): approx. 1.7 %/K
- Acids (e.g. HNO_3): approx. 1.3 %/K

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Ref. temp.	-5.0 to 100.0 °C (23.0 to 212.0 °F) **Factory setting** 25.0 °C (77.0 °F)	Reference temperature for calculating the temperature-compensated conductivity
Factor alpha	0.000 to 20.000 %/K **Factory setting** 2.100 %/K	Enter the alpha coefficient of your process medium

NaCl compensation
In the case of NaCl compensation (as per IEC 60746), a fixed non-linear curve specifying the relationship between the temperature coefficient and temperature is saved in the device. This curve applies to low concentrations of up to approx. 5 % NaCl.



Compensation for natural water
A non-linear function in accordance with ISO 7888 is saved in the device for temperature compensation in natural water.

Ultrapure water compensation (for conductive sensors)
Algorithms for pure and ultrapure water are stored in the device. These algorithms take the dissociation of the water and its temperature dependency into account. They are used for conductivity levels of up to approx. 10 µS/cm.
- UPW HCl
  Optimized for measuring the acid conductivity downstream of a cation exchanger. Also suitable for ammonia (NH_3) and caustic soda (NaOH).
- UPW NaCl
  Optimized for pH-neutral contamination.

User-defined tables
You can save a function that takes the properties of your specific process into account. To do so, determine the value pairs made up of the temperature T and conductivity κ with:
- $\kappa(T_0)$ for the reference temperature T_0
- $\kappa(T)$ for the temperatures that occur in the process
- Use the following formula to calculate the α values for the temperatures that are relevant in your process:

$$\alpha = \frac{100\%}{\kappa(T_0)} \cdot \frac{\kappa(T) - \kappa(T_0)}{T - T_0} \; ; T \neq T_0$$

Values must be constantly increasing or decreasing.

Menu/Setup/Inputs/Channel: Conductivity		
Function	**Options**	**Info**
Temp. comp. mode	**Selection** ▪ Conductivity ▪ Coeff. Alpha **Factory setting** Conductivity	**Conductivity** You specify the temperature, conductivity and uncompensated conductivity. Recommended for large measuring ranges and small measured values. **Coeff. Alpha** As the value pairs, you specify an alpha value and the related temperature.
Table name **Conc. table** = **User table 1 … 4**	Customized text, 16 characters	Assign a meaningful name to the selected table.
▶ Edit table **Conc. table** = **User table 1 … 4**	▪ Temperature ▪ Conductivity ▪ Temperature comp. cond. ▪ Temperature ▪ Coefficient alpha	Maximum number of rows: 25 The type of table depends on the option selected under **Temp. comp. mode**.

6.2 Extended setup

6.2.1 Temperature format

Menu/Setup/InputsChannel: Conductivity/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.

6.2.2 Customer ID (only for E-sensors)

You can enter an individual identifier for the sensor. This can then be found in the menu **DIAG**/**Sensor information**/Channel No. <Sensor type>/**General information**.

6.2.3 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

6.2.4 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

6.2.5 Sterilization settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Sterilization settings		
Function	**Options**	**Info**
Temperature threshold	120 to 150 °C **Factory setting** 121 °C	This temperature must be exceeded for the sterilization counter to start and a sterilization cycle to be counted.
Duration	1 to 250 min **Factory setting** 20 min	The set temperature must be reached during this time for a sterilization cycle to be counted.

6.2.6 CIP settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ CIP settings		
Function	**Options**	**Info**
Mode	**Selection** ▪ On ▪ Off **Factory setting** Off	Switch the counter for the CIP cycles on or off
Signal type	**Selection** ▪ Acidic ▪ Alkaline **Factory setting** Acidic	▶ Specify whether an acidic or alkaline CIP should be recognized.
pH threshold	pH 2.0 to 11.0 **Factory setting** pH 11.0	A CIP cycle is counted if the temperature threshold is exceeded and, simultaneously, the pH threshold is exceeded or undershot, depending on the selected type. ▪ **Signal type** = **Acidic** → The device counts when the pH threshold is undershot ▪ **Signal type** = **Alkaline** → The device counts when the pH threshold is exceeded
Upper temp. threshold	**Factory setting** 85 °C	A CIP cycle is taken into consideration within the temperature thresholds. ▪ **Upper temp. threshold**: If the temperature measured value exceeds this limit value, the CIP conditions are breached and a CIP cycle is not counted. ▪ **Lower temp. threshold**: A CIP cycle is counted if the temperature exceeds the lower temperature threshold and drops below the threshold again after the set minimum time at the very earliest.
Lower temp. threshold	**Factory setting** 75 °C	
Duration	1 to 250 min **Factory setting** 20 min	Minimum time period in which the temperature must be between the lower and upper temperature threshold for a CIP cycle to be counted.

6.2.7 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Sterilizations

The system counts the number of operating hours during which the sensor is exposed to a temperature that is typical for a sterilization. This temperature depends on the sensor.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/Diagnostics settings/▶ Sterilizations		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0 to 1000 **Factory setting** Depends on sensor [1]	Specify the limit value for the number of sensor sterilizations. Diagnostics code and associated message text: 108 **SIP, CIP, autoclaving**

1) Every sensor type has its own factory setting. Can be viewed at: **DIAG**/**Sensor information**/Channel <Sensor type>/**Recommended diag. limit values**

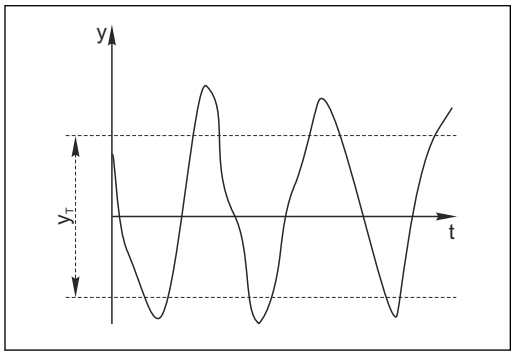
CIP cycles (only four-pin sensors)

The system counts the number of operating hours during which the sensor is exposed to a temperature that is typical for a cleaning. This temperature depends on the sensor.

Menu/Setup/Inputs/Channel: Conductivity/Extended setup/Diagnostics settings/▶ CIP-cycles		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0 to 3000 **Factory setting** 1000	▶ Specify the limit value for the number of CIP cycles of your sensor. Diagnostics code and associated message text: 108 **SIP, CIP, autoclaving**

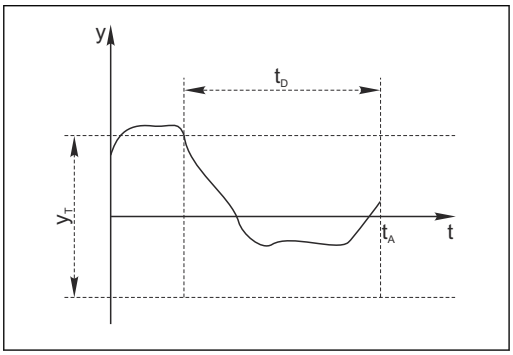
Process Check System (PCS)

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).



11 Normal measuring signal, no alarm

y Measuring signal
y_T Set value for **Tolerance width**



12 Stagnating signal, alarm is triggered

t_D Set value for **Duration**
t_A Time when the alarm is triggered

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Conductivity/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the Diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**

Menu/Setup/Inputs/Channel: Conductivity/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
▶ Operation > 80 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 193 **Operating time**
▶ Operation > 100 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 194 **Operating time**
▶ Operation > 120 °C		**Only conductive sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 195 **Operating time**
▶ Operation > 125 °C		**Only inductive sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 196 **Operating time**
▶ Operation > 140 °C		**Only conductive sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 197 **Operating time**
▶ Operation > 150 °C		**Only inductive conductivity sensors and four-pin sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 198 **Operating time**
▶ Operation > 80°C < 100nS/cm		**Only conductive sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 187 **Operating time**
▶ Operation < 5 °C		**Only inductive sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 188 **Operating time**

Polarization compensation (only conductive two-pin sensors)

As a result of flow through the electrolyte/electrode interface, reactions take place here which result in additional voltage. These polarization effects limit the measuring range of conductive sensors. Sensor-specific compensation increases the level of accuracy at the measuring range limits.

The controller recognizes the Memosens sensor and automatically applies a suitable compensation. You can view the measuring range limits of the sensor under **Diagnostics/Sensor information/Sensor specifications**.

Menu/Setup/Inputs/Channel: Conductivity/Extended setup/Diagnostics settings/▶ Polarization compensation		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Diagnostics code and associated message text: 168 **Polarization**

Pharmaceutical water

Here you can make settings for monitoring pharmaceutical water in accordance with the United States Pharmacopoeia (USP) or European Pharmacopoeia (EP).

The uncompensated conductivity value and the temperature are measured for the 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, you can also set a preliminary alarm (warning limit) which signals undesired operating states before they occur.

Menu/Setup/Inputs/Channel: Conductivity/Extended setup/Diagnostics settings/▶ Pharmacy-water		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ EP ▪ USP **Factory setting** Off	The alarm values are stored in the device in accordance with USP <645> or EP <169> specifications. Diagnostic message 914 **USP/ EP alarm** is displayed if the USP or EP alarm values programmed into the software are exceeded.
Warning limit	10.0 to 99.9 % **Factory setting** 80.0 %	You define the warning limit as a % of the alarm value. Diagnostics code and associated message text: 915 **USP / EP warning**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

6.2.8 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

6.2.9 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

6.2.10 Sensor factory settings (only inductive conductivity sensors)

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

6.2.11 Calibration monitoring

Menu/Setup/Inputs/Channel: Conductivity/Extended setup		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ During operation ▪ When connecting **Factory setting** Off	This function checks the time elapsed since the last sensor calibration. This may occur continuously during operation or just once while the calibration data are being read (sensor connection, device start). ▪ During operation The function constantly provides information about the time that has elapsed since the last calibration. ▪ When connecting The time elapsed since the last calibration is only reported when a sensor is connected or a device is restarted. No error message is generated during operation.
▶ Calibration validity		The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
Warning limit	**Factory setting** 800 h	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 1000 h	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 20000 h Generally, the following applies: alarm limit > warning limit		

6.2.12 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

6.2.13 Recommended values (only for E-sensors)

The recommended values apply for the limit values in the diagnostic settings (**Setup**/**Inputs**/Channel No: <Sensor type>/**Extended setup**/**Diagnostics settings**) and are loaded implicitly the first time an E-sensor is connected. You can view the values here:

DIAG/Sensor information/Channel No.: <Sensor type>/**Recommended diag. limit values**

1. ▷ **Load recommended values**
2. OK
   ↳ The recommended sensor values for calibration and diagnostic settings are accepted and the current settings are overwritten.

7 Inputs: Oxygen

7.1 Basic settings

7.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

7.1.2 Main value

Menu/Setup/Inputs/Channel: DO		
Function	**Options**	**Info**
Main value	**Selection** ▪ Concentration liquid ▪ Concentration gaseous ▪ Saturation ▪ Partial pressure ▪ Raw value nA [1] ▪ Raw value µs [2] **Factory setting** Concentration liquid	Decide how you want to display the main value. Other functions, such as the setting for the unit, depend on this setting.

1) Amperometric sensor
2) Optical sensor

7.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

7.1.4 Unit

Menu/Setup/Inputs/Channel: DO		
Function	**Options**	**Info**
Unit	**Selection** ▪ mg/l [1)] ▪ µg/l [1)] ▪ ppm [1)] ▪ ppb [1)] ▪ %Vol [2)] ▪ ppmVol [2)] **Factory setting** mg/l [1)] %Vol [2)]	The unit can only be selected for the main measured values: ▪ Concentration liquid ▪ Concentration gaseous

1) **Main value** = **Concentration liquid**
2) **Main value** = **Concentration gaseous**

7.1.5 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

7.2 Extended setup

7.2.1 Temperature compensation (only amperometric sensors and COS81E)

Menu/Setup/Inputs/Channel: DO/Extended setup		
Function	**Options**	**Info**
Temp. compensation	**Selection** ▪ Automatic ▪ Manual **Factory setting** Automatic	Decide how you want to compensate the medium temperature: ▪ Automatically using the temperature sensor of your sensor This means that the temperature is always compensated based on the current temperature value. ▪ Manually by entering the medium temperature This means that the measured value is always compensated against the value entered, e.g. for inlet and outlet monitoring in a cooling facility.
Temperature **Temp. compensation** = **Manual**	0 to 80 °C (32 to 176 °F) **Factory setting** 20 °C (68 °F)	Enter the temperature of your medium, or another temperature which you want to use as a reference temperature.

7.2.2 Measured value formats

Menu/Setup/Inputs/Channel: DO/▶ Extended setup		
Function	**Options**	**Info**
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.##	Specify the number of decimal places.
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	

7.2.3 Medium compensation (in the process)

Menu/Setup/Inputs/Channel: DO/▶ Extended setup		
Function	**Options**	**Info**
Medium pressure	**Selection** ▪ Process pressure ▪ Air pressure ▪ Altitude ▪ Measured value **Factory setting** Air pressure	Press **Measured value** you can connect a pressure measured value via a fieldbus input or a current input. This measured value is then used for medium pressure compensation. For the other types of compensation, specify a compensation value for the measurement in each case. 1. Specify either the altitude (-300 to 4000 m), the process pressure (500 to 9999 hPa) or the air pressure (500 to 1200 hPa) of the measuring point. ↳ The pressure used during the calibration is also displayed for information purposes. You can change this pressure in: **Calib. settings**/**Medium pressure**. 2. ▷ **Confirm**.
Input pressure **Medium pressure** = **Measured value**	**Selection** ▪ Current inputs ▪ Fieldbus signals ▪ None **Factory setting** None	Only available if a fieldbus is activated or a current input is available. Configure a current input before using its measured value for pressure compensation of the oxygen sensor. Operating Instructions of the transmitter/ analyzer/sampler, → 6 Configure the input variable of the current input with **Parameter** with the hPa unit in order to ensure correct scaling. Adjust the measuring range limits accordingly. Example: The measuring range of the connected pressure sensor is from 0 to 10 bar. 1. **Parameter**: Configure current input. 2. Define hPa as the unit. 3. Enter 0 for **Lower range value** and 10,000 for **Upper range value** (1 bar ≈ 1000 hPa).

Menu/Setup/Inputs/Channel: DO/▶ Extended setup		
Function	**Options**	**Info**
Salinity	**Selection** ▪ Fixed value ▪ Measured value **Factory setting** Fixed value	
Fixed value **Salinity** = **Fixed value**	0 to 40 g/kg **Factory setting** 0 g/kg	The influence of salt content on oxygen measurement is compensated with this function. Example: sea water measurement as per Copenhagen Standard (30 g/kg).
Sensorselection **Salinity** = **Measured value**	**Selection** ▪ None ▪ Conductivity sensor **Factory setting** None	As an alternative to specifying a fixed value that corresponds to your application, you can use the measured value of a connected conductivity sensor. A CLS50D or a CLS54D is recommended to this end. Salinity compensation via a measured value works optimally in the temperature range 2 - 35 °C at a conductivity level up to a maximum of 42 S/m.

7.2.4 LED settings (only COS81E) and measurement filter

Menu/Setup/Inputs/Channel: DO/▶ Extended setup		
Function	**Options**	**Info**
LED temp. mode	**Selection** ▪ Off ▪ On **Factory setting** On	Switches off the LED when the set temperature threshold is exceeded. This prevents the premature aging of the sensor cap, e.g. during a CIP or SIP cycle.
LED temp. threshold **LED temp. mode** = **On**	30 to 130 °C (86 to 266 °F) **Factory setting** 80 °C (176 °F)	
LED measuring interval	**Selection** ▪ 1 second ▪ 3 seconds ▪ 10 seconds ▪ 30 seconds **Factory setting** 1 second	The LED measuring interval influences the response time on the one hand and the operating life of the sensor cap on the other. Shorter intervals improve the response time but reduce the operating life of the sensor cap. Make your setting depending on the requirements of your process.
Measurement filter	**Selection** ▪ Normal ▪ Life science - standard ▪ Life science - strong ▪ (Off) ▪ (Low) ▪ (High) ▪ (Very high) **Factory setting** Normal	Smoothing filter for the measured value Filters indicated in brackets are only intended for very special applications (e.g. research work). **Unknown**: Appears if a sensor is configured with a filter that the current firmware version does not recognize. In this case, you must update the firmware or select a valid measurement filter.

7.2.5 Customer ID (only for E-sensors)

You can enter an individual identifier for the sensor. This can then be found in the menu **DIAG**/**Sensor information**/Channel No. <Sensor type>/**General information**.

7.2.6 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	▸ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

7.2.7 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

7.2.8 Sterilization settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Sterilization settings		
Function	**Options**	**Info**
Temperature threshold	120 to 150 °C **Factory setting** 121 °C	This temperature must be exceeded for the sterilization counter to start and a sterilization cycle to be counted.
Duration	1 to 250 min **Factory setting** 20 min	The set temperature must be reached during this time for a sterilization cycle to be counted.

7.2.9 CIP settings (only hygienic sensors)

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ CIP settings		
Function	**Options**	**Info**
Mode	**Selection** ▪ On ▪ Off **Factory setting** Off	Switch the counter for the CIP cycles on or off
Signal type	**Selection** ▪ Acidic ▪ Alkaline **Factory setting** Acidic	▶ Specify whether an acidic or alkaline CIP should be recognized.
pH threshold	pH 2.0 to 11.0 **Factory setting** pH 11.0	A CIP cycle is counted if the temperature threshold is exceeded and, simultaneously, the pH threshold is exceeded or undershot, depending on the selected type. ▪ **Signal type** = **Acidic** → The device counts when the pH threshold is undershot ▪ **Signal type** = **Alkaline** → The device counts when the pH threshold is exceeded
Upper temp. threshold	**Factory setting** 85 °C	A CIP cycle is taken into consideration within the temperature thresholds. ▪ **Upper temp. threshold**: If the temperature measured value exceeds this limit value, the CIP conditions are breached and a CIP cycle is not counted. ▪ **Lower temp. threshold**: A CIP cycle is counted if the temperature exceeds the lower temperature threshold and drops below the threshold again after the set minimum time at the very earliest.
Lower temp. threshold	**Factory setting** 75 °C	
Duration	1 to 250 min **Factory setting** 20 min	Minimum time period in which the temperature must be between the lower and upper temperature threshold for a CIP cycle to be counted.

7.2.10 Calibration settings

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during the calibration. If the permitted difference is exceeded, the calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: DO/▶ Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta signal	0.1 to 2.0 % **Factory setting** 0.2 %	Permitted measured value fluctuation during calibration. Referenced to the raw value in nA in the case of amperometric sensors, and referenced to the raw value in µS in the case of optical sensors.
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	5 to 60 s **Factory setting** 10 s	Timeframe within which the permitted measured value fluctuation must not be exceeded

Medium compensation (during calibration)

Menu/Setup/Inputs/Channel: DO/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Medium pressure	**Selection** ▪ Process pressure ▪ Air pressure ▪ Altitude ▪ As in measurement **Factory setting** Air pressure	Specify the pressure at which calibration takes place ▪ Process pressure The pressure during calibration differs from the normal process pressure (calibration in the process) ▪ Air pressure Air pressure at which the calibration takes place (calibration in air) ▪ Altitude Altitude at which the calibration takes place (calibration in air) ▪ As in measurement Process conditions set in the Sensor menu correspond to the calibration conditions (calibration in the process)
Process pressure **Medium pressure** = **Process pressure**	500 to 9999 hPa **Factory setting** 1013 hPa	
Air pressure **Medium pressure** = **Air pressure**	500 to 1200 hPa **Factory setting** 1013 hPa	
Altitude **Medium pressure** = **Altitude**	-300 to 4000 m **Factory setting** 0 m	
Rel. hum. (air variable)	0 to 100 % **Factory setting** 100 %	

Calibration monitoring

The calibration interval for the sensor can be specified here. Once the configured time elapses, the diagnostic message **Calibration validity** is shown on the display.

The timer is reset automatically if the sensor is recalibrated.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ During operation ▪ When connecting **Factory setting** Off	This function checks the time elapsed since the last sensor calibration. This may occur continuously during operation or just once while the calibration data are being read (sensor connection, device start, calibration kit replacement). 1. During operation During continuous operation, this function informs the user of the time elapsed since the last calibration. 2. When connecting During a batch process, this function ensures that only recently calibrated sensors are used. No error message is generated during the batch process.
▶ Calibration validity		
Warning limit	**Factory setting** 800 h	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 1000 h	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 20000 h Generally, the following applies: alarm limit > warning limit		

7.2.11 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Slope (only amperometric sensors and COS61D)

The (relative) slope characterizes the sensor condition. Decreasing values indicate electrolyte exhaustion. You can control when the electrolyte should be replaced by specifying limit values and the diagnostics messages these limit values trigger.

▶ Specify the limit values for slope monitoring in your sensor.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Slope		
Function	**Options**	**Info**
Upper warning limit	0.0 to 200.0 % [1] 80.1 to 200.0 % [2] **Factory setting** 140.0 % [1] 110.0 % [2]	Associated diagnostics code and message text: 511 **Sensor calibration**
Lower warning limit	0.0 to 200.0 % [1] 0.0 to 109.9 % [2] **Factory setting** 60.0 % [1] 80.0 % [2]	Associated diagnostics code and message text: 509 **Sensor calibration**

1) Amperometric sensors
2) COS61D

Delta slope (only amperometric sensors)

The device determines the difference in slope between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor.

An increasing change indicates the formation of buildup on the sensor membrane or electrolyte contamination. Replace the diaphragm and electrolyte as specified in the instructions in the sensor operating manual.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Delta slope		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0.0 to 50.0 % **Factory setting** 15.0 %	Specify your limit values for monitoring the slope differential. Associated diagnostics code and message text: 518 **Sensor calibration**

Zero point (only amperometric sensors)

The zero point corresponds to the sensor signal that is measured in a medium in the absence of oxygen. You can calibrate the zero point in water that is free from oxygen or in high-purity nitrogen. This improves accuracy in the trace range.

▶ Specify limit values for zero point monitoring of the sensor.

General range of adjustment: -10 to 10 nA.

The set values influence the available range of adjustment of the other limit.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Zero point		
Function	**Options**	**Info**
Upper warning limit	**Factory setting** 1.0 nA	Associated diagnostics code and message text: 505 **Zero warning**
Lower warning limit	**Factory setting** -1.0 nA	Associated diagnostics code and message text: 507 **Zero warning**

Delta zero point (only amperometric sensors)

The device determines the difference between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor. Increasing differences indicate the formation of buildup on the cathode. Clean or replace the cathode as specified in the instructions in the sensor operating manual.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Delta zero point		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0.0 to 10 nA **Factory setting** 0.5 nA	▶ Specify the limit values for monitoring the slope differential. Associated diagnostics code and message text: 520 **Sensor calibration**

Calibration quality index (only COS81E)

The current calibration is compared against the first calibration of the mounted sensor cap and the condition of the cap is displayed as a percentage.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Calibration quality index		
Function	**Options**	**Info**
Warning limit	0 to 100 % **Factory setting** 80 %	Associated diagnostics code and message text: 734 **Calibration quality**

Cap calibrations (all sensors except COS61D)

The calibration counters in the sensor make a distinction between sensor calibrations and calibrations with the membrane cap currently used. If this cap is replaced, only the (cap) counter is reset.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Number of calibrations cap		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switch the function on/off
Warning limit	1 to 1000 **Factory setting** 500 [1] 20 [2]	▶ Specify how many calibrations may be performed with a sensor cap before the cap has to be replaced. The number depends heavily on the process and must be determined individually. Associated diagnostics code and message text: 535 **Sensor check**

1) Amperometric sensors
2) COS81E

Sterilizations (only sterilizable E-sensors)

The system counts the number of operating hours during which the sensor is exposed to a temperature that is typical for a sterilization. This temperature depends on the sensor.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/Diagnostics settings/▶ Sterilizations		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0 to 1000 **Factory setting** Depends on sensor [1]	Specify the limit value for the number of sensor sterilizations. Diagnostics code and associated message text: 108 **SIP, CIP, autoclaving**

1) Every sensor type has its own factory setting. Can be viewed at: **DIAG**/**Sensor information**/Channel <Sensor type>/**Recommended diag. limit values**

Cap sterilizations (only sterilizable E-sensors)

The sterilization counters in the sensor make a distinction between the sensor and the membrane/fluorescence cap currently used. If this cap is replaced, only the (cap) counter is reset.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Number of cap sterilizations		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	▶ Specify how many sterilizations may be performed with a sensor cap before the cap has to be replaced. The number depends heavily on the process and must be determined individually.
Warning limit	0 to 200 **Factory setting** ▪ 25 [1] ▪ 200 [2]	Associated diagnostics code and message text: 109 **SIP, CIP, autoclav cap**

1) Amperometric sensors
2) COS81E

CIP cycles (only sterilizable E-sensors)

The system counts the number of operating hours during which the sensor is exposed to a temperature that is typical for a cleaning. This temperature depends on the sensor.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ CIP-cycles		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	1 to 1000 **Factory setting** 1000	▶ Specify the limit value for the number of CIP cycles of your sensor. Diagnostics code and associated message text: 108 **SIP, CIP, autoclaving**

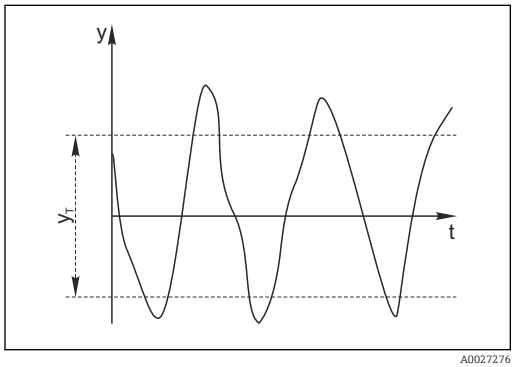
CIP cycles cap (only sterilizable E-sensors)

The sterilization counters in the sensor make a distinction between the sensor and the membrane or fluorescence cap currently used. If this cap is replaced, only the cap counter is reset.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ CIP-cycles cap		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	1 to 300 **Factory setting** 200	▶ Specify the limit value for the number of CIP cycles of the sensor cap. Diagnostics code and associated message text: 109 **SIP, CIP, autoclav cap**

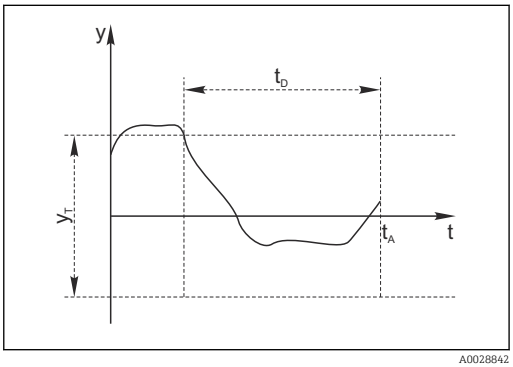
Process Check System (PCS)

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).



13 Normal measuring signal, no alarm

y Measuring signal
y_T Set value for **Tolerance width**



14 Stagnating signal, alarm is triggered

t_D Set value for **Duration**
t_A Time when the alarm is triggered

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation < 5 °C		**Only optical sensors**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 188 **Operating time**
▶ Operation > 5 °C		**Only COS51D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 189 **Operating time**
▶ Operation > 25 °C		**Only COS61D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 190 **Operating time**
▶ Operation > 30 °C		**Only COS51D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 191 **Operating time**

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
▶ Operation > 40 °C		**Only COS22D, COS61D and COS81D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 192 **Operating time**
▶ Operation > 80 °C		**Only COS22D and COS81D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 193 **Operating time**
Operation > 120 °C		**Only COS81D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 195 **Operating time**
▶ Operation > 15 nA		**Only COS22D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 183 **Operating time**
Operation > 30 nA		**Only COS51D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 184 **Operating time**
Operation > 50 nA		**Only COS22D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 185 **Operating time**
Operation > 160 nA		**Only COS51D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 186 **Operating time**
Operation < 25 µs		**Only COS61D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 181 **Operating time**
Operation > 40 µs		**Only COS61D**
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 182 **Operating time**

Cap operating hours limit values (only COS81E and COS22E)

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Limits operating hours cap		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor cap
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation > 40 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 192 **Operating time**

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Limits operating hours cap		
Function	**Options**	**Info**
▶ Operation > 80 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 193 **Operating time**
Operation > 120 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 195 **Operating time**
Operation < 5 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 188 **Operating time**

Electrolyte counter (only amperometric sensors)

Menu/Setup/Inputs/Channel: DO/Extended setup/Diagnostics settings/▶ Electrolyte counter		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Electrolyte depletion is calculated based on the quantity of analyte transformed. ▶ After replacing electrolyte: Reset counter (**CAL/Oxygen (amp.)/ Change electrolyte**).
Electrolyte capacity	Display only	Displays the remaining capacity
Warning limit	100 000 to 20 000 000 µAs **Factory setting** 2896000 µAs	Associated diagnostics code and message text: 534 **Electrolyte warning**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

7.2.12 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

7.2.13 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

7.2.14 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

7.2.15 Sensor factory settings (only COS61D)

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

8 Inputs: disinfection

8.1 Basic settings

8.1.1 Sensor identification

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Disinfection
Sensor element		▪ Free chlorine ▪ Chlorine dioxide
Order code		Order code of the connected sensor

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.1.2 Main value

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>		
Function	**Options**	**Info**
Main value	**Selection** ▪ Concentration ▪ Sensor current **Factory setting** Concentration	Decide how you want to display the main value.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

8.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

8.1.5 Unit

Menu/Setup/Inputs/Channel: <Sensor DI [1]>		
Function	**Options**	**Info**
Unit **Main value** = **Concentration**	**Selection** ▪ mg/l ▪ µg/l ▪ ppm ▪ ppb **Factory setting** mg/l	The measured parameter is displayed in abbreviated format after the unit. Example: If chlorine is being measured in mg/l, the unit is displayed as **mg/l Cl2**, and chlorine dioxide is displayed as **mg/l ClO2**.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.2 Extended setup

8.2.1 Measured value formats

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.##	

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.2.2 Medium and temperature compensation

Medium compensation (only sensors for free chlorine or bromine)

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/▶ Extended setup		
Function	**Options**	**Info**
Medium comp. (pH)	**Selection** ▪ Off ▪ On **Factory setting** On	**Off** The measured value corresponds to the share of hypochlorous acid (HOCl) in free chlorine or hypobromous acid (HOBr) in free bromine. **On** On the basis of the pH value, the corresponding share of the hypochlorite anion OCl- (or OBr-) is added to the measured value of the hypochlorous acid (HOCl or HOBr) and specified as the total value of the free chlorine or free bromine.
Mode **Medium comp. (pH)** = **On**	**Selection** ▪ Fixed value ▪ Measured value **Factory setting** Fixed value	▪ Fixed value A fixed pH value is used to calculate the total free chlorine or bromine. ▪ Measured value The measured value of a pH sensor connected to another input is used to calculate the total free chlorine or bromine.
Fixed value pH **Mode** = **Fixed value**	pH 4.00 to 9.00 **Factory setting** pH 7.20	Useful for media with a constant pH value 1. Determine the pH value of the medium with a reference measurement. 2. Enter the pH value from the reference measurement here.
Associated pH-sensor **Mode** = **Measured value**	Select the pH sensor **Factory setting** None	Preferred method for media with varying pH values ▶ Select the sensor input with the connected pH sensor. ↳ Its measured value is permanently used to calculate the total free chlorine or bromine.

1) **Free chlorine** or **Free bromine**

Temperature source

Use this menu if you want to use an external measured value as the temperature source. Use the **Temp. compensation** (→ 63) function for compensation via the internal temperature sensor or by entering a medium temperature.

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>/▶ Extended setup		
Function	**Options**	**Info**
Temp. source	**Selection** ▪ Manual ▪ Internal sensor ▪ External meas. value **Factory setting** Internal sensor	▪ Internal sensor Automatic compensation using the internal temperature sensor ▪ Manual Compensation by manually entering the medium temperature ▪ External meas. value Compensation with the measured value of an external temperature sensor
Medium temperature **Temp. source** = **Manual**	0 to 55 °C (32 to 130 °F) **Factory setting** 20.0 °C (68 °F)	▶ Enter the temperature of the medium.
Input **Temp. source** = **External meas. value**	**Selection** ▪ Sensor input ▪ Fieldbus input with subsequent selection of the input signal	External temperature signals only in °C 1. Select the input to which a temperature sensor is connected 2. Alternatively Use the temperature signal over the fieldbus. Select the fieldbus input for this purpose.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Temperature compensation

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>/▶ Extended setup		
Function	**Options**	**Info**
Temp. compensation	**Selection** ▪ Automatic ▪ Manual **Factory setting** Automatic	▪ Automatic Automatic compensation using the internal temperature sensor ▪ Manual Compensation by manually entering the medium temperature
Temperature **Temp. compensation** = **Manual**	-5.0 to 50.0 °C (23.0 to 122.0 °F) **Factory setting** 20.0 °C (68 °F)	▶ Enter the temperature of the medium.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.2.3 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

8.2.4 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

8.2.5 Calibration settings

Calibration monitoring

The calibration interval for the sensor can be specified here. Once the configured time elapses, the diagnostic message **Calibration validity** is shown on the display.

The timer is reset automatically if the sensor is recalibrated.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ During operation ▪ When connecting **Factory setting** Off	This function checks the time elapsed since the last sensor calibration. This may occur continuously during operation or just once while the calibration data are being read (sensor connection, device start, calibration kit replacement). 1. During operation During continuous operation, this function informs the user of the time elapsed since the last calibration. 2. When connecting During a batch process, this function ensures that only recently calibrated sensors are used. No error message is generated during the batch process.
▶ Calibration validity		
Warning limit	**Factory setting** 800 h	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 1000 h	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 20000 h Generally, the following applies: alarm limit > warning limit		

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during the calibration. If the permitted difference is exceeded, the calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>/Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta slope	0.1 to 5.0 % **Factory setting** Depends on the sensor	Permitted measured value fluctuation during slope calibration (with reference to the raw value in nA).
Delta zero point	0.1 to 12.0 nA **Factory setting** Depends on the sensor	Permitted measured value fluctuation during zero point calibration.
Delta temperature	0.10 to 2.00 K **Factory setting** Depends on the sensor	Permitted temperature fluctuation during calibration
Duration signal	1 to 60 s **Factory setting** Depends on the sensor	Timeframe within which the permitted measured value fluctuation must not be exceeded

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

8.2.6 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Slope

The (relative) slope characterizes the sensor condition. Decreasing values can indicate that maintenance is needed. By specifying limit values and the diagnostics messages these limit values trigger, you can control when the system should alert you that maintenance is needed.

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Slope		
Function	**Options**	**Info**
Upper warning limit	3.0 to 500.0 % **Factory setting** 200.0 %	Associated diagnostics code and message text: 511 **Sensor calibration**
Lower warning limit	3.0 to 500.0 % **Factory setting** 25.0 %	Associated diagnostics code and message text: 509 **Sensor calibration**

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Delta slope

The device determines the difference in slope between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor.

An increasing change indicates the formation of dirt on the sensor membrane or electrolyte consumption. Replace the diaphragm and electrolyte as specified in the instructions in the sensor operating manual.

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Delta slope		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0 to 50.0 % **Factory setting** 15.0 %	Associated diagnostics code and message text: 518 Sensor calibration ▶ Specify the limit values for monitoring the slope differential.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Zero point

The zero point corresponds to the sensor signal that is measured in a medium in the absence of the disinfectant. You can determine the zero point using the zero-point gel COY8. This improves accuracy in the trace range.

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Zero point		
Function	**Options**	**Info**
Warning limit	0.0 to 10.0 nA **Factory setting** 1.0 nA	Associated diagnostics code and message text: 513 Zero warning ▶ Specify limit values for zero point monitoring of your sensor.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Delta zero point

The device determines the difference between the last calibration and the penultimate calibration, and issues a warning or an alarm depending on the setting configured. The difference is an indicator for the condition of the sensor.

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Delta zero point		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Warning limit	0.0 to 10.0 nA **Factory setting** 5.0 nA	Associated diagnostics code and message text: 520 Sensor calibration ▶ Specify the limit values for monitoring the slope differential.

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Number of cap calibrations

The calibration counters in the sensor make a distinction between sensor calibrations and calibrations with the membrane cap currently used. If this cap is replaced, only the (cap) counter is reset.

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Number of calibrations cap		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Specify how many calibrations may be performed with a membrane cap before the cap has to be replaced. The number depends heavily on the process and must be determined individually.
Warning limit	1 to 75 **Factory setting** 8	Associated diagnostics code and message text: 535 **Sensor check**

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

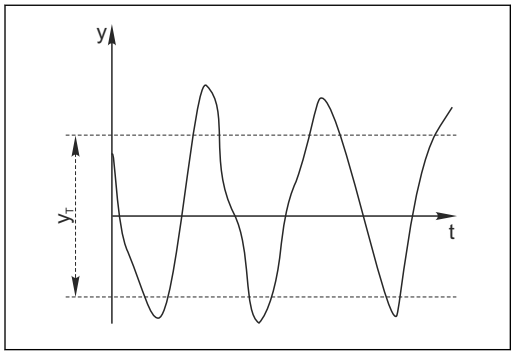
Cap change monitoring

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Cap change monitoring		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Associated diagnostics code and message text: 987 **Calibration required**

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

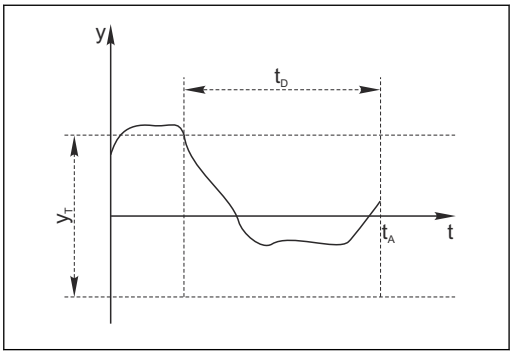
Process Check System (PCS)

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).



15 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



16 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Disinfection/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Options** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation > 15 ℃		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 178 **Operating time**
▶ Operation > 30 ℃		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 191 **Operating time**
▶ Operation > 20 nA		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 177 **Operating time**
▶ Operation > 100 nA		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 176 **Operating time**

Limits operating hours cap

Menu/Setup/Inputs/Channel: <Sensor DI [1)]>/Extended setup/Diagnostics settings/▶ Limits operating hours cap		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor cap under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the Diagnostics menu.
▶ Operating time		Total operating time of the sensor cap
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation > 15 ℃		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 178 **Operating time**

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Limits operating hours cap		
Function	**Options**	**Info**
▶ Operation > 30 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 191 **Operating time**
▶ Operation > %0V nA		%0V is a variable. Depending on the sensor, a numerical value is displayed instead of this variable.
Warning limit	**Factory setting** 2200 h	Diagnostics code and associated message text: 111 **Operating time cap**
▶ Operation > %0V nA		%0V is a variable. Depending on the sensor, a numerical value is displayed instead of this variable.
Warning limit	**Factory setting** 2200 h	Diagnostics code and associated message text: 111 **Operating time cap**

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

Electrolyte counter

The electrolyte consumption is calculated in the sensor as the total sensor current over time. The transmitter reads this value out of the sensor as the amount of charge and displays it in ampere-seconds. The amount of charge counts up from zero while the sensor is in operation. Each sensor has an individual electrolyte capacity (As), which corresponds to the maximum amount of charge to be reached. A diagnostic message is displayed if the warning limit for electrolyte consumption is reached (usually at 80% electrolyte capacity).

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ Electrolyte counter		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Electrolyte capacity	Read only	
Warning limit	**Range of adjustment and factory setting** Depends on the sensor	Associated diagnostics code and message text: 534 **Electrolyte warning**

1) **Total chlorine** or **Chlorine dioxide** or **Free chlorine** or **Free bromine** or **Ozone**

pH limit value monitoring (only sensors for free chlorine or bromine)

Menu/Setup/Inputs/Channel: <Sensor DI [1]>/Extended setup/Diagnostics settings/▶ pH limit monitoring		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off Upper and lower alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: pH 1.0 to 14.0 Generally, the following applies: **Upper warning limit** > **Lower warning limit**
Upper warning limit	**Factory setting** pH 9.00 [2] pH 10.00 [3]	Associated diagnostics code and message text: 945 **pH value high**
Lower warning limit	**Factory setting** pH 4.00 [2] pH 5.0 [3]	Associated diagnostics code and message text: 946 **pH value low**

1) **Free chlorine** or **Free bromine**
2) Sensor for free chlorine
3) Sensor for free bromine

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

8.2.7 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

8.2.8 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

8.2.9 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

9 Inputs: Drinking water turbidity

9.1 Basic settings

9.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

9.1.2 Application

The sensor is precalibrated on leaving the factory. As such, it can be used in a wide range of applications (e.g. clear water measurement) without the need for additional calibration. The factory calibrations for the Formazine, Kaolin, PSL and Diatomite applications are based on 20 calibration points in each case. In addition to the factory calibration data, which cannot be modified, the sensor has five other data records to be used for storing process calibrations.

Calibration data records are saved under an individual name. You can add your own data records during each calibration. These are then available for selection under **Application** .

Menu/Setup/Inputs/Channel: Turbidity		
Function	**Options**	**Info**
Application type	**Selection** Clear water **Factory setting** Clear water	Preselection for saved calibration data records
Application	**Selection** ▪ Formazine ▪ Kaolin ▪ PSL ▪ Diatomite **Factory setting** Clear water	Select a saved calibration data record

9.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

9.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

9.2 Extended setup

9.2.1 Measured value formats

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.#	

9.2.2 Unit

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup		
Function	**Options**	**Info**
Unit **Application** = **Formazine**	**Selection** ▪ FNU ▪ NTU ▪ FTU ▪ TE/F ▪ EBC ▪ ASBC **Factory setting** FNU	Select the unit for the main measured value. **FNU** Formazine Nephelometric Unit, 90° scattered light measurement as per ISO 7027 **NTU** Nephelometric Turbidity Unit, 90° scattered light measurement as per US standards, identical to FTU **FTU** Formazine Turbidity Unit, used in water treatment **TE/F** Turbidity unit/formazine, German unit in water treatment **EBC** Turbidity unit, European/international unit in breweries **ASBC** American Society of Brewing Chemists **auto (g/l; mg/l)** Automatic changeover between mg/l or g/lfnu
Unit **Application** = **Kaolin** *or* **Diatomite**	**Selection** ▪ auto (g/l; mg/l) ▪ ppm ▪ mg/l ▪ g/l **Factory setting** mg/l	
Unit **Application** = **PSL**	**Selection** 度 **Factory setting** 度	

9.2.3 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

9.2.4 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

9.2.5 Calibration settings

Calibration timer and calibration expiration date

You can specify the calibration interval for the sensor here. Once the time configured elapses, the **Calibration timer**.

The timer is reset automatically if you recalibrate the sensor.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calibration timer	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value	1 to 10 000 h **Factory setting** 1000 h	Enter the time after which the timer should time out. When this time expires, diagnostic message **Calibration timer** is displayed with code 102.
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	The function checks whether the calibration of a sensor is still valid. Example: you install a pre-calibrated sensor. The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
▶ Calib. expiration time		
Warning limit	**Factory setting** 48 weeks	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 52 weeks	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible adjustment range. Range of adjustment which must include both limits: 1 to 104 weeks Generally, the following applies: alarm limit > warning limit		

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during calibration. If the permitted difference is exceeded, calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta signal	0.1 to 5.0 % **Factory setting** 2.0 %	Permitted measured value fluctuation during calibration.
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	5 to 100 s **Factory setting** 20 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

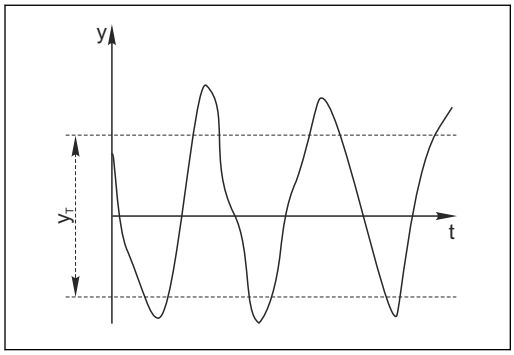
9.2.6 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

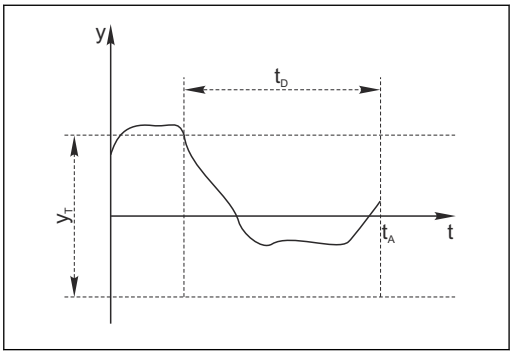
Process Check System (PCS)

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).



17 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



18 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Turbidity/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
The names of the following menu functions depend on the sensor specification. For this reason, they cannot be specified here.		
▶ Below specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**
▶ Above specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**
▶ Below specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 943 **Process value**

Menu/Setup/Inputs/Channel: Turbidity/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
▶ Above specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 942 **Process value**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

9.2.7 Signal processing

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup/Signal processing/▶ Measurement filter		
Function	**Options**	**Info**
Configuration method	**Selection** ▪ Standard ▪ Specialist **Factory setting** Specialist	**Standard** Choice of 3 predefined configurations **Specialist** You specify in detail how the measured value filter should react.
Filter level **Configuration method** = **Standard**	**Selection** ▪ Low ▪ Medium ▪ High **Factory setting** Medium	Select a filter method. The following parameters are preset at the factory and are displayed as non-editable parameters. With **Configuration method** = **Specialist** you can configure the parameters.
▶ Display parameter **Configuration method** = **Standard**	Read only	
Relative limit **Configuration method** = **Specialist**	0.000000 to 1.000000 **Factory setting** 0.000020	Specify the filter strength 0.000000 ... constant measured value 0.000020 ... standard 0.010000 ... low 1.000000 ... off
Dwell time before jump **Configuration method** = **Specialist**	0 to 1000 s **Factory setting** 10 s	Specify the time after which the measured value must change at the very latest.
Integ. time before jump **Configuration method** = **Specialist**	0 to 1000 s **Factory setting** 4 s	Specify the number of measured values (time span) which should be used for the next change value.
Dynamic **Configuration method** = **Specialist**	1 to 3 **Factory setting** 3	How dynamically should the filter respond: slow (1) to fast (3).
Smoothing **Configuration method** = **Specialist**	0.00000 to 10.00000 **Factory setting** 0.00800	Value smoothing The smoothing value should always be attuned with the filter strength (**Relative limit**). The higher the relative limit the smaller the smoothing and vice versa. You should set the smoothing value to 0 as of a relative limit of 0.01.

9.2.8 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

9.2.9 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

9.2.10 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

9.2.11 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

10 Inputs: Turbidity and solids

10.1 Basic settings

10.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

10.1.2 Application

The sensor is precalibrated on leaving the factory. As such, it can be used in a wide range of applications (e.g. clear water measurement) without the need for additional calibration. The factory calibrations are each based on a "three-point calibration". The Kaolin and Formazine applications are already fully calibrated and can be used without any further calibration. All other applications are precalibrated with reference samples and require calibration to the corresponding application. In addition to the factory calibration data, which cannot be modified, the sensor has five other data records to be used for storing process calibrations.

Calibration data records are saved under an individual name. You can add your own data records during each calibration. These are then available for selection under **Application** .

Menu/Setup/Inputs/Channel: Turbidity		
Function	**Options**	**Info**
Application type	**Selection** ▪ Clear water ▪ Solid **Factory setting** Clear water	Preselection for saved calibration data records
Application	Depends on the sensor	Select a saved calibration data record Detailed information on selecting the relevant data record is provided in the Operating Instructions for the sensor. Operating Instructions Turbimax CUS51D, BA00461C

10.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

10.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

10.2 Extended setup

10.2.1 Measured value formats

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.#	

10.2.2 Unit

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup		
Function	**Options**	**Info**
Unit **Application type** = **Clear water**	**Selection** ▪ FNU ▪ NTU **Factory setting** FNU	Select the unit for the main measured value. **FNU** Formazine Nephelometric Unit, 90° scattered light measurement as per ISO 7027 **NTU** Nephelometric Turbidity Unit, 90° scattered light measurement as per US standards, identical to FTU **%TS** % total solids **auto (g/l; mg/l)** Automatic changeover between mg/l or g/lfnu
Unit **Application type** = **Solid**	**Selection** ▪ auto (g/l; mg/l) ▪ ppm ▪ %TS ▪ mg/l ▪ g/l **Factory setting** auto (g/l; mg/l)	

10.2.3 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

10.2.4 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

10.2.5 Calibration settings

Calibration timer and calibration expiration date

You can specify the calibration interval for the sensor here. Once the time configured elapses, the **Calibration timer**.

The timer is reset automatically if you recalibrate the sensor.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calibration timer	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value	1 to 10 000 h **Factory setting** 1000 h	Enter the time after which the timer should time out. When this time expires, diagnostic message **Calibration timer** is displayed with code 102.
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	The function checks whether the calibration of a sensor is still valid. Example: you install a pre-calibrated sensor. The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
▶ Calib. expiration time		
Warning limit	**Factory setting** 48 weeks	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 52 weeks	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible adjustment range. Range of adjustment which must include both limits: 1 to 104 weeks Generally, the following applies: alarm limit > warning limit		

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during calibration. If the permitted difference is exceeded, calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: Turbidity/▶ Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta signal	0.1 to 5.0 % **Factory setting** 2.0 %	Permitted measured value fluctuation during calibration.
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	5 to 100 s **Factory setting** 20 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

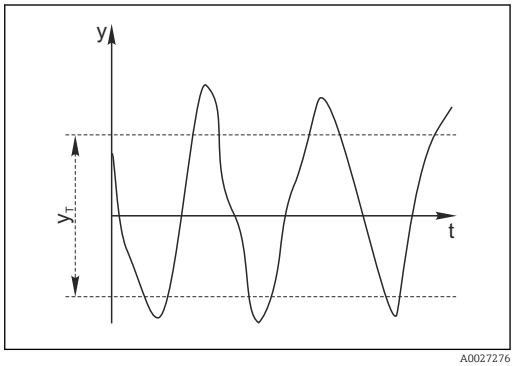
10.2.6 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

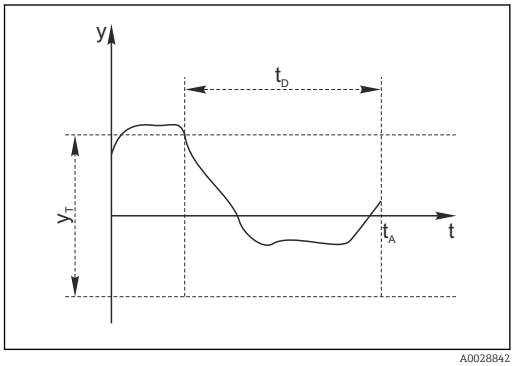
Process Check System (PCS)

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).



19 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



20 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Turbidity/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
The names of the following menu functions depend on the sensor specification. For this reason, they cannot be specified here.		
▶ Below specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**
▶ Above specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**
▶ Below specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 943 **Process value**
▶ Above specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 942 **Process value**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

10.2.7 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

10.2.8 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

10.2.9 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

10.2.10 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

11 Inputs: SAC

11.1 Basic settings

11.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

11.1.2 Basic application

Calibration data records are saved under an individual name in the sensor. A new sensor is calibrated in the factory and therefore already contains relevant data records. You can add your own data records with every calibration. You can then select them under **Application**.

Menu/Setup/Inputs/Channel: SAC		
Function	**Options**	**Info**
Basic application	**Selection** ▪ SAC ▪ Transm. ▪ Tr. 10mm ▪ Absorption ▪ COD ▪ TOC ▪ DOC ▪ BOD **Factory setting** SAC	Preselection for saved calibration data records **Tr. 10mm** The measured transmission is converted to an optical path length of 10 mm.
Application	**Selection** ▪ Factory calib. ▪ Dataset 1 … 6 **Factory setting** Factory calib.	Select a saved calibration data record

11.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

11.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

11.2 Extended setup

11.2.1 Measured value formats, unit and flash rate

Menu/Setup/Inputs/Channel: SAC/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.#	
Unit	**Selection** ▪ None ▪ % ▪ mg/l ▪ ppm ▪ 1/m	The unit of the main value depends on the basic application selected. Depending on the **Basic application** you can only choose from certain units. The factory setting is also dependent on the basic application.
Flash rate	0.1 to 2.0 Hz **Factory setting** 2.0 Hz	The flash rate influences the response time of the sensor on the one hand, and the sensor operating life on the other. The lower the rate, the slower the measured value change and the longer the operating life of the sensor. The faster the process needs to react to changes depending on the measured value, the higher the flash rate setting should be. However, this negatively impacts the sensor operating life.

11.2.2 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	▸ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

11.2.3 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

11.2.4 Calibration settings

Calibration timer and calibration expiration date

You can specify the calibration interval for the sensor here. Once the time configured elapses, the **Calibration timer**.

The timer is reset automatically if you recalibrate the sensor.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calibration timer	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value	1 to 10 000 h **Factory setting** 1000 h	Enter the time after which the timer should time out. When this time expires, diagnostic message **Calibration timer** is displayed with code 102.
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	The function checks whether the calibration of a sensor is still valid. Example: you install a pre-calibrated sensor. The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
▶ Calib. expiration time		
Warning limit	**Factory setting** 48 weeks	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 52 weeks	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible adjustment range. Range of adjustment which must include both limits: 1 to 104 weeks Generally, the following applies: alarm limit > warning limit		

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during calibration. If the permitted difference is exceeded, calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: SAC/▶ Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta SAC	0.1 to 5.0 % **Factory setting** 2.0 %	Permitted measured value fluctuation during calibration.
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	5 to 100 s **Factory setting** 10 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

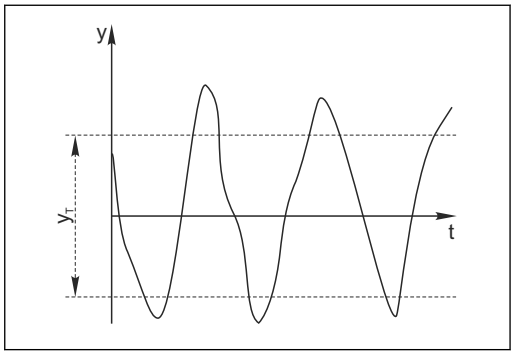
11.2.5 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

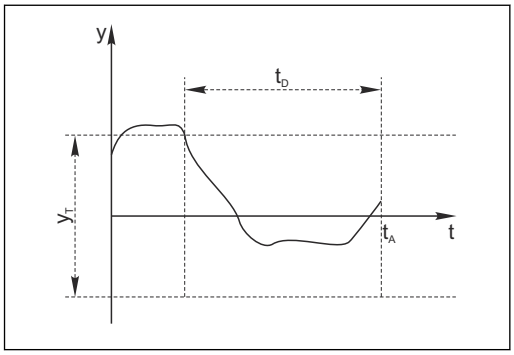
Process Check System (PCS)

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).



21 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



22 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: SAC/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
The names of the following menu functions depend on the sensor specification. For this reason, they cannot be specified here.		
▶ Below specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**
▶ Above specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**
▶ Below specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 170 **Process value**
▶ Above specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 169 **Process value**
▶ Filter change		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 157 **Filter change**
Alarm limit	**Factory setting** 15000 h	Diagnostics code and associated message text: 161 **Filter change**
▶ Flash counter, lamp		
Warning limit	**Factory setting** 126000000	Diagnostics code and associated message text: 171 **Filter change**
Alarm limit	**Factory setting** 131400000	Diagnostics code and associated message text: 771 **Filter change**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

11.2.6 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

11.2.7 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

11.2.8 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

11.2.9 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

12 Inputs: Nitrate

12.1 Basic settings

12.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

12.1.2 Application

Calibration data records are saved under an individual name in the nitrate sensor. A new sensor is calibrated at the factory and always has a corresponding data record. You can add additional data records during each calibration. These are then available for selection under **Application** .

Menu/Setup/Inputs/Channel: Nitrate		
Function	**Options**	**Info**
Application	Depends on the sensor	Select a saved calibration data record

12.1.3 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

12.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

12.2 Extended setup

12.2.1 Measured value formats, unit and flash rate

Menu/Setup/Inputs/Channel:Nitrate /▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ #.# ▪ #.## ▪ #.### ▪ # **Factory setting** #.#	
Unit	**Selection** ▪ mg/l NO3-N ▪ mg/l NO3 ▪ ppm NO3-N ▪ ppm NO3 **Factory setting** mg/l NO3-N	Select the unit for the main measured value.
Flash rate	0.1 to 2.0 Hz **Factory setting** 2.0 Hz	The flash rate influences the response time of the sensor on the one hand, and the sensor operating life on the other. The lower the rate, the slower the measured value change and the longer the operating life of the sensor. The faster the process needs to react to changes depending on the measured value, the higher the flash rate setting should be. However, this negatively impacts the sensor operating life.

12.2.2 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

12.2.3 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

12.2.4 Calibration settings

Calibration timer and calibration expiration date

You can specify the calibration interval for the sensor here. Once the time configured elapses, the **Calibration timer**.

The timer is reset automatically if you recalibrate the sensor.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calibration timer	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value	1 to 10 000 h **Factory setting** 1000 h	Enter the time after which the timer should time out. When this time expires, diagnostic message **Calibration timer** is displayed with code 102.
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	The function checks whether the calibration of a sensor is still valid. Example: you install a pre-calibrated sensor. The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
▶ Calib. expiration time		
Warning limit	**Factory setting** 48 weeks	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 52 weeks	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible adjustment range. Range of adjustment which must include both limits: 1 to 104 weeks Generally, the following applies: alarm limit > warning limit		

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during calibration. If the permitted difference is exceeded, calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: Nitrate/▶ Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta nitrate	0.1 to 5.0 % **Factory setting** 2.0 %	Permitted measured value fluctuation during calibration.
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	10 to 100 s **Factory setting** 10 s	Timeframe within which the permitted range for measured value fluctuation should not be exceeded

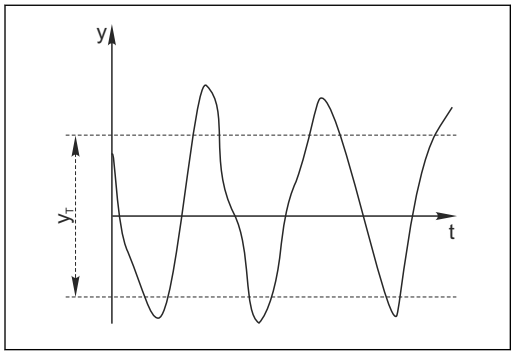
12.2.5 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

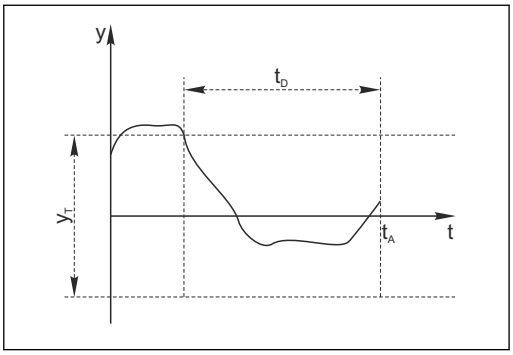
Process Check System (PCS)

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).



23 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



24 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Nitrate/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
The names of the following menu functions depend on the sensor specification. For this reason, they cannot be specified here.		
▶ Below specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**
▶ Above specified temperature		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**
▶ Below specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 943 **Process value**

Menu/Setup/Inputs/Channel: Nitrate/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
▶ Above specified limit value		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 942 **Process value**
▶ Filter change		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 157 **Filter change**
Alarm limit	**Factory setting** 15000 h	Diagnostics code and associated message text: 161 **Filter change**
▶ Flash counter, lamp		
Warning limit	**Factory setting** 126000000	Diagnostics code and associated message text: 171 **Filter change**
Alarm limit	**Factory setting** 131400000	Diagnostics code and associated message text: 771 **Filter change**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

12.2.6 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

12.2.7 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

12.2.8 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

12.2.9 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

13 Inputs: ISE

13.1 Basic settings

13.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

13.1.2 Main value

Menu/Setup/Inputs/Channel: ISE		
Function	**Options**	**Info**
Main value	**Selection** ▪ Ammonium ▪ Nitrate ▪ Potassium ▪ Chloride ▪ pH ▪ ORP **Factory setting** pH	Decide which parameter you want to display as the main value for the ISE channel. Here, you can only choose from the electrodes which you configured via the electrode slot menus. At the factory, this is equivalent to the types of electrode that are actually installed in the ISE sensor.

13.1.3 Damping of the temperature measured value

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: ISE		
Function	**Options**	**Info**
Damping temp.	0 to 600 s **Factory setting** 0 s	Damping of the integrated temperature sensor

13.1.4 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

13.2 Extended setup

13.2.1 Temperature format

Menu/Setup/Inputs/Channel: ISE/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.

13.2.2 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

13.2.3 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/**Setup**/**General settings**/**Hold settings**/**External hold**.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

13.2.4 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: ISE/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 100000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the Diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 6000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation > 30 °C		
Warning limit	**Factory setting** 3000 h	Diagnostics code and associated message text: 191 **Operating time**
▶ Operation > 40 °C		
Warning limit	**Factory setting** 1500 h	Diagnostics code and associated message text: 192 **Operating time**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

13.2.5 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

13.2.6 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

13.2.7 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

13.3 Electrode slot menus

13.3.1 Electrode slot and measured variable

A CAS40D sensor has 4 electrode slots in total. Consequently, each of these slots has its own menu.

Making the settings

1. Define the parameters for the slot (slots 2-4 only). The 1st slot is always designated to the pH electrode. It is not possible to select another parameter for this slot.
2. You can populate and assign the other three slots as you wish.
3. **Slots 2 to 4 only:**
   Specify the measured variable that should be output.

Selection **Measured variable** *depending on the parameter*

pH and ORP	Ammonium	Nitrate	Potassium	Chloride
No options	NH4-N NH4	NO3-N NO3	K	Cl

You can also configure a user-defined measured variable (**Measured variable** = **user defined**). The following values must then be specified for calculation purposes:
- **Electrode name**
  Customized text. Enter a name. This is displayed under **Electrode slot** afterwards.
- **Measured variable**
  Customized text
- **Valency**
  Specify the ion charge including the sign.
- **Molar mass**
  Specify the molar mass of the measured variable.

Selecting the pH reference electrode

4. **Reference electrode**: Specify the pH electrode version, **Standard** or **Salt ring**.

The pH electrode version can be found only on its nameplate (CPS11-1AS*** = **Salt ring**, CPS11-1AT*** = **Standard**).

NOTICE

Incorrect assignment between the electrode (hardware) and the software menu
Unreliable measured values and faults in the measuring point can occur!
- ▶ When assigning the slot in the software, make sure it matches the assignment in the sensor.
- ▶ Example: You have connected the ammonium electrode to cable no. 2 in the sensor. Then configure the ammonium parameter in the software menu for slot 2.

13.3.2 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: ISE/Electrode slot		
Function	**Options**	**Info**
Damping	0 to 600 s **Factory setting** 0 s	Specify the damping of the main value of the electrode assigned to the slot.

13.3.3 Compensation (not available in an ORP sensor)

Depending on the selectivity of the ion-selective electrode vis-à-vis other ions (interference ions), and the concentration of these ions, such ions could also be interpreted as part of the measuring signal and thus cause measuring errors.

When measuring in wastewater, the potassium ion which is chemically similar to the ammonium ion can cause higher measured values.

The measured values for nitrate may be too high due to high concentrations of chloride. To reduce measuring errors resulting from such cross-interference, the concentration of the potassium or chloride interference ion can be measured and compensated for with a suitable additional electrode.

For the pH, chloride and the potassium electrode, you can only configure an offset. The settings to compensate for the effect of interference ions are only available for ammonium.

Menu/Setup/Inputs/Channel: ISE/Electrode slot/▶ Compensation		
Function	**Options**	**Info**
Offset	-14.00 to 14.00 pH -100 to 100 mg/l **Factory setting** 0.00 pH 0.00 mg/l	The offset compensates for a difference between a laboratory measurement and an online measurement which is caused by interference ions. Enter this value manually. If you are using a compensation electrode, keep the offset at zero.
Compensation	**Selection** ▪ Off ▪ On **Factory setting** Off	Function only available for ammonium If you want to use the compensation function, you must have installed a compensation electrode (potassium or chloride) in another electrode slot and have configured it in the software.
Compensation type	**Selection** ▪ Chloride ▪ pH ▪ Potassium ▪ pH and potassium **Factory setting** Chloride Potassium	The options depend on the parameter to be compensated. You compensate for chloride when using a nitrate electrode, and you can compensate for potassium and pH when using the ammonium electrode. The factory setting depends on the electrode used.
Comp. electrode	Choice of slot	If you have installed and configured several compensation electrodes of the same type in the CAS40D sensor, you must specify the electrode to be used for compensation here. You generally have a potassium or chloride electrode and Liquiline detects the correct slot.
Selectivity coefficient	-10.00 to 10.00 **Factory setting** -2.00 (chloride) -0.85 (potassium)	The coefficients are empirical values.
Mode	**Selection** ▪ + ▪ - **Factory setting** -	The standard setting (-) corrects a measured value that is too high due to the influence of interference ions.

13.3.4 Extended setup

Format of main measured value and membrane timer

Menu/Setup/Inputs/Channel: ISE/Electrode slot/▶ Extended setup		
Function	**Options**	**Info**
Main value format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.##	▶ Specify the number of decimal places.
Membrane timer	**Selection** ▪ Off ▪ On **Factory setting** Off	
Membrane timer value	0 to 80 weeks **Factory setting** 26 weeks	

Calibration settings

Stability criterion

Menu/Setup/Inputs/Channel: ISE/Electrode slot/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Stability criteria	**Selection** ▪ Off ▪ Weak ▪ Medium ▪ Hard **Factory setting** Weak	Recommendations ▪ Normal situation Weak ▪ Standard addition Medium

Buffer recognition (only pH)

Menu/Setup/Inputs/Channel: ISE/Electrode slot/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Buffer recognition	**Selection** ▪ Fixed ▪ Manual **Factory setting** Fixed	**Fixed** Select values from a list. The list depends on the setting in **Buffer manufacturer**. **Manual** Enter any two buffer values. These must differ in terms of their pH value.
Buffer manufacturer	**Selection** ▪ Endress+Hauser ▪ Ingold/Mettler ▪ DIN 19266 ▪ DIN 19267 ▪ Merck/Riedel ▪ Hamilton ▪ Special buffer **Factory setting** Endress+Hauser	Temperature tables are stored internally in the unit for the following pH values: ▪ **Endress+Hauser** 2.00 / 4.00 / 7.00 / (9.00) / 9.22 / 10.00 / 12.00 ▪ **Ingold/Mettler** 2.00 / 4.01 / 7.00 / 9.21 ▪ **DIN 19266** 1.68 / 4.01 / 6.86 / 9.18 ▪ **DIN 19267** 1.09 / 4.65 / 6.79 / 9.23 / 12.75 ▪ **Merck/Riedel** 2.00 / 4.01 / 6.98 / 8.95 / 12.00 ▪ **Hamilton** 1.09 / 1.68 / 2.00 / 3.06 / 4.01 / 5.00 / 6.00 7.00 / 8.00 / 9.21 / 10.01 / 11.00 / 12.00
With the **Special buffer** option, it is possible to define two buffers of your own. For this purpose, two tables are displayed in which pH value/temperature value pairs can be saved.		
Calibration buffer 1 … 2	The options and factory setting depend on the **Buffer manufacturer**	

Calibration timer

You can specify the calibration interval for the sensor here. Once the configured time elapses, the diagnostic message **Calibration timer** is shown on the display.

The timer is reset automatically if you recalibrate the sensor.

Menu/Setup/Inputs/Channel: ISE/Electrode slot/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calibration timer	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calibration timer value	1 to 10000 h **Factory setting** 2500 h	▶ Enter the time after which the timer should time out. After this time, the diagnostic message is displayed with the code 102 (**Calibration timer**).

Standard addition (all except for pH)

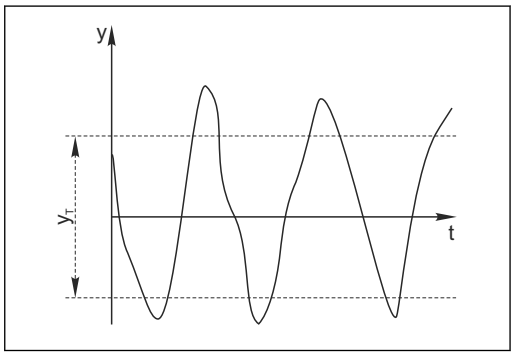
Different types of calibration are available to calibrate an ion-selective electrode. Initial settings only have to be made for the standard addition method.

Menu/Setup/Inputs/Channel: ISE/Electrode slot/▶ Standard addition		
Function	**Options**	**Info**
Sampling volume	0.00 to 5000.00 ml **Factory setting** 1000.00 ml	Here, specify the sample volume which you use during the calibration.
Standard volume	0.00 to 100.00 ml **Factory setting** 1.00 ml	Volume of the added standard solution per addition step
Standard concentration	0.00 to 10.00 mol/l **Factory setting** 1.00 mol/l	Concentration of the standard solution
No. of additions	1 to 4 **Factory setting** 3	Number of addition steps (=measuring points of the calibration function)

Diagnostic settings

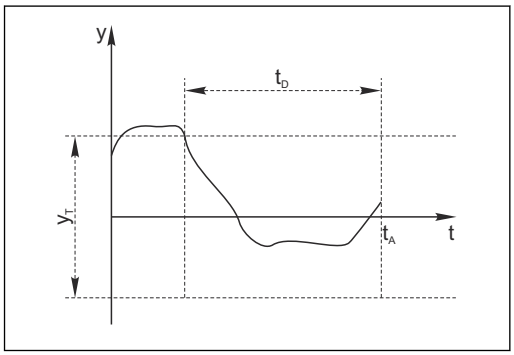
Process check system

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).



25 *Normal measuring signal, no alarm*

y *Measuring signal*
y_T *Set value for* **Tolerance width**



26 *Stagnating signal, alarm is triggered*

t_D *Set value for* **Duration**
t_A *Time when the alarm is triggered*

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

14 Inputs: Interface

14.1 Basic settings

14.1.1 Sensor identification

The CUS71D sensor is not recognized automatically. It must be selected manually (**Current sensor**). When you commission for the first time, data are recorded for 3-5 minutes and calculated before a measured value is displayed.

Menu/Setup/Inputs/Channel: Ultrasonic interface		
Function	**Options**	**Info**
Sensor operation	**Selection** ▪ Scan for memosens sensor ▪ Current sensor **Factory setting** Current sensor	**Scan for memosens sensor** Searches for Memosens sensors **Current sensor** Connected sensor is used
Wiper function	**Selection** ▪ Off ▪ On **Factory setting** On	Only for sensor version with wiper function
Wiper timing	10 to 240 min **Factory setting** 240 min	Only for sensor version with wiper function

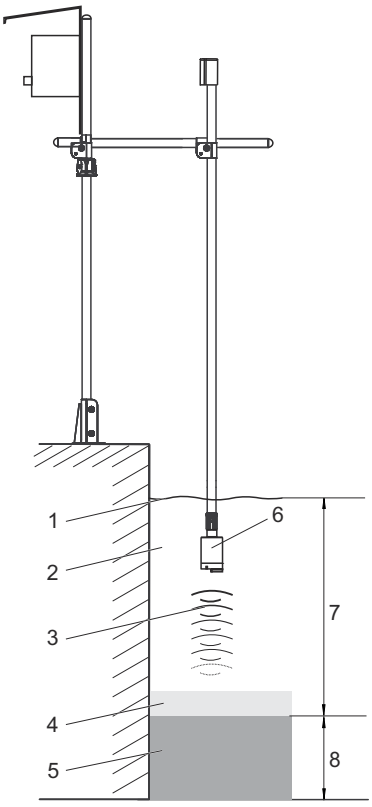
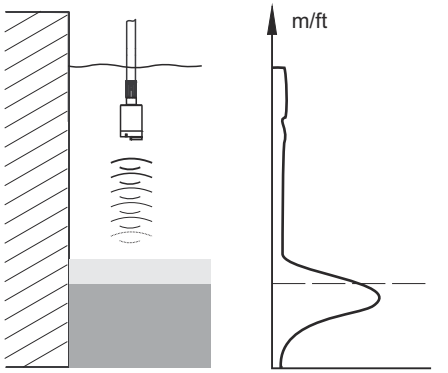
14.1.2 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

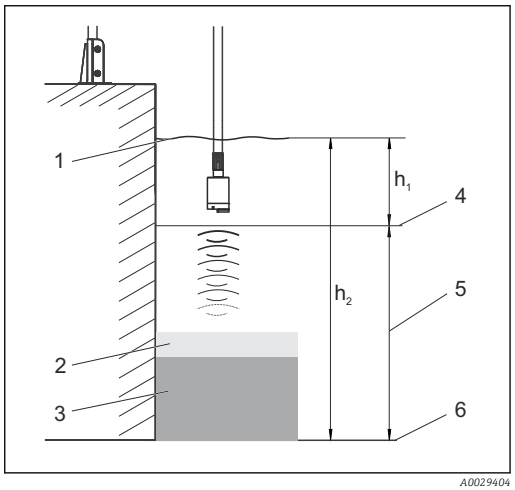
14.2 Tank configuration

The mounting location is defined by the tank depth and the sensor zero point. The accuracy of the measurement results depends on the accuracy of these settings.

Since the data in the sensor are overwritten with each change, data input might be delayed.

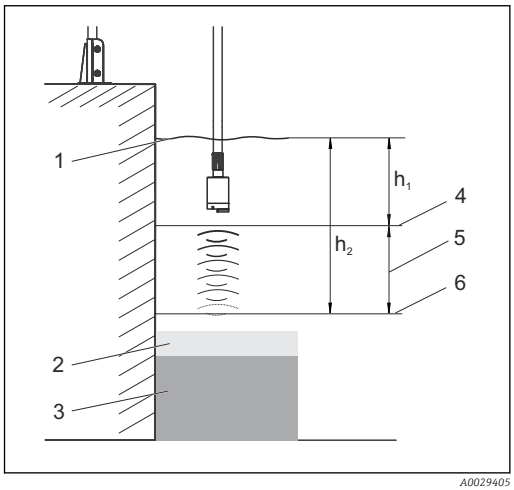
Menu/Setup/Inputs/Channel: Ultrasonic interface/▶ Tank configuration		
Function	**Options**	**Info**
Blanket definition	**Selection** ▪ Interface level ▪ Interface range **Factory setting** Interface level	Type of measurement that should be displayed and calculated **Interface level** Distance from the tank floor to the interface, measuring direction from bottom to top **Interface range** Distance from the water line to the interface, measuring direction from top to bottom
 A0029402		 A0029403 *1 Reference point, e.g. water line* *2 Clear water* *3 Transmitted and reflected ultrasonic waves* *4 Solids/clear water separation zone* *5 Deposited sludge* *6 Ultrasonic transmitter and receiver* *7 Interface range* *8 Interface level* **Tank depth** and **Zero adjust** have the same reference point.
Unit of measure	**Selection** ▪ m ▪ cm ▪ ft ▪ inch **Factory setting** m	Any change to the unit is automatically accepted in all the displays.
Tank depth	Possible range of adjustment: 0.0 to 10.0 m (0.0 to 32.8 ft) **Factory setting** 8.0 m (26.2 ft)	Distance from the water level to the tank floor **Zero adjust**: This setting sets a lower limit for the range of adjustment.
Zero adjust	Possible range of adjustment: 0.0 to 10.0 m (0.0 to 32.8 ft) **Factory setting** 0.4 m(1.3 ft)	Distance from the water level to the sensor membrane **Tank depth**: This setting sets an upper limit for the range of adjustment.

Menu/Setup/Inputs/Channel: Ultrasonic interface/▶ Tank configuration		
Function	**Options**	**Info**
Blanking zone	**Selection** ▪ Off ▪ On **Factory setting** Off	Permanent echo signals above and below a search window are masked out as interference signals.
Upper window limit **Blanking zone** = **On**	0.0 m ... **Lower window limit**(1.4 ft ...) **Factory setting** 0.7 m (2.3 ft)	Distance to the water line below which the system should search for an interface. Permanent echo signals above this value are masked out as interference signals.
Lower window limit **Blanking zone** = **On**	**Upper window limit** ... 11.0 m (... 33 ft) **Factory setting** 7.7 m (25 ft)	Distance to the water line Permanent echo signals below this value are masked out as interference signals.



27 Detection limit on tank floor

1 Reference point, for example water line
2 Solids/clear water separation zone
3 Deposited sludge



28 Detection limit above tank floor

4 Upper window limit
5 Measuring range
6 Lower window limit

If the lower detection limit is above the tank floor, all signals below this value are hidden and no separation zone is displayed.

14.3 Sensor signal

Change the factory settings in this menu if you discover incorrect measurements.

Menu/Setup/Inputs/Channel: Ultrasonic interface/▶ Sensor signal		
Function	**Options**	**Info**
Acoustic control	**Selection** ▪ Manual ▪ Automatic **Factory setting** Automatic	Controls the graphic display of the echo signal **Manual** You can enter a fixed gain value for diagnostics or test purposes. **Automatic** The transmitter uses the gain value determined in the self-test (initialization). In the measuring mode, this value is automatically adapted to the current process conditions.
Current gain	0 to 100 **Factory setting** 30	You can only configure the value with manual acoustic control. The value is read-only for automatic acoustic control.
Common gain values for applications involving relatively clear water and a "hard" interface are between 25 and 35. The values can be as high as 60 if the sludge/water transition is relatively "soft". If you require significantly higher gain values, this is an indication of overranging. It is then difficult or impossible to reliably evaluate the echo signal.		
Gain control set point **Acoustic control** = **Automatic**	5 to 50 **Factory setting** 10	Horizontal position of the intersection of the interface line with the echo peak. The factory setting "10" corresponds to 10 % of the maximum display height.
Refresh rate	**Selection** ▪ 2 s ▪ 4 s ▪ 6 s ▪ 8 s **Factory setting** 6 s	Time frame for data refresh
Damping	5 to 250 **Factory setting** 130	Number of averaged values until data refresh Select a low damping value if the height of the interface can change very quickly. Higher damping prevents the system from tracking echo signals that occur briefly (e.g. caused by material movement, a rake or a floor scraper).

14.4 Extended setup

14.4.1 Sensor signal

You can adapt the sensor signal to the measuring point in this menu.

Menu/Setup/Inputs/Channel: Ultrasonic interface/Extended setup/▶ Sensor signal		
Function	**Options**	**Info**
Speed of sound	300 to 2000 m/s (985 to 6561 ft/s) **Factory setting** 1482 m/s (4862 ft/s)	The sound speed depends on the medium temperature and the medium density. Since the temperature and density only fluctuate slightly in most water and wastewater applications, the factory setting of 1482 m/s has proven to be a suitable value.
Always consult with the manufacturer service department before you change the setting for the **Speed of sound**.		

Menu/Setup/Inputs/Channel: Ultrasonic interface/Extended setup/▶ Sensor signal		
Function	**Options**	**Info**
▶ Sedimentation area		
Gain band	5 to 30 **Factory setting** 20	Restricts the gain in automatic mode in order to prevent system overload.
Gain increment	0.1 to 5.0 **Factory setting** 2.0	Defines how quickly the gain can adapt to changing process conditions in the automatic mode.
Bottom definition		
Range above bottom	0.0 to 1.0 m (0.0 to 3.2 ft) **Factory setting** 0.1 m(0.3 ft)	Zone around the tank bottom in which extraneous signals can occur. Signals above your setting are masked out. This is needed for very low sludge levels or tanks free from sludge.
Bottom signal set point	0 to 100 **Factory setting** 60	Restricts the gain in automatic mode in order to prevent system overload when the tank is empty or does not have an interface.

14.4.2 Calculation

You can adapt the sensor signal to the measuring point in this menu.

Menu/Setup/Inputs/Channel: Ultrasonic interface/Extended setup/▶ Calculation		
Function	**Options**	**Info**
Interface	**Selection** ▪ Top layer ▪ Lower interface **Factory setting** Top layer	Defines which signal the system should track and display when several interfaces are calculated. **Top layer** Determine the interface of thin material in the upper section **Lower interface** Determine the interface of thicker material near the floor
Interface window	**Selection** ▪ Off ▪ On **Factory setting** On	You can open another window near the interface. Specify a distance above and below the interface. The system primarily focuses on the signal within this window. Any signal outside this window must meet the search criteria for an interface for an extended period before the system recognizes it as an interface.
Above interface **Interface window** = **On**	0.0 to 10.0 m (0.0 to 32.8 ft) **Factory setting** 0.6 m (2.0 ft)	The search window is indicated by broken lines in the graphic mode. The search window is 1.2 m wide in the factory setting for both parameters.
Below interface **Interface window** = **On**		
Gate response rate	1 to 50 **Factory setting** 1	The response rate determines the speed at which the system updates the measuring window. A high value stands for a quick change.
Threshold	0 to 100 **Factory setting** 0	Filter for examining signals If a high value is selected, stronger signals are taken into account more. If a low value is selected, weaker signals are taken into account more.

14.4.3 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Alarm delay echo loss

Menu/Setup/Inputs/Channel: Ultrasonic interface/Extended setup/ Diagnostics settings		
Function	**Options**	**Info**
Alarm delay echo loss	0 to 255 min **Factory setting** 30 min	Delay time for an error message if the echo is lost

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu/Setup/Additional functions/Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

14.4.4 Restart the sensor signal

Restart sensor signal

The sensor is reinitialized with this action. The sensor starts in the automatic mode and searches for the interface with the last sensor settings. The first measured value appears after around 3 to 5 minutes.

14.4.5 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

14.4.6 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

14.4.7 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

14.4.8 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

15 Inputs: Spectrometer

15.1 Basic settings

15.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

15.1.2 Application type and data record

The sensor is precalibrated on leaving the factory. As such, it can be used in a wide range of applications without the need for additional calibration. In addition to the factory calibration data, which cannot be modified, the sensor has five other data records to be used for storing process calibrations.

Calibration data records are saved under an individual name. You can add your own data records with every calibration. You can then select them under **Dataset**.

Menu/Setup/Inputs/Channel: Spectrometer		
Function	**Options**	**Info**
Application type	The ordered parameter package is displayed	Overview of parameter packages available: Technical Information for Memosens Wave CAS80E, TI01522C
Dataset		

15.1.3 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

15.2 Extended setup

15.2.1 Measured value formats

Menu/Setup/Inputs/Channel: Spectrometer/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	▶ Specify the number of decimal places.
▶ Main value format	The parameters are derived from the ordered parameter package. The format can be determined individually for every parameter. There is an individual factory setting for every parameter. Overview of the possible parameters: Technical Information for Memosens Wave CAS80E, TI01522C	
Format settings for every parameter		

15.2.2 Measuring period

Menu/Setup/Inputs/Channel: Spectrometer/▶ Extended setup		
Function	**Options**	**Info**
Measurement period	**Selection** ▪ Default ▪ Manual **Factory setting** Default	▶ Specify the interval in which measuring should take place. ▪ Default Interval of 20 s ▪ Manual Set an individual interval
Measurement period	**Selection** 1.00 to 3600.00 s **Factory setting** 20.00 s	A fast measuring period is recommended for processes with frequent temperature or matrix changes or permanently low process temperatures (default = 20 s).

15.2.3 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 ... 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

15.2.4 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

15.2.5 Calibration settings

Stability criteria

You define the permitted measured value fluctuation which must not be exceeded in a certain timeframe during the calibration. If the permitted difference is exceeded, the calibration is not permitted and is aborted automatically.

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/Calib. settings/▶ Stability criteria		
Function	**Options**	**Info**
Delta temperature	0.10 to 2.00 K **Factory setting** 0.50 K	Permitted temperature fluctuation during calibration
Duration	5 to 100 s **Factory setting** 20 s	Timeframe within which the permitted measured value fluctuation must not be exceeded

Calibration monitoring

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Calib. expiration time	**Selection** ▪ Off ▪ On **Factory setting** Off	The function checks whether the calibration of a sensor is still valid. Example: You install a precalibrated sensor. The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
▶ Calib. expiration time		
Warning limit	**Factory setting** 48 weeks	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 52 weeks	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 104 weeks Generally, the following applies: alarm limit > warning limit		

15.2.6 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 50000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the Diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 199 **Operating time**
The names of the following menu functions depend on the sensor specification. For this reason, they cannot be specified here.		
▶ Operation < 5 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**
▶ Operation > 50 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu**/**Setup**/**Additional functions**/**Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

15.2.7 Signal processing

Measurement filter

Allows the user to adapt the behavior of the sensor over time to the medium.

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/Signal processing/▶ Measurement filter		
Function	**Options**	**Info**
Measurement filter	**Selection** ▪ Default ▪ Manual **Factory setting** Default	▶ Specify the number of spectra over which the measured value should be averaged.
Measurement filter	**Selection** ▪ Off ▪ Low ▪ Medium ▪ High **Factory setting** Low	Number of spectra over which the value is averaged: ▪ Low Averaging over 3 spectra ▪ Medium Averaging over 7 spectra ▪ High Averaging over 11 spectra ▪ Off No smoothing

15.2.8 Spectrum

Spectrum visualization, configuration of the upper and lower limit frequency, and spectrum display type.

Menu/Setup/Inputs/Channel: Spectrometer/Extended setup/Signal processing/▶ Spectrum		
Function	**Options**	**Info**
Spectrum	**Selection** ▪ Intensity ▪ Absorption ▪ Reference **Factory setting** Absorption	Spectrum display type
Logging	**Selection** ▪ On ▪ Off **Factory setting** On	Logging of raw spectra for diagnostic and service purposes. Saving of data to SD card.
Dspl. spctr. lower limit	**Factory setting** 190.0 nm	Start and end value of the wavelength in the spectrum display **Range of adjustment** 160.0 to 1030.0 nm The selected setting sets an upper or lower limit for the range of adjustment available for the opposite limit. For example, in the factory setting the range of adjustment for the upper limit (**Dspl. spctr. upper limit**) starts at 190.0 nm, the value of the lower limit (**Dspl. spctr. lower limit**). Recommendation for CAS80E: ▪ **Dspl. spctr. lower limit** = 200 nm ▪ **Dspl. spctr. upper limit** = 800 nm
Dspl. spctr. upper limit	**Factory setting** 1000.0 nm	

15.2.9 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

15.2.10 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

15.2.11 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

16 Inputs: Fluorescence

16.1 Basic settings

16.1.1 Sensor identification

Menu/Setup/Inputs/Channel: sensor type		
Function	**Options**	**Info**
Channel	**Selection** ▪ Off ▪ On **Factory setting** On	**On** The channel display is switched on in the measuring mode **Off** The channel is not displayed in the measuring mode, regardless of whether a sensor is connected or not.
Sensor type	Read only (Only available if a sensor is connected)	Connected sensor type
Order code		Order code of the connected sensor

16.1.2 Damping

The damping causes a floating average curve of the measured values over the time specified.

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Depends on the sensor [1)]	0 to 600 s **Factory setting** 0 s	The damping of the main value and of the integrated temperature sensor can be specified.
Damping temp.		

1) **Damping pH** or **Damping ORP** or **Damping Cond** or **Damping DO** or **Damping DI** or **Damping nitrate** or **Damping SAC** or **Damping turbidity** or **Damping PAHphe**

16.1.3 Manual hold

Menu/Setup/Inputs/Channel: Sensor type		
Function	**Options**	**Info**
Manual hold	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** You can use this function to set the channel manually to "Hold". **Off** No channel-specific hold

16.2 Extended setup

16.2.1 Measured value formats

Menu/Setup/Inputs/Channel: Fluorescence/▶ Extended setup		
Function	**Options**	**Info**
Temperature format	**Selection** ▪ #.# ▪ #.## **Factory setting** #.#	Specify the number of decimal places.
Main value format	**Selection** ▪ # ▪ #.# ▪ #.## ▪ #.### **Factory setting** #.#	

16.2.2 Unit

Menu/Setup/Inputs/Channel: Fluorescence/▶ Extended setup		
Function	**Options**	**Info**
Main value unit	**Selection** ▪ µg/l ▪ ppb **Factory setting** µg/l	

16.2.3 Medium compensation

Menu/Setup/Inputs/Channel: Fluorescence/▶ Extended setup		
Function	**Options**	**Info**
Medium comp. (TU)	**Selection** ▪ On ▪ Off **Factory setting** Off	The measured value of the sensor is affected by turbidity that may occur. This function compensates for the turbidity effects automatically and in real-time.
Medium comp. source **Medium comp. (TU)** = **On**	Selection depends on the inputs available	Ways to compensate for turbidity: ▪ Via a connected sensor, e.g. CUS52D ▪ Via an analog input ▪ Via the fieldbus

16.2.4 Cleaning hold

Menu/Setup/Inputs/Channel: <Sensor type>/▶ Extended setup		
Function	**Options**	**Info**
Cleaning hold	**Selection** ▪ None ▪ Cleaning 1 … 4 **Factory setting** None	▶ For selecting one or more cleaning programs (multiple selection). ↳ For the programs defined, the channel switches to "Hold" while cleaning is in progress. Cleaning programs are executed: ▪ At a specified interval For this, the cleaning program must be started. ▪ If a diagnostics message is pending on the channel and a cleaning has been specified for this message (→ **Inputs**/Channel: Sensor type/**Diagnostics settings**/**Diag. behavior**/Diagnostic number/**Cleaning program**).

The cleaning programs are defined in the menu: **Setup**/**Additional functions**/**Cleaning**.

16.2.5 External hold

A hold can be triggered for all the devices of a measuring point via a digital signal, e.g. a fieldbus signal. Make sure that the hold signal is not used elsewhere. An external hold can be assigned individually to every sensor input.

The function only appears in the Inputs menu if the signals for the external hold were configured beforehand in the general hold settings:

Menu/Setup/General settings/Hold settings/External hold.

Menu/Setup/Inputs/Channel: <Sensor type>/Extended setup/▶ External hold		
Function	**Options**	**Info**
Source	**Selection** ▪ Binary inputs ▪ Fieldbus signals **Factory setting** None	1. For selecting the signal source of the external hold. ↳ Multiple selection is possible. 2. **OK**: Confirm your selection.

16.2.6 Calibration settings

Calibration validity

Menu/Setup/Inputs/Channel: Fluorescence/Extended setup/▶ Calib. settings		
Function	**Options**	**Info**
Calib. expiration time	**Selection** ▪ Off ▪ During operation **Factory setting** During operation	Switches the function on or off
▶ Calibration validity		The function checks how long ago the sensor was last calibrated. A diagnostics message is displayed if the time since the last calibration is longer than specified by the predefined warning and alarm limit.
Warning limit	**Factory setting** 5000 h	Diagnostic message: 105 **Calibration validity**
Alarm limit	**Factory setting** 10000 h	Diagnostic message: 104 **Calibration validity**
Warning and alarm limits mutually influence each other's possible range of adjustment. Range of adjustment which must include both limits: 1 to 20000 h Generally, the following applies: alarm limit > warning limit		

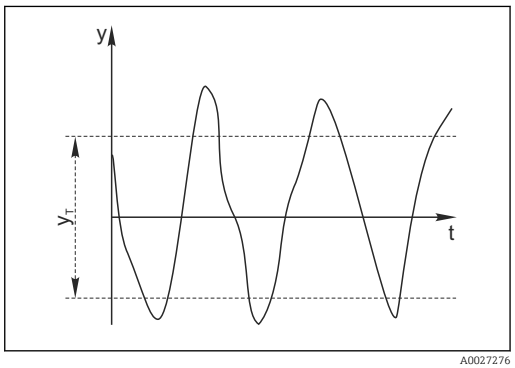
16.2.7 Diagnostics settings

In this menu branch, warning limits are specified or the use of diagnostics tools is defined.

The associated diagnostics code is displayed for every setting.

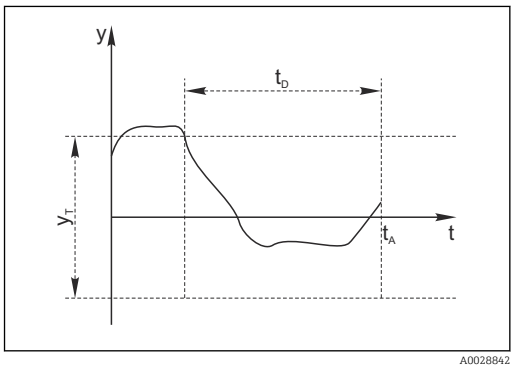
Process Check System (PCS)

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).



29 Normal measuring signal, no alarm

y Measuring signal
y_T Set value for **Tolerance width**



30 Stagnating signal, alarm is triggered

t_D Set value for **Duration**
t_A Time when the alarm is triggered

Main causes of stagnating measured values

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

Remedial measures

1. Clean sensor.
2. Check positioning of sensor in medium.
3. Check electrode system.
4. Switch controller off and then switch it back on.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Diagnostics settings/▶ Process check system		
Function	**Options**	**Info**
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	Switches the function on or off
Duration	1 to 240 min **Factory setting** 60 min	Enter the time after which the timer should time out. After this time, the diagnostic message **Process check alarm** is displayed with the code 904.
Tolerance width *Not for pH/ORP sensors*	The range depends on the sensor **Factory setting** Depends on the sensor	Interval around the measuring signal (raw value) for detecting stagnation. Measured values within the set interval are regarded as stagnating.

Operating hours limit values

The total operating time of the sensor and its use under extreme conditions is monitored. If the operating time exceeds the defined threshold values, the device issues a corresponding diagnostics message.

Each sensor has a limited life expectancy which heavily depends on the operating conditions. If warning limits for operating times under extreme conditions are specified and maintenance tasks are performed in time, the operation of the measuring point without any downtime can be guaranteed.

Menu/Setup/Inputs/Channel: Fluorescence/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
The range of adjustment for the operating hours alarm and warning limits is generally 1 to 60000 h.		
Function	**Selection** ▪ Off ▪ On **Factory setting** Off	**On** The operation of the sensor under extreme conditions is monitored, recorded in the sensor and diagnostics messages are displayed on the controller. **Off** No diagnostics messages. However, the time the sensor operates under extreme conditions is recorded in the sensor and can be read in the sensor information in the Diagnostics menu.
▶ Operating time		Total operating time of the sensor
Warning limit	**Factory setting** 40000 h	Diagnostics code and associated message text: 199 **Operating time**
▶ Operation < -20 °C		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 935 **Process temp. low**

Menu/Setup/Inputs/Channel: Fluorescence/Extended setup/Diagnostics settings/▶ Limits operating hours		
Function	**Options**	**Info**
Operation > 60 °C▶		
Warning limit	**Factory setting** 10000 h	Diagnostics code and associated message text: 934 **Process temp. high**

Diagnostic behavior

The list of diagnostic messages displayed depends on the path selected. There are device-specific messages, and messages that depend on what sensor is connected.

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
List of diagnostic messages		▶ Select the message to be changed. Only then is it possible to make the settings for this message.
Diag. code	Read only	
Diagnostic message	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	Deactivate the diagnostic message or activate it again. Deactivating means: ▪ No error message in the measuring mode ▪ No failure current at the current output
Failure current	**Selection** ▪ On ▪ Off **Factory setting** Depends on the message	▶ Decide whether a failure current should be output at the current output if the diagnostic message display is activated. In the event of general device errors, the failure current is output at all the current outputs. In the event of channel-specific errors, the failure current is only output at the assigned current output.
Status signal	**Selection** ▪ Maintenance (M) ▪ Out of specification (S) ▪ Function check (C) ▪ Failure (F) **Factory setting** Depends on the message	The messages are divided into different error categories in accordance with NAMUR NE 107. ▶ Decide whether a status signal assignment should be changed for the application.
Diag. output	**Selection** ▪ None ▪ Alarm relay ▪ Binary output ▪ Relay 1 to n (depends on the device version) **Factory setting** None	Select an output to which the diagnostic message should be assigned. A relay output must first be configured for **Diagnostics** before it is possible to assign the message to an output. (**Menu**/**Setup**/**Outputs**: Assign the **Diagnostics** function and set **Operating mode** to **as assigned**.)
Alarm relays are available, depending on the device version.		

Menu/Setup/(General settings or Inputs<Sensor channel>)/Extended setup/Diagnostics settings/Diag. behavior		
Function	**Options**	**Info**
Cleaning program (for sensors)	**Selection** ▪ None ▪ Cleaning 1 ▪ Cleaning 2 ▪ Cleaning 3 ▪ Cleaning 4 **Factory setting** None	▶ Decide whether the diagnostic message should trigger a cleaning program. The cleaning programs can be defined under: **Menu/Setup/Additional functions/Cleaning**.
Detail information	Read only	Additional information on the diagnostic message and instructions on how to resolve the problem.

Hardware limits

These limit values are used to assess the condition of the sensor in Heartbeat Diagnostics.

The menu is only available if the "Heartbeat Verification+Monitoring" software option has been ordered and an additional activation code has been installed for this option.

Menu/Setup/Inputs/Channel: Fluorescence/Extended setup/Diagnostics settings/▶ Hardware limits		
Function	**Options**	**Info**
Warn. limit lightsource	10 to 90 **Factory setting** 50	The function monitors the aging of the light source. A value of 100 is the best state. The warning limit means that the sensor health deteriorates as of this value and lower values, and the Heartbeat smiley changes as a result (😐 or ☹).
Warn. limit adjustment	10 to 100 **Factory setting** 50	The function monitors the deviation from the adjustment with the solid state reference. The smaller the deviation the better. The warning limit means that the sensor health deteriorates as of this value and larger values, and the Heartbeat smiley changes as a result (😐 or ☹).

The current values can be read in the Expert menu (password required). (**Expert/Diagnostics/Sensor information/Current base value/Lightsource monitoring** or **Adjustment deviation**)

16.2.8 Signal processing

Menu/Setup/Inputs/Channel: Fluorescence/Extended setup/Signal processing/▶ Measurement filter		
Function	**Options**	**Info**
Configuration method	**Selection** ▪ Standard ▪ Specialist **Factory setting** Standard	**Standard** Choice of 3 predefined configurations **Specialist** You specify in detail how the measurement filter should react.
Filter level **Configuration method** = **Standard**	**Selection** ▪ Low ▪ Medium ▪ High **Factory setting** Medium	▪ Low The measurement filter only has a minor influence on the measuring signal. The sensor quickly follows all the changes in the process. Potential interference from one-off events is not ignored. The response time is short; the sensor responds quickly. ▪ High The measurement filter has a large influence on the measuring signal. The sensor follows the average turbidity value. Transient, one-off events are ignored. The response time is rather long; the sensor only responds to long-term process changes. ▪ Medium The influence of the measurement filter is between the two extremes.
Relative limit **Configuration method** = **Specialist**	0.000000 to 1.000000 **Factory setting** 0.001000	Specify the filter strength 0.000000 ... constant measured value 0.001000 ... standard 0.010000 ... low 1.000000 ... off
Dwell time before jump **Configuration method** = **Specialist**	**Factory setting** 10 s	▶ Specify the period of time after which the measured value must change at the very latest. **Dwell time before jump** and **Integ. time before jump** influence each other's adjustment limits. Total range of adjustment: 2 to 1000 s, **Dwell time before jump** > **Integ. time before jump**
Integ. time before jump **Configuration method** = **Specialist**	**Factory setting** 4 s	▶ Specify the number of measured values (time span) which should be used for the next change value.
Dynamic **Configuration method** = **Specialist**	1 to 3 **Factory setting** 3	How dynamically should the filter respond: slow (1) to fast (3).

16.2.9 Tag control

This function is used to specify which sensors are accepted at the device.

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/▶ Tag control		
Function	**Options**	**Info**
Operating mode	**Selection** ▪ Off ▪ Tag ▪ Group **Factory setting** Off	**Off** No tag control, all sensors are accepted. **Tag** Only sensors with the same tag name are accepted. **Group** Only sensors in the same tag group are accepted.
Tag	User-defined text **Factory setting** ▪ EH_CM44_ ▪ EH_CM44R_	Enter the tag name. The controller checks every sensor to be connected as to whether this sensor belongs to the measuring point, and only accepts the sensors that have the same name.
Group	Numerical **Factory setting** 0	

16.2.10 Sensor change

Menu/Setup/Inputs/Channel: Sensor type/Extended setup/Sensor change

- On
  When the sensor is replaced, the last measured value is retained via the "hold" function. A diagnostics message is not triggered.
- Off
  When the sensor is replaced, the last measured value is not retained and triggers a diagnostics message.

16.2.11 Data processing factory setting

Possibility to restore the factory settings for the sensor input.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default measurement processing**
2. Answer the question: **OK** (press the navigator button).
   ↳ Only the factory settings for this particular input are restored. All other settings remain unchanged.

16.2.12 Sensor factory setting

Here you can restore the sensor factory settings.

Menu/**Setup**/**Inputs**/Channel: Sensor type/**Extended setup**

1. ▷ **Factory default sensor**
2. Respond to prompt: **OK**when the prompt for the device software appears.
   ↳ Only the factory settings for the sensor are restored. The settings for the input remain unchanged.

17 Diagnostics and troubleshooting

17.1 Process errors without messages

17.1.1 pH/ORP measurement

Problem	Possible cause	Tests and/or remedial measures
Display deviates from reference measurement	Incorrect calibration	Repeat calibration Where necessary, check the calibration with the reference device and repeat.
	Sensor fouled	Clean sensor
	Temperature measurement	Check the temperature measured values of both devices
	Temperature compensation	Check the settings for temperature compensation and adjustment for both devices
Measuring chain zero-point cannot be adjusted	Contaminated reference system	Test with a new sensor
	Membrane clogged	Clean or grind membrane
	Asymmetric sensor voltage too high	Clean junction or test with another sensor
No or slow change of readings	▪ Sensor fouled ▪ Sensor old ▪ Sensor defective (reference lead)	Clean sensor
	Reference has low level of KCl	Check KCl supply: 0.8 bar (12 psi) over medium pressure
Measuring chain slope: ▪ Cannot be adjusted ▪ Too low ▪ No slope	Device input defective	Check device directly
	▪ Sensor old ▪ Hair-line crack in the glass membrane	Replace sensor
Constant, incorrect measured value	Sensor does not immerse properly or protection cap not removed	Check installation position, remove protection cap
	Air pockets in assembly	Check assembly and installation position
	Grounding short at or in device	Perform test measurement in insulated vessel, with buffer solution if applicable
	Hair-line crack in the glass membrane	Replace sensor
	Device in impermissible operating condition (does not respond when key pressed)	Switch off device and switch it on again
Incorrect temperature value	Sensor defective	Change sensor
Fluctuations in measured value	Interference on signal output cable	Check cable routing, possibly route cable separately
	Interference potential in medium	Eliminate source of interference or ground medium as close as possible to sensor.
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer
Fixed current output signal	Current simulation active	Switch off simulation

Problem	Possible cause	Tests and/or remedial measures
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference

17.1.2 Conductivity measurement

Problem	Possible cause	Tests and/or remedial measures
Display deviates from reference measurement	Incorrect calibration	Repeat calibration Where necessary, check the calibration with the reference device and repeat.
	Sensor fouled	Clean sensor
	Temperature measurement	Check the temperature measured values of both devices
	Temperature compensation	Check the settings for temperature compensation and adjustment for both devices
	Polarization errors	Use suitable sensor ▪ Larger cell constant ▪ Graphite instead of stainless steel (observe material resistance properties)
Implausible measured values: ▪ Measured value constantly 000 ▪ Measured value too low ▪ Measured value too high ▪ Measured value frozen ▪ Current output value not as expected	Short-circuit/moisture in sensor	Check the sensor
	Short-circuit in cable or socket	Check cable and socket
	Disconnection in sensor	Check the sensor
	Disconnection in cable or socket	Check cable and socket
	Incorrect cell constant setting	Check cell constant
	Incorrect output assignment	Check assignment of measured value to current signal
	Air pockets in assembly	Check assembly and installation position
	Grounding short at or in device	Measure in insulated vessel
	Device in impermissible operating condition (does not respond when key pressed)	Switch off device and switch it on again
Incorrect temperature value	Sensor defective	Change sensor
Measured value in process incorrect	No/incorrect temperature compensation	ATC: select type of compensation; if linear, set suitable coefficients MTC: set process temperature
	Incorrect temperature measurement	Check temperature measured value
	Bubbles in medium	Suppress formation of bubbles by: ▪ Gas bubble trap ▪ Creating counterpressure (orifice plate) ▪ Measurement in bypass
	Flow rate too high (can lead to bubble formation)	Reduce flow rate or select less turbulent mounting location
	Voltage potential in medium (only for conductive)	Ground medium close to sensor
	Sensor fouling or buildup on sensor	Clean sensor

Problem	Possible cause	Tests and/or remedial measures
Fluctuations in measured value	Interference on signal output cable	Check cable routing, possibly route cable separately
	Interference potential in medium	Eliminate source of interference or ground medium as close as possible to sensor.
	Interference on measuring cable	Connect cable shield as per wiring diagram
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer
Fixed current output signal	Current simulation active	Switch off simulation
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference

17.1.3 Oxygen measurement

Problem	Possible cause	Tests and/or remedial measures
Display value - - - -	Sensor defective	Test with a new sensor
	Sensor cable disconnected	Check the cable or cable extension
	Incorrect sensor connection	Check connection at input module (→ 🖹 8)
	Electronics module defective	Replace module
No or slow change of readings	▪ Sensor fouled ▪ Sensor old	Clean sensor Where necessary, replace the electrolyte, membrane cap (amperometric sensor) or fluorescence cap (optical sensor)
Constant, incorrect measured value	Device in impermissible operating condition (does not respond when key pressed)	Switch off device and switch it on again
Measured value too low	Membrane soiled	Clean sensor or replace cap
	Electrolyte used up or contaminated	Replace the electrolyte
	Anode coating worn	Repolarize sensor
	Black anode coating	Regenerate sensor in factory
Measured value too high	Air pocket under membrane	Clean sensor, optimize installation where necessary
	Polarization not complete	Wait for polarization time to finish (→ Techn. data the Operating Instructions of the sensor)
Implausible measured value	Incorrect temperature measurement	Check/correct value
	Incorrect altitude setting	Incorrect calibration Reconfigure and repeat calibration
	Incorrect air pressure	
Incorrect temperature value	Sensor defective	Change sensor
	Incorrect sensor connection	Check input module (→ 🖹 8)

Problem	Possible cause	Tests and/or remedial measures
Fluctuations in measured value	Interference on signal output cable	Check cable routing, possibly route cable separately
	Interference potential in medium	Eliminate source of interference or ground medium as close as possible to sensor.
	Interference on measuring cable	Connect cable shield as per wiring diagram
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer
Fixed current output signal	Current simulation active	Switch off simulation
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference

17.1.4 Measurement of disinfection parameters

Problem	Possible cause	Tests and/or remedial measures
Display value - - - -	Sensor defective	Test with a new sensor
	Sensor cable disconnected	Check the cable or cable extension
	Incorrect sensor connection	Check connection at input module (→ 🖹 8)
	Electronics module defective	Replace module
Slope too low	Sensor was in chlorine-free water or in air	Short conditioning over (not in!) chlorine bleach Wait for adjustment time in water to elapse before calibration
No match with DPD control measurement	Measurement takes place without pH compensation, while DPD measurement is always buffered to pH 6.3.	Measure chlorine value pH-compensated
DPD measured value much too high	Organic chlorination agent used (may also be used only at times or for shock chlorination). In this case, no correlation between actual free chlorine, DPD measurement and amperometric measurement. DPD value too high by a factor of up to 5.	Use free (gaseous) chlorine or chlorine from inorganic chlorine compounds
Chlorine value too high	Membrane defective	Replace membrane cap
	Polarization not complete	Wait for polarization time to finish
	Foreign oxidizing agent	Analyze medium
	Shunt in chlorine sensor	Replace sensor
Chlorine value too low	Measuring chamber not closed	Refill and screw closed carefully
	Air cushion outside in front of membrane	Remove air bubble, possibly select better installation position
	Air cushion inside membrane	Refill and screw closed so that it is bubble-free
No or slow change of readings	Sensor fouled	Clean sensor
	Sensor old	Replace sensor
	Sensor defective (reference lead)	Replace sensor

Problem	Possible cause	Tests and/or remedial measures
Constant, incorrect measured value	Sensor does not immerse properly or protection cap not removed	Check installation position, remove protection cap
	Air pockets in assembly	Check assembly and installation position
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer
Fixed current output signal	Current simulation active	Switch off simulation
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference

17.1.5 Turbidity, SAC and nitrate measurement

Problem	Possible cause	Tests and/or remedial measures
Display value - - - -	Sensor defective	Test with a new sensor
	Sensor cable disconnected	Check the cable or cable extension
	Incorrect sensor connection	Check connection at input module (→ 🖹 8)
	Electronics module defective	Replace module
No or slow change of readings	Sensor fouled	Clean sensor
Constant, incorrect measured value	Device in impermissible operating condition (does not respond when key pressed)	Switch off device and switch it on again
Implausible measured value	Sensor not calibrated or incorrectly calibrated	Calibration with original sample might be necessary for concentration or solids content
	Sensor fouled	Clean sensor
	Sensor installed in "dead zone" or air pocket in assembly or flange	Check installation position, move sensor to area that receives good flow. Pay attention when mounting in horizontal pipes
	Incorrect sensor orientation	Align sensor: ▪ Normal media: Direct flow to measuring window ▪ For high solids content: Align measuring window at angle of 90° to flow
Incorrect temperature value	Sensor defective	Change sensor
	Incorrect sensor connection	Check input module (→ 🖹 8)
Fluctuations in measured value	Interference on signal output cable	Check cable routing, possibly route cable separately
	Irregular flow / turbulence / air bubbles / large solid particles	Select a better mounting location or reduce turbulence, use a large measured value damping factor if necessary
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer

Problem	Possible cause	Tests and/or remedial measures
Fixed current output signal	Current simulation active	Switch off simulation
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference
Value switches to zero and back to measured value	Air bubbles	Do not mount sensor above aeration discs

17.1.6 Interface measurement

When troubleshooting, the entire measuring point must be taken into account:
- Transmitter
- Electrical connections and cables
- Assembly
- Sensor

The possible causes of errors in the following table refer primarily to the sensor.

Display	Check	Remedial action
Blank display, no sensor reaction	▪ Mains voltage connected to the transmitter ▪ Sensor connected correctly ▪ Deposit buildup on sensor membrane ▪ Check sensor/channel configuration	▪ Apply mains voltage ▪ Make the right connection ▪ Clean sensor ▪ Assign sensor
Display value too high or too low	▪ Basin configuration ▪ Check sensor installation	Configure sensor
Display value fluctuating greatly	▪ Check mounting location ▪ Deposit buildup on sensor membrane ▪ Basin configuration	▪ Select a different mounting location ▪ Clean sensor ▪ Configure sensor

Pay attention to the troubleshooting information in the Operating Instructions for the transmitter. Check the transmitter if necessary.

17.1.7 Measurement with ion-selective sensors

Problem	Possible cause	Tests and/or remedial measures
Temperature value always 20 °C or incorrect	▪ Temperature sensor not connected or connected incorrectly ▪ Temperature sensor defective ▪ Cable to temperature sensor defective	Check temperature sensor and replace where necessary Replace the cable
Display deviates from reference measurement	Incorrect calibration	Repeat calibration Where necessary, check the calibration with the reference device and repeat.
	Electrode connected to the wrong slot	Compare terminal assignment to setting on transmitter
	Electrode is contaminated	Clean the electrode
	Temperature measurement	Check the temperature measured values of both devices
	Temperature compensation	Check the settings for temperature compensation and adjustment for both devices
	pH compensation (only for ammonium), pH measurement	Check the settings and the pH measurement if necessary
No or slow change of readings	▪ Electrodes fouled ▪ Electrodes too old ▪ Electrodes defective	▪ Clean the electrodes ▪ Replace membrane cap and electrolyte ▪ Replace the electrodes
Measured value drift	Reference of pH electrode defective	Replace the pH electrode
	Contamination of reference electrode or ion-selective electrodes	Application problem
Measuring chain zero-point not stable and cannot be adjusted	Sensor does not immerse properly or protection cap of the pH electrode not removed	Check installation position, remove protection cap
	Air bubble in the electrode between membrane and inner terminal leads	Tap the electrolyte in the electrode towards the membrane
	Membrane cap or electrode defective	Replace the membrane cap or electrode
	Electrodes contaminated	Test with new electrodes
	Reference of pH electrode used	Replace the pH electrode
	Electrode connected to the wrong slot	Compare terminal assignment to setting on transmitter
Display fluctuates greatly	Air bubbles in the electrodes	Tap the electrolyte in the electrode towards the membrane
Fluctuations in measured value	Interference on signal output cable	Check cable routing, possibly route cable separately
	Interference potential in medium	Eliminate source of interference or ground medium as close as possible to sensor.
No current output signal	Cable disconnected or short-circuited	Disconnect cable and measure directly at device
	Output defective	→ "Device-specific errors" in the Operating Instructions of the transmitter, sampler, analyzer
Fixed current output signal	Current simulation active	Switch off simulation

Problem	Possible cause	Tests and/or remedial measures
Incorrect current output signal	Total load in current loop too high	Measure the load and reduce it to the permitted value if necessary (→ "Technical data" in the Operating Instructions of the transmitter, sampler, analyzer)
	EMC (interference coupling)	Check the wiring, identify and eliminate cause of interference

17.1.8 Spectrometer

When troubleshooting, the entire measuring point must be taken into account:
- Transmitter
- Electrical connections and cables
- Assembly
- Spectrometer

The possible causes of error in the following table relate mainly to the spectrometer.

Problem	Check	Remedial action
Nothing displayed, no reaction from the spectrometer	▪ Mains voltage at transmitter? ▪ Current transmitter software incorporated? ▪ Spectrometer connected correctly? ▪ Buildup on optical windows?	▸ Connect mains voltage. ▸ Perform software update. ▸ Establish correct connection. ▸ Clean the spectrometer.
Display value too high or too low	▪ Buildup on optical windows? ▪ Spectrometer calibrated?	▸ Clean the windows. ▸ Calibrate the spectrometer.
Display value fluctuating greatly	▪ Air bubbles in the measurement gap? ▪ Is the mounting location correct?	▸ Clean the windows. ▸ Select a different mounting location. ▸ Adjust measurement filter.
Measured value drift	Buildup on optical windows?	▸ First clean the spectrometer. ▸ Record the reference spectrum.

Pay attention to the troubleshooting information in the Operating Instructions for the transmitter. Check the transmitter if necessary.

17.1.9 Fluorescence measurement

When troubleshooting, the entire measuring point must be taken into account:
- Transmitter
- Electrical connections and cables
- Sensor

The possible causes of error in the following table refer primarily to the sensor.

Problem	Check	Remedial action
Blank display, no sensor reaction	▪ Line voltage at transmitter? ▪ Sensor connected correctly? ▪ Buildup on optical windows?	▸ Connect mains voltage. ▸ Establish correct connection. ▸ Clean sensor.
Display value too high or too low	▪ Buildup on optical windows? ▪ Sensor calibrated?	▸ Clean device. ▸ Calibrate device.
Display value fluctuating greatly	Is the mounting location correct?	▸ Select a different mounting location. ▸ Adjust measured value filter.

Pay attention to the troubleshooting information in the Operating Instructions for the transmitter. Check the transmitter if necessary.

17.2 Overview of diagnostic information

17.2.1 Device-specific diagnostic messages

Operating Instructions of the transmitter, sampler or analyzer

17.2.2 Sensor-specific diagnostic messages

The following abbreviations for the various sensor types are used in the table:
- P ... pH/ORP (general, applies for all pH sensors)
  - P (glass) ... only applies for glass electrodes
  - P (ISFET) ... only applies for ISFET sensors
- C ... conductivity (general, applies for all conductivity sensors)
  - C (cond.) ... only applies for sensors with conductive measurement of conductivity
  - C (ind.) ... only applies for sensors with inductive measurement of conductivity
- O ... oxygen (general, applies for all oxygen sensors)
  - O (opt.) ... only applies for optical oxygen sensors
  - O (amp.) ... only applies for amperometric oxygen sensors
- N ... nitrate sensors
- T ... turbidity and solids sensors
- S ... SAC sensors
- U ... interface sensors
- I ... ion-selective sensors
- DI ... disinfection sensors
- SC ... spectrometer for water analysis
- FL ... sensors for fluorescence measurement

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
002	Sensor unknown	F	On	On	All	▸ Replace sensor.
004	Sensor defective	F	On	On	All	
005	Sensor data invalid	F	On	On	All	1. Check the firmware compatibility of the sensor and transmitter or load suitable firmware 2. Set the sensor to the factory settings, disconnect the sensor and reconnect it. 3. Update transmitter data 4. Replace sensor.
010	Sensor scanning	F	Off	On	All	▸ Wait for initialization to be finished.
012	Writing data failed	F	On	On	All	1. Repeat write process. 2. Replace sensor.
013	Sensor type wrong	F	On	On	All	Sensor does not suit the device configuration or device configuration must be changed to new type of sensor 1. Change to a sensor of the type that is configured. 2. Adapt the device configuration to the connected sensor.
018	Sensor not ready	F	On	On	All	Sensor communication blocked 1. Sensor fails tag check. Replace. 2. Internal software error. Contact the Service Department.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
022	Temperature sensor	F	On	On	P, C, O, I, DI, SC, FL	Temperature sensor defective ▶ Replace sensor.
061	Sensor electronic	F	On	On	All	Sensor electronics defective ▶ Replace sensor.
062	Sensor connection	F	On	On	All	1. Check sensor connection. 2. Contact Service Department.
081	Initialization	F	On	On	All	▶ Wait for initialization to be finished.
100	Sensor communication	F	On	On	All	Sensor not communicating 1. Check sensor connection. 2. Check sensor connector. 3. Contact Service Department.
101	Sensor incompatible	F	On	On	All	1. Update sensor firmware 2. Replace sensor. 3. Contact Service Department.
102	Calibration timer	M	On	Off	All except SC, FL	Calibration interval elapsed. Measurement can still take place. ▶ Calibrate sensor.
103	Calibration timer	M	On	Off	All except SC, FL	Calibration interval will elapse soon. Measurement can still take place. ▶ Calibrate sensor.
104	Calibration validity	M	On	Off	All	Last calibration no longer valid. Measurement can still take place. ▶ Calibrate sensor.
105	Calibration validity	M	On	Off	All	Last calibration will lose its validity soon. Measurement can still take place. ▶ Calibrate sensor.
106	Sensor TAG	F	On	On	All	Sensor has invalid tag or tag group
107	Calibration active	C	On	Off	P, C, O, I, DI	▶ Wait for calibration to be finished.
108	SIP, CIP, autoclaving	M	On	Off	P, C, O	Specified number of sterilizations will soon be reached. Measurement can still take place. ▶ Replace sensor.
109	SIP, CIP, autoclav cap	M	On	Off	O (amp.)	Specified number of sterilizations for the cap is reached. Measurement can still take place. ▶ Replace membrane cap.
110	Init. channel	F	On	On	All except SC	Channel initialization has failed. Measuring operation not possible. ▶ Contact Service Department.
111	Operating time cap	M	On	Off	DI	Hours of operation monitoring The limit set for the total hours of operation for the cap has been reached. Measurement can still take place. 1. Replace the cap. 2. Change monitoring limit.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
113	Incompatible filter	F	On	On	O (opt)	Incompatible filter setting in the sensor 1. Switch to valid measurement filter (sensor settings). 2. Update the device firmware. 3. Contact Service Department.
114	Temp.offset high	M	On	Off	All except U, SC, FL	Calibration alarm: Limit values for temperature offset exceeded 1. Check temperature sensor. 2. Replace sensor.
115	Temp. offset low	M	On	Off	All except U, SC, FL	
116	Temp. slope high	M	On	Off	All except U, SC, FL	Calibration alarm: Limit values for temperature slope exceeded Sensor old or defective 1. Repeat calibration. 2. Replace sensor.
117	Temp. slope low	M	On	Off	All except U, SC, FL	
118	Sensor glass break.	F	On	Off	P (glass)	Glass breakage warning, impedance of pH glass too low Measuring can continue until the alarm (118) occurs. 1. Inspect sensor for hair-line cracks and breakage. 2. Check medium temperature. 3. Replace sensor.
119	Sensor check	M	On	Off	P (glass)	
120	Sensor reference	F	On	Off	P (glass)	Reference warning, impedance of reference too low Measuring can continue until the alarm (120) occurs. 1. Check reference for clogging/ contamination. 2. Clean reference/junction. 3. Replace sensor.
121	Sensor reference	M	On	Off	P (glass)	
122	Sensor glass	F	On	Off	P (glass)	Impedance limit values exceeded/ undershot Measuring can continue until the alarm (122, 124) occurs. 1. Inspect sensor for hair-line cracks and breakage. 2. Check or change limit values. 3. Replace sensor.
123	Sensor glass	M	On	On	P (glass)	
124	Sensor glass	M	On	Off	P (glass)	
125	Sensor glass	F	On	Off	P (glass)	
126	Sensor check	M	On	Off	P (glass)	Sensor condition check (SCC), poor sensor condition Glass membrane fouled or dry, junction blocked 1. Clean sensor, regenerate 2. Replace sensor.
127	Sensor check	M	On	Off	P (glass)	Sensor condition check (SCC), adequate sensor condition
128	Sensor leakage	F	On	Off	P (ISFET), O (amp.), DI	Leak current alarm Defective due to abrasion or damage Damage to the gate (only ISFET) ▶ Replace sensor.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
129	Sensor leakage	F	On	Off	P (ISFET), O (amp.), DI	Leak current warning Measuring can continue until the alarm occurs
130	Sensor supply	F	On	Off	P, O, I, DI	Poor sensor power supply 1. Check sensor connection. 2. Replace sensor.
131	Sensor calibration	M	On	Off	O (opt.)	Limit values for sensor relaxation time (fluorescence decay time) exceeded/ undershot Reasons: high oxygen content, incorrect calibration 1. Repeat calibration. 2. Replace sensor cap. 3. Contact Service Department.
132	Sensor calibration	M	On	Off	O (opt.)	
133	Sensor signal	F	On	Off	O (opt.)	No signal (fluorescence decay) 1. Replace sensor cap. 2. Contact Service Department.
134	Sensor signal	M	On	Off	O (opt.)	Low signal amplitude. Measurement can still take place. 1. Replace sensor cap. 2. Contact Service Department.
135	Sensor temp. low	S	On	Off	O	Temperature outside specification 1. Check process. 2. Check installation.
136	Sensor temp. high	S	On	Off	O	
137	Sensor LED	F	On	Off	O (opt.)	Sensor LED: no voltage ▶ Contact Service Department.
138	Sensor LED	F	On	Off	O (opt.)	Sensor LED: no power ▶ Contact Service Department.
140	Sensor check	F	On	Off	O	Sensor range errors ▶ Contact Service Department.
141	Polarization	F	On	Off	C (cond.)	Polarization warning The measured value is corrupted at high conductivity levels. ▶ Use a sensor with a larger cell constant.
142	Sensor signal	F	On	Off	C	Reasons: sensor in air, sensor defective 1. Check installation. 2. Replace sensor.
143	Sensor check	F	On	Off	C	Sensor self-test error 1. Replace sensor. 2. Contact Service Department.
144	Conductivity range	S	Off	On	C	Conductivity outside measuring range ▶ Use a sensor with a suitable cell constant.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
146	Sensor temperature	S	Off	Off	C, N, T, S, FL	Temperature outside specification 1. Check the temperature. 2. Check electrode system. 3. Replace sensor type.
147	Sensor check	F	On	On	C (ind.)	Coil transmission current too high Reasons: transmission coil short-circuit, inductance too low 1. Replace sensor. 2. Contact Service Department.
148	Sensor check	F	On	On	C (ind.)	Reasons: transmission coil interrupted, inductance too high 1. Replace sensor. 2. Contact Service Department.
149	Sensor LED	F	On	On	T	Sensor LED error 1. Replace sensor. 2. Contact Service Department.
151	Sensor buildup	F	On	On	T	Buildup, high degree of contamination 1. Clean sensor. 2. Replace sensor. 3. Contact Service Department.
152	Sensor data invalid	M	Off	Off	C (ind.)	No calibration data ► Perform air set calibration.
153	Sensor defective	F	On	On	N, T, S	Sensor strobe lamp defective Reasons: aging, end of operating life, mechanical disturbance/vibration 1. Replace sensor. 2. Contact Service Department.
154	Sensor data invalid	M	Off	Off	C	Factory calibration is used ► Calibrate.
155	Sensor defective	F	On	On	N, T, S	Sensor defective Error with analog evaluation 1. Replace sensor. 2. Contact Service Department.
156	Organic pollution	F	On	On	N, T, S	Excessive organic fouling Reasons: sensor fouling, high organic content, incorrect orientation 1. Clean sensor 2. Install automatic cleaning. 3. Check application.
157	Filter change	M	On	Off	N, S	Optical filter must be replaced Reasons: long period of operation, moisture in sensor 1. Replace sensor. 2. Contact Service Department.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
158	Sensor check	F	On	Off	N, T, S	Invalid measured value 1. Check sensor power supply. 2. Restart the device. 3. Contact Service Department.
159	Sensor check	F	On	Off	N, T, S	Uncertain measured value Reasons: sensor fouling, incorrect application 1. Clean sensor. 2. Check application.
160	Sensor data invalid	F	On	Off	N, T, S, DI, SC, FL	No calibration data Reasons: data deleted 1. Select other data record. 2. Use factory calibration. 3. Contact Service Department.
161	Filter change	F	On	Off	N, T, S	Filter needs to be changed Reasons: long period of operation, moisture in sensor 1. Replace sensor. 2. Contact Service Department.
162	Install.factor	M	On	Off	C (ind.)	Installation factor exceeded/undershot, alarm Reason: distance between wall and sensor too small (< 15 mm) 1. Check pipe diameter. 2. Clean sensor. 3. Calibrate sensor.
163	Install.factor	M	On	Off	C (ind.)	
164	Sensor data invalid	M	Off	Off	C	No temperature calibration data Factory calibration is used 1. Check process. 2. Check or replace sensor.
168	Polarization	S	On	Off	C (cond.)	Polarization warning The measured value is corrupted at high conductivity levels. ▶ Use a sensor with a larger cell constant.
169	Operating time	M	On	Off	S	Operating hours, conc. > 200 mg/l, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
170	Operating time	M	On	Off	S	Operating hours, conc. < 50 mg/l, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
171	Lamp change	M	On	Off	N, T, S, SC	Lamp change recommended ▶ Contact the Service Department to have the lamp replaced.
172	Echo lost	F	On	On	U	Echo signal lost
173	Sludge level	F	On	On	U	Incorrect separation zone measurement ▶ Replace sensor.
174	Turbid. failure	F	On	On	U	Incorrect turbidity measurement ▶ Replace sensor.
175	Wiper failure	F	On	On	U	Wiper not working ▶ Clean or replace sensor.
176	Operating time	M	On	Off	DI	Operating hours > 100 nA, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
177	Operating time	M	On	Off	DI	Operating hours > 20 nA, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
178	Operating time	M	On	Off	DI	Operating hours > 15 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
179	Operating time	M	On	Off	P	Operating hours > 300 mV, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
180	Operating time	M	On	Off	P	Operating hours < -300 mV, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
181	Operating time	M	On	Off	O (opt.)	Operating hours < 25 µS, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
182	Operating time	M	On	Off	O (opt.)	Operating hours > 40 µS, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
183	Operating time	M	On	Off	O (amp.)	Operating hours > 10 nA (COS51D), measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
184	Operating time	M	On	Off	O (amp.)	Operating hours > 30 nA (COS22D), measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
185	Operating time	M	On	Off	O (amp.)	Operating hours > 40 nA (COS51D), measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
186	Operating time	M	On	Off	O (amp.)	Operating hours > 160 nA (COS22D), measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
187	Operating time	M	On	Off	C	Operating hours > 80 °C, 100 nS/cm, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
188	Operating time	M	On	Off	C, O	Operating hours < 5 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
189	Operating time	M	On	Off	O	Operating hours > 5 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
190	Operating time	M	On	Off	O	Operating hours > 25 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
191	Operating time	M	On	Off	O, I, DI	Operating hours > 30 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
192	Operating time	M	On	Off	O, I	Operating hours > 40 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
193	Operating time	M	On	Off	P, C, O	Operating hours > 80 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
194	Operating time	M	On	Off	P	Operating hours > 100 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
195	Operating time	M	On	Off	C	Operating hours > 120 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
196	Operating time	M	On	Off	C	Operating hours > 125 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
197	Operating time	M	On	Off	C	Operating hours > 140 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
198	Operating time	M	On	Off	C	Operating hours > 150 °C, measurement can still take place 1. Replace sensor. 2. Change monitoring limit. 3. Disable monitoring.
199	Operating time	M	On	Off	All except U	The limit set for the total operating hours has been reached. Measurement can still take place. 1. Replace sensor. 2. Change monitoring limit.
215	Simulation active	C	On	Off	All, except FL	Simulation active End simulation by changing to measuring mode.
408	Calibration aborted	M	Off	Off	P, C, O, I, DI	Calibration aborted

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
500	Sensor calibration	M	On	Off	All, except SC, FL	Calibration aborted, main measured value varies Reasons: sensor too old, sensor occasionally dry, calibration value not constant 1. Check sensor. 2. Check calibration solution.
501	Sensor calibration	M	On	Off	All except U, SC, FL	Calibration aborted, temperature measured value varies Reasons: sensor too old, sensor occasionally dry, temperature of calibration solution not constant 1. Check sensor. 2. Regulate calibration solution temperature.
505	Sensor calibration	M	On	Off	P, O, I, DI	Max. zero point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
507	Sensor calibration	M	On	Off	P, O, I, DI	Min. zero point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
509	Sensor calibration	M	On	Off	P, O, I, DI	Min. slope warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
511	Sensor calibration	M	On	Off	P, O, I, DI	Max. slope warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
513	Zero warning	M	On	Off	O (amp.), DI	Zero point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
515	Sensor calibration	M	On	Off	P (ISFET)	Max. operating point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
517	Sensor calibration	M	On	Off	P (ISFET)	Min. operating point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
518	Sensor calibration	M	On	Off	P, O, I, DI	Delta slope warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
520	Sensor calibration	M	On	Off	P, O, I, DI	Delta zero point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
522	Sensor calibration	M	On	Off	P (ISFET)	Delta operating point warning, measurement can still take place Possible reasons: sensor old or defective, reference blocked, calibration solution too old or contaminated 1. Check or replace sensor. 2. Check or replace calibration solution. 3. Repeat calibration.
534	Electrolyte warning	M	On	Off	DI	Electrolyte consumption warning The limit set for the electrolyte capacity has been reached. 1. Replace electrolyte. 2. Reset consumption counter. 3. Replace sensor.
535	Sensor check	M	On	Off	O (amp.), DI	Specified number of cap calibrations is reached Measurement can still take place. ▶ Replace sensor cap.
550	Process temperature	S	On	On	C	Process temperature above/below concentration table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
551	Process temperature	S	On	On	C	
552	Conductivity low	S	On	On	C	Process concentration above/below concentration table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
553	Conductivity high	S	On	On	C	
554	Concentration low	S	On	On	C	Process concentration above/below concentration table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
555	Concentration high	S	On	On	C	
556	Temperature low	S	On	On	C	Process temperature above/below compensation table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
557	Temperature high	S	On	On	C	
558	Conductivity low	S	On	On	C	Process conductivity above/below compensation table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
559	Conductivity high	S	On	On	C	
560	Conduc. compensation	S	On	On	C	Conductivity compensation above/below compensation table ▪ Process value outside specifications ▪ Table incomplete ▶ Extend table.
561	Conduc. compensation	S	On	On	C	
566	Package incompatible	C	On	Off	SC	Incompatible model package ▶ Check the configuration of the assigned outputs, measuring settings and application calibration.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
720	Membrane change	M	On	Off	I	Membrane cap must be replaced 1. Replace membrane cap. 2. Reset timer.
722	Sensor reference	F	On	On	P	Alarm: Reference membrane impedance too low. 1. Check or replace sensor. 2. Check/correct reference limit value.
723	Sensor reference	M	On	Off	I	Warning: Reference membrane impedance too low. Can continue measuring until the alarm occurs. 1. Check or replace sensor. 2. Check/correct reference limit value.
724	Sensor reference	F	On	On	I	Alarm: Reference membrane impedance too high. 1. Check or replace sensor. 2. Check/correct reference limit value.
725	Sensor reference	M	On	Off	I	Warning: Reference membrane impedance too high. Can continue measuring until the alarm occurs. 1. Check or replace sensor. 2. Check/correct reference limit value.
734	Calibration quality	M	On	Off	O (opt.)	Warning: The calibration quality index indicates a substantial change since the last calibration. Measurement can still take place. 1. Repeat calibration. 2. Check the sensor and replace if necessary.
740	Sensor defective	F	On	On	C (only four-pin sensor)	Internal electrode failure 1. Replace sensor. 2. Contact Service Department.
771	Lamp change	F	On	Off	N, T, S, SC	Lamp change alarm Configured operating time has been reached ▶ Contact the Service Department to have the lamp replaced.
772	Lamp change	M	On	Off	SC	Lamp change warning Possible reasons: remaining lamp intensity low, lamp service life was not reset after lamp replacement 1. Replace lamp and reset lamp service life. 2. Contact Service Department.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
773	Lamp change	F	On	On	SC	Lamp change alarm Possible reasons: remaining lamp intensity low, lamp service life was not reset after lamp replacement 1. Replace lamp and reset lamp service life. 2. Contact Service Department.
774	Lamp defective	F	On	On	SC	Possible reasons: cable defective, lamp defective 1. Check cable. 2. Replace lamp. 3. Contact Service Department.
832	Temp. range exceeded	S	Off	Off	All except U, FL	Outside temperature specification 1. Check application. 2. Check temperature sensor.
841	Operating range	S	Off	Off	All except FL	Process value outside operational range 1. Check application. 2. Check sensor.
842	Process value	S	Off	Off	P	Process limit value exceeded/undershot Reasons: sensor in air, air pockets in assembly, incorrect flow to sensor, sensor defective 1. Change process value. 2. Check electrode system. 3. Change sensor type.
843	Process value	S	Off	Off	P	
844	Process value	S	Off	Off	N, T, S	Measured value outside specified range Reasons: sensor in air, air pockets in assembly, incorrect flow to sensor, sensor defective 1. Increase process value. 2. Check electrode system. 3. Change sensor type.
904	Process check alarm	F	On	On	All except Phot	Stagnating measuring signal Reasons: sensor in air, sensor fouling, incorrect flow to sensor, sensor defective 1. Check electrode system. 2. Check sensor. 3. Restart the device.
914	USP/ EP alarm	M	On	Off	C	USP limit values exceeded ▶ Check process.
915	USP / EP warning	M	On	Off	C	
934	Process temp. high	S	Off	Off	N, S, U, SC, FL	Process temperature high 1. Do not increase process temperature. 2. Check electrode system. 3. Change sensor type.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
935	Process temp. low	S	Off	Off	N, S, U, SC, FL	Process temperature low 1. Do not lower process temperature. 2. Check electrode system. 3. Change sensor type.
942	Process value	S	Off	Off	N, P, U	Process value high 1. Do not increase process value. 2. Check electrode system. 3. Change sensor type.
943	Process value	S	Off	Off	N, P, U	Process value low 1. Do not decrease process value. 2. Check electrode system. 3. Change sensor type.
944	Sensor range	S	On	Off	S, U, FL	Measurement at periphery of sensor dynamic range Reasons: changes in process to a higher or lower measuring range 1. Check application. 2. Use sensor that suits the measuring range of the application.
945	pH value high	S	On	Off	DI	Warning maximum pH value exceeded 1. Check application. 2. Check pH sensor.
946	pH value low	S	On	Off	DI	Warning minimum pH value not reached. Potential leaking of gaseous chlorine! 1. Check application. 2. Check pH sensor.
950	Process temperature	F	On	On	C	Concentration table (conductivity) Process temperature below the lowest value in the table ► Extend table.
951	Process temperature	F	On	On	C	Concentration table (conductivity) Process temperature above the highest value in the table ► Extend table.
952	Conductivity low	F	On	On	C	Concentration table (conductivity) Process conductivity below the lowest value in the table ► Extend table.
953	Conductivity high	F	On	On	C	Concentration table (conductivity) Process conductivity above the highest value in the table ► Extend table.
954	Concentration low	F	On	On	C	Concentration table (conductivity) Process concentration below the lowest value in the table ► Extend table.

No.	Message	Factory settings			Sensor type	Tests or remedial action
		S [1]	D [2]	F [3]		
955	Concentration high	F	On	On	C	Concentration table (conductivity) Process concentration above the highest value in the table ▶ Extend table.
983	Sensor ISE check	F	On	On	I	Electrode or membrane defective 1. Check or replace electrode. 2. Check or replace membrane cap.
984	Process temp. high	S	On	On	I	Temperature outside specification 1. Check process temperature. 2. Check electrode system.
985	Sensor Interface	F	On	On	I	Sensor interface error 1. Check connector. 2. Check or replace cable.
987	Calibration required	M	On	On	I, DI, SC	A calibration is required due to sensor maintenance.

1) **Status signal**
2) **Diagnostic message**
3) **Failure current**

17.2.3 Configuration options for troubleshooting

The table only lists the diagnostics messages that depend on your settings in the menu. The path where you can change the settings is specified in the table.
- The sensor type is only indicated if the message only applies to one type of sensor.
- If several types of sensor are affected, the abbreviation ../ is used for the path.

No.	Menu/Setup/Inputs/..
102	../**Extended setup/Calib. settings/Calibration timer**
103	../**Extended setup/Calib. settings/Calibration timer**
104	../**Extended setup/Calib. settings/Calib. expiration time/Alarm limit**
105	../**Extended setup/Calib. settings/Calib. expiration time/Warning limit**
108	../**Extended setup/Diagnostics settings/Sterilizations/Warning limit**
109	**Oxygen (amp.)/Extended setup/Diagnostics settings/Number of cap sterilizations/Warning limit**
111	**Disinfection/Extended setup/Diagnostics settings/Limits operating hours cap**
122	**pH Glass/Extended setup/Diagnostics settings/Glass impedance (SCS)/Lower alarm limit**
123	**pH Glass/Extended setup/Diagnostics settings/Glass impedance (SCS)/Lower warning limit**
124	**pH Glass/Extended setup/Diagnostics settings/Glass impedance (SCS)/Upper alarm limit**
125	**pH Glass/Extended setup/Diagnostics settings/Glass impedance (SCS)/Upper warning limit**
126	**pH Glass/Extended setup/Diagnostics settings/Sensor condition check**
127	**pH Glass/Extended setup/Diagnostics settings/Sensor condition check**
145	**pH Glass/Extended setup/Diagnostics settings/Sensor condition check**
157	**Nitrate/Extended setup/Diagnostics settings/Limits operating hours/Filter change**
168	**Cond c/Extended setup/Diagnostics settings/Polarization compensation**
169	**SAC/Extended setup/Diagnostics settings/Limits operating hours/Operation > 200 mg/l/Warning limit**

No.	Menu/Setup/Inputs/..
170	SAC/Extended setup/Diagnostics settings/Limits operating hours/Operation < 50 mg/l/Warning limit
176	Chlorine/Extended setup/Diagnostics settings/Limits operating hours/Operation > 100 nA/ Warning limit
178	Oxygen (amp.)/Extended setup/Diagnostics settings/Number of cap sterilizations/Alarm limit
179	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 300 mV/Warning limit
180	../Extended setup/Diagnostics settings/Limits operating hours/Operation < -300 mVWarning limit
181	Oxygen (opt. fixed cable)/Extended setup/Diagnostics settings/Limits operating hours/Operation < 25 µs/Warning limit
182	Oxygen (opt. fixed cable)/Extended setup/Diagnostics settings/Limits operating hours/Operation > 40 µs/Warning limit
183	Oxygen (amp.)/Extended setup/Diagnostics settings/Limits operating hours/Operation > 15 nA/ Warning limit
184	Oxygen (amp.)/Extended setup/Diagnostics settings/Limits operating hours/Operation > 30 nA/ Warning limit
185	Oxygen (amp.)/Extended setup/Diagnostics settings/Limits operating hours/Operation > 50 nA/ Warning limit
186	Oxygen (amp.)/Extended setup/Diagnostics settings/Limits operating hours/Operation > 160 nA/ Warning limit
187	Cond c/Extended setup/Diagnostics settings/Limits operating hours/Operation > 80°C < 100nS/cm/Warning limit
188	../Extended setup/Diagnostics settings/Limits operating hours/Operation < 5 °C/Warning limit
190	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 25 °C/Warning limit
192	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 40 °C/Warning limit
193	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 80 °C/Warning limit
194	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 100 °C/Warning limit
195	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 120 °C/Warning limit
196	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 125 °C/Warning limit
197	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 140 °C/Warning limit
198	../Extended setup/Diagnostics settings/Limits operating hours/Operation > 150 °C/Warning limit
199	../Extended setup/Diagnostics settings/Limits operating hours/Operating time/Warning limit
505	../Extended setup/Diagnostics settings/Zero point/Upper warning limit
507	../Extended setup/Diagnostics settings/Zero point/Lower warning limit
509	Oxygen (amp.)/Extended setup/Diagnostics settings/Slope/Lower warning limit
511	Oxygen (amp.)/Extended setup/Diagnostics settings/Slope/Upper warning limit
513	Oxygen (amp.)/Extended setup/Diagnostics settings/Zero point/Warning limit
515	pH ISFET/Extended setup/Diagnostics settings/Operating point/Upper warning limit
517	pH ISFET/Extended setup/Diagnostics settings/Operating point/Lower warning limit
518	../Extended setup/Diagnostics settings/Delta slope/Warning limit
520	../Extended setup/Diagnostics settings/Delta zero point/Warning limit
522	pH ISFET/Extended setup/Diagnostics settings/Delta operating point/Warning limit
535	Chlorine/Extended setup/Diagnostics settings/Number of calibrations cap/Warning limit
842	ORP/Extended setup/Diagnostics settings/ORP meas. value/Upper alarm limit
843	ORP/Extended setup/Diagnostics settings/ORP meas. value/Lower alarm limit
904	../Extended setup/Diagnostics settings/Process check system

No.	Menu/Setup/Inputs/..
942	ORP/Extended setup/Diagnostics settings/ORP meas. value/Upper warning limit
943	ORP/Extended setup/Diagnostics settings/ORP meas. value/Lower warning limit

17.3 Sensor information

▶ Select the channel you want from the list of channels.

Information in the following categories is displayed:
- **Extreme values**
  Extreme conditions to which the sensor was previously exposed, e. g. min./max. temperatures [1)]
- **Operating time**
  Operating time of the sensor under defined extreme conditions
- **Calibration information**
  Calibration data of the last calibration
- **Sensor specifications**
  Measuring range limits for main measured value and temperature
- **General information**
  Information on sensor identification

The specific data that are displayed depends on what sensor is connected.

1) Not available for all sensor types.

18 Maintenance

18.1 Cleaning digital sensors

⚠ CAUTION

Programs not switched off during maintenance activities.
Risk of injury due to medium or cleaning agent!
- ▶ Quit any programs that are active.
- ▶ Switch to the service mode.
- ▶ If testing the cleaning function while cleaning is in progress, wear protective clothing, goggles and gloves or take other suitable measures to protect yourself.

Replacing the sensor while ensuring measuring point availability

If an error occurs or the maintenance schedule stipulates that the sensor has to be replaced, use a new sensor, or a sensor that has been precalibrated in the laboratory.
- A sensor is calibrated in the laboratory under optimum external conditions, thereby ensuring better quality of measurement.
- You must perform onsite calibration if you use a sensor that is not precalibrated.

1. Pay attention to the safety instructions regarding the removal of the sensor that are provided in the Operating Instructions for the sensor.
2. Remove the sensor that requires maintenance.
3. Install the new sensor.
   ↳ The sensor data are automatically accepted by the transmitter. A release code is not required.
   Measurement is resumed.
4. Take the used sensor back to the laboratory.
   ↳ In the laboratory get the sensor ready for reuse while ensuring the availability of the measuring point.

Prepare the sensor for reuse

1. Clean sensor.
   ↳ For this purpose, use the cleaning agent specified in the sensor manual.
2. Inspect the sensor for cracks or other damage.
3. If no damage is found, regenerate the sensor. Where necessary, store the sensor in a regeneration solution (→ sensor manual).
4. Recalibrate the sensor for reuse.

18.2 Cleaning assemblies

Refer to the assembly operating instructions for information on servicing and troubleshooting the assembly. The assembly operating manual describes the procedure for mounting and disassembling the assembly, replacing the sensors and seals, and contains information on the material resistance properties, as well as on spare parts and accessories.

18.3 Performing a decade resistance test on digital inductive conductivity sensors

The inductive sensor cannot be simulated.

However, the overall system comprising the transmitter and inductive sensor can be tested using equivalent resistors. Note the cell constant k (e.g. $k_{nominal}$ = 1.98 cm^{-1} for CLS50D, $k_{nominal}$ = 6.3 cm^{-1} for CLS54D).

For accurate simulation, the actual cell constant used must be used to calculate the display value.

The formula for calculation also depends on the type of sensor:
- CLS50D: conductivity reading [mS/cm] = k[cm^{-1}] ·1/R[kΩ]
- CLS54D: conductivity reading [mS/cm] = k[cm^{-1}] ·1/R[kΩ] · 1.21

Simulation with CLS50D at 25 °C (77 °F):

Simulation resistance R	Default cell constant k	Conductivity reading
2 Ω	1.98 cm^{-1}	990 mS/cm
10 Ω	1.98 cm^{-1}	198 mS/cm
100 Ω	1.98 cm^{-1}	19.8 mS/cm
1 kΩ	1.98 cm^{-1}	1.98 mS/cm

Simulation with CLS54D at 25 °C (77 °F):

Simulation resistance R	Default cell constant k	Conductivity reading
10 Ω	6.3 cm^{-1}	520 mS/cm
26 Ω	6.3 cm^{-1}	200 mS/cm
100 Ω	6.3 cm^{-1}	52 mS/cm
260 Ω	6.3 cm^{-1}	20 mS/cm
2.6 kΩ	6.3 cm^{-1}	2 mS/cm
26 kΩ	6.3 cm^{-1}	200 µS/cm
52 kΩ	6.3 cm^{-1}	100 µS/cm

Conductivity simulation
Guide a suitable cable through the opening of the sensor (sensor coil). Then connect the cable to a decade resistor.

19 Calibration

- Sensors with Memosens protocol are calibrated at the factory.
- Users must decide whether the process conditions present require calibration during initial commissioning.
- Additional calibration is not required in many standard applications.

▶ Calibrate sensors at sensible intervals depending on the process.

19.1 Definitions

Calibration
(according to DIN 1319)
A calibration is defined as an operation to establish the relationship between the measured value or expected value of the output variable and the related true or correct value of the measured variable (input variable) for a measuring system under specified conditions.
A calibration does not alter the performance of the measuring device.

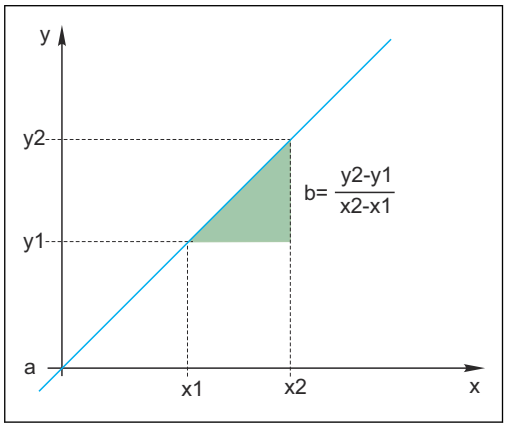
Adjustment
An adjustment corrects the value displayed by a measuring device, in other words the measured/displayed value (the actual value) is corrected so that the reading agrees with the correct, set value.
The value determined during calibration is used to calculate the correct measured value and saved in the sensor.

19.2 Terminology

19.2.1 Zero point and slope

Using a mathematical function, the transmitter converts the input signal of the sensor y (raw measured value) to the measured value x. In many cases, this function is a simple linear function with the form $y = a + b \cdot x$.

The linear element "a" is usually equivalent to the zero point and the factor "b" is the slope of the line and is often known as the sensor slope.



The Nernst equation, which is used to calculate the pH value, is a typical linear relationship:

$$U_i = U_0 - \frac{2.303\ RT}{F}\ pH$$

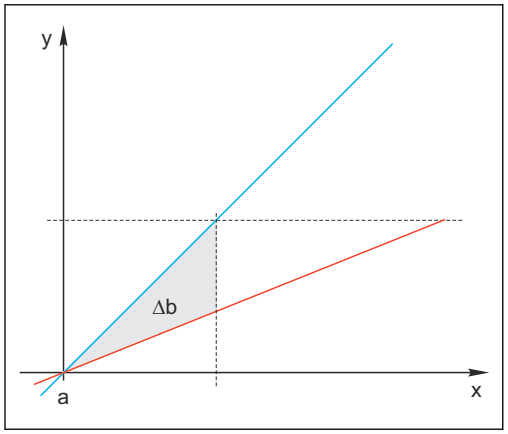
pH = -lg(a_{H+}), a_{H+} ... activity of the hydrogen ions
U_i ... raw measured value in mV
U_0 ... zero point (=voltage at pH 7)
R ... universal gas constant (8.3143 J/molK)
T ... temperature [K]
F ... Faraday constant (26.803 Ah/mol)

The slope of the Nernst equation (-2.303RT/F) is known as the **Nernst factor** and has the value -59.16 mV/pH at 25 °C (298 K).

19.2.2 Delta slope

The device determines the difference in the slope between the calibration currently valid and the last calibration. Depending on the sensor type, this difference is an indicator of the condition of the sensor. The smaller the slope, the less sensitive the measurement, and the accuracy deteriorates particularly in the low measuring range.

Depending on the operating conditions, users can define limit values that represent the still tolerable absolute values of the slope and/or slope differentials. If the limit values are exceeded, maintenance must be performed on the sensor at the very least. The sensor must be replaced if the insensitivity problems persist after maintenance has been carried out.



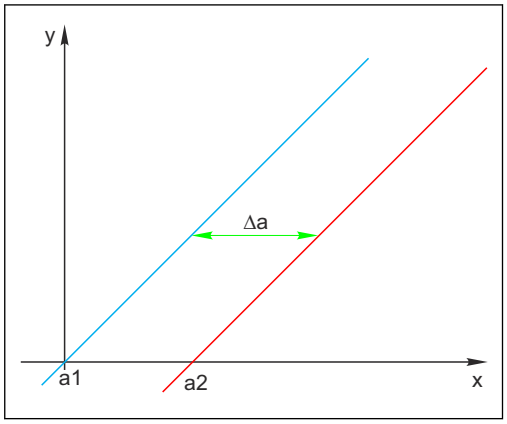
31 Delta slope

BU Last calibration
RD Current calibration
Δb Delta slope

19.2.3 Delta zero point

The device determines the difference between the zero points or operating points (ISFET sensor) of the last and second-last calibration. A shift in the zero point or operating point (= offset) does not alter the sensitivity of the measurement. However, if the offset is not corrected this can falsify the measured value.

As with the slope, you can also define and monitor limit values for the offset. If the limit values are exceeded, this means that maintenance must be performed on the sensor. For example, you may have to eliminate a blockage in the reference for the pH sensor.



32 *Delta zero point/operating point*

a1 *Zero point/operating point, penultimate calibration*
a2 *Zero point/operating point, last calibration*
Δa *Delta zero point/operating point*

19.3 Calibration instructions

The following rules apply for all parameters:

1. Calibrate in a way that reflects conditions in the process.

- If the process medium is constantly moving, also move the calibration solution accordingly (e.g. use a magnetic stirrer if calibrating in the laboratory).
- If your medium is relatively stationary, calibrate in solutions that are also stationary.

2. Always make sure that the samples are homogeneous for reference measurements, sample calibration etc.
3. Avoid changes in the medium samples resulting from ongoing biological activity. **Example:** Use outlet water instead of a sample from the aeration basin for nitrate calibration.
4. Use the same menu settings as those in the process to perform the calibration. **Example:** If you automatically compensate for the temperature effect during pH measurement, switch on automatic temperature compensation for the calibration also.

It is advisable to perform the laboratory calibration using the "Memobase Plus" (→ 222)database software. This improves the availability of your measuring points and all the calibration and sensor data records are stored securely in the database.

19.4 pH sensors

19.4.1 Calibration intervals

The service life of a pH glass electrode is limited. This is due, in part, to the deterioration and aging of the pH-sensitive membrane glass. This aging causes the gel-like layer to change and become thicker over time.

Symptoms of aging include:
- Higher membrane resistance
- Slow response
- Decrease in the slope

A change in the reference system (e.g. due to contamination, i.e. unwanted redox reactions at the reference electrode) or electrolyte solution dissolving away in the reference half cell can change the reference potential, which, in turn, causes a zero point shift in the measuring electrode.

To ensure a high level of accuracy, it is important to readjust the pH sensors at set intervals.

The calibration interval depends heavily on the area of application of the sensor, as well as the required level of accuracy and reproducibility. The calibration interval can vary between daily and once every few months.

Defining the calibration interval for the process

1. Check sensor using a buffer solution, e.g. pH 7.
   ↳ Proceed as specified in Step 2 only if the value deviates from the set point. No calibration/adjustment is necessary if the value is within the defined deviation tolerance range (→ Technical Information for the sensor).
2. Calibrate and adjust the sensor.
3. After 24 hours, check again with the buffer solution.
   ↳ a) If the deviation is within the permitted tolerance range, increase the test interval by doubling it, for example.
   b) If the deviation is larger, you must shorten the interval.
4. Continue to proceed as defined in Steps 2 and 3 until you have identified the appropriate interval for your sensor.

Monitoring the calibration

- Define the limit values for monitoring the slope and zero point differences: **Menu/Setup/Inputs/pH/Extended setup/Diagnostics settings/Delta slope** or **Delta zero point** (**Delta operating point**).
  ↳ These limit values depend on the process and must be determined by empirical means.

During calibration a diagnostics message is displayed if the defined warning limits have been exceeded. You then have to service the sensor, e.g. by cleaning the sensor or reference, or by regenerating the glass membrane.

You have to replace the sensor if warning messages continue to be displayed despite the maintenance measure.

Monitoring the calibration interval

You can also allow the device to monitor the calibration intervals for your process.

- **Menu/Setup/Inputs/pH/Extended setup/Calib. settings/Calib. expiration time**
  ↳ Set time limits to specify how long a calibration should be regarded as valid. Memosens sensors save all the calibration data. In this way it is easy to see whether the last calibration took place in the specified timeframe and is therefore still valid. This is particularly advantageous when working with precalibrated sensors.

19.4.2 Types of calibration

The following types of calibration are possible:
- Two-point calibration
  With calibration buffers
- One-point calibration
  - Entry of an offset or a reference value
  - Sample calibration with laboratory comparative value
- Data entry
  Entry of the zero point, slope and temperature
- Temperature adjustment by entering a reference value

In the case of a combined sensor (CPS16E/CPS76E/CPS96E), you must calibrate both the pH and the ORP electrode to obtain reliable rH values.

19.4.3 Two-point calibration

Applications and requirements

Two-point calibration is the preferred method for pH sensors, particularly in the following applications:
- Municipal and industrial wastewater
- Natural waters and drinking water
- Boiler feedwater and condensates
- Beverages

Calibrating with buffers with pH 7.0 and 4.0 is recommended for most applications.

Alkaline buffer solutions have the disadvantage that carbon dioxide from the air can alter the pH value of the buffer on the long term. If calibrating with alkaline buffers it is best to do so in closed systems, such as flow assemblies or retractable assemblies with a rinse chamber, to minimize the effect of air.

You use calibration buffers to perform two-point calibration. The quality buffers supplied by Endress+Hauser are certified and measured in an accredited laboratory. The accreditation (DAR registration number "DKD-K-52701") confirms that the actual values and the maximum deviations are correct and traceable.

With calibration buffers

To calibrate the sensor, remove it from the medium and calibrate it in the laboratory. Since Memosens sensors save the data, you can always work with "precalibrated" sensors and do not have to stop monitoring the process to perform a calibration.

1. Open the menu: **CAL/pH Glass** or **pH ISFET/2-pnt. calibration**.
2. Follow the instructions of the software.
3. **After** you have immersed the sensor in the first buffer and the measured value has stabilized, press **OK**.
   ↳ The system starts calculating the measured value for the first buffer. Once the stability criterion is met, the measured value is displayed in mV.
4. Continue to follow the instructions.
5. **After** you have immersed the sensor in the second buffer and the measured value has stabilized, press **OK**.
   ↳ The system starts calculating the measured value for the second buffer. Once the stability criterion is met, the measured values of the two buffers and the calculated values for the slope and zero point are displayed.
6. Respond to the prompt to accept the calibration data for adjustment.
7. Return the sensor to the medium and press **OK** again.
   ↳ This deactivates the hold and the system starts measuring again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Only use calibration buffers once.

19.4.4 One-point calibration

Applications and requirements
Single-point calibration is particularly useful if the deviation of the pH value from a reference value, and not the absolute pH value itself, is of interest to the user. Applications for single-point calibration include:
- Process control
- Quality assurance

Fluctuations in the process value should not exceed ±0.5 pH and the process temperature must remain relatively constant. As the measuring range is limited as a result, it is possible to set the slope to -59 mV/pH (at 25 °C). To adjust the sensor, you enter an offset or a reference value.

Alternatively, you can also use the **Sample calibration**. Here, you take a sample from the process and determine the pH value in the laboratory. In the case of the laboratory sample, you must make sure that the pH value is determined at the process temperature.

Entering a reference value

You enter a previously determined reference measured value. This then shifts the calibration function along the X-axis (pH). The slope is not affected.

1. Open the menu: **CAL/pH Glass** or **pH ISFET/1-pnt. calibration**.
2. **Reference**: Enter previously determined value.
3. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Sample calibration

With this type of calibration, you take a sample of the medium and determine its pH value (at process temperature) in the laboratory. You then use this laboratory value to adjust the sensor. This does not change the slope of the calibration function.

1. Open the menu: **CAL/pH Glass** or **pH ISFET/Sample calibration**.
2. Follow the instructions of the software.
3. **After** you have taken the sample: Press **OK**.
   ↳ The following message appears on the display: ▶ **Sample calibration**.
4. **After** you have determined the laboratory value, press the navigation button.
   ↳ A line appears where you can enter the laboratory value.
5. Enter the laboratory measured value here and then go to ▷**Continue**.
   ↳ The measured value, laboratory value and the resulting offset (zero point for ISE) are displayed.
6. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.4.5 Data entry

You enter the slope, zero point and temperature manually. The function for determining the pH value is calculated from these values. Thus, the data entry returns the same result as two-point calibration.

1. Determine the slope, zero point and temperature in an alternative way (reference measurement).
2. Open the menu: **CAL/pH Glass** or **pH ISFET/Numeric input**.
   ↳ The slope, zero point and temperature are shown on the display.
3. Select each value one after the other and then enter the desired numerical value.
   ↳ Since you are entering all the variables for the Nernst equation directly, no additional information is displayed by the software.
4. Respond to the prompt to accept the calibration data for adjustment by selecting **OK**.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.4.6 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL**/<Sensor type>/**Temperature adjustment**.
3. **Leave the sensor in the process medium** and keep clicking **OK** until temperature measurement is started via the sensor.
4. Enter the reference temperature from the alternative measurement. You can either enter the absolute value or an offset for this purpose.
5. Then keep clicking **OK** until the new data have been accepted.
   ↳ This completes the temperature adjustment.

19.4.7 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. Do you want to start a new calibration? Slope out of tolerance. Zeropoint out of tolerance. Sample concentration too low.	The calibration buffer is contaminated or the pH value is no longer within the permitted limits. As a result, the permitted measured value deviation is exceeded. 1. Check the expiry date 2. Use a fresh buffer
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value or temperature is not stable. As a result, the stability criterion is not met. 1. Keep the temperature constant during calibration. 2. Replace the buffer. 3. Sensor old or contaminated. Clean or regenerate. 4. Adjust stability criteria → 15.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.5 ORP sensors

19.5.1 Types of calibration

The following types of calibration are possible:
- Two-point calibration with medium samples
  (**Main value** = **ORP %**)
- Single-point calibration with calibration buffer
  (**Main value** = **ORP mV**)
- Entry of data for an offset
  (**Main value** = **ORP mV**)
- Temperature adjustment by entering a reference value

19.5.2 One-point calibration

The buffers contain ORP pairs with a high exchange current density. Such buffers have the advantage of higher accuracy levels, better reproducibility and faster measurement response times.

Temperature compensation does not take place when measuring the ORP since the thermal behavior of the medium is not known. However, the temperature is indicated with the measurement result and for this reason it makes sense to adjust the temperature sensor at process-dependent intervals.

Single-point calibration with calibration buffers

With this type of calibration, you work with calibration buffers, e.g. ORP buffers from Endress+Hauser. For this purpose, you remove the sensor from the medium and calibrate it in the laboratory. Since Memosens sensors save the data, you can always work with "precalibrated" sensors and do not have to stop monitoring the process for extended periods to perform a calibration (does not apply to ISE).

1. Open the menu: **CAL/ORP/1-pnt. calibration**.
2. Follow the instructions of the software.
3. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.5.3 Numeric input (offset)

Entry of data for an offset

You enter the offset directly with this type of calibration. Use the measured value of a reference measurement, for example, to determine the offset.

1. Open the menu: **CAL/ORP/Numeric input (offset)**.
   ↳ Display **Offset**.
2. Decide whether you wish to retain the current value or enter a new value.
3. Change value or retain value.
4. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.5.4 Two-point calibration (only ORP %)

You must adapt the sensor to your process to obtain useful ORP % values. This is achieved through two-point calibration. The two calibration points are characteristic of the most important states your medium can assume in the process.

You require two different compositions of your medium that represent the characteristic limits of your process (e.g. 20% and 80% value). The absolute value in mV is not relevant for the ORP % measurement.

1. Open the menu: **CAL/ORP/2-pnt. calibration**.
2. Follow the instructions of the software.
3. Determine ORP of medium for the first calibration point.
4. Specify which % value this point represents.
5. ▷ **Continue**.
6. Follow the instructions of the software.
7. Determine ORP of medium for the second calibration point.
8. Specify which % value this point represents.
9. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.5.5 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL**/<Sensor type>/**Temperature adjustment**.
3. **Leave the sensor in the process medium** and keep clicking **OK** until temperature measurement is started via the sensor.
4. Enter the reference temperature from the alternative measurement. You can either enter the absolute value or an offset for this purpose.
5. Then keep clicking **OK** until the new data have been accepted.
   ↳ This completes the temperature adjustment.

19.5.6 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. Do you want to start a new calibration?	The calibration buffer is contaminated or the ORP potential is no longer within the permitted limits. As a result, the permitted measured value deviation is exceeded. 1. Check the expiry date 2. Use a fresh buffer
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value is not stable. As a result, the stability criterion is not met. 1. Replace the buffer. 2. Sensor old or contaminated. Clean or regenerate. 3. Adjust stability criteria → 🖹 15.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.6 Conductivity sensors

19.6.1 Types of calibration

The following types of calibration are possible:
- Cell constant with calibration solution
- Installation factor
  (Only inductive sensors and CLS82D)
- Air set (residual coupling)
  (Only inductive sensors)
- Temperature adjustment by entering a reference value

19.6.2 Cell constant

A conductivity measuring system is generally calibrated in such a way that the exact cell constant is determined or checked using suitable calibration solutions.

This process is described in the standards EN 27888 and ASTM D 1125, for example, and the method for producing a number of calibration solutions is explained.

Another alternative is to purchase international calibration standards from national measurement institutes. This is particularly important in the pharmaceutical industry, which requires a calibration to be traced to internationally recognized standards. To calibrate its testing units, the manufacturer, uses special reference material (SRM) from the US National Institute of Standards and Technology (NIST).

Calibrating the cell constant

You enter a reference value for the conductivity with this type of calibration. In addition, you specify how the system should compensate for the influence of temperature. In the result, the device calculates a new cell constant for the sensor.

1. Open the menu: **CAL/Cond c** or **Cond i** or **Cond c 4-pol/Cell constant**.
2. Make the settings:

CAL/Cond c or Cond i or Cond c 4-pol/Cell constant		
Function	**Options**	**Info**
Current cell const.	Read only	Value currently saved in the sensor
Temp. compensation	**Selection** ▪ Yes ▪ No **Factory setting** Yes	As an alternative to the compensated conductivity (**Yes**) you can also determine the cell constant by calibrating the uncompensated conductivity (**No**).
Coeff. Alpha **Temp. compensation** = **Yes**	0.00 to 20.00 %/K **Factory setting** Depends on the sensor	The alpha coefficients and alpha reference temperatures of Endress+Hauser can be found in the documentation supplied with the calibration solutions. ▶ Enter the appropriate values.
Alpha ref. temp. **Temp. compensation** = **Yes**	-5.0 to 100.0 °C (23.0 to 212.0 °F) **Factory setting** 25.0 °C (77.0 °F)	
Temp. source	**Selection** ▪ Sensor ▪ Manual **Factory setting** Sensor	Decide how you want to compensate the medium temperature: ▪ Automatically using the temperature sensor of your sensor ▪ Manually by entering the medium temperature

CAL/Cond c or Cond i or Cond c 4-pol/Cell constant		
Function	**Options**	**Info**
Medium temperature **Temp. source** = **Manual**	-50.0 to 250.0 °C (-58.0 to 482.0 °F) **Factory setting** 25.0 °C (77.0 °F)	▶ Enter the temperature of your medium.
Conductivity ref.	0.000 to 2000000 µS/cm **Factory setting** 0.000 µS/cm	Temp. compensation = Yes ▶ Enter the **compensated** conductivity of your calibration solution here. Temp. compensation = No ▶ Enter the **uncompensated** conductivity of your calibration solution here.

3. ▷ **Start calibration**.
4. Follow the instructions.
5. Decide whether to use the calibration data captured, or to abort or repeat the calibration.

After calibration, the transmitter automatically switches back to the measuring mode and your measuring point is now ready for operation.

19.6.3 Air set (residual coupling, only inductive sensors)

While the calibration line goes through zero for physical reasons in the case of conductive sensors (a current flow of 0 corresponds to a conductivity of 0), when working with inductive sensors, the residual coupling between the primary coil (transmitter coil) and secondary coil (receiver coil) must be taken into account or compensated for. The residual coupling is not only caused by the direct magnetic coupling of the coils but also by crosstalk in the supply cables. For this reason, the process of commissioning an inductive sensor always starts with an "air set". Here, the sensor is connected to the transmitter with the cables provided, held in air in a dry state (zero conductivity) and an air set calibration is performed at the transmitter.

The cell constant is then determined using a precise calibration solution, as is the case with conductive sensors.

Sensors with a Memosens protocol are already calibrated at the factory and their residual coupling generally does not have to be adjusted on site.

19.6.4 Installation factor (only inductive conductivity sensors and CLS82D)

In confined installation conditions, the conductivity measurement is affected by the pipe walls. The installation factor compensates for this effect. The transmitter corrects the cell constant by multiplying by the installation factor. The value of the installation factor depends on the diameter and the conductivity of the pipe nozzle as well as the sensor's distance to the wall.

If there is a sufficient distance between the wall and the sensor, the installation factor f does not have to be taken into consideration (f = 1.00). If the distance to the wall is smaller, the installation factor increases for electrically insulating pipes (f > 1) and decreases for electrically conductive pipes (f < 1).

There are two ways to compensate the installation factor:
- Determine the installation factor using calibration solutions
- Enter a known installation factor

Calibrating the installation factor

1. Open the menu: **CAL/Cond i** or **Cond c 4-pol/Inst. factor/Calibration**.

2. Make the settings:

CAL/Cond i or Cond c 4-pol/Inst. factor/Calibration		
Function	**Options**	**Info**
Current cell const.	Read only	Value currently saved in the sensor
Temp. compensation	**Selection** ▪ Yes ▪ No **Factory setting** Yes	As an alternative to the compensated conductivity (**Yes**) you can also determine the cell constant by calibrating the uncompensated conductivity (**No**).
Coeff. Alpha **Temp. compensation** = **Yes**	0.00 to 20.00 %/K **Factory setting** Depends on the sensor	The alpha coefficients and alpha reference temperatures of Endress+Hauser can be found in the documentation supplied with the calibration solutions. ▶ Enter the appropriate values.
Alpha ref. temp. **Temp. compensation** = **Yes**	-5.0 to 100.0 °C (23.0 to 212.0 °F) **Factory setting** 25.0 °C (77.0 °F)	
Temp. source	**Selection** ▪ Sensor ▪ Manual **Factory setting** Sensor	Decide how you want to compensate the medium temperature: ▪ Automatically using the temperature sensor of your sensor ▪ Manually by entering the medium temperature
Medium temperature **Temp. source** = **Manual**	-50.0 to 250.0 °C (-58.0 to 482.0 °F) **Factory setting** 25.0 °C (77.0 °F)	▶ Enter the temperature of your medium.
Conductivity ref.	0.000 to 2000000 µS/cm **Factory setting** 0.000 µS/cm	Temp. compensation = Yes ▶ Enter the **compensated** conductivity of your calibration solution here. Temp. compensation = No ▶ Enter the **uncompensated** conductivity of your calibration solution here.

3. ▷ **Start calibration**.
4. Follow the instructions.
5. Decide whether to use the calibration data captured, or to abort or repeat the calibration.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Entering the installation factor

1. Open the menu: **CAL/Cond i** or **Cond c 4-pol/Inst. factor/Entry**.
   ↳ The installation factor currently used is displayed.
2. **New inst. factor**: Enter the installation factor which you took from the Operating Instructions for your sensor, for example.
3. ▷ **Start calibration**.
4. Decide whether to use the calibration data captured, or to abort or repeat the calibration.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.6.5 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL/Cond c** or **Cond i** or **Cond c 4-pol/Temperature adjustment**.
   ↳ The offset (of the last calibration) and the actual temperature value are shown on the display.
3. **Mode**: Decide on the mode of temperature adjustment.

- **1-point calibration**
  You measure the medium temperature with a reference measurement and use this value to adjust the temperature sensor.
- **2-point calibration**
  You use two samples of different temperatures.
- **Table**
  Adjustment based on data entries. You enter value pairs comprising the measured temperature of the temperature sensor and the related reference temperature. The temperature function is calculated from these value pairs. Press **SAVE** once you have entered all the points and select **OK**.

4. Follow the instructions of the software.
5. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.6.6 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. Do you want to start a new calibration?	Calibration solution exhausted. As a result, the permitted measured value deviation is exceeded. 1. Check the expiry date 2. Use a fresh calibration solution
Currently no calibration possible due to sensor failure.	Sensor communication problem 1. Replace sensor. 2. Contact the Service Department.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.7 Oxygen sensors

19.7.1 Signal generation with amperometric sensors

The amperometric oxygen sensor is based on the reduction of oxygen at the noble metal cathode of a system filled with electrolyte.

Oxygen coming from the medium (e.g. air) diffuses through a membrane into the electrolyte film and is reduced at the cathode. This means that there is practically no molecular oxygen at the cathode. Intense oxygen consumption takes place here and the oxygen partial pressure approaches zero.

The oxygen partial pressure of the medium is present in front of the membrane. This pressure is approx. 209 hPa in water vapor-saturated air under reference conditions (1013 hPa, 20°C). The partial pressure acts as the driving force to transport oxygen molecules

through the membrane. The membrane acts as a diffusion barrier, i.e. oxygen molecules permeate the membrane depending on the difference in partial pressure.

In summary, an amperometric oxygen sensor has two important features:
- The rate of oxygen consumption at the cathode is extremely high. Oxygen permeates the membrane depending on the external oxygen partial pressure (the internal pressure is practically zero) - the external oxygen partial pressure is the driving force.
- Due to the diffusion-inhibiting properties of the membrane, the flow of oxygen through the membrane and thus the electric signal current subsequently generated is in direct proportion to the oxygen partial pressure in front of the membrane, i.e. the sensor provides a linear signal current that depends on the oxygen partial pressure.

→ The amperometric oxygen sensor is therefore an oxygen partial pressure sensor.

19.7.2 Signal generation with optical sensors

The optical oxygen sensor is based on the principle of fluorescence quenching.

The basic concept is as follows:
The medium to be measured and the sensor optics are separated by an area that is sensitive to oxygen, known as the sensor spot.
Towards the process this sensor spot is protected against pressure, temperature and other influences of medium by a black covering that is permeable to oxygen. This covering therefore allows the oxygen that is present in the medium to diffuse into the sensor spot, based on the equilibrium of the oxygen partial pressure in the medium.
The sensor optics direct light at a constant wavelength A or color A onto the sensor spot containing a fluorescent dye (stimulation). As a result of this stimulation, the molecules of the dye emit a light at a constant wavelength B or color B (response).
The oxygen in the medium and therefore in the sensor spot changes the fluorescence properties of the dye. This process is known as quenching.
The relation between the stimulation and response therefore depends on the oxygen partial pressure in the medium, and is used in the sensor for measurement purposes. From a technical perspective, the concentration of oxygen is often calculated based on the relation of the signals over time (also known as the phase angle).

19.7.3 Calibration intervals

Specifying the intervals

If you want to calibrate the sensor intermittently for a special application and/or on account of a special type of installation, you can calculate the intervals using the following method:

1. Remove the sensor from the medium.
2. Clean the outside of the sensor with a damp cloth.
3. Then dry the sensor diaphragm carefully with a soft paper towel for example.
4. NOTICE

   Incorrect measurements caused by atmospheric influences!
   ▶ Protect the sensor against external influences such as sunlight and wind.

   After 20 minutes (amperometric sensors) or 10 minutes (optical sensors), measure the oxygen saturation index in air.
5. Decide using the results:

a) Amperometric sensor: Measured value is **not** 102 ± 2 %SAT (COS51D) or 100 ± 2 %SAT (COS22D) → Calibrate sensor.

Optical sensor: Measured value is **not** 100 ± 2 %SAT → Calibrate sensor.

b) If the values are within the specified interval, the sensor does not need to be calibrated. The time period between inspections can be extended.

6. Repeat the steps specified after two, four or eight months to determine the optimum calibration interval for your sensor.

Monitoring the calibration

- Determine the imit values for monitoring slope and zero point differentials: **Menu/Setup/Inputs/Oxygen (amp.)** or **Oxygen (opt.)/Extended setup/Diagnostics settings/Delta slope** or **Delta zero point** (amperometric sensors or COS61D) or **Calibration quality index** (COS81D).
  - These limit values depend on the process and must be determined by empirical means.

During calibration a diagnostics message is displayed if the defined warning limits have been exceeded. You then have to service the sensor by cleaning the sensor or reference, or by regenerating the glass membrane.

You have to replace the sensor if warning messages continue to be displayed despite the maintenance measure.

Monitoring the calibration interval

Once you have established the calibration intervals for your process, you can also have the device monitor them.

- **Menu/Setup/Inputs/Oxygen (amp.)** or **Oxygen (opt.)/Extended setup/Calib. settings/Calib. expiration time**
  - Set time limits to specify how long a calibration should be regarded as valid. Memosens sensors save all the calibration data. In this way it is easy to see whether the last calibration took place in the specified timeframe and is therefore still valid. This is particularly advantageous when working with precalibrated sensors.

19.7.4 Types of calibration

The following types of calibration are possible:
- **Zero point**
  - **1-point cal.** (single-point calibration in nitrogen or COY8 zero-point gel)
  - **Numeric input**
- **Slope** (amperometric sensors and COS61D) or **Point at oxygen** (COS81D)
  - **Air 100% rh** (air, water vapor-saturated)
  - **H2O air-saturated** (air-saturated water)
  - **Air variable** (air, variable)
  - **Test gas calibration** (only COS81D)
  - **Numeric input**
- Sample calibration
  - **Slope** (only amperometric sensors and COS61D)
  - **Point at oxygen** (only COS81D)
  - **Zero point** (only amperometric sensors)
- **Fermenter scaling** (only COS81D)
- **Temperature adjustment**

Furthermore, the calibration menu for amperometric sensors and COS81D contains two additional functions to reset the sensor's internal counters:
- **Change electrolyte** (only amperometric sensors)
- **Change sensor cap** (amperometric sensors and COS81D)
- **Reset to factory calibration** (only COS81D)

19.7.5 Slope calibration (COS22D, COS51D, COS61D) or point at oxygen (COS81D)

In the case of slope calibration, the dependency on partial pressure is used to compare the signal current to a known and readily available reference – air.

The composition of dry air is known:
- 20.95 % oxygen
- 79.05 % nitrogen and other gases

Altitude and partial pressure
The oxygen partial pressure otherwise only depends on the altitude or the current absolute air pressure.
At an air pressure of 1013 hPa at sea level, the oxygen partial pressure is approximately 212 hPa. The absolute pressure and thus also the oxygen partial pressure change depending on the altitude. Using the barometric formula, the expected oxygen partial pressure can be calculated with only marginal errors up to a height of several kilometers. As a result, calibration is independent of the altitude.

Three methods for obtaining reliable values for the absolute pressure of air

1. Using the altitude and the barometric formula which provide the correlation between the expected value for the average absolute air pressure and the altitude (also saved and accessible in the transmitter or sensor).
2. By measuring the absolute pressure of air with a pressure cell, for example.
3. The relative air pressure reduced to sea level is often available from weather reports. This relative air pressure can be converted to the absolute value using the barometric formula.

Water vapor
In reality, water in the form of water vapor is also always present in air. This is a contributing factor to the total pressure. This means that the water vapor in the air changes the oxygen partial pressure.
However, air can only hold a specific maximum volume of water. The rest is given off as condensate in liquid form (e.g. drops). The maximum amount of water vapor in air depends on the temperature and follows known functions.

Air 100% rh
In this calibration model, the percentage of water vapor is deducted on the basis of the altitude and temperature so that information is available on the oxygen partial pressure actually present.
For this model to work correctly, the sensor to be calibrated must be close to a water surface or be located in the headspace of a vessel partially filled with water. In this way, oxygen sensors can be precisely calibrated in a wide variety of applications, ranging from power stations to water treatment.

H2O air-saturated
After an adequate amount of time, water which has been aerated sufficiently is in equilibrium with the oxygen partial pressure of the air above the water. This calibration model uses this property.
Here too, the model uses the temperature value to automatically reference back to the expected oxygen partial pressures. This model is often used to measure oxygen in closed tanks, such as fermenters filled with water.

Air variable
This calibration model is for all applications in which the air pressure and air humidity in the vicinity of the sensor do not correspond to the standard atmospheric values previously mentioned, but are still known. Both variables can be specified here.
The model is used, for example, for installed sensors that should be calibrated in operation at known conditions, such as in dry rinse air at 1020 hPa.

Test gas calibration (only COS81D)
This calibration model allows the user to calibrate the slope of the sensor using a defined oxygen gas mixture. Traceable calibration can be performed in conjunction with an absolute pressure measurement (to determine the gas pressure at the sensor membrane) and a certified calibration gas. The reference variable in oxygen volume concentration and the gas pressure are entered here as input variables in the transmitter. The model assumes a dry gas mixture with 0% humidity.

Sample calibration
Sample calibration is another calibration option. Here, the measured value of the sensor is adjusted to a reference, obtained externally, of the same medium.

Calibrating the sensor in the media mentioned

The calibration procedure is identical regardless of whether you are calibrating in water vapor-saturated air, air-saturated water or variable air:

1. Open the menu: **CAL/Oxygen (amp.)** or **Oxygen (opt.)/Slope** or **Point at oxygen**.
2. Choose from the following: **Air 100% rh** or **H2O air-saturated** or **Air variable** or **Test gas calibration** (COS81D only) or **Sample calibration**.
3. Follow the instructions of the software.
4. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Calibrating the sensor by data entry

1. Open the menu: **CAL/Oxygen (amp.)** or **Oxygen (opt.)/Slope/Numeric input**.
2. **New slope**: Enter value.
3. Respond to the prompt to accept the calibration data for adjustment by selecting **OK**.
   ↳ The new slope is used.

19.7.6 Zero point calibration

The zero point is not so important when working with relatively high concentrations of oxygen.

This situation changes, however, as soon as oxygen sensors are used in the trace range and calibration should be performed in the zero point. Zero point calibrations are demanding as the ambient medium - usually air - already has a high oxygen content. This oxygen must be excluded for the zero point calibration of the sensor and existing residual oxygen must be eliminated from the sensor environment.

There are two preferred methods of doing so:

1. Calibration of the zero point in a flow assembly that has been rinsed with gaseous nitrogen of acceptable quality (N5).
2. The calibration in oxygen-depleting zero point gel.

Alternatively you can also adjust the zero point via data entry. You require a reference measured value for this.

Prior to sensor zero point calibration
- Has the sensor signal settled and is it steady?
- Is the value displayed plausible?
  If the oxygen sensor is calibrated too early, this can result in an incorrect zero point. As a general rule, operate the sensor in a zero point gel for 0.5 hours and then assess the signal current in the steady state. If the sensor was already operated in the trace range before the zero point calibration, the time specified above generally suffices. If the sensor was operated in air, significantly more time must be factored in to also remove residual oxygen from any dead volume inherent to the design. Here a value of 2 hours applies as a general rule.

The zero point can be calibrated as soon as the sensor signal has settled. Here, the current measured value is calibrated to the zero value. The reference method (sample calibration in zero point) can also be used here if appropriate collecting vessels or reference measurement are available.

Zero point calibration with zero point gel

As an alternative to the zero point gel, you can also work in an atmosphere that is free from oxygen, such as high-purity nitrogen.

1. Open the menu: **CAL/Oxygen (amp.)** or **Oxygen (opt.)/Zero point**.
2. ▷ **1-point cal.**.
3. Immerse the sensor in **zero-point gel** or hold it in **nitrogen** (not in air!).
4. ▷ **Start calibration**.
5. Decide whether to use the calibration data captured, or to abort or repeat the calibration.
6. Clean the sensor and then place it back in the medium.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Calibrating the sensor by data entry

You can calibrate the zero point by entering a percentage offset. To do this, determine the zero point by comparing with a reference measurement.

1. Open the menu: **CAL/Oxygen (amp.)** or **Oxygen (opt.)/Zero point/▷ Numeric input**.
2. **New zeropoint**: Enter value.
3. ▷ **Accept calibration data**.
   ↳ The new zero point is used.

19.7.7 Sample calibration

Calibration is possible both in the medium (in the process or in the laboratory) and in air.

For this purpose, you measure the raw oxygen value using a reference measurement. You use this reference value to adjust the sensor.

You can either calibrate the slope or the zero point with the reference value.

1. Open the menu: **CAL/Oxygen (amp.)** or **Oxygen (opt.)/Sample calibration**.
2. Choose from the following: **Slope** or **Zero point** (amperometric sensor only).
   ↳ Use the calibration of the zero point if you want to align the measurement with another measurement. You can correct the sensitivity of your measurement with the slope calibration.
3. Follow the instructions of the software.
   ↳ The current measured value is displayed.
4. **Reference**Enter the comparative value from the external measurement.
5. ▷ **Continue**.
6. ▷ **Accept calibration data**.
   ↳ Sample calibration is completed.
7. If you have performed the calibration in the laboratory, clean the sensor and then immerse it in the medium again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.7.8 Fermenter scaling

As a general rule, overpressure is present in a fermenter before fermentation begins. In addition, the sensor was subjected to stress in the form of sterilization in place (SIP).

Using the **Fermenter scaling** method, the measured value of the installed sensor is adjusted to match your preferred start value in %SAT.

You determine the set point of the saturation (**Required saturation**) to which the measured saturation should correspond (100 %SAT generally). This results in a factor for the calibration function (**Scaling factor**). In the menu, select the saturation index as primary value and you will then see the scaled saturation index in the measured value display.

1. Open the menu: **CAL**/**Oxygen (opt.)**/**Fermenter scaling**.
2. ▷ **Activate**.
3. Respond to the prompt by selecting **OK**.
   ↳ The current measured saturation (**Current saturation**) is displayed.
4. **Required saturation**: Specify the saturation to which this value should correspond.
5. ▷ **Continue**.
   ↳ The scaling factor is calculated and displayed (**Scaling factor**).
6. Respond to the prompt by selecting **OK**.

If you no longer wish to use fermenter scaling, deactivate the function in the calibration menu.

19.7.9 Resetting the counters

These functions do not adjust the sensor, but reset the sensor's internal counters to "0".

The counters can be used to set warning limits and alarm limits for changing the membrane cap (fluorescence cap) or the electrolyte (amperometric sensors only). This ensures that exhausted caps and electrolyte are replaced in time.

Reset the counters to "0" after replacing the cap or electrolyte.

1. Select the desired action: ▷ **Change sensor cap** or ▷ **Change electrolyte**.
2. Respond to query: ▷ **Save**.
   ↳ The sensor's internal counter is reset.

19.7.10 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL**/<Sensor type>/**Temperature adjustment**.
3. **Leave the sensor in the process medium** and keep clicking **OK** until temperature measurement is started via the sensor.
4. Enter the reference temperature from the alternative measurement. You can either enter the absolute value or an offset for this purpose.
5. Then keep clicking **OK** until the new data have been accepted.
   ↳ This completes the temperature adjustment.

19.7.11 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. The range was overrun. Do you want repeat the last step?	Sensor contaminated or zero point gel used up. As a result, the permitted limit values for the zero point are exceeded. 1. Clean sensor 2. Renew the zero point gel 3. Repeat calibration
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value is not stable. As a result, the stability criterion is not met. 1. Replace exhausted electrolyte and/or sensor cap 2. Adjust stability criteria → 49.
Storage of the data failed. Do you want to retry?	*Optical fixed cable sensor only* The calibration data could not be stored in the sensor 1. Check the sensor connection 2. Repeat calibration
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.8 Disinfection sensors

19.8.1 Calibration intervals

The calibration intervals depend greatly on:
- The application
- The installation position of the sensor

Specifying the intervals

If you want to calibrate the sensor intermittently for a special application and/or on account of a special type of installation, you can calculate the intervals using the following method:

1. Check the sensor three months (in the case of drinking water) or one month (in the case of process water) after commissioning using a reference measured value (DPD method) of a medium sample.
2. Compare the sensor measured value to the reference measured value.
3. Depending on your requirements, decide whether the deviation is acceptable or whether the sensor should be recalibrated.

Make sure to calibrate the sensor at least twice a year.

Please note that the DPD method itself is susceptible to high measured errors when the measured values are very low (< 0.2 mg/l) and can then no longer be regarded as a reliable method.

Monitoring the calibration

▶ Define the limit values for monitoring the slope and zero point differences: **Menu/Setup/Inputs/Disinfection /Extended setup/Diagnostics settings/Delta slope** or **Delta zero point**.
  ↳ These limit values depend on the process and must be determined by empirical means.

During calibration a diagnostics message is displayed if the defined warning limits have been exceeded. You then have to service the sensor by cleaning the sensor or reference, or by regenerating the glass membrane.

You have to replace the sensor if warning messages continue to be displayed despite the maintenance measure.

Monitoring the calibration interval

Once you have established the calibration intervals for your process, you can also have the device monitor them.

- **Menu/Setup/Inputs/Disinfection/Extended setup/Calib. settings/ Calib. expiration time**
  - Set time limits to specify how long a calibration should be regarded as valid. Memosens sensors save all the calibration data. In this way it is easy to see whether the last calibration took place in the specified timeframe and is therefore still valid. This is particularly advantageous when working with precalibrated sensors.

19.8.2 Polarization

The voltage applied between cathode and anode by the transmitter polarizes the surface of the working electrode. Therefore, after switching on the transmitter with the senor connected, you must wait until the polarization period has elapsed before starting calibration.

To achieve a stable display value, the sensor requires the following polarization periods:

First commissioning

Sensor for standard measuring range	60 min.
Sensor for trace measuring range	90 min.

Recommissioning

Sensor for standard measuring range	30 min.
Sensor for trace measuring range	45 min.

19.8.3 Types of calibration

The following types of calibration are possible:
- Slope
  - Sample calibration
  - Data entry
- Zero point
  - Sample calibration
  - Data entry
- Temperature adjustment

Furthermore, the calibration menu contains additional functions to reset the sensor's internal counters:
- Change electrolyte
- Change sensor cap
- Reset to factory settings of the sensor channel

19.8.4 Reference measurement

Reference measurement according to the DPD method
To calibrate the measuring system, carry out a colorimetric comparison measurement in accordance with the DPD method. Chlorine as well as chlorine dioxide react with diethyl-p-phenylenediamine (DPD) and turn red. The intensity of the red coloration is proportional to the chlorine content.
This red coloration is measured with a photometer (e.g. CCM182) and indicated as the chlorine content.

Prerequisites
The sensor reading is stable (no drifts or unsteady values for at least 5 minutes). This is normally guaranteed once the following preconditions have been met:
- The polarization period has elapsed.
- The flow is constant and within the correct range.
- The sensor and the medium are at the same temperature.
- The pH value is within the permitted range.

19.8.5 Slope calibration

You can correct the sensitivity of your measurement with the slope calibration.

Sample calibration

Measure the raw chlorine value using a reference measurement. You use this reference value to adjust the sensor.

1. Open the menu: **CAL/Disinfection/Slope**.
2. ▷ **Sample calibration**.
3. **Follow** the software instructions.
4. Choose between the following: ▷ **Continue calibration** or **Back to measurement (finish cal. later)**.
5. **Nominal value**: Enter the reference value.
6. ▷ **Accept calibration data**.
7. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Data entry

Measure the raw chlorine value using a reference measurement. You use this reference value to adjust the sensor.

1. Open the menu: **CAL/Disinfection/Slope**.
2. ▷ **Numeric input**.
3. **New abs. slope** or **New rel. slope**: Enter value.
   ↳ The other value is calculated by the device.
4. ▷ **Accept calibration data**.
5. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.8.6 Zero point calibration

Zero point calibration is particularly important if measuring close to the zero point.

Sample calibration

Measure the raw chlorine value using a reference measurement. You use this reference value to adjust the sensor.

1. Open the menu: **CAL**/**DisinfectionZero point**/.
2. ▷ **Sample calibration**.
3. **Follow** the software instructions.
4. Choose: ▷ **Continue calibration** or **Back to measurement (finish cal. later)**.
5. **Nominal value**: enter the reference value.
6. ▷ **Accept calibration data**.
7. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing the **ESC** key. No data are then used to adjust the sensor.

Data entry

Measure the raw chlorine value using a reference measurement. You use this reference value to adjust the sensor.

1. Open the menu: **CAL**/**Disinfection**/**Zero point**.
2. ▷ **Numeric input**.
3. **New zero point**: enter the value.
4. ▷ **Accept calibration data**.
5. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing the **ESC** key. No data are then used to adjust the sensor.

19.8.7 Change electrolyte and Change sensor cap and electrolyte: resetting the counters

These functions do not adjust the sensor, but reset the sensor's internal counters to "0".

The counter for sensor cap calibrations is used to set warning limits and alarm limits for changing the cap. This ensures that exhausted membrane caps are replaced in time.

Reset the counters to "0" after replacing the cap or electrolyte.

1. Select the desired action: **Change electrolyte** or **Change sensor cap and electrolyte**.
2. Respond to query: ▷ **Save**.
   ↳ The sensor's internal counter is reset.

19.8.8 Resetting to factory calibration

1. **CAL**/Channel No. <Sensor DI>/**Disinfection**/▷ **Reset to factory calibration**
2. OK
   ↳ The calibration data are reset to the factory setting.

19.8.9 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. Do you want to start a new calibration?	Sensor contaminated. As a result, the permitted limit values for the zero point are exceeded. 1. Clean sensor 2. Repeat calibration
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value is not stable. As a result, the stability criterion is not met. 1. Replace exhausted electrolyte and/or sensor cap 2. Adjust stability criteria → 64.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.9 Ion-selective sensors

Some measured values from other electrodes or sensors are used for measured value compensation of ion-selective electrodes:
- Measured value of temperature sensor for temperature compensation
- pH measured value for pH compensation of ammonium (optional)
- Potassium or chloride measured value for compensation of interference ions in the case of ammonium or nitrate (optional)

For this reason, there is a sequence for calibration and adjustment that must be followed in order to achieve a reliable measurement:

1. Temperature adjustment
2. Calibration and adjustment of pH electrode
3. If compensation electrodes are used:
   Calibration and adjustment of ion-selective compensation electrodes (potassium, chloride)
4. If no compensation electrodes are used:
   A correct manual offset is configured for the ammonium and nitrate electrode
5. Calibration and adjustment of ion-selective measuring electrodes (ammonium, nitrate)

19.9.1 Types of calibration

The following types of calibration are possible:
- pH electrode:
  - Two-point calibration
  - Single-point calibration
- Ion-selective electrodes:
  - Single-point calibration
  - Data entry
  - Two-point calibration
  - Standard addition ("Expert" user role only)
  - Sample calibration ("Expert" user role only)
- ORP sensor:
  Single-point calibration
- Temperature adjustment by entering a reference value

19.9.2 pH sensor

Two-point calibration

You use calibration buffers to perform two-point calibration. The quality buffers supplied by Endress+Hauser are certified and measured in an accredited laboratory. The accreditation (DAR registration number "DKD-K-52701") confirms that the actual values and the maximum deviations are correct and traceable.

1. Open the menu: **CAL/ISE/2-pnt. calibration**.
2. Select the pH sensor and ▷ **Start calibration**.
3. Follow the instructions of the software.
4. **After** you have immersed the sensor in the first buffer and the measured value has stabilized, press **OK**.
   ↳ The system starts calculating the measured value for the first buffer. Once the stability criterion is met, the measured value is displayed in mV.
5. Continue to follow the instructions.
6. **After** you have immersed the sensor in the second buffer and the measured value has stabilized, press **OK**.
   ↳ The system starts calculating the measured value for the second buffer. Once the stability criterion is met, the measured values of the two buffers and the calculated values for the slope and zero point are displayed.
7. Respond to the prompt to accept the calibration data for adjustment by selecting **Yes** .
8. Return the sensor to the medium and press **OK** again.
   ↳ This deactivates the hold and the system starts measuring again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Only use calibration buffers once.

One-point calibration

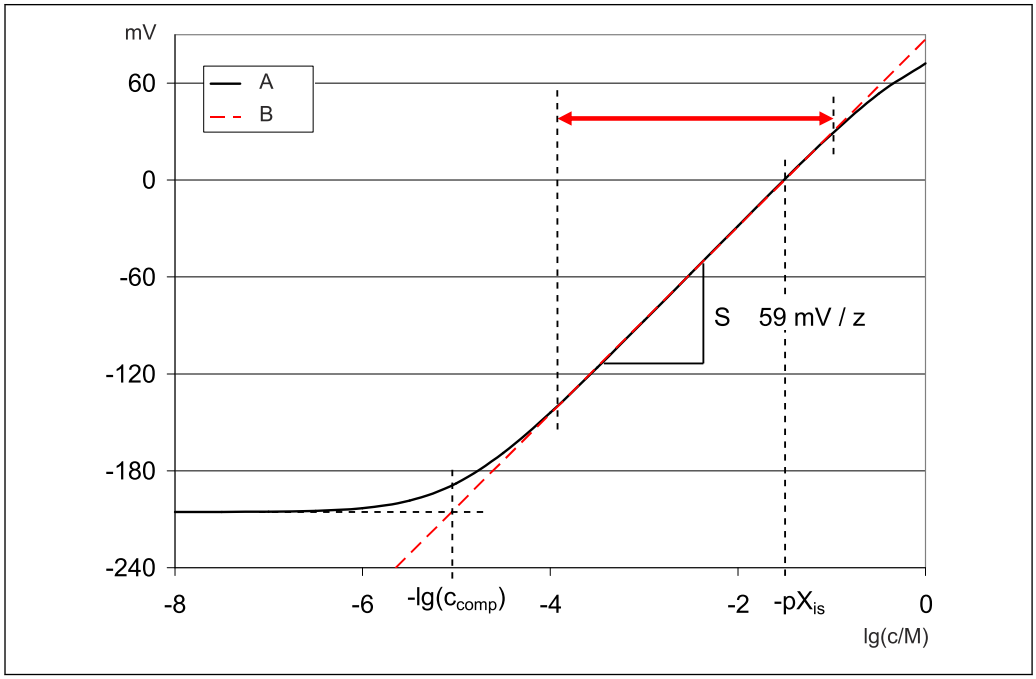
1. Open the menu: **CAL/ISE/1-pnt. calibration**.
2. Select the pH sensor and ▷ **Start calibration**.
   ↳ A question is displayed: **Do you know the measured value of the reference medium?**
3. Respond by selecting ▷ **Yes**.
4. **Reference value**: Enter the value of the buffer.
5. Follow the software instructions, and immerse the sensor in the buffer.
6. ▷ **Continue**.
7. **OK**: Start calibration.
   ↳ The system starts calculating the measured value for the buffer. Once the stability criterion is met, the measured value is displayed in mV.
8. Respond to the prompt to accept the calibration data for adjustment by selecting **Yes**.
9. Return the sensor to the medium and press **OK** again.
   ↳ This deactivates the hold and the system starts measuring again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Only use calibration buffers once.

19.9.3 Ammonium, nitrate, potassium, chloride

In the case of potentiometric methods to determine the ion concentration, the voltage supplied by the electrochemical measuring cell (comprising the ion-selective electrode and a reference electrode), is proportional to the logarithm of the concentration (or activity) of the ions under analysis within the "linear" or preferably "NERNST" range (→ 33, red arrow). The slope and zero point calibration parameters refer to this logarithmic relationship, which gives these parameters a completely different meaning in this measurement method compared with other measurement methods.



33 *The measuring signal of ion-selective electrodes depends on the concentration*

A Real curve
B Ideal curve

Within this range, the following applies for the correlation between the logarithm of the concentration and the measured voltage:

$$E = E_0 + S \cdot \log\left\{\frac{c}{1\ \text{mol/l}}\right\}$$

E ... measured voltage
E_0 ... voltage at concentration of 1 mol/l
S ... slope of electrode in mV/mol

Single-point calibration

You use a calibration solution with a known concentration.

1. Open the menu: **CAL/ISE/1-pnt. calibration**.
2. Select the electrode to be calibrated and ▷ **Start calibration**.
   ↳ A question is displayed: **Do you know the measured value of the reference medium?**
3. Respond by selecting ▷ **Yes**.
4. **Reference value**: Enter the value of the buffer.

5. Follow the software instructions, and immerse the sensor in the buffer.

During the calibration, move the sensor in the tank to ensure the necessary flow of medium to the ion-selective electrode.

6. ▷ **Continue**.
7. **OK**: Start calibration.
   ↳ The system starts calculating the measured value for the buffer. Once the stability criterion is met, the measured value is displayed in mV.
8. Respond to the prompt to accept the calibration data for adjustment by selecting **Yes**.
9. Return the sensor to the medium and press **OK** again.
   ↳ This deactivates the hold and the system starts measuring again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Two-point calibration

Remove the sensor from the medium for calibration.

1. Open the menu: **CAL/ISE/2-pnt. calibration**.
2. Select the electrode to be calibrated and ▷ **Start calibration**.
3. Follow the instructions of the software.
4. Immerse the sensor in the first calibration solution and, once the measured value has stabilized, press **OK**.
   ↳ The sensor starts calculating the measured value. Once the stability criterion is met, the measured value is displayed.
5. Continue to follow the instructions.
6. Immerse the sensor in the second calibration solution and, once the measured value has stabilized, press **OK**.
   ↳ The sensor starts calculating the measured value. Once the stability criterion is met, the measured values of the two calibration solutions and the calculated values for the slope and zero point are displayed.
7. Respond to the prompt to accept the calibration data for adjustment by selecting **Yes** .
8. Return the sensor to the medium and press **OK** again.
   ↳ This deactivates the hold and the system starts measuring again.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Data entry

You enter the slope and zero point manually. The calibration function is calculated from these values. Thus, the data entry returns the same result as two-point calibration. You must determine the slope and zero point in an alternative way.

1. Open the menu: **CAL/ISE/Numeric input**.
2. Select the electrode to be calibrated and ▷ **Start calibration**.
   ↳ The slope and zero point are shown on the display.
3. Select each value one after the other and enter value.
4. Then ▷ **Accept calibration data**.
   ↳ Since you are entering all the variables directly, no additional information is displayed by the controller.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.9.4 ORP

Single-point calibration with calibration buffers

With this type of calibration, you work with calibration buffers, e.g. ORP buffers from Endress+Hauser. For this calibration, you remove the sensor from the medium.

1. Open the menu: **CAL/ISE/ORP/1-pnt. calibration**.
2. Select the ORP sensor and ▷ **Start calibration**.
3. **Buffer:**: Enter the value of the buffer.
4. ▷ **Continue**.
5. Follow the software instructions, and immerse the sensor in the buffer.
6. **OK**: Start calibration.
   ↳ The system starts calculating the measured value for the buffer. Once the stability criterion is met, the measured value is displayed in mV.
7. Accept the calibration data and then return to the measuring mode.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

19.9.5 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibration is invalid. Do you want to start a new calibration? Slope out of tolerance. Zeropoint out of tolerance. Sample concentration too low.	The calibration buffer is contaminated or the pH value is no longer within the permitted limits. As a result, the permitted measured value deviation is exceeded. 1. Check the expiry date 2. Use a fresh buffer Incorrect buffers used. As a result, the buffer recognition function - for example - does not work correctly. 1. pH values of the buffers are too close together, e.g. pH 9 and 9.2 2. Use buffers with a larger pH difference Sensor aging or contaminated. As a result, the permitted limit values for the slope and/or zero point are exceeded 1. Clean sensor 2. Adjust the limit values 3. Regenerate or replace the sensor
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value or temperature is not stable. As a result, the stability criterion is not met. 1. Keep the temperature constant during calibration 2. Replace the buffer 3. Clean or regenerate aged or contaminated sensor 4. Adjust stability criteria → 📄 114.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.10 Turbidity and solids sensors

19.10.1 Sensor for turbidity and solids content (CUS51D)

The sensor is precalibrated on leaving the factory. As such, it can be used in a wide range of applications (e.g. clear water measurements) without the need for additional calibration. The **Kaolin** and **Formazine** applications are already fully calibrated and can be used without any further calibration.

All other applications are precalibrated with reference samples and require calibration to the corresponding application.

In addition to the factory calibration data, which cannot be modified, the sensor has five other data records to be used for storing process calibrations.

Operating Instructions Turbimax CUS51D, BA00461C

All information regarding the range of applications, recommended calibration types, sampling, handling and use of the sensor during calibration and reference measurement can be found in the Operating Instructions for the sensor.

One to five points can be calibrated for each application.

Opening the calibration menu

1. Press **CAL**.
2. <Channel no.>: select **TU/TS**.

Creating a calibration data record

1. Perform a single-point or multi-point calibration.
   ↳ A new calibration data record is created.
2. *Alternatively:*
   Duplicate an existing data record.

One-point or multiple point calibration

If possible, start the calibration at the same time as the sampling procedure and enter the laboratory value of the sample as the set point. If no laboratory value is available during calibration, enter an approximate value as the set point. As soon as the laboratory value is available, amend the set point on the transmitter.

From Liquiline-software version 01.06.04:

1. Select an empty data record (identified by an empty box before the name, e.g. **Dataset1**).
2. **Dataset name**: Assign a name to the data record.
3. **Basic application**: Select application.
4. **Unit**: Select unit.
5. **Calibration table**: Select table.
6. **Add calibration points**: Select function.
7. Confirm prompts (start calibration, clean sensor): **OK**.
8. Enter reference value (set point).
9. Where necessary, select **Calibrate next assay**.
10. Once you have determined the last measuring point:
    Accept calibration data.
    ↳ A message is displayed informing you whether the data record is valid.
11. Confirm prompt (clean sensor): **OK**.
    ↳ Decide if you wish to activate the calibrated data record.

Only set points can be changed in the case of activated data records. It is then no longer possible to delete measuring points.

Duplicating a data record

1. **Duplicate dataset**: Start function.
2. **Copy from**: Select source data record.
3. **Copy to**: Select target data record.
4. **Dataset name**: Enter a name for the duplicated record.
5. **Duplicate dataset**.

Editing a data record

You can apply a factor or an offset to the data records created. This factor or offset is determined by means of a reference measurement. In addition, the active table can be also edited or extended to include additional calibration points.

Editing options:
- Factor/offset
  - Data input (offset)
  - Data input (factor)
- Edit table
  - Add calibration points
  - Substitute calib. point

▶ Factor/offset

1. **▶ Data input (offset)**
2. **Offset**: Enter offset from reference measurement.
3. ▷ **Accept calibration data**.

1. **▶ Data input (factor)**
2. **Cal. factor**: Enter the factor calculated from the measured value and reference value.
3. ▷ **Accept calibration data**.

▶ Calibration table

1. ▷ **Edit table**
   ↳ You will receive a warning if the data record is the one that is currently active. Take note of this warning before continuing.
2. **OK**: Adjust values.
3. **SAVE**.

Adding a calibration point

1. ▷ **Add calibration points**
   ↳ You will receive a warning if the data record is the one currently active for the measurement. Adding calibration points can result in invalid data.
2. **OK**: Add additional calibration points.
3. Immerse the sensor in the calibration solution, and wait for the measured value to stabilize.
4. Enter set point.
5. Add additional points or ▷ **Accept calibration data**.

Calibration points can also be added to the table by entering data for target and actual values (**INSERT**).

Replacing a calibration point

You can replace a calibration point if is regarded as valid.

6. ▷ **Substitute calib. point**
   ↳ Prompt, asking if calibration should be started.
7. **OK**.
8. Immerse the sensor in the calibration solution, and wait for the measured value to stabilize.
9. Select the point to be replaced.
10. ▷ **Accept calibration data**.

Measurement filter

Measured value filter	Description
Weak	Low filtering, high sensitivity, fast response time
Normal (factory setting)	Medium filtering
Strong	Strong filtering, low sensitivity, slow response to changes

1. **Configuration method**: Select **Standard**.
2. **Filter level**: Select in accordance with the above table.
3. ▷ **Accept calibration data**.

Configuration method = **Specialist**

The individual parameters for filtering must be entered here. This task should be left to Endress+Hauser Service.

Editing the name of the sample set

1. **Dataset name**: Enter the desired name.
2. ▷ **Accept calibration data**.

19.10.2 Turbidity sensor for drinking water applications (CUS52D)

The sensor is precalibrated on leaving the factory. As such, it can be used in a wide range of applications without the need for additional calibration. The **Formazine** application is already fully calibrated and can be used without any further calibration.

All other applications are precalibrated with reference samples and require calibration to the corresponding application.

In addition to the factory calibration data, which cannot be modified, the sensor has six other data records to be used for storing process calibrations.

Operating Instructions Turbimax CUS52D, BA01275C

All information regarding the range of applications, recommended calibration types, sampling, handling and use of the sensor during calibration and reference measurement can be found in the Operating Instructions for the sensor.

One to six points can be calibrated for each application.

Opening the calibration menu

1. Press **CAL**.
2. <Channel no.>: Select **TU**.

Creating a calibration data record

1. Perform a single-point or multi-point calibration.
   ↳ A new calibration data record is created.
2. *Alternatively:*
   Duplicate an existing data record.

One-point or multiple point calibration

If possible, start the calibration at the same time as the sampling procedure and enter the laboratory value of the sample as the set point. If no laboratory value is available during calibration, enter an approximate value as the set point. As soon as the laboratory value is available, amend the set point on the transmitter.

From Liquiline-software version 01.06.04:

1. Select an empty data record (identified by an empty box before the name, e.g. **Dataset1**).
2. **Dataset name**: Assign a name to the data record.
3. **Basic application**: Select application.
4. **Unit**: Select unit.
5. **Calibration table**: Select table.
6. **Add calibration points**: Select function.
7. Confirm prompts (start calibration, clean sensor): **OK**.
8. Enter reference value (set point).
9. Where necessary, select **Calibrate next assay**.
10. Once you have determined the last measuring point:
    Accept calibration data.
    ↳ A message is displayed informing you whether the data record is valid.
11. Confirm prompt (clean sensor): **OK**.
    ↳ Decide if you wish to activate the calibrated data record.

Only set points can be changed in the case of activated data records. It is then no longer possible to delete measuring points.

Activating a data record at a later time

1. **Menu/Setup/Inputs/TU/Application**: Select application.
2. If the application is selected correctly:
   Select data record.

Duplicating a data record

1. **Duplicate dataset**: Start function.
2. **Copy from**: Select source data record.
3. **Copy to**: Select target data record.
4. **Dataset name**: Enter a name for the duplicated record.
5. **Duplicate dataset**.

Editing a data record

You can apply a factor or an offset to the active data record. This factor or offset is determined by means of a reference measurement. In addition, the active table can be also edited or extended to include additional calibration points.

Editing options:
- Factor/offset
  - Data input (offset)
  - Data input (factor)
- Edit table
  Add calibration points

▶ Factor/offset

1. **▶ Data input (offset)**
2. **Offset**: Enter offset from reference measurement.
3. ▷ **Accept calibration data**.

1. **▶ Data input (factor)**
2. **Cal. factor**: Enter the factor calculated from the measured value and reference value.
3. ▷ **Accept calibration data**.

▶ Calibration table

1. ▷ **Edit table**
   ↳ You will receive a warning if the data record is the one that is currently active. Take note of this warning before continuing.
2. **OK**: Adjust values.
3. **SAVE**.

Adding a calibration point

1. ▷ **Add calibration points**
   ↳ You will receive a warning if the data record is the one currently active for the measurement. Adding calibration points can result in invalid data.
2. **OK**: Add additional calibration points.
3. Immerse the sensor in the calibration solution, and wait for the measured value to stabilize.
4. Enter set point.
5. Add additional points or ▷ **Accept calibration data**.

Calibration points can also be added to the table by entering data for target and actual values (**INSERT**).

Assembly adjustment

Both the optical design of the CUS52D turbidity sensor and the CUA252 and CUA262 flow assemblies are optimized to minimize measured errors from the effects of walls in assemblies or pipes (measured error in CUA252 < 0.02 FNU).

The **Assembly adjustment** function can automatically compensate for the remaining measured errors caused by wall effects. The functionality is based on formazine measurements and may thus require a calibration downstream in order to adapt the measurement to the corresponding application or medium.

Adjustment	Description
PE100	Adjustment to CUA252 flow assembly (material: polyethylene)
1.4404 / 316L	Adjustment to CUA262 weld-in flow assembly (material: stainless steel 1.4404)
Customized	Adjustment to any pipe/assembly
Customized advanced	Adjustment only recommended for Endress+Hauser Service staff

- **PE100** and **1.4404 / 316L**
  All of the parameters are assigned default values in the firmware and cannot be changed.
- **Customized**
  It is possible to select the material, surface (matte/shiny) and the internal diameter of the assembly in which the sensor is installed.
- **Customized advanced**
  For special adjustments, the following table provides recommendations. Alternatively, adjustments can be performed by the manufacturer's service department.

Assembly/pipe built-in adapter	Zero adjustment	Upper limit	Adjustment characteristic
CUA250 [1)]	0.14	33	1.001
CYA251 [1)]	0.075	25	1.5
VARIVENT N DN 65	1.28	500	6
VARIVENT N DN 80	0.75	500	6
VARIVENT N DN 100	0.35	500	6
VARIVENT N DN 125	0.20	500	6

1) Sensor adapter required for the installation of CUS52D in this assembly, see the Operating Instructions for the sensor

Performing an assembly adjustment

1. Open the function: .../**TU**/**Assembly adjustment**.
2. Select adjustment.
3. ▷ **Accept calibration data**.

Editing the name of the sample set

1. **Dataset name**: Enter the desired name.
2. ▷ **Accept calibration data**.

19.10.3 Absorption sensor for the measurement of turbidity and suspended solids (CUS50D)

The "Absorption" and "Formazine" applications are calibrated at the factory. The absorption factory calibration is used as the basis for precalibrating additional applications and optimizing them for the different media characteristics.

Application	Specified operating range
Factory calibration for absorption	0.000 to 5.000 AU or 0.000 to 10.000 OD
Factory calibration for formazine	40 to 4,000 FAU
Application: Kaolin	0 to 60 g/l
Application: Sludge	0 to 25 g/l
Application: Auto sludge	0 to 25 g/l
Product loss	0 to 100 %

To adapt to a specific application, it is possible to perform customer calibrations with up to 10 points.

Factory calibration for the formazine application is carried out with the formazine turbidity standard.

Sensor measured values in the unit [FAU] are only comparable to the measured values of any other sensor e.g. scattered light sensor with the unit [FNU] or [NTU] in this standard medium. In any other medium, the measured values will be different to those obtained when measuring with another scattered light sensor.

The absorption and formazine applications are calibrated at the factory. All other applications are merely precalibrated and must therefore be adapted to the corresponding application and medium.

The sensor has 8 data records. Six of these are prepopulated at the factory with sample data records, i.e. typical settings, for all available applications:
- Absorption
- Formazine
- Kaolin
- Sludge
- Auto sludge
- Product loss

The desired data record is activated by selecting the corresponding application. It can be adapted to that application using the following options:
- Calibration (1 to 10 points)
- Entering of a factor (multiplication of measured values by a constant factor)
- Entering of an offset (addition/subtraction of a constant factor to/from the measured values)
- Duplication of factory calibration data records

Further data records can be created in the sensor and adapted to the application by means of calibration or by entering a factor or offset. Two free, unused data records are available for this. The number of free data records can be increased if necessary by deleting (sample) data records that are not required. The sample data records are restored to factory status when the sensor is reset.

Operating Instructions Turbimax CUS50D, BA01846C

All information regarding the range of applications, recommended calibration types, sampling, handling and use of the sensor during calibration and reference measurement can be found in the Operating Instructions for the sensor.

Opening the calibration menu

1. Press **CAL**.
2. <Channel no.>: Select **TU/AU**.

Single-point or multi-point calibration for data records already created

If possible, start the calibration at the same time as the sampling procedure and enter the laboratory value of the sample as the set point. If no laboratory value is available during calibration, enter an approximate value as the set point. As soon as the laboratory value is available, amend the set point on the transmitter.

From Liquiline-software version 01.06.04:

1. Select sample data record (e.g. **Absorption**).
2. **Calibration table**: Select table.
3. **Add calibration points**: Select function.
4. Confirm prompts (start calibration, clean sensor): **OK**.
5. Enter reference value (set point).
6. Where necessary, select **Calibrate next assay**.

7. Once you have determined the last measuring point:
   Accept calibration data.
   ↳ A message is displayed informing you whether the data record is valid.
8. Confirm prompt (clean sensor): **OK**.
   ↳ Decide if you wish to activate the calibrated data record.

Only set points can be changed in the case of activated data records. It is then no longer possible to delete measuring points.

Single-point or multi-point calibration for empty data records

1. Select empty data record (identified by empty box before the name, e.g. **Dataset7**).
2. **Dataset name**: Assign a name to the data record.
3. **Basic application**: Select application.
4. **Measurement path**: Select path length.
5. **Unit**: Select unit.
6. **Calibration table**: Select table.
7. **Add calibration points**: Select function.
8. Confirm prompts (start calibration, clean sensor): **OK**.
9. Enter reference value (set point).
10. Where necessary, select **Calibrate next assay**.
11. Once you have determined the last measuring point:
    Accept calibration data.
    ↳ A message is displayed informing you whether the data record is valid.
12. Confirm prompt (clean sensor): **OK**.
    ↳ Decide if you wish to activate the calibrated data record.

Once you have activated the data record you can only change the set points. It is then no longer possible to delete measuring points.

Activating a data record at a later time

1. Select application: **Menu/Setup/Inputs/TU/AU/Application**.
2. If the application is selected correctly:
   Select data record.

Duplicating a data record

1. **Duplicate dataset**: Start function.
2. **Copy from**: Select source data record.
3. **Copy to**: Select target data record.
4. **Dataset name**: Enter a name for the duplicated record.
5. **Duplicate dataset**.

Editing a data record

You can apply a factor or an offset to the active data record. This factor or offset is determined by means of a reference measurement. In addition, the active table can be also edited or extended to include additional calibration points.

Editing options:
- Factor/offset
  - Data input (offset)
  - Data input (factor)
- Edit table
  Add calibration points

▶ **Factor/offset**

1. ▶ **Data input (offset)**
2. **Offset**: Enter offset from reference measurement.
3. ▷ **Accept calibration data**.

1. ▶ **Data input (factor)**
2. **Cal. factor**: Enter the factor calculated from the measured value and reference value.
3. ▷ **Accept calibration data**.

▶ **Calibration table**

1. ▷ **Edit table**
   ↳ You will receive a warning if the data record is the one that is currently active. Take note of this warning before continuing.
2. **OK**: Adjust values.
3. **SAVE**.

Adding a calibration point

1. ▷ **Add calibration points**
   ↳ You will receive a warning if the data record is the one currently active for the measurement. Adding calibration points can result in invalid data.
2. **OK**: Add additional calibration points.
3. Immerse the sensor in the calibration solution, and wait for the measured value to stabilize.
4. Enter set point.
5. Add additional points or ▷ **Accept calibration data**.

Calibration points can also be added to the table by entering data for target and actual values (**INSERT**).

Measurement filter

Measured value filter	Description
Weak	Low filtering, high sensitivity, fast response time
Normal (factory setting)	Medium filtering
Strong	Strong filtering, low sensitivity, slow response to changes

1. **Configuration method**: Select **Standard**.
2. **Filter level**: Select in accordance with the above table.
3. ▷ **Accept calibration data**.

Configuration method = **Specialist**

The individual parameters for filtering must be entered here. This task should be left to Endress+Hauser Service.

Air bubble trap

In addition to the measured value filter, the sensor also features a filter function to suppress the measured errors caused by air bubbles.

Air bubbles cause the measured value to increase in liquids with low turbidity or with a low solids content. The filter function cuts off these measured value peaks by outputting the minimum value within a specified time interval. The time interval can be configured using a numerical value between 0 and 180 seconds. The air bubble trap is disabled (value 0) by default. Enabling the air bubble trap in the case of liquids with high turbidity or high solids content is not of any benefit. Air bubbles do not cause the measured value to increase in media of this type and thus cannot be eliminated with the minimum filter.

1. **Bubble suppression filter**: Select function.
2. ▷ **Accept calibration data**.

Editing the name of the sample set

1. **Dataset name**: Enter the desired name.
2. ▷ **Accept calibration data**.

19.10.4 Error messages during calibration (all sensors)

Display message	Causes and possible remedial measures
The calibrated dataset is invalid. Do you want to restart the calibration?	Calibration point not plausible 1. Repeat calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Exchange the calibration medium 5. Clean any dirt from the sensor
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value or temperature is not stable. As a result, the stability criterion is not met. 1. Keep the temperature constant during calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Clean any dirt from the sensor 5. Adjust stability criteria → 🖹 86.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.11 SAC sensors

19.11.1 Types of calibration

In addition to the factory calibrations, which cannot be changed, the sensor contains six additional data records for storing process calibrations or for adaptation to the relevant

measuring point (application). Each calibration data record can have up to five calibration points.

The sensor offers a wide range of options for adapting the measurement to the application in question:
- Calibration or adjustment (1 to 5 points)
- Entry of a factor (multiplication of measured values by a constant factor)
- Entry of an offset (addition/subtraction of a constant factor to/from the measured values)
- Duplication of factory calibration data records

One-point or multiple point calibration

Do not remove the sensor from the medium for calibration purposes; it can be calibrated directly in the application.

1. For the calibration, ensure that the measuring gap is not soiled with deposit buildup:
   Clean the measuring gap of the sensor (remove soiling and deposits).
2. To perform the calibration, immerse the sensor in the medium in such a way that the measuring gap is completely filled with the medium.
   ↳ All air bubbles and air pockets must be cleaned out of the measuring gap during immersion.

- In the calibration table, the actual values can be edited as well as the set points (right and left columns).
- Additional pairs of calibration values (actual values and set points) can be added, if required, even without measurement in a medium.

19.11.2 SAC

Factory calibration

The sensor is precalibrated on leaving the factory (calibrated with KHP).
Calibration to the customer process is nevertheless advantageous in the majority of cases.
Reason: Organic compounds other than KHP react differently in the spectrum.

The factory calibration is based on 20 calibration points and is adjusted at three points during production. The factory calibration cannot be deleted and can be retrieved at any time. Single-point and two-point calibrations - performed as customer calibrations - are referenced to this factory calibration.

Principle of calibration

Lines interpolate between the calibration points.

▶ Give your calibration data records meaningful and useful names.

For example, the name can contain the name of the application on which the data record was originally based. This makes it easier to distinguish between different data records.

Determining the reference values in the laboratory

Different methods are available for the calibration:
- Serial dilution of a medium sample
- Serial calibration with standard solutions (KHP = potassium hydrogen phthalate)
- Combination of both (medium sample with added standard)

1. Take a representative sample of the medium.
2. Take suitable measures to ensure that the process of biological and chemical reduction in the sample does not progress any further.

3. Determine the measured values of your sample array using the laboratory method (for example, by colorimetric means using a cuvette test).

Calibration and adjustment of the sensor

To calibrate the sensor, use the same medium sample or sample array that was used to determine the laboratory measured values. The sample array can also be pure standard solutions.

The general sequence of a calibration is as follows:

1. Select data record.
2. Place sensor in medium.
3. During calibration, ensure that the medium is well homogenized.
4. Start the calibration for the measuring point.
5. If only one point should be calibrated:
   End the calibration by accepting the calibration data.
   ↳ Otherwise continue with the next step.
6. Add parent solution to the sample for the 2nd measuring point.
7. Determine the measured value.
8. Calculate the reference value from the laboratory measured value plus the added concentration.
9. Repeat the previous step as often as needed until you have reached the desired number of calibration points (maximum 5).

To avoid incorrect calibration from carryover:
- Always go from a low concentration to a high concentration.
- Clean and dry the sensor after each measurement.
- Make sure to remove medium residue in the sensor gap and in the connection opening for the compressed air (e.g. by rinsing with the next calibration solution).

Calibration on the transmitter

1. **CAL**: Select sensor and open its calibration menu.
2. **Dataset**: Select data record. This must not be the active data record (identifiable by a marker in front of the data record name).
3. **Dataset name**: Assign a name to the data record.
4. **Basic application**: Decide which value you want to calibrate. **SAC**, **COD**, **TOC**, **DOC** or **BOD** are available for selection.
   ↳ Only if **Basic application** = **SAC**:
   The transmitter can determine the derived variables COD, TOC, DOC and BOD from the SAC value. Different calculation factors exist for this depending on the reference method. You can adapt the calculation factor saved at the factory for COD/BOD and TOC/DOC to your application and also enter an SAC offset.
5. **Unit**: Select the unit. Use the unit in which you also obtained the laboratory values.
6. ▷ **Start calibration**: Follow the instructions to record the first measuring point (lowest concentration).
   ↳ Once a stable measured value has been determined, you will be asked for the set point (=laboratory value) of the sample.
7. Enter set point.
8. Decide whether you want to add another calibration point (**Calibrate next assay**) or whether you want to end the calibration and accept the data for adjustment (**Take over the calibration data?**).
9. Determine all the desired measuring points.

10. Once you have determined the last measuring point:
    Accept data.
    ↳ A message is displayed informing you whether the data record is valid.
11. Respond to the prompt to accept the calibration data for adjustment by selecting **OK**.
    ↳ You are asked whether you want to activate the data record just recorded. If you select **OK**, the measured values are calculated on the basis of the new calibration function.

You still have the possibility of editing the data record.

Once you have activated the data record you can only change the set points. It is then no longer possible to delete measuring points.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Editing data records

You can apply a factor or an offset to the active data record. This factor or offset is determined by means of a reference measurement. In addition, the active table can be also edited or extended to include additional calibration points.

Editing options:
- Edit offset
- Edit factor
- Edit table
- Start calibration
- Substitute calib. point

▶ Edit offset

1. **Offset**: Enter offset from reference measurement.
2. ▷ **Accept calibration data**.

▶ Edit factor

1. **Cal. factor**: Enter the factor calculated from the measured value and reference value.
2. ▷ **Accept calibration data**.

▷ Edit table

You will receive a warning indicating that the data record is the one that is currently active. Take note of this warning before continuing.

1. **OK**: Adjust values.
2. **SAVE**.

▷ Start calibration

You will receive a warning indicating that the data record is the one currently active for the measurement. Adding calibration points can result in invalid data. If you proceed, the factory calibration automatically becomes active for the current measurement.

1. **OK**: Add additional calibration points.
2. Immerse sensor in calibration solution, and wait for the measured value to stabilize.
3. Enter set point.
4. Add additional points or ▷ **Accept calibration data**.

▷ Substitute calib. point

You can replace a calibration point if is regarded as valid.

1. Respond to prompt asking if calibration should be started by selecting **OK**.

2. Immerse sensor in calibration solution, and wait for the measured value to stabilize.
3. Select the point to be replaced.
4. ▷ **Accept calibration data**.

Duplicating data records

This function makes it possible to edit an existing calibration data record, such as the factory calibration, for example.

By entering appropriate data you can then configure an offset for the copied data record or change the nominal values using a table. This provides a quick and easy way to react to modified conditions in your process which you are aware of without the need for calibration.

1. **Duplicate dataset**: Start function.
2. Select data record to be duplicated.
3. Select memory location and enter a name for the duplicated record.
   ↳ You can only duplicate a record if you have not yet used all the available space for data records. If no more room is available you must first delete a data record.

You can now:
- Configure an offset for the new data record
- Change the nominal values of the individual calibration points via the function **Edit table**.

4. If you want to use the modified data record as the active data record:
   Open the menu **Setup/Inputs**.
5. Select the new data record under **Application**.

19.11.3 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL**/<Sensor type>/**Temperature adjustment**.
3. **Leave the sensor in the process medium** and keep clicking **OK** until temperature measurement is started via the sensor.
4. Enter the reference temperature from the alternative measurement. You can either enter the absolute value or an offset for this purpose.
5. Then keep clicking **OK** until the new data have been accepted.
   ↳ This completes the temperature adjustment.

19.11.4 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibrated dataset is invalid. Do you want to restart the calibration?	Calibration point not plausible 1. Repeat calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects, air bubbles, etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Exchange the calibration medium 5. Clean any dirt from the sensor
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value or temperature is not stable. As a result, the stability criterion is not met. 1. Keep the temperature constant during calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects, air bubbles, etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Clean any dirt from the sensor 5. Adjust stability criteria → 94.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.12 Nitrate sensors

Processes with nitrate values > 0.1 mg/l

1. Take sample and determine nitrate concentration in the laboratory.
2. Calibrate and adjust the sensor using the laboratory value.

Processes with very different nitrate values

1. At time A, take a sample with a high concentration, and measure and calibrate the sample.
2. At time B - which can be a few days later - take a sample with a low concentration, and measure and calibrate the second value.

Calibration with the addition of standard

If the sludge parameters tend to be constant, you can perform the calibration with a sample with a low concentration of nitrate and then add standard to the sample.

1. Take a larger sample (bucket) and analyze some of it by colorimetric means.
2. Calibrate the value of the calorimetric measurement in the sensor.
3. Add standard to the sample and determine the laboratory value.
4. Calibrate the laboratory value of the sample with added standard in the sensor.

Avoid incorrect measurements:
- Drinking water may contain higher concentrations of nitrate and is not suitable as a blank value. Use fully deionized water as a blank value.
- During calibration, make sure the sample is homogeneous.
- When calibrating, start with a low concentration and increase the concentrations gradually to prevent nitrate carryover.
- Clean and dry the sensor after a calibration. Ensure that there is no medium residue in the cuvette gap. In this way, you avoid mixing the different samples and changing the nitrate concentrations.

19.12.1 Types of calibration

In addition to the factory calibrations, which cannot be changed, the sensor contains six additional data records for storing process calibrations or for adaptation to the relevant measuring point (application). Each calibration data record can have up to five calibration points.

The sensor offers a wide range of options for adapting the measurement to the application in question:
- Calibration or adjustment (1 to 5 points)
- Entry of a factor (multiplication of measured values by a constant factor)
- Entry of an offset (addition/subtraction of a constant factor to/from the measured values)
- Duplication of factory calibration data records

One-point or multiple point calibration

Do not remove the sensor from the medium for calibration purposes; it can be calibrated directly in the application.

1. For the calibration, ensure that the measuring gap is not soiled with deposit buildup:
   Clean the measuring gap of the sensor (remove soiling and deposits).
2. To perform the calibration, immerse the sensor in the medium in such a way that the measuring gap is completely filled with the medium.
   ↳ All air bubbles and air pockets must be cleaned out of the measuring gap during immersion.

- In the calibration table, the actual values can be edited as well as the set points (right and left columns).
- Additional pairs of calibration values (actual values and set points) can be added, if required, even without measurement in a medium.

19.12.2 Nitrate

Factory calibration

The sensor is precalibrated on leaving the factory.
As such, it can be used in a wide range of clear water measurements without the need for additional calibration.

The factory calibration is based on 20 calibration points and is adjusted at three points during production. The factory calibration cannot be deleted and can be retrieved at any time. Single-point and two-point calibrations - performed as customer calibrations - are referenced to this factory calibration.

Principle of calibration

Lines interpolate between the calibration points.

▶ Give your calibration data records meaningful and useful names.

For example, the name can contain the name of the application on which the data record was originally based. This makes it easier to distinguish between different data records.

Determining the reference values in the laboratory

1. Take a representative sample of the medium.
2. Take suitable measures to ensure that the process of nitrate reduction in the sample does not progress any further, such as immediate filtration (0.45 µm) of the sample as per DIN 38402.
3. Determine the concentration of nitrate in the sample using the laboratory method (for example, by colorimetric means using a cuvette test - the standard method as per DIN 38405 Part 9).

Calibration and adjustment of the sensor

To calibrate the sensor, use the same medium sample or sample array that was used to determine the laboratory measured values. The sample array can also be pure standard solutions.

The general sequence of a calibration is as follows:

1. Select data record.
2. Place sensor in medium.
3. During calibration, ensure that the medium is well homogenized.
4. Start the calibration for the measuring point.
5. If only one point should be calibrated:
   End the calibration by accepting the calibration data.
   ↳ Otherwise continue with the next step.
6. Add parent solution to the sample for the 2nd measuring point.
7. Determine the measured value.
8. Calculate the reference value from the laboratory measured value plus the added concentration.
9. Repeat the previous step as often as needed until you have reached the desired number of calibration points (maximum 5).

To avoid incorrect calibration from carryover:
- Always go from a low concentration to a high concentration.
- Clean and dry the sensor after each measurement.
- Make sure to remove medium residue in the sensor gap and in the connection opening for the compressed air (e.g. by rinsing with the next calibration solution).

Calibration on the transmitter

1. **CAL**: Select sensor and open its calibration menu.
2. **Dataset**: Select data record. This must not be the active data record (identifiable by a marker in front of the data record name).
3. **Dataset name**: Assign a name to the data record.
4. **Unit**: Select the unit. Use the unit in which you also obtained the laboratory values.
5. ▷ **Start calibration**: Follow the instructions to record the first measuring point (lowest concentration).
   ↳ Once a stable measured value has been determined, you will be asked for the set point (=laboratory value) of the sample.
6. Enter set point.

7. Decide whether you want to add an additional value (next highest concentration, **Calibrate next assay**) or whether you want to end the calibration and accept the data for adjustment (**Take over the calibration data?**).
8. Determine all the desired measuring points.
9. Once you have determined the last measuring point:
   Accept data.
   ↳ A message is displayed informing you whether the data record is valid.
10. Respond to the prompt to accept the calibration data for adjustment by selecting **OK**.
    ↳ You are asked whether you want to activate the data record just recorded. If you select **OK**, the measured values are calculated on the basis of the new calibration function.

You still have the possibility of editing the data record.

Once you have activated the data record you can only change the set points. It is then no longer possible to delete measuring points.

You can cancel the calibration any time by pressing **ESC**. No data are then used to adjust the sensor.

Editing data records

You can apply a factor or an offset to the active data record. This factor or offset is determined by means of a reference measurement. In addition, the active table can be also edited or extended to include additional calibration points.

Editing options:
- Edit offset
- Edit factor
- Edit table
- Start calibration
- Substitute calib. point

▶ Edit offset

1. **Offset**: Enter offset from reference measurement.
2. ▷ **Accept calibration data**.

▶ Edit factor

1. **Cal. factor**: Enter the factor calculated from the measured value and reference value.
2. ▷ **Accept calibration data**.

▷ Edit table

You will receive a warning indicating that the data record is the one that is currently active. Take note of this warning before continuing.

1. **OK**: Adjust values.
2. **SAVE**.

▷ Start calibration

You will receive a warning indicating that the data record is the one currently active for the measurement. Adding calibration points can result in invalid data. If you proceed, the factory calibration automatically becomes active for the current measurement.

1. **OK**: Add additional calibration points.
2. Immerse sensor in calibration solution, and wait for the measured value to stabilize.
3. Enter set point.
4. Add additional points or ▷ **Accept calibration data**.

▷ **Substitute calib. point**

You can replace a calibration point if is regarded as valid.

1. Respond to prompt asking if calibration should be started by selecting **OK**.
2. Immerse sensor in calibration solution, and wait for the measured value to stabilize.
3. Select the point to be replaced.
4. ▷ **Accept calibration data**.

Duplicating data records

This function makes it possible to edit an existing calibration data record, such as the factory calibration, for example.

By entering appropriate data you can then configure an offset for the copied data record or change the nominal values using a table. This provides a quick and easy way to react to modified conditions in your process which you are aware of without the need for calibration.

1. **Duplicate dataset**: Start function.
2. Select data record to be duplicated.
3. Select memory location and enter a name for the duplicated record.
   ↳ You can only duplicate a record if you have not yet used all the available space for data records. If no more room is available you must first delete a data record.

You can now:
- Configure an offset for the new data record
- Change the nominal values of the individual calibration points via the function **Edit table**.

4. If you want to use the modified data record as the active data record:
   Open the menu **Setup/Inputs**.
5. Select the new data record under **Application**.

19.12.3 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. Open the menu: **CAL**/<Sensor type>/**Temperature adjustment**.
3. **Leave the sensor in the process medium** and keep clicking **OK** until temperature measurement is started via the sensor.
4. Enter the reference temperature from the alternative measurement. You can either enter the absolute value or an offset for this purpose.
5. Then keep clicking **OK** until the new data have been accepted.
   ↳ This completes the temperature adjustment.

19.12.4 Error messages when performing the calibration

Display message	Causes and possible remedial measures
The calibrated dataset is invalid. Do you want to restart the calibration?	Calibration point not plausible 1. Repeat calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects, air bubbles, etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Exchange the calibration medium 5. Clean any dirt from the sensor
The stability criterion is not fulfilled. Do you want to repeat the last step?	The measured value or temperature is not stable. As a result, the stability criterion is not met. 1. Keep the temperature constant during calibration 2. Check the position of the sensor in the calibration vessel (fixed position, wall effects, air bubbles, etc.) 3. Ensure the medium is mixed thoroughly (e.g. use a magnetic stirrer) 4. Clean any dirt from the sensor 5. Adjust stability criteria → 94.
Calibration aborted. Please clean sensor before immersing in process medium. (Hold will be disabled)	The user has aborted the calibration.

19.13 Spectrometer

Operating Instructions for Memosens Wave CAS80E, BA02005C

The calibration always depends on the application. With the field calibration, you adapt the factory-calibrated spectrometer more accurately to your process. Use calibration points that limit the expected measuring range at the highest and lowest point. This improves the resolution and accuracy of the measurement.

1. **WARNING**

   Mineral acids

   Risk of serious or fatal injury from caustic burns!
   - ▶ Wear goggles to protect eyes.
   - ▶ Wear protective gloves and appropriate protective clothing.
   - ▶ Avoid all contact with the eyes, mouth and skin.

   Clean the optical windows before the calibration (with 5 to 10% H_3PO_4 or 5 to 10% HCl or 5 to 10% H_2SO_4).

2. Take the reference sample (laboratory sample) at the same time and place as the sample for the calibration point of the spectrometer.
3. The following applies for a nitrate reference sample:
   Filter the sample immediately through a 0.45 µm filter (e.g. filter paper or syringe filter). Reason: The nitrate concentration changes quickly if microorganisms are left in the sample.
4. If the sample cannot be measured quickly in the laboratory:
   Set the sample with H_2SO_4 to pH < 2 and preserve it in this way.

5. Check whether the factory calibration demonstrates an acceptable level of accuracy in the required measuring range.
6. If the performance of the spectrometer is not sufficient due to the factory calibration: Perform a factor calibration.
7. If the performance of the spectrometer is not sufficient due to the factor calibration: Perform an offset calibration.
8. If the factor and/or offset calibration cannot be used or is not sufficient: Enter a calibration table.

Calibrating the parameters

1. **CAL**/Channel No. **Spectrometer**/**Spectrometer**/**Application calibration**
2. Select the data record. The factory calibration is preselected.
3. Select the parameter to be calibrated and the associated unit.
4. Select the type of calibration: **Edit factor**, **Edit offset** or **Calibration table**.

19.13.1 Edit factor

This type of calibration can be used if a fixed factor applies between the laboratory and sensor measured value for the entire desired measuring range.

1. **CAL**/Channel No. **Spectrometer**/**Spectrometer**/**Application calibration**/**Edit factor**
2. **Cal. factor**: Enter the factor.
3. ▷ **Accept calibration data**
   ↳ The new factor is saved for the selected parameter.

19.13.2 Edit offset

This type of calibration can be used if the spectrometer deviates from the laboratory measured value. The deviation must apply in the entire desired measuring range.

1. **CAL**/Channel No. **Spectrometer**/**Spectrometer**/**Application calibration**/**Edit offset**
2. **Offset**: Enter the value.
3. ▷ **Accept calibration data**
   ↳ The offset is saved for the selected parameter.

19.13.3 Calibration table

This type of calibration is useful if the factor and/or offset calibration are not sufficient.

1. **CAL**/Channel No. **Spectrometer**/**Spectrometer**/**Application calibration**/**Calibration table**
2. **INSERT**: Specify the calibration point by entering measured values and nominal values.
3. Enter a maximum of 6 calibration points in this way.
4. **SAVE**.
   ↳ If the table is valid, the calibration data are saved for the selected parameter.

19.13.4 Take reference spectrum (zero calibration)

The zero calibration is the reference calibration on which the calculations are based. The spectrometer leaves the factory with a zero calibration performed in ultrapure water.

1. Clean the spectrometer.

2. Record spectrum in ultrapure water: **CAL**/Channel No. **Spectrometer**/**Spectrometer**/**Take reference spectrum**
3. Follow the instructions on the display.

19.13.5 Temperature adjustment

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. **CAL**/Channel No. **Spectrometer**/**Temperature**.
   ↳ You have 2 options: **Edit offset** or **Start calibration**.
3. If you only want to enter a deviation of the sensor value in relation to the reference measurement:
   Edit offset: Enter the deviation in relation to the reference measurement in K.
4. If you want to adjust the temperature sensor by entering a reference temperature:
   Start calibration/**OK**.
5. Leave the sensor in the process medium and select **OK**.
   ↳ Temperature measurement via the sensor is started.
6. Enter the reference temperature from the alternative measurement.
7. ▷ **Continue** and **OK** (several times).
   ↳ This completes the temperature adjustment.

19.14 Fluorescence

19.14.1 Types of calibration

The sensor is precalibrated on leaving the factory. It can be used directly without the need for additional calibration.

The following calibrations are possible:
- Calibration
  - In-situ calibration with the certified solid state reference
  - Recalibration by the manufacturer
- Application adjustment
  - Calibration or adjustment using reference samples via a value table (1-6 points)
  - Entry of a factor (multiplication of the measured values by a constant factor)
  - Entry of an offset (add/subtract a constant value to/from the measured values)

19.14.2 Solid state reference

The sensor is adjusted ex-works in compliance with Resolution MEPC 259(68).

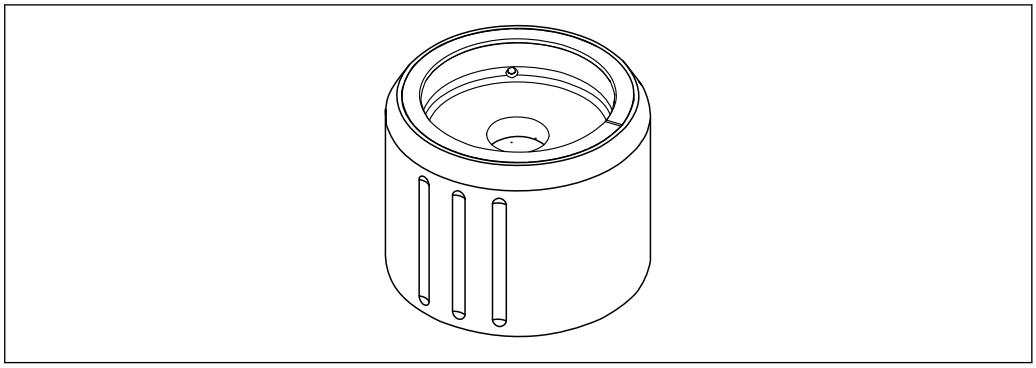
1. To comply with the MEPC 256 (68) criteria, calibrate the sensor at regular intervals using the solid state reference.
2. If necessary, adjust the sensor with the solid state reference.

We recommend you send in the device to the manufacturer every 4 years for inspection and recalibration.

During factory calibration, the solid state reference is adapted to the sensor. The solid state reference can only be used with this sensor. The solid state reference and the sensor are therefore permanently assigned to one another.

The functional integrity of the sensor can be checked using the solid state reference. The sensor can be calibrated and adjusted. Adjustment is performed automatically by the

transmitter following calibration. The reference value indicated by the solid state reference is used to adjust the sensor.



34 *Solid state reference*

Calibration with solid state reference

⚠ CAUTION

High pressure and high temperatures when removing the sensor

Risk of injury!

- ▶ Pay attention to the process pressure and process temperature.
- ▶ If the process pressure is elevated, reduce the process pressure before removing the sensor. Use the manual valve mounted onsite for this purpose.

⚠ CAUTION

Medium leaking

Risk of injury, damage to clothing and the system!

- ▶ Make sure that the inlet and outlet of the assembly are shut off.
- ▶ Make sure that automatic cleaning is switched off before performing the calibration.

NOTICE

Condensation and fouling cause incorrect calibration results!

- ▶ Clean the sensor and the optical windows thoroughly beforehand.
- ▶ Avoid condensation on the sensor.
- ▶ Pay attention to the ambient conditions of the sensor, particularly the ambient temperature range.

For detailed information on transmitter settings, see the Operating Instructions for the transmitter

Pay attention to the following conditions for the calibration:

- No condensation on the sensor or the solid state reference
- Stable temperature of the sensor and the solid state reference
- Compliance with ambient temperature ranges
- Optical windows have been cleaned of dirt

Start calibration

1. Select **Calibration** on the transmitter.
2. Select the fluorescence sensor.
3. Select **Fluorescence**.
4. Select **Solid state reference**.
5. Follow the instructions of the transmitter.

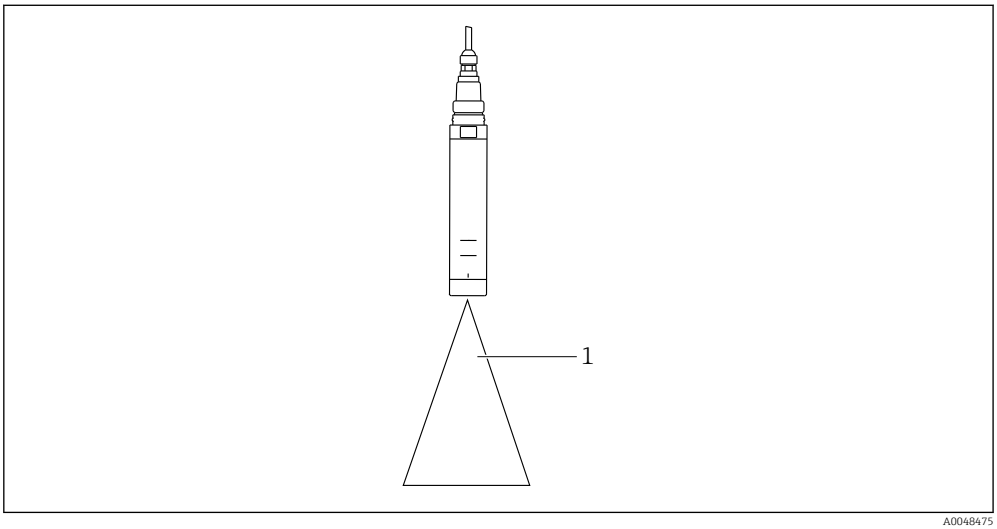
Function check in air:

▶ NOTICE

Objects and items of clothing in front of the optical windows result in incorrect measured values!

▶ Keep a sufficient distance from the device.

▶ Remove any objects below the sensor.



1 Free space

Hold the sensor in the free space.

Failed function check in air:

1. Clean the optical windows again.
2. Repeat the measurement procedure.
3. If the measurement is still outside the specified limits after multiple rounds of cleaning, send the sensor to your local Endress+Hauser sales organization.

Once the process of calibrating with the solid state reference is completed, the following statuses are possible:

- Calibration completed successfully
  The measured value is within the limit values indicated and therefore an automatic adjustment was not necessary
- Calibration completely successfully and automatic adjustment performed
  The measured value has exceeded the limit values and has been successfully corrected by the automatic adjustment
- Calibration has failed, no automatic adjustment has been performed
  The measured value is outside the limit values and an automatic adjustment was not possible. The device is therefore no longer operational according to MEPC.

▶ If the calibration fails, send the sensor in to your Endress+Hauser sales organization.

19.14.3 Factor/offset

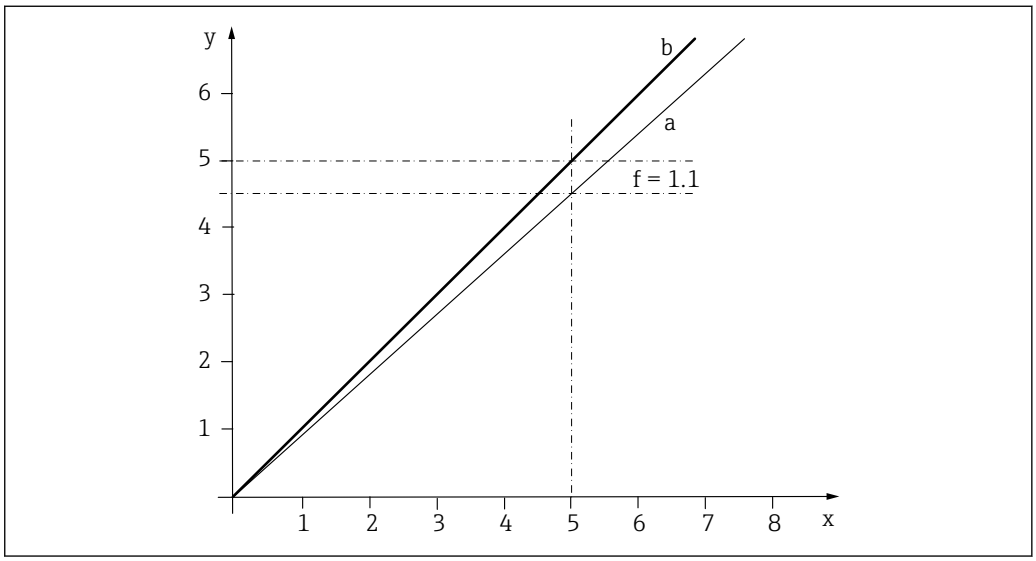
Data input (factor)

With the "Factor" function, the measured values are multiplied by a constant factor. The functionality corresponds to that of a 1-point calibration.

Example:

This type of adjustment can be selected if the measured values are compared to the laboratory values over a longer period of time and all values are too low by a constant factor, e.g. 10%, in relation to the laboratory value (target sample value).

In the example, the adjustment is made by entering the factor 1.1.

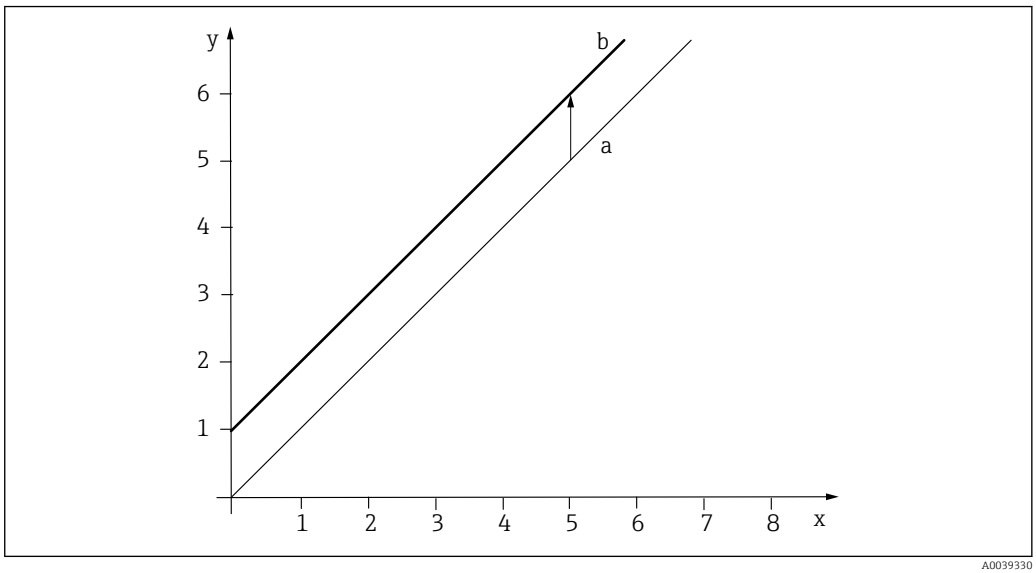


35 *Principle of factor calibration*

x *Measured value*
y *Target sample value*
a *Factory calibration*
b *Factor calibration*

Numeric input (offset)

With the "Offset" function, the measured values are offset by a constant amount (added or subtracted).



36 *Principle of an offset*

x *Measured value*
y *Target sample value*
a *Factory calibration*
b *Offset calibration*

19.14.4 Calibration table

This type of calibration is useful if the factor and/or offset calibration are not sufficient.

1. **CAL**/Channel No. **Fluorescence**/**Fluorescence**/**Calibration table**/▷ **Edit table**
2. **INSERT**: Specify the calibration point by entering measured values and nominal values.
3. Enter a maximum of 6 calibration points in this way.
4. **SAVE**.
   ↳ If the table is valid, the calibration data are saved for the selected parameter.

19.14.5 Temperature adjustment

Adjust the measured value of the internal temperature sensor to a reference measurement

1. Determine the temperature of the process medium with an alternative measurement, such as a precision thermometer.
2. **CAL**/Channel No. **Fluorescence**/**Temperature**/**Edit offset**.
3. Enter the deviation of the sensor measured value in relation to the reference measurement in K.
4. ▷ **Accept calibration data**.
   ↳ This completes the temperature adjustment.

19.15 Calibration accessories

19.15.1 Memobase Plus

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

19.15.2 pH calibration buffer

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

19.15.3 ORP buffer

ORP buffer solution CPY3
- 220 mV, pH 7
- 468 mV, pH 0.1

Product Configurator on the product page: www.endress.com/cpy3

19.15.4 Conductivity calibration solutions

Conductivity calibration solutions CLY11
Precision solutions referenced to SRM (Standard Reference Material) by NIST for qualified calibration of conductivity measuring systems in accordance with ISO 9000
CLY11-B, 149.6 µS/cm (reference temperature 25 °C (77 °F)), 500 ml (16.9 fl.oz)
Order No. 50081903

Technical Information TI00162C

19.15.5 Oxygen

COY8
Zero-point gel for oxygen and disinfection sensors
- Disinfectant-free gel for the verification, zero point calibration and adjustment of oxygen and disinfection measuring points
- Product Configurator on the product page: www.endress.com/coy8

Technical Information TI01244C

Calibration vessel
- For COS61D/61
- Order No.: 51518599

19.15.6 Disinfection

Photometer
- Photometer for determining chlorine and pH value
- Order no.: 71257946

19.15.7 ISE and nitrate

CAY40
- Standard solutions for ammonium, nitrate, potassium and chloride
- Ordering information: www.endress.com/cas40d under "Accessories/spare parts"

19.15.8 Nitrate

Nitrate standard solutions, 1 liter
- 5 mg/l NO_3-N, order number: CAY342-V10C05AAE
- 10 mg/l NO_3-N, order number: CAY342-V10C10AAE
- 15 mg/l NO_3-N, order number: CAY342-V10C15AAE
- 20 mg/l NO_3-N, order number: CAY342-V20C10AAE
- 30 mg/l NO_3-N, order number: CAY342-V20C30AAE
- 40 mg/l NO_3-N, order number: CAY342-V20C40AAE
- 50 mg/l NO_3-N, order number: CAY342-V20C50AAE

19.15.9 SAC

KHP standard solution
CAY451-V10C01AAE, 1000 ml parent solution 5 000 mg/l TOC

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W

Z

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